Caterpillar Performance Handbook

CATERPILLAR®

CONTENTS

CATERPILLAR PERFORMANCE HANDBOOK

a publication by Caterpillar, Peoria, Illinois, U.S.A.

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Performance information in this booklet is intended for estimating purposes only. Because of the many variables peculiar to individual jobs (including material characteristics, operator efficiency, underfoot conditions, altitude, etc.), neither Caterpillar nor its dealers warrant that the machines described will perform as estimated.

NOTE: Always refer to the appropriate Operation and Maintenance Manual for specific product information.

Materials and specifications are subject to change without notice.

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PUBLICATION UPDATE:

This publication removes main technical specifications from Performance Handbook version 49. For accurate reference of Specifications, Rimpull and Retarding Charts, Dimensions, Matching Guides, etc. please reference published machine specific documents such as Product Brochures and Technical Specifications through www.cat.com or your Caterpillar Dealer.

The Cat Product Line Section only includes production models at the moment of publishing this book.

PREFACE

Machine performance must ultimately be measured in unit cost of material moved, a measure that includes both production and costs. Factors bearing directly on productivity include such things as weight to horsepower ratio, capacity, type of transmission, speeds and operating costs. The Performance Handbook considers these factors in detail. There are other less direct machine performance factors for which no tables, charts or graphs are possible. Serviceability, parts availability and operator convenience are examples. In comparing machine performance, all factors should be considered. This Handbook is intended as an aid which, when coupled with experience and a good knowledge of local conditions, can assist in estimating true machine performance.

Many sections of the Handbook include tables or curves showing cycle times or hourly production figures for Cat® machines under certain conditions. Statements of conditions always accompany or precede the curves or tables. Before using any performance information in this Handbook, a complete understanding of the qualifying conditions is essential. The data is based on field testing, computer analysis, laboratory research and experience; and every effort has been made to assure their correctness.

However, all such data is based upon 100% efficiency in operation — a status which cannot be achieved continuously even under ideal conditions. Thus, in using such performance and production data, it is necessary to correct the results indicated in the handbook tables by appropriate factors. This allows for the anticipated actual job efficiency, operator efficiency, material characteristics, haul road conditions, altitude and other factors which may reduce performance or production on a particular job.

Methods for estimating machine owning and operating costs vary widely, depending on locality, industry practices, owner preferences and other factors. One method is suggested in the Handbook section on Owning and Operating Costs. When used with good judgment, it has provided reasonably accurate estimates in the past. Included in the Owning and Operating Section are guidelines, based on working conditions, to assist in estimating consumption of fuel and lubricants, tire life and repair costs for Cat machines. However, what one Handbook user regards as "excellent" conditions, another may consider "severe" or "average", depending on his own experience and basis of comparison. Therefore, these guidelines should be considered only approximations.

Caterpillar has made every effort to assure that the information contained in this Handbook is accurate and is a fair statement of the results to be achieved in the circumstances indicated. However, because of the many variables involved in estimating the production or performance of earthmoving machinery, their consumption of fuel and lubricants, tire life and repair costs, and the possibility of inadvertent errors or omissions in assembling this data, Caterpillar cannot and does not imply that all data in this book are complete nor that this level of performance will be achieved on a given job.

Caterpillar

ENVIRONMENT AND SUSTAINABILITY

Caterpillar supports environmental responsibility through sustainable development. Our products and services are intended to support sustainable development of global resources and they will meet or exceed applicable regulations and standards wherever they are initially sold. We establish and adhere to environmentally sound policies and practices in product design, engineering, and manufacturing. We educate and encourage our customers to use the products they purchase from us in environmentally responsible ways. We take effective steps to continually increase the natural resources efficiency and cleanliness of our facilities. When available, the various product groups have included relevant sustainability data with their content updates for inclusion in the Performance Handbook.

OPERATOR AND MACHINE PROTECTION

A well trained operator, working under suitable conditions, utilizing a modern, properly-equipped machine provides a machine-operator team capable of giving maximum production. These factors, along with appropriate job site rules and communication procedures, are essential to coordinate people and machines working together.

Appropriately protected and maintained machines are less likely to suffer premature component failure or damage, and give operators the confidence and assurance they need to carry out their work. Furthermore, training is not complete until the operator reads, understands and agrees to follow the instructions provided in the Operation and Maintenance Manual included with every Cat machine.

Employers have a duty to provide a safe work place for their employees. The purchaser of a Cat machine has a duty to review his/her particular application and job site for the machine to identify potential hazards inherent to that application or job site. Based on the results of this hazard analysis, the appropriate operator and machine protection configuration can be determined.

Caterpillar designs, builds, and tests its products to ensure the safety of operators, maintenance persons, service persons, and bystanders. That means people in, on and around Cat products. Caterpillar provides as standard equipment the appropriate operator and machine protection for most applications. However, particular applications, including the use of some Work Tools, may require additional operator and/or machine protection. Caterpillar offers related options for most such applications. However, there may be very special applications where the Cat dealer or the Purchaser may want to fabricate, or request Caterpillar to provide, custom or special guarding. Your Cat dealer can help you with this hazard analysis and guarding configuration process.

I. Operator Training and Protection Practices

Remember that any kind of machine or mechanical device can be hazardous if not kept in good condition, or if operated by careless or improperly trained operators, or if operated in an irresponsible manner.

Listed below are some recommended basic steps that can be broadly applied to most work environments:

- Train operators for the job they are assigned to do. The length and type of training must comply with governmental and local regulations wherever they apply. As an example, machine operators in mining activities must be trained in accordance with Mine Safety and Health Administration (MSHA) regulations. Where specific regulations do not apply, no operator should be assigned to a job until he or she meets the following minimum requirements:
  - Completes proper training to operate the assigned machine and understands that seat belts must be worn whenever seated in operator's compartment. SEAT BELTS SAVE LIVES!
  - Reads and understands the Operation & Maintenance manual for that machine, and knows that a copy of that manual is stored in the operator's compartment.
  - Reads and understands the AEM (Association of Equipment Manufacturers) Safety Manual, or any other furnished manual related to rules for safe machine operation and identification of hazards. For example, that includes the Work Tool Operation and Maintenance Manual if a Cat Work Tool is involved in the given application.
  - Has appropriate personal protective equipment and knows how to use it. This includes such things as hard hat, gloves, safety glasses, hearing protection, high-visibility vest, and safety shoes.
  - Knows what the job requirements are, what other machines are working in the area, and is aware of any hazardous conditions that may arise.

- Be sure operators are alert and in proper physical and mental condition to perform their work assignments safely. No machine should be operated by a person who is drowsy, under the affect of medicines or drugs, suffers blackouts, or is suffering from any physical or mental distraction that could contribute to unsafe operation.
- Maintain proper job conditions and working procedures. Check the job for possible hazards, both above and below ground level. Look for all possible sources of danger to the operator and others in the area. When operating in hazardous conditions the door and windows must always be closed. Pay particular attention to conditions which may be hazardous or near the operating limits of the machine: e.g., side slopes, steep grades, potential overloads, etc. Examine the work site for restricted traffic patterns, obstructed views, congestion, underground power or gas lines, etc. If the machine is equipped with a Quick Coupler, always make sure the Work Tool is properly attached by conducting an attachment test as directed in the Quick Coupler or Machine Operation and Maintenance Manual. Hazardous work conditions should be corrected wherever possible and adequate warnings should be posted when applicable.
- Provide the correct machine to handle the job and equip it properly for the job to provide the necessary operator protection. Check for compliance with all applicable governmental and local regulations. It is the legal responsibility of the machine owner or employer to see that his equipment complies with, and is operated in accordance with, all such requirements.
- Make sure the machine is properly maintained. The operator at the beginning of each shift should perform a walk-around inspection before the machine is placed in operation. This process is described in the machine and Work Tool Operation and Maintenance Manual. If this inspection reveals any problems that could affect safety, the machine or Work Tool must not be operated until these problems are corrected. Some examples include:
  - Loose, bent or missing grab irons, railings or steps;
  - Worn, cut or missing seat belts (any seat belt over three (3) years old must be replaced regardless of condition);
  - Damaged windows in the operator's compartment;
  - Worn, rubbing or abraded electrical insulation and hydraulic hoses;
  - Material or unwanted debris accumulation;
  - Incompatibility of the component attachments (Quick Couplers);
  - Hydraulic leaks that could impair the lock/secure feature of a Quick Coupler or other securing devices;
  - Any fluid leaks; and
  - Missing or damaged guards.
- Know the limits of your machine and equipment. With certain Work Tool combinations, including Quick Couplers, the Work Tool can hit the cab or the machine. Always check for interference limits when first operating.
- It is the machine owner's or employer's responsibility to ensure the machine is properly maintained. Your Cat dealer will be glad to assist you in selecting and equipping the machine best suited for your job and in providing maintenance for your machines.

II. Machine Modifications

Modifications must not be made to the machine that:

- Interfere with operator visibility;
- Interfere with ingress or egress from the machine;
- Exceed the rated payload or gross combination weight of the machine resulting in overloading the braking and/or steering system or the roll-over protective structure (ROPS) capacity rating (shown on a plate affixed to the ROPS); or
- Place objects in the cab that intrude into the operator's space or that are not firmly fixed into place.
- Are not authorized by Caterpillar.

III. Operator-related Equipment Options

Each job presents unique conditions that must be taken into account. Consider direct dangers to the operator as well as all possible sources of distraction that could reduce operator efficiency and increase the chances of costly and dangerous mistakes. Climate-controlled, sound-suppressed cabs, and special exterior lighting are options available from Caterpillar that can address requirements of special working environments.

"Flexible" machines include hydraulic excavators (track-type, wheel-type, and compact), skid-steer loaders, backhoe loaders and integrated tool-carriers can utilize interchangeable "Work Tools" to accomplish specific tasks. Work Tools or any tool used in hazardous applications like demolition, quarry, logging, stump grinding, scrap handling, milling, and scaling, can create a need for special operator guarding. When flying debris from impact, cutting, shearing or sweeping attachments is present, additional protective devices such as a front screen, Falling Object Guarding System (FOGS, includes top & front guarding), thick polycarbonate windshields or a combination of these is recommended by Caterpillar. The failure to provide proper operator/machine guarding in some of these applications can lead to machine damage, personal injury or death. Contact your Cat dealer for operator guarding options on your machine.

IV. Machine Protection

Check the job for unusually demanding conditions that could cause premature failure or excessive wear of machine components. Additional protective devices such as heavy-duty radiator guards, crankcase guards, engine enclosures, track roller guards and/or brake shields may be needed. Also, consider the use of anti-vandalism devices, such as cap locks and instrument panel guards. The failure to provide proper guarding in some of these applications may lead to machine damage, personal injury or death. Contact your Cat dealer for machine-protection and vandalism-prevention options for your machine.

V. Fire Prevention

Remember that most fluids on your machine are flammable!

To minimize the risk of fire, Caterpillar recommends following these basic steps:

- Always perform the Walk-Around Inspection described in Part I. It can identify many of the fire hazards described below.
- Remove trash (leaves, twigs, papers, etc.) that may accumulate in the engine compartment or around other hot parts on the product.
- Do not operate a machine if leakage of flammable fluids is noticed. Repair leaks before resuming machine operation. Most fluids used in Cat machines should be considered flammable.
- Keep access doors to major machine compartments in working order to permit the use of fire fighting equipment, should a fire occur.
- Avoid attaching electrical wiring to hoses and tubes that contain flammable or combustible fluids. Hydraulic hoses can move during machine operation and abrade wires and other hoses if improperly secured.
- Replace any rubbing, damaged, frayed, kinked or leaking hydraulic hoses or fittings. Use genuine Cat parts or their equivalent, including both pressure and temperature limit capabilities.
- Follow safe fueling practices as described in Cat Operation and Maintenance Manuals, AEM Safety Manuals, and local regulations. Never store flammable fluids in the machine operator's compartment, nor smoke while fueling the machine.
- As an additional safety measure, keep a fire extinguisher on the machine in a location as specified in the Operation and Maintenance Manual.
- Consider installation of an after-market fire-suppression system (FSS) on the equipment if the application and working conditions warrant it.

VI. Safety Regulations

Regulations vary from country to country and often within country. Your Cat dealer can assist you in properly equipping your machine to meet applicable requirements. **Note: The general summaries given below are not substitutes for Owners or Employers reading and being familiar with the appropriate local laws.**

(a) United States (US)

With a few exceptions, all machine operations in the United States are covered by federal and/or state regulations. If the machine is used in mining activities, the regulations are administered by the Mine Safety and Health Administration (MSHA). Other activities, including construction, are under regulations administered by the Occupational Safety and Health Administration (OSHA). These agencies require employers to provide a safe working environment for employees. Caterpillar has the same objective.

OSHA and MSHA have adopted criteria for ROPS, Falling Object Protective Structures (FOPS), seat belts, warning horns, back-up alarms, operator sound levels, steering systems, and braking systems. Additional operator's compartment protection may be required for machines engaged in logging, demolition and other special applications.

(b) European Union (EU)

The EU Machinery Safety Directive applies to Cat machines and most work tools. It requires that the "CE mark" be applied to the product and that a manufacturer's declaration be provided. The "CE mark" indicates that safety issues have been addressed by applying the appropriate safety standards in the design and manufacture of the machine. The objective of the Safety Directive is to protect operators, spectators and maintenance personnel. Caterpillar fully supports this objective.

VII. Sound Suppression

Different marketing areas have different noise emission requirements. Noise regulations usually specify limits for operators and spectators.

(a) United States

OSHA and MSHA noise-control regulations set permissible noise-exposure limits for machine operators and employees. Operator protection from machine noise can be achieved by use of factory-built cabs as offered in the Caterpillar Price List. These cabs, when properly maintained and operated with the doors and windows closed, reduce the operator sound level for an eight-hour operating period to meet the OSHA and MSHA noise-exposure limits in effect at the date of manufacture. Variables that may be encountered on the job site, such as other nearby noise sources or noise-reflecting surfaces, may reduce the allowable work hours. If this occurs, hearing protection may be required. This is especially true if a machine is not equipped with a closed cab. For example if the machine has no cab, or is being operated with the doors or windows opened.

(b) European Union

Operator sound-exposure requirements for machines in Europe are very similar to the OSHA and MSHA regulations mentioned above. In addition to operator sound-exposure requirements, most types of Cat machines are subject to European Commission regulations for exterior sound levels. Caterpillar ensures its products sold in the EU comply with the applicable noise regulations.

VIII. Replacement Parts for your Cat Machine

⚠ WARNING

When replacement parts are required for this product, Caterpillar recommends using Cat replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength and material. Failure to heed this warning can lead to premature failures, product damage, personal injury or death of persons on, or around, the product.

Nomenclature

THE CAT PRODUCT LINE

Note: Not all Sales Models are available in all countries. Engines may vary with local emission requirements. This Product Line includes production models at the moment of publishing this book.

ARTICULATED TRUCKS

725
730
730 EJ
735
740 EJ
740 GC
745

BACKHOE LOADERS

415 IL
415
416
420
420 XE
424
426 F2
428
430
432
434
440
444
450

FOREST PRODUCTS

Forest Machines

538
548/548LL
558/558LL
568

HYDRAULIC EXCAVATORS

Track Models

Mini Excavators

300.9D
300.9D VPS
301.5
301.6
301.7CR
301.8
302CR
302.7CR
303CR
303.5CR
304
305CR
305.5
306CR
306CR XTC
306.5
307.5
308CR
308CR VAB
309CR
309CR VAB
310

Small Excavators

313
313 GC
313D2
313D2 LGP
313D2 GC
315
315 GC
316 GC
317
317 GC
318D2 L

Medium Excavators

320D3 GC
320D3
320 GX
320 GC
320
323D3
323 GX
323 GC
323
325
326 GC
326
330 GC
330
333
335

Large Excavators

336 GC
336
340
345 GC
349
350
352
355
374
395

Demolition

340 SB
340 UHD
352 UHD

Wheel Models

M314
M315
M315F
M316
M317D2
M317
M318
M319
M320D2
M320
M322
M323F

HYDROMECHANICAL ATTACHMENTS

Hydraulic Hammers

H110 GC	H115 GC S	H120 S	H140 GC	H180 S
H110 GC S	H115 S	H130 GC	H140 GC S	H190 S
H110 S	H120 GC	H130 GC S	H140 S	H215 S
H115 GC	H120 GC S	H130 S	H160 S	

Mobile Scrap and Demolition Shears

S3015	S3035	S3050	S3070	S3090
S3025	S2050 Straight	S2070 Straight	S2090 Straight	

Multi-Processors

MP318	MP324	MP332	MP345	MP365

Contractor's Grapples

G113	G120	G136	G174
G117	G126	G149	

Concrete Crushers

P315	P335
P325	P360

Secondary Pulverizers

P215	P235
P225	

Demolition and Sorting Grapples

G212 GC	G312 GC	G317 GC	G324	G345
G213 GC	G313 GC	G318	G324 WH	
G217 GC	G314	G318 WH	G332	

Orange Peel Grapples

GSH420	GSH440	GSH520	GSH555	GSM-60	GSV520
GSH425	GSH455	GSH525	GSM-50	GSV520 GC	GSV525

MATERIAL HANDLERS

Wheeled Material Handlers

MH3022	MH3026
MH3024	MH3040

Tracked Material Handlers

MH3250
MH3260

MINING & OFF-HIGHWAY TRUCKS

770G	773G	777G	789D	793F	797F
772G	775G	785D	789	794 AC	798 AC
773E	777E	785	793D	796 AC	

MOTOR GRADERS

12K	140K	160K	14
120K	140 GC	150	16
120 GC	140	160	18
120			24

PAVING PRODUCTS

Cold Planers

PM310
PM312
PM313
PM620
PM622
PM820
PM822
PM825

Rotary Mixers

RM400
RM500B

Asphalt Pavers

AP300F/AP355F
AP500F/AP555F
AP655F L
AP600F/AP655F
AP1000F/AP1055F

Pneumatic Compactors

CW12
CW16
CW34

Vibratory Asphalt Compactors

CB1.7
CB1.8
CB22B
CB24B
CB24B XT
CB32B
CC24B
CB2.5
CB2.7
CB2.9
CC2.6
CB2.5
CB2.7
CB2.9
CC2.7
CB2.5 GC
CB2.7 GC
CC2.7 GC
CB34B
CB36B
CC34B
CB4.0(03A)
CB4.4(03A)
CC4.0 (03A)
CB7
CB8
CB10
CB7 (02A)
CB10 (02A)
CCS7
CCS9
CD8
CD10
CB13
CB15
CB16

Vibratory Single Drum Soil Compactors

CS10 GC
CS11 GC
CS12 GC
CP11 GC
CP12 GC
CS34
CP34
CS44B
CP44B
CS533E
CP533E
CS54B
CP54B
CS56B
CP56B
CS64B
CS66B
CS68B
CP68B
CS74B
CP74B
CS76B
CP76B
CS79B

PIPELAYERS

PL61
PL72
PL83
PL87

SKID STEER LOADERS/COMPACT TRACK LOADERS

Skid Steer Loaders

216B3
226B3
226D3
232D3
236D3
242D3
246D3
262D3
272D3
272D3 XE

Compact Track Loaders

239D3
249D3
259D3
279D3
289D3
299D3
299D3 XE

TELESCOPIC HANDLER

TL Series

TL642
TL943
TL1055
TL1255

TH Series

TH255C
TH357
TH408
TH3510

TRACK LOADERS

953
953K
963
963K
973K

TRACK-TYPE TRACTORS

D1	D5	D6 GC	D8R	D9R	D11T
D2	D5R2	D6T	D8T	D9T	
D3	D6/D6 XE	D7	D9	D10T2	
D4	D6R2	D7R	D9 GC	D11	

WHEEL DOZERS

814	834K	854K
824K	844K	

LANDFILL COMPACTORS

816
826K
836K

SOIL COMPACTORS

815
825K

WHEEL LOADERS & INTEGRATED TOOLCARRIERS

901C2	910	938K	966 GC	980L	986K
902C2	914	938M	966L	980M	988K
903C2	914K	950 GC	966M	980	988K XE
903D	920	950L	966M XE	980 XE	990K
906K	920K	950M	972L	982	992
906M	921E	950M Z	972M	982 XE	992K
907K	924K	962L	972M XE	982M	993K
907M	926M	962M			994K
908K	930K	962M Z			
908M	930M				

WHEEL TRACTOR-SCRAPERS

Open Bowl Scrapers

621K	631K	651
627K	637K	657

Elevating Scrapers

623K

MINING

Draglines

8000	8200	8750

Rotary Drills

MD6200	MD6310
MD6250	MD6640

Electric Rope Shovels

7295	7495	7495 HD
7395	7495 HF	

Hydraulic Mining Shovels

6015	6020B	6030 AC	6060
6015B	6030	6040	6060 AC

Underground – Load Haul Dump Loaders

R1300G	R1700	R2900	R3000H
R1600H	R1700G	R2900G	

Underground – Mining Trucks

AD22	AD45	AD60
AD30	AD45B	AD63

NOMENCLATURE VALUE IDENTIFIER (XE, GC):

Most Cat Products are named without any value identifiers. Those models are considered Performance products that offer high production and high efficiency. However, to differentiate against other models the following value identifiers are used:

- The "XE" as an identifier for our Premium products with advanced technology where significant additional customer value is offered. The "XE" represents to our customers a family of Cat premium products that are technology leading and include a specific breakthrough technological advancement that is clearly differentiating in the industry and provides dramatic benefits to our customers' owning and operating costs.
- The "GC" is an identifier for products that are intentionally and purposefully designed for customers who value the Cat brand offering but are also the most focused on cost per hour and have the lowest cost of downtime/affordability of the Lifecycle Value segment. Customers see these machines as providing an exceptional value proposition for the applications and markets where they are designed to compete.

ARTICULATED TRUCKS

CONTENTS

Features:

- **Cat® engines with ACERT™ Technology** meet U.S. EPA Tier 4 Final/EU Stage V/Japan 2014 (Tier 4 Final), or Tier 2/Stage II/Japan 2001 (Tier 2) equivalent emission standards. The four core elements of meeting these standards are:

  I) Common Rail;

  II) Electronics, ADEM™ A4;

  III) Fuel delivery, Mechanical-activated Electronic Unit Injection (MEUI™ A-C);

  IV) Air Management, Wastegate Turbocharging, Air to Air Aftercooling (ATAAC) with the proven technology of a crossflow cylinder head.

- **Cat electronically controlled transmissions** … Transmissions purpose built and designed for articulated trucks and their applications. Advanced Productivity Electronic Control Strategy (APECS) delivering smooth shifting transmissions with improved acceleration and high productivity. Providing complete integration with the engines for efficient power delivery as well as offering advanced diagnostic and troubleshooting capabilities.

- **Articulating and fully oscillating hitch** … Links front and rear frames for exceptional maneuverability and traction on uneven terrain while eliminating damaging twisting of the frames. Bolted hitch design allows optimum material choices for the cast hitch head and the hard-wearing tube. Bolted design allows easier rebuild and repair.

- **Three-point front suspension** … Three-point front suspension with long-stroke, low-pressure suspension cylinders provide unparalleled ride quality for operator comfort and higher average haul speeds. Front and rear suspension together with the hitch provide for excellent traction in all conditions.

- **Wide, long and low dump body design** … For excellent loadability and high fill factors, excellent machine stability and load retention as well as a good match for other Cat loading systems. Diverging flow design also gives excellent material ejection.

- **Standard ROPS/FOPS, low sound level cab** … Two man cab common across the range. Large cab with excellent visibility, ergonomic control layout and plentiful storage.

- **High capacity low pressure tires in single formation** … For superior traction and flotation in poor underfoot conditions.

- **Bare Chassis offerings** … For certain applications the Caterpillar OEM Solutions Group offers non-dumper/Bare Chassis arrangements.

  Bare Chassis arrangements applications could include: water, service (fuel and lube), high capacity body (waste, coal, etc.), open body (log, pipe, etc.), container carrier, hook lift, tow, cable reel, etc. Please refer to specific OEM for additional information.

Use of Ground Pressure Charts

Articulated trucks are normally equipped with wide base radial tires, for improved flotation in poor underfoot conditions. Ground pressure is a function of tire deflection and is also affected by tire penetration. The charts in this section provide a means to estimate ground pressure for 0 and 76 mm (3") tire penetration, when gross vehicle weight, axle load distribution and tire inflation pressure are known. The ground pressure charts on the following pages are based on Michelin XADN tire characteristics. Results may differ for other tread patterns.

Tire load can be calculated by the following formula:

$$\text{Tire Load} = \frac{\text{Heaviest Axle Load}}{2}$$

Example

Find the ground pressure generated by a 725C fully loaded with zero and 76 mm (3") tire penetration. The machine is equipped with standard Michelin 23.5R25 tires, inflated to the recommended pressure.

$$\text{725C Tire Load} = \frac{46\,820 \text{ kg} \times 0.34}{2} = 7959 \text{ kg}$$

$$\text{725C Tire Load} = \frac{103{,}220 \text{ lb} \times 0.34}{2} = 17{,}547 \text{ lb}$$

Note: The Front Axle of a fully loaded 725C (46,820 kg/103,220 lb machine weight) supports 34% of the load. This represents the Heaviest Axle Load.

From the tire manufacturer, inflation pressure for the 725C is 325 kPa = 3.25 bar (47 psi).

From the ground pressure chart for 23.5R25 tires, Ground pressure = 3.1 kg/cm^2 (44 psi) with zero tire penetration.

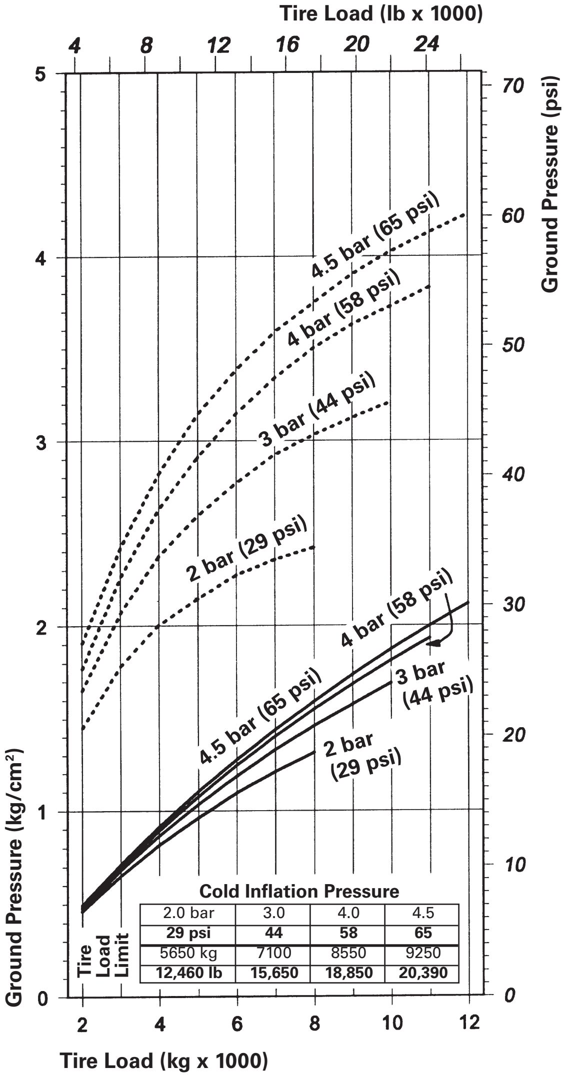
Ground pressure = 1.4 kg/cm^2 (21 psi) with 76 mm (3") tire penetration.

See the Wheel Tractor Scraper section for explanation on using:

- **Rimpull-Speed-Gradeability Curves**
- **Retarder Curves**

See Mining & Off-Highway Trucks section for Fixed Times for Hauling Units.

23.5R25 Tires*



Cold Inflation Pressure			
2.0 bar	3.0	4.0	4.5
29 psi	**44**	**58**	**65**
5650 kg	7100	8550	9250
12,460 lb	**15,650**	**18,850**	**20,390**

KEY

——— Zero Penetration (Flat Plate)

- - - - 76 mm (3") Penetration

*Charts based on Michelin XADN tire characteristics. Results may differ for other tread patterns and/or brands. Charts are to be used to calculate ground pressure. To determine the inflation as a function of load and conditions or when loads exceed tire load limit, contact your tire manufacturer representative.

BACKHOE LOADERS

CONTENTS

Features:

- **Pilot operated backhoe controls** provide smooth, efficient operation and operator comfort. Thumb roller controllers provide ergonomic function of the extendible stick and/or auxiliary hydraulic circuits. Convenient pattern changer switch is within the cab. Optional on 415, 416, 428 and 434. Standard on 420 and 430. Includes E/H finger-tip actuated stabilizer controls.
- **E/H seat mounted joystick controls** are standard on 420XE, 432, 440, 444 and 450. Provides improved ergonomics, comfort, floor space and operating efficiency due to new "Dual Mode" feature. Includes E/H finger-tip actuated stabilizer controls.
- **The Cat C3.6 Direct Injection Turbocharged Aftercooled engines meet U.S. EPA & CARB Tier 4 Final and EU Stage V.** The new C3.6 is the perfect balance of compact size, reliability, and performance.
- **XT™-3 ES** hoses combined with Cat couplings and O-ring face seal fittings provide a dry, reliable machine. The F and F2 Series backhoe circuits incorporate the XT-3 ES ToughGuard™ hoses.
- **Operator station features:** Air-suspension seat is standard on all models. Adjustable tilt steering is standard except on 415 canopy configurations. Rear, door, and side windows can be fully opened for enhanced ventilation and cab roof is extended to help keep operator dry. Four-post Rollover Protective Structure (ROPS) for increased protection. Analog display with soft-key navigation/selection is standard with optional touchscreen display on certain models.
- **High performance backhoe linkage** offers 205° of bucket rotation with one pin position. Backhoe geometry creates more stick force than previous series, brought closer to the operator to pull spoil through trench. The 450F has a backhoe bucket rotation of 198°.
- **Diagonal Retention System (DRS)** standard on all factory installed buckets with weld-on tooth adapters, excluding the 450F. Bucket teeth are attached with diagonal pins rather than horizontal pins for easy exchange of bucket teeth. 450F buckets remain fitted with J225 size, horizontal fastener pins. All other buckets have bolt-on Uni-teeth.
- **Integrated lift eye** on backhoe linkage. Object handling installation available on 428, 432, 434 and 444 for EU countries.
- **Cat Cushion Swing** system smooths the swing function, improving the return-to-trench controllability.
- **The extendible stick** on 415 thru 450 models offers object clamping while extending. Serrated edges secure clamped objects. Wear pad configuration eases adjustment on all four sliding surfaces. All center pivot sticks have thumb-ready provision.
- **The hydraulic system** uses load sensing, flow sharing valves with anti-drift characteristics. Smooth, multifunction operation with the ability to have maximum lifting and digging forces at any RPM.
- **Ride Control** available as an option on all models but is standard on the 450. The ride control system smooths the ride under all job-site conditions.
- **4F/4R fully synchronized gear box** provides on-the-go shifting in all gears and on-the-go engagement of optional all-wheel drive. Maximum travel speed is 40 km/h (25 mph). Available on 415, 416, 428 and 434.
- **Powershift, with optional autoshift** is available as an option on 420, 420XE, 428, 432 and 434. Autoshift is standard on 440 and 450.
- **Lock-up torque converter** available as an option on 420, 420XE, 428, 430, 432, 434 and 440 models for improved performance and efficiency while roading.
- **Brakes** are oil immersed, multi-disc, self-adjusting, and wear surface is made of Kevlar® for long service life. Brakes are boosted on all models.
- **4WD is standard on all models.** It improves mobility and loader performance in poor traction conditions and can be engaged at any time in any operating condition. Includes 4-wheel braking effect feature.
- **Sloping, flip-open multi-access hood** allows excellent visibility to the loader working area and tilts forward for single location access to all daily service points.
- **Dry-type, radial seal air cleaner** with automatic, integrated dust ejector system provides efficient pre-separation. The two-stage air filter incorporates both air cleaner and pre-cleaner functions into a single unit mounted under the hood.

At A Glance:

Operator Comfort

- Wide Opening Windows
- Standard Air Suspension Seat
- Adjustable seat, steering column, and backhoe controls
- Easy to read and navigate displays

Versatility

- IT Loader Coupler (Optional) – All Models
- Mechanical and Hydraulic Backhoe Quick Coupler (Optional) – All Models

Control

- Hand Control DIF lock
- Brake Mode Selector Switch
- Lock up Torque Converter (Optional) – 420/420 XE/430/440
- Ride Control (Optional) – All Models

Serviceability

- Grouped Daily Service Checks
- Easy Access Cooling Package (No Tools Required)
- Battery Disconnect (Standard)
- Greaseless E-Stick with fast and easy adjustments.

Hydraulics

- Variable Displacement Piston Pump
- Flow Sharing Valves
- Mech/Pilot/EH controls
- EH Technology – 420 XE/440/450
- Full implement forces at any RPM

Safety/Security

- Transmission Neutralizer Switch
- Hydraulic Lock Out
- Back up alarm standard
- Security System (Optional) Operator Display Enabled

Road Construction & Utilities "Oil & Gas"

Examples of Basic Applications

- *Re-Surfacing Work*
  - Installing Utilities – Trenching
- *Maintenance*
  - Broom for debris clean up
  - Snow blowers to clear roadways
- *Installing Utilities – Trenching*

Governmental

Examples of Basic Applications

- *Land Management*
- *Log and Brush Clearing*
  - Grapples and Multi-purpose buckets
- *Post Holes and Fence work*
  - Use augers to bore holes
  - Forks to carry post

Agriculture

Examples of Basic Applications

- *Farm Maintenance*
  - Augers
  - MP Buckets
  - Forks for fencing
  - Tiling

General Construction

Examples of Basic Applications

- *Ground Prep*
  - Compactor level jobsite
- *Lay Drainage Pipe*
- *Installing Utilities*

DRILLS

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ROTARY BLASTHOLE DRILLS

Throughout this document, references to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim) include U.S. EPA Tier 4 Interim, EU Stage IIIB, and Japan 2011 (Tier 4 Interim) equivalent emission standards. References to Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) include U.S. EPA Tier 4 Final, EU Stage V, and Japan 2014 (Tier 4 Final) emission standards.

Throughout this document, references to Tier 1/Stage I include U.S. EPA Tier 1 and EU Stage I equivalent emission standards. References to Tier 2/Stage II/Japan 2001 (Tier 2) equivalent include U.S. EPA Tier 2, EU Stage II, and Japan 2001 (Tier 2) equivalent emission standards. References to Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent include U.S. EPA Tier 3, EU Stage IIIA, and Japan 2006 (Tier 3) equivalent emission standards.

PRODUCT LINE DESCRIPTION

The Cat® Rotary Drill Family consists of the: MD6200, MD6250, MD6310, MD6380 and MD6640. With a wide range of pulldown and related weight on bit, the Cat drill family offers a maximum bit load of up to 63 975 kg (141,000 lb), to suit a wide variety of applications. They're proven to deliver efficiency, high productivity and low cost, as well as provide a comfortable environment for the operator.

With a synergy of robust structures, long-lasting systems and innovative technology, the Cat line of rotary drills has demonstrated its effectiveness and longevity in a variety of mining and quarry environments, including both soft- and hard-rock applications, as well as extreme temperature and high-altitude locations.

Equipped with low pressure compressors and hydraulic drive systems to power rotary tricone bits of various sizes and configurations, the MD6200, MD6250 and MD6310 diesel powered drills can also be configured with high pressure compressors for DTH (down-the-hole) hammer drilling. Caterpillar has the drill that delivers the optimal combination of bit load, rotary torque and onboard air to ensure maximum productivity in a wide range of applications.

PRIMARY APPLICATIONS FOR ROTARY BLASTHOLE DRILLS

MODEL	Bench Drilling	Cast Blast Drilling	Presplit Drilling	Over Burden Drilling
MD6200*	x		x	x
MD6250	x	x		x
MD6310	x	x		x
MD6380**	x	x		x
MD6640***	x	x		x

*Primary production blasthole drill, with the ability to do limited presplit drilling.
**Ultra-Class production blasthole drill, available with only low pressure compressor package.
***Ultra-Class production blasthole drill (Electric), available with only low pressure compressor package.

CAT ROTARY DRILL FEATURES

Solid Structures

The Box section frame rail construction with optimized, profiled transitions in all high stress areas provides exceptional structural durability. The A-frame and axle are integrally connected to ensure smooth load transitions. Caterpillar undercarriages have three-point oscillating suspension, GLT (grease lubricated track pins), and PPR2 (positive pin retention).

Sturdy Mast

Some models can be configured with various mast lengths to suit specific application requirements for single pass or multi pass drilling.

Designed with double-cut lacing to assure long life, mast groups are designed to ensure a torsionally strong structure reducing deflection and material fatigue.

Machined frame/mast connections eliminate custom fitment and allow for easy mast replacement or swapping of masts between drills without cutting or welding.

Jack System

Jack casing assemblies are integrally welded to the main frame providing structural strength and durability and reduce torsional flexing of the main frame.

The leveling jacks are positioned to provide excellent stability and weight over the hole.

HOBO Wrench

The variable grip Hydraulically Operated Break Out wrench is part of a highly efficient breakout system that increases speed of pipe changing operations, consequently increasing productivity.

The hydraulic break out wrench is operated from the cab thus protecting the operator.

It also reduces impact loading to the mast and rotary head during pipe changes, further increasing drill mechanical availability.

Power Group

Fast cycle times are achieved through best in class bit load, rotary head horsepower, and bailing air for maximum efficiency.

Ergonomic Cab

Cab rubber shock-mounts absorb mechanical vibration and restrict exterior noise. The operator station design integrates an ergonomic seat, multi-function joystick controls with full instrumentation, dual 254 mm (10 in) color displays, high definition touchscreen monitors, and a 12 volt power port. There is an additional display screen for cc cameras which is color, high-definition and 254 mm (10 in).

MODEL	MD6200	MD6250
Hole Diameter	• 127-200 mm **(5.0-7.87 in)**	• 152-250 mm **(6-9.8 in)**
Hole Depth	• Single-pass — 11 m **(36 ft)** • Multi-pass — Down to 47.5 m **(156 ft)**	**For short mast:** • Single-pass — 11.2 m **(36.7 ft)**, Multi-pass — Down to 53.6 m **(176.7 ft)** **For long mast:** • Single-pass — 13.6 m **(44.6 ft)**, Multi-pass — Down to 37.9 m **(124.6 ft)**
Air compressor	• Rotary — 32.6 m^3/min **(1150 ft^3/min)** @ 8.6 bar **(125 psi)** • DTH — 29.7 m^3/min **(1050 ft^3/min)** @ 24.1 bar **(350 psi)**	• Rotary — 56.6 m^3/min **(2000 ft^3/min)** @ 8.6 bar **(125 psi)** • DTH — 38.2 m^3/min **(1350 ft^3/min)** @ 34.4 bar **(500 psi)** • DTH — 42.4 m^3/min (**1500 ft^3/min)** @ 24.1 bar **(350 psi)**
Engine	• C18 @ 1800 RPM • Emissions — U.S. EPA Tier 4 Final • Power Rating (ISO 14396) — 439 kW **(589 hp)** • C18 @ 1800 RPM • Emissions — U.S. EPA Tier 2 equivalent • Power Rating (ISO 14396) — 438 kW **(587 hp)**	• C27 @ 1800 RPM • Emissions — U.S. EPA Tier 4 Final • Power Rating (ISO 14396) — 650 kW **(872 hp)** • C27 @ 1800 RPM • Emissions — U.S. EPA Tier 2 equivalent • Power Rating (ISO 14396) — 616 kW **(826 hp)**
Cooler ambient rating	• Up to 52° C **(125° F)**	• Up to 52° C **(125° F)**
Cab	• FOPS cab has 1.9 m^2 **(20.5 ft^2)** floor space	• FOPS cab has 3 m^2 **(32.3 ft^2)** floor space
Fuel Tank	• 833 L **(220 U.S. gal)**	• Primary tank is 1416 L **(374 U.S. gal)** plus expansion of +1416 L **(374 U.S. gal)** for a total of 2832 L **(748 U.S. gal)** (option)
Pipe Rack	• 9.14 m **(30 ft)** pipes	• 10.67 m **(35 ft)** pipes – for short mast • 6.1 m **(20 ft)** pipes – for long mast
Drill Pipe Capacity	• Quantity — 4 pod	• Quantity — 4 pod
Tram Speed Maximum	• high speed tram — 3.3 km/h **(2.0 mph)** low speed tram — 2.1 km/h **(1.3 mph)**	• 2.45 km/h **(1.5 mph)**
Angle Hole Drilling	• Vertical to 30° (in 5° increments) • Optional negative angle drilling package (0° to –15°, in 5° increments) for a total range of (30° to –15°)	• Vertical to 30° (in 5° increments)

MODEL	**MD6310**	**MD6380**
Hole Diameter	• 203-311 mm **(8-12.25 in)**	• 251 to 381 mm **(9.875-15 in)**
Hole Depth	**For short mast:** • Single-pass — 13.7 m **(44.9 ft)**, Multi-pass — Down to 74.6 m **(244.9 ft)** **For long mast:** • Single-pass — 17.5 m **(57.4 ft)**, Multi-pass — Down to 47.9 m **(157.4 ft)**	• Single-pass — 19.8 m **(65 ft)** • Multi-pass — Down to 39.6 m **(129 ft)**
Air compressor	• Rotary — 56.6 m^3/min **(2000 ft^3/min)** @ 8.6 bar **(125 psi)** • Rotary — 73.6 m^3/min **(2600 ft^3/min)** @ 7.6 bar **(110 psi)** • DTH — 42.2 m^3/min **(1500 ft^3/min)** @ 34.4 bar **(500 psi)**	• Rotary — 101.9 m^3/min **(3600 ft^3/min)** @ 6.9 bar **(100 psi)**
Engine	• C32 @ 1800 RPM • Emissions — U.S. EPA Tier 4 Final • Power Rating (ISO 14396) — 751 kW **(1007 hp)** • C32 @ 1800 RPM • Emissions — U.S. EPA Tier 2 equivalent • Power Rating (ISO 14396) — 769 kW **(1031 hp)**	• 3512C @ 1800 RPM • Emissions — U.S. EPA Tier 2 equivalent • Power Rating (ISO 14396) – 949 kW **(1273 hp)**
Cooler ambient rating	• Up to 52° C **(125° F)**	• Up to 52° C **(125° F)**
Cab	• FOPS cab has 3 m^2 **(32.4 ft^2)** floor space (standard cab) • Optional extended size cab for a total of 4.2 m^2 **(45.2 ft^2)** floor space	• FOPS cab has 4.2 m^2 **(45.2 ft2)** floor space
Fuel Tank	• Primary tank is 1609 L **(425 U.S. gal)** plus expansion of +1609 L **(+425 U.S. gal)** for total of 3218 L **(850 U.S. gal)** (option)	• 4164 L **(1100 U.S. gal)**
Pipe Rack	• 12.19 m **(40 ft)** pipes – for short mast • 7.62 m **(25 ft)** pipes – for long mast	• 9.9 m **(32.5 ft)** pipes
Drill Pipe Capacity	• Quantity — 4 or 5 pod	• Quantity — 2 pod
Tram Speed Maximum	• 2.45 km/h **(1.5 mph)**	• 1.93 km/h **(1.2 mph)**
Angle Hole Drilling	• Vertical to 30° (in 5° increments)	• Vertical to 30° (in 5° increments)

MODEL	**MD6640**
Hole Diameter	• 244-406 mm **(9.6-16 in)**
Hole Depth	• Single-pass — 21.3 m **(70 ft)** • Multi-pass — Down to 42.6 m **(140 ft)**
Air compressor	• 108 m^3/min **(3800 ft^3/min)** @ 4.5 bar **(65 psi)**
Engine	• Electric Motor • 597 kW **(800 hp)** • 4160V/7200V **(50 or 60 Hz)**
Cooler ambient rating	• Up to 52° C **(125° F)**
Cab	• FOPS cab has 4.2 m^2 **(45.2 ft^2)** floor space
Fuel Tank	• Not applicable
Pipe Rack	• 9.14 m **(30 ft)** or 12.19 m **(40 ft)** pipes
Drill Pipe Capacity	• Quantity — 2 pod
Tram Speed Maximum	• 1.77 km/h **(1.1 mph)**
Angle Hole Drilling	• Vertical to 25° in 5° increments

FOREST PRODUCTS

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PROCESSING/LOADING

MILLYARDS

WORK TOOLS

TABLES

Introduction

Cat forestry machines are specifically designed for tough forest work. Each model uses purpose built booms, sticks and grapples designed by Caterpillar for maximum performance and durability.

The following information provides features, specifications, dimensions, working ranges and major component weights for the forest machines.

Features

538/538 LL

- **Cat C7.1 ACERT engine** provides exceptional fuel efficiency while delivering maximum power for this machine size class.
- **Optimized hydraulics** minimize losses due to inefficiencies through component design, component layout and finely tuned machine and work tool parameters.
- **Performance** is enhanced with over 10% more swing torque, 12% more travel speed, and 10% more hydraulic flow compared to the previous model.
- **Rugged frame designs** are purpose built for forest applications; these include reinforcements to the upper frame, heavy duty doors and guarding, rugged swing bearing, reinforced carbody and roller frames that help protect your investment.
- **Undercarriage** is high-wide design for stability and ground clearance, and has 15% or 4" more ground clearance than the previous model. Undercarriage includes 203 mm (8 in) pitch 330 PPR3 track links; roller frames include eight bottom rollers total with full length track guards and high drawbar final drives.
- **Engineered reliability** is provided through the use of proven Cat components and increased cooling capacity with hydraulic reversing fan standard equipment and 2 A/C condensers for superior HVAC performance and cab cooling capability.
- **Diverse machine configurations** are available to meet the many applications of todays forest machines; these include front omission, road builder, rotate grapple, processor, under/under, over/under, powerclam, and material handler options.
- **Operator station** standard equipment includes heated and ventilated seat with lumbar support, 4 point seat belt, 1.25" or 32 mm polycarbonate front window, and high resolution 10" touchscreen display that integrates standard rear view camera and optional side view camera.
- **Diverse work tool options** include integrated heel racks and GLL grapples; both deliver high performance and reliability in severe logging applications.

558 LL

- **Cat C7.1 ACERT engine** provides exceptional fuel efficiency while delivering maximum power for this machine size class.
- **Optimized hydraulics** minimize losses due to inefficiencies through component design, component layout and finely tuned machine and work tool parameters.
- **Performance** is enhanced by 25% more swing torque than previous model that helps maximize work site efficiency.
- **Rugged frame designs** are purpose built for forest applications; these include reinforcements to the upper frame, heavy duty doors and guarding, rugged swing bearing, reinforced carbody and roller frames that help protect your investment.
- **Undercarriage** includes roller frames that deliver nine rollers for needed stability and to minimize point loading; 216 mm (8.5 in) pitch 349 HEX track are used for durability.
- **Engineered reliability** is provided through the use of proven Cat components and increased cooling capacity.
- **Diverse machine configurations** are available to meet the many applications of todays forest machines; these include under/under, over/under, processor, powerclam, and material handler options.
- **Operator station** consists of updated seat with heated and ventilated functionality along with a new improved LCD display that is 40% larger and includes four times the screen resolution; LED lights are standard on the machine. Cab options include side-entry cab and rear-entry cab on log loader configurations.
- **Diverse work tool options** include integrated heel racks and GLL grapples; both deliver high performance and reliability in severe logging applications.

568/568 LL

- **Cat C9.3 ACERT engine** provides exceptional power and fuel efficiency.
- **Attachments** — Factory installed log loader fronts with live heel and Cat grapples; harvester, road builder and butt-n-top fronts; help meet diverse forestry applications.
- **Cat GLL forestry grapples**, built with high-grade steel throughout the grapple, matched with Cat Forest Machines provide high performance and reliability in logging applications.
- **Reinforced carbody design** stands up to the most demanding forest applications, assuring outstanding durability and service life.
- **Undercarriage** — Heavy-duty link assemblies provide toughness and durability, maximizing undercarriage life and minimizing operating costs. Long 10 roller track frames provide excellent machine stability and maneuverability on steep slopes.
- **Guarding** — Purpose designed guarding helps extend service life, reduces downtime and helps protect your forestry machine investment.
- **Operator station** — Spacious, quiet, automatically climate controlled cab has excellent sightlines to the work area. Cat offers a premium rear entry cab for those regions or operations that require this functionality.
- **Serviceability** — Simplified service and maintenance, and electronic diagnostics help save time, money and increase productivity.

Wheel Loader Forestry Features:

Wheel loader Forestry-specific configurations equip the 990, 988, 980, 966, 962, 950, as well as XE models, with additional features to deliver the performance, strength and durability required to be productive in tough millyard applications including loading and unloading trucks, sorting, decking and feeding the mill.

Logging, millyard and wood pallet forks as well as woodchip and clean-up buckets can be added to equip the machines for forestry applications.

Ride control, axle oil coolers, heavy-duty tilt cylinders, factory 3V and 4V hydraulic options, lockup clutch, reversing fan, and additional counterweight are among some of the factory integrated solutions for use in forestry and logging applications.

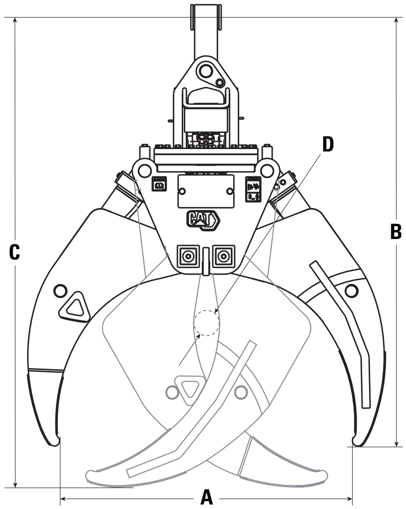
Specially designed work tools for forestry applications are matched to the machines for optimum performance along with optional guarding packages for machine protection.

WORK TOOLS

Features:

- **Full 360° continuous rotation**.
- **Paddle style tines** are made of high strength steel, and use abrasion resistant material on tips for longer life.
- **Induction hardened** pins and bushings.
- **Heavy duty hydraulic cylinders** with built in check valves, and protective hose guarding for more uptime.

Dimensions for Log Loading Grapples



	GLL52		GLL55		GLL60	
Part Number	**591-0042**		**591-0043**		**591-0044**	
Weight	1253 kg	**2,762.4 lb**	1297 kg	**2,860 lb**	1388 kg	**3,060 lb**
Width	561 mm	**22.09"**	561 mm	**22.09"**	561 mm	**22.09"**
A Maximum Opening	1321 mm	**52.01"**	1397 mm	**55"**	1524 mm	**60"**
B Height, Open	1839 mm	**72.4"**	1885 mm	**74.21"**	1975 mm	**77.76"**
C Height, Closed	1887 mm	**74.29"**	1958 mm	**77.09"**	2032 mm	**80"**
D Minimum Opening	127 mm	**5"**	127 mm	**5"**	127 mm	**5"**
Rotation, Continuous	**360°**		**360°**		**360°**	
Rotation, Torque	1153 N·m	**850.41 ft-lb**	1153 N·m	**850.41 ft-lb**	1153 N·m	**850.41 ft-lb**

Forestry Grapple Matching Guide

Optimal ● Acceptable ○ No match (shaded)

Machine Model	GLL52	GLL55	GLL60
538 LL	●	○	
548 LL	●	●	
558 LL	○	●	●
568 LL	○	○	●
MH3040*		○	●
M325D L MH*		○	●
320 FM	●	○	
322 FM	●	●	
324 FM	●	●	
325 FM	○	●	●
330 FM	○	●	●

*When equipped with appropriate front linkage

Features:

Loader Fork

- Few work tool lines can match the range and utility of Cat Forks. Forks transform loaders into high performance material handling platforms capable of sorting, stacking and working wherever product, palletized material or lumber is at hand.

Millyard and Logging Forks

- Cat Millyard and double top clamp forks are performance-matched to Cat Wheel Loaders for unmatched on-the-job performance. The design features of fork and loader complement each other to make the ideal total system solution for log handling applications. Both forks are ideally suited for heavy-duty applications: loading and unloading trucks, sorting, decking, and feeding the mill.

Log and Lumber Forks

- Handle logs or finished lumber with equal ease. The top clamp holds loose loads securely, and the pallet-style forks make short palletized material. This versatility makes them suitable for a wide range of jobs including loading trucks, decking and sorting lumber or logs.

Features — Couplers

Fusion Couplers

- Fusion Quick Couplers provide unmatched versatility to any loader. Change tools in seconds without leaving the cab. Any work tool backed by coupler hooks can be picked up; allowing the loader to fit whatever application is at hand.

Center-Lock™ Pin Grabber Couplers

- The Cat Center-Lock Pin Grabber Coupler allows buckets and other standard work tools to be used without any modification. Exchanging work tools in seconds improves overall production and increases machine versatility. The Coupler is pinned on in place of the bucket with standard pins, and can be easily removed should the need arise to mount a tool directly to the stick.
- The Center-Lock Coupler offers new possibilities. Buckets can be turned around and used in front shovel mode for final trench clean up. An integral lift eye on the coupler body allows lifting without the weight of the bucket, increasing both machine capacity and visibility from the cab.

Features — Buckets and Thumbs

Cat Bucket Thumbs for Hydraulic Excavators

- Multiply the performance of a Cat Excavator by adding a Cat Bucket Thumb. This highly versatile work tool acts in conjunction with the bucket to allow the excavator to grab irregularly shaped items and load loose materials and debris.

Mini Bucket Thumbs

- Cat Bucket Thumbs are matched to Hydraulic Excavator Buckets for increased on-the-job performance. A thumb works with the bucket to grab, pick and sort debris, brush, trash and rock, opening up new production opportunities for your Cat Mini Excavator. Thumbs are an ideal complement to excavators working in demolition, land clearing, landscaping, material handling and construction jobs.

Clamshell Buckets

- Cat Clamshell Buckets are the premier tools for cleanup, demolition, ground clearing and forestry work. Built of heavy T1 steel, these buckets are tough and durable for long service life in the most difficult applications. Clamshell buckets feature continuous 360° rotation, powered by a high-torque hydraulic motor.

Features – Woodchip Dozers and Scoops

Buckets, U-blades, Bowldozers, Chip Scoops

- The high-capacity, high-efficiency design of these tools makes them high-production workhorses. They are matched to specific machines and material densities for optimum performance. The extra capacity and load retention capabilities ensure maximum usage and productivity.

Features — Rakes

Loader, Clearing and Clamp and Blade Rakes

- Rakes are durable, high-capacity tools that will increase production for land clearing, site cleanup and site preparation. Available in quick coupler and pin-on models, rakes pile brush, stack and carry debris and load trucks. Features include thick, fabricated teeth, a heavy-duty push bar and serrated tree pusher. A high brush rack retains the load, prevents back spillage and increases carrying capacity.

USE OF LOG VOLUME TABLES

The tabulated volumes on these pages were calculated with no taper in log diameter from base to top. Therefore each value listed in the table represents the volume of a true cylinder. In practice this may occur only in short sections of large diameter trees. To obtain the volume of solid wood logs, excluding bark:

1. Establish the base diameter of the log inside the bark and above the butt flare (extreme end taper).
2. Repeat the procedure for the top (small end) of log.
3. Enter log volume table at each of the two established diameters. Move horizontally to the vertical column closest to the length of the log being measured.
4. Establish the volume figures for each end of the log, add the two together and divide by two to obtain average log volume.

METRIC LOG VOLUMES (in Cubic Meters)

Log Diameter (cm)	LOG LENGTH (METERS)														
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
10	0.016	0.031	0.047	0.063	0.078	0.094	0.12	0.13	0.14	0.16	0.17	0.19	0.20	0.22	0.24
15	0.035	0.071	0.11	0.14	0.18	0.21	0.25	0.28	0.32	0.35	0.39	0.42	0.46	0.49	0.53
20	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50	0.57	0.63	0.69	0.75	0.82	0.86	0.94
25	0.10	0.20	0.30	0.39	0.49	0.59	0.69	0.79	0.88	0.98	1.08	1.18	1.28	1.37	1.47
30	0.14	0.28	0.42	0.57	0.71	0.85	0.99	1.13	1.27	1.42	1.56	1.70	1.84	1.98	2.12
35	0.19	0.38	0.58	0.7	0.96	1.15	1.35	1.54	1.73	1.93	2.12	2.31	2.50	2.69	2.89
40	0.25	0.50	0.75	1.01	1.26	1.51	1.77	2.02	2.27	2.52	2.78	3.02	3.27	3.51	3.77
45	0.32	0.64	0.95	1.27	1.59	1.91	2.22	2.54	2.86	3.18	3.50	3.82	4.13	4.45	4.77
50	0.39	0.79	1.18	1.57	1.96	2.36	2.76	3.16	3.54	3.94	4.34	4.71	5.10	5.49	5.89
55	0.48	0.95	1.43	1.90	2.38	2.85	3.33	3.80	4.28	4.75	5.23	5.70	6.18	6.65	7.12
60	0.57	1.13	1.70	2.26	2.83	3.39	3.96	4.52	5.09	5.65	6.22	6.78	7.35	7.92	8.48
65	0.66	1.33	1.99	2.65	3.32	3.98	4.65	5.31	5.98	6.64	7.30	7.96	8.62	9.29	9.95
70	0.77	1.54	2.31	3.08	3.85	4.62	5.40	6.15	6.93	7.70	8.48	9.23	10.0	10.77	11.54
75	0.88	1.77	2.65	3.53	4.42	5.30	6.19	7.06	7.95	8.84	9.72	10.60	11.49	12.37	13.25
80	1.01	2.01	3.02	4.02	5.03	6.03	7.05	8.06	9.07	10.08	11.09	12.10	13.10	14.10	15.10
85	1.13	2.27	3.40	4.54	5.67	6.81	7.94	9.08	10.20	11.32	12.47	13.62	14.75	15.89	17.02
90	1.27	2.54	3.82	5.09	6.36	7.63	8.90	10.17	11.43	12.71	13.99	15.27	16.54	17.81	19.10
95	1.42	2.84	4.75	5.67	7.09	8.51	9.92	11.33	12.76	14.18	15.60	17.01	18.43	19.85	21.26
100	1.57	3.14	4.71	6.28	7.85	9.42	11.0	12.58	14.16	15.72	17.30	18.85	20.42	22.0	23.56
125	2.45	4.90	7.36	9.82	12.27	14.73	17.18	19.6	22.1	24.5	27.0	29.5	32.0	34.4	36.8
150	3.53	7.1	10.6	14.1	17.7	21.2	24.7	28.3	31.8	35.3	38.8	42.4	45.9	49.5	53.0
175	4.8	9.6	14.5	19.2	24.0	28.9	33.7	38.5	43.3	48.1	53.0	57.7	62.6	67.3	72.2
200	6.3	12.6	18.8	25.1	31.4	37.7	44.0	50.3	56.5	62.8	69.1	75.4	81.7	88.0	94.2

ENGLISH MEASURE LOG VOLUMES (in Cubic Feet)

Log Diameter (inches)	LOG LENGTH (FEET)																	
	8	**12**	**16**	**20**	**24**	**28**	**32**	**36**	**40**	**44**	**48**	**52**	**56**	**60**	**70**	**80**	**90**	**100**
4	0.7	1	1.4	1.7	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.5	4.9	5.2	6.1	7	7.8	8.7
6	1.6	2.4	3.1	3.9	4.7	5.5	6.3	7.1	7.8	8.6	9.4	10	11	12	13	16	18	20
8	2.8	4.2	5.6	7	8.4	9.8	11	13	14	15	17	18	19	21	24	28	31	35
10	4.4	6.5	8.7	11	13	15	17	20	22	24	26	28	31	33	38	44	49	55
12	6.3	9.4	13	16	19	22	25	28	31	35	38	41	44	47	55	63	71	79
14	8.5	13	17	21	26	30	34	39	43	47	51	56	60	64	74	86	96	101
16	11	17	22	28	34	39	45	50	56	61	67	73	78	84	98	112	126	140
18	14	21	28	35	42	49	57	64	71	78	85	92	99	106	124	141	159	177
20	17	26	35	44	52	61	70	79	87	96	105	113	122	131	153	175	196	218
22	21	32	42	53	63	74	85	95	106	116	127	137	148	158	185	211	238	264
24	25	38	50	63	75	88	101	113	126	138	151	163	176	189	220	251	283	314
26	29	44	59	74	89	103	118	113	147	162	177	192	207	221	258	295	332	369
28	34	51	68	86	103	120	137	154	171	188	205	222	240	256	299	342	385	428
30	39	59	79	98	118	137	157	177	196	216	236	255	275	295	344	393	442	491
32	45	67	89	118	134	156	179	201	223	246	268	290	313	335	391	447	503	559
34	50	76	101	126	151	177	202	227	252	277	303	328	353	378	441	504	567	631
36	57	85	113	141	170	198	226	255	282	311	339	368	396	424	495	566	637	707
38	63	95	126	158	189	220	252	284	315	347	378	410	441	473	551	630	709	788
40	70	105	140	175	210	244	279	314	349	384	419	454	489	524	611	698	785	873
50	109	164	218	273	327	382	436	491	545	600	645	709	764	818	955	1091	1227	1364
60	157	234	314	393	471	550	628	707	785	864	943	1021	1100	1178	1374	1571	1767	1964
70	214	321	428	535	642	748	855	962	1069	1176	1283	1389	1497	1604	1871	2138	2405	2673
80	279	420	559	698	838	977	1117	1257	1396	1536	1676	1815	1955	2095	2441	2293	3142	3491

WEIGHTS OF COMMERCIALLY IMPORTANT WOODS

Species	kg/m³ (Green)	lb/ft³ (Green)
A. Temperate Zone*		
Alder, Red	737	**46**
Ash, White	769	**48**
Aspen	689	**43**
Baldcypress	817	**51**
Basswood	673	**42**
Beech	865	**54**
Birch, Paper	801	**50**
Yellow	929	**58**
Cedar, Alaska	577	**36**
Incense	721	**45**
Northern, White	449	**28**
Port-Orford	897	**56**
Western Red	433	**27**
Cherry, Black	721	**45**
Cottonwood, Eastern	785	**49**
Douglas Fir, (Coast)	881	**55**
(Inland Empire)	577	**36**
Elm, American	865	**54**
Fir, Alpine	449	**28**
Balsam	721	**45**
Nobel	481	**30**
Red	769	**48**
Silver	577	**36**
White	753	**47**
Gum, Black	721	**45**
Blue	1121	**70**
Red	801	**50**
Tupelo	897	**56**
Hemlock, Eastern	801	**50**
Western	961	**60**
Hickory, Pecan	993	**62**
True	1009	**62**
Larch, Western	769	**48**
Locust, Black	929	**58**
Magnolia, Cucumber	785	**49**
Maple, Big Leaf	753	**47**
Black	865	**54**
Red	801	**50**
Silver	721	**45**
Sugar	897	**56**
Oak, Black	1009	**63**
Chestnut	977	**61**
Red	1009	**63**
Red, Swamp	1073	**67**
Swamp Chestnut	1041	**65**
White	993	**62**
White, Swamp	1105	**69**
Pine, Jack	801	**50**
Loblolly	993	**62**
Lodgepole	625	**39**
Long Leaf	993	**62**
Norway (Red)	673	**42**
Short Leaf	993	**62**
Slash	993	**62**
Sugar	817	**51**
Western Yellow, (Ponderosa)	721	**45**
White (Western)	561	**35**
White (Eastern)	577	**36**
Poplar, Yellow	609	**38**
Redwood	801	**50**
Spruce, Black	513	**32**
Engleman	625	**39**
Red	545	**34**
Sitka	529	**33**
White	545	**34**
Sweetgum	801	**50**
Sycamore	833	**52**
Tamarack	753	**47**
Walnut, Black	929	**58**
Willow, Black	801	**50**

***NOTE:** Weights taken from U.S. Dept. of Agriculture handbook No. 72, Wood Handbook.

Species	kg/m³ (Green)	lb/ft³ (Green)
B. Southeast Asia		
Apitong	961	**60**
Bintangor	865	**54**
Chumprak	929	**58**
Ebony	1746	**109**
Geronggang	721	**45**
Jelutong	641	**40**
Kapur (Borneo Camphorwood)	1073	**67**
Keruing	1121	**70**
Krabak	817	**51**
Kruen	1121	**70**
Lumbayau	929	**58**
Mahogany, Philippine		
(Red Luan)	753	**47**
(White Luan)	769	**48**
(Yellow Luan)	769	**48**
Mahoni	913	**57**
Alayan Kauri (Damar Minyak)	817	**51**
Melantai	705	**44**
Melapi	849	**53**
Mangkulang	929	**58**
Meranti Bakau	849	**53**
Meranti, Dark Red	753	**47**
White	769	**48**
Yellow	769	**48**
Mersawa	817	**51**
Nyatoh	897	**56**
Palosapis	817	**51**
Pulai	545	**34**
Ramin	1073	**67**
Rosewood (Sonokelina)	1314	**82**
Seraya, Dark Red	753	**47**
Yellow	769	**48**
White	769	**48**
Teak	1073	**67**

Species	kg/m³ (Green)	lb/ft³ (Green)
C. West Africa		
Abura	850	**53.06**
Ako	800	**49.94**
Azobe	1300	**81.16**
Aniegre (Mukali)	950	**59.31**
Bete	900	**56.19**
Bosse	900	**56.19**
Bubinga	1000	**62.43**
Dibetau	750	**46.82**
Douka (Makore)	950	**59.31**
Doussie	1200	**74.91**
Framire	850	**53.06**
Fromager	550	**34.34**
Ilomba	750	**46.82**
Iroko	1200	**74.91**
Kokrodua (Afrormosia)	1000	**62.43**
Kosipo	900	**56.19**
Limba	750	**46.82**
Mahogany	750	**46.82**
Moabi	1100	**68.67**
Niangon	900	**56.19**
Okoume	650	**40.57**
Ozigo	900	**56.19**
Padouk	1000	**62.43**
Samba (Obeche)	650	**40.58**
Sapelli	900	**56.19**
Sipo	800	**49.94**
Tchitola	850	**53.06**
Tiaba	900	**56.19**
Tola	850	**53.06**

Weights of Commercially Important Woods
- Australia
- New Zealand
- Papua New Guinea

Species	kg/m³ (Green)	lb/ft³ (Green)
D. Australia		
Ash Alpine	1041	**65**
Mountain	1009	**63**
Silvertop	1330	**83**
Black Butt	1121	**70**
Box Long Leaf	993	**62**
Yellow	1105	**69**
Black	1105	**69**
Brownbarrel	1073	**67**
Candle Bark	657	**41**
Gum Grey	1217	**76**
Manna	1121	**70**
Mountain	1169	**73**
Mountain Grey	1057	**66**
River Red	1137	**71**
Forest Red	1201	**75**
Southern Blue	1217	**76**
Spotted	1201	**75**
Sydney Blue	1153	**72**
Iron Bark Gray	1330	**83**
Narrowleaved	1330	**83**
Red	1330	**83**
Jarrah	1169	**73**
Karri	1169	**73**
Mahogany Red	1153	**72**
White	1282	**80**
Myrtle	1169	**73**
Peppermint	1120	**70**
Pine Radiata	865	**54**
Monerey	865	**54**
Celerytop	1057	**66**
Stringy Bark Brown	1233	**77**
Messmate	1169	**73**
Yellow	1217	**76**
White	1121	**70**
Tallowwood	1201	**75**
Wandoo	1282	**80**

Species	kg/m³ (Green)	lb/ft³ (Green)
E. New Zealand		
Exotic Softwoods		
Radiata Pine	1000	**62**
Douglas Fir	734	**45**
Corsican Pine	985	**61**
Redwood	1016	**63**
Larch	960	**60**
Indigenous Softwoods		
Mati	1120	**70**
Rimu	1130	**70**
Exotic Hardwoods		
Eucaliptus Botryoides	893	**56**
Eucaliptus Saligna	1200	**75**
Indigenous Hardwoods		
Beech — Silver	920	**57**
Beech — Red	1200	**75**
Tawa	1022	**64**

Species	kg/m³ (Green)	lb/ft³ (Green)
F. Papua New Guinea		
Pine, Hoop	520	**32**
Kauri	480	**30**
Klinki	510	**31**
Kwila	800	**50**
Erima	390	**24**
Taun	680	**42**
Walnut, PNG	560	**35**
Cedar, Pencil	720	**50**
Mersawa	650	**40**
Celtis, Hard	780	**48**
Rosewood, PNG	600	**37**
Beech, PNG	830	**51**
Oak, PNG	650	**40**
Ebony, PNG Black	1115	**69**
PNG White	720	**50**
Hardwood, Yellow	780	**48**
Hopea, Heavy	960	**60**
Light	710	**44**
Podocarp, Black	410	**25**
Terminalia, Brown	450	**28**

ESTIMATING NUMBER OF TREES PER HECTARE

Spacing (Meters)	Spacing (Meters) 1	2	3	4	5	6	7	8
1	10 000	5000	3333	2500	2000	1667	1428	1250
2	5000	2500	1667	1250	1000	834	714	625
3	3333	1667	1111	834	667	556	477	417
4	2500	1250	834	625	500	417	357	313
5	2000	1000	667	500	400	330	286	250
6	1667	834	556	417	333	278	238	208
7	1428	714	477	357	286	238	204	179
8	1250	625	417	313	250	208	179	156

ESTIMATING NUMBER OF TREES PER ACRE

Spacing (Feet)	Spacing (Feet) 5	6	7	8	9	10	11	12
5	1742	1452	1244	1089	968	871	792	726
6	1452	1210	1037	907	806	726	660	605
7	1244	1037	888	777	691	622	565	518
8	1089	907	777	680	605	544	495	453
9	968	806	691	605	537	484	440	403
10	871	726	622	544	484	435	396	363
11	792	660	565	495	440	396	360	330
12	726	605	518	453	403	363	330	302
13	671	558	478	418	372	335	304	279
14	622	518	444	390	346	311	283	259
15	580	484	415	363	323	290	264	242

COMPARISON OF LOG RULES ● Board Foot Values for 16-Foot Logs

Diameter at Small End, Inside Bark, Inches	International 1/4 Inch	Scribner	Scribner Decimal	Spaulding	Doyle
4	5	10	10	—	—
6	20	18	20	—	4
8	40	32	30	—	16
10	65	54	60	50	36
12	95	79	80	77	64
14	135	114	110	114	100
16	180	159	160	161	144
18	230	213	210	216	196
20	290	280	280	276	256
22	355	334	330	341	324
24	425	404	400	412	400
26	500	500	500	488	484
28	585	582	580	569	576
30	675	657	660	656	676
32	770	736	740	748	784
34	875	800	800	845	900
36	980	923	920	950	1024
38	1095	1068	1070	1064	1156
40	1220	1204	1200	1185	1296

UNIT OF MEASUREMENT DEFINITIONS

1 board foot	= 1/12 ft^3 of solid wood (1' × 1' × 1")
1000 board feet	= 83.33 ft^3 of solid wood
1 c. unit of wood	= 100 solid ft^3
	= 1200 board feet
	= 2.83^3
1 cord of wood	= 128 ft^3 of stacked logs
	= 3.62 m^3
1 unit of wood	= 200 ft^3 of loose chips
	= 5.66 m^3
1 cord of wood	= 0.85 units
1 Hoppus Ton	= 50 ft^3 (assumed)
	= 63.65 ft^3 (actual)
	= 600 board feet
	= 763.8 BF Brereton
	= 1.8 m^3 actual
	= 1.4 m^3 assumed
1 cubic meter	= 35.32 ft^3
	= 424 board feet
	= 333 board feet Hoppus tons
	= 0.555 Hoppus Tons
1 MBF Brereton	= 2.36 m^3
	= 785.4 board feet Hoppus
1 MBF Hoppus	= 1273 board feet-Brereton
MBF	= Thousand board feet
1 Super Foot	= 1 board foot
100 Super Feet	= 1000 board foot
	= 0.236 m^3
600 Super Feet	= 50 ft^3
1 lb/ft^3	= 16.0185 kg/m^3

CUBIC FEET OF SOLID WOOD PER CORD

Length of Sticks-Ft.	Diameter at Small End		
	1"-2.5"	2.5"-5.5"	Over 5.5"
2	65	84	91
4	64	82	89
8	59	77	84
12	54	71	78

RULE OF THUMB CONVERSIONS

1 c. unit of wood = 1.117 cords = 1.25 units of chips = 250 ft^3 of chips = 7.08 m^3
1 cord of wood = 85 ft^3 of solid wood = 1.06 units of chips = 2.41 m^3
1 unit of chips = 80 ft^3 of solid wood = 2.27 m^3
1 cord of wood = 500 board feet = 1.18 m^3
2000 pounds of chips = 500 pounds of pulp
1 cord = 212 ft^3 of chips = 6 m^3

HYDRAULIC EXCAVATORS

CONTENTS

HYDRAULIC EXCAVATORS

NEXT GEN MINI EXCAVATORS

The Next Generation Excavators have been imagined, designed, and built with an improved customer experience in mind. The work and development of this product has been done with a customer focused framework that was designed to exceed expectations when compared to the current Cat and competitive offerings. This product is truly differentiated from competitors and creates an overall experience in its size class.

To simplify the sales and marketing story for these products, an acronym has been developed for internal use to help make remembering areas of differentiation easy for dealer sales staff. The acronym, CAPES, highlights the five key areas of strength and differentiation of the products, and will be further detailed later in this document. See the overview below of the **CAPES** message:

C: Customer: These Next Gen Mini Excavators have been designed with the customer in mind and should exceed expectations with strong performance, differentiation, and the greatest operator experience. The safety of customers is at the forefront of the machine's design, seen in how the Next Gen Mini Excavators are equipped with a sealed and pressurized cab, and a three-inch hi-vis seatbelt, among other safety features.

A: Affordability: These Next Gen Mini Excavators, with their innovative, standard features, will provide a great price/value proposition for customers. It will also offer industry exclusive features like the canopy and tilt-up cab (some models), air conditioning (AC), the standard monitor with the option to upgrade to the touch-screen advanced monitor, and competitively priced basket of service parts.

P: Performance: These Next Gen Mini Excavators will excel versus competition and previous Cat models in productivity. The machines will also travel faster, dig to blade, and outperform any competitive model with regards to digging and trenching. In conjunction with Stick Steer, you can operate the machine just like a dozer with travel in the left joystick and the blade in the right joystick.

E: Experience: These Next Gen Mini Excavators will provide the most comfortable and unique customer experience of any excavators of its size. Some of the options include Stick Steer and Cruise Control, sealed and pressurized cab with AC, and a Next Gen LCD Monitor as standard with an option to upgrade to a Next Gen Advanced Monitor on cab units.

S: Serviceability: These Next Gen Mini Excavators boast an industry first and uniquely designed tilt-up cab that offers best in class access to all components and reduced service time. All common maintenance points are easily accessible through all-around service door access in addition to the tilt-up cab.

These Next Gen Mini Excavators will employ Cat Diesel engines that offer among the highest horsepower, displacement, and performance in the industry. The engine is Tier 4 Final Compliant and will offer the durability, performance, and serviceability that Cat engines are known for.

The Next Gen machines will feature nomenclature that corresponds to the weight of the machines in metric tons, just as the other machines in the Cat mini excavator lineup.

EXCAVATOR LIFTING CAPACITY

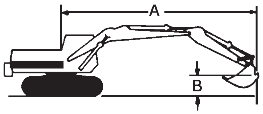
On many sewer jobs an excavator must lift and swing heavy pipe and manboxes in and out of the trench, place manholes and unload material from trucks. In some situations the excavator's lift requirements may be so critical that they determine the size excavator selected.

An excavator's lift capacity depends on its weight, center of gravity, the lift point position (see sketches) and its hydraulic capability. An excavator's lifting capability for any given lift position is limited by its tipping stability or hydraulic capacity.

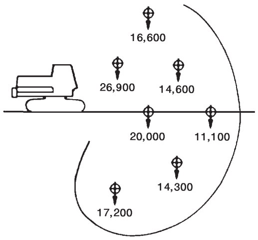
Changes in boom, stick and bucket position affect attachment geometry and can drastically change a machine's hydraulic lifting capacity. Caterpillar defines excavator lifting capabilities using the following SAE guidelines.

Tipping Conditions — An excavator is considered to be at the tipping point when the weight in the bucket acting at the center of gravity causes the rear rollers to lift clear of the track rails. Suspended loads are considered to be hung from the back of the excavator's bucket or bucket linkage by a sling or chain. Weights of attachments, slings or auxiliary lifting devices are considered part of the suspended load.

Thus, the tipping load is defined as the load producing a tipping condition at a specified radius. The load radius shall be measured as the horizontal distance from the axis of upper structure rotation (before loading) to the center of vertical load line with load applied (dimension A, below). The rating height is based on the vertical distance of the bucket lift point to the ground (dimension B).



A. Radius from swing centerline
B. Bucket lift point height



HYPOTHETICAL MACHINE

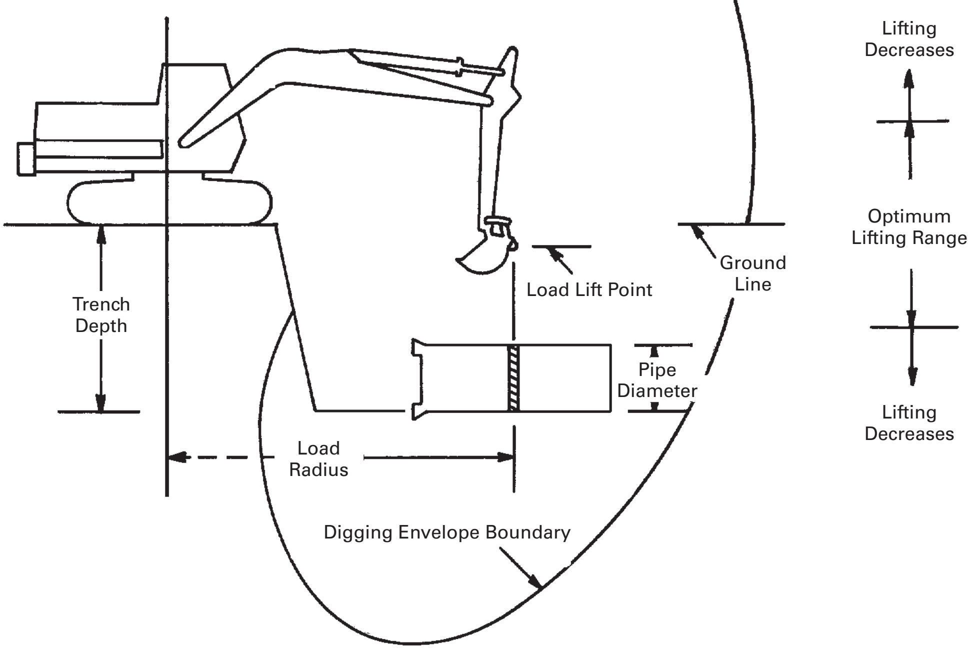
Rated Hoist Load — The rated load is established using the vertical distance of the lifting point to the ground and the radius of load. Ratings for the ability of a specific machine attachment to lift a load slung from the designated bucket are defined as follows:

a. The rated load will not exceed 75% of the tipping load.
b. The rated load will not exceed 87% of the excavator's hydraulic capacity. This means the machine should be able to lift 115% of the rated load.
c. The rated load will not exceed the machine's structural capability.

5

This drawing shows how an excavator's lifting capacity can vary with load position:

HYPOTHETICAL MACHINE



Tips for Lifting Above Ground:

Get the load as close to the excavator as possible.

Use a cable short enough and position the excavator so as to put the load lift point in the "optimum lifting range" (see sketch).

Problem: Long reach cable — Can't lift.

Solution: Shorten reach and cable — Can lift.

Tips for Lifting Below Grade:

Use a cable for sufficient length to position the load lift point in the "optimum lifting range".

Problem: Short cable, deep trench — Can't lift.

Solution: Lengthen cable to locate bucket hinge pin in optimum lifting area — Can lift.

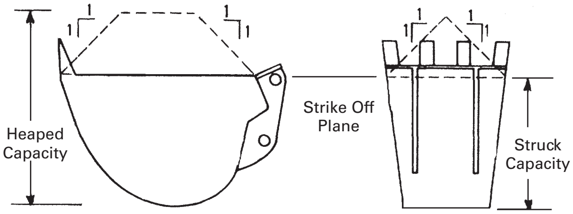
For lifting capacities at different heights please consult specific excavator model Technical Specifications.

EXCAVATOR BUCKET CAPACITIES

Caterpillar rates excavator buckets to conform with both PCSA standard No. 3 and SAE standard J-296. Buckets are rated on both their struck and heaped capacities as follows:

Struck Capacity

Volume actually enclosed inside the outline of the sideplates and rear and front bucket enclosures without any consideration for any material supported or carried by the spillplate or bucket teeth.



Excavator Bucket Rating

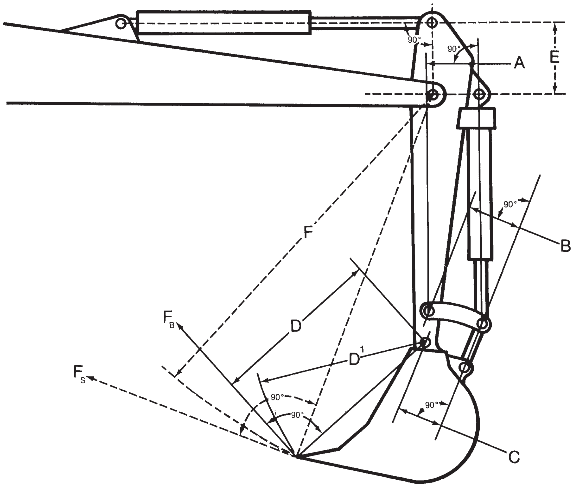
Heaped Capacity

Volume in the bucket under the strike off plane plus the volume of the heaped material above the strike off plane, having an angle of repose of 1:1 without any consideration for any material supported or carried by the spillplate or bucket teeth.

The Committee on European Construction Equipment (CECE) rates heaped bucket pay loads on a 2:1 angle of repose for material above the strike off plane.

CURL AND CROWD FORCES

Bucket penetration into a material is achieved by the bucket curling force (F_B) and stick crowd force (F_S). Rated digging forces are the digging forces that can be exerted at the outermost cutting point. These forces can be calculated by applying working relief hydraulic pressure to the cylinder(s) providing the digging force. The digging forces listed on next page conform with SAE Standard J1179 and PCSA Standard No. 3. The values may not be directly comparable to forces for machines rated by other methods than those described below.



F_B = Radial tooth force due to bucket cylinder

$$= \frac{\text{Bucket cylinder force}}{\text{Arm D length}} \left(\frac{\text{Arm A} \times \text{Arm C}}{\text{Arm B}} \right)$$

Cylinder force = (Pressure) × (End area of cylinder head)

Arm D = Bucket tip radius

Maximum radial tooth force due to bucket cylinder (bucket curling force) is the digging force generated by the bucket cylinder(s) and tangent to the arc of radius D^1. The bucket shall be positioned to obtain maximum output moment from the bucket cylinder(s) and connecting linkages. When calculating, maximum F_B occurs when the factor — Arm A times Arm C divided by Arm B — becomes the maximum.

F_S = Radial tooth force due to stick cylinder

$$= \frac{(\text{Stick cylinder force}) \times (\text{Arm E length})}{(\text{Arm F length})}$$

Arm F = Bucket tip radius + stick length

Maximum radial tooth force due to stick cylinder (stick crowd force) is the digging force generated by the stick cylinder(s) and tangent to the arc of radius F. The stick shall be positioned to obtain the maximum output moment from the arm cylinder and the bucket positioned as described in the bucket force rating. When calculating, maximum F_S occurs when the axis in the stick cylinder working direction is at a right angle to the line connecting the stick cylinder pin and the boom nose pin.

Bucket Selection Considering Bucket Curl and Stick Crowd Forces

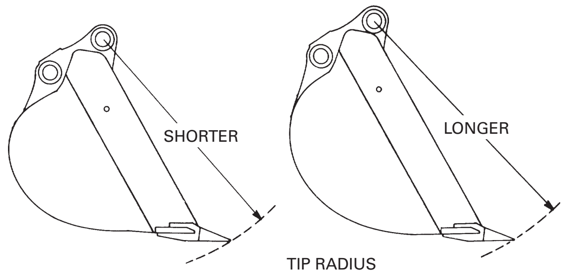
The combination of the excavator's stick crowd force and bucket curling force give this machine configuration more effective bucket penetration force per mm (inch) of bucket cutting edge than is available with other machine types such as wheel and track loaders.

As a result of high penetration force, an excavator bucket is comparatively easy to load. Also, the higher unit breakout forces allow the excavator's economic application range to be extended farther into the tougher soils (coral, caliche, shale, limestone) before blasting or ripping is required.

To take full advantage of an excavator's high penetration forces, buckets should be selected so they are well matched to soil conditions that are encountered. The two important things to consider are bucket width and bucket tip radius.

As a general rule, wide buckets are used in easily dug soil and narrow buckets in harder material. In hard rocky soils, tip radius also has to be considered in bucket selection. Because the shorter tip radius buckets provide more total bucket curling force than the long tip radius buckets, they are generally the easiest to load. A good rule of thumb when selecting a Cat bucket for hard material is to choose the narrowest bucket that has a short tip radius.

Other factors such as trench bottom width specifications, manbox size, or the desire to conserve bedding material may also influence excavator bucket selection.



Caterpillar offers a very comprehensive list of high strength steel buckets. High strength steel allows thinner components which helps keep the weight down, maintains durability and improves loadability. The wrong bucket can reduce production 30-40% or more. Caterpillar's in-depth knowledge of machine design, bucket design and application experience allows offering **machine matched** packages that optimize performance.

Additional buckets may be available and the listed buckets may not be available in all sales areas. Contact your Cat dealer for your specific bucket needs.

NOMENCLATURE FOR HYDRAULIC EXCAVATOR BUCKETS

Caterpillar has moved to a global nomenclature for buckets on small, medium and large excavator (HEX) machines and associated linkages. The end result has been a manageable, consistent bucket offering in all regions regardless of where the machine or bucket may be built and shipped.

Why the change?

Consistent product line

Buckets sold into different regions of the world have been designed and manufactured independent of each other resulting in different bucket styles and nomenclature. As Caterpillar became more global, we recognized this lead to confusion in the marketplace as machines and buckets are sourced from different areas.

Improved bucket selection

Caterpillar continues to recognize the need for a range of buckets for various applications and with varying durability requirements — from site development to granite quarries. The new, global nomenclature is simplified, consistent, and based on the durability of the bucket. These considerations allow a clear and consistent bucket positioning to help facilitate appropriate bucket selection and recommendation — and put Caterpillar in a better position to support machines on a global scale.

In the past, HEX buckets were grouped into three main categories: General Purpose (GP), Heavy Duty (HD), and Heavy Duty Rock (HDR). New nomenclature brings in four primary categories, each represent durability. They are: General Duty (GD), Heavy Duty (HD), Severe Duty (SD), and Extreme Duty (XD). Within the Extreme Duty class a new bucket specific for use in granite will be available for the large excavators.

Nomenclature for Hydraulic Excavator Buckets

The diagram below illustrates how previous nomenclature aligns with the current, followed by a brief description of each category.

Previous Nomenclature	**GP**	**HD**	**HDR**	**Custom** (ie: granite applications)
Current Nomenclature	**GD**	**HD**	**SD**	**XD**

Description:

General Duty
- Low impact
- Lower abrasion materials (ie: dirt, loam, mixed compositions of dirt and fine gravel)
- Pin-on and coupler

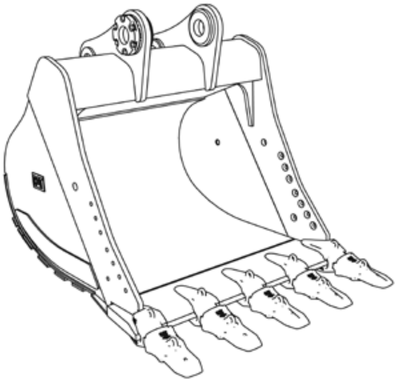
Heavy Duty
- Wide range of impact
- Wide range of abrasion material (ie: mixed dirt, clay and rock)
- Trenching
- Variety of applications
- Pin-on and coupler

Severe Duty
- Higher abrasion conditions (ie: shot granite)
- Wear bars, wear plates are substantially thicker and larger for added protection
- Pin-on and coupler

Extreme Duty
- High abrasion conditions (ie: granite quarries with high quartzite content
- Corner shrouds have been added and side wear plates are larger for added protection against abrasion and gouging wear
- Pin-on and coupler

BUCKET TYPES

General Duty

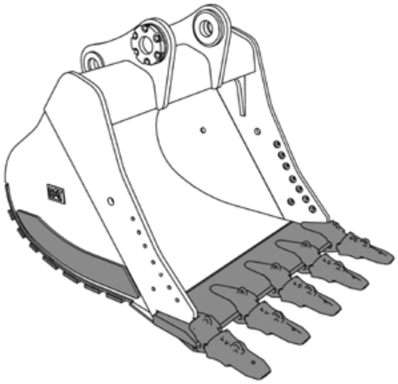


For digging in low impact, lower abrasion materials such as dirt, loam, and mixed compositions of dirt and fine gravel. Example: Digging conditions in which General Duty tip life exceeds 800 hours.

Typically larger General Duty buckets are the most popular sizes, and are used by site developers to mass excavate in low abrasion applications.

- Lighter structures decrease load time and increase the weight that can be lifted.
- Standard size adapters and tips.
- Sidebars are pre-drilled for optional sidecutters and sidebar protectors.

Heavy Duty



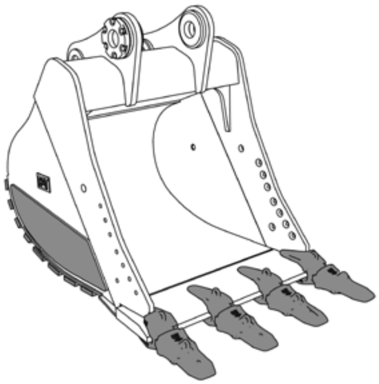
The most popular excavator bucket style. A good "center line" choice, or starting point, when application conditions are not well known.

For a wide range of impact and abrasion conditions including mixed dirt, clay and rock. Example: Digging conditions where Penetration Plus tip life ranges from 400 to 800 hours.

Heavy Duty Buckets are recommended for trenching in utilities work, and for the general contractor working in a variety of different situations.

- Thicker bottom and side wear plates than General Duty buckets for more durability.
- Adapters and tips are up-sized for enhanced performance and durability.
- Sidebars are pre-drilled for optional sidecutters and sidebar protectors.

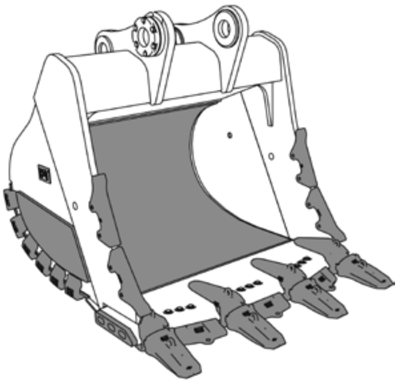
Severe Duty



For higher abrasion conditions such as well shot granite and caliche. Example: Digging conditions where tip life ranges from 200 to 400 hours with Penetration Plus tips.

- Bottom wear plates are about 50% thicker than Heavy Duty buckets.
- Side wear plates are about 40% larger than Heavy Duty buckets for added protection against abrasive and gouging wear.
- Heavy Duty and Severe Duty buckets use same size adapters.
- Adapters are sized to accommodate higher abrasion conditions.
- Tips are up-sized (over the General Duty bucket) for enhanced performance and durability.
- Sidebars are pre-drilled for optional sidecutters and sidebar protectors.

Extreme Duty



For very high abrasion conditions including high quartzite granite. Example: Digging conditions where tip life is less than or equal to 200 hours with Extra Duty tips.

- Corner (or heel) shrouds, Base Edge End Protectors (BEEPs), base edge segments, liners, and Mechanically Attached Wear Plates (MAWPs) protect the bucket from wear.
- Side wear plates are larger.
- Sidebar protection has been added for protection against abrasion and gouging wear.
- Adapters are sized to accommodate higher abrasion conditions.
- Tips are up-sized (over the General Duty bucket) for enhanced performance and durability.

A wide range of specialty buckets to fit your specialty applications. These buckets are designed with specific tasks or applications in mind such as ditch cleaning, grading, and trenching.

Clean-Up

Clean-up buckets combine the straight edge and width options of a Ditch Cleaning bucket with the capacity and durability of a General Duty bucket, creating the ideal bucket for digging, grading, and finishing work.

Ditch Cleaning and Ditch Cleaning Tilt

Ditch Cleaning buckets work best for cleaning ditches, sloping, grading, and other finish work as the only style with side liquid drainage holes, making it easier to move solid materials. Ditch Cleaning Tilt buckets have 90° of hydraulic tilting capability, 45° left and 45° right powered by two, double-acting cylinders.

Grading and Trenching

Grading and Trenching buckets are primarily used to create a smooth finish or grade to a job. Primarily used with the Tiltrotator, the bucket gains the capability to create a smooth finish from multiple angles. The narrower profile of Trenching buckets allows for digging specific widths when necessary.

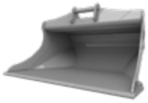
Skeleton

Some applications may require the removal of larger materials while sifting out finer materials, for example removing large rocks from a sandy area. Skeleton buckets are ideal for these situations. Skeleton buckets can excavate, sort, and sift due to their mesh design.

Clean-Up

Ditch Cleaning

Ditch Cleaning Tilt



Grading

Profile

Severe Duty Extreme

Skeleton

Trenching

Utility Duty

Utility Duty

Utility Duty buckets are a cost-effective solution for your basic digging needs. Ideal applications are low-impact, low-abrasion materials. The shallow profile makes it easier to empty sticky materials such as loam or clay.

Severe Duty Extreme

Severe Duty Extreme buckets are capable of handling, loading, and face scraping of high-impact materials such as high quartzite granite, ore, coal, and shot rock. Designed specifically for 35 ton and higher excavators in highly abrasive applications.

Profile

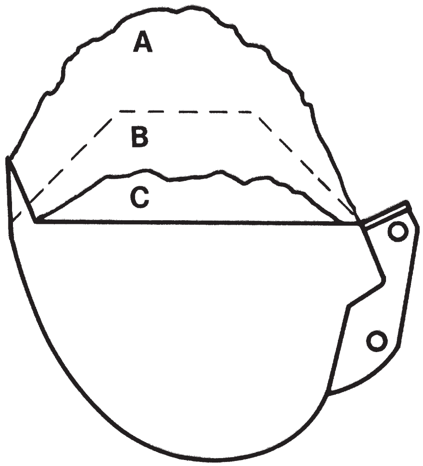
Trench digging is an easy task with the use of a Profile bucket, which has fixed or have adjustable wings, allowing the operator to conform to the size and shape of certain trenches. Profile buckets with wings are adjustable from 30-45° relative to the plane being dug.

BUCKET PAYLOAD

An excavator's bucket payload (actual amount of material in the bucket on each digging cycle) is dependent on bucket size, shape, curl force, and certain soil characteristics, i.e., the fill factor for that soil. Fill factors for several types of material are listed below.

Average Bucket Payload =
(Heaped Bucket Capacity) × (Bucket Fill Factor)

Material	Fill Factor Range (Percent of heaped bucket capacity)
Moist Loam or Sandy Clay	**A** — 100-110%
Sand and Gravel	**B** — 95-110%
Hard, Tough Clay	**C** — 80-90%
Rock — Well Blasted	60-75%
Rock — Poorly Blasted	40-50%



Working Weights — Bucket & Payload

The following tables give maximum "bucket plus payload" weights to assist in selecting the correct bucket for a specific application. These weights are based on actual job conditions. In better than average conditions the excavator may be able to achieve rated lift capacities listed in this section.

NOTE: Bucket sizes are suitable for a maximum material density of 1800 kg/m³ (3035 lb/yd³). Payloads shown are calculated at 1500 kg/m³ (2530 lb/yd³).

Many Cat excavators have simple to use technologies that help boost operator efficiency that includes Cat Grade with 2D, Cat Grade with Assist, Cat Payload, Cat Lift Assist, and Cat E-Fence. Other available optional upgrades include Cat Grade with Advanced 2D and Cat Grade with 3D.

CAT GRADE WITH 2D

Cat Grade with 2D helps operators reach grade faster. Operators cut and fill to exact specifications without overcutting. It can be programmed to the site's most used target depth and slope offsets so grade can be obtained with ease – a real time saver on the jobsite. No grade checkers are needed so the work area is safer.

CAT GRADE WITH ASSIST

Automated boom, stick, and bucket movements deliver more accurate cuts with less effort. The operator simply sets the depth and slope in the monitor and activates single-lever digging. Also reducing operator fatigue and improving operator accuracy, speed, versatility and safety.

CAT PAYLOAD

Cat Payload technology delivers precise load targets with on-the-go weighing, which helps prevent over/underloading and maximizes efficiency. Automated tracking helps manage production and lower cost. The monitor's USB port lets the operator download the results from production so progress can be managed without needing an internet connection.

LIFT ASSIST

Lift Assist quickly calculates the actual load that is being lifted and compares it to the rated load the excavator is capable of handling. Visual and auditory alerts tell the operators if they are within safe working range or need to take action to avoid tipping.

2D E-FENCE TECHNOLOGY

Whether a bucket or a hammer is being used, standard 2D E-fence automatically stops excavator motion using boundaries operators set in the monitor for the entire working envelope – above, below, sides and front. E-fence protects equipment from damage and reduces fines related to zoning or underground utility damage. Automatic boundaries even help prevent operator fatigue by reducing overswinging or digging.

AVAILABLE OPTIONAL UPGRADES

Cat Grade with Advanced 2D and Cat Grade with 3D increase productivity and expand grading capabilities. Grade with Advanced 2D adds in-field design capabilities through an additional 254 mm (10 in) high-resolution touchscreen monitor. Grade with 3D adds GPS, GNSS, and GLONASS positioning for pinpoint accuracy.

INTRODUCTION

Long reach excavators are designed purposely for light duty digging that requires reach capability well above that of normal digging machines. To be able to have high enough digging forces together with an acceptable size bucket, the long reach excavators have a smaller digging envelope than the ditch cleaning machines. Long reach excavators are ideally suited for deep digging in gravel or sand pits then feeding directly into a hopper.

Caterpillar's long reach hydraulic excavators use purpose-built booms and sticks designed by Caterpillar for maximum performance and durability in light duty applications.

Long Reach Excavation Fronts include: boom, stick, linkage cylinders (boom, stick, and bucket), hydraulic lines, additional counterweight for stability over the side and heavy duty wide undercarriage. Dimensions include light excavation bucket.

INTRODUCTION

Long Reach Excavation machines are designed specifically for jobs requiring longer reach than standard excavators, combined with digging capabilities.

The boom and the stick are purposely designed to perform digging operations with an acceptable bucket size.

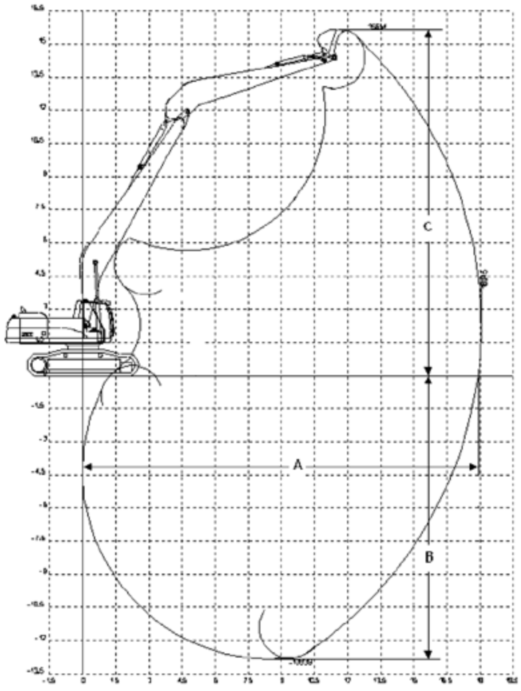
The performances of the machine are attained through the use of bigger boom cylinders, heavy-duty wide undercarriage and significant additional counterweight. A heavy-duty upper-frame is also used in order to guarantee durability and resistance to the extra stresses generated by that demanding application.

Long Reach Excavation machines are ideally suited for deep or long distance digging in sand or gravel pits, slope forming, cleaning of settling banks, river conservation and other work formerly reserved for draglines.

These excavators can of course feed directly into a hopper or load a truck that would stand by their side.

The boom and the stick are designed following Caterpillar's standards, in order to provide the maximum performance and durability in digging applications.

Long Reach Excavation Fronts include: boom, stick, linkage (boom, stick, and bucket cylinders), hydraulic lines and additional counterweight. Dimensions include the bucket.

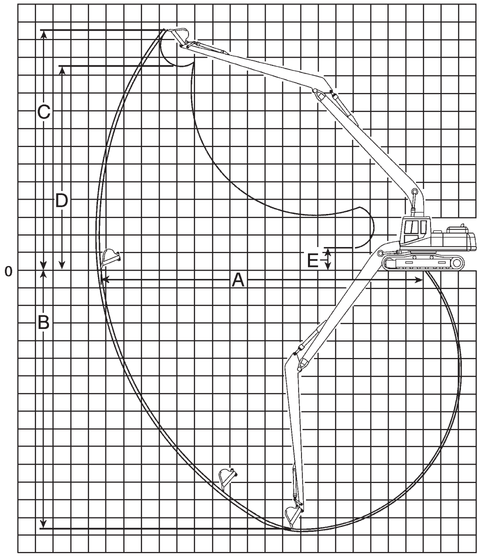


INTRODUCTION

Super long reach excavators are designed specifically for those jobs requiring maximum reach well beyond the range of normal excavators. Those machines are designed to drag a small bucket at about 90 degrees over the side of the tracks towards the excavator; they are not suited for digging work. Caterpillar offers the Long Reach excavators for light digging applications with a much larger digging envelope than normal excavators. Super long reach excavators are suited for ditch cleaning, slope finishing, river conservation and other work formerly reserved to draglines.

Caterpillar's super long reach hydraulic excavators use purpose-built booms and sticks designed by Caterpillar for maximum performance and durability in dragging applications.

Super long reach fronts include: boom, stick, linkage cylinders (boom, stick, and bucket), hydraulic lines and additional counterweight for stability while working over the side. Dimensions include bucket.



MACHINE SELECTION: TRACKS VERSUS WHEELS

Features:

Tracks	Wheels
● Flotation	● Mobility and speed
● Traction	● No pavement damage
● Maneuverability	● Better stability with outriggers or dozers
● Severe underfoot	● Leveling machine with outriggers
● Faster machine repositioning	● Dozing capability

Tracks (10T to 95T)

Unless the application calls for a lot of travel to, from, and around the job sites, a track-type excavator could be the better choice. Tracked-type excavators provide good traction and flotation in almost all kinds of underfoot conditions. Consistently good drawbar power provides excellent maneuverability. The Tracked undercarriage also provides good overall stability. If the job calls for frequent machine repositioning, a track-type excavator will provide better operating efficiency — where raising and lowering outriggers would take extra time.

Wheels (15T to 24T)

Looking for a highly versatile machine? A machine that can do more than mass excavation and trenching. Consider a Wheeled Excavator.

A Wheeled Excavator combines traditional excavator features such as 360° swing, long reach, deep digging depth, high loading height, high digging forces and high lift capacities, with the mobility of a wheeled undercarriage. The rubber tires allow the excavator to travel paved roads, work in shopping malls, squares, parking lots and other paved areas without damaging the pavement. It's mobility allows fast independent travel between job sites as well as on the job site giving you more job planning flexibility. The Wheeled Excavator is the ideal tool for truck loading in tight quarters, undercutting concrete or asphalt, patching, shoulder work, curb and gutter repair, landscaping, spreading top soil, fine grading, laying pipe, placing manholes or ditch cleaning.

A Wheeled Excavator is also an ideal machine in material handling. It can load or unload trucks and carry loads around the job site. Stabilizers and a dozer blade can be pinned to the undercarriage increasing the machine's stability during lifting.

Equip the Wheeled Excavator with dedicated special attachments such as cab riser, material handling stick and boom. Add the additional hydraulic circuit option and your ready for a complete range of special tools. Ditch cleaning bucket, clamshell, grapples, hammers to name a few.

Cat wheeled Excavators offer a load independent, load-sensing, flow distribution hydraulic system that gives the operator absolute precision and control no matter what the application.

Machine weight is the key to selecting a Wheeled Excavator. Following are some additional factors that need to be considered.

Choose the proper boom and stick for your reach, digging depth and lifting requirements. Stability can be greatly enhanced by adding outriggers and/or a dozer blade. Additional hydraulic circuits can be added depending on your application and stick end attachments.

Acceptable Bucket/Stick Combinations

The following charts identify the acceptable bucket and stick combinations for Cat wheeled Excavators and are based on stability. Minimum stability occurs with the linkage oriented over the side and positioned as shown in the visual. Dozer and/or stabilizers (if equipped) are raised and the bucket contains a full load. The longest stick is shown that has acceptable stability for each bucket. That stability is 1.1 moment ratio or better. Once this stability factor is established, all shorter sticks are then acceptable with the listed bucket.

EXCAVATOR SHOE SELECTION

Undercarriage life can be extended by equipping the machine properly for the application.

Many excavators work on pavement or flat, soft ground and experience few undercarriage problems. But if those same machines (usually equipped with wide track pads) were placed in severe underfoot conditions, undercarriage destruction could occur very rapidly.

The rule, used for other track-type machines — *"Whenever possible use the narrowest shoes available"* — is even more valid for excavators.

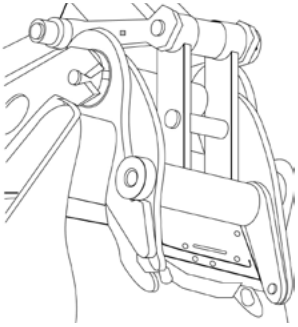
The best general purpose track shoe is the triple grouser. It has a good section modulus and offers the best compromise between traction and minimum disturbance to paved surface.

The double grouser shoe has a better section modulus and is more aggressive than the triple grouser section. Single grouser shoes are offered for maximum traction. Some users like single grousers for added mobility in hilly terrain.

QUICK COUPLER SYSTEMS

Quick couplers can greatly increase a machine's versatility and productivity. They make it much easier to switch attachments which can increase utilization. Quick couplers also encourage changing buckets when the application changes, rather than continue to use a less efficient bucket. Example: An application that is predominately dirt with occasional pockets or seams of rock. Without a quick coupler the owner may choose to live with a rock bucket but, rock buckets are normally smaller and heavier which reduces performance in a dirt application. A quick coupler allows the use of the rock bucket in the rock and a GP bucket in the dirt.

Caterpillar offers two main types of quick couplers. The first is a dedicated type. A typical system substitutes hooks on the bucket for the pin-on hinges used with conventional buckets. The mating portion is pinned on the stick and bucket linkage. It slips into the hooks to secure the bucket or other attachment.



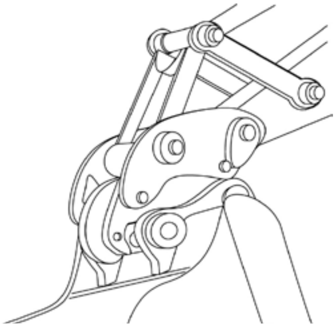
Advantages:

Bucket tip radius (distance from the bucket pivot point to the bucket tip) does not increase. Increased tip radius reduces curl and stick forces which can reduce the loadability of the bucket. The hook type coupler also does not add appreciable weight at the end of the stick. Keeping the tip radius and weight the same ensure no compromise in performance. The machine portion of the hook type coupler can be designed to allow more than one machine to use the same buckets.

Disadvantages:

The hook type system requires special buckets. Conventional pin-on buckets cannot be used. The ability to use buckets on more than one machine requires careful application analysis. Larger machines generate forces that can destroy the wrong buckets. Smaller machines with the wrong bucket may develop loads in excess of the machine's capability. Even if the machine can handle the loads, the tip radius may be too large to allow the bucket to load properly. With the flexibility of a quick coupler comes the responsibility to make sure the bucket or other attachments are properly sized for each application.

The second type of quick coupler is the pin grabber type. This device pins on the stick and bucket linkage and grabs the bucket pins on standard pin-on buckets.



Advantages:

The advantage of the pin grabber is that it will pick up standard pin-on buckets. No need to purchase new attachments that will fit the system.

Disadvantages:

The pin grabber is mounted between the stick and the bucket which increases the tip radius. The amount of increase depends on the pin grabber's manufacturer. Increasing tip radius can compromise performance by decreasing bucket forces. The coupler also adds weight and reduces the payload capability.

Pin grabbers are required to mate up with existing bucket pins. Because different machines require different pin spreads and diameters, they offer very limited ability to match with buckets from other machines.

Both types of quick couplers offer cab activated… this allows an attachment change in 30 seconds or less.

Pin grabber couplers allow work tools to be changed quickly — improving overall production and increasing machine versatility. A coupler is pinned on in place of the bucket with standard pins, and can be easily removed should the need arise to mount a tool directly to the stick.

The Pin Grabber Coupler is designed for use on machines sized from 10T to 95T — and is designed to engage and disengage the same range of work tools as previous pin grabber couplers.

No dimensional or interface changes have been made to this coupler. However, a new concept in the locking mechanism inside Center-Lock brings many benefits to the operator.

Compliant

The Cat Pin Grabber Coupler gives operators confidence through its locking system and visible locking mechanism. Couplers meet or exceed latest EN and ISO safety standards: EN474 and ISO/DIS 13031.

Visible Secondary Lock

The Pin Grabber Coupler was designed with the operator in mind. The secondary lock is clearly visible from the cab, providing an obvious indicator of coupler status: open or closed. The ability to see the lock on the front pin give the operator confidence and makes changing tools faster, while giving everyone on the job site reassurance that the Pin Grabber is locked tight.

Job Site Confidence

From engagement, all while working, to the time the attachment is disengaged, you can be completely confident attachments are connected properly.

From the operator's seat, visual and audible indicators help assure attachment is coupled. Your Cat excavator hydraulics, mechanisms inside the coupler, along with digging forces assure the attachment operates as expected.

The Cat Pin Grabber Coupler meets and exceeds safety standards allowing you to work anywhere in the world.

Productivity

As with any quick coupler, the Pin Grabber changes between attachments in seconds, allowing one machine to be used for multiple tasks on the job site.

The ease of operation and quickness of tool changeover maximizes productivity on the job site. The coupler is easy to operate, regardless of user skill level, and it's easier to train new operators to use. The ability to see when the coupler is open and closed saves time whenever a tool is changed. The elimination of the locking bar allows for operation regardless of boom, stick and machine position.

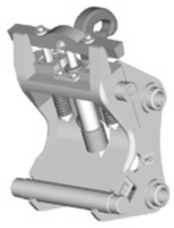
The Pin Grabber Coupler can pick up many buckets in reverse "front shovel" position for better control in utility work and precise digging and grading operations. Many competitive buckets can be engaged, making the Cat Pin Grabber invaluable in mixed fleets or rental fleets.

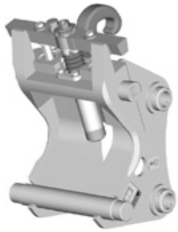
The Cat CW quick coupler can pick up any work tool and is equipped with a wedge-style locking system minimizing break-out force loss. The CW is highly suitable for harsh applications, such as demolition and quarries. The CW has become the industry standard in Europe. It is interchangeable with different machine classes, and has been designed for use with more than 700 different machines, both Cat and non Cat.

The Cat CW Series is available in a spindle and hydraulic version. A spindle version can easily be modified into a hydraulic version and vice versa.

Additional Benefit:

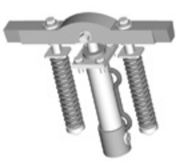
Hoisting hooks — To make the CW Series more versatile, hoisting hooks are available from 2 metric tons (2.2 tons) up to 20 metric tons (22 tons) capacity for maximum lifting capacity.

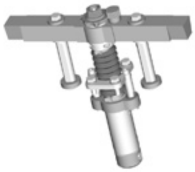


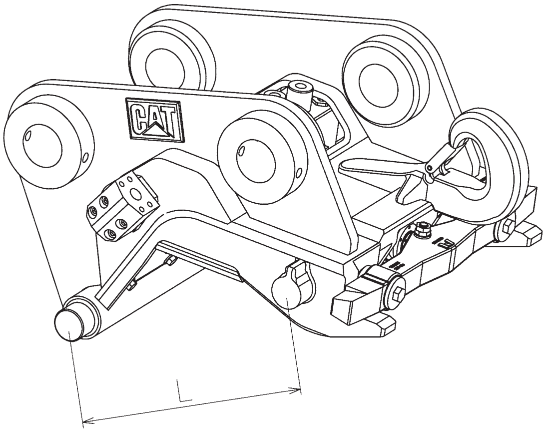


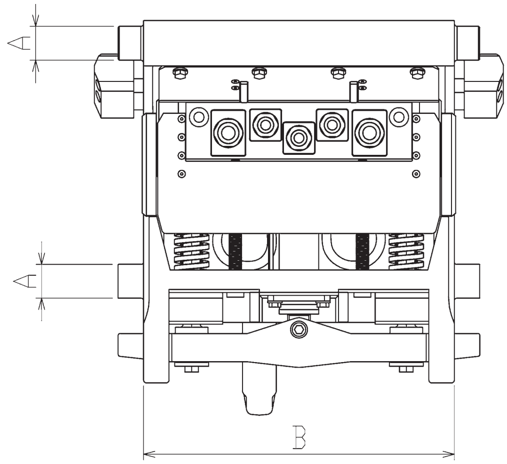
Hydraulic Version

Spindle Version









Auto-Connect Quick Coupler

The Auto-Connect quick coupler automates tool exchange fully, so operators can change work tools quickly, from the safety and comfort of their cabs. Tool changes become a matter of seconds. Built on the field proven quick coupler CW platform, the unique design of the Auto-Connect prevents ruptured hoses and oil spills, avoiding unplanned downtime.

Full Contamination Control on Both Quick Coupler and Work Tool:

A sliding cover keeps any dust and debris away from the hydraulic area, protecting the fluid connectors when not in use. Seals on both the Quick Coupler and the work tool cover have been included to close the gap with the cartridges, ensuring full contamination control. Rigid work tools without hydraulics, like buckets, do not need conversion to be picked up by the Auto-Connect quick coupler, avoiding unnecessary expenses. Due to the location of the hydraulic coupling unit, it's protected against damage from outside.

Plug-and-Perform System:

Auto-Connect is a "plug-and-perform" system based on Caterpillar's dedicated CW platform, and fits directly to the machine and existing controls. The Auto-Connect is controlled via the Quick coupler actuation circuit. Combined with Cat Tool Control, it's really easy for operators to select tools and make fast changeovers. With features like Auto Depressurization as standard no additional hydraulic components are required.

RIPPING & LOADING IN QUARRIES

The "Rip & Load" concept includes a large mass excavator equipped with a hydraulic quick coupler, a rock bucket and a ripper tine. The ripper tine is used to disrupt the in-situ rock formation, after which same excavator switches to the bucket to load the rock. This system is used where economical, environmental or legal issues prevent or restrict the use of explosives. In these situations, depending on geology, ripping either reduces the amount of explosives necessary, or replaces explosives all together.

Advantages:

- Reduction or elimination of blasting costs.
- Reduced safety risks.
- Smaller environmental impact (less noise and vibrations).
- Less exposure to precipitation, resulting in less water damage.
- Less waste (up to 35% reduction).
- Less internal cracks, resulting in higher quality product.
- Work areas can be closer to existing infrastructures.
- Fewer machines and personnel.
- Increased versatility with quick coupler (different buckets, hammers).
- Lower Cost per Ton.

Rip and Load Hourly Production

(With Hydraulic Quick Coupler)

Model	Metric Tons/Hour	Short Tons/Hour
45T	150 - 300	**165 - 330**
65T-74T	200 - 400	**220 - 440**
85T-95T	300 - 500	**330 - 550**

Rippability

Refer to "Tip Selection", "Estimating Ripping Production" and "Use of Seismic Velocity Charts" in the Track-type Tractors section. This information generally applies to usage of a ripper tine on the mass excavator.

Rippability Comparison between LHEX and LTTT

The excavator ripping technique is different from production ripping with a track-type tractor. The track-type tractor pulls the ripper(s) through the rock mass at a constant rate, whereas the excavator uses its stick- and curl forces to break material away from a horizontal or vertical face. Forward visibility in the excavator allows the operator to position the ripper tooth and attack geological discontinuities to assist the ripping process.

In ripping and loading, the ripper is typically used between 15% and 20% of the hour preparing the material. Tool change time, when using the hydraulic quick coupler, is insignificant with 2% to 6%. The remainder of the time is used for loading.

The ripping process improves bucket penetration which will increase service life of the bucket.

CYCLE TIME ESTIMATING CHARTS

The digging cycle of the excavator is composed of four segments:

1. Load Bucket
2. Swing Loaded
3. Dump Bucket
4. Swing Empty

Total excavator cycle time is dependent on machine size (small machines can cycle faster than large machines) and job conditions. With excellent job conditions the excavator can cycle fast. As job conditions become more severe (tougher digging, deeper trench, more obstacles, etc.), the excavator slows down accordingly. As the soil gets harder to dig, it takes longer to fill the bucket. As the trench gets deeper and the spoil pile larger, the bucket has to travel farther and the upper structure has to swing farther on each digging cycle.

Spoil pile or truck location also affects cycle time. If a truck is located on the floor of the excavation beside material being moved, 10 to 17 second cycles are practical. The other extreme would be a truck or spoil pile located above the excavator 180° from the excavation.

In sewer construction work the operator may not be able to work at full speed because he has to dig around existing utilities, load the bucket inside a trench shield, or avoid people working in the area.

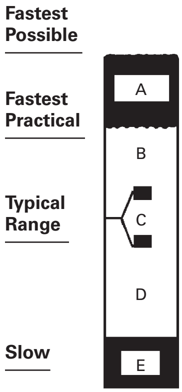
The Cycle Time Estimating Chart outlines the range of total cycle time that can be expected as job conditions range from excellent to severe. Many variables affect how fast the excavator is able to work. The chart defines the range of cycle times frequently experienced with a machine and provides a guide to what is an "easy" or a "hard" job. The estimator can then evaluate the conditions of his job and use the Cycle Time Estimating Chart to select the appropriate working range. A practical method of further calibrating the Cycle Time Estimating Chart is to observe excavators working in the field and correlate measured cycle times to job conditions, operator ability, etc.

The following table breaks down what experience has shown to be typical Cat excavator cycle times with:

— no obstruction in the right of way
— above average job conditions
— an operator of average ability and
— 60°-90° swing angle.

These times would decrease as job conditions or operator ability improved and would get slower as conditions become less favorable.

CYCLE TIME -vs- JOB CONDITION DESCRIPTION



— Easy digging (unpacked earth, sand gravel, ditch cleaning, etc.). Digging to less than 40% of machine's maximum depth capability. Swing angle less than 30°. Dump onto spoil pile or truck in excavation. No obstructions. Good operator.

— Medium digging (packed earth, tough dry clay, soil with less than 25% rock content). Depth to 50% of machine's maximum capability. Swing angle to 60°. Large dump target. Few obstructions.

— Medium to hard digging (hard packed soil with up to 50% rock content). Depth to 70% of machine's maximum capability. Swing angle to 90°. Loading trucks with truck spotted close to excavator.

— Hard digging (shot rock or tough soil with up to 75% rock content). Depth to 90% of machine's maximum capability. Swing angle to 120°. Shored trench. Small dump target. Working over pipe crew.

— Toughest digging (sandstone, caliche, shale, certain limestones, hard frost). Over 90% of machine's maximum depth capability. Swing over 120°. Loading bucket in man box. Dump into small target requiring maximum excavator reach. People and obstructions in the work area.

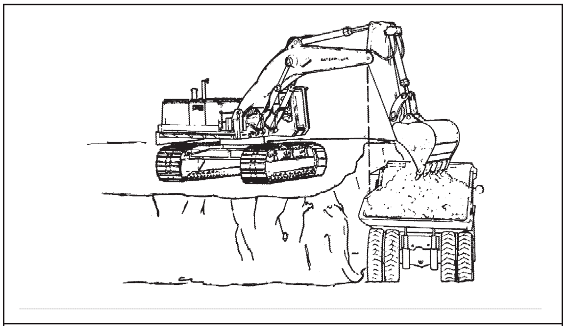
KEY

A — Excellent
B — Above Average
C — Average
D — Below Average
E — Severe

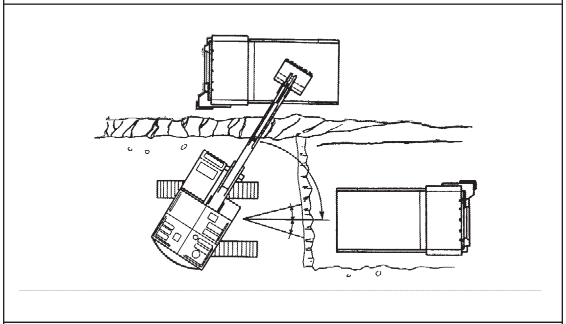
CYCLE TIME ESTIMATING CHART												
CYCLE TIME	**Tracked 10T-11T**	**Tracked 12T Wheeled 14T-15T**	**Tracked 15T Wheeled 16T-18T**	**Tracked 19T Wheeled 20T**	**Tracked 20T Wheeled 22T**	**Tracked 23-24T**	**Tracked 30T**	**Tracked 36T**	**Tracked 49T**	**Tracked 65-74T**	**Tracked 85T-95T**	**CYCLE TIME**
10 sec.												**0.17** min.
15												**0.25** min.
20 sec.												**0.33** min.
25												**0.42** min.
30 sec.												**0.50** min.
35												**0.58** min.
40 sec.												**0.67** min.
45												**0.75** min.
50 sec.												**0.83** min.
55												**0.92** min.
60 sec.												**1.0** min.

Cat 300 Series Mass Excavation booms and buckets coupled with the proper stick will help you move material faster and more efficiently in production excavation and loading applications. With the largest bucket, shortest stick and long undercarriage your excavator can often do the work of a larger machine. A longer stick and standard undercarriage make it ideal for loading on-highway trucks and general construction jobs.

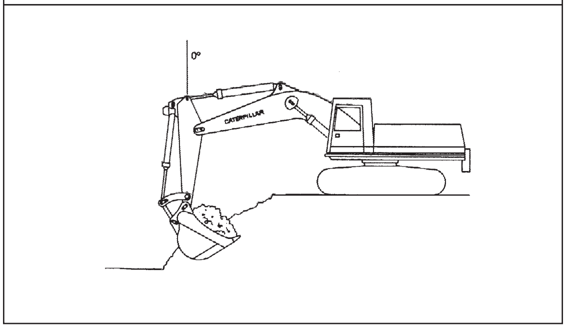
MAXIMIZING PRODUCTION WITH A MASS EXCAVATOR



Ideal Bench Height and Truck Distance — For stable or consolidated materials, bench height should be about equal to stick length. For unstable materials it should be less. The most useful truck position is when the inside truck body rail is below the boomstick hinge pin.



Optimum Work Zone and Swing Angle — For maximum production, the work zone should be limited to 15° either side of machine center or about equal to undercarriage width. Trucks should be positioned as close as possible to machine centerline. Two alternatives shown here.



Best Distance from the Edge — The machine should be positioned so that the stick is vertical when the bucket reaches full load. If the unit is farther back, breakout force is reduced. If it is closer to the edge, undercutting may occur and time is wasted bringing the stick back out. Also, the operator should begin boom-up when the bucket is 75% of the way through the curl cycle. This should be as the stick nears the vertical position.

This example reflects the ideal situation. Not all points are usable on each job, but incorporation of as many of these points as possible will positively affect production.

SELECTING A MASS EXCAVATOR

Selecting a mass excavator model for optimum production requires matching the machine and bucket to the customer's production requirements, material, and haulers. The following 6-Step selection process will help you to consider the key factors which will impact machine selection. Failure to consider these key elements in the selection process may result in choosing a machine that is too small to efficiently handle the desired bucket size or to meet the production requirement. Selecting a mass excavator which is too large may lead to excessive loader wait time, creating excessive "load shocks" into the hauler, and/or overloading the hauler capacity.

Step 1

Determine the material type and bucket fill factor

Refer to the bucket fill factors table.

Example:

Average Blasted Rock = 75 to 90%

Step 2

Estimate the Cycle Time

Refer to the cycle time estimating chart.

Example:

$$\frac{\text{Tracks 65T Excavator in Hard Rock Digging}}{\text{Shot Rock}} = .43 \text{ to } .52 \text{ minute}$$

Step 3

Calculate the Effective Cycles per Hour

Divide the 60 minute hour by cycle time and adjust for availability and efficiencies.

Example:

Cycle Time	0.48 minute
$\dfrac{\textit{60 minute hour}}{\textit{Cycle Time}}$	$\dfrac{60}{0.48} = 125$
Operator Skill/Efficiency	0.9 (90%)
Machine Availability	0.95 (95%)
Gen Operational Efficiency	0.83 (50 min/hr)
Effective Cycles per Hour	125 × .9 × .95 × .83 = 89

Step 4

Calculate the Required Bucket Capacity

Divide hourly production requirement by effective cycles per hour, adjust for material density and fill factor.

Example (Metric):

Hourly Production Required	500 Tons/hour
Effective cycles/hour	89
$\dfrac{\textit{Hourly Production Required}}{\textit{Effective cycles/hour}} = \textit{Required Payload}$	$\dfrac{500}{89} = 5.6$
Material Density/Loose	1.6 Ton/m³
$\dfrac{\textit{Required Payload}}{\textit{Material Density/Loose}} = \textit{Bucket Payload Volume}$	$\dfrac{5.6}{1.6} = 3.5\ m^3$
Fill Factor	0.85 (85%)
$\dfrac{\textit{Bucket Payload Volume}}{\textit{Fill Factor}} = \textit{Nominal Bucket Size}$	$\dfrac{3.5}{.85} = 4.1\ m^3$

Example (English):

Hourly Production Required	550 tons/hour
Effective cycles/hour	89
$\dfrac{\textit{Hourly Production Required}}{\textit{Effective cycles/hour}} = \textit{Required Payload}$	$\dfrac{550 \times 2000}{89} = 12{,}360$ lb
Material Density/Loose	2700 lb/yd³
$\dfrac{\textit{Required Payload}}{\textit{Material Density/Loose}} = \textit{Bucket Payload Volume}$	$\dfrac{12{,}360}{2700} = 4.6\ yd^3$
Fill Factor	0.85 (85%)
$\dfrac{\textit{Bucket Payload Volume}}{\textit{Fill Factor}} = \textit{Nominal Bucket Size}$	$\dfrac{4.6}{.85} = 5.4\ yd^3$

Step 5

Select Mass Excavator for required bucket size

Refer to machine Technical Specifications to compare models and bucket ranges. Confirm bucket type, size and maximum material density in Technical Specifications for desired model.

Example:

Required bucket capacity approximately
4.1 m^3 (5.4 yd^3)

45T Track Excavator ME bucket capacity
to 3.5 m^3 (4.6 yd^3)

65T Track Excavator ME bucket capacity
to 5.3 m^3 (6.9 yd^3)

85T Track Excavator ME bucket capacity
to 5.6 m^3 (7.3 yd^3)

Best Choice 65T Track Excavator ME
with 4.0 m^3 (5.2 yd^3)
Rock Bucket rated to 1.8 Ton/m^3 (3000 lb/yd^3)
material density in Technical Specification

Important: Re-calculate Steps 2 - 5 based on cycle times of model selected.

Step 6

Select Haulers

General rule for matching trucks is based on number of cycles to fill the truck.

ME:	4 to 6 passes
Front Shovels:	3 to 5 passes

Example (Metric):

Bucket Selected	4 m^3
Volume in 5 passes	5 × 4 × .85 = 17 m^3
Payload	17 × 1.6 = 27.2 Tons
Consider weight of Liners	27.2 + 2 = 29.2 Tons

Suitable Truck Match Options:

35T AT with capacity	19.2 m^3/31.8 t
37T-40T OHT with capacity	24.2 m^3/37.9 t

Example (English):

Bucket Selected	5.2 yd^3
Volume in 5 passes	5 × 5.2 × .85 = 22.1 yd^3
Payload	22.1 × 2700 = 59,670 lb
Consider weight of Liners	59,670 + 4400 lb = 64,070 lb

Suitable Truck Match Options:

35T AT with capacity	25.1 yd^3/70,000 lb
37T-40T OHT with capacity	31.7 yd^3/83,570 lb

EARTHMOVING PRODUCTION

As with any other piece of material handling equipment, excavator earthmoving production is dependent on average bucket payload, average cycle time and job efficiency. If an estimator can accurately predict excavator cycle time and bucket payload, a machine's earthmoving production can be derived from the following formula.

$$m^3\ (yd^3)/60\ \text{min hr} = \text{Cycles}/60\ \text{min hr} \times \text{Avg. Bucket Payload in } m^3\ (yd^3)$$

$$m^3\ (yd^3)/60\ \text{min hr} = \frac{60\ \text{min/hr}}{\text{Cycle Time – min}} \times \text{Avg. Bucket Payload in } m^3\ (yd^3)$$

$$\text{Avg. Bucket Payload} = \text{Heaped Bucket Capacity} \times \text{Bucket Fill Factor}$$

$$\text{Actual } m^3\ (yd^3)/\text{hr} = m^3\ (yd^3)/60\ \text{min hr} \times \text{Job Efficiency Factor}$$

The Production Estimating Tables (next page) will provide theoretical earthmoving production in cubic meters (yards) per hour if bucket size and cycle time can be estimated. The use of an average cycle time allows adjusting the estimated production for specific job sites and applications. For instance, estimating truck loading applications should include truck exchange times which extends the average cycle time and reduces production potential. The values in the table are based on a 60 minute work hour or 100% efficiency (a condition that is never achieved in reality). The estimator should apply a job efficiency factor to the figures in the table based on his judgment or knowledge of actual job conditions.

Areas outlined on the Production Estimating Table define the work ranges of excavators in the size classes of Cat 10T to 95T Excavators. The upper limit on each area corresponds to the "fastest practical" cycle time for the machines. The width of each area corresponds to the range of bucket payload sizes the machine can handle. An unshaded box has been provided in each machine area to provide a guide indicating that the upper limit of earthmoving production is being approached. When working beyond the values in the white area, the estimator should be certain that excellent job conditions will be encountered (easy digging, shallow trench, good operator, etc.).

The Production Estimating Table can also serve as a guide when selecting the proper size machine to do a job, as is shown in the following example.

Example problem (Metric)

Contractor has a job to move 15 300 Bm^3 (19 100 Lm^3 considering 25% swell factor) of wet sandy loam material in rear dump on-highway trucks which will be loaded by an excavator. Average face depth will be 2.4 m with 60-90 degree average swing angle. Ten days are available to do the work. Contractor plans to work 10 hrs/day and estimates a 50 min. work hour (83% job efficiency). He has two excavators that could be made available to do the work — a 320 with 1.0 m^3 bucket or a 336 with 1.9 m^3 bucket. Experience has shown that either machine can get its rated capacity in the sandy loam soil. Could this job be done with either machine or will the 336 have to be used?

Solution: The excavator must produce 1900 Lm^3/ Day (19 100 Lm^3 ÷ 10 Days) which means the required average hourly rate will be 190 Lm^3/60 Min. Hr. (1900 Lm^3/ Day ÷ 10 hrs/day). Further considering the 83% job efficiency, the excavator's capability will have to be 230 Lm^3/ 50 min hr.

The production estimating table shows that the Track 20T excavator with a 1.0 m^3 bucket would have to achieve a 17.1 sec. average cycle time to produce the required 190 Lm^3/ 60 min. hr. With job efficiency applied a 15.0 second average cycle time is required to produce the 230 Lm^3/ 50 min. hr. The 336 with a 1.9 m^3 bucket could obtain the same 60 min. hr. production level with a 35 second average cycle, or 30 second cycles to meet the 50 min. hr. production requirement. The cycle times estimating chart shows that the Track 20T excavator would be working near its maximum capability to meet the production requirement, whereas, the Track 36T excavator could handle the job easily. This information can then be weighed against what else is known about the job (reach requirements, job conditions, operator ability, etc.) to decide whether or not the larger machine is needed.

Example problem (English)

Substitute these English values in the preceding problem:
Job — 20,000 BCY (25,000 LCY considering 25% swell).
Average face depth — 8-12 ft
Track 20T excavator with 1.25 yd^3 bucket or Track 36T excavator with 2.5 yd^3 bucket.

Solution: The excavator must produce 2500 LCY/ Day, which means the required average hourly rate will be 250 LCY/60 min hr. Further considering the 83% job efficiency the excavator's capability will have to be 300 LCY/50 min hr.

The same concluding comments regarding the Production Estimating Table apply here as in the Metric example.

Cubic Meters per 60 Minute Hour*

ESTIMATED CYCLE TIMES		ESTIMATED BUCKET PAYLOAD** — LOOSE CUBIC METERS																			ESTIMATED CYCLE TIMES	
Cycle Time																					Cycles	Cycles
Seconds	Min.	0.2	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	4.0	Per Min.	Per Hr.
10.0	0.17																				6.0	360
11.0	0.18																				5.5	330
12.0	0.20	60	90	150	210	270															5.0	300
13.3	0.22	54	81	135	189	243	297	351	405	459	513	567	621	675	729	783	837	891	945	1080	4.5	270
15.0	0.25	48	72	120	168	216	264	312	360	408	456	504	552	600	648	696	744	792	840	960	4.0	240
17.1	0.29	42	63	105	147	189	231	273	315	357	399	441	483	525	567	609	651	693	735	840	3.5	210
20.0	0.33	36	54	90	126	162	198	234	270	306	342	378	414	450	486	522	558	544	630	720	3.0	180
24.0	0.40	30	45	75	105	135	165	195	225	255	285	315	345	375	405	435	465	495	525	600	2.5	150
30.0	0.50	24	36	60	84	108	132	156	180	204	228	252	276	300	324	348	372	396	420	480	2.0	120
35.0	0.58	20	31	51	71	92	112	133	153	173	194	214	235	255	275	296	316	337	357	408	1.7	102
40.0	0.67					81	99	177	135	153	171	189	207	225	243	261	279	297	315	360	1.5	90
45.0	0.75									133	148	164	179	195	211	226	242	257	273	312	1.3	78
50.0	0.83																				1.2	72

Cubic Yards per 60 Minute Hour*

ESTIMATED CYCLE TIMES		ESTIMATED BUCKET PAYLOAD** — LOOSE CUBIC YARDS																			ESTIMATED CYCLE TIMES	
Cycle Time																					Cycles	Cycles
Seconds	Min.	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.50	5.00	5.25	Per Min.	Per Hr.
10.0	0.17																				6.0	360
11.0	0.18																				5.5	330
12.0	0.20	75	150	225	300	375															5.0	300
13.3	0.22	67	135	202	270	337	404	472	540	607	675	742	810	877	945	1012	1080	1215	1350	1417	4.5	270
15.0	0.25	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1080	1200	1260	4.0	240
17.1	0.29	52	105	157	210	262	315	367	420	472	525	577	630	682	735	787	840	945	1050	1102	3.5	210
20.0	0.33	45	90	135	180	225	270	315	360	405	450	495	540	585	630	675	720	810	900	945	3.0	180
24.0	0.40	37	75	112	150	187	225	262	300	337	375	412	450	487	525	562	600	675	750	787	2.5	150
30.0	0.50	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510	600	630	2.0	120
35.0	0.58	36	51	77	102	128	154	180	205	231	256	282	308	333	360	385	410	462	513	535	1.7	102
40.0	0.67					112	135	157	180	202	225	247	270	292	315	337	360	405	450	472	1.5	90
45.0	0.75									180	200	220	240	260	280	300	320	360	400	409	1.3	78
50.0	0.83																				1.2	72

Job Efficiency Estimator

Work Time/Hour	Efficiency
60 Min	100%
55	91%
50	83%
45	75%
40	67%

*Actual hourly production = (60 min. hr. production) × (Job Efficiency Factor)
**Estimated Bucket Payload = (Amount of Material in the Bucket)
= (Heaped Bucket Capacity) × (Bucket Fill Factor)
Unshaded area indicates average production.

Cubic Meters/Yards per 60 Minute Hour*

ESTIMATED CYCLE TIMES		ESTIMATED BUCKET PAYLOAD** — LOOSE CUBIC METERS/YARDS											ESTIMATED CYCLE TIMES	
Cycle Time													Cycles Per	Cycles Per
Seconds	Min.	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	Min.	Hr.
15.0	0.25	1200	1440	1680	1920	2160	2400	2640	2880	3120	3360	3600	4.0	240
17.1	0.29	1050	1260	1470	1680	1890	2100	2310	2520	2730	2940	3150	3.5	210
20.0	0.33	900	1080	1260	1440	1620	1800	1980	2160	2340	2520	2700	3.0	180
24.0	0.40	750	900	1050	1200	1350	1500	1650	1800	1950	2100	2250	2.5	150
30.0	0.50	600	720	840	960	1080	1200	1320	1440	1560	1680	1800	2.0	120
35.0	0.58	510	612	714	816	918	1020	1122	1224	1326	1428	1530	1.7	102
40.0	0.67	450	540	630	720	810	900	990	1080	1170	1260	1350	1.5	90
45.0	0.75	390	468	546	624	702	780	858	936	1014	1092	1170	1.3	78
50.0	0.83	360	432	504	576	648	720	792	864	936	1008	1080	1.2	72
55.0	0.92	330	396	462	528	594	660	726	792	858	924	990	1.1	66
60.0	1.00	300	360	420	480	540	600	660	720	780	840	900	1.0	60

Cubic Meters/Yards per 60 Minute Hour*

ESTIMATED CYCLE TIMES		ESTIMATED BUCKET PAYLOAD** — LOOSE CUBIC METERS/YARDS										ESTIMATED CYCLE TIMES	
Cycle Time												Cycles Per	Cycles Per
Seconds	Min.	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	Min.	Hr.
15.0	0.25	3840	4080	4320	4560	4800	5040	5280	5520	5760	6000	4.0	240
17.1	0.29	3360	3570	3780	3990	4200	4410	4620	4830	5040	5250	3.5	210
20.0	0.33	2880	3060	3240	3420	3600	3780	3960	4140	4320	4500	3.0	180
24.0	0.40	2400	2550	2700	2850	3000	3150	3300	3450	3600	3750	2.5	150
30.0	0.50	1920	2040	2160	2280	2400	2520	2640	2760	2880	3000	2.0	120
35.0	0.58	1632	1734	1836	1938	2040	2142	2244	2346	2448	2550	1.7	102
40.0	0.67	1440	1530	1620	1710	1800	1890	1980	2070	2160	2250	1.5	90
45.0	0.75	1248	1326	1404	1482	1560	1638	1716	1794	1872	1950	1.3	78
50.0	0.83	1152	1224	1296	1368	1440	1512	1584	1656	1728	1800	1.2	72
55.0	0.92	1056	1122	1188	1254	1320	1386	1452	1518	1584	1650	1.1	66
60.0	1.00	960	1020	1080	1140	1200	1260	1320	1380	1440	1500	1.0	60

Job Efficiency Estimator

Work Time/Hour	Efficiency
60 Min	100%
55	91%
50	83%
45	75%
40	67%

*Actual hourly production = (60 min. hr. production) × (Job Efficiency Factor)
**Estimated Bucket Payload = (Amount of Material in the Bucket)
= (Heaped Bucket Capacity) × (Bucket Fill Factor)
NOTE: For estimating truck loading production include approximately 0.7 minutes for truck exchange time.

EXCAVATOR TRENCHING PRODUCTION

When an excavator is used for trenching applications, a meaningful expression of work produced is the machine's trenching rate expressed in meters or lineal feet per hour or per day. Trenching rate depends on the earthmoving production of the excavator being used and the size of the trench being excavated. Earthmoving production converts to trenching production as follows:

$$\text{Lineal Meters of Trench per Hour} = \frac{\text{Cubic Meters Excavated per Hour}}{\text{Cubic Meters per Lineal Meter of Trench}}$$

Lineal Meters of Trench per day = (Lineal Meters per Hour) × (Trenching Hours per Day)

$$\text{Lineal Feet of Trench per Hour} = \frac{\text{Yd}^3\text{ Excavated Per Hour}}{\text{Yd}^3\text{ Per Lineal Foot of Trench}}$$

Lineal Feet of Trench Per Day = (Lineal Ft Per Hour) × (Trenching Hours Per Day)

For machines that work in trenching applications where they dig all of the time, the *Trenching Conversion Chart* provides easy conversion from m^3 (yd^3) per hour to m (lineal feet) per hour, if the excavating rate m^3/hr (yd^3/hr) and trench volume m^3/m (yd^3/ft) are known. The following examples demonstrate how the Trenching Conversion Chart can be used.

Example problem (Metric)

Contractor estimates that a Track 30T Excavator will produce 200 Lm^3/hour. Trench survey shows that the trench contains 2.5 Lm^3/meter. What trenching rate will the Track 30T produce?

Solution: Enter the horizontal axis of the Trenching Conversion Chart at 200 m^3/Hour and move up to the 2.5 m^3/m diagonal line. Then move left to the vertical axis of chart and read answer of 80 m/hour.

● ● ●

Example problem 2 (Metric)

Contractor knows he must produce 1000 meters of trench in every 10 hour work day. Survey shows that trench contains 1.5 Bm^3 per lineal meter and soil swell factor is estimated at 30%. How much earthmoving production will the excavator have to provide in order to get the job done on time assuming a 50 min work hour? What Cat excavator will provide needed production at 6 meter maximum depth in sandy loam soil?

Solution: Determine trenching requirement 1000 meters in 10 hrs = 100 m/h. Convert Bm^3 to Lm^3 (excavator handles Lm^3) 1.5 Bm^3/m × 1.30 = 2.0 Lm^3/m. Enter vertical axis of trenching conversion chart at m/h and travel horizontally to diagonal line representing 2.0 m^3/m. Next move down to horizontal axis and read answer to 200 Lm^3/50 min hr. Convert 200 Lm^3/ 50 min hr to Lm^3/ 60 min hr = 200 = 241 Lm^3/60 min hr.

Production estimating tables in this section show that 241 Lm^3/60 min hr is within the capability of a Track 30T Excavator. Job should then be checked for reach and lifting requirements to make sure that a Track 30T could handle these aspects of the work.

● ● ●

Example problem (English)

Contractor estimates that a Track 30T Excavator will produce 250 LCY/Hour. Trench survey shows that the trench contains 2.5 LCY/Foot. What trenching rate will a Track 30T produce?

Solution: Enter the horizontal axis of the Trenching Conversion Chart at 250 yd^3/hr. Then move to the vertical axis of chart and read answer of 100 ft/hr.

The Trenching Conversion Chart can also be used to determine the required excavating rate if the contractor can define his trenching production requirement and the trench volume per lineal foot.

● ● ●

5

Example problem 2 (English)

Contractor knows he must produce 1000 ft of trench in every 10 hr work day. Survey shows that trench contains 1.6 BCY per lineal ft and soil swell factor is estimated at 25%. How much earthmoving production will excavator have to provide in order to get the job done on time assuming 50 min work hour? What Cat model will provide needed production at 8 ft depth in sandy loam soil?

Solution: Determine trenching requirement —
1000 ft in 10 Hrs. = 100 ft/hr
Convert BCY to LCY — 1.6 BCY/ft × 1.25 = 2.0 LCY/ft

Enter vertical axis of trenching conversion chart at 100 ft/hr and travel over to diagonal line representing 2.0 yd³/ft. Next move down to horizontal axis and read answer of 200 LCY/50 min hr.

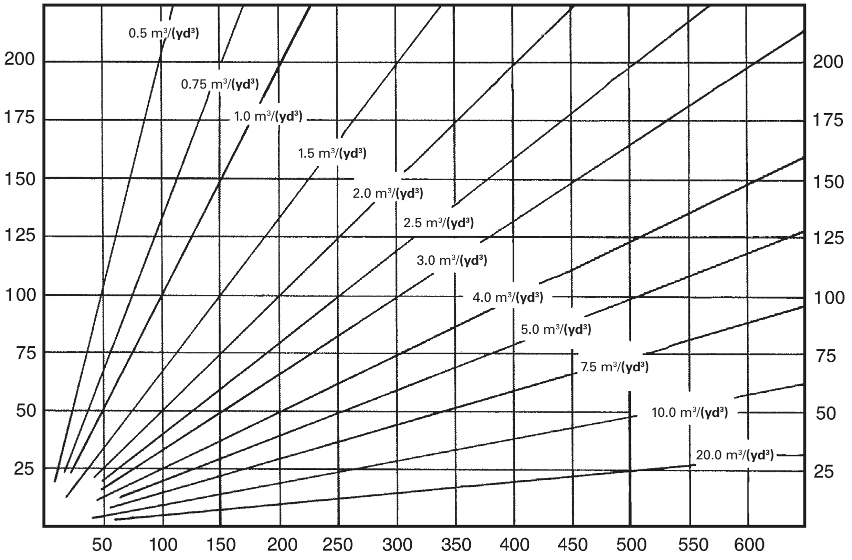
Convert 200 LCY/50 min hr to LCY/60 min hr =

$$\frac{200}{0.83} = 241 \text{ LCY/60 min hr}$$

Production estimating tables in this section show that 241 LCY/60 min. hr. is within capability of a 30T Excavator. Job should then be checked for reach and lifting requirements to make sure that the 30T could handle these aspects of the work.

● ● ●

TRENCHING CONVERSION CHART — CUBIC METERS (yd³) PER HOUR TO METER (ft) PER HOUR



m (ft.)= m³/(yd³) Hr.
Hr. = m³/(yd³) m (ft.)

Values in m³/m or yd³/ft

If excavating rate has been calculated in Bm³/h use Bm³/m for Trench Volume/m.
" " " " " " " Lm³/h use Lm³/m for Trench Volume/m.
" " " " " " " BCY/Hr use BCY/ft for Trench Volume/ft.
" " " " " " " LCY/Hr use LCY/ft for Trench Volume/ft.

Estimating Bucket Size

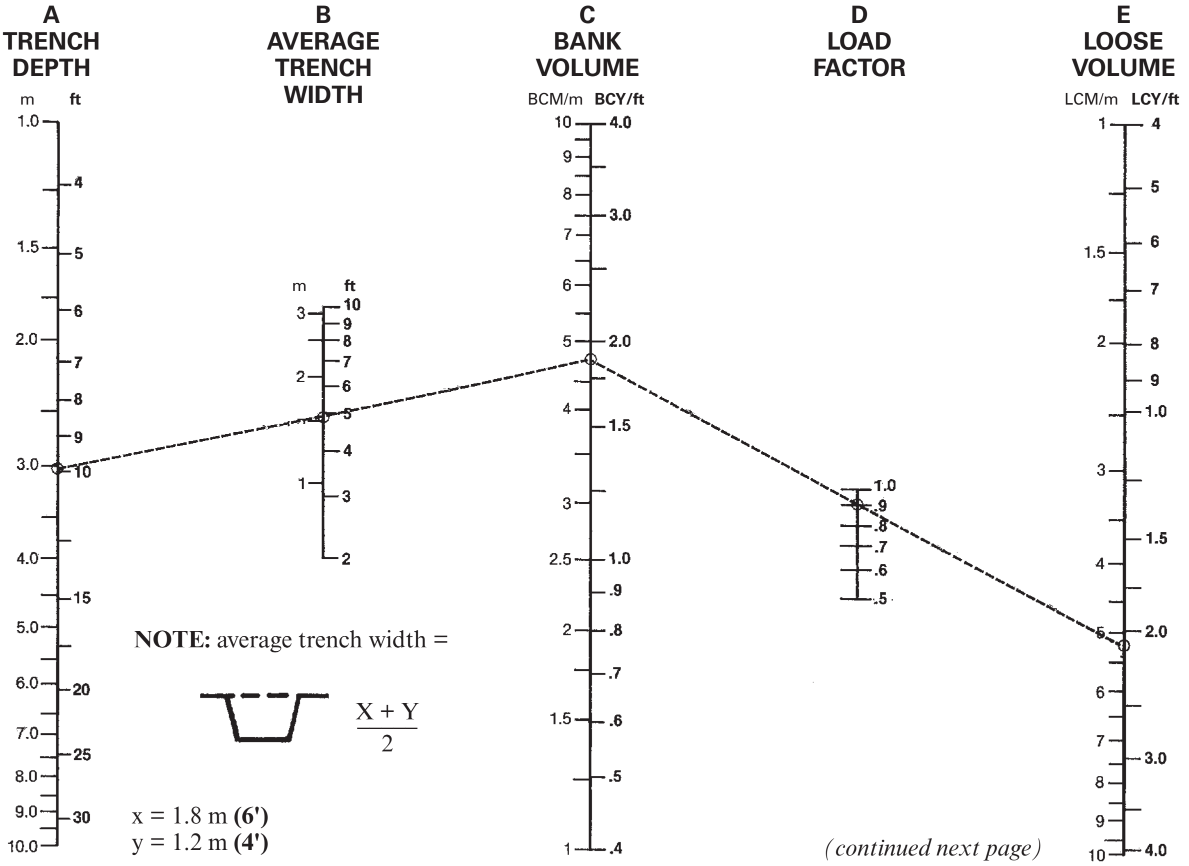
In addition to the trenching calculations on the previous pages, an alternative method of figuring trenching production is the nomograph. Shown on the following pages, this particular nomograph can be used for estimating bucket size when given trench dimensions and linear production rate. The nomograph is quicker and easier than the preceding example because it does not require as many calculations, yet the accuracy is about the same within the normal limits of input data.

Be careful when entering and reading data from the nomographs because some scales increase from bottom to top, while others are the reverse. Do not be overly concerned with the precision as affected by pencil line width or reading to the hundredth of a m^3 (yd^3). Remember that bucket fill factor, material density and cycle time are at best close estimates.

Example problem:

A sewer contractor owns a 30T with 2 piece boom and short stick. He wants to bid a contract for a 3.1 m (10') deep trench which measures 1.8 m (6') at the top and 1.2 m (4') at the bottom. He must dig 9 m/hr (30 ft/hr) to finish on time. The material is sand and gravel with a load factor of 0.90 and 100% bucket fill factor. He works 54 minutes per hour, half the time digging and half setting pipe. Cycle time is estimated at 23 seconds which includes a 90° swing angle.

1) Enter trench depth 3.1 m (10') on scale A and average trench width 1.5 m (5') on scale B.
2) Connect A and B and extend to scale C for bank volume per m (ft).
3) Enter estimated load factor (0.90) on scale D.
4) Connect C & D and extend to scale E for loose volume per m (ft).



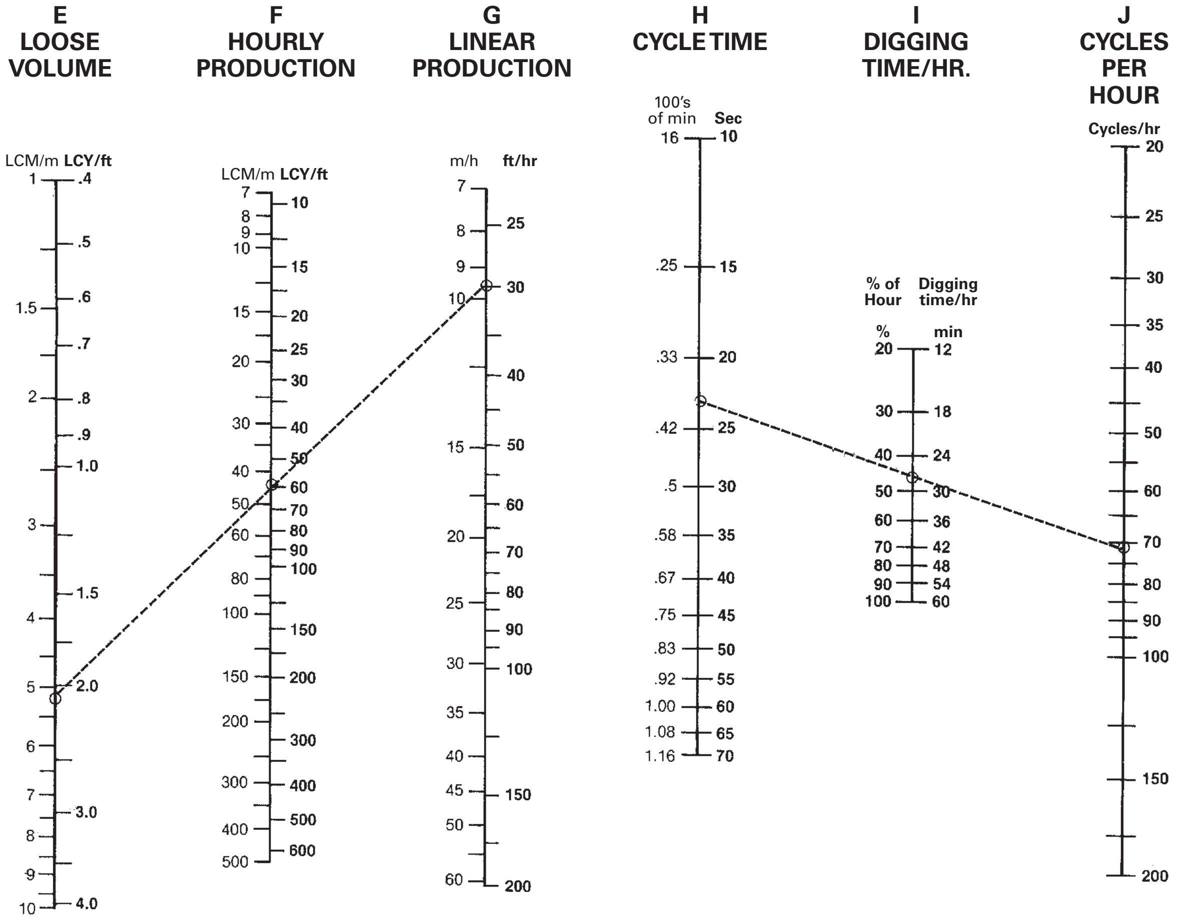
NOTE: average trench width = $\frac{X + Y}{2}$

x = 1.8 m **(6')**
y = 1.2 m **(4')**

(continued next page)

(Get loose volume from scale E and enter on this page scale E.)

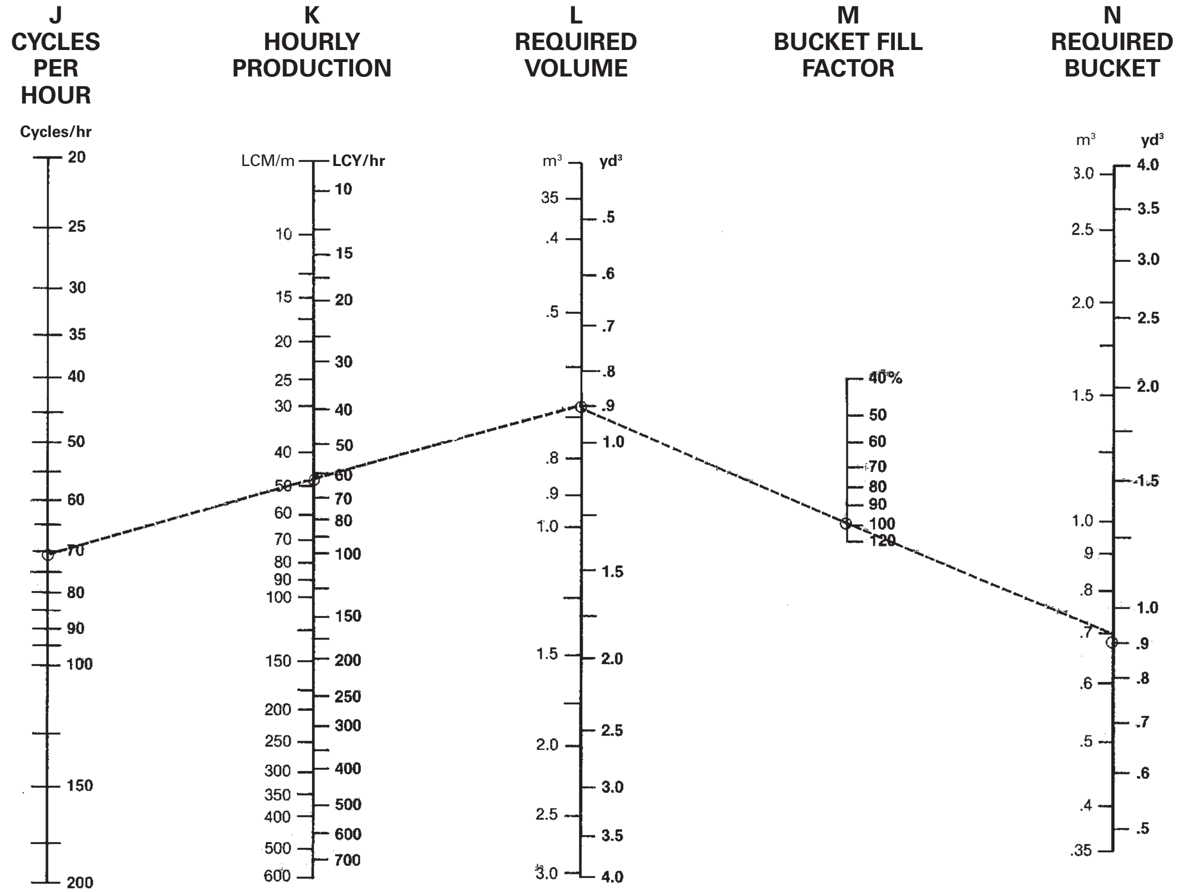
5) Enter required linear production rate 9 m/h (30 t/hr) on scale G.
6) Connect E and G. Transfer hourly production rate from scale F to scale K (next page).
7) Estimate cycle time (23 sec) based on anticipated conditions and enter on scale H.
8) Estimate hourly digging time (27 min) and enter on scale I.
9) Connect H through I to scale J for cycles per hour.

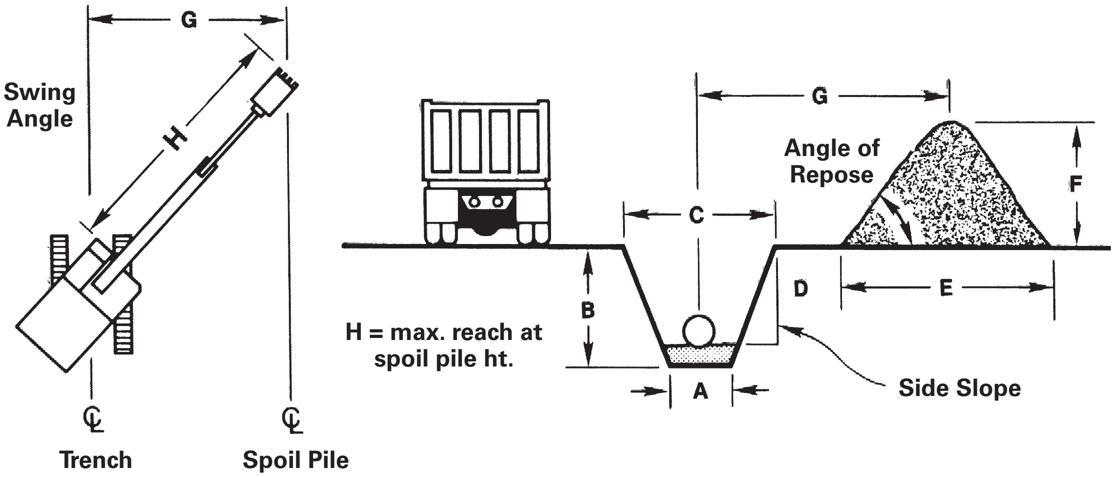


(Get cycles per hour from scale J and enter on this page scale J.)

10) Connect J through K to scale L for required volume per cycle.
11) Enter estimated bucket fill factor (100%) on scale M.
12) Connect L through M to scale N for required bucket size.

NOTE: Ensure bucket width does not exceed minimum trench width and also that weight of bucket and payload does not exceed machine working weight capacity (see lift capacity charts in this section).





Excavation Volumes Per Meter or Foot of Trench Length

Metric version

Bank m^3/meter = (Trench end area m^2) × (one m)
Trench volume (Bm^3/m) = $\frac{1}{2}$ (A + C) × B
Spoil pile volume (Lm^3/m) = (Bm^3/m) × (1.00 + % Swell)

English version

$$\text{Bank yd}^3\text{/foot} = \frac{(\text{Trench end area ft}^2) \times (\text{one ft})}{27}$$

$$\text{Trench volume (BCY/ft)} = \frac{\frac{1}{2}(A + C) \times B}{27}$$

Spoil pile volume (LCY/ft) = (BCY/ft) × (1.00 + % Swell)

The following table provides a general guide to trench bottom width for various outside diameters of pipe.

Pipe Diameter		Trench Width		Pipe Diameter		Trench Width	
mm	ft/in	m	ft/in	mm	ft/in	m	ft/in
102	**4"**	0.49	**1'7"**	1524	**5'0"**	2.59	**8'6"**
152	**6"**	0.55	**1'10"**	1676	**5'6"**	2.80	**9'2"**
203	**8"**	0.61	**2'0"**	1829	**6'0"**	3.05	**10'0"**
254	**10"**	0.70	**2'4"**	1981	**6'6"**	3.26	**10'8"**
305	**12"**	0.76	**2'6"**	2134	**7'0"**	3.47	**11'5"**
381	**15"**	0.91	**3'0"**	2286	**7'6"**	3.69	**12'1"**
457	**18"**	1.03	**3'5"**	2438	**8'0"**	3.93	**12'11"**
533	**1'9"**	1.16	**3'10"**	2591	**8'6"**	4.15	**13'7"**
610	**2'0"**	1.25	**4'1"**	2743	**9'0"**	4.36	**14'4"**
686	**2'3"**	1.37	**4'6"**	2896	**9'6"**	4.54	**14'11"**
838	**2'9"**	1.58	**5'2"**	3048	**10'0"**	4.75	**15'7"**
914	**3'0"**	1.70	**5'7"**	3200	**10'6"**	4.99	**16'5"**
1067	**3'6"**	1.92	**6'4"**	3353	**11'0"**	5.21	**17'1"**
1219	**4'0"**	2.13	**7'0"**	3505	**11'6"**	5.43	**17'10"**
1372	**4'6"**	2.38	**7'10"**	3658	**16'2"**	5.64	**18'6"**

NOTE: Trench widths based on 1.25 Bc + 1.0 where Bc is the outside diameter of the pipe in feet.
Table courtesy of American Concrete Pipe Association

Trenching Production with Pipesetting

On many sewer construction jobs the excavator does more than just dig the trench. Other tasks include handling the shoring system, placing bedding material, and lowering the pipe. The normal work procedure is to open a section of trench and then stop and make a pipe installation before going on to dig the next section of trench. At that point the key to trenching production is the total amount of time required to install each section of pipe. Pipe installation time can be broken down as follows:

Digging time + other time = Total pipe installation time

Total Pipe Installation Time	Pipe Installed Per Hour
60 min	1 Pipe/hr
30 min	2 Pipe/hr
15 min	4 Pipe/hr
10 min	6 Pipe/hr

Digging Time can be calculated once the trenching rate has been calculated using the methods described earlier in this section. Once Digging Time has been calculated, it can be added to an estimate of "Other Time" to determine Total Pipe Installation Time. "Other Time" can be estimated based on a contractor's judgment, experience, or actual measurement on a job. The following formula and table relate the trenching rate of the excavator to the time required to open a section of trench for pipe of various lengths.

$$\text{Digging Time (Min.)} = \frac{\text{Pipe Length (ft)}}{\text{Trenching Rate (ft/hr)}} \times 60 \text{ (Min/hr)}$$

Trenching Rate Ft. Per Hour	Time Required to Dig for Pipe of Various Lengths							
	8 ft Pipe		12 ft Pipe		16 ft Pipe		20 ft Pipe	
	Hours	Min.	Hours	Min.	Hours	Min.	Hours	Min.
20 ft/hr	0.400	24.00	0.600	36.00	0.800	48.00	1.000	60.00
40 ft/hr	0.200	12.00	0.300	18.00	0.400	24.00	0.500	30.00
60 ft/hr	0.130	8.00	0.200	12.00	0.260	16.00	0.333	20.00
80 ft/hr	0.100	6.00	0.150	9.00	0.200	12.00	0.250	15.00
100 ft/hr	0.080	4.80	0.120	7.20	0.160	9.60	0.200	12.00
120 ft/hr	0.060	4.00	0.100	6.00	0.120	7.20	0.167	10.00
140 ft/hr	0.057	3.43	0.086	5.14	0.114	6.86	0.143	8.57
160 ft/hr	0.050	3.00	0.075	4.50	0.100	6.00	0.125	7.50
180 ft/hr	0.044	2.66	0.067	4.00	0.089	5.33	0.111	6.67
200 ft/hr	0.040	2.40	0.060	3.60	0.080	4.80	0.100	6.00

This table can be used to show how an excavator that is capable of more trenching production will provide significant advantages even on jobs where the machine does not dig all of the time. Consider 12,000' job with 12' sections of pipe (1000 pipe to be installed). Excavator "A" can work at 60 ft/hr while Excavator "B" is capable of producing 120 ft/hr. Table shows that Excavator "B" will only take 0.10 hr to do the same work. This means that over the course of installing the 1000 pipe the more productive machine will save 0.10 hr/pipe or 100 hours of working time.

Example problem (English)

The following example shows how trenching production can be calculated on a job where the excavator is also required to set pipe. This example is based on the assumption that the excavator's earthmoving rate and the pipe installation time have already been estimated by the contractor.

Problem: Contractor estimates that the 50T Excavator will be able to produce 500 LCY/60 min. hr. Survey shows that an average cross section trench contains 3.2 BCY/ft and swell factor for sandy clay soil is estimated at 25%. How much trenching production can a contractor expect; assuming it takes 10.0 min. to install each 20 ft length of pipe after trench has been opened. Also assume 83% job efficiency — 50 min. work hour and 8 work hours out of a 9 hour shift. (0.5 hours for lunch and two 15 minute breaks.)

Solution:

Convert trench volume to LCY/ft:

1.25 (3.2 BCY/ft) = 4.0 LCY/ft

Convert Earthmoving rate to Trenching rate:

$$\frac{500\ \text{LCY/hr}}{4.0\ \text{LCY/ft}} = 125\ \text{ft/hr}$$

Calculate digging time for each pipe:

$$\frac{20\ \text{ft/pipe}}{125\ \text{ft/hr}} = 0.16\ \text{hr/pipe} = 9.6\ \text{min}$$

Calculate pipe installation time:

Digging time	=	9.6 min
Other time	=	10.0 min
Pipe Installation time	=	19.6 min

Calculate pipe installations/hour:

$$\frac{60\ \text{min/hr}}{19.6\ \text{min/pipe}} = 3.06\ \text{pipe/hr}$$

Calculate max. pipe installations/day:

8 hrs (3.06 pipe/hr) = 24.48 pipe/day

Actual pipe/day:

0.83 (24.48 pipe/day) = 20.3 – 20 pipe/day

Actual feet/day:

(20 pipe/day) × (20 ft/pipe) = 400 ft/day

HYDROMECHANICAL ATTACHMENTS

CONTENTS

Performance Line

- Oil Fired Operating Cycle
- Silenced as Standard
- World class production
- Automatic Shut Off (blank fire protection)
- Slip – fit/Rotatable lower tool bushing
- Machine protection: buffer system
- Machine protection: accumulator
- Optional machine or hammer mount auto – lube system
- Optional wear package for housing

Lifecycle Value

GC Silenced

- Gas Fired Operating Cycle
- Silenced as Standard
- Industry standard production
- Automatic Shut Off (Blank fire protection)
- Slip-fit lower tool bushing
- Machine protection: buffer system
- Machine protection: accumulator
- Optional machine or hammer mount auto – lube system
- Manual adjustable piston stroke selector

GC Line

- Gas Fired Operating Cycle
- Industry standard production
- Slip-fit lower tool bushing
- Machine protection: accumulator
- Manual adjustable piston stroke selector

Tool Family	Standard Tools		
Tool Type	**Chisel**	**Moil**	**Blunt**
Road building/construction			
Breaking of road surface	○	○	■
Breaking uneven bedrock to lay a road	●	●	■
Primary breaking to prepare road bed	○	○	■
Trench excavation for drainage	○	○	■
Demolition of bridges	○	○	○
Heavily reinforced bridge pillars	○	○	●
Making holes (for traffic signs, lamp posts)	■	○	■
Breaking of frozen ground	●	●	■
Demolition/housing development			
Demolition of concrete walls, roofs, floors	●	●	●
Demolition of light, reinforced concrete (<20")	○	○	○
Brick walls	○	○	○
Rock trenches for mains/water supply/utilities	○	○	■
Rock excavation for foundation	○	○	■
Mass excavation of rock for industrial building bases	○	●	■
Massive reinforced concrete foundations	○	●	■
Separating rebar from concrete (for recycling)	○	○	●
Quarrying/open cast mining			
Secondary boulder breaking	■	■	○
Primary breaking of rock	●	●	■
Breaking over sizes on a crusher/feeder/feed chute	○	○	○
Underground applications			
Scaling	■	■	■
Metallurgical applications			
Breaking of slag in casting ladles	■	■	■
Breaking of slag in converter openings	●	●	■
Cleaning of castings	■	■	■
Breaking of massive steel slug	■	■	■
Breaking of aluminum electrolyze slug	●	●	■
Other applications			
Demolition/Rock breaking under water	●	●	■

● Optimal ○ Acceptable ■ Not Recommended

H110 S-H180 S Hammer Features:

- **Unique Suspension System** — Improved recoil, support and guidance protects the carrier, increases hammer durability. Entire power cell is secured firmly inside housing. Noise suppression, operator feel and control is improved.
- **Auto Shut Off (ASO)** — Instantly stops the piston when breaking through material. Prevents blank firing, which is a top cause of hammer wear. Reducing wear improves maintenance and more productive hours of work.
- **Accumulator** — Self-contained membrane accumulator designed for long life. Port is accessible while hammer is mounted on the machine making testing and recharging a routine task achievable in the field.
- **Hydraulic Valves** — A Pressure Control Valve (PCV) maintains maximum hydraulic pressure to ensure the hammer delivers all blows at full power. PCV can be easily checked and adjusted from outside the hammer in about 30 minutes. A check valve (not shown) isolates harmful pulsation spikes from the carrier hydraulic circuit.
- **Autolube Connection and Grease Channel** — Provides grease to the upper and lower tool bushings to ensure proper greasing, longer life for bushings and tool.
- **Seal Carrier** — Contains special high performance seals to extend leak-proof operation.
- **Piston** — Long piston transfers a long shock wave into the rock. Tool-piston diameters are matched for maximum energy transfer.
- **Tie-Rods** — Larger threads improve load carrying capability, durability and reliability.
- **Cylinder** — Engineered to be durable and reliable with minimal maintenance and downtime.
- **Upper Tool Bushing** — Guides the tool to optimize in-line piston to tool contact.
- **Tool Retaining Pins and Keepers** — Tool removal process is simplified, achievable with common hand tools. Removal time reduced by 40% over previous models.
- **Lower Tool Bushing** — As bushing reaches the wear limit, it can be easily rotated (90°) or replaced to bring it back into specification. Dust seals keep contaminants out.

NOTE: Internal components of hammers are machined to close tolerances and require clean oil with full lubricating properties. When operating in high ambient temperatures or extreme temperature applications (e.g. foundries), higher viscosities are recommended to extend hammer life and improve performance. Hammers tend to shear multigrade mineral oil so that oil viscosity decreases. Contamination, water in oil, and decreased viscosity lead to earlier oil deterioration and the need for more frequent oil changes than normally recommended for the excavator. Extra care should be taken to avoid the entry of dust or dirt when installing or removing a hammer in the field.

Large Hammer Tools

Chisel	Hard Rock Chisel	Moil	Blunt	Super Blunt
C	C	M	B	B

	H110 S	H115 S	H120 S	H130 S	H140 S	H160 S	H180 S
Road building/construction							
Breaking of road surface	C, M	C, M	C, M	C, M	C, M	C, M	C, M
Breaking uneven bedrock to lay a road	C, M	C, M	C, M	C, M	C, M	C, M	C, M
Primary breaking to prepare road bed					C, M	C, M	C, M
Trench excavation for drainage	C, M	C, M	C, M	C, M	C, M	C, M	C, M
Demolition of bridges	C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M
Heavily reinforced bridge pillars					B	B	B
Making holes (for traffic signs, lamp posts)	M	M	M	M	M	M	M
Breaking of frozen ground	C, M	C, M	C, M	C, M	C, M	C, M	C, M
Demolition/housing development							
Demolition of concrete walls, roofs, floors	C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M
Demolition of light, reinforced concrete [<0.5 m **(<20")**]	M	B, M	B, M	B, M			
Brick walls	C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M
Rock trenches for mains/water supply/utilities	C, M	C, M	C, M	C, M	C, M	C, M	C, M
Rock excavation for foundation	C, M	C, M	C, M	C, M	C, M	C, M	C, M
Mass excavation of rock for industrial building bases				C, M	C, M	C, M	C, M
Massive reinforced concrete foundations					M	M	M
Separating rebar from concrete (for recycling)	C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M	B, C, M
Quarrying/open cast mining							
Secondary boulder breaking	B	B	B	B	B	B	B
Primary breaking of rock				C, M	C, M	C, M	C, M
Breaking over sizes on a crusher/feeder/feed chute	C, M	B, C, M,	B, C, M	B, C, M	B, C, M	B, C, M	
Underground applications							
Scaling	C	C					
Metallurgical applications							
Breaking of slag in casting ladles	C, M	C, M					
Breaking of slag in converter openings	C, M	C, M	C, M	C, M	C, M		
Cleaning of castings	C, M	C, M					
Breaking of massive steel slag						C, M	C, M
Breaking of aluminum electrolyze slag	C, M	C, M	C, M	C, M	C, M		
Other applications							
Demolition/rock breaking under water		C, M	C, M	C, M	C, M	C, M	C, M

	H95 S	H110 S	H115 S	H120 S	H130 S	H140 S	H160 S	H180 S
Excavators								
307D	•							
308D CR/308E CR SB/308E2 CR SB	•							
311D RR	•	•						
312D/312D L/312E/312E L	•	•	•					
314D CR/314E CR		•	•					
315D		•	•	•				
316E		•	•	•				
318E			•	•	•			
319D			•	•	•			
320D/320E			•	•	•			
320D RR/320E RR			•	•	•			
321D LCR				•	•			
324D				•	•	•		
324E				•	•	•		
328D LCR					•	•		
329D/329E				•	•	•		
336D/336E/336EH						•	•	
345D							•	•
349E							•	•
365C								•
374D								•

*Installation of add-on optional counterweight to machine is required.
**Hydraulic flows and pressures must be checked to verify they match the requirements for the hammer being installed.
Note: Caterpillar recommends the use of a suitable shield/guard system to insure operator has adequate protection from flying debris.
Note: These matches are for general reference purposes for Cat machines only. When special boom and quick coupler arrangements are used, these matches may not apply.
Note: When matching hammers to competitive carriers, selection should be made by carrier weight. Refer to the carrier range at the top of the table in order to determine the correct match.

Hammer Model / Machines (WHEX)	H110 S	H115 S	H120 S	H130 S
M314	■	■		
M315	■	■		
M316	■	■	■	
M317	■	■	■	
M318	■	■	■	
M319	■	■	■	
M320		■	■	■
M322		■	■	■

Hammer Model / Machines (THEX)	H110 S	H115 S	H120 S	H130 S	H140 S	H160 S	H180 S	H190 S	H215 S
312 GC	■	■							
313 GC	■	■							
313	■	■							
315 GC	■	■							
315	■	■							
316 GC	■	■							
317 GC	■	■	■						
317	■	■	■						
320 GX		■	■	■					
320 GC		■	■	■					
320		■	■	■					
323 GX			■	■					
323 GC			■	■					
323		■	■	■					
325		■	■	■					
325 Tunneling			■	■	■				
326 GC			■	■	■				
326			■	■	■				
330 GC			■	■	■				
330			■	■	■				
335			■	■	■				
336 GC					■	■			
336					■	■			
340					■	■			
340 UHD					■	■			
345 GC						■	■	■	
349						■	■	■	
352						■	■	■	
352 UHD						■	■	■	
374							■	■	■
395									■

Please refer to Caterpillar Reference Guide GEJQ9332-02. Some model generations may NOT be official configuration.

Note 1: Caterpillar recommends the use of a suitable shield/guard system to ensure operator has adequate protection from flying debris.

Note 2: These matches are for general reference purposes for Cat machines only. When special boom and quick coupler arrangements are used, these matches may not apply.

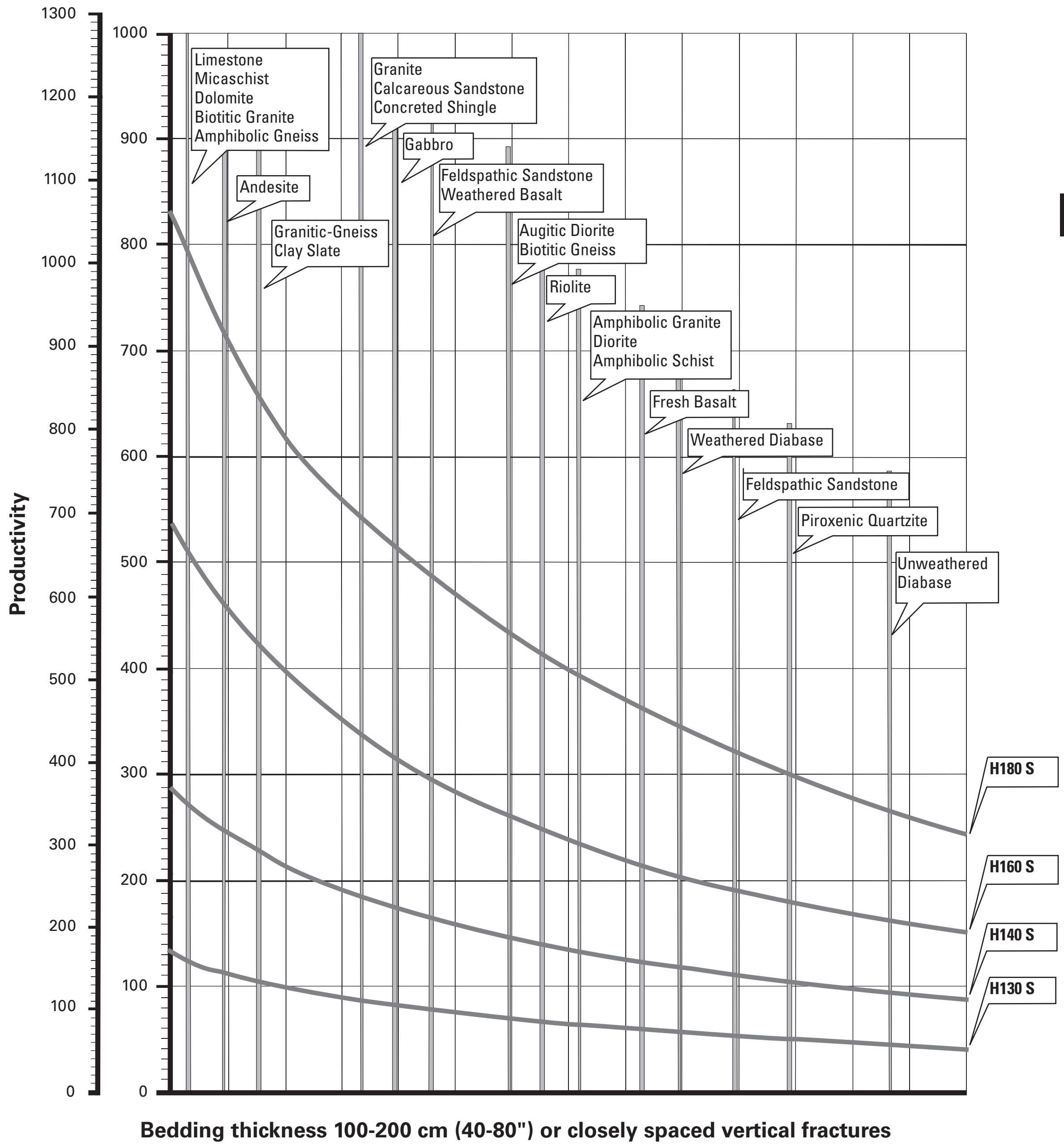
Note 3: When matching hammers to competitive carriers, selection should be made by career weight. Refer to the carrier range at the top of the table in order to determine the correct match.

Productivity Rates: 8 hour shift

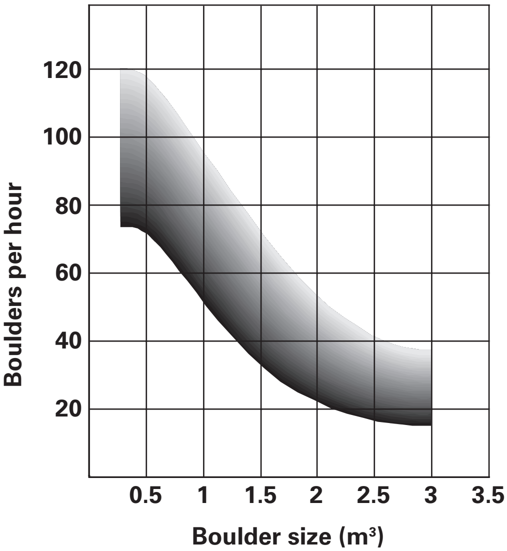
Production rates listed are for general estimation purposes only and must not be used to guarantee any production figure to the customer. The actual working results may vary according to the quality and structure of the material to be broken, required degree of material size reduction, installation, condition of the carrier, conditions at the work site, haulage of the broken material, skills of the operator, etc.

Hammer Models	Non-Reinforced Concrete		Reinforced Concrete		Sedimentary Rock		Volcanic Rock	
H110 S	99-214 m^3	**130-280 yd^3**	96-134 m^3	**125-175 yd^3**	84-121 m^3	**110-250 yd^3**	42-99 m^3	**55-130 yd^3**
H115 S	115-287 m^3	**150-375 yd^3**	107-184 m^3	**140-240 yd^3**	126-229 m^3	**165-300 yd^3**	57-115 m^3	**75-150 yd^3**
H120 S	153-344 m^3	**200-450 yd^3**	122-229 m^3	**160-300 yd^3**	153-260 m^3	**200-340 yd^3**	84-153 m^3	**110-200 yd^3**
H130 S	210-375 m^3	**275-490 yd^3**	153-268 m^3	**200-350 yd^3**	191-306 m^3	**250-400 yd^3**	103-210 m^3	**135-210 yd^3**
H140 S			191-497 m^3	**250-650 yd^3**	229-535 m^3	**300-700 yd^3**	115-268 m^3	**150-350 yd^3**
H160 S			229-650 m^3	**300-850 yd^3**	268-688 m^3	**350-900 yd^3**	153-459 m^3	**200-600 yd^3**
H180 S			295-1301 m^3	**385-1705 yd^3**	337-1345 m^3	**440-1760 yd^3**	210-757 m^3	**275-990 yd^3**

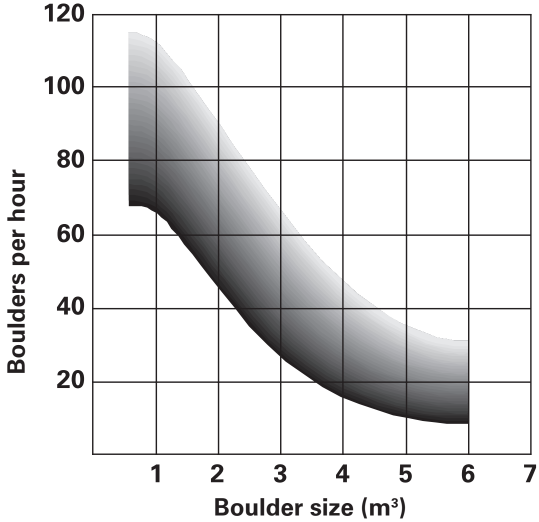
The figures are for comparison and evaluation purposes only. Results will vary depending on operator, carrier and job conditions.



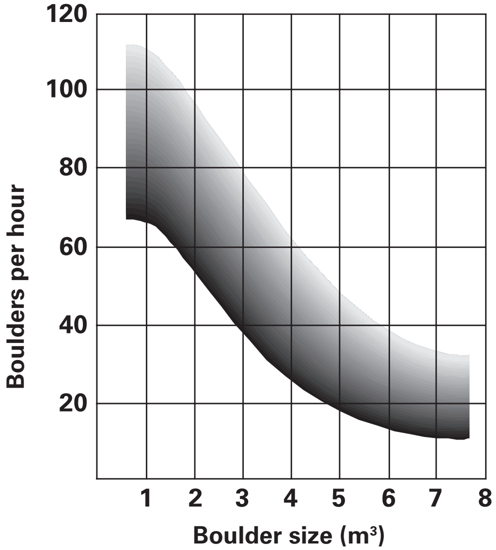
H130 S



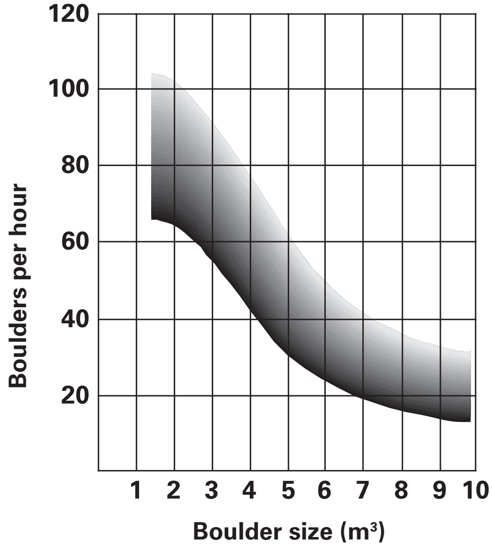
H140 S



H160 S



H180 S



SOFT ROCK **HARD ROCK**

LIMESTONE SLATE GABBRO HARD ORES
DOLOMITE GRANITE DIABASE
ANDESITE

- **Piston Stroke Adjuster** — Manual adjustment located on the side of the hammer power cell will increase piston speed and lower the power of each piston blow. This feature allows the owner/operator to match the speed and power of hammer for a particular application. Less frequency, more power for tougher jobs, increased frequency, less power for lighter jobs.
- **Automatic Shut Off (ASO)** — This feature offers blank firing protection by stopping the piston from cycling internally when there is an absence of material to be broken under the tool. Eliminating blank firing protects the hammer by reducing internal stresses and heat, which lowers overall hammer owning and operating costs. Additionally, ASO will protect rental fleet hammers where operator skill level and expertise may vary.
- **Simplistic Design/Gas Fired Hammer** — The design of the Cat GC hammer line is well proven with our customers. The simplistic design allows shorter rebuild time and lower owning and operating costs. The Gas fired operating cycle, delivers expected industry production and power that customers have come to expect from Cat Hammers.
- **Hammer Auto-Lube Options** — The most critical maintenance requirement for hammers is that it receives Cat Hammer Paste. In addition to manually greasing, customers and dealers have the option of installing either a carrier mounted auto-lube system or a hammer mounted auto-lube system.
- **Slip Fit Lower Tool Bushing** — The lower tool bushing is a “slip-fit” design which allows for field replacement. The lower tool bushing is critical for piston/tool alignment and ultimately greater uptime with the GC hammer. The design reduces overall service time and lowers owning and operating costs.

- **Piston Stroke Adjuster** — Manual adjustment located on the side of the hammer power cell will increase piston speed and lower the power of each piston blow. This feature allows the owner/operator to match the speed and power of hammer for a particular application. Less frequency more power for tougher jobs, increased frequency, less power for lighter jobs.
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Machines (WHEX) / Hammer Model	M313	M314	M315	M316	M317	M318	M320	M322
H115GC S/H115GC	■	■	■	■	■	■	■	■
H120GC S/H120GC						■	■	■

Machines (THEX) / Hammer Model	311	312	313	314	315	316	318	320	323	325	326	329-330	335	336-340
H110GC S/H110GC	■	■	■	■	■									
H115GC S/H115GC			■	■	■	■	■							
H120GC S/H120GC							■	■	■	■	■			
H130GC S/H130GC										■	■	■		
H140GC S/H140GC												■	■	■

Please refer to Caterpillar Reference Guide GEJQ9332-02. Some model generations may NOT be official configuration.

NOTE 1: Caterpillar recommends the use of a suitable shield/guard system to ensure operator has adequate protection from flying debris.

NOTE 2: These matches are for general reference purposes for Cat machines only. When special boom and quick coupler arrangements are used, these matches may not apply.

NOTE 3: When matching hammers to competitive carriers, selection should be made by career weight. Refer to the carrier range at the top of the table in order to determine the correct match.

Productivity Rates: 8 hour shift

Production rates listed are for general estimation purposes only and must not be used to guarantee any production figure to the customer. The actual working results may vary according to the quality and structure of the material to be broken, required degree of material size reduction, installation, condition of the carrier, conditions at the work site, haulage of the broken material, skills of the operator, etc.

Hammer Models	Non-Reinforced Concrete		Reinforced Concrete		Sedimentary Rock		Volcanic Rock	
H110GC S	87-190 m^3	**115-250 yd^3**	85-119 m^3	**111-157 yd^3**	74-107 m^3	**97-122 yd^3**	35-87 m^3	**47-116 yd^3**
H115GC S	102-257 m^3	**132-335 yd^3**	97-164 m^3	**125-215 yd^3**	111-205 m^3	**148-265 yd^3**	50-101 m^3	**66-132 yd^3**
H120GC S	137-308 m^3	**177-402 yd^3**	107-205 m^3	**143-265 yd^3**	136-231 m^3	**157-305 yd^3**	75-135 m^3	**97-157 yd^3**
H130GC S	188-335 m^3	**245-435 yd^3**	137-238 m^3	**176-312 yd^3**	173-279 m^3	**222-357 yd^3**	90-188 m^3	**121-189 yd^3**
H140GC S			168-445 m^3	**222-589 yd^3**	201-482 m^3	**267-625 yd^3**	100-238 m^3	**135-312 yd^3**

Principles of Selection

Key to the successful sale of a hammer is proper hammer selection.

Background Information

Collection of background information is the first step. The following information will assist in being sure the customer receives the correct hammer and that he has a positive hammer experience. The following issues should be examined…

1. If any, what brand and model hammer was previously used and how did the hammer perform?
2. What % of time will the hammer be used on the machine?
3. Will the hammer be used in primary breaking or secondary breaking? (mainly an issue for large hammers)
4. What machine will the hammer be used on and what are the hydraulic flow and pressures of this machine?
5. What is the type of material to be broken and production required from the hammer? (best to obtain this from the end user but a table is available at the end of this section)

Hammer Selection Process

1. Using Cat carrier matching guide, identify 2 or 3 possible hammers for your application (for competitive carriers use carrier weight class as reference).
2. Compare machine/carrier flow and pressures to those of the hammer candidates to validate compatibility. Eliminate hammers outside carrier specs.
3. If hammer is to be used in primary breaking consider larger of hammer candidates.
4. Check productivity guidance tables within this section. Identify hammer most compatible with requirements.
5. Determine if the application requires special hammer modifications, i.e. steel mill, underwater, tunneling, etc.

Other Issues

Once the hammer has been chosen, other elements need to be considered to have a successful hammer experience.

1. Select the correct hammer tool for the application (see tool application chart in this section).
2. Check to be sure the correct hammer bracket and hoses are specified. Be sure correct carrier oil is specified for hammer use (particularly important in high ambient areas).
3. Consider supplemental carrier cooling in areas of high ambient temperature.

Actual operating pressure and back pressure MUST be checked when the hammer is fitted to the carrier (just as important if the hammer goes on a competitive carrier or is installed by the contractor at his shop).

Guarding Recommendation

Hammers used in hazardous applications like demolition, quarrying, and scaling, can create a need for special operator guarding due to flying objects. When using a hammer, additional protective devices such as a front screen, Falling Object Guarding System (FOGS, includes top and front guarding), thick polycarbonate windshields or a combination of these is recommended by Caterpillar. Contact your Cat dealer for operator guarding options on your machine.

Mobile Scrap and Demolition Shears Features:

Cat scrap and demolition shears are designed to make you money. An innovative, robust design with fast cycle times provides the production and reliability you need to be profitable. Cat shears can handle everything from structural steel to mixed scrap. Cat shears are designed to get the job done.

Not all attachments are available in all regions. Consult your Cat dealer for specific configurations available in your region.

Features:

Cut More, Cut Faster

- Shears are designed as a system solution to cut more tons per day and make you more money.
- Dual apex jaw increases cut efficiency by 15 percent.
- Accurately place the jaws in optimum cutting position using the standard 360° rotator on the S3000 Series.
- Power is consistent through the entire cutting cycle.
- Increase cutting efficiency with tapered spacer plates which reduce jamming and drag.
- The cylinder rod is completely protected inside the frame reducing downtime and the risk of damage.
- The jaw relief area allows material to fall away freely without hindering the next cutting cycle.

Long-Lasting Quality

- Reduce maintenance costs with the new Bolt-on Piercing Tip. Dowels and bushings divert stress, keeping the tip tight and in one piece.
- Work confidently. Major hydraulic components are built with a 4 to 1 safety factor and can withstand pressure spikes up to 1378 bar (20000 psi).
- Increase overall durability with the solid plate construction of the upper jaw.
- The housing is designed with a 60 percent safety factor in yield strength.

Easy to Maintain

- Easily and safely complete maintenance tasks. Shears can be greased at ground level along with the machine stick cylinder pin and boom pin.
- Reduce downtime with field serviceable swivels. Removing and resealing can be done easily while the shear is mounted to the machine.
- Service and adjust the pivot group without the need for any special tools.
- Easily change the tip and flip the blades in thirty minutes with standard tools.
- Access the cylinder's hoses and speed valve easily from the side of the shear.
- You are supported. The Cat Dealer Network is your one point of contact for all your service needs.

Options to Meet Your Needs

- Connecting your shear has never been easier. Dual high-pressure ports attach to any compatible machine regardless of the hydraulic layout.
- Meet your specific needs with straight and rotating configurations and boom and stick mount options.

  Straight – S2000 Series
  – Boom mounted
  – Used in secondary demolition and scrap applications
  – Rotator is eliminated, reducing maintenance costs
  – Larger shears can be used on smaller machine size classes

  Rotating – S3000 Series
  – Boom or Stick mounted
  – Used in scrap, primary, and secondary demolition applications
  – Provides optimal cycle times and positioning
- Boom Mounted – Ideal for scrap processing, allows use of a larger shear for increased production.
- Stick Mounted – Ideal for demolition applications, maximizes reach for structural demolition.

Machines (HEX)	304	305	307	308	311	312	313	314	315	316	318	320	323	325	326	329-330	336-340	349-352	374	385-390
Model																				
S305	B	B	S	S																
S3015			B	B	S	S	S	S	S	S	S									
S3025										B	B	S	S							
S3035												B	B	B	S	S	S			
S2050 Straight												B	B							
S3050															B	B				
S2070 Straight																B	B			
S3070																	B	B	S	S
S2090 Straight																	B	B		
S3090																		B	S	S

Primary Match   **B** Boom Mount   **S** Stick Mount

MULTI-PROCESSORS

Cat Multi-Processors accept multiple interchangeable jaws for a wide range of demolition tasks. Faster cycle times get your jobs done quicker. Greater power means taking on bigger jobs. Quick jaw change gives you the right tool for the task at hand without slowing you down. All built on a durable, easy-to-maintain platform.

Features:

Cycle Times are 50 Percent Faster

- New speed booster technology dynamically shifts hydraulic force from speed to boost mode automatically as you operate.
- You'll spend less time waiting for the jaw to open or close to contact, as the speed valve automatically adjusts to fast flow when there's no load.
- Maximum crushing/cutting force is applied as soon as the jaw contacts material.

Up to 19 Percent More Force

- Process more per hour, ship more per shift, make more every day. Speed booster magnifies hydraulic force when the jaw contacts material, quickly making the cut.
- Mount more power even on smaller excavators. Compact design keeps center of gravity as close as possible to the machine.
- Get maximum performance and total support with a complete Cat demolition solution. Programs for the MP are built into the Next Gen Cat operator display. Single point of support for your entire system by your local Cat dealer.

Change Jaws in 15 minutes

- Innovative jaw locking enables a single operator to easily change jaws in 15 minutes or less. Requires only standard hand tools.
- Simple and safe jaw changes are part of the design. Every jaw sits stably, even on the roughest work site, on the included jaw stand.
- Multi-Processors use these jaw types
  - **Concrete Cutter** – outer jaw cracks concrete; inner shear jaw cuts steel
  - **Demolition** – opens wide to crack the largest concrete structures
  - **Pulverizer** – crushes concrete, separating the rebar
  - **Secondary Pulverizer** – crushes concrete into finer particles; total rebar separation
  - **Shear** – cuts structural steel, pipe, and cable
  - **Tank Shear** – cuts at right angle on three sides, cleanly cutting tanks or plate steel
  - **Universal** – innovative design cuts steel and crushes concrete

Durable and Maintainable

- Protect your investment and maintain performance, quickly and economically. Jaws are protected with easily changed, individually replaceable wear parts.
- Get more production time per cutter before replacement. Most cutting blades can be flipped in two ways to use four different cutting edges.
- Even when deep into debris, the cylinder rod is armored to prevent damage and the main cylinder body is protected inside the housing.

Multi-Processors Matching Guide:

Cat MP Model	Machine	Interface
MP318	318F, 320F, 323F, 325F, 320, 323 NGH, 340F UHD	Pin-On, CW/CPG quick Coupler and Flat top solution
MP324	326F, 329F, 330F, 335F, 336F SB, 340F UHD	Pin-On, CW/CPG quick Coupler and Flat top solution
MP332	336F, 336F SB, 340F	Pin-On, CW/CPG quick Coupler and Flat top solution
	340F UHD	Pin-On with CC or S-jaw only
MP345	349F, 352F	Pin-On, CW/CPG quick Coupler and Flat top solution
MP365	374F, 390F	Pin-On, CW/CPG quick Coupler and Flat top solution

These matches are for general reference purpose for Cat machines only.

Please always check the stability of the machine-tool configuration.

The stability depends on application, tool used and your machine configuration. For questions please contact your Cat dealer.

When choosing between various multi-processor models that can be installed onto the same machine configuration, consider work tool application, productivity requirements, and durability.

Guarding Recommendation

Multi-Processors used in hazardous applications like demolition, and scrap and material handling can create a need for special operator guarding due to flying or falling objects. When using a Multi-Processor, additional protective devices such as a front screen, Falling Object Guarding System (FOGS, includes top and front guarding), thick polycarbonate windshields or a combination of these is recommended by Caterpillar. Contact your Cat dealer for operator guarding options on your machine.

CONTRACTOR'S GRAPPLES

Cat Contractors' Grapples are a proven product built for your high-volume material handling needs. Designed for long-lasting durability, Contractors' Grapples are made to help you in the toughest of applications.

Not all attachments are available in all regions. Consult your Cat dealer for specific attachments available in your region.

Features:

Strong and Durable

- Wide surface area for demolition and material handling applications with a rigid, box-type design.
- Penetrate, securely grasp, and retain materials better with two-over-three interlocking tines.
- Keep an eye on your work with long, wide-spaced tines for better visibility.
- Tips, wrapper, and wear strips are made of AR400 steel for longlasting durability in the harshest applications.

Increase Productivity

- Debris loads and unloads seamlessly without catching due to the tips mounted flush with the wrapper.
- Optimize material flow and penetration into piles with less curvature in the lower jaw.
- Maintain high-volume production when using the grapple pinned to the machine or with a Pin Grabber Coupler.
- Purpose-designed to match their respective machine sizes for maximum performance in break out and lift capacity.
- Share your grapple across similar-sized excavators for maximum utilization with the use of replaceable pins to match different linkages.
- Capacities calculated according to SAE J2754, an industry-leading standard for fabricated grapples.
- Optimal for applications such as: structural demolition, material handling and sorting, and loading and unloading rock, scrap, pipe, waste material, and other debris.

Easy to Maintain

- No need for added hydraulics or hoses. Contractors' Grapples utilize the bucket linkages for operation.
- Long-lasting, field-serviceable tips have extended service life without extra weight.
- Jaws stay connected when the grapple pin is removed with the advanced modular pin hub system.
- Field-install an extreme duty wear package for extra protection on your grapple.

Grapple Model	G113	G117	G120	G126	G120	G126	G136	G136	G149	G174
Linkage	**312**	**315**	**B**	**B**	**CB**	**CB**	**CB**	**DB**	**TB**	**VB/VB2**
Small Excavators										
311D/F	•									
312D/E	•									
312D2/D2 GC	•									
313D2/D2 GC	•									
312F GC/313F GC	•									
312F/313F	•									
313/313 GC	•									
314D/E/F	•									
315F	•									
315/315 GC	•									
315D/316E/F		•								
318E/F		•								
318D2		•								
319D			•	•						
Medium Excavators										
320D/E/F			•	•						
320D2/D3			•	•						
320 GC			•	•						
320			•	•						
321D			•	•						
323D/D3			•	•						
323E/F			•	•						
323			•	•						
324D/E					•	•	•	•		
325D/F					•	•	•	•		
325					•	•	•	•		
326D2/F					•	•	•	•		
326					•	•	•	•		
328D					•	•	•			
329D/E/F					•	•	•	•		
330D								•	•	
330D2					•	•	•	•		
330F					•	•	•	•		
330 GC					•	•	•	•		
330					•	•	•	•		
335F					•	•	•			

• Match   No Match

Contractor's Grapple Matching Guide
● Large Excavators
● Wheeled Excavators

Grapple Model	G113	G117	G120	G126	G120	G126	G136	G136	G149	G174
Linkage	**312**	**315**	**B**	**B**	**CB**	**CB**	**CB**	**DB**	**TB**	**VB/VB2**
Large Excavators										
336D/D2/E								•	•	
336D2 GC								•	•	
336D2 XE								•	•	
336E H								•		
336F								•	•	
336F XE								•	•	
336 GC								•	•	
336								•	•	
340D2								•	•	
340F								•	•	
340								•	•	
345 GC									•	
345D/349D									•	
349D2									•	
349E/F									•	
349									•	
352F									•	
352									•	
374F										•
374										•
Wheeled Excavators										
M313D		•								
M314F		•								
M315D		•								
M315D2		•								
M315F		•								
M316D		•								
M316F		•								
M317D2		•								
M317F		•								
M318D			•	•						
M318F		•								
M320D2			•	•						
M320F			•	•						
M322D			•	•						
M322D2			•	•						
M322F			•	•						

• Match   No Match

Grapple Model	G113	G117	G120	G126	G120	G126	G136	G136	G149	G174
Linkage	312	315	B	B	CB	CB	CB	DB	TB	VB/VB2
Material Handlers†										
MH3022			•	•						
MH3024			•	•						
MH3026			•	•						
MH3040					•	•	•			

† When equipped with appropriate stick and bucket linkage

• Match   No Match

Cat Demolition and Sorting Grapples are designed for fast, productive material handling. Capable of high-volume, production loading and precise sorting, they enhance the productivity and efficiency of your operation. The grapples can handle anything from primary and secondary demolition to recycling to get the job done.

Not all attachments are available in all regions. Consult your Cat dealer for specific configurations available in your region.

Features:

Precise Control

- Move production-sized loads with wide shell opening for material handling.
- Synchronized shells and total load control every move with the cross-mounted cylinder.
- Maintain grip on large loads or pick, sort, and place small materials with overbite stops for edge-to-edge jaw contact and prevent overbite.
- Screen dirt and other fine materials out through skeleton and perforated shells, which also give operator good visibility to the load.
- Material sorting is quick, making it easier to sort on-site and saving on tipping fees.
- Shell movement is smooth and controlled with cylinder damping.
- Integrated stop locks the rotator and keeps the shells from drifting open during transport.

Powerful Performance

- High clamping force and fast cycle times are the result of a single, large-bore cylinder design.
- Standard Load Holding Valve:
  - Maintains pressure on cylinder and load without operator constantly engaging close function, improving operator comfort and ergonomics.
  - Keeps material secure in case of hydraulic pressure loss or hose damage for added safety.
  - When active, oil flow to the grapple is blocked, which reduces fuel consumption.
- Work close to container edges and walls. Grapple shell profile has zero clearance from cutting edge against vertical walls and edges, providing access to corners in trucks, trailers, containers, bins, and 90 degree angles.
- Easy access to internal parts through large maintenance panels.
- Get the most out of your grapple with a high torque motor and longer service intervals.

Durable and Tough

- Reinforced shells made of high-strength steel are designed for the most demanding conditions and applications, such as: primary and secondary demolition, recycling, waste transfer stations, tree removal, building retaining walls, and more.
- Material fills and flows smoothly and efficiently due to countersunk bolts in the cutting edge and smooth inner profile of the shell.
- Grapple has ample rotation power to handle twisting and pulling material apart with the motor located on the outer ring.
- Increased reliability in the hydraulic system with swivel and open/close functions run independently of rotation.
- Rotate and align the grapple to pick up and grab material from any angle without moving the machine, saving wear and tear on your undercarriage.
- Operator stays safe in the cab while having the ability to strip down entire structures with the grapple.

Reliable and Easy to Maintain

- Protected rotation with high torque motor for a long service life.
- Bearings and dust seals are inside and protected from damage and debris.
- Internal dust seals provide less axial play, additionally machined surface, optimal protection against damage, and less grease consumption.
- Minimize downtime with the easy-to-replace, abrasion-resistant cutting edge for your grapple.
- Ground level access to all grease points and removable panels make grapple maintenance simple.

Options to Meet Your Needs

- Meet your specific needs with rotating and static grapples and different shell options.
- G300 and G300 GC Grapples – Rotating
  - Rotate G300 Series grapples 360 degrees in either direction, with no limit due to the slewing ring and motor, for precise positioning.
  - Standard models: Optimal for severe applications and frequent use.
  - GC models: Optimal for lighter applications and occasional use.
- G200 GC Grapples – Static
  - Non-rotating grapple intended use with Tiltrotator.
  - Optimal for light applications and occasional use.
- Shell Types:
  - Skeleton shell – Suited for primary and secondary demolition and other harsh applications.
  - Closed shell – Best when used in high-volume processing and sorting applications for large, bulky materials.
  - Perforated shell – Largest capacity and best when used in high-volume processing and sorting applications for light material densities.
- Grapples with waste handling nomenclature can handle 33-150% more material than the standard models of the same size.
- Fixed upper head models: Some models include the CW dedicated coupler hinge plate fixed to the upper head. This creates more stability with the machine due to a lower overall build-up height and less weight.

Cat Demolition and Sorting Grapple Model	Excavator Model
G212 GC	312F, 313F, 313 GC, 313, 314F, 315F CR, 315, 316F, 318F, M314F, M314, M315F, M316F, M316, M317F, M318F, M318
G213 GC	313, 316F, 318F, M314F, M314, M315F, M316F, M316, M317F, M318F, M318
G217 GC	320F, 320 GC, 320, 323F, 323, 325F CR, 325, M320F, M320, M322F
G312 GC	311F, 312D2, 312E, 312F, 313D2, 313F GC, 313F, 313 GC, 313, 314E CR, 314F, 315F CR, 315, 316F, M314F, M314, M315D2, M315F, M315
G313 GC	312D2, 312E, 312F, 313D2, 313F GC, 313F, 313 GC, 313, 314E CR, 314F, 315F CR, 315, 316E, 316F, M314F, M314, M315D2, M315F, M315, M316F, M316, M317D2, M317F, M318F, M318
G314	311F, 312D2, 312E, 312F, 313D2 GC, 313D2, 313F GC, 313F, 313 GC, 313, 314E CR
G317 GC	316E, 316F, 318D2, 318E, 318F, 320D2 GC, 320D2, 320E, 320E RR, 320F, 320 GC, 320, 323D2, 323E, 323F, 323, 325F CR, 325, M316F, M316, M317D2, M317F, M318F, M318, M320D2, M320F, M320, M322D2, M322F, M322D2 MH, M324D2 MH, MH3022, MH3024, MH3026
G318	316E, 316F, 318D2, 318E, 318F, 320D2 GC, 320D2, 320E, 320E RR, 320F, 320 GC, 320, 323D2, 323E, 323F, 323, 325F CR, 325, M316F, M317D2, M318F, M320D2, M320F, M320, M322D2, M322F, M322D2 MH, M324D2 MH, MH3022, MH3024, MH3026
G318 WH	316F, 318D2, 318E, 318F, 320D2 GC, 320D2, 320E, 320E RR, 320F, 320 GC, 320, 323D2, 323E, 323F, 323, 325F CR, M316F, M318F, M318, M320D2, M320F, M320, M322D2, M322F, M322D2 MH, M324D2 MH, MH3022, MH3024, MH3026
G324	323D2, 323E, 323F, 323, 324E, 325, 326D2, 326F, 326, 329D2, 329E, 329F, 330D2, 330F, 330 GC, 330, 335F CR, 340 UHD, 352 UHD
G324 WH	323D2, 323F, 323, 324E, 325, 326D2, 326F, 326, 329E, 330D2, 330F, 330 GC
G332	324E, 326D2, 326F, 329D2, 329E, 330D2, 330F, 330 GC, 330, 335F CR, 336D2 GC, 336D2, 336D2 XE, 336E, 336E H, 336F, 336F XE, 336 GC, 336, 340F, 340F UHD, 340, 340 UHD
G345	329D2, 329E, 330D2, 330 GC, 330, 336D2 GC, 336D2, 336D2 XE, 336E, 336E H, 336F, 336F XE, 336 GC, 336, 340D2, 340F, 340F UHD, 340, 340 UHD, 345 GC, 349D2, 349E, 349F, 349F XE, 349, 352F, 352F XE, 352, 352 UHD

Cat GSH Orange Peel Grapples expand your capabilities. With faster cycle times and increased capacities, GSH Grapples allow you to move more while spending less. A more efficient product design increases the grapple's overall productivity and reduces maintenance costs.

Not all attachments are available in all regions. Consult your Cat dealer for specific configurations available in your region.

Features:

High Performance, Less Fuel Burn

- Move more tons per hour with faster cycle times.
- Increase hydraulic flow capacity up to 160 percent with a new rotation system.
- Improve your overall fill factor up to 140-200 percent because of refined tine curvature.
- Cat Machines are pre-programmed with optimum performance settings for your grapple to maximize the pairing and efficiency of the machine and grapple.
- Reach new heights and increase your swing control. The compact height of GSH grapples extends your capabilities and is ideal for indoor applications.

Long-lasting, Quality

- Grapple life is prolonged because of lighter, force distributing cast pieces in place of welds.
- Prevent cylinders from overextending, and avert unnecessary wear on hinge points and tine tips with heavy duty, abrasion resistant upper and lower stops on the grapple's housing.
- Strength you can count on. Solid construction inner tines and tips are built of high grade steel, resisting abrasion and metal-on-metal wear. Hinge points are cast eliminating weak points on the frame.
- Increase wear life with easy to replace, cast tine tips.

Easy to Maintain

- Spend more time working with decreased maintenance time. Usage before first service interval is increased up to 250 percent and ground level grease points are safer and easier to use.
- Integral hydraulic components have been rerouted and are protected inside the tine, decreasing tension on hoses and eliminating interference with materials.
- Easy, inside-the-tine access to the hydraulics through removable panels. Panels also include dust seals to protect the critical parts inside the tines.
- Maintain a safe working environment by using the Mounting Bracket Aid which allows the bracket to stay in an upright position while installing the grapple to the machine.

Options for Specific Applications

- Meet your specific application needs with 4 or 5-tine models and optional semi-open or closed tine styles.
  - – Four tines – square footprint, clean corners in rail cars and trailers. Safe grab closure for bulky goods such as car bodies.
  - – Five tines – optimal retention of smaller materials.
  - – Semi-open tines work best for applications where larger steel scrap or car bodies are being moved.
  - – Closed tines are optimal in instances where smaller, shredded materials are the primary use.
- GSH420 and GSH520 models now come with a standard lift eye on the bottom side of the housing where a magnet can be mounted.
- Other GSH models have the option of including a lift eye when ordering the grapple.

Cat GSV Orange Peel Grapples more options to fit your needs. With faster cycle times and increased capacities, GSV Grapples allow you to move more while spending less. A more efficient product design increases the grapple's overall productivity and reduces maintenance costs. The addition of a GC model provides an economical option while delivering the same Cat quality you expect.

Not all attachments are available in all regions. Consult your Cat dealer for specific configurations available in your region.

Features:

- Continuous, bi-directional 360° hydraulic rotation.
- Heavy-duty, fully protected cylinders.
- Tines constructed of high-strength wear-resistant steel.

High Performance, Less Fuel Burn

- Move more tons per hour with faster cycle times.
- Increase hydraulic flow capacity up to 160 percent with a new rotation system.
- Improve your overall fill factor up to 140-200 percent because of refined tine curvature.
- Cat Machines are pre-programmed with optimum performance settings for your grapple to maximize the pairing and efficiency of the machine and grapple.

Long-lasting, Quality

- Grapple life is prolonged because of lighter, force distributing cast pieces in place of welds.
- Prevent cylinders from overextending, and avert unnecessary wear on hinge points and tine tips with heavy duty, abrasion resistant upper and lower stops on the grapple's housing.
- Strength you can count on. Solid construction inner tines and tips are built of high grade steel, resisting abrasion and metal-on-metal wear. Hinge points are cast eliminating weak points on the frame.
- Increase wear life with easy to replace, cast tine tips.

Easy to Maintain

- Spend more time working with decreased maintenance time. Usage before first service interval is increased up to 250 percent and ground level grease points are safer and easier to use.
- Integral hydraulic components have been rerouted, decreasing tension on hoses and eliminating interference with materials.
- Easy access to the hydraulics makes maintenance quicker, so more time can be spent moving materials.
- An optional cylinder guard is available to protect hydraulic hoses from materials.
- Maintain a safe working environment by using the Mounting Bracket Aid which allows the bracket to stay in an upright position while installing the grapple to the machine.

Options for Specific Applications

- Meet your specific needs with semi-open or closed tine style options.
  - Semi-open tines work best for applications where larger steel scrap or pipes and beams are being moved.
  - Closed tines are optimal for smaller, shredded materials.
- GC Grapples are lighter, which make them the ideal choice for recycling applications.
- Standard Grapples have been optimized for large and shredded scrap materials.

Cat OPG Model	Excavator Model
GSH420	320 GC, 323, 325, M313, M314, M318
GSH425	320 GC, 323, 325, 326, 330 GC, 330, MH3040
GSH440	326, 330 GC, 330, 336 GC, 336, 340, 340 UHD, MH3040
GSH455	336 GC, 336, 340, 340 UHD, 345 GC, 349, 352, 352 UHD
GSH520	320 GC, 323, 325, M313, M314, M318
GSH525	323, 325, 326, 330 GC, 330, MH3040
GSH555	336 GC, 336, 340, 340 UHD, 345 GC, 349, 352, 352 UHD
GSM-50	336 GC, 336, 340, 340 UHD, 345 GC, 349, 352, 352 UHD
GSM-60	345 GC, 349, 352, 352 UHD, 374D, 374F
GSV520 GC	313F, 320 GC, M313, M314, M318
GSV520	320 GC, 323, 325, M313, M314, M318
GSV525	320 GC, 323, 325, 326, 330 GC, 330

Guarding Recommendation

Orange Peel Grapples used in hazardous applications like scrap and material handling can create a need for special operator guarding due to flying objects. When using an Orange Peel Grapple, additional protective devices such as a front screen, Falling Object Guarding System (FOGS, includes top and front guarding), thick polycarbonate windshields or a combination of these is recommended by Caterpillar. Contact your Cat dealer for operator guarding options on your machine.

Selection by Application

	Grapple Application	4 Tines O	4 Tines S	4 Tines C	4 Tines N	5 Tines O	5 Tines S	5 Tines C	5 Tines N
Handling Scrap, Iron and Steel	**Small-sized pieces (shredded)**	x	Good	Very good	Good	x	Good	Very good	Good
	Large-sized pieces up to 1000 × 1000 mm (39" × 39") (steel scrap, wrought iron, white goods, motor blocks)	Very good	Good		Very good	Very good	Good		Very good
	Heavy/long-sized pieces (I-beams, pipes, plates)	Very good	Good	x	Very good	Good	Good	x	Good
	Car bodies	Very good	Very good	x	Very good	Good	Good	x	Good
Handling Nonferrous Scrap Metals	**Small-sized pieces (beverage cans, electric devices)**	x	Good	Very good	Good	x	Very good	Very good	Very good
	Large-sized pieces (car radiators, batteries)	Good	Very good	Good	Very good	Good	Very good	Good	Very good
	Wires and cables (copper, lead)	Good	Very good	Good	Very good	Good	Very good	Good	Very good
Other Nonferrous Materials	**Waste**	Good	Very good	Good	Very good	Good	Very good	Good	Very good
	Rocks, concrete blocks	Very good	Good	x	Very good	Good	Good	x	Very good

Very good   Good   x Not Recommended   **O** Open   **S** Semi-closed   **C** Closed   **N** Narrow

Features:

- Multi-functional operation, the crusher combines several demolition operations in one piece of equipment. Breaking out concrete from fixed structures, pulverizing concrete and cutting reinforcement rods and small steel profiles.
- High force-to-weight ratio, the crusher's special cylinder position allows it to maintain the same power with significantly lower weight.
- Enhanced performance, the standard speed valve enables cutting/crushing with great force and in even shorter cycle times.
- Optimized serviceability, the teeth and blades are replaceable and the hydraulics is easy accessible through bolted hatches.

Guarding Recommendation

Multi-Functional Concrete Crushers used in hazardous applications like breaking out concrete from fixed structures, pulverizing concrete and cutting, can create a need for special operator guarding due to flying objects. When using a Multi-Functional Concrete Crusher, additional protective devices such as a front screen, Falling Object Guarding System (FOGS, includes top and front guarding), thick polycarbonate windshields or a combination of these is recommended by Caterpillar. Contact your Cat dealer for operator guarding options on your machine.

Matching Guide

Multi-Functional Concrete Crushers

Model	Cat Excavator
P315	315C/D, 318C, 319C/D, 320B/C/D, 322B/C, 323D, 324D, 325B/C, 325UHD C/D, 330UHD B/C/D, 345UHD B/C, 385UHD B/C
P325	320D, 322B/C, 324D, 325B/C/D, 329D, 330B/C/D, 336D, 325UHD C/D, 330UHD B/C/D, 345UHD C, 365UHD B/C, 385UHD B/C
P335	325B/C/D, 329D, 330B/C/D, 336D, 345B/C, 365UHD BII/C, 385 UHD B/C
P360	345B/C, 365B/C, 385B/C

Features:

- **Ideal for pulverizing from non fixed structures** — The Secondary Pulverizer is an excellent choice for all those recyclers who need to prepare concrete for fine crushing and is an excellent attachment for secondary demolition. Concrete chunks released during the demolition of concrete structures can be fine-crushed at source. In this process the concrete and the reinforcement are separated. This considerably reduces the transport volume, saving dumping and transportation expenses.
- **Innovative jaw arrangement** — The Cat Secondary Pulverizer offers wide jaws with pick-up tips, large opening, reversible cutting edges and fast closing times that bring a high return on your investment. This high force-to-weight work tool has been specially developed to reduce the largest possible amount of concrete in the shortest possible time.
- **Enhanced performance** — The ripper tooth splits concrete instantly and the large number of teeth have a large pulverizing effect. The cylinder of the pulverizer is equipped with a speed valve as standard. This device controls the speed of the cylinder and enables to cut/crush with great force in short cycle times.
- **Optimized serviceability** — Service and repairs are a necessary part of operating any work tool. So the less time and money needed for both, the better. That's why Caterpillar gives major attention to reducing both. The teeth and blades are replaceable and the hydraulics are easily accessible through bolted hatches. Parts commonality is designed into Cat products to significantly benefit owners of several work tools.
- **Long lifetime** — Cat Work Tools are designed to last long. Precision machined and forged parts, wear protection and stress relieving plates as well as fully protected hydraulic cylinder provide a long lifetime of low cost production.

Guarding Recommendation

Hydraulic Concrete Pulverizers are used in hazardous applications like breaking out concrete from fixed structures, pulverizing concrete and cutting; creating a need for special operator guarding due to flying objects. When using these tools, additional protective devices such as a front screen, Falling Object Guarding System (FOGS, includes top and front guarding), thick polycarbonate windshields or a combination of these is recommended by Caterpillar. Contact your Cat dealer for operator guarding options on your machine.

Matching Guide

Hydraulic Concrete Pulverizers

Model	Cat Excavator
P215	315C/D, 318C, 319C/D, 320B/C/D, 322B/C, 323D, 324D, 325B/C/D
P225	320D, 322B/C, 324D, 325B/C/D, 329D, 330B/C/D, 336D
P235	325B/C/D, 329D, 330B/C/D, 336D, 345B/C

MATERIAL HANDLERS

CONTENTS

(Scrap specifications and classifications can be found in the Institute of Scrap Iron and Steel Inc.'s "Handbook." The common unit measure for the scrap industry is the gross ton which is 2240 pounds. However, short tons, net tons and metric tons may also be used.)

The versatility of Cat® material handlers, plus their ability to be equipped in any number of ways, make them an effective, low cost way to handle scrap and other materials.

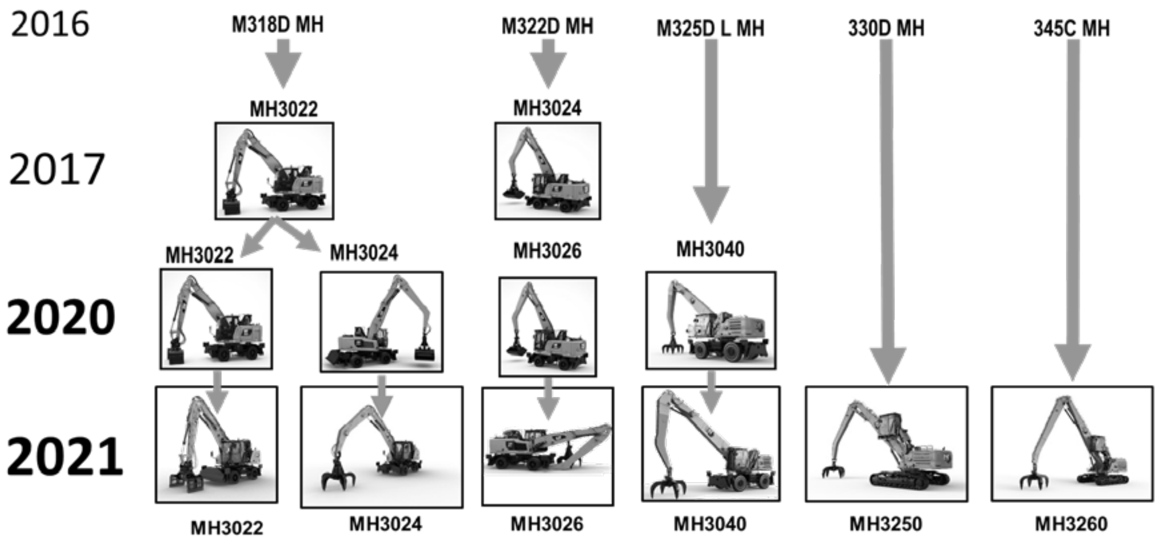
NOTE: Contact your Cat dealer for additional information on equipping Cat Material Handlers for scrap or bulk material handling applications.

Design Features

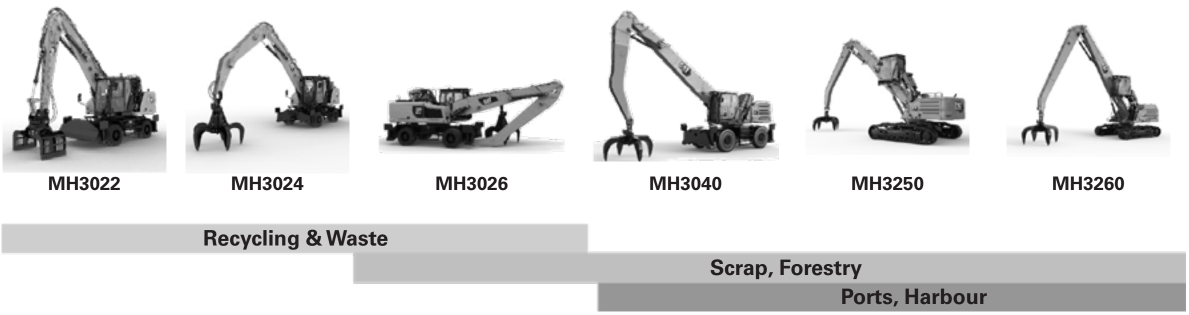
- Focused on delivering superior performance
- Sharing 100% validated Caterpillar proven components
- Driving lower owning and operating cost
- Delivering highest levels of operator comfort
- Ensuring jobsite safety – operator, technician, ground level personnel

Customer Value Message

- Reliability from proven components
- Serviceability – grouped service points, parts commonality, easy access
- Different modes (SMART, ECO, POWER) matched to the application
- Stability and ground clearance matched to underfoot conditions
- One stop shop – machine, attachment, generator



System Solutions



	G318 and G318 WH	G324 and G324 WH		
	GSH420, GSH520	GSH425, GSH525	GSH440	GSH445, GSH555

INSTITUTE OF SCRAP RECYCLING INDUSTRIES INC.

Scrap Specifications Guidelines for Ferrous Scrap

ISRI Code	Definition
200	**No. 1 heavy melting steel.** Wrought iron and/or steel scrap 6.35 mm (1/4 in) and over in thickness. Individual pieces not over 1524 × 610 mm (60 × 24 in) (charging box size) prepared in a manner to insure compact charging.
203	**No. 2 heavy melting steel.** Wrought iron and steel scrap, black and galvanized, 3.18 mm (1/8 in) and over in thickness, charging box size to include material not suitable as No. 1 heavy melting steel. Prepared in a manner to insure compact charging.
207	**No. 1 busheling.** Clean steel scrap, not exceeding 305 mm (12 in) in any dimensions, including new factory busheling (for example, sheet clippings, stampings, etc.). May not include old auto body and fender stock. Free of metal coated, limed, viteous enameled, and electrical sheet containing over 0.5 percent silicon.
208	**No. 1 bundles.** New black steel sheet scrap, clippings or skeleton scrap, compressed or hand bundled, to charging box size, and weighing not less than 34 kg (75 lb) per cubic foot. (Hand bundles are tightly secured for handling with a magnet.) May include Stanley balls or mandrel wound bundles or skeleton reels, tightly secured. May include chemically detinned material. May not include old auto body or fender stock. Free of metal coated, limed, viteous enameled, and electrical sheet containing over 0.5 percent silicon.
209	**No. 2 bundles.** Old black and galvanized steel sheet scrap, hydraulically compressed to charging box size and weighing not less than 34 kg (75 lb) per cubic foot. May not include tin or lead-coated material of vitreous enameled material.
210	**Shredded Scrap.** Homogeneous iron and steel scrap magnetically separated, originating from automobiles, unprepared No. 1 and No. 2 steel, miscellaneous baling and sheet scrap. Average density 23 kg (50 lb) per cubic foot.
211	**Shredded Scrap.** Homogeneous iron and steel scrap magnetically separated, originating from automobiles, unprepared No. 1 and No. 2 steel, miscellaneous baling and sheet scrap. Average density 34 kg (70 lb) per cubic foot.
219	**Machine shop turnings.** Clean steel or wrought iron turnings, free of iron borings, nonferrous metals in a free state, scale, or excessive oil. May not include badly rusted or corroded stock.
231	**Plate and structural steel, 1.5 m (5 ft) and under.** Cut structural and plate scrap, 1.5 m (5 ft) and under. Clean open hearth steel plates, structural shapes, crop ends, shearings, or broken steel tires. Dimensions not less than 6.35 mm (1/4 in) thickness, not over 1.5 m (5 ft) in length and 457 mm (18 in) in width. Phosphorous or sulphur not over 0.05 percent.
234	**Punchings and plate scrap.** Punchings or stampings, plate scrap, and bar crops containing not over 0.05 percent phosphorous or sulphur and not over 0.5 percent silicon, free from alloys. All materials cut 305 mm (12 in) and under, and with the exception of punchings or stampings, at least 3.18 mm (1/8 in) in thickness. Punchings or stampings under 152 mm (6 in) in diameter may be any gauge.

MINING & OFF-HIGHWAY TRUCKS

CONTENTS

8

Features:

- **Cat® Four-Stroke Diesel Engines** — Turbocharged, aftercooled, adjustment-free fuel system (direct injection).
- **Electronically-Controlled Automatic Transmission** — Speed sensing device automatically shifts transmission between 1st and gear selected by operator.
- **Truck Production Management System (TPMS)** — Utilizes strut pressure sensors and an on-board microprocessor to determine payload weight, cycle segment times, delay times, actual clock time and date of each cycle.
- **Basic Health or Advanced Health (Formerly VIMS)** — Monitors all vital machine functions. Keeps operator informed of current machine operating conditions, helps reduce downtime and allows service personnel easy access to data for fast accurate diagnosis. Basic Health or Advanced Health (Formerly VIMS) includes the Truck Production Management System.
- **Mechanical Electronic Unit Injection (MEUI™)** in the 770 through 793D — Electronically maintains fuel settings, provides automatic altitude and air filter restriction compensation, and features automatic variable timing, improved diagnostics and increased fuel efficiency.
- **Common Rail Fuel System** — in the C175 engines are used on (793F, 794 AC, 795F AC, and 797F) trucks.
- **Oil Cooled Disc Brakes —** Provide retarding, service, parking, and secondary braking in a single sealed, fade-resistant, maintenance-free unit. Standard on the 770 through 775G and 777E, front brakes are caliper disc and can be switched out of the service system when not needed but activate as part of the secondary system. Standard on the 777G through 797F, front brakes are oil-cooled disc, providing excellent control in slippery conditions.
- **Automatic Retarder Control (ARC)** — Electronically controls braking on grade to maintain optimal engine RPM and oil cooling. ARC benefits include engine overspeed protection, ease of operation, faster downhill speeds, smoother ride and better control in slippery conditions.
- **Traction Control System (TCS)** — Electronically monitors and controls rear wheel slippage for greater traction and enhanced truck performance in poor underfoot conditions. If slippage exceeds a set limit, the oil-cooled disc brakes engage to slow the spinning wheel. Torque is then automatically transferred to the wheel with better traction. Available on the 770 through 797F.
- **Full Hydraulic Steering** — Functions with front suspension cylinders serving as kingpins.
- **Suspension Cylinders** — Four independent, self-contained, nitrogen/oil-pneumatic suspension cylinders absorb loading and road shocks. Wide spacing for stability.
- **Truck Bodies** — A variety of truck bodies are available to meet your application specific requirements. Those options include MSDII (mine specific design), X, HE, HP, dual slope and gateless coal bodies. The Caterpillar body program ensures the truck is configured for an optimal haulage solution.
- **Integral Roll Over Protective Structure (ROPS)** — Integral Four-Post ROPS cab standard on all models. Resiliently mounted to the main frame to reduce vibration and sound, the integral ROPS structure is designed as an extension of the truck frame. The ROPS/FOPS structure provides "five sided protection" for the operator and trainer.
- **Separate Hydraulic Systems** — Prevent cross contamination.
- **Safety** — Caterpillar continues to be proactive in developing construction and mining trucks that meet or exceed industry standards. Safety is an integral part of the machine design.

  An example of enhanced safety through the development of products, processes and solutions includes Cat Integrated Object Detection System which is an integrated camera and radar technology. More information on Object Detection is available in the technology section.

NOTE: Not all features are available on all models at this time.

Sustainability:

A variety of features improve sustainability in areas of decreasing waste, extending component life and lowering emissions levels. The 777G, 785D and 797F trucks offer Oil Renewal systems. The 777G, 785D, 793F, 797F trucks offer Continuous Rear Axle Filtration, Extended Life Filters and Extended maintenance intervals which aid in decreasing the amount of waste contributed to our environment.

- **Engines with advanced technology** contribute less emissions to the environment while maintaining fuel efficiency.
- **Advanced Surface Technology (AST)** is a replacement for hard chrome coatings on some steel parts, including Suspension and hoist Cylinder Rods.
- **Other features on 793F, 797F Mining trucks** include rear axle oil savers, front wheel sight glass, two piece cover on the final drive, ecology drains and brake wear indicators all of which help to maximize component life.

NOTE: Not all features are available on all models at this time.

Non-Dumper Offerings:

For certain applications the Caterpillar OEM Solution Group offers non-dumper arrangements for the 770G, 772G, 773G, 775G, 777G and 785D.

Non-dumper arrangements include a water truck and tractor configuration. For updates on additional offerings please contact Caterpillar OEM Solutions Group.

NOTE: Listed features may be standard on some models. Optional on others. Contact your Cat dealer for specific information.

TRUCK WEIGHT DEFINITIONS

Rated Gross Machine Weight	– Designated GMW for the machine – Optimum productivity and cost per ton – Used for performance curves and calculations
Base Machine Weight	This is the basic chassis weight which includes shipping fluids, but no attachments or options.
Attachment Weight	This is the selection of attachments, mandatory and optional, chosen for a particular truck configuration.
Body Weight	Weight of body specified in Body Type. Body Type and weight will change based on application.
Liner Weight	Liner Weight for Body Type specified. Liner Weights will change based on application.
Nominal Empty Machine Weight	Base Machine Weight plus full Fuel, Tires, Rims, Attachment Weight, Operator Weight, Body Weight, and Liner Weight.
Nominal Rated Payload	Rated Gross Machine Weight minus Nominal Empty Machine Weight.

TRUCK WEIGHT RELATIONS

Nominal Empty Machine Weight	Nominal Empty Machine Weight = Base Machine Weight + Operator Weight + Attachment Weight + Body Weight + Liner Weight.
Nominal Rated Payload	Nominal Rated Payload = Rated Gross Machine Weight – Nominal Empty Machine Weight.
Rated Gross Machine Weight	RGMW
Base Machine Weight	BMW
Nominal Empty Machine Weight	NEMW
Nominal Rated Payload	NRP

USE OF BRAKE PERFORMANCE CURVES

The speed that can be maintained when the machine is descending a grade with retarder applied can be determined from the retarder curves in this section when gross machine weight and total effective grade are known.

Select appropriate grade distance chart that covers total downhill haul; don't break haul into individual segments.

To determine brake performance: Read from gross weight down to the percent effective grade. (Effective grade equals actual % grade *minus* 1% for each 10 kg/metric ton (20 lb/U.S. ton) of rolling resistance.) From this weight-effective grade point, read horizontally to the curve with the highest obtainable speed range, then down to maximum descent speed brakes can safely handle without exceeding cooling capacity. When braking, engine RPM should be maintained at the highest possible level without overspeeding. If cooling oil overheats, reduce ground speed to allow transmission to shift to next lower speed range.

Brake Performance Curves are made in compliance with ISO 10268 and applicable to Sea Level and 32° C (90° F) temperature. Contact Factory for Application Specific Performance.

USE OF RIMPULL-SPEED-GRADEABILITY CURVES

For best results, use Caterpillar Fleet Production and Cost Analysis (FPC) to simulate cycle time, fuel burn, and production for Application Specific Performance inquiries. Contact Factory Representative for more information.

(See Wheel Tractor Scraper Section)

Total Effective Grade (or Total Resistance) is grade assistance *minus* rolling resistance.

10 kg/metric ton (20 lb/U.S. ton) = 1% adverse grade.

Example —

With a favorable grade of 20% and rolling resistance of 50 kg/metric ton (100 lb/U.S. ton), find Total Effective Grade.

(50 kg/metric ton) = 50 ÷ 10 = 5% Effective Grade
(from Rolling Resistance)
100 lb/ton = 100 ÷ 20 = 5% Effective Grade
20% (grade) – 5% (resistance) =
15% Total Effective Grade

TYPICAL FIXED TIMES FOR HAULING UNITS

Wait time, delays and operator efficiency all impact cycle time. Minimizing truck exchange time can have a significant effect on productivity.

Fixed time for hauling units include:
1. Truck load time (various with loading tool)
2. Truck maneuver in load area (Truck exchange) (Typically 0.6-0.8 min.)
3. Maneuver and dump time at dump point (Typically 1.0-1.2 min.)

Total cycle time is the combination of:
1. The above fixed time
2. Hauling time (Loaded)
3. Return time (Empty)

Example — assume load tool spots hauler with full bucket

		988F	5130B
cycle times		.60	.45
First pass	(dump time)	.10 min.	.05 min.
2 passes	(full cycle)	.70	.50
3 passes	"	1.30	.95
4 passes	"	1.90	1.40
5 passes	"	2.50	1.85
6 passes	"	3.10	2.30
7 passes	"	3.70	2.75
8 passes	"	4.30	3.20
9 passes	"	4.90	3.65
10 passes	"	5.40	4.10

NOTE: Other sizes of loading tools will have different cycle times. See Wheel Loader section for **average** cycle times for truck loading.

CALCULATING POWERTRAIN EFFICIENCIES

In selling against competitive OEM models, both mechanical drive and electric drive, powertrain efficiency is an important consideration. To better illustrate the advantages of Caterpillar's proven performance, grade horsepower, powertrain efficiency, and retarding horsepower should be compared to competitive OEM models.

Grade horsepower can be calculated by the following formula:

Metric

$$\text{grade HP} = \frac{\text{GMW (kg)} \times \text{TR} \times \text{Speed (km/h)}}{273.75}$$

English

$$= \frac{\text{GMW (lb)} \times \text{TR} \times \text{Speed (mph)}}{375}$$

where TR
(total resistance) = Rolling resistance + Grade resistance (expressed as a decimal)

English example

700,000 lb GMW, 2% rolling resistance, +8% actual grade at 8.2 mph would require 1530 HP

$$\frac{700{,}000 \times (.02 + .08) \times 8.2}{375} = 1530 \text{ HP}$$

Metric example

317 520 kg GMW, 2% rolling resistance, +8% actual grade at 13.2 km/h would require 1530 HP

$$\frac{317\,520 \times (.02 + .08) \times 13.2}{273.75} = 1530 \text{ HP}$$

We then calculate powertrain efficiency by dividing grade horsepower by the gross horsepower produced by the engine. Most electric drive trucks run at constant maximum horsepower while under load. Mechanical drive trucks, however, lug the engine and may produce somewhat less than maximum horsepower. Engine power curves must be utilized to determine exact horsepower produced.

Example

$$\frac{\text{1530 grade horsepower}}{\text{1800 gross engine HP}} \times 100 = 85\% \text{ powertrain efficiency}$$

Likewise, retarding horsepower being consumed by the retarding system can be calculated by the following formula:

Metric

$$\text{retarding HP} = \frac{\text{GMW (kg)} \times \text{TR} \times \text{Speed (km/h)}}{273.75}$$

English

$$= \frac{\text{GMW (lb)} \times \text{TR} \times \text{Speed (mph)}}{375}$$

where TR
(total resistance) = Rolling resistance + Grade resistance (expressed as a decimal)

English example

700,000 lb GMW, 2% rolling resistance, –8% actual grade at 14.7 mph would equate to –1646 HP

$$\frac{700{,}000 \times (.02 - .08) \times 14.7}{375} = 1646 \text{ HP}$$

Metric example

317 520 kg GMW, 2% rolling resistance, –8% actual grade at 23.6 km/h would equate to –1646 HP

$$\frac{317\,520 \times (.02 - .08) \times 23.6}{273.75} = 1646 \text{ HP}$$

This formula is intended for use in determining horsepower being consumed in the field based on field measurements. It is not intended to indicate how fast trucks should be operated on grade. Only job conditions, proper operating procedure, and good judgement should determine safe operating speeds during retarder use.

MOTOR GRADERS

CONTENTS

APPLICATIONS, Motor Graders:

The broad line of Cat motor graders allows the customer to choose a motor grader that best fits the intended application. Below is a summary of the typical motor grader applications.

Finish Grading

This application involves preparing a roadway or site surface for future paving or other construction activity. The material being moved is usually a hard, dry base material on a solid underfoot. Finish blading is the motor grader application that requires the highest degree of accuracy. Thus, it is primarily done at low operating speeds — usually less than 5 km/h (3 mph) — in gears 1 and 2. To ensure a smooth, even finished surface, one gear is usually maintained for a given pass. Pass lengths during this application are usually less than 600 m (2000 feet) for road construction and 150 m (500 feet) for site development. Most finish blading is performed by contractors in the Heavy Construction and Building Construction industries.

Heavy Blading

This application involves cutting, moving, and mixing material, usually in the initial stages of surface preparation. A variety of material types are moved in this manner, and the blade tip position varies accordingly. Full blade loads are usually experienced during heavy blading, since moving material is the primary goal. Pass lengths within this application vary, but are usually less than 600 m (2000 feet). Unlike finish blading, the speed of the machine is dependent on the load being moved when heavy blading material. Typical operating speeds are from 0-10 km/h (0 to 6 mph). Therefore, gears 2 through 4 are frequently used in this application. Most heavy blading activity is performed by contractors in the Heavy Construction, Governmental, Industrial, and Forestry industries.

Site Preparation

This application involves any material cutting, moving, and mixing necessary to prepare a residential, commercial, or industrial site for construction. A variety of materials are encountered in this application. Blade loads vary depending on the activity being performed. Both heavy blading and finish blading are performed when preparing a site. Pass lengths are typically in the range of 30-300 m (100 to 1000 feet). Typical operating speeds for site preparation vary depending on whether heavy blading or finish blading activities are being performed. Most site preparation activities are performed by contractors in the Building Construction industry.

Road Maintenance

This application involves reshaping dirt or gravel roads to maintain a crown or superelevation, or restoring the surface itself. This generally involves secondary roads maintained by governmental bodies such as townships and counties. Materials being moved in this application vary from extremely hard dirt bases to moist gravel surfaces. The typical blade load falls between that of finish blading and heavy blading. Pass lengths are frequently longer than 600 m (2000 feet) and can extend for miles. The general speed range for this application is 5-16 km/h (3 to 10 mph), corresponding to gears 2 (heavy dirt) through 5 (soft gravel). As with finish blading, accuracy of the graded surface is the primary concern in this application. Thus, frequent shifts should be avoided whenever possible. A gear should be chosen and maintained unless there is a significant change in the material being moved. Most road maintenance activities are performed by the Governmental industry.

Haul Road Maintenance

This application of the motor grader involves reshaping haul roads at mining, construction, or forestry work sites, usually for the purpose of maintaining smooth travel surfaces for equipment. Materials being moved while maintaining haul roads vary widely. Typical blade loads are about one-third to half of full capacity. Haul roads that experience large hauling units travelling on soft material may require heavy blade loads in order to reshape the road surface. Pass lengths vary depending on the application but can extend for miles on remote forestry or large mine haul roads. The general speed range for haul road maintenance is heavily dependent on the material being moved as well as the grade of the haul road. Many mine sites are in mountainous areas, requiring haul roads with steep grades. Generally, haul-road maintenance is performed at speeds similar to those required for general road maintenance 5-16 km/h (3 to 10 mph).

A travel surface that allows for the safe and efficient movement of machinery is the ultimate goal with this motor grader application. Very precise roadway elevations and slopes are desired but less crucial than when finish blading. Most haul road maintenance activities are performed by the Mining, Heavy Construction, and Forestry industries.

Side/Bank Slope Work

This application involves preparing side slopes or bank slopes along roadways by placing the moldboard on a sloped surface. Slopes of up to a 2:1 angle can be cut using a motor grader. Often the motor grader is operated on the level surface adjacent to the slope, and the moldboard is extended outward to the sloped surface. Fine soils are generally encountered in this application of the motor grader. Blade loads are usually less than half of the full blade capacity, and pass lengths are seldom longer than 600 m (2000 feet). A smooth-graded sloped surface is the primary concern in this application so frequent shifts should be avoided. The typical speed range is 0-6 km/h (0 to 4 mph), corresponding to a gear selection of 1 to 3. The nominal speed is heavily dependent on the type of material being moved and on the slope of the surface. Most side/bank slope work is performed by the Heavy Construction and Governmental industries.

Ditch Building/Cleaning

This application involves cutting “V” and flat-bottom ditches for drainage purposes and rebuilding them when necessary. Due to excessive rain and/or poor material, ditches often need cleaning and reshaping. When building ditches, materials with a wide range of densities are encountered. Blade loads vary accordingly, from half to full-blade capacity. Pass lengths are usually less than 600 m (2000 feet). The primary objective is to move material in a manner that yields a ditch with the desired slope. Ditch building often involves cutting and moving material of high density. Therefore, typical speed ranges vary. Most ditch building work, however, is performed in gears 1 through 3, corresponding to a maximum speed of about 8 km/h (5 mph). Ditch cleaning usually involves blading moist materials underneath a sod cover. Blade loads are usually less than half of full blade capacity when cleaning ditches, and pass lengths are similar to those encountered in ditch building. Typical maximum speeds for this activity are similar to that of ditch building, but less of a blade load is experienced. Ditch building and cleaning activities are usually performed by the Heavy Construction and Governmental industries.

Ripping/Scarifying

This application involves conditioning hard, rough soils before they are bladed. Shanks on the ripper and/or scarifier are pushed into the ground, thus breaking up otherwise hard surfaces. Hard materials such as asphalt can also be loosened in order to make grading operations less damaging to the moldboard. Rippers and scarifiers can also be used to mix aggregates together. The materials being ripped/ scarified are usually hard and dry. Rippers generally penetrate 150-300 mm (6 to 12 inches) into the ground, while scarifiers typically penetrate to a depth of 25-200 mm (1 to 8 inches). Pass lengths are generally less than 600 m (2000 feet) for both activities. Since the material being ripped/scarified is generally hard, the typical maximum speed for this application is about 6 km/h (4 mph) gears 1-2. If the ripper/scarifier is used for mixing aggregates, the typical operating range becomes 6-20 km/h (4 to 12 mph) gears 3-6. Most ripping/scarifying activities are performed by the Heavy Construction and Governmental industries.

Snow Removal

Snow removal is the process of cutting and removing snow or ice from the roadway. In addition to the standard motor grader moldboard, other attachments such as a snow wing, V-plow, one-way plow, or reversible plow can be used to remove the snow. The moldboard itself is the most commonly used attachment for snow plowing. It is used in areas where snow depths are low, the terrain is relatively flat, and where excessive drifting does not occur. A snow wing is a moldboard that attaches to the machine's right side. The wing's curvature lifts the snow and "wings" it off the plowed surface. The snow wing is often used in conjunction with the standard moldboard, where the moldboard cuts the material and feeds it onto the wing. V-plows are mounted in front of the motor grader and are designed to dig into and lift packed snow. The typical speed range for snow removal is 10-30 km/h (6 to 18 mph), corresponding to a gear range of 3 to 7. Snow plowing often involves lower speeds than snow removal. The typical operating range for snow plowing is 8-19 km/h (5 to 12 mph) gears 2 to 4. The majority of Snow Removal/Plowing operations are performed by the Governmental, Mining, and Forestry industries.

TRUCK TO MOTOR GRADER MATCH

	740	770	775	777	785	789	793	797
12/140/160								
14								
16								
18								
24								

NOTE: Calculations based on 30 degree blade angle, standard moldboard width.
May not be applicable in all applications depending on haul road damage.
Rule of thumb 2.5 times the truck width.

PRODUCTION

The motor grader is used in a variety of applications in a variety of industries. Therefore, there are many ways to measure its operating capacity, or production. One method expresses a motor grader's production in relation to the area covered by the moldboard.

Formula:

$$A = S \times (L_e - L_o) \times 1000 \times E \quad \text{(Metric)}$$
$$A = S \times (L_e - L_o) \times 5280 \times E \quad \text{(English)}$$

where A: Hourly operating area (m^2/h or ft^2/h)
S: Operating speed (km/h or mph)
L_e: Effective blade length (m or ft)
L_o: Width of overlap (m or ft)
E: Job efficiency

Operating Speeds:

Typical operating speeds by application

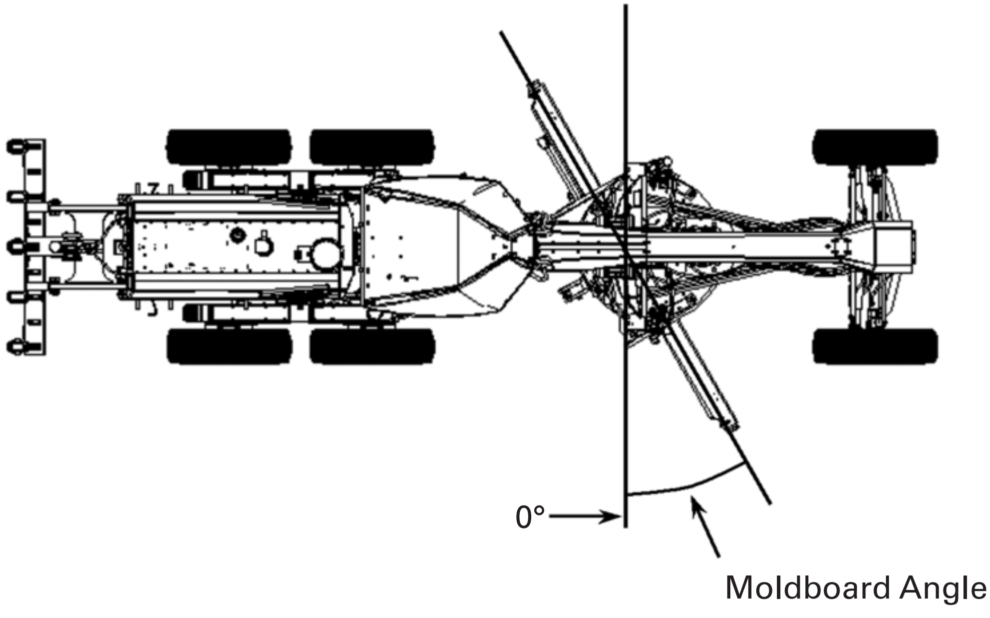
Finish Grading:	0-4 km/h	(0-2.5 mph)
Heavy Blading:	0-9 km/h	(0-6 mph)
Ditch Repair:	0-5 km/h	(0-3 mph)
Ripping:	0-5 km/h	(0-3 mph)
Road Maintenance:	5-16 km/h	(3-9.5 mph)
Haul Road Maintenance:	5-16 km/h	(3-9.5 mph)
Snow Plowing:	7-21 km/h	(4-13 mph)
Snow Winging:	15-28 km/h	(9-17 mph)

Effective Blade Length:

Since the moldboard is usually angled when moving material, an effective blade length must be computed to account for this angle. This is the actual width of material swept by the moldboard.

NOTE: Angles are measured as shown below. The effective length becomes shorter as the angle increases.

9



Moldboard Length, m (ft)	Effective Length, m (ft) 30 degree blade angle	Effective Length, m (ft) 45 degree blade angle
3.658 **(12)**	3.17 **(10.4)**	2.59 **(8.5)**
4.267 **(14)**	3.70 **(12.1)**	3.02 **(9.9)**
4.877 **(16)**	4.22 **(13.9)**	3.45 **(11.3)**
7.315 **(24)**	6.33 **(20.8)**	5.17 **(17.0)**

For other blade lengths and carry angles:
Effective length = COS [Radians (Blade L)] 3 Blade Length

Width of Overlap:

The width of overlap is generally 0.6 m (2.0 ft). This overlap accounts for the need to keep the tires out of the windrow on the return pass.

Job Efficiency:

Job efficiencies vary based on job conditions, operator skill, etc.

A good estimation for efficiency is approximately 0.70 to 0.85, but actual operating conditions should be used to determine the best value.

Example problem:

A Cat motor grader with a 3.66 m (12 ft) moldboard is performing road maintenance on a township road. The machine is working at an average speed of 13 km/h (8 mph) with a moldboard carry angle of 30 degrees. What is the motor grader's production based on coverage area?

Note: Due to the long passes involved in road maintenance — fewer turnarounds — a higher job efficiency of 0.90 is chosen.

Solution:

From the table, the effective blade length is 3.17 m (10.4 ft).

Metric

Production, A = 13 km/h × (3.17 m − 0.6 m) × 1000 × 0.90
= **30 069 m²/hr (3.07 hectares/hr)**

English

Production, A = 8 mph × (10.4 ft − 2.0 ft) × 5280 × 0.90
= **319,334 ft²/hr (7.33 acres/hr)**

To pinpoint the theoretical number of motor graders required to properly maintain your haul roads, based on your specific mining applications, please download the haul road maintenance calculator on *https://catminer.cat.com.*

Haul road maintenance impacts cycle time, tire, frame and drive train components, safety and ultimately your cost per ton. To achieve optimal truck productivity, your haul roads must be properly maintained.

Moderate:
- Road Maintenance
- Pad Cleaning
- Rock Clearing
- Shoulder Sweeping

Difficult:
- Ripping
- Spreading Dump Material
- Road Profiling/Reshaping

BLADE PULL

This specification is also known as drawbar pull. This spec can be calculated as follows:

Variables:

Rear weight of machine = Wr

Tire traction coefficient = T (Look up the table entitled "Coefficient of Traction Factors")

$$\mathbf{Wr \times T = Blade\ Pull}$$

Example problem:

Calculate the blade pull for a 140M Global Version version machine operating in a quarry pit...

Metric

RW = 10 501 kg

T = 0.65

$$\mathbf{10\,501 \times 0.65 = 6825.65}$$

English

RW = 23,151 lb

T = 0.65

$$\mathbf{23{,}151 \times 0.65 = 15{,}048.15}$$

BLADE DOWN PRESSURE

This spec can be calculated as follows:

Variables:

Blade to front axle length = BA

Wheel base length = WB

Weight on front wheels = FW

Blade down pressure = BD

$$\frac{\mathbf{WB}}{\mathbf{(WB - BA)}} \times \mathbf{FW = BD}$$

Example problem:

Calculate the blade down pressure for a 140M Global Version version machine...

Metric

BA = 2565 mm FW = 4223 kg

WB = 6086 mm BD = ?

$$\frac{\mathbf{6086}}{\mathbf{(6086 - 2565)}} \times \mathbf{4223 = 7299\ kg}$$

English

BA = 101 in FW = 9310 lb

WB = 240 in BD = ?

$$\frac{\mathbf{240}}{\mathbf{(240 - 101)}} \times \mathbf{9310 = 16{,}075\ lb}$$

This specification is only a minor indicator of a motor grader's productivity. It alone gives no measure of overall machine productivity. When considering motor grader production you need an optimum balance between the machine's front and rear weights. If a machine has too much weight on the front axle, it might have a high blade down pressure spec. It will, however, lack the essential rear weight and traction needed to push through the load. Too much weight in the rear and it will not have the necessary weight in the front during heavy cuts to maintain proper steering control.

Cat machines are built with this optimum balance in mind. A Cat motor grader is engineered with the proper weight distribution necessary for maximum productivity.

Effective Blade Length*

	Moldboard							
	3.66 m (12')		4.27 m (14')		4.88 m (16')		7.32 m (24')	
Angle°	m	ft	m	ft	m	ft	m	ft
0°	3.66	**12.00**	4.27	**14.00**	4.88	**16.00**	7.32	**24.00**
5°	3.64	**11.95**	4.25	**13.95**	4.86	**15.94**	7.29	**23.91**
10°	3.60	**11.82**	4.20	**13.79**	4.80	**15.76**	7.21	**23.64**
15°	3.53	**11.59**	4.12	**13.52**	4.71	**15.45**	7.07	**23.18**
20°	3.44	**11.28**	4.01	**13.16**	4.58	**15.04**	6.87	**22.55**
25°	3.32	**10.88**	3.87	**12.69**	4.42	**14.50**	6.63	**21.75**
30°	3.17	**10.39**	3.69	**12.12**	4.22	**13.86**	6.33	**20.78**
35°	3.00	**9.83**	3.50	**11.47**	4.00	**13.11**	5.99	**19.66**
40°	2.80	**9.19**	3.27	**10.72**	3.74	**12.26**	5.61	**18.39**
45°	2.59	**8.49**	3.02	**9.90**	3.45	**11.31**	5.17	**16.97**

*Effective blade length is the amount of blade coverage the machine is capable of when the blade is at a given angle.

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EXTREME SLOPE OPERATION

There are two ways of defining slope work. The slope perpendicular to the machine's direction of travel is commonly referred to as "Side Sloping." The slope parallel to the machine's direction of travel — the machines ability to travel up or down terrain, is commonly referred to as "Gradeability."

Side Sloping capability for our Cat graders is somewhat subjective, but general agreement among professional operators is that working on a slope ratio of 2.5:1 (21.8 degrees) is the safe limit … an experienced operator may be able to operate on a 2:1 (28 degrees) slope. Many factors influence this limit such as operator experience, machine configuration, tires and soil conditions, but a 2.5:1 is achievable. Further, a 3:1 slope is the approximate maximum side slope a grader can work on in straight frame configuration. The steeper side slopes all require the machine be articulated to safely navigate the slope.

Gradeability is approximately 22 degrees. This is established by the grader's ability to stop without skidding the tires while moving downhill. The motor grader can, however, *climb* grades steeper than 22 degrees. The traction coefficient is the critical factor in determining whether a grader can safely navigate the slope. Caterpillar recommends that you never climb a slope steeper than you can safely descend.

Maximum lubrication angle: We have measured the graders on a tilt table and pump cavitation occurs around 30 degrees (58% or 1.7:1). This is beyond the grade or slope a motor grader can operate on.

When working side hills and slopes, consideration should be given to the following important points.

- **Speed of Travel** — At higher speeds, inertia forces tend to make the grader less stable.
- **Roughness of Terrain or Surface** — Ample allowance should be made where the terrain or surface is uneven.
- **Mounted Equipment** — Mounted attachments such as front plows, snow wings, rippers and other mounted equipment cause the tractor to balance differently.
- **Nature of Surface** — New earthen fills may give way with the weight of the grader. Rocky surfaces may promote side slipping of grader.
- **Excessive Loads or Side Draft** — This may cause wheel slippage, where the downhill tires "dig in," increasing the angle of grader.
- **Tire Selection and Maintenance** — Consideration should be given to proper tire selection and air pressure. For more information, consult Caterpillar publications — Motor Grader Tire Selection Guide and Operation and Maintenance Manual.
- **Drawbar, Circle and Blade Position —** The position of the blade can affect the stability of the machine.
- **Articulation Angle** — Articulation angle can affect the stability of the machine.
- **Wheel Lean Angle** — Wheel lean angle can affect the stability of the machine.

NOTE: Safe operation on steep slopes may require special machine maintenance as well as excellent operator skill and proper equipment setup for the specific application. Consult Caterpillar publications for further operating tips — Operation & Maintenance Manual, Motor Grader Application Guide, and the Grade Comparison Chart in the Tables section of this Performance Handbook.

PAVING PRODUCTS

CONTENTS

COLD PLANERS

ROTARY MIXERS

ASPHALT PAVERS

VIBRATORY AND PNEUMATIC TIRE COMPACTORS

Cold Planer

Sustainability:

- **Long-lasting lubricants and fluids** extend maintenance intervals, decreasing the amount of waste and filters contributed to environment.
- **Superior Cat® cutting tools last longer**, providing higher daily productivity with less fuel burn.
- **Available Cat Diamond Cutting Bits** last up to 80 times longer than conventional carbide bits.
- **Ecology drains** provide a simple means to drain machine fluids with a minimized risk of spillage.
- **Maintenance free Cat batteries** are recyclable.
- **Cat engines** meet applicable emission standards.
- **Cold planers recycle aggregate from worn out roads** for use in new roads, reducing the cost and energy needs required for excavating, processing and hauling virgin aggregate.

Features:

- **Cat engines.**
- **Up-cutting mandrels** provide cutting efficiency and improved bit life.
- **Excellent maneuverability** for productivity and job site flexibility.
- **Front-discharge conveyor** facilitates haul unit movement in congested urban applications.
- **Optimum weight-to-horsepower balance** for delivering maximum available horsepower to the cutter.
- **Computerized Monitoring System (CMS)** provides three warning levels for abnormal operating conditions.
- **Load control system** keeps machine operating at peak efficiency.
- **Water spray system** for dust control and bit cooling.
- **Optional Cat Grade and Slope** available for PM620 and PM622 models.

Speed		Cutter/Drum Width — m²/min (yd²/min)									
		350 mm (1'2")		**400 mm (1'4")**		**500 mm (1'8")**		**600 mm (2'0")**		**1000 mm (3'4")**	
m/min	**ft/min**	**m²**	**yd²**	**m²**	**yd²**	**m²**	**yd²**	**m²**	**yd²**	**m²**	**yd²**
3.0	**10**	1.1	**1.3**	1.2	**1.4**	1.5	**1.8**	1.8	**2.2**	3.0	**3.6**
4.6	**15**	1.6	**1.9**	1.8	**2.2**	2.3	**2.8**	2.8	**3.3**	4.6	**5.5**
6.1	**20**	2.1	**2.6**	2.4	**2.9**	3.1	**3.6**	3.7	**4.4**	6.1	**7.3**
7.6	**25**	2.7	**3.2**	3.0	**3.6**	3.8	**4.5**	4.6	**5.5**	7.6	**9.1**
9.1	**30**	3.2	**3.8**	3.6	**4.4**	4.6	**5.4**	5.5	**6.5**	9.1	**10.9**
10.7	**35**	3.7	**4.5**	4.3	**5.1**	5.4	**6.4**	6.4	**7.7**	10.7	**12.8**
12.2	**40**	4.3	**5.1**	4.9	**5.8**	6.1	**7.3**	7.3	**8.8**	12.2	**14.6**
13.7	**45**	4.8	**5.7**	5.5	**6.6**	6.9	**8.2**	8.2	**9.8**	13.7	**16.4**
15.2	**50**	5.3	**6.4**	6.1	**7.3**	7.6	**9.1**	9.1	**10.9**	15.2	**18.2**
16.8	**55**	5.9	**7.0**	6.7	**8.0**	8.4	**10.0**	10.1	**12.1**	16.8	**20.1**
18.3	**60**	6.4	**7.7**	7.3	**8.8**	9.2	**10.9**	11.0	**13.1**	18.3	**21.9**
Speed		**1220 mm (4'0")**		**1900 mm (6'3")**		**2010 mm (6'7")**		**2100 mm (6'11")**		**2210 mm (7'3")**	
m/min	**ft/min**	**m²**	**yd²**	**m²**	**yd²**	**m²**	**yd²**	**m²**	**yd²**	**m²**	**yd²**
3.0	**10**	3.7	**4.4**	5.7	**6.8**	6.0	**7.2**	6.3	**7.5**	6.6	**7.9**
4.6	**15**	5.6	**6.7**	8.7	**10.5**	9.2	**11.1**	9.7	**11.6**	10.2	**12.2**
6.1	**20**	7.4	**8.9**	11.6	**13.9**	12.3	**14.7**	12.8	**15.3**	13.5	**16.1**
7.6	**25**	9.3	**11.1**	14.4	**17.3**	15.3	**18.3**	16.0	**19.1**	16.8	**20.1**
9.1	**30**	11.1	**13.3**	17.3	**20.7**	18.3	**21.9**	19.1	**22.9**	20.1	**24.1**
10.7	**35**	13.1	**15.6**	20.3	**24.3**	21.5	**25.7**	22.5	**26.9**	23.6	**28.3**
12.2	**40**	14.9	**17.8**	23.2	**27.7**	24.5	**29.3**	25.6	**30.6**	27.0	**32.2**
13.7	**45**	16.7	**20.0**	26.0	**31.1**	27.5	**32.9**	28.8	**34.4**	30.3	**36.2**
15.2	**50**	18.5	**22.2**	28.9	**34.5**	30.6	**36.5**	31.9	**38.2**	33.6	**40.2**
16.8	**55**	20.5	**24.5**	31.9	**38.2**	33.8	**40.4**	35.3	**42.2**	37.1	**44.4**
18.3	**60**	22.3	**26.7**	34.8	**41.6**	36.8	**44.0**	38.4	**46.0**	40.4	**48.4**
Speed		**3050 mm (10'0")**		**3500 mm (11'6")**		**3810 mm (12'6")**					
m/min	**ft/min**	**m²**	**yd²**	**m²**	**yd²**	**m²**	**yd²**				
3.0	**10**	9.2	**10.9**	10.5	**12.6**	11.4	**13.7**				
4.6	**15**	14.0	**16.8**	16.1	**19.3**	17.5	**21.0**				
6.1	**20**	18.6	**22.3**	21.4	**25.5**	23.2	**27.8**				
7.6	**25**	23.2	**27.7**	26.6	**31.8**	29.0	**34.6**				
9.1	**30**	27.8	**33.2**	31.9	**38.1**	34.7	**41.5**				
10.7	**35**	32.6	**39.0**	37.5	**44.8**	40.8	**48.8**				
12.2	**40**	37.2	**44.5**	42.7	**51.1**	46.5	**55.6**				
13.7	**45**	41.8	**50.0**	48.0	**57.3**	52.2	**62.4**				
15.2	**50**	46.4	**55.4**	53.2	**63.6**	57.9	**69.3**				
16.8	**55**	51.2	**61.3**	58.8	**70.3**	64.0	**76.6**				
18.3	**60**	55.8	**66.8**	64.1	**76.6**	69.7	**83.4**				

NOTE: Above figures are based on approximately 25 mm **(1 in)** depth of cut. For greater depths of cut, multiply the production rate by cutting depth. Figures are based on asphalt density of 2322 kg/m³ **(145 lb/ft³)**. (As referenced on *AsphaltPavement.org* — the website of NAPA.)

Speed		Cutter/Drum Width — metric tons/min (U.S. tons/min)									
		350 mm (1'2")		400 mm (1'4")		500 mm (1'8")		600 mm (2'0")		1000 mm (3'4")	
m/min	ft/min	Metric tons	U.S. tons	Metric tons	U.S. tons	Metric tons	U.S. tons	Metric tons	U.S. tons	Metric tons	U.S. tons
3.0	**10**	0.06	**0.07**	0.07	**0.08**	0.09	**0.10**	0.10	**0.12**	0.17	**0.19**
4.6	**15**	0.09	**0.10**	0.11	**0.12**	0.13	**0.15**	0.16	**0.18**	0.27	**0.29**
6.1	**20**	0.12	**0.14**	0.14	**0.16**	0.18	**0.20**	0.21	**0.23**	0.35	**0.39**
7.6	**25**	0.15	**0.17**	0.18	**0.19**	0.22	**0.24**	0.26	**0.29**	0.44	**0.49**
9.1	**30**	0.18	**0.20**	0.21	**0.23**	0.26	**0.29**	0.32	**0.35**	0.53	**0.58**
10.7	**35**	0.22	**0.24**	0.25	**0.27**	0.31	**0.34**	0.37	**0.41**	0.62	**0.68**
12.2	**40**	0.25	**0.27**	0.28	**0.31**	0.35	**0.39**	0.42	**0.47**	0.71	**0.78**
13.7	**45**	0.28	**0.31**	0.32	**0.35**	0.40	**0.44**	0.48	**0.53**	0.80	**0.88**
15.2	**50**	0.31	**0.34**	0.35	**0.39**	0.44	**0.49**	0.53	**0.58**	0.88	**0.97**
16.8	**55**	0.34	**0.38**	0.39	**0.43**	0.49	**0.54**	0.59	**0.64**	0.98	**1.07**
18.3	**60**	0.37	**0.41**	0.42	**0.47**	0.53	**0.59**	0.64	**0.70**	1.06	**1.17**
Speed		1220 mm (4'0")		1900 mm (6'3")		2010 mm (6'7")		2100 mm (6'11")		2210 mm (7'3")	
m/min	ft/min	Metric tons	U.S. tons	Metric tons	U.S. tons	Metric tons	U.S. tons	Metric tons	U.S. tons	Metric tons	U.S. tons
3.0	**10**	0.21	**0.23**	0.33	**0.36**	0.35	**0.39**	0.37	**0.40**	0.38	**0.42**
4.6	**15**	0.33	**0.36**	0.51	**0.56**	0.54	**0.59**	0.56	**0.62**	0.59	**0.65**
6.1	**20**	0.43	**0.48**	0.67	**0.74**	0.71	**0.78**	0.74	**0.82**	0.78	**0.86**
7.6	**25**	0.54	**0.59**	0.84	**0.92**	0.89	**0.98**	0.93	**1.02**	0.98	**1.07**
9.1	**30**	0.64	**0.71**	1.00	**1.11**	1.06	**1.17**	1.11	**1.22**	1.17	**1.29**
10.7	**35**	0.76	**0.84**	1.18	**1.30**	1.25	**1.38**	1.30	**1.44**	1.37	**1.51**
12.2	**40**	0.86	**0.95**	1.35	**1.48**	1.42	**1.57**	1.49	**1.64**	1.57	**1.72**
13.7	**45**	0.97	**1.07**	1.51	**1.67**	1.60	**1.76**	1.67	**1.84**	1.76	**1.94**
15.2	**50**	1.08	**1.19**	1.68	**1.85**	1.77	**1.95**	1.85	**2.04**	1.95	**2.15**
16.8	**55**	1.19	**1.31**	1.85	**2.04**	1.96	**2.16**	2.05	**2.26**	2.16	**2.38**
18.3	**60**	1.30	**1.43**	2.02	**2.22**	2.14	**2.35**	2.23	**2.46**	2.35	**2.59**
Speed		3050 mm (10'0")		3500 mm (11'6")		3810 mm (12'6")					
m/min	ft/min	Metric tons	U.S. tons	Metric tons	U.S. tons	Metric tons	U.S. tons				
3.0	**10**	0.53	**0.59**	0.61	**0.67**	0.66	**0.73**				
4.6	**15**	0.81	**0.90**	0.93	**1.03**	1.02	**1.12**				
6.1	**20**	1.08	**1.19**	1.24	**1.37**	1.35	**1.49**				
7.6	**25**	1.35	**1.48**	1.54	**1.70**	1.68	**1.85**				
9.1	**30**	1.61	**1.78**	1.85	**2.04**	2.01	**2.22**				
10.7	**35**	1.89	**2.09**	2.17	**2.40**	2.37	**2.61**				
12.2	**40**	2.16	**2.38**	2.48	**2.73**	2.70	**2.97**				
13.7	**45**	2.43	**2.67**	2.78	**3.07**	3.03	**3.34**				
15.2	**50**	2.69	**2.97**	3.09	**3.40**	3.36	**3.70**				
16.8	**55**	2.97	**3.28**	3.41	**3.76**	3.72	**4.09**				
18.3	**60**	3.24	**3.57**	3.72	**4.10**	4.05	**4.46**				

NOTE: Above figures are based on approximately 25 mm **(1 in)** depth of cut. For greater depths of cut, multiply the production rate by cutting depth. Figures are based on asphalt density of 2322 kg/m³ **(145 lb/ft³)**. (As referenced on *AsphaltPavement.org* — the website of NAPA.)

MACHINE SELECTION

Prime considerations in selecting the proper cold planer model are:
— specifics of work to be done
— type of projects generally done by the contractor
● City/Urban or Highway/Airport
— desired production capacities

PM310/PM312/PM313 Cold Planers

The Cat PM310/PM312/PM313 Cold Planers feature compact dimensions and excellent maneuverability ideal for easy operation in urban applications. The machine performs controlled, full-depth removal of asphalt layers in a single pass and is also capable of concrete removal. The machine is available with a wheel or track undercarriage and features four steering modes for high maneuverability.

PM620 and PM622 Cold Planers

The Cat PM620 and PM622 Cold Planers are high-production, half-lane milling machines with excellent maneuverability and plenty of power to perform controlled full-depth removal of asphalt and concrete pavements in a single pass. The track-driven machine features four steering modes for high maneuverability. The PM620 features a 2.0 m (79") cutting width and performs well in urban environments or in applications where great maneuverability is required. The PM622 features a 2.2 m (88") cutting width and is ideal for high-production applications such as main line milling.

Cold Planer Characteristics (Highway/Airport)

Highway/Airport work requires high-volume cold planers. The PM620, PM622 and other high horsepower half-lane cold planers are being used more on Highway/Airport projects. Users like to have one machine that can work successfully on high production jobs then switch to city/urban applications.

Cold Planer Characteristics (City/Urban)

All Cat cold planers are four-track, front discharge models. Front discharge cold planers make traffic control easier in congested quarters. The trucks travel forward in the same direction as the cold planer. The trucks move in and out of traffic faster increasing production.

COLD PLANING FUNDAMENTALS

Definition

Cold planing is automatically controlled cold milling to restore the pavement surface to a specified grade and slope; remove bumps, ruts, and other imperfections; and leave a textured surface which can be opened immediately to traffic or overlayed with new pavement materials.

Production and Tooth Wear

Because pavement materials vary, so do production and tooth wear. While predicting the exact production rate and tooth wear on a particular job is difficult, general guidelines are available.

Production depends on the milling rate (the speed at which the cold planer moves forward). The machine's forward speed is determined, primarily, by aggregate type, asphalt bond strength and depth of cut. When milling asphalt pavement, the cold planer's teeth essentially are breaking the bond between asphalt-coated aggregate, not actually fracturing the aggregate itself. A pavement made with a mix containing a high percentage of fine aggregate and a high asphalt content is more difficult to mill than a pavement with a high percentage of coarse aggregate.

A dense or fine mix usually requires more power at the cutting drum, limiting the cold planer's forward speed. Decreased speed lowers production, and the tough bond between the small aggregate particles causes increased cutting-tooth wear. Lower production and higher tooth wear result in increased unit costs.

Cutting depth affects power demand at the drum and helps determine the cold planer's forward speed. However, production increases, to a point, as the depth of cut increases. For example, changing from a 25 mm (1 in) cut to a 51 mm (2 in) cut slows the machine only slightly but doubles the amount of material produced.

As the cut increases beyond the machine's peak-production depth, the reduced forward speed begins to offset the production gains of the deeper cut. For example, production at a 152 mm (6 in) cutting depth and slow speed may be no greater than cutting at a 76 mm (3 in) depth and a much faster speed.

Low Density Asphalt

Depth		PM620, PM622	
mm	in	m/min	ft/min
51	**2**	40	**130**
101	**4**	32	**105**
127	**5**	21	**70**
178	**7**	12	**40**
254	**10**	6	**20**
305	**12**	5	**15**

High Density Asphalt

Depth		PM620, PM622	
mm	in	m/min	ft/min
51	**2**	32	**105**
101	**4**	26	**85**
127	**5**	18	**60**
178	**7**	9	**30**
254	**10**	5	**15**
305	**12**	4	**12**

As long as the cold planer maintains a productive forward speed, deeper cuts will yield greater production and tend to lower tooth cost. Tooth wear does not increase in direct proportion to production when the machine is working in an efficient range.

Tooth wear at various depths for a given material is affected by how long the tooth remains in the cut. Because the teeth are mounted on a circular drum, each tooth cuts through the pavement in an arc. The tooth arc at a 102 mm (4 in) cutting depth, however, is not four times longer than at a 25 mm (1 in) cutting depth, even though production may be four times greater. The cutting arc at 102 mm (4 in) is approximately twice as long as that at 25 mm (1 in).

The peak cutting depth for a particular cold planer on a specific job is best determined by examining production, and subsequent costs, of a single deep cut versus multiple passes at a shallow depth.

APPLICATIONS

Although new applications for cold planers are being discovered, most work can be classified in six general categories:

Leveling and Bonding

This application removes a layer of pavement to eliminate potholes, ruts, bumps and other surface imperfections. The cold planer leaves a level, textured surface ideal for bonding to a new, thin overlay of asphalt or concrete. The surface has an interlocking texture with double the bonding area of a conventional smooth pavement. The textured surface and overlay form a monolithic bond, eliminating the shear plane that causes pavement layers to move and separate. Thinner overlays can be used, making the technique more economical than traditional overlay methods.

Surface Refinishing

Rough pavement can also be cold planed to specified grade and slope, providing a new riding surface without adding new paving materials. This application is particularly useful when base and sub-base are in good shape, or when several layers have been added to the roadway over the years. Roads can be cold planed during cold, wet months and reopened immediately. New overlays can be added whenever weather permits. This lengthens the practical working season for many contractors. The cold planer can also be used to correct expansion joint faults and pavement cracks.

Surface Repair

This category generally requires deeper cutting than leveling. It consists of removing isolated distressed pavement sections down to subbase, if necessary, prior to adding new overlay materials. Since the cutter mandrel on Cat cold planers cuts forward and upward, there's no damaging impact to the underlying base.

Pavement Removal

Pavement buildup is a problem that plagues most older streets, roads and highways. As overlays are added, curbs and drains are buried — creating drainage problems. Overhead clearances are dangerously reduced … and additional weight is added to over-passes and bridges. Cold planing is an economical method of curing all these problems.

Surface Texturing

Serious accidents increase when pavement becomes slick from wear. The textured surface produced by cold planing is highly skid-resistant and has dramatically reduced hydroplaning characteristics.

Pavement Mining

Cold milling has made it practical to actually "mine" deteriorated pavement materials from existing roads and streets. The cold planer produces an ideally-sized asphalt or concrete material which can be recycled in a variety of ways. Depending on type, age and condition of pavement, the largest cold planer can reclaim up to 900 tons of material per hour.

COLD PLANER USE BY PROJECT TYPE

Applications	Highway/Airport	City/Urban
Planing (Milling)	• To establish grade and slope. • Remove excess pavement.	• To establish proper grade and slope. • To establish new grade and slope.
Partial Removal	• For use with hot mix recycle. • Remove pavement irregularities. • Texture for skid resistance.	• To correct drainage and curb reveal. • To lower elevation at overpass. • For use with hot recycle. • Eliminate leveling course.
Full Depth Removal	• Total rebuild. RAP used for base or hot recycle. • Cold recycle. This requires additional surface treatment.	• Total rebuild. RAP used for base or hot recycle. • Cold recycle. Requires additional surface treatment.
Texturing	• For skid resistance and improved bond when overlay is applied.	• For skid resistance and improved bond when overlay is applied.
Leveling		• At intersections to remove bumps, shoving and improve drainage.
Special	• Joint and crack repair. • Cut rumble grooves on shoulders of bridge approaches. • Concrete removal.	• Intersection defect repair. • Pothole repair. • Railroad crossing repair. • Tight radius profiling around manhole covers, etc. • Pavement adjustments (transitions from existing pavements to new overlays).

Rotary Mixers Overview:

The Cat Rotary Mixers combine superior performance and reliability to achieve the most demanding job specifications while maximizing machine uptime. With many enhanced features and options, the Cat Rotary Mixers are designed to work well in both full depth reclamation and soil stabilization applications.

Rotary Mixers Sustainability:

- Long-lasting lubricants and fluids extend maintenance intervals, decreasing the amount of waste and filters contributed to environment.
- Ecology drains provide a simple means to drain machine fluids with a minimized risk of spillage.
- Maintenance free Cat batteries are recyclable.
- Cat engines meet applicable emission standards.
- Rotary Mixers recycle the materials into aggregate on site. That reduces overall fuel consumption and engine emissions.
- Rotary Mixers and the reclamation process can eliminate the need for an excavator and motor grader at most job sites.
- Rotary Mixers can reclaim and stabilize simultaneously. If stabilization is required, the agent can be placed on top of the reclamation project. The Rotary Mixer then makes a single pass, mixing the stabilizer with the material beneath the surface. At the same time, it reduces the aggregate to its original size. All this is accomplished with one machine — in one pass.
- The reclamation and stabilization process can easily incorporate environmentally sensitive sealants. Now the life of the road bases can be extended without fear of harming wildlife.
- The reclamation process usually is quicker than full replacement, allowing roads to open sooner. This means fewer traffic jams — a quality of life issue as well.
- Reclamation and stabilization dramatically extend the life of roads. Some contractors conservatively estimate that a reclaimed/stabilized base will help a recycled road last 30 to 40 years. Extending that life is an enormous cost-saver, and also results in the use of less energy.

Cat RM Features:

- **Maximum Production** … from Cat engines.
- **Highly Maneuverable** … separate hydraulic pump provides hydraulic flow to large displacement motors on each rear wheel.
- **Versatility** … choice of three rotors for full depth reclamation or soil stabilization.
- **Reliability** … field proven Cat components maximize machine availability.
- **Standard all-wheel drive with advanced traction control system** for maximum traction.
- **Rotating operator's station with handwheel steering and integrated touchscreen display** provides operator with fingertip control, high visibility and exceptional comfort.

Rotor Options

Rotor	Maximum Depth of Work		No. of Bits/Tools	Direction of Cut	Stabilization	Reclamation
Universal 406 mm **(16")***	406 mm	**16"**	200	Up	X	X
Universal 457 mm **(18")****	457 mm	**18"**	200	Up	X	X
Soil	508 mm	**20"**	238	Up	X	
Combination	508 mm	**20"**	114	Up	X	
Spade	457 mm	**18"**	58	Up	X	

*Designed to produce maximum breakout force, the Universal Rotor 406 mm **(16")** performs well in severe asphalt cuts.
The Universal Rotor 457 mm **(18") is designed to provide maximum mixing depth and has lower breakout force compared to the Universal Rotor 406 mm **(16")**.

Rotor Options:

Some rotor options are not available in certain markets.

- **Soil Rotor** is designed primarily for use in soil stabilization.
- **Combination Rotor** is designed primarily for use in soil stabilization with a secondary application in light cuts of asphalt reclamation.
- **Universal Rotor** can be used for either reclamation or stabilization.
- **Spade Rotor** is designed for soil stabilization applications.

PRODUCTION ESTIMATING

The maximum cutting depth for Cat Rotary Mixers is 508 mm (20 in). In addition, the cutting width of their rotors is 2.4 m (8 ft). The following formulas allow you to determine the production in square yards (yd^2)/minute or cubic yards (yd^3)/minute.

Production in square yards (yd^2) per minute

$$yd^2/min = \frac{\text{FPM of travel speed}}{1.125}$$

$$\frac{9\ ft^2/yd^2}{\text{8 ft Cutting width}} = 1.125$$ (This is a constant value for an eight foot wide rotor)

Gallons of additive (for units with pump and metering additive system)

$$\frac{GPM}{yd^2/min} = gal/yd^2$$

Or, if required additive amounts are known, you can determine necessary travel speed as shown:

$$\frac{GPM}{gal/yd^2} = yd^2/min;\ yd^2/min \times 1.125 = ft/min$$

Production in Cubic Yards (yd^3) per minute

$$\frac{\text{FPM of travel speed}}{1.125} \times \frac{\text{Cutting or mixing depth in inches}}{36} = \frac{yd^3}{min}$$

Production in Tons per Minute

$$yd^3/min \times \frac{\text{Wt. of Material per yd in lbs}}{\text{2000 lb/ton}} = tons/min$$

Abbreviations

FPM = Feet Per Minute
GPM = Gallons Per Minute

WEIGHT OF MATERIALS

Material		LOOSE kg/m³	LOOSE lb/yd³	BANK kg/m³	BANK lb/yd³
Clay	— Dry	1480	**2500**	1840	**3100**
	— Wet	1660	**2800**	2080	**3500**
Clay and Gravel	— Dry	1420	**2400**	1660	**2800**
	— Wet	1540	**2600**	1840	**3100**
Sand and Gravel	— Dry	1720	**2900**	1930	**3250**
	— Wet	2020	**3400**	2220	**3750**
Sand	— Dry	1420	**2400**	1600	**2700**
	— Damp	1690	**2850**	1900	**3200**
	— Wet	1840	**3100**	2080	**3500**
Earth	— Dry Packed	1510	**2550**	1900	**3200**
	— Wet Excavated	1600	**2700**	2020	**3400**
	— Top Soil	950	**1600**	1360	**2300**
	— Loam	1250	**2100**	1540	**2600**
Bituminous Concrete	— Windrowed Chunks (25% Voids)	1740	**2925**	—	**—**
	— Compacted	—	**—**	2310	**3900**

STABILIZATION/RECLAMATION PRODUCTION

The following charts list production in square meters per minute, square yards per minute, cubic meters per minute, and cubic yards per minute. The information is based on various travel speeds and cutting depths for Cat Rotary Mixers equipped with a 2438 mm **(8 ft)** cutting rotor.

PRODUCTION RATES

Travel Speed m/min	m²/min	m³/minute — Cutting Depth — mm: 100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
3	7.3	0.73	0.9	1.1	1.3	1.5	1.6	1.8	2.0	2.2	2.4	2.6	2.7	2.9	3.1	3.3	3.5	3.7
6	14.6	1.46	1.8	2.2	2.6	2.9	3.3	3.7	4.0	4.4	4.8	5.1	5.5	5.9	6.2	6.6	6.9	7.3
9	21.9	2.2	2.7	3.3	3.8	4.4	4.9	5.5	6.0	6.6	7.1	7.7	8.2	8.8	9.3	9.9	10.4	11.0
12	29.3	2.9	3.7	4.4	5.1	5.9	6.6	7.3	8.0	8.8	9.5	10.2	11.0	11.7	12.4	13.2	13.9	14.6
15	36.6	3.6	4.6	5.5	6.4	7.3	8.2	9.1	10.0	11.0	11.9	12.8	13.7	14.6	15.5	16.5	17.4	18.3
18	43.9	4.4	5.5	6.6	7.7	8.8	9.9	11.0	12.1	13.2	14.3	15.4	16.5	17.6	18.7	19.7	20.8	21.9
21	51.2	5.1	6.4	7.7	9.0	10.2	11.5	12.8	14.1	15.4	16.6	17.9	19.2	20.5	21.8	23.0	24.3	25.6
24	58.5	5.9	7.3	8.8	10.2	11.7	13.2	14.6	16.1	17.6	19.0	20.5	21.9	23.4	24.9	26.3	27.8	29.3
27	65.8	6.6	8.2	9.9	11.5	13.2	14.8	16.4	18.1	19.7	21.4	23.0	24.7	26.3	28.0	29.6	31.3	32.9

PRODUCTION RATES

Travel Speed ft/min	yd²/min	yd³/minute — Cutting Depth — inches: 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
10	8.9	0.98	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.2	3.5	3.7	4.0	4.2	4.5	4.7	4.9
20	17.8	1.96	2.5	3.0	3.4	4.0	4.4	4.9	5.5	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9
30	26.7	2.9	3.7	4.5	5.2	5.9	6.7	7.4	8.2	8.9	9.6	10.4	11.1	11.9	12.6	13.4	14.0	14.8
40	35.6	3.9	4.9	5.9	6.9	7.9	8.9	9.9	10.9	11.9	12.8	13.9	14.8	15.8	16.8	17.8	18.7	19.8
50	44.5	4.9	6.2	7.4	8.6	9.9	11.1	12.4	13.6	14.8	16.0	17.3	18.5	19.8	21.0	22.3	23.4	24.7
60	53.4	5.9	7.4	8.9	10.3	11.9	13.3	14.8	16.4	17.8	19.2	20.8	22.2	23.7	25.2	26.7	28.1	29.7
70	62.3	6.8	8.6	10.4	12.0	13.8	15.6	17.3	19.1	20.8	22.4	24.3	25.9	27.7	29.5	31.2	32.8	34.6
80	71.2	7.8	9.9	11.9	13.7	15.8	17.8	19.8	21.8	23.7	25.6	27.7	29.6	31.6	33.7	35.6	37.5	39.6
90	80.1	8.8	11.1	13.4	15.5	17.8	20.0	22.4	24.5	26.7	28.8	31.2	33.3	35.6	37.9	40.1	42.1	44.5

Asphalt Pavers
Sustainability:

- Long-lasting lubricants and fluids extend maintenance intervals, decreasing the amount of waste and filters contributed to environment.
- Ecology drains provide a simple means to drain machine fluids with a minimized risk of spillage.
- Maintenance free Cat batteries are recyclable.
- Cat engines meet applicable emission standards.
- Proprietary undercarriage design on Mobil-Trac™ pavers significantly reduces track belt wear, reducing frequency of replacement.
- Cat electric-heated screeds provide a reduction in engine emissions, which not only reduces the impact to the environment, but helps prevent soot build-up on indicators and decals — for enhanced safety.
- Electric-heated screeds produce less noise, which is appreciated by the crew as well as those who work and live near the construction sites.
- Electric-heated screeds, unlike their diesel counterparts, don't require a constant flame — another way emissions are reduced, and operators spared some heat.
- Electric-heated screeds are lighter, which means the paver consumes less fuel.
- Electric-heated screeds warm up quickly, another energy saver.
- Pavers equipped with Eco-mode can reduce engine speed to increase fuel efficiency during normal operation conditions.
- Pavers equipped with automatic engine speed control can be programmed to idle the engine when machine is in neutral for a predetermined amount of time, reducing fuel burn.

Features:

- **Variable width screeds** available.
- **Self-dumping hydraulic hoppers** are heavy-duty and high capacity.
- **Soldered and molded** electrical connections.
- **Self diagnostics** on propel and feeder systems.
- **Electrically heated screeds**.
- **Dual independent operating stations**.
- **Mobil-Trac undercarriage** provides speed of a wheeled paver with maneuverability of a track paver.
- **Optional Cat Grade and Slope** is integrated with the paver.
- **Large generators** deliver fast heat with less fuel consumption.*
- **One-touch functions** for cleanout/warm up mode.*
- **One-touch Auto-fill function**.*
- **One-touch feeder system activation**.*
- **Advanced generator diagnostics** helps determine heating element life.*

*Feature available on F Series pavers only.

ASPHALT PAVING CHARTS

These charts will assist you when trying to match plant output with paving speeds. Keep in mind when using these charts, it will be at 100% efficiency. If you know efficiency, multiply T.P. hour × efficiency. (Example: 75% efficiency at 300 T.P.H. – 300 × 0.75 = 225 T.P.H.)

Production in tons/hr with 1" compacted mat

Speed	Paving Widths						
ft/min	6'0"	7'0"	8'0"	9'0"	10'0"	11'0"	12'0"
10	22	26	29	33	37	40	44
20	44	51	58	66	73	80	88
30	66	77	87	99	110	120	131
40	88	102	116	131	146	161	175
50	110	129	145	164	183	201	219

Production in tons/hr with 2" compacted mat

Speed	Paving Widths						
ft/min	6'0"	7'0"	8'0"	9'0"	10'0"	11'0"	12'0"
10	44	52	58	66	74	80	88
20	88	176	116	132	146	160	176
30	132	154	174	198	220	240	262
40	176	204	232	262	292	322	350
50	220	258	290	328	366	402	438

Production in tons/hr with 3" compacted mat

Speed	Paving Widths						
ft/min	6'0"	7'0"	8'0"	9'0"	10'0"	11'0"	12'0"
10	66	78	87	99	111	120	132
20	132	153	174	198	219	240	284
30	198	231	261	297	330	360	393
40	264	306	348	393	438	483	525
50	330	387	435	492	549	603	657

Production in tons/hr with 4" compacted mat

Speed	Paving Widths						
ft/min	6'0"	7'0"	8'0"	9'0"	10'0"	11'0"	12'0"
10	88	104	116	132	148	160	176
20	176	204	232	264	292	320	352
30	264	308	348	396	440	480	524
40	352	408	464	524	584	644	700
50	440	516	580	656	732	804	876

Slope Conversion Table

Percent	Inches per foot	Inches per 12 foot	Percent	Inches per foot	Inches per 12 foot
0.17%		$\frac{1}{4}$	5.21%	$\frac{5}{8}$	$7\frac{1}{2}$
0.35%		$\frac{1}{2}$	5.38%		$7\frac{3}{4}$
0.52%	$\frac{1}{16}$	$\frac{3}{4}$	5.56%		8
0.70%		1	5.73%	$\frac{11}{16}$	$8\frac{1}{4}$
0.87%		$1\frac{1}{4}$	5.90%		$8\frac{1}{2}$
1.04%	$\frac{1}{8}$	$1\frac{1}{2}$	6.08%		$8\frac{3}{4}$
1.22%		$1\frac{3}{4}$	6.25%	$\frac{3}{4}$	9
1.39%		2	6.42%		$9\frac{1}{4}$
1.56%	$\frac{3}{16}$	$2\frac{1}{4}$	6.60%		$9\frac{1}{2}$
1.74%		$2\frac{1}{2}$	6.77%	$\frac{13}{16}$	$9\frac{3}{4}$
1.91%		$2\frac{3}{4}$	6.94%		10
2.08%	$\frac{1}{4}$	3	7.12%		$10\frac{1}{4}$
2.26%		$3\frac{1}{4}$	7.29%	$\frac{7}{8}$	$10\frac{1}{2}$
2.43%		$3\frac{1}{2}$	7.47%		$10\frac{3}{4}$
2.60%	$\frac{5}{16}$	$3\frac{3}{4}$	7.64%		11
2.78%		4	7.81%	$\frac{15}{16}$	$11\frac{1}{4}$
2.95%		$4\frac{1}{4}$	7.99%		$11\frac{1}{2}$
3.13%	$\frac{3}{8}$	$4\frac{1}{2}$	8.16%		$11\frac{3}{4}$
3.30%		$4\frac{3}{4}$	8.33%	1	12
3.47%		5	8.51%		$12\frac{1}{4}$
3.65%	$\frac{7}{16}$	$5\frac{1}{4}$	8.68%		$12\frac{1}{2}$
3.82%		$5\frac{1}{2}$	8.85%	$1\frac{1}{16}$	$12\frac{3}{4}$
3.99%		$5\frac{3}{4}$	9.03%		13
4.17%	$\frac{1}{2}$	6	9.20%		$13\frac{1}{4}$
4.34%		$6\frac{1}{4}$	9.38%	$1\frac{1}{8}$	$13\frac{1}{2}$
4.51%		$6\frac{1}{2}$	9.55%		$13\frac{3}{4}$
4.69%	$\frac{9}{16}$	$6\frac{3}{4}$	9.72%		14
4.86%		7	9.90%	$1\frac{3}{16}$	$14\frac{1}{4}$
5.04%		$7\frac{1}{4}$	10.07%		$14\frac{1}{2}$

Formula:

$$\text{Percent} = \frac{\text{Inches per foot} \times 100}{12}$$

Inches in decimals of a foot

$\frac{1}{16}$ = .0052	1 = .0833
$\frac{3}{32}$ = .0078	2 = .1667
$\frac{1}{8}$ = .0104	3 = .2500
$\frac{3}{16}$ = .0156	4 = .3333
$\frac{1}{4}$ = .0208	5 = .4167
$\frac{5}{16}$ = .0260	6 = .5000
$\frac{3}{8}$ = .0313	7 = .5833
$\frac{1}{2}$ = .0417	8 = .6667
$\frac{5}{8}$ = .0521	9 = .7500
$\frac{3}{4}$ = .0625	10 = .8333
$\frac{7}{8}$ = .0729	11 = .9167

Vibratory and Pneumatic Tire Compactors Sustainability:

- Long-lasting lubricants and fluids extend maintenance intervals, decreasing the amount of waste and filters contributed to environment.
- Ecology drains provide a simple means to drain machine fluids with a minimized risk of spillage.
- Maintenance free Cat batteries are recyclable.
- Cat engines meet applicable emission standards.
- Biodegradable oil option available.

General Compactor Features:

- **Routine maintenance** simplified by grouped service points and easy access to service areas.
- **Operator stations** designed for maximum comfort, easy control, and optimal visibility.
- **Direct hydrostatic drive to front (drums or wheels) and rear (drums or wheels)** provides dependable, responsive, propulsion effort and maximum gradeability. (Does not include pneumatic tire compactors or GC Series soil compactors.)
- **Eco-mode standard equipment** on Vibratory Soil Compactors and Double Drum Rollers reduces fuel consumption.

Vibratory Compactor Features:

Single Drum

- **Dual pump system** delivers positive tractive effort to both drum and rear wheels, regardless of underfooting. This increases the machine's ability to maneuver in a wide variety of soil types and conditions and improves gradeability. (Does not pertain to GC Series compactors.)
- **Limited slip high traction differential** is standard on all units for best traction of rear tires.
- **Optional heavy-duty front-mounted blade** with reversible cutting edge is available to allow backfilling and leveling during compaction. (Check for model availability.)
- **ROPS (Roll Over Protective Structure)** optional on all units. Enclosed cabs with EROPS rating available as an option.
- **Optional Cat Compaction Control** featuring exclusive Machine Drive Power (MDP) or CMV (accelerometer-based) measurement scalable to include GNSS mapping and recording.
- **Adjustable jaw-type cleaner bar** keeps drums clean between pads during forward and reverse movement.

Double Drum and Combi

- **Vibration automatically ceases before machine comes to a stop** to help produce a smooth, flawless mat surface.
- **Close side clearances** allow compactors to work close to curbs, walls and other obstructions.
- **Large, rust-proof water tanks and pressure spray system** provide hours of reliable operation between fill-ups.
- **Emulsion system** available for combi compactor rear tires to prevent materials sticking to tires.
- **ROPS (Roll Over Protective Structure)** available on all models. Enclosed cabs with EROPS rating available on some models.
- **Optional Cat Compaction Control** featuring GNSS mapping of pass count and mat surface temperature.

Pneumatic Tire Compactor Features:

- **All wheel oscillation.** Front and rear tires provide even wheel loads regardless of evenness underfoot.
- **High drive propel system.** Completely hydrostatic with drive motors and brakes located in mainframe away from contamination and damage.
- **Ballast compartments** are easily accessible for quick loading and are located to provide balanced wheel/weight ratio.
- **Single-lever hand control** of forward and reverse movement makes smooth rolling easy.
- **Optional Cat Compaction Control** featuring GNSS mapping of pass count and mat surface temperature.

NOTE: All models and options are not available in all markets.

Pneumatic Tires — Bias Ply and Radial

Model	Tire Size	Ply Rating	Tire Inflation Pressure			
			Minimum Pressure		Maximum Pressure	
			kPa	psi	kPa	psi
CW16	7.5 × 15	12-ply Radial	344	**50**	757	**110**
	7.5 × 15	14-ply Bias	344	**50**	862	**125**
CW34	13/80-R20	Radial	300	**44**	900	**131**

Ballast Configurations

Model	Load	Ballast Configuration					
		Empty	Water Only	Steel Only	Wet Sand Only	Steel and Water	Steel and Wet Sand
CW16	Wheel Load	580 kg **1279 lb**	970 kg **2139 lb**	940 kg **2072 lb**	1360 kg **2998 lb**	1310 kg **2888 lb**	1670 kg **3682 lb**
	Machine Weight	5200 kg **11,464 lb**	8700 kg **19,180 lb**	8500 kg **18,739 lb**	12 200 kg **26,896 lb**	11 750 kg **25,904 kg**	15 000 kg **33,069 lb**
CW16 (11-wheel)	Wheel Load	480 kg **1058 lb**	800 kg **1764 lb**	780 kg **1720 lb**	1110 kg **2447 lb**	1060 kg **2337 lb**	1350 kg **2976 lb**
	Machine Weight	5300 kg **11,685 lb**	8800 kg **19,400 lb**	8600 kg **18,960 lb**	12 300 kg **27,117 lb**	11 750 kg **25,904 kg**	14 900 kg **32,849 lb**
CW34	Wheel Load	1250 kg **2756 lb**	1620 kg **3572 lb**	2820 kg **6217 lb**	2000 kg **4409 lb**	3080 kg **6790 lb**	3375 kg **7441 lb**
	Machine Weight	10 000 kg **22,050 lb**	13 000 kg **28,660 lb**	22 550 kg **49,715 lb**	16 000 kg **35,275 lb**	24 700 kg **54,450 kg**	27 000 kg **59,525 lb**

*Configuration not available.

Ground Contact Pressures — CW16

Average Wheel Load	Tire Pressures: 12-Ply Radial						
	344 kPa 50 psi	**413 kPa 60 psi**	**482 kPa 70 psi**	**550 kPa 80 psi**	**619 kPa 90 psi**	**688 kPa 100 psi**	**757 kPa 110 psi**
545 kg **1200 lb**	236 kPa **34 psi**	266 kPa **39 psi**	284 kPa **41 psi**	306 kPa **44 psi**	317 kPa **46 psi**	317 kPa **46 psi**	344 kPa **50 psi**
970 kg **2145 lb**	250 kPa **36 psi**	284 kPa **41 psi**	314 kPa **46 psi**	343 kPa **50 psi**	369 kPa **54 psi**	378 kPa **55 psi**	410 kPa **60 psi**
1440 kg **3180 lb**	280 kPa **41 psi**	304 kPa **44 psi**	331 kPa **48 psi**	358 kPa **52 psi**	390 kPa **57 psi**	405 kPa **59 psi**	607 kPa **88 psi**

Average Wheel Load	Tire Pressures: 14-Ply Bias								
	344 kPa 50 psi	**413 kPa 60 psi**	**482 kPa 70 psi**	**550 kPa 80 psi**	**619 kPa 90 psi**	**688 kPa 100 psi**	**757 kPa 110 psi**	**826 kPa 120 psi**	**862 kPa 125 psi**
545 kg **1200 lb**	243 kPa **35 psi**	266 kPa **39 psi**	284 kPa **41 psi**	295 kPa **43 psi**	317 kPa **46 psi**	330 kPa **48 psi**	344 kPa **50 psi**	359 kPa **52 psi**	367 kPa **53 psi**
970 kg **2145 lb**	259 kPa **38 psi**	295 kPa **43 psi**	321 kPa **47 psi**	343 kPa **50 psi**	369 kPa **54 psi**	388 kPa **56 psi**	420 kPa **60 psi**	421 kPa **61 psi**	427 kPa **62 psi**
1440 kg **3180 lb**	273 kPa **40 psi**	312 kPa **45 psi**	336 kPa **49 psi**	364 kPa **53 psi**	390 kPa **57 psi**	413 kPa **60 psi**	437 kPa **64 psi**	465 kPa **68 psi**	475 kPa **69 psi**

NOTES:

1. Each tire type has a unique pressure distribution which varies with both tire inflation pressure and wheel load. The distribution of pressure along both transverse and longitudinal profiles is rarely uniform.
2. The measurements in this table represent the peak pressures measured in a transverse profile at each of the ballast conditions at maximum tire inflation pressure.
3. For most applications, it can be assumed that normal operation of the pneumatic compactor will result in the ground being subjected to pressures near the maximum during at least one machine pass.

Ground Contact Pressures — CW34

Average Wheel Load	Tire Pressure							
	300 kPa 44 psi	**400 kPa 58 psi**	**500 kPa 73 psi**	**600 kPa 87 psi**	**700 kPa 102 psi**	**800 kPa 116 psi**	**850 kPa 123 psi**	**900 kPa 131 psi**
1500 kg **3307 lb**	242 kPa **35 psi**	309 kPa **45 psi**	406 kPa **59 psi**	612 kPa **89 psi**	680 kPa **99 psi**	1038 kPa **151 psi**	1265 kPa **184 psi**	1587 kPa **230 psi**
2000 kg **4410 lb**	260 kPa **38 psi**	299 kPa **43 psi**	357 kPa **52 psi**	462 kPa **67 psi**	498 kPa **72 psi**	628 kPa **91 psi**	691 kPa **100 psi**	764 kPa **111 psi**
2500 kg **5512 lb**	308 kPa **45 psi**	322 kPa **47 psi**	360 kPa **52 psi**	429 kPa **62 psi**	458 kPa **66 psi**	539 kPa **78 psi**	577 kPa **84 psi**	618 kPa **90 psi**
3000 kg **6614 lb**	397 kPa **58 psi**	369 kPa **54 psi**	386 kPa **56 psi**	433 kPa **63 psi**	457 kPa **66 psi**	516 kPa **75 psi**	543 kPa **79 psi**	573 kPa **83 psi**
3375 kg **7441 lb**	518 kPa **75 psi**	423 kPa **61 psi**	418 kPa **61 psi**	448 kPa **65 psi**	469 kPa **68 psi**	517 kPa **75 psi**	539 kPa **78 psi**	564 kPa **82 psi**

NOTES:

1. Each tire type has a unique pressure distribution which varies with both tire inflation pressure and wheel load. The distribution of pressure along both transverse and longitudinal profiles is rarely uniform.
2. The measurements in this table represent the peak pressures measured in a transverse profile at each of the ballast conditions at maximum tire inflation pressure.
3. For most applications, it can be assumed that normal operation of the pneumatic compactor will result in the ground being subjected to pressures near the maximum during at least one machine pass.

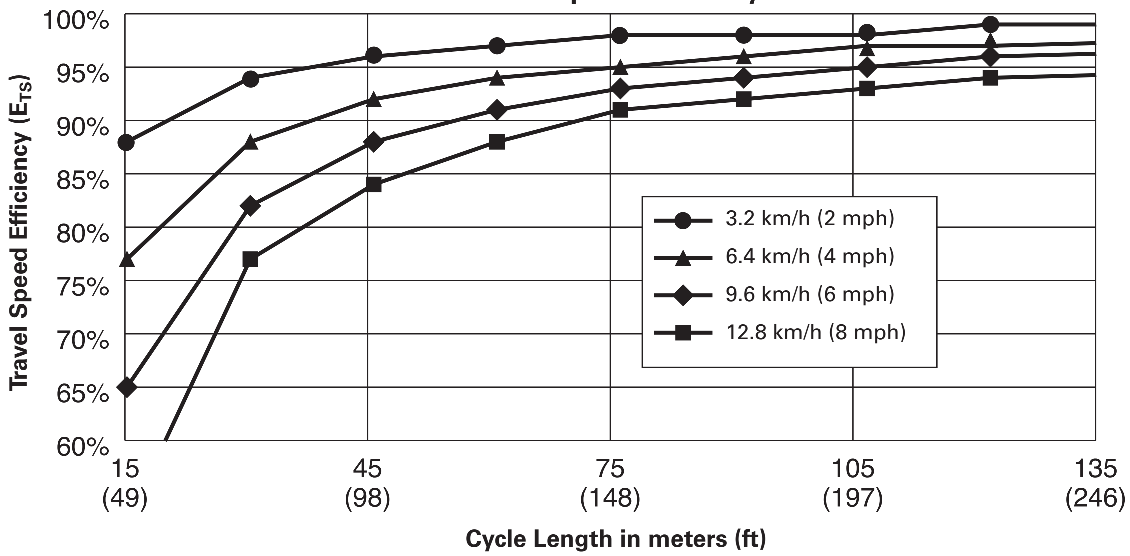
The tables in this section give production estimates for the following assumed conditions:

Nominal machine travel speed: 6.4 km/h (4.0 mph)
Overlap of rolling width: 15.2 cm (6.0 inches)

Table values give **representative** production rates for three common construction conditions: trenches, roads, and wide areas (> 15 m, or 50 ft).

Model	Drum Width		Lift Thickness		Passes Required	Production Estimates			
	cm	in	cm	in			3.7 m (12 ft) Trench	9.15 m (30 ft) Road Base	Wide Areas
CS423E, CS44, CS44B	167.6	**66**	10.2	**4**	4	m^3/hr	159	249	249
						yds³/hr	**209**	**326**	**326**
CS533E, CS54, CS56, CS54B, CS56B, CS64B, CS66B	213.4	**84**	15.2	**6**	6	m^3/hr	239	299	324
						yds³/hr	**313**	**391**	**424**
CS64, CS68B	213.4	**84**	15.2	**6**	5	m^3/hr	—	373	405
						yds³/hr	**—**	**489**	**530**
CS74, CS74B	213.4	**84**	15.2	**6**	4	m^3/hr	—	448	486
						yds³/hr	**—**	**587**	**636**
CS76, CS76B	213.4	**84**	15.2	**12**	6	m^3/hr	—	598	648
						yds³/hr	**—**	**782**	**848**
CS76 XT, CS78B, CS79B	213.4	**84**	15.2	**12**	4	m^3/hr	—	896	972
						yds³/hr	**—**	**1174**	**1272**
CP44, CP44B	167.6	**66**	15.2	**6**	6	m^3/hr	159	199	249
						yds³/hr	**209**	**261**	**326**
CP533E, CP54, CP56, CP54B, CP56B	213.4	**84**	30.5	**12**	6	m^3/hr	478	478	647
						yds³/hr	**626**	**626**	**847**
CP76, CP68B, CP74B	213.4	**84**	30.5	**12**	6	m^3/hr	—	598	648
						yds³/hr	**—**	**782**	**848**

Travel Speed Efficiency



Adjusting the Production Estimate

If the assumed conditions are not close to the actual construction conditions, the production estimates should be corrected. The production estimate from the table can be adjusted for 'actual' construction conditions by applying adjustment factors:

Q (actual) = Q (assumed) × Fs × Ft × Fp

Where: Q (actual) = adjusted productivity
Q (assumed) = productivity from table based on assumed conditions
Fs = adjustment for machine speed
Ft = adjustment for layer thickness
Fp= adjustment for no. of passes

The adjustment factors are determined by comparing the 'actual' conditions to the 'assumed' ones:

Fs = actual speed/assumed speed
Ft = actual thickness/assumed thickness
Fp = assumed passes/actual passes

Metric example

Actual Conditions — An 9.15-meter (full road width) base aggregate job is being completed with a compacted thickness of 15 cm. A CS44B is being used, operating at 4.0 km/h, and making 6 passes to achieve the desired compaction. The roller is overlapping its passes 6 inches.

For a 9.15-meter road base the table gives a CS44B productivity of 249 m^3/hr. Since the speed, thickness, and passes are *different* from the assumed conditions, we should adjust this estimate:

	Assumed	Actual
Speed	6.4 km/h	4.0 km/h
Thickness	10.2 cm	15 cm
Passes	4 passes	6 passes

Fs = 4.0 km/h/6.4 km/h = 0.6
Ft = 15 cm/10.2 cm = 1.5
Fp = 4 passes/6 passes = 0.7

The estimated production is adjusted using these factors:

Q (actual) = 249 m^3/hr × 0.6 × 1.7 × 0.7
= 178 m^3/hr (233 yds^3/hr)

English example

Actual Conditions — An wide area commercial site development job is being compacted in lifts of 8 inches. A CP56B is being used, operating at 4.0 mph, and making 4 passes to achieve the target density.

First, the table gives a CP56B productivity of 847 yds^3/hr. Since lift thickness and passes required are *different* from the assumed conditions, we should adjust this estimate:

	Assumed	Actual
Speed	4.0 mph	4.0 mph
Thickness	12 inches	8 inches
Passes	6 passes	4 passes

Fs = no correction necessary
Ft = 8 inches/12 inches = 0.7
Fp = 6 passes/4 passes = 1.5

The estimated production is adjusted using these factors:

Q (actual) = 847 yds^3/hr × 0.7 × 1.5
= 890 yds^3/hr (680 m^3/hr)

Notes on Productivity:

- For jobs that are relatively narrow, especially road construction jobs, it is important to understand that certain widths of construction will be more productive than others for a given compactor. A productive construction width will make the most use of each side by side pass required by the compactor in order to cover the width.
- Production estimates should be adjusted further if the length of the compaction cycles are shorter than 75 m (250 ft). Refer to the Travel Speed Efficiency chart to determine efficiency E_{TS}. For example, a compactor traveling at 6.4 km/h (4 mph) operating at cycle lengths of 150 ft has an E_{TS} of 0.91. Multiply Q (actual) by E_{TS}.

The table in this section gives production estimates for the following assumed conditions:

Compacted Layer Thickness	51 mm	**2 in**
Maximum Vibratory Frequency*	—	
Impacts Spacing	33 impacts/m	**10 impacts/ft**
Passes per Machine Width	**2**	
Compacted Material Density	2483 kg/m³	**155 lb/ft³**
Overlap of Rolling Width	152 mm	**6 in**
Overhang at Lane Edge	76 mm	**3 in**
Efficiency	**75%**	

*Maximum vibratory frequency varies by machine, refer to table.

Table values give **representative** production rates for common construction widths. If the actual width falls between two assumed widths, use the higher number to estimate production. Minor adjustments can normally be made in the rolling method to reach this higher production: reduce overlap or overhang, increase speed, or increase the cycle time.

			PAVING WIDTH						
Model	**Vibration Frequency**	**Units**	1.8 m **6 ft**	2.4 m **8 ft**	3.0 m **10 ft**	3.7 m **12 ft**	4.3 m **14 ft**	4.9 m **16 ft**	5.5 m **18 ft**
CB1.7	57 Hz	Tonnes/hr	154.6	160.4	164.0	166.6	–	–	–
	3420 vpm	**tons/hr**	**170.4**	**176.7**	**180.7**	**183.5**	**–**	**–**	**–**
CB1.8	57 Hz	Tonnes/hr	154.6	2062.9	200.5	196.9	–	–	–
	3420 vpm	**tons/hr**	**170.4**	**227.2**	**220.9**	**216.8**	**–**	**–**	**–**
CB2.5, CB2.5GC	64 Hz	Tonnes/hr	173.5	231.4	224.9	221.0	218.0	249.2	243.0
	3840 vpm	**tons/hr**	**191.3**	**255.1**	**248.0**	**243.5**	**240.4**	**274.7**	**267.9**
CB2.7, CB2.7GC, CC2.7, and CC2.7GC	64 Hz	Tonnes/hr	243.0	231.4	289.3	270.0	257.6	294.5	280.4
	3840 vpm	**tons/hr**	**267.9**	**255.1**	**318.9**	**297.7**	**284.0**	**324.7**	**309.0**
CB2.9	64 Hz	Tonnes/hr	243.0	231.4	289.3	270.0	315.0	294.5	331.3
	3840 vpm	**tons/hr**	**267.9**	**255.1**	**318.9**	**297.7**	**347.2**	**324.7**	**365.2**
CB4.0, CC4.0	55 Hz	Tonnes/hr	208.8	198.9	248.6	232.0	270.7	253.1	284.7
	3300 vpm	**tons/hr**	**230.2**	**219.2**	**274.0**	**255.8**	**298.4**	**279.0**	**313.9**
CB4.4	55 Hz	Tonnes/hr	208.8	278.4	248.6	298.3	270.6	309.3	284.8
	3300 vpm	**tons/hr**	**230.2**	**306.9**	**274.1**	**328.9**	**298.3**	**341.0**	**313.9**
CB7	53 Hz	Tonnes/hr	201.2	268.3	239.6	287.5	260.8	298.1	274.4
	3200 vpm	**tons/hr**	**221.8**	**295.7**	**264.1**	**316.9**	**287.5**	**328.6**	**302.5**
CB10	63.3 Hz	Tonnes/hr	240.5	320.6	400.8	343.5	400.8	356.3	400.8
	3800 vpm	**tons/hr**	**265.1**	**353.4**	**441.8**	**378.6**	**441.8**	**392.7**	**441.8**
CB13	63.3 Hz	Tonnes/hr	400.8	320.6	400.8	480.9	400.8	458.0	515.3
	3800 vpm	**tons/hr**	**441.8**	**353.4**	**441.8**	**530.1**	**441.8**	**504.9**	**568.0**
CB15, CB16	63.3 Hz	Tonnes/hr	400.8	320.6	400.8	480.9	400.8	458.0	515.3
	3800 vpm	**tons/hr**	**441.8**	**353.4**	**441.8**	**530.1**	**441.8**	**504.9**	**568.0**

Example

Actual Conditions — A 3.7 m (12 ft) lane is being paved with a compacted asphalt thickness of 10 cm (4 in). A CB10 is operating with a frequency of 42 Hz (2520 vpm) and 46 impacts per meter (14 impacts per ft) and making 4 passes to achieve target density. The roller is overlapping its passes 15 cm (6 in) and is overhanging the edges by 7.5 cm (3 in).

First, the table gives a CB10 productivity of 343 Tonnes/hr (378.6 tons/hr) for a 3.7 m (12 ft) paving width. Since the actual vibratory speed, thickness, impact spacing and passes are different from the assumed conditions, the estimate should be adjusted.

	Assumed		Actual	
Vibratory Speed	63.3 Hz	**3800 vpm**	42 Hz	**2520 vpm**
Impact Spacing	33 impacts/m **10 impacts/ft**		46 impacts/m **14 impacts/ft**	
Thickness	5 cm	**2 in**	10 cm	**4 in**
Passes	**2**		**4**	

Fs = 42 Hz (2520 vpm)/63.3 Hz (3800 vpm) = 0.66
Fi = 33 impacts/m (10 impacts/ft)/46 impacts/m (14 impacts/ft) = 0.71
Ft = 10 cm (4 in)/5 cm (2 in) = 2.0
Fp = 2 passes/4 passes = 0.5

The actual, or adjusted, production estimate can then be determined from the following:

Q (actual) = 343 Tonnes/hr (378.6 tons/hr) × 0.66 × 0.71 × 2 × 0.5 = 161 Tonnes/hr (177.4 tons/hr)

Notes on Productivity:

- Higher speed usually results in lower density achieved per pass.
- Productivity on uphill slopes may be reduced.
- Tabulated production estimates assume that 1 pass is used for re-positioning the machine at the beginning of the next run.

The tables in this section give production estimates for the following assumed conditions:

	Hot Mix Asphalt		Soil and Aggregate		Cold In-Place Recycled Asphalt	
Compacted Layer Thickness	51 mm	**2 in**	152 mm	**6 in**	203 mm	**8 in**
Maximum Propelling Speed	8 km/h	**5 mph**	8 km/h	**5 mph**	4.8 km/h	**3 mph**
Passes per Machine Width	**4**		**4**		**6**	
Compacted Material Density	2486 kg/cm³	**155 lb/ft³**	2085 kg/cm³	**130 lb/ft³**	2246 kg/cm³	**140 lb/ft³**
Overlap of Rolling Width	152 mm	**6 in**	152 mm	**6 in**	152 mm	**6 in**
Overhang at Lane Edge	76 mm	**3 in**	76 mm	**3 in**	76 mm	**3 in**
Cycle Time (2 passes)	**120 seconds**		**120 seconds**		**120 seconds**	

Table values give **representative** production rates for common construction widths. If the actual width falls between two assumed widths, use the higher number to estimate production. Minor adjustments can normally be made in the rolling method to reach this higher production: reduce overlap or overhang, increase speed, or increase the cycle time.

Hot Mix Asphalt		**PAVING WIDTH**						
		1.8 m	2.4 m	3.0 m	3.7 m	4.3 m	4.9 m	5.5 m
Model	**Units**	**6 ft**	**8 ft**	**10 ft**	**12 ft**	**14 ft**	**16 ft**	**18 ft**
CW16	Tonnes/hr	195.2	260.2	325.3	270.2	315.3	275.5	310.0
	tons/hr	**215.1**	**286.8**	**358.6**	**297.9**	**347.5**	**303.7**	**341.7**
CW34	Tonnes/hr	323.2	239.4	299.3	359.1	419.0	331.5	372.9
	tons/hr	**356.2**	**263.9**	**329.9**	**395.9**	**461.8**	**365.4**	**411.1**
Soil and Aggregate								
CW16	Tonnes/hr	490.1	653.4	816.8	678.6	791.7	691.9	778.4
	tons/hr	**540.2**	**720.3**	**900.4**	**748.0**	**872.7**	**762.7**	**858.0**
CW34	Tonnes/hr	811.6	601.1	751.5	901.8	1052.1	832.4	936.5
	tons/hr	**894.6**	**662.7**	**828.4**	**994.0**	**1159.7**	**917.5**	**1032.3**
PS360C	Tonnes/hr	882.2	653.4	816.8	980.2	1143.5	904.8	1017.9
	tons/hr	**972.4**	**720.3**	**900.4**	**1080.4**	**1260.5**	**997.3**	**1122.0**
Cold In-Place Recycled Asphalt								
CW16	Tonnes/hr	288.0	384.0	480.0	394.1	459.8	399.4	449.3
	tons/hr	**317.5**	**423.3**	**529.2**	**434.5**	**506.9**	**440.3**	**495.3**
CW34	Tonnes/hr	492.1	353.3	441.6	530.0	618.3	483.5	543.9
	tons/hr	**542.4**	**389.5**	**486.9**	**584.2**	**681.5**	**533.0**	**600.0**

Example

Actual Conditions — A 7.3 m (23'11") (full road width) base aggregate job is being completed with a compacted thickness of 200 mm (8 in). A CW16 is being used, operating at 6.5 km/h (4 mph), and making 6 passes achieve the desired compaction. The roller is overlapping its passes 152 mm (6 in).

First, the table does not show production for 7.3 m (23'11") so use the greatest width on the table: 5.5 m (18'1"). The table gives a CW16 productivity of 778.4 Tonnes/hr (858.0 tons/hr) for this paving width. We can expect that the actual productivity for 7.3 m (23'11") will be slightly higher than that. Since the speed, thickness, and passes are *different* from the assumed conditions, we should adjust this estimate:

	Assumed		**Actual**	
Speed	8 km/h	**5 mph**	6.5 km/h	**4 mph**
Thickness	152 mm	**6 in**	200 mm	**8 in**
Passes	**4**		**6**	

Fs = 6.5 km/h/8 km/h (4 mph/5 mph) = 0.8
Ft = 200 mm/152 mm (8 in/6 in) = 1.3
Fp = 4 passes/6 passes = 0.7

The estimated production is adjusted using these factors:

Q (actual) = 778.4 Tonnes/hr (858.0 tons/hr) × 0.8 × 1.3 × 0.7 = 567 Tonnes/hr (625 ton/hr)

Notes on Productivity:

- Ballast weight and tire pressure can significantly affect performance of a pneumatic tire compactor. Refer to machine specifications to choose the best configuration.
- Productivity on uphill grades and very thick layers (>127 mm, or 5 in) may be reduced due to a necessary reduction in speed.
- The 11-tire configuration for the CW16 is designed only for chip-and-seal applications. It is not recommended in other applications.

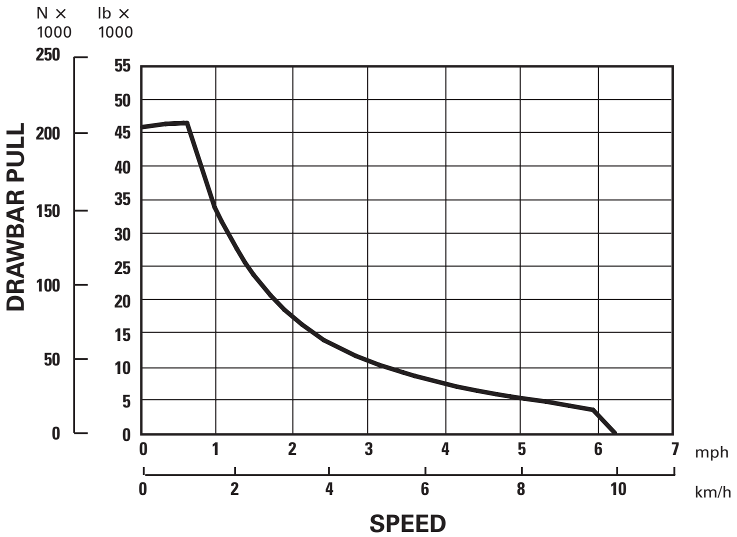
PIPELAYERS

CONTENTS

Features:

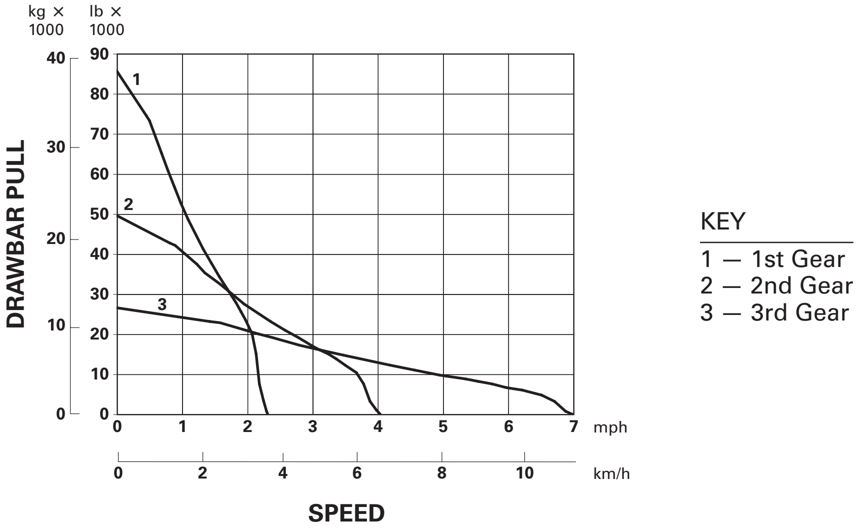
- **Hydrostatic transmission** on PL61.
- **Planetary power shift** transmission on PL72, PL83 and PL87 models.
- **Kick-out helps prevent boom bending** as boom approaches near-vertical.
- **Sealed and Lubricated Track.**
- **Simplified Controls** for all functions including raise, lower, quick-drop and power down, variable range and speed adjustments.
- **Modular design of major components and accessory drive system** for simplified repair.
- **Separate, self-energizing brakes** for boom and hook winches.
- **Positive** track pin retention (PL83 and PL87).
- **Hydraulic Drawworks** with two independently driven hydraulic motors for boom and hook winches.

PL61

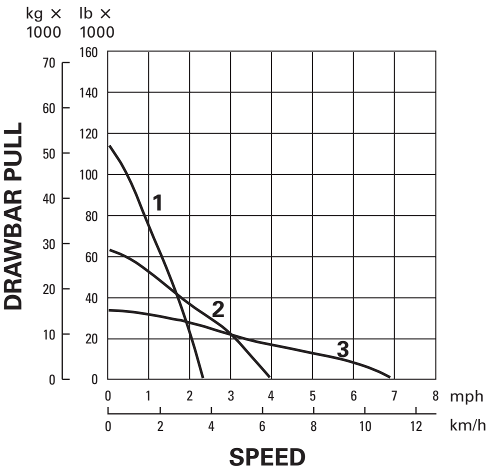


NOTE: Usable pull will depend upon weight and traction of equipped tractor.

PL72



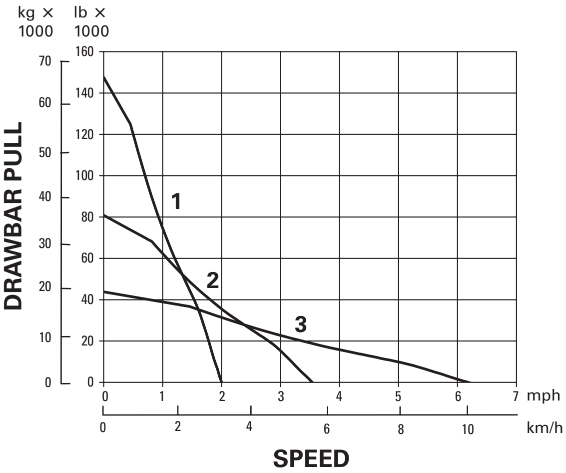
PL83



KEY

1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear

PL87



KEY

1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear

PIPELAYER APPLICATION CALCULATIONS:

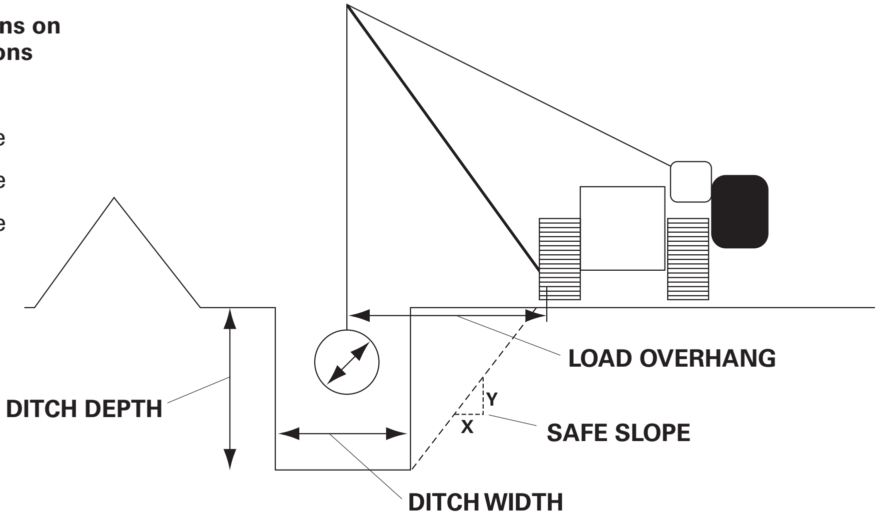
Typical pipelayer applications on flat, firm underfoot conditions

PL61 laying 8" to 16" pipe

PL72 laying 16" to 24" pipe

PL83 laying 24" to 36" pipe

PL87 laying 36" to 56" pipe



The chart above provides general information representing typical pipelayer applications. While the following scenario explores many of the variables involved in pipelaying it does not cover all the possible variables that must be considered by pipelaying contractors.

When sizing pipelayers for an application there are many considerations other than the machine's SAE rated lift capacity. These include but are not limited to:

- pipe diameter and weight per linear foot
- ditch width and depth
  ditch width is typically 2 × pipe diameter
  ditch depth is typically >2.5 × pipe diameter
- distance from the ditch (safe slope) required by soil stability conditions
  varies by local ground conditions but typically 2:1 (meaning the pipelayer must be 2 × ditch depth from the ditch edge)
- acceptable distance between pipe lifting points while suspended (to prevent bending)
  determined by the pipe's bending characteristics. If the lifting points are too far apart a pipe can sag enough due to its own weight that it will damage itself.
- the operating safety factor desired by the contractor
- the length of pipe that will need to be suspended while laying-in
  determined by pipe bending characteristics, terrain, etc.
- ground conditions, road bed preparation

An important consideration is the necessary load overhang. This is the distance from the center of the pipe to the tractor's left track rail. The load overhang required for an application can be estimated by:

- load overhang = safe slope × ditch depth + (0.5 × ditch width)

The pipelayer's rated load capacity at a specific load overhang (per ANSI/ASME B30.14) can be found in the load capacity graphs in this section of the performance handbook. Once the load capacity is determined the maximum lift point spacing can be estimated by:

- $$\text{max lift point spacing} = \frac{\text{load capacity at load overhang}}{\text{safety factor} \times \text{pipe weight per linear foot}}$$

The maximum distance between pipe lift points (based on pipe bending characteristics) may be a shorter distance than the maximum spacing between lift points as calculated based on pipelayer load capacity. If this is the case, then in order to avoid damaging the pipe, the shorter distance should be considered to be the maximum distance between pipelayers.

As an example, consider a project involving 0.5" wall 24" diameter pipe which has a weight per linear foot of 125.5 lb and the soil has a safe slope of 2. Using the above formulas:

- the ditch depth would be 3 × 2 ft = 6 ft deep
- the ditch width would be 2 × 2 ft = 4 ft
- the load overhang would be 2 × 6 ft + (0.5 × 4 ft) = 14 ft

Using the PL72's lift capacity chart we find that the PL72 has an ANSI rated load capacity of approximately 21,250 lb at a 14 ft load overhang.

When using rated load numbers it is important to understand that the lift capacity charts are based on SAE and ANSI test procedures that rate pipelayers on level, concrete surfaces. Working on softer underfoot conditions, working on slopes, (and other) can greatly reduce the pipelayer's load capacity.

If the contractor employs a safety factor of 2 then the maximum spacing between pipe lift points is:

$$\frac{21{,}250\text{ lb}}{2 \times 125.5\text{ lb/ft}} = 84.7\text{ ft}$$

It is important to remember that this is the distance between the lift points, not the distance nose-to-tail between pipelayers. For this example, assume that 500 ft of pipe must be suspended during the laying-in process.

$$\frac{500\text{ ft}}{84.7\text{ ft per pipelayer}} = \text{5.9 which means that six pipelayers are needed}$$

The number of pipelayers required could also be determined by a second method:

$$\frac{\text{ft of pipe suspended} \times \text{pipe weight per ft} \times \text{safety factor}}{\text{rated load at overhang}}$$

In this case:

$$\frac{500\text{ ft} \times 125.5\text{ lb/ft} \times 2}{21{,}250\text{ lb}} = \text{5.9 which again implies six pipelayers}$$

If, in this same example, soil conditions required a safe slope of 2.33 then the load overhang would have been 16 ft. At this load overhang the 90,000 lb lift pipelayer's rated load capacity is approximately 18,125 lb. Using the equations above, this results in 72.2 ft between lift points which means that seven 90,000 lb lift pipelayers are now necessary. Using the second method:

$$\frac{500\text{ ft} \times 125.5\text{ lb/ft} \times 2}{18{,}125\text{ lb}} = \text{6.9 again implying that seven 90,000 lb lift pipelayers are needed}$$

Rather than adding another pipelayer, PL83's could be used. At a 16 ft load overhang the PL83 has a rated load capacity of 29,400 lb. This translates to 117.1 ft between lift points. If the pipe's bending characteristics will allow this space between lift points, the job could be done with only five PL83's.

EXTREME SLOPE OPERATION

The maximum fore and aft grade in static condition on which each track-type tractor or pipelayer will maintain proper lubrication is 45 degrees (100%). Consult Operation & Maintenance Manual (if applicable) for POWERTRAIN fluid level overfill requirements for operation on extreme slopes. Extreme slope operation is anytime the slope exceeds 25° (47%).

The ENGINE should never be overfilled with oil. This may lead to rapid overheating. For extreme slope operation, engine oil should be maintained at the full mark.

NOTE: Both ENGINE and POWERTRAIN fluid levels should be checked on level ground before working sidehills and slopes.

When working sidehills and slopes, consideration should be given to the following important points:

- Speed of travel — At higher speeds, inertia forces tend to make the tractor less stable.
- Roughness of terrain or surface — Ample allowance should be made where the terrain or surface is uneven.
- Mounted equipment — Bulldozers, sidebooms, winches, and other mounted equipment cause the tractor to balance differently.
- Nature of surface — New earthen fills may give way with the weight of the tractor. Rocky surfaces may promote side slipping of tractor.
- Track slippage due to excessive loads — This may cause downhill track to "dig in," increasing angle of tractor.
- Implements hitched to the drawbar — This may decrease weight on uphill track, e.g., logging arch, two-wheel wagon.
- Height of hitch on tractor — When a high drawbar is used the tractor is less stable than with the standard drawbar.
- Width of shoes — Wide track shoes tend to decrease "digging in", hence tractor is more stable.
- Operated equipment — Be aware of the stability and other performance features of the equipment operated by the tractor.
- Keep all attachments or pulled loads low to the ground for optimum stability.

NOTE: Safe operation on steep slopes may require special machine maintenance as well as excellent operator skill and proper equipment for the specific application. Consult Operation & Maintenance Manual (if applicable) for proper fluid level requirements.

SKID STEER LOADERS/ COMPACT TRACK LOADERS

CONTENTS

SKID STEER LOADERS/ COMPACT TRACK LOADERS

Features:

- **The standard demand cooling fan** provides improved fuel efficiency and increased horsepower.
- **Industry leading sealed and pressurized cab option** provides a cleaner and quieter operating environment with excellent Work Tool visibility on D3 Series machines.
- **Ergonomically designed cab** provides maximum operator comfort and visibility.
- **Low-effort** joystick controls, armrest, and retractable seat belt for easy operation.
- **Available high-back, heated, air ride seat with seat mounted adjustable joystick controls and independently adjustable arm bars** make the D3 Series machines the industry leaders in operator comfort.
- **Deep skid resistant steps** make egress/ingress easy.

Features ***(continued)***:

- **Hand and foot throttle** for continuous or variable engine speed.
- **Anti-stall feature/Electronic Torque Management** provide maximum rimpull and hydraulic power while preventing engine stalling.
- **Direct drive hystat pumps** eliminate drive belts for efficient power transfer.
- **Ground level access** to all daily service and routine maintenance points helps reduce machine downtime for greater productivity.
- **High performance power train** provides maximum performance and production capability on D and D2 Series machines through the Electronic Torque Management system, optional two speed travel and an electronic hand/foot throttle with decel pedal capability.
- **Cat® "Intelligent Leveling" system (ILEV)** provides industry leading technology and integration through available features such as dual direction self-level, work tool return to dig and work tool positioner.
- **Speed Sensitive Ride Control** option on D3 Series machines improves operation on rough terrain, enabling better load retention, increased productivity, and greater operator comfort.
- **Maximize machine capability and control with the Advanced Display** providing on-screen adjustment capability on D3 Series machines for implement response, hystat response, and creep control, multi-language functionality with customizable layouts, security system, and rearview camera.
- **High performance cooling systems and extended life coolant,** along with high performance engine and hydraulic oils, extend service intervals for low operating costs.
- **Deutsch electrical connectors with wires that** are color coded, numbered, and protected with nylon braiding.
- **Electro-depositioned** or "E" coat corrosion protection for long paint life.
- **High flow XPS hydraulics** are optional on most D3 Series models. The XE hydraulic package option on the 272D3 and 299D3 combines the high pressure of XPS with even higher flow for the most demanding hydromechanical work tool applications such as mulching, cold planing, and wheel saw cutting.
- **High flow hydraulics** on the 226D3, 232D3, 236D3, 239D3, 242D3, 249D3, 257D3, and 259D3 operate more demanding, rotating work tools such as brooms, cold planers, trenchers, landscape rakes, power rakes, tillers, snow blowers, brush cutters, and stump grinders.
- **Creep Control** allows the operator to select the optimal ground speed while maintaining maximum hydraulic flow to the attachment to achieve the best match between machine hydraulics, ground/operating conditions and attachment, especially effective with hydro-mechanical attachment.

SURFACE MINING EXTRACTION
Draglines
Electric Rope Shovels
Hydraulic Mining Shovels

CONTENTS

DRAGLINES

ELECTRIC ROPE SHOVELS

HYDRAULIC MINING SHOVELS

DRAGLINES

INTRODUCTION

Draglines are an important excavating tool used in many surface mining operations worldwide. These highly productive machines operate 24 hours a day, seven days a week and are able to reach depths of 79.8 m (262 ft) with capacities up to 116.2 m³ (152 yd³). Offering the lowest material removal cost per tonne (ton) and an average operating life of 40 years, draglines are the most productive and versatile machine in the industry. Caterpillar offers an extensive variety of dragline specifications and on-staff application engineers who will help determine the solution that best addresses specific needs.

With over 100 years of dragline experience and the largest operating fleet of draglines with buckets of 40 m³ (52.3 yd³) and above, coupled with an active installed base of over 300 machines, Cat draglines are the most efficient and proven overburden removal solution.

SAFETY AND SERVICEABILITY

Safety plays an integral role in everything we do at Caterpillar, from our factory floors to our service centers to our clients' mine sites. Caterpillar's commitment to safety is apparent in our product designs, which undergo risk assessments and are designed to meet strict codes and regulations. Stairways, walkways, platforms and access points are incorporated throughout Cat® draglines to ensure safe and convenient access for maintenance personnel. With safety and serviceability enhancing features incorporated into the operator cab, structures, surfaces and electrical equipment, among others, Cat draglines were designed with safety in mind.

Throughout this document, references to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim) include U.S. EPA Tier 4 Interim, EU Stage IIIB, and Japan 2011 (Tier 4 Interim) equivalent emission standards. References to Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) include U.S. EPA Tier 4 Final, EU Stage V, and Japan 2014 (Tier 4 Final) emission standards.

Throughout this document, references to Tier 1/Stage I include U.S. EPA Tier 1 and EU Stage I equivalent emission standards. References to Tier 2/Stage II/Japan 2001 (Tier 2) equivalent include U.S. EPA Tier 2, EU Stage II, and Japan 2001 (Tier 2) equivalent emission standards. References to Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent include U.S. EPA Tier 3, EU Stage IIIA, and Japan 2006 (Tier 3) equivalent emission standards.

FEATURES

AC IGBT Electrics

Cat draglines are equipped with AC IGBT electrics which allow for greater machine uptime, lower operating costs, and faster cycle times, with AC providing up to 10% energy savings over the life of the machine.

- **Superior availability:** AC IGBT electric draglines have routinely demonstrated electrical availabilities of greater than 95%.
- **Greater reliability:** Fewer components including interchangeable inverters. IGBT systems require no fuses or circuit breakers.
- **Reduced maintenance:** No regular maintenance is required on IGBT power control modules. Motor maintenance on AC machines is reduced to greasing and replacing bearings every 30,000 hours.
- **Reduced inventory:** Hoist, drag, swing, and propel motions are all controlled by AC motors. Cat IGBT is a mine quality system with rugged welded cabinets to withstand harsh mining conditions.

Major Structures

Cat major structures are designed for extended performance in harsh mining conditions. Structures are manufactured using impact-resistant, high-strength steel with select welds of full-penetration, profiled and ground type. All structural welds undergo visual inspection, with critical welds also receiving MT, UT or X-ray inspection. Large furnaces are used to stress-relieve entire weldments for reduced susceptibility to cracking. Interiors of finished structures are painted white to facilitate field inspection.

Tri-Structure Design

The exclusive tri-structure design on Cat draglines reduces front end weight to enable optimization of boom configurations, allowing for increased load and reach. The tri-structure is manufactured with high impact strength steel for a simplified wide flange beam construction, and less maintenance points are required in comparison with an A-frame or mast assembly. Inventory stocking needs are reduced as the sheaves are interchangeable with both the fairlead and boom assemblies.

Cat Cab

Cat's state-of-the-art operator's cab is the product of a multi-year collaboration between Caterpillar, mining companies and operators. The cab provides industry-leading visibility with excellent line of sight supplemented by five optimally-mounted cameras and display screens. It provides enhanced safety through dual access/egress doors and an optimally-placed trainer seat with independent emergency stop. Additionally, the cab offers the smoothest, most comfortable ride available with an ergonomic, adjustable operator's seat with a fully pneumatic suspension system, low-effort joysticks and dual display screens optimized for operator comfort.

Custom Design and Aftermarket Support

The Cat dragline model selection process is grounded in analysis and collaboration with experienced application engineering professionals and a dragline optimization process to assist in determining the configuration optimally suited for a particular application. Additionally, mechanical and electrical upgrades, and component rebuilds are available to ensure productivity and reliability for the life of the machine. Caterpillar also offers machine relocation and field assembly services supported by experienced industry experts.

ELECTRIC ROPE SHOVELS

CONTENTS

ELECTRIC ROPE SHOVELS

INTRODUCTION

Electric rope shovels are one of the largest loading tools on the market. They run in a truck-shovel operation with mining trucks in order to move large quantities of material at a low cost per ton. Electric rope shovels are used to mine a variety of minerals including oil sands, coal overburden, copper, gold, iron ore, etc. They operate in extreme climates in tough surface mining applications all over the world. With over 130 years' experience in the rope shovel industry, and an active population of over 225 machines, Cat Electric Rope Shovels are the most efficient and cost effective loading tools available.

SAFETY AND SERVICEABILITY

Safety plays an integral role in everything we do at Caterpillar, from our factory floors to our service centers to our clients' mine sites. Caterpillar's commitment to safety is apparent in our product designs, which undergo risk assessments and are designed to meet strict codes and regulations.

Stairways, walkways, platforms and access points are incorporated throughout Cat Electric Rope Shovels to ensure safe and convenient access for maintenance personnel. With safety and serviceability enhancing features incorporated into the operator cab, structures, and electrical equipment, among others, Cat Electric Rope Shovels were designed with safety in mind.

FEATURES

AC IGBT Electrics

With over 40 years of AC experience and over 200 operating AC machines, Bucyrus led the industry in AC electric rope shovels. Caterpillar continues to carry on this proud tradition. Since its launch in 1981, the AC electric rope shovel has gained strong industry acceptance, offering:

- **Superior availability:** AC IGBT electric rope shovels have routinely demonstrated electrical availabilities of greater than 98%.
- **Greater reliability:** Fewer components including interchangeable inverters. IGBT systems require no fuses or circuit breakers.
- **Reduced maintenance:** No regular maintenance is required on IGBT power control modules. Motor maintenance on AC machines is reduced to greasing and replacing bearings every 30,000 hours.
- **Durability:** Cat IGBT is a mine quality system with rugged unitized construction to withstand harsh mining conditions.
- **Reduced inventory:** One IGBT part number is used in multiple locations allowing for decreased component inventory.

Major Structures

Cat major structures are designed for extended performance in harsh mining conditions. Structures are manufactured using cold-weather, impact-resistant, high-strength steel with select welds of full-penetration, profiled and ground type. All structural welds undergo visual inspection, with critical welds also receiving MT, UT or X-ray inspection. Large furnaces are used to stress-relieve entire weldments for reduced susceptibility to cracking. Interiors of finished structures are painted white to facilitate field inspection.

Robust Front End Design

The Cat crowd/retract system design presents many benefits over traditional rack-and-pinions systems, including:

- **Fast swing times:** The Cat deck-mounted, rather than boom-mounted, crowd machinery greatly reduces front end weight for reduced swing inertia and fast swing times.
- **Elimination of torsional loading:** The free-floating tubular handle design allows the Cat handle to rotate under uneven loading, transferring force into the ropes rather than into the boom.
- **Superior visibility:** With deck-mounted crowd machinery, Cat machines provide operators with a clear left-hand line of sight for higher visibility and enhanced safety.
- **Efficient digging:** Wide-set boom point sheaves stabilize the dipper as it engages the bank for easier and more efficient digging.

Cat Cab

Caterpillar's state-of-the-art operator's cab is the product of a multi-year collaboration between Caterpillar, mining companies and shovel operators. The cab provides industry-leading visibility supplemented by five optimally-mounted cameras and display screens. It provides enhanced safety through dual access/egress doors and an optimally-placed trainer seat with independent emergency stop. Additionally, the cab offers the smoothest, most comfortable ride available with an ergonomic, adjustable operator's seat with a fully pneumatic suspension system, low-effort joysticks and dual display screens optimized for operator comfort.

HydraCrowd™

HydraCrowd represents the first new crowd technology developed in the past 70 years. A hydraulic cylinder inside the tubular dipper handle maintains all the benefits of the Cat front end while eliminating the need for routine crowd/retract rope replacements. HydraCrowd cuts downtime by reducing the number of maintenance events needed to keep the machine operational. HydraCrowd is controlled with proven Cat IGBT technology and has complete diagnostic and troubleshooting information with step-by-step instructions.

LatchFree™

The LatchFree Dipper System is Caterpillar's solution to customers' number one cause of downtime — the traditional latch assembly. The LatchFree dipper eliminates the latch assembly, replacing it with a strong steel link mounted to the dipper back, away from material flow. The system enhances safety by reducing the number of maintenance events required to maintain the system and increases reliability by reducing unplanned downtime. The LatchFree Dipper System comes complete with a comprehensive training program to ensure customers achieve maximum system benefits.

FastFil™ Dipper Design

The unique FastFil dipper provides customers with faster and fuller dipper loads where the application permits. Its trapezoidal shape accommodates the natural configuration of the load, eliminating voids that occur with box-shaped dippers for improved fill factors. The trapezoidal shape also optimizes dipper size and weight for improved maneuverability and faster swing times. Additionally, an adjustable pitch brace allows rake angle changes to improve bank penetration, eliminate bulldozing, and improve productivity. Combined, the FastFil features maximize the fill factor.

Operator Assist — Enhanced Motion Control

The operator assist — enhanced motion control system eliminates or reduces the occurrence of crowd over-speeds, crowd impacts, hoist stalls, boom jacking, and swinging while engaged in the bank. This is accomplished by intelligently controlling how motions are allowed to operate under certain conditions. The reduced system stress and equal or better cycle times improve shovel performance and cost per ton. This software is standard on all 7495 Series electric rope shovels.

Product Link Elite

This sytem boosts connectivity and increases the availability of data provided by the shovel. The onboard hardware enables the shovel to collect and transmit information into locally hosted or cloud-hosted applications such as Cat MineStar™ Solutions Health Office, Health Equipment Insights, Equipment Care Advisor or Vision Link.

PTM Payload

Loadcell technology directly measures padlock pin force and dipper accelerations to determine payload, thereby providing real time feedback. It is an improvement over traditional systems, which are quasi-static methods that rely on averaging to estimate dipper force and inertial effects. PTM Payload can calculate material moved, monitor overloading of trucks, and empower operators to study their loading efficiency and shift performance.

Cycle Segmentation

Standard on new machines, this feature detects the machine operation mode and classifies the severity of those operations (dig, swing to dump, dump, and return to dig). It creates application profiles and composite work cycles based on machine data. The data is stored onboard to provide key performance indicators and operator feedback in real time. It is also transmitted offboard through Product Link Elite for back office applications.

Integrated Technology Platform

This hardware provides the foundation to seamlessly integrate software solutions as well as interface with the MineStar™ product portfolio. It provides a multigenerational building block approach to mature and launch machine-level technology solutions digitally, eliminating future work stoppage for additional hardware installation. It enables deployment of onboard machine technologies that support higher productivity, improved reliability, and increased cyber security. The Technology Controls network provides simple maintenance, troubleshooting and feature upgrades.

Integral Fast Propel Transfer Switch

The Cat integral fast propel transfer switch is a more responsive system that improves mode transfer as much as 75% — delivering more production hours and reducing service and costs due to downtime.

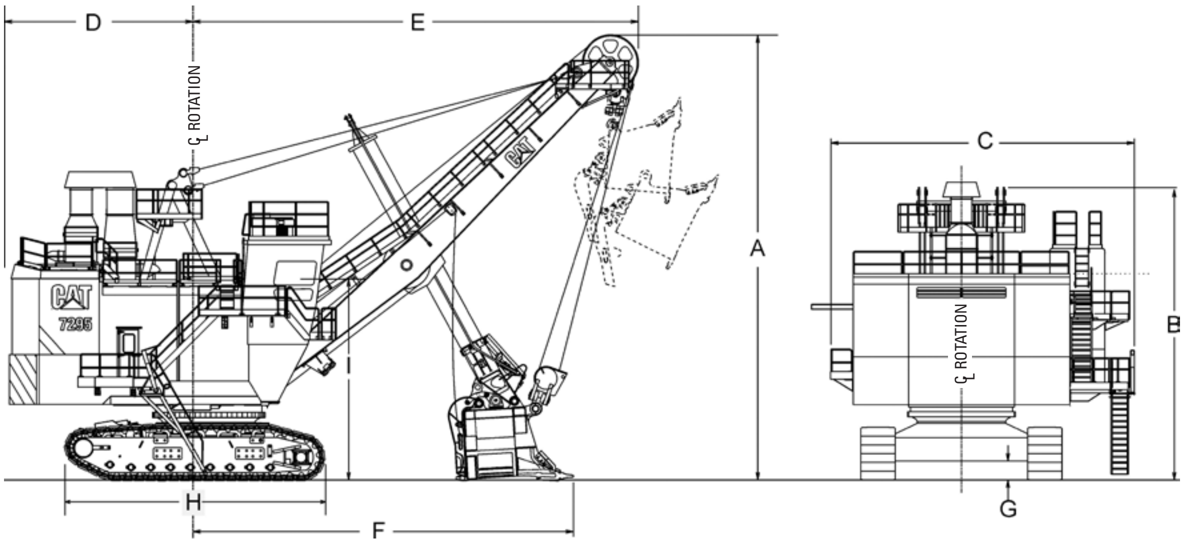
MineStar™ Health

MineStar™ Health is an industry-leading technology offering that helps maximize equipment availability and reliability. MineStar™ Health keeps you connected to your machines so you can head off small problems while they're still small, run machines as efficiently as possible for as long as possible, and keep unplanned downtime to a minimum.

MineStar™ Health products and services enable you to collect and transmit equipment data, monitor critical machine parameters, obtain real-time alerts, analyze operational trends and patterns, predict failures and receive repair recommendations — assisting you with proactive maintenance services and predictive equipment analysis.

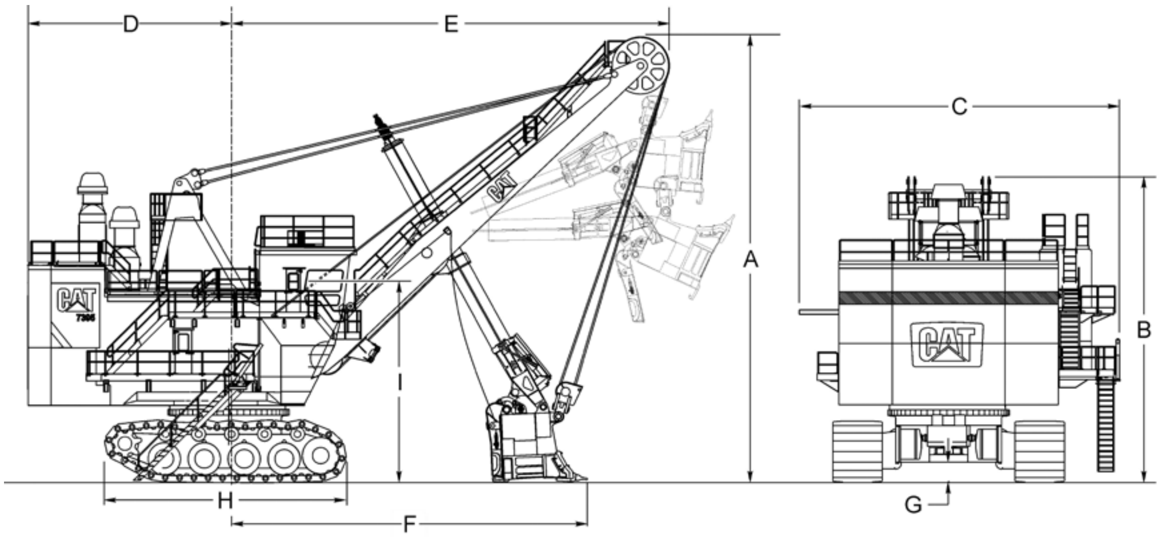
MineStar™ Terrain

MineStar™ Terrain for loading is a machine guidance system that delivers real-time data in the cab—on everything from bucket positioning and bench height to ore bodies and volume of material cut and filled. That enables every operator to maximize machine efficiency, leading to better material management, more accurate grades and less rework and wear.



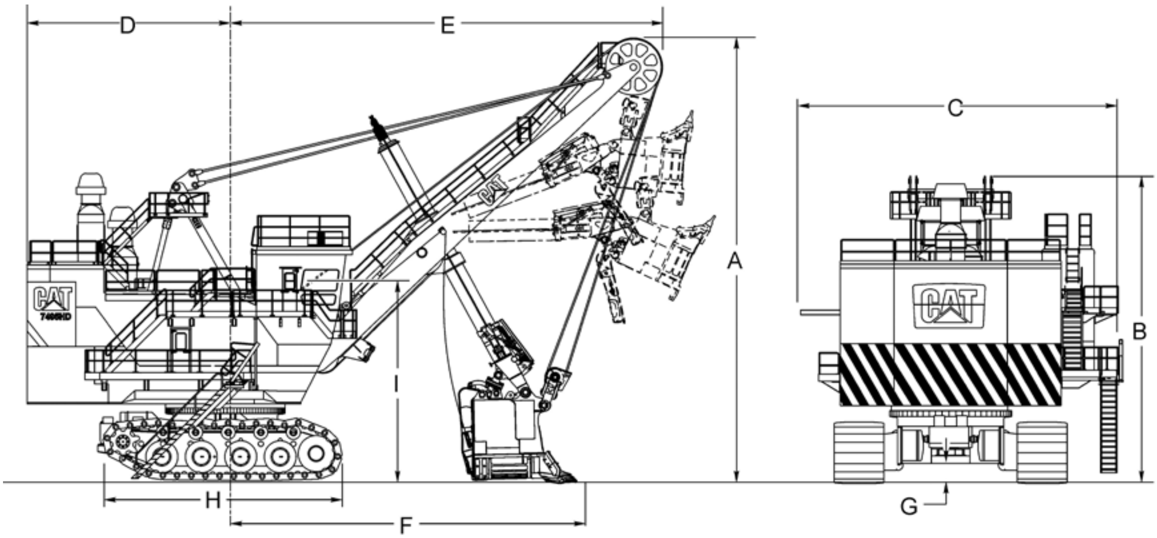
MODEL	**7295**	
Boom Length	18.00 m	**59'0"**
A Height	18.15 m	**59'7"**
B A-Frame Height	11.94 m	**39'2"**
C Overall Width	12.39 m	**40'8"**
D Tail Swing Radius	7.80 m	**25"8"**
E Clearance Radius	17.48 m	**57'4"**
F Radius of Level Floor*	14.90 m	**48'11"**
G Minimum Ground Clearance	0.78 m	**2'6"**
H Track Length	10.26 m	**33'8"**
I Operator Eye Level	8.20 m	**26'11"**

*Dimensions based on 19 m^3 **(25 yd^3)** dipper.
Information subject to change.
All dimensions are approximate and will vary depending on dipper size.



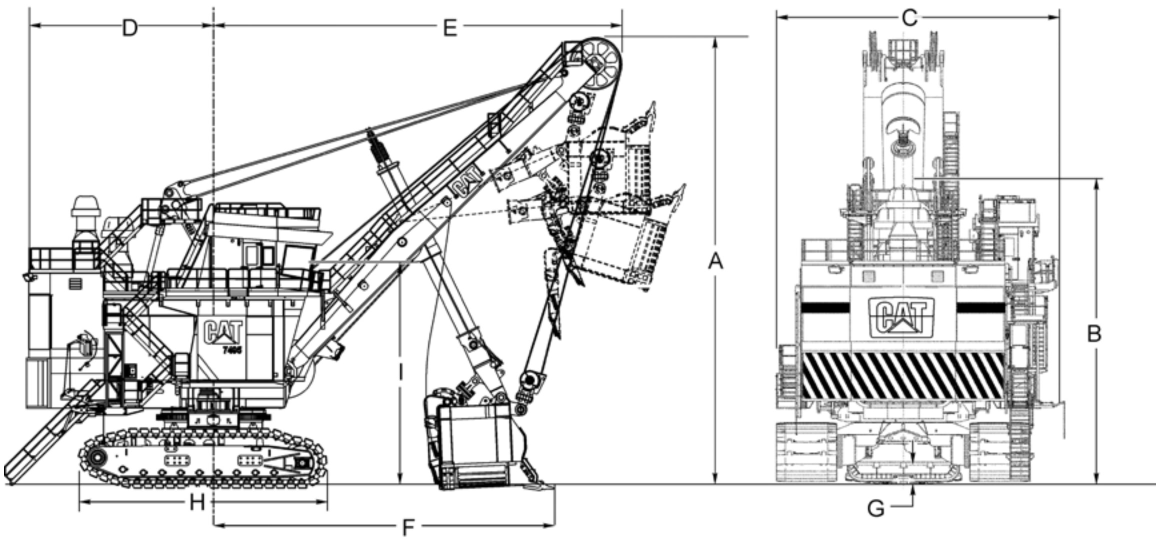
MODEL	7395	
Boom Length	19.51 m	**64'0"**
A Height	19.50 m	**63'11"**
B A-Frame Height	13.30 m	**43'8"**
C Overall Width	13.01 m	**42'8"**
D Tail Swing Radius	9.30 m	**30'8"**
E Clearance Radius	19.05 m	**62'6"**
F Radius of Level Floor*	16.00 m	**52'4"**
G Minimum Ground Clearance	0.86 m	**2'10"**
H Track Length	10.41 m	**34'2"**
I Operator Eye Level	8.64 m	**28'4"**

*Dimensions based on 24 m^3 **(32 yd^3)** dipper.
Information subject to change.
All dimensions are approximate and will vary depending on dipper size.



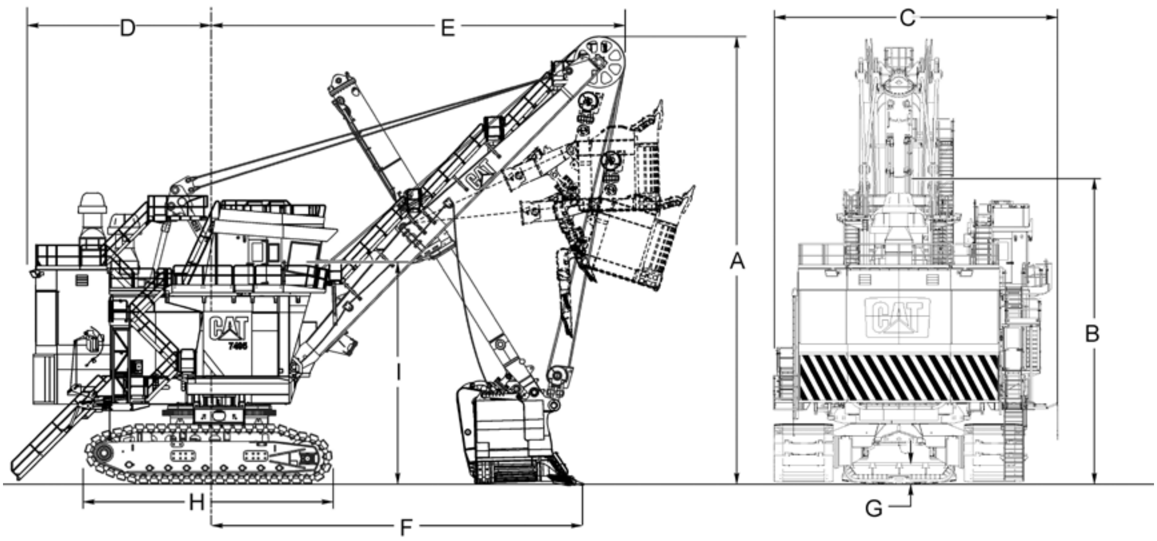
MODEL	7495 HD	
Boom Length	20.40 m	**67'0"**
A Height	20.10 m	**65'10"**
B A-Frame Height	13.30 m	**43'8"**
C Overall Width	13.01 m	**42'8"**
D Tail Swing Radius	9.30 m	**30'8"**
E Clearance Radius	19.74 m	**64'9"**
F Radius of Level Floor*	15.70 m	**51'8"**
G Minimum Ground Clearance	0.86 m	**2'10"**
H Track Length	10.41 m	**34'2"**
I Operator Eye Level	8.64 m	**28'4"**

*Dimensions based on 32 m^3 **(42 yd^3)** dipper.
Information subject to change.
All dimensions are approximate and will vary depending on dipper size.



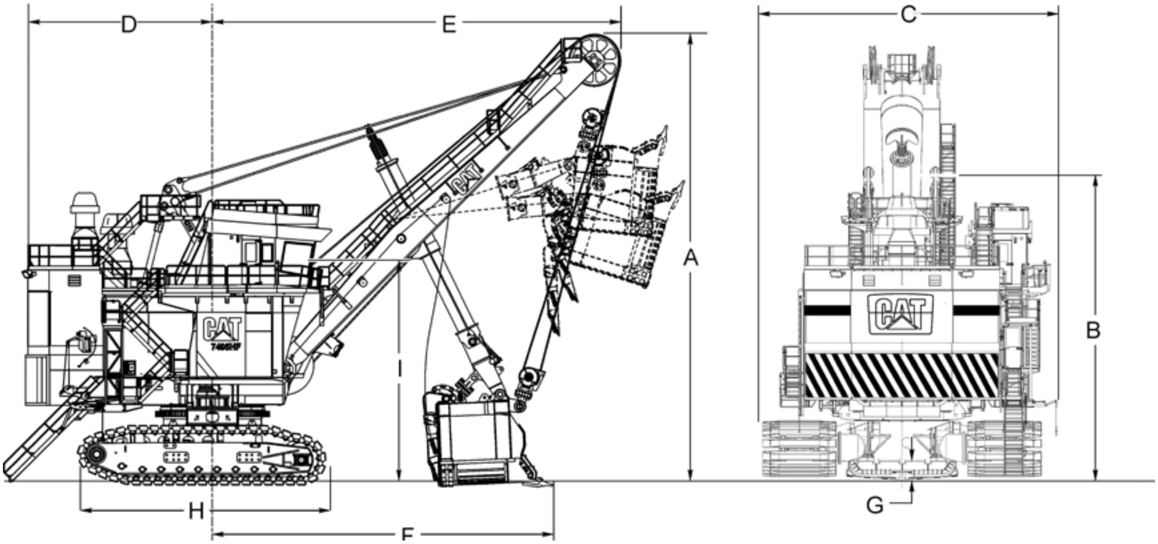
MODEL		7495	
Boom Length		20.40 m	**67'0"**
A	Height	20.87 m	**68'6"**
B	A-Frame Height	14.00 m	**46'0"**
C	Overall Width	13.11 m	**43'0"**
D	Tail Swing Radius	9.30 m	**30'8"**
E	Clearance Radius	19.65 m	**64'5"**
F	Radius of Level Floor*	17.10 m	**56'1"**
G	Minimum Ground Clearance	0.90 m	**3'0"**
H	Track Length	11.43 m	**37'6"**
I	Operator Eye Level	10.61 m	**34'10"**

*Dimensions based on 56 m^3 **(73 yd^3)** dipper.
Information subject to change.
All dimensions are approximate and will vary depending on dipper size.



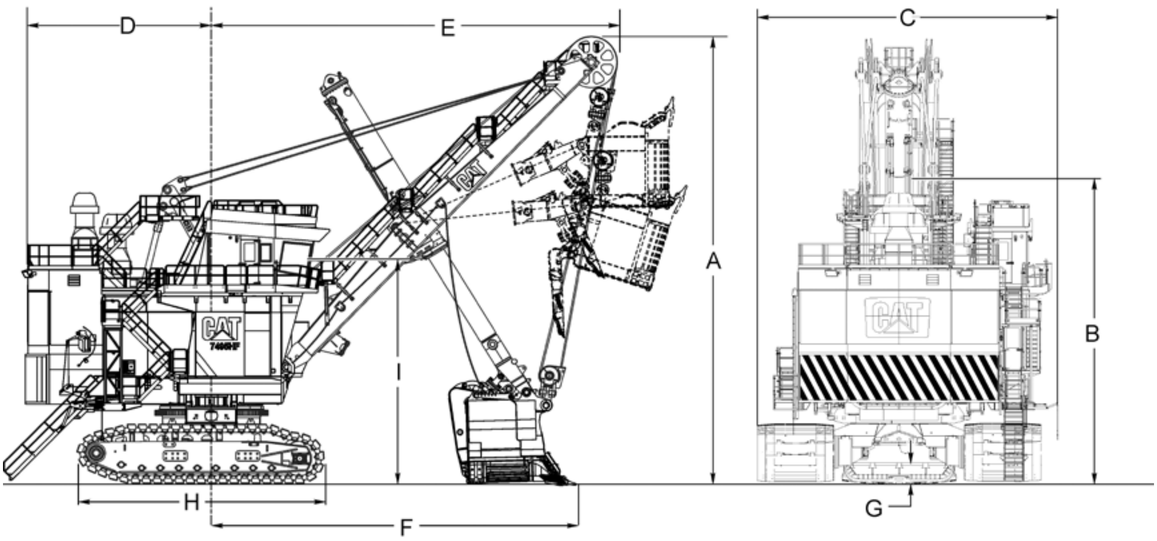
MODEL	7495 HydraCrowd	
Boom Length	20.40 m	**67'0"**
A Height	20.87 m	**68'6"**
B A-Frame Height	14.00 m	**46'0"**
C Overall Width	13.11 m	**43'0"**
D Tail Swing Radius	9.30 m	**30'8"**
E Clearance Radius	19.65 m	**64'5"**
F Radius of Level Floor*	17.10 m	**56'1"**
G Minimum Ground Clearance	0.90 m	**3'0"**
H Track Length	11.43 m	**37'6"**
I Operator Eye Level	10.61 m	**34'10"**

*Dimensions based on 56 m^3 **(73 yd^3)** dipper.
Information subject to change.
All dimensions are approximate and will vary depending on dipper size.



MODEL	**7495 HF**	
Boom Length	20.40 m	**67'0"**
A Height	20.87 m	**68'6"**
B A-Frame Height	14.00 m	**46'0"**
C Overall Width	13.96 m	**46'1"**
D Tail Swing Radius	9.30 m	**30'8"**
E Clearance Radius	19.65 m	**64'5"**
F Radius of Level Floor*	17.00 m	**55'11"**
G Minimum Ground Clearance	0.90 m	**3'0"**
H Track Length	11.43 m	**37'6"**
I Operator Eye Level	10.61 m	**34'10"**

*Dimensions based on 45 m^3 **(59 yd^3)** dipper.
Information subject to change.
All dimensions are approximate and will vary depending on dipper size.



MODEL	7495 HF HydraCrowd	
Boom Length	20.40 m	**67'0"**
A Height	20.87 m	**68'6"**
B A-Frame Height	14.00 m	**46'0"**
C Overall Width	13.96 m	**46'1"**
D Tail Swing Radius	9.30 m	**30'8"**
E Clearance Radius	19.65 m	**64'5"**
F Radius of Level Floor*	17.00 m	**55'11"**
G Minimum Ground Clearance	0.90 m	**3'0"**
H Track Length	11.43 m	**37'6"**
I Operator Eye Level	10.61 m	**34'10"**

*Dimensions based on 45 m^3 **(59 yd^3)** dipper.
Information subject to change.
All dimensions are approximate and will vary depending on dipper size.

GROUND BEARING PRESSURE

Ground bearing pressure, or the amount of weight that can be supported by ground conditions, determines the link width (and occasionally the machine model) that can be used at a mine site. Softer ground conditions require wider links while the softest conditions (i.e. oil sands) require a specific model (7495 HF) which was designed to operate under low ground bearing pressure conditions. A link too narrow for the application may even cause the crawlers to sink into the ground.

The chart below lists the link length options for each electric rope shovel model as well as the corresponding minimum ground bearing pressures.

MODEL	7295[1]		7395[2]		7495 HD[3]		7495[4]	
Standard Link Length	183 cm	**72"**	213 cm	**84"**	213 cm	**84"**	200 cm	**79"**
Ground Bearing Pressure	269 kPa	**39 psi**	371 kPa	**54 psi**	400 kPa	**58 psi**	380 kPa	**55 psi**
Optional Link Length	—		274 cm	**108"**	274 cm	**108"**	259 cm	**102"**
Ground Bearing Pressure	—		276 kPa	**43 psi**	316 kPa	**46 psi**	297 kPa	**43 psi**

MODEL	7495 HydraCrowd[4]		7495 HF[5]		7495 HF HydraCrowd[5]	
Standard Link Length	200 cm	**79"**	318 cm	**125"**	318 cm	**125"**
Ground Bearing Pressure	382 kPa	**55 psi**	247 kPa	**36 psi**	248 kPa	**36 psi**
Optional Link Length	259 cm	**102"**	—		—	
Ground Bearing Pressure	298 kPa	**43 psi**	—		—	

[1] Based on 19 m^3 **(25 yd^3)** dipper.
[2] Based on 24 m^3 **(32 yd^3)** dipper.
[3] Based on 32 m^3 **(42 yd^3)** dipper.
[4] Based on 56 m^3 **(73 yd^3)** dipper.
[5] Based on 45 m^3 **(59 yd^3)** dipper.
Information subject to change.
All dimensions are approximate.

DIPPER SELECTION

Selecting the correct dipper size plays an integral role in maximizing productivity from a truck shovel operation. Optimal dipper size is a function of truck size, material loose density, and fill factor.

The first step in calculating dipper size is to determine the machine's optimal payload based on truck size. To calculate this, divide truck payload by three and four (three or four pass even loading is ideal for high productivity). Compare these values to the machine's maximum payload. The machine's optimal payload is the largest value that is less than the maximum payload.

For example, consider a mine operating a 7495 shovel (maximum payload = 120 tons) and 797 trucks (payload = 400 tons). 400 ÷ 3 = 133.3 and 400 ÷ 4 = 100. 133.3 can be eliminated as it is greater than the shovel's maximum payload (120 tons). 100 tons is the largest value less than the machine's maximum payload, and therefore, is the machine's optimal payload.

Once optimal machine payload is determined, material loose density and fill factor are used to calculate the optimum dipper size. To calculate material loose density, divide insitu (undisturbed material density) by 1 + swell factor.

$$\text{Material loose density} = \frac{\text{Insitu}}{(1 + \text{swell factor})}$$

Once material loose density is calculated, use the equation below to find the optimal dipper size. Fill factor is affected by the dipper geometry, rake angle, and material properties, including fragmentation and critical angle of repose. Fill factors are generally between 90% and 115% for efficiently-sized dippers.

$$\text{Optimal dipper size} = \frac{\text{Optimal machine payload}}{\text{Material loose density}} \times \text{Fill factor}$$

For example: For a mine with the following conditions:

Insitu: 2.276 ton/yd³
Swell factor: 35%
Fill factor: 95%
Optimal machine payload: 100 tons

$$\text{Optimal dipper size} = \frac{100 \text{ tons}}{2.276 \div (1 + 0.35)} \times .95 = 62.5 \text{ yd}^3$$

TRUCK MATCH

Truck shovel match, or the number of passes necessary to load a truck, has a major impact on an operation's productivity. To optimize productivity, 3 to 4 even pass loading of trucks is ideal. The chart below shows pass match between Cat electric rope shovels and Cat trucks.

	Payload	7295	7395	7495 HD	7495	7495 HF
MODEL	tonne **(ton)**	45 **(50)**	64 **(70)**	82 **(90)**	109* **(120*)**	109* **(120*)**
785D	136 **(150)**	**3**				
789D	181 **(200)**	**4**	**3**			
793F	227 **(250)**		**4**	**3**		
794 AC	291 **(320)**			**4**	**3**	**3**
795F AC	313 **(345)**			**4**	**3**	**3**
797F	363 **(400)**				**4**	**4**
796 AC	327 **(360)**			**4**	**3**	**3**
798 AC	372 **(410)**				**4**	**4**

*Indicates maximum payload.

RATED SUSPENDED LOAD

Rated Suspended Load is the designed maximum load limit for any Cat Electric Rope Shovel (ERS) model/machine serial number. The maximum load limit is defined as the combined total of Dipper Weight plus Struck Payload Weight.

- **Dipper Weight:** Dipper Weight is the combined total dead weights of dipper body, GET, lip and corner shrouds, dipper door, door latch assembly, wear liner packages for body and door, snubbers, pitch braces, padlocks and pins/pin retainers. (**Note:** Handle weight is NOT included in calculation of Dipper Weight.)
- **Struck Payload Weight:** Struck Payload Weight is the live weight of the material in the dipper. This is a calculated payload weight based on the struck volume of the dipper multiplied by the density of the loose material in the dipper.

  Struck volume of a dipper is the contained interior volume of the dipper from the closed door up to the plane of a straight line from the front edge of the dipper back (top) to a point on the dipper lip (floor) where the teeth are attached.

The below values for Rated Suspended Loads (RSL) for Cat Electric Rope Shovels are applicable to shovels commissioned on or after June 1, 2016. Since Cat Electric Rope Shovels have seen numerous upgrades throughout their history which will affect shovel capability, a Rated Suspended Load (RSL) value based on the specific configuration of each machine is more appropriate for machines manufactured or commissioned prior to that date.

ERS MODEL	Rated Suspended Load (RSL)	
7295	81 647 kg	**180,000 lb**
7395	117 934 kg	**260,000 lb**
7495 HD	154 221 kg	**340,000 lb**
7495 with 100 tonnes **(110 short tons)** Payload	185 973 kg	**410,000 lb**
7495 HF with 100 tonnes **(110 short tons)** Payload	185 973 kg	**410,000 lb**
7495 with 109 tonnes **(120 short tons)** Payload	195 045 kg	**430,000 lb**
7495 HF with 109 tonnes **(120 short tons)** Payload	195 045 kg	**430,000 lb**

10/10/20 LOAD MANAGEMENT POLICY — ELECTRIC ROPE SHOVELS

"Machine overload" shall consist of operating the shovel(s) outside of the acceptable allowable load distribution.

The customer shall be responsible for the monitoring and management of all shovel operational activities, including, but not limited to, management of the machine loading such that its loaded distribution is within the acceptable allowable load distribution.

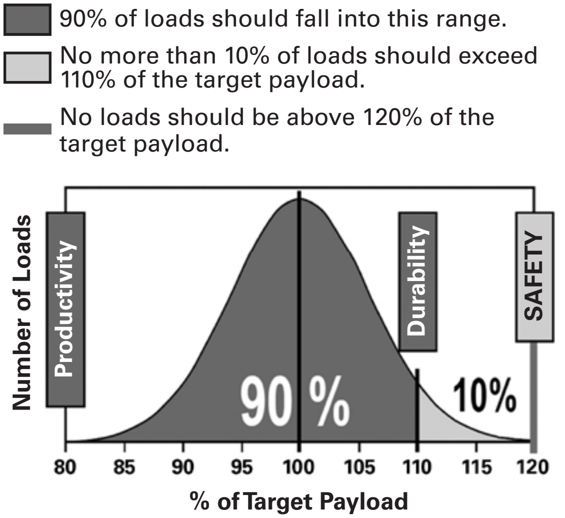
Operating outside of these parameters over any rolling 30 day period can void the customer's standard warranty; any extended warranty; any availability guarantee and/or result in adjustments to Caterpillar's obligations under any contract or agreement.

Loading Distribution

Loading use over any rolling 30 Day period analyzed:

- No more than 10% of loads should exceed 110% of rated payload.
- No load should exceed 120% of rated payload.
- The average of all loads for the unit not to exceed the rated payload.

KEY



Loading use in excess of this prescribed distribution is considered "machine overload."

Notes

- For this policy to be in effect, the "operational cycle" payload feedback must be available to the operator in order that the customer can control actual payloads.
- Customer must procure, install, and use Caterpillar payload measurement and monitoring systems.
- Caterpillar must be notified in a timely fashion if the payload monitoring and feedback system is out of service.

HYDRAULIC MINING SHOVELS

CONTENTS

HYDRAULIC MINING SHOVELS

GENERAL INTRODUCTION

Hydraulic Mining Shovels

Hydraulic mining shovels are designed to move large volumes of materials, and the majority are employed in the mining industry for loading large Mining and Off-Highway Trucks. Key design characteristics are high digging forces and quick working cycles for best performance, and a durable design to handle severe working conditions. Hydraulic mining shovels dig and load various commodities, such as gold, copper, iron ore, diamonds and coal, or they remove overburden, in any climatic condition around the world. Typically operated around the clock, Hydraulic Mining Shovels accumulate up to 6500 hours per year.

Nomenclature

The 6000 Series constitutes the Cat hydraulic mining shovel product line. The name of each individual model gives a direct reference to the size of the machine and consists of a four-digit number.

The first digit designates the 6000 Series and is followed by another three digits indicating the approximate bucket payload of that model in metric tonnes. 6015 and 6020B models are only available with a backhoe attachment and buckets while 6030 and larger models are also available with a face shovel attachment.

The following table gives a summary of all versions currently available.

Backhoe	Front Shovel
6015	N/A
6020B	N/A
6030	6030
6040	6040
6060	6060

N/A = Not Available

Technical Specifications

All data given herewith is subject to change. The specalogs/spec sheets for individual models may have been updated after publishing of this Performance Handbook edition.

Contact Details

If there are any questions or comments regarding the information on hydraulic mining shovels given in this chapter please contact:

Feddern_Nils@cat.com or
Tegtmeier_Dirk@cat.com

TriPower

On all face shovel (FS) models, Caterpillar uses a unique boom design, called TriPower, that employs rotatable triangular rockers to generate superior mechanical leverage and control. This unique Caterpillar design results in:

- Increased effective lifting force
- Constant boom momentum
- Automatic constant bucket angle position in horizontal and vertical direction
- Automatic roll-back limiter

Furthermore, the TriPower system enables Cat hydraulic front shovels to use smaller-diameter boom cylinders. This benefit results in faster lifting speeds.

Superior Oil Cooling System

From 6020B up to 6060 the independent oil cooling system utilizes dedicated pumps to provide cooling capacity as needed, whether the engine is idling or under load, whereas conventional cooling systems only provide cooling when the engine is under load and the machine is working. Consequently, on these models the hydraulic oil circulates through the cooling system even when the machine is waiting for the next truck. This system provides a more efficient means of cooling, particularly in demanding applications. The radiator fan speed is thermostatically controlled for greater efficiency.

Closed-Loop Swing Circuit

The Cat closed-loop swing circuit results in fast implement motions during swing. The kinetic energy of the swing motion is used during deceleration to support driving the main and auxiliary pumps. Compared to conventional open circuit systems, the Cat closed-loop swing circuit is more energy-efficient, generates less heat and delivers faster cycle times.

The 6020B includes an open-loop swing circuit due to its newly designed advanced hydraulics. Utilizing dedicated pump flow allocation technology, hydraulic pumps are allocated to individual circuits on demand, allowing all produced oil flow to be translated into cylinder motion, minimizing hydraulic inefficiencies and heat generation. To fully leverage the advantages of this innovative technology, the open-loop swing system was incorporated for its use of a common set of pumps to serve all functions and the flexibility it offers for utilization of hydraulic flow.

Simple and Efficient Hydraulic System

From 6020B up to 6060 the main hydraulic valve block is located on top of the boom. This design reduces the total number of hoses that are needed and ensures they are neatly organized for safe operation, easy inspection and fast service. Because float valves are used to lower the boom instead of engaging pumps, the boom moves faster and other operating functions can occur simultaneously, such as bucket curl and stick in/out. This results in faster cycle times.

Monitoring and Diagnostic System

Enhancing diagnostic capabilities and providing detailed troubleshooting functions, the machine control system uses sensors throughout the machine to monitor operating data, record faults, and notify the operator audibly and visually. This promotes the earliest possible detection of faults and allows for timely maintenance planning and assistance for speedy repair.

Machine Accessibility

Systems throughout Cat hydraulic mining shovels are designed for easy access, enhancing serviceability.

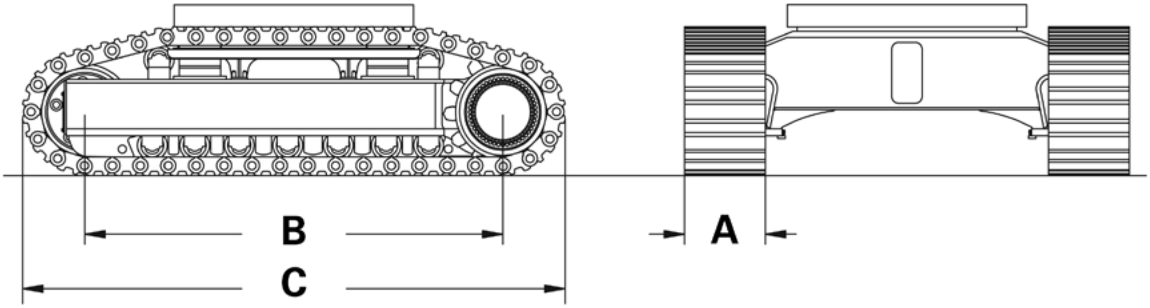
- **Hydraulic Valve Block** — The valve block is located on the boom where it's cleanly laid out and easily accessed by walkways on both sides. This reduces the number of hoses leading from the superstructure.
- **Superstructure** — Exceptional accessibility is provided to systems like the swing motor, swing gearbox and rotary distributor in the well-organized superstructure. The engine is accessible from three sides on most models.

GROUND PRESSURE

The ground pressure specifies the specific weight load transferred to the surface, and can be an indicator for the stability against subsidence. Though such conditions typically apply to smaller excavators in heavy earthmoving operations, there could be rare instances where this may apply in mining applications. Nevertheless, the vast majority of hydraulic mining shovels are delivered with standard track shoes.

The value is determined by setting the machine weight force in relation to the ground contact area of the tracks.

Ground Contact Area



Keys

A = Width of standard track shoe
B = Track length, idler center to sprocket center
C = Overall track length, grouser bar to grouser bar

To define the ground contact area on soft ground the following formula is used (ISO 16754):

$$2 \times A \times (B + (C - B) \times 0.35)$$

Optional Track Pads

In addition to the standard track shoes, optional track pads with different widths are available; however, these optional track pads are only procured on machine orders, and may therefore effect the lead time of the entire hydraulic mining shovel. Furthermore, a front shovel (FS) configured machine equipped with wider track pads increases the risk of track pad damage from bucket strikes.

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BUCKET SELECTION

To maximize the durability and life expectancy of Hydraulic Mining Shovels, it is important to choose the correct bucket size based on the maximum loose density of the material to be loaded. Different bucket volumes for common material densities are available for most models. A loose density of 1.8 t/m^3 (3030 lb/yd^3) is considered standard and the respective bucket volume is suitable for the majority of applications. Additional bucket sizes are offered for lighter or heavier materials.

Rated Bucket Capacity

The following standards are used to determine the rated bucket capacity:

ISO 7451 for backhoe buckets
ISO 7546 for face shovel buckets

Rated bucket capacity for Hydraulic Mining Shovels is calculated with different bucket tilt angles for backhoe and face shovel buckets. The linkage geometry on backhoe attachments allows for larger bucket tilt angles allowing steaper heaps compared to face shovel buckets. Therefore, the nominal bucket capacity is calculated on backhoe buckets with a heap of 1:1, and on face shovel buckets with a heap of 2:1 as shown in the adjacent example sketch.

Nominal Bucket Material Density Ratings and Classification

Each bucket is classified using a nominal material density value that allows 100% fill factor using a standard configuration e.g. penetration style tips.

The following density categories are used:

Light Rock	Nominal loose density < 1.75 t/m^3
Standard Rock	1.95 t/m^3 > loose density > 1.75 t/m^3
Heavy Rock	Nominal loose density > 2.0 t/m^3

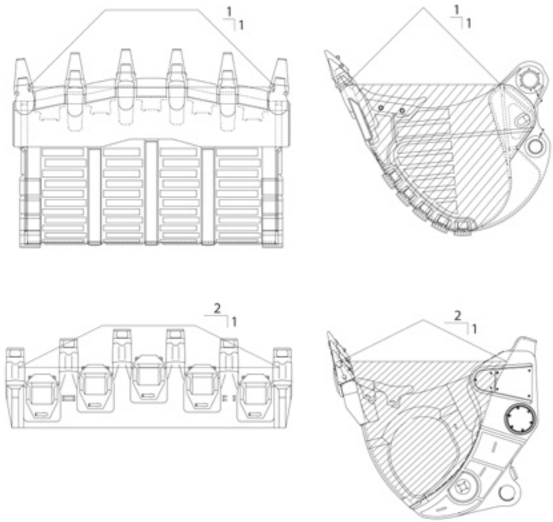
Coal buckets are suitable for material density up to 1.5 t/m^3 (2,540 $lb./yd^3$), depending on the configuration.

Hydraulic Mining Shovel backhoe and face shovel buckets use two additional descriptions of the wear package; Type and Duty.

Abrasion type wear packages use the hardest materials and are for excavated material that causes wear mainly through sliding.

Impact type wear packages use hard but tough materials and are for excavated material which is large and blocky in size.

The wear package also uses a "Duty" rating using three levels; "Extreme Duty", "Heavy Duty" and "Standard Duty". Extreme Duty wear packages provide the highest thickness and wear resistance but add the most weight to the bucket weight and reduce the available payload. Standard Duty wear packages provide the lowest resistance but add the least amount to the bucket weight.



Practical Bucket Capacity

The ratio of actual material volume or mass versus theoretical capacity is defined as the fill factor. Depending on the material, level of fragmentation, operating practice and machine setup, the actual fill factor with each pass can be more or less than 100%. An experienced, well-trained operator achieves between 90-95% fill factor in reasonably blasted material.

HMS PAYLOAD MANAGEMENT GUIDELINES

The total gross bucket weight and maximum material payload is defined as the Rated Swung Load (RSL). This value is published for each configuration of Hydraulic Mining Shovel. Refer to PEBJ0162 for further information.

Nominal Rated Payload is a reference value for a standard configuration with a loose material density of 1.8 t/m^3 (3,030 lb/yd^3).

Field Rated Payload is a specific calculation for a machine configuration including attachment, bucket and GET that can be used for productivity and truck match calculations for a unique customer application.

The Payload Management Guidelines allow buckets to be used with higher or lower density materials with varying fill factor results that still comply with the rated material payload and RSL. Rated payloads are published at 100% of allowed weight, even though a bucket can be filled beyond this and Caterpillar does allow up to 110% of Rated Payload on an infrequent basis.

Payloads of 80%-100% of Rated Payload result in higher productivity without reducing the life of structures and components. Excessive loads will likely reduce the life of structures and components thereby reducing the economic life of the machine.

Payloads from 100%-110% of Rated Payload can reduce life depending on the amount and duration of overloading.

Payloads between 100%-110% of Rated Payload should occur on no more than 10% of the loads.

The Maximum Allowable Payload is 110% of the Field Rated Payload.

CYCLE TIMES

The cycle time of a hydraulic mining shovel is an important productivity factor, and a key driver for high or low performance. There are two main areas that influence cycle times. One factor is the pure technical capability of the hydraulic mining shovel. The engine output and associated hydraulic power defines the maximum available oil flow, which consequently determines the speed of the hydraulic cylinders and swing drives, and ultimately the achievable working speed of the machine. The other factor is site specific parameters, such as operator skill, bench height (in particular for hydraulic front shovels), and swing angle, will impact cycle times considerably. Material fragmentation and penetration resistance make a big difference, as well.

Large hydraulic mining shovels are used as the prime mover in most applications. Therefore, the set-up of the loading area is pre-considered to be favorable for productive loading conditions when defining cycle times. Those are for example:

	For backhoe machines	For face shovel machines
Truck position	lower level	same level
Average swing angle	60°–90°	90°
Bench height	similar to stick length	75% of max. reach height

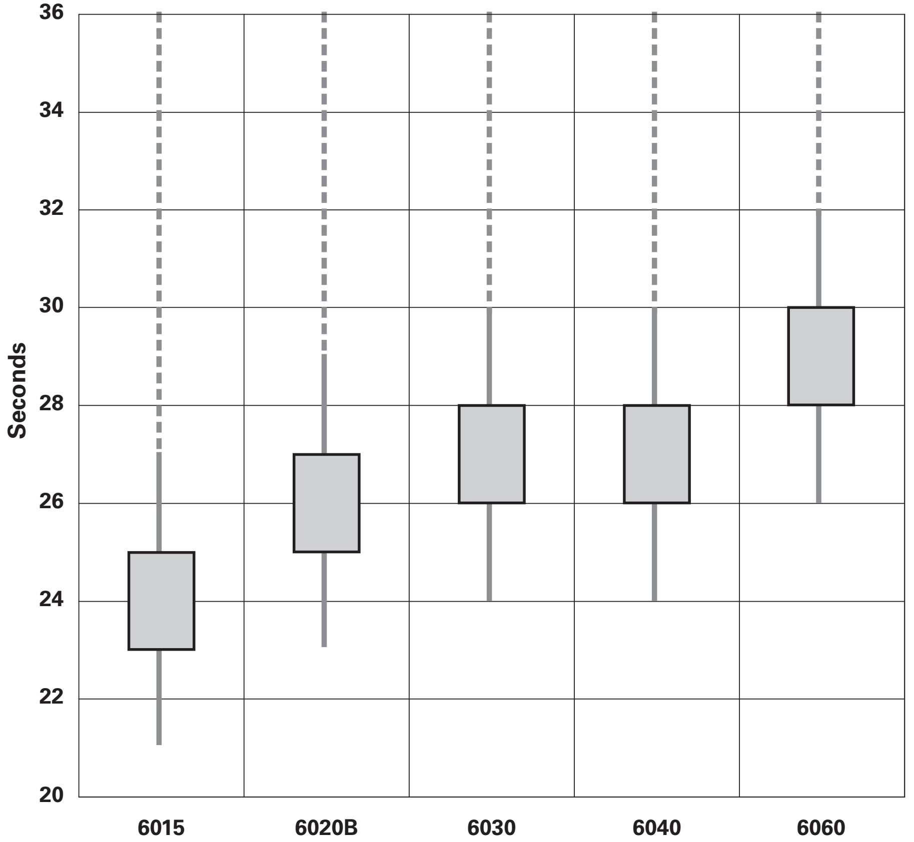
A complete working cycle of a hydraulic mining shovel can be separated into four segments:

- Bucket fill
- Swing loaded
- Dump
- Swing empty

However, the bucket fill process constitutes the main fraction of the loading cycle, with a portion between 40% and 50% of the total time. This is heavily influenced by the material parameters, therefore, the different cycle times, shown for each model in the attached diagram, only consider the increasing effort to fill the bucket:

- **Ideal loading conditions** — Loose material, such as dry sand, soil and gravel, or re-handled or tipped material with no effort to achieve a good fill. Bucket can penetrate anywhere in the face or pile without resistance.
- **Average loading conditions** — Soft overburden with low grade of compaction, and well-shot material with good and consistent fragmentation. Operator doesn't have to concentrate on loosening or finding the right spot for penetration.
- **Fair digging conditions** — Shot rock with partially interlocked sections, or compacted overburden, requiring some effort to loosen the material.
- **Difficult digging conditions** — Inhomogeneous shot rock with some oversized boulders and interlocking, or unblasted material. Also free digging applications in sediment type of rock with fractures and layers which allow to penetrate the material. Considerable effort required to break out material.
- **Severe digging conditions** — Poorly shot rock with a large amount of oversized boulders and/or heavily interlocked material in the majority of the face. Also free digging operations with high digging resistance. In those conditions neither cycle times nor bucket fills are predictable.

Cycle Time Estimating Chart



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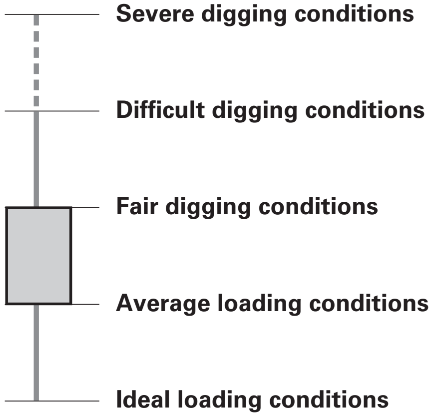


NOTE: The cycle times mentioned above are a guideline under the described application conditions.

Actual achievable cycle times depend on site specific conditions.

PRODUCTION OVERVIEWS

As with any other material loading machine, the productivity of a Hydraulic Mining Shovel depends on various aspects. These influencing factors are either defined by machine specifications, such as bucket capacity, or by application conditions and operator skills, such as bucket fill factor and cycle time. In addition, there are parameters, which fall neither under the hydrauilc mining shovel's physical capabilities, nor can they be controlled by the shovel operator or the set-up of the loading area. The major factors in this category are truck exchange time and overall mine efficiency.

The following tables indicate, for a typical hydraulic mining shovel/truck combination, the wide range of productivity figures under various conditions. The overall mine efficiency starts at 83%, which corresponds to 50 minutes per hour. This efficiency is generally achievable only during a short period of time, and could be the relevant factor for a short time production test. However, in the long-run, the overall mine efficiency tends to be in the 65% to 75% range. The grey highlighted area illustrates average productivity figures which can be expected under typical site conditions in well organized mines.

Furthermore, the size of the truck, and the required number of passes to load it, has an effect on hydraulic mining shovel productivity. The larger the truck, the higher the hydraulic mining shovel's productivity will be, because unproductive truck exchange time will be reduced.

The figures in the following tables given in t/h (tons/h) means the production per net loading hour and not per service meter units [SMU].

MODEL: 6015 ● Bucket Size: 8.1 m³ ● Number of Cycles: 4 ● Material Density: 1.80 t/m³

		Bucket Fill Factor	100%				95%			
		Load per Bucket	14.6 t				13.9 t			
		Load per Truck	58 t				55 t			
Overall Mine Efficiency	Truck Exchange	Cycle Time	21 sec	23 sec	25 sec	27 sec	21 sec	23 sec	25 sec	27 sec
			0.35 min	**0.38 min**	**0.42 min**	**0.45 min**	**0.35 min**	**0.38 min**	**0.42 min**	**0.45 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	1818 t/h	1721 t/h	1607 t/h	1531 t/h	1724 t/h	1633 t/h	1524 t/h	1452 t/h
	42 sec	**0.70 min**	1616 t/h	1539 t/h	1447 t/h	1385 t/h	1533 t/h	1460 t/h	1373 t/h	1314 t/h
	54 sec	**0.90 min**	1454 t/h	1392 t/h	1316 t/h	1264 t/h	1380 t/h	1320 t/h	1248 t/h	1200 t/h
	66 sec	**1.10 min**	1322 t/h	1270 t/h	1207 t/h	1163 t/h	1254 t/h	1205 t/h	1145 t/h	1104 t/h
80%	30 sec	**0.50 min**	1745 t/h	1652 t/h	1543 t/h	1470 t/h	1656 t/h	1568 t/h	1464 t/h	1394 t/h
	42 sec	**0.70 min**	1551 t/h	1478 t/h	1389 t/h	1330 t/h	1472 t/h	1402 t/h	1318 t/h	1262 t/h
	54 sec	**0.90 min**	1396 t/h	1336 t/h	1264 t/h	1214 t/h	1325 t/h	1268 t/h	1199 t/h	1152 t/h
	66 sec	**1.10 min**	1269 t/h	1220 t/h	1159 t/h	1117 t/h	1204 t/h	1157 t/h	1099 t/h	1060 t/h
75%	30 sec	**0.50 min**	1636 t/h	1549 t/h	1446 t/h	1378 t/h	1552 t/h	1469 t/h	1372 t/h	1307 t/h
	42 sec	**0.70 min**	1454 t/h	1385 t/h	1302 t/h	1246 t/h	1380 t/h	1314 t/h	1235 t/h	1182 t/h
	54 sec	**0.90 min**	1309 t/h	1252 t/h	1184 t/h	1138 t/h	1242 t/h	1188 t/h	1124 t/h	1080 t/h
	66 sec	**1.10 min**	1190 t/h	1143 t/h	1086 t/h	1047 t/h	1129 t/h	1084 t/h	1030 t/h	993 t/h
70%	30 sec	**0.50 min**	1526 t/h	1445 t/h	1349 t/h	1285 t/h	1448 t/h	1371 t/h	1280 t/h	1219 t/h
	42 sec	**0.70 min**	1357 t/h	1292 t/h	1215 t/h	1163 t/h	1287 t/h	1226 t/h	1153 t/h	1103 t/h
	54 sec	**0.90 min**	1221 t/h	1169 t/h	1105 t/h	1062 t/h	1158 t/h	1109 t/h	1048 t/h	1007 t/h
	66 sec	**1.10 min**	1110 t/h	1067 t/h	1013 t/h	977 t/h	1053 t/h	1012 t/h	961 t/h	927 t/h
65%	30 sec	**0.50 min**	1417 t/h	1341 t/h	1253 t/h	1193 t/h	1344 t/h	1273 t/h	1188 t/h	1132 t/h
	42 sec	**0.70 min**	1259 t/h	1200 t/h	1128 t/h	1080 t/h	1195 t/h	1138 t/h	1070 t/h	1024 t/h
	54 sec	**0.90 min**	1134 t/h	1085 t/h	1026 t/h	986 t/h	1075 t/h	1029 t/h	973 t/h	935 t/h
	66 sec	**1.10 min**	1030 t/h	990 t/h	941 t/h	907 t/h	978 t/h	939 t/h	892 t/h	860 t/h

		Bucket Fill Factor	90%				85%			
		Load per Bucket	13.1 t				12.4 t			
		Load per Truck	52 t				50 t			
Overall Mine Efficiency	Truck Exchange	Cycle Time	21 sec	23 sec	25 sec	27 sec	21 sec	23 sec	25 sec	27 sec
			0.35 min	**0.38 min**	**0.42 min**	**0.45 min**	**0.35 min**	**0.38 min**	**0.42 min**	**0.45 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	1634 t/h	1547 t/h	1444 t/h	1376 t/h	1543 t/h	1461 t/h	1364 t/h	1299 t/h
	42 sec	**0.70 min**	1452 t/h	1383 t/h	1300 t/h	1245 t/h	1371 t/h	1306 t/h	1228 t/h	1176 t/h
	54 sec	**0.90 min**	1307 t/h	1251 t/h	1183 t/h	1136 t/h	1234 t/h	1181 t/h	1117 t/h	1073 t/h
	66 sec	**1.10 min**	1188 t/h	1141 t/h	1085 t/h	1046 t/h	1122 t/h	1078 t/h	1024 t/h	987 t/h
80%	30 sec	**0.50 min**	1569 t/h	1485 t/h	1387 t/h	1321 t/h	1482 t/h	1403 t/h	1310 t/h	1248 t/h
	42 sec	**0.70 min**	1394 t/h	1328 t/h	1249 t/h	1195 t/h	1317 t/h	1254 t/h	1179 t/h	1129 t/h
	54 sec	**0.90 min**	1255 t/h	1201 t/h	1136 t/h	1091 t/h	1185 t/h	1134 t/h	1073 t/h	1031 t/h
	66 sec	**1.10 min**	1141 t/h	1096 t/h	1041 t/h	1004 t/h	1078 t/h	1035 t/h	984 t/h	948 t/h
75%	30 sec	**0.50 min**	1470 t/h	1392 t/h	1300 t/h	1238 t/h	1389 t/h	1315 t/h	1228 t/h	1169 t/h
	42 sec	**0.70 min**	1307 t/h	1245 t/h	1170 t/h	1120 t/h	1234 t/h	1176 t/h	1105 t/h	1058 t/h
	54 sec	**0.90 min**	1176 t/h	1126 t/h	1064 t/h	1023 t/h	1111 t/h	1063 t/h	1005 t/h	966 t/h
	66 sec	**1.10 min**	1069 t/h	1027 t/h	976 t/h	941 t/h	1010 t/h	970 t/h	922 t/h	889 t/h
70%	30 sec	**0.50 min**	1372 t/h	1299 t/h	1213 t/h	1155 t/h	1296 t/h	1227 t/h	1145 t/h	1091 t/h
	42 sec	**0.70 min**	1219 t/h	1161 t/h	1092 t/h	1045 t/h	1152 t/h	1097 t/h	1031 t/h	987 t/h
	54 sec	**0.90 min**	1098 t/h	1050 t/h	993 t/h	954 t/h	1037 t/h	992 t/h	938 t/h	901 t/h
	66 sec	**1.10 min**	998 t/h	959 t/h	911 t/h	878 t/h	942 t/h	905 t/h	860 t/h	829 t/h
65%	30 sec	**0.50 min**	1273 t/h	1206 t/h	1126 t/h	1072 t/h	1203 t/h	1139 t/h	1063 t/h	1013 t/h
	42 sec	**0.70 min**	1132 t/h	1078 t/h	1014 t/h	970 t/h	1069 t/h	1018 t/h	957 t/h	916 t/h
	54 sec	**0.90 min**	1019 t/h	975 t/h	922 t/h	886 t/h	962 t/h	921 t/h	871 t/h	837 t/h
	66 sec	**1.10 min**	926 t/h	890 t/h	845 t/h	815 t/h	875 t/h	840 t/h	799 t/h	770 t/h

MODEL: 6015 • Bucket Size: 10.6 yd^3 • Number of Cycles: 4 • Material Density: 3030 lb/yd^3

		Bucket Fill Factor	100%				95%			
		Load per Bucket	16.1 tons				15.3 tons			
		Load per Truck	64 tons				61 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	21 sec	23 sec	25 sec	27 sec	21 sec	23 sec	25 sec	27 sec
			0.35 min	**0.38 min**	**0.42 min**	**0.45 min**	**0.35 min**	**0.38 min**	**0.42 min**	**0.45 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	2004 tons/h	1897 tons/h	1771 tons/h	1687 tons/h	1901 tons/h	1800 tons/h	1680 tons/h	1601 tons/h
	42 sec	**0.70 min**	1781 tons/h	1696 tons/h	1595 tons/h	1527 tons/h	1690 tons/h	1609 tons/h	1513 tons/h	1448 tons/h
	54 sec	**0.90 min**	1603 tons/h	1534 tons/h	1451 tons/h	1394 tons/h	1521 tons/h	1455 tons/h	1376 tons/h	1322 tons/h
	66 sec	**1.10 min**	1457 tons/h	1400 tons/h	1330 tons/h	1282 tons/h	1382 tons/h	1328 tons/h	1262 tons/h	1217 tons/h
80%	30 sec	**0.50 min**	1924 tons/h	1822 tons/h	1701 tons/h	1620 tons/h	1825 tons/h	1728 tons/h	1614 tons/h	1537 tons/h
	42 sec	**0.70 min**	1710 tons/h	1629 tons/h	1532 tons/h	1466 tons/h	1622 tons/h	1545 tons/h	1453 tons/h	1391 tons/h
	54 sec	**0.90 min**	1539 tons/h	1473 tons/h	1393 tons/h	1338 tons/h	1460 tons/h	1397 tons/h	1321 tons/h	1270 tons/h
	66 sec	**1.10 min**	1399 tons/h	1344 tons/h	1277 tons/h	1231 tons/h	1327 tons/h	1275 tons/h	1212 tons/h	1168 tons/h
75%	30 sec	**0.50 min**	1803 tons/h	1707 tons/h	1594 tons/h	1519 tons/h	1711 tons/h	1620 tons/h	1512 tons/h	1441 tons/h
	42 sec	**0.70 min**	1603 tons/h	1527 tons/h	1435 tons/h	1374 tons/h	1521 tons/h	1448 tons/h	1362 tons/h	1303 tons/h
	54 sec	**0.90 min**	1443 tons/h	1381 tons/h	1306 tons/h	1254 tons/h	1369 tons/h	1310 tons/h	1239 tons/h	1190 tons/h
	66 sec	**1.10 min**	1311 tons/h	1260 tons/h	1197 tons/h	1154 tons/h	1244 tons/h	1195 tons/h	1136 tons/h	1095 tons/h
70%	30 sec	**0.50 min**	1683 tons/h	1593 tons/h	1487 tons/h	1417 tons/h	1596 tons/h	1511 tons/h	1411 tons/h	1344 tons/h
	42 sec	**0.70 min**	1496 tons/h	1424 tons/h	1339 tons/h	1282 tons/h	1419 tons/h	1351 tons/h	1271 tons/h	1216 tons/h
	54 sec	**0.90 min**	1346 tons/h	1288 tons/h	1218 tons/h	1171 tons/h	1277 tons/h	1222 tons/h	1156 tons/h	1110 tons/h
	66 sec	**1.10 min**	1224 tons/h	1176 tons/h	1117 tons/h	1077 tons/h	1161 tons/h	1115 tons/h	1060 tons/h	1022 tons/h
65%	30 sec	**0.50 min**	1562 tons/h	1479 tons/h	1381 tons/h	1315 tons/h	1482 tons/h	1403 tons/h	1310 tons/h	1248 tons/h
	42 sec	**0.70 min**	1388 tons/h	1322 tons/h	1243 tons/h	1190 tons/h	1317 tons/h	1254 tons/h	1180 tons/h	1129 tons/h
	54 sec	**0.90 min**	1250 tons/h	1196 tons/h	1131 tons/h	1087 tons/h	1185 tons/h	1134 tons/h	1073 tons/h	1031 tons/h
	66 sec	**1.10 min**	1136 tons/h	1091 tons/h	1037 tons/h	1000 tons/h	1078 tons/h	1035 tons/h	984 tons/h	948 tons/h

		Bucket Fill Factor	90%				85%			
		Load per Bucket	14.5 tons				13.7 tons			
		Load per Truck	58 tons				55 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	21 sec	23 sec	25 sec	27 sec	21 sec	23 sec	25 sec	27 sec
			0.35 min	**0.38 min**	**0.42 min**	**0.45 min**	**0.35 min**	**0.38 min**	**0.42 min**	**0.45 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	1801 tons/h	1705 tons/h	1592 tons/h	1516 tons/h	1701 tons/h	1610 tons/h	1503 tons/h	1432 tons/h
	42 sec	**0.70 min**	1601 tons/h	1525 tons/h	1433 tons/h	1372 tons/h	1512 tons/h	1440 tons/h	1354 tons/h	1296 tons/h
	54 sec	**0.90 min**	1441 tons/h	1379 tons/h	1304 tons/h	1253 tons/h	1361 tons/h	1302 tons/h	1231 tons/h	1183 tons/h
	66 sec	**1.10 min**	1310 tons/h	1258 tons/h	1196 tons/h	1153 tons/h	1237 tons/h	1188 tons/h	1129 tons/h	1089 tons/h
80%	30 sec	**0.50 min**	1729 tons/h	1637 tons/h	1529 tons/h	1456 tons/h	1633 tons/h	1546 tons/h	1444 tons/h	1375 tons/h
	42 sec	**0.70 min**	1537 tons/h	1464 tons/h	1377 tons/h	1318 tons/h	1452 tons/h	1383 tons/h	1300 tons/h	1244 tons/h
	54 sec	**0.90 min**	1383 tons/h	1324 tons/h	1252 tons/h	1203 tons/h	1307 tons/h	1250 tons/h	1182 tons/h	1136 tons/h
	66 sec	**1.10 min**	1258 tons/h	1208 tons/h	1148 tons/h	1107 tons/h	1188 tons/h	1141 tons/h	1084 tons/h	1045 tons/h
75%	30 sec	**0.50 min**	1621 tons/h	1534 tons/h	1433 tons/h	1365 tons/h	1531 tons/h	1449 tons/h	1353 tons/h	1289 tons/h
	42 sec	**0.70 min**	1441 tons/h	1372 tons/h	1290 tons/h	1235 tons/h	1361 tons/h	1296 tons/h	1218 tons/h	1166 tons/h
	54 sec	**0.90 min**	1297 tons/h	1241 tons/h	1173 tons/h	1127 tons/h	1225 tons/h	1172 tons/h	1108 tons/h	1065 tons/h
	66 sec	**1.10 min**	1179 tons/h	1132 tons/h	1076 tons/h	1037 tons/h	1113 tons/h	1069 tons/h	1016 tons/h	980 tons/h
70%	30 sec	**0.50 min**	1512 tons/h	1432 tons/h	1337 tons/h	1273 tons/h	1428 tons/h	1352 tons/h	1263 tons/h	1203 tons/h
	42 sec	**0.70 min**	1344 tons/h	1280 tons/h	1204 tons/h	1152 tons/h	1270 tons/h	1209 tons/h	1137 tons/h	1088 tons/h
	54 sec	**0.90 min**	1210 tons/h	1158 tons/h	1095 tons/h	1052 tons/h	1143 tons/h	1093 tons/h	1034 tons/h	994 tons/h
	66 sec	**1.10 min**	1100 tons/h	1057 tons/h	1004 tons/h	968 tons/h	1039 tons/h	998 tons/h	948 tons/h	914 tons/h
65%	30 sec	**0.50 min**	1404 tons/h	1329 tons/h	1241 tons/h	1182 tons/h	1326 tons/h	1255 tons/h	1172 tons/h	1116 tons/h
	42 sec	**0.70 min**	1248 tons/h	1188 tons/h	1117 tons/h	1070 tons/h	1178 tons/h	1122 tons/h	1055 tons/h	1010 tons/h
	54 sec	**0.90 min**	1123 tons/h	1075 tons/h	1016 tons/h	977 tons/h	1061 tons/h	1015 tons/h	960 tons/h	922 tons/h
	66 sec	**1.10 min**	1021 tons/h	981 tons/h	932 tons/h	898 tons/h	964 tons/h	926 tons/h	880 tons/h	849 tons/h

MODEL: 6020B ● Bucket Size: 12.0 m³ ● Number of Cycles: 4 ● Material Density: 1.80 t/m³

	Bucket Fill Factor		**100%**				**95%**			
	Load per Bucket		21.6 t				20.5 t			
	Load per Truck		86 t				82 t			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	23 sec	25 sec	27 sec	29 sec	23 sec	25 sec	27 sec	29 sec
			0.38 min	**0.42 min**	**0.45 min**	**0.48 min**	**0.38 min**	**0.42 min**	**0.45 min**	**0.48 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	2546 t/h	2377 t/h	2265 t/h	2162 t/h	2419 t/h	2258 t/h	2151 t/h	2054 t/h
	42 sec	**0.70 min**	2277 t/h	2141 t/h	2049 t/h	1965 t/h	2163 t/h	2034 t/h	1946 t/h	1866 t/h
	54 sec	**0.90 min**	2059 t/h	1947 t/h	1871 t/h	1800 t/h	1956 t/h	1850 t/h	1777 t/h	1710 t/h
	66 sec	**1.10 min**	1879 t/h	1785 t/h	1721 t/h	1661 t/h	1785 t/h	1696 t/h	1635 t/h	1578 t/h
80%	30 sec	**0.50 min**	2445 t/h	2283 t/h	2175 t/h	2076 t/h	2323 t/h	2169 t/h	2066 t/h	1972 t/h
	42 sec	**0.70 min**	2186 t/h	2056 t/h	1967 t/h	1887 t/h	2077 t/h	1953 t/h	1869 t/h	1792 t/h
	54 sec	**0.90 min**	1977 t/h	1870 t/h	1796 t/h	1729 t/h	1878 t/h	1776 t/h	1707 t/h	1642 t/h
	66 sec	**1.10 min**	1804 t/h	1714 t/h	1653 t/h	1595 t/h	1714 t/h	1629 t/h	1570 t/h	1515 t/h
75%	30 sec	**0.50 min**	2291 t/h	2139 t/h	2038 t/h	1946 t/h	2177 t/h	2033 t/h	1936 t/h	1849 t/h
	42 sec	**0.70 min**	2049 t/h	1927 t/h	1844 t/h	1768 t/h	1946 t/h	1830 t/h	1752 t/h	1680 t/h
	54 sec	**0.90 min**	1853 t/h	1752 t/h	1684 t/h	1620 t/h	1760 t/h	1665 t/h	1599 t/h	1539 t/h
	66 sec	**1.10 min**	1691 t/h	1607 t/h	1549 t/h	1495 t/h	1606 t/h	1526 t/h	1472 t/h	1420 t/h
70%	30 sec	**0.50 min**	2138 t/h	1996 t/h	1902 t/h	1816 t/h	2031 t/h	1896 t/h	1807 t/h	1725 t/h
	42 sec	**0.70 min**	1912 t/h	1798 t/h	1721 t/h	1650 t/h	1816 t/h	1708 t/h	1635 t/h	1567 t/h
	54 sec	**0.90 min**	1729 t/h	1635 t/h	1571 t/h	1512 t/h	1642 t/h	1553 t/h	1492 t/h	1436 t/h
	66 sec	**1.10 min**	1578 t/h	1499 t/h	1445 t/h	1395 t/h	1499 t/h	1424 t/h	1373 t/h	1325 t/h
65%	30 sec	**0.50 min**	1985 t/h	1853 t/h	1765 t/h	1685 t/h	1885 t/h	1760 t/h	1677 t/h	1601 t/h
	42 sec	**0.70 min**	1775 t/h	1669 t/h	1597 t/h	1532 t/h	1686 t/h	1585 t/h	1517 t/h	1455 t/h
	54 sec	**0.90 min**	1605 t/h	1518 t/h	1458 t/h	1403 t/h	1525 t/h	1442 t/h	1385 t/h	1333 t/h
	66 sec	**1.10 min**	1465 t/h	1392 t/h	1342 t/h	1295 t/h	1391 t/h	1322 t/h	1275 t/h	1230 t/h

	Bucket Fill Factor		**90%**				**85%**			
	Load per Bucket		19.4 t				18.4 t			
	Load per Truck		78 t				73 t			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	23 sec	25 sec	27 sec	29 sec	23 sec	25 sec	27 sec	29 sec
			0.38 min	**0.42 min**	**0.45 min**	**0.48 min**	**0.38 min**	**0.42 min**	**0.45 min**	**0.48 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	2291 t/h	2139 t/h	2038 t/h	1946 t/h	2164 t/h	2021 t/h	1925 t/h	1838 t/h
	42 sec	**0.70 min**	2049 t/h	1927 t/h	1844 t/h	1768 t/h	1935 t/h	1820 t/h	1742 t/h	1670 t/h
	54 sec	**0.90 min**	1853 t/h	1752 t/h	1684 t/h	1620 t/h	1750 t/h	1655 t/h	1590 t/h	1530 t/h
	66 sec	**1.10 min**	1691 t/h	1607 t/h	1549 t/h	1495 t/h	1597 t/h	1518 t/h	1463 t/h	1412 t/h
80%	30 sec	**0.50 min**	2200 t/h	2054 t/h	1957 t/h	1869 t/h	2078 t/h	1940 t/h	1848 t/h	1765 t/h
	42 sec	**0.70 min**	1967 t/h	1850 t/h	1771 t/h	1698 t/h	1858 t/h	1747 t/h	1672 t/h	1604 t/h
	54 sec	**0.90 min**	1779 t/h	1683 t/h	1617 t/h	1556 t/h	1680 t/h	1589 t/h	1527 t/h	1469 t/h
	66 sec	**1.10 min**	1624 t/h	1543 t/h	1487 t/h	1436 t/h	1534 t/h	1457 t/h	1405 t/h	1356 t/h
75%	30 sec	**0.50 min**	2062 t/h	1926 t/h	1834 t/h	1751 t/h	1948 t/h	1819 t/h	1732 t/h	1654 t/h
	42 sec	**0.70 min**	1844 t/h	1734 t/h	1660 t/h	1591 t/h	1742 t/h	1638 t/h	1567 t/h	1503 t/h
	54 sec	**0.90 min**	1668 t/h	1577 t/h	1515 t/h	1458 t/h	1575 t/h	1489 t/h	1431 t/h	1377 t/h
	66 sec	**1.10 min**	1522 t/h	1446 t/h	1394 t/h	1346 t/h	1437 t/h	1366 t/h	1317 t/h	1271 t/h
70%	30 sec	**0.50 min**	1924 t/h	1797 t/h	1712 t/h	1634 t/h	1817 t/h	1697 t/h	1616 t/h	1543 t/h
	42 sec	**0.70 min**	1721 t/h	1618 t/h	1549 t/h	1485 t/h	1625 t/h	1528 t/h	1463 t/h	1402 t/h
	54 sec	**0.90 min**	1556 t/h	1471 t/h	1414 t/h	1361 t/h	1470 t/h	1390 t/h	1335 t/h	1285 t/h
	66 sec	**1.10 min**	1420 t/h	1349 t/h	1301 t/h	1256 t/h	1341 t/h	1274 t/h	1229 t/h	1186 t/h
65%	30 sec	**0.50 min**	1786 t/h	1668 t/h	1589 t/h	1517 t/h	1687 t/h	1575 t/h	1500 t/h	1433 t/h
	42 sec	**0.70 min**	1597 t/h	1502 t/h	1437 t/h	1378 t/h	1508 t/h	1418 t/h	1358 t/h	1302 t/h
	54 sec	**0.90 min**	1444 t/h	1366 t/h	1312 t/h	1263 t/h	1364 t/h	1290 t/h	1240 t/h	1193 t/h
	66 sec	**1.10 min**	1318 t/h	1253 t/h	1207 t/h	1165 t/h	1245 t/h	1183 t/h	1140 t/h	1101 t/h

MODEL: 6020B ● Bucket Size: 15.7 yd³ ● Number of Cycles: 4 ● Material Density: 3030 lb/yd³

		Bucket Fill Factor	100%				95%			
		Load per Bucket	23.8 tons				22.6 tons			
		Load per Truck	95 tons				90 tons			
Overall Mine Efficiency	Truck Exchange	Cycle Time	23 sec	25 sec	27 sec	29 sec	23 sec	25 sec	27 sec	29 sec
			0.38 min	**0.42 min**	**0.45 min**	**0.48 min**	**0.38 min**	**0.42 min**	**0.45 min**	**0.48 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	2806 tons/h	2620 tons/h	2496 tons/h	2383 tons/h	2666 tons/h	2489 tons/h	2371 tons/h	2264 tons/h
	42 sec	**0.70 min**	2509 tons/h	2360 tons/h	2259 tons/h	2166 tons/h	2384 tons/h	2242 tons/h	2146 tons/h	2057 tons/h
	54 sec	**0.90 min**	2269 tons/h	2146 tons/h	2062 tons/h	1984 tons/h	2156 tons/h	2039 tons/h	1959 tons/h	1885 tons/h
	66 sec	**1.10 min**	2071 tons/h	1968 tons/h	1897 tons/h	1831 tons/h	1968 tons/h	1870 tons/h	1802 tons/h	1740 tons/h
80%	30 sec	**0.50 min**	2695 tons/h	2516 tons/h	2397 tons/h	2289 tons/h	2560 tons/h	2390 tons/h	2277 tons/h	2174 tons/h
	42 sec	**0.70 min**	2410 tons/h	2266 tons/h	2169 tons/h	2080 tons/h	2289 tons/h	2153 tons/h	2060 tons/h	1976 tons/h
	54 sec	**0.90 min**	2179 tons/h	2061 tons/h	1980 tons/h	1906 tons/h	2070 tons/h	1958 tons/h	1881 tons/h	1810 tons/h
	66 sec	**1.10 min**	1989 tons/h	1890 tons/h	1822 tons/h	1758 tons/h	1889 tons/h	1795 tons/h	1731 tons/h	1671 tons/h
75%	30 sec	**0.50 min**	2526 tons/h	2358 tons/h	2247 tons/h	2145 tons/h	2400 tons/h	2240 tons/h	2134 tons/h	2038 tons/h
	42 sec	**0.70 min**	2259 tons/h	2124 tons/h	2033 tons/h	1949 tons/h	2146 tons/h	2018 tons/h	1931 tons/h	1852 tons/h
	54 sec	**0.90 min**	2042 tons/h	1932 tons/h	1856 tons/h	1786 tons/h	1940 tons/h	1835 tons/h	1763 tons/h	1697 tons/h
	66 sec	**1.10 min**	1864 tons/h	1771 tons/h	1707 tons/h	1648 tons/h	1771 tons/h	1683 tons/h	1622 tons/h	1566 tons/h
70%	30 sec	**0.50 min**	2357 tons/h	2201 tons/h	2096 tons/h	2001 tons/h	2239 tons/h	2090 tons/h	1991 tons/h	1901 tons/h
	42 sec	**0.70 min**	2107 tons/h	1982 tons/h	1897 tons/h	1819 tons/h	2002 tons/h	1882 tons/h	1802 tons/h	1728 tons/h
	54 sec	**0.90 min**	1906 tons/h	1802 tons/h	1732 tons/h	1666 tons/h	1810 tons/h	1712 tons/h	1645 tons/h	1583 tons/h
	66 sec	**1.10 min**	1739 tons/h	1653 tons/h	1593 tons/h	1538 tons/h	1652 tons/h	1570 tons/h	1514 tons/h	1461 tons/h
65%	30 sec	**0.50 min**	2188 tons/h	2043 tons/h	1946 tons/h	1858 tons/h	2078 tons/h	1941 tons/h	1849 tons/h	1765 tons/h
	42 sec	**0.70 min**	1956 tons/h	1839 tons/h	1761 tons/h	1688 tons/h	1858 tons/h	1747 tons/h	1673 tons/h	1604 tons/h
	54 sec	**0.90 min**	1769 tons/h	1673 tons/h	1607 tons/h	1547 tons/h	1681 tons/h	1589 tons/h	1527 tons/h	1470 tons/h
	66 sec	**1.10 min**	1614 tons/h	1534 tons/h	1479 tons/h	1427 tons/h	1534 tons/h	1457 tons/h	1405 tons/h	1356 tons/h

		Bucket Fill Factor	90%				85%			
		Load per Bucket	21.4 tons				20.2 tons			
		Load per Truck	86 tons				81 tons			
Overall Mine Efficiency	Truck Exchange	Cycle Time	23 sec	25 sec	27 sec	29 sec	23 sec	25 sec	27 sec	29 sec
			0.38 min	**0.42 min**	**0.45 min**	**0.48 min**	**0.38 min**	**0.42 min**	**0.45 min**	**0.48 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	2526 tons/h	2358 tons/h	2247 tons/h	2145 tons/h	2386 tons/h	2227 tons/h	2122 tons/h	2026 tons/h
	42 sec	**0.70 min**	2259 tons/h	2124 tons/h	2033 tons/h	1949 tons/h	2133 tons/h	2006 tons/h	1920 tons/h	1841 tons/h
	54 sec	**0.90 min**	2042 tons/h	1932 tons/h	1856 tons/h	1786 tons/h	1929 tons/h	1824 tons/h	1753 tons/h	1687 tons/h
	66 sec	**1.10 min**	1864 tons/h	1771 tons/h	1707 tons/h	1648 tons/h	1760 tons/h	1673 tons/h	1613 tons/h	1557 tons/h
80%	30 sec	**0.50 min**	2425 tons/h	2265 tons/h	2157 tons/h	2060 tons/h	2291 tons/h	2139 tons/h	2037 tons/h	1945 tons/h
	42 sec	**0.70 min**	2169 tons/h	2039 tons/h	1952 tons/h	1872 tons/h	2048 tons/h	1926 tons/h	1843 tons/h	1768 tons/h
	54 sec	**0.90 min**	1961 tons/h	1855 tons/h	1782 tons/h	1715 tons/h	1852 tons/h	1752 tons/h	1683 tons/h	1620 tons/h
	66 sec	**1.10 min**	1790 tons/h	1701 tons/h	1640 tons/h	1583 tons/h	1690 tons/h	1606 tons/h	1548 tons/h	1495 tons/h
75%	30 sec	**0.50 min**	2273 tons/h	2123 tons/h	2022 tons/h	1931 tons/h	2147 tons/h	2005 tons/h	1910 tons/h	1823 tons/h
	42 sec	**0.70 min**	2033 tons/h	1911 tons/h	1829 tons/h	1754 tons/h	1920 tons/h	1805 tons/h	1728 tons/h	1657 tons/h
	54 sec	**0.90 min**	1838 tons/h	1738 tons/h	1670 tons/h	1607 tons/h	1736 tons/h	1642 tons/h	1578 tons/h	1518 tons/h
	66 sec	**1.10 min**	1678 tons/h	1594 tons/h	1537 tons/h	1483 tons/h	1584 tons/h	1506 tons/h	1451 tons/h	1401 tons/h
70%	30 sec	**0.50 min**	2121 tons/h	1980 tons/h	1887 tons/h	1801 tons/h	2003 tons/h	1870 tons/h	1782 tons/h	1701 tons/h
	42 sec	**0.70 min**	1897 tons/h	1783 tons/h	1707 tons/h	1637 tons/h	1791 tons/h	1684 tons/h	1612 tons/h	1546 tons/h
	54 sec	**0.90 min**	1715 tons/h	1622 tons/h	1559 tons/h	1500 tons/h	1620 tons/h	1532 tons/h	1472 tons/h	1417 tons/h
	66 sec	**1.10 min**	1565 tons/h	1487 tons/h	1434 tons/h	1384 tons/h	1478 tons/h	1405 tons/h	1354 tons/h	1307 tons/h
65%	30 sec	**0.50 min**	1969 tons/h	1838 tons/h	1751 tons/h	1672 tons/h	1860 tons/h	1736 tons/h	1654 tons/h	1579 tons/h
	42 sec	**0.70 min**	1761 tons/h	1655 tons/h	1585 tons/h	1519 tons/h	1663 tons/h	1563 tons/h	1496 tons/h	1435 tons/h
	54 sec	**0.90 min**	1592 tons/h	1506 tons/h	1447 tons/h	1392 tons/h	1504 tons/h	1422 tons/h	1366 tons/h	1315 tons/h
	66 sec	**1.10 min**	1453 tons/h	1381 tons/h	1331 tons/h	1285 tons/h	1372 tons/h	1304 tons/h	1257 tons/h	1213 tons/h

MODEL: 6030 with Backhoe attachment ● Bucket Size: 17.0 m³ ● Number of Cycles: 5 ● Material Density: 1.80 t/m³

		Bucket Fill Factor	100%				95%			
		Load per Bucket	30.6 t				29.1 t			
		Load per Truck	153 t				145 t			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3544 t/h	3357 t/h	3136 t/h	2988 t/h	3367 t/h	3189 t/h	2979 t/h	2839 t/h
	42 sec	**0.70 min**	3242 t/h	3085 t/h	2897 t/h	2771 t/h	3080 t/h	2931 t/h	2752 t/h	2632 t/h
	54 sec	**0.90 min**	2988 t/h	2854 t/h	2692 t/h	2583 t/h	2839 t/h	2711 t/h	2558 t/h	2454 t/h
	66 sec	**1.10 min**	2771 t/h	2655 t/h	2515 t/h	2419 t/h	2632 t/h	2522 t/h	2389 t/h	2298 t/h
80%	30 sec	**0.50 min**	3403 t/h	3223 t/h	3011 t/h	2869 t/h	3233 t/h	3062 t/h	2860 t/h	2726 t/h
	42 sec	**0.70 min**	3113 t/h	2962 t/h	2782 t/h	2661 t/h	2958 t/h	2814 t/h	2643 t/h	2528 t/h
	54 sec	**0.90 min**	2869 t/h	2740 t/h	2585 t/h	2480 t/h	2726 t/h	2603 t/h	2456 t/h	2356 t/h
	66 sec	**1.10 min**	2661 t/h	2549 t/h	2415 t/h	2323 t/h	2528 t/h	2422 t/h	2294 t/h	2207 t/h
75%	30 sec	**0.50 min**	3190 t/h	3021 t/h	2822 t/h	2689 t/h	3030 t/h	2870 t/h	2681 t/h	2555 t/h
	42 sec	**0.70 min**	2918 t/h	2776 t/h	2607 t/h	2494 t/h	2772 t/h	2637 t/h	2477 t/h	2369 t/h
	54 sec	**0.90 min**	2689 t/h	2568 t/h	2423 t/h	2325 t/h	2555 t/h	2440 t/h	2302 t/h	2208 t/h
	66 sec	**1.10 min**	2494 t/h	2389 t/h	2263 t/h	2177 t/h	2369 t/h	2270 t/h	2150 t/h	2068 t/h
70%	30 sec	**0.50 min**	2976 t/h	2819 t/h	2633 t/h	2509 t/h	2827 t/h	2678 t/h	2501 t/h	2384 t/h
	42 sec	**0.70 min**	2723 t/h	2590 t/h	2433 t/h	2327 t/h	2587 t/h	2461 t/h	2311 t/h	2210 t/h
	54 sec	**0.90 min**	2509 t/h	2396 t/h	2261 t/h	2169 t/h	2384 t/h	2277 t/h	2148 t/h	2061 t/h
	66 sec	**1.10 min**	2327 t/h	2229 t/h	2112 t/h	2031 t/h	2210 t/h	2118 t/h	2006 t/h	1930 t/h
65%	30 sec	**0.50 min**	2763 t/h	2617 t/h	2444 t/h	2329 t/h	2624 t/h	2486 t/h	2322 t/h	2213 t/h
	42 sec	**0.70 min**	2527 t/h	2405 t/h	2258 t/h	2160 t/h	2401 t/h	2284 t/h	2145 t/h	2052 t/h
	54 sec	**0.90 min**	2329 t/h	2225 t/h	2099 t/h	2013 t/h	2213 t/h	2113 t/h	1994 t/h	1913 t/h
	66 sec	**1.10 min**	2160 t/h	2069 t/h	1960 t/h	1886 t/h	2052 t/h	1966 t/h	1862 t/h	1791 t/h

		Bucket Fill Factor	90%				85%			
		Load per Bucket	27.5 t				26.0 t			
		Load per Truck	138 t				130 t			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3190 t/h	3021 t/h	2822 t/h	2689 t/h	3012 t/h	2853 t/h	2665 t/h	2540 t/h
	42 sec	**0.70 min**	2918 t/h	2776 t/h	2607 t/h	2494 t/h	2756 t/h	2622 t/h	2463 t/h	2355 t/h
	54 sec	**0.90 min**	2689 t/h	2568 t/h	2423 t/h	2325 t/h	2540 t/h	2426 t/h	2289 t/h	2195 t/h
	66 sec	**1.10 min**	2494 t/h	2389 t/h	2263 t/h	2177 t/h	2355 t/h	2257 t/h	2137 t/h	2056 t/h
80%	30 sec	**0.50 min**	3063 t/h	2901 t/h	2710 t/h	2582 t/h	2893 t/h	2740 t/h	2559 t/h	2439 t/h
	42 sec	**0.70 min**	2802 t/h	2666 t/h	2504 t/h	2394 t/h	2646 t/h	2518 t/h	2365 t/h	2261 t/h
	54 sec	**0.90 min**	2582 t/h	2466 t/h	2327 t/h	2232 t/h	2439 t/h	2329 t/h	2198 t/h	2108 t/h
	66 sec	**1.10 min**	2394 t/h	2294 t/h	2173 t/h	2090 t/h	2261 t/h	2167 t/h	2052 t/h	1974 t/h
75%	30 sec	**0.50 min**	2871 t/h	2719 t/h	2540 t/h	2420 t/h	2711 t/h	2568 t/h	2399 t/h	2286 t/h
	42 sec	**0.70 min**	2626 t/h	2499 t/h	2347 t/h	2244 t/h	2480 t/h	2360 t/h	2216 t/h	2120 t/h
	54 sec	**0.90 min**	2420 t/h	2312 t/h	2181 t/h	2092 t/h	2286 t/h	2183 t/h	2060 t/h	1976 t/h
	66 sec	**1.10 min**	2244 t/h	2150 t/h	2037 t/h	1959 t/h	2120 t/h	2031 t/h	1924 t/h	1850 t/h
70%	30 sec	**0.50 min**	2678 t/h	2537 t/h	2370 t/h	2258 t/h	2530 t/h	2396 t/h	2238 t/h	2133 t/h
	42 sec	**0.70 min**	2450 t/h	2331 t/h	2190 t/h	2094 t/h	2314 t/h	2202 t/h	2068 t/h	1978 t/h
	54 sec	**0.90 min**	2258 t/h	2157 t/h	2035 t/h	1952 t/h	2133 t/h	2037 t/h	1922 t/h	1844 t/h
	66 sec	**1.10 min**	2094 t/h	2006 t/h	1901 t/h	1828 t/h	1978 t/h	1895 t/h	1795 t/h	1727 t/h
65%	30 sec	**0.50 min**	2486 t/h	2355 t/h	2200 t/h	2096 t/h	2348 t/h	2224 t/h	2078 t/h	1980 t/h
	42 sec	**0.70 min**	2275 t/h	2164 t/h	2033 t/h	1944 t/h	2148 t/h	2044 t/h	1920 t/h	1836 t/h
	54 sec	**0.90 min**	2096 t/h	2002 t/h	1889 t/h	1812 t/h	1980 t/h	1891 t/h	1784 t/h	1711 t/h
	66 sec	**1.10 min**	1944 t/h	1863 t/h	1764 t/h	1697 t/h	1836 t/h	1759 t/h	1666 t/h	1603 t/h

MODEL: 6030 with Backhoe attachment ● Bucket Size: 22.2 yd³ ● Number of Cycles: 5 ● Material Density: 3030 lb/yd³

		Bucket Fill Factor	100%				95%			
		Load per Bucket	33.7 tons				32.1 tons			
		Load per Truck	169 tons				160 tons			
Overall Mine Efficiency	Truck Exchange	Cycle Time	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3906 tons/h	3700 tons/h	3456 tons/h	3294 tons/h	3715 tons/h	3519 tons/h	3287 tons/h	3132 tons/h
	42 sec	**0.70 min**	3574 tons/h	3400 tons/h	3194 tons/h	3054 tons/h	3399 tons/h	3234 tons/h	3037 tons/h	2904 tons/h
	54 sec	**0.90 min**	3294 tons/h	3146 tons/h	2968 tons/h	2847 tons/h	3132 tons/h	2991 tons/h	2822 tons/h	2708 tons/h
	66 sec	**1.10 min**	3054 tons/h	2926 tons/h	2772 tons/h	2666 tons/h	2904 tons/h	2783 tons/h	2636 tons/h	2536 tons/h
80%	30 sec	**0.50 min**	3751 tons/h	3553 tons/h	3319 tons/h	3163 tons/h	3567 tons/h	3379 tons/h	3156 tons/h	3008 tons/h
	42 sec	**0.70 min**	3432 tons/h	3265 tons/h	3067 tons/h	2933 tons/h	3264 tons/h	3105 tons/h	2916 tons/h	2789 tons/h
	54 sec	**0.90 min**	3163 tons/h	3021 tons/h	2850 tons/h	2734 tons/h	3008 tons/h	2873 tons/h	2710 tons/h	2600 tons/h
	66 sec	**1.10 min**	2933 tons/h	2810 tons/h	2662 tons/h	2560 tons/h	2789 tons/h	2672 tons/h	2531 tons/h	2435 tons/h
75%	30 sec	**0.50 min**	3516 tons/h	3330 tons/h	3111 tons/h	2964 tons/h	3343 tons/h	3167 tons/h	2958 tons/h	2819 tons/h
	42 sec	**0.70 min**	3217 tons/h	3060 tons/h	2874 tons/h	2749 tons/h	3059 tons/h	2910 tons/h	2733 tons/h	2614 tons/h
	54 sec	**0.90 min**	2964 tons/h	2831 tons/h	2671 tons/h	2562 tons/h	2819 tons/h	2692 tons/h	2540 tons/h	2437 tons/h
	66 sec	**1.10 min**	2749 tons/h	2634 tons/h	2495 tons/h	2400 tons/h	2614 tons/h	2505 tons/h	2372 tons/h	2282 tons/h
70%	30 sec	**0.50 min**	3281 tons/h	3107 tons/h	2903 tons/h	2766 tons/h	3120 tons/h	2955 tons/h	2760 tons/h	2630 tons/h
	42 sec	**0.70 min**	3001 tons/h	2856 tons/h	2682 tons/h	2565 tons/h	2854 tons/h	2716 tons/h	2550 tons/h	2439 tons/h
	54 sec	**0.90 min**	2766 tons/h	2642 tons/h	2492 tons/h	2391 tons/h	2630 tons/h	2512 tons/h	2370 tons/h	2274 tons/h
	66 sec	**1.10 min**	2565 tons/h	2458 tons/h	2328 tons/h	2239 tons/h	2439 tons/h	2337 tons/h	2214 tons/h	2129 tons/h
65%	30 sec	**0.50 min**	3045 tons/h	2884 tons/h	2694 tons/h	2568 tons/h	2896 tons/h	2743 tons/h	2562 tons/h	2442 tons/h
	42 sec	**0.70 min**	2786 tons/h	2651 tons/h	2489 tons/h	2381 tons/h	2649 tons/h	2521 tons/h	2367 tons/h	2264 tons/h
	54 sec	**0.90 min**	2568 tons/h	2452 tons/h	2313 tons/h	2219 tons/h	2442 tons/h	2332 tons/h	2200 tons/h	2111 tons/h
	66 sec	**1.10 min**	2381 tons/h	2281 tons/h	2161 tons/h	2078 tons/h	2264 tons/h	2169 tons/h	2055 tons/h	1977 tons/h

		Bucket Fill Factor	90%				85%			
		Load per Bucket	30.3 tons				28.7 tons			
		Load per Truck	152 tons				143 tons			
Overall Mine Efficiency	Truck Exchange	Cycle Time	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3511 tons/h	3325 tons/h	3106 tons/h	2960 tons/h	3319 tons/h	3144 tons/h	2937 tons/h	2799 tons/h
	42 sec	**0.70 min**	3212 tons/h	3056 tons/h	2870 tons/h	2745 tons/h	3037 tons/h	2889 tons/h	2713 tons/h	2595 tons/h
	54 sec	**0.90 min**	2960 tons/h	2827 tons/h	2667 tons/h	2559 tons/h	2799 tons/h	2673 tons/h	2522 tons/h	2419 tons/h
	66 sec	**1.10 min**	2745 tons/h	2630 tons/h	2491 tons/h	2396 tons/h	2595 tons/h	2487 tons/h	2355 tons/h	2266 tons/h
80%	30 sec	**0.50 min**	3371 tons/h	3193 tons/h	2983 tons/h	2842 tons/h	3187 tons/h	3019 tons/h	2820 tons/h	2687 tons/h
	42 sec	**0.70 min**	3084 tons/h	2934 tons/h	2756 tons/h	2636 tons/h	2916 tons/h	2774 tons/h	2606 tons/h	2492 tons/h
	54 sec	**0.90 min**	2842 tons/h	2715 tons/h	2561 tons/h	2457 tons/h	2687 tons/h	2567 tons/h	2421 tons/h	2323 tons/h
	66 sec	**1.10 min**	2636 tons/h	2525 tons/h	2392 tons/h	2301 tons/h	2492 tons/h	2388 tons/h	2262 tons/h	2175 tons/h
75%	30 sec	**0.50 min**	3160 tons/h	2993 tons/h	2796 tons/h	2664 tons/h	2987 tons/h	2829 tons/h	2643 tons/h	2519 tons/h
	42 sec	**0.70 min**	2891 tons/h	2750 tons/h	2583 tons/h	2470 tons/h	2733 tons/h	2600 tons/h	2442 tons/h	2336 tons/h
	54 sec	**0.90 min**	2664 tons/h	2544 tons/h	2400 tons/h	2303 tons/h	2519 tons/h	2406 tons/h	2270 tons/h	2177 tons/h
	66 sec	**1.10 min**	2470 tons/h	2367 tons/h	2242 tons/h	2157 tons/h	2336 tons/h	2238 tons/h	2120 tons/h	2039 tons/h
70%	30 sec	**0.50 min**	2948 tons/h	2792 tons/h	2608 tons/h	2486 tons/h	2787 tons/h	2640 tons/h	2466 tons/h	2350 tons/h
	42 sec	**0.70 min**	2697 tons/h	2566 tons/h	2410 tons/h	2305 tons/h	2550 tons/h	2426 tons/h	2279 tons/h	2179 tons/h
	54 sec	**0.90 min**	2486 tons/h	2374 tons/h	2240 tons/h	2149 tons/h	2350 tons/h	2245 tons/h	2118 tons/h	2031 tons/h
	66 sec	**1.10 min**	2305 tons/h	2209 tons/h	2092 tons/h	2012 tons/h	2179 tons/h	2088 tons/h	1978 tons/h	1902 tons/h
65%	30 sec	**0.50 min**	2737 tons/h	2592 tons/h	2421 tons/h	2307 tons/h	2587 tons/h	2451 tons/h	2289 tons/h	2182 tons/h
	42 sec	**0.70 min**	2504 tons/h	2382 tons/h	2237 tons/h	2140 tons/h	2367 tons/h	2252 tons/h	2115 tons/h	2023 tons/h
	54 sec	**0.90 min**	2307 tons/h	2204 tons/h	2079 tons/h	1995 tons/h	2182 tons/h	2083 tons/h	1966 tons/h	1886 tons/h
	66 sec	**1.10 min**	2140 tons/h	2050 tons/h	1942 tons/h	1868 tons/h	2023 tons/h	1938 tons/h	1836 tons/h	1766 tons/h

MODEL: 6030 with Face Shovel attachment ● Bucket Size: 16.5 m³ ● Number of Cycles: 5 ● Material Density: 1.80 t/m³

		Bucket Fill Factor	100%				95%			
		Load per Bucket	29.7 t				28.2 t			
		Load per Truck	149 t				141 t			
Overall Mine Efficiency		Cycle Time	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
	Truck Exchange		**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3440 t/h	3258 t/h	3043 t/h	2900 t/h	3266 t/h	3093 t/h	2890 t/h	2754 t/h
	42 sec	**0.70 min**	3147 t/h	2994 t/h	2812 t/h	2689 t/h	2988 t/h	2843 t/h	2670 t/h	2553 t/h
	54 sec	**0.90 min**	2900 t/h	2770 t/h	2613 t/h	2507 t/h	2754 t/h	2630 t/h	2481 t/h	2380 t/h
	66 sec	**1.10 min**	2689 t/h	2577 t/h	2441 t/h	2348 t/h	2553 t/h	2447 t/h	2317 t/h	2229 t/h
80%	30 sec	**0.50 min**	3303 t/h	3128 t/h	2922 t/h	2785 t/h	3136 t/h	2970 t/h	2775 t/h	2644 t/h
	42 sec	**0.70 min**	3022 t/h	2875 t/h	2700 t/h	2582 t/h	2869 t/h	2730 t/h	2564 t/h	2452 t/h
	54 sec	**0.90 min**	2785 t/h	2660 t/h	2509 t/h	2407 t/h	2644 t/h	2525 t/h	2383 t/h	2286 t/h
	66 sec	**1.10 min**	2582 t/h	2474 t/h	2344 t/h	2254 t/h	2452 t/h	2349 t/h	2225 t/h	2141 t/h
75%	30 sec	**0.50 min**	3096 t/h	2932 t/h	2739 t/h	2610 t/h	2939 t/h	2784 t/h	2601 t/h	2478 t/h
	42 sec	**0.70 min**	2832 t/h	2695 t/h	2531 t/h	2420 t/h	2689 t/h	2559 t/h	2403 t/h	2298 t/h
	54 sec	**0.90 min**	2610 t/h	2493 t/h	2352 t/h	2256 t/h	2478 t/h	2367 t/h	2233 t/h	2142 t/h
	66 sec	**1.10 min**	2420 t/h	2319 t/h	2197 t/h	2113 t/h	2298 t/h	2202 t/h	2086 t/h	2006 t/h
70%	30 sec	**0.50 min**	2888 t/h	2736 t/h	2556 t/h	2435 t/h	2743 t/h	2598 t/h	2427 t/h	2312 t/h
	42 sec	**0.70 min**	2643 t/h	2514 t/h	2361 t/h	2258 t/h	2509 t/h	2387 t/h	2242 t/h	2144 t/h
	54 sec	**0.90 min**	2435 t/h	2326 t/h	2194 t/h	2105 t/h	2312 t/h	2208 t/h	2084 t/h	1999 t/h
	66 sec	**1.10 min**	2258 t/h	2164 t/h	2050 t/h	1972 t/h	2144 t/h	2055 t/h	1946 t/h	1872 t/h
65%	30 sec	**0.50 min**	2681 t/h	2540 t/h	2372 t/h	2261 t/h	2546 t/h	2411 t/h	2253 t/h	2147 t/h
	42 sec	**0.70 min**	2453 t/h	2334 t/h	2192 t/h	2096 t/h	2329 t/h	2216 t/h	2081 t/h	1990 t/h
	54 sec	**0.90 min**	2261 t/h	2159 t/h	2037 t/h	1954 t/h	2147 t/h	2050 t/h	1934 t/h	1855 t/h
	66 sec	**1.10 min**	2096 t/h	2009 t/h	1903 t/h	1830 t/h	1990 t/h	1907 t/h	1806 t/h	1738 t/h

		Bucket Fill Factor	90%				85%			
		Load per Bucket	26.7 t				25.2 t			
		Load per Truck	134 t				126 t			
Overall Mine Efficiency		Cycle Time	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
	Truck Exchange		**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3092 t/h	2929 t/h	2736 t/h	2607 t/h	2919 t/h	2764 t/h	2582 t/h	2461 t/h
	42 sec	**0.70 min**	2829 t/h	2692 t/h	2528 t/h	2418 t/h	2670 t/h	2540 t/h	2386 t/h	2282 t/h
	54 sec	**0.90 min**	2607 t/h	2490 t/h	2349 t/h	2254 t/h	2461 t/h	2350 t/h	2217 t/h	2127 t/h
	66 sec	**1.10 min**	2418 t/h	2316 t/h	2194 t/h	2111 t/h	2282 t/h	2186 t/h	2071 t/h	1992 t/h
80%	30 sec	**0.50 min**	2969 t/h	2812 t/h	2627 t/h	2504 t/h	2802 t/h	2654 t/h	2480 t/h	2363 t/h
	42 sec	**0.70 min**	2717 t/h	2585 t/h	2427 t/h	2321 t/h	2564 t/h	2439 t/h	2291 t/h	2191 t/h
	54 sec	**0.90 min**	2504 t/h	2391 t/h	2256 t/h	2164 t/h	2363 t/h	2257 t/h	2129 t/h	2042 t/h
	66 sec	**1.10 min**	2321 t/h	2224 t/h	2107 t/h	2027 t/h	2191 t/h	2099 t/h	1989 t/h	1913 t/h
75%	30 sec	**0.50 min**	2783 t/h	2636 t/h	2462 t/h	2346 t/h	2627 t/h	2488 t/h	2324 t/h	2215 t/h
	42 sec	**0.70 min**	2546 t/h	2422 t/h	2275 t/h	2176 t/h	2403 t/h	2286 t/h	2147 t/h	2054 t/h
	54 sec	**0.90 min**	2346 t/h	2241 t/h	2114 t/h	2028 t/h	2215 t/h	2115 t/h	1996 t/h	1914 t/h
	66 sec	**1.10 min**	2176 t/h	2085 t/h	1975 t/h	1900 t/h	2054 t/h	1968 t/h	1864 t/h	1793 t/h
70%	30 sec	**0.50 min**	2597 t/h	2459 t/h	2298 t/h	2189 t/h	2451 t/h	2321 t/h	2168 t/h	2066 t/h
	42 sec	**0.70 min**	2376 t/h	2260 t/h	2123 t/h	2030 t/h	2242 t/h	2133 t/h	2004 t/h	1916 t/h
	54 sec	**0.90 min**	2189 t/h	2091 t/h	1973 t/h	1893 t/h	2066 t/h	1974 t/h	1862 t/h	1786 t/h
	66 sec	**1.10 min**	2030 t/h	1945 t/h	1843 t/h	1772 t/h	1916 t/h	1836 t/h	1739 t/h	1673 t/h
65%	30 sec	**0.50 min**	2410 t/h	2283 t/h	2133 t/h	2032 t/h	2275 t/h	2155 t/h	2013 t/h	1918 t/h
	42 sec	**0.70 min**	2205 t/h	2098 t/h	1971 t/h	1885 t/h	2081 t/h	1980 t/h	1860 t/h	1779 t/h
	54 sec	**0.90 min**	2032 t/h	1941 t/h	1831 t/h	1757 t/h	1918 t/h	1832 t/h	1728 t/h	1658 t/h
	66 sec	**1.10 min**	1885 t/h	1806 t/h	1710 t/h	1645 t/h	1779 t/h	1704 t/h	1614 t/h	1553 t/h

MODEL: 6030 with Face Shovel attachment ● Bucket Size: 21.6 yd³ ● Number of Cycles: 5 ● Material Density: 3030 lb/yd³

		Bucket Fill Factor	**100%**				**95%**			
		Load per Bucket	32.7 tons				31.1 tons			
		Load per Truck	164 tons				155 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3792 tons/h	3591 tons/h	3355 tons/h	3197 tons/h	3600 tons/h	3410 tons/h	3185 tons/h	3035 tons/h
	42 sec	**0.70 min**	3469 tons/h	3300 tons/h	3100 tons/h	2964 tons/h	3294 tons/h	3134 tons/h	2943 tons/h	2815 tons/h
	54 sec	**0.90 min**	3197 tons/h	3053 tons/h	2881 tons/h	2763 tons/h	3035 tons/h	2899 tons/h	2735 tons/h	2624 tons/h
	66 sec	**1.10 min**	2964 tons/h	2840 tons/h	2690 tons/h	2588 tons/h	2815 tons/h	2697 tons/h	2555 tons/h	2457 tons/h
80%	30 sec	**0.50 min**	3641 tons/h	3448 tons/h	3221 tons/h	3070 tons/h	3457 tons/h	3274 tons/h	3059 tons/h	2915 tons/h
	42 sec	**0.70 min**	3331 tons/h	3169 tons/h	2976 tons/h	2846 tons/h	3163 tons/h	3009 tons/h	2826 tons/h	2703 tons/h
	54 sec	**0.90 min**	3070 tons/h	2932 tons/h	2766 tons/h	2653 tons/h	2915 tons/h	2784 tons/h	2626 tons/h	2519 tons/h
	66 sec	**1.10 min**	2846 tons/h	2727 tons/h	2583 tons/h	2485 tons/h	2703 tons/h	2590 tons/h	2453 tons/h	2360 tons/h
75%	30 sec	**0.50 min**	3412 tons/h	3232 tons/h	3019 tons/h	2877 tons/h	3240 tons/h	3069 tons/h	2867 tons/h	2732 tons/h
	42 sec	**0.70 min**	3122 tons/h	2970 tons/h	2790 tons/h	2668 tons/h	2964 tons/h	2820 tons/h	2649 tons/h	2533 tons/h
	54 sec	**0.90 min**	2877 tons/h	2748 tons/h	2592 tons/h	2487 tons/h	2732 tons/h	2609 tons/h	2462 tons/h	2361 tons/h
	66 sec	**1.10 min**	2668 tons/h	2556 tons/h	2421 tons/h	2329 tons/h	2533 tons/h	2427 tons/h	2299 tons/h	2211 tons/h
70%	30 sec	**0.50 min**	3184 tons/h	3016 tons/h	2817 tons/h	2685 tons/h	3023 tons/h	2863 tons/h	2675 tons/h	2549 tons/h
	42 sec	**0.70 min**	2913 tons/h	2772 tons/h	2603 tons/h	2489 tons/h	2766 tons/h	2632 tons/h	2471 tons/h	2364 tons/h
	54 sec	**0.90 min**	2685 tons/h	2564 tons/h	2419 tons/h	2321 tons/h	2549 tons/h	2434 tons/h	2297 tons/h	2203 tons/h
	66 sec	**1.10 min**	2489 tons/h	2385 tons/h	2259 tons/h	2173 tons/h	2364 tons/h	2265 tons/h	2145 tons/h	2063 tons/h
65%	30 sec	**0.50 min**	2956 tons/h	2799 tons/h	2615 tons/h	2492 tons/h	2806 tons/h	2658 tons/h	2483 tons/h	2366 tons/h
	42 sec	**0.70 min**	2704 tons/h	2573 tons/h	2416 tons/h	2311 tons/h	2568 tons/h	2443 tons/h	2294 tons/h	2194 tons/h
	54 sec	**0.90 min**	2492 tons/h	2380 tons/h	2245 tons/h	2154 tons/h	2366 tons/h	2260 tons/h	2132 tons/h	2045 tons/h
	66 sec	**1.10 min**	2311 tons/h	2214 tons/h	2097 tons/h	2017 tons/h	2194 tons/h	2102 tons/h	1991 tons/h	1915 tons/h

		Bucket Fill Factor	**90%**				**85%**			
		Load per Bucket	29.4 tons				27.8 tons			
		Load per Truck	147 tons				139 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	3409 tons/h	3228 tons/h	3016 tons/h	2874 tons/h	3217 tons/h	3047 tons/h	2846 tons/h	2712 tons/h
	42 sec	**0.70 min**	3119 tons/h	2967 tons/h	2786 tons/h	2665 tons/h	2943 tons/h	2800 tons/h	2630 tons/h	2515 tons/h
	54 sec	**0.90 min**	2874 tons/h	2745 tons/h	2590 tons/h	2484 tons/h	2712 tons/h	2591 tons/h	2444 tons/h	2345 tons/h
	66 sec	**1.10 min**	2665 tons/h	2553 tons/h	2419 tons/h	2327 tons/h	2515 tons/h	2410 tons/h	2283 tons/h	2196 tons/h
80%	30 sec	**0.50 min**	3273 tons/h	3100 tons/h	2896 tons/h	2760 tons/h	3089 tons/h	2926 tons/h	2733 tons/h	2605 tons/h
	42 sec	**0.70 min**	2995 tons/h	2849 tons/h	2676 tons/h	2559 tons/h	2826 tons/h	2689 tons/h	2525 tons/h	2415 tons/h
	54 sec	**0.90 min**	2760 tons/h	2636 tons/h	2487 tons/h	2385 tons/h	2605 tons/h	2488 tons/h	2347 tons/h	2251 tons/h
	66 sec	**1.10 min**	2559 tons/h	2452 tons/h	2322 tons/h	2234 tons/h	2415 tons/h	2314 tons/h	2192 tons/h	2109 tons/h
75%	30 sec	**0.50 min**	3068 tons/h	2906 tons/h	2714 tons/h	2587 tons/h	2895 tons/h	2742 tons/h	2562 tons/h	2441 tons/h
	42 sec	**0.70 min**	2807 tons/h	2670 tons/h	2508 tons/h	2398 tons/h	2649 tons/h	2520 tons/h	2367 tons/h	2264 tons/h
	54 sec	**0.90 min**	2587 tons/h	2470 tons/h	2331 tons/h	2236 tons/h	2441 tons/h	2331 tons/h	2200 tons/h	2110 tons/h
	66 sec	**1.10 min**	2398 tons/h	2298 tons/h	2177 tons/h	2094 tons/h	2264 tons/h	2169 tons/h	2054 tons/h	1976 tons/h
70%	30 sec	**0.50 min**	2862 tons/h	2711 tons/h	2533 tons/h	2413 tons/h	2702 tons/h	2559 tons/h	2390 tons/h	2278 tons/h
	42 sec	**0.70 min**	2619 tons/h	2492 tons/h	2340 tons/h	2238 tons/h	2472 tons/h	2352 tons/h	2209 tons/h	2112 tons/h
	54 sec	**0.90 min**	2413 tons/h	2305 tons/h	2175 tons/h	2086 tons/h	2278 tons/h	2175 tons/h	2052 tons/h	1969 tons/h
	66 sec	**1.10 min**	2238 tons/h	2144 tons/h	2031 tons/h	1954 tons/h	2112 tons/h	2024 tons/h	1917 tons/h	1844 tons/h
65%	30 sec	**0.50 min**	2657 tons/h	2517 tons/h	2351 tons/h	2240 tons/h	2508 tons/h	2375 tons/h	2219 tons/h	2114 tons/h
	42 sec	**0.70 min**	2431 tons/h	2313 tons/h	2172 tons/h	2077 tons/h	2294 tons/h	2183 tons/h	2050 tons/h	1961 tons/h
	54 sec	**0.90 min**	2240 tons/h	2140 tons/h	2019 tons/h	1937 tons/h	2114 tons/h	2019 tons/h	1905 tons/h	1828 tons/h
	66 sec	**1.10 min**	2077 tons/h	1990 tons/h	1885 tons/h	1814 tons/h	1961 tons/h	1879 tons/h	1779 tons/h	1712 tons/h

MODEL: 6040 ● Bucket Size: 22.0 m³ ● Number of Cycles: 4 ● Material Density: 1.80 t/m³

		Bucket Fill Factor	100%				95%			
		Load per Bucket	39.6 t				37.6 t			
		Load per Truck	158 t				150 t			
Overall Mine Efficiency	Truck Exchange	Cycle Time	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	4508 t/h	4287 t/h	4025 t/h	3848 t/h	4280 t/h	4071 t/h	3821 t/h	3654 t/h
	42 sec	**0.70 min**	4045 t/h	3867 t/h	3652 t/h	3506 t/h	3841 t/h	3672 t/h	3468 t/h	3329 t/h
	54 sec	**0.90 min**	3669 t/h	3522 t/h	3343 t/h	3220 t/h	3484 t/h	3344 t/h	3174 t/h	3057 t/h
	66 sec	**1.10 min**	3357 t/h	3233 t/h	3081 t/h	2977 t/h	3187 t/h	3070 t/h	2926 t/h	2826 t/h
80%	30 sec	**0.50 min**	4328 t/h	4117 t/h	3865 t/h	3695 t/h	4110 t/h	3909 t/h	3669 t/h	3508 t/h
	42 sec	**0.70 min**	3884 t/h	3713 t/h	3507 t/h	3367 t/h	3688 t/h	3526 t/h	3330 t/h	3197 t/h
	54 sec	**0.90 min**	3523 t/h	3382 t/h	3210 t/h	3092 t/h	3345 t/h	3211 t/h	3048 t/h	2936 t/h
	66 sec	**1.10 min**	3223 t/h	3104 t/h	2959 t/h	2858 t/h	3060 t/h	2948 t/h	2809 t/h	2714 t/h
75%	30 sec	**0.50 min**	4057 t/h	3858 t/h	3622 t/h	3463 t/h	3852 t/h	3664 t/h	3439 t/h	3288 t/h
	42 sec	**0.70 min**	3641 t/h	3480 t/h	3287 t/h	3155 t/h	3457 t/h	3304 t/h	3121 t/h	2996 t/h
	54 sec	**0.90 min**	3302 t/h	3169 t/h	3008 t/h	2898 t/h	3135 t/h	3009 t/h	2856 t/h	2751 t/h
	66 sec	**1.10 min**	3021 t/h	2910 t/h	2773 t/h	2679 t/h	2868 t/h	2763 t/h	2633 t/h	2544 t/h
70%	30 sec	**0.50 min**	3785 t/h	3600 t/h	3380 t/h	3231 t/h	3594 t/h	3418 t/h	3209 t/h	3068 t/h
	42 sec	**0.70 min**	3397 t/h	3247 t/h	3067 t/h	2944 t/h	3226 t/h	3083 t/h	2912 t/h	2795 t/h
	54 sec	**0.90 min**	3081 t/h	2957 t/h	2807 t/h	2704 t/h	2925 t/h	2808 t/h	2665 t/h	2567 t/h
	66 sec	**1.10 min**	2819 t/h	2715 t/h	2588 t/h	2500 t/h	2676 t/h	2578 t/h	2457 t/h	2373 t/h
65%	30 sec	**0.50 min**	3514 t/h	3342 t/h	3137 t/h	3000 t/h	3336 t/h	3173 t/h	2979 t/h	2848 t/h
	42 sec	**0.70 min**	3153 t/h	3014 t/h	2847 t/h	2733 t/h	2994 t/h	2862 t/h	2703 t/h	2595 t/h
	54 sec	**0.90 min**	2860 t/h	2745 t/h	2606 t/h	2510 t/h	2716 t/h	2606 t/h	2474 t/h	2383 t/h
	66 sec	**1.10 min**	2617 t/h	2520 t/h	2402 t/h	2320 t/h	2484 t/h	2393 t/h	2281 t/h	2203 t/h

		Bucket Fill Factor	90%				85%			
		Load per Bucket	35.6 t				33.7 t			
		Load per Truck	142 t				135 t			
Overall Mine Efficiency	Truck Exchange	Cycle Time	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	4052 t/h	3854 t/h	3618 t/h	3459 t/h	3836 t/h	3648 t/h	3425 t/h	3275 t/h
	42 sec	**0.70 min**	3637 t/h	3476 t/h	3283 t/h	3152 t/h	3443 t/h	3291 t/h	3108 t/h	2984 t/h
	54 sec	**0.90 min**	3298 t/h	3166 t/h	3005 t/h	2894 t/h	3122 t/h	2997 t/h	2845 t/h	2740 t/h
	66 sec	**1.10 min**	3018 t/h	2906 t/h	2770 t/h	2676 t/h	2857 t/h	2751 t/h	2622 t/h	2533 t/h
80%	30 sec	**0.50 min**	3891 t/h	3701 t/h	3474 t/h	3322 t/h	3684 t/h	3503 t/h	3289 t/h	3144 t/h
	42 sec	**0.70 min**	3492 t/h	3338 t/h	3153 t/h	3026 t/h	3306 t/h	3160 t/h	2984 t/h	2865 t/h
	54 sec	**0.90 min**	3167 t/h	3040 t/h	2885 t/h	2779 t/h	2998 t/h	2878 t/h	2731 t/h	2631 t/h
	66 sec	**1.10 min**	2898 t/h	2791 t/h	2660 t/h	2570 t/h	2743 t/h	2642 t/h	2518 t/h	2433 t/h
75%	30 sec	**0.50 min**	3647 t/h	3469 t/h	3256 t/h	3113 t/h	3452 t/h	3284 t/h	3083 t/h	2947 t/h
	42 sec	**0.70 min**	3273 t/h	3129 t/h	2955 t/h	2837 t/h	3098 t/h	2962 t/h	2797 t/h	2685 t/h
	54 sec	**0.90 min**	2969 t/h	2849 t/h	2704 t/h	2605 t/h	2810 t/h	2697 t/h	2560 t/h	2466 t/h
	66 sec	**1.10 min**	2716 t/h	2616 t/h	2493 t/h	2408 t/h	2571 t/h	2476 t/h	2360 t/h	2280 t/h
70%	30 sec	**0.50 min**	3403 t/h	3237 t/h	3038 t/h	2905 t/h	3221 t/h	3064 t/h	2876 t/h	2750 t/h
	42 sec	**0.70 min**	3054 t/h	2919 t/h	2757 t/h	2647 t/h	2891 t/h	2763 t/h	2610 t/h	2505 t/h
	54 sec	**0.90 min**	2770 t/h	2659 t/h	2523 t/h	2431 t/h	2622 t/h	2517 t/h	2389 t/h	2301 t/h
	66 sec	**1.10 min**	2534 t/h	2441 t/h	2326 t/h	2247 t/h	2399 t/h	2310 t/h	2202 t/h	2127 t/h
65%	30 sec	**0.50 min**	3159 t/h	3004 t/h	2820 t/h	2697 t/h	2990 t/h	2844 t/h	2670 t/h	2553 t/h
	42 sec	**0.70 min**	2835 t/h	2710 t/h	2559 t/h	2457 t/h	2684 t/h	2565 t/h	2423 t/h	2326 t/h
	54 sec	**0.90 min**	2571 t/h	2468 t/h	2342 t/h	2256 t/h	2434 t/h	2336 t/h	2217 t/h	2136 t/h
	66 sec	**1.10 min**	2352 t/h	2266 t/h	2159 t/h	2086 t/h	2227 t/h	2145 t/h	2044 t/h	1975 t/h

MODEL: 6040 ● Bucket Size: 28.8 yd³ ● Number of Cycles: 4 ● Material Density: 3030 lb/yd³

	Bucket Fill Factor		**100%**				**95%**			
	Load per Bucket		43.7 tons				41.4 tons			
	Load per Truck		175 tons				166 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	4969 tons/h	4726 tons/h	4436 tons/h	4242 tons/h	4718 tons/h	4487 tons/h	4212 tons/h	4027 tons/h
	42 sec	**0.70 min**	4459 tons/h	4262 tons/h	4026 tons/h	3865 tons/h	4234 tons/h	4047 tons/h	3822 tons/h	3669 tons/h
	54 sec	**0.90 min**	4044 tons/h	3882 tons/h	3684 tons/h	3549 tons/h	3840 tons/h	3686 tons/h	3498 tons/h	3370 tons/h
	66 sec	**1.10 min**	3700 tons/h	3564 tons/h	3397 tons/h	3281 tons/h	3513 tons/h	3384 tons/h	3225 tons/h	3116 tons/h
80%	30 sec	**0.50 min**	4771 tons/h	4538 tons/h	4260 tons/h	4073 tons/h	4530 tons/h	4309 tons/h	4045 tons/h	3867 tons/h
	42 sec	**0.70 min**	4282 tons/h	4093 tons/h	3866 tons/h	3711 tons/h	4066 tons/h	3886 tons/h	3670 tons/h	3524 tons/h
	54 sec	**0.90 min**	3884 tons/h	3728 tons/h	3538 tons/h	3408 tons/h	3687 tons/h	3539 tons/h	3359 tons/h	3236 tons/h
	66 sec	**1.10 min**	3553 tons/h	3422 tons/h	3262 tons/h	3151 tons/h	3374 tons/h	3249 tons/h	3097 tons/h	2992 tons/h
75%	30 sec	**0.50 min**	4472 tons/h	4253 tons/h	3993 tons/h	3817 tons/h	4246 tons/h	4038 tons/h	3791 tons/h	3625 tons/h
	42 sec	**0.70 min**	4013 tons/h	3836 tons/h	3623 tons/h	3478 tons/h	3811 tons/h	3642 tons/h	3440 tons/h	3302 tons/h
	54 sec	**0.90 min**	3640 tons/h	3494 tons/h	3316 tons/h	3194 tons/h	3456 tons/h	3317 tons/h	3149 tons/h	3033 tons/h
	66 sec	**1.10 min**	3330 tons/h	3207 tons/h	3057 tons/h	2953 tons/h	3162 tons/h	3045 tons/h	2903 tons/h	2804 tons/h
70%	30 sec	**0.50 min**	4173 tons/h	3968 tons/h	3726 tons/h	3562 tons/h	3962 tons/h	3768 tons/h	3537 tons/h	3382 tons/h
	42 sec	**0.70 min**	3745 tons/h	3579 tons/h	3381 tons/h	3245 tons/h	3556 tons/h	3399 tons/h	3210 tons/h	3081 tons/h
	54 sec	**0.90 min**	3396 tons/h	3260 tons/h	3094 tons/h	2980 tons/h	3225 tons/h	3095 tons/h	2938 tons/h	2830 tons/h
	66 sec	**1.10 min**	3107 tons/h	2993 tons/h	2852 tons/h	2755 tons/h	2950 tons/h	2841 tons/h	2708 tons/h	2616 tons/h
65%	30 sec	**0.50 min**	3873 tons/h	3684 tons/h	3458 tons/h	3306 tons/h	3678 tons/h	3498 tons/h	3284 tons/h	3139 tons/h
	42 sec	**0.70 min**	3476 tons/h	3323 tons/h	3138 tons/h	3013 tons/h	3300 tons/h	3155 tons/h	2980 tons/h	2860 tons/h
	54 sec	**0.90 min**	3153 tons/h	3026 tons/h	2872 tons/h	2767 tons/h	2993 tons/h	2873 tons/h	2727 tons/h	2627 tons/h
	66 sec	**1.10 min**	2884 tons/h	2778 tons/h	2648 tons/h	2558 tons/h	2739 tons/h	2638 tons/h	2514 tons/h	2429 tons/h

	Bucket Fill Factor		**90%**				**85%**			
	Load per Bucket		39.2 tons				37.1 tons			
	Load per Truck		157 tons				149 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	24 sec	26 sec	28 sec	30 sec	24 sec	26 sec	28 sec	30 sec
			0.40 min	**0.43 min**	**0.47 min**	**0.50 min**	**0.40 min**	**0.43 min**	**0.47 min**	**0.50 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	4467 tons/h	4248 tons/h	3988 tons/h	3813 tons/h	4228 tons/h	4022 tons/h	3775 tons/h	3610 tons/h
	42 sec	**0.70 min**	4009 tons/h	3832 tons/h	3619 tons/h	3474 tons/h	3795 tons/h	3627 tons/h	3426 tons/h	3289 tons/h
	54 sec	**0.90 min**	3636 tons/h	3490 tons/h	3312 tons/h	3191 tons/h	3442 tons/h	3304 tons/h	3136 tons/h	3020 tons/h
	66 sec	**1.10 min**	3326 tons/h	3204 tons/h	3054 tons/h	2950 tons/h	3149 tons/h	3033 tons/h	2891 tons/h	2792 tons/h
80%	30 sec	**0.50 min**	4289 tons/h	4079 tons/h	3830 tons/h	3662 tons/h	4060 tons/h	3862 tons/h	3625 tons/h	3466 tons/h
	42 sec	**0.70 min**	3849 tons/h	3680 tons/h	3475 tons/h	3336 tons/h	3644 tons/h	3483 tons/h	3290 tons/h	3158 tons/h
	54 sec	**0.90 min**	3491 tons/h	3351 tons/h	3181 tons/h	3064 tons/h	3305 tons/h	3172 tons/h	3011 tons/h	2900 tons/h
	66 sec	**1.10 min**	3194 tons/h	3076 tons/h	2932 tons/h	2833 tons/h	3024 tons/h	2912 tons/h	2776 tons/h	2681 tons/h
75%	30 sec	**0.50 min**	4020 tons/h	3824 tons/h	3589 tons/h	3432 tons/h	3806 tons/h	3619 tons/h	3398 tons/h	3249 tons/h
	42 sec	**0.70 min**	3608 tons/h	3449 tons/h	3257 tons/h	3127 tons/h	3415 tons/h	3265 tons/h	3083 tons/h	2960 tons/h
	54 sec	**0.90 min**	3272 tons/h	3141 tons/h	2981 tons/h	2872 tons/h	3098 tons/h	2973 tons/h	2822 tons/h	2718 tons/h
	66 sec	**1.10 min**	2994 tons/h	2883 tons/h	2748 tons/h	2655 tons/h	2834 tons/h	2729 tons/h	2602 tons/h	2513 tons/h
70%	30 sec	**0.50 min**	3751 tons/h	3568 tons/h	3349 tons/h	3202 tons/h	3551 tons/h	3377 tons/h	3170 tons/h	3031 tons/h
	42 sec	**0.70 min**	3366 tons/h	3218 tons/h	3039 tons/h	2918 tons/h	3187 tons/h	3046 tons/h	2877 tons/h	2762 tons/h
	54 sec	**0.90 min**	3053 tons/h	2931 tons/h	2782 tons/h	2679 tons/h	2890 tons/h	2774 tons/h	2633 tons/h	2536 tons/h
	66 sec	**1.10 min**	2793 tons/h	2690 tons/h	2564 tons/h	2477 tons/h	2644 tons/h	2547 tons/h	2427 tons/h	2345 tons/h
65%	30 sec	**0.50 min**	3482 tons/h	3312 tons/h	3109 tons/h	2972 tons/h	3296 tons/h	3135 tons/h	2943 tons/h	2814 tons/h
	42 sec	**0.70 min**	3125 tons/h	2987 tons/h	2821 tons/h	2708 tons/h	2958 tons/h	2828 tons/h	2671 tons/h	2564 tons/h
	54 sec	**0.90 min**	2834 tons/h	2720 tons/h	2582 tons/h	2487 tons/h	2683 tons/h	2575 tons/h	2444 tons/h	2354 tons/h
	66 sec	**1.10 min**	2593 tons/h	2497 tons/h	2380 tons/h	2299 tons/h	2455 tons/h	2364 tons/h	2253 tons/h	2177 tons/h

MODEL: 6060 ● Bucket Size: 34.0 m³ ● Number of Cycles: 4 ● Material Density: 1.80 t/m³

	Bucket Fill Factor		100%				95%			
	Load per Bucket		61.2 t				58.1 t			
	Load per Truck		245 t				232 t			
Overall Mine Efficiency	**Cycle Time**		26 sec	28 sec	30 sec	32 sec	26 sec	28 sec	30 sec	32 sec
	Truck Exchange		**0.43 min**	**0.47 min**	**0.50 min**	**0.53 min**	**0.43 min**	**0.47 min**	**0.50 min**	**0.53 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	6626 t/h	6220 t/h	5947 t/h	5697 t/h	6290 t/h	5905 t/h	5646 t/h	5408 t/h
	42 sec	**0.70 min**	5976 t/h	5644 t/h	5418 t/h	5210 t/h	5673 t/h	5358 t/h	5144 t/h	4946 t/h
	54 sec	**0.90 min**	5442 t/h	5166 t/h	4976 t/h	4800 t/h	5167 t/h	4904 t/h	4724 t/h	4557 t/h
	66 sec	**1.10 min**	4996 t/h	4762 t/h	4600 t/h	4449 t/h	4743 t/h	4521 t/h	4367 t/h	4224 t/h
80%	30 sec	**0.50 min**	6362 t/h	5973 t/h	5710 t/h	5470 t/h	6040 t/h	5670 t/h	5421 t/h	5193 t/h
	42 sec	**0.70 min**	5738 t/h	5420 t/h	5203 t/h	5003 t/h	5448 t/h	5145 t/h	4939 t/h	4749 t/h
	54 sec	**0.90 min**	5226 t/h	4960 t/h	4778 t/h	4609 t/h	4961 t/h	4709 t/h	4536 t/h	4375 t/h
	66 sec	**1.10 min**	4798 t/h	4573 t/h	4417 t/h	4272 t/h	4555 t/h	4341 t/h	4194 t/h	4056 t/h
75%	30 sec	**0.50 min**	5963 t/h	5598 t/h	5352 t/h	5127 t/h	5661 t/h	5314 t/h	5081 t/h	4867 t/h
	42 sec	**0.70 min**	5378 t/h	5080 t/h	4876 t/h	4689 t/h	5106 t/h	4822 t/h	4629 t/h	4451 t/h
	54 sec	**0.90 min**	4898 t/h	4649 t/h	4478 t/h	4320 t/h	4650 t/h	4414 t/h	4251 t/h	4101 t/h
	66 sec	**1.10 min**	4497 t/h	4286 t/h	4140 t/h	4004 t/h	4269 t/h	4069 t/h	3931 t/h	3802 t/h
70%	30 sec	**0.50 min**	5564 t/h	5223 t/h	4994 t/h	4784 t/h	5282 t/h	4959 t/h	4741 t/h	4542 t/h
	42 sec	**0.70 min**	5018 t/h	4740 t/h	4550 t/h	4375 t/h	4764 t/h	4500 t/h	4320 t/h	4153 t/h
	54 sec	**0.90 min**	4570 t/h	4338 t/h	4179 t/h	4031 t/h	4339 t/h	4118 t/h	3967 t/h	3826 t/h
	66 sec	**1.10 min**	4196 t/h	3999 t/h	3863 t/h	3736 t/h	3983 t/h	3796 t/h	3668 t/h	3547 t/h
65%	30 sec	**0.50 min**	5165 t/h	4849 t/h	4636 t/h	4441 t/h	4903 t/h	4603 t/h	4401 t/h	4216 t/h
	42 sec	**0.70 min**	4658 t/h	4400 t/h	4224 t/h	4061 t/h	4422 t/h	4177 t/h	4010 t/h	3855 t/h
	54 sec	**0.90 min**	4242 t/h	4027 t/h	3879 t/h	3741 t/h	4028 t/h	3823 t/h	3682 t/h	3552 t/h
	66 sec	**1.10 min**	3895 t/h	3712 t/h	3586 t/h	3468 t/h	3697 t/h	3524 t/h	3404 t/h	3293 t/h

	Bucket Fill Factor		90%				85%			
	Load per Bucket		55.1 t				52.0 t			
	Load per Truck		220 t				208 t			
Overall Mine Efficiency	**Cycle Time**		26 sec	28 sec	30 sec	32 sec	26 sec	28 sec	30 sec	32 sec
	Truck Exchange		**0.43 min**	**0.47 min**	**0.50 min**	**0.53 min**	**0.43 min**	**0.47 min**	**0.50 min**	**0.53 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	5965 t/h	5600 t/h	5354 t/h	5129 t/h	5630 t/h	5285 t/h	5053 t/h	4840 t/h
	42 sec	**0.70 min**	5380 t/h	5081 t/h	4878 t/h	4691 t/h	5078 t/h	4796 t/h	4604 t/h	4427 t/h
	54 sec	**0.90 min**	4900 t/h	4651 t/h	4480 t/h	4321 t/h	4624 t/h	4389 t/h	4228 t/h	4078 t/h
	66 sec	**1.10 min**	4498 t/h	4287 t/h	4142 t/h	4006 t/h	4245 t/h	4046 t/h	3909 t/h	3780 t/h
80%	30 sec	**0.50 min**	5728 t/h	5377 t/h	5141 t/h	4925 t/h	5406 t/h	5075 t/h	4852 t/h	4648 t/h
	42 sec	**0.70 min**	5166 t/h	4879 t/h	4684 t/h	4504 t/h	4876 t/h	4605 t/h	4421 t/h	4251 t/h
	54 sec	**0.90 min**	4705 t/h	4466 t/h	4302 t/h	4149 t/h	4440 t/h	4215 t/h	4060 t/h	3916 t/h
	66 sec	**1.10 min**	4319 t/h	4117 t/h	3977 t/h	3847 t/h	4076 t/h	3885 t/h	3753 t/h	3630 t/h
75%	30 sec	**0.50 min**	5369 t/h	5040 t/h	4819 t/h	4616 t/h	5067 t/h	4756 t/h	4548 t/h	4356 t/h
	42 sec	**0.70 min**	4842 t/h	4573 t/h	4390 t/h	4222 t/h	4570 t/h	4316 t/h	4143 t/h	3984 t/h
	54 sec	**0.90 min**	4410 t/h	4186 t/h	4032 t/h	3889 t/h	4162 t/h	3950 t/h	3805 t/h	3670 t/h
	66 sec	**1.10 min**	4048 t/h	3859 t/h	3728 t/h	3605 t/h	3821 t/h	3642 t/h	3518 t/h	3402 t/h
70%	30 sec	**0.50 min**	5009 t/h	4703 t/h	4496 t/h	4307 t/h	4727 t/h	4438 t/h	4243 t/h	4065 t/h
	42 sec	**0.70 min**	4518 t/h	4267 t/h	4097 t/h	3939 t/h	4264 t/h	4027 t/h	3866 t/h	3717 t/h
	54 sec	**0.90 min**	4115 t/h	3906 t/h	3762 t/h	3629 t/h	3883 t/h	3686 t/h	3550 t/h	3425 t/h
	66 sec	**1.10 min**	3778 t/h	3600 t/h	3478 t/h	3364 t/h	3565 t/h	3398 t/h	3282 t/h	3175 t/h
65%	30 sec	**0.50 min**	4650 t/h	4365 t/h	4174 t/h	3998 t/h	4388 t/h	4120 t/h	3939 t/h	3773 t/h
	42 sec	**0.70 min**	4194 t/h	3961 t/h	3803 t/h	3656 t/h	3958 t/h	3738 t/h	3589 t/h	3451 t/h
	54 sec	**0.90 min**	3820 t/h	3625 t/h	3492 t/h	3368 t/h	3605 t/h	3421 t/h	3296 t/h	3179 t/h
	66 sec	**1.10 min**	3507 t/h	3342 t/h	3229 t/h	3123 t/h	3309 t/h	3154 t/h	3047 t/h	2947 t/h

MODEL: 6060 ● Bucket Size: 44.5 yd³ ● Number of Cycles: 4 ● Material Density: 3030 lb/yd³

	Bucket Fill Factor		**100%**				**95%**			
	Load per Bucket		67.5 tons				64.0 tons			
	Load per Truck		270 tons				256 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	26 sec	28 sec	30 sec	32 sec	26 sec	28 sec	30 sec	32 sec
			0.43 min	**0.47 min**	**0.50 min**	**0.53 min**	**0.43 min**	**0.47 min**	**0.50 min**	**0.53 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	7303 tons/h	6856 tons/h	6555 tons/h	6280 tons/h	6933 tons/h	6509 tons/h	6223 tons/h	5962 tons/h
	42 sec	**0.70 min**	6587 tons/h	6221 tons/h	5973 tons/h	5743 tons/h	6254 tons/h	5906 tons/h	5670 tons/h	5452 tons/h
	54 sec	**0.90 min**	5999 tons/h	5694 tons/h	5485 tons/h	5291 tons/h	5695 tons/h	5406 tons/h	5207 tons/h	5023 tons/h
	66 sec	**1.10 min**	5508 tons/h	5249 tons/h	5071 tons/h	4904 tons/h	5229 tons/h	4983 tons/h	4814 tons/h	4656 tons/h
80%	30 sec	**0.50 min**	7013 tons/h	6584 tons/h	6295 tons/h	6030 tons/h	6658 tons/h	6250 tons/h	5976 tons/h	5724 tons/h
	42 sec	**0.70 min**	6326 tons/h	5974 tons/h	5735 tons/h	5515 tons/h	6005 tons/h	5671 tons/h	5445 tons/h	5235 tons/h
	54 sec	**0.90 min**	5761 tons/h	5468 tons/h	5267 tons/h	5080 tons/h	5469 tons/h	5191 tons/h	5000 tons/h	4823 tons/h
	66 sec	**1.10 min**	5289 tons/h	5041 tons/h	4869 tons/h	4709 tons/h	5021 tons/h	4785 tons/h	4623 tons/h	4471 tons/h
75%	30 sec	**0.50 min**	6573 tons/h	6171 tons/h	5900 tons/h	5652 tons/h	6240 tons/h	5858 tons/h	5601 tons/h	5365 tons/h
	42 sec	**0.70 min**	5929 tons/h	5599 tons/h	5375 tons/h	5169 tons/h	5628 tons/h	5316 tons/h	5103 tons/h	4907 tons/h
	54 sec	**0.90 min**	5399 tons/h	5125 tons/h	4937 tons/h	4762 tons/h	5126 tons/h	4865 tons/h	4686 tons/h	4520 tons/h
	66 sec	**1.10 min**	4957 tons/h	4724 tons/h	4564 tons/h	4414 tons/h	4706 tons/h	4485 tons/h	4333 tons/h	4190 tons/h
70%	30 sec	**0.50 min**	6133 tons/h	5758 tons/h	5505 tons/h	5273 tons/h	5822 tons/h	5466 tons/h	5226 tons/h	5006 tons/h
	42 sec	**0.70 min**	5532 tons/h	5225 tons/h	5016 tons/h	4823 tons/h	5252 tons/h	4960 tons/h	4761 tons/h	4578 tons/h
	54 sec	**0.90 min**	5038 tons/h	4782 tons/h	4606 tons/h	4443 tons/h	4783 tons/h	4540 tons/h	4373 tons/h	4218 tons/h
	66 sec	**1.10 min**	4625 tons/h	4408 tons/h	4258 tons/h	4119 tons/h	4391 tons/h	4185 tons/h	4043 tons/h	3910 tons/h
65%	30 sec	**0.50 min**	5693 tons/h	5345 tons/h	5110 tons/h	4895 tons/h	5405 tons/h	5074 tons/h	4851 tons/h	4647 tons/h
	42 sec	**0.70 min**	5135 tons/h	4850 tons/h	4656 tons/h	4477 tons/h	4875 tons/h	4604 tons/h	4420 tons/h	4250 tons/h
	54 sec	**0.90 min**	4677 tons/h	4439 tons/h	4276 tons/h	4124 tons/h	4440 tons/h	4214 tons/h	4059 tons/h	3915 tons/h
	66 sec	**1.10 min**	4293 tons/h	4092 tons/h	3953 tons/h	3823 tons/h	4076 tons/h	3885 tons/h	3753 tons/h	3629 tons/h

	Bucket Fill Factor		**90%**				**85%**			
	Load per Bucket		60.7 tons				57.3 tons			
	Load per Truck		243 tons				229 tons			
Overall Mine Efficiency	**Truck Exchange**	**Cycle Time**	26 sec	28 sec	30 sec	32 sec	26 sec	28 sec	30 sec	32 sec
			0.43 min	**0.47 min**	**0.50 min**	**0.53 min**	**0.43 min**	**0.47 min**	**0.50 min**	**0.53 min**
83% = maximum 50 min/hour	30 sec	**0.50 min**	6575 tons/h	6173 tons/h	5902 tons/h	5654 tons/h	6206 tons/h	5826 tons/h	5570 tons/h	5336 tons/h
	42 sec	**0.70 min**	5931 tons/h	5601 tons/h	5377 tons/h	5170 tons/h	5597 tons/h	5286 tons/h	5075 tons/h	4880 tons/h
	54 sec	**0.90 min**	5401 tons/h	5127 tons/h	4938 tons/h	4763 tons/h	5097 tons/h	4838 tons/h	4660 tons/h	4495 tons/h
	66 sec	**1.10 min**	4959 tons/h	4726 tons/h	4566 tons/h	4416 tons/h	4680 tons/h	4460 tons/h	4309 tons/h	4167 tons/h
80%	30 sec	**0.50 min**	6314 tons/h	5927 tons/h	5667 tons/h	5429 tons/h	5959 tons/h	5594 tons/h	5348 tons/h	5123 tons/h
	42 sec	**0.70 min**	5695 tons/h	5379 tons/h	5163 tons/h	4965 tons/h	5375 tons/h	5076 tons/h	4873 tons/h	4686 tons/h
	54 sec	**0.90 min**	5187 tons/h	4923 tons/h	4742 tons/h	4574 tons/h	4895 tons/h	4646 tons/h	4475 tons/h	4317 tons/h
	66 sec	**1.10 min**	4761 tons/h	4538 tons/h	4384 tons/h	4240 tons/h	4494 tons/h	4283 tons/h	4137 tons/h	4002 tons/h
75%	30 sec	**0.50 min**	5918 tons/h	5556 tons/h	5312 tons/h	5088 tons/h	5585 tons/h	5243 tons/h	5013 tons/h	4802 tons/h
	42 sec	**0.70 min**	5338 tons/h	5041 tons/h	4840 tons/h	4653 tons/h	5037 tons/h	4758 tons/h	4567 tons/h	4392 tons/h
	54 sec	**0.90 min**	4861 tons/h	4614 tons/h	4444 tons/h	4287 tons/h	4588 tons/h	4354 tons/h	4194 tons/h	4046 tons/h
	66 sec	**1.10 min**	4463 tons/h	4254 tons/h	4109 tons/h	3974 tons/h	4212 tons/h	4014 tons/h	3878 tons/h	3750 tons/h
70%	30 sec	**0.50 min**	5522 tons/h	5184 tons/h	4956 tons/h	4748 tons/h	5211 tons/h	4892 tons/h	4677 tons/h	4481 tons/h
	42 sec	**0.70 min**	4980 tons/h	4704 tons/h	4516 tons/h	4342 tons/h	4700 tons/h	4439 tons/h	4262 tons/h	4098 tons/h
	54 sec	**0.90 min**	4536 tons/h	4305 tons/h	4147 tons/h	4000 tons/h	4281 tons/h	4063 tons/h	3914 tons/h	3775 tons/h
	66 sec	**1.10 min**	4164 tons/h	3969 tons/h	3834 tons/h	3708 tons/h	3930 tons/h	3746 tons/h	3618 tons/h	3499 tons/h
65%	30 sec	**0.50 min**	5126 tons/h	4812 tons/h	4601 tons/h	4407 tons/h	4837 tons/h	4541 tons/h	4342 tons/h	4159 tons/h
	42 sec	**0.70 min**	4623 tons/h	4366 tons/h	4192 tons/h	4030 tons/h	4363 tons/h	4121 tons/h	3956 tons/h	3804 tons/h
	54 sec	**0.90 min**	4210 tons/h	3996 tons/h	3850 tons/h	3713 tons/h	3974 tons/h	3771 tons/h	3633 tons/h	3504 tons/h
	66 sec	**1.10 min**	3865 tons/h	3684 tons/h	3559 tons/h	3442 tons/h	3648 tons/h	3477 tons/h	3359 tons/h	3248 tons/h

TELESCOPIC HANDLERS

CONTENTS

Features:

- **Intuitive control layout** enables efficient and comfortable operation.
- **Hydraulic system** enables the use of work tools requiring both intermittent and continuous auxiliary hydraulic flows.
- **Range of lift heights and load capacities** from 2500 kg (5,500 lb) to 5443 kg (12,000 lb) capacity and 5.6 m (18'4") to 17.3 m (56'9") lift height.
- **Cat® Telehandlers offer extended reach** to easily enable material to be delivered to high elevations or placed over onsite obstacles.

Features ***(continued)***:

- **Three steering modes and tight turning circles** allow simplified movement onsite and therefore increased productivity.
- **Cat Telehandlers have engine options** which either meet U.S. EPA Tier 4 Final emission standards, EU Stage V emission standards, or U.S. EPA Tier 3/ Stage IIIA equivalent emission standards.
- **Three transmissions options are available on telehandlers.** The TH255 is fitted with a hydrostatic transmission. The TL and TH construction range are fitted with 4-speed powershift transmissions. The high horsepower TH Ag Handler range is fitted with a 6-speed powershift transmission.
- **Three types of quick couplers are offered on the various telehandler models.** The TH255C is fitted with a skid-steer loader style universal coupler. The TL and TH lines of telehandlers offer hydraulic and manual style IT interface couplers which provide excellent work tool compatibility with older models of telehandlers and other products (for example Backhoe Loaders and Small Wheel Loaders).
- **Hydraulic Options** – On all product models single auxiliary service is standard and Hydraulic quick coupler is an option (not considered a separate hydraulic service). For the TH357, TH408, and TH3510 models, Continuous Flow is a standard feature, with Dual or Secondary Auxiliary Hydraulic service as an option. These options allow maximum work tool utilization.
- **Daily maintenance** consists of only a walkaround inspection, all major components and service points are located at ground level, providing excellent ease of service.

TRACK LOADERS

CONTENTS

Features of 953-963:

One Machine, Many Jobs

- Track loader power, traction and agility mean you can use one machine and one operator to do everything from clearing the site to installing utilities and finishing around buildings.
- Fusion™ Quick Coupler option lets you make fast attachment changes with a wide range of tools like forks, buckets, etc. from wheel loaders and other Fusion compatible machines.
- Bucket/tooth, undercarriage, track shoe and attachment choices help you equip your machine for optimal performance in your applications.
- Purpose-built Waste Handler, Ship Hold and Low Ground Pressure (LGP) configurations stand up to the toughest tasks.

Easy to Operate

- Updated cab offers more comfort and an intuitive 254 mm (10-inch) touchscreen dash display.
- Standard High Definition rearview camera shows prominently in the main display.
- Slope Indicate helps make operation easier by showing machine mainfall and cross slope right on the display.
- Enjoy operator comforts like suspension seat and adjustable armrests and controls.
- Choose either joystick or two-lever implement controls to match operator preference or application.
- Speed/steering control choices include either a joystick or a v-lever and foot pedals.
- Set implement response – fine, normal, coarse – to match operator preference or application.
- Emissions reduction technology is designed to work in the background, with no action required from the operator.

Top Performer

- 963 and 953 uses up to 10% less fuel per hour than the respective previous model.
- Performance Series bucket option boosts productivity up to 20% compared to General Purpose bucket.
- Efficient Cat C7.1 engine delivers power and fast response when the machine is under load.
- Meets U.S. EPA Tier 4 Final/EU Stage V/Japan 2014/Korea Tier 4 Final emission standards.
- Smoother implement and steering response, and improved steering performance provide more controllability.
- Load sensing hydraulics and position sensing cylinders offer precise, responsive performance.

Save on Maintenance

- Designed to help you take care of routine maintenance and get back to work.
- Grouped service points located behind large access doors; daily grease points in easy reach at ground level.
- Service mode in the operator display shows hydrostatic and implement pressure for easier troubleshooting and servicing.
- Demand fan provides efficient cooling plus easy fold-down service access.
- Handy bracket holds a shovel for quick undercarriage clean-out.
- Tilt cab and convenient service access points for easier maintenance and repair.
- Diesel Particulate Filter in the Clean Emissions Module designed to work for the life of the engine without needing to clean or replace the filter.

Features of 953-963 ***(continued):***

Focus on Safety

- Excellent visibility to the bucket and all around the machine enhances safety and helps operators work more confidently.
- Handles and steps help operators climb on and off the machine more easily, from the front or the back of the tracks.
- Standard rear vision camera enhances visibility behind the machine.
- Seat belt indicator gives an alarm and registers fault code through Product Link™ if the operator fails to buckle up, enhancing job site safety.
- Ergonomics, a quiet engine and low-effort controls help lessen fatigue, so operators are better able to remain fresh and focused.

Take on the Trash

- Waste Handler configuration is a versatile machine for loading, sorting, excavation and spreading cover, well suited to the landfill or transfer station.
- Specialized guarding, striker bars and seals help protect the machine and components from impact and airborne debris.
- Final Drive guarding helps prevent wrapping and damage.
- Screen helps protect windshield and operator from breakage and debris.
- High debris cooling system – radiator fan folds out for easy cleanout access.
- Specialized air handling features help deliver cleaner air to the machine and to the cab.
- Choice of buckets and track shoes allow you to further optimize the machine for greater performance and service life.
- Enhanced Cleaning Package reduces cleaning time, adds machine protection and increases compaction.

Keep Things Shipshape

- Optimal combination of traction, high reach and machine balance makes track loaders ideal for working in ship holds and port handling duties.
- Specialized implements, like coal buckets and trim blades, help you sweep down walls and handle a variety of materials.
- Fusion Quick Coupler option adds versatility with easy use of forks, buckets and other attachments from compatible machines.
- Specialized sealing, guards and bumpers help protect key components.
- Front and rear eyes widely spaced for stability during lifting.
- Added lighting packages help illuminate the work area.

EXTREME SLOPE OPERATION

The maximum fore and aft grade in static condition on which each track loader will maintain proper lubrication is 45 degrees (100%). Consult Operation & Maintenance Manual (if applicable) for POWERTRAIN fluid level overfill requirements for operation on extreme slopes. Extreme slope operation is anytime the slope exceeds 25° (47%).

The ENGINE should never be overfilled with oil. This may lead to rapid overheating. For extreme slope operation, engine oil should be maintained at the full mark.

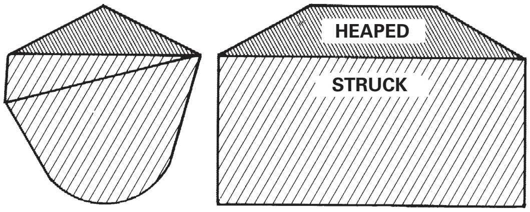
NOTE: Both ENGINE and POWERTRAIN fluid levels should be checked on level ground before working sidehills and slopes.

When working sidehills and slopes, consideration should be given to the following important points:

- Speed of travel — At higher speeds, inertia forces tend to make the track loader less stable.
- Roughness of terrain or surface — Ample allowance should be made where the terrain or surface is uneven.
- Mounted equipment — Buckets, rippers, winches, and other mounted equipment cause the track loader to balance differently.
- Nature of surface — New earthen fills may give way with the weight of the track loader. Rocky surfaces may promote side slipping of track loader.
- Track slippage due to excessive loads — This may cause downhill track to “dig in,” increasing angle of track loader.
- Width of shoes — Wide track shoes tend to decrease “digging in,” hence track loader is more stable.
- Operated equipment — Be aware of the stability and other performance features of the equipment operated by the track loader.
- Keep all attachments or pulled loads low to the ground for optimum stability.

NOTE: Safe operation on steep slopes may require special machine maintenance as well as excellent operator skill and proper equipment for the specific application. Consult Operation & Maintenance Manual (if applicable) for proper fluid level requirements.

SAE BUCKET RATING



SAE Bucket Capacities

Struck capacity is that volume contained in a bucket after a load is leveled by drawing a straight edge resting on the cutting edge and the back of the bucket.

Heaped capacity is a struck capacity *plus* that additional material that would heap on the struck load at a 2:1 angle of repose with the struck line parallel to the ground.

SAE J742 (Oct. 79) specifies that the addition of any auxiliary spill guard to protect against spillage of material which might injure the operator will not be included in bucket capacity ratings. Buckets with irregular shaped cutting edges (vee edge) the strike plane should be drawn at one-third the distance of the protruding portion of the cutting edge. Cat rock buckets are built with integral see-through rock guards. Cat light material buckets come standard with bolt-on edges. These features which add to actual bucket capacity are included in published ratings.

Dump Height

SAE J732 JUN92 specifies that dump height is the vertical distance from the ground to the lowest point of the cutting edge with the bucket hinge pin at maximum height and the bucket at a 45° dump angle. Dump angle is the angle in degrees that the longest flat section of the inside bottom of the bucket will rotate below horizontal.

Static Tipping Load

The minimum weight at center of gravity of "SAE Rated" load in bucket which will rotate rear of machine to a point where, on track loaders, front rollers are clear of the track under the following conditions:

a. Loader on hard level surface and stationary.
b. Unit at standard operating weight.
c. Bucket at maximum rollback position.
d. Load at maximum forward position during raising cycle.
e. Unit with standard equipment as described in specifications unless otherwise noted under the heading.

Operating Load

In order to comply with SAE standard J818 MAY87, the operating load for track loaders should not exceed 35% of the Static Tipping load rating. See "Performance Data" of each machine in this handbook for increases to static tipping load by adding cab, counterweights, ripper-scarifier, etc.

SELECTING A MACHINE

Steps in selecting the proper size loader:

1. Determine production required or desired.
2. Determine loader cycle time and cycles per hour. A machine size must be assumed to select a basic cycle time.
3. Determine required payload per cycle in loose cubic yards and pounds (meters and kilograms).
4. Determine bucket size needed.
5. Make machine selection using bucket size and payload as criteria to meet production requirements.
6. Compare the loader cycle time used in calculations to the cycle time of the machine selected. If there is a difference, rework the process beginning at step 2.

1. Production Required

The production required of a track loader should be slightly greater than the production capability of the other critical units in the earth or material moving system. For example, if a hopper can handle 300 tons per hour, a loader capable of slightly more than 300 tons should be used. Required production should be carefully calculated so the proper machine and bucket selections are made.

2. Loader Cycle Times

Material type, pile height, and other factors may improve or reduce production, and should be added to or subtracted from the basic cycle time when applicable.

When hauls are involved, obtain haul and return portions of the cycle from the estimated travel chart (this section). Add the haul and return times to the estimated basic cycle time to obtain total cycle time.

CYCLE TIME FACTORS

A basic cycle time (Load, Dump, Maneuver) of 0.25-0.35 minutes is average for a track loader [the basic cycle for large track loaders, 2 m^3 (2.6 yd^3) and up, can be slightly longer], but variations can be authenticated in the field. The following values for many variable elements are based on normal operations. Adding or subtracting any of the variable times will give the total basic cycle time.

Estimating Cycle Time

Cycle time of a track loader needs to be determined to find loads per hour. Total cycle time includes the following segments:

Load Time + Maneuver Time + Travel Time + Dump Time

Load Time —

Material	Minutes
Uniform aggregates	0.03-0.05
Moist mixed aggregates	0.03-0.06
Moist loam	0.03-0.07
Soil, boulders, roots	0.04-0.20
Cemented materials	0.05-0.20

Maneuver Time — includes basic travel, four changes of direction and turning time, and will be about 0.20 minutes with a competent operator.

Travel Time — in a load and carry operation is comprised of haul and return times which can be determined by the travel charts in this section.

Dump Time — is dictated by the size and strength of the dump target and varies from 0.00 to 0.10 minutes. Typical dump times into highway trucks are from 0.04 to 0.07 minutes.

NOTE: When comparing hydrostatic track loaders with former power shift models (using the production estimating method) two factors must be considered: (1) The hydrostatic track loaders on the average outcycle power shift models by up to 10 percent due to faster machine speed and easier operation. (2) Larger, rear engine hydrostatic track loaders incorporate Z-bar linkage, which provides substantially better bucket fill factors. The degree to which each factor affects estimated production should be left to the user's judgment depending on the particular job application and conditions.

Example: Moist loam is being excavated from a bank and loaded into trucks.

	Minutes
Load — moist loam	0.05
Maneuver Time	0.20
Travel — none required	0.00
Dump	<u>0.05</u>
Total Cycle	0.30 min. or 200 cycles per 60 min. hour

	Minutes added (+) or Subtracted (–) From Basic Cycle
Materials	
— Mixed	+0.02
— Up to 3 mm (1/8 in)	+0.02
— 3 mm (1/8 in) to 20 mm (3/4 in)	–0.02
— 20 mm (3/4 in) to 150 mm (6 in)	0.00
— 150 mm (6 in) and over	+0.03 and Up
— Bank or broken	+0.04 and Up
Pile	
— Conveyor or Dozer piled 3 m (10 ft) and up	0.00
— Conveyor or Dozer piled 3 m (10 ft) or less	+0.01
— Dumped by truck	+0.02
Miscellaneous	
— Common ownership of trucks and loaders	Up to –0.04
— Independently owned trucks	Up to +0.04
— Constant operation	Up to –0.04
— Inconsistent operation	Up to +0.04
— Small target	Up to +0.04
— Fragile target	Up to +0.05

Using actual job conditions and the above factors, total cycle time can be estimated. Convert total cycle time to cycles per hour.

$$\textit{Cycles per hour at 100\% Efficiency} = \frac{\textit{60 Min}}{\textit{Total Cycle Time in Minutes}}$$

Job efficiency is an important factor in machine selection. Efficiency is the actual number of minutes worked during an hour. Job efficiency accounts for operator breaks, and other work interruptions. See "Efficiency Considerations" in this section.

Bucket Fill Factors

The following indicates the approximate amounts of material as a percent of rated bucket capacity which will actually be delivered per bucket per cycle. This is known as "Bucket Fill Factor."

Loose Material	Fill Factor
Mixed Moist Aggregates	95-110%
Uniform Aggregates	
up to 3 mm (1/8 in)	95-110
3 mm-9 mm (1/8 in-3/8 in)	90-110
12 mm-20 mm (1/2 in-3/4 in)	90-110
24 mm and over (1 in)	90-110
Blasted Rock	
Well	80-95%
Average	75-90
Poor	60-75
Other	
Rock Dirt Mixtures	100-120%
Moist Loam	100-120
Soil, Boulders, Roots	80-100
Cemented Materials	85-100

Fill factors on track loaders are affected by bucket penetration, breakout force, rack back angle, bucket profile and ground engaging tools such as bucket teeth and segments or bolt-on replaceable cutting edges.

GENERAL PURPOSE BUCKET W/TEETH & SEGMENTS MAXIMUM OPERATING CAPACITIES

MODEL	GENERAL PURPOSE BUCKET SIZE m^3	yd^3	MAXIMUM OPERATING CAPACITY kg	lb
953D/953K	1.85	**2.4**	3182	**7015**
963D/963K	2.45	**3.2**	4214	**9290**
973D	3.21	**4.2**	5521	**12,174**

LOADER PRODUCTION

Loader production equals quantity of material the bucket carries per load × number of bucket loads per hour.

Estimating Bucket Load

The quantity of material in a loader bucket is estimated by two methods, depending on whether the material being loaded is in a loose or bank state.

1. When the material is loose, as in stockpile loading, the bucket load is estimated in loose meters (or cubic yards) by a Bucket Fill Factor (see Tables Section or chart following this discussion). The quantity of material is determined as follows:

   Rated Bucket Capacity × Bucket Fill Factor = Bucket Payload in Loose m^3 (yd^3)

   For example, a 973 with a 3.2 m^3 (4.2 yd^3) General Purpose bucket loading moist loam material will carry:

   3.2 m^3 × 1.15 = 3.68 loose cubic meters
   (4.2 yd^3 × 1.15 = 4.83 loose cubic yards)

   Once the potential bucket load has been determined, check the static tipping load ratings on the specific machine to determine if bucket load is in fact a safe operating load. *(Safe operating load as defined by SAE for track loaders should not exceed 35% of static tipping load.)*

   Productivity in many applications is measured in tons. See Tables Section for material densities if conversion to tons is desired.

2. When material is in the bank state, as in excavation, productivity is measured in bank meters (cubic yards). Bucket load in Bm^3 (BCY) is estimated by applying one of the load factors from the Tables section to convert the excavated material in the bucket from Bm^3 (BCY) to Lm^3 (LCY) to allow for the digging and carrying characteristics of the material. The quantity of excavated material a bucket carries is then determined as follows:

   Rated Bucket Capacity × Load Factor × Bucket Fill Factor = Bucket Payload in Bm^3 (BCY)

   Example: a 953D with a 1.85 m^3 (2.4 yd^3) General Purpose bucket loading wet loam earth from bank:

   1.85 m^3 × 0.79 × 1.15 = 1.68 Bm^3
   (2.4 yd^3 × 0.79 × 1.15 = 2.18 BCY)

Estimating Production

Machine and job considerations include:
- Machine model and bucket size
- Material type, particle size, density and load factor (see Tables Section)
- Bucket fill factor
- Haul distance
- Underfoot conditions
- Altitude
- Dump target size, height, and type

Example:

Conditions —

Machine	953D
Bucket size	1.85 m^3 (2.4 yd^3)
Material	Moist Loam
Bucket fill factor	1.15
Haul length	30 m (100 ft)
Dump target	Pile
Travel in forward speed	
Cycle Time	**Minutes**
Load time	0.15
Maneuver time	0.20
Travel time (from curves)	0.40
Dump time	0.05
Total	0.80

Loads Per Hour —

$$\frac{60 \text{ min/hr}}{0.80 \text{ min/cycle}} = \text{75 cycles per hour @ 100\% efficiency}$$

Load Per Cycle —

1.85 m^3 × 1.15 BFF = 2.13 Lm^3 × 0.81 LF = 1.72 Bm^3

(2.4 yd^3 × 1.15 BFF = 2.76 LCY × 0.81 LF = 2.24 BCY)

Hourly Production —

1.72 Bm^3 × 75 cycles/h = 129 Bm^3/h

(2.24 BCY × 75 cycles/hr = 168 BCY/hr)

More accurate production estimates can be made by recording actual machine cycle times in the same or similar application. Then visually verify the approximate bucket fill factor.

Efficiency Considerations

Loader capacity should always be matched to peak production requirements of the job. Actual "on-the-job" loader productivity will be influenced by factors such as operator skill, personal delays, job layout and other delays. Experience and knowledge of local conditions will be the best indicators of actual job efficiency.

Operation	Working Hour	Efficiency Factor
Day	50 min/Hr	0.83

An Alternative Machine Selection Method

Another method of selecting the right Track Loader and bucket to meet production requirements is by use of the nomographs on the following pages. The method is quicker and easier than the proceding example because it does not require as many calculations, yet the accuracy is about the same within the normal limits of input data.

Be careful when entering and reading data from the nomographs because some scales increase from bottom to top, while others are the reverse. Do not be overly concerned with the precision as affected by pencil line width or reading to the hundredth of a m^3 (yd^3). Remember that bucket fill factor, material density, and cycle time are at best close estimates.

Example problem

A track loader must produce 200 Lm^3 (262 LCY) per hour. Estimated cycle time is 0.5 minutes, working 50 minutes per hour. Bucket fill factor is 110% and the material density is 1600 kg/Lm^3 (2700 lb/LCY).

Determine bucket size, machine model and hourly production in tons and yards.

Solution

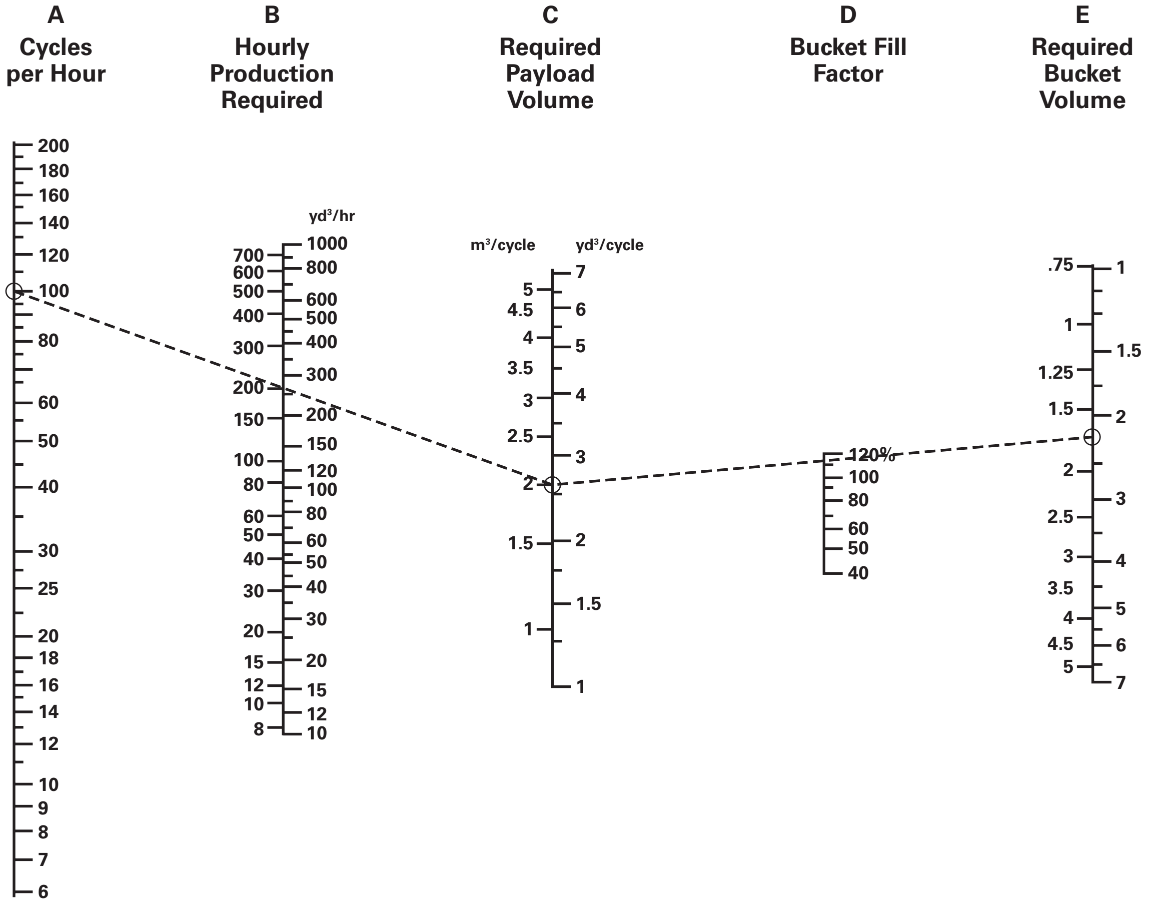
At full efficiency, it will cycle 120 times per hour. Since only an average 50 minutes are available, only 100 cycles will be completed per hour.

Starting on Scale A at 100 cycles per hour draw a straight line intersecting 200 m^3/hr (262 yd^3/hr) on Scale B and continuing the line on to Scale C giving 2.0 m^3 (2.62 yd^3) required payload.

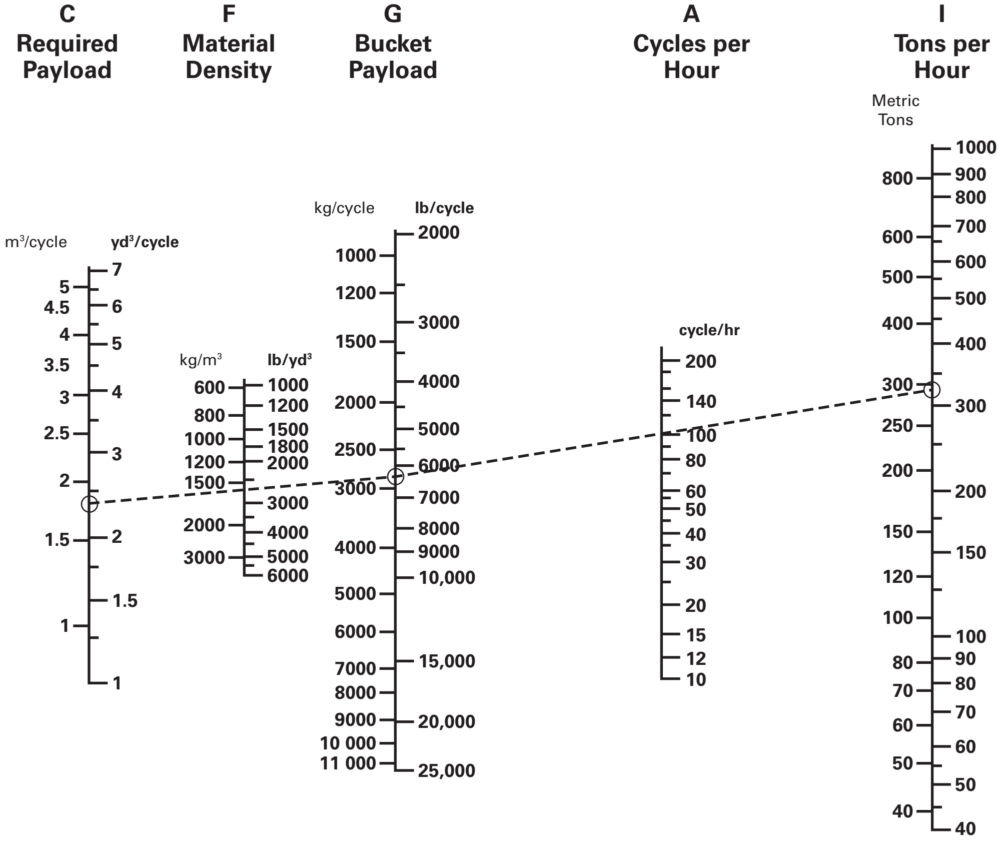
Follow steps 1 through 7 on the next two pages.

● ● ●

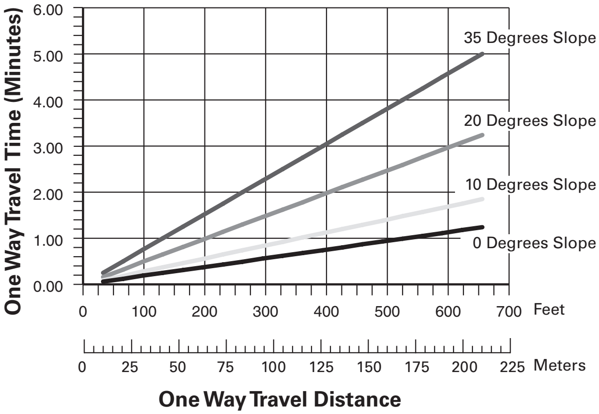
1) Enter Scale A cycles per hour (100) and B hourly production 200 m^3/hr (262 yd^3/hr).
2) Connect A and B and extend to C to find required payload 2.0 m^3 (2.62 yd^3).
3) Connect C to bucket fill factor on Scale D (110%) and extend to E to find required bucket size 1.8 m^3 (2.35 yd^3).
4) Transfer Scale A and C readings to nomograph on following page.



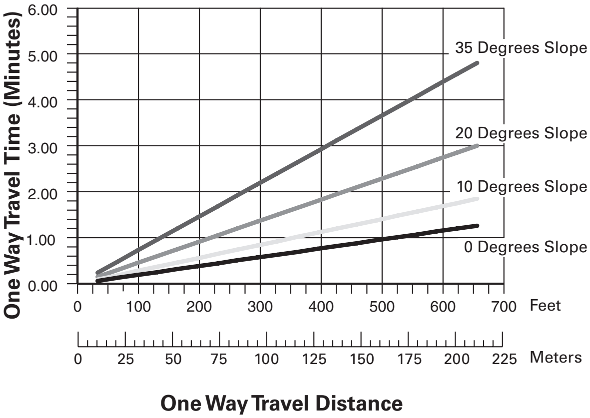
5) Connect C 1.8 m³ (2.35 yd³) to F 1600 kg/m³ (2700 lb/yd³) and extend to G to find payload weight 2880 kg (6345 lb).
6) Compare G bucket payload weight 2880 kg (6345 lb) with maximum operating capacities table in this section to see if the 1.85 m³ (2.4 yd³) bucket can handle the desired payload. Table indicates the 953D with a 1.85 m³ (2.4 yd³) bucket equipped with bolt-on cutting edge or teeth and segments has a greater operating capacity of 3343 kg (7370 lb), therefore stability is okay.
7) Extend Scale G reading 2880 kg (6345 lb) through Scale A (100) to Scale I to find tons per hour 288 metric ton/hr (317 U.S. ton/hr).



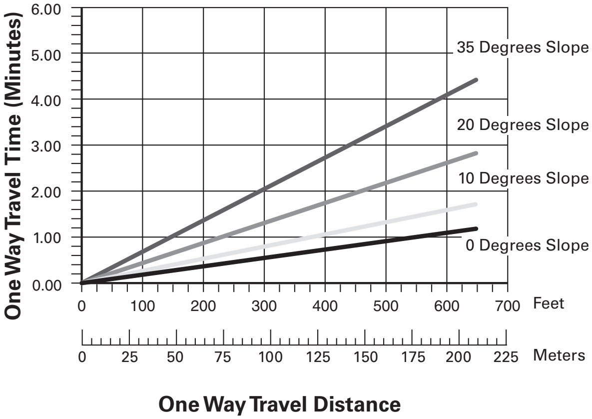
953D/953K



963D/963K



973D



TRAVEL TIME CHARTS

Conditions:

- No grades.
- Speeds loaded and empty essentially the same.
- Bucket position constant during travel.
- Travel encountered in maneuver portion of cycle not included.
- Acceleration time accounted for in maneuver time.

Travel Time (in minutes) =

$$\textit{Metric} - \frac{\text{number of meters traveled}}{\text{speed (in km/h)} \times 16.67}$$

$$\textit{English} - \frac{\text{number of feet traveled}}{\text{speed (in mph)} \times 88}$$

KEY

953D/953K — Hydrostatic top speed both forward and reverse 10 km/h **(6.2 mph)**
963D/963K — Hydrostatic top speed both forward and reverse 10 km/h **(6.2 mph)**
973D — Hydrostatic top speed both forward and reverse 11 km/h **(6.83 mph)**

Track Loaders

Production Estimating Table
- m^3 or yd^3/60 min. hour
- Estimated bucket payload in bank m^3 or yd^3

Bucket Size (m^3 or yd^3)		1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Cycle Time Hundredths of a minute	**Cycles Per Hr**	**Unshaded area indicates average work range**								
0.25	240	240	360	480	600	720	840	960		
0.30	200	200	300	400	500	600	700	800		
0.35	171	171	257	342	428	513	599	684	769	
0.40	150	150	225	300	375	450	525	600	675	750
0.45	133	133	200	268	332	400	466	530	600	665
0.50	120	120	180	240	300	360	420	480	540	600
0.55	109	109	164	218	272	328	382	436	490	545
0.60	100	100	150	200	250	300	350	400	450	600
0.65	92	92	138	184	230	276	322	368	416	460

Work Tools	953D/953K	963D/963K	973D
Fusion™ Coupler	X (953K only)	X	
Quick Coupler	X	X	X
Fusion General Purpose Bucket	X (953K only)	X	
General Purpose (GP) bucket	X	X	X
GP bucket with trash rack	X	X	X
MP bucket with trash rack	X	X	X
Landfill bucket	X	X	X
Landfill Multi-purpose	X	X	X
Multi-purpose (MP) bucket	X	X	X
Trim blade	X	X	X
Slag bucket			X
Fusion Pallet Forks	X (953K only)	X	
Forks (for QC or bucket)	X	X	X
Material handling arm	X	X	X
Loader rake	X	X	X
Top-Clamp bucket	X		X
Side Dump bucket	X	X	X

Fusion Coupler System for Track Loaders

This coupler system is a performance multiplier for Track Loaders, giving owners many times the value over a machine with only a pin-on bucket.

The biggest gain for the track loader user is durability; the Fusion coupler endures like no other. Dual wedge locks pull the tool tight to the coupler and hold it there for a solid, rattle-free fit. No rattle means no wear, so tools last longer. The wedge lock is built to stay tight even after thousands of tool changes. This coupler is built to be as tough as the linkage itself, for trouble-free performance day in and day out.

The Track Loaders Fusion Coupler is supported by a set of tools:

General Purpose Buckets provide good all-around performance for stockpiling, re-handling, excavating and bank loading. A wide bucket is available for use with a machine that has wide gauge tracks.

Multi-Purpose Buckets have a unique four-way action that can load, strip top soil, bulldoze, clamp pipe or large chunks of concrete, clean up debris and many other tasks.

Pallet Forks are an essential tool on construction job sites. Cat Fusion Pallet Forks can be configured to allow the tines to either swing or stay in a fixed position.

Fusion Interchangeability

The Fusion Coupler for the track loaders is compatible with most of the Fusion tools for wheel loaders, allowing interchangeability. However, common sense must be used as machine power envelopes and use profiles are very different for each machine platform.

Care must be taken to get the best performance while taking advantage of tool interchangeability. While all Fusion couplers can pick up any Fusion tool, some tools are less useful when used on a different type of carrier than their design intent.

For compatibility questions, contact Cat Work Tools.

SHOE OPTIONS

① **Double Grouser Shoes**　② **Trapezoidal Center Hole Shoes**　③ **Single Grouser Shoes**　④ **Chopper Shoes**

- **Extreme service shoes** are available which have more hardened wear material for longer wear life and higher impact applications.
- **Wider shoes** are also available to reduce ground pressure in soft underfoot conditions.

Other shoe options are available. Consult a Cat dealer for more information.

SYSTEMONE SHOES

Double Grouser Shoes

- Work best in applications that require less penetration and traction.
- Recommended for applications that require better turning capability and less ground disturbance.
- Feature two or three short grousers instead of one tall grouser.

Center Hole Shoes

- Work best in applications where packing causes the track to tighten. They are recommended for applications with large amounts of debris what tend to pack in the track.
- Reduces extricable packing between the shoe and the bushing since they allow the sprocket to punch out dirt and debris.

Other shoe options are available. Consult a Cat dealer for more information.

TRACK-TYPE TRACTORS
Hydraulic Controls
Bulldozers
Rippers

CONTENTS

TRACK-TYPE TRACTORS

Features:

- **Cat® Diesel Engines** provide the power, high torque rise, reliability and performance you can depend on.
- **HEUI™** on D6R and D7R increases fuel efficiency, reduces smoke, improves cold starting and enhances diagnostic capabilities.
- **Mechanical Electronic Unit Injector (MEUI™)** on D8T, D9, D10 and D11 excels in its ability to control injection pressure over the entire engine operating speed range. It combines the technical advancement of an electronic control system with the simplicity of direct mechanically controlled unit fuel injection. These features allow the engine to have complete control over injection timing, duration, and pressure.
- **Common Rail fuel injection system** on D1, D2, D3, D6K2, D5R2, D6N, D6T, D6, D6XE and D7E machines; optimizes performance and fuel consumption, minimizes heat rejection, and lowers emissions.

- **Oil cooled steering clutches and brakes** standard on D6GC, D9, D10 and D11.
- **Finger Tip Controls (FTC)** of transmission, steering clutches and brakes on D10T2 and D11.
- **Differential steering** allows infinitely variable turning radius. Standard on the D5R2, D6N, D6R2, D6T, D7R, D7E, D8R, D8T, D9, D5, D6, D6 XE, D7 and D8 GC, allows the tractor to make a "power turn" keeping both tracks working for more traction and higher performance.
- **Electronic Hydrostatic Power Train System** on D1 through D4 allows power turns, stepless speed range, smooth modulation, dynamic hydrostatic braking, superior maneuverability and excellent controllability.
- **Electric Drive Power Train System** on D6 XE and D7E allows stepless speed range, smooth modulation, and excellent efficiency. When coupled with differential steer it provides superior maneuverability with locked-track pivot turn capability and excellent controllability.
- **Combined hand lever steering** located left of operator provides easier operation on D9R.
- **Standard Tractors** designed for heavy dozing and general grading.
- **XL Tractors D6T, D5R2 and D6R2** offer higher horsepower and longer roller frames for increased finish grading capability, flotation and productivity.
- **Extra Wide (XW) gauge** on D6T length roller frame provides wider shoes for greater flotation and stability for steep slope grading.
- **Sealed and Lubricated Track** reduces pin and bushing wear for lower undercarriage repair costs.
- **Cat Abrasion Undercarriage** extends undercarriage system life, improves reliability, and reduces owning and operating costs.
- **Elevated sprockets** (not on D4 or D7E) eliminate final drive stress induced by roller frame movement and ground impact loads. Final drives pull chain only. Seals moved up out of dirt, sand and water for longer life. Blade visibility improved because operator sits higher.
- **Resilient mounted bogie undercarriage** on D8R, D8T, D9, D10 and D11 reduces shock transmitted to tractor. Allows track to conform to rough ground for better traction.
- **Solid mounted undercarriage** standard on D1 through D3 provides stable platform for low impact, and high abrasion applications. Provides optimum finish grading performance.
- **Oscillating undercarriage** on D6K2 through D7E and optional on the D8R and D8T decreases ground shock to the machine and provides a smoother, more comfortable ride for the operator.
- **Accessible modular design** on D5, D6N XL and up greatly reduces drive train removal and installation time resulting in reduced repair costs.
- **Tag link** on D7, D7R, D8R/D8T and up; L-shaped push arms on D5, D6, D6R2, D6N, D6T and D7E. Both designs allow closer mounting of dozer blades. This reduces total tractor length, improves maneuverability, balance, blade penetration and pryout.
- **Low ground pressure (LGP)** tractors offer greater flotation in soft, swampy conditions. Available on D1 through D8T.

EXTREME SLOPE OPERATION

The maximum fore and aft grade in static condition on which each track-type tractor or pipelayer will maintain proper lubrication is 45 degrees (100%). Consult Operation & Maintenance Manual (if applicable) for POWERTRAIN fluid level overfill requirements for operation on extreme slopes. Extreme slope operation is anytime the slope exceeds 35°.

The ENGINE should never be overfilled with oil. This may lead to rapid overheating. For extreme slope operation, engine oil should be maintained at the full mark.

NOTE: Both ENGINE and POWERTRAIN fluid levels should be checked on level ground before working sidehills and slopes.

When working sidehills and slopes, consideration should be given to the following important points:

- Speed of travel — At higher speeds, inertia forces tend to make the tractor less stable.
- Roughness of terrain or surface — Ample allowance should be made where the terrain or surface is uneven.
- Mounted equipment — Bulldozers, sidebooms, winches, and other mounted equipment cause the tractor to balance differently.
- Nature of surface — New earthen fills may give way with the weight of the tractor. Rocky surfaces may promote side slipping of tractor.
- Track slippage due to excessive loads — This may cause downhill track to "dig in," increasing angle of tractor.
- Implements hitched to the drawbar — This may decrease weight on uphill track, e.g., logging arch, two-wheel wagon.
- Height of hitch on tractor — When a high drawbar is used the tractor is less stable than with the standard drawbar.
- Width of shoes — Wide track shoes tend to decrease "digging in", hence tractor is more stable.
- Operated equipment — Be aware of the stability and other performance features of the equipment operated by the tractor.
- Keep all attachments or pulled loads low to the ground for optimum stability.

NOTE: Safe operation on steep slopes may require special machine maintenance as well as excellent operator skill and proper equipment for the specific application. Consult Operation & Maintenance Manual (if applicable) for proper fluid level requirements.

Features:

- **Designed and built for specific tractor applications.** Valves and components sized for exacting quality and performance.
- **Job requirements matched** through various arrangements.
- **Hydraulic blade and ripper controls:** Mechanical controls on G Series. Electro hydraulic controls on D6N and D6K2. Pilot blade and ripper controls on D6T Tier 3/Stage IIIA, Japan 2006 (Tier 3) equivalent with optional electro hydraulic blade control. Electro hydraulic blade and ripper controls on D6T Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim) equivalent Mechanical controls on D9R. Electro hydraulic blade and ripper controls on D7E, D8T, D9, D10 and D11.
- **Full flow filters***… all oil completely filtered.
- **Dual tilt** — standard on D11 and D11 CD, attachment option on D7E, D8R, D8T, D9 and D10.

*Exception — D8R 2-pump.

BULLDOZERS

CONTENTS

Features:

- **Straight Bulldozers** — adjustable tilt angle controls blade penetration.
- **Variable cutting edge Power Angle and Tilt (VPAT)** — blade available on certain models. The blade can be mechanically tipped forward for improved penetration or back for more productivity and easier finish grading.
- **Angling Bulldozers** — 25° right/left angling; C-frame allows mounting other tools.
- **Universal Bulldozers** — 25° wings provide increased capacity, less spillage.
- **Semi-Universal Bulldozers** — combines penetration ability of straight blade with increased load capacity provided by short 25° wings.
- **Wheel Dozer blades** are offered in straight and universal blade design with hydraulic pitch and tilt control.
- **Box-section construction** on blades adds rigidity and strength.
- **Cutting edges** are heat treated and reversible for extra life.
- **Performance Cutting edge** available for D6, D7 and D8.

BLADE SELECTION

Properly matching tractor and dozer is a basic requirement for maximizing production. First consider the kind of work the tractor will be doing most of its life. Then evaluate:

- Material to be moved.
- Tractor limitations.

Materials to be moved

Most materials are dozeable. However, dozer performance will vary with material characteristics such as:

Particle Size and Shape — The larger the individual particle size, the harder it is for a cutting edge to penetrate. Particles with sharp edges resist the natural rolling action of a dozer blade. These particles require more horsepower to move than a similar volume of material with rounded edges.

Voids — Few voids or the absence of voids means the individual particles have most or all of their surface area in contact with other particles. This forms a bond which must be broken. A well graded material, which lacks voids, is generally heavy, and will be hard to remove from the bank state.

Water Content — In most materials the lack of moisture increases the bond between particles and makes the material difficult to remove from the bank state. A high moisture content makes dozing difficult because the material is heavy and requires more force to move. Optimum moisture reduces dust and offers the best condition for dozing ease and operator comfort.

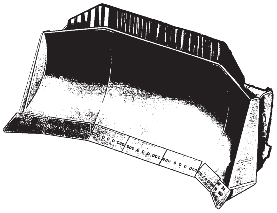
The effect of freezing depends on the moisture content. When frozen, the material's bond strengthens as moisture content increases and temperature decreases. However, freezing a completely dry material does not change its characteristics.

An indication of a blade's ability to penetrate and obtain a blade load is kW per meter (or horsepower per foot) of cutting edge. The higher the kW/meter (HP/foot), the more aggressive the blade. Kilowatt per Lm^3 (horsepower per loose cubic yard) indicates a blade's ability to push material. The higher the kW/Lm^3 (HP/LCY), the greater the blade's potential capability for carrying material at a greater speed.

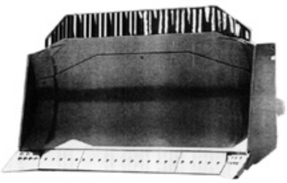
Tractor Limitations

The weight and horsepower of the machine determines its ability to push. No tractor can exert more pounds push than the machine itself weighs and its power train can develop. Various terrain and underfoot conditions on the job limit the tractor's ability to use its weight and horsepower. The "approximate coefficient of traction factors" chart in the Tables Section presents these traction factors for common materials. To use the chart, take the total tractor weight (with attachments) times the factor to arrive at the maximum usable push the dozer can exert.

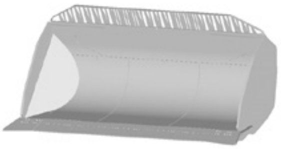
Production Dozing Tools



"U" — Universal blade — the large wings on this blade include one end bit and at least one section of cutting edge which make it efficient for moving big loads over long distances as in land reclamation, stockpile work, charging hoppers and trapping for loaders. As this blade has a lower kW/meter (HP/foot) of cutting edge than an "S" or "SU", penetration should not be a prime objective. With a lower kW/Lm^3 (HP/LCY) than an "S" or "SU", this blade is best for lighter or relatively easily dozed material. If equipped with tilt cylinders the U blade can be used to pry out, level, cut ditches and steer the tractor.

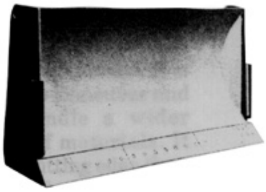


"SU" — The Semi-U blade combines the desirable characteristics of S and U-blades into one package. It has increased capacity by the addition of short wings which include only the dozer end bits. The wings provide improved load retention capabilities while maintaining the blade's ability to penetrate and load quickly in tightly packed materials and to handle a wide variety of materials in production oriented applications. Tilt cylinder(s) increase both the productivity and versatility of this dozer. Equipped with a push plate, it is effectively used for push loading scrapers.

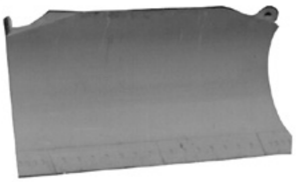


"CD" — The CD or CarryDozer Blade is available for the D11T CarryDozer only. It is built to the same high standard of structural integrity as the "U" and "SU" Dozers. The CD Blade has a unique "bucket" shape that allows it to carry several cubic yards or cubic meters of material in the blade. This acts as a disposable counterweight that allows the CarryDozer to push more material per pass than a standard D11T. The CarryDozer will not be as effective as the "U" or "SU" dozer in tightly packed or poorly shot material. It is also more sensitive to the carry-back in sticky materials.

General Purpose Dozing Tools



"S" — The Straight blade provides excellent versatility. Since it is physically smaller than the SU or U-blade, it is easier to maneuver and can handle a wider range of materials. It has a higher kW/ meter (HP/foot) of cutting edge than the SU or U-blade; consequently, the "S" is more aggressive in penetrating and obtaining a blade load. A tilt cylinder increases both the productivity and versatility of this dozer. With a high kW/Lm^3 (HP/LCY), the S-blade can handle heavy material easily.



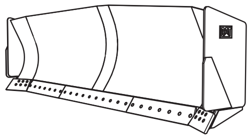
Power Angle and Tilt Blade — Versatility is its key feature with its ability to perform a variety of site development to general dozing work as well as heavy-duty applications. Angle and tilt control is with 2 levers on some machines, 1 lever on others.

Variable Power Angle and Tilt (VPAT) blade can be mechanically tipped forward for improved penetration or shedding sticky material and backward for finish grading and improved productivity.

Special Application Dozing Tools

Caterpillar provides specialty bulldozers for specific applications. The blades are designed to increase production while performing certain tasks. Following are the most popular special applications blades.

Variable Radius (VR) Blades



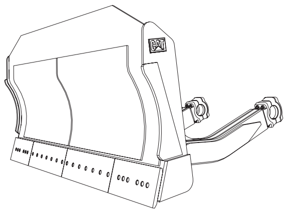
Variable Radius Semi-U Blades are excellent tools for land improvement, soil conservation, site development or general construction. They combine the penetration ability of a Semi-U Blade with the load retention and high capacity of a U-blade.

They provide the aggressive cutting action needed for digging, while having the material retention characteristics needed for moving high volumes over a distance. This is accomplished through a moldboard which varies in radius from the edge to the center. This creates a rolling action in the material being moved, pushing it to the center of the blade for better retention. The extended side wings, angled to thirty degrees, further increase the capacity over a standard blade.

Angle Blade (A-Blade)

"A" — Or Angling blade can be positioned straight or angled 25 degrees to either side. It is designed for side-casting, pioneering roads, backfilling, cutting ditches and other similar tasks. It can reduce the amount of maneuvering required to do these jobs. Its "C" frame can be used for attachments such as pushing, land clearing, or snow removal tools. A-blades are not recommended for rock or severe applications.

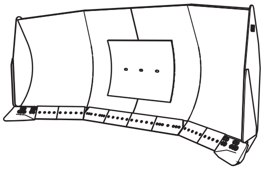
Cushion Dozers



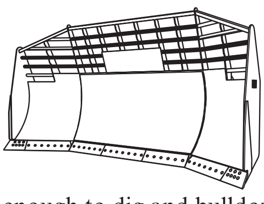
Cushion Dozers are designed to push-load wheel-tractor scrapers, or track-type tractors. The heavy-duty design includes reinforcement to transfer machine power without damaging the blade or the tractor. Blade cylinders are pinned to the C-frame, and the blade height is such that the blade lift cylinders are isolated from damaging forces.

The taller blade allows pushing from a higher position, eliminating blade drag and increasing productivity. The blade curvature is matched to the curve of the Cat Push Block for maximum contact area, preventing the block from riding over the top of the blade. Extended side plates make it easier for operators to "catch" the stinger when repositioning for a new pass. The center of the blade is armored with T-1 plate steel for maximum service life. The narrow width of the cushion blade increases machine maneuverability in congested cuts and reduces the possibility of cutting tires associated with SU and U-blades.

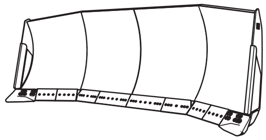
When not push-loading, the dozer can be used for cut maintenance and other general dozing jobs.



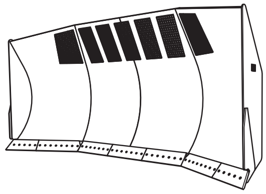
Coal U-Blades are designed specifically to move large volumes of coal in coal piles, at powerplants and transshipment points. The wing angle of thirty degrees crowds material to the center of the blade, maximizing capacity by minimizing side spill. The moldboard is much higher and wider than standard, specifically to match the material density and loading characteristics of coal. The curve of the moldboard rolls the material forward, enhancing the carrying capacity. With this design, coal-moving capacity can be as much as 200 percent greater than a standard U-blade.



Landfill U-Blades provide capacity increases of up to fifty percent over a straight blade. Landfill blades have the height and width to handle large volumes of low-density refuse, but are tough enough to dig and bulldoze ground cover. Vision to the load is provided by areas of screen in the upper blade. Angled wings slice into natural bed earth for trenches or cover material, adding to the versatility in the landfill.

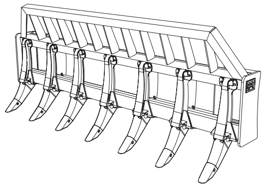


Reclamation U-Blades — are purpose-built for reclamation of mine spoil piles. The blade has a larger capacity than a standard U-blade. The wing angle of 28 degrees provides a good balance between load retention and shearing action, keeping the optimal load in front of the blade, but cutting cleanly through the material when necessary.



The width of **Woodchip U-Blades** gives operators maximum control and greater confidence, even in steep chip piles. Deep curvature of the moldboard keeps material flowing to liven dead chips and optimize production on long pushes. Blade height and wings angled at thirty degrees combine for excellent material retention – giving better production with every pass. An operator visibility window in the top section is standard.

Multi-Application/Rock and Root Rakes



Multi-Application/Rock and Root Rakes are perfectly suited for heavy duty land clearing including removal of stumps, large rocks or large trees and for work in clay and other heavy soils. Frames are constructed of high strength steel for longer life. Cast teeth, with replaceable tips, are designed for maximum ground penetration and resistance to shock loading when prying or pushing trees, stumps and rocks. Brush rack is standard and increases height and capacity by as much as 40%.

Rake is a direct replacement for existing blade, and utilizes existing push arms and C-frames.

BULLDOZER PRODUCTION OFF-THE-JOB

You can estimate bulldozer production using the production curves that follow and the correction factors that are applicable. Use this formula:

$$\underset{\text{(LCY/hr)}}{\text{Production (Lm}^3\text{/hr)}} = \underset{\text{production}}{\text{Maximum}} \times \underset{\text{factors}}{\text{Correction}}$$

The bulldozer production curves give maximum uncorrected production for universal, semi-universal, and straight blades and are based on the following conditions:

1. 100% efficiency (60 minute hour — level cycle).
2. Power shift machines with 0.05 min. fixed times.
3. Machine cuts for 15 m (50 feet), then drifts blade load to dump over a high wall. (Dump time — 0 sec.)
4. Soil density of 1370 kg/Lm³ (2300 lb/LCY).
5. Coefficient of traction:*
   a. Track machines — 0.5 or better
   b. Wheel machines — 0.4 or better
6. Hydraulic controlled blades used.
7. Dig 1F**
   Carry 2F**
   Return 2R**

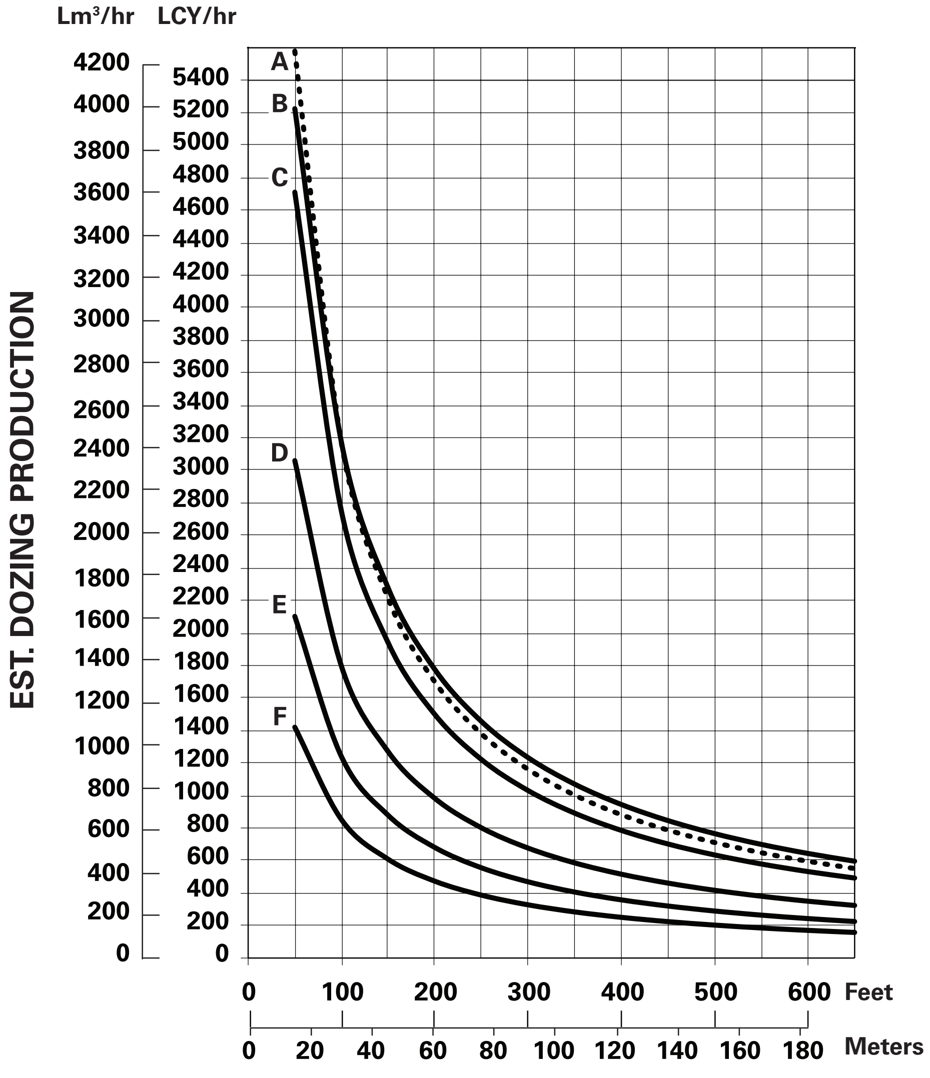
To obtain estimated production in bank cubic meters or bank cubic yards, appropriate load factor from the Tables section should be applied to the corrected production as calculated above.

$$\underset{\text{(BCY/h)}}{\text{Production Bm}^3\text{/hr}} = \underset{\text{(LCY/h)}}{\text{Lm}^3\text{/hr}} \;\underset{\times\ \text{LF}}{\times\ \text{LF}}$$

*Coefficient of traction assumed to be at least 0.4. While poor traction affects both track and wheel vehicles, causing them to take smaller blade loads, wheeled units are affected more severely and production falls much more rapidly. While no fixed rules can predict this production loss, a rough rule of thumb is that wheel dozer production falls off 4% for each one-hundredth decrease in coefficient of traction below 0.40. If, for example, coefficient of traction is 0.30, the difference is ten-hundredths (0.10), and production is 60% (10 × 4% = 40% decrease).

**This gear sequence is based on level to downhill terrain, light to medium density material, and no blade extensions such as spill plates, rock guards, etc. Exceeding these conditions may require carry in 1F, but productivity should equal or exceed "standard conditions" due to the larger loads that can be carried in 1F.

ESTIMATED DOZING PRODUCTION ● Universal Blades ● D8 through D11



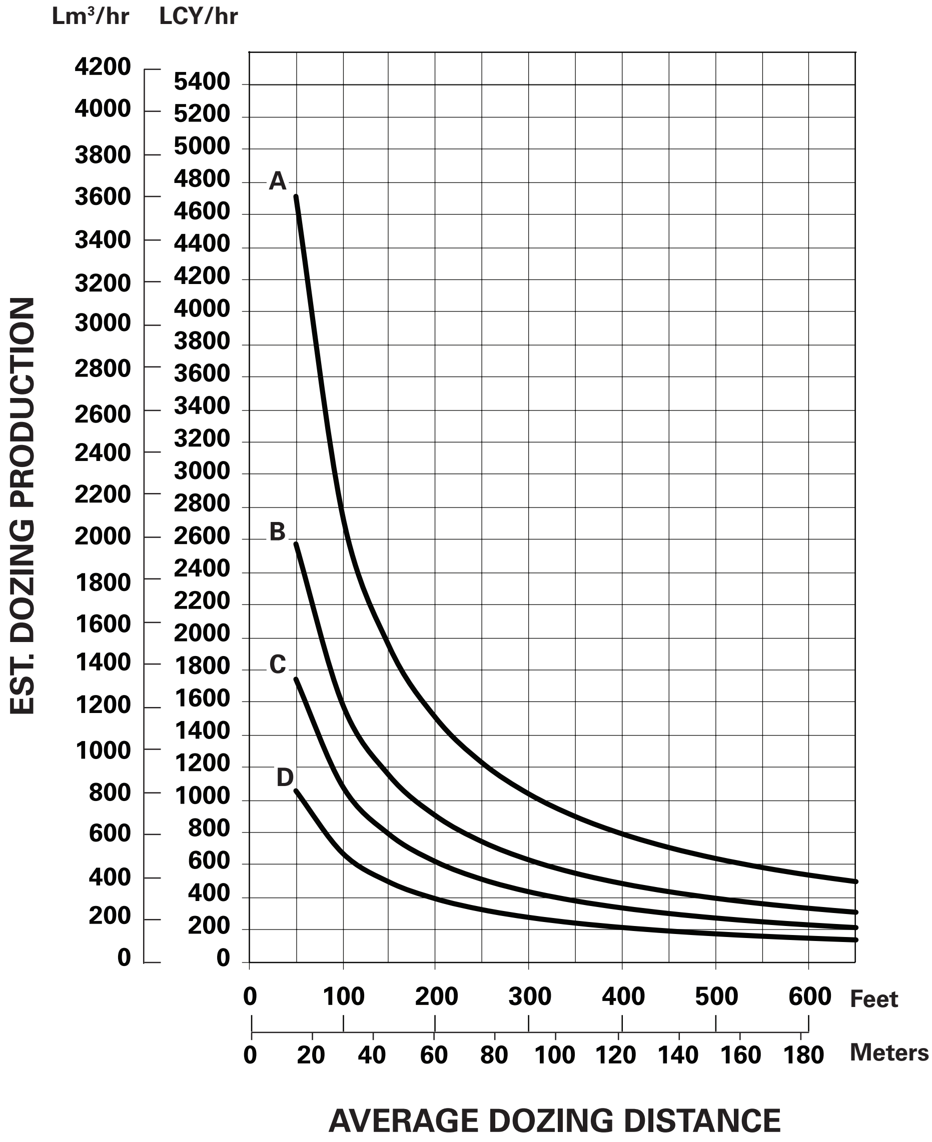
AVERAGE DOZING DISTANCE

KEY

A — D11 XU
B — D11 CD
C — D11 U
D — D10 U
E — D9 U
F — D8 U

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

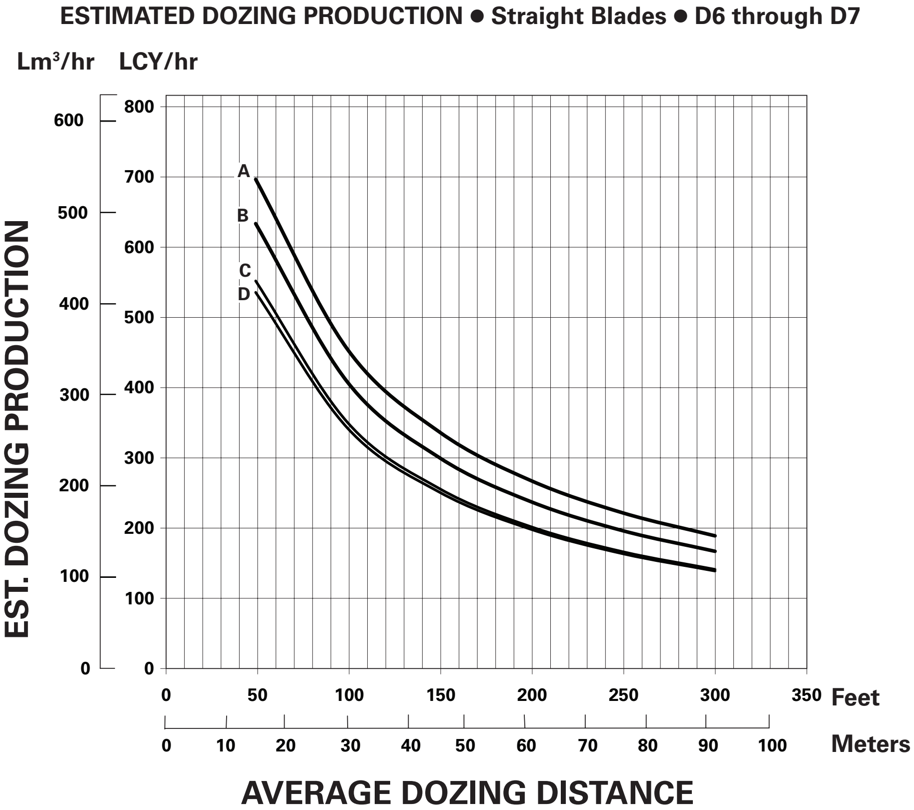
ESTIMATED DOZING PRODUCTION ● Semi-Universal Blades ● D8 through D11



KEY

A — D11 SU
B — D10 SU
C — D9 SU
D — D8 SU

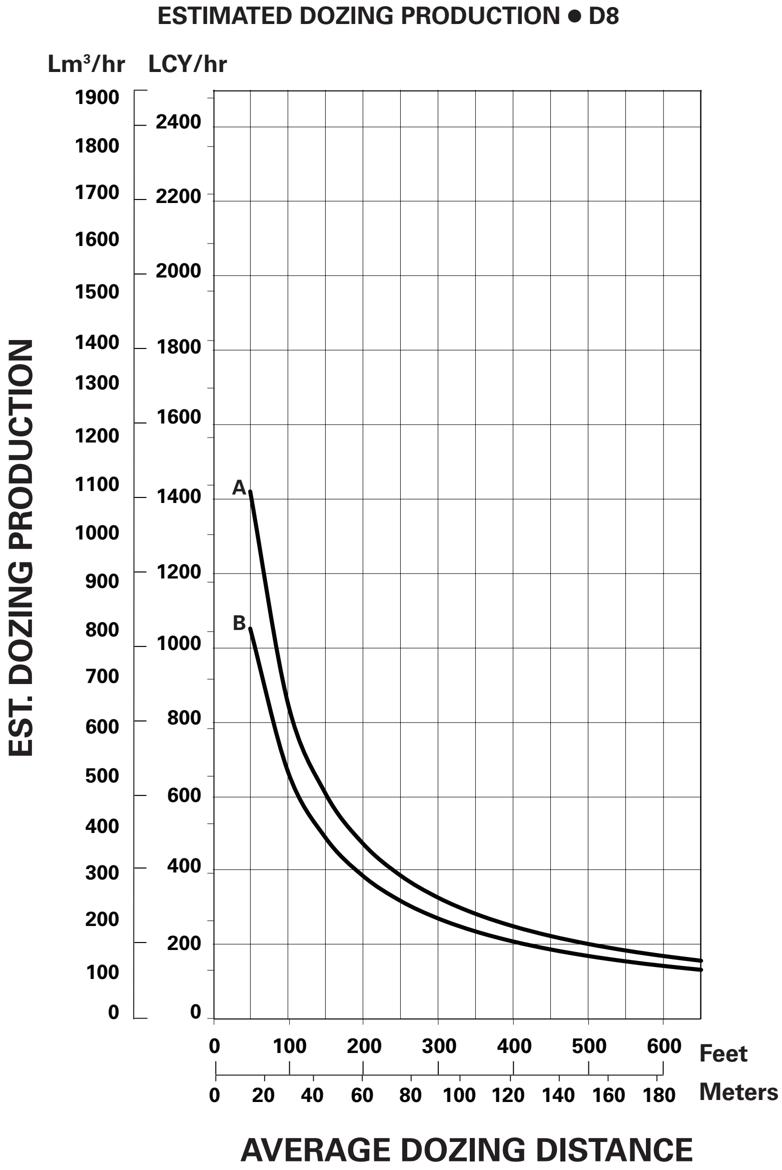
NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.



KEY

A — D7E
B — D7RII
C — D6T
D — D7G

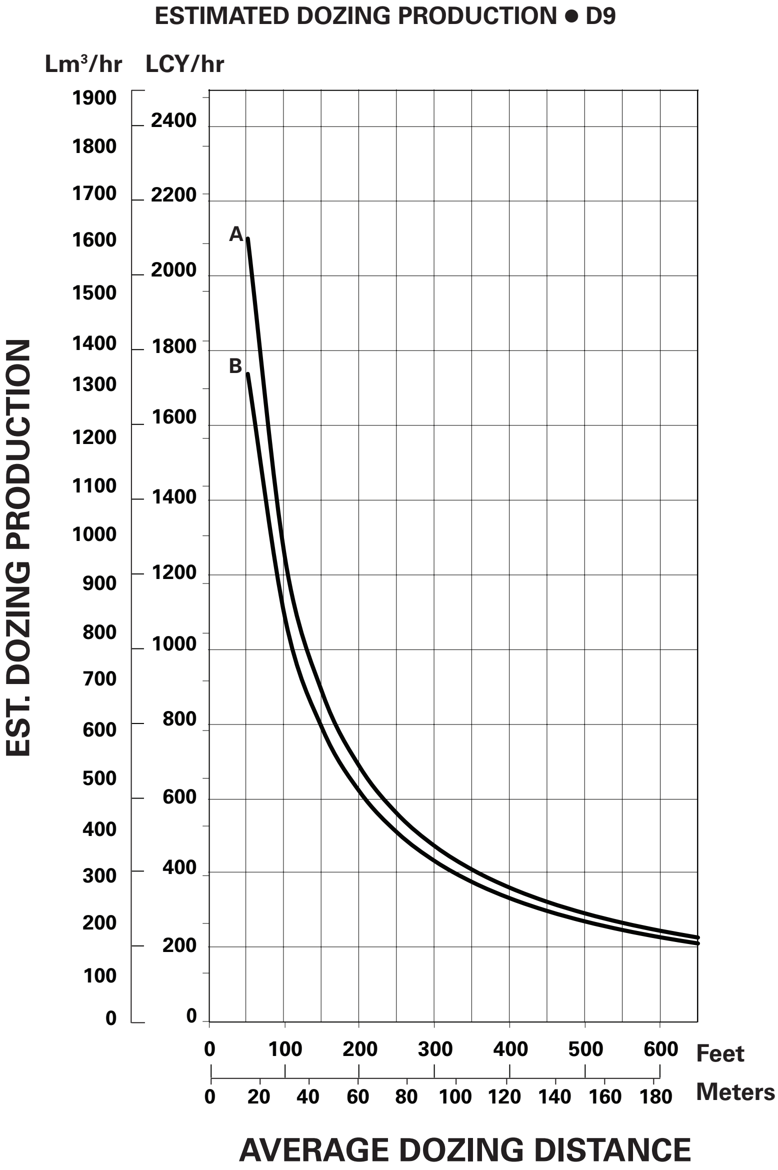
NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.



KEY

A — D8 U
B — D8 SU

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

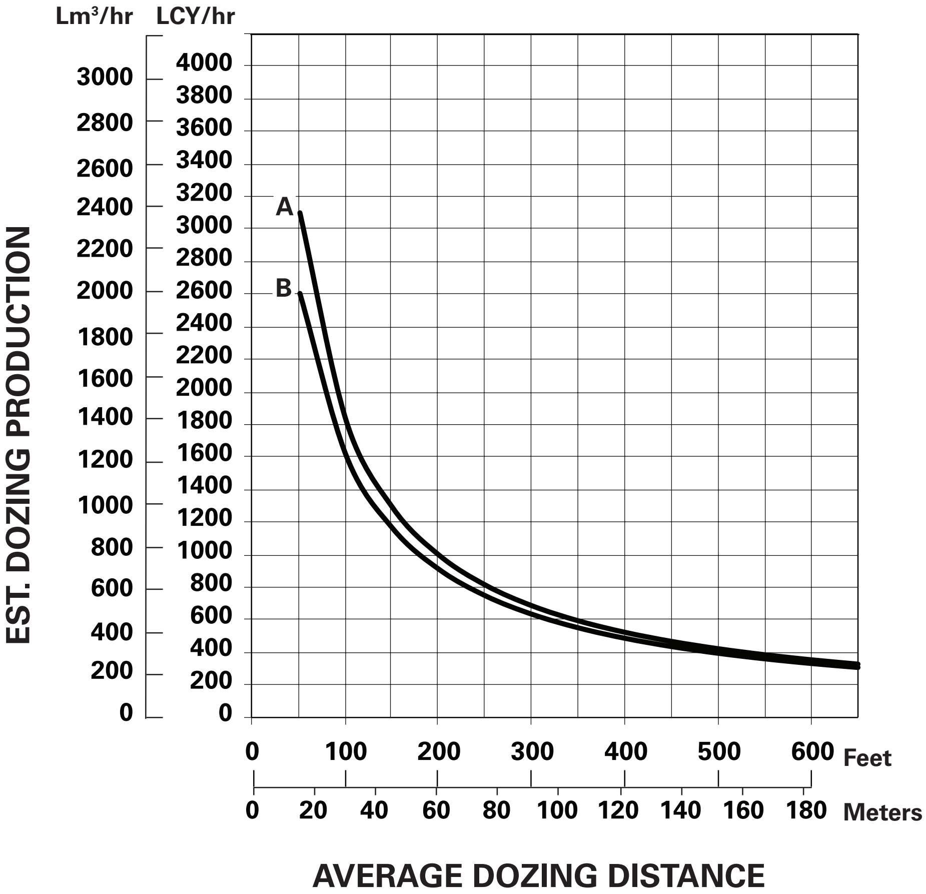


KEY

A — D9 U
B — D9 SU

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

ESTIMATED DOZING PRODUCTION ● D10

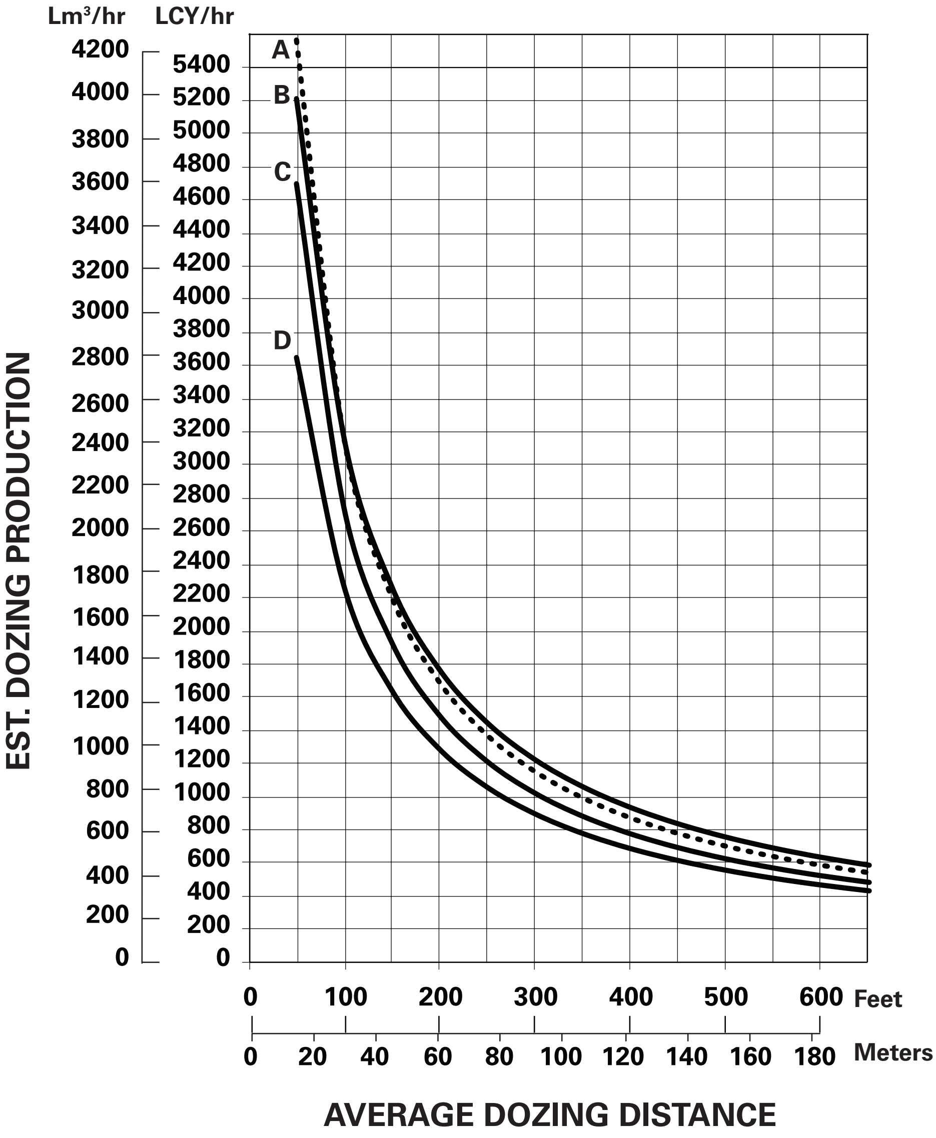


KEY

A — D10 U
B — D10 SU

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

ESTIMATED DOZING PRODUCTION ● D11



KEY

A — D11 XU
B — D11 CD
C — D11 U
D — D11 SU

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

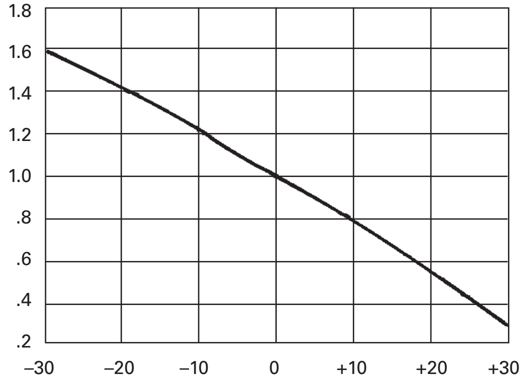
JOB CONDITION CORRECTION FACTORS

	TRACK-TYPE TRACTOR
OPERATOR —	
Excellent	1.00
Average	0.75
Poor	0.60
MATERIAL —	
Loose stockpile	1.20
Hard to cut; frozen —	
with tilt cylinder	0.80
without tilt cylinder	0.70
Hard to drift; "dead" (dry, non-cohesive material) or very sticky material	0.80
Rock, ripped or blasted	0.60-0.80
SLOT DOZING	1.20
SIDE BY SIDE DOZING	1.15-1.25
VISIBILITY —	
Dust, rain, snow, fog or darkness	0.80
JOB EFFICIENCY —	
50 min/hr	0.83
40 min/hr	0.67
BULLDOZER*	
Adjust based on SAE capacity relative to the base blade used in the Estimated Dozing Production graphs.	
GRADES — See following graph.	

***NOTE:** Angling blades and cushion blades are not considered production dozing tools. Depending on job conditions, the A-blade and C-blade will average 50-75% of straight blade production.

% Grade vs. Dozing Factor

(–) Downhill
(+) Uphill



ESTIMATING DOZER PRODUCTION OFF-THE-JOB

Example problem:

Determine average hourly production of a D8 SU (with tilt cylinder) moving hard-packed clay an average distance of 45 m (150 feet) down a 15% grade, using a slot dozing technique.

Estimated material weight is 1600 kg/Lm³ (2650 lb/LCY). Operator is average. Job efficiency is estimated at 50 min/hr.

Uncorrected Maximum Production — 375 Lm³/h (490 LCY/hr) (example only)

Applicable Correction Factors:

Hard-packed clay is "hard to cut" material . . .–0.80
Grade correction (from graph) . . . .–1.30
Slot dozing . . . .–1.20
Average operator . . . .–0.75
Job efficiency (50 min/hr) . . . .–0.83
Weight correction. . . . . (2300/2650)–0.87

Production = Maximum Production × Correction Factors
= (490 LCY/hr) (0.80) (1.30) (1.20) (0.75) (0.83) (0.87)
= 331.2 LCY/hr

To obtain production in metric units, the same procedure is used substituting maximum uncorrected production in Lm³.

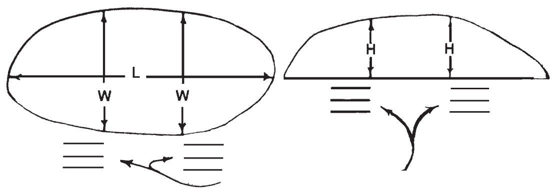
= 375 Lm³/h × Factors
= 253.5 Lm³/h

MEASURING PRODUCTION ON-THE-JOB

Three generally accepted methods of measuring bulldozer production are listed below. The third method is empirical, but is the simplest to conduct.

1. Employing Surveying Techniques
   a. Conduct time study and then cross-section the cut to determine the volume of material removed. (Production in Bm^3 or BCY per unit of time)
   b. Conduct time study and then cross-section the fill to determine the volume of fill material. (Production in Lm^3 or LCY per unit of time)
2. Weighing Blade Loads
   Conduct time study and weigh material moved by bulldozer by weighing the loader bucket loads.
3. Measuring Blade Loads
   a. Dozer operation
      (1) Pick up and carry load onto a level area and stop.
      (2) Raise the blade directly over the pile pulling forward slightly as blade comes up, leaving a nearly symmetrical pile.
      (3) Reverse to clear the pile.
   b. Measurements
      (1) The average *height* (H) of the pile in feet. Hold the tape vertically at the inside edge of each grouser mark. Sight along top of the pile to obtain the correct measurement.

TOP VIEW **SIDE VIEW**



GROUSER MARKS

      (2) The average *width* (W) of the pile in feet. Hold the tape horizontally over the pile and sight at the inside edge of each grouser mark and the corresponding opposite side of the pile.
      (3) The greatest *length* (L) of the pile in feet. Hold the tape horizontally over the pile and sight at each end of the pile.
   c. With the above measurements, now compute the blade load.
      (1) Average the height measurement (H)
      (2) Average the width measurement (W)
      (3) Load (Lm^3 or LCY) = 0.0138 × (HWL)
      (4) Load (Bm^3 or BCY) = Lm^3 or LCY × LF
   d. Combine the calculated blade load with time study to figure production.

RIPPERS

CONTENTS

Features:

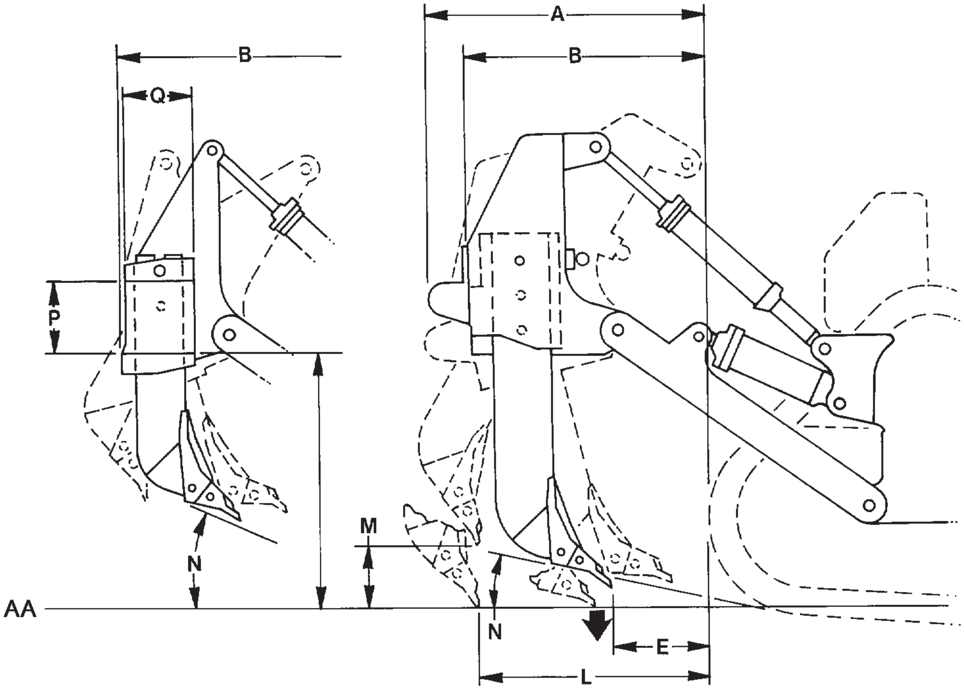
- **Parallelogram linkage with hydraulically variable pitch** on D7 and above. Operator can adjust angle of ripper tip to the material for penetration at all ripping depths to increase production.
- **Fixed Parallelogram linkage design** used on tractors up to D6. This design holds tooth angle constant at all ripping depths.
- **Adjustable Single shank** arrangements available for D8 and above tractors for tough ripping applications and deep ripping requirements.
- **Hydraulically Variable Pitch Multi-shank** arrangements available on D7 and above allow wide-beam coverage in easier-to-rip materials.
- **Counterweighted CarryDozer Ripper single shank** available for D11.

DEFINITION OF FORCES SHOWN IN TABLES THAT FOLLOW

"Pryout," (Breakout) kilonewtons (and pounds) — the maximum sustained upward force, generated by the lift cylinders measured at the ripper tip. Breakout force is measured with the shank in the top hole, shank vertical and ripper full down. Breakout force may be hydraulically or balance limited.

"Penetration force," kilonewtons (and pounds) — the maximum sustained downward force, generated by the ripper lift cylinders measured at the ripper tip, which is required to raise the back end of the vehicle with the tip on ground and the shank (pinned in the top hole) vertical.

Adjustable Parallelogram Ripper

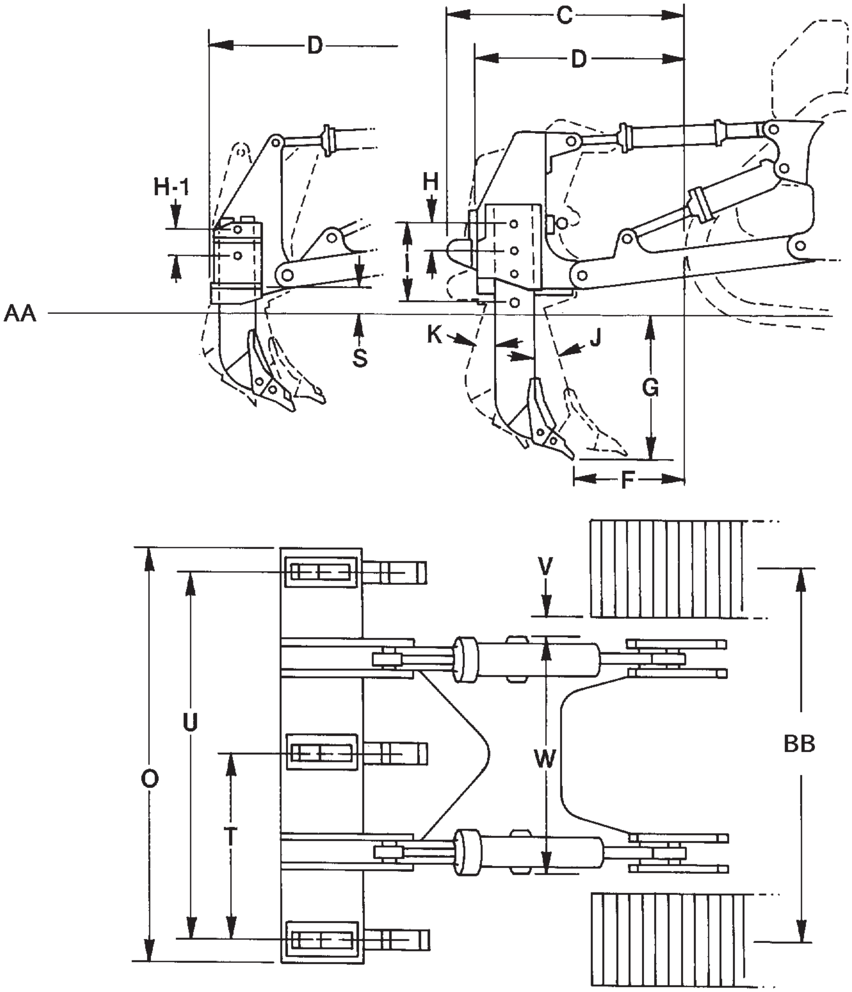


NOTE: Letters correspond to ripper specifications on pages that follow.

KEY

AA — Ground Line

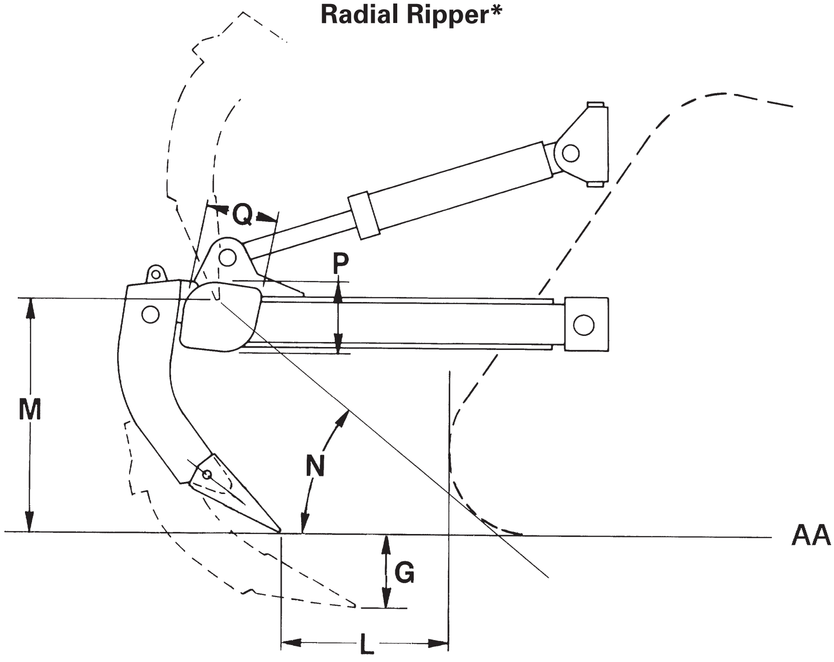
Adjustable Parallelogram Ripper



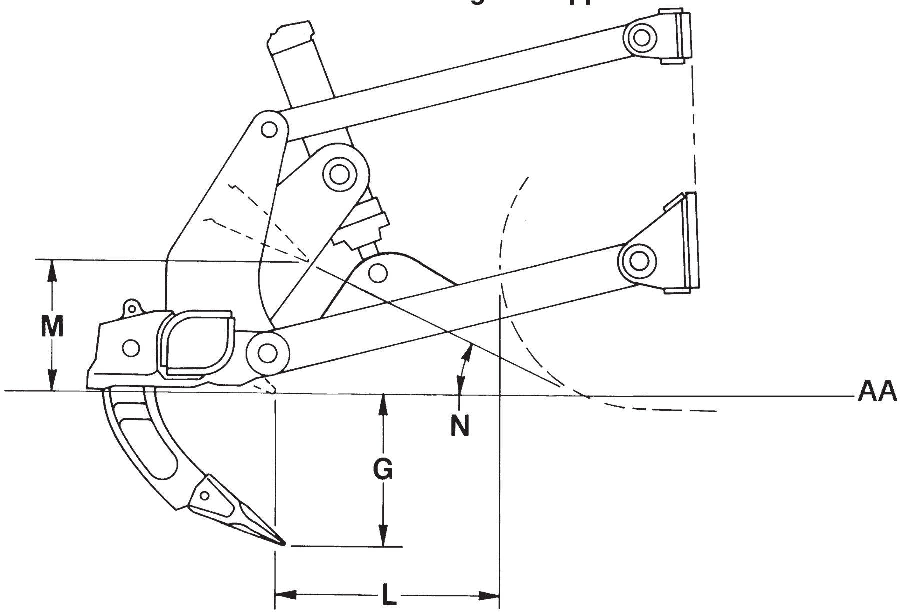
NOTE: Letters correspond to ripper specifications on pages that follow.

KEY
AA — Ground Line
BB — Track Gauge

Radial Ripper*



Fixed Parallelogram Ripper



NOTE: Letters correspond to ripper specifications on pages that follow.

KEY

AA — Ground Line
* — Tip Standard

TIP SELECTION FOR THE D8R/D8T, D9, D10 AND D11 RIPPERS

Three tip configurations (short, intermediate and long) in two styles (centerline and penetration) are available for economical operation in a variety of conditions.

RECOMMENDED TIP USAGE

Short — Use in high impact conditions where breakage problems occur. The shorter the tip, the more it resists breakage.

Intermediate — Most effective in moderate impact conditions where abrasion is not excessive.

Long — Use in loose, abrasive materials where breakage is not a problem. Generally offers the most wear material.

Centerline vs Penetration

The materials being ripped and the tractor doing the ripping will both have an effect on which tip will do the best job. High density material requires a "penetration" tip. High impact material requires a "centerline" tip. The following is a general guide to tip application.

	Tips to use		
Ripping Condition	**D8R/D8T D9**	**D10**	**D11**
Tandem Tractors	Short	Short	Short
Single Shank and Multi-shank			
Extreme Duty	Int.	Short	Short
Medium Duty	Long	Int.	Int.
Abrasive Duty	Long	Long	Long

Always use the longest tip that will wear without excessive breakage. Different tips should be tried to determine the most economical.

ESTIMATING RIPPING PRODUCTION

Ripping costs must be compared to other methods of loosening the material — usually drilling and blasting — on a cost per ton or bank cubic yard basis. Thus, an accurate estimation of ripper production is needed to determine unit ripping costs.

There are three general methods of estimating ripping production:

1. The best method is to record the time spent ripping, then remove (using scrapers or loaders and trucks) and weigh the ripped material. The total weight divided by the time spent will give hourly production. If the contractor is paid by volume, then a density must be used and the accuracy is only as good as the density used. For payment by volume removed, method 2 may be desirable. Some care will be needed to assure that only ripped material is removed.
2. Another method is to cross-section the area and then record the time spent ripping. After the material has been removed, cross-section the area again to determine the volume of rock removed. The volume divided by the time spent ripping gives the ripping rate per minute or hour.
3. Timing the ripper over a measured distance is the least accurate method, but valuable for quick estimating on the job. An average cycle time should be determined from a number of timed cycles. Turn-around or back-up time must be included. Measure the average rip distance, rip spacing and depth of penetration. This data will give the volume per cycle from which the production in bank cubic yards can be calculated. Experience has shown results obtained from this method are about 10 to 20% higher than the more accurate method of cross-sectioning.

An example of the measured distance method for calculating ripper production is:

Data — D10T2 — No. 10 with one shank.
910 mm (36 in) between passes.
1.6 km/h (1 mph) average speed (including slippage and stalls).
Every 91 m (300 ft) requires 0.25 min to raise, pivot, turn, and lower again: 91 m (300 ft) = 1 pass.
610 mm (24 in) penetration.
Full time ripping (no pushing or dozing assignment).

Example of Estimating Production (Metric)

Time per pass:

1.6 km/h = 26.7 m/min. Then $\frac{91 \text{ m}}{26.7 \text{ m/min}} = 3.41$ min;

3.41 min + 0.25 min (turn time) = 3.66 min/pass.

If the operator works an average of 45 min per h, it is possible to make = $\frac{45}{3.66}$ = 12.3 passes per h

Volume ripped: 91 m × 0.9 m × 0.6 m = 49.1 BCM per pass

Production = 49.1 × 12.3 = 604 BCM per h

Remember the results from this method are usually 10 to 20 per cent higher than the actual production that can be expected on the job.

●●●

Example of Estimating Production (English)

Time per pass:

MPH = 88 fpm. Then $\frac{300 \text{ ft}}{88 \text{ fpm}} = 3.41$ min;

3.41 min + 0.25 min. (turn time) = 3.66 min/pass.

If the operator works an average of 45 min per h, it is possible to make = $\frac{45}{3.66}$ = 12.3 passes per h

Volume ripped: $\frac{300 \times 3 \times 2}{27}$ = 66.7 BCY per pass

Production = 66.7 × 12.3 = 820 BCY per hr

●●●

NOTE: The demands of heavy ripping will increase the normal owning and operating costs of the tractor.

These costs should be increased no less than 30-40% in heavy ripping applications to estimate rock loosening costs.

There is no ready answer or rule-of-thumb solution to predict ripping production. Even if everything is known about the seismic velocity of the material, its composition, job conditions, equipment and operator, only a "guesstimate" can be given. The final answer must come from a production study obtained on the job site.

Sample problem (Metric)

Determine the loosening costs in the following situation:

Machine	— D10T2 Tractor with No. 10 Single Shank Ripper
Rip Spacing	— 915 mm
Ripper Penetration	— 610 mm
Rip Distance	— 91 m
Rip Time	— 3.41 minutes
Maneuver Time	— 0.25 minutes
Seismic Velocity	— 1830 meters per second

Assume 60 min. hour

Solution:

1. Total Cycle Time = 3.41 + 0.25 = 3.66 min

   Cycles/hour = $\frac{60 \text{ min/hr}}{3.66 \text{ min/cycle}}$ = 16.4
2. Production per cycle = 91 m × 0.9 m × 0.6 m = 49.1 BCM/cycle
3. Production = 49.1 BCM/cycle × 16.4 cycles/h = 805 BCM/h
4. Remember results of this method are usually 10 to 20% high.

   Actual Production = 80% of 805 BCM/h
   = 644 BCM/h

   Or 90% of 805 BCM/h = 725 BCM/h
5. Owning and Operating Costs

   A D10T2 (ripping only) could have a $115.00/h O & O costs including $30/h operator.
6. Loosening Costs

   $115.00/hr ÷ 644 BCM/h = $0.179/BCM
   $115.00/hr ÷ 725 BCM/h = $0.159/BCM

   The loosening cost should range from 15.9¢ to 17.9¢/BCM

●●●

Sample problem (English)

Determine the loosening costs in the following situation:

Machine	— D10T2 Tractor with No. 10 Single Shank Ripper
Rip Spacing	— 3 feet
Ripper Penetration	— 2 feet
Rip Distance	— 300 feet
Rip Time	— 3.41 minutes
Maneuver Time	— 0.25 minutes
Seismic Velocity	— 6000 feet per second

Assume 60 min. hour

Solution:

1. Total Cycle Time = 3.41 + 0.25 = 3.66 min

   $$\text{Cycles/hour} = \frac{60 \text{ min/hr}}{3.66 \text{ min/cycle}} = 16.4$$

2. Production per cycle = $\frac{300 \times 3 \times 2}{27}$ = 66.7 BCY/cycle

3. Production = 66.7 BCY/cycle × 16.4 cycles/hr = 1094 BCY/hour

4. Remember results of this method are usually 10 to 20% high.
   Actual Production = 80% × 1094 = 875 BCY/hr
   or 90% × 1094 = 984 BCY/hr

5. Owning and Operating Costs
   A D10T2 (ripping only) could have a $115.00/hr O & O costs including $30/hr operator

6. Loosening Costs
   $115.00/hr ÷ 875 BCY/hr = $0.131/BCY
   $115.00/hr ÷ 984 BCY/hr = $0.117/BCY
   The loosening cost should range from 11.7¢ to 13.1¢/BCY

● ● ●

USE OF SEISMIC VELOCITY CHARTS

The charts of ripper performance estimated by seismic wave velocities have been developed from field tests conducted in a variety of materials. Considering the extreme variations among materials and even among rocks of a specific classification, the charts must be recognized as being at best only one indicator of rippability.

Accordingly, consider the following precautions when evaluating the feasibility of ripping a given formation:

— Tooth penetration is often the key to ripping success, regardless of seismic velocity. This is particularly true in homogeneous materials such as mudstones and claystones and the fine-grained caliches. It is also true in tightly cemented formations such as conglomerates, some glacial tills and caliches containing rock fragments.

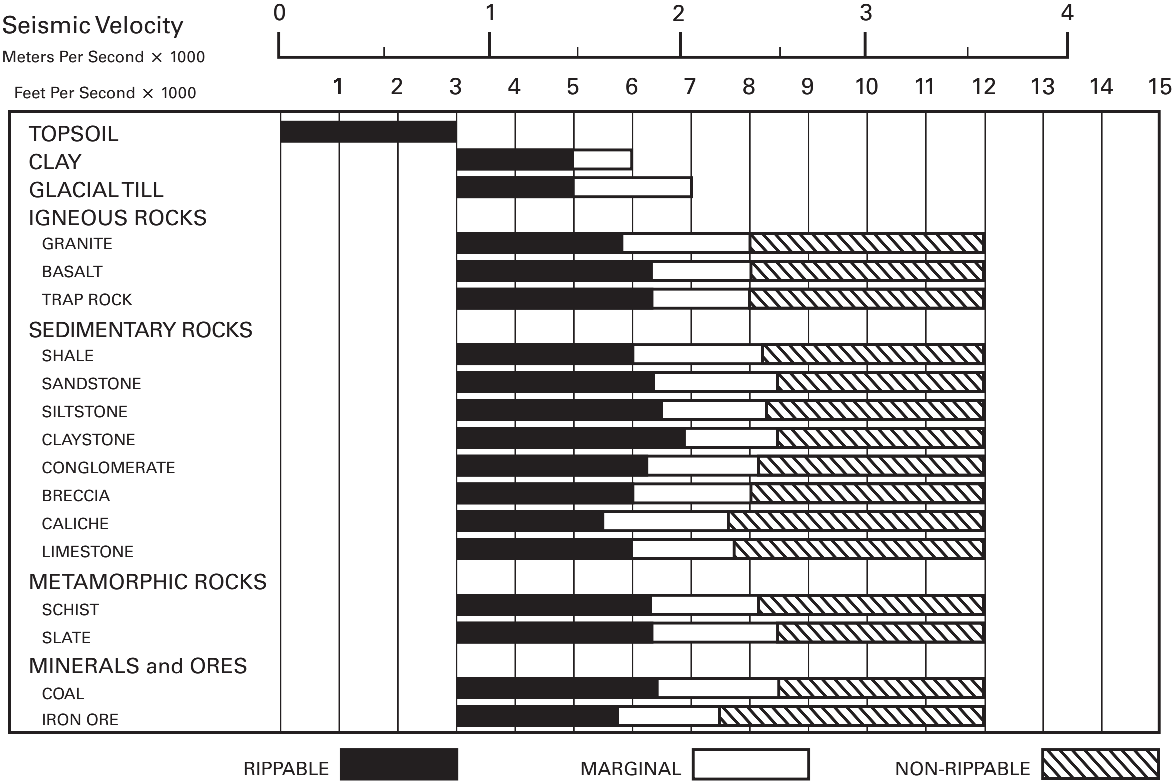
— Low seismic velocities of sedimentaries can indicate probable rippability. However, if the fractures and bedding joints do not allow tooth penetration, the material may not be ripped effectively.

— Pre-blasting or "popping" may induce sufficient fracturing to permit tooth entry, particularly in the caliches, conglomerates and some other rocks; but the economics should be checked carefully when considering popping in the higher grades of sandstones, limestones and granites.

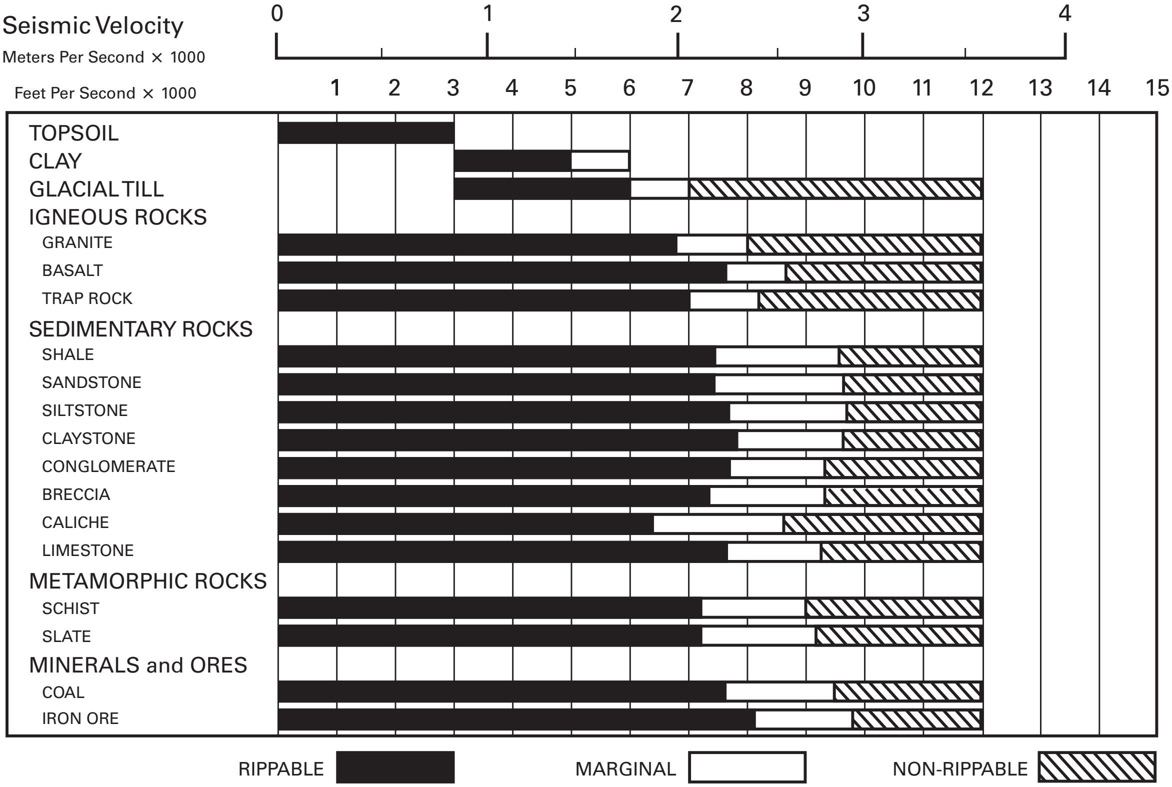
Ripping is still more art than science, and much will depend on operator skill and experience. Ripping for scraper loading may call for different techniques than if the same material is to be dozed away. Cross-ripping requires a change in approach. The number of shanks used, length and depth of shank, tooth angle, direction, throttle position — all must be adjusted according to field conditions. Ripping success may well depend on the operator finding the proper combination for those conditions.

NOTE: For more detailed information of ripping please refer to The Handbook of Ripping (Media No. AEDK0752).

D8R/D8T
● Multi- or Single Shank No. 8 Ripper
● Estimated by Seismic Wave Velocities



D9
- **Multi- or Single Shank No. 9 Ripper**
- **Estimated by Seismic Wave Velocities**



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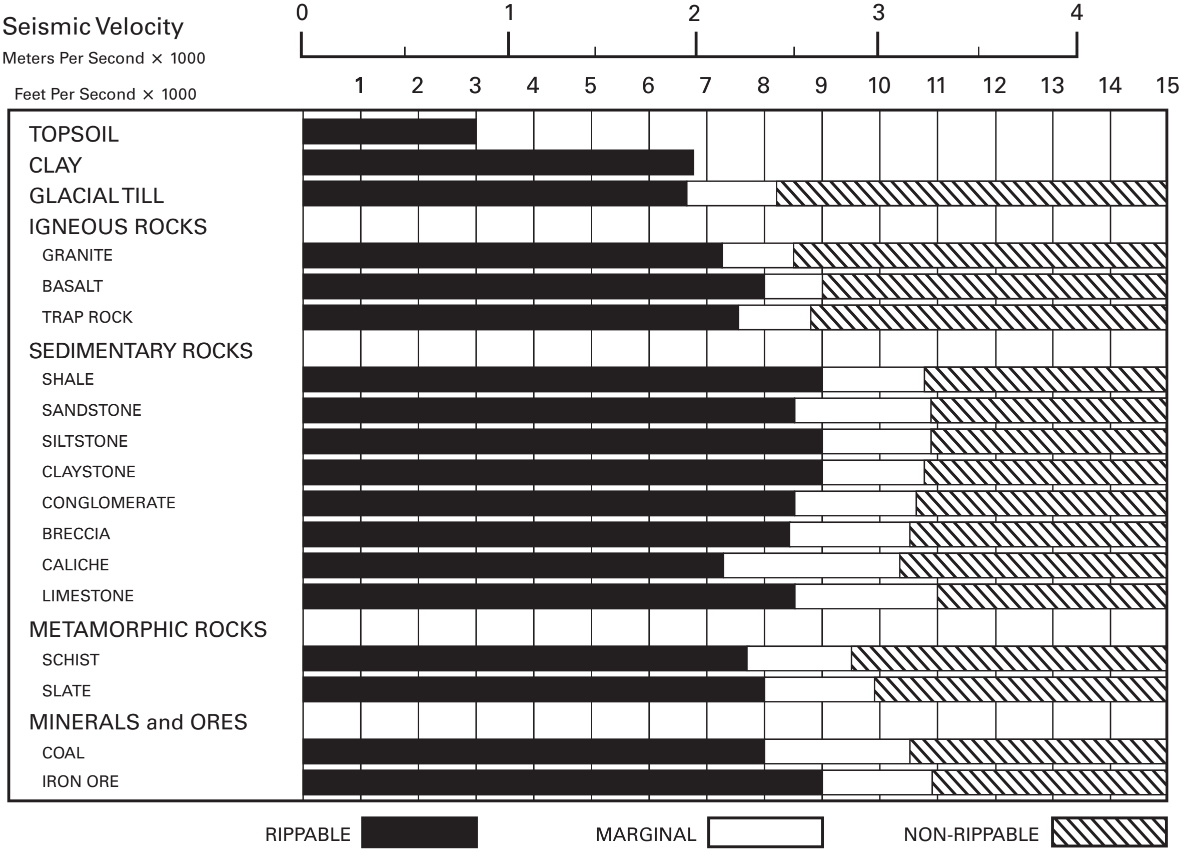
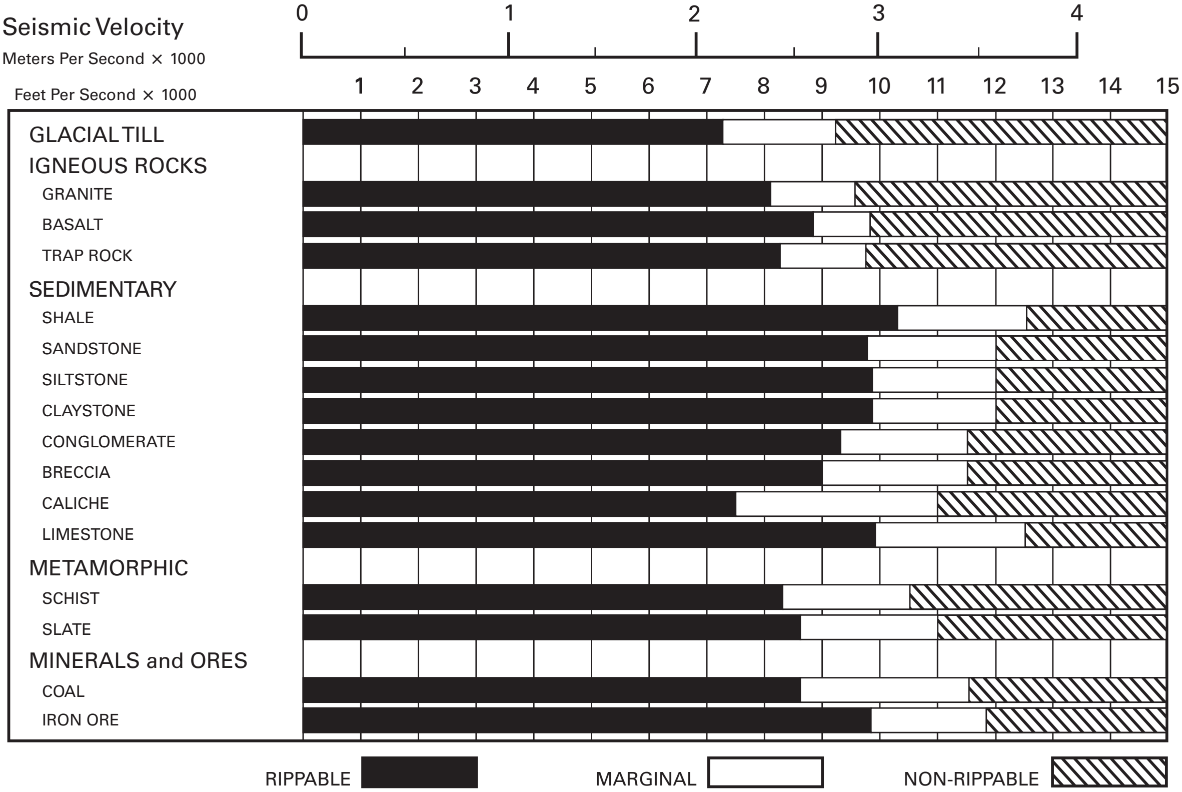
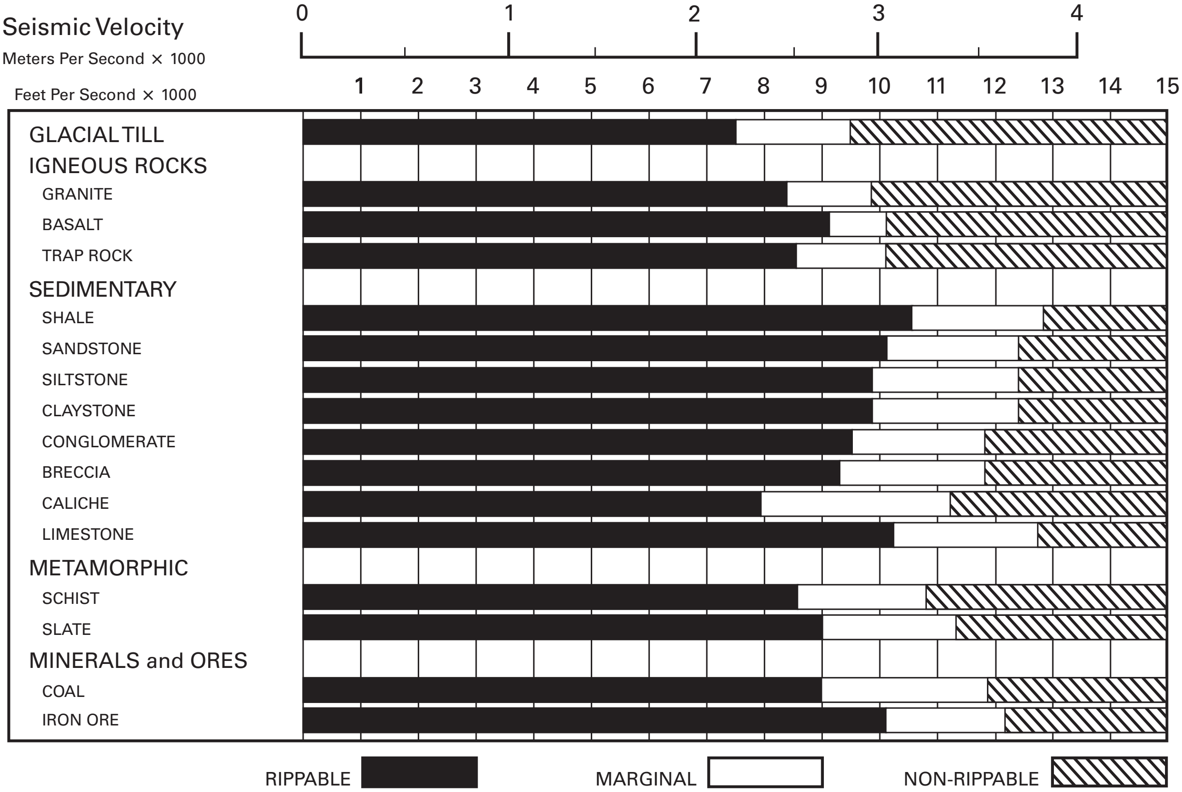
D10
● Multi- or Single Shank No. 10 Ripper
● Estimated by Seismic Wave Velocities



D11
- **Multi- or Single Shank No. 11 Ripper**
- **Estimated by Seismic Wave Velocities**



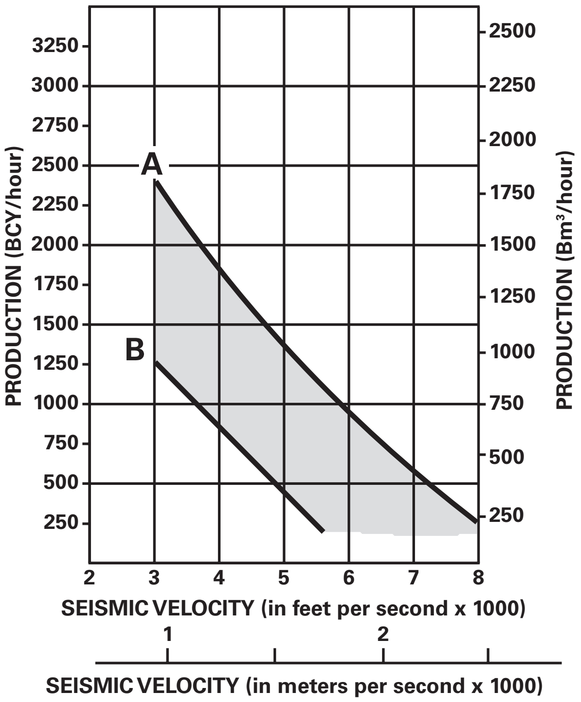
D11 CD
- **Single Shank No. 11 Ripper**
- **Estimated by Seismic Wave Velocities**



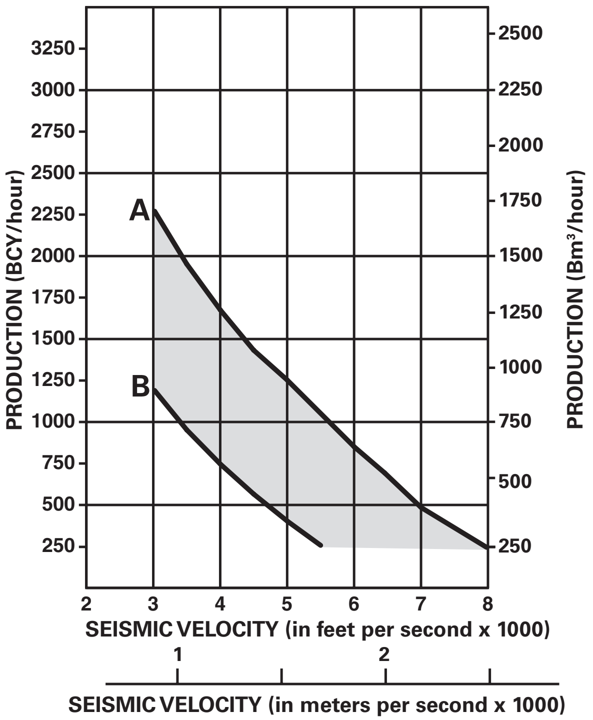
CONSIDERATIONS FOR USING PRODUCTION ESTIMATED GRAPHS:

- Machine rips full-time — no dozing.
- Power shift tractors with single shank rippers.
- 100% efficiency (60 min hour).
- Charts are for all classes of material.
- In igneous rock with seismic velocity of 8000 fps (2450 mps) or higher for the D11, and 6000 fps (1830 mps) or higher for the D10, D9 and D8R/D8T, the production figures shown should be reduced by 25%.
- Upper limit of charts reflect ripping under ideal conditions only. If conditions such as thick lamination, vertical lamination or any factor which would adversely affect production are present, the lower limit should be used.

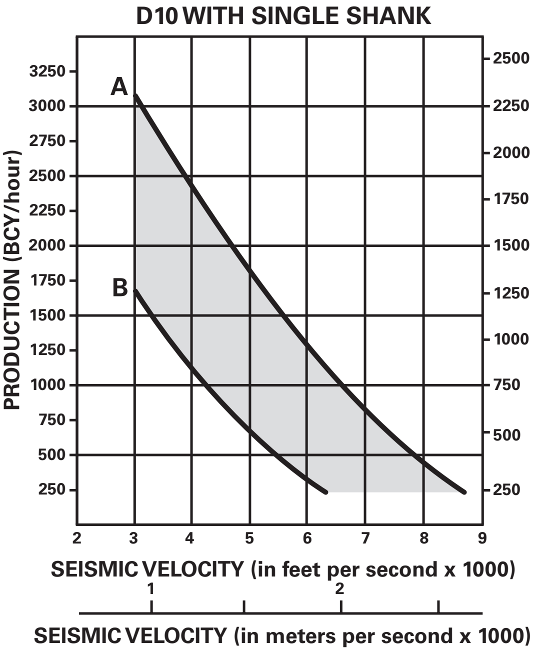
D9 WITH SINGLE SHANK

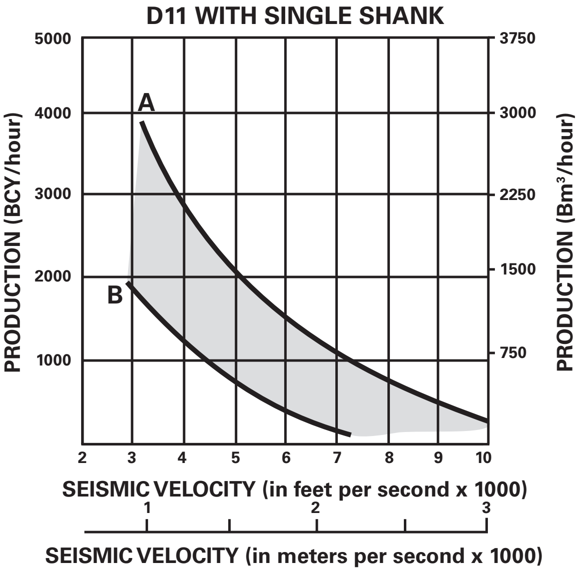


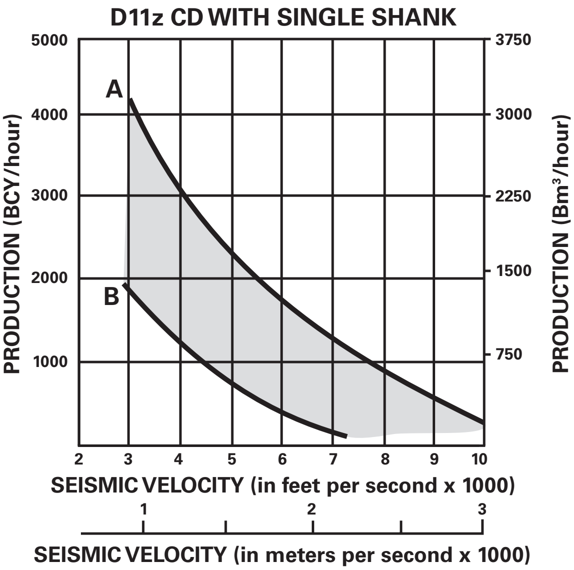
D8R/D8T WITH SINGLE SHANK



KEY
A — IDEAL
B — ADVERSE







KEY
A — IDEAL
B — ADVERSE

HARD ROCK
Load-Haul-Dumps (LHDs)
Underground Trucks

CONTENTS

HARD ROCK

17

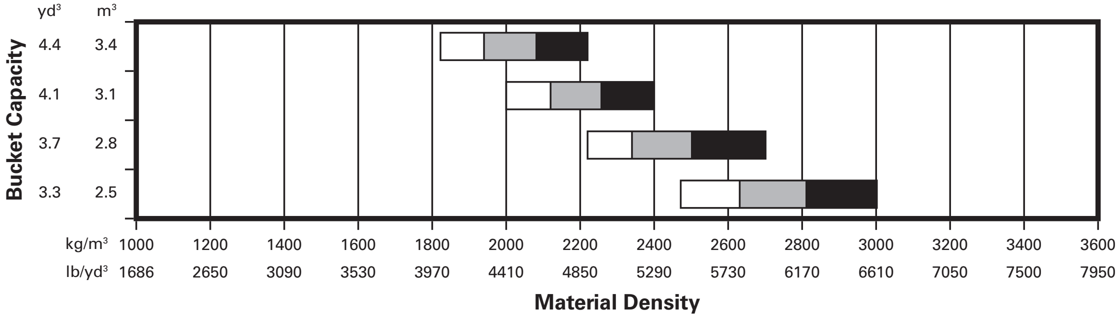
Features, all models:

- Rugged design for underground application.
- Engineered for productivity, reliability, safety and machine rebuildability.
- Extensive use of steel castings and forgings.
- Computerized machine function monitoring.
- Four wheel enclosed wet disc brakes.
- Remote Control Interface Group options and scalable autonomy options on loaders.
- Payload control system option on all loaders and selected trucks.
- Ride control system operational on all loaders and selected trucks.
- Fully enclosed air conditioned operator stations available.
- Operator Stations are ROPS certified.
- Autodig on LHD.
- Traction control.
- Operator safety monitoring.
- PLE data management.

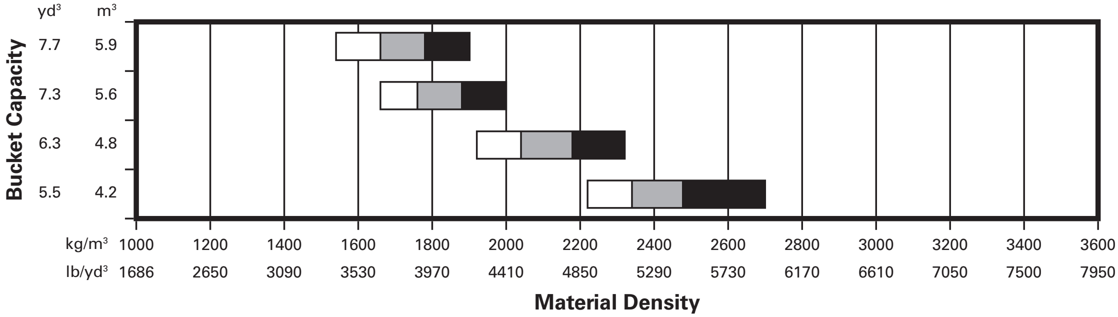
Product Line:

- Six models of Load-Haul-Dump (LHD) machines, with rated bucket payloads ranging from 6800 kg (14,991 lb) to 20 000 kg (44,100 lb).
- Five models of articulated dump trucks, with payload capacities of 22 000 kg (48,501 lb) to 63 000 kg (138,891 lb).

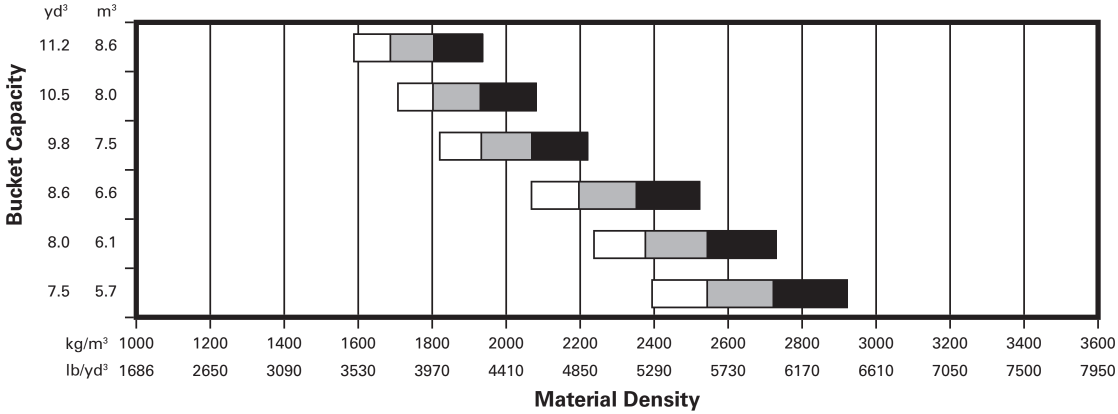
R1300G



R1600H



R1700

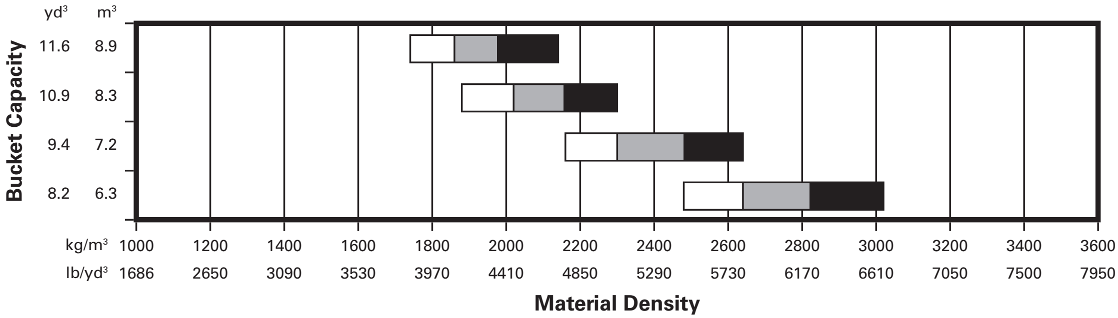


KEY

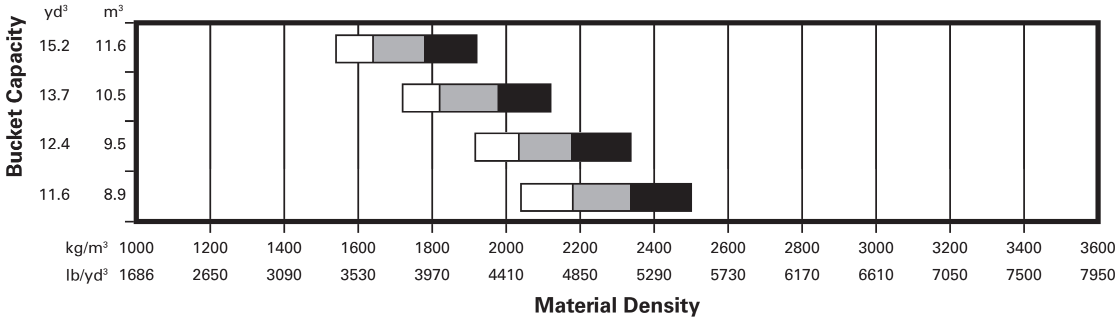
Bucket Fill Factor

110% 100% 90%

R2900G



R3000H



KEY

Bucket Fill Factor

110% 100% 90%

Turning Dimensions

Model	R1300G		R1600H		R1700		R2900G		R3000H	
Outer Turning Radius	5717 mm	**225.1"**	6638 mm	**261.3"**	6857 mm	**270"**	7323 mm	**288.3"**	7536 mm	**296.7"**
Inner Turning Radius	2825 mm	**111.2"**	3291 mm	**129.6"**	3139 mm	**124"**	3383 mm	**133.2"**	3247 mm	**127.8"**
Articulation Angle	**±42.5°**		**±42.5°**		**±44.0°**		**±42.5°**		**±42.5°**	

WASTE HANDLING

CONTENTS

INTRODUCTION

An increasing volume of refuse is generated by every person, household, commercial and industrial, entity day after day … 365 days a year. Disposal of this waste is a major concern worldwide. Increased governmental regulations designed to protect the environment along with rising transportation and land acquisition costs dictate that customers need to be cost conscience. Waste applications are very demanding and are a significant user of earthmoving and specialty mobile equipment, parts, and service. Caterpillar has Waste Specialists in each of the below categories. If you have questions, please contact your local dealer, Waste representative, or go to *Cat.com*.

SAFETY

Waste industry operators work in some of the world's harshest conditions, so Caterpillar has developed a range of safety resources to help your organization build a culture that delivers everyone SAFELY HOME. EVERYONE. EVERYDAY.™ Caterpillar Safety Services offers training programs, safety checklists, Toolbox Talks, videos, virtual walk arounds and other resources specific to the waste industry at *www.cat.com/safety*. Click on the Industry Safety tab, and then select Waste.

OVERVIEW

Waste applications are some of the harshest environments that machines and operators will work in. By definition waste is any discarded, rejected, abandoned, unwanted or surplus material.

The Waste Stream — It is important to understand the type of material you are working with when trying to spec a work tool and machine. Through many site assessments and machine productivity/competitive testing, we have found one underlying theme, the type of waste stream and site conditions, will dictate the type of work, tool, and machine. Residential waste (MSW), construction and demolition (C&D), green waste, commercial waste, wet waste*, industrials and sludges, auto fluff/car shred, etc., are just some of the types of waste that are dealt with daily. Each type of waste has different characteristics and properties. Weights of these materials could be as low as 148 kg/m^3 (250 lb/yd^3) to over 1187 kg/m^3 (2000 lb/yd^3) (sludges and soils). For example, during a recovering/recycling application, your work tool **Fill Factor** could be as high as **150–200%** when dealing with some MSW and shredded C&D.

MATERIAL RECOVERY FACILITIES, SORTING, AND TRANSFER STATIONS

Safety

MRF's, Sorting and Transfer Stations are not only harsh but busy environments. Inbound loads, mobile equipment, tip floor personnel, and outbound loads, are only a part of the traffic and dynamics dealt with minute by minute in very close settings. Proper PPE (personal protective equipment) for people, guarding for machines, and safety equipment on machines, are essential to keep safe.

Technology

Due to the demanding type of applications within MRF's, Sorting and Transfer Stations, machine technology has to lead the way in offering the ability to: scale loads, manage fuel and machine utilization, keep tire wear to a minimum, and help the operator with visual safety front and rear. Eco Modes on machines allow the ability to switch to a fuel saving mode. Product Link™ helps with tracking fuel burn, machine idle time and utilization. Traction control enables the operator to keep tire wear to a minimum.

Overview: Changing Attitudes in Waste Applications

MRF's (material recovery facilities) sorting, and transfer stations are becoming an important part of the waste industry. Diversion of waste from landfills is a global trend. The European Union, (EU), Canada, Japan, are just a few of the countries who divert 50–75% of their waste stream away from landfills. Cardboard, plastics, paper, food and green wastes are recovered, recycled, or composted. Major changes in the waste stream dictate different methods to gain density. The old mantra of "4–5 passes is enough," now becomes 4–7 passes so that materials can be shredded and bound together for higher densities. The U.S.A. is following this trend as regulations become stricter and the costs of siting/building landfills become higher. Transfer stations become a necessity as disposal sites continue to decline and/or move further away from city centers. MRF's, Sorting/Recycling and Transfer Stations all help reduce primary road and landfill traffic which helps create a safer environment for all.

*Wet Waste — Several country's, regions, and areas globally have concerns with waste that has a high moisture content. If you or your customer are working with a 'higher moisture content' type of waste, please see the *Wet Waste* section under *Landfills — Types of Waste and Refuse Densities*.

Primary Roles

- MRF's (Material Recovery Facilities) Sorting and Recycling Stations are designed to divert recyclable materials from the waste stream. Depending on whether the material is single stream, co-mingled, or pre-sorted, the goal is to divert recyclable material for re-consumption thus lowering the amount of waste placed in a landfill. The natural life of the landfill will be extended by this action. Additional savings of hauling costs can be realized by recovering/recycling materials close to the source (at the MRF or Transfer Station).
- Transfer stations, are designed to consolidate the loads of several residential vehicles in to long-haul vehicles such as rail cars, transfer trailers, barges, and ISO containers. On an average 2–5 inbound loads or more (depending on method of haul) can be consolidated into one outbound load. As a result, transfer stations offer cost savings over direct haul to landfills.

MRF's (Material Recovery Facilities), Sorting Stations, Recycling Stations

A well-coordinated recycling program will reduce volume going to the landfill by 50% or more. Trends are towards sorting and 1 of 2 types of MRF's.

- Dirty MRF — A dirty MRF accepts mixed waste, (normal household waste that has not been separated) that later may be sorted for recycling. Recoverable/recyclable materials are sorted either by hand or automation or a combination of the two. The materials are either baled and/or are hauled to a plant/industry that will utilize the recovered goods.
- Clean MRF — A clean MRF accepts source separated materials from residential or commercial sources. These are normally delivered in separate collection vehicles. As in the 'dirty' MRF, materials are either sorted by hand, automation, or a combination of both, baled and/or are taken to someplace that will recycle or utilize the recovered goods.
- Sorting Stations — Some transfer stations are designed for some waste diversion from mixed streams and are normally described as 'sorting stations.'

MRF's, Sorting and Transfer Stations Applications

There is a wide range of variability in MRF, Sorting and Transfer Station applications and operations. Depending on facility size, amount of material handled, type of station, etc. a wide variety of mobile equipment could be utilized.

In all the facilities mentioned above, materials are tipped by residential or commercial vehicles on to a tip platform or tip floor area. The materials are stockpiled then loaded into hoppers, conveyors, or a haul vehicle. Wheel loaders and excavators (tracked or wheeled) are the primary equipment for stockpiling, loading, sorting, topping off loads, and 'tamping' material into the haul vehicles.

"Volumetric consolidation of material" (normally in Transfer Station applications) is a method of compression and shredding that helps reduce the size of the waste loaded into a haul vehicle. It helps maximize the allowable weight carried by each haul unit. Common machines used for material consolidation are, track-type tractors, track loaders and compactors. These machines are equipped with track shoes or tips/teeth that help in shredding, compression, and reduction of the volume of waste. In most instances, machines performing the material consolidation/reduction are aided by a wheel loader or excavator.

For all applications within MRF's, Sorting, Recycling, and Transfer Stations, there is normally support equipment aiding the primary equipment. Small and compact loaders and excavators, backhoe loaders, skid steer loaders, and fork lifts, are just a few of these machines being utilized.

Types of Transfer Stations

Globally, top loading and compaction transfer stations are the two most popular designs. There are many different types of transfer stations, but, most conform to these two designs.

Top loading systems are the most common and simplest to operate. In top loading designs, there are normally five types of loading arrangements: direct, surge pit, full separation, half separation, and same level or floor loading. Depending on the type of transfer station, wheel loaders, excavators (tracked or wheeled), dozers, track loaders, and compactors can be utilized alone or in systems providing quick efficient waste handling.

Compaction transfer stations utilize hydraulic compaction equipment prior to or during the loading of the haul vehicle to compress the material into bales/logs or into the haul vehicle itself. The hydraulic compactor can be top loaded or side loaded by wheel loaders or excavators, depending on the type of design.

EQUIPMENT SELECTION

In waste applications, the largest single cost in daily operations is purchasing, operating, and maintaining the equipment that will handle the waste. Undersized, inadequate, or unreliable equipment results in inefficient operation and higher maintenance and fuel costs. As in many Cat® applications/industries, right sizing equipment should follow the familiar path of; Task, Tool, Machine. TASK: Understand the task or application the machine will work in. TOOL: What tool or tools will aid the machine in performing the task most efficiently? MACHINE: After finding the 'right tool(s)' to perform the job, then match it to the right sized machine.

Equipment in MRF, Sorting and Transfer Station applications perform the below operations.

1. **Stockpiling the Waste.** Once it is dumped onto the tip floor, wheel loaders, wheeled or tracked excavators, track-type tractors, track loaders, or compactors will push the material up into a stockpile. Stockpiling helps: recover storage and working space within the building, get the waste slightly denser, store the waste till it can be processed or loaded.

   Factors for a machine in stockpiling are: type of tool, reach, lift, ceiling height, storage space, and maneuverability.
2. **Recovering and Sorting.** Waste streams are rich in recoverable/recyclable materials. Waste diversion or recovery not only helps reduce the amount of waste going to landfills, but adds to profitability when sold to commodity markets. Sorting and recovery prior to stockpiling or loading can be accomplished with specialized machines equipped with sorting grabs, grapple buckets, or grapples. Stockpiled materials are sorted prior to loading or when loaded with grapples or grapple buckets. All sizes of equipment could be used depending on type of material and material flow. Compact wheel loaders/excavators, skid steer loaders, backhoe loaders, medium wheel loaders and excavators, and telehandlers should be sized according to amount of waste and type of application and type of tool(s) needed. It should be noted that in this type of application couplers on primary and support equipment could be a necessity.
3. **Loading the Waste.** No matter what type of haul/load out, vehicle/conveyor or hopper, materials are either pushed, load and carried, grappled or bucket loaded into transport vehicles or containers. Wheel loaders, tracked or wheeled excavators, track-type tractors, track loaders, compactors or any combination of these (systems) can be utilized. Note that the type of loading application will dictate the type of tool and machine necessary for optimum efficiency in the loading process.
4. **Reducing Volume of Material.** Haul vehicles/transport vehicles need to leave with the maximum allowable weight for the type of transportation mode being used. Wheel loaders and tracked or wheeled excavators can keep stockpiling or turning the waste to get the waste more dense. However, best compression, shredding and volume reduction of the waste is seen by layering waste in thin layers, continuous running over (passes) the waste, turning the waste, and "working" the waste. Track-type tractors, track loaders, and compactors normally see an average of about 60–120 kg/m^3 (100–200 lb/yd^3) higher density than wheel loaders or excavators in this type of application. Type of track or wheel/tip design is very important for shredding and compression in this type of application.

5. **Support Equipment.** Primary equipment often are supported by machines performing; clean up and sorting with specialized work tools, sweeping with brooms, stacking and loading with pallet forks or bale clamps, etc. Compact wheel loaders and excavators, backhoe loaders, skid steer loaders, and telehandlers equipped specifically for the tasks they need to perform can increase production and efficiency in all areas. Most of the time one or two machines are equipped with couplers to increase their versatility and efficiency helping lower costs.

Machine Selection Factors

Parameters that could influence tool and machine size, quantity, and possible combinations of machines in MRF's, Sorting and Transfer Stations could include:

1. Amount and type of daily waste to be handled (daily tonnage). During daily inbound tonnage, some peak delivery times occur. It has been found that approximately 50%–60% of inbound tonnages occur on 2–3 "Peak" hours/times of the day. Depending on the inbound tonnage during these times, machines could be spec'd towards these peak times (type and size of facility). What loading platform (top loading/compaction facilities) are they using and how much overall space to work in.
2. Facility load out dynamics.
   a. Maneuverability
   b. Ceiling height
   c. Floor size/storage space
   d. Floor arrangements
   e. Type of load out (below grade, ½ separation, same level, surge pit — loading)
   f. Haul unit specifications
   g. Inbound/outbound traffic patterns
3. Requirements for volume reduction for higher tonnages in load out.
4. Supplemental tasks performed in daily operations.
5. Budget.
6. Future growth.

NOTE: Waste applications place high demands on machinery requiring protection of the machine and its components. Special guarding is needed on all moving parts like axles and drive shafts. Windshields, fuel and hydraulic tanks, radiators, hoses, engine enclosures, are all vulnerable to debris and damage and require guarding. Specially designed debris screens and radiators will ensure clean out and better heat transfer for more efficiency.

Wheel Loaders

Wheel loaders are normally the primary machine used in MRF's, Sorting and Transfer Stations. Wheel loaders are designed, guarded and built in factory to withstand these harsh environments. Primary operations include: sorting and recovery of materials, push and stockpiling of waste, cleaning floors, support work, and loading conveyors/hoppers/and outbound haul vehicles. Depending on type of material, reach needed, amount of sorting required, ceiling height, floor wear, and type of load out, the machines can be equipped with a wide variety of buckets, attachments and tires. Keeping the thought process of Task, Tool, Machine in mind, a good knowledge of the facility, its waste stream, and type of support work, is needed to 'right size' the wheel loader(s) for these applications.

- Compact Wheel Loaders (906–920) — Normally used in small tonnage MRF's/Sorting Stations or as support in larger stations, maneuverability and versatility (coupler equipped) are its main strengths.

- Small Wheel Loaders (924–938) — Used in small–medium MRF's, Sorting and Transfer Stations and as support in larger stations, the small wheel loader brings maneuverability and versatility (coupler equipped) to these types of applications.

- Medium Wheel Loaders (950, 962, 966, 972, 980, 966XE and 972 XE) — When larger tasks, better reach, higher stockpiling, larger tonnages, etc. are needed, a medium sized wheel loader is normally utilized. These machines have excellent weight to horsepower ratio for better traction and moving larger loads.

The following Wheel Loader Operating Recommendations Chart is an estimate of possible machine(s) for tonnages and type of facility. (Note: Keep in mind the task/application the machine will work in, what tool(s) might accomplish the tasks and then size the machine.)

Wheel Loader Operating Recommendations

Tons per Day Volume	Clean MRF Recovery/Recycling	Dirty MRF/ Sorting Station	Waste Transfer Station	C&D MRF	C&D Transfer Station
0-100	906-930	924-930	924-930	930-950	930-950[b]
100-350	908-930[a]	924-930[a]	924-938[a]	950-966[d]*	950-966[d]*
350-500	930-950	930-950*	938-966*	966-980[a]*	950-966[d]*
500-1000	930-950[a]*	938-950[e]*	950-966[c]*	966-980*	950-980[d]*
1000-1500	938-950[e]*	938-966[e]*	966-980[d]*	950-980[d,e]*	966-980[d,e]*
1500-2000	950-966[e]*	966-980[e]*	966-980[d,e]*	950-980[e]*	966-980[d,e]*
2000-2500	950-966[e]*	966-980[d,e]*	966-980[d,e]*	950-980[e]*	966-980[d,e]*
2500-3000	950-966[e]*	966-980[e]*	966-980[e]*	950-980[e]*	966-980[d]*
3000 Plus	966-980[e]*	980[e]	980[e]	980[e]	980[d,e]

C&D = Construction and Demolition

*Depending on inbound/outbound tonnage, reach, production required, this machine could step up to either a 962 or 972.

a = Multiple machines recommended (contact your local Cat dealership for recommendations)
b = Depends on type and density of C&D material
c = Waste stream mixture may require multiple machines
d = Operating hours may require additional machines
e = Multiple machines required

The above are rule of thumb estimates. Your application might vary enough to change the machine for the above recommendations.
Other questions that might need answered are:

- What are you loading? Conveyors, haul vehicles, hoppers, etc.?
- If loading conveyors or drums — what are the feed capacities, FPS rate?
- How much storage capability in your building?
- What type of loading are you performing?
- How much reach is required for stockpiling and loading?
- "Other" required operations that the machine might perform?

Additional Considerations

All facilities are different and require special considerations when ordering and specifying tools and equipment. If tonnage and operating hours change, then tool and machine might change. Machine weight has to balance power to ground for best traction on slick floors. Keep in mind Task, Tool, Machine. (What type of work will the machine be asked to perform during the shift? What tool(s) will apply to that type of work cycle? What machine fits to that type of tool?)

It should be noted that most of the wheel loaders being sold into MRF, Sorting and Transfer Stations are high lift. This arrangement offers increased reach and lift height not only for loading and stockpiling, but in case the haul vehicle has to be brought to the same level as the machine to be loaded.

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Hydraulic Excavators (Tracked and Wheeled)

Hydraulic excavators (tracked and wheeled) are often found in MRF, Sorting and Transfer stations either as a primary or secondary tool for loading haul vehicles/ conveyors/hoppers, tamping and finishing off loads, and sorting materials. Fast cycle times are the primary advantage of an Excavator over a Wheel Loader. Wheeled excavators come with a maneuverability advantage especially in tight loading and stockpiling areas. Depending on the type of application, tracked and wheeled excavators would be equipped either for high production loading/ compaction, or with sorting/separating tools for recovery of recyclable materials.

Again, keeping the Task, Tool, Machine concept in mind, you should take into account the following when sizing a tracked or wheeled excavator. Type of material and density, tonnage, work load for the machine, ceiling height, work area/swing area, floor size, along with maneuverability needed, ability to 'see' into haul vehicles or down into the floor load out area (cab risers), and reach. Special guarding packages, radiators, and reversing fans are options that may be needed to meet the most demanding needs.

Track-Type Tractors

Waste Handling Track-Type Tractors are designed, guarded, and built in factory so that they can accommodate all waste applications. Although its primary use is for pushing and layering the waste and cover materials in landfills they offer alternative waste movement and volume reduction in large transfer stations and C&D transfer stations. Ex: In surge pit operations where waste is tipped into a level below the tipping floor. Track-type tractors will push, layer, and compress/shred the material during operations and push into a haul vehicle. This method is used when maximum volume reduction is required or peak rate of waste exceeds available floor space.

Track Loaders

Waste Handling Track Loaders are designed, guarded, and built in factory so that they can accommodate all waste applications. Transfer stations are a strength for this machine due to its versatility in this application. Sorting, pushing, layering, and compaction are all part of typical operations within the transfer station application. Just like the track-type tractor, the track loader is used in higher tonnage transfer stations, C&D transfer stations, and when waste needs volume reduction. Equipped with a multi-purpose bucket, the track loader can sort, push, layer, compress and shred, and load material into outbound haul vehicles.

Landfill Compactors

Although landfill compactors are designed for spreading and compacting large volumes of material in a landfill environment, in some instances, transfer stations might have a large enough working area to allow the compactor to be utilized to reduce waste volume prior to loading into haul vehicles. They offer two advantages in this type of application.

1. They are configured and guarded to work in this type of environment.
2. They achieve higher compression, shredding, and compaction levels compared to other machines.

CAUTION! Operating a landfill compactor, track-type tractor, or track loader on a concrete floor could be counterproductive due to floor wear and maintenance costs. Always keep a layer of waste between the floor and machine until final movement of the day. Wheel loaders and/or excavators (wheeled/tracked) should be used to support these machines. (Please see #4 under previous Equipment Selection.) (It is not recommended to use a landfill compactor larger than the 826.)

Work Tools for Material Recovery Facilities, Sorting and Transfer Stations

As described in the opening statements of this section, the waste stream can consist of many different types of materials sometimes all blended together. For that reason, work tools become a very important part of moving, sorting, and dozing in waste applications.

At the end of this section, there will be a Work Tool section and chart discussing possible tools to use. Please contact your dealer/regional waste representative for more information.

LANDFILLS

Safety

Landfills are harsh and busy environments. A variety of vehicle traffic on haul roads, busy tipping areas, people on the tip floor, a large variety of different types of waste, mobile heavy equipment operations, special waste haulers, etc. are all part of the dynamics of a landfill working face. Proper PPE (personal protective equipment) for people, guarding for machines, proper training, and safety equipment on machines, are essential for a safe work environment.

Compaction Power with the Cat Compaction Technology

Our Accugrade™ Cat Compaction Technology software supplies dependable, real-time data in the form of pass count, compaction and cut/fill mapping, as well as map sharing. Utilizing 3D mapping technology, Cat Compaction Technology offers system options for a variety of landfill sizes and waste management needs. The result? With proper machine usage, you could see up to 40% better compaction. Ask your dealer for more details.

Payload Systems for Loaders, Haulers and Managers

Whether you're using wheel loaders or excavators, on-highway trucks, off-road haulers or hoppers, there is Cat Payload technology made for your applications. Operators can see how much they're lifting in every bucket load and when they've reached optimum hauler capacity. Managers can then track tonnage output on whatever time frame they need.

Cat® Command is revolutionizing equipment operation. By removing the operator from the machine, Command opens up new possibilities—for safe operation in hazardous areas, for improved sightlines in tricky applications, for enhanced productivity by putting operators in more comfortable settings or by enabling them to manage multiple machines at once.

Cat® Detect safety technology helps operators become more aware of their surroundings and automatically prevents them from engaging in certain unsafe operations. Proximity sensing systems limit machine movement in tight spaces, while cameras and other sensors keep operators informed about equipment and personnel working near their machines.

Cat® Inspect allows you to access your equipment data on your mobile device. This easy-to-use app lets you capture inspection data and integrates with your other Cat data systems, so you can keep a close eye on your fleet. More than one million inspections are completed each year, providing convenience and accountability to equipment owners.

Technology

Due to the demanding environment and its possible applications, machine technology has to lead the way in offering the ability to: manage fuel and machine utilization, keep undercarriage cost to a minimum, and help the operator with visual safety front and rear. Eco Modes on machines allow the ability to switch to a fuel saving mode. Product Link helps with tracking fuel burn, machine idle time and utilization. Computers, VIMS™ (Vital Information Management Systems,) and Traction Control (in some track-type tractors) helps operators control spin and keep track of mileage to help decrease undercarriage wear.

Landfill Overview: Landfilling Now and in the Future

Although recovering and recycling materials is becoming more prevalent, landfilling still provides a place to deposit waste materials or refuse not able to be recovered/recycled. A landfill protects the environment by disposing of the waste in an engineered cell. Siting, designing, building, and operating a landfill is costly. Depending on country, state, region, etc., landfills have to design and operate to very strict regulations. Proper equipment selection and daily operating techniques can maximize and extend the operational life of the landfill along with lowering costs.

Primary types of landfills are MSW (municipal solid waste/residential), C&D (construction and demolition), and Hazardous (hazardous industrial sludges, asbestos, etc.) with the majority of landfills being MSW or residential waste. Landfills can take in many different types of materials and will range from less than 90 metric tons/day (100 tons/day) to over 13 610 metric tons/day (15,000 tons/day). Depending on the country you live in and its regulations on recycling, the waste stream going to the landfill could be a mix of food wastes, packaging, plastics, cardboard/paper, metals, C&D, etc. In some highly regulated countries, food wastes, plastics, cardboard/paper, metals, and C&D, are diverted to C&D landfills, composting sites, and/or facilities that will recycle the recovered product.

In keeping with environmental concerns, most landfills have a highly engineered method of dealing with leachate, gas, and inbound waste. (See the *Caterpillar Equipment and Application Guide — Waste Landfills* or your countries Environmental Landfill sites.) Once cell, leachate, and gas methane extraction development are in place, the basics are to: push, layer, compact the waste in thin layers, adding daily cover or ADC (alternative daily cover) sparingly. The idea is to fill the landfill with as much waste as possible without robbing airspace by using too much cover soil.

Diversion rates of recoverable materials within the EU Canada, some Asia Pacific countries, and starting in the U.S. will eventually reach 60%–80% diversion or more. This will all depend upon commodity markets and the demand for the recycled materials. It also drastically changes the waste stream going to the landfill. The type of waste going to a landfill from a good diversion plan is normally light plastics, packaging, hard to handle materials, metals and materials that can't be recycled. This waste stream might require different handling, processing, amount of passes, and compaction techniques to shred and compress it as much as possible and possibly different wheel tips and tip patterns. (See text in *Factors Governing Compaction —Developing a Pattern* and *Running Proper Passes*.)

EQUIPMENT SELECTION

A landfill's largest single cost for daily operations is purchasing, operating, and maintaining its mobile equipment fleet. Undersized, inadequate or unreliable equipment results in low machine utilization, higher fuel and maintenance costs and eventually improper landfill operations.

Landfill equipment performs three major distinct functions:

1. Waste disposal: Which includes, pushing, spreading, and compaction. Track-type tractors, track loaders, and landfill compactors are primary machines in this application.
2. Cover material mining and application: Machines will provide daily cover requirements whether cover soil or ADC (alternative daily cover). If supplying cover material is a machine's sole function, then it can be selected on the same criteria as normal earthmoving. Distance to borrow pit, material characteristics, volume to transport, production needs, underfoot conditions, etc. are all important in right sizing the equipment. Lowest cost is determined by best efficiency and lowest cost/m^3 (yd^3).
3. Support activities: What 'other' roles might the equipment be asked to accomplish or what support is needed for the primary equipment? Water trucks to keep dust down, motor graders to maintain haul roads, wheel loaders/excavators/backhoes/skid steer loaders, telehandlers, etc., with couplers that can utilize all types of work tools, generators, service vehicles, air compressors, etc. are all necessary equipment to keep the landfill running efficiently.
4. Peak periods: Most landfills have to deal with 2–4 periods during the day where more volume of waste is delivered by more inbound vehicles than normal. These are called peak periods. Depending on the size of the landfill and amount of peak waste coming in, it should be noted that some landfill equipment can or should be specified in order to handle these peak times of waste and vehicles.

There are many variables when choosing the "right" sized equipment for landfill use. Again, we point to the direction of thinking: Task, Tool, and Machine. What are the application, production, compaction, support requirements? What tool or tools can accomplish this task? And finally, what machine(s) will handle the tool(s) most efficiently? (To help with 'right sizing' a compactor and/or track-type tractor together, Waste Fleet Analysis/WFA (downloaded at *Dealer.Cat.com*) can be utilized as a rule of thumb to determine possible compactors/track-type tractors and combinations of the two.)

Track-Type Tractors

Waste Handling Track-Type Tractors are designed, guarded, and built in factory so that they can accommodate all waste applications. The track-type tractor is the most popular machine on the landfill. They prepare the site, build haul roads, push/spread/and sometimes compact the refuse, spread cover material, and perform a variety of support functions. Quantity of material to be moved/hr., type of inbound delivery vehicles, distance of push, support work needed, etc., all should be taken into consideration when sizing a track-type tractor for its application. Economic distances for dozing waste or cover soil efficiently is no more than 90 m (300 ft) or less. The track-type tractor, when used to compact, can achieve densities of approximately 475–590 kg/m^3 (800–1000 lb/yd^3) (MSW, 3:1 or less slope, multiple passes).

Track Loaders

Waste Handling Track Loaders are designed, guarded, and built in factory so that they can accommodate all waste applications. These machines are highly versatile and perform many primary and support activities. They can be used in any size landfill and are ideal for landfills under 135 metric tons (150 tons) since they can work solo to perform waste handling and cover material functions. Equipping the machine with a coupler or a multi-purpose bucket increases its versatility. The multi-purpose bucket can be used for pushing waste, sorting materials, and dozing cover soils. The machine can be equipped with different track options from double to single grouser allowing it to work in normal operations or be utilized to more aggressively shred materials (Heavy MSW or C&D). Utilizing correct methods of compaction, (spread thin and load the bucket with soils to increase weight) will achieve higher densities during compaction. Compaction densities can range from 475–590 kg/m^3 (800–1000 lb/yd^3).

Landfill Compactors

Landfill Compactors are specifically designed, built, and guarded in the factory to effectively shred and compress large volumes of waste. Depending on landfill size and amount of tons inbound daily, the compactor will work solo (pushing, spreading, compacting) handling all the inbound waste, or work in tandem with a track-type tractor (track-type tractor — push/spread, compactor — shred/compact). When working the track-type tractor and landfill compactor together as a "system," productivity and compaction densities will increase. Depending on the type of waste stream to be compacted, initial waste density, depth of the layer spread, and size/weight of the landfill compactor, compaction densities can be 593–1100 kg/m^3 (1000–1854 lb/yd^3). Although the compactor can work on steeper slopes, best slopes for highest density for landfill compactors are 4:1 or less.

Wheel Loaders

Wheel loaders are designed, guarded and built in factory to withstand these harsh environments. Not recommended as a compaction machine, wheel loaders are mobile and versatile and sometimes are used by communities sharing a single machine which can travel and support community/landfill projects. Wheel loaders are normally equipped with a coupler and many different tools to make it more versatile. Loading cover soils, sorting, clean up, spreading road material, and handling leachate/gas pipes are just a few of the activities wheel loaders perform in landfill applications.

Hydraulic Excavators (Tracked/Wheeled)

Every landfill has a tracked or wheeled excavator supporting its operations. Whether equipped with a coupler, which accommodates multiple tools, or a pinned attachment, wheeled and tracked excavators offer superior versatility in: cell development, cover soil mining, ditch/pond clean out, and leachate and gas extraction support. Wheeled excavators give you mobility and maneuverability along with the ability to be able to respond quickly to support needs. When loading cover materials is the primary application, it is critical to know the size of the haul vehicle, type of material, and production required, so as to define the proper size bucket, stick, and finally machine to meet production needs.

Wheel Tractor-Scrapers

Wheel tractor-scrapers mainly perform cover soil operations. Wheel tractor-scrapers work in site preparation, cell construction and hauling/placing cover material. When underfoot conditions are good and the haul over 185 m (600 ft) the wheel tractor-scraper will be economical. The machine should be selected as if performing a typical earthmoving application. Average sized landfills prefer the work alone capability of either an elevating or twin engine scraper since they are self-loading machines. Larger landfills sometimes utilize larger push–pull scraper units to meet their daily cover soil production needs. Preferably, the scraper unloads the cover material close to the working face where track-type tractors or track loaders can push and spread the material in the required layer depth. This will reduce tire damage and extra maintenance costs to the machine.

Articulated Trucks

Articulated trucks are versatile, highly maneuverable, all weather haulers that can negotiate poor underfoot conditions. Like wheel tractor-scrapers, articulated trucks work in site preparation, cell construction, and hauling/placing cover material. Articulated trucks are normally loaded by a variety of loading tools and economically effective with hauls from 0.2 km–5 km (600 ft–3 miles). In dump configuration, cover material is dumped close to the work face and spread by a supporting track-type tractor or track loader. Ejector configured trucks are preferred and provide safer on-the-go dumping in normal to softer more sloped ground conditions where a "dump configuration" machine would not be suitable. Cat articulated trucks offer optional container handling and refuse body configurations for specialized landfill applications.

Work Tools for Working in Waste Landfill Applications

As described in the opening statements of this section, the waste stream can consist of many different types of materials sometimes all blended together. For that reason, work tools become a very important part of moving, sorting, and dozing in waste applications.

At the end of this section, there will be a Work Tool section and chart discussing possible tools to use. Please contact your dealer/regional waste representative for more information.

Machine Selection Factors

Selecting the type, size, quantity, and combination of machines required to spread, compact, and cover varying daily refuse volumes is determined by the following parameters:

1. Amount and type of waste to be handled (daily tonnage) (peak periods should be charted and reviewed and taken into considerations)
2. Amount and type of cover material to be handled
3. Distance cover material to be transported
4. Compaction/density requirements
5. Weather conditions
6. Supplemental tasks
7. Budget
8. Growth

A. Daily tonnage and peak periods — Amount of waste produced by a community is the major variable in selecting the appropriate sized machine. The following chart serves as a "guideline" in sizing a landfill machine. For example, if a community generates approximately 180 metric tons (200 tons) of refuse per day, a D6, 953, and/or an 816F2 landfill compactor could be considered. Depending on the tonnage, type of waste, and peak periods, multiple machines or a 'system' of machines (ex: 836K and D8T) could be considered. As discussed earlier, peak periods during the day, (periods of time where a higher than normal average amount of waste comes in) could dictate what size machine is needed to keep up with the inbound waste. During these times, another machine could be added to the mix until the waste is layered and compacted correctly.

B. Amount and type of cover material to be handled — Landfill, size, type, and methods of operation vary dramatically from site to site. The type and amount of cover material utilized is important. The use of Alternative Daily Cover (ADC) is highly recommended to reduce loss of valuable airspace. Landfill managers track cover material use as close as they track their airspace and maintenance. The use of cover material is broken down into three segments: daily, intermediate, and final. Landfill operators agree that daily cover should be no more than 10% or less of the entire lift. No matter how much daily or intermediate cover is used, the growing trend is to remove or 'mine' cover material prior to beginning the daily operation in that area. The total combination of daily and intermediate cover if not removed, could end up being more than 25%–35% of total landfill airspace loss. Removal of cover material increases airspace and helps facilitate leachate and gas migration.

Blade/bucket design is paramount if a machine is used specifically for working with cover soil. Straight blades, Semi U blades, and multi-purpose buckets are primarily used by track-type tractors and track loaders. With the need to carry and layer cover material to an exacting maximum, blades/buckets that can shed material easily are recommended. If the machine will be used in waste and cover soil operations, then a Semi Universal blade (for load and carry) and the multi-purpose bucket are good recommendations.

C. Distance cover material is to be transported — Whether working with daily, intermediate, or final cover, the following guidelines are recommended for cover material movement. Quantity of material to be moved, required production, and maintenance results, must also be considered when using these guidelines.

Track-type tractor	0-61 m (0-200 ft)
Track loader	
Push/spread	0-61 m (0-200 ft)
Load & Carry/spread	0-150 m (0-500 ft)
(Type of material/application needs to be considered for possible excessive track wear)	
Wheel loader	0-185 m (0-600 ft)
Wheel tractor-scraper	over 185 m (over 600 ft)
Articulated truck	over 185 m (over 600 ft)
(Haul distance, road and borrow pit conditions, weather, tip area dynamics — all need to be taken into consideration when making a decision to use a scraper or articulated truck)	

D. Compaction requirements — Best utilization of airspace is critical to extending landfill life. Quantity and type of material, work face variables, operator skill, operating hours, size and type of equipment, etc., all play a part in achieving high densities. Highest density is gained by utilizing a 'system' approach of machines (track-type tractor pushing and spreading — compactor leveling and compacting) or to a lesser extent, just using a compactor.

The following product segments of this section will contain features, specifications, and work tools for primary Cat Waste Handling machines. Additional drawbar/rimpull vs. groundspeed charts, ground pressures, controls, production estimating tools, information, can be found in respective product sections within this *Performance Handbook*.

The below *Machine Tonnage and Usage Selection Factor Guide* should be considered a 'rule of thumb.'

To use; find the amount of tonnage/day that the landfill takes in (left column) — to the right of that column find the possible machines that could be used for that amount of tonnage (marked by an ×). Please note that depending on the type of waste, amount of waste/day, and even amount of waste/hr., a single machine could be utilized or multiple machines might be necessary.

For example: Follow the left column down to 45.3 to 136 Metric Tons/day (50 to 150 tons per day) — For MSW Landfills — All the machines marked by ×'s could be utilized. Smaller machines for smaller tonnages, larger machines for larger tonnages. Depending on budget and required density, and required support activity, a single machine might be used or a combination of machines could be needed.

Machine Tonnage and Usage Selection Guide	D5 WHA	D6 WHA D6XE WHA	D7 WHA	D8T	D9T	953	963	973	816	826K	836K
0 to 45.3 Metric Tons per Day (0 to 50 Tons per Day)											
MSW Landfills	×	×				×	×				
Construction and Demolition Landfills/Other		×	×				×	×			
45.3 to 136 Metric Tons per Day (50 to 150 Tons per Day)											
MSW Landfills	×	×				×	×		×		
Construction and Demolition Landfills/Other		×	×				×	×	×	×	
136 to 227 Metric Tons per Day (150 to 250 Tons per Day)											
MSW Landfills	×	×				×	×	×	×	×	
Construction and Demolition Landfills/Other		×	×	×			×	×	×	×	
227 to 317.5 Metric Tons per Day (250 to 350 Tons per Day)											
MSW Landfills		×	×	×			×	×	×	×	
Construction and Demolition Landfills/Other			×	×				×		×	
317.5 to 453.6 Metric Tons per Day (350 to 500 Tons per Day)											
MSW Landfills		×	×	×			×	×		×	×
Construction and Demolition Landfills			×	×	×			×		×	×
453.6 to 680.4 Metric Tons per Day (500 to 750 Tons per Day)											
MSW Landfills			×	×			×	×		×	×
Construction and Demolition Landfills/Other			×	×	×			×		×	×
680.4 to 907.2 Metric Tons per Day (750 to 1000 Tons per Day)											
MSW Landfills			×	×	×			×			×
Construction and Demolition Landfills/Other			×	×	×			×			×
907.2 to 2721 Metric Tons per Day (1000 to 3000 Tons per Day)*											
MSW Landfills			×	×	×			×			×
Construction and Demolition Landfills/Other			×	×	×			×			×
2721 PLUS Metric Tons per Day (3000 PLUS Tons per Day)*											
MSW Landfills			×	×	×			×			×
Construction and Demolition Landfills/Other				×	×			×			×

*Might require multiple machines or 'systems.' Systems = dozer/compactor combination (S).

TYPE OF WASTE AND REFUSE DENSITIES

The type and density of the waste stream inbound to MRF's, Sorting/Transfer Stations, and Landfills determine how it is handled, the type of work tool, and ultimately the type of machine to handle it. Type of waste to be handled will strongly influence machine selection. The major waste components for the community and landfill should be identified and machine selection based on the type of waste and compaction density required. For example, if the site receives a high proportion of material that is hard to compact like medium to heavy C&D waste, (rocks, bricks, concrete, tree stumps, telephone poles, etc.) a landfill compactor might have a hard time achieving normal densities without the help of a track-type tractor or track loader. Tracked machines have more difficulty pushing and compacting bulk waste such as trees, road materials, iron, etc. A combination or "system" of both tracked machine and landfill compactor might work best. Depending on the type of waste, different tip/cleat designs will help with shredding, traction, and density.

On average, Americans generate approximately 2 kg (4.4 lb) waste/day while the European Union (EU) generates about 1.4 kg (3.0 lb) waste/day. (Before recovery/recycling) Waste composition varies from location to location, the following charts are representative of the waste stream in the U.S. and EU. (Please note that the growing trend within the EU and to a lesser extent the U.S. is to use waste as a resource. Subsequently the numbers represented in these charts will have annual changes.) The EU-27 are avoiding waste to landfills through recovery, recycling, composting, and incineration, and are trying to use waste as a resource. For the EU-27, approximately 38% of waste is landfilled. The U.S. is currently approximately 33% recovered/recycled with a slow trend towards composting.

Generally, loose residential and commercial refuse weighs 150–267 kg/m³ (250–450 lb/yd³). A refuse truck will increase this density to 237–593 kg/m³ (400–1000 lb/yd³). Once ejected from the refuse truck, some waste has a 'rebound' tendency and it will lose some density. Typically, loose on the landfill, we see loose refuse weights with an average of 207–475 kg/m³ (350–800 lb/yd³). This waste needs to be compacted and in-place densities can vary from between 356–889 kg/m³ (600–1500 lb/yd³) depending on the shredding and compression applied by the compacting machine. C&D landfill sites, depending on type of inbound material, sometimes see a wide range of densities from 593–1187 kg/m³ (1000–2000 lb/yd³) (depending on compacting machine). Cover material will raise fill densities 119–296 kg/m³ (200–500 lb/yd³) from the numbers above. When asked about the density of their landfill, most managers will give you the 'in-place with cover' estimates of density — Please see weights of refuse below:

Weight of Refuse

	kg/m³	lb/yd³
Loose Refuse:	148-237	**250-400**
Packer Truck:	237-474	**400-800**
Fill Density:	355-949	**600-1600**
Refuse and Cover:	474-1186	**800-2000**

The Current U.S. Picture

EPA began collecting and reporting data on the generation and disposition of waste in the United States more than 35 years ago. The Agency uses this information to measure the success of materials management programs across the country and to characterize the national waste stream. These Facts and Figures are current through calendar year 2018.

The total generation of municipal solid waste (MSW) in 2018 was 292.4 million tons (U.S. short tons, unless specified) or 4.9 pounds per person per day. Of the MSW generated, approximately 69 million tons were recycled and 25 million tons were composted. Together, almost 94 million tons of MSW were recycled and composted, equivalent to a 32.1 percent recycling and composting rate. An additional 17.7 million tons of food were managed by other methods. Other food management includes the following management pathways: animal feed, bio-based materials/biochemical processing, co-digestion/anaerobic digestion, donation, land application and sewer/wastewater treatment. For more information on food management, see Food: Material-Specific Data. In addition, nearly 35 million tons of MSW (11.8 percent) were combusted with energy recovery and more than 146 million tons of MSW (50 percent) were landfilled.

More Information

Check out the Facts and Figures methodology.

See our Sustainable Materials Management web area for relevant information and our State Measurement Program page for state-specific information.

EPA refers to trash, or MSW, as various items consumers throw away after they are used. These items include bottles and corrugated boxes, food, grass clippings, sofas, computers, tires and refrigerators. However, MSW does not include everything that may be landfilled at the local level, such as construction and demolition (C&D) debris, municipal wastewater sludge, and other non-hazardous industrial wastes. While the analysis in Facts and Figures focuses primarily on MSW, EPA has been including estimates of C&D generation and management as a separate non-hazardous waste stream in recent years.

Recycling

The total MSW recycled was more than 69 million tons, with paper and paperboard accounting for approximately 67 percent of that amount. Metals comprised about 13 percent, while glass, plastic and wood made up between 4 and 5 percent.

Measured by tonnage, the most-recycled products and materials in 2018 were corrugated boxes (32.1 million tons), mixed nondurable paper products (8.8 million tons), newspapers/mechanical papers (3.3 million tons), lead-acid batteries (2.9 million tons), major appliances (3.1 million tons), wood packaging (3.1 million tons), glass containers (3 million tons), tires (2.6 million tons), mixed paper containers and packaging (1.8 million tons) and selected consumer electronics (1 million tons). Collectively, these products accounted for 90 percent of total MSW recycling in 2018.

Wet Waste

There are a number of global landfills that deal with a heavier than normal amount of 'wet waste,' or waste with higher than normal moisture content. In previous discussions, 'type of waste' will determine how the waste is handled or worked. With higher than normal moisture contents, the idea of 'multiple' passes (3–5) will be changed. For example, the waste will already be heavier/denser than normal (ex: 1186 kg/m^3 or 2000 lb/yd^3) this type of waste might only require a track-type tractor or track loader to spread it. During the spread cycle, the shredding/tearing action of the track cleats provides an additional density. Or, the compactor could be equipped with a 'wider' flotation wheel (optional wheel from Caterpillar) that provides better flotation along with shredding and compression that will add to the density of the waste. Whichever system is used, less passes on the waste are needed to reduce the waste and add to density. (Too many passes could lead to the waste breaking down and causing traction/flotation problems on the landfill.)

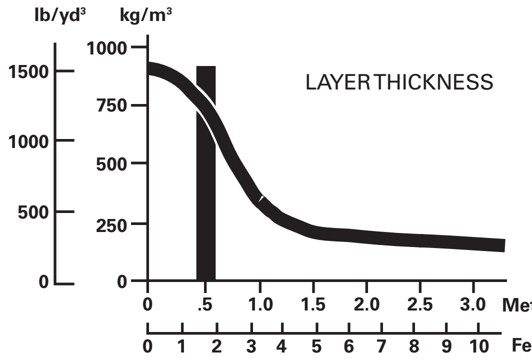
FACTORS GOVERNING COMPACTION

There are four factors that will determine best compaction density (layer thickness, patterns/passes, slope, and moisture content). The three areas that can be affected most by proper machine applications are:

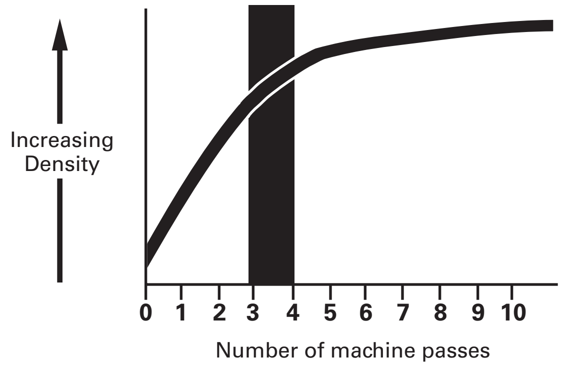
1. Refuse Layer Thickness — The single most important factor in gaining maximum density is the depth of the layer being spread to compact. Depending on the amount of tips/wheel, type of tips, type of waste, and weight of the machine, optimum layer depth will vary. Through field testing and computer analysis, optimum layer depths for highest density have been analyzed. Below are guidelines of optimum layer depth for each compactor.
   a. 816 — 0.3–0.4 m (12–15 in)
   b. 826 — 0.45–0.5 m (18–20 in)
   c. 836 — 0.5–0.6 m (20 24 in)

   Layers may be placed thicker however; density will be reduced no matter how many passes the compactor performs.

   Below is a Layer Thickness chart based on MSW and 4 passes by an 836.



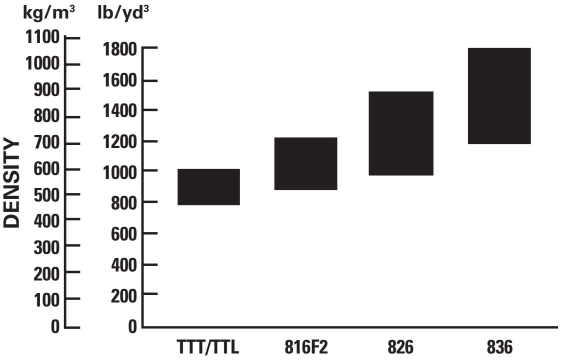
2. Developing a Pattern and Running Proper Passes — Maximum compaction density is obtained by putting the waste down in proper layer height, running a proper pattern and going over the waste with the proper number of passes. Those operators who develop a pattern, (starting from one side of the working face and running passes over entire area that waste has been layered in a logical sequence) and run proper amount of passes, normally obtain high density. In the past, it was said "that 3–5 passes is maximum to achieve highest density. Any more passes does not justify the added fuel and maintenance for the incremental gain in density." Again, through testing and computer modeling, it has been noted that running an extra 1–2 passes diagonally (45 degrees) over the waste after the first 4 passes, can achieve higher density through 'shredding and knitting' the waste together (less cover soil/ADC could also be used due to the blending of the waste). In many countries, the 'diversion' of compost and biodegradable materials leaves some waste streams very dry. Drier waste streams demand more passes than normal, (sometimes 5–8 passes,) so that the material can be shredded or broken down properly for best compaction density.



3. Slope — Maximum density is achieved by shredding and compression of material. Track-Type Tractors and Track Loaders achieve highest density on a 3:1 or less slope. The dynamics of track and gravity working together help shred material into smaller pieces. Although Landfill Compactors can work on steeper than 4:1 slopes, their best density is realized at 4:1 or less. The flatter the slope the better the density. The weight of the compactor is more efficiently utilized and concentrated on flatter slopes. Slight slopes sometimes add higher density due to the shearing stress that aids in shredding and blending of materials. Depending on degree of slope and whether working with another machine, (track-type tractor, dozer, or compactor) fuel use can sometimes be better uphill or downhill. Of course production is always better downhill. Again, depending on type of material and slope, tip selection for the compactor should be taken into consideration.

COMPACTION COMPARISON ESTIMATE

The following graph may be used as a rule of thumb for the compaction ranges of landfill machines assuming the proper operating technique is employed. (The mid ranges of each graph is assuming average waste stream and average operator.)



With correct operating procedures, tip/track/tool selection, and finally machine selection, density can be increased. An example of how increased density can increase landfill life is depicted in the next charts.

EXAMPLE OF INCREASED COMPACTION ON POTENTIAL LANDFILL LIFE

Landfill refuse capacity	1 530 000 m³ **(2,000,000 yd³)**	
Operating days	260	
Daily volume	365 metric tons **(400 tons)**	
Yearly volume	94 328 metric tons **(104,000 tons)**	
Compaction	**Landfill Life**	**Gain**
590 kg/m³ **1000 lb/yd³**	9.6 years	0
710 kg/m³ **1200 lb/yd³**	11.5 years	1.9 years
830 kg/m³ **1400 lb/yd³**	13.4 years	3.8 years
950 kg/m³ **1600 lb/yd³**	15.3 years	5.7 years
1070 kg/m³ **1800 lb/yd³**	17.2 years	7.6 years

COMPACTOR PRODUCTION GUIDELINES

Model	Metric Tons/hr	U.S. Tons/hr
836K	140	**135**
826K	120	**115**
816F2	65	**65**

Parameters for the above: MSW, 4 passes, 18–30 m **(60–100 ft)** push distance, 4:1–5:1 slope, good operator.

All models are making 3 to 4 passes.

A pass is defined as: A machine traveling over the refuse one time in one direction on flat ground.

Adverse (uphill) or favorable (downhill) grades, deep layered waste, hard to handle waste, etc., will affect the above production figures.

(For tons/day — multiply by the amount of hours the machine will work in a days time.)

A. Weather Conditions — Inclement weather affects production and density. Equipping machines with the proper track shoe or wheels and tips for the typical climate it works in will increase production and density while decreasing costs.
B. Supplemental Tasks — There are a wide variety of tasks to be performed daily on a landfill. Understanding the ‘supplemental’ tasks that a machine might be asked to perform daily is paramount to adding the work tool(s) and right sizing the machine. For example, will the machine be required to perform site clearing, asked to build or maintain access roads, excavate cover soil, etc.? Logical choices of machines could change according to type of tasks and versatility required.
C. Budget — Smaller landfill operations with limited budgets may have to consider single machine versatility ahead of specialized machines or multiple units.
D. Growth — Population growth or added contracts can both increase and change inbound refuse. Future increases/decreases in refuse, type of material, density of material, etc., must be considered to properly pick tools and size machines.

LANDFILL ESTIMATING

Example Problem #1

A professional engineer has developed a small, rural landfill master plan. The local legislative regulatory agency has approved the plan and site.

Assume:

Waste generation: 2.04 kg/day (4.5 lb/day) per person
Waste collection: 6 days/week
Topography: flat
Land availability:
area has several suitable sites at nominal price
Population served: 30,000
Projected population in 3 years: 40,000
Current daily refuse volume: ?
Type of refuse: mostly household, some commercial
Operation: propose 8 hours/day, 5½ days/week
Present equipment: none — new site

What would your comments and recommendations be on the following:?

a. Probable amount of refuse generated daily?
b. Type of machine for the proposed Landfill?
c. Size of machine for the proposed Landfill?

Solution

a. The current incoming waste stream can be determined to be 2.04 kg/day (4.5 lb/day) per person × 30,000 people = 61.2 metric tons (67.5 tons) daily. You must now multiply that daily generation rate by 7 for the total weekly generation, and divide by the number of days that the waste is collected (6). Therefore, your waste collection per day will be (61.2 tons/day × 7 days)/6 days of collection = 71.4 metric tons (78.7 tons) collected daily.

   The same equation can be used to determine the three year projected waste stream of 40,000 residents to be 81.6 metric tons (90 tons) generated daily, 95.2 metric tons (105 tons) collected each day.

b. Track loader — excavating ability, single machine application based on tonnage requirements.
c. 953C handle current refuse, and has extra capacity for future growth. Small compactor if additional compaction is required.

Example Problem #2

Existing landfill has been in operation for several years.

Assume:

Type of operation: area fill
Cover material: suitable material within 90 m (300 ft)
Current daily refuse volume: 500 metric tons (550 tons)
Anticipated daily refuse volume in 3 years:
680 metric tons (750 tons)
Type of refuse: household, commercial, large amount of brush and building demolition debris
Land availability: limited, very expensive
Available Refuse Volume: 3 249 125 m^3 (4,250,000 yd^3)
Operation: 8 hours/days, 5½ days/week
Present equipment: D8 (3 years old)

What would your comments and recommendations be on the following:

a. What range of in-place densities could be expected using a track-type tractor; a Cat steel wheeled landfill compactor?
b. What effect does machine selection have on site life?
c. What are the advantages and limitations of steel wheeled landfill compactors?
d. What are the advantages and limitations of track-type units?
e. How many machines should be used on the site?
f. What type should they be?
g. What size should they be?

Solution

a. The Track-Type Tractor will achieve 475 to 595 kg/m^3 (800 to 1000 lb/yd^3) in-place density. The Cat steel wheeled landfill compactor will achieve 595 to 830 kg/m^3 (1000 to 1400 lb/yd^3) in-place density.

b. There are 3 249 125 m^3 (4,250,000 yd^3) available. 500 metric tons (550 tons) per day is how many m^3 (yd^3)? Assume a minimum density of 475 kg/m^3 (800 lb/yd^3).

$$\text{500 metric tons/day} \times \frac{\text{1000 kg/metric ton}}{\text{475 kg/m}^3} = \text{1052 m}^3\text{/day}$$

$$\text{550 tons/day} \times \frac{\text{2000 lb/ton}}{\text{800 lb/yd}^3} = \text{1375 yd}^3\text{/day}$$

5.5 days/week × 52 weeks/year = 286 days/year

Yearly volume: 1052 × 286 = 300 872 m^3
1375 × 286 = 393,250 yd^3

Landfill life at this density:

$$\frac{\text{3 250 000 m}^3}{\text{300 872 m}^3\text{/year}} = \frac{\text{4,250,000 yd}^3}{\text{393,250 yd}^3\text{/year}} = \text{10.8 years}$$

Similar calculations are performed to generate the following tables.

500 METRIC TONS/DAY (550 TONS/DAY)

Density kg/m³	Density lb/yd³	Landfill Life (years)
475	**800**	10.8
595	**1000**	13.5
715	**1200**	16.2
835	**1400**	18.9
950	**1600**	21.6

680 METRIC TONS/DAY (750 TONS/DAY)

Density kg/m³	Density lb/yd³	Landfill Life (years)
475	**800**	7.9
595	**1000**	9.9
715	**1200**	11.9
835	**1400**	13.9
950	**1600**	15.9

From the tables we determine that a track-type tractor, at 500 metric tons per day (550 tons/day), will provide 13.5 landfill life years at 595 kg/m^3 (1000 lb/yd^3). Compaction will extend that life 5.4 years to 18.9 years at 835 kg/m^3 (1400 lb/yd^3).

Proper compaction techniques are necessary to achieve the higher refuse densities and increase landfill life.

c. Advantages: Provides highest compaction densities extending landfill life.
Limitations: Specialty unit designed to spread and compact — does not excavate virgin material economically, but can handle stockpile cover material.

d. Advantages: most versatile unit, well suited to site preparation, finishing and access road construction and maintenance; all weather machines with excellent tractive ability.
Limitation: compaction — cannot achieve the in-place refuse densities of the specialized landfill compactors.

e. Minimum of two. Additional equipment would depend on supplemental tasks.

f. Track-type tractor — for earthmoving and refuse spreading work; steel wheeled compactor-quantity of refuse and land cost would justify.

g. D8 — keeping existing unit; D9 — when new tractor is necessary; 826H — with large amount of demolition debris and brush and projected increase in tonnage would justify 826H over 816F2.

NOTE: Ballasting the wheels on Cat Landfill Compactors to increase machine weight and achieve higher compaction densities is not recommended. Landfills are high rimpull applications. Ballasting the wheels will significantly increase machine weight but decrease overall performance when traveling on the fill. The additional weight of ballasted wheels will also result in reduced final drive life.

GREEN WASTE/COMPOSTING

Green waste and compostable material are being eliminated from most landfills. Composting is normally regulated at the state level in the U.S., and on higher governmental levels within the EU. Green and compostable waste is realized as: soil amendments, bio fuels, and incinerated energy sources. With more and more green waste and compostable material being diverted from the waste stream, tools and machines that can handle this type of waste are needed. Most commonly used are wheel loaders and excavators (wheeled/tracked) of all sizes. Most are equipped with coupler for versatility of different tools. Work tools utilized range from grapple buckets, multi-purpose buckets, and light material buckets for wheel loaders, to waste grapples, orange peel grapples, and sorting grabs for excavators. It is normal, in some areas, for regulations to request added cab filtration and protection from composting airborne debris.

WASTE RELATED ENERGY PRODUCTION

There are a variety of ways to produce energy from waste. C&D landfills, green waste, biodigesters, and composting facilities, will process wood, organics and other products for: gasification, bio fuels, possible incineration, and energy from newer technologies.

LANDFILLS — RENEWABLE POWER WITH LANDFILL GAS

Landfill gas, composed mostly of methane and carbon dioxide, is produced naturally as organic waste decomposes in landfills. Driven by mandate of carbon reduction goals, modern sanitary landfills capture this gas for use as a renewable fuel in specially configured Cat landfill gas generator sets. These systems deliver reliable and environmentally sound electricity to the local community from 400 kW to 2 mW power nodes.

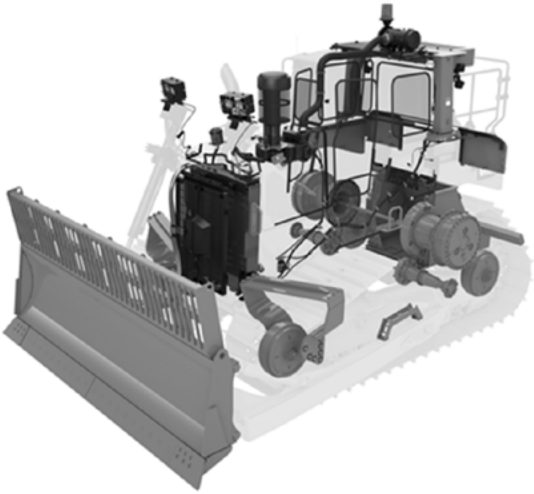
Please contact your local dealership, Waste representative, or *Cat.com* for more information.

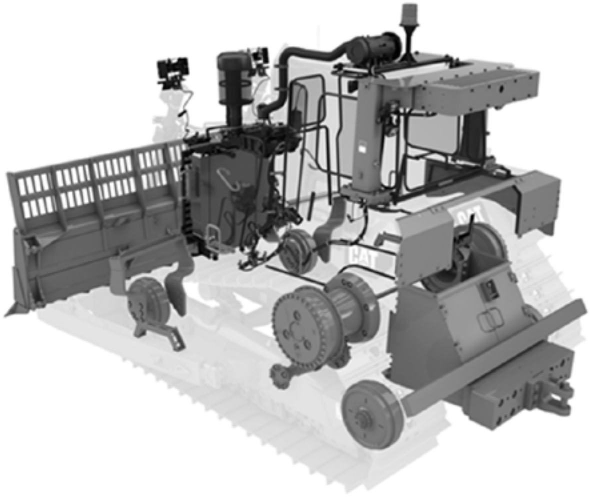
Cat Waste Handling Track-Type Tractor modifications are purpose built and installed at the original manufacturing facility prior to shipment.

Features:

- **Landfill blade** increases capacity
- **Front and rear striker bars** help protect machine from debris impact
- **Clamshell guards** on final drives and idler/final drive seals help prevent wire wrap and keep debris from wrapping around Duo-Cone™ seals.
- **Bottom guard, chassis and tilt cylinder guards,** and guarding over the fuel tank and battery box
- **Center-hole track shoes** help eject debris from the tracks.
- **Specialized air handling features** help deliver cleaner air to the machine and cab
- **Lights mounted up and away** from main debris area for protection, while providing plenty of light on the work area
- **Cooling system** designed for high debris environments and easy access for cleanout
- **Powered cab precleaner** is on back of cab to help increase cab pressurization and keep debris and odor out.
- **Debris sealing** in the machine improved
- **Waste cab** with dual pane windows, polycarb doors resistant to impact
- **Better door sealing** for improved cab pressurization
- **Integrated beacon lights**
- **Striker bar box** for Waste, no counterweight needed

WASTE GUARDING – PROTECT YOUR INVESTMENT





953, 963, 973 Waste Handlers

- **Waste Handler** is a versatile machine for loading, sorting, excavation and spreading cover, well suited to the landfill or transfer station.
- **Specialized guarding, striker bars and seals** help protect the machine and components from impact and airborne debris.
- **Final Drive guarding** helps prevent wrapping and damage.
- **Screen** helps protect windshield and operator from breakage and debris.
- **High debris cooling system** – radiator fan folds out for easy cleanout access.
- **Specialized air handling features** help deliver cleaner air to the machine and to the cab.
- **Choice of buckets and track shoes** allow you to further optimize the machine for greater performance and service life.
- **Enhanced Cleaning Package** reduces cleaning time, adds machine protection and increases compaction.
- **Track loader power, traction and agility** mean you can use one machine and one operator to do everything from clearing the site to installing utilities and finishing around buildings.
- **Fusion™ Quick Coupler** option lets you make fast attachment changes with a wide range of tools like forks, buckets, etc. from wheel loaders and other Fusion compatible machines.
- **Bucket/tooth, undercarriage, track shoe and attachment choices** help you equip your machine for optimal performance in your applications.
- **Purpose-built Waste Handler and Low Ground Pressure (LGP)** configurations stand up to the toughest tasks.

Features:

- **Caterpillar designed and manufactured power train** … for optimum match, performance and efficiency. Responsive Cat diesel engine. Single-lever planetary power shift. All-wheel drive.
- **Center-point articulation** … excellent maneuverability. Front and rear drums track, so material is chopped and compacted twice each pass.
- **Protective guarding** … helps keep trash from damaging machine components.
- **Cat landfill blades** spread refuse and cover material … built strong to handle the wide range of refuse encountered in landfills.
- **Operator comfort and convenience** … sound suppressed cab with pressurized and filtered air circulation system. Adjustable suspension seat. Electronic Monitoring System and gauge package is standard.
- **Striker bars** … standard on all Cat Landfill Compactors, prevents refuse from being carried over the rear wheels.
- **Caterpillar designed wheels** … We test and build a Cat system. Engineers who work together with our power train, structures and manufacturing engineers design and manufacture our wheels in the same facility in which the machines are designed and built. This ensures the entire system is complemented by each component. If you alter components, you could compromise a system that was designed and tested for peak performance. If a wheel is produced that does not meet our design specifications and does not balance the load over our final drives, it could reduce the life of the bearing substantially and wear out other components creating unnecessary downtime. This also allows our standard axle guard system to work with the components for which it was designed.
- **Wheel and tip configurations** … Three new wheel and tip configurations are available to meet your particular application:

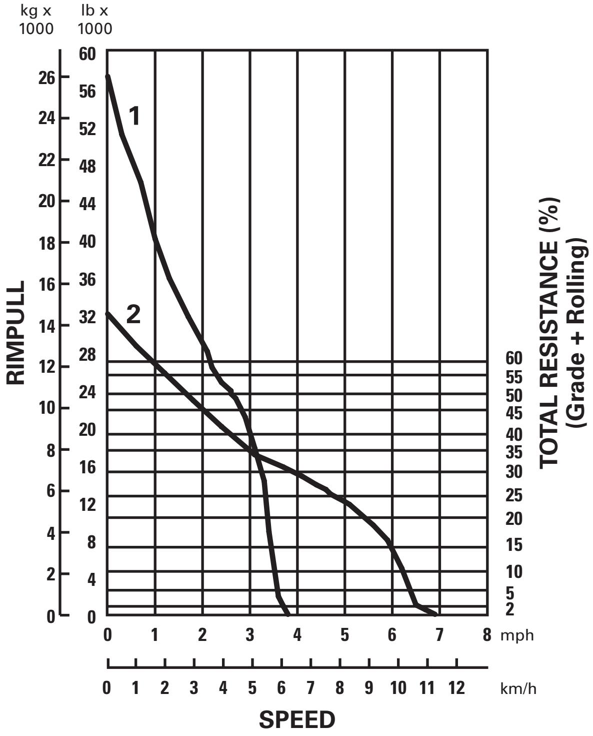
  1) **Paddle tip** — High performance and less fuel burn with more traction and less weight.

  2) **Plus tip** — Traditional design for increased side slope stability and more mass for longer life.

  3) **Combination tip** — Both paddle and plus tips to give high performance with side slope stability.

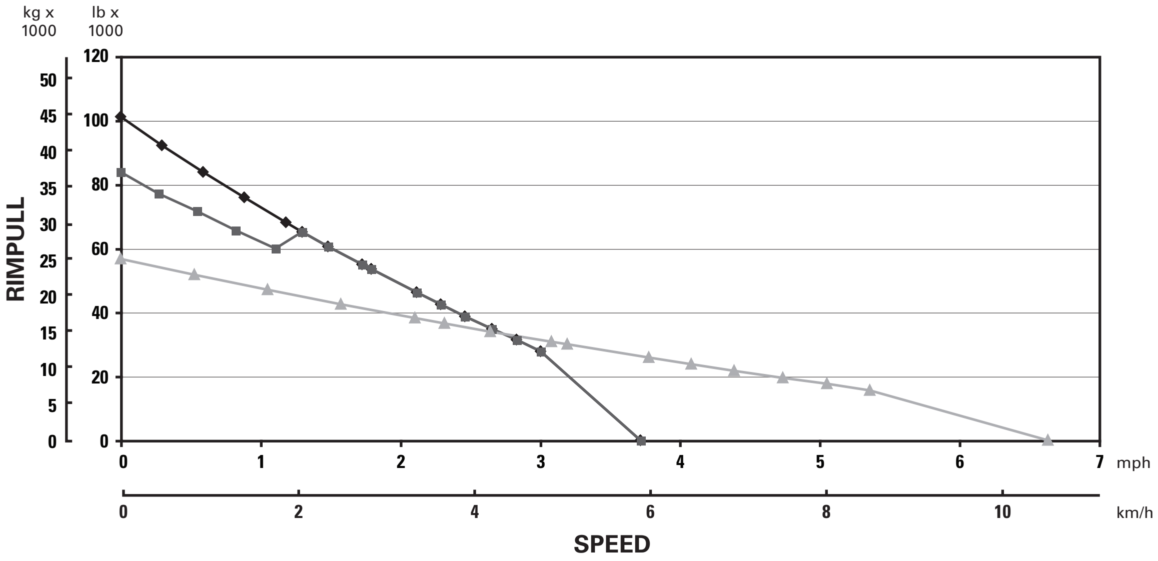
  4) **Diamond tips** — Diamond tips are high performance and rated up to 15,000 hrs. These tips are the heaviest of all tips but designed to last longer.

816F2

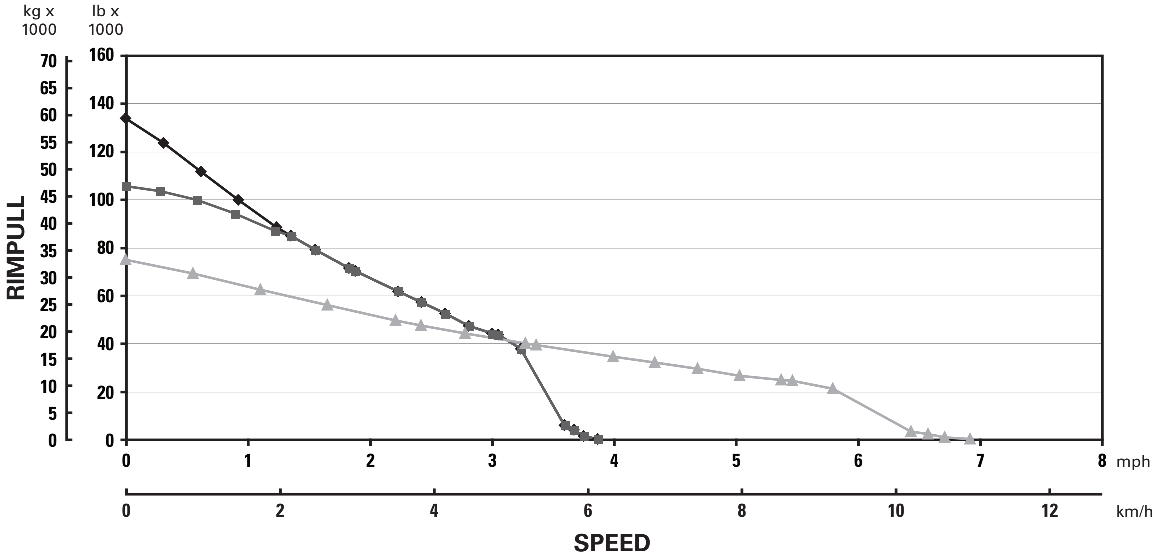


KEY
1 — 1st Gear
2 — 2nd Gear

826K



836K



KEY
- 1F CD
- 1F CD with PTS
- 2F CD

Features:

The section below is 950 – 980 MWL:

- **Tilt cylinder guard** – Heavy duty sliding guard mounts to the cylinder and protects the tilt cylinder rod from damage due to contact/impact from falling debris or material spillage over the work tool. If the rod(s) are pitted, scratched, the cylinder seals may be worn prematurely.
- **Axle seal guard** – Axle seal guard bolts to the axle shafts and protect each axle seal by preventing material, springs, wire, from cutting and damaging seals as material winds around when the tires rotate.
- **Front frame guard** – Guard bolts to the front frame to protect the caliper parking brake and prevent material accumulation front frame, protecting the front drive shaft.
- **Hinged powertrain guard** – Powertrain guard bolts underneath the rear frame to protect the transmission from contact with debris and prevents material ingress around the transmission. The guard is hinged to make servicing easier. An electric actuator available to provide easy removal of accumulated debris.
- **Hitch guard** – Hitch guard bolts to the butterfly plate to prevent debris from packing around the transmission and hydraulic pumps , while providing visibility to the transmission oil sight glass..
- **Steering cylinder guards** – Steering cylinder guards bolt to the frame just forward of the tires to protects the steering cylinders, sensors and pins from damage from debris from the rear tires.
- **Light guards (roading, work, rear)** – Light guards protect the front roading lights, cab work lights (standard halogen and premium lights) and rear stop/tail lights from damage by debris.
- **Steel rear deflectors** – The standard non-metallic rear deflectors are replaced with steel versions for use in extreme applications.
- **Narrow steel front fenders** – The narrow steel front fenders replace standard full-coverage fenders to provide more clearance to walls when the machine is operating in a confined place.
- **Reinforced service centers and platforms** – The electrical and hydraulic service centers are reinforced with additional bolted wear plates to resist damage to key components in the service centers. The service platforms are reinforced with welded-on plates to support additional weight for 3rd party suppression systems.
- **Heavy-Duty ladder and cable steps** – The heavy duty ladder replaces the standard ladder to provide additional resistance to damage when the machine is operated in a confined space. Steel cables replace the standard rubber strap and mates with the heavy duty steps to withstand the extreme nature of the application.
- **Turbine trash precleaner** – Cyclone engine air cleaner that uses centrifugal force to spin debris out of the air stream, extending the service interval for the air filter elements. A metallic screen prevents larger debris from clogging the filter.
- **Carbon fresh air filter** – Activated charcoal filter replaces the standard cab recirculation filter to reduce the odor causing debris particles in the operator environment.
- **Lift cylinder baffles** – Lift cylinder baffles prevent the accumulation of debris and compaction under the lift cylinders, protecting the cylinder from damage.

The section below is SWL features:

- **Windshield guard** – Windshield guard protects the cab glass from damage while working in tough waste applications. Guard can swing open for easy access to cleaning.
- **Tilt cylinder guards** – Heavy duty sliding tilt cylinder guards provide protection against airborne debris and potential bucket spill material from damaging the tilt cylinders.
- **Light guards** – Guards are provided to shield the front, rear and roading lights from debris damage while working in waste handling applications. Rear lights are not an option when rear waste gate is selected.
- **Narrow steel front fenders** – Standard full-coverage front fenders are replaced with a heavy duty narrow steel fender design. These robust fenders are designed specifically to live in a waste handling application.

- **Driveshaft guard** – Protecting the underside of the front half of the machine, these guards prevent debris build up and damage to major components such as the drive shaft.
- **Hitch guard** – Provides protection to hitch area of the rear frame, preventing debris from entering the frame while allowing visibility to gear box site gauge.

SMALL WHEEL LOADER GUARDING AND OPTIONAL EQUIPMENT 926-938 MACHINE MODELS

- **Steering cylinder guard** – Provides protection to both steering cylinders, preventing damage to rods and cylinder seals.
- **Power train side guard** – Mounts on side of machine to provide protection for the transmission components.
- **Power train lower guard** – Protecting the underside of the rear half of the machine, belly guards prevent debris build-up and damage to major components such as the engine and transmission. Side power train guard is an option as well.
- **Crankcase guard** – Mounts underneath machine to provide protection to the engine components.
- **Rear waste guard gate** – Heavy Duty radiator guard provides additional rear machine protection in this tough application. The guard is hinged for easy access to the airborne debris screen and cooling cores.
- **Reversing fan** – The reversing fan, with three settings, auto/off/manual along with a single plain, wide spaced and 100% sealed cooling package, will help clear out any debris that makes its way into the area. In the auto mode, the timing for the reversing fan can be customized to fit the application needs.
- **Sealed alternator** – A filtered, brushless alternator is ideal for dusty or corrosive environments/applications.
- **Turbine engine precleaner** – Turbine precleaner extends filter life and helps to provide clean air to the engine in high debris applications.
- **RESPA cab filtration** – RESPA cab filtration system is a powered cab precleaning system which supplies clean air to the cab in high debris application.

Recommended Waste Handling Options

- **Powered crankcase and power train guards** raise and lower at the flip of a switch allowing fast, easy and frequent cleanings.
- **High lift arrangement** increases bucket hinge pin height offering increased stacking and stockpiling capability. A critical feature when incoming volumes exceed conveyor capacity or floor space.
- **Traction control system (TCS)** option for 938H/IT38H provides maximum traction in slippery conditions. TCS electronically senses and limits wheel slip at each wheel independently.
- **Limited-slip differential** limits tire slip on both front and rear axles. Increases traction and reduces tire wear and scuffing in wet or dry conditions. Provides an alternative to the No SPIN differential which is not recommended due to increased tire wear, turning interference and poor tracking on dry surfaces.
- **Tire options:**
  L-5 bias hard rock lug
  L-5 slick
  RL-5K Goodyear radials
  XMINE Michelin radials (varies by model)
  Foam-filled
- **Hitch guards** help protect components in hitch area from damage.
- **Reversing radiator fan** is hydraulically driven and can be reversed by a switch in the operator station or automatically by timer. Reduces need for cooling system cleaning and improves cooling capability.
- **Other guarding and options** are available. Contact your Cat dealer for information.

Work Tools

- **Refuse bucket** has excellent dozing and stockpiling capability. Large spill plate helps protect the machine from debris falling over the top of the bucket. Available in pin-on or quick coupler configurations.
- **Pallet forks** are ideal for handling refuse destined for further recycling or stacking refuse in landfills for covering.
- **Multi-purpose bucket** has the capability to clamp and sort large objects, doze cover material or other light dozing chores.
- **Quick coupler** increases versatility by allowing a single machine to utilize a wide variety of work tools in a host of applications.

WORK TOOLS

As described in the opening statements of this section, the waste stream can consist of many different types of materials sometimes all blended together. For that reason, work tools become a very important part of moving, sorting, and dozing in waste applications. (Continue to consider the thought process of; "what is the application and material(s) you will work with — then, what tool(s) will accomplish your objectives, and finally, what machine(s) will utilize that tool to perform in that application?")

Wheel Loader Work Tools

MODEL	924K, 926M	930K, 930M	938K, 938M	950M, 962M, 950L, 962L, 950K, 962K, 950H, 962H	966M, 972M, 966L, 972L, 966K, 972K, 966H, 972H	980M, 980L, 980K, 980H
Bucket — Load & Carry	×	×	×	×	×	×
Bucket — Dozing	×	×	×	×	×	×
Bucket — Multi-Purpose	×	×	×	×	×	
Bucket — Waste Handling*	×	×	×	×	×	×

*The "Waste Handling" bucket is a current bucket that is being phased out and replaced by the Load & Carry and Dozing buckets. All are in the current price lists.

NOTE: Other attachments available upon request. Contact your Cat dealer.

NOTE: Learn more about available work tools @ Work Tool Central: *https://dealer.cat.com/products/wtc.*

Excavator Work Tools

MODEL	308E CR	315D L, 316E L	318E	319D L, 319D LN	M313D, M315D	M316D, M318D, M322D	M318D MH, M322D MH	320E L, 320E LRR, 321D CR, 323D	320C MH	M322D MH	324D, 324E
Grapple — Contractors'	×	×	×	×	×	×		×			×
Grapple — Demolition and Sorting		×	×	×	×	×		×			×
Grapple — Orange Peel							×		×	×	
Grapple — Trash		×	×	×	×	×		×			×

NOTE: Normal Waste Applications utilize the Trash, Sorting, and Orange Peel Grapples. Depending on the application, these work tools might be advisable.

NOTE: Learn more about available work tools in the *Hydromechanical Work Tools* chapter of the *Performance Handbook.*

NOTE: Learn more about available work tools @ Work Tool Central: *https://dealer.cat.com/products/wtc.*

(Chart continued on next page)

Excavator Work Tools (cont'd) **MODEL**	M325D MH, 320C MH	329D, 329E	336D, 336E	MH3049	345D, 349D, 349E	345C MH	MH3059	365C L	374D	385C	390D
Grapple — Contractors'		×	×		×			×	×	×	×
Grapple — Demolition and Sorting		×	×		×						
Grapple — Orange Peel	×			×		×	×				
Grapple — Trash		×	×		×						

NOTE: Normal Waste Applications utilize the Trash, Sorting, and Orange Peel Grapples. Depending on the application, these work tools might be advisable.

NOTE: Learn more about available work tools in the *Hydromechanical Work Tools* chapter of the *Performance Handbook*.

NOTE: Learn more about available work tools @ Work Tool Central: *https://dealer.cat.com/products/wtc*.

There are a variety of work tools for small–medium wheel loaders that have couplers. It is important to check the tasks that the wheel loader will perform and equip as needed. The 924–980 wheel loaders have three waste specific designed 'pin on' buckets to choose from.

- Load & Carry Bucket — An overall use bucket that is open and deep throated to gather and retain large loads. This bucket provides the ability to push, stockpile, load, and tamp no matter what type of loading is required.
- Doze Bucket — The height of this bucket provides more of a push platform to move heavy loads on the floor into waiting haul vehicles. Its main strengths are for pushing, stockpiling, and loading below grade vehicles.
- Tamp and Clamp Bucket — Designed with a longer snout and "optional" top clamps, this bucket is best for sorting, loading, and tamping haul vehicles with hard to handle materials. It has slightly less capacity than the load & carry and push buckets.

There are a variety of waste work tools for excavators and wheeled excavators. For Tracked and Wheeled Excavators you need to ask its primary use. Loading and Tamping, Sorting, Combination, Other Support?

- Trash Grapple — Designed to load and tamp large loads of material into haul vehicles. They can perform some material separation, but its main strength would be to load and tamp.
- Sorting Grapple — This grapple is designed to sort, separate, and load material. Equipped with a rotator, its main strength lies in the ability to separate material quickly, swing/rotate, and load haul vehicles, conveyors, and hoppers efficiently.
- Orange Peel Grapple — Also designed to sort, separate, and load material, its main strength is in a slightly larger load capability than the sorting grab. It also has the capability to rotate.
- Contractor's Grapple — Designed like the Waste Grapple, it is slightly smaller with a two over three tine configuration instead of four over five. It is heavier in construction and designed for materials heavier than MSW.

There is a wide variety of work tools for Excavators (wheeled and tracked) that can be used in waste applications; the above are "waste handling" tools designed for the application.

Support Work Tools

Brooms, pallet forks, bale clamps, blades, lifting arms, are just a few of the 'coupler attached' work tools that are used within the waste industry. A thorough assessment of primary and support roles of machine needs to be performed.

As stated in the chart, please contact your Dealer/Waste Representative or *Cat.com* websites for more information.

WHEEL DOZERS
SOIL COMPACTORS

CONTENTS

WHEEL DOZERS

SOIL COMPACTORS

WHEEL DOZERS

Features:

- **Reliable Cat® power train:** four-stroke-cycle diesel with adjustment-free fuel system … full power shift with single lever on-the-go shifting.
- **Articulated frame steering** with hinge point midway between front and rear axles … short turning radius, long wheelbase … rear and front wheels track at all times.
- **Machine balance** … equal weight distribution on axles when blading.
- **All dozer functions,** including tip and tilt, hydraulically controlled from operator's seat.
- **STIC™ (Steering Transmission Integrated Control) Steering** is now offered on all Wheel Dozers.

Throughout this document, references to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim) include U.S. EPA Tier 4 Interim, EU Stage IIIB, and Japan 2011 (Tier 4 Interim) equivalent emission standards. References to Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) include U.S. EPA Tier 4 Final, EU Stage V, and Japan 2014 (Tier 4 Final) emission standards.

Throughout this document, references to Tier 1/Stage I include U.S. EPA Tier 1 and EU Stage I equivalent emission standards. References to Tier 2/Stage II/Japan 2001 (Tier 2) equivalent include U.S. EPA Tier 2, EU Stage II, and Japan 2001 (Tier 2) equivalent emission standards. References to Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent include U.S. EPA Tier 3, EU Stage IIIA, and Japan 2006 (Tier 3) equivalent emission standards.

CONSIDERATIONS IN MACHINE SELECTION

The following factors should be considered when comparing wheels vs. tracks:

Traction

You can figure coefficient of traction, depending on underfoot conditions, from the Table Section in this book.

Wheels — up to 0.65 (in quarry pit with good floor)

Track — up to 0.90 (in soils permitting grouser penetration)

Usable Rimpull = Machine Weight × Coefficient of Traction

Speed

Wheels — travel speeds up to three times higher than track.

Maneuverability

Articulated steering and good visibility give wheel tractors high maneuverability.

Cost

See Owning and Operating Costs section. Tire vs. undercarriage costs can often be the deciding factor in selecting wheels or tracks.

Compaction

Ground Pressure:

Wheels — from 241 kPa (35 psi) to 310 kPa (45 psi)

Tracks — from 82 kPa (12 psi) to 97 kPa (14 psi)

Application

Utility … mobility, maneuverability and good speed suit wheel tractors for yard and stockpile work and for clean-up around shovels. Lower maintenance costs may be realized in certain soils that can be highly abrasive to track-type undercarriages.

Coal pile … recommend wheel tractors in this application when following conditions are present:

— Long push distances
— Need for good material spread
— High degree of compaction desired

Production Dozing … a wheel tractor should be considered in the following conditions:

— Long push distances
— Loose soils, little or no rock
— Level or downhill work
— Good underfoot conditions

Pushloading Scrapers … a wheel tractor should be considered in the following conditions:

— Thin scraper cut
— Good underfoot conditions — no rock
— Higher push speeds

Chip and Coal Scoops … a wheel dozer scoop should be considered in the following conditions:

— Long push distances
— Light, well processed materials such as coal or wood chips
— High degree of compaction desired
— Low to modest grades

COUNTERWEIGHTS AND BALLAST

For each specific application, there is a correct machine weight for proper balancing of traction, flotation, mobility and response.

- Low machine weight may increase tire slipping and wear, but improves flotation, mobility and machine response.
- High machine weight increases traction, but decreases mobility and response.

The machine weight is optimum for the operating conditions when wheel slipping barely occurs in the gear being used. Weight distribution under operating conditions should then be approximately equal between the wheels to balance power to each axle.

Application

Lower machine weight is usually required for applications such as fill spreading, stockpiling, road maintenance, towing compactors, and shovel cleanup. These are generally performed in either first or second gear. However, usage of second gear may involve a tradeoff of increased GET wear on the blade.

Higher machine weight is usually required for applications such as heavy dozing and push-loading, which are generally performed in first gear.

TIRE SELECTION & MAINTENANCE

Requirements of traction, flotation and tire life are met by a choice of tire size, tread design and inflation pressure.

Tire Width
For good conditions with little rolling resistance on surfaces where flotation is no problem, a narrower tire may be most economical. It may also be considered in muddy conditions in which the mud can be penetrated to reach firm earth underneath.

Where flotation problems and increased rolling resistance are encountered, wider tires are recommended. The greater contact area and shallower penetration increases flotation.

Tire Size
Larger optional tires will also improve flotation in soft conditions. With larger diameter, rimpull will be reduced which may be desirable to help control wheel spin.

Rock — Deep Tread (L-4) provides 50% more tread depth, thicker undertread and sidewall with increased tire life when compared to the L-3 tire. Recommended in rock conditions where sharp fragments cause high tire wear or sudden failures.

Rock — Extra Deep Tread (L-5) provides 150% more tread depth when compared to the L-3 tire. Intended for severe rock conditions with extreme penetration hazards.

Inflation Pressure
In average operating conditions the recommended inflation pressure prevents excessive deflection and minimizes tire rollover on side slopes.

Over-inflation
Reduces amount of tread contact with ground and provides less flotation. Over-inflation causes center of tread to wear faster and increases the chance of cuts and impact breaks.

Under-inflation
Can cause permanent tire damage in the form of flex breaks, radial cracks, and tread or ply separation. On jobs where wrinkling and bead rollover *are not* apparent, inflation pressure may be reduced to a minimum of:

Bias Ply	—	170 kPa (25 psi) on 35/65-33
		170 kPa (25 psi) on 29.5-25
		170 kPa (25 psi) on 26.5-25
		170 kPa (25 psi) on 23.5-25
Radial	—	310 kPa (45 psi) on 35/65-R33
		310 kPa (45 psi) on 29.5-R25
		205 kPa (30 psi) on 26.5-R25
		240 kPa (35 psi) on 23.5-R25

Reduced pressure will:
- Increase flotation and traction in sand.
- Improve envelopment characteristics to reduce sudden death failure on rock jobs.
- Provide better tread wear by reducing contact pressure between tire and ground.

Consult your tire manufacturer before changing tire pressures.

SOIL COMPACTORS

CONTENTS

Features:

- **Dozing, filling and compacting versatility.**
- **High speed operation** with responsive Cat diesel engine, single-lever planetary power shift transmission, and all-wheel drive.
- **Articulated frame** makes maneuvering quick and easy. Long wheel base for stability.
- **Wheels with tamping foot design and chevron pattern** give traction, penetration and compaction needed for high production. Foot pattern reversed on trailing drums to prevent overprinting lead drums.
- **Rear drums track front** for double compactive effort. Drum spacing covers mid-axle strip on return pass.
- **Rear axle oscillation** keeps all drums on ground for traction and stability.
- **Cleaner bars** keep drums free of carry over earth regardless of rolling direction. Adjustable, replaceable.
- **Optional fill spreading dozer** has single lever control for raise, lower, hold and float. (Blade tilt optional.)
- The 825K now offers **STIC (Steering Transmission Integrated Control) Steering** as a standard feature.

COMPACTION FUNDAMENTALS

The following discussion applies to soil compaction only.

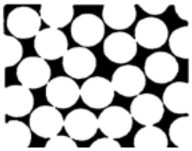
Definition

Compaction is the process of physically densifying or packing the soil … resulting in increased weight per unit volume. It is generally accepted that the strength of a soil can be increased by densification. Three important factors affect compaction.

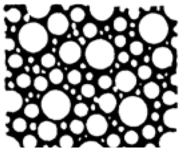
— Material gradation
— Moisture content
— Compactive effort

Material Gradation — refers to the distribution (% by weight) of the different particle sizes within a given soil sample. A sample is *well-graded* if it contains a good, even distribution of particle sizes. A sample composed of predominantly one size particle, is said to be *poorly-graded*. In terms of compaction, a well-graded soil will compact more easily than one that is poorly-graded. In well-graded material the smaller particles tend to fill the empty spaces between the larger particles, leaving fewer voids after compaction.

MATERIAL GRADATION



Poorly-graded



Well-graded

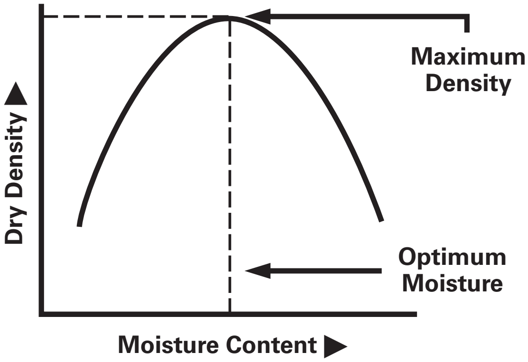
Moisture Content — or the amount of water present in a soil, is very important to compaction. Water lubricates soil particles thus helping them slide into the most dense position. Water also creates clay particle bonding, giving cohesive materials their sticky qualities.

OPTIMUM MOISTURE

Heavy clay	17.5%
Silty clay	15.0%
Sandy clay	13.0%
Sand	10.0%
Gravel, sand, clay mix (pit run)	7.0%

Experience has shown that it is very difficult, if not impossible, to achieve proper compaction in materials that are too dry or too wet. Soil experts have determined that in practically every soil there is an amount of water, called optimum moisture content, at which it is possible to obtain maximum density with a given amount of compactive effort. The curve below shows this relationship between dry density and moisture content. It is called a compaction curve, moisture-density curve or Proctor curve.

MOISTURE CONTENT



Compactive Effort — refers to the method employed by a compactor to impart energy into the soil to achieve compaction. Compactors are designed to use one or a combination of the following types of compactive effort.

— Static weight (or pressure)
— Kneading action (or manipulation)
— Impact (or sharp blow)
— Vibration (or shaking)

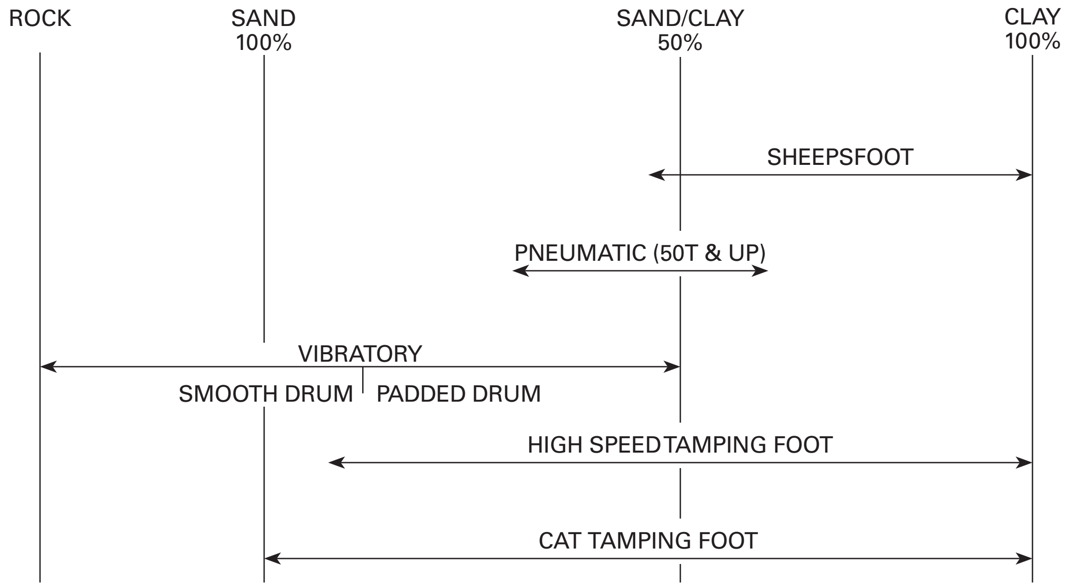
COMPACTOR TYPES

Compaction equipment can be grouped generally into the following classifications:
sheepsfoot
vibratory
pneumatic
high speed tamping foot
chopper wheels (see Landfill Compactor section)

Combinations of these types are also available, such as a vibrating smooth steel drum.

For ease of comparison, the compactors have been placed on the Zones of Application Chart shown below. This chart contains a range of material moistures from 100% clay to 100% sand, plus a rock zone. Each type has been positioned in what is considered to be its most effective and economical zone of application. However, it is not uncommon to find them working out of their zones. Exact positioning of the zones can vary with differing material conditions.

**RANGES OF SOIL TYPES FOR
SOIL COMPACTION EQUIPMENT**



COMPACTOR PRODUCTION

Compactor production is expressed in compacted cubic meters (Cm^3) or compacted cubic yards (CCY) per hour. Material in its natural or bank state is measured in bank cubic meters or yards (Bm^3 or BCY). When it is removed or placed in a fill, it is measured in loose cubic meters or yards (Lm^3 or LCY).

When the loose material is worked into a compacted state, the relationship of *compacted material to bank material* is shown as the shrinkage factor (SF).

$$SF = \frac{\text{Compacted cubic meters } (Cm^3)}{\text{Bank cubic meters } (Bm^3)}$$

$$SF = \frac{\text{Compacted cubic yards (CCY)}}{\text{Bank cubic yards (BCY)}}$$

The construction industry has developed the following formula for use in estimating compactor production. This formula gives the material volume a given machine can compact in a 60-minute hour.

Metric Method

$$Cm^3 = \frac{W \times S \times L}{P}$$

W = Compacted width per pass, in meters. (For Cat Compactors it is recommended that W = Twice the width of one wheel.)

S = Average speed, in kilometers per hour.

L = Compacted thickness of lift, in millimeters.

P = Number of machine passes to achieve compaction **(can only be determined by testing the compacted material density on-the-job).**

English Method

$$CCY/hr = \frac{W \times S \times L \times 16.3}{P}$$

W = Compacted width per pass, in feet. (For Cat Compactors it is recommended that W = Twice the width of one wheel.)

S = Average speed, in miles per hour.

L = Compacted thickness of lift, in inches.

16.3 = Conversion constant, equals 5280 feet ÷ 12 inches ÷ 27 cubic feet

P = Number of machine passes to achieve compaction **(can only be determined by testing the compacted material density on-the-job).**

Example problem (Metric)

Determine production for an 815F2 operating under the following conditions:

P = 5, S = 10 km/h, L = 100 mm

Refer to 815K in the production table on the next page. Read down the first column until reaching section for 5 passes. Within this section in the second column, find the speed closest to 10 km/h. Read across this line to the 100 mm compacted lift. Read the production figure given.

Answer: 377 Cm^3/h. (Since the machine's speed of 10 km/h is slightly faster than the 9.5 of the table, production may be interpolated slightly higher — say 395 Cm^3/h.)

Example problem (English)

Determine production for an 825K operating under the following conditions:

P = 4, S = 8 mph, L = 6 inches

Refer to the production estimating table on the next page. This table contains estimates for the 815F2 and 825K Compactors using various speeds, lift thicknesses and number of passes. These figures were calculated using the formula discussed on this page. The figures represent 100% efficiency. W = Twice the width of one wheel.

In the 825K portion of this table, read down the first column until reaching the section for four passes. Within this section in the second column, find the line for 8 mph. Read across this line to the lift thickness column for 6 inches. Read the production figure given.

Answer: 1444 CCY/hr.

● ● ●

PRODUCTION TABLE

MODEL AND MACHINE PASSES*		AVERAGE SPEED km/h	AVERAGE SPEED mph	COMPACTED LIFT THICKNESS 100 mm m³/h	4 in yd³/hr	150 mm m³/h	6 in yd³/hr	200 mm m³/h	8 in yd³/hr	250 mm m³/h	10 in yd³/hr
815K	3	6.5	**4**	419	**548**	628	**822**	837	**1095**	—	
		9.5	**6**	628	**822**	942	**1232**	1256	**1643**	—	
		13.0	**8**	837	**1095**	1256	**1643**	1675	**2191**	—	
	4	6.5	**4**	314	**411**	471	**616**	628	**822**	—	
		9.5	**6**	471	**616**	706	**924**	942	**1232**	—	
		13.0	**8**	628	**822**	942	**1232**	1256	**1643**	—	
	5	6.5	**4**	251	**329**	377	**493**	502	**657**	—	
		9.5	**6**	377	**493**	565	**739**	754	**986**	—	
		13.0	**8**	502	**657**	754	**986**	1005	**1314**	—	
	6	6.5	**4**	286	**274**	314	**411**	419	**548**	—	
		9.5	**6**	314	**411**	471	**616**	628	**822**	—	
		13.0	**8**	419	**548**	628	**822**	837	**1095**	—	
825K	3	6.5	**4**	488	**642**	731	**962**	975	**1283**	1219	**1604**
		9.5	**6**	713	**962**	1069	**1444**	1425	**1925**	1781	**2406**
		13.0	**8**	975	**1283**	1463	**1925**	1950	**2566**	2438	**3208**
	4	6.5	**4**	366	**481**	534	**722**	731	**962**	914	**1203**
		9.5	**6**	534	**722**	802	**1083**	1069	**1444**	1336	**1804**
		13.0	**8**	731	**962**	1097	**1444**	1463	**1925**	1828	**2406**
	5	6.5	**4**	293	**385**	439	**577**	585	**770**	731	**962**
		9.5	**6**	428	**577**	641	**866**	855	**1155**	1069	**1444**
		13.0	**8**	585	**770**	878	**1155**	1170	**1540**	1463	**1925**
	6	6.5	**4**	244	**321**	366	**481**	488	**642**	609	**802**
		9.5	**6**	356	**481**	534	**722**	713	**962**	891	**1203**
		13.0	**8**	488	**642**	731	**962**	975	**1283**	1219	**1604**

*The number of machine passes required is dependent on soil type, moisture content, desired compaction and machine weight.

815K and 825K
Ground Contact Pressure/Soil Compactors

815K Tip	Weight Front Axle 9664 kg (21,305 lb) Ground Contact Pressure		Weight Rear Axle 12 722 kg (28,047 lb) Ground Contact Pressure		Contact Area Four Wheels	
Tip Penetration	**kPa**	**psi**	**kPa**	**psi**	**cm²**	**in²**
12.5 mm **(0.5 in)**	4727.05	**685.6**	6989.35	**706.7**	425.81	**66**
25 mm **(1.0 in)**	1347.92	**195.5**	1827.94	**215.7**	1445.16	**224**
38 mm **(1.5 in)**	902.52	**130.9**	1094.20	**156.8**	2077.42	**322**
50 mm **(2.0 in)**	658.45	**95.5**	872.95	**97.7**	3064.51	**475**

825K Standard Tip	Weight Front Axle 14 469 kg (31,899 lb) Ground Contact Pressure		Weight Rear Axle 21 059 kg (46,427 lb) Ground Contact Pressure		Contact Area Four Wheels	
Tip Penetration	**kPa**	**psi**	**kPa**	**psi**	**cm²**	**in²**
12.7 mm **(0.5 in)**	7178.41	**1041.14**	8092.55	**1173.73**	407.65	**63.19**
25 mm **(1.0 in)**	2609.39	**378.46**	2941.72	**426.66**	1121.55	**173.84**
38 mm **(1.5 in)**	1411.35	**204.70**	1591.10	**230.77**	2073.54	**321.40**
50 mm **(2.0 in)**	704.99	**102.25**	794.76	**115.27**	4150.96	**643.40**
75 mm **(3.0 in)**	610.19	**88.50**	687.89	**99.77**	4795.60	**743.32**
100 mm **(4.0 in)**	421.68	**61.16**	475.39	**68.95**	6939.86	**1075.68**
125 mm **(5.0 in)**	382.52	**55.48**	431.27	**62.55**	7650.04	**1185.76**
150 mm **(6.0 in)**	324.33	**47.04**	365.63	**53.03**	9022.18	**1398.44**
175 mm **(7.0 in)**	311.09	**45.12**	350.74	**50.87**	9405.66	**1457.88**
200 mm **(8.0 in)**	139.55	**20.24**	157.34	**22.82**	20 965.89	**3249.72**

825K Heavy Duty Tip	Weight Front Axle 14 469 kg (31,899 lb) Ground Contact Pressure		Weight Rear Axle 21 059 kg (46,427 lb) Ground Contact Pressure		Contact Area Four Wheels	
Tip Penetration	**kPa**	**psi**	**kPa**	**psi**	**cm²**	**in²**
12.7 mm **(0.5 in)**	7615.41	**1104.52**	8585.20	**1245.18**	96.07	**14.89**
25 mm **(1.0 in)**	6199.83	**899.21**	6989.35	**1013.72**	472.00	**73.16**
38 mm **(1.5 in)**	3614.20	**524.19**	1915.27	**277.79**	430.61	**66.74**
50 mm **(2.0 in)**	1621.44	**235.17**	1827.94	**265.12**	1804.64	**279.72**
75 mm **(3.0 in)**	970.64	**140.78**	1094.20	**158.70**	3014.96	**467.32**
100 mm **(4.0 in)**	774.28	**112.30**	872.95	**126.61**	3779.35	**585.80**
125 mm **(5.0 in)**	570.89	**82.80**	643.56	**93.34**	5126.18	**794.56**
150 mm **(6.0 in)**	443.13	**64.27**	499.59	**72.46**	6603.60	**1023.56**
175 mm **(7.0 in)**	417.06	**60.49**	470.22	**68.20**	7016.24	**1087.52**
200 mm **(8.0 in)**	389.07	**56.43**	438.64	**63.62**	7520.76	**1165.72**
225 mm **(9.0 in)**	381.07	**55.27**	429.61	**62.31**	7678.95	**1190.24**
250 mm **(10.0 in)**	128.59	**18.65**	145.00	**21.03**	22 753.76	**3526.84**

WHEEL LOADERS

CONTENTS

SPECIFICATION DEFINITIONS FOR FRONT END LOADERS

Cat wheel and track loader specifications conform to Society of Automotive Engineers (SAE) definitions as expressed in standards J732 (JUN92), as follows:

Description of Specification Machine

On wheel loaders the tire inflation pressure at which specifications are taken must be described in addition to the current written basic machine description. On track loaders the type of grouser must be specified.

Hydraulic Cycle Times

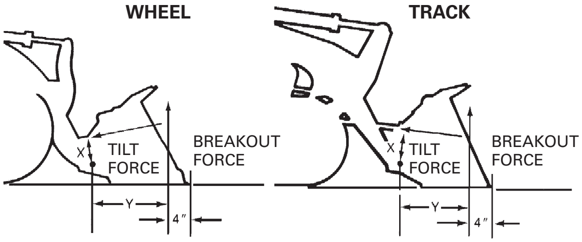
a. "Raise Time" — Time in seconds required to raise the bucket from level position on the ground.
b. "Lower Time" — Time in seconds required to lower the empty bucket from the full height to a level position on the ground.
c. "Dump Time" — Time in seconds required to move the bucket at maximum height from the maximum rollback position to full dump position while dumping the SAE loose material operating load.

Breakout Force

"Breakout force," pounds (and kilonewtons or kilograms) — the maximum sustained vertical upward force exerted 100 mm (4") behind the tip of the bucket cutting edge and achieved through the ability to lift and/or rollback about the specified pivot point under the following conditions:

a. Loader on a hard level surface with transmission in neutral.
b. All brakes released.
c. Unit at standard operating weight — rear of loader not tied down.
d. Bottom of cutting edge parallel to and not more than 20 mm (0.75") above or below the ground line.
e. When bucket circuit is used the pivot point must be specified as the bucket hinge pin, and the unit blocked under the bucket hinge pin pivot point in order to minimize linkage movement.
f. When the lift circuit is used, the pivot point must be specified as the lift arm hinge pin. Wheel loaders shall have front axle blocked to eliminate change in position of pivot pins due to tire deflection.
g. If both circuits are used simultaneously, the dominating pivot point listed in (e) or (f) must be specified.
h. If the circuit used causes the rear of the vehicle to leave the ground, then the vertical force value required to raise the rear of the vehicle is the breakout force.
i. For irregular shaped buckets, the tip of the bucket cutting edge referred to above shall mean the farther forward point of the cutting edge.

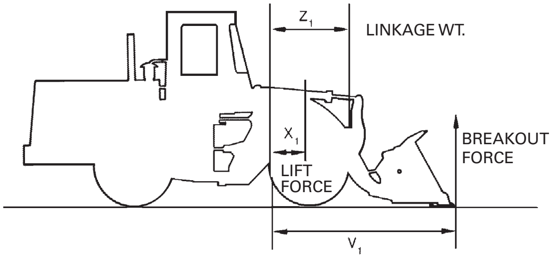
The following are illustrations used (according to provisions of SAE J732 JUN92) to measure Cat Loader breakout forces.

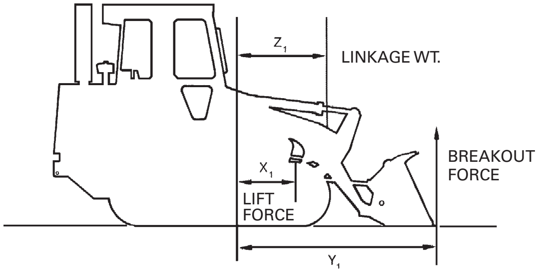


a. Breakout force resulting from rack back:
(Tilt Force) × (Dist. "X") = ("Y" Dist.) × (Breakout Force)

$$\frac{(\text{Tilt Force}) \times (\text{Dist. “X”})}{\text{“Y” Dist.}} = \text{Breakout Force}$$

b. Breakout force resulting from bucket lift:





$$(\text{Lift Force}) \times (\text{Dist. "}X_1\text{"}) = (\text{"}Y_1\text{" Dist.}) \times (\text{Breakout Force}) + (\text{Linkage Wt.}) \times (\text{Dist. "}Z_1\text{"}) + (\text{Breakout Force}) \times (\text{Linkage Mechanical Advantage}) \text{ "}V_1\text{"}$$

or

$$\text{Breakout Force} = \frac{(\text{Lift Force}) \times (\text{Dist. "}X_1\text{"}) - (\text{Linkage Wt.}) \times (\text{Dist. "}Z_1\text{"})}{(\text{Dist. "}Y_1\text{"}) + (\text{Dist. "}V_1\text{"}) \times (\text{Linkage Mech. Advantage})}$$

Static Tipping Load

The minimum weight at center of gravity of "SAE Rated" load in bucket which will rotate rear of machine to a point where, on track loaders, front rollers are clear of the track and on wheel loaders, rear wheels are clear of the ground under the following conditions:

a. Loader on hard level surface and stationary.
b. Unit at standard operating weight.
c. Bucket at maximum rollback position.
d. Load at maximum forward position during raising cycle.
e. For articulated wheel loaders, the test will be run both with frame straight (straight static tipping load) and fully turned to a specific angle (full turn static tipping load).
f. Unit with standard equipment as described in specifications unless otherwise noted under the heading.

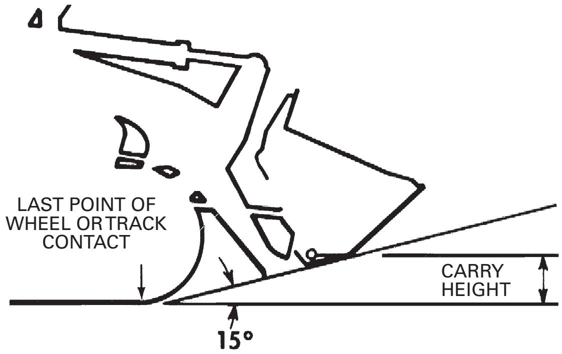
Operating Load

In order to comply with SAE standard J818 MAY87, the operating load of Wheel Loaders should not exceed 50% of the full turn Static Tipping load of the machine when equipped with attachments needed for the job. (For track loaders, operating load should not exceed 35% of the Static Tipping load rating.) See "Performance Data" of each machine in this handbook for increases to static tipping load by adding cab, counterweights, ripper-scarifier, etc.

The SAE operating load is not an indication of a wheel loader's rated payload. It takes into consideration only hydraulic lift and tipping capacity. There is no regard to structural and/or component lives, and for wheel loaders is measured on hard, moderately smooth and level operating surfaces.

Carry Position

SAE defines carry positions as: "The vertical distance from the ground to the center line of the bucket hinge pin, with the angle of approach at 15°." The sketch below illustrates this definition:



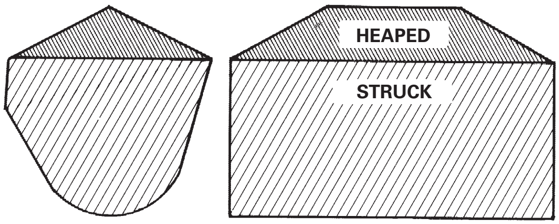
Loader Clearance Circle

SAE J732 JUN92 states that "minimum turning radius (over tire)" and "loader clearance circle" should be given for wheel loaders. Both are given on Cat specification sheets, including loader clearance circles for all available buckets for each machine.

Digging Depth

J732 JUN92 specifies digging depth as "the vertical distance in mm (inches) from the ground line to the bottom of the bucket cutting edge at the lowest position with the bucket cutting edge horizontal."

SAE BUCKET RATING



SAE Bucket Capacities

Struck capacity is that volume contained in a bucket after a load is leveled by drawing a straight edge resting on the cutting edge and the back of the bucket.

Heaped capacity is a struck capacity plus that additional material that would heap on the struck load at a 2:1 angle of repose with the struck line parallel to the ground.

SAE J742 (FEB85) specifies that the addition of any auxiliary spill guard to protect against spillage which might injure the operator will not be included in bucket capacity ratings. Buckets with irregular shaped cutting edges (vee edge) the strike plane should be drawn at one-third the distance of the protruding portion of the cutting edge. Cat rock buckets are built with integral see-through rock guards. Cat light material buckets come standard with bolt-on edges. These features which add to actual bucket capacity are included in published ratings.

Dump Height

SAE J732 JUN92 specifies that dump height is the vertical distance from the ground to the lowest point of the cutting edge with the bucket hinge pin at maximum height and the bucket at a 45° dump angle. Dump angle is the angle in degrees that the longest flat section of the inside bottom of the bucket will rotate below horizontal.

SELECTING A MACHINE

Steps in selecting the proper size loader:

1. Determine production required or desired.
2. Determine loader cycle time and cycles per hour. A machine size must be assumed to select a basic cycle time.
3. Determine required payload per cycle in loose cubic yards and pounds (meters and kilograms).
4. Determine bucket size needed.
5. Make machine selection using bucket size and payload as criteria to meet production requirements.
6. Compare the loader cycle time used in calculations to the cycle time of the machine selected. If there is a difference, rework the process beginning at step 2.

1. Production Required

The production required of a wheel or track loader should be slightly greater than the production capability of the other critical units in the earth or material moving system. For example, if a hopper can handle 300 tons per hour, a loader capable of slightly more than 300 tons should be used. Required production should be carefully calculated so the proper machine and bucket selections are made.

2. Loader Cycle Times

When hauling loose granular material on a hard smooth operating surface, a .45-.55 minute basic cycle time is considered reasonable for Cat articulated loaders with a competent operator. This includes load, dump, four reversals of direction, full cycle of hydraulics and minimum travel.

Material type, pile height, and other factors may improve or reduce production, and should be added to or subtracted from the basic cycle time when applicable.

When hauls are involved, obtain the haul and return portion of the cycle from the estimated travel chart (this section). Add the haul and return times to the estimated basic cycle time to obtain total cycle time.

CYCLE TIME FACTORS

A basic cycle time (Load, Dump, Maneuver) of .45-.55 minutes is average for an articulated loader [the basic cycle for large loaders, 3 m^3 (4 yd^3) and up, can be slightly longer], but variations can be anticipated in the field. The following values for many variable elements are based on normal operations. Adding or subtracting any of the variable times will give the total basic cycle time.

	Minutes added (+) or Subtracted (–) From Basic Cycle
Machine	
— Material handler	–.05
Materials	
— Mixed	+.02
— Up to 3 mm (1/8 in)	+.02
— 3 mm (1/8 in) to 20 mm (3/4 in)	–.02
— 20 mm (3/4 in) to 150 mm (6 in)	.00
— 150 mm (6 in) and over	+.03 and Up
— Bank or broken	+.04 and Up
Pile	
— Conveyor or Dozer piled 3 m (10 ft) and up	.00
— Conveyor or Dozer piled 3 m (10 ft) or less	+.01
— Dumped by truck	+.02
Miscellaneous	
— Common ownership of trucks and loaders	Up to –.04
— Independently owned trucks	Up to +.04
— Constant operation	Up to –.04
— Inconsistent operation	Up to +.04
— Small target	Up to +.04
— Fragile target	Up to +.05

Using actual job conditions and the above factors, total cycle time can be estimated. Convert total cycle time to cycles per hour.

$$\textit{Cycles per hour at 100\% Efficiency} = \frac{\textit{60 min}}{\textit{Total Cycle Time in Minutes}}$$

Job efficiency is an important factor in machine selection. Efficiency is the actual number of minutes worked during an hour. Job efficiency accounts for bathroom breaks and other work interruptions.

$$\text{Cycles per hour at 50 minutes per hour (83\% efficiency)} = \text{Cycles per hour at 100\% efficiency} \times \frac{\text{50 min actual work time}}{\text{60 min hour}}$$

TRUCK LOADING

Average loader cycle times

910-962	0.45-0.50 min
966-980	0.50-0.55 min
986-990	0.55-0.60 min
992-994	0.60-0.70 min

3. Required Payload Per Cycle

Required payload per cycle is determined by dividing required hourly production by the number of cycles per hour.

4. Bucket Selection

After required payload per cycle has been calculated, the payload should be divided by the loose cubic yard (meter) material weight to determine number of loose cubic yards (meters) required per cycle.

The bulk of material handled does not weigh 1800 kg/m^3 (3000 lb/yd^3), so a reasonable knowledge of material weight is necessary for accurate production estimates. The Tables Section has average weight for certain materials when actual weights are not known.

The percentage of rated capacity a bucket carries in various materials is estimated below. The bucket size required to handle the required volume per cycle is found with the aid of the percentage of rated bucket capacity called "Bucket Fill Factor."

The bucket size needed is determined by dividing loose cubic meters (or yards) required per cycle by the bucket fill factor.

$$\textit{Bucket size} = \frac{\textit{Volume Required/Cycle}}{\textit{Bucket Fill Factor}}$$

BUCKET FILL FACTORS

The following indicates the approximate amounts of material as a percent of rated bucket capacity which will actually be delivered per bucket per cycle. This is known as "Bucket Fill Factor."

Loose Material	Fill factor
Mixed moist aggregates	95-100%
Uniform aggregates up to 3 mm (1/8 in)	95-100
3 mm (1/8 in) to 9 mm (3/8 in)	90-95
12 mm (1/2 in) to 20 mm (3/4 in)	85-90
24 mm (1.0 in) and over	85-90

Blasted Rock

Well blasted	80-95%
Average	75-90
Poor	60-75

Other

Rock dirt mixtures	100-120%
Moist loam	100-110
Soil, boulders, roots	80-100
Cemented materials	85-95

NOTE: Fill factors on wheel loaders are affected by bucket penetration, breakout force, rack back angle, bucket profile and ground engaging tools such as bucket teeth or bolt-on replaceable cutting edges.

Example:

12 mm (1/2 in) material and 3 m^3 (4 yd^3) bucket.
$0.90 \times 3\ m^3 = 2.75$ Loose m^3 delivered per cycle.
$0.90 \times 4\ yd^3 = 3.6$ Loose yd^3 delivered per cycle.

NOTE: Check the static tipping load on the specific machine to determine if bucket load is in fact a safe operating load.

Bucket Selection

$$\textit{Tons Required/Cycle} = \frac{\textit{Tons Required/Hour}}{\textit{Cycles/Hour}}$$

$$\textit{Kg (Pounds) Required/Cycle} = \textit{Tons Required/Cycle} \times \textit{907 kg (2000 lb)}$$

$$\textit{Volume Required/Cycle} = \frac{\textit{kg (Pounds) Cycle}}{\textit{Material Weight kg/m}^3\ \textit{(lb/yd}^3\textit{)}}$$

Always select a machine with a greater capacity than the calculated required operating capacity. For most applications, payload above recommended and excessive counterweight can hinder machine performance and reduce dynamic stability and machine life.

For optimum performance in fast cycling situations such as truck loading, operating loads should not exceed the recommended capacity. To provide extra stability, calcium chloride ($CaCl_2$) ballast may be desired when operating at recommended operating load, see SAE Loader rating pages in this section.

When selecting special application buckets, such as multi-purpose and side dump the additional bucket weight must be deducted from recommended capacity.

Specific circumstances may involve other conditions which would also affect loader capacity. Because of the greatly varied applications and conditions, your Cat dealer should be contacted for guidance.

Example problem:

JOB CONDITIONS

Application	Truck loading
Production Required	450 metric ton (496 Tons) per hour
Material	9 mm (3/8") gravel in 6 m (20 ft) high stockpile
Density	1660 kg/m^3 (2800 lb/yd^3)

Trucks are 6-9 m^3 (8-12 yd^3) capacity and are owned by three contractors. Loading is constant. Hard level surface for loader maneuvering.

1. *PRODUCTION REQUIRED:* Given
2. *CYCLE TIME:* Assume loader size between 910K and 962H for initial choice of basic cycle.

(Refer to Cycle Time Factors in this section)

Independent trucks	.04 min
Basic Cycle	.50 min
Material	–.02 min
Independent trucks	+.04 min
Constant operation	–.02 min
Total Cycle	.50 min

NOTE: Load and carry times not required in total cycle.

$$\text{Cycles/hr at 83\% efficiency} = 120 \text{ cycles/hr} \times \frac{\text{50 min actual work time}}{\text{60 min per hr}} = 100 \text{ cycles/hr}$$

3. *VOLUME REQUIRED PER CYCLE*
(Density in tons)
Density in this example was given. When not given, refer to Tables Section to obtain an estimated density for the material being handled.

Metric: $\dfrac{1660\ \text{kg/m}^3}{1000\ \text{kg/ton}} = 1.66\ \text{ton/m}^3$

English: $\dfrac{2800\ \text{lb/yd}^3}{2000\ \text{lb/ton}} = 1.4\ \text{tons/yd}^3$

Production Rate Required

Metric: $\dfrac{450 \text{ tons/hr}}{1.66 \text{ tons/m}^3} = 271 \text{ m}^3\text{/hr}$

English: $\dfrac{496 \text{ tons/hr}}{1.4 \text{ tons/yd}^3} = 354 \text{ yd}^3\text{/hr}$

Volume Required per Cycle

Metric: $\dfrac{271 \text{ m}^3\text{/hr}}{100 \text{ cycles/hr}} = 2.71 \text{ m}^3\text{/cycle}$

English: $\dfrac{354 \text{ yd}^3\text{/hr}}{100 \text{ cycles/hr}} = 3.54 \text{ yd}^3\text{/cycle}$

4. *DETERMINE BUCKET SIZE*

BUCKET FILL FACTOR

The volume of material required per cycle has been determined. Because of varying material fill factors, buckets do not always carry their rated load, a larger capacity bucket may be needed to carry the volume required. For fill factors, refer to Bucket Fill Factor Chart in this section.

Rated Bucket Capacity Required (Heaped)

$$\frac{2.71 \text{ m}^3\text{/cycle}}{0.95 \text{ fill factor}} = 2.85 \text{ m}^3$$

$$\frac{3.54 \text{ yd}^3\text{/cycle}}{0.95 \text{ fill factor}} = 3.73 \text{ yd}^3$$

A 2.9 m^3 (3.75 yd^3) bucket would provide the required capacity.

5. *MACHINE SELECTION*

The bucket size required and material density lead to the choice of a 950H with a 2.9 m^3 (3.75 yd^3) General Purpose Bucket (see bucket selection guide pages which follow.)

Finally, SAE payload criteria must be satisfied as follows:

The required operating capacity must not exceed one-half of the full turn static tipping load of the loader as equipped with a specific bucket.

The required operating capacity of the machine is determined by the volume the machine will carry per load times the density.

$2.9 \text{ m}^3 \times 1660 \text{ kg/m}^3 = 4814 \text{ kg}$
$(3.75 \text{ yd}^3 \times 2800 \text{ lb/yd}^3 = 10{,}500 \text{ lb})$

One half of full turn static tipping load for the 950H with a 2.9 m^3 (3.75 yd^3) General Purpose Bucket is 5410 kg (11,925 lb). SAE criteria is satisfied.

● ● ●

An Alternative Method of Machine Selection

Another method of selecting the right Wheel Loader and bucket to meet production requirements is by use of the nomographs on the following pages. The method is quicker and easier than the preceding example because it does not require as many calculations, yet the accuracy is about the same within the normal limits of input data.

Be careful when entering and reading data from the nomographs because some scales increase from bottom to top, while others are the reverse. Do not be overly concerned with the precision as affected by pencil line width or reading to the hundredth of a m^3 (yd^3). Remember that bucket fill factor, material density and cycle time are at best close estimates.

Example problem:

A Wheel Loader must produce 230 m^3 (300 yd^3) per hour in a truck loading application. Estimated cycle time is .6 minutes, working 45 minutes per hour. Bucket fill factor is 95% and material density is 1780 kg/m^3 (3000 lb/yd^3).

Determine bucket size and machine model.

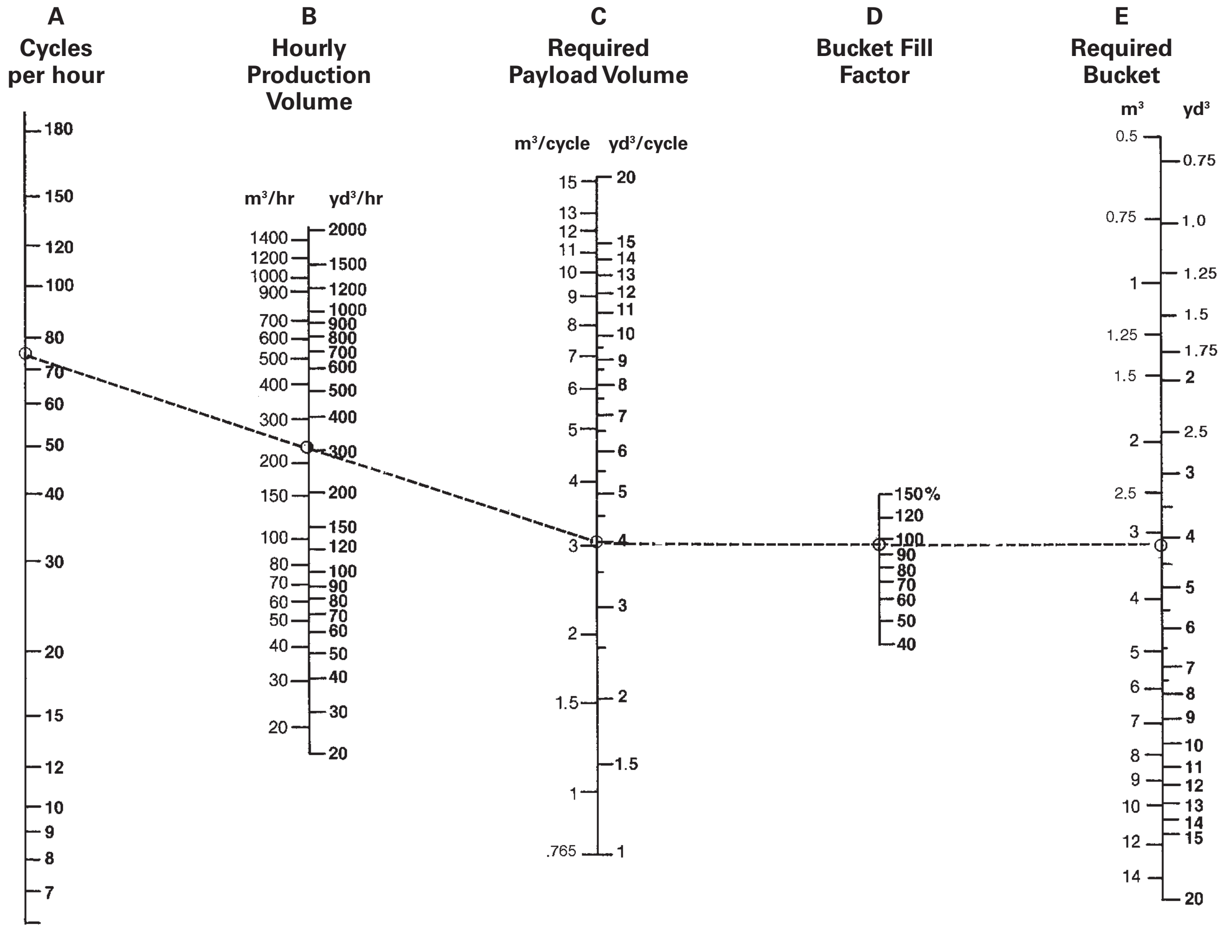
Solution:

At full efficiency, the Wheel Loader will cycle 100 times per hour. Since only an average of 45 minutes are available, only 75 cycles will be completed.

Starting on Scale A at 75 cycles per hour draw a straight line intersecting 230 m^3/hr (300 yd^3/hr) on Scale B and extending it on to Scale C giving 3 m^3/cycle (4 yd^3/cycle) required payload. Follow solution steps 1-10.

● To find required bucket payload and bucket size

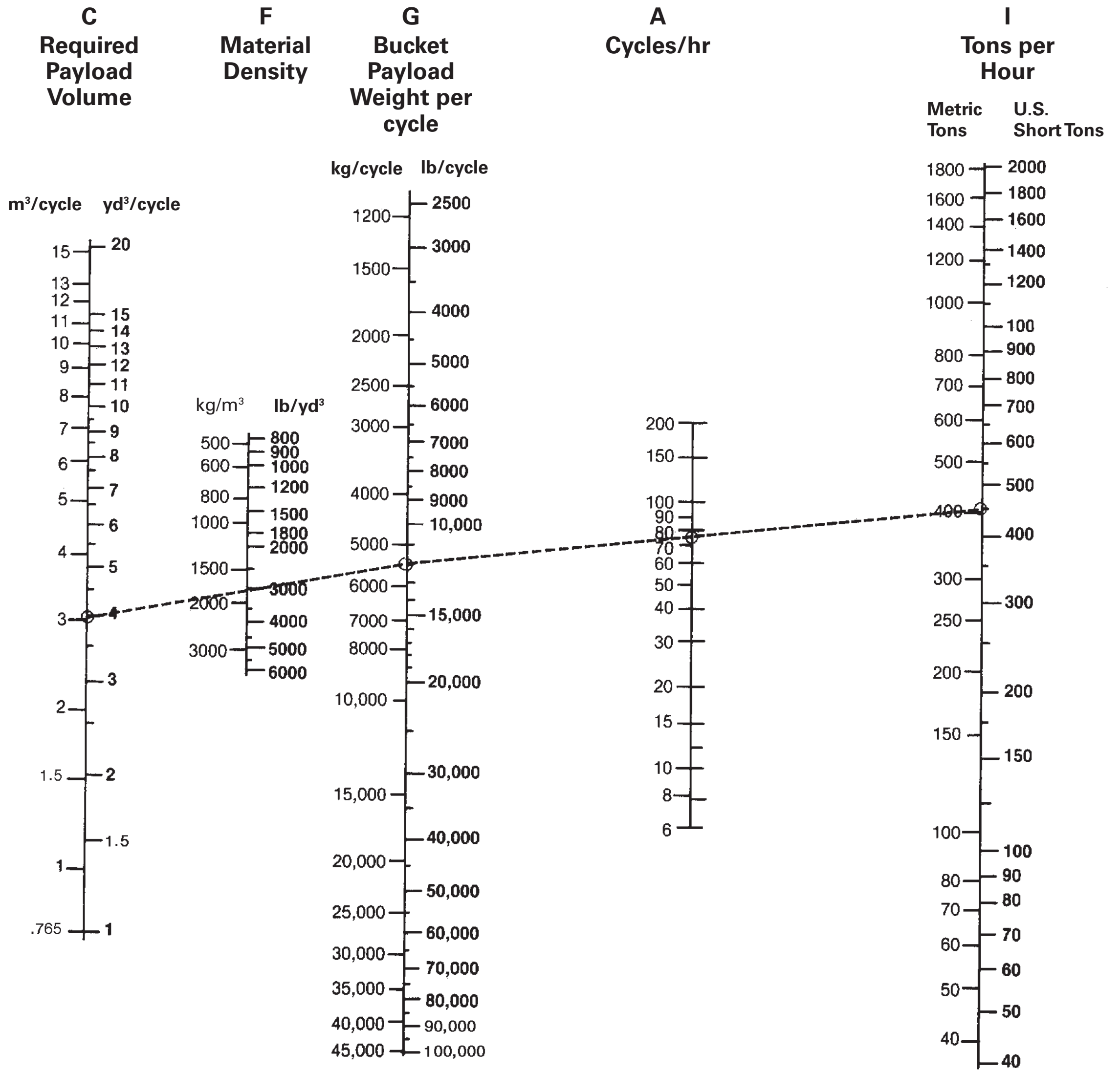
1. Enter required hourly production on Scale B 230 m^3/hr (300 yd^3/hr).
2. Enter cycles per hour on Scale A (60 ÷ .6 = 100 × .75 = 75 cycles/hr).
3. Connect A through B to C. This shows a required payload of 3 m^3 (4 yd^3) per cycle.
4. Enter estimated bucket fill factor on Scale D (0.95).
5. Connect C through Scale D to E for required bucket size 3 m^3 (4 yd^3).
6. Transfer cycles per hour Scale A and required payload Scale C to the following page.



7. Enter material density on Scale F 1780 kg/m³ (3000 lb/yd³).
8. Connect C through Scale F to Scale G to give payload weight per cycle 5300 kg (11,500 lb).
9. Compare Scale G quantity 5300 kg (11,500 lb) with recommended machine working range listed on the following bucket selection pages.

Operating capacity for the 950H with 3.1 m³ (4 yd³) bucket is dependent on material density and bucket capacity (see bucket selection pages that follow).

10. For hourly tonnage, draw a straight line from Scale G through Scale A to Scale I 400 metric tons (450 U.S. tons).

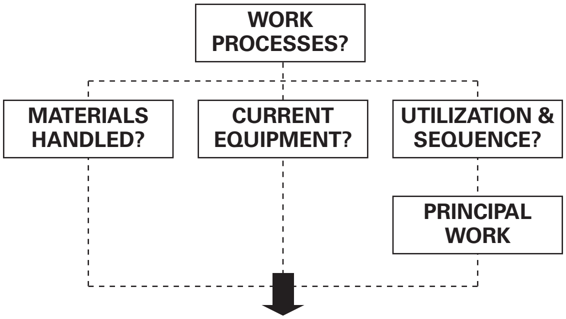


MACHINE/ATTACHMENT SELECTION

The Integrated Toolcarrier's versatility and the wide range of attachments makes the "single machine fleet" concept highly attractive to an increasing number of users.

A Job Analysis helps identify applications, work requirements, material handling parameters and the current working method. Thoroughly research each element in the following chart, the gathered information will help select the proper Integrated Toolcarrier System.

JOB ANALYSIS METHOD



- **APPROPRIATE INTEGRATED TOOLCARRIER MODEL SIZE**
- **NECESSARY ATTACHMENTS**

Work Processes:

The first step in the job analysis is to identify all work processes from start to finish. Key questions outlined below will begin to indicate the required attachments and potential Integrated Toolcarrier applications.

- What kinds of work are performed: (e.g., dozing, loading, stacking, digging, sweeping, handling special materials, etc.)
  - ... in site preparation?
  - ... below ground level?
  - ... at ground level?
  - ... above ground level?
  - ... in landscaping?
  - ... in maintenance equipment yard?
  - etc.
- What work is done manually that could be done with an Integrated Toolcarrier?
- What are the work conditions?:
  - ... underfoot?
  - ... grades?
  - ... tight quarters?
  - ... time restraints?
  - ... climate?
  - etc.

Materials Handled:

Examining the materials handled will assist in determining necessary attachments. Sizes and weights of material(s) handled will indicate the appropriate Integrated Toolcarrier model by defining lift and reach requirements. Concentrate on the material flow at the job site — the point of origin as well as the final destination for the various materials will undoubtedly have material handling requirements.

- What kinds of materials are handled (e.g. snow, earth, bricks, chemicals, pipe, logs, etc.)
- What form are the materials handled in: bulk? palletized?
- How much does each weigh?
- What are the dimensions of each?
- What are the... movement parameters:
  - ... dozed what distance?
  - ... load and carried what distance?
  - ... lifted how high?
  - ... placed below ground level?
  - ... placed what distance from machine?

Current Equipment:

If determining material weight is not possible, much information can be determined from looking at the current equipment fleet. This will suggest required performance capabilities such as lifting capacity.

- Machines currently doing the work (e.g. wheel loaders, lift trucks, sweepers, light capacity cranes, snow plows, etc.)?
- What special (maximum) capabilities does each machine have (production, lift height, load capacity, width/height dimensions, reach, turning radius, travel speed, etc.)?
- To what extent are each machine's maximum capabilities used?
- What are owning/operating costs of each?

Utilization & Sequence:

Utilization implies how often the current machines are used and what will be the utilization factors for the Integrated Toolcarrier with each individual attachment. Sequence implies what order these tasks are accomplished in and if two or more machines operate at the same time. This portion of the job analysis should assist in comparing economies of various systems. Other important considerations may be the number of operators needed, storage space, reduced maintenance requirements, etc.

- How often (what percent) is each machine used?
- How often and when does it sit idle?
- How often and when do two or more machines work at the same time?
- Can the operation be changed to permit single machine operation?

Principal Work:

Utilization and sequence will indicate the principal work the Integrated Toolcarrier will do, further assisting in attachment and model sizing and selection. The basic machine/tool package should be able to handle the toughest, most frequently performed jobs for the primary application. Secondary tools can have a little more "give and take" in their performance capabilities than the primary tool.

- What work can be accomplished by an Integrated Toolcarrier?
- What work will take up the majority of Integrated Toolcarrier time?
- What work will use the maximum static tipping capabilities of the Integrated Toolcarrier?
- What high cost (owning and operating) and/or low utilization machines can be replaced by an Integrated Toolcarrier?

Additional Tips for Tool Sizing and Selection

Tool selection will principally concern hydraulic power requirements and static tipping load considerations. The standard tools offered by Caterpillar can be used on any Integrated Toolcarrier machine with little difficulty. However, tools such as the hydraulic broom, claws, blades and asphalt cutter will require additional consideration before proposing a system to the customer.

Fork Rating

ISO 14397-1 states that articulated wheel loaders require the following method for calculating rated load on forks. 50% of the fully articulated tipping load when the lift arms and fork are level, and the load is applied at a point on the longitudinal center line of the machine at half the distance from the most rearward point of the load opening to the tip of the fork, this will be the rated load for that machine in its present configuration. As the machine configuration changes, so does the rated load. EN474-3 states a load center dependent on the value of the load itself. Please refer to that standard for the load center location table. Always refer to the manufacturer of the fork to determine the load rating for the fork tine.

Bucket Rating

Bucket capacity, SAE J742 FEB85 (nominally heaped)

ISO 14397-1 states that articulated wheel loaders require the following method for calculating rated load, also known as the maximum payload, with buckets. 50% of the fully articulated tipping load when the lift arms are level and bucket fully racked back, and the load is applied at a point on the longitudinal center line of the machine and acting through the bucket volume centroid, this will be the rated load for that machine in its present configuration. As the machine configuration changes, so does the rated load. Please consult your Cat dealer to ensure proper machine configuration selection in conformance to Caterpillar payload policy.

The maximum material density would be determined by dividing the payload by the bucket capacity. If the actual material density exceeds the recommended material density, the process should be repeated to select the properly sized bucket.

A similar procedure would be used with the forks and material handling arm to determine maximum recommended lifting capacity and/or required IT model size.

Pallet Fork

The pallet fork will fulfill many material handling needs. A modified Class 3 fork carriage provides visibility to the tines for precision pallet work. This carriage with non-standard spacing accepts many Class 3 lift truck attachments.

Pallet fork rated operating loads are based on the following:

SAE J1197 FEB91: 50% of the full turn static tipping load or the hydraulic/structural limitations.

CEN 474-3 (European standard): 60% of the full static tipping load on rough terrain or the hydraulic/structural limitations. 80% of the full turn static tipping load on firm, level ground or the structural/hydraulic limitation. Other local, regional or international guidelines may also apply.

If operation is on rough ground these criteria may need modification. In this instance, the size and rating of existing equipment should be considered.

Sizing for pallet work generally consists of answering the following questions.

1. What are the average loaded pallet dimensions?
2. Lift Capacity — what capacity is required to lift and move the average pallet load? The maximum pallet load?
3. Lift Height — can the machine reach the top level of the standard pallet stack? What are the maximum reach, lift and height requirements?
4. Maneuverability — can the machine work around the current aisle configuration? In the stacking aisles? Main aisles? Intersecting aisles? Are 90° turns required in any aisle for material placement?
5. Length — what tine length is required to fit the commonly used pallets? (1219 mm [4'0"] tines are standard length for most palletized material.)
6. Any machine height restrictions?
7. Any special fork configurations required?

Lift capacity, lift height, aisle configuration and tine length are the most important considerations in recommending a pallet handling machine.

Example problem:

The following example applies the job analysis method to a work situation.

Sewer & Water Contractor

Sets water lines (152 mm-610 mm [6 in-24 in] iron pipe), sanitary sewer lines (152 mm-457 mm [6 in-18 in] PVC) and storm sewer lines (610 mm-1067 mm [24 in-42 in] concrete pipe) primarily in urban areas ... oftentimes across or down existing streets.

Materials

Loam/Clay: 1600 kg/m³ (2700 lb/yd³) loose density

Bedding (Gravel): 1900 kg/m³ (3200 lb/yd³) loose density

Water Pipe: 610 mm (24 in) push-on joint ductile iron, 6.1 m (20 ft) sections, 1309 kg (2885 lb) 215 kg/m (144.3 lb/ft) × 6.1 m (20 ft).

Storm Sewer: 1067 mm (42 in), Wall B, concrete pipe, 1.5 m (5 ft) sections, 1556 kg (3430 lb) 1021 kg/m (686 lb/ft × 5 ft).

Manhole Boxes: 1361 kg (3000 lb)

WHAT INTEGRATED TOOLCARRIER MODEL SHOULD BE RECOMMENDED?

WHICH ATTACHMENTS?

Work Processes	Integrated Toolcarrier Attachment Possibilities
Bundled PVC and individual concrete/iron pipe-loaded/unloaded (yardsite) and strung along trench	Forks/Material Handling Arm
Unload, handle, set manhole boxes	Material Handling Arm
Excess excavated material truck loaded	Bucket
Bedding material handled/ placed	Bucket
Trench backfilled	Bucket/Blade
Trench compaction	Compactor Wheel
Rough and finish grading	Bucket/Blade
Street cleanup	Bucket/Broom
Pavement removal	Rebar Snips/Asphalt Cutter

Current Equipment

Current Equipment	Utilization
Cat 225	90%
Champ CB607 lift truck, 3175 kg (7000 lb) capacity	15%
Deere 444 with 1.1 m³ (1.5 yd³) G.P. bucket	60%
Rosco D-50 sweeper	one half hour/day
Rammax 1361 kg (3000 lb) self-propelled trench compactor	25%

Machine Sizing

1372 mm (54 in) Forks

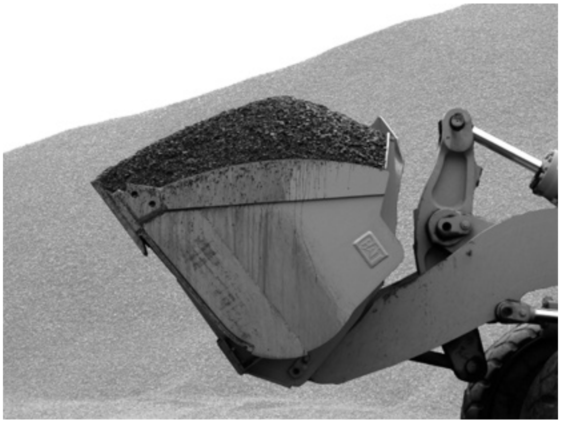
Operating Load at Full Turn*

Model	kg	lb
926M Standard	2819	**6214**
930M Standard	3195	**7043**
938M Standard	3846	**8478**

Water pipes:
1309 kg (2885 lb)
926M Standard ... 1 pipe — no problem
930M ... 1 pipe — no problem
938M ... 1 pipe — no problem

Storm sewer pipes:
1556 kg (3430 lb)
926M Standard ... 1 pipe — no problem
930M ... 1 pipe — no problem
938M ... 1 pipe — no problem

Performance Series Buckets



Performance Series Buckets utilize a system-based approach to balance bucket shape against the machine's linkage, weight, lift and tilt capacities. The result is a bucket optimized for performance and productivity, and intended for use in production applications. Performance Series Buckets for Wheel Loaders are designed for use in truck loading, stockpiling and load-and-carry applications. Performance is improved over current buckets in these production applications with materials such as sand, gravel and aggregates.

Loads Easy

Proven design characteristics improve material flow into the bucket and improve material retention during transport. In some situations, the number of passes required to fill a truck is reduced. Performance Series Buckets are designed for optimum performance on the machine. Profile changes (over current buckets) improve loadability and make Performance Series Buckets machine-specific.

Fuel Efficient

Performance Series Buckets have a longer floor — easily digging through the pile. Less time in the pile equals less fuel consumed.

Higher Fill Factors

When comparing buckets of the same rated capacity, Performance Series Buckets have higher fill factors — up to 115%.

Move More Material with the Same Rated Capacity

More material can be moved with a Performance Series Bucket compared to a same-size rated capacity current bucket. Likewise, a smaller Performance Series Bucket can be utilized to move the same amount of material as a larger rated capacity current bucket.

Carries More

Productive

Bucket shape and strike plane angle are designed for material retention and consistent load sizes. More material loads into the bucket and is carried all the way to the truck, hopper or stockpile.

A spill guard diverts overflow away from hinge pins, lift arms, hydraulic cylinders and tilt sensors helping to protect these areas of the machine.

Bucket Size (m³ or yd³)		1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
Cycle Time	**Cycles Per Hr**																			
0.35	171																			
0.40	150	150	225	330	375	450	525													
0.45	133	135	200	268	332	400	466	530	600	665	730	800	865							
0.50	120	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1003	1080	1140	1200
0.55	109	109	164	218	272	328	382	436	490	545	600	655	705	765	820	870	925	980	1008	1090
0.60	100	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0.65	92	92	138	184	230	276	322	368	416	460	505	555	600	645	690	735	780	830	875	920
0.70	86							342	386	430	474	515	560	600	645	690	730	775	815	860
0.75	80													560	600	640	680	720	760	800

Unshaded area indicates average production.

Bucket Size (m³ or yd³)		11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
Cycle Time	**Cycles Per Hr**																
0.35	171																
0.40	150																
0.45	133																
0.50	120	1320	1440														
0.55	109	1200	1310	1420	1520	1635	1740	1850	1960	2070	2180	2285	2395	2505	2615	2725	2830
0.60	100	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600
0.65	92	1010	1105	1195	1285	1380	1470	1560	1655	1745	1840	1930	2020	2115	2205	2300	2390
0.70	86	945	1030	1120	1200	1290	1375	1460	1545	1630	1720	1805	1890	1975	2060	2150	2235
0.75	80	880	960	1040	1120	1200	1280	1360	1440	1520	1600	1680	1760	1840	1920	2000	2080
0.80	75			975	1050	1125	1200	1275	1350	1425	1500	1575	1650	1725	1800	1875	1950

Unshaded area indicates average production.

Job Efficiency Worktime/Hr	Efficiency Factor	Bucket Load Factor
60 Min Hr	100%	Bucket Size × 1.00
55	91%	0.95
50	83%	0.90
45	75%	0.85
40	69%	0.80
—	—	0.75

Production Estimating Table
- 60 min hour
- Shot Rock
- Metric Tons

Metric Tons • 1600 kg Lm³ (1.6 t) density

Bucket Size m³		1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5
Cycle Time	Cycles Per Hr	Unshaded area indicates average production.																	
0.40	150	240	360	480	600	720													
0.45	133	213	319	426	532	638	745	851	958	1064	1170								
0.50	120	192	288	384	480	576	672	768	864	960	1056	1152	1248	1344	1440	1536	1632	1730	1825
0.55	109	174	262	349	436	523	610	698	785	872	959	1046	1134	1221	1308	1395	1482	1570	1655
0.60	100	160	240	320	400	480	560	640	720	800	880	960	1040	1120	1200	1280	1360	1440	1520
0.65	92	147	221	294	368	442	515	589	662	736	810	883	957	1030	1104	1178	1251	1325	1400
0.70	86						482	550	619	688	757	826	894	963	1032	1101	1170	1238	1310
0.75	80											768	832	896	960	1024	1088	1150	1215
Bucket Payload Metric (Tons)		**1.6**	**2.4**	**3.2**	**4.0**	**4.8**	**5.6**	**6.4**	**7.2**	**8.0**	**8.8**	**9.6**	**10.4**	**11.2**	**12.0**	**12.8**	**13.6**	**14.4**	**15.2**

Bucket Size m³		10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Cycle Time	Cycles Per Hr	Unshaded area indicates average production.										
0.40	150											
0.45	133											
0.50	120											
0.55	109	1744	1918	2092	2267	2441	2616	2790	2964	3139	3313	3488
0.60	100	1600	1760	1920	2080	2240	2400	2560	2720	2880	3040	3200
0.65	92	1472	1619	1766	1913	2060	2208	2355	2502	2649	2796	2944
0.70	86	1376	1513	1651	1788	1926	2064	2201	2339	2476	2614	2752
0.75	80	1280	1408	1536	1664	1792	1920	2048	2176	2304	2432	2560
0.80	75	1200	1320	1440	1560	1680	1800	1920	2040	2160	2280	2400
Bucket Payload Metric (Tons)		**16.0**	**17.6**	**19.2**	**20.8**	**22.4**	**24.0**	**25.6**	**27.2**	**28.8**	**30.4**	**32.0**

U.S. Tons • 2700 lb/LCY (1.35 T) density

Bucket Size yd³		1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
Cycle Time	Cycles Per Hr	Unshaded area indicates average production.																		
0.40	150	203	330	420	510	615	705	810												
0.45	133	180	293	360	454	545	625	720	810	905	985	1080	1170							
0.50	120	162	254	324	408	492	565	650	730	815	890	970	1060	1140	1200	1300	1380	1470	1540	1620
0.55	109	147	240	294	370	448	515	590	665	740	805	885	960	1030	1090	1180	1250	1330	1400	1740
0.60	100	135	220	270	340	410	470	540	610	680	740	810	880	950	1000	1080	1150	1220	1280	1350
0.65	92	124	200	250	314	380	435	500	560	625	680	750	810	875	920	985	1060	1120	1180	1250
0.70	86								525	585	635	695	755	815	860	930	990	1050	1100	1160
0.75	80													760	800	865	920	975	1030	1080
Bucket Payload (Tons)		**1.35**	**2.2**	**2.7**	**3.4**	**4.1**	**4.7**	**5.4**	**6.1**	**6.8**	**7.4**	**8.1**	**8.8**	**9.5**	**10.0**	**10.8**	**11.5**	**12.2**	**12.8**	**13.5**

Bucket Size yd³		11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0
Cycle Time	Cycles Per Hr	Unshaded area indicates average production.															
0.40	150																
0.45	133																
0.50	120	1782	1945														
0.55	109	1620	1765	1905	2060	2200	2350	2495	2645	2790	2940	3080	3235	3375	3530	3670	3825
0.60	100	1485	1620	1750	1890	2020	2160	2290	2430	2560	2700	2830	2970	3100	3240	3370	3510
0.65	92	1365	1490	1610	1735	1855	1985	2105	2235	2355	2480	2600	2730	2850	2980	3100	3225
0.70	86	1275	1390	1505	1625	1735	1855	1965	2085	2200	2320	2430	2550	2665	2785	2895	3015
0.75	80	1190	1295	1400	1510	1615	1725	1830	1940	2045	2160	2260	2375	2480	2590	2695	2805
0.80	75			1310	1415	1515	1620	1715	1820	1920	2025	2120	2225	2325	2430	2525	2630
Bucket Payload (Tons)		**14.9**	**16.4**	**17.5**	**18.9**	**20.2**	**21.6**	**22.9**	**24.3**	**25.6**	**27.0**	**28.3**	**29.7**	**31.0**	**32.4**	**33.7**	**35.1**

FUSION COUPLER SYSTEM

Caterpillar is breaking new ground with the Fusion Coupler System. Caterpillar engineers designed this new system to exceed the performance of any other Cat or competitive coupler solution in the marketplace. This coupler system is a factory- or field-installed option for Cat Loaders from 924K through 972. Fusion offers benefits in four main categories:

Performance

This new interface provides coupler flexibility with performance virtually identical to pin-on.

Imagine lifting a hundred-pound box with your arms fully extended. Now, imagine lifting that same load close to your body. That's the genius of Fusion: designed to integrate the attachment and the machine by pulling the coupler and tool closer to the wheel loader. As a result, the center of gravity is moved inward, towards the machine. This translates to increased lifting ability when compared to machines equipped with competing coupler systems.

Durability

The advanced wedging mechanism of the Fusion Coupler creates a tight, rattle-free fit. This new lock up system eliminates play and wear — resulting in a long service life.

Wedges pull the attachment tight to the machine in two directions — in and down. Constant hydraulic pressure on the coupler wedges compensate for wear, assuring a tight fit throughout the life of the coupler. Tight fit gives better tool control and increased productivity. Plus, coupler durability is substantially increased over traditional couplers.

Visibility

A new, open coupler frame design opens sight lines from the operator's seat, making it easier than ever before to engage and disengage attachments with certainty.

Offset tines and other design changes to Fusion Pallet Forks, working in conjunction with the Fusion Coupler, increase visibility substantially at ground level and truck bed height when compared to traditional coupler and fork combinations.

Flexibility/Compatibility

With the Fusion Coupler system, Caterpillar customers get **one common interface**. This unique, single interface eliminates the need for many different couplers across the entire range of Cat Small and Medium Wheel Loaders. This expanded machine compatibility not only allows one machine to pick up a range of attachments, but also for one attachment to be used by a host of different machines. Realize the flexibility and opportunity afforded your rental operation, or the improvements to machine and attachment management on your customers' job sites.

Fusion is supported by a full line of attachments. Just about any attachment available for pin-on is also available, or can be converted, to work with Fusion. For complete information on Fusion attachments available for Cat Loaders 924 through 972, consult Fusion Product Bulletin GEJQ0222.

WHEEL TRACTOR-SCRAPERS

CONTENTS

WHEEL TRACTOR-SCRAPERS

Single Engine Open Bowl

The Open Bowl Wheel Tractor-Scraper is available as a self-loading, 631K push pull or push-loaded hauling system with a broad material appetite. The broad material appetite allows the Open Bowl Wheel Tractor-Scraper to be used in general construction, heavy construction, mining, and waste applications.

Open Bowl Advantages:

- Quick load/unload
- Spread evenly on-the-go
- Broad material appetite
- Aids in compaction
- Varying material conditions
- High production

Single Engine Advantages (Compared to Tandem Engine):

- Lower fuel usage
- Lower gross vehicle weight
- Loads quickly with the aid of a Track-Type Tractor and hauls to fill carrying minimum machine weight

Twin Engine Open Bowl

The Open Bowl Wheel Tractor-Scraper is available as a self-loading, push-loaded, or push-pulled hauling system with a broad material appetite. The broad material appetite allows the Open Bowl Wheel Tractor-Scraper to be used in general construction, heavy construction, mining, and waste applications.

Open Bowl Advantages:
- Quick load/unload
- Spread evenly on-the-go
- Broad material appetite
- Aids in compaction
- High Production
- Varying material conditions
- High production

Twin Engine Advantages (Compared to Single Engine):
- More power for loading, traveling up grades, or over fill area
- Faster cycle times
- High rolling resistance applications
- Variable site conditions
- Poor underfoot conditions
- Steep grades
- Can be self-loaded, push loaded with the aid of a Track-Type Tractor, or push-pulled

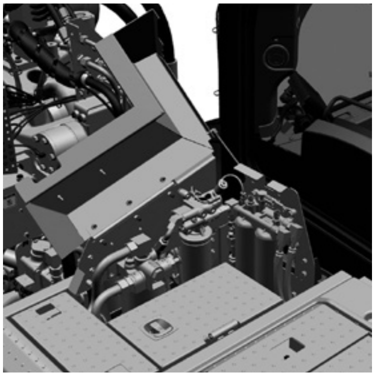
Coal Bowl

Coal Bowl Wheel Tractor-Scrapers are typically used for building and maintaining coal stockpiles and hauling coal to the supply system at coal power plants. The self-loading capability, large capacity, coal pile compaction, and high speed of Coal Bowl Wheel Tractor-Scrapers make them the tool of choice for moving coal both short and long distances. Coal Bowl Wheel Tractor-Scrapers are available in the 637K and 657 tandem engine models.

Coal Bowl Advantages:
- Load hoppers
- Manage coal stockpiles
- Compaction reduces risk of spontaneous combustion in coal stockpile
- Exclusively designed large capacity coal bowls

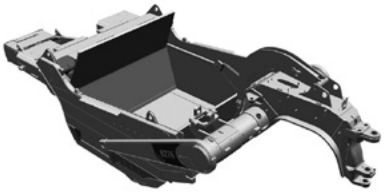
Notes:
- The 637K Coal Scraper is 736 mm **(29.0")** longer, the bowl sides are 476 mm **(18.7")** taller, and the apron is 499 mm **(19.6")** taller than its earthmoving counterpart.
- The 657 Coal Scraper is 1072 mm **(42.2")** longer, the bowl sides are 1010 mm **(39.8")** taller, the apron is 677 mm **(26.7")** taller, and the ejector is 944 mm **(37.2")** taller than its earthmoving counterpart.

K SERIES FEATURES AND BENEFITS



- **Tractor Serviceability Improvement** — The filter bank located at the rear of the engine compartment has undergone improvements for serviceability by raising the filter bank up for easier access.
- **Engine Over Speed Protection** — In the event of an engine over speed situation, the compression brake will automatically engage with no operator input. The machine determines the over speed condition based on rate of acceleration and applies compression brake automatically.
- **Fuel Economy Mode** — Fuel Economy Mode is a two part feature when selected, the first part of the feature lowers the transmission shift points allowing shifting to take place at lower rpms to aid in fuel savings. The second part of the Fuel Economy Mode allows the machine when operated at engine rpms less than full throttle to automatically vary the power distribution between the tractor and the scraper, allowing the machine to utilize the more efficient tractor power train vs. the full time torque converter drive scraper power train.
- **Advanced Cushion Hitch** — With similar technology as the Cat Advanced Ride Management seat suspension, this software allows the cushion hitch to prevent end stroke by having the ability to predict end stroke events and manage the rate of dampening. The desired result is improved hitch repair, reduced maintenance and improved operator ride in rough conditions.
- **High Pressure Steering** — The K Series steering system design requires significantly less steering effort. The reduced steering effort allows for decreased operator fatigue and a more efficient operator resulting in possible higher rates of production late in the work shift.
- **Sequence Assist (Optional Attachment)** — This option uses cylinder position sensors to automate bowl, apron and further implement controls throughout the four core work cycles: Dig, Haul, Unload and Return. When utilized this can reduce up to 14 individual operator commands per cycle. Sequence Assist simplifies control over the implements, reduces joystick usage, automatically controls cushion hitch, transmission hold and ejector.
- **Load Assist (Optional Attachment)** — Is designed to help shorten the learning curve of inexperienced operators to ensure consistency and faster loading of material while reducing effort of the operator. Based on the speed of the machine, Load Assist automatically adjusts the cutting edge height to manage wheel slip and to ensure consistent and efficient loading in bulk earthmoving applications.

- **Cat Grade Control (Optional Attachment)** — Intelligently ensures the machine does not cut below grade in the cut area or over fill in the fill area – avoiding rework and moving unnecessary material.
- **Payload Estimator (Optional Attachment)** — The Payload Estimator will calculate the payload of the machine in tonnes or tons by measuring the bowl lift cylinder pressures at the beginning of the loaded haul segment. This feature works best when using Sequence Assist. Using Payload Estimator during testing has achieved better than 95% accuracy when compared to actual scale weights. The Payload Estimator feature comes automatically when a machine is ordered with Sequence Assist.



- **Draft Arm Overflow Guards** — The open bowls now come standard with bowl side overflow guards to help prevent material from flowing over the bowl sides and falling onto the draft arms where material becomes embedded between the bowl side and draft arm resulting in decreased work cycle times.
- **Auto Stall** — In cold weather conditions the machine will use the Auto Stall feature to help warm up the transmission oil faster resulting in the machine shifting out of torque converter drive (2nd gear) faster than on previous models.
- **Differential Lock Engagement Protection (Standard)** — This standard feature allows the machine to prevent the operator from engaging the differential lock when damage could occur.

- **Cab Improved** — The interior of the K Series cabs has improved the operator comfort and visibility by redesigning the dash area and key pad placement.
- **Machine Speed Limit** — This feature is designed to take the place of top gear selection. If the machine top speed needs to be limited the operator can select the top speed through the display or the top speed can be set in ET. This will allow the machine to find the correct gear that works best for the engine and transmission. Allowing the engine and transmission to select the correct gear to pull the load in most cases resulting in a lower engine load factor and lower fuel burn verses using top gear selection that required the machine to run at engine speeds at or close high idle.
- **Ground Speed Control** — Ground Speed Control sets the desired top speed by the operator if job site conditions or segment speed limits require a speed less than full run out. Machine Speed Limit is intended for use when top speed needs to be limited for longer durations and Ground Speed Control is intended for use when the top speed needs to be reduced for shorter segments or intermediate periods of time. The operator can set the desired top speed and the machine will find the correct gear that works best for the engine and transmission. Allowing the engine and transmission to select the correct gear to pull the load in most cases will result in a lower engine load factor and lower fuel burn verses top gear selection.

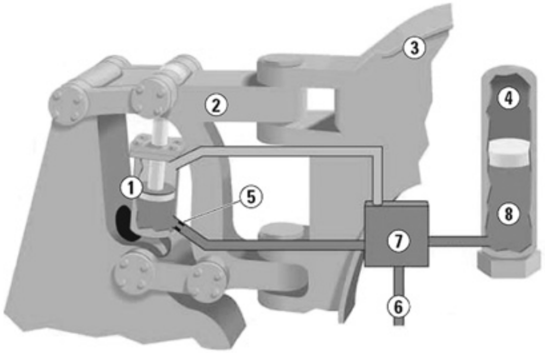
Material Application Guide	Elevator	**Self-Load** *Single and Tandem Engine*	**Push-Load** *Single and Tandem Engine*	Push Pull	Coal Bowl	Remarks
Decomposed Granite/Soil						Excellent loading
Decomposed Granite (Ripped)						Excellent loading by push- loading or push-pull to reduce cutting of tires
Moist Top Soil						Good to Excellent Loading
Top Soil						Excellent for WTS
Clay/Sand Mixture						Excellent for WTS
Sand						Good to Excellent loading, but some cases may need to be push loaded by a TTT or Push-Pull
Antigo						Excellent WTS material: lower portion may require ripping depending on material density
Coal						Excellent for WTS: ripping may be required in dense material
Limestone						In natural state, not suitable for WTS
Granite						Not suitable for WTS
Sandstone						For WTS to be productive in sandstone, material needs to be ripped. In some cases where density is high, WTS would not be a good fit
Shot Rock						Below 610 mm **(24")** good for WTS when push-loaded by a TTT to reduce cutting of tires
Loess Overtill (Banked)						Excellent for WTS: ripping may be required in dense material
Loess Overtill (Ripped)						Excellent WTS material provided rock size does not exceed 610 mm **(24")**
Aridisols						Excellent WTS material, ripping will decrease load times
Glacial Outwash/River Rock						Excellent WTS material provided rock size does not exceed 610 mm **(24")**

FOR MORE INFORMATION ON WHEEL TRACTOR-SCRAPER MATERIAL APPLICATIONS REFERENCE PUBLICATION AEXQ0442.

Push-Load TTT Match	D8	D9	D10	D11
621				
627				
631				
637				
657				

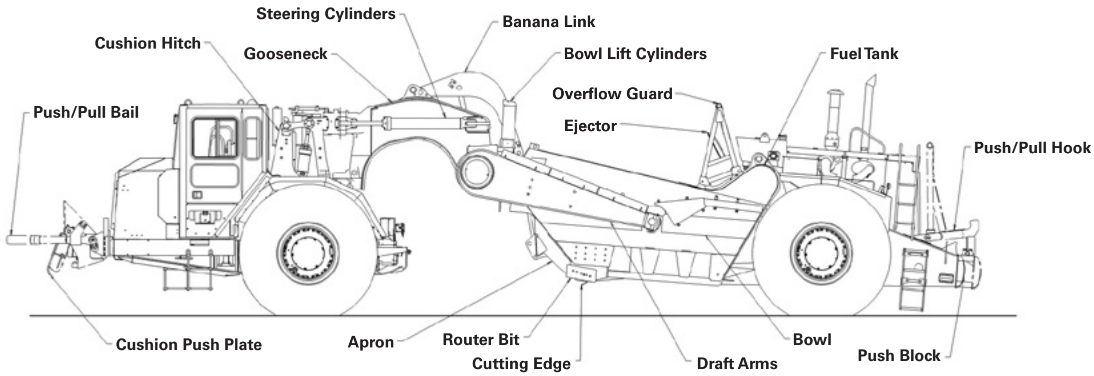
CUSHION HITCH

- Cushion Hitch dampens shocks to provide a smoother ride
- Nitrogen over oil accumulators absorb and dampen road shock



1. Load Cylinder
2. Hitch Castings
3. Scraper Gooseneck
4. Nitrogen Accumulators
5. Orifice
6. Oil from Tractor Hydraulic System
7. Leveling Valve
8. Free-Floating Pistons

WHEEL TRACTOR-SCRAPER ANATOMY



USE OF RIMPULL-SPEED-GRADEABILITY CURVES

The following explanation applies to Rimpull-Speed-Gradeability curves for Wheel Tractor-Scrapers, Construction & Mining Trucks/Tractors and Articulated Trucks.

Maximum speed attainable, gear range and available rimpull can be determined from curves on the following pages when machine weight and total effective grade (or total resistance) are known.

Rimpull is the force (in kg, lb or kN) available between the tire and the ground to propel the machine (limited by traction).

Weight is defined as Gross Machine Weight (kg or lb) = Machine + Payload.

Total Effective Grade (or Total Resistance) is grade resistance plus rolling resistance expressed as percent grade.

Grade is measured or estimated.

Rolling resistance is estimated (see Tables section for typical values.)

10 kg/metric ton (20 lb/U.S. ton) = 1% adverse grade.

Example

With a 6% grade and a rolling resistance of 40 kg/metric ton (80 lb/U.S. ton), find total resistance.

Rolling resistance = 40 kg/t ÷ 10 = 4% Effective Grade

(English: 80 lb ÷ 20 = 4%)

Total resistance = 4% rolling + 6% grade = 10%

Altitude Derating

Rimpull force and speed must be derated for altitude similar to flywheel horsepower. The percentage loss in rimpull force approximately corresponds to the percentage loss in flywheel horsepower. See Tables Section for altitude derations.

Rimpull-Speed-Gradeability

To determine gradeability performance: Read from gross weight down to the % of total resistance. (Total resistance equals actual % grade *plus* 1% for each 10 kg/metric ton (20 lb./U.S. ton) of rolling resistance.) From this weight-resistance point, read horizontally to the curve with the highest obtainable speed range, then down to the maximum speed. Usable rimpull depends upon traction and weight on drive wheels.

Example problem:

A 631K with an estimated payload of 37 013 kg (81,600 lb) is operating on a total effective grade of 10%. Find the available rimpull and maximum attainable speed.

Empty weight payload = Gross Weight
47 628 kg + 37 013 kg = 84 641 kg
(105,002 lb + 81,600 lb = 186,602 lb)

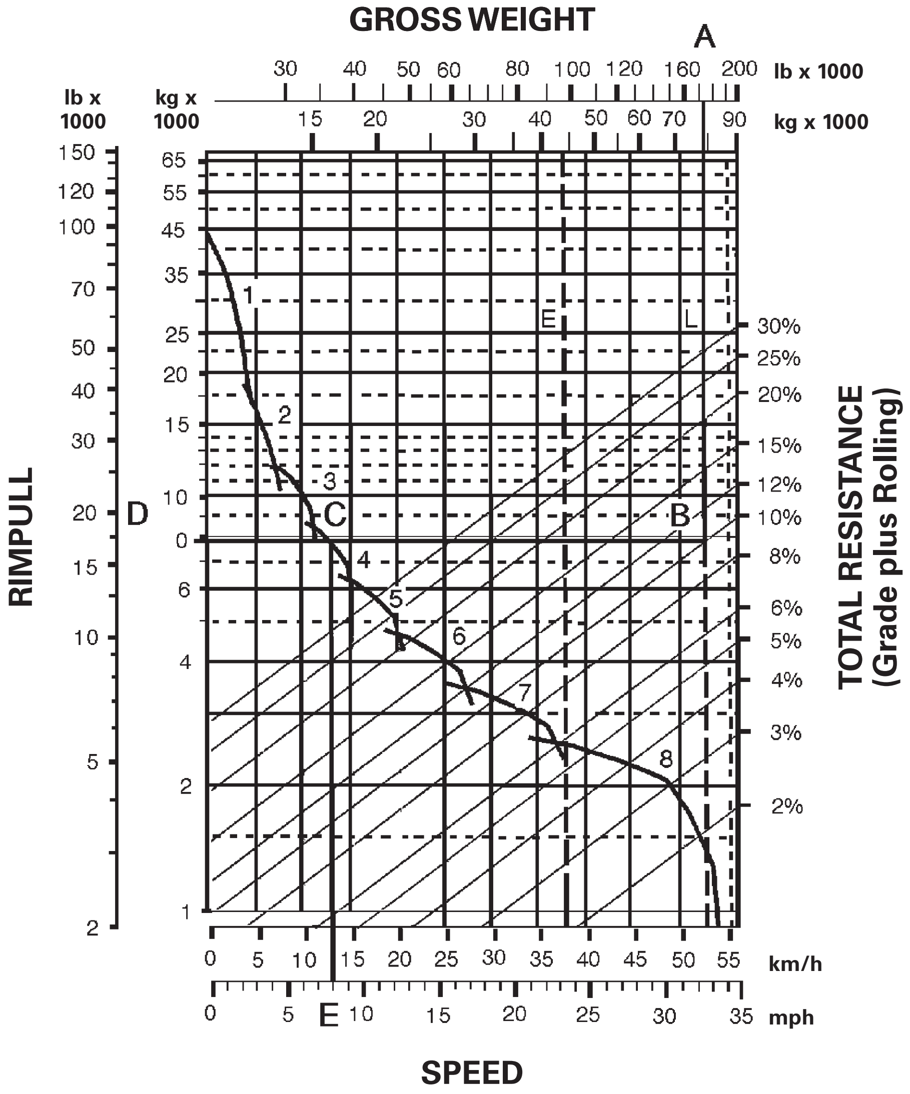
Solution: Using graph on the next page, read from 84 641 kg (186,602 lb) (point A) on top of gross weight scale down the line to the intersection of the 10% total resistance line (point B).

Go across horizontally from B to the Rimpull Scale on the left (point D). This gives the required rimpull: 7756 kg (17,100 lb).

Where the line cuts the speed curve (point C), read down vertically (point E) to obtain the maximum speed attainable for the 10% effective grade: 12.9 km/h (8 mph).

ANSWER: The machine will climb the 10% effective grade at a maximum speed of 12.9 km/h (8 mph) in 4th gear. Available rimpull is 7756 kg (17,100 lb).

● ● ●



KEY	
1 — 1st Gear Torque Converter Drive	A — Loaded 84 641 kg (186,602 lb)
2 — 2nd Gear Torque Converter Drive	B — Intersection with 10% total resistance line
3 — 3rd Gear Direct Drive	C — Intersection with rimpull curve (4th gear)
4 — 4th Gear Direct Drive	D — Required rimpull 7756 kg (17,100 lb)
5 — 5th Gear Direct Drive	E — Speed 12.9 km/h (8 mph)
6 — 6th Gear Direct Drive	
7 — 7th Gear Direct Drive	
8 — 8th Gear Direct Drive	

TYPICAL FIXED TIMES FOR SCRAPERS
(Times may vary depending on job conditions)

Model	Loaded By	Load Time (Min.)	Maneuver and Spread or Maneuver and Dump (Min.)
613G	Self	0.9	0.7
623K	Self	0.9	0.7
621K	One D8	0.5	0.7
627K	One D8	0.5	0.6
621K	One D9	0.4	0.7
627K	One D9	0.4	0.6
627K/PP	Self	0.9*	0.6
631K	One D9	0.6	0.7
637K	One D9	0.6	0.6
631K	One D10	0.5	0.7
637K	One D10	0.5	0.6
637K/PP	Self	1.0*	0.6
657	One D11	0.6	0.6
657	Push Pull Self	1.1*	0.6
637K	Coal	0.8	0.7
657	Coal	0.8	0.6

*Load time per pair, including transfer time.

NOTE: Empty Weights shown on the Wheel Tractor-Scraper charts includes ROPS Canopy. When calculating TMPH loadings *any* additional weight must be considered in establishing mean tire loads.

USE OF RETARDER CURVES

The following explanation applies to retarder curves for Wheel Tractor-Scrapers and Articulated Trucks.

The speed that can be maintained (without use of service brake) when the machine is descending a grade with retarder fully on can be determined from the retarder curves in this section if gross machine weight and total effective grade are known.

Total Effective Grade (or Total Resistance) is grade assistance *minus* rolling resistance.

10 kg/metric ton (20 lb/U.S. ton) = 1% adverse grade.

Example

15% favorable grade with 5% rolling resistance. Find Total Effective Grade.

Total Effective Grade = 15% Grade Assistance — 5%

Rolling Resistance = 10% Total Effective Grade Assistance.

Example problem:

A 651 with an estimated payload of 47 175 kg (104,000 lb) descends a 10% total effective grade. Find constant speed and gear range with maximum retarder effort. Find travel time if the slope is 610 m (2000 ft) long.

Empty Weight + Payload = Gross Weight
= 60 950 kg + 47 175 kg = 108 125 kg
(134,370 lb + 104,000 lb = 238,370 lb)

Solution: Using the retarder curve below, read from 108 125 kg (238,370 lb) (point A) on top of gross weight scale down the line to the intersection of the 10% effective grade line (point B).

Go across horizontally from point B to the intersection of the retarder curve (point C). Point C intersects at the 5 (5th gear) range.

Where point C intersects the retarder curve, read down vertically to point D on the bottom scale to obtain the constant speed: 21.7 km/h (13.5 mph).

ANSWER: The 651 will descend the slope at 21.7 km/h (13.5 mph) in 5th gear. Travel time is 1.68 minutes.

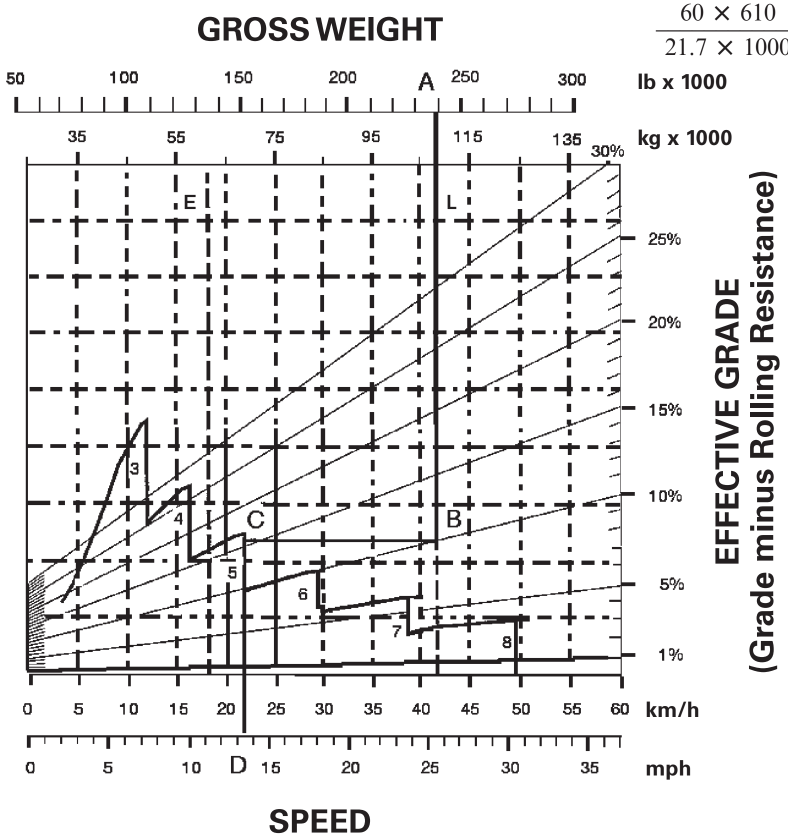
$$\frac{610 \text{ m}}{363 \text{ m/min}} = 1.68 \text{ min}$$

*(mph × 88 = F.P.M.)

$$\frac{2000 \text{ ft}}{13.5 \text{ mph} \times 88^*} = 1.68 \text{ min}$$

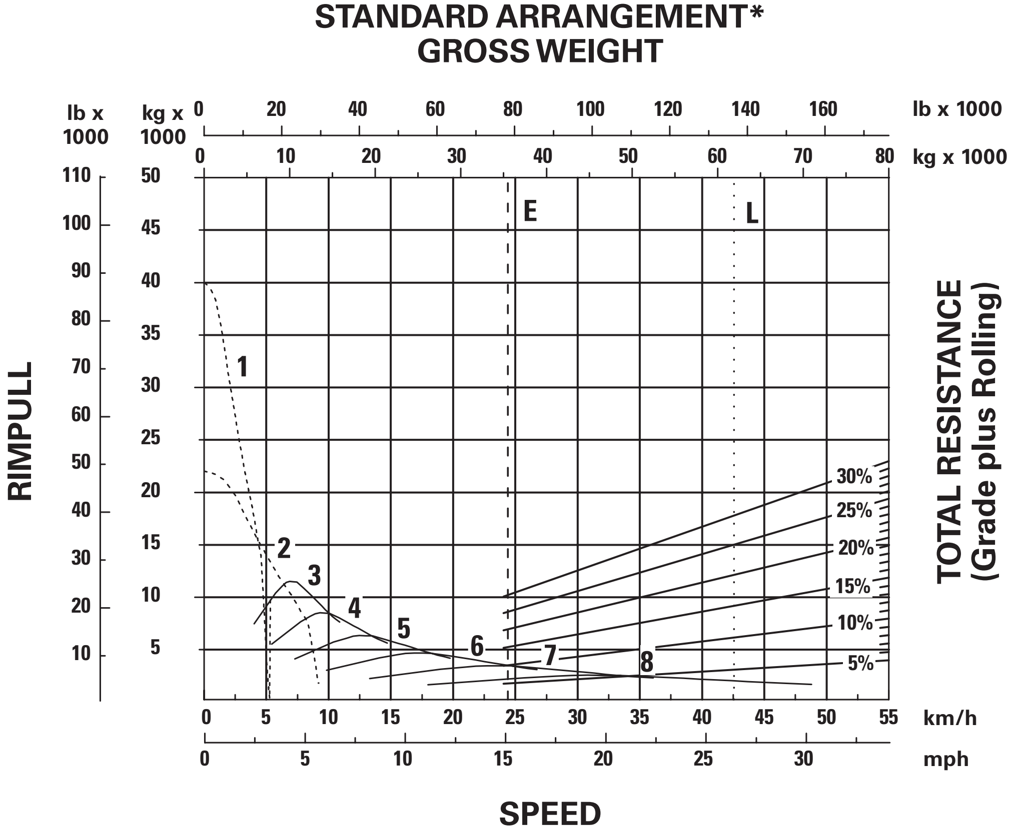
NOTE: The basic Distance-Speed-Time formula is 60 D ÷ S = T (or "60 D Street"), where 60 is minutes, D is distance, S is speed and T is time. In the above problem, 60 × 610 m ÷ 21.7 km/h × 1000 = T.

$$\frac{60 \times 610}{21.7 \times 1000} = T = (1.68)$$



KEY
- 3 — 3rd Gear Direct Drive
- 4 — 4th Gear Direct Drive
- 5 — 5th Gear Direct Drive
- 6 — 6th Gear Direct Drive
- 7 — 7th Gear Direct Drive
- 8 — 8th Gear Direct Drive

KEY
- A — Loaded 108 125 kg (238,370 lb)
- B — Intersection with 10% effective grade line
- C — Intersection with retarder curve (5th gear)
- D — Constant speed 21.7 km/h (13.5 mph)



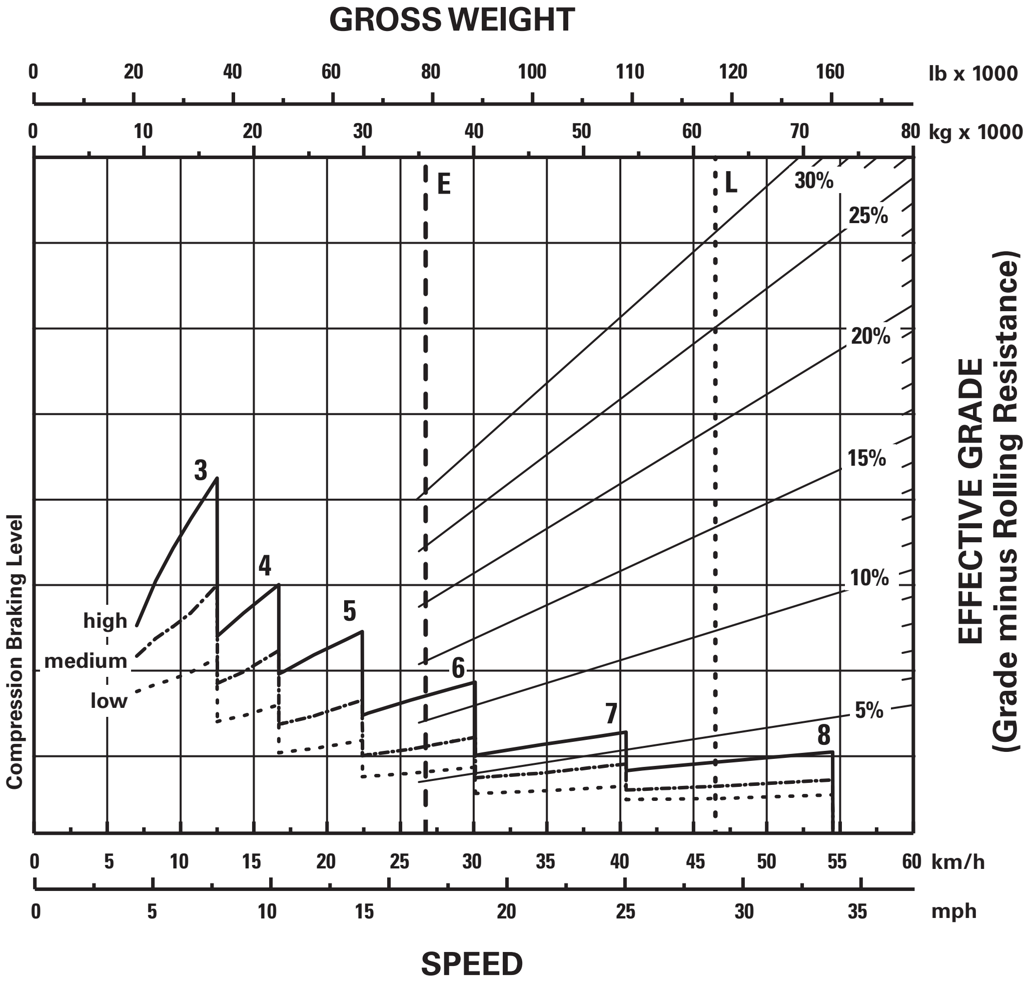
*at sea level

KEY

1 — 1st Gear Torque Converter Drive
2 — 2nd Gear Torque Converter Drive
3 — 3rd Gear Direct Drive
4 — 4th Gear Direct Drive
5 — 5th Gear Direct Drive
6 — 6th Gear Direct Drive
7 — 7th Gear Direct Drive
8 — 8th Gear Direct Drive

KEY

E — Empty 35 808 kg (78,943 lb)
L — Loaded 61 935 kg (136,553 lb)



*at sea level

KEY
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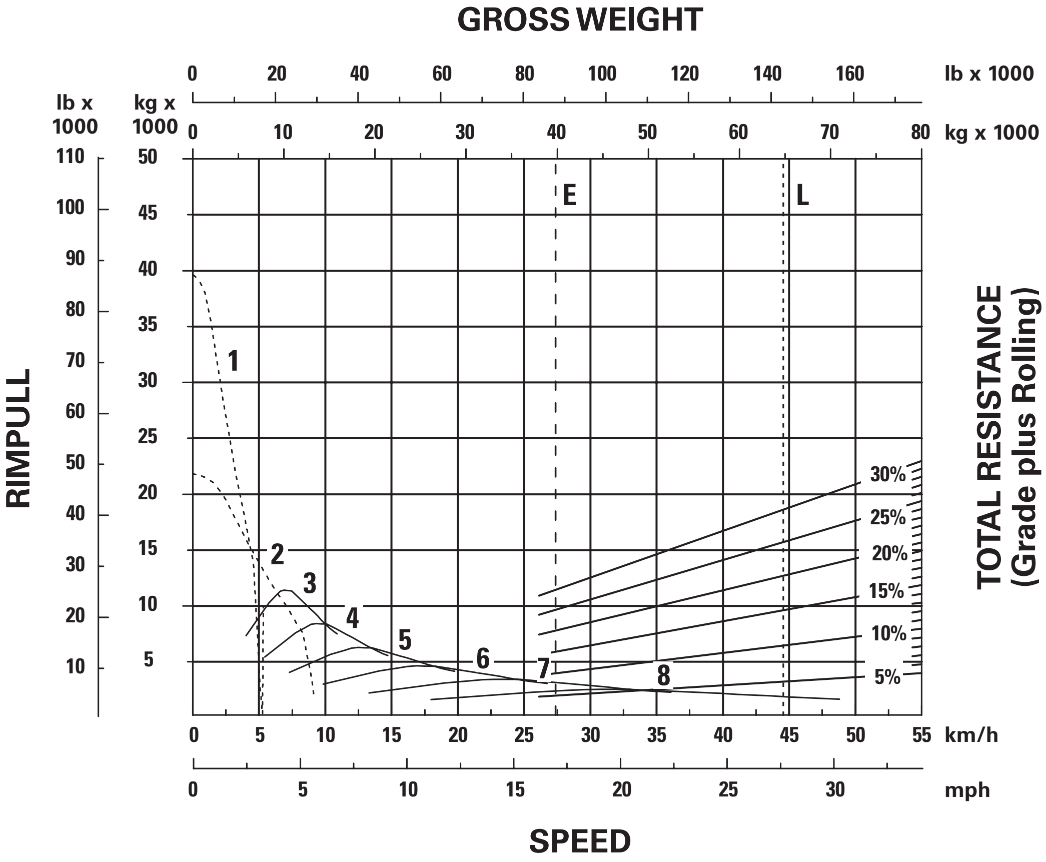

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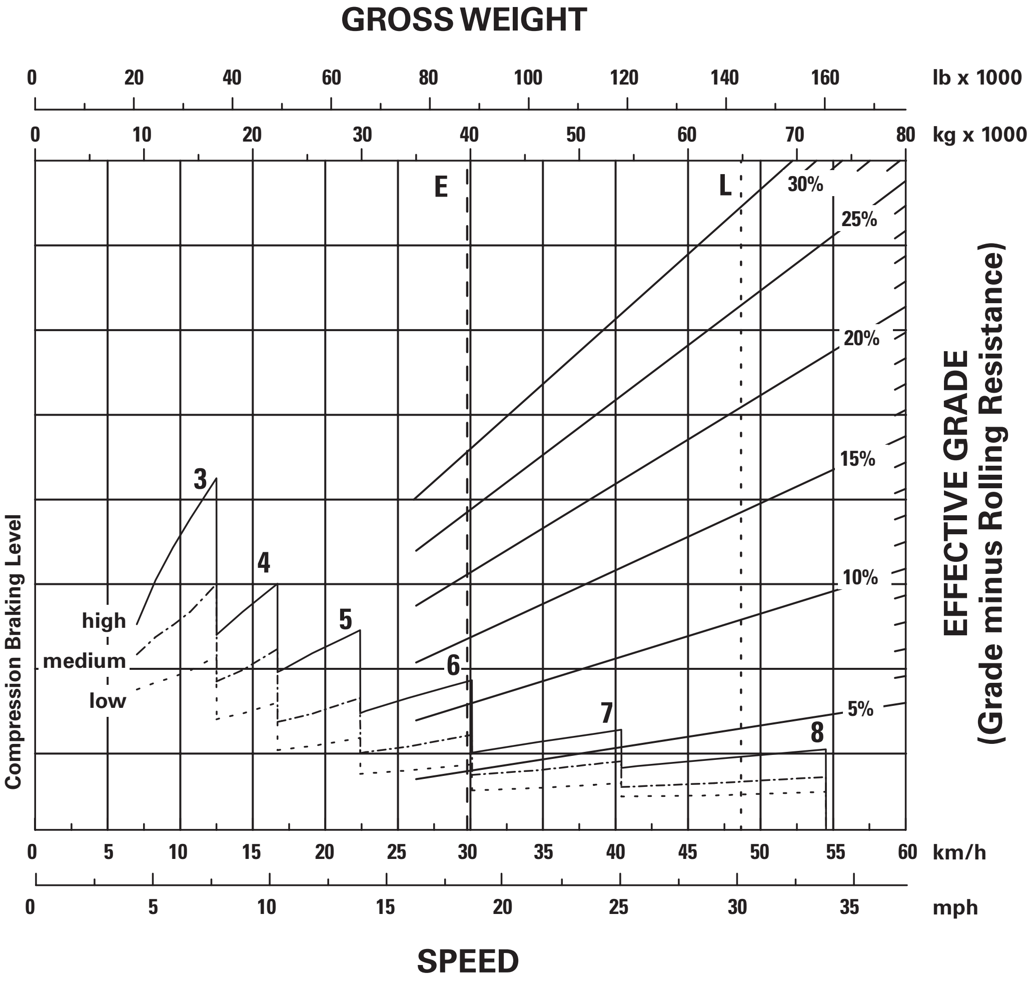
8 — 8th Gear Direct Drive

KEY

E — Empty 39 866 kg (87,809 lb)
L — Loaded 64 904 kg (143,009 lb)



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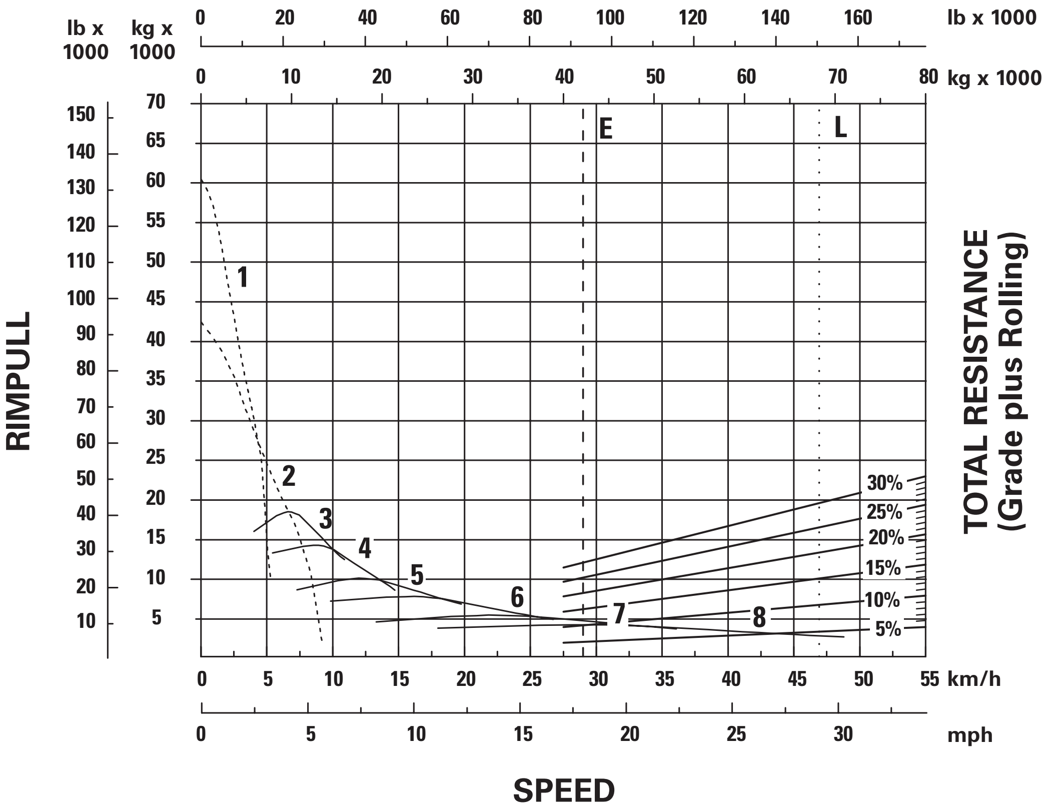
L — Loaded 64 904 kg (143,009 lb)

STANDARD ARRANGEMENT*
GROSS WEIGHT



*at sea level

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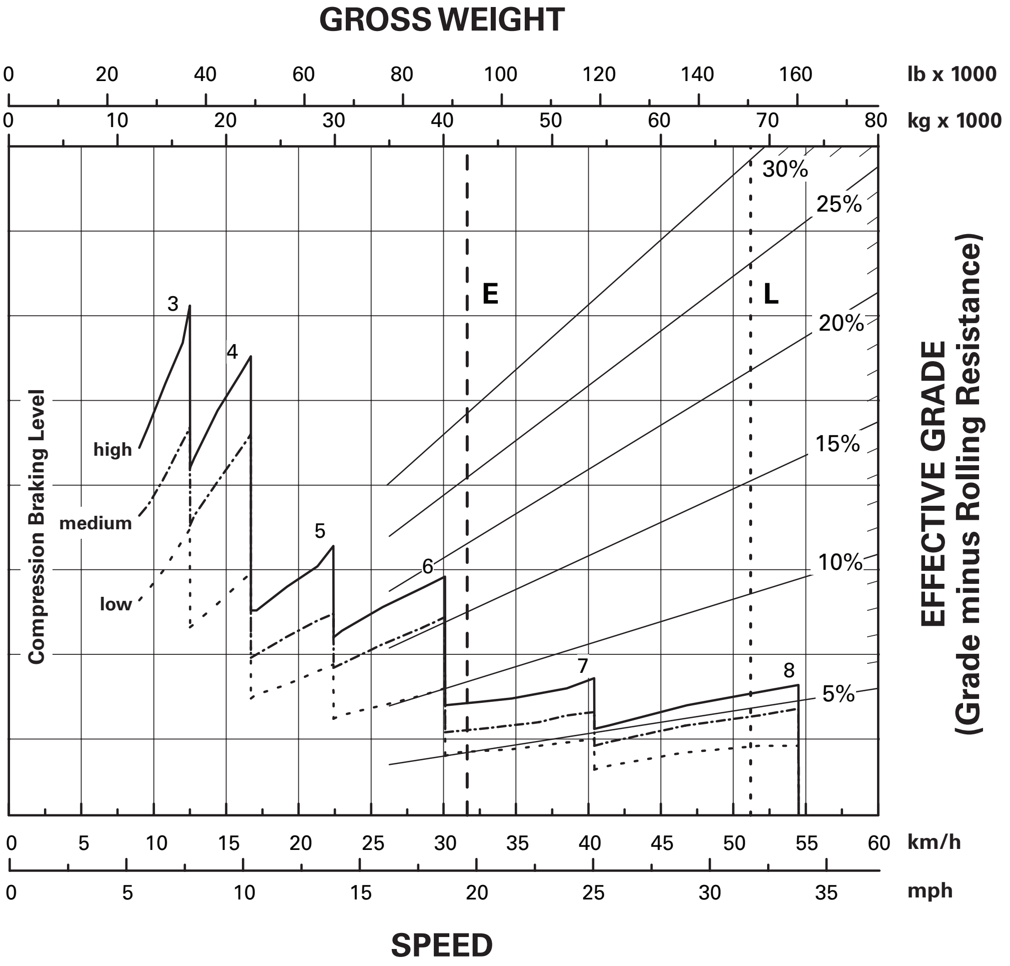
8 — 8th Gear Direct Drive

KEY
E — Empty 42 158 kg (92,942 lb)
L — Loaded 68 289 kg (150,552 lb)



*at sea level

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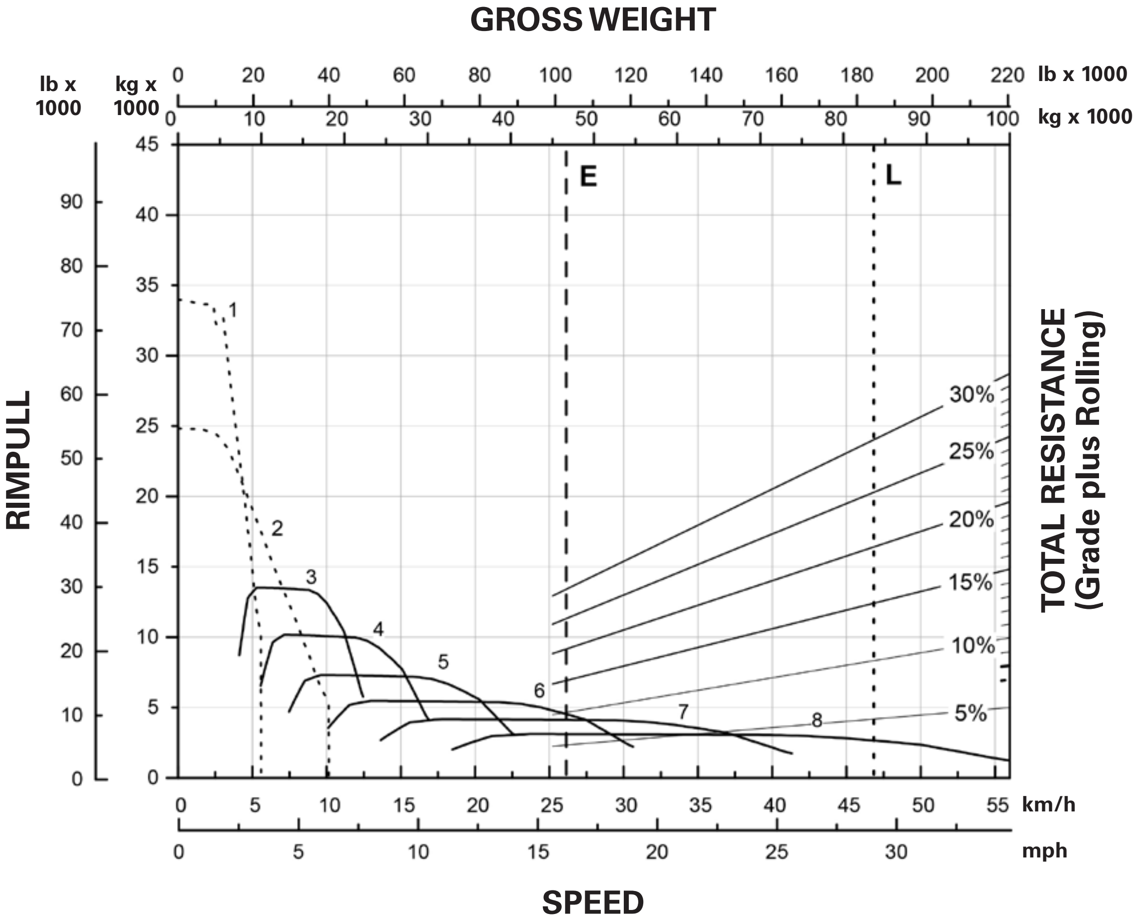

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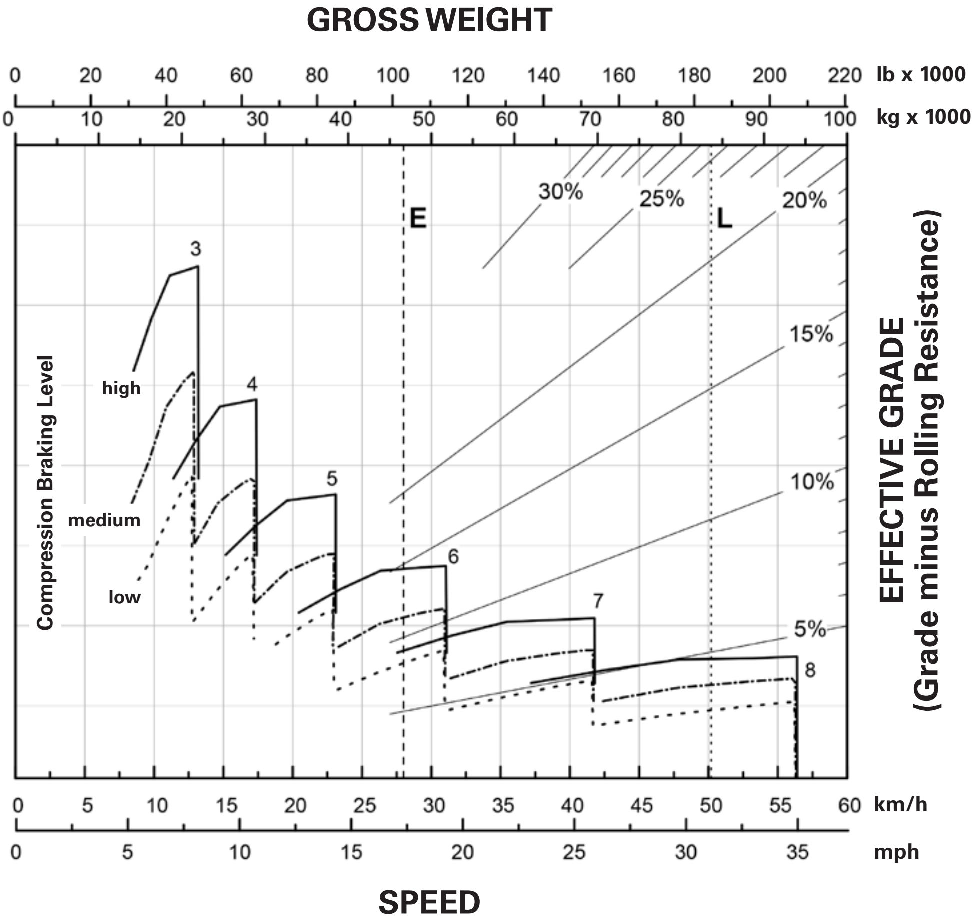
5 — 5th Gear Direct Drive
6 — 6th Gear Direct Drive
7 — 7th Gear Direct Drive
8 — 8th Gear Direct Drive

KEY

E — Empty 46 607 kg (102,750 lb)
L — Loaded 83 892 kg (184,950 lb)



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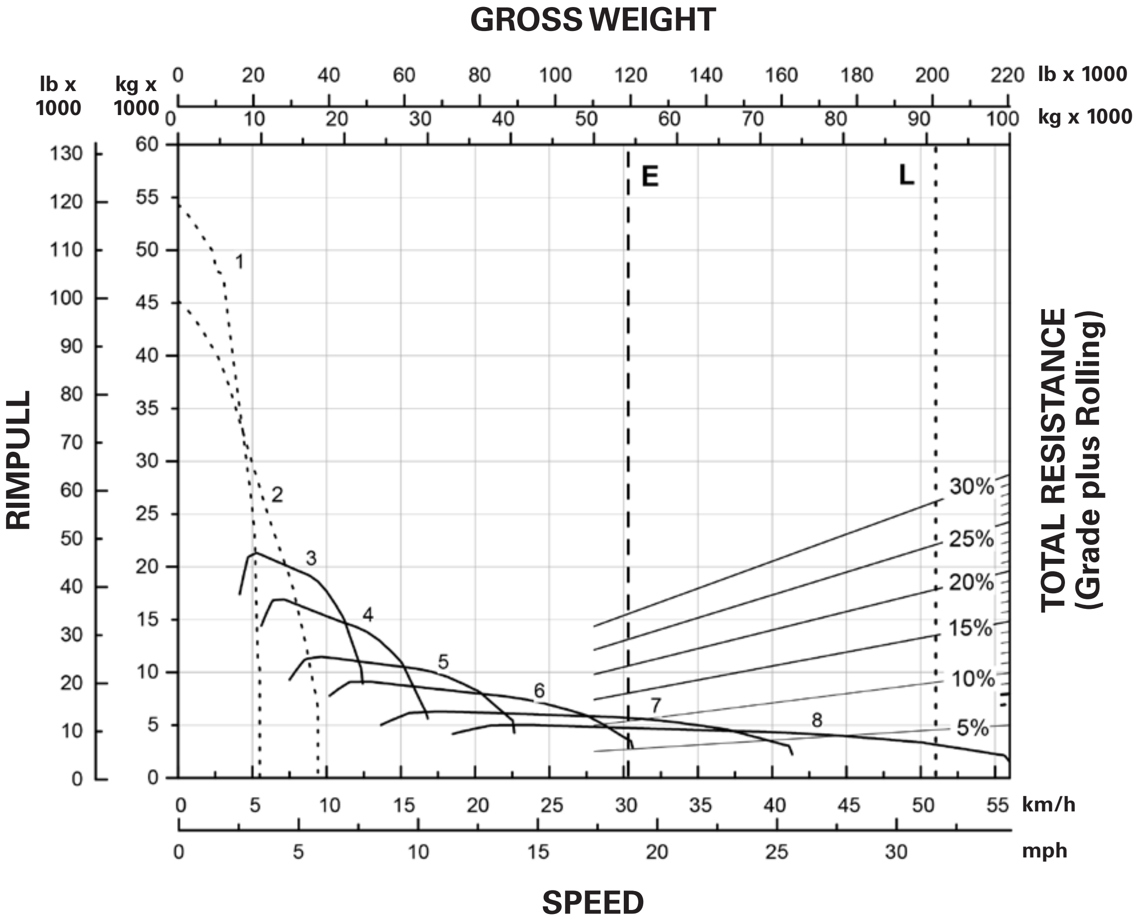

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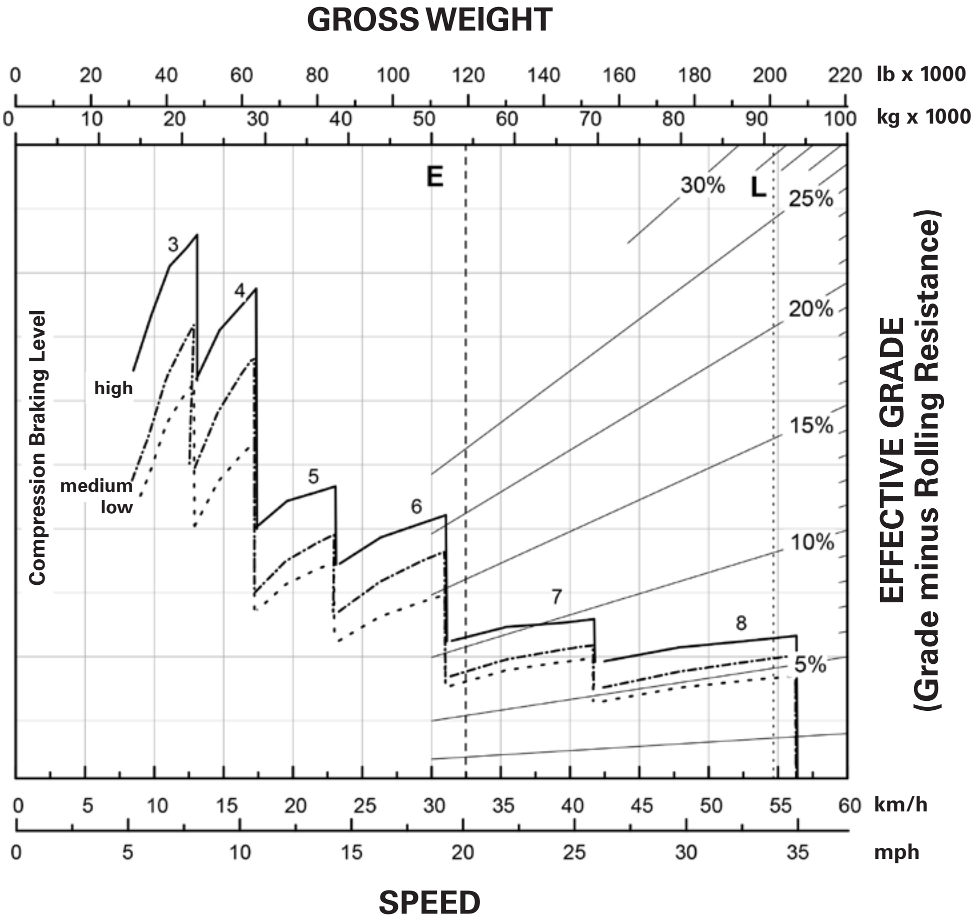
7 — 7th Gear Direct Drive
8 — 8th Gear Direct Drive

KEY

E — Empty 54 005 kg (119,060 lb)
L — Loaded 91 290 kg (201,260 lb)



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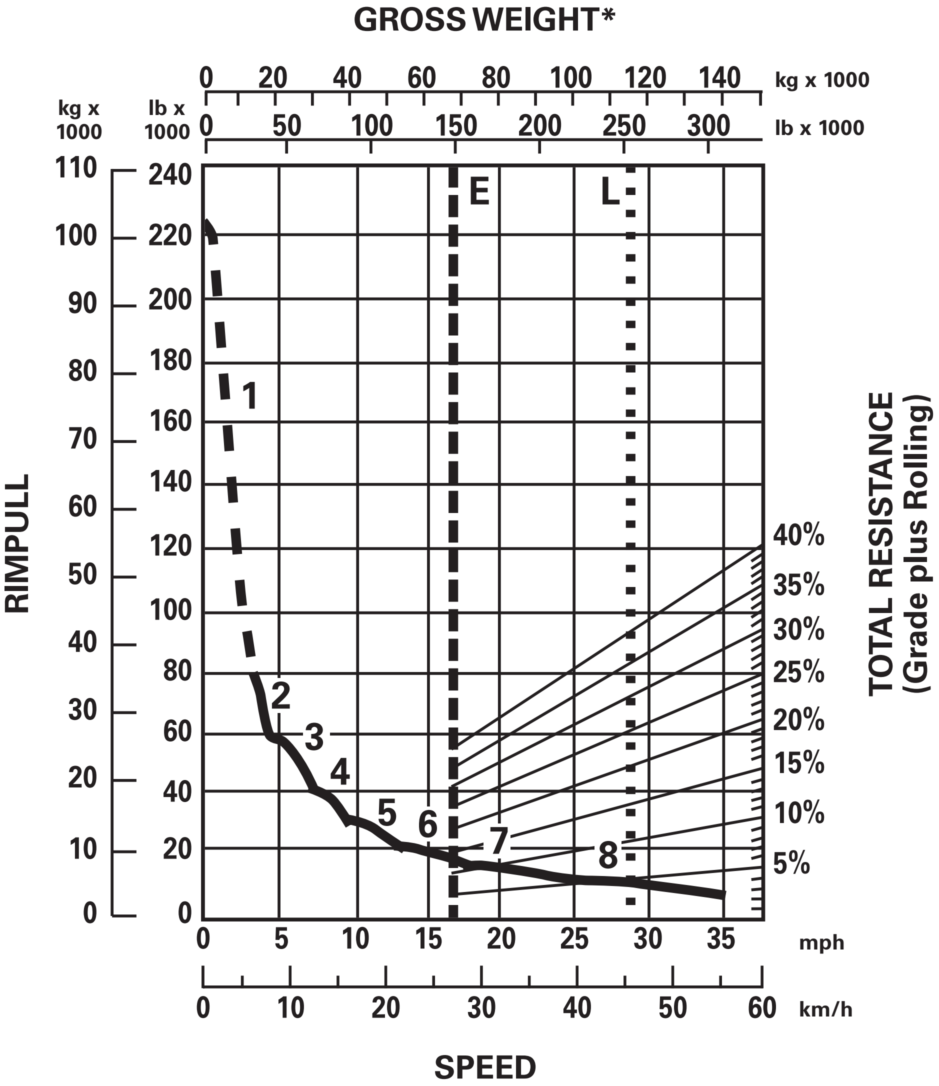

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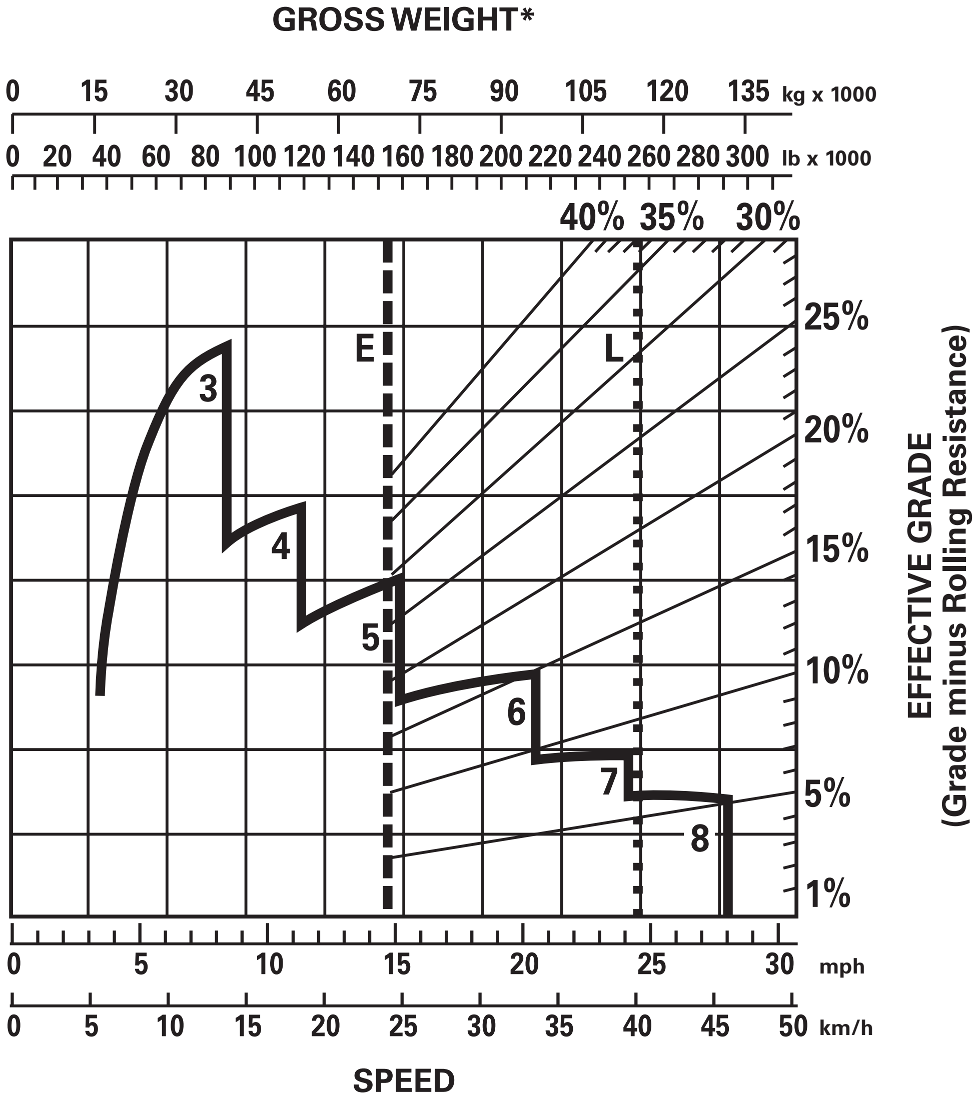
KEY
E — Empty 72 804 kg (160,505 lb)
L — Loaded 119 978 kg (264,505 lb)



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ESTIMATING OWNING & OPERATING COSTS

CONTENTS

General

Machine users must balance productivity and costs to achieve optimum performance ... that is, achieve the desired production at the lowest possible cost. The approach most often used to measure machine performance is this simple equation:

$$\frac{\textit{Lowest Possible Hourly Costs}}{\textit{Highest Possible Hourly Productivity}} = \textit{Top Machine Performance}$$

Most sections of this Handbook deal with the productivity of Cat machines. This section considers the cost aspect of performance.

Hourly Owning and Operating Costs for a given machine can vary widely because they are influenced by many factors: the type of work the machine does, the ownership period, local prices of fuel and labor, the repair and maintenance costs, shipping costs from the factory, interest rates, etc. No attempt is made in this handbook to provide precise hourly costs for each model. Users must be able to estimate with a reasonable degree of accuracy what a machine will cost per hour to own and operate in a given application and locality. Therefore, this section provides a suggested method of estimating hourly owning and operating costs. When this method is coupled with local conditions and dealer input, it will result in reasonable estimates.

The method suggested follows several basic principles:

- Repair and Planned Maintenance cost per hour are developed jointly by the customer and local Cat dealer.
- In the examples, labor is assumed @ $60.00 per hour, fuel @ $1.25 per gallon. For reliable estimates, these costs must always be obtained locally.
- Because of different standards of comparison, what may seem a high application to one machine owner may appear only medium to another.
- Unless otherwise specified, the word "hour" when used in this section means clock or operating hours, not Service Meter Units.

NOTE: An Excel O&O Estimating Form is available, in electronic spreadsheet format, to calculate an Hourly Owning & Operating Cost Estimate based on the procedure outlined in this section.
The spreadsheet my be accessed via the website at https://dealer.cat.com – From the home page, select "Product Support," "Equipment Management Solutions," "Owning & Operating Costs." Under the heading "Machine Technical Information," select "O&O COST ESTIMATING Form."

HOURLY OWNING AND OPERATING COST ESTIMATE

DATE ____________

	Estimate #1	Estimate #2
A–Machine Designation	________	________
B–Estimated Ownership Period (Years)	________	________
C–Estimated Usage (Hours/Year)	________	________
D–Ownership Usage (Total Hours)(B × C).	________	________

OWNING COSTS

	Estimate #1	Estimate #2
1. a. Delivered Price (P), to the Customer (including attachments)	________	________
b. Less Tire Replacement Cost if desired	________	________
c. Delivered Price Less Tires.	________	________
2. Less Residual Value at Replacement (S) . . . . (See subsection 2A on back)	(___%) ________	(___%) ________
3. a. Net Value to be recovered through work . . . . (line 1c less line 2)	________	________
b. Cost Per Hour: $\frac{\text{Net Value}}{\text{Total Hours}}$ (1) ________ (2) ________	________	________

4. Interest Costs N = No. Yrs.

$$\frac{\frac{P(N+1)+S(N-1)}{2N} \times \text{Simple Int. \% Rate}}{\text{Hours/Year}} =$$

(1) $\frac{\frac{\_\_\_ + 1 + \_\_\_ - 1}{\_\_\_} \times \_\_\_\%}{\_\_\_\ \text{Hours/Yr.}} =$ (2) $\frac{\frac{\_\_\_ + 1 + \_\_\_ - 1}{\_\_\_} \times \_\_\_\%}{\_\_\_\ \text{Hours/Yr.}} =$ ________ ________

5. Insurance N = No. Yrs.

$$\frac{\frac{P(N+1)+S(N-1)}{2N} \times \text{Insurance \% Rate}}{\text{Hours/Year}} =$$

(1) $\frac{\frac{\_\_\_ + 1 + \_\_\_ - 1}{\_\_\_} \times \_\_\_\%}{\_\_\_\ \text{Hours/Yr.}} =$ (2) $\frac{\frac{\_\_\_ + 1 + \_\_\_ - 1}{\_\_\_} \times \_\_\_\%}{\_\_\_\ \text{Hours/Yr.}} =$ ________ ________

(Optional method when Insurance cost per year is known)

Ins. $ ________ Per Yr. ÷ ________ Hours/Yr. =

22

	Estimate #1	Estimate #2
6. Property Tax N = No. Yrs. $\dfrac{\dfrac{P(N+1)+S(N-1)}{2N} \times \text{Tax Rate \%}}{\text{Hours/Year}} =$		
(1) $\dfrac{\dfrac{\_\_\_+1 + \_\_\_-1}{\_\_\_} \times \_\_\_\ \%}{\_\_\_\ \text{Hours/Yr.}} =$ (2) $\dfrac{\dfrac{\_\_\_+1 + \_\_\_-1}{\_\_\_} \times \_\_\_\ \%}{\_\_\_\ \text{Hours/Yr.}} =$	________	________
(Optional method when Property Tax cost per year is known)		
Property Tax $ ________ Per Yr. ÷ ________ Hours/Yr. =		
7. TOTAL HOURLY OWNING COST (add lines 3b, 4, 5 and 6)	☐	☐

OPERATING COSTS

	Estimate #1	Estimate #2
8. Fuel: Unit Price × Consumption		
(1) ______ × ________ =	________	________
(2) ______ × ________ =		
9. Planned Maintenance (PM)-Lube Oils, Filters, Grease, Labor: (contact your local Cat dealer).	________	________
10. a. Tires: Replacement Cost ÷ Life in Hours $\dfrac{\text{Cost}}{\text{Life}}$ (1) ________ (2) ________	________	________
b. Undercarriage (Impact + Abrasiveness + Z Factor) × Basic Factor		
(1) (_____ + _____ + _____) = _____ × _____ =	________	________
(2) (_____ + _____ + _____) = _____ (Total) × _____ (Factor) =		
11. Repair Cost (Per Hour) (contact your local Cat dealer).	________	________
12. Special Wear Items: Cost ÷ Life . . . . (See subsection 12A on back)	________	________
13. TOTAL OPERATING COSTS (add lines 8, 9, 10a (or 10b), 11 and 12)	________	________
14. MACHINE OWNING PLUS OPERATING (add lines 7 and 13)	________	________
15. OPERATOR'S HOURLY WAGE (include fringes)	________	________
16. TOTAL OWNING AND OPERATING COST	☐	☐

SUBSECTION 2A: Residual Value at Replacement

Gross Selling Price	(est. #1) (___%)	__________	(est. #2) (___%)	__________
Less: a. Commission		__________		__________
b. Make-ready costs		__________		__________
c. Inflation during ownership period*		__________		__________
Net Residual Value (Enter on line 2)		__________	(___%)	__________ (___%) of original delivered price

*When used equipment auction prices are used to estimate residual value, the effect of inflation during the ownership period should be removed to show in constant value what part of the asset must be recovered through work.

SUBSECTION 12A: Special Items
(cutting edges, ground engaging tools, bucket teeth, etc.)

(1)	Cost		Life		Cost/Hour	(2)					
1.	____________	÷	____________	=	____________	1.	____________	÷	____________	=	____________
2.	____________	÷	____________	=	____________	2.	____________	÷	____________	=	____________
3.	____________	÷	____________	=	____________	3.	____________	÷	____________	=	____________
4.	____________	÷	____________	=	____________	4.	____________	÷	____________	=	____________
5.	____________	÷	____________	=	____________	5.	____________	÷	____________	=	____________
6.	____________	÷	____________	=	____________	6.	____________	÷	____________	=	____________
			Total	(1)	____________	(2)	____________				

(Enter total on line 12)

1-7 ESTIMATING OWNING COSTS

(Line Items 1 through 7)

To protect their equipment investment and be able to replace it, the machine owner must recover over the ownership period an amount equal to the loss in resale value plus the other costs of owning the equipment including interest, insurance and taxes.

The machine owner, for accounting purposes, estimates resale value loss in advance, and recovers his original equipment investment by establishing depreciation schedules according to the various uses of the equipment. Proper financial and tax assistance is highly recommended when establishing depreciation schedules.

Considering today's economic conditions worldwide and the trend toward larger, more expensive equipment, many users choose to keep these units on the job well after they have been fully depreciated for tax purposes. On the other hand, tax incentives in many areas may favor trading a machine well before that occurs.

The ownership period in years, the hours per year, and the total number of hours on a machine, are significant factors in determining O&O costs. Additionally, since the ownership period and machine hours can vary widely for different customers for a given model, it is not practical to calculate O&O costs using an assumed ownership period. The customer must provide that information for each situation.

These same factors will be used to develop the Repair costs and Planned Maintenance costs by your local Cat dealer.

The machine depreciation method suggested in this handbook is not based on or related to any tax considerations, but rather is a simple straight line write-off based solely on the number of years and hours the owner expects to use during the ownership period.

Accordingly, it is imperative that careful consideration be given the selection of depreciation periods, and that for owning and operating cost calculations they be based on actual ownership periods and hours on the machine rather than tax write-off life.

Typical Application Descriptions

The following tables show typical descriptions for work performed by each product family for three different application levels. It is only a guide and can be used along with the fuel and tire charts to help determine fuel and tire cost factors. Additionally, many times the ownership period and the number of hours per year a machine is used, is related to application.

1 DELIVERED PRICE TO CUSTOMER

(Line Item 1a, b and c)

Delivered price should include all costs of putting a machine on the user's job including transportation and any applicable sales taxes.

On rubber tired machines, tires are considered a wear item and covered as an operating expense. Accordingly, some users may wish to deduct tire costs from the delivered price particularly for larger machines.

2 RESIDUAL VALUE AT REPLACEMENT

(Line Item 2 and Subsection 2A)

Any piece of earthmoving machinery will have some residual value at trade-in. While many owners prefer to depreciate their equipment to zero value, others recognize the residual resale or trade-in value. This is at the estimator's option, but as in the discussion of depreciation, today's higher equipment costs almost dictate that resale value be considered in determining the net depreciable investment. And if machines are traded early for tax incentive purposes, resale value becomes even more significant.

For many owners, potential resale or trade-in value is a key factor in their purchasing decisions, since this is a means of reducing the investment they must recover through depreciation charges. The high resale value of Caterpillar built machines can reduce hourly depreciation charges, lower total hourly owning costs and improve the owner's competitive position.

When resale or trade-in value is used in estimating hourly owning and operating costs, local conditions must be considered, as used equipment values vary widely around the world. However, in any given used equipment business, factors which have greatest influence on resale or trade-in value are: age of machine (years), the number of hours on the machine at the time of sale or trade, the type of jobs and operating conditions in which it worked, and the physical condition of the machine. Your local Cat dealer is your best source for determining current used equipment values.

Subsection 2A can be used to calculate the estimated residual value. If recent auction prices for used machines are used as a guide, then the value (or percentage) should be adjusted downward to remove the effect of inflation. Governmental indices on construction equipment costs or Dealer price records can be used to calculate the amount of inflation for the appropriate useful life. Another way to estimate residual value is comparing the current used machine value to the current new machine price provided major product changes haven't occurred.

3 VALUE TO BE RECOVERED THROUGH WORK

(Line Item 3a and b)

The delivered price (P) less the estimated residual value (S) results in the value to be recovered through work, divided by the total usage hours, gives the hourly cost to protect the asset's value.

4 INTEREST

(Line Item 4)

Many owners charge interest as part of hourly owning and operating costs, others consider it as general overhead in their overall operation. When charged to specific machines, interest is usually based on the owner's average annual investment in the unit.

Interest is considered to be the cost of using capital. The interest on capital used to purchase a machine must be considered, whether the machine is purchased outright or financed.

If the machine will be used for N years (where N is the number of years of use), calculate the average annual investment during the use period and apply the interest rate and expected annual usage:

$$\frac{\left[\dfrac{P(N+1)+S(N-1)}{2N}\right] \times \text{Simple Int. \% Rate}}{\text{Hours/Year}}$$

5-6 INSURANCE AND TAXES

(Line Items 5 and 6)

Insurance cost and property taxes can be calculated in one of two ways. If the specific annual cost is known, this figure should be divided by the estimated usage (hours/years) and used. However, when the specific interest and tax costs for each machine are not known, the following formulas can be applied:

$$\frac{\text{Insurance}}{\text{N = No. Years}}$$

$$\frac{\left[\dfrac{P(N+1)+S(N-1)}{2N}\right] \times \text{Insurance \% Rate}}{\text{Hours/Year}}$$

$$\frac{\text{Property Tax}}{\text{N = No. Years}}$$

$$\frac{\left[\dfrac{P(N+1)+S(N-1)}{2N}\right] \times \text{Tax Rate \%}}{\text{Hours/Year}}$$

8-13 ESTIMATING OPERATING COSTS

(Line Items 8 through 13)

8 FUEL CONSUMPTION

(Line Item 8)

Actual fuel consumption should be measured in the field. However, if no opportunity exists to do this, fuel consumption estimates can be provided by the Caterpillar dealer based on Product Link™ data and experience in the application.

To estimate hourly fuel cost, determine the hourly fuel consumption and multiply by the local unit price of fuel.

Hourly consumption × Local Unit Price of Fuel = Hourly Fuel Cost

9

**PLANNED MAINTENANCE (PM)
LUBE OILS, FILTERS, GREASE, LABOR**

Planned Maintenance (PM) costs should be developed by the Cat dealer, with customer input for the specific application.

PM costs include the parts and labor at the intervals specified in the Operation and Maintenance Manuals provided for each machine. PM costs for each machine may vary slightly depending upon factors required or specified by the customer. See your local Cat dealer to develop the specific PM cost per hour estimate for your machine and application.

10a TIRES

(Line Item 10a)

Tire costs are an important part of the hourly cost of any wheel machine. Tire costs are also one of the most difficult to predict with many variables. The best estimate for tire costs are obtained when tire life estimates are based upon actual customer experience, and are used with prices the machine owner actually pays for the replacement tires.

For cases in which tire experience is not available, use the following tire life estimator curves.

Tire Life Estimators

- Curves do not allow for additional life from recapping. They assume new tires run to destruction, but this is not necessarily recommended.
- Based on standard machine tires. Optional tires will shift these curves either up or down.
- Sudden failure (blow out) due to exceeding Ton-MPH (tkm/h) limitations is not considered. Nor are premature failures due to puncture.
- Application Descriptions/Zones:

  Low/Zone A: almost all tires actually wear through the tread from abrasion.

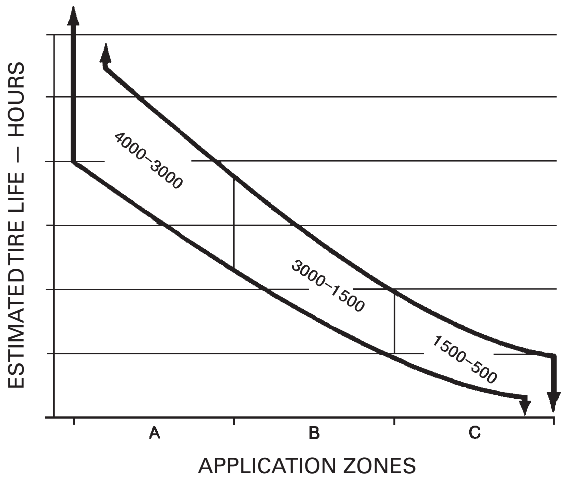
  Medium/Zone B: tires wear out normally but others fail prematurely due to rock cuts, impacts and non-repairable punctures.

  High/Zone C: few, if any, tires wear through the tread due to non-repairable damages, usually from rock cuts, impacts and continuous overloading.

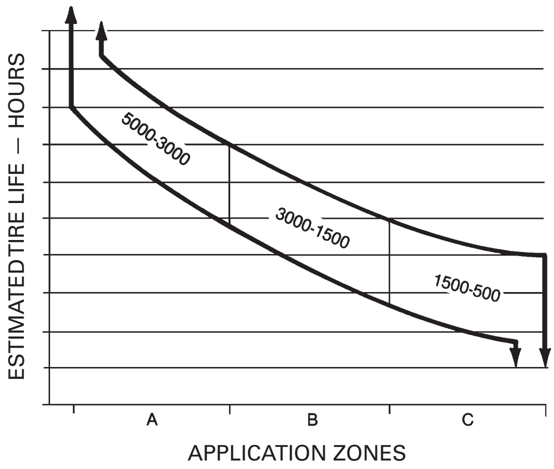
NOTE: Tire life can often be increased by using extra tread and extra deep tread tires.

NOTE: Premature failure could occur at any time due to puncture.

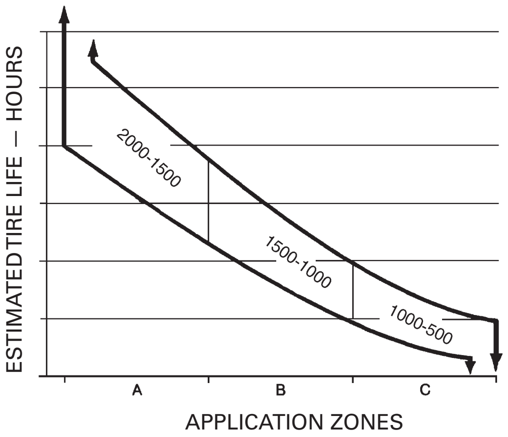
MOTOR GRADERS



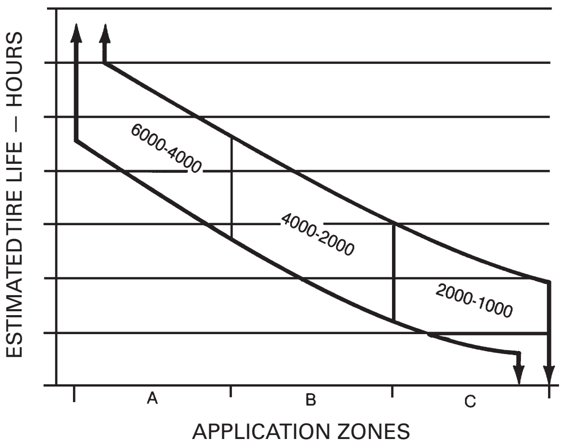
WHEEL TRACTOR-SCRAPERS



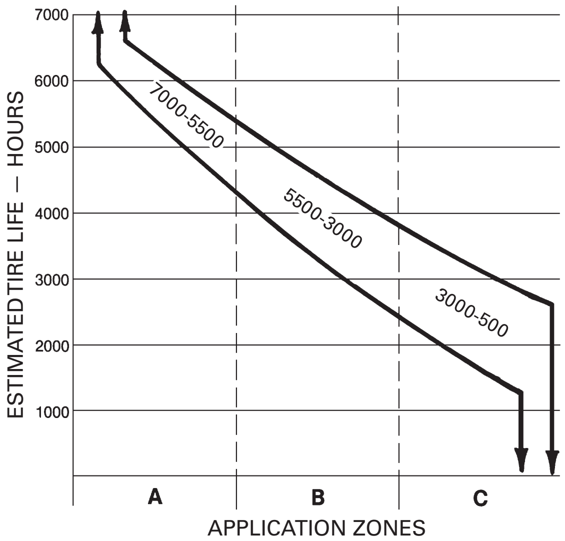
LOAD HAUL DUMP UNITS



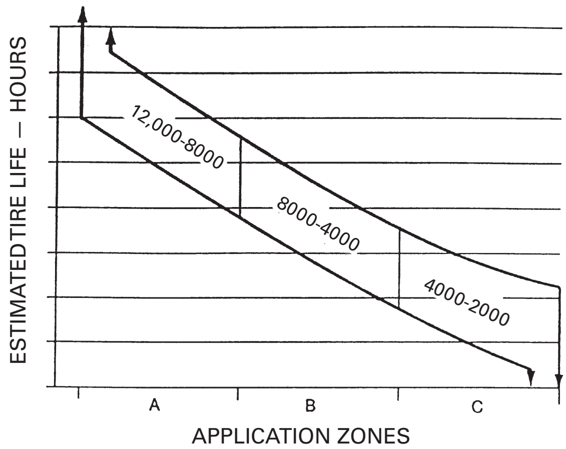
MINING & OFF-HIGHWAY TRUCKS



ARTICULATED TRUCKS



TRACTORS/WAGONS



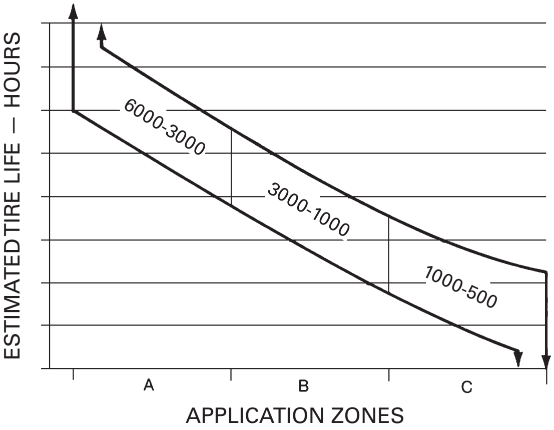
Key:

Zone A — Almost all tires actually wear through the tread due to abrasion.

Zone B — Some tires wear out normally while others fail prematurely due to rock cuts, impacts and non-repairable punctures.

Zone C — Few, if any, tires wear through the tread because of non-repairable damages, usually from rock cuts, impacts or continuous overloading.

WHEEL TRACTORS
WHEEL LOADERS



Key:

Zone A — Almost all tires actually wear through the tread due to abrasion.

Zone B — Some tires wear out normally, others fail prematurely due to rock cuts, impacts, and non-repairable punctures.

Zone C — Few, if any, tires wear through the tread because of non-repairable damages, usually from rock cuts, impacts, or continuous overloading.

GOODYEAR LIFE ESTIMATING SYSTEM

As an additional assist in estimating *hauling unit* tire life, Goodyear Tire and Rubber Co. has furnished the following information which is included here with their permission. READ THE PREAMBLE CAREFULLY.

"… at present, there is no completely accurate, fool-proof method of forecasting tire life. Tire engineers have many theoretical methods … but these generally are so involved and time consuming that they are impractical for field use.

"However, the tire industry has made many surveys of tire performance and arrived at a system which can give rough *estimates* of tire life. Studies done by the major tire companies and by at least two major equipment manufacturers are in close agreement.

"The table [which follows] shows how to apply this system …"

ESTIMATED TIRE SERVICE LIFE OF HAULING UNITS (Trucks and Scrapers)

No.	Condition	Factor
I	**Maintenance**	
	Excellent	1.090
	Average	0.981
	Poor	0.763
II	**Speeds (Maximum)**	
	16 km/h ~ **10 mph**	1.090
	32 km/h ~ **20 mph**	0.872
	48 km/h ~ **30 mph**	0.763
III	**Surface Conditions**	
	Soft Earth — No Rock	1.090
	Soft Earth — Some Rock	0.981
	Well Maintained — Gravel Road	0.981
	Poorly Maintained — Gravel Road	0.763
	Blasted — Sharp Rock	0.654
IV	**Wheel Positions**	
	Trailing	1.090
	Front	0.981
	Driver (Rear Dump)	0.872
	(Bottom Dump)	0.763
	(Self Propelled Scraper)	0.654
V	**Loads** (See No. VIII note)	
	T&RA/ETRTO* Recommended Loading	1.090
	20% Overload	0.872
	40% Overload	0.545
VI	**Curves**	
	None	1.090
	Medium	0.981
	Severe	0.872
VII	**Grades** (Drive Tires Only)	
	Level	1.090
	5% Max.	0.981
	15% Max.	0.763
VIII	**Other Miscellaneous Combinations** (See note below)	
	None	1.090
	Medium	0.981
	Severe	0.872
	Condition VIII is to be used when overloading is present in combination with one or more of the primary conditions of maintenance, speeds, surface conditions and curves. The combination of severe levels in these conditions, together with an overload, will create a new and more serious condition which will contribute to early tire failure to a larger extent than will the individual factors of each condition.	

*Tire and Rim Association/European Tire and Rim Technical Organization.

Type of Tire	Base Average Life Hours	km	Miles
E-3 Std. Bias Tread	2510	40 400	**25,100**
E-4 Bias Xtra Tread	3510	56 500	**35,100**
E-4 Radial Xtra Tread	4200	67 600	**42,000**

Using Base Hours (or Miles), multiply by the appropriate factor for *each* condition to obtain approximate estimated hours (or miles) as the final product.

Example: An off-highway truck equipped with E-4 drive tires running on a well maintained haul road having easy curves and minimum grades and receiving "average" tire maintenance attention but being 20% overloaded:

Condition:	I	II	III	IV	V	VI	VII	VIII
Factor:	0.981 ×	0.872 ×	0.981 ×	0.872 ×	0.872 ×	0.981 ×	0.981 ×	0.981

× 3510 base hours = 2114 hours (say 2100 hours)

As can be seen, this system requires the careful application of strictly subjective judgments, and can be expected to result in conservative estimates. Keep in mind, however, **that the system is offered only as an aid in estimating and not as a rigid set of rules.**

On the other hand, if tire life on a given job is considered less than satisfactory, an analysis of these factors may point to conditions which can be improved to the betterment of tire life.

Replacement tire prices should always be obtained from local tire company sources.

Since tires are considered a wear item in this method of estimating owning and operating costs, total tire replacement cost is deducted from machine delivered price to arrive at a net figure for depreciation purposes. Outlay for tires is then included as an item in operating costs:

$$\text{Hourly Tire Cost} = \frac{\text{Replacement Cost of Tires}}{\text{Estimating Tire Life in Hours}}$$

Recapping can sometimes lower hourly tire cost. Considerations are availability of molds, local recapping costs, and experience with recap life.

10b UNDERCARRIAGE

(Line Item 10b)

Undercarriage expense can be a major portion of the operating costs for track-type machines, and these costs can vary *independently* of basic machine costs. That is, the undercarriage can be employed in an extremely abrasive, high-wear environment while the basic machine may be in an essentially easy application, and vice-versa. For that reason, it is recommended that the hourly cost of undercarriage be calculated separately as a wear item rather than being included in the repair costs for the basic machine.

Three primary conditions affect probable life-expectancy of track-type undercarriage:

1. **Impact.** The most measurable effect of impact is structural – that is bending, chipping, cracking, spalling, roll-over, etc., and problems with hardware and pin and bushing retention.

   Impact ratings:

   High – Non-penetrable hard surfaces with 150 mm (6") or higher bumps.

   Moderate – Partially penetrable surfaces and bumps of 75-150 mm (3-6") height.

   Low – Completely penetrable surfaces (which provide full shoe plate support) with few bumps.

2. **Abrasiveness.** The tendency of the underfoot materials to grind away the wear surfaces of track components.

   Abrasiveness ratings:

   High – Saturated wet soils containing a high proportion of hard, angular or sharp sand or rock particles.

   Moderate – Slightly or intermittently damp soils containing a low proportion of hard, angular or sharp particles.

   Low – Dry soils or rock containing a low proportion of hard, angular or sharp sand or rock chip particles.

   Impact and abrasiveness in combination can accelerate wear rates beyond their individual effects when considered alone, thus further reducing component life. This should be taken into account in determining impact and abrasiveness ratings or, if preferred, the combination can be included in selecting the "Z" factor.

3. **"Z" factor.** Represents the combined effect on component life of the many intangible environmental, operational and maintenance considerations on a given job.

   Environment and Terrain. Earth which may not be abrasive itself can pack in sprocket teeth, causing mis-match and high stress as the teeth engage the bushings. Corrosive chemicals in the materials being moved or in the natural soil can affect wear rates, while moisture and temperature can exaggerate the effect. Temperature alone can play its own role – hot slag and hard-frozen soils being but the extremes. Constant sidehill work can increase wear on the sides of components.

Operation. Some operator practices tend to increase track wear and cost if not controlled on the job. Such practices include high-speed operation, particularly in reverse; tight turns or constant corrections in direction; and stalling the tractor under load forcing the tracks to slip.

Maintenance. Good maintenance – proper track tension, daily cleaning when working in sticky materials, etc. – combined with periodic wear measurement and timely attention to recommended services (CTS) can extend component life and lower costs by minimizing the effects of these and other adverse conditions.

While impact and abrasion should not be too difficult to judge, selection of the proper "Z" factor will require careful analysis of job conditions such as weather, tendency for soil packing, side-hill loading, corrosive environment, etc.; operational factors such as high-speed reverse, amount of travel, tight turns, track slippage under overload, etc.; and maintenance considerations such as proper tensioning, use of Custom Track Service, etc.

Selection of the "Z" multiplier is strictly a matter of judgement and common sense, but its effect on cost can be the difference between profit on a controlled job and heavy loss where control is allowed to slip. To assist in arriving at an appropriate value for the "Z" factor, consider that proper maintenance – or the lack thereof – will represent about 50% of its effect, environment and terrain 30%, and operator practices 20%. For large excavators the amount of travel is the critical part of the "Z" factor. A good operator working under good field conditions can be counterbalanced by poor maintenance practices to yield a fairly high "Z" factor. On the other hand, close attention to maintenance, tension and alignment can more than offset a bad underfoot condition resulting in severe sprocket packing, and lead to selection of a moderate to low "Z" factor. Obviously, flexibility in selection of a "Z" factor has been built into the system, and use of this flexibility is encouraged. Further, a considerable measure of control can be maintained over the "Z" factor, and any reduction of its effects is money in the bank. Your Cat dealer CTS man can be invaluable in this endeavor as well as helping you establish a comprehensive undercarriage cost control program.

Estimating Undercarriage Cost

The guide below gives a basic factor for the various track-type machines and a series of conditions multipliers to modify the basic cost according to the anticipated impact, abrasive and miscellaneous ("Z") conditions under which the unit will be operating.

Step 1. Select machine and its corresponding basic factor.
Step 2. Determine range for impact, abrasiveness and "Z" conditions.
Step 3. *Add* selected conditions multipliers and apply sum to basic factor.

The result will be the estimated hourly cost for undercarriage in that application.

Undercarriage Basic Factors	
Model	**Basic Factor**
5230B	28.2
D11T	26.1
5130B	20.4
D10T2	16.2
5110B	13.6
D9T	10.9
D8T	9.6
973D, 587T, 589, D7R LGP, D7E LGP	11.2
D7R, 963D, 583T, D6T LGP, D7R XR, D7E	9.1
385C, 5090B	7.2
D6T, 953D, 572R, 527	7.0
365C	6.8
345D	5.9
D6N XL, 517	5.6
336D	5.0
D3K (All), D4K (All), D5K (All), 939C, PL61	4.1
329D	3.9
314D, 315D, 319D, 323D	3.4
320D	2.9
307D, 308D, 311D, 312D	2.4

Conditions Multipliers			
	Impact	**Abrasiveness**	**"Z"**
High	0.3	1.0	1.0
Moderate	0.2	0.5	0.5
Low	0.1	0.1	0.2

Example: D10T2 in high impact, non-abrasive material with a moderate "Z" factor.

D10T2 Basic Factor = 16.2
Multipliers: I = 0.3
A = 0.1
Z = 0.5

U.C. cost = 16.2 (0.3 + 0.1 + 0.5) = **$14.58/hour**

NOTE: 1. Conditions Multipliers may be selected in any combination. Thus, a multiplier of 0.4 (all low-range multipliers) represents the best of the best, while 1.7 (all high range multipliers) would be the worst of the worst conditions.

2. The hourly undercarriage cost estimate resulting from this method will be made up of *approximately* 70% parts cost and 30% labor charges. The cost of undercarriage components is based on published U.S. Consumers List Prices and may be adjusted as needed for import duties, exchange rates, etc. outside the United States. Labor has been figured at $60.00 (U.S.) per shop hour.

3. For further information and guidance, refer to the current issue of the Caterpillar Custom Track Service Handbook.

4. This formula for estimating undercarriage cost should not be used for tractors working in stockpile coal handling applications. Undercarriage costs are nominal in stockpile coal handling, and using this formula will result in estimating cost substantially above actual costs.

11 REPAIR COSTS

(Line Item 11)

Repair cost per hour should be developed by the Cat dealer, with customer input for the specific machine application and requirements.

As with PM cost per hour, repair costs are significantly affected by the specific application and situation. Several important variables must be provided by the customer and the local Cat dealer. This will enable a calculated cost per hour that is specific to the machine conditions and customer needs.

Machine applications, operating conditions, ownership periods, component life, and maintenance attention determine repair costs. In any specific application, actual cost experience on similar machines and applications provides the best basis for establishing the hourly repair cost.

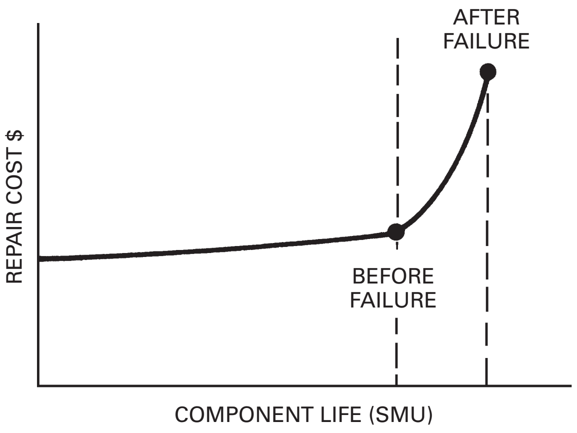
Repairs and component lives are normally the largest single item in operating costs and include all parts and direct labor (except operator's wages) chargeable to the machine. Shop overhead can be absorbed in general overhead or charged to machines as a percent of direct labor cost, whichever is the owner's normal practice.

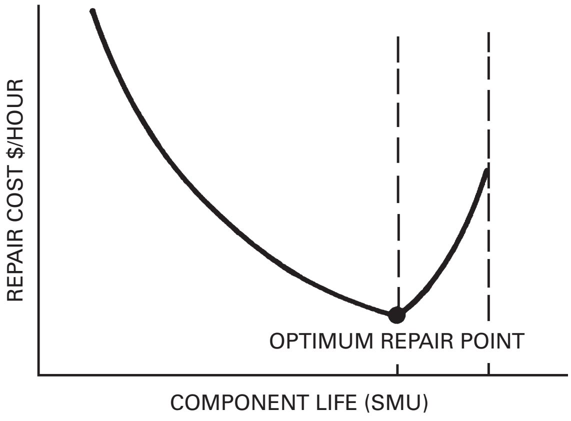
Hourly repair costs for a single machine normally follow an upward stairstep pattern since major outlays for repairs usually come in spurts. However, when broad averages are considered, the stairstep becomes a smooth, upward curve. Since this hourly repair cost curve starts low and gradually rises over time, hourly operating costs must be adjusted upward as the unit ages. Alternatively an average repair cost can be used which provides a straight line graph. Most owners prefer the average method, and it is the one suggested here.

Since repair costs are low initially and rise gradually, averaging them produces extra funds at first which are reserved to cover future higher costs.

Your Cat dealer has the ability to make more accurate repair cost estimates and we suggest you use their experience and expertise if you need help in estimating operating costs.

As stated, repair costs are affected by application, operating conditions, ownership period, maintenance, and age of the equipment. The most significant effects on cost will be those factors affecting major component life. A second significant factor is whether the repair is performed before or after catastrophic failure. Repair before a major component fails can be one-third of an after failure repair with only a moderate sacrifice in life (see graphs). Oil analysis and other diagnostic tools, maintenance inspections and indicators, and operator notes are vital to determine the optimum repair point and thereby achieving lower hourly repair costs. Maintenance practices are significant because they affect component longevity and the percentage of scheduled, before failure repairs.





12 SPECIAL WEAR ITEMS

(Line Item 12 and Subsection 12A)

All costs for high-wear items such as cutting edges, ripper tips, bucket teeth, body liners, router bits, etc., and welding costs on booms and sticks should be included here. These costs will vary widely depending on applications, materials and operating techniques. Consult your Cat dealer Parts Department for estimated life under your job conditions.

15 OPERATOR'S HOURLY WAGE

(Line Item 15)

This item should be based on local wage scales and should include the hourly cost of fringe benefits.

EXAMPLES OF FIGURING OWNING AND OPERATING COSTS

(The following two examples are for illustrative purposes only. The intent is to show how the worksheets could be filled out. The PM and Repair costs should be developed by your local Cat dealer.)

Example I: ESTIMATING HOURLY OWNING AND OPERATING COSTS OF A TRACK-TYPE TRACTOR

Assume a power shift track-type tractor with straight bulldozer, hydraulic control, tilt cylinder and three-shank ripper, is purchased by a contractor for $135,000, delivered price at job site.

Application will be production dozing of bank gravel. Minimal ripping will be required to loosen material.

In the following calculations, refer as necessary to the source material already reviewed.

OWNING COSTS —

To Determine Residual Value at Replacement

Enter delivered price, $135,000, in space (A). (See example form at end of this discussion.) Since the machine being considered is a track-type tractor, no tires are involved. This particular owner's experience is that at trade-in time, the tractor will be worth approximately 35% of its original value. This $47,250 trade-in value is entered in space (B) leaving a net of $87,750 to be recovered through work.

Enter the net value to be recovered through work in space (C).

Indicated ownership period is 7 years with annual usage of 1200 hours per year or 8400 hours of total ownership usage.

Divide the Net Value from space (C), $87,750, by Ownership Usage, 8400 hours, and enter result $10.45 in space (D).

Interest, Insurance, Taxes

In this example, local rates are assumed as follows:

Interest	16%
Insurance	1%
Taxes	1%
	18%

Using the following formula:

N = 7:

$$\frac{\left[\dfrac{135{,}000\ (7+1) + 47{,}250\ (7-1)}{2 \times 7}\right] \times 0.16}{1200} = 12.99$$

Enter $12.99 in space (E).

Insurance and property taxes can also be calculated using the same formula as shown for the interest cost, and entering them on lines 5 and 6.

Items 3b, 4, 5 and 6 can now be added and the result, $25.06 entered in space (H) Total Hourly Owning Costs.

OPERATING COSTS —

Fuel

Assume that the estimated fuel consumption based on field data is 17 liter/hr (4.5 U.S. gal/hr.). Cost of fuel in this locality is $0.34/liter ($1.25/U.S. gal.).

Consumption		Unit Cost		Total
17 liter/hr	×	$0.34 liter	=	$5.78
4.5 gal/hr	×	$1.25 gal.	=	$5.63

Enter this figure in space (I).

Planned Maintenance (PM) Cost per Hour

Use PM cost per hour estimate developed by your local Cat dealer. (For this example assume cost per hour is $2.30) Enter this figure in space (J) on line 9.

Tires

Since this example considers a track-type tractor, space (K) is left blank.

Undercarriage

Our estimating reference gives an undercarriage cost Basic Factor of 6.6 for this tractor. It is anticipated that with some ripping on the job, impact loading of track components will be medium, indicating an "I" multiplier of 0.2. The gravel-sand mix in the bank, being dry, should be only moderately abrasive for an "A" multiplier of 0.2. In analyzing the miscellaneous conditions: there is enough clay in the bank to produce some packing of the sprockets; the operator is careful, but is forced into some tight turns because of space limitations; there is good drainage in the pit; track tension is checked weekly; and all track-type equipment on the job is enrolled in the Custom Track Service program. Accordingly, the "Z" multiplier is judged to be somewhat greater than low level — 0.3 in this case.

It should be noted that in applying particularly the "Z" factor, rather wide flexibility is provided and was used in the above example. Such flexibility is intended and its use encouraged.

Then:

Cost per hour = Basic Factor × (I + A + Z)
Basic Factor = 6.6
Conditions Multipliers: I = 0.2
A = 0.2
Z = 0.3

Cost per hour 6.6 (0.2 + 0.2 + 0.3) = $4.62 which is entered in space (L).

Repair Cost per Hour

Use the Repair cost per hour estimate developed by your local Cat dealer. (For this example assume cost per hour is $6.12) Enter this figure in space (M) on line 11.

Special Items

Assuming the tractor is equipped with a three-shank ripper and an "S" dozer, allowance must be made for ripper tips, shank protectors, and dozer cutting edges.

Assume your knowledge of the operation indicates the ripper will be used only about 20% of total tractor operating time. Estimated tip life while in use is 30 hours. Therefore, tips will be replaced:

$$\frac{30 \text{ Hours}}{0.20} = \text{each 150 hours of tractor operation}$$

Shank protector life is estimated at three times tip life or 450 hours of tractor operation.

Cutting edge life is estimated to be 500 hours.

Using local prices for these items, hourly costs are estimated as follows:

$$\text{Tips: } \frac{3 \text{ @ \$35.00 ea.}}{150 \text{ hr.}} = \$0.70 \text{ per hour}$$

$$\text{Shank Protectors: } \frac{3 \text{ @ \$55.00 ea.}}{450 \text{ hr.}} = \$0.37 \text{ per hour}$$

$$\text{Cutting Edges: } \frac{\$125 \text{ per set}}{500 \text{ hr.}} = \$0.25 \text{ per hour}$$

The total of these, $1.32; is entered in space (N).

Items 8, 9, 10b, 11 and 12 can now be added and the result, $19.99, is entered in space (O), Total Hourly Operating Costs.

Operator's Hourly Wage

Assume this is $25.00 including fringe benefits. This figure is entered in space (P).

Total Owning Costs, Total Operating Costs and Operator's Hourly Wage are now added together and the result, $67.01, is entered in space (Q). The itemized estimate of Hourly Owning and Operating Costs is now complete.

Example II: ESTIMATING HOURLY OWNING AND OPERATING COSTS OF A WHEELED VEHICLE

With only a few simple changes, owning and operating costs for a wheeled vehicle are calculated using the same format as that used for the Track-Type Tractor. Only the differences will be explained as we look at example calculations for a wheel loader.

OWNING COSTS —

To Determine Residual Value at Replacement

Enter delivered price in space (A). The cost of tires is deducted since they will be treated as a wear item. For purposes of illustration, the Wheel Loader is estimated to have a potential 48% trade-in value (B) at the end of the 5 year/7500 hour ownership usage, leaving a net value to be recovered through work of $34,320 (C).

Interest, Insurance, Taxes

Refer to the formulas using the same rates as before and 1500 operating hours per year. The result $4.22 is applied to the interest cost (E).

Insurance and property taxes can also be calculated using the same formula as shown for the interest cost.

The sum of lines 3b, 4, 5 and 6 gives the total hourly owning cost, line 7.

OPERATING COSTS —

Fuel

Estimate fuel consumption and apply the actual cost of purchasing fuel in the project area (I).

Planned Maintenance (PM) Cost per Hour

Use PM cost per hour estimate developed by your local Cat dealer. (For this example assume cost per hour is $2.10.) Enter this figure in space (J) on line 9.

Tires

Use the tire replacement cost and the best estimate of tire life based on experience and anticipated job conditions.

Repair Cost per Hour

Use the Repair cost per hour estimate developed by your local Cat dealer. (For this example assume cost per hour is $3.39.) Enter this figure in space (M) on line 11.

Special Items

Ground engaging tools, welding, etc. are covered here. Use current costs for cutting edges and similar items. Use your best estimate of the hours of life which can be expected from them based on previous experience in like materials. Enter the total on line 12.

The total of lines 8 through 13 represents hourly operating costs.

Operator's Hourly Wage

To give a true picture of operator cost, include fringe benefits as well as direct hourly wages (line 15).

TOTAL O&O

The total of lines 7, 13 and 15 is the total hourly owning and operating cost of the machine. Keep in mind that this is an estimate and can change radically from project to project. For the greatest accuracy, the hourly cost reflected in actual on-the-job cost records should be used.

HOURLY OWNING AND OPERATING COST ESTIMATE

DATE ____________

		Estimate #1		Estimate #2
A–Machine Designation		Track-type Tractor		Wheel Loader
B–Estimated Ownership Period (Years)		7		5
C–Estimated Usage (Hours/Year)		1200		1500
D–Ownership Usage (Total Hours)(B × C)		8400		7500

OWNING COSTS

		(1)		(2)
1. a. Delivered Price (P), to the Customer (including attachments)		135,000 (A)		70,000
b. Less Tire Replacement Cost if desired		N/A		4000
c. Delivered Price Less Tires		135,000		66,000
2. Less Residual Value at Replacement (S) (See subsection 2A on back)	(35 %)	47,250 (B)	(48 %)	31,680
3. a. Net Value to be recovered through work (line 1c less line 2)		87,750 (C)		34,320

b. Cost Per Hour:

$$\frac{\text{Net Value}}{\text{Total Hours}} \quad (1)\ \frac{87{,}750}{8400} \quad (2)\ \frac{34{,}320}{7500}$$

10.45 (D) | 4.58

4. Interest Costs, N = No. Yrs.

$$\frac{\dfrac{P(N+1)+S(N-1)}{2N} \times \text{Simple Int. \% Rate}}{\text{Hours/Year}} =$$

$$(1)\ \frac{\dfrac{[135{,}000\,(7+1)] + [47{,}250\,(7-1)]}{2 \times 7} \times 0.16}{1200\ \text{Hours/Yr.}} = \qquad (2)\ \frac{\dfrac{[66{,}000\,(5+1)] + [31{,}680\,(5-1)]}{2 \times 5} \times 0.16}{1500\ \text{Hours/Yr.}} =$$

12.99 (E) | 5.58

5. Insurance, N = No. Yrs.

$$\frac{\dfrac{P(N+1)+S(N-1)}{2N} \times \text{Insurance \% Rate}}{\text{Hours/Year}} =$$

$$(1)\ \frac{\dfrac{[135{,}000\,(7+1)] + [47{,}250\,(7-1)]}{2 \times 7} \times 0.01}{1200\ \text{Hours/Yr.}} = \qquad (2)\ \frac{\dfrac{[66{,}000\,(5+1)] + [31{,}680\,(5-1)]}{2 \times 5} \times 0.01}{1500\ \text{Hours/Yr.}} =$$

0.81 (F) | 0.35

(Optional method when Insurance cost per year is known)

Ins. $ __________ Per Yr. ÷ __________ Hours/Yr. =

Estimating form continues next page

		Estimate #1	Estimate #2
6. Property Tax N = No. Yrs.	$\dfrac{\dfrac{P(N+1)+S(N-1)}{2N} \times \text{Tax Rate \%}}{\text{Hours/Year}} =$		
	(1) $\dfrac{\dfrac{[135{,}000\,(7+1)] + [47{,}250\,(7-1)]}{2 \times 7} \times 0.01}{1200 \text{ Hours/Yr.}} =$ (2) $\dfrac{\dfrac{[66{,}000\,(5+1)] + [31{,}680\,(5-1)]}{2 \times 5} \times 0.01}{1500 \text{ Hours/Yr.}} =$	0.81 (G)	0.35
	(Optional method when Property Tax cost per year is known) Property Tax $ ________ Per Yr. ÷ ________ Hours/Yr. =		
7. TOTAL HOURLY OWNING COST	(add lines 3b, 4, 5 and 6)	25.06 (H)	10.86

OPERATING COSTS

		Estimate #1	Estimate #2
8. Fuel:	Unit Price × Consumption		
	(1) 1.25 × 4.50 =	5.63 (I)	2.50
	(2) 1.25 × 2 =		
9. Planned Maintenance (PM)-Lube Oils, Filters, Grease, Labor:	(contact your local Cat dealer)	2.30 (J)	2.10
10. a. Tires: Replacement Cost ÷ Life in Hours	$\dfrac{\text{Cost}}{\text{Life}}$ (1) N/A (2) $\dfrac{4000}{3500}$	(K)	1.14
b. Undercarriage	(Impact + Abrasiveness + Z Factor) × Basic Factor		
	(1) (0.2 + 0.2 + 0.3) = 0.7 (Total) × 6.6 (Factor) =	4.62 (L)	
	(2) (____ + ____ + ____) = ____ (Total) × ____ (Factor) =		
11. Repair Cost (Per Hour)	(contact your local Cat dealer)	6.12 (M)	3.39
12. Special Wear Items: Cost ÷ Life	(See subsection 12A on back)	1.32 (N)	0.60
13. TOTAL OPERATING COSTS	(add lines 8, 9, 10a (or 10b), 11 and 12)	19.99 (O)	9.73
14. MACHINE OWNING PLUS OPERATING	(add lines 7 and 13)	45.05	20.59
15. OPERATOR'S HOURLY WAGE (include fringes)		25.00 (P)	25.00
16. TOTAL OWNING AND OPERATING COST		70.05(Q)	45.59

SUBSECTION 2A: Residual Value at Replacement

	(est. #1)		(est. #2)	
Gross Selling Price	(___%)	______	(___%)	______
Less: a. Commission		______		______
b. Make-ready costs		______		______
c. Inflation during ownership period*		______		______
Net Residual Value (Enter on line 2)		47,250	(35 %)	31,680	(48 %) of original delivered price

*When used equipment auction prices are used to estimate residual value, the effect of inflation during the ownership period should be removed to show in constant value what part of the asset must be recovered through work.

SUBSECTION 12A: Special Items
(cutting edges, ground engaging tools, bucket teeth, etc.)

(1)	Cost		Life		Cost/Hour	(2)				
1.	105	÷	150	=	0.70	1.	120	÷	200	= 0.60
2.	165	÷	450	=	0.37	2.		÷		=
3.	125	÷	500	=	0.25	3.		÷		=
4.		÷		=		4.		÷		=
5.		÷		=		5.		÷		=
6.		÷		=		6.		÷		=
			Total	(1)	1.32	(2)	0.60			

(Enter total on line 12)

FORMER MODELS

NOTE: This list stopped being updated since PHB49.

TRACK-TYPE TRACTORS

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D2	4U	47-58	43/38	3258	1.02	2.74	DD	3609	2588	2061	1634	1067	
				(7175)	**(3'4")**	**(9'0")**		**(7950)**	**(5700)**	**(4540)**	**(3600)**	**(2350)**	
					1.42	1.57		2.9	4.4	5.2	6.3	8.9	
					(4'8")	**(5'2")**		**(1.8)**	**(2.7)**	**(3.2)**	**(3.9)**	**(5.5)**	
D2	4U	47-58	42/35	3258	1.02	2.74	DD	3609	2588	2061	1634	1067	
				(7175)	**(3'4")**	**(9'0")**		**(7950)**	**(5700)**	**(4540)**	**(3600)**	**(2350)**	
					1.57	1.57		2.7	4.0	4.8	5.8	8.2	
					(5'2")	**(5'2")**		**(1.7)**	**(2.5)**	**(3.0)**	**(3.6)**	**(5.1)**	
D2	5U	57-58	38/32	3119	1.27	2.74	DD	3033	2483	2007	1703	1035	
				(5870)	**(4'2")**	**(9'0")**		**(6680)**	**(5420)**	**(4420)**	**(3570)**	**(2280)**	
					1.42	1.57		2.7	4.0	4.8	5.8	8.2	
					(4'8")	**(5'2")**		**(1.7)**	**(2.5)**	**(3.0)**	**(3.6)**	**(5.1)**	
D2	5U	57-58	43/38	3373	1.27	2.74	DD	3609	2588	2061	1634	1067	
				(7430)	**(4'2")**	**(9'0")**		**(7950)**	**(5700)**	**(4540)**	**(3600)**	**(2250)**	
					1.67	1.57		2.9	4.4	5.2	6.3	8.9	
					(5'6")	**(5'2")**		**(1.8)**	**(2.7)**	**(3.2)**	**(3.9)**	**(5.5)**	
D3	79U	72-79	62/—	4812	1.42	2.77	PS						
				(10,610)	**(4'8")**	**(9'1")**							
					1.78	1.70		3.1	5.6	11.3			
					(5'10")	**(5'7")**		**(1.9)**	**(3.5)**	**(7.0)**			
D3 LGP	6N	72-79	62/—	5410	1.65	2.97	PS						
				(11,925)	**(5'5")**	**(9'10")**							
					2.29	1.70		3.1	5.6	11.3			
					(7'6")	**(5'7")**		**(1.9)**	**(3.5)**	**(7.0)**			
D3B	23Y	79-87	65	6719	1.42	2.77	PS						
				(14,812)	**(4'8")**	**(9'1")**							
					1.78	2.67		3.1	5.6	11.4			
					(5'10")	**(8'9")**		**(1.9)**	**(3.5)**	**(7.1)**			
D3B	27Y	79-87	65	6877	1.42	2.77	PS						
				(15,160)	**(4'8")**	**(9'1")**							
					1.78	2.67		3.1	5.9	10.6			
					(5'10")	**(8'9")**		**(1.9)**	**(3.7)**	**(6.6)**			
D3B LGP	24Y	79-87	65	7479	1.65	2.99	PS						
				(16,488)	**(5'5")**	**(9'10")**							
					2.29	2.67		3.1	5.6	11.4			
					(7'6")	**(8'9")**		**(1.9)**	**(3.5)**	**(7.1)**			
D3B LGP	28Y	79-87	65	7637	1.65	2.99	PS						
				(16,836)	**(5'5")**	**(9'10")**							
					2.29	2.67		3.1	5.9	10.7			
					(7'6")	**(8'9")**		**(1.9)**	**(3.7)**	**(6.7)**			
D3B	3YC	85-87	65	6719	1.42	2.77	DD	5593	3993	2694	1830	1326	
				(14,812)	**(4'8")**	**(9'1")**		**(12,330)**	**(8802)**	**(5940)**	**(4034)**	**(2925)**	
					1.78	2.67		2.48	3.40	4.68	6.45	8.27	
					(5'10")	**(8'9")**		**(1.5)**	**(2.1)**	**(2.9)**	**(4.0)**	**(5.1)**	
D3B LGP	5MC	85-87	65	7479	1.65	2.99	DD	5595	3993	2694	1830	1326	
				(16,488)	**(5'5")**	**(9'10")**		**(12,330)**	**(8802)**	**(5940)**	**(4034)**	**(2925)**	
					2.29	2.67		2.48	3.40	4.68	6.45	8.27	
					(7'6")	**(8'9")**		**(1.5)**	**(2.1)**	**(2.9)**	**(4.0)**	**(5.1)**	

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D3C	5KG	87-90	67	7084 **(15,618)**	1.42 **(4'8")**	2.8 **(9'4")**	PS						
					1.79 **(5'10.6")**	2.66 **(8'8.9")**		3.1 **(1.9)**	5.9 **(3.7)**	10.8 **(6.7)**			
D3C Series II		90-93	70	7001 **(15,435)**	1.42 **(4'8")**		PS						
					1.79 **(5'11")**			3.1 **(1.9)**	5.9 **(3.7)**	10.8 **(6.7)**			
D3C Series III		93-01	70	7110 **(15,650)**	1.45 **(4'9")**	3.98 **(13'1")**	HYS						
					1.85 **(6'1")**	2.73 **(8'11")**			0-9.0 **(0-5.6)**				
D3C XL Series II		91-93	70	7242 **(15,965)**	1.42 **(4'8")**		PS						
					1.83 **(6'0")**			3.1 **(1.9)**	5.9 **(3.7)**	10.8 **(6.7)**			
D3C XL Series III		93-01	70	7304 **(16,100)**	1.45 **(4'9")**	3.98 **(13'1")**	HYS						
					1.85 **(6'1")**	2.73 **(8'11")**			0-9.0 **(0-5.6)**				
D3G XL	CFC	01-03	70	7314 **(16,125)**	1.45 **(4'9")**	4.02 **(13'2")**	HYS						
					1.85 **(6'1")**	2.72 **(8'11")**			0-9.0 **(0-5.6)**				
D3G XL*	JMH	03-07	70	7345 **(16,193)**	1.45 **(4'9")**	4.02 **(13'2")**	HYS						
					1.85 **(6'1")**	2.72 **(8'11")**			0-9.0 **(0-5.6)**				
D3C LGP	1PJ	87-90	67	7788 **(17,170)**	1.65 **(5'4")**	3.0 **(9'10.1")**	PS						
					2.29 **(7'6")**	2.66 **(8'8.9")**		3.1 **(1.9)**	5.9 **(3.7)**	10.8 **(6.7)**			
D3C LGP Series II		90-93	70	7788 **(17,170)**	1.65 **(5'5")**		PS						
					2.29 **(7'6")**			3.1 **(1.9)**	5.9 **(3.7)**	10.8 **(6.7)**			
D3C LGP Series III		93-01	70	7710 **(17,000)**	1.68 **(5'6")**	3.95 **(13'0")**	HYS						
					2.31 **(7'7")**	2.73 **(8'11")**			0-9.0 **(0-5.6)**				
D3G LGP	CFF	01-03	70	7723 **(17,026)**	1.68 **(5'6")**	4.02 **(13'2")**	HYS						
					2.31 **(7'7")**	2.72 **(8'11")**			0-9.0 **(0-5.6)**				
D3G LGP*	BYR	03-07	70	7768 **(17,126)**	1.68 **(5'6")**	4.02 **(13'2")**	HYS						
					2.31 **(7'7")**	2.72 **(8'11")**			0-9.0 **(0-5.6)**				

*Emits equivalent to U.S. EPA Tier 2/EU Stage II/Japan 2001 (Tier 2).
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D4	6U	47-59	48/43	4629	1.12	3.07	DD	4531	3496	2656	2089	1339	
				(10,195)	**(3'8")**	**(11'0")**		**(9980)**	**(7700)**	**(5850)**	**(4600)**	**(2950)**	
					1.58	1.54		2.7	4.2	4.8	6.0	8.7	
					(5'2")	**(5'1")**		**(1.7)**	**(2.4)**	**(3.0)**	**(3.7)**	**(5.4)**	
D4	6U	47-59	60/48	4847	1.12	3.16	DD	4858	3496	2724	2093	1326	
				(10,675)	**(3'8")**	**(10'5")**		**(10,700)**	**(7700)**	**(6000)**	**(4610)**	**(2920)**	
					1.58	1.54		3.1	4.3	5.5	6.8	9.8	
					(5'2")	**(5'1")**		**(1.9)**	**(2.7)**	**(3.4)**	**(4.2)**	**(6.1)**	
D4	6U	47-59	63/50	4844	1.12	3.18	DD	4858	3528	2724	2093	1326	
				(10,675)	**(3'8")**	**(10'5")**		**(10,700)**	**(7770)**	**(6000)**	**(4610)**	**(2920)**	
					1.58	1.76		3.1	4.3	5.5	6.8	9.8	
					(5'2")	**(5'10")**		**(1.9)**	**(2.7)**	**(3.4)**	**(4.2)**	**(6.1)**	
D4	7U	47-59	63/50	5067	1.52	3.16	DD	4858	3528	2724	2093	1326	
				(10,970)	**(5'0")**	**(10'5")**		**(10,700)**	**(7770)**	**(6000)**	**(4610)**	**(2920)**	
					1.98	1.76		3.1	4.3	5.5	6.8	9.8	
					(6'6")	**(5'10")**		**(1.9)**	**(2.7)**	**(3.4)**	**(4.2)**	**(6.1)**	
D4B	2XF	87	75	7450	1.42	2.78	PS						
				(16,420)	**(4'8")**	**(9'1")**							
					1.78	2.67		3.2	6.0	11.1			
					(5'10")	**(8'9")**		**(2.0)**	**(3.7)**	**(6.9)**			
D4B LGP	1SG	87	75	7800	1.65	2.99	PS						
				(17,200)	**(5'5")**	**(9'10")**							
					2.29	2.67		3.2	6.0	11.1			
					(7'6")	**(8'9")**		**(2.0)**	**(3.7)**	**(6.9)**			
D4C	39A	59-63	65/52	5064	1.12	3.05	DD	4858	3528	2724	2093	1321	
				(11,155)	**(3'8")**	**(10'1")**		**(10,700)**	**(7770)**	**(6000)**	**(4610)**	**(2910)**	
					1.58	1.76		3.1	4.3	5.5	6.8	9.8	
					(5'2")	**(5'10")**		**(1.9)**	**(2.7)**	**(3.4)**	**(4.2)**	**(6.1)**	
D4C	40A	59-63	65/52	4881	1.52	3.05	DD	4858	3528	2724	2093	1321	
				(10,750)	**(5'0")**	**(10'1")**		**(10,700)**	**(7770)**	**(6000)**	**(4610)**	**(2910)**	
					1.98	1.76		3.1	4.3	5.5	6.8	9.8	
					(6'6")	**(5'10")**		**(1.9)**	**(2.7)**	**(3.4)**	**(4.2)**	**(6.1)**	
D4C	1RJ	87-90	78	7581	1.42	3.00	PS						
				(16,714)	**(4'7")**	**(9'10.1")**							
					1.83	2.66		3.1	5.9	11.1			
					(6'0")	**(8'8.9")**		**(1.9)**	**(3.7)**	**(6.9)**			
D4C Series II		90-93	80	7557	1.42		PS						
				(16,660)	**(4'8")**								
					1.83			3.2	5.9	11.1			
					(6'5")			**(2.0)**	**(3.7)**	**(6.9)**			
D4C Series III		93-01	80	7330	1.50	3.99							
				(16,150)	**(4'11")**	**(13'1")**	HYS						
					1.91	2.73			0-9.0				
					(6'3")	**(8'11")**			**(0-5.6)**				
D4C XL Series III		93-01	80	7520	1.50	3.99							
				(16,570)	**(4'11")**	**(13'1")**	HYS						
					1.96	2.73			0-9.0				
					(6'5")	**(8'11")**			**(0-5.6)**				

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D4C LGP	2CJ	87-90	78	7905	1.65	3.00	PS						
				(17,427)	**(5'4")**	**(9'10.1")**							
					2.29	2.66							
					(7'6")	**(8'8.9")**							
D4C LGP		90-93	80	7905	1.65		PS						
Series II				**(17,427)**	**(5'5")**								
					2.29			3.2	5.9	11.1			
					(7'6")			**(2.0)**	**(3.7)**	**(6.9)**			
D4C LGP		93-01	80	7790	1.68	3.99							
Series III				**(17,160)**	**(5'6")**	**(13'1")**	HYS						
					2.31	2.73			0-9.0				
					(7'6")	**(8'11")**			**(0-5.6)**				
D4D	78A	63-68	65/52	5900	1.52	3.35	DD	5300	3700	2560	1880	1350	
				(13,000)	**(5'0")**	**(11'0")**		**(11,690)**	**(8160)**	**(5640)**	**(4150)**	**(2980)**	
					1.98	2.41		2.7	3.9	5.5	7.1	9.3	
					(6'6")	**(7'11")**		**(1.7)**	**(2.4)**	**(3.4)**	**(4.4)**	**(5.8)**	
D4D	22C	67-68	65/—	5900	1.52	3.38	PS						
				(13,100)	**(5'0")**	**(11'1")**							
					1.98	2.41		3.2	5.8	9.3			
					(6'6")	**(7'11")**		**(2.0)**	**(3.6)**	**(5.8)**			
D4D	82J	63	—/65	7910	1.52	3.38	DD	6150	4150	2820	2030	1420	
				(17,440)	**(5'0")**	**(11'1")**		**(13,550)**	**(9140)**	**(6210)**	**(4480)**	**(3120)**	
					1.98	2.67		2.7	4.0	5.4	7.2	9.4	
					(6'6")	**(8'9")**		**(1.7)**	**(2.5)**	**(3.4)**	**(4.5)**	**(5.9)**	
D4D	83J	67-71	—/65	8270	1.52	3.38	PS						
				(18,240)	**(5'0")**	**(11'1")**							
					1.98	2.67		3.2	5.7	9.3			
					(6'6")	**(8'9")**		**(2.0)**	**(3.6)**	**(5.8)**			
D4D	83J	72-77	—/75	5900	1.52	3.38	DD	6150	4150	2820	2030	1420	
				(13,100)	**(5'0")**	**(11'1")**		**(13,550)**	**(9140)**	**(6210)**	**(4480)**	**(3120)**	
					1.98	2.67		2.7	4.0	5.4	7.2	9.4	
					(6'6")	**(8'9")**		**(1.7)**	**(2.5)**	**(3.4)**	**(4.5)**	**(5.9)**	
D4E	27X	77-84	80/—	9013	1.52	3.86	DD	6495	4425	3018	2172	1509	
				(19,820)	**(5'0")**	**(12'8")**		**(14,320)**	**(9756)**	**(6654)**	**(4788)**	**(3327)**	
					2.44	2.72		2.8	4.0	5.5	7.2	9.5	
					(8'0")	**(8'11")**		**(1.7)**	**(2.5)**	**(3.4)**	**(4.5)**	**(5.9)**	
D4E	28X	77-84	80/—	9090	1.52	3.86	PS						
				(20,040)	**(5'0")**	**(12'8")**							
					2.44	2.72		3.3	5.9	9.5			
					(8'0")	**(8'11")**		**(2.1)**	**(3.7)**	**(5.9)**			
D4G XL	CFN	01-03	80	7761	1.50	4.04	HYS						
				(17,110)	**(4'11")**	**(13'3")**							
					1.96	2.72			0-9.0				
					(6'5")	**(8'11")**			**(0-5.6)**				
D4G XL*	HYD	03-07	80	7800	1.50	4.04	HYS						
				(17,196)	**(4'11")**	**(13'3")**							
					1.96	2.72			0-9.0				
					(6'5")	**(8'11")**			**(0-5.6)**				

*Emits equivalent to Tier 2/Stage II/Japan 2001 (Tier 2).
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D4G LGP	FDC	01-03	80	8109 **(17,877)**	1.68 **(5'6")**	4.04 **(13'3")**	HYS						
					2.31 **(7'7")**	2.72 **(8'11")**			0-9.0 **(0-5.6)**				
D4G LGP**	TLX	03-07	80	8143 **(17,952)**	1.68 **(5'6")**	4.04 **(13'3")**	HYS						
					2.31 **(7'7")**	2.72 **(8'11")**			0-9.0 **(0-5.6)**				
D4H (JPN)	8PB*	85-89	90/—	9975 **(21,991)**	1.67 **(5'6")**	3.422 **(11'3")**	PS						
					2.13 **(7'0")**	2.933 **(9'8")**		3.5 **(2.2)**	6.2 **(3.9)**	10.2 **(6.3)**			
D4H (JPN)	2AC*	85-89	90/—	10 111 **(22,291)**	1.67 **(5'6")**	3.422 **(11'3")**	DD	7618 **(16,798)**	5843 **(12,884)**	4333 **(9554)**	3207 **(7071)**	2335 **(5149)**	1640 **(3617)**
					2.13 **(7'0")**	2.933 **(9'8")**		2.5 **(1.6)**	3.2 **(2.0)**	4.3 **(2.6)**	5.5 **(3.4)**	7.2 **(4.4)**	9.5 **(5.9)**
D4H (JPN)	8PB*	89-90	95/—	10 105 **(22,277)**	1.67 **(5'6")**	3.422 **(11'3")**	PS						
					2.13 **(7'0")**	2.933 **(9'8")**		3.5 **(2.2)**	6.2 **(3.9)**	10.2 **(6.3)**			
D4H (JPN)	8PB	91-96	95/—	11 019 **(24,242)**	1.67 **(5'6")**	3.44 **(11'3")**	PS						
					2.13 **(7'0")**	2.939 **(9'8")**		3.5 **(2.2)**	6.2 **(3.9)**	10.2 **(6.3)**			
D4H (JPN)	2AC*	89-90	95/—	10 231 **(22,555)**	1.67 **(5'6")**	3.422 **(11'3")**	DD	7454 **(16,434)**	5715 **(12,599)**	4235 **(9336)**	3132 **(6904)**	2277 **(5020)**	1597 **(3520)**
					2.13 **(7'0")**	2.933 **(9'8")**		2.5 **(1.6)**	3.2 **(2.0)**	4.3 **(2.6)**	5.5 **(3.4)**	7.2 **(4.4)**	9.5 **(5.9)**
D4H (JPN)	2AC	91-96	95/—	11 019 **(24,242)**	1.67 **(5'6")**	3.44 **(11'3")**	DD	7454 **(16,434)**	5715 **(12,599)**	4235 **(9336)**	3132 **(6904)**	2227 **(5020)**	1597 **(3520)**
					2.13 **(7'0")**	2.939 **(9'8")**		2.5 **(1.6)**	3.2 **(2.0)**	4.3 **(2.6)**	5.5 **(3.4)**	7.2 **(4.4)**	9.5 **(5.9)**
D4H LGP (JPN)	9DB*	85-89	90/—	11 245 **(24,790)**	2.00 **(6'7")**	3.693 **(10'4")**	PS						
					2.76 **(9'1")**	2.986 **(9'10")**		3.5 **(2.2)**	6.2 **(3.9)**	10.2 **(6.3)**			
D4H LGP (JPN)	3AC*	85-89	90/—	11 381 **(25,090)**	2.00 **(6'7")**	3.693 **(10'4")**	DD	7618 **(16,798)**	5843 **(12,884)**	4333 **(9554)**	3207 **(7071)**	2335 **(5149)**	1640 **(3617)**
					2.76 **(9'1")**	2.986 **(9'10")**		2.5 **(1.6)**	3.2 **(2.0)**	4.3 **(2.6)**	5.5 **(3.4)**	7.2 **(4.4)**	9.5 **(5.9)**
D4H LGP (JPN)	9DB*	89-90	95/—	11 350 **(25,022)**	2.00 **(6'7")**	3.693 **(10'4")**	PS						
					2.76 **(9'1")**	2.986 **(9'10")**		3.5 **(2.2)**	6.2 **(3.9)**	10.2 **(6.3)**			
D4H LGP (JPN)	9DB	91-96	105/—	12 440 **(27,368)**	2.00 **(6'7")**	3.718 **(12'2")**	PS						
					2.76 **(9'1")**	3.04 **(10'0")**		3.4 **(2.1)**	6.0 **(3.7)**	10.2 **(6.4)**			

*D4H models prior to Series II. Product identification number prefix still in use for current product.
**Emits equivalent to Tier 2/Stage II/Japan 2001 (Tier 2).
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D4H LGP (JPN)	3AC*	89-90	95/—	11 476 **(25,300)**	2.00 **(6'7")**	3.693 **(10'4")**	DD	7454 **(16,434)**	5715 **(12,599)**	4235 **(9336)**	3132 **(6904)**	2277 **(5020)**	1597 **(3520)**
					2.76 **(9'1")**	2.986 **(9'10")**		2.5 **(1.6)**	3.2 **(2.0)**	4.3 **(2.6)**	5.5 **(3.4)**	7.2 **(4.4)**	9.5 **(5.9)**
D4H LGP (JPN)	9GJ	92-96	105/—	12 440 **(27,368)**	2.00 **(6'7")**	3.718 **(12'2")**	PS						
					2.76 **(9'1")**	3.04 **(10'0")**		3.4 **(2.1)**	6.0 **(3.7)**	10.2 **(6.4)**			
D4H XL (JPN)	8PS	92-96	105/—	11 786 **(25,929)**	1.77 **(5'10")**	3.446 **(11'4")**	PS						
					2.28 **(7'6")**	2.99 **(9'10")**		3.4 **(2.1)**	6.0 **(3.7)**	10.2 **(6.4)**			
D5	81H	67-67	93/75	8300 **(18,200)**	1.52 **(5'0")**	3.89 **(12'9")**	DD	7870 **(17,330)**	4910 **(10,820)**	3330 **(7320)**	2230 **(4920)**	1440 **(3170)**	
					2.02 **(6'8")**	2.00 **(8'7")**		3.8 **(2.3)**	4.7 **(2.9)**	5.8 **(3.6)**	7.1 **(4.4)**	8.9 **(5.5)**	
D5	82H	67-67	93/75	8400 **(18,600)**	1.88 **(6'2")**	3.89 **(12'9")**	DD	7870 **(17,330)**	4910 **(10,820)**	3330 **(7320)**	2230 **(4920)**	1440 **(3170)**	
					2.38 **(7'10")**	2.00 **(8'7")**		2.7 **(1.7)**	4.2 **(2.6)**	5.8 **(3.6)**	8.0 **(5.0)**	11.1 **(6.9)**	
D5	83H	67-67	93/—	8500 **(18,800)**	1.52 **(5'0")**	3.89 **(12'9")**	PS						
					2.02 **(6'8")**	2.64 **(8'8")**		2.7 **(1.7)**	4.2 **(2.6)**	5.8 **(3.6)**	8.0 **(5.0)**	11.1 **(6.9)**	
D5	84H	67-67	93/—	8700 **(19,200)**	1.88 **(6'2")**	3.89 **(12'9")**	PS						
					2.38 **(7'10")**	2.64 **(8'8")**		3.6 **(2.2)**	6.1 **(3.8)**	10.1 **(6.3)**			
D5	98J	67-77	105	11 290 **(24,400)**	1.52 **(5'0")**	3.89 **(12'9")**	DD	8770 **(19,340)**	5500 **(12,130)**	3750 **(8270)**	2540 **(5610)**	1660 **(3660)**	
					2.02 **(6'8")**	2.74 **(9'0")**		4.0 **(2.5)**	4.8 **(3.0)**	5.6 **(3.5)**	6.4 **(4.0)**	7.4 **(4.6)**	9.0 **(5.6)**
D5	93J	67-77	105	11 290 **(24,400)**	1.52 **(5'0")**	3.89 **(12'9")**	DD	8770 **(19,340)**	5500 **(12,130)**	3750 **(8270)**	2540 **(5610)**	1660 **(3660)**	
					2.02 **(6'8")**	2.74 **(9'0")**		2.7 **(1.7)**	4.2 **(2.6)**	5.8 **(3.6)**	8.0 **(5.0)**	11.1 **(6.9)**	
D5	94J	66-77	105	11 390 **(25,100)**	1.88 **(6'2")**	3.89 **(12'9")**	DD	8770 **(19,340)**	5500 **(12,130)**	3750 **(8270)**	2540 **(5610)**	1660 **(3660)**	
					2.38 **(7'10")**	2.74 **(9'0")**		2.7 **(1.7)**	4.2 **(2.6)**	5.8 **(3.6)**	8.0 **(5.0)**	11.1 **(6.9)**	
D5	95J	66-77	105	11 290 **(24,900)**	1.52 **(5'0")**	3.89 **(12'9")**	PS						
					2.02 **(6'8")**	2.74 **(9'0")**							
D5	96J	66-77	105	11 600 **(25,600)**	1.88 **(6'2")**	3.89 **(12'9")**	PS						
					2.38 **(7'10")**	2.74 **(9'0")**							

*D4H models prior to Series II. Product identification number prefix still in use for current product.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D5B	25X	77-84	105/—	11 619 **(25,615)**	1.88 **(6'2")**	4.60 **(15'1")**	PS						
					3.15 **(10'4")**	2.77 **(9'1")**		3.5 **(2.2)**	6.1 **(3.8)**	10.1 **(6.3)**			
D5B	23X	77-82	105/—	11 283 **(24,875)**	1.88 **(6'2")**	4.60 **(15'1")**	DD	8060 **(17,770)**	5030 **(11,100)**	3410 **(7520)**	2290 **(5060)**	1480 **(3260)**	
					3.15 **(10'4")**	2.77 **(9'1")**		2.7 **(1.7)**	4.2 **(2.6)**	5.8 **(3.6)**	8.0 **(5.0)**	11.1 **(6.9)**	
D5C		91-93	90	8460 **(18,650)**	1.54 **(5'1")**		PS						
					2.01 **(6'7")**			3.5 **(2.2)**	6.3 **(3.9)**	10.0 **(6.2)**			
D5C Series III		93-01	90	8490 **(18,710)**	1.55 **(5'1")**	4.07 **(13'4")**	HYS						
					2.00 **(6'7")**	2.74 **(9'0")**			0-9.0 **(0-5.6)**				
D5C XL Series III		93-01	90	8820 **(19,450)**	1.55 **(5'1")**	4.32 **(14'2")**	HYS						
					2.06 **(6'9")**	2.74 **(9'0")**			0-9.0 **(0-5.6)**				
D5C LGP		91-93	90	8987 **(19,800)**	1.72 **(5'8")**		PS						
					2.38 **(7'10")**			3.5 **(2.2)**	6.3 **(3.9)**	10.0 **(6.2)**			
D5C LGP Series III		93-01	90	8970 **(19,780)**	1.73 **(5'8")**	4.07 **(13'4")**	HYS						
					2.39 **(7'10")**	2.74 **(9'0")**			0-9.0 **(0-5.6)**				
D5E		-99	105	11 700 **(25,800)**	1.52 **(5'0")**	3.88 **(12'8")**	DD	8770 **(19,340)**	5500 **(12,130)**	3750 **(8270)**	2450 **(5600)**	1660 **(3660)**	
D5G XL	FDH	01-03	90	8863 **(19,540)**	1.55 **(5'1")**	4.34 **(14'3")**	HYS						
					2.06 **(6'9")**	2.73 **(8'11")**			0-9.0 **(0-5.6)**				
D5G XL*	WGB	03-07	90	8919 **(19,662)**	1.55 **(5'1")**	4.34 **(14'3")**	HYS						
					2.06 **(6'9")**	2.73 **(8'11")**			0-9.0 **(0-5.6)**				
D5G LGP	FDW	01-03	90	9207 **(20,298)**	1.73 **(5'8")**	4.25 **(13'11")**	HYS						
					2.39 **(7'10")**	2.73 **(8'11")**			0-9.0 **(0-5.6)**				
D5G LGP*	RKG	03-07	90	9269 **(20,434)**	1.73 **(5'8")**	4.25 **(13'11")**	HYS						
					2.39 **(7'10")**	2.73 **(8'11")**			0-9.0 **(0-5.6)**				

*Emits equivalent to Tier 2/Stage II/Japan 2001 (Tier 2).
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D5H (FR)	8RC*	85-90	120/—	12 144	1.8	3.6	PS						
				(26,772)	(5'11")	(11'10")		—	—	—			
					2.21	2.93		3.3	5.9	10.0			
					(7'3")	(9'7")		(2.1)	(3.7)	(6.2)			
D5H (FR)	8RC	91-96	120/—	13 250	1.8	3.6	DD						
				(29,200)	(5'11")	(11'10")							
					2.31	3.0		3.3	5.9	10.0			
					(7'7")	(9'10")		(2.1)	(3.7)	(6.2)			
D5H (FR)	7NC*	85-90	120/—	12 212	1.8	3.6	DD	9140	7005	5190	3835	2785	1950
				(26,922)	(5'11")	(11'10")		(20,150)	(15,440)	(11,440)	(8450)	(6140)	(4300)
					2.21	2.93		2.7	3.4	4.5	5.8	7.6	10.0
					(7'3")	(9'7")		(1.7)	(2.1)	(2.8)	(3.6)	(4.7)	(6.2)
D5H (FR)	7NC	91-96	120/—	13 250	1.8	3.6	DD	9140	7005	5190	3835	2785	1950
				(29,200)	(5'11")	(11'10")		(20,150)	(15,440)	(11,440)	(8450)	(6140)	(4300)
					2.31	3.0		2.7	3.4	4.5	5.8	7.6	10.0
					(7'7")	(9'10")		(1.7)	(2.1)	(2.8)	(3.6)	(4.7)	(6.2)
D5H LGP (FR)	1DD*	86-90	120/—	14 685	2.16	4.129	PS						
				(32,380)	(7'1")	(13'7")							
					3.02	3.069		3.3	5.9	10.0			
					(9'11")	(10'1")		(2.1)	(3.7)	(6.2)			
D5H LGP (FR)	1DD	91-96	130/—	16 200	2.16	4.133	PS						
				(35,700)	(7'1")	(13'7")							
					3.02	3.135		3.3	5.9	10.0			
					(9'11")	(10'3")		(2.1)	(3.7)	(6.2)			
D5H LGP (FR)	9HC*	85-90	120/—	14 878	2.16	4.129	DD	9140	7005	5190	3835	2785	1950
				(32,800)	(7'1")	(13'7")		(20,150)	(15,440)	(11,440)	(8450)	(6140)	(4300)
					3.02	3.069		2.7	3.4	4.5	5.8	7.6	10.0
					(9'11")	(10'1")		(1.7)	(2.1)	(2.8)	(3.6)	(4.7)	(6.2)
D5H LGP (FR)	9HC	91-96	130/—	16 200	2.16	4.133	DD	10 061	7725	5738	4256	3109	2195
				(35,700)	(7'1")	(13'7")		(22,181)	(17,031)	(12,650)	(9384)	(6855)	(4840)
					3.02	3.135		2.6	3.4	4.5	5.8	7.5	9.9
					(9'11")	(10'3")		(1.6)	(2.1)	(2.7)	(3.6)	(4.7)	(6.2)
D5H (JPN)	3MD*	86-90	120/—	12 144	1.8	3.6	PS						
				(26,772)	(5'11")	(11'10")							
					2.21	2.93		3.3	5.9	10.0			
					(7'3")	(9'7")		(2.1)	(3.7)	(6.2)			
D5H (JPN)	3MD	91-96	120/—	13 250	1.8	3.6	PS						
				(29,200)	(5'11")	(11'10")							
					2.31	3.0		3.3	5.9	10.0			
					(7'7")	(9'10")		(2.1)	(3.7)	(6.2)			
D5H (JPN)	1YD*	86-90	120/—	12 212	1.8	3.6	DD	9140	7005	5190	3835	2785	1950
				(26,922)	(5'11")	(11'10")		(20,150)	(15,440)	(11,440)	(8450)	(6140)	(4300)
					2.21	2.93		2.7	3.4	4.5	5.8	7.6	10.0
					(7'3")	(9'7")		(1.7)	(2.1)	(2.8)	(3.6)	(4.7)	(6.2)

*D5H models prior to Series II. Product identification number prefix still in use for current product.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D5H (JPN)	1YD*	91-96	120/—	13 250	1.8	3.6	DD	9140	7005	5190	3835	2785	1950
				(29,200)	**(5'11")**	**(11'10")**		**(20,150)**	**(15,440)**	**(11,440)**	**(8450)**	**(6140)**	**(4300)**
					2.31	3.0		2.7	3.4	4.5	5.8	7.6	10.0
					(7'7")	**(9'10")**		**(1.7)**	**(2.1)**	**(2.8)**	**(3.6)**	**(4.7)**	**(6.2)**
D5H LGP	4KD*	86-90	120/—	14 685	2.16	4.129	PS						
(JPN)				**(32,380)**	**(7'1")**	**(13'7")**							
					3.02	3.069		3.3	5.9	10.0			
					(9'11")	**(10'1")**		**(2.1)**	**(3.6)**	**(6.2)**			
D5H LGP	4KD	91-96	130/—	16 200	2.16	4.133	PS						
(JPN)				**(35,700)**	**(7'1")**	**(13'7")**							
					3.02	3.135		3.3	5.9	10.0			
					(9'11")	**(10'3")**		**(2.1)**	**(3.7)**	**(6.2)**			
D5H LGP	2SD*	86-90	120/—	14 878	2.16	4.129	DD	9140	7005	5190	3835	2785	1950
(JPN)				**(32,800)**	**(7'1")**	**(13'7")**		**(20,150)**	**(15,440)**	**(11,440)**	**(8450)**	**(6140)**	**(4300)**
					3.02	3.069		2.7	3.4	4.5	5.8	7.6	10.0
					(9'11")	**(10'1")**		**(1.7)**	**(2.1)**	**(2.8)**	**(3.6)**	**(4.7)**	**(6.2)**
D5H LGP	2SD	91-96	130/—	16 200	2.16	4.133	DD	10 061	7725	5738	4256	3109	2195
(JPN)				**(35,700)**	**(7'1")**	**(13'7")**		**(22,181)**	**(17,031)**	**(12,650)**	**(9384)**	**(6855)**	**(4840)**
					3.02	3.135		2.6	3.4	4.5	5.8	7.5	9.9
					(9'11")	**(10'3")**		**(1.6)**	**(2.1)**	**(2.7)**	**(3.6)**	**(4.7)**	**(6.2)**
D5H XL	8RJ	92-96	130/—	13 900	1.89	3.606	PS						
(FR)				**(30,600)**	**(6'2")**	**(11'10")**							
					2.49	3.08		3.3	5.9	10.0			
					(8'2")	**(9'11")**		**(2.1)**	**(3.7)**	**(6.2)**			
D5M XL	4BR	96-02	82/110	12 250	1.77	3.544	PS	22 347	12 166	6745			
(FR)				**(27,006)**	**(5'10")**	**(11'8")**		**(49,264)**	**(26,821)**	**(14,870)**			
					2.33**	3.002***		3.27	5.81	9.93			
					(7'8")**	**(9'10")*****		**(2.03)**	**(3.61)**	**(6.17)**			
D5M XL	6GN	96-02	82/110	12 250	1.77	3.544	PS	22 347	12 166	6745			
(FR)				**(27,006)**	**(5'10")**	**(11'8")**		**(49,264)**	**(26,821)**	**(14,870)**			
					2.33**	3.002***		3.27	5.81	9.93			
					(7'8")**	**(9'10")*****		**(2.03)**	**(3.61)**	**(6.17)**			
D5M LGP	3DR	96-02	82/110	13 100	2.00	3.72	PS	22 347	12 166	6745			
(FR)				**(28,880)**	**(6'7")**	**(12'2")**		**(49,264)**	**(26,821)**	**(14,870)**			
					2.76**	3.046***		3.27	5.81	9.93			
					(9'1")**	**(10'0")*****		**(2.03)**	**(3.61)**	**(6.17)**			
D5M LGP	3CR	96-02	82/110	13 100	2.00	3.72	PS	22 347	12 166	6745			
(FR)				**(28,880)**	**(6'7")**	**(12'2")**		**(49,264)**	**(26,821)**	**(14,870)**			
					2.76**	3.046***		3.27	5.81	9.93			
					(9'1")**	**(10'0")*****		**(2.03)**	**(3.61)**	**(6.17)**			

*D5H models prior to Series II. Product identification number prefix still in use for current product.
**Width without blade and with standard shoes.
***Height with ROPS cab.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6	4R	47-59	85	8042	1.88	3.75	DD	8618	5534	3837	2617	1842	
				(17,730)	**(6'2")**	**(12'4")**		**(19,000)**	**(12,200)**	**(8460)**	**(5770)**	**(4060)**	
					1.52	1.91		2.7	4.2	5.8	8.0	10.6	
					(5'0")	**(6'3")**		**(1.7)**	**(2.6)**	**(3.6)**	**(5.0)**	**(6.6)**	
D6	9U	47-59	93/75	8153	1.88	3.75	DD	8618	5534	3837	2617	1842	
				(17,975)	**(6'2")**	**(12'4")**		**(19,000)**	**(12,200)**	**(8460)**	**(5770)**	**(4060)**	
					1.52	1.91		2.7	4.2	5.8	8.0	10.6	
					(5'0")	**(6'3")**		**(1.7)**	**(2.6)**	**(3.6)**	**(5.0)**	**(6.6)**	
D6B	37A	59-67	93/75	8130	1.52	3.85	DD						
				(17,930)	**(5'0")**	**(12'9")**							
					2.02	1.91							
					(6'8")	**(6'3")**							
D6B	44A	59-67	93/75	8300	1.88	3.85	DD	7820	4940	3220	2120	1450	
				(18,300)	**(6'2")**	**(12'9")**		**(16,240)**	**(10,900)**	**(7090)**	**(4670)**	**(3190)**	
					2.38	1.91		2.7	4.2	6.0	8.4	10.9	
					(7'10")	**(6'3")**		**(1.7)**	**(2.6)**	**(3.7)**	**(5.2)**	**(6.8)**	
D6C	74A	63-67	120	10 400	1.88	3.95	DD	12 050	8020	5300	3360	2030	
				(23,000)	**(6'2")**	**(13'0")**		**(26,540)**	**(17,670)**	**(11,690)**	**(7400)**	**(4470)**	
					2.38	1.92		2.4	3.4	4.8	6.8	9.5	
					(7'9")	**(6'4")**		**(1.5)**	**(2.1)**	**(3.0)**	**(4.2)**	**(5.9)**	
D6C	76A	63-67	120	10 700	1.88	3.95	PS						
				(23,500)	**(6'2")**	**(13'0")**							
					2.38	1.92							
					(7'9")	**(6'4")**							
D6C	10K	67-76	140	13 880	1.88	3.73	PS						
				(30,600)	**(6'2")**	**(12'3")**							
					2.38	2.87		4.0	6.9	10.8			
					(7'9")	**(9'5")**		**(2.5)**	**(4.3)**	**(6.7)**			
D6 LGP	69U	72-77	140	17 010	2.11	3.94	PS						
				(37,500)	**(6'11")**	**(12'11")**							
					3.02	2.97							
					(9'11")	**(9'9")**							
D6C	99J	67-76	140	14 243	1.88	3.73	DD	11 500	7750	5180	3350	2090	
				(31,400)	**(6'2")**	**(12'3")**		**(25,360)**	**(17,090)**	**(11,420)**	**(7380)**	**(4610)**	
					2.38	2.87		2.7	4.0	5.6	7.9	11.1	
					(7'9")	**(9'5")**		**(1.7)**	**(2.5)**	**(3.5)**	**(4.9)**	**(6.9)**	
D6C LGP	69U	72-77	140	13 835	2.11	2.97	PS						
				(30,500)	**(6'11")**	**(9'9")**							
					3.02	3.94							
					(9'11")	**(12'11")**							

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6D	3X	77-86	140	14 290	1.88	3.73	DD	11 500	7750	5180	3350	2090	
				(31,500)	**(6'2")**	**(12'3")**		**(25,360)**	**(17,090)**	**(11,420)**	**(7380)**	**(4610)**	
					2.36	3.06		1.7	4.0	5.6	7.9	11.1	
					(7'9")	**(10'0")**		**(2.7)**	**(2.5)**	**(3.5)**	**(4.9)**	**(6.9)**	
D6D	4X	77-86	140	14 290	1.88	3.73	PS	4.0	6.9	10.8			
				(31,500)	**(6'2")**	**(12'3")**		**(2.5)**	**(4.3)**	**(6.7)**			
D6D LGP	6X	77-86	140	17 370	2.1	3.94	PS						
				(38,300)	**(6'11")**	**(12'1")**							
					3.02	3.06		4.0	6.9	10.8			
					(9'11")	**(10'0")**		**(2.5)**	**(4.3)**	**(6.7)**			
D6H	4RC*	85-90	165/—	16 950	1.88	4.069	PS						
				(37,367)	**(6'2")**	**(13'4")**							
					2.64	3.114		3.8	6.5	11.3			
					(8'8")	**(10'3")**		**(2.4)**	**(4.0)**	**(7.0)**			
D6H	8KB	85-88	165/—	16 954	1.88	4.069	DD	12 500	9520	7140	5440	4010	2820
				(37,377)	**(6'2")**	**(13'4")**		**(27,560)**	**(20,990)**	**(15,740)**	**(11,990)**	**(8840)**	**(6220)**
					2.64	3.114		2.7	3.5	4.6	5.8	7.6	10.0
					(8'8")	**(10'3")**		**(1.7)**	**(2.2)**	**(2.9)**	**(3.6)**	**(4.7)**	**(6.2)**
D6H	3ZF*	88-90	165/—	17 055	1.88	4.069	PS/DS						
				(37,599)	**(6'2")**	**(13'4")**							
					2.64	3.114		3.8	6.5	11.3			
					(8'8")	**(10'3")**		**(2.4)**	**(4.0)**	**(7.0)**			
D6H LGP	6FC*	87-90	165/—	19 555	2.225	4.493	PS						
				(43,111)	**(7'4")**	**(14'9")**							
					3.43	3.164		3.8	6.5	11.3			
					(11'3")	**(10'5")**		**(2.4)**	**(4.0)**	**(7.0)**			
D6H LGP	3YG*	88-90	165/—	19 527	2.225	4.493	PS/DS						
				(43,049)	**(7'4")**	**(14'9")**							
					3.43	3.164		3.8	6.5	11.3			
					(11'3")	**(10'5")**		**(2.4)**	**(4.0)**	**(7.0)**			
D6H (JPN)	2KD*	86-90	165/—	16 950	1.88	4.069	PS						
				(37,367)	**(6'2")**	**(13'4")**							
					2.64	3.114		3.8	6.5	11.3			
					(8'8")	**(10'3")**		**(2.4)**	**(4.0)**	**(7.0)**			
D6H (DS)	32F	92-96	123/165	18 111	1.88	4.07	PS						
	(E. Peoria)			**(39,928)**	**(6'2")**	**(13'4")**							
	4YF				3.36	3.12		3.8	6.6	11.4			
	(Sagami)				**(11'0")**	**(10'3")**		**(2.3)**	**(4.1)**	**(7.1)**			
	6CF												
	(Grenoble)												

*D6H models prior to Series II. Product identification number prefix still in use for current product.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6H (CB)	4RC	92-96	123/165	17 997	1.88	4.07	PS						
	(E. Peoria)			**(39,676)**	**(6'2")**	**(13'4")**							
	2KD				3.36	3.12		3.8	6.6	11.4			
	(Sagami)				**(11'0")**	**(10'3")**		**(2.3)**	**(4.1)**	**(7.1)**			
	4LG												
	(Grenoble)												
D6H XL (DS)	9KJ	92-96	130/175	19 080	1.88	4.07	PS						
	(E. Peoria)			**(42,063)**	**(6'2")**	**(13'4")**							
	8SK				3.36	3.12		3.8	6.6	11.4			
	(Sagami)				**(11'0")**	**(10'3")**		**(2.3)**	**(4.1)**	**(7.1)**			
	9LK												
	(Grenoble)												
D6H XL (CB)	8ZJ	92-96	130/175	18 966	1.88	4.07	PS						
	(E. Peoria)			**(41,811)**	**(6'2")**	**(13'4")**							
	9RK				3.36	3.12		3.8	6.6	11.4			
	(Sagami)				**(11'0")**	**(10'3")**		**(2.3)**	**(4.1)**	**(7.1)**			
	8KK												
	(Grenoble)												
D6H XR (DS)	6CK	92-96	130/175	18 799	1.88	4.22	PS						
	(E. Peoria)			**(41,444)**	**(6'2")**	**(13'10")**							
	2TL				3.36	3.12		3.8	6.6	11.4			
	(Sagami)				**(11'0")**	**(10'3")**		**(2.3)**	**(4.1)**	**(7.1)**			
	1YL												
	(Grenoble)												
D6H XR (CB)	5KK	92-96	130/175	18 799	1.88	4.22	PS						
	(E. Peoria)			**(41,444)**	**(6'2")**	**(13'10")**							
	7ZK				3.36	3.12		3.8	6.6	11.4			
	(Sagami)				**(11'0")**	**(10'3")**		**(2.3)**	**(4.1)**	**(7.1)**			
	2BL												
	(Grenoble)												
D6H LGP (DS)	3YG	92-96	134/180	20 486	2.24	4.49	PS						
	(E. Peoria)			**(45,163)**	**(7'3")**	**(14'9")**							
	4GG				4.0	3.17		3.8	6.6	11.4			
	(Sagami)				**(13'1")**	**(10'5")**		**(2.3)**	**(4.1)**	**(7.1)**			
	5HF												
	(Grenoble)												
D6H LGP (CB)	6FC	92-96	134/180	20 486	2.24	4.49	PS						
	(E. Peoria)			**(45,163)**	**(7'3")**	**(14'9")**							
	1KD				4.0	3.17		3.8	6.6	11.4			
	(Sagami)				**(13'1")**	**(10'5")**		**(2.3)**	**(4.1)**	**(7.1)**			
	2TG												
	(Grenoble)												
D6H (JPN)	3ED*	86-92	165/—	16 954	1.88	4.069	DD	12 500	9520	7140	5440	4010	2820
				(37,377)	**(6'2")**	**(13'4")**		**(27,560)**	**(20,990)**	**(15,740)**	**(11,990)**	**(8840)**	**(6220)**
					2.64	3.114		2.7	3.5	4.6	5.8	7.6	10.0
					(8'8")	**(10'3")**		**(1.7)**	**(2.2)**	**(2.9)**	**(3.6)**	**(4.7)**	**(6.2)**
D6H (JPN)	4YF*	88-90	165/—	17 055	1.88	4.069	PS/DS						
				(37,599)	**(6'2")**	**(13'4")**							
					2.64	3.114		3.8	6.5	11.3			
					(8'8")	**(10'3")**		**(2.4)**	**(4.0)**	**(7.0)**			

*D6H models prior to Series II. Product identification number prefix still in use for current product.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6H LGP (JPN)	1KD*	86-90	165/—	19 555 **(43,111)**	2.225 **(7'4")**	4.493 **(14'9")**	PS						
					3.43 **(11'3")**	3.164 **(10'5")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6H LGP (JPN)	8FC*	86-90	165/—	19 676 **(43,380)**	2.225 **(7'4")**	4.485 **(14'9")**	DD	12 500 **(27,560)**	9520 **(20,990)**	7140 **(15,740)**	5440 **(11,990)**	4010 **(8840)**	2820 **(6220)**
					3.43 **(11'3")**	3.164 **(10'5")**		2.7 **(1.7)**	3.5 **(2.2)**	4.6 **(2.9)**	5.8 **(3.6)**	7.6 **(4.7)**	10.0 **(6.2)**
D6H LGP (JPN)	4GG*	88-90	165/—	19 527 **(43,049)**	2.225 **(7'4")**	4.493 **(14'9")**	PS/DS						
					3.43 **(11'3")**	3.164 **(10'5")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6H (FR)	4LG*	87-90	165/—	16 950 **(37,367)**	1.88 **(6'2")**	4.069 **(13'4")**	PS						
					2.64 **(8'8")**	3.114 **(10'3")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6H (FR)	1FJ*	88-90	165/—	16 954 **(37,377)**	1.88 **(6'2")**	4.069 **(13'4")**	DD	12 500 **(27,560)**	9520 **(20,990)**	7140 **(15,740)**	5440 **(11,990)**	4010 **(8840)**	2820 **(6220)**
					2.64 **(8'8")**	3.114 **(10'3")**		2.7 **(1.7)**	3.5 **(2.2)**	4.6 **(2.9)**	5.8 **(3.6)**	7.6 **(4.7)**	10.0 **(6.2)**
D6H (FR)	6CF*	88-90	165/—	17 055 **(37,599)**	1.88 **(6'2")**	4.069 **(13'4")**	PS/DS						
					2.64 **(8'8")**	3.114 **(10'3")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6H LGP (FR)	2TG*	87-90	165/—	19 555 **(43,111)**	2.225 **(7'4")**	4.493 **(14'9")**	PS						
					3.43 **(11'3")**	3.164 **(10'5")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6H LGP (FR)	5HF*	88-90	165/—	19 527 **(43,049)**	2.225 **(7'4")**	4.493 **(14'9")**	PS/DS						
					3.43 **(11'3")**	3.164 **(10'5")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6H (SCOT)	7PC	86-87	165/—	16 950 **(37,367)**	1.88 **(6'2")**	4.069 **(13'4")**	PS						
					2.64 **(8'8")**	3.114 **(10'3")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6H LGP (SCOT)	8YC	86-87	165/—	19 555 **(43,111)**	2.225 **(7'4")**	4.493 **(14'9")**	PS						
					3.43 **(11'3")**	3.164 **(10'5")**		3.8 **(2.4)**	6.5 **(4.0)**	11.3 **(7.0)**			
D6K XL	FBH	05-14	125	12 886 **(28,409)**	1.77 **(5'10")**	2.65 **(8'8")**	Hystat						
					2.33 **(7'8")**	2.91 **(9'7")**							
D6K LGP	DHA	05-13	125	13 467 **(29,690)**	2 **(6'7")**	2.65 **(8'8")**	Hystat						
					2.76 **(9'1")**	2.91 **(9'7")**							

*D6H models prior to Series II. Product identification number prefix still in use for current product.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D6R STD CB (US)	2YN	95-02	165/—	18 100 **(40,000)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R STD CB (BRAZIL)	9ZS	97-02	165/—	18 100 **(40,000)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R STD CB (FRANCE)	2HM	96-01	165/—	18 100 **(40,000)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R STD CB (JAPAN)	6FR	96-02	165/—	18 100 **(40,000)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R STD DS (US)	3ZN	95-02	165/—	18 300 **(40,400)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		3.9 **(2.4)**	6.8 **(4.2)**	11.9 **(7.6)**			
D6R STD DS (BRAZIL)	1RW	97-02	165/—	18 300 **(40,400)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		3.9 **(2.4)**	6.8 **(4.2)**	11.9 **(7.6)**			
D6R STD DS (FRANCE)	4FM	96-01	165/—	18 300 **(40,400)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		3.9 **(2.4)**	6.8 **(4.2)**	11.9 **(7.6)**			
D6R STD DS (JAPAN)	5PR	97-02	165/—	18 300 **(40,400)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		3.9 **(2.4)**	6.8 **(4.2)**	11.9 **(7.6)**			
D6R XL CB (US)	4MN	96-02	175/—	19 000 **(41,900)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R XL CB (BRAZIL)	6MR	97-02	175/—	19 000 **(41,900)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R XL CB (FRANCE)	4JR	96-01	175/—	19 000 **(41,900)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R XL CB (JAPAN)	4WR	97-02	175/—	19 000 **(41,900)**	1.88 **(6'2")**	4.08 **(13'4")**	PS						
					2.64 **(8'8")**	3.20 **(10'6")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6R XL DS	5LN	95-02	175/—	19 200	1.88	4.08	PS						
(US)				**(42,300)**	**(6'2")**	**(13'4")**							
					2.64	3.20		3.9	6.8	11.9			
					(8'8")	**(10'6")**		**(2.4)**	**(4.2)**	**(7.6)**			
D6R XL DS	7GR	96-02	175/—	19 200	1.88	4.08	PS						
(BRAZIL)				**(42,300)**	**(6'2")**	**(13'4")**							
					2.64	3.20		3.9	6.8	11.9			
					(8'8")	**(10'6")**		**(2.4)**	**(4.2)**	**(7.6)**			
D6R XL DS	9BM	96-01	175/—	19 200	1.88	4.08	PS						
(FRANCE)				**(42,300)**	**(6'2")**	**(13'4")**							
					2.64	3.20		3.9	6.8	11.9			
					(8'8")	**(10'6")**		**(2.4)**	**(4.2)**	**(7.6)**			
D6R XL DS	5RR	97-02	175/—	19 200	1.88	4.08	PS						
(JAPAN)				**(42,300)**	**(6'2")**	**(13'4")**							
					2.64	3.20		3.9	6.8	11.9			
					(8'8")	**(10'6")**		**(2.4)**	**(4.2)**	**(7.6)**			
D6R XR CB	6JN	95-02	175/—	18 780	1.88	4.22	PS						
(US)				**(41,400)**	**(6'2")**	**(13'10")**							
					2.64	3.19		4.0	7.1	12.4			
					(8'8")	**(10'5")**		**(2.5)**	**(4.4)**	**(7.7)**			
D6R XR CB	8XN	97-01	175/—	18 780	1.88	4.22	PS						
(FRANCE)				**(41,400)**	**(6'2")**	**(13'10")**							
					2.64	3.19		4.0	7.1	12.4			
					(8'8")	**(10'5")**		**(2.5)**	**(4.4)**	**(7.7)**			
D6R XR CB	6HR	97-02	175/—	18 780	1.88	4.22	PS						
(JAPAN)				**(41,400)**	**(6'2")**	**(13'10")**							
					2.64	3.19		4.0	7.1	12.4			
					(8'8")	**(10'5")**		**(2.5)**	**(4.4)**	**(7.7)**			
D6R XR DS	7KN	95-02	175/—	18 910	1.88	4.22	PS						
(US)				**(41,700)**	**(6'2")**	**(13'10")**							
					2.64	3.19		3.9	6.8	11.9			
					(8'8")	**(10'5")**		**(2.4)**	**(4.2)**	**(7.6)**			
D6R XR DS	9MN	97-01	175/—	18 910	1.88	4.22	PS						
(FRANCE)				**(41,700)**	**(6'2")**	**(13'10")**							
					2.64	3.19		3.9	6.8	11.9			
					(8'8")	**(10'5")**		**(2.4)**	**(4.2)**	**(7.6)**			
D6R XR DS	7DR	97-02	175/—	18 910	1.88	4.22	PS						
(JAPAN)				**(41,700)**	**(6'2")**	**(13'10")**							
					2.64	3.19		3.9	6.8	11.9			
					(8'8")	**(10'5")**		**(2.4)**	**(4.2)**	**(7.6)**			
D6R LGP CB	8LN	95-02	185/—	20 500	2.23	4.24	PS						
(US)				**(45,200)**	**(7'3")**	**(13'11")**							
					3.43	3.19		4.0	7.1	12.4			
					(11'3")	**(10'5")**		**(2.5)**	**(4.4)**	**(7.7)**			
D6R LGP CB	4HN	97-01	185/—	20 500	2.23	4.24	PS						
(FRANCE)				**(45,200)**	**(7'3")**	**(13'11")**							
					3.43	3.19		4.0	7.1	12.4			
					(11'3")	**(10'5")**		**(2.5)**	**(4.4)**	**(7.7)**			

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6R LGP CB (JAPAN)	7AR	97-01	185/—	20 500 **(45,200)**	2.23 **(7'3")**	4.24 **(13'11")**	PS						
					3.43 **(11'3")**	3.19 **(10'5")**		4.0 **(2.5)**	7.1 **(4.4)**	12.4 **(7.7)**			
D6R LGP DS (US)	9PN	95-02	185/—	20 680 **(45,600)**	2.23 **(7'3")**	4.24 **(13'11")**	PS						
					3.43 **(11'3")**	3.19 **(10'5")**		3.9 **(2.4)**	6.8 **(4.2)**	11.9 **(7.6)**			
D6R LGP DS (FRANCE)	8TM	96-01	185/—	20 680 **(45,600)**	2.23 **(7'3")**	4.24 **(13'11")**	PS						
					3.43 **(11'3")**	3.19 **(10'5")**		3.9 **(2.4)**	6.8 **(4.2)**	11.9 **(7.6)**			
D6R LGP DS (JAPAN)	4TR	96-02	185/—	20 680 **(45,600)**	2.23 **(7'3")**	4.24 **(13'11")**	PS						
					3.43 **(11'3")**	3.19 **(10'5")**		3.9 **(2.4)**	6.8 **(4.2)**	11.9 **(7.6)**			
D6R LGP DD (JAPAN)	6GR	95-02	185/—	20 680 **(45,600)**	2.23 **(7'3")**	4.24 **(13'11")**	PS						
					3.43 **(11'3")**	3.19 **(10'5")**		3.4 **(2.1)**	5.9 **(3.7)**	10.4 **(6.5)**			
D6M XL (FR)	9ZM	96-02	104/140	15 530 **(34,240)**	1.89 **(6'2")**	3.74 **(12'3")**	PS	30 493 **(67,222)**	16 643 **(36,689)**	9211 **(20,306)**			
					2.49* **(8'2")***	3.08** **(10'1")****		3.4 **(2.1)**	6.0 **(3.7)**	10.3 **(6.4)**			
D6M XL (FR)	3WN	96-02	104/140	15 530 **(34,240)**	1.89 **(6'2")**	3.74 **(12'3")**	PS	30 493 **(67,222)**	16 643 **(36,689)**	9211 **(20,306)**			
					2.49* **(8'2")***	3.08** **(10'1")****		3.4 **(2.1)**	6.0 **(3.7)**	10.3 **(6.4)**			
D6M LGP (FR)	2RN	96-02	104/140	16 930 **(37,320)**	2.16 **(7'1")**	4.146 **(13'7")**	PS	30 493 **(67,222)**	16 643 **(36,689)**	9211 **(20,306)**			
					3.02* **(9'11")***	3.194** **(10'6")****		3.4 **(2.1)**	6.0 **(3.7)**	10.3 **(6.4)**			
D6M LGP (FR)	4JN	96-02	104/140	16 930 **(37,320)**	2.16 **(7'1")**	4.146 **(13'7")**	PS	30 493 **(67,222)**	16 643 **(36,689)**	9211 **(20,306)**			
					3.02* **(9'11")***	3.194** **(10'6")****		3.4 **(2.1)**	6.0 **(3.7)**	10.3 **(6.4)**			
D6R SII STD CB (FTC) (US)	AEM	02-05	123/165	17 826 **(39,300)**	1.88 **(6'2")**	3.86 **(12'8")**	PS						
					2.64 **(8'8")**	3.2 **(10'6")**		3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			
D6R SII STD CB (FTC) (BRAZIL)	BRJ	02-06	123/165	17 826 **(39,300)**	1.88 **(6'2")**	3.86 **(12'8")**	PS						
					2.64 **(8'8")**	3.2 **(10'6")**		3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			
D6R SII STD CB (FTC) (FRANCE)	BLE	01-05	123/165	17 826 **(39,300)**	1.88 **(6'2")**	3.86 **(12'8")**	PS						
					2.64 **(8'8")**	3.2 **(10'6")**		3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			

*Width without blade and with standard shoes.
**Height with ROPS cab.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6R SII STD CB (FTC) (JAPAN)	BMK	01-06	123/165	17 826 **(39,300)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			
D6R SII STD DS (US)	AFM	01-05	123/165	18 099 **(39,900)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.3)**	6.6 **(4.1)**	11.4 **(7.1)**			
D6R SII STD DS (BRAZIL)	BPM	03-06	123/165	18 099 **(39,900)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.3)**	6.6 **(4.1)**	11.4 **(7.1)**			
D6R SII STD DS (FRANCE)	BLT	02-05	123/165	18 099 **(39,900)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.3)**	6.6 **(4.1)**	11.4 **(7.1)**			
D6R SII STD DS (JAPAN)	BNL	01-06	123/165	18 099 **(39,900)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.3)**	6.6 **(4.1)**	11.4 **(7.1)**			
D6R SII XL CB (FTC) (US)	AGM	00-05	138/185	18 711 **(41,250)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			
D6R SII XL CB (FTC) (BRAZIL)	CAD	02-06	138/185	18 711 **(41,250)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			
D6R SII XL CB (FTC) (FRANCE)	BMJ	02-05	138/185	18 711 **(41,250)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			
D6R SII XL CB (FTC) (JAPAN)	BPS	01-06	138/185	18 711 **(41,250)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.4)**	6.6 **(4.1)**	11.5 **(7.2)**			
D6R SII XL DS (US)	AAX	00-05	138/185	18 847 **(41,550)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.3)**	6.6 **(4.1)**	11.4 **(7.1)**			
D6R SII XL DS (BRAZIL)	FDT	02-06	138/185	18 847 **(41,550)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.3)**	6.6 **(4.1)**	11.4 **(7.1)**			
D6R SII XL DS (FRANCE)	BMY	01-05	138/185	18 847 **(41,550)**	1.88 **(6'2")** 2.64 **(8'8")**	3.86 **(12'8")** 3.2 **(10'6")**	PS	3.8 **(2.3)**	6.6 **(4.1)**	11.4 **(7.1)**			

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D6R SII XL	BRZ	01-06	138/185	18 847	1.88	3.86	PS						
DS				**(41,550)**	**(6'2")**	**(12'8")**							
(JAPAN)					2.64	3.2		3.8	6.6	11.4			
					(8'8")	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SII XW	AEP	2001	138/185	19 550	2.03	3.86	PS						
DS				**(43,100)**	**(6'8")**	**(12'8")**							
(US)					2.95	3.2		3.8	6.6	11.4			
					(9'8")	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SII XW	DAE	02-05	138/185	19 550	2.03	3.86	PS						
DS				**(43,100)**	**(6'8")**	**(12'8")**							
(FRANCE)					2.95	3.2		3.8	6.6	11.4			
					(9'8")	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SII XW	BRE	01-06	138/185	19 550	2.03	3.86	PS						
DS				**(43,100)**	**(6'8")**	**(12'8")**							
(JAPAN)					2.95	3.2		3.8	6.6	11.4			
					(9'8")	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SII LGP	ACJ	01-05	138/185	20 865	2.23	4.24	PS						
CB (FTC)				**(46,000)**	**(7'3")**	**(13'11")**							
(US)					3.43	3.25		3.8	6.6	11.5			
					(11'3")	**(10'8")**		**(2.4)**	**(4.1)**	**(7.2)**			
D6R SII LGP	BPP	01-06	138/185	20 865	2.23	4.24	PS						
CB (FTC)				**(46,000)**	**(7'3")**	**(13'11")**							
(JAPAN)					3.43	3.25		3.8	6.6	11.5			
					(11'3")	**(10'8")**		**(2.4)**	**(4.1)**	**(7.2)**			
D6R SII LGP	ADE	00-05	138/185	21 047	2.23	4.24	PS						
DS				**(46,400)**	**(7'3")**	**(13'11")**							
(US)					3.43	3.25		3.8	6.6	11.4			
					(11'3")	**(10'8")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SII LGP	BNC	01-05	138/185	21 047	2.23	4.24	PS						
DS				**(46,400)**	**(7'3")**	**(13'11")**							
(FRANCE)					3.43	3.25		3.8	6.6	11.4			
					(11'3")	**(10'8")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SII LGP	BPZ	01-06	138/185	21 047	2.23	4.24	PS						
DS				**(46,400)**	**(7'3")**	**(13'11")**							
(JAPAN)					3.43	3.25		3.8	6.6	11.4			
					(11'3")	**(10'8")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII			138/185	18 326	1.88	3.86	PS						
(US)	HCD	05-07		**(40,400)**	**(6'2")**	**(12'8")**							
(BRAZIL)	GMT	06-07				3.20		3.8	6.6	11.4			
(FRANCE)	TBC	06-07				**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII	JEK	06-10	138/185	18 326	1.88	2.67	PS	3.8	6.6	11.4			
(JAPAN)				**(40,400)**	**(6'2")**	**(8'9")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII XL			149/200	20 081	1.88	3.86	PS						
(US)	GJB	05-07		**(44,270)**	**(6'2")**	**(12'8")**							
(BRAZIL)	JDL	05-07			2.13	3.20		3.8	6.6	11.4			
(FRANCE)	LFM	06-07			**(7'0")**	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII XL	EXL	06-12	149/200	20 081	1.88	2.87	PS	3.8	6.6	11.4			
(JAPAN)				**(44,270)**	**(6'2")**	**(9'5")**		**(2.3)**	**(4.1)**	**(7.1)**			

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D6R SIII XL			149/200	20 081	1.88	3.86	PS						
PAT (US)	HKE	05-07		**(44,270)**	**(6'2")**	**(12'8")**							
(FRANCE)	RFC	06-07			2.13	3.20		3.8	6.6	11.4			
					(7'0")	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII XW			149/200	20 672	2.03	3.86	PS						
(US)	MRT	05-07		**(45,573)**	**(6'8")**	**(12'8")**							
(BRAZIL)	DPS	06-07			2.29	3.20		3.8	6.6	11.4			
					(7'6")	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII XW			149/200	20 672	2.03	3.86	PS						
PAT (US)	HDC	05-07		**(45,573)**	**(6'8")**	**(12'8")**							
(FRANCE)	MTJ	05-07			2.29	3.20		3.8	6.6	11.4			
					(7'6")	**(10'6")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII XW	EXW	07-09	149/200	20 672	2.03	2.87	PS	3.8	6.6	11.4			
(JAPAN)				**(45,573)**	**(6'8")**	**(9'5")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII LGP			149/200	21 716	2.29	4.25	PS						
(US)	WRG	05-07		**(47,874)**	**(7'6")**	**(13'11")**							
(FRANCE)	DMK	06-07			2.29	3.25		3.8	6.6	11.4			
					(7'6")	**(10'8")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII LGP	LGP	06-12	149/200	21 716	2.29	3.28	PS	3.8	6.6	11.4			
(JAPAN)				**(47,874)**	**(7'6")**	**(10'9")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6R SIII LGP			149/200	21 716	2.29	4.25	PS						
PAT (US)	WCB	05-07		**(47,874)**	**(7'6")**	**(13'11")**							
(FRANCE)	DLM	05-07			2.29	3.25		3.8	6.6	11.4			
					(7'6")	**(10'8")**		**(2.3)**	**(4.1)**	**(7.1)**			
D6T XL*	GMK	11-14	207	21 306	1.88	3.86	PS/DS	36 936	22 343	12 124	12 124		
				(46,791)	**(6'2")**	**(12'8")**		**(81,430)**	**(49,260)**	**(26,730)**	**(26,730)**		
					2.64	3.13		3.8	5.1	8.5	11.4		
					(8'8")	**(10'2")**		**(2.3)**	**(3.2)**	**(5.3)**	**(7.1)**		
D6T XL	DTD	11-14	207	23 663	2.13	3.86	PS/DS	36 936	22 343	12 124	12 124		
VPAT*				**(52,167)**	**(7'0")**	**(12'8")**		**(81,430)**	**(49,260)**	**(26,730)**	**(26,730)**		
						3.13		3.8	5.1	8.5	11.4		
						(10'2")		**(2.3)**	**(3.2)**	**(5.3)**	**(7.1)**		
D6T XW*	SLJ	11-14	207	22 191	2.03	3.86	PS/DS	36 936	22 343	12 124	12 124		
				(48,922)	**(6'8")**	**(12'8")**		**(81,430)**	**(49,260)**	**(26,730)**	**(26,730)**		
					2.95	3.13		3.8	5.1	8.5	11.4		
					(9'8")	**(10'2")**		**(2.3)**	**(3.2)**	**(5.3)**	**(7.1)**		
D6T XW	RCW	11-14	207	24 118	2.29	4.25	PS/DS	36 936	22 343	12 124	12 124		
VPAT*				**(53,170)**	**(7'6")**	**(13'11")**		**(81,430)**	**(49,260)**	**(26,730)**	**(26,730)**		
						3.18		3.8	5.1	8.5	11.4		
						(10'5")		**(2.3)**	**(3.2)**	**(5.3)**	**(7.1)**		
D6T LGP*	ZJB	11-14	207	24 020	2.29	4.25	PS/DS	36 936	22 343	12 124	12 124		
				(52,954)	**(7'6")**	**(13'11")**		**(81,430)**	**(49,260)**	**(26,730)**	**(26,730)**		
					3.48	3.18		3.8	5.1	8.5	11.4		
					(11'5")	**(10'5")**		**(2.3)**	**(3.2)**	**(5.3)**	**(7.1)**		
D6T LGP	KSB	11-14	207	22 009	2.29	4.25	PS/DS	36 936	22 343	12 124	12 124		
VPAT*				**(48,521)**	**(7'6")**	**(13'11")**		**(81,430)**	**(49,260)**	**(26,730)**	**(26,730)**		
						3.18		3.8	5.1	8.5	11.4		
						(10'5")		**(2.3)**	**(3.2)**	**(5.3)**	**(7.1)**		

*Emits equivalent to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim).
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D7	3T	54-55	108/90	11 770	1.88	4.27	DD						
				(25,925)	**(6'2")**	**(14'0")**							
					2.64	2.06							
					(8'1")	**(6'10")**							
D7C	17A	55-59	128/102	11 954	1.88	4.26	DD	11 759	8045	4521	3428	2397	
				(26,355)	**(6'2")**	**(14'0")**		**(25,900)**	**(17,720)**	**(11,960)**	**(7550)**	**(5280)**	
					2.64	2.06		2.4	3.5	5.2	7.4	9.5	
					(8'1")	**(6'10")**		**(1.5)**	**(2.2)**	**(3.2)**	**(4.6)**	**(5.9)**	
D7D	17A	59-61	140/112	12 056	1.88	4.26	DD	12 300	8600	5700	3650	2600	
				(26,555)	**(6'2")**	**(14'0")**		**(27,100)**	**(18,900)**	**(12,550)**	**(8080)**	**(5720)**	
					2.64	2.06		2.4	3.5	5.2	7.4	9.5	
					(8'1")	**(6'10")**		**(1.5)**	**(2.2)**	**(3.2)**	**(4.6)**	**(5.9)**	
D7E	47A	61-68	160/128	14 787	1.98	4.47	DD	14 741	10 296	6803	4259	3070	
				(32,590)	**(6'6")**	**(14'8")**		**(32,500)**	**(22,700)**	**(15,000)**	**(9390)**	**(6770)**	
					2.56	2.30		2.4	3.5	4.9	7.4	9.4	
					(8'5")	**(7'7")**		**(1.5)**	**(2.2)**	**(3.1)**	**(4.6)**	**(5.9)**	
D7E	48A	61-66	160/128	14 787	1.98	4.47	PS						
				(32,590)	**(6'6")**	**(14'8")**							
					2.56	2.30		3.3	5.7	9.3			
					(8'5")	**(7'7")**		**(2.1)**	**(3.6)**	**(5.8)**			
D7E	47A	66-69	180/144	15 200	1.98	4.47	DD	17 140	11 350	7420	4540	3180	
				(33,500)	**(6'6")**	**(14'8")**		**(37,750)**	**(25,000)**	**(16,340)**	**(9990)**	**(7010)**	
					2.56	2.18		2.4	3.5	5.0	7.4	9.5	
					(8'5")	**(7'2")**		**(1.5)**	**(2.2)**	**(3.1)**	**(4.6)**	**(5.9)**	
D7E	48A	66-69	180	15 500	1.98	4.47	PS						
				(34,000)	**(6'6")**	**(14'8")**							
					2.56	2.18		3.7	6.4	10.1			
					(8'5")	**(7'2")**		**(2.3)**	**(4.0)**	**(6.3)**			
D7E*	TAN	10-14	235	26 055	1.98	4.6	E						
				(57,441)	**(6'6")**	**(15'1")**							
					2.88	3.36							
					(9'5")	**(11'0")**							
D7E LGP*	TJA	10-14	235	28 525	2.28	4.6	E						
				(62,886)	**(7'6")**	**(15'1")**							
					3.42	3.36							
					(11'3")	**(11'0")**							
D7F	94N	69-74	180	14 700	1.98	4.15	PS						
				(32,400)	**(6'6")**	**(13'8")**							
					2.56	2.26		3.5	6.3	9.5			
					(8'5")	**(7'5")**		**(2.2)**	**(3.9)**	**(5.9)**			
D7F	93N	69-74	180	14 700	1.98	4.15	DD	17 100	11 350	7450	4580	3240	
				(32,400)	**(6'6")**	**(13'8")**		**(37,600)**	**(25,000)**	**(16,400)**	**(10,000)**	**(7140)**	
					2.56	2.26		2.4	3.5	5.0	7.4	9.5	
					(8'5")	**(7'5")**		**(1.5)**	**(2.2)**	**(3.4)**	**(4.6)**	**(5.9)**	

*Emits equivalent to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim).
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D7G	92V	77-86	200	20 090	1.98	4.19	PS						
				(44,300)	**(6'6")**	**(13'9")**							
					2.62	3.35		3.7	6.4	10.0			
					(8'7")	**(11'0")**		**(2.3)**	**(4.0)**	**(6.2)**			
D7G	91V	77-86	200	20 090	1.98	4.19	DD	17 690	11 730	7680	4700	3320	
				(44,300)	**(6'6")**	**(13'9")**		**(39,010)**	**(25,860)**	**(16,940)**	**(10,370)**	**(7320)**	
					2.62	3.35		2.5	3.7	5.3	7.8	10.1	
					(8'7")	**(11'0")**		**(1.6)**	**(2.3)**	**(3.3)**	**(4.9)**	**(6.3)**	
D7G	65V	75-07	149/200	20 580	1.98	2.72	PS	3.7	6.4	10.0			
(JAPAN)				**(45,381)**	**(6'6")**	**(8'11")**		**(2.3)**	**(4.0)**	**(6.2)**			
D7G	7MB	83-07	149/200	20 580	1.98	2.72	PS	3.7	6.4	10.0			
(INDONESIA)				**(45,381)**	**(6'6")**	**(8'11")**		**(2.3)**	**(4.0)**	**(6.2)**			
D7G LGP	72W	77-86	200	22 630	2.18	4.22	PS						
				(52,100)	**(7'2")**	**(13'9")**							
					3.3	3.28		3.7	6.4	10.0			
					(10'11")	**(10'9")**		**(2.3)**	**(4.0)**	**(6.2)**			
D7G SII	7MB	08-12	149/200	20 580	1.98	2.72	PS	3.7	6.4	10.0			
(INDONESIA)				**(45,381)**	**(6'6")**	**(8'11")**		**(2.3)**	**(4.0)**	**(6.2)**			
D7G SII	C7G	06-11	149/200	20 580	1.98	2.72	PS	3.7	6.4	10.0			
(CHINA)				**(45,381)**	**(6'6")**	**(8'11")**		**(2.3)**	**(4.0)**	**(6.2)**			
D7H (CB)	79Z	92-96	171/230	24 778	1.98	4.74	PS						
	(E. Peoria)			**(54,635)**	**(6'6")**	**(15'6")**							
	4AB				3.9	3.5		3.5	6.2	10.6			
	(Sagami)				**(12'10")**	**(11'6")**		**(2.2)**	**(3.8)**	**(6.6)**			
D7H (DS)	5BF	92-96	171/230	25 077	1.98	4.74	PS						
	(E. Peoria)			**(55,295)**	**(6'6")**	**(15'6")**							
	2RG				3.9	3.5		3.5	6.2	10.6			
	(Sagami)				**(12'10")**	**(11'6")**		**(2.2)**	**(3.8)**	**(6.6)**			
D7H LGP	80Z	92-96	171/230	27 065	2.24	4.74	PS						
(CB)	(E. Peoria)			**(59,678)**	**(7'4")**	**(15'6")**							
	5WB				4.50	3.58		3.5	6.2	10.6			
	(Sagami)				**(14'9")**	**(11'9")**		**(2.2)**	**(3.8)**	**(6.6)**			
D7H LGP	4FG	92-96	171/230	27 065	2.24	4.74	PS						
(DS)	(E. Peoria)			**(59,678)**	**(7'4")**	**(15'6")**							
	3XG				4.50	3.58		3.5	6.2	10.6			
	(Sagami)				**(14'9")**	**(11'9")**		**(2.2)**	**(3.8)**	**(6.6)**			
D7H XR (CB)	79Z	92-96	171/230	25 193	1.98	4.74	PS						
	(E. Peoria)			**(55,551)**	**(6'6")**	**(15'6")**							
	4AB				3.9	3.5		3.5	6.2	10.6			
	(Sagami)				**(12'10")**	**(11'6")**		**(2.2)**	**(3.8)**	**(6.6)**			
D7H XR (DS)	5BF	92-96	171/230	25 492	1.98	4.74	PS						
	(E. Peoria)			**(56,211)**	**(6'6")**	**(15'6")**							
	2RG				3.9	3.5		3.5	6.2	10.6			
	(Sagami)				**(12'10")**	**(11'6")**		**(2.2)**	**(3.8)**	**(6.6)**			
D7H	77Z	85-86	215	19 680	1.98	4.73	DD	16 834	12 861	9703	7436	5522	3940
				(43,380)	**(6'6")**	**(15'6")**		**(37,113)**	**(28,353)**	**(21,390)**	**(16,394)**	**(12,173)**	**(8686)**
					2.54			2.7	3.5	4.5	5.8	7.6	10.0
					(8'5")			**(1.7)**	**(2.2)**	**(2.8)**	**(3.6)**	**(4.7)**	**(6.2)**
D7H (US)	79Z*	85-90	215/—	23 647	1.981	4.619	PS						
				(52,134)	**(6'6")**	**(15'2")**							
					2.869	3.421		3.9	6.8	11.9			
					(9'5")	**(11'3")**		**(2.4)**	**(4.2)**	**(7.4)**			

*D7H models prior to Series II. Product identification number prefix still in use for current product.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th
D7H (US)	77Z	85-90	215/—	23 570	1.981	4.619	DD	16 834	12 861	9703	7436	5522	3940
				(51,960)	**(6'6")**	**(15'2")**		**(37,113)**	**(28,353)**	**(21,390)**	**(16,394)**	**(12,173)**	**(8686)**
					2.869	3.421		2.7	3.5	4.6	5.8	7.6	10.0
					(9'5")	**(11'3")**		**(1.7)**	**(2.2)**	**(2.8)**	**(3.6)**	**(4.7)**	**(6.2)**
D7H (US)	5BF*	88-90	215/—	24 351	1.981	4.624	PS/DS						
				(53,683)	**(6'6")**	**(15'2")**							
					2.871	3.429		3.7	6.4	11.1			
					(9'5")	**(11'3")**		**(2.3)**	**(4.0)**	**(6.9)**			
D7H (JPN)	4AB*	86-90	215/—	23 647	1.981	4.619	PS						
				(52,134)	**(6'6")**	**(15'2")**							
					2.869	3.421		3.9	6.8	11.9			
					(9'5")	**(11'3")**		**(2.4)**	**(4.2)**	**(7.4)**			
D7H (JPN)	2SB*	86-91	215/—	23 570	1.981	4.619	DD	16 834	12 861	9703	7436	5522	3940
				(51,960)	**(6'6")**	**(15'2")**		**(37,113)**	**(28,353)**	**(21,390)**	**(16,394)**	**(12,173)**	**(8686)**
					2.869	3.421		2.7	3.5	4.6	5.8	7.6	10.0
					(9'5")	**(11'3")**		**(1.7)**	**(2.2)**	**(2.8)**	**(3.6)**	**(4.7)**	**(6.2)**
D7H (JPN)	2RG*	88-90	215/—	24 351	1.981	4.624	PS/DS						
				(53,683)	**(6'6")**	**(15'2")**							
					2.871	3.429		3.7	6.4	11.1			
					(9'5")	**(11'3")**		**(2.3)**	**(4.0)**	**(6.9)**			
D7R LGP	6ER	96-02	179	30 605	2.24	5.8	PS/DS	3.5	6.4	10.8			
(JPN)			**(240)**	**(67,472)**	**(7'4")**	**(19'0")**		**(2.3)**	**(4.0)**	**(6.8)**			
D7H LGP	5WB*	86-90	215/—	25 237	2.235	4.619	PS						
(JPN)				**(55,638)**	**(7'4")**	**(15'2")**							
					3.371	3.503		3.9	6.8	11.9			
					(11'1")	**(11'6")**		**(2.4)**	**(4.2)**	**(7.4)**			
D7H LGP	82Z*	86-91	215/—	25 445	2.235	4.619	DD	16 834	12 861	9703	7436	5522	3940
(JPN)				**(56,096)**	**(7'4")**	**(15'2")**		**(37,113)**	**(28,353)**	**(21,390)**	**(16,394)**	**(12,173)**	**(8686)**
					3.371	3.503		2.7	3.5	4.6	5.8	7.6	10.0
					(11'1")	**(11'6")**		**(1.7)**	**(2.2)**	**(2.8)**	**(3.6)**	**(4.7)**	**(6.2)**
D7H LGP	3XG*	88-90	230/—	25 894	2.235	4.624	PS/DS						
(JPN)				**(57,086)**	**(7'4")**	**(15'2")**							
					3.377	3.505		3.7	6.4	11.1			
					(11'1")	**(11'6")**		**(2.3)**	**(4.0)**	**(6.9)**			
D7R STD	2HR	95-01	171	27 413	2.0	6.04	PS/FTC	3.5	6.4	10.8			
(US)			**(230)**	**(60,436)**	**(6'6")**	**(19'9")**		**(2.3)**	**(4.0)**	**(6.8)**			
D7R STD	3ZR	96-02	171	27 413	2.0	6.04	PS/FTC	3.5	6.4	10.8			
			(230)	**(60,436)**	**(6'6")**	**(19'9")**		**(2.3)**	**(4.0)**	**(6.8)**			
D7R SII STD	BRM	02-12	179/240	25 455	1.98	2.87	PS	3.52	6.10	10.54			
(JAPAN)				**(56,129)**	**(6'6")****	**(9'5")†**		**(2.19)**	**(3.79)**	**(6.55)**			
D7R SII STD	AEC	00-10	179/240	25 455	1.98	2.87	PS	3.52	6.10	10.54			
(US)				**(56,129)**	**(6'6")****	**(9'5")†**		**(2.19)**	**(3.79)**	**(6.55)**			
D7R XR	2EN	95-01	171	27 776	2.0	6.04	PS/DS	3.5	6.4	10.8			
(US)			**(230)**	**(61,236)**	**(6'6")**	**(19'9")**		**(2.3)**	**(4.0)**	**(6.8)**			
D7R XR	5MR	97-02	171	27 776	2.0	6.04	PS/DS	3.5	6.4	10.8			
			(230)	**(61,236)**	**(6'6")**	**(19'9")**		**(2.3)**	**(4.0)**	**(6.8)**			
D7R SII XR	BPT	03-12	179/240	27 002	1.98	3.05	PS	3.52	6.10	10.54			
(JAPAN)				**(59,540)**	**(6'6")****	**(10'0")†**		**(2.19)**	**(3.79)**	**(6.55)**			
D7R SII XR	AGN	00-10	179/240	27 002	1.98	3.05	PS	3.52	6.10	10.54			
(US)				**(59,540)**	**(6'6")****	**(10'0")†**		**(2.19)**	**(3.79)**	**(6.55)**			
D7H LGP	80Z*	85-90	215/—	25 237	2.235	4.619	PS						
(US)				**(55,638)**	**(7'4")**	**(15'2")**							
					3.371	3.503		3.9	6.8	11.9			
					(11'1")	**(11'6")**		**(2.4)**	**(4.2)**	**(7.4)**			

*D7H models prior to Series II. Product identification number prefix still in use for current product.
**D7R SII STD, XR and LGP machine width is for without trunnion.
†D7R SII STD, XR and LGP machine height is over EROPS, length is for basic machine.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th	Remarks
D7R LGP	4SR	96-02	179	29 500	2.24	5.8	PS/FTC	3.5	6.4	10.8				
			(240)	**(65,036)**	**(7'4")**	**(19'0")**		**(2.3)**	**(4.0)**	**(6.8)**				
D7H LGP	4FG*	87-90	230/—	25 894	2.235	4.624	PS/DS							
(US)				**(57,086)**	**(7'4")**	**(15'2")**								
					3.377	3.505		3.7	6.4	11.1				
					(11'1")	**(11'6")**		**(2.3)**	**(4.0)**	**(6.9)**				
D7R LGP	3DN	95-01	179	30 605	2.24	5.8	PS/DS	3.5	6.4	10.8				
(US)			**(240)**	**(67,472)**	**(7'4")**	**(19'0")**		**(2.3)**	**(4.0)**	**(6.8)**				
D7R LGP	9HM	95-01	179	29 500	2.24	5.8	PS/FTC	3.5	6.4	10.8				
(US)			**(240)**	**(65,036)**	**(7'4")**	**(19'0")**		**(2.3)**	**(4.0)**	**(6.8)**				
D7E	MDB	10-11	175	25 700	1.98	4.88	ED**							
			(235)	**(56,669)**	**(6'6")**	**(16'0")**								
					2.88	3.32				FORWARD 11.3 **(7.0)**				
					(9'5")	**(10'11")**				REVERSE 11.3 **(7.0)**				
D7R SII	BNX	01-12	179/240	27 626	2.24	3.16	PS	3.52	6.10	10.54				
LGP				**(60,916)**	**(7'4")†**	**(10'5")††**		**(2.19)**	**(3.79)**	**(6.55)**				
D7R SII	ABJ	00-10	179/240	27 626	2.24	3.16	PS	3.52	6.10	10.54				
LGP				**(60,916)**	**(7'4")†**	**(10'5")††**		**(2.19)**	**(3.79)**	**(6.55)**				
D7E LGP	SCG	10-11	175	28 170	2.29	4.88	ED**							
			(235)	**(62,115)**	**(7'6")**	**(16'0")**								
					3.42	3.32				FORWARD 11.3 **(7.0)**				
					(11'3")	**(10'11")**				REVERSE 11.3 **(7.0)**				
D8	1H	35-41	110/95	14 790	1.98	4.64	•	9680	6870	5720	4800	3860	2740	
				(32,600)	**(6'6")**	**(15'3")**		**(21,350)**	**(15,150)**	**(12,610)**	**(10,590)**	**(8520)**	**(6050)**	
					2.64	2.28		2.7	3.8	4.5	5.1	6.3	8.5	RD-8 with 192 cm
					(8'8")	**(7'6")**		**(1.7)**	**(2.4)**	**(2.8)**	**(3.2)**	**(3.9)**	**(5.3)**	**(78")** gauge
D8	8R	41-45	131/113	15 490	1.98	4.64	••	13 060	9750	7940	6800	5620	3990	
				(34,160)	**(6'6")**	**(15'3")**		**(28,800)**	**(21,500)**	**(17,500)**	**(15,000)**	**(12,400)**	**(8800)**	
					2.64	1.85		2.5	3.5	4.2	4.8	5.8	7.9	Horsepower
					(8'8")	**(6'1")**		**(1.6)**	**(2.2)**	**(2.6)**	**(3.0)**	**(3.6)**	**(4.9)**	Increase
D8	2U	45-53	148/130	16 470	1.98	4.85	DD	13 560	9840	7120	5400	3900		
				(36,310)	**(6'6")**	**(15'10")**		**(29,900)**	**(21,700)**	**(15,700)**	**(11,900)**	**(8600)**		
					2.64	2.18		2.5	3.7	4.6	5.9	7.7		HP increase,
					(8'8")	**(7'2")**		**(1.6)**	**(2.3)**	**(2.9)**	**(3.7)**	**(4.8)**		DD transmission
D8	13A	53-55	185/150	16 866	1.98	4.88	DD	20 358	12 939	8926	6955	4935		
				(37,150)	**(6'6")**	**(16'1")**		**(44,840)**	**(28,500)**	**(19,660)**	**(15,320)**	**(10,870)**		
					2.64	2.18		3.1	4.3	5.6	7.2	9.3		
					(8'8")	**(7'2")**		**(1.9)**	**(2.7)**	**(3.5)**	**(4.5)**	**(5.8)**		
D8D, G	15A	55-57	191/155	16 310	1.98	5.23	TC							
				(35,925)	**(6'6")**	**(17'2")**								
					2.58	2.23		5.8	8.5	11.9				
					(8'6")	**(7'8")**		**(3.6)**	**(5.3)**	**(7.4)**				
D8E, F	14A	55-57	191/155	17 734	1.98	4.88	DD	20 439	16 135	10 964	7373	4953		
			Belt	**(39,060)**	**(6'6")**	**(16'1")**		**(45,020)**	**(35,540)**	**(24,150)**	**(16,240)**	**(10,910)**		
					2.64	2.26		2.4	3.1	4.5	6.1	8.3		
					(8'8")	**(7'6")**		**(1.5)**	**(1.9)**	**(2.8)**	**(3.8)**	**(5.2)**		
D8H	35A	59-61	235	20 924	2.13	5.20	TC							
				(46,032)	**(7'0")**	**(17'1")**								
					2.87	2.39		5.6	8.2	12.2				
					(9'1")	**(7'10")**		**(3.5)**	**(5.1)**	**(7.6)**				

*D7H models prior to Series II. Product identification number prefix still in use for current product.
**Electric drive machines do not have transmission gears.
†D7R SII STD, XR and LGP machine width is for without trunnion.
††D7R SII STD, XR and LGP machine height is over EROPS, length is for basic machine.
•Power transmitted through dry tape flywheel clutch to selective type hinge speed gear set.
••Power transmitted through flexible and over center engagement, dry flywheel clutch with metallic friction surfaces. Selective type change speed gear set.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th	Remarks
D8H	36A	58-66	235/185	21 400	2.13	5.20	DD	19 958	15 648	10 931	8051	5869	3832	
				(47,180)	**(7'0")**	**(17'1")**		**(44,400)**	**(34,500)**	**(24,100)**	**(17,750)**	**(13,000)**	**(8450)**	
					2.87	2.39		2.4	3.0	4.3	5.6	7.4	10.1	
					(9'1")	**(7'10")**		**(1.5)**	**(1.9)**	**(2.7)**	**(3.5)**	**(4.6)**	**(6.3)**	
D8H	46A	58-74	270	21 863	2.13	5.20	PS							
				(48,210)	**(7'0")**	**(17'1")**								
					2.87	2.39		3.8	6.7	10.4				
					(9'1")	**(7'10")**		**(2.4)**	**(4.2)**	**(6.5)**				
D8K	76V	74-82	300	31 980	2.13	5.26	DD	25 400	18 930	12 990	9370	6610	4090	
				(69,300)*	**(7'0")**	**(17'3")**		**(56,000)**	**(41,740)**	**(28,640)**	**(20,650)**	**(14,580)**	**(9010)**	Turbocharged, Sealed and Lubricated Track
					3.05	2.44		2.7	3.5	4.8	6.3	8.2	11.3	
					(10'0")	**(8'0")**		**(1.7)**	**(2.2)**	**(3.0)**	**(3.9)**	**(5.1)**	**(7.0)**	
D8K	77V	74-82	300	31 430	2.13	5.26	PS							
				(70,500)†	**(7'0")**	**(17'3")**								Turbocharged, Sealed and Lubricated Track
					3.05	2.44		4.0	7.1	10.9				
					(10'0")	**(8'0")**		**(2.5)**	**(4.4)**	**(6.8)**				
D8L	53Y	82-86	335	37 305	2.2	4.95	PS							
	7JC	84-90		**(82,243)**	**(7'3")**	**(16'2")**								
	7YB	85-92			2.84	3.79		3.9	6.8	11.9				
					(9'4")	**(12'5")**		**(2.4)**	**(4.2)**	**(7.4)**				
D8L SA	4FB	84-87	400/325	36 650	2.54		DD	31 679	23 115	17 196	12 388	9154	6428	
				(80,820)	**(8'4")**			**(69,840)**	**(50,960)**	**(37,910)**	**(27,310)**	**(20,180)**	**(14,170)**	
					3.11			2.9	3.9	5.0	6.8	8.9	11.9	
					(10'3")			**(1.8)**	**(2.4)**	**(3.1)**	**(4.2)**	**(5.5)**	**(7.4)**	
D8N	9TC	87-92	285	37 462	2.08	4.95	PS							
	5TJ	92-95	285	**(82,590)**	**(6'10")**	**(16'3")**								
					3.05	3.43		3.5	6.2	10.8				
					(10'0")	**(11'3")**		**(2.2)**	**(3.9)**	**(6.7)**				
D8R Series II (US)	6YZ	00-04	310	37 830	2.08	6.91	PS							
				(83,400)	**(6'10")**	**(22'8")**								
					3.05	3.51		3.4	6.0	10.6				
					(10'0")	**(11'6")**		**(2.1)**	**(3.7)**	**(6.6)**				
D8R Series II (BRAZIL)	AKA	2000	231/310	37 830	2.08	6.91	PS							
				(83,400)	**(6'10")**	**(22'8")**								
					3.05	3.51		3.4	6.0	10.6				
					(10'0")	**(11'6")**		**(2.1)**	**(3.7)**	**(6.6)**				
D8T**	MLN-FTC	11-14	271	39 420	2.08	4.55	PS/DS	67 414	37 025	20 139				
				(86,900)	**(6'10")**	**(14'7")**		**(148,621)**	**(81,628)**	**(44,399)**				
					3.06	3.5		3.4	6.1	10.6				
					(10'1")	**(11'6")**		**2.1**	**3.8**	**6.6**				
D8T LGP**	MLN-FTC	11-14	271	37 420	2.33	4.55	PS/DS	67 414	37 025	20 139				
				(82,496)	**(7'8")**	**(14'7")**		**(148,621)**	**(81,628)**	**(44,399)**				
					3.37	3.5		3.4	6.1	10.6				
					(11'1")	**(11'6")**		**2.1**	**3.8**	**6.6**				

*Approximate operating weight. Includes lubricants, coolant, full fuel tank, hydraulic control, 8S Bulldozer, ROPS canopy and operator. All other weights listed in this column are shipping weights.

**Emits equivalent to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim).

†Power transmitted through dry tape flywheel clutch to selective type hinge speed gear set.

NOTE: Power Shift models show speeds only, not drawbar pull.

NOTE: Track-Type Tractor weights do not include blades until 1967.

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Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph)					
								1st	2nd	3rd	4th	5th	6th
D9D	18A	55-56	286/230	25 772	2.29	5.46	DD	27 631	21 207	15 423	10 706	7658	4958
				(56,765)	**(7'6")**	**(17'11")**		**(60,860)**	**(46,710)**	**(33,970)**	**(23,580)**	**(16,670)**	**(10,920)**
					3.03	2.67		2.6	3.4	4.7	6.3	8.1	10.9
					(10'0")	**(8'9")**		**(1.6)**	**(2.1)**	**(2.9)**	**(3.9)**	**(5.0)**	**(6.8)**
D9D	18A	56-59	320/260	26 125	2.29	5.46	DD	28 603	23 835	16 617	12 167	9171	6106
				(57,543)	**(7'6")**	**(17'11")**		**(63,000)**	**(52,500)**	**(36,600)**	**(26,800)**	**(20,200)**	**(13,450)**
					3.03	2.67							
					(10'0")	**(8'9")**							
D9D	19A	55-56	286/230	25 729	2.29	5.46	TC						
				(56,670)	**(7'6")**	**(17'11")**							
					3.03	2.67		6.6	9.0	12.6			
					(10'0")	**(8'9")**		**(4.1)**	**(5.6)**	**(7.8)**			
D9D	19A	56-59	320/260	26 238	2.29	5.46	TC						
				(57,990)	**(7'6")**	**(17'11")**							
					3.03	2.68		6.6	9.5	13.0			
					(10'0")	**(8'9")**		**(4.1)**	**(5.9)**	**(8.1)**			
D9E	50A	59-60	335	27 016	2.29	5.50	TC						
				(59,506)	**(7'6")**	**(18'1")**							
					3.03	2.70		6.8	9.7	13.2			
					(10'0")	**(8'11")**		**(4.2)**	**(6.0)**	**(8.2)**			
D9D	34A	59-61	335	27 167	2.29	5.50	PS						
				(59,837)	**(7'6")**	**(18'1")**							
					3.03	2.70		4.2	7.2	11.2			
					(10'0")	**(8'11")**		**(2.6)**	**(4.5)**	**(7.0)**			
D9E	49A	59-60	335/268	26 957	2.29	5.50	DD						
				(59,375)	**(7'6")**	**(18'1")**							
					3.03	2.70		2.7	3.5	4.8	6.4	8.2	11.4
					(10'0")	**(8'11")**		**(1.7)**	**(2.2)**	**(3.0)**	**(4.0)**	**(5.1)**	**(7.1)**
D9G	66A	61-74	385	31 072	2.29	5.50	PS						
				(68,500)	**(7'6")**	**(18'1")**							
					3.10	2.10		3.9	6.8	10.5			
					(10'0")	**(8'7")**		**(2.4)**	**(4.2)**	**(6.5)**			

NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th	Remarks
S × S D9G	29N	69-74	770	86 200• **(190,000)**	5.8* **(19'0")**	8.0◀ **(25'0")**	PS							L.H. of S × S D9G
	30N				7.3** **(24'0")**	2.8◀◀ **(9'2")**		3.9 **(2.4)**	6.8 **(4.2)**	10.0 **(6.2)**				R.H. of S × S D9G
Dual D9G	90J	69-74	770	79 470• **(175,200)**	2.3* **(7'6")**	12.9◀ **(42'6")**	PS							Front of Dual D9G
	91J				3.3** **(10'9")**	3.1◀◀ **(9'11")**		3.9 **(2.4)**	6.8 **(4.2)**	10.5 **(6.5)**				Rear of Dual D9G
S × S D9H	99V	74-77	820	83 400• **(183,900)**	5.8* **(19'0")**	9.0◀ **(26'1")**	PS							L.H. of S × S D9H
	12U				7.3** **(24'0")**	2.9◀◀ **(9'6")**		4.0 **(2.5)**	6.9 **(4.3)**	10.8 **(6.7)**				R.H. of S × S D9H
Dual D9H	97V	74-80	820	81 100• **(178,800)**	2.3* **(7'6")**	12.9◀ **(42'6")**	PS							Front of Dual D9H
	98V				3.3** **(10'9")**	3.1◀◀ **(9'11")**		4.0 **(2.5)**	6.9 **(4.3)**	10.8 **(6.7)**				Rear of Dual D9H
D9H	90V	74-81	410	32 840 **(72,400)**	2.3* **(7'6")**	5.6 **(18'5")**	PS							Standard Model
					3.0 **(9'11")**	2.7◀◀ **(8'10")**		4.0 **(2.5)**	6.9 **(4.3)**	10.8 **(6.7)**				
D9L	14Y	80-87	460	52 055 **(114,656)**	2.5 **(8'2")**	5.32 **(17'5")**								
					3.11 **(10'2")**	4.41 **(14'6")**		3.9 **(2.4)**	7.2 **(4.5)**	12.4 **(7.7)**				
D9N	1JD	86-94	370	42 816 **(96,196)**	2.55 **(7'5")**	5.17 **(16'11.5")**	PS							
	6XJ	93-95			2.43 **(9'7")**	3.91 **(12'10")**		3.9 **(2.4)**	6.9 **(4.3)**	12.1 **(7.5)**				
D9R (CB) (US)	ACL	00-04	410	49 147 **(108,350)**	2.25 **(7'5")**	6.84 **(22'5")**	PS							
					3.30 **(10'10")**	3.99 **(13'1")**		3.8 **(2.4)**	6.8 **(4.2)**	11.9 **(7.4)**				
D9R (DS) (US)	ABK	00-04	410	49 510 **(109,150)**	2.25 **(7'5")**	6.84 **(22'5")**	PS							
					3.30 **(10'10")**	3.99 **(13'1")**		3.8 **(2.4)**	6.8 **(4.2)**	11.9 **(7.4)**				
D9T	RJS	04-11	410	47 900 **(105,600)**	2.25 **(7'5")**	6.85 **(22'6")**	PS							
					3.31 **(10'11")**	3.99 **(13'1")**		3.9 **(2.4)**	6.8 **(4.2)**	11.7 **(7.3)**				

*Gauge of both tractors combined.
**Width to outside of dozer blade.
◀Length including dozer blade.
◀◀Overall height excluding stack and canopy.
•Approximate weight of both machines plus Bulldozer, hydraulic controls, coolant and 5% fuel. (D10, D11N, D11R includes SS ripper)
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

Track-Type Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Gauge m (ft) and Width m (ft)	Length m (ft) and Height m (ft)	Trans-mission	Rated Drawbar Pull — kg (lb) and Forward Speed — km/h (mph) 1st	2nd	3rd	4th	5th	6th	Remarks
D10	84W	78-86	700	88 245	2.9	5.92	PS							Width 2.2 m **(7'0")**
				(194,140)	**(9'6")**	**(19'8")**								2.9 m **(9'6")** gauge
	76X				3.65	4.63◀		3.9	6.8	11.6				1.9 × 2.7 m
					(12'0")	**(15'2")**		**(2.4)**	**(4.2)**	**(7.2)**				**(6'4" × 8'10")** gauge
D10N	2YD	87-93	520	66 400	2.55	5.89	PS							Width 3.45 m **(11'4")**
				(147,405)	**(8'4")**	**(18'4")**								
	3SK	93-96			3.30	4.45		4.0	7.1	12.5				
					(10'10")	**(14'7")**		**(2.5)**	**(4.4)**	**(7.7)**				
D10R	3KR	95-02	570	65 764	2.55	7.50	TD							3412 DITA HEUI™
				(144,986)	**(8'4")**	**(24'7")**	3-Spd PS							
					3.72	3.27		4.0	7.1	12.5				
					(12'2")	**(10'9")**		**(2.5)**	**(4.4)**	**(7.7)**				
D10R	AKT	01-04	580	65 400	2.55	9.16	PS							
				(144,200)	**(8'4")**	**(30'0")**								
					3.74	4.27		4.0	7.1	12.5				
					(12'3")	**(14'0")**		**(2.5)**	**(4.4)**	**(7.7)**				
D10T	RJG	05-14	580	70 171	2.55	7.42	TD							C27 ACERT™ DITA
				(154,700)	**(8'4")**	**(24'4")**	3-Spd PS							MEUI™
					3.74	3.22		4.0	7.2	12.7				
					(12'3")	**(10'7")**		**(2.5)**	**(4.5)**	**(7.9)**				
D11N	74Z	86-93	770	95 900	2.90	6.16	PS							
				(211,000)	**(9'6")**	**(20'3")**								
	4HK	93-96		97 450	3.65	4.65		3.9	6.8	11.6				
				(214,850)	**(12'0")**	**(15'3")**		**(2.4)**	**(4.4)**	**(7.2)**				
D11R	8ZR	96-97	770	98 413	2.89	6.16	PS							
				(216,963)	**(9'6")**	**(20'3")**								
					3.60	4.65		3.9	6.8	11.6				
					(11'10")	**(15'3")**		**(2.4)**	**(4.4)**	**(7.2)**				
D11R	9TR	97-99	850	104 590	2.89	6.16	PS							
				(230,100)	**(9'6")**	**(20'3")**								
					3.60	4.65		3.9	6.8	11.8				
					(11'10")	**(15'3")**		**(2.4)**	**(4.2)**	**(7.3)**				
D11R	7PZ	00-07	850	104 600	2.89	5.21	PS							
				(230,100)	**(9'6")**	**(17'1")**								
					3.60	4.57		3.9	6.8	11.8				
					(11'10")	**(15'0")**		**(2.4)**	**(4.2)**	**(7.3)**				
D11R CD	9XR	96-99	850	111 590	2.89	6.16	PS							
				(246,000)	**(9'6")**	**(20'3")**								
					3.60	4.65		3.9	6.8	11.8				
					(11'10")	**(15'3")**		**(2.4)**	**(4.2)**	**(7.3)**				
D11R CD	AAF	96-07	850	113 000	2.89	5.21	PS							
				(248,600)	**(9'6")**	**(17'1")**								
					3.81	4.57		3.9	6.8	11.8				
					(12'6")	**(15'0")**		**(2.4)**	**(4.2)**	**(7.3)**				
D11T	GEB	07-11	850	104 590	2.89	8.64	TD							C32 ACERT DITA
				(230,581)	**(9'6")**	**(28'4")**	3-Spd PS							MEUI
					4.38	3.64		3.9	6.8	11.8				
					(14'4")	**(11'11")**		**(2.4)**	**(4.2)**	**(7.3)**				
D11T CD	TPB	07-11	850	113 000	2.89	8.77	TD							C32 ACERT DITA
				(249,122)	**(9'6")**	**(28'9")**	3-Spd PS							MEUI
					4.38	3.64		3.9	6.8	11.8				
					(14'4")	**(11'11")**		**(2.4)**	**(4.2)**	**(7.3)**				

◀Overall height excluding stack and canopy.
NOTE: Power Shift models show speeds only, not drawbar pull.
NOTE: Track-Type Tractor weights do not include blades until 1967.

TRACK-TYPE TRACTORS MANUFACTURED OUTSIDE U.S.A.

Source	Model	Product Ident. No. Prefix	Years Built	Horsepower Flywheel/ Drawbar	Transmission	Gauge m (ft)
U.K.	D4C	24A	60-64	63/50	DD	1.52 **(5'0")**
	D4D	88A	64-67	65/52	DD	1.52 **(5'0")**
	D6C	82A	64-68	120/93	DD	1.88 **(6'2")**
	D6C	83A	64-68	120/—	PS	1.88 **(6'2")**
	D6C	46J	71-77	140/—	DD	1.88 **(6'2")**
	D6C	47J	71-77	140/—	PS	1.88 **(6'2")**
	D8H	52A	59-61	235/—	PS	2.13 **(7'0")**
	D8H	22A	59-66	235/185	DD	2.13 **(7'0")**
	D8H	68A	60-66	235/—	PS	2.13 **(7'0")**
	D8K	66V	74-82	300/—	PS	2.13 **(7'0")**
Brazil	D4D	97F	69-78	75/—	DD	1.52 **(5'0")**
	D4D	74U	71-78	75/—	PS	1.52 **(5'0")**
	D6C	24U	71-77	120/93	PS	1.88 **(6'2")**
	D6C	23U	73-77	120/93	DD	1.88 **(6'2")**
	D6D	74W	77-92	140/—	DD	1.88 **(6'2")**
	D6D	75W	77-92	140/—	PS	1.88 **(6'2")**
	D6D	9FK	92-96	140/—	PS	1.88 **(6'2")**
	D6E	2MJ	92-96	155/—	PS	1.88 **(6'2")**
	D6D	19B	85-91	140/—	PS	1.88 **(6'2")**
	D6G	2MJ	89-03	160/—	PS	1.88 **(6'2")**
	D6G SR	3SR	97-01	160/—	PS	
	D6M XL	5WR	96-02	104/140	PS	1.89 **(6'2")**
	D6M XL	6LR	96-02	104/140	PS	1.89 **(6'2")**
	D8L	7JC	84-90	335/—	PS	2.2 **(7'3")**
	D8L	7YB	85-92	335/—	PS	2.2 **(7'3")**
	D8N	7TK	93-95	285/—	PS	2.08 **(6'10")**
	D8R	9EM	95-	305/—		
	D8R Series II	AKA	00-04	310	PS	2.08 **(6'10")**
	D8R Series II	AKA	00-04	310	PS	3.05 **(10'0")**
Australia	D4	29A	59-61	63/50	DD	1.12 **(3'8")**
	D4	30A	59-60	63/50	DD	1.52 **(5'0")**
	D4C	54A	60-62	63/52	DD	1.12 **(3'8")**
	D4C	55A	60-62	65/52	DD	1.52 **(5'0")**
	D4D	85A	63-68	65/52	DD	1.52 **(5'0")**
	D5	51H	68-68	93/75	DD	1.88 **(6'2")**
	D5	52H	68-69	93/—	PS	1.88 **(6'2")**
	D6	31A	58-60	93/75	DD	1.52 **(5'0")**
	D6	32A	58-60	93/75	DD	1.18 **(6'2")**
	D6B	56A	60-66	90/73	DD	1.52 **(5'0")**
	D6B	57A	60-68	90/73	DD	1.88 **(6'2")**
	D6C	71A	63-68	120/93	DD	1.88 **(6'2")**
	D6C	73A	63-68	120/—	PS	1.88 **(6'2")**
	D6C	55J	69-72	125/—	DD	1.88 **(6'2")**
	D6C	56J	69-72	125/—	PS	1.88 **(6'2")**
China	D6G Series 2	C6G	06-11	160	PS	1.88 **(6'2")**
	D6G Series 2 LGP	C6X	08-11	160/—	PS	2.11 **(6'11")**
	D7G Series 2	C7G	06-11	200	PS	1.98 **(6'6")**
	D7G Series 2	C7G	04-11	149/200	PS	1.98 **(6'6")**
Indonesia	D6G Series 2	P6G	06-11	160/—	PS	1.88 **(6'2")**
	D7G	7MB	83-11	202/—	PS	1.98 **(6'6")**
	D7G Series 2	7MB	83-12	149/200	PS	1.98 **(6'6")**
France	D4C	69A	61-63	63/50	DD	1.52 **(5'0")**
	D4D	86A	63-68	65/52	DD	1.52 **(5'0")**
	D4D LGP	18J	66-68	65/52	DD	1.79 **(5'10")**
	D4D	58J	67-68	65/—	PS	1.52 **(5'0")**

Track-Type Tractors Manufactured Outside U.S.A. (cont'd)

Source	Model	Product Ident. No. Prefix	Years Built	Horsepower Flywheel/ Drawbar	Transmission	Gauge m (ft)
France (cont'd)	D4E	68X	78-86	80/—	DD	1.52 **(5'0")**
	D4E	69X	78-85	80/—	PS	1.52 **(5'0")**
	D4E LGP	71X	78-85	80/—	DD	1.77 **(5'10")**
	D4E LGP	72X	78-86	80/—	PS	1.77 **(5'10")**
	D5	62J	69-77	105/—	DD	1.88 **(6'2")**
	D5	63J	69-77	105/—	PS	1.88 **(6'2")**
	D5 LGP	6R	70-77	105/—	PS	2.06 **(6'9")**
	D5 LGP	12R	70-77	105/—	DD	2.06 **(6'9")**
	D5B	43X	77-85	105/—	DD	1.88 **(6'2")**
	D5B	44X	77-86	105/—	PS	1.88 **(6'2")**
	D5B LGP	45X	77-86	105/—	DD	2.06 **(6'9")**
	D5B LGP	46X	77-86	105/—	PS	2.06 **(6'9")**
	D5B	8MB	84-86	105/—	PS	1.52 **(5'0")**
	D5H	8RC	85-96	120/—	PS	1.80 **(5'11")**
	D5H LGP	1DD	86-96	130/—	PS	2.16 **(7'1")**
	D5H XL	8RJ	86-96	130/—	PS	1.89 **(6'2")**
	D5H	7NC	85-96	120/—	DD	1.80 **(5'11")**
	D5H LGP	9HC	85-96	130/—	DD	2.16 **(7'1")**
	D5M XL	4BR	96-02	82/110	PS	1.77 **(5'10")**
	D5M XL	6GN	96-02	82/110	PS	1.77 **(5'10")**
	D5M LGP	3DR	96-02	82/110	PS	2.00 **(6'7")**
	D5M LGP	3CR	96-02	82/110	PS	2.00 **(6'7")**
	D6M XL	9ZM	96-02	104/140	PS	1.89 **(6'2")**
	D6M XL	3WN	96-02	104/140	PS	1.89 **(6'2")**
	D6M LGP	2RN	96-02	104/140	PS	2.16 **(7'1")**
	D6M LGP	4JN	96-02	104/140	PS	2.16 **(7'1")**
Scotland	D6D	19X	78-86	140/—	DD	1.88 **(6'2")**
	D6D	20X	78-86	140/—	PS	1.88 **(6'2")**
	D6D	0IY	79-87	125/—	PS	1.88 **(6'2")**
Glasgow	D6H	7PC	86-87	165/—	PS	1.88 **(6'2")**
	D6H LGP	8YC	86-87	165/—	PS	2.23 **(7'4")**
Japan	D3	79U	73-79	62/—	PS	1.42 **(4'8")**
	D3	82U	73-78	62/—	PS	1.42 **(4'8")**
	D3 LGP	6N	73-79	62/—	PS	1.65 **(5'5")**
	D3 LGP	83U	73-79	62/—	PS	1.65 **(5'5")**
	D3B	23Y	79-87	65/—	PS	1.42 **(4'8")**
	D3B LGP	24Y	79-87	65/—	PS	1.65 **(5'5")**
	D3B	27Y	79-87	65/—	PS	1.42 **(4'8")**
	D3B LGP	28Y	79-87	65/—	PS	1.65 **(5'5")**
	D3B	3YC	85-87	65/—	DD	1.42 **(4'8")**
	D3B LGP	5MC	85-87	65/—	DD	1.65 **(5'5")**
	D3C	5KG	87-90	67/—	PS	1.42 **(4'7")**
	D3C Series II	7JG/4HJ	90-93	70/—	PS	1.42 **(4'7")**
	D3C LGP	1PJ	87-90	67/—	PS	1.65 **(5'4")**
	D3C LGP Series II	8GD/5CJ	90-93	70/—	PS	1.65 **(5'4")**
	D3G XL	CFC	01-03	70	HYS	1.45 **(4'9")**
	D3G XL*	JMH	03-07	70	HYS	1.45 **(4'9")**
	D3G LGP	CFF	01-03	70	HYS	1.68 **(5'6")**
	D3G LGP*	BYR	03-07	70	HYS	1.68 **(5'6")**
	D4D LGP	67A	65-68	65/52	DD	1.79 **(5'10")**
	D4D	91A	65-68	65/52	DD	1.52 **(5'0")**
	D4E	50X	77-86	80/—	DD	1.52 **(5'0")**
	D4E	51X	77-86	80/—	PS	1.52 **(5'0")**
	D4E LGP	52X	77-86	80/—	DD	1.77 **(5'10")**
	D4C	1RJ	87-90	78/—	PS	1.42 **(4'7")**
	D4C Series II	7KG	90-93	80/—	PS	1.42 **(4'7")**

*Emits equivalent to Tier 2/Stage II/Japan 2001 (Tier 2).

Track-Type Tractors Manufactured Outside U.S.A. (cont'd)

Source	Model	Product Ident. No. Prefix	Years Built	Horsepower Flywheel/ Drawbar	Transmission	Gauge m (ft)
Japan (cont'd)	D4C LGP	2CJ	87-90	78/—	PS	1.65 **(5'4")**
	D4C LGP Series II	98G	90-93	80/—	PS	1.65 **(5'4")**
	D4G XL	CFN	01-03	80	HYS	1.50 **(4'11")**
	D4GXL*	HYD	03-07	80	HYS	1.50 **(4'11")**
	D4G LGP	FDC	01-03	80	HYS	1.68 **(5'6")**
	D4G LGP*	TLX	03-07	80	HYS	1.68 **(5'6")**
	D4H	8PB	85-96	90/95	PS	1.67 **(5'5")**
	D4H LGP	9DB	85-96	105/—	PS	2.0 **(6'7")**
	D4H	2AC	85-92	90/95	DD	1.67 **(5'5")**
	D4H LGP	3AC	85-90	90/95	DD	2.0 **(6'7")**
	D4H XL	8PJ	92-96	105/—	PS	1.77 **(5'10")**
	D4H LGP	9GJ	92-96	105/—	PS	2.0 **(6'7")**
	D4H LGP	4NK	92-93	105/—	DD	2.0 **(6'7")**
	D5	37J	67-68	93/75	DD	1.88 **(6'2")**
	D5 LGP	98A	67-68	93/75	DD	2.06 **(6'9")**
	D5	67J	68-77	105/—	DD	1.88 **(6'2")**
	D5	97J	71-76	105/—	PS	1.88 **(6'2")**
	D5 LGP	68J	68-77	105/—	DD	2.06 **(6'9")**
	D5B	47X	77-86	105/—	DD	1.88 **(6'2")**
	D5B	48X	77-86	105/—	PS	1.88 **(6'2")**
	D5B LGP	49X	77-86	105/—	DD	2.06 **(6'9")**
	D5C	6PJ	91-93	90/—	PS	1.54 **(5'1")**
	D5C LGP	3MK	91-93	90/—	PS	1.72 **(5'8")**
	D5G XL	FDH	01-03	90	HYS	1.55 **(5'1")**
	D5GXL*	WGB	03-07	90	HYS	1.55 **(5'1")**
	D5G LGP	FDW	01-03	90	HYS	1.73 **(5'8")**
	D5G LGP*	RKG	03-07	90	HYS	1.73 **(5'8")**
	D5H	3MD	86-96	120/—	PS	1.80 **(5'11")**
	D5H LGP	4KD	86-96	130/—	PS	2.16 **(7'1")**
	D5H	1YD	86-96	120/—	DD	1.80 **(5'11")**
	D5H LGP	2SD	86-96	130/—	DD	2.16 **(7'1")**
	D5M XL	4JS	96-	82/110	PS	1.77 **(5'10")**
	D5M XL	5ES	96-02	82/110	PS	1.77 **(5'10")**
	D5M LGP	5FS	96-	82/110	PS	2.00 **(6'7")**
	D5M LGP	6AS	96-02	82/110	PS	2.00 **(6'7")**
	D5M LGP	7LR	97-02	78/105	DDPS	2.00 **(6'7")**
	D6B	37H	66-67	93/75	DD	1.88 **(6'2")**
	D6B LGP	38H	66-67	93/75	DD	2.06 **(6'9")**
	D6C	41A	66-68	120/93	DD	1.88 **(6'2")**
	D6C	96A	66-68	120/93	PS	1.88 **(6'2")**
	D6C	26K	68-77	125/—	DD	1.88 **(6'2")**
	D6C	69C	68-77	125/—	PS	1.88 **(6'2")**
	D6C LGP	90B	71-77	140/—	DD	2.11 **(6'11")**
	D6D LGP LS	6HC	86-96	160/—	DD	1.88 **(6'2")**
	D6D	31X	86-98	140/—	PS	1.88 **(6'2")**
	D6D	30X	85-96	140/—	DD	1.88 **(6'2")**
	D6D PTNR	5YB	88-96	160/—	PS	1.88 **(6'2")**
	D6G	BWJ	02-07	160/—	PS	1.88 **(6'2")**
	D6M XL	2YS	96-	104/140	PS	1.89 **(6'2")**
	D6M XL	4HS	96-02	104/140	PS	1.89 **(6'2")**
	D6M LGP	4GS	96-	104/140	PS	2.16 **(7'1")**
	D6M LGP	5NR	96-02	104/140	PS	2.16 **(7'1")**

*Emits equivalent to Tier 2/Stage II/Japan 2001 (Tier 2).

Track-Type Tractors Manufactured Outside U.S.A. (cont'd)

Source	Model	Product Ident. No. Prefix	Years Built	Horsepower Flywheel/ Drawbar	Transmission	Gauge m (ft)
Japan	D6R	S6X	10-	175	PS	1.88 **(74")**
(cont'd)	D6R XL	S6T	10-	195	PS	1.88 **(74")**
	D6R LGP	S6Y	10-	195	PS	2.286 **(90")**
	D6R SIII	JEK	06-10	138/185	PS	1.88 **(6'2")**
	D6R SIII XL	EXL	06-12	149/200	PS	1.88 **(6'2")**
	D6R SIII XW	EXW	07-09	149/200	PS	2.03 **(6'8")**
	D6R SIII LGP	LGP	06-12	149/200	PS	2.29 **(7'6")**
	D7G	35N	80-91	202/—	PS	1.98 **(6'6")**
	D7G LGP	44W	76-87	202/—	PS	1.98 **(6'6")**
	D7G LGP	45W	75-86	202/—	DD	1.98 **(6'6")**
	D7G	64V	75-88	202/—	DD	1.98 **(6'6")**
	D7G	65V	75-07	202/—	PS	1.98 **(6'6")**
	D7G	65V	75-07	149/200	PS	1.98 **(6'6")**
	D7H	25B	85-92	215/—	DD	1.98 **(6'6")** 2.54 **(8'5")**
	D7H LGP	82Z	85-92	215/—	DD	2.23 **(7'4")** 3.15 **(10'4")**
	D7R	DSH	12-	240	PS	1.98 **(78")**
	D7R XR	DJR	12-	240	PS	1.98 **(78")**
	D7R LGP	DLN	12-	240	PS	2.235 **(88")**
	D7R SII	BRM	02-12	179/240	PS	1.98 **(6'6")**
	D7R SII XR	BPT	03-12	179/240	PS	1.98 **(6'6")**
	D7R SII LGP	BNX	01-12	179/240	PS	2.24 **(7'4")**

AGRICULTURAL TRACTORS

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Height m (ft) Gauge m (ft)	Drawbar Pull kg (lb)* and Forward Speed km/h (mph)							
						1st	2nd	3rd	4th	5th	6th	7th	8th
Challenger 35	8DN	94-98	175/150	9838 -	3.05	8604	8499	8314	7851	7161	6694	5949	5147
				12 133	**(10'0")**	**(18,968)**	**(18,737)**	**(18,329)**	**(17,307)**	**(15,787)**	**(14,757)**	**(13,116)**	**(11,348)**
				(21,690 -	1.47*	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(60")***	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger 35	8RD	99-01	175/150	9838 -	3.05	8604	8499	8314	7851	7161	6694	5949	5147
				12 133	**(10'0")**	**(18,968)**	**(18,737)**	**(18,329)**	**(17,307)**	**(15,787)**	**(14,757)**	**(13,116)**	**(11,348)**
				(21,690 -	1.47	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(60")**	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger 35	ADK	99-01	175/150	9838 -	3.05	8604	8499	8314	7851	7161	6694	5949	5147
				12 133	**(10'0")**	**(18,968)**	**(18,737)**	**(18,329)**	**(17,307)**	**(15,787)**	**(14,757)**	**(13,116)**	**(11,348)**
				(21,690 -	2.03	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(80")**	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger MT735		01-02	235/185	10 977 -	3.37	12 680	12 680	12 680	10 890	9130	8105	7187	6388
				20 400	**(11'1")**	**(27,900)**	**(27,900)**	**(27,900)**	**(23,950)**	**(20,090)**	**(17,830)**	**(15,810)**	**(14,050)**
				(24,200 -		2.7	3.4	4.3	5.4	6.5	7.3	8.2	9.3
				45,000)		**(1.7)**	**(2.1)**	**(2.7)**	**(3.4)**	**(4.0)**	**(4.5)**	**(5.1)**	**(5.8)**
Challenger 45	1DR	94-98	200/170	9838 -	3.05	8675	8675	8675	8255	7710	7318	6757	5891
				12 133	**(10'0")**	**(19,125)**	**(19,125)**	**(19,125)**	**(18,199)**	**(16,997)**	**(16,134)**	**(14,897)**	**(12,987)**
				(21,690 -	1.47*	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(60")***	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger 45	ABF	99-01	200/170	9838 -	3.05	8675	8675	8675	8255	7710	7318	6757	5891
				12 133	**(10'0")**	**(19,125)**	**(19,125)**	**(19,125)**	**(18,199)**	**(16,997)**	**(16,134)**	**(14,897)**	**(12,987)**
				(21,690 -	1.47	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(60")**	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger 45	3BK	99-01	200/170	9838 -	3.05	8675	8675	8675	8255	7710	7318	6757	5891
				12 133	**(10'0")**	**(19,125)**	**(19,125)**	**(19,125)**	**(18,199)**	**(16,997)**	**(16,134)**	**(14,897)**	**(12,987)**
				(21,690 -	2.03	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(80")**	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger MT745		01-02	255/205	10 977 -	3.37	12 680	12 680	12 680	11 828	9920	8806	7808	6941
				20 400	**(11'1")**	**(27,900)**	**(27,900)**	**(27,900)**	**(26,020)**	**(21,820)**	**(19,370)**	**(17,180)**	**(15,270)**
				(24,200 -		2.7	3.4	4.3	5.4	6.5	7.3	8.2	9.3
				45,000)		**(1.7)**	**(2.1)**	**(2.7)**	**(3.4)**	**(4.0)**	**(4.5)**	**(5.1)**	**(5.8)**
Challenger 55	7DM	96-98	225/191	9838 -	3.05	8675	8675	8675	8675	8255	7802	7188	6593
				12 133	**(10'0")**	**(19,125)**	**(19,125)**	**(19,125)**	**(19,125)**	**(18,200)**	**(17,200)**	**(15,848)**	**(14,535)**
				(21,690 -	1.47*	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(60")***	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger 55	AEN	99-01	225/191	9838 -	3.05	8675	8675	8675	8675	8255	7802	7188	6593
				12 133	**(10'0")**	**(19,125)**	**(19,125)**	**(19,125)**	**(19,125)**	**(18,200)**	**(17,200)**	**(15,848)**	**(14,535)**
				(21,690 -	2.03	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(80")**	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger 55	6NN	99-01	225/191	9838 -	3.05	8675	8675	8675	8675	8255	7802	7188	6593
				12 133	**(10'0")**	**(19,125)**	**(19,125)**	**(19,125)**	**(19,125)**	**(18,200)**	**(17,200)**	**(15,848)**	**(14,535)**
				(21,690 -	1.47	2.62	3.11	3.64	4.17	4.93	5.76	6.79	8.02
				26,750)	**(60")**	**(1.6)**	**(1.9)**	**(2.3)**	**(2.6)**	**(3.1)**	**(3.6)**	**(4.2)**	**(5.0)**
Challenger MT755		01-02	290/235	10 097 -	3.37	12 682	12 682	12 682	12 682	11 302	10 032	8896	7908
				20 400	**(11'1")**	**(27,900)**	**(27,900)**	**(27,900)**	**(27,900)**	**(24,865)**	**(22,070)**	**(19,570)**	**(17,397)**
				(24,200 -		2.7	3.4	4.3	5.4	6.5	7.3	8.2	9.3
				45,000)		**(1.7)**	**(2.1)**	**(2.7)**	**(3.4)**	**(4.0)**	**(4.5)**	**(5.1)**	**(5.8)**
Challenger MT765		01-02	306/255	10 977 -	3.37	12 682	12 682	12 682	12 682	11 894	10 558	9362	8322
				20 411	**(11'1")**	**(27,900)**	**(27,900)**	**(27,900)**	**(27,900)**	**(26,168)**	**(23,228)**	**(20,597)**	**(18,308)**
				(24,200 -		2.7	3.4	4.3	5.4	6.5	7.3	8.2	9.3
				45,000)		**(1.7)**	**(2.1)**	**(2.7)**	**(3.4)**	**(4.0)**	**(4.5)**	**(5.1)**	**(5.8)**

*Base gauge (no spacers) of 1.47 m **(60")** available on 8DN1-849, 1DR1-1699, 7DM1-849. Base gauges (no spacers) of 1.47 m **(60")** and 2.03 m **(80")** available on 8DN850-Up, 1DR1700-Up, and 7DM850-Up.

Agricultural Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Height m (ft) Gauge m (ft)	Drawbar Pull kg (lb)* and Forward Speed km/h (mph) 9th	10th	11th	12th	13th	14th	15th	16th
Challenger 35	8DN	94-98	175/150	9838 -	3.05	4436	3740	3171	2601	2154	1771	1449	1196
				12 133	**(10'0")**	**(9779)**	**(8244)**	**(6991)**	**(5735)**	**(4749)**	**(3904)**	**(3194)**	**(2637)**
				(21,690 -	1.47*	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(60")***	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger 35	8RD	99-01	175/150	9838 -	3.05	4436	3740	3171	2601	2154	1771	1449	1196
				12 133	**(10'0")**	**(9779)**	**(8244)**	**(6991)**	**(5735)**	**(4749)**	**(3904)**	**(3194)**	**(2637)**
				(21,690 -	1.47	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(60")**	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger 35	ADK	99-01	175/150	9838 -	3.05	4436	3740	3171	2601	2154	1771	1449	1196
				12 133	**(10'0")**	**(9779)**	**(8244)**	**(6991)**	**(5735)**	**(4749)**	**(3904)**	**(3194)**	**(2637)**
				(21,690 -	2.03	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(80")**	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger MT735		01-02	235/185	10 977 -	3.37	5678	5047	4476	3974	3339	2628	2077	1635
				20 400	**(11'1")**	**(12,490)**	**(11,100)**	**(9850)**	**(8742)**	**(7346)**	**(5782)**	**(4568)**	**(3598)**
				(24,200 -		10.4	11.7	13.2	14.9	17.7	22.5	28.5	39.7
				45,000)		**(6.5)**	**(7.3)**	**(8.2)**	**(9.3)**	**(11.0)**	**(14.0)**	**(17.7)**	**(24.6)**
Challenger 45	1DR	94-98	200/170	9838 -	3.05	5063	4170	3547	2920	2427	2003	1646	1365
				12 133	**(10'0")**	**(11,162)**	**(9193)**	**(7821)**	**(6438)**	**(5351)**	**(4416)**	**(3629)**	**(3010)**
				(21,690 -	1.47*	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(60")***	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger 45	ABF	99-01	200/170	9838 -	3.05	5063	4170	3547	2920	2427	2003	1646	1365
				12 133	**(10'0")**	**(11,162)**	**(9193)**	**(7821)**	**(6438)**	**(5351)**	**(4416)**	**(3629)**	**(3010)**
				(21,690 -	1.47	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(60")**	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger 45	3BK	99-01	200/170	9838 -	3.05	5063	4170	3547	2920	2427	2003	1646	1365
				12 133	**(10'0")**	**(11,162)**	**(9193)**	**(7821)**	**(6438)**	**(5351)**	**(4416)**	**(3629)**	**(3010)**
				(21,690 -	2.03	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(80")**	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger MT745		01-02	255/205	10 977 -	3.37	6169	5484	4864	4317	3628	2856	2256	1777
				20 400	**(11'1")**	**(13,573)**	**(12,065)**	**(10,700)**	**(9498)**	**(7981)**	**(6282)**	**(4963)**	**(3909)**
				(24,200 -		10.4	11.7	13.2	14.9	17.7	22.5	28.5	39.7
				45,000)		**(6.5)**	**(7.3)**	**(8.2)**	**(9.3)**	**(11.0)**	**(14.0)**	**(17.7)**	**(24.6)**
Challenger 55	7DM	96-98	225/191	9838 -	3.05	5663	4676	3990	3295	2747	2275	1876	1562
				12 133	**(10'0")**	**(12,484)**	**(10,310)**	**(8796)**	**(7264)**	**(6056)**	**(5015)**	**(4135)**	**(3443)**
				(21,690 -	1.47*	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(60")***	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger 55	AEN	99-01	225/191	9838 -	3.05	5663	4676	3990	3295	2747	2275	1876	1562
				12 133	**(10'0")**	**(12,484)**	**(10,310)**	**(8796)**	**(7264)**	**(6056)**	**(5015)**	**(4135)**	**(3443)**
				(21,690 -	2.03	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(80")**	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger 55	6NN	99-01	225/191	9838 -	3.05	5663	4676	3990	3295	2747	2275	1876	1562
				12 133	**(10'0")**	**(12,484)**	**(10,310)**	**(8796)**	**(7264)**	**(6056)**	**(5015)**	**(4135)**	**(3443)**
				(21,690 -	1.47	9.39	11.11	12.70	15.04	17.60	20.70	24.49	28.64
				26,750)	**(60")**	**(5.8)**	**(6.9)**	**(7.9)**	**(9.3)**	**(10.9)**	**(12.9)**	**(15.2)**	**(17.8)**
Challenger MT755		01-02	290/235	10 097 -	3.37	7029	6248	5541	4919	4133	3253	2570	2024
				20 400	**(11'1")**	**(15,464)**	**(13,745)**	**(12,190)**	**(10,821)**	**(9093)**	**(7157)**	**(5655)**	**(4454)**
				(24,200 -		10.4	11.7	13.2	14.9	17.7	22.5	28.5	39.7
				45,000)		**(6.5)**	**(7.3)**	**(8.2)**	**(9.3)**	**(11.0)**	**(14.0)**	**(17.7)**	**(24.6)**
Challenger MT765		01-02	306/255	10 977 -	3.37	7397	6575	5831	5176	4350	3424	2705	2130
				20 411	**(11'1")**	**(16,274)**	**(14,466)**	**(12,829)**	**(11,388)**	**(9569)**	**(7533)**	**(5951)**	**(4687)**
				(24,200 -		10.4	11.7	13.2	14.9	17.7	22.5	28.5	39.7
				45,000)		**(6.5)**	**(7.3)**	**(8.2)**	**(9.3)**	**(11.0)**	**(14.0)**	**(17.7)**	**(24.6)**

*Base gauge (no spacers) of 1.47 m **(60")** available on 8DN1-849, 1DR1-1699, 7DM1-849. Base gauges (no spacers) of 1.47 m **(60")** and 2.03 m **(80")** available on 8DN850-Up, 1DR1700-Up, and 7DM850-Up.

Agricultural Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Height m (ft) Gauge m (ft)	Drawbar Pull kg (lb)* and Forward Speed km/h (mph) 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Challenger 65	7YC	86-90	270/200	14 061	3.24	14 825	10 393	8880	7701	6656	5708	4950	4245	2858	1725
				(31,000)	**(10'8")**	**(32,684)**	**(22,912)**	**(19,577)**	**(16,978)**	**(14,674)**	**(12,583)**	**(10,912)**	**(9358)**	**(6300)**	**(3803)**
					2.15	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	29.3
					(7'1")	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 65B	7YC	91-92	285/225	14 060	3.24	14 893	11 074	9492	8252	7138	6109	5294	4545	3057	1851
				(31,000)	**(10'8")**	**(32,914)**	**(24,413)**	**(20,926)**	**(18,193)**	**(15,737)**	**(13,467)**	**(11,672)**	**(10,019)**	**(6740)**	**(4080)**
					2.15	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	29.3
					(7'1")	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 65C	2ZJ	93-95	285/225	14 330	3.24	12 587	9574	8186	7156	6147	5230	4497	3855	2701	1637
				(31,530)	**(10'8")**	**(27,750)**	**(21,106)**	**(18,046)**	**(15,775)**	**(13,551)**	**(11,530)**	**(9914)**	**(8498)**	**(5955)**	**(3610)**
					2.29	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	29.1
					(7'5")	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 65D	2ZJ	95-97	300	14 909	3.24	12 689	10 706	9161	7934	6837	5843	5005	4256	3119	2030
				(32,875)	**(10'8")**	**(27,975)**	**(23,603)**	**(20,197)**	**(17,492)**	**(15,072)**	**(12,881)**	**(11,034)**	**(9382)**	**(6875)**	**(4475)**
					2.29	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	29.1
					(7'5")	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 65E		97-02	310/277	15 186	3.4	15 098	10 808	9265	8096	6964	6017	5247	4469	3396	2279
				(33,480)	**(11'2")**	**(33,284)**	**(23,827)**	**(20,425)**	**(17,849)**	**(15,352)**	**(13,265)**	**(11,567)**	**(9853)**	**(7488)**	**(5025)**
						4.3	6.4	7.6	8.7	10.0	11.3	12.9	14.8	19.3	29.0
						(2.7)	**(4.0)**	**(4.7)**	**(5.4)**	**(6.2)**	**(7.0)**	**(8.0)**	**(9.2)**	**(12.0)**	**(18.0)**
Challenger 70C	2YL	93-95	1st Gear	16 201	3.24	12 621	9574	8186	7156	6147	5230	4497	3855	2701	1637
			215/154	**(35,685)**	**(10'8")**	**(27,825)**	**(21,106)**	**(18,046)**	**(15,775)**	**(13,551)**	**(11,530)**	**(9914)**	**(8498)**	**(5955)**	**(3610)**
			2nd & up		2.29	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	21.1
			285/225		**(7'5")**	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 75	4CJ	91-92	325/256	14 060	3.24	15 391	12 371	10 753	9382	8073	6923	6017	5162	3588	2181
				(31,000)	**(10'8")**	**(33,931)**	**(27,273)**	**(23,706)**	**(20,684)**	**(17,797)**	**(15,263)**	**(13,264)**	**(11,379)**	**(7910)**	**(4830)**
					2.15	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	29.3
					(7'1")	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 75C	4KK	92-97	325/268	15 158	3.24	12 689	10 761	9329	8106	6932	5944	5095	4380	3075	1878
				(33,419)	**(10'8")**	**(27,975)**	**(23,724)**	**(20,567)**	**(17,871)**	**(15,282)**	**(13,105)**	**(11,232)**	**(9657)**	**(6780)**	**(4140)**
					2.29	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	29.1
					(7'5")	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 75D	5AR	96-97	330	14 878	3.24	12 884	12 562	10 919	9526	8197	7030	6109	5241	3643	2225
				(32,800)	**(10'8")**	**(28,406)**	**(27,693)**	**(24,071)**	**(21,003)**	**(18,071)**	**(15,498)**	**(13,468)**	**(11,554)**	**(8031)**	**(4904)**
					2.29	4.2	6.4	7.5	8.6	9.9	11.3	13.0	14.9	19.3	29.1
					(7'5")	**(2.6)**	**(4.0)**	**(4.7)**	**(5.3)**	**(6.1)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.0)**	**(18.1)**
Challenger 75E		97-02	340/301	15 186	3.4	15 174	11 696	9402	8155	7015	6412	5543	4798	3502	2447
				(33,480)	**(11'2")**	**(33,452)**	**(25,785)**	**(20,728)**	**(17,979)**	**(15,466)**	**(14,135)**	**(12,221)**	**(10,578)**	**(7722)**	**(5395)**
					2.29	4.5	6.4	7.9	9.0	10.3	11.3	12.9	14.8	20.1	29.0
					(7'6")	**(2.8)**	**(4.0)**	**(4.9)**	**(5.6)**	**(6.4)**	**(7.0)**	**(8.0)**	**(9.2)**	**(12.5)**	**(18.0)**
Challenger 85C	9TK	92-97	1-2 Gears		3.24	12 689	11 596	9544	8302	7089	6406	5490	4720	3146	2024
			325/216		**(10'8")**	**(27,975)**	**(25,565)**	**(21,042)**	**(18,304)**	**(15,629)**	**(14,122)**	**(12,104)**	**(10,406)**	**(6935)**	**(4461)**
			3-10												
			Gears		2.29	4.5	6.4	7.9	9.0	10.5	11.3	13.0	14.9	20.3	29.1
			355/272		**(7'5")**	**(2.8)**	**(4.0)**	**(4.9)**	**(5.6)**	**(6.5)**	**(7.0)**	**(8.1)**	**(9.3)**	**(12.6)**	**(18.1)**
Challenger 85D	4GR	96-97	Gears	15 286	3.24	15 529	10 684	9599	8247	7175	6590	5705	4887	3825	2461
			1-2 330	**(33,700)**	**(10'8")**	**(34,234)**	**(23,553)**	**(21,162)**	**(18,181)**	**(15,819)**	**(14,528)**	**(12,578)**	**(10,774)**	**(8432)**	**(5425)**
			3-5 360		2.29	4.0	6.25	7.75	8.9	10.2	11.2	12.8	14.7	20.3	29.1
			6-10 370		**(7'5")**	**(2.5)**	**(3.9)**	**(4.8)**	**(5.5)**	**(6.4)**	**(7.0)**	**(8.0)**	**(9.2)**	**(12.6)**	**(18.1)**
Challenger 85E		97-02	375/339	15 413	3.4	15 454	11 576	10 566	9177	7997	7268	6323	5417	3954	2763
				(33,980)	**(11'2")**	**(34,070)**	**(25,520)**	**(23,294)**	**(20,232)**	**(17,629)**	**(16,022)**	**(13,940)**	**(11,942)**	**(8718)**	**(6090)**
					2.29	4.5	6.4	7.9	9.0	10.3	11.3	12.9	14.8	20.1	29.0
					(7'6")	**(2.8)**	**(4.0)**	**(4.9)**	**(5.6)**	**(6.4)**	**(7.0)**	**(8.0)**	**(9.2)**	**(12.5)**	**(18.0)**

*Drawbar pull figures for SA and SR models are max. at lug.
NOTE: Drawbar pull figures for the Challenger 65 is at max. power as found in University of Nebraska Tractor Test no. 1268.
This test was performed on concrete. Therefore, usable drawbar pull may be less depending upon soil conditions.

Agricultural Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Height m (ft) Gauge m (ft)	Drawbar Pull kg (lb)* and Forward Speed km/h (mph) 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Challenger 95E		97-02	410/375	15 413	3.4	15 968	11 506	10 505	10 085	8729	7903	6865	5901	4308	3010
				(33,980)	**(11'2")**	**(35,202)**	**(25,366)**	**(23,159)**	**(22,234)**	**(19,244)**	**(17,423)**	**(15,134)**	**(13,009)**	**(9497)**	**(6635)**
					2.29	4.5	6.4	7.9	9.0	10.3	11.3	12.9	14.8	20.1	29.0
					(7'6")	**(2.8)**	**(4.0)**	**(4.9)**	**(5.6)**	**(6.4)**	**(7.0)**	**(8.0)**	**(9.2)**	**(12.5)**	**(18.0)**
D3B SA	2PC	85-87	101	6650	2.71	7634	6226	5306	4531	3888					
				(14,670)	**(8'11")**	**(16,830)**	**(13,725)**	**(11,700)**	**(9990)**	**(8573)**					
						4.1	5.0	5.7	6.5	7.6					
						(2.5)	**(3.1)**	**(3.6)**	**(4.0)**	**(4.7)**					
D3C SA	7JF	87-92	101	7202	2.71	5552	4521	3827	3235	2755					
				(15,846)	**(8'11")**	**(12,250)**	**(9960)**	**(8450)**	**(7130)**	**(6070)**					
					1.52	4.1	5.0	5.7	6.5	7.6					
					(5'0")	**(2.5)**	**(3.1)**	**(3.6)**	**(4.0)**	**(4.7)**					
D4D SA	20J	66-68	—/68	6750	2.44	4590	3928	3098	2631	2232					
				(14,900)	**(8'0")**	**(10,120)**	**(8660)**	**(6830)**	**(5800)**	**(4920)**					
					1.52	4.0	4.7	5.6	6.4	7.4					
					(5'0")	**(2.5)**	**(2.9)**	**(3.5)**	**(4.0)**	**(4.6)**					
D4D SA	84J	66	—/68	6470	2.67	4880	4170	3310	2840	2420					
				(14,270)	**(8'9")**	**(10,750)**	**(9200)**	**(7300)**	**(6260)**	**(5330)**					
					1.52	4.0	4.7	5.6	6.4	7.4					
					(5'0")	**(2.5)**	**(2.9)**	**(3.5)**	**(4.0)**	**(4.6)**					
D4E SA	7PB	84-89	97	7600	2.71	5901	5148	5831	5002	4433					
	2CB	84-91		**(16,760)**	**(8'11")**	**(13,102)**	**(11,349)**	**(12,859)**	**(11,027)**	**(9773)**					
						3.4	4.6	5.5	6.4	8.3					
						(2.1)	**(2.8)**	**(3.5)**	**(4.0)**	**(5.1)**					
D4E SA	29X	77-84	—/74	7585	2.72	5802	4986	4007	3814	2896					
				(16,722)	**(8'11")**	**(12,791)**	**(10,993)**	**(8835)**	**(8408)**	**(6384)**					
					1.52	4.1	4.7	5.8	6.6	7.5					
					(5'0")	**(2.5)**	**(2.9)**	**(3.6)**	**(4.1)**	**(4.7)**					
D4E SR		84-99	125/—	9400	1.93	5450	3744	5068	4408	3832					
				(20,730)	**(6'4")**	**(12,010)**	**(8250)**	**(11,170)**	**(9715)**	**(8450)**					
					1.52										
					(5'0")										
D5 SA	21J	67-67	—/90	9300	2.64	6620	5160	3990	3080	2290					
				(20,400)	**(8'8")**	**(14,580)**	**(11,360)**	**(8740)**	**(6790)**	**(5030)**					
					1.88										
					(6'2")										
D5 SA	98J	67-77	—/90	9660	2.95	6120	5180	4110	3640	2950	2250				
				(21,300)	**(9'8")**	**(13,500)**	**(11,410)**	**(9950)**	**(7620)**	**(6500)**	**(4970)**				
					1.88	3.7	4.6	5.8	7.1	8.8					
					(6'2")	**(2.3)**	**(2.9)**	**(3.6)**	**(4.4)**	**(5.5)**					
D5B SA	26X	77-84	—/90		2.77	6409	5384	4323	3688	3180	2486				
					(9'1")	**(14,130)**	**(11,870)**	**(9530)**	**(8130)**	**(7010)**	**(5480)**				
					1.88	4.0	4.7	5.6	6.6	7.4	9.0				
					(6'2")	**(2.5)**	**(2.9)**	**(3.5)**	**(4.1)**	**(4.6)**	**(5.6)**				
D5B SA	22X	77-82	105/—	11 283	2.77	8060	5030	3410	2290	1480					
				(24,875)	**(9'1")**	**(17,770)**	**(11,100)**	**(7520)**	**(5060)**	**(3260)**					
					1.52	2.7	4.2	5.8	8.0	11.1					
					(5'0")	**(1.7)**	**(2.6)**	**(3.6)**	**(5.0)**	**(6.9)**					
D5B SA	24X	77-84	105/—	11 619	2.77										
				(25,615)	**(9'1")**										
					1.52	3.5	6.1	10.1							
					(5'0")	**(2.2)**	**(3.8)**	**(6.3)**							

*Drawbar pull figures for SA and SR models are max. at lug.

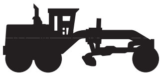
NOTE: Drawbar pull figures for the Challenger 65 is at max. power as found in University of Nebraska Tractor Test no. 1268. This test was performed on concrete. Therefore, usable drawbar pull may be less depending upon soil conditions.

Agricultural Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power FW/ Drawbar	Approx. Machine Weight kg (lb)	Height m (ft) Gauge m (ft)	Drawbar Pull kg (lb)* and Forward Speed km/h (mph)									
						1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
D6C SA	17R	70-76	140	13 064	2.67	850	6970	5880	4810	4080	3190				
				(28,800)	**(8'9")**	**(18,750)**	**(15,370)**	**(12,780)**	**(10,610)**	**(9000)**	**(7030)**				
						4.0	4.8	5.6	6.4	7.4	8.8				
						(2.5)	**(3.0)**	**(3.5)**	**(4.0)**	**(4.6)**	**(5.5)**				
D6D SR	7XF	89-91	140	15 200	2.87	14 358	12 429	11 721	7067	6096	4931				
				(33,500)	**(9'5")**	**(31,645)**	**(27,394)**	**(25,833)**	**(15,576)**	**(13,436)**	**(10,868)**				
						2.0	2.9	4.1	6.5	7.4	8.9				
						(1.2)	**(1.8)**	**(2.5)**	**(4.0)**	**(4.6)**	**(5.5)**				
D6D SA	38C	83-91	165	14 500	2.87	10 098	8510	9210	7789	6732	5456				
123-161 kW				**(32,000)**	**(9'5")**	**(22,243)**	**(18,744)**	**(20,287)**	**(17,156)**	**(14,828)**	**(12,017)**				
(165-215 HP)						4.5	5.3	6.1	7.1	8.2	9.8				
						(2.8)	**(3.3)**	**(3.8)**	**(4.4)**	**(5.1)**	**(6.1)**				
D6D SA	19B	83-91	165	14 500	2.87	10 098	8510	7181	8732	7560	6144				
123-179 kW				**(32,000)**	**(9'5")**	**(22,243)**	**(18,744)**	**(15,817)**	**(19,234)**	**(16,651)**	**(13,532)**				
(165-240 HP)						4.5	5.3	6.1	7.1	8.2	9.8				
						(2.8)	**(3.3)**	**(3.8)**	**(4.4)**	**(5.1)**	**(6.1)**				
D6E SR	8FJ	91-96	155/216	14 960	2.03	11 308	7771	8130	6866	5926	3135				
			121/170	**(32,987)**	**(6'8")**	**(24,878)**	**(17,097)**	**(17,887)**	**(15,105)**	**(13,037)**	**(6987)**				
					1.88	3.0	4.3	5.8	6.8	7.7	9.3				
					(6'2")	**(1.9)**	**(2.7)**	**(2.6)**	**(4.3)**	**(4.8)**	**(5.8)**				
Ag 6	05X	77-86	165/240	14 787	3.43	10 034	8455	7134	9041	7830					
Generation				**(32,600)**	**(11'3")**	**(22,120)**	**(18,639)**	**(15,727)**	**(19,931)**	**(17,268)**					
One						4.5	5.3	6.1	7.1	8.2					
						(2.8)	**(3.3)**	**(3.8)**	**(4.4)**	**(5.1)**					
Ag 6	05X	77-86	200/240	14 787	3.48	12 407	10 482	10 667	9091	7830					
Generation Two				**(32,600)**	**(11'5")**	**(27,353)**	**(23,110)**	**(23,514)**	**(19,931)**	**(17,263)**					
						4.5	5.3	6.1	7.1	8.2					
						(2.8)	**(3.3)**	**(3.8)**	**(4.4)**	**(5.1)**					
D7G SA	35N	80-86	250	18 462	3.2	19 101	13 622	11 358	10 015	8627	7584				
std. trans.				**(40,700)**	**(10'6")**	**(42,110)**	**(30,030)**	**(25,040)**	**(22,080)**	**(19,020)**	**(16,720)**				
						3.5	4.8	5.6	6.4	7.2	8.2				
						(2.2)	**(3.0)**	**(3.5)**	**(4.0)**	**(4.5)**	**(5.1)**				
D7G SA		77-86	250	18 462	3.2	16 990	12 090	11 358	10 015	8627	7584				
std. trans.				**(40,700)**	**(10'6")**	**(37,424)**	**(26,631)**	**(25,040)**	**(22,080)**	**(19,020)**	**(16,720)**				
168-186 kW						3.5	4.8	5.6	6.4	7.2	8.2				
(225-250 HP)						**(2.2)**	**(3.0)**	**(3.5)**	**(4.0)**	**(4.5)**	**(5.1)**				
D8L SA		84-87	400	36 650	3.87	40 252	39 466	22 013	15 953	11 880	8446				
				(80,820)	**(12'8")**	**(88,740)**	**(64,960)**	**(48,530)**	**(35,170)**	**(26,190)**	**(18,620)**				
					2.2	2.9	3.9	5.0	6.8	8.9	11.9				
					(7'3")	**(1.8)**	**(2.4)**	**(3.1)**	**(4.2)**	**(5.5)**	**(7.4)**				

*Drawbar pull figures for SA and SR models are max. at lug.

NOTE: Drawbar pull figures for the Challenger 65 is at max. power as found in University of Nebraska Tractor Test no. 1268. This test was performed on concrete. Therefore, usable drawbar pull may be less depending upon soil conditions.



MOTOR GRADERS

Model	Product Ident. No. Prefix	Years Built	Horse-power, Rated	Approx. Ship Wt. kg (lb)	Wheel-base m (ft)	Length m (ft)	Width m (ft)	Mold-board Length m (ft)	Turning Radius m (ft)	Controls	Maximum Speed km/h (mph) Forward	Maximum Speed km/h (mph) Rev.
212TD	79C	54-57	50	6030	5.03	6.68	2.07	3.05	11.10	Mech.	18.1	4.2
				(13,290)	**(16'6")**	**(21'11")**	**(6'10")**	**(10'0")**	**(36'5")**		**(11.2)**	**(2.6)**
112	3U	47-59	70	8770	5.72	7.59	2.39	3.66	10.87	Mech.	25.7	6.4
				(19,330)	**(18'9")**	**(24'11")**	**(7'10")**	**(12'0")**	**(35'8")**		**(16.0)**	**(4.0)**
112	81C	55-59	75	9435	5.72	7.59	2.39	3.66	10.74	Mech.	25.7	6.4
				(20,805)	**(18'9")**	**(24'11")**	**(7'10")**	**(12'0")**	**(35'3")**		**(16.0)**	**(4.0)**
112E	68E(U.S.)	59-64	85	9500	5.72	7.62	2.36	3.66	10.74	Mech.	29.3	9.3
	91G(U.S.)	64-68		**(20,900)**	**(18'9")**	**(25'0")**	**(7'9")**	**(12'0")**	**(35'3")**		**(18.2)**	**(5.8)**
112F	82F(U.S.)	60-64	100	9800	5.72	7.82	2.36	3.66	10.70	Mech.	29.9	9.7
	46D(U.S.)	64-68		**(21,600)**	**(18'9")**	**(25'8")**	**(7'9")**	**(12'0")**	**(35'3")**		**(18.6)**	**(6.0)**
	74H(U.S.)	67-68										
	89J(U.S.)	68-74										
	80J(AUSTL)	69-84										
120	89G(U.S.)	64-67	115	10 480	5.71	7.62	2.36	3.66	10.74	Mech.	32.2	10.3
				(23,100)	**(18'9")**	**(25'0")**	**(7'9")**	**(12'0")**	**(35'3")**		**(20.0)**	**(6.4)**
120	14K(U.S.)	67-69	125	10 600	5.71	7.80	2.36	3.66	10.74	Mech.	32.2	41.5
				(23,500)	**(18'9")**	**(25'8")**	**(7'9")**	**(12'0")**	**(35'3")**		**(20.0)**	**(25.8)**
120	10R(U.S.)	69-74	125	10 700	5.85	7.95	2.36	3.66	10.90	Mech.	32.2	6.6
				(23,700)	**(19'2")**	**(26'1")**	**(7'9")**	**(12'0")**	**(35'9")**		**(20.0)**	**(4.1)**
120	13U(U.S.)	71-74	125	11 000	5.85	7.95	2.36	3.66	10.90	Mech.	32.2	6.6
				(24,300)	**(19'2")**	**(26'1")**	**(7'9")**	**(12'0")**	**(35'9")**		**(20.0)**	**(4.1)**
120B	64U(BRAZ)	72-89	125	12 000	5.85	7.92	2.36	3.66	10.90	Mech.	35.4	23.8
				(26,460)	**(19'2")**	**(26'0")**	**(7'9")**	**(12'0")**	**(35'9")**		**(22.0)**	**(14.8)**
120G	87V(U.S.)	73-95	125	12 859	5.69	7.92	2.45	3.66	6.7	Hyd.	40.9	40.9
	4HD(BRAZ)	86-95		**(28,350)**	**(18'8")**	**(26'0")**	**(8'0")**	**(12'0")**	**(22'0")**		**(25.4)**	**(25.4)**
	11W(AUSTL)	75-95										
	82V(CAN)	74-80										
120H	4MK(U.S.)	95-02	125/140	12 520	5.86	8.26	2.44	3.66	7.2	Hyd.	42.6	33.7
	6NM(U.S.)			**(27,600)**	**(19'3")**	**(27'1")**	**(7'11")**	**(12'0")**	**(23'8")**		**(26.5)**	**(20.9)**
	9YR(BRAZ)											
	2AN(AUSTL)											
	3GR(S. AFRICA)											
	124 (AUSTL)	03-05										
	ALZ(U.S.)	02-04										
	CAF(BRAZ)	03-07										
120H	ALZ(U.S.)	02-03	125/140	12 650	5.92	8.31	2.44	3.66	7.3	Hyd.	42.6	33.7
	CAF(BRAZ)	02-07		**(27,880)**	**(19'5")**	**(27'3")**	**(8'0")**	**(12'0")**	**(23'7")**		**(26.5)**	**(20.9)**
	124(AUSTL)	03-05										
120H	6TM(U.S.)	96-99	125/140	12 466	5.87	8.15	2.44	3.66	7.2	Hyd.	42.6	33.7
STD	5FM(BRAZ)	96-09		**(27,483)**	**(19'3")**	**(26'9")**	**(8'0")**	**(12'0")**	**(23'8")**		**(26.5)**	**(20.9)**
	9FN(INDO)	96-04										

Motor Graders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power, Rated	Approx. Ship Wt. kg (lb)	Wheel-base m (ft)	Length m (ft)	Width m (ft)	Mold-board Length m (ft)	Turning Radius m (ft)	Controls	Maximum Speed	
											km/h (mph) Forward	km/h (mph) Rev.
130G	74V(U.S.)	73-95	135	13 050	5.92	8.30	2.45	3.66	7.3	Hyd.	39.4	39.4
	12W(AUSTL)	75-89		**(28,770)**	**(19'5")**	**(27'3")**	**(8'0")**	**(12'0")**	**(24'0")**		**(24.5)**	**(24.5)**
135H	3YK(U.S.)	95-02	135/155	12 950	5.86	8.26	2.44	3.66	7.2	Hyd.	41.9	33.1
	AMX(U.S.)	02-04		**(28,550)**	**(19'3")**	**(27'1")**	**(7'11")**	**(12'0")**	**(23'8")**		**(26.0)**	**(20.6)**
	CBC(BRAZ)	03-07										
135H	AMX(U.S.)	02-04	135/155	13 080	5.92	8.31	2.44	3.66	7.3	Hyd.	41.9	33.1
	CBC(BRAZ)	02-07		**(28,840)**	**(19'5")**	**(27'3")**	**(8'0")**	**(12'0")**	**(23'7")**		**(26.1)**	**(20.6)**
12	6M(U.S.)	39-42	66	9440	5.72	7.62	2.39	3.66	10.87	Mech.	24.5	6.1
				(20,820)	**(18'9")**	**(25'0")**	**(7'10")**	**(12'0")**	**(35'8")**		**(15.2)**	**(3.8)**
12	9K(U.S.)	38-45	70	9590	5.72	7.62	2.39	3.66	10.87	Mech.	24.5	6.1
				(21,140)	**(18'9")**	**(25'0")**	**(7'10")**	**(12'0")**	**(35'8")**		**(15.2)**	**(3.8)**
12	7T(U.S.)	45-47	75	9750	5.72	7.62	2.39	3.66	10.87	Mech.	24.5	6.1
				(21,500)	**(18'9")**	**(25'0")**	**(7'10")**	**(12'0")**	**(35'8")**		**(15.2)**	**(3.8)**
12	8T(U.S.)	47-55	100	10 100	5.72	7.62	2.39	3.66	10.87	Mech.	31.1	6.6
	94C(AUSTL)	55-58		**(22,375)**	**(18'9")**	**(25'0")**	**(7'10")**	**(12'0")**	**(35'8")**		**(19.3)**	**(4.1)**
12	70D-71D(U.S.)	57-59	115	10 200	5.72	7.62	2.37	3.66	10.87	Mech.	31.1	10.1
	80C(U.S.)	55-67		**(22,410)**	**(18'9")**	**(25'0")**	**(7'10")**	**(12'0")**	**(35'8")**		**(19.3)**	**(6.3)**
	38E(AUSTL)	58-60										
12E	99E(U.S.)	59-65	115	11 100	5.72	8.03	2.36	3.66	10.90	Mech.	32.0	22.2
	21F(AUSTL)	60-68		**(24,400)**	**(18'9")**	**(26'4")**	**(7'9")**	**(12'0")**	**(35'9")**		**(19.9)**	**(13.8)**
	17K(AUSTL)	68-75										
12F	73G(U.S.)	65-67	115	12 973	6.0	8.20	2.36	3.66	11.40	Hyd.	32.0	22.2
				(28,600)	**(19'8")**	**(26'10")**	**(7'9")**	**(12'0")**	**(37'5")**	Mech.	**(19.9)**	**(13.8)**
12F	89H(U.S.)	69-73	125	12 973	6.00	8.20	2.36	3.65	11.40	Hyd.	34.3	41.5
	13K(U.S.)	67-73		**(28,600)**	**(19'8")**	**(26'10")**	**(7'9")**	**(12'0")**	**(37'5")**	Mech.	**(21.3)**	**(25.8)**
12G	61M(U.S.)	73-95	135	13 554	5.92	8.30	2.45	3.66	7.30	Hyd.	39.4	39.4
	3PL(BRAZ)	93-95		**(29,860)**	**(19'5")**	**(27'3")**	**(8'0")**	**(12'0")**	**(24'0")**		**(24.5)**	**(24.5)**
	3WC(AUSTL)	85-95										
12H	4XM(U.S.)	95-02	140	14 247	6.10	8.57	2.44	3.66	7.40	Hyd.	39.7	31.3
	2LR(U.S.)			**(31,410)**	**(20'0")**	**(28'1")**	**(7'11")**	**(12'0")**	**(24'3")**		**(24.7)**	**(19.5)**
	8MN(BRAZ)											
	2GS(BRAZ)											
	2WR(AUSTL)											
	AMZ(U.S.)	02-07										
	CBK(BRAZ)	02-07										
	125(AUSTL)	03-05										
12H	AMZ(U.S.)	02-07	145/185	14 200	6.09	8.57	2.44	3.66	7.40	Hyd.	44.0	34.7
	CBK(BRAZ)	02-07		**(31,320)**	**(20'0")**	**(28'1")**	**(8'0")**	**(12'0")**	**(24'3")**		**(27.4)**	**(21.6)**
	125(AUSTL)	03-05										
12H	5ZM(U.S.)	97-98	140	14 185	6.09	8.45	2.44	3.66	7.4	Hyd.	41.7	32.9
STD	4ER(BRAZ)	96-09		**(31,273)**	**(20'0")**	**(27'9")**	**(8'0")**	**(12'0")**	**(24'3")**		**(25.9)**	**(20.5)**
	XZJ(CHINA)	06-10										

Motor Graders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power, Rated	Approx. Ship Wt. kg (lb)	Wheel-base m (ft)	Length m (ft)	Width m (ft)	Mold-board Length m (ft)	Turning Radius m (ft)	Controls	Maximum Speed km/h (mph) Forward	km/h (mph) Rev.
140	14U(U.S.)	71-74	150	13 109	5.84	7.95	2.44	3.66	10.97	Mech.	38.8	47.0
	11R(U.S.)	70-74		**(28,900)**	**(19'2")**	**(26'1")**	**(8'0")**	**(12'0")**	**(36'0")**		**(24.1)**	**(29.2)**
	55F(AUSTL)	71-75										
	24R(CAN)	71-74										
140B	61S(BRAZ)	81-87	150	13 620	6.14	8.07	2.39	3.96	11.60	Mech.	37.6	25.6
				(30,003)	**(20'2")**	**(26'6")**	**(7'10")**	**(13'0")**	**(38'0")**		**(23.4)**	**(15.9)**
140G	72V(U.S.)	73-95	150	14 102	5.92	8.33	2.45	3.66	7.30	Hyd.	41.0	41.0
	5MD(BRAZ)	87-95		**(31,090)**	**(19'5")**	**(27'4")**	**(8'0")**	**(12'0")**	**(24'0")**		**(25.5)**	**(25.5)**
	13W(AUSTL)	75-95										
	81V(CAN)	74-80										
140G	72V(U.S.)	73-95	150	14 914	5.92	8.33	2.45	3.66	7.30	Hyd.	41.0	41.0
AWD				**(32,880)**	**(19'5")**	**(27'4")**	**(8'0")**	**(12'0")**	**(24'0")**		**(25.5)**	**(25.5)**
140H	2ZK(U.S.)	95-02	165/185	14 724	6.10	8.60	2.46	3.66	7.40	Hyd.	41.1	32.4
	8KM(U.S.)			**(32,460)**	**(20'0")**	**(28'3")**	**(8'1")**	**(12'0")**	**(24'3")**		**(25.5)**	**(20.2)**
	9TN(BRAZ)											
	3AS(BRAZ)											
	9ZN(AUSTL)											
	APM(U.S.)	02-07										
	CCA(BRAZ)	02-07										
	126(AUSTL)	03-05										
140H	APM(U.S.)	02-07	165/205	14 677	6.17	8.71	2.46	3.66	7.5	Hyd.	44.0	34.7
	CCA(BRAZ)	02-07		**(32,357)**	**(20'3")**	**(28'7")**	**(8'1")**	**(12'0")**	**(24'7")**		**(27.4)**	**(21.6)**
	126(AUSTL)	03-05										
140H	8JM(U.S.)	96-99	165/185	14 661	6.09	8.60	2.46	3.66	7.4	Hyd.	41.1	32.4
STD	5HM(BRAZ)	96-09		**(32,321)**	**(20'0")**	**(28'3")**	**(8'1")**	**(12'0")**	**(24'3")**		**(25.5)**	**(20.2)**
	XZH(CHINA)	05-10										
143H	1AL(U.S.)	95-02	165/185	15 023	6.10	8.60	2.46	3.66	7.40	Hyd.	41.1	32.4
	APN(U.S.)	02-07		**(33,120)**	**(20'0")**	**(28'3")**	**(8'1")**	**(12'0")**	**(24'3")**		**(25.5)**	**(20.2)**
143H	APN(U.S.)	02-07	165/205	15 270	6.17	8.71	2.55	3.66	7.5	Hyd.	44.0	34.7
				(33,670)	**(20'3")**	**(28'7")**	**(8'5")**	**(12'0")**	**(24'7")**		**(27.4)**	**(21.6)**
14B	78E(U.S.)	59-59	150	13 300	5.84	8.03	2.44	3.66	10.97	Mech.	34.8	11.3
	64C(U.S.)	59-69		**(29,280)**	**(19'2")**	**(26'4")**	**(8'0")**	**(12'0")**	**(36'0")**		**(21.6)**	**(7.0)**
14C	35F(U.S.)	59-61	150	12 973	5.84	8.03	2.44	3.66	10.97	Mech.	34.8	11.3
				(28,600)	**(19'2")**	**(26'4")**	**(8'0")**	**(12'0")**	**(36'0")**		**(21.6)**	**(7.0)**
14D	96F(U.S.)	61-65	150	13 700	6.15	8.33	2.44	3.96	11.58	Mech.	34.1	23.5
				(30,300)	**(20'2")**	**(27'4")**	**(8'0")**	**(13'0")**	**(38'0")**		**(21.2)**	**(14.6)**
14E	99G(U.S.)	65-68	150	13 699	6.15	8.33	2.44	3.96	11.58	Hyd.	36.4	24.9
				(30,200)	**(20'2")**	**(27'4")**	**(8'0")**	**(13'0")**	**(38'0")**	Mech.	**(22.6)**	**(15.5)**
14E	12K(U.S.)	67-73	150	14 300	6.10	8.30	2.44	3.96	11.60	Hyd.	39.1	47.3
	72G(U.S.)	69-73		**(31,600)**	**(20'2")**	**(27'4")**	**(8'0")**	**(13'0")**	**(38'0")**	Mech.	**(24.3)**	**(29.4)**
14G	96U(U.S.)	73-95	200	20 688	6.45	9.21	2.83	4.27	7.90	Hyd.	43.0	50.1
				(45,610)	**(21'2")**	**(30'3")**	**(9'3")**	**(14'0")**	**(25'11")**		**(26.8)**	**(31.1)**
14H	7WJ(U.S.)	95-02	215	18 784	6.45	9.21	2.70	4.27	7.90	Hyd.	42.7	47.3
	ASE(U.S.)	02-07		**(41,410)**	**(21'2")**	**(30'2")**	**(8'10")**	**(14'0")**	**(25'11")**		**(26.5)**	**(29.4)**
14H	ASE(U.S.)	02-07	220/240	18 809	6.56	9.34	2.82	4.27	8.0	Hyd.	46.1	51.1
				(41,465)	**(21'6")**	**(30'8")**	**(9'3")**	**(14'0")**	**(26'4")**		**(28.7)**	**(31.8)**
14M	B9J	07-10	259/275	21,676	6.56	9.35	2.8	4.27	7.9	Electro-	50.4	39.8
	R9J	10-15		**(47,787)**	**(21'6")**	**(30'8")**	**(9'2")**	**(14'0")**	**(25'11")**	Hyd	**(31.3)**	**(24.7)**

Motor Graders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power, Rated	Approx. Ship Wt. kg (lb)	Wheel-base m (ft)	Length m (ft)	Width m (ft)	Mold-board Length m (ft)	Turning Radius m (ft)	Controls	Maximum Speed km/h (mph) Forward	Maximum Speed km/h (mph) Rev.
160H	9EJ(U.S.)	95-02	180/200	15 586	6.10	8.60	2.46	4.27	7.40	Hyd.	40.7	32.1
	6WM(U.S.)			**(34,360)**	**(20'0")**	**(28'3")**	**(8'1")**	**(14'0")**	**(24'3")**		**(25.3)**	**(20.0)**
	3GM(BRAZ)											
	2HS(BRAZ)											
	ASD(U.S.)	02-07										
	CCP(BRAZ)	02-07										
160H	ASD(U.S.)	02-07	180/220	15 676	6.17	8.71	2.48	4.27	7.5	Hyd.	43.6	34.4
	CCP(BRAZ)	03-07		**(34,560)**	**(20'3")**	**(28'7")**	**(8'2")**	**(14'0")**	**(24'7")**		**(27.1)**	**(21.4)**
160H	9JM(U.S.)	96-99	180/200	15 524	6.09	8.49	2.46	4.27	7.4	Hyd.	40.7	32.1
STD	2FM(BRAZ)	96-98		**(34,225)**	**(20'0")**	**(27'10")**	**(8'1")**	**(14'0")**	**(24'3")**		**(25.3)**	**(20.0)**
	XZK(CHINA)	06-10										
163H	5AK(U.S.)	95-02	180/200	16 538	6.10	8.60	2.46	4.27	7.40	Hyd.	40.7	32.1
	ARL(U.S.)	02-07		**(36,460)**	**(20'0")**	**(28'3")**	**(8'1")**	**(14'0")**	**(24'3")**		**(25.3)**	**(20.0)**
163H	ARL(U.S.)	02-07	180/220	16 280	6.17	8.71	2.55	4.27	7.5	Hyd.	43.6	34.4
				(35,890)	**(20'3")**	**(28'7")**	**(8'5")**	**(14'0")**	**(24'7")**		**(27.1)**	**(21.4)**
16	49G(U.S.)	63-73	225	22 499	6.86	9.50	3.00	4.27	13.56	Hyd.	49.7	49.7
				(49,600)	**(22'6")**	**(31'2")**	**(9'10")**	**(14'0")**	**(44'6")**	Mech.	**(30.9)**	**(30.9)**
16G	93U(U.S.)	73-95	275	27 284	6.96	9.99	3.08	4.88	8.20	Hyd.	43.6	43.6
				(60,150)	**(22'10")**	**(32'8")**	**(10'1")**	**(16'0")**	**(27'0")**		**(27.1)**	**(27.1)**
16H	6ZJ(U.S.)	95-02	275	24 748	6.96	9.99	2.99	4.88	8.20	Hyd.	44.5	42.3
	ATS(U.S.)	02-07		**(54,560)**	**(22'10")**	**(32'9")**	**(9'10")**	**(16'0)"**	**(27'0")**		**(27.7)**	**(26.3)**
16H	ATS(U.S.)	02-07	265/285	24 740	6.96	9.99	3.08	4.88	8.2	Hyd.	48.1	45.7
				(54,550)	**(22'10")**	**(32'9")**	**(10'1")**	**(16'0")**	**(26'11")**		**(29.9)**	**(28.4)**
16M	B9H	07-10	291/326	27 531	6.99	9.96	3.10	4.88	8.9	Electro-	51.7	40.8
	R9H	10-15		**(60,695)**	**(22'11")**	**(32'8")**	**(10'2")**	**(16'0")**	**(29'3")**	Hyd	**(32.1)**	**(25.3)**
24H	7KK(U.S.)	96-07	500	61 955	10.23	14.16	4.23	7.3	12.0	Hyd.	37.7	36.1
				(136,611)	**(33'7")**	**(46'6")**	**(13'10")**	**(24'0")**	**(39'11")**		**(23.4)**	**(22.4)**

SKID STEER LOADERS

Model	Product Ident. No. Prefix	Years Built	Approx. Machine Weight kg (lb)	Net Power kW (hp)	Length to Coupler mm (in)	Width over Tires mm (in)**	Height to Top of Cab mm (in)	Engine Model	Top Travel Speed km/h (mph)	Rated Operating Capacity at 50% kg (lb)	Rated Operating Capacity at 50% with counter-weight kg (lb)
216	4NZ	99-03	2490	36	2519	1525	1950	3024C	11.5	635	680
			(5490)	**(48)**	**(99)**	**(60)**	**(77)**		**(7.0)**	**(1400)**	**(1500)**
216B	RLL	04-07	2589	37	2519	1525	1950	3024C	12.7	635	680
			(5709)	**(49)**	**(99)**	**(60)**	**(77)**		**(7.9)**	**(1400)**	**(1500)**
216B2	RLL	07-10	3212	35	2519	1525	1950	C2.2	12.7	635	680
			(7082)	**(47)**	**(99)**	**(60)**	**(77)**		**(7.9)**	**(1400)**	**(1500)**
226	5FZ	99-03	2560	41	2519	1525	1950	3034	11.5	680	726
			(5645)	**(54)**	**(99)**	**(60)**	**(77)**		**(7.0)**	**(1500)**	**(1600)**
226B	MJH	04-07	2646	42	2519	1525	1950	3024CT	12.7	680	726
			(5834)	**(57)**	**(99)**	**(60)**	**(77)**		**(7.9)**	**(1500)**	**(1600)**
226B2	MJH	07-10	3283	42	2519	1525	1950	C2.2T	12.7	680	726
			(7238)	**(56)**	**(99)**	**(60)**	**(77)**		**(7.9)**	**(1500)**	**(1600)**
228	6BZ	99-03	2650	41	2519	1525	1950	3034	11.5	680	726
			(5843)	**(54)**	**(99)**	**(60)**	**(77)**		**(7.0)**	**(1500)**	**(1600)**
232	CAB	02-04	3005	36	2776	1525	1953	3024C	11.1	793	815
			(6627)	**(48)**	**(110)**	**(60)**	**(77)**		**(7.0)**	**(1750)**	**(1795)**
232B	SCH	04-07	3021	37	2760	1525	1953	3024C	11.1	793	815
			(6661)	**(49)**	**(109)**	**(60)**	**(77)**		**(6.9)**	**(1750)**	**(1795)**
232B2	SCH	07-10	3588	42	2760	1525	1950	C2.2T	11.1	862	883
			(7910)	**(56)**	**(109)**	**(60)**	**(77)**		**(6.9)**	**(1900)**	**(1947)**
236	4YZ	99-03	3134	44	2800	1676	2092	3034	12.1	793	839
			(6810)	**(59)**	**(110)**	**(66)**	**(82)**		**(7.5)**	**(1750)**	**(1850)**
236B	HEN	04-07	3178	52	2800	1676	2092	3044C	12.2/18.6*	793	815
			(7007)	**(70)**	**(110)**	**(66)**	**(82)**	DIT	**(7.6/11.6*)**	**(1750)**	**(1850)**
236B2	HEN	07-10	3878	53	2800	1676	2092	C3.4 DIT	12.1	884	929
			(8550)	**(71)**	**(110)**	**(66)**	**(82)**		**(7.5)**	**(1950)**	**(2050)**
236B3	A9H	10-13	3178	53	2800	1676	2092	Cat® C3.4	18.1	884	929
			(7007)	**(71)**	**(110)**	**(66)**	**(82)**	DIT	**(11.2)**	**(1950)**	**(2050)**
242	CMB	02-04	3060	41	2776	1676	1986	3034	11.3	907	930
			(6748)	**(54)**	**(110)**	**(66)**	**(78)**		**(7.0)**	**(2000)**	**(2045)**
242B	BXM	04-07	3085	42	2760	1676	1986	3024CT	12.0	907	930
			(6805)	**(57)**	**(109)**	**(66)**	**(78)**		**(7.4)**	**(2000)**	**(2045)**
242B2	BXM	07-10	3629	42	2760	1676	1986	C2.2T	12.1	952	Standard
			(8000)	**(56)**	**(109)**	**(66)**	**(78)**		**(7.5)**	**(2100)**	on 242B2
242B3	SRS	10-13	3179	53	2760	1676	2019	Cat C3.4	18.4	975	1000
			(7008)	**(71)**	**(108.7)**	**(66)**	**(79)**	DIT	**(11.4)**	**(2150)**	**(2200)**

*With two-speed option.
Models 216-236B with 254 mm **(10") wide tires, 242-268B with 305 mm **(12")** wide tires.

Skid Steer Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Approx. Machine Weight kg (lb)	Net Power kW (hp)	Length to Coupler mm (in)	Width over Tires mm (in)**	Height to Top of Cab mm (in)	Engine Model	Top Travel Speed km/h (mph)	Rated Operating Capacity at 50% kg (lb)	Rated Operating Capacity at 50% with counter-weight kg (lb)
246	5SZ	99-03	3214	55	2800	1676	2092	3034T	12.1	907	952
			(7087)	**(74)**	**(110)**	**(66)**	**(82)**		**(7.5)**	**(2000)**	**(2100)**
246B	PAT	04-07	3239	58	2800	1676	2092	3044CT	12.5/19.1*	907	952
			(7142)	**(78)**	**(110)**	**(66)**	**(82)**		**(7.7/11.8*)**	**(2000)**	**(2100)**
246C	JAY	08-13	3393	54	3692	1676	2104	Cat C3.4	19.3	975	1066
			(7480)	**(73)**	**(145.3)**	**(66)**	**(82.8)**	DIT	**(12.0)**	**(2150)**	**(2350)**
248	6LZ	99-03	3328	55	2800	1676	2092	3034T	12.1	907	952
			(7338)	**(74)**	**(110)**	**(66)**	**(82)**		**(7.5)**	**(2000)**	**(2100)**
248B	SCL	04-07	3320	57	2800	1676	2092	3044C	12.5/19.1*	907	952
			(7321)	**(76)**	**(110)**	**(66)**	**(82)**	DIT	**(7.7/11.8*)**	**(2000)**	**(2100)**
252	FDG	01-03	3454	44	2776	1829	1968	3034	12.1	1020	1043
			(7615)	**(59)**	**(110)**	**(72)**	**(78)**		**(7.5)**	**(2250)**	**(2300)**
252B	SCP	04-07	3552	52	2902	1829	2063	3044C	11.2/17.8*	1134	1134
			(7832)	**(70)**	**(114)**	**(72)**	**(81)**	DIT	**(6.9/11.0*)**	**(2500)**	**(2500)**
252B2	SCP	07-10	4172	53	2901	1829	2063	C3.4 DIT	12.1	1134	1157
			(9198)	**(71)**	**(114)**	**(72)**	**(83)**		**(7.5)**	**(2500)**	**(2551)**
252B3	TNK	10-13	3565	53	2901	1829	2063	Cat C3.4	17.8	1202	1225
			(7861)	**(71)**	**(114.2)**	**(72)**	**(82.6)**	DIT	**(11.1)**	**(2650)**	**(2700)**
262	CED	01-03	3472	55	2902	1829	2098	3034T	12.1	1134	1156
			(7655)	**(74)**	**(114)**	**(72)**	**(83)**		**(7.5)**	**(2500)**	**(2550)**
262B	PDT	04-07	3565	58	2902	1829	2063	3044C	11.6/17.8*	1225	1247
			(7861)	**(78)**	**(114)**	**(72)**	**(81)**	DIT	**(7.2/11.0*)**	**(2700)**	**(2750)**
262C	MST	08-13	3614	61	2979	1676	2104	Cat C3.4	19.3	1225	1336
			(7968)	**(82)**	**(117.3)**	**(66)**	**(82.8)**	DIT	**(12.0)**	**(2700)**	**(2945)**
262C2	TMW	12-13	3614	54	2979	1676	2104	Cat C3.4	19.3	1225	1336
			(7968)	**(73)**	**(117.3)**	**(66)**	**(82.8)**	DIT	**(12.0)**	**(2700)**	**(2945)**
268B	LBA	04-07	3626	57	2902	1829	2063	3044C	11.6/17.8*	1225	1247
			(7995)	**(76)**	**(114)**	**(72)**	**(81)**	DIT	**(7.2/11.0*)**	**(2700)**	**(2750)**
272C	RED	08-13	3793	67	3120	1676	2104	Cat C3.4	16.1	1474	1579
			(8362)	**(90)**	**(122.8)**	**(66)**	**(82.8)**	DIT	**(10.0)**	**(3250)**	**(3480)**
272D	GSL	12-13	3812	71	3139	1930	2104	Cat C3.8	15.1	1451	1565
			(8404)	**(95)**	**(123.6)**	**(76)**	**(82.8)**	DIT	**(9.4)**	**(3200)**	**(3450)**
272D	SHY	12-13	4220	79	3119	1930	2104	Cat C3.8	15.1	1633	—
XHP			**(9403)**	**(106)**	**(122.8)**	**(76)**	**(84.3)**	DIT	**(9.4)**	**(3600)**	**—**
272D	B5W	13-15	3743	71	3156	1829	2111	Cat C3.8	15.1	1451	1565
			(8252)	**(95)**	**(124.3)**	**(72)**	**(83.1)**	DIT	**(9.4)**	**(3200)**	**(3450)**
272D	ETL	13-15	4220	79	3136	1930	2147	Cat C3.8	16.6	1678	—
XHP			**(9403)**	**(106)**	**(123.5)**	**(76)**	**(84.5)**	DIT	**(10.3)**	**(3700)**	**—**

*With two-speed option.
Models 216-236B with 254 mm **(10") wide tires, 242-268B with 305 mm **(12")** wide tires.

MULTI TERRAIN LOADERS

Model	Product Ident. No. Prefix	Years Built	Approx. Machine Weight kg (lb)	Net Power kW (hp)	Length to Coupler mm (in)	Width over Tracks mm (in)*	Height to Top of Cab mm (in)	Engine Model	Top Travel Speed km/h (mph)	Rated Operating Capacity at 50% kg (lb)
247	CML	02-04	3023	41	2518	1676	1990	3034	12.1	877
			(6665)	**(54)**	**(99)**	**(66)**	**(78)**		**(7.5)**	**(1933)**
247B	MTL	04-07	3024	42	2518	1676	1990	3024CT	12.2	885
			(6668)	**(57)**	**(99)**	**(66)**	**(78)**		**(7.6)**	**(1950)**
247B2	MTL	07-10	3497	42	2518	1676	1990	C2.2T	0-11.3	929
			(7710)	**(56)**	**(8'3")**	**(5'6")**	**6'6"**		**(0-7.0)**	**(2050)**
247B3	MTL	10-15	3174	42	2518	1676	1990	Cat C2.2T	11.3	975
			(6997)	**(56)**	**(99.0)**	**(66.0)**	**(78.0)**		**(7.0)**	**(2150)**
257	CMM	02-04	3460	44	2701	1676	2022	3034T	12.1	1046
			(7628)	**(59)**	**(106)**	**(66)**	**(80)**		**(7.5)**	**(2306)**
257B	SLK	04-07	3428	42	2701	1676	2022	3024CT	11.4	1047
			(7559)	**(57)**	**(106)**	**(66)**	**(80)**		**(7.1)**	**(2310)**
257B2	SLK	7-10	3906	42	2701	1676	2022	C2.2T	0-11.3	1134
			(8611)	**(56)**	**(8'10")**	**(5'6")**	**6'7"**		**(0-7.0)**	**(2500)**
257B3	B7H	10-13	3656	53	2718	1676	2035	Cat C3.4	16.1	1213
			(8060)	**(71)**	**(107)**	**(66)**	**(80)**	DIT	**(10.0)**	**(2675)**
267	CMP	01-04	4134	44	2923	1898	2074	3034	9.7	1315
			(9088)	**(59)**	**(115)**	**(75)**	**(82)**		**(6.0)**	**(2900)**
267B	CYC	04-07	4250	52	2923	1898	2074	3044C	11.2	1315
			(9371)	**(70)**	**(115)**	**(75)**	**(82)**	DIT	**(7.0)**	**(2900)**
277	CNC	01-04	4148	55	2923	1898	2074	3034T	9.7	1338
			(9126)	**(74)**	**(115)**	**(75)**	**(82)**		**(6.0)**	**(2950)**
277B	MDH	04-07	4269	58	2923	1898	2074	3044C	11.2	1338
			(9411)	**(78)**	**(115)**	**(75)**	**(82)**	DIT	**(7.0)**	**(2950)**
277C	JWF	08-13	4307	61	2974	1981	2115	Cat C3.4	14.9	1451
			(9495)	**(82)**	**(117.2)**	**(78)**	**(83.2)**	DIT	**(9.3)**	**(3200)**
277C2	MET	12-13	4307	54	2974	1981	2115	Cat C3.4	14.9	1451
			(9495)	**(73)**	**(117.2)**	**(78)**	**(83.2)**	DIT	**(9.3)**	**(3200)**
287	CNY	03-04	4471	55	2900	1962	2122	3034T	11.0	1587
			(9870)	**(74)**	**(114)**	**(77)**	**(84)**		**(7.0)**	**(3500)**
287B	ZSA	04-07	4660	58	2900	1962	2122	3044C	11.2	1632
			(10,275)	**(78)**	**(114)**	**(77)**	**(84)**	DIT	**(7.0)**	**(3600)**
287C	MAS	08-13	4517	61	2974	1981	2115	Cat C3.4	14.9	1724
			(9958)	**(82)**	**(117.2)**	**(78)**	**(83.2)**	DIT	**(9.3)**	**(3800)**
287C2	SSB	12-13	4517	54	2974	1981	2115	Cat C3.4	14.9	1724
			(9958)	**(73)**	**(117.2)**	**(78)**	**(83.2)**	DIT	**(9.3)**	**(3800)**
297C	GCP	07-12	4870	67	2974	1981	2115	C3.4	9.0	1060
			(10,736)	**(90)**	**(108)**	**(78)**	**(83)**	DIT	**(5.6)**	**(2337)**
									14.9	
									(9.2)	
297D	BE7	14-15	4590	71	3155	1935	2125	Cat C3.8	15.1	2063
			(10,120)	**(95)**	**(124.2)**	**(76.2)**	**(83.6)**	DIT	**(9.4)**	**(4550)**
297D XHP	HP7	14-15	4905	79	3155	1935	2125	Cat C3.8	15.1	2268
			(10,815)	**(106)**	**(124.2)**	**(76.2)**	**(83.6)**	DIT	**(9.4)**	**(5000)**

*With 457 mm **(18")** wide track.

COMPACT TRACK LOADERS

Model	Product Ident. No. Prefix	Years Built	Approx. Machine Weight kg **(lb)**	Net Power kW **(hp)**	Length to Coupler mm **(in)**	Width over Tracks mm **(in)**	Height to Top of Cab mm **(in)**	Engine Model	Top Travel Speed km/h **(mph)**	Rated Operating Capacity at 50% kg **(lb)**
259B3*	YYZ	10-13	4052 **(8934)**	53 **(71)**	2722 **(107)**	1676 **(66)**	1986 **(78)**	Cat C3.4 DIT	13.6 **(8.5)**	1338 **(2950)**
279C	MBT	10-13	4487 **(9892)**	61 **(82)**	2960 **(116.5)**	1981 **(78)**	2117 **(83.3)**	Cat C3.4 DIT	13.6 **(8.5)**	1451 **(3200)**
279C2	KWB	12-13	4475 **(9865)**	54 **(73)**	2960 **(116.5)**	1981 **(78)**	2117 **(83.3)**	Cat C3.4 DIT	13.6 **(8.5)**	1383 **(3050)**
289C	JMP	10-13	4702 **(10,365)**	61 **(82)**	2960 **(116.5)**	1981 **(78)**	2117 **(83.3)**	Cat C3.4 DIT	13.6 **(8.5)**	1746 **(3850)**
289C2	RTD	12-13	4687 **(10,332)**	54 **(73)**	2960 **(116.5)**	1981 **(78)**	2117 **(83.3)**	Cat C3.4 DIT	13.6 **(8.5)**	1656 **(3650)**
299C	JSP	10-13	4867 **(10,730)**	67 **(90)**	3101.0 **(122.1)**	1981 **(78)**	2117 **(83.3)**	Cat C3.4 DIT	13.6 **(8.5)**	1882 **(4150)**
299D	HCL	12-13	4943 **(10,898)**	71 **(95)**	3138 **(123.5)**	1931 **(76)**	2104 **(82.8)**	Cat C3.8 DIT	13.6 **(8.5)**	1928 **(4250)**
299D XHP	NLC	12-13	5283 **(11,647)**	79 **(106)**	3138 **(123.5)**	1931 **(76)**	2104 **(82.8)**	Cat C3.8 DIT	13.6 **(8.5)**	1882 **(4150)**
299D	GTC	13-15	4862 **(10,718)**	71 **(95)**	3136 **(123.5)**	1931 **(76)**	2127 **(83.7)**	Cat C3.8 DIT	13.5 **(8.4)**	1928 **(4250)**
299D XHP	JST	13-15	5267 **(11,612)**	79 **(106)**	3136 **(123.5)**	1931 **(76)**	2127 **(83.7)**	Cat C3.8 DIT	13.5 **(8.4)**	2109 **(4650)**

*Configured with 320 mm **(12.6")** tracks.

HYDRAULIC EXCAVATORS (Track)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
205 LC	(3HC)	84-89	Deutz-67	13 135	1.895	3.00	7.30	2.40	8.17	3290
	(4DC)		Perkins®-71	**(28,957)**	**(6'2.5")**	**(9'10")**	**(23'11")**	**(7'10")**	**(26'10")**	**(7300)**
205B	5ZF	90-92	80	12 900	1.895	2.976	7.67	2.495	8.9	3740
				(28,443)	**(6'2.5")**	**(9'9")**	**(25'2")**	**(8'2")**	**(29'2")**	**(8250)**
211 LC	(4EC)	84-89	Deutz-84	15 540	2.08	3.02	8.01	2.49	9.88	4240
	(5CC)		Perkins-94	**(34,260)**	**(6'9.9")**	**(9'11")**	**(26'3")**	**(8'2")**	**(32'5")**	**(9340)**
213 LC	3ZC	83-87	102	17 300	2.08	3.08	8.34	2.49	10.30	5127
				(38,140)	**(6'10")**	**(10'1")**	**(27'4")**	**(8'2")**	**(33'9.5")**	**(11,305)**
215	(96L)	76-80	85	17 450	1.92	3.10	8.94	2.47	9.25	5090
	(57Z) (14Z)	79-84	90	**(38,480)**	**(6'4")**	**(10'1")**	**(29'4")**	**(8'0")**	**(30'4")**	**(11,200)**
215 SA	(57Y) (14Z)	82-84	90	19 440	2.18	3.22	8.94	2.73	9.23	5130
				(42,860)	**(7'2")**	**(10'6")**	**(29'4")**	**(8'11")**	**(30'3")**	**(11,300)**
215B LC	(9YB)	84-87	105	18 510	1.92	3.10	8.94	2.44	9.25	5760
				(40,806)	**(6'4")**	**(10'2")**	**(29'4")**	**(8'0")**	**(30'4")**	**(12,700)**
215C LC	(4HG)	87-89	115	19 570	1.92	3.1	8.94	2.42	9.29	7070
				(43,150)	**(6'4")**	**(10'2")**	**(29'4")**	**(7'11")**	**(30'6")**	**(15,200)**
215D LC	(9TF)	89-92	125	19 900	1.92	3.2	9.0	2.44	9.23	6830
				(43,900)	**(6'4")**	**(10'6")**	**(24'6")**	**(8'0")**	**(30'3")**	**(14,700)**
219	(5CF)	87-89	130	21 120	2.18	3.12	8.94	2.73	10.39	7080
				(46,550)	**(7'2")**	**(10'3")**	**(29'4")**	**(8'11")**	**(34'1")**	**(15,300)**
219D	(5XG)	89-92	140	21 600	2.18	3.12	9.41	2.73	9.75	7670
				(47,500)	**(7'2")**	**(10'3")**	**(30'10")**	**(8'11")**	**(32'0")**	**(16,500)**
219 LC	(5CF)	87-89	130	22 020	2.18	3.12	8.94	2.73	10.39	7080
				(48,550)	**(7'2")**	**(10'3")**	**(29'4")**	**(8'11")**	**(34'1")**	**(15,300)**
219D LC	(5XG)	89-92	140	22 400	2.18	3.12	9.41	2.73	9.75	7670
				(49,300)	**(7'2")**	**(10'3")**	**(30'10")**	**(8'11")**	**(32'0")**	**(16,500)**
225 LC	(51U)	72-86	135	23 900	2.64	3.17	9.83	2.99	9.58	7300
				(52,700)	**(8'8")**	**(10'5")**	**(32'3")**	**(9'10")**	**(31'5")**	**(15,600)**
225 SA	(51U)	77-86	135	27 125	2.64	3.17	9.83	3.35	9.55	7340
				(59,800)	**(8'8")**	**(10'5")**	**(32'3")**	**(11'0")**	**(31'4")**	**(15,700)**
225B	(2ZD)	86-89	145	24 960	2.44	3.17	9.83	2.99	10.16	11 040
	(3YD)	87-89		**(55,030)**	**(8'0")**	**(10'5")**	**(32'3")**	**(9'10")**	**(33'4")**	**(26,100)**
225D	(6RG)	89-91	150	25 400	2.44	3.23	9.94	2.99	10.13	—
				(55,900)	**(8'0")**	**(10'7")**	**(32'7")**	**(9'10")**	**(33'3")**	—
225B LC	(2ZD)	86-89	145	26 140	2.44	3.17	9.83	2.99	10.16	11 040
	(3YD)	87-89		**(58,230)**	**(8'0")**	**(10'5")**	**(32'3")**	**(9'10")**	**(33'4")**	**(26,100)**
225D LC	(2SJ)	89-91	165	26 700	2.44	3.23	9.94	2.99	10.13	12 450
				(58,900)	**(8'0")**	**(10'7")**	**(32'7")**	**(9'10")**	**(33'3")**	**(26,900)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
229	(1GF)	86-89	145	29 140	2.64	3.38	9.83	3.45	10.11	—
	(1AF)	86-89		**(64,830)**	**(8'8")**	**(11'1")**	**(32'3")**	**(11'4")**	**(33'2")**	—
229 LC	(1GF)	86-89	180	33 540	2.64	3.38	11.02	3.45	11.35	7940
Custom 180				**(73,940)**	**(8'8")**	**(11'1")**	**(36'2")**	**(11'4")**	**(37'3")**	**(17,100)**
229D	(2LJ)	89-91	157	31 700	2.64	3.52	10.9	3.25	10.76	8300
				(69,900)	**(8'8")**	**(11'7")**	**(35'9")**	**(10'8")**	**(35'4")**	**(18,300)**
231D		90-92	200	34 300	2.64	3.45	10.83	3.45	11.20	15 300
				(75,600)	**(8'8")**	**(11'4")**	**(35'6")**	**(11'4")**	**(36'9")**	**(33,000)**
231D LC		90-92	200	35 500	2.64	3.45	10.83	3.45	11.20	15 300
				(78,100)	**(8'8")**	**(11'4")**	**(35'6")**	**(11'4")**	**(36'9")**	**(33,000)**
235	(32K)	73-86	195	39 320	2.69	3.40	11.27	3.45	11.23	7050
	(64R)			**(86,700)**	**(8'10")**	**(11'2")**	**(37'0")**	**(11'4")**	**(36'10")**	**(17,300)**
235B	(7WC)	86-88	215	40 960	2.69	3.40	11.27	3.45	11.23	9934
	(9PC)			**(89,700)**	**(8'10")**	**(11'2")**	**(37'0")**	**(11'4")**	**(36'10")**	**(21,900)**
235C	(4DG) (5AF)	88-92	250	42 140	2.69	3.50	11.50	3.45	12.00	14 720
	(2PG) (3WG)			**(92,800)**	**(8'10")**	**(11'4")**	**(37'7")**	**(11'4")**	**(39'5")**	**(35,000)**
235D	(8KJ)	92-93	250	46 270	2.69	3.50	11.50	3.45	12.00	14 840
	(8TJ)			**(103,780)**	**(8'10")**	**(11'5")**	**(37'7")**	**(11'4")**	**(39'5")**	**(35,200)**
235D LC	(8KJ)	92-93	250	49 270	3.30	3.60	11.60	3.79	11.97	15 070
	(8TJ)			**(108,620)**	**(10'10")**	**(11'9")**	**(38'1")**	**(12'5")**	**(39'3")**	**(35,700)**
245	(82X)	74-88	325	65 745	3.24	4.62	13.18	3.71	14.02	14 930
	(84X)			**(144,941)**	**(10'7")**	**(15'2")**	**(43'3")**	**(12'2")**	**(46'0")**	**(32,920)**
245B	6MF	88-92	360	65 200	3.24	4.78	13.13	3.61	14.02	—
	1SJ			**(143,500)**	**(10'7")**	**(15'8")**	**(43'1")**	**(11'10")**	**(46'0")**	—
245D	(4LK)	92-93	385	68 420	3.24	5.46	12.82	3.61	13.84	14 640†
	(7ZJ)			**(150,520)**	**(10'7")**	**(17'11")**	**(42'0")**	**(11'10")**	**(45'9")**	**(31,600)**
E70	3BG	87-89	52	6500	1.65	2.59	6.02	2.25	6.67	1300
	3CG	87-89		**(14,300)**	**(5'5")**	**(8'6")**	**(19'9")**	**(7'5")**	**(21'10")**	**(2750)**
E70B	7YF(JPN)	89-94	54	6760	1.75	2.56	6.09	2.32	6.72	1315
	5TG(OSJ)	89-94		**(14,900)**	**(5'9")**	**(8'5")**	**(20'0")**	**(7'7")**	**(22'1")**	**(2900)**
	6AK(OSJ)	92-94								
E110	3FG	87-89	74	10 700	1.9	2.73	7.345	2.5	7.93	2700
	3GG	87-89		**(23,600)**	**(6'3")**	**(8'11")**	**(24'0")**	**(8'2")**	**(26'0")**	**(5750)**
E110B	9HF(OSJ)	90-92	79	11 600	1.99	2.70	7.25	2.495	8.10	3350
	8MF(JPN)	90-92		**(25,600)**	**(6'6")**	**(8'10")**	**(23'9")**	**(8'2")**	**(26'7")**	**(7200)**
	5GK(OSJ)	90-92								

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Lift capacity at 7.5 m **(25'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
E120	1LF(OSJ)	87-89	84	12 200	1.99	2.775	7.66	2.490	8.58	3850
	1MF(JPN)	87-89		**(26,800)**	**(6'6")**	**(9'1")**	**(25'1")**	**(8'2")**	**(28'2")**	**(8300)**
E120B	7NF(OSJ)	90-92	84	12 680	1.99	2.70	7.62	2.495	8.74	4310
	6JF(JPN)	90-92		**(28,200)**	**(6'6")**	**(8'10")**	**(25'10")**	**(8'2")**	**(28'8")**	**(9250)**
	4XK(OSJ)	90-92								
E140	1PF(JPN)	87-94	89	13 970	1.99	2.89	8.29	2.55	5.49	4380
	1NF(OSJ)			**(30,800)**	**(6'6")**	**(9'6")**	**(27'6")**	**(8'4")**	**(18'0")**	**(9650)**
E200B	6KF(OSJ)	87-91	118	18 800	2.20	2.97	9.48	2.83	10.63	8100
	4SG(JPN)	87-91		**(41,400)**	**(7'3")**	**(9'9")**	**(3'11")**	**(9'4")**	**(34'10")**	**(17,350)**
EL200B	7DF(OSJ)	87-91	118	20 100	2.38	2.97	9.48	3.18	10.63	8150
	5EG(JPN)	87-91		**(44,300)**	**(7'10")**	**(9'9")**	**(31'1")**	**(10'5")**	**(34'10")**	**(17,600)**
E240	1FG(OSJ)	87-89	148	23 000	2.39	3.02	9.73	3.19	10.6	9800
	2HF(JPN)	87-89		**(50,700)**	**(7'10")**	**(9'11")**	**(31'11")**	**(10'6")**	**(34'9")**	**(21,600)**
E240B	8SF(OSJ)	89-92	148	23 000	2.39	3.02	9.73	3.19	10.6	9800
	9PF(JPN)			**(50,700)**	**(7'10")**	**(9'11")**	**(31'11")**	**(10'6")**	**(34'9")**	**(21,600)**
E240C	2RL(OSJ)	92-93	148	23 000	2.39	3.02	9.73	3.19	10.6	9800
	8MK(JPN)			**(50,700)**	**(7'10")**	**(9'11")**	**(31'11")**	**(10'6")**	**(34'9")**	**(21,600)**
EL240	4JF(OSJ)	87-89	148	23 600	2.58	3.02	9.73	3.38	10.6	11 300
	4MF(JPN)	87-89		**(52,000)**	**(8'6")**	**(9'11")**	**(31'11")**	**(11'1")**	**(34'9")**	**(24,300)**
EL240B	5WG(OSJ)	89-92	148	23 600	2.58	3.02	9.73	3.38	10.6	10 320
	6MG(JPN)			**(52,000)**	**(8'6")**	**(9'11")**	**(31'11")**	**(11'1")**	**(34'9")**	**(22,750)**
EL240C	9PK(OSJ)	92-93	148	23 600	2.58	3.02	9.73	3.38	10.6	10 320
	9NK(JPN)			**(52,000)**	**(8'6")**	**(9'11")**	**(31'11")**	**(11'1")**	**(34'9")**	**(22,750)**
E300	2CF(OSJ)	87-89	187	30 500	2.6	3.22	10.94	3.4	11.84	12 550
	1KG(JPN)	87-89		**(67,300)**	**(8'6")**	**(10'7")**	**(35'11")**	**(11'2")**	**(38'9")**	**(27,650)**
E300B	1WJ(OSJ)	90-91	206	30 200	2.6	3.22	10.94	3.4	11.84	12 450
	2HJ(JPN)	90-91		**(66,580)**	**(8'6")**	**(10'7")**	**(35'11")**	**(11'2")**	**(38'9")**	**(26,850)**
EL300	4NF(OSJ)	87-89	187	31 600	2.6	3.22	10.94	3.4	11.84	12 550
	4SF(JPN)	87-89		**(69,700)**	**(8'6")**	**(10'7")**	**(35'11")**	**(11'2")**	**(38'9")**	**(27,650)**
EL300B	3FJ(OSJ)	90-91	206	31 200	2.6	3.22	10.94	3.4	11.84	12 450
	1GK(JPN)	90-91		**(68,780)**	**(8'6")**	**(10'7")**	**(35'11")**	**(11'2")**	**(38'9")**	**(26,850)**
E450	3HG(OSJ)	87-93	276	46 000	2.89	3.49	11.96	3.15	13.08	10 900
	3JG(JPN)	87-93		**(101,430)**	**(9'6")**	**(11'5")**	**(39'3")**	**(10'4")**	**(42'11")**	**(23,500)**
E650	3KG(OSJ)	87-92	375	62 600	3.25	4.84	14.0	3.49	13.33	15 850
	3LG(JPN)	87-92		**(138,000)**	**(10'8")**	**(15'11")**	**(45'11")**	**(11'5")**	**(43'9")**	**(34,000)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
301.5	3YW	98-05	17.4	1650 **(3640)**	0.75 **(2'6")**	2.19 **(7'2")**	3.69 **(12'1")**	0.98 **(3'3")**	3.8 **(12'6")**	380† **(830)**
301.6	BDH	00-05	17.4	1690 **(3726)**	0.75 **(2'6")**	2.19 **(7'2")**	3.69 **(12'1")**	0.98 **(3'3")**	3.8 **(12'6")**	370† **(810)**
301.8	BFA	00-05	17.4	1725 **(3803)**	0.75 **(2'6")**	2.19 **(9'8")**	3.69 **(12'1")**	0.98 **(3'3")**	3.8 **(12'6")**	370† **(810)**
302.5	4AZ	99-05	22.9	2730 **(6020)**	1.15 **(3'9")**	2.3 **(7'7")**	4.52 **(14'10")**	1.45 **(4'9")**	4.83 **(15'10")**	870† **(1910)**
303 CR	DMA	01-05	26.1	3210 **(7077)**	1.25 **(4'1")**	2.48 **(8'2")**	4.68 **(15'4")**	1.55 **(5'1")**	5.39 **(17'8")**	1200† **(2646)**
303C CR	BXT	06-10	29.5	7573 **(3435)**	1.25 **(4'1")**	2.5 **(8'2")**	4.73 **(15'6")**	15.5 **(5'1")**	5.1 **(16'9")**	1200 **(2646)**
303.5	AFW DCH	99-02 01-02	25	7430 **(7546)**	1.25 **(4'1")**	2.44 **(8'0")**	5.07 **(16'6")**	1.55 **(5'1")**	5.54 **(18'2")**	1030† **(2270)**
303.5C CR	DMY	06-10	38.9	3790 **(8356)**	1.48 **(4'10")**	2.5 **(8'2")**	4.82 **(15'10")**	17.8 **(5'10")**	5.35 **(17'7")**	1630 **(3594)**
303.5D CR	RHP	10-12	30	3770 **(8300)**	1.48 **(4'10")**	2.5 **(8'2")**	4.73 **(15'6")**	1.78 **(5'10")**	5.32 **(17'5")**	1340† **(2950)**
303.5E CR	RKY	11-	31.6	3800 **(8380)**	1.48 **(4'10")**	2.5 **(8'2")**	4.73 **(15'6")**	1.78 **(5'10")**	5.32 **(17'5")**	1340† **(2950)**
304 CR	NAD	02-05	35.5	4300 **(9480)**	1.58 **(5'2")**	2.6 **(8'6")**	5.18 **(17'0")**	1.98 **(6'6")**	5.95 **(19'6")**	2250† **(5000)**
304C CR	FPK	06-10	41.6	4800 **(10,582)**	1.58 **(5'2")**	2.55 **(8'4")**	5.17 **(17'0")**	19.8 **(6'6")**	5.46 **(17'11")**	2250 **(5000)**
304D CR	TYK	10-12	39	4080 **(8995)**	1.60 **(5'3")**	2.5 **(8'2")**	4.82 **(15'10")**	1.95 **(6'5")**	5.47 **(18'0")**	1570† **(3460)**
304E CR	TTN	11-15	40	4000 **(8820)**	1.6 **(5'3")**	2.5 **(8'2")**	4.82 **(15'10")**	1.95 **(6'5")**	5.47 **(18'0")**	1570† **(3460)**
304.5	ANK WAK	99-02 01-02	38	4475 **(9866)**	1.5 **(4'11")**	2.5 **(8'4")**	5.7 **(18'8")**	1.9 **(6'6")**	6.05 **(19'10")**	1600† **(3630)**
305 CR	DSA	01-03	42	4800 **(10,582)**	1.58 **(5'2")**	2.6 **(8'6")**	5.37 **(17'7")**	1.98 **(6'6")**	6.14 **(20'2")**	2550† **(5622)**
	DGT	03-05	42	4800 **(10,582)**	1.58 **(5'2")**	2.6 **(8'6")**	5.37 **(17'7")**	1.98 **(6'6")**	6.14 **(20'2")**	2550† **(5622)**
305C CR	HWJ	06-10	46.9	5200 **(11,464)**	1.58 **(5'2")**	2.55 **(8'4")**	5.33 **(17'6")**	19.8 **(6'6")**	5.65 **(18'6")**	2550 **(5622)**
305D CR	XER	10-11	42	5260 **(11,600)**	1.58 **(5'2")**	2.55 **(8'4")**	5.18 **(17'0")**	1.98 **(6'6")**	5.81 **(19'1")**	2250† **(4960)**
305E CR	XFA	11-14	40	5210 **(11,490)**	1.58 **(5'2")**	2.55 **(8'4")**	5.18 **(17'0")**	1.98 **(6'6")**	5.81 **(19'1")**	2250† **(4960)**
305.5D CR	FLZ	10-12	47	5560 **(12,260)**	1.58 **(5'2")**	2.55 **(8'4")**	5.33 **(17'6")**	1.98 **(6'6")**	6.02 **(19'9")**	2480† **(5470)**
305.5E CR	FKY	11-14	44.2	5480 **(12,080)**	1.58 **(5'2")**	2.55 **(8'4")**	5.33 **(17'6")**	1.98 **(6'6")**	6.02 **(19'9")**	2490† **(5490)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Lift capacity at 3 m **(10'0")** over front, blade down, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
307	2WM	94-98	54	7600	1.75	2.61	6.3	2.4	6.38	2450
				(16,760)	**(5'9")**	**(8'7")**	**(20'8")**	**(7'11")**	**(20'11")**	**(5400)**
	2PM(OSJ)	94-98	54	6740	1.75	2.63	6.08	2.28	6.72	1350
				(14,860)	**(5'9")**	**(8'8")**	**(19'11")**	**(7'6")**	**(22'1")**	**(3000)**
	9ZL(JPN)	94-97	54	6650	1.75	2.63	6.08	2.28	6.72	1350
				(14,660)	**(5'9")**	**(8'8")**	**(19'11")**	**(7'6")**	**(22'1")**	**(3000)**
307B	5CW(OSJ)	98-00	54	6960	1.75	2.63	6.08	2.28	6.72	1350
				(15,340)	**(5'9")**	**(8'8")**	**(19'11")**	**(7'6")**	**(22'1")**	**(3000)**
	4RW(JPN)	97-00	54	6500	1.75	2.64	6.08	2.28	6.72	1350
				(14,330)	**(5'9")**	**(8'8")**	**(19'11")**	**(7'6")**	**(22'1")**	**(3000)**
307B SB	AFB	99-00	40/54	7500	1.75	2.9	6.75	2.28	7.01	1410
				(16,530)	**(5'9")**	**(9'6")**	**(22'2")**	**(7'6")**	**(23'0")**	**(3100)**
	6KZ(OSJ)	98-01	40/54	8040	1.75	2.64	6.73	2.28	7.42	1500
	7DZ(JPN)			**(17,730)**	**(5'9")**	**(8'8")**	**(22'1")**	**(7'6")**	**(24'4")**	**(3300)**
307C	(BCM)	00-09	54	7210	1.75	2.78	6.07	2.29	6.85	947
				(15,900)	**(5'9")**	**(9'1")**	**(19'11")**	**(7'6")**	**(22'6")**	**(2100)**
	BAJ	00-08	54	6450	1.75	2.63	6.07	2.29	6.34	1052
				(14,220)	**(5'9")**	**(8'8")**	**(19'11")**	**(7'6")**	**(20'10")**	**(2300)**
307C SB	(BNE)	00-07	54	8390	1.75	2.63	6.79	2.29	7.55	822
				(18,500)	**(5'9")**	**(8'8")**	**(22'3")**	**(7'6")**	**(24'9")**	**(1800)**
307D	DSG	07-12	55.6	7075	1.84	2.63	6.07	2.29	6.67	3650†
				(15,600)	**(6'0")**	**(8'8")**	**(19'11")**	**(7'6")**	**(21'11")**	**(8050)**
307E	H1Y	12-	55.6	7160	1.75	2.63	6.07	2.29	6.16	4200†
				(15,785)	**(5'9")**	**(8'8")**	**(19'11")**	**(7'6")**	**(20'3")**	**(9260)**
308B CR	3YS(JPN)	99-02	54	7650	1.85	2.61	5.77	2.3	6.9	1600
				(16,870)	**(6'1")**	**(8'7")**	**(18'11")**	**(7'7")**	**(22'8")**	**(3500)**
308C CR	(KCX)	02-07	54	8040	1.87	2.61	5.83	2.47	6.9	947
				(17,730)	**(6'2")**	**(8'7")**	**(19'2")**	**(8'1")**	**(22'8")**	**(2100)**
	CPE	01-08	54	7390	1.87	2.61	5.83	2.32	6.39	1135
				(16,290)	**(6'2")**	**(8'7")**	**(19'2")**	**(7'7")**	**(21'0")**	**(2500)**
308D CR	GBT	07-12	55.6	7850	1.87	2.63	5.81	2.32	6.71	3650†
				(17,310)	**(6'2")**	**(8'7")**	**(19'1")**	**(7'7")**	**(22'0")**	**(8050)**
308D SB	FYC	07-12	55.6	8400	1.87	2.59	6.45	2.32	7.43	3200†
				(18,520)	**(6'2")**	**(8'6")**	**(21'2")**	**(7'7")**	**(24'5")**	**(7055)**
308E SB	GBJ	11-13	65	8330	1.87	2.55	6.38	2.32	7.35	3610†
				(18,365)	**(6'2")**	**(8'4")**	**(20'11")**	**(7'7")**	**(24'1")**	**(7960)**
311	9LJ(OSJ)	93-96	79	11 100	1.99	2.76	7.25	2.49	8.1	3100
				(24,470)	**(6'6")**	**(9'1")**	**(23'9")**	**(8'2")**	**(26'7")**	**(6800)**
	5PK(JPN)	93-96	79	11 050	1.99	2.76	7.25	2.49	8.10	3100
				(24,360)	**(6'6")**	**(9'1")**	**(23'9")**	**(8'2")**	**(26'7")**	**(6800)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Lift capacity at 3 m **(10'0")** over front, blade down, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
311B	2LS(blade)	96-01	79	11 890	1.99	2.76	7.25	2.495	8.1	3080
	(OSJ)			**(26,210)**	**(6'6")**	**(9'1")**	**(23'9")**	**(8'2")**	**(26'7")**	**(6800)**
	2MS(blade)	96-01	79	11 900	1.99	2.76	7.25	2.5	8.1	3100
	(JPN)			**(26,230)**	**(6'6")**	**(9'1")**	**(23'9")**	**(8'2")**	**(26'7")**	**(6800)**
	8GR(OSJ)	96-01	79	11 130	1.99	2.76	7.25	2.495	8.1	3120
				(24,540)	**(6'6")**	**(9'1")**	**(23'9")**	**(8'2")**	**(26'7")**	**(6900)**
	8HR(JPN)	96-01	79	11 200	1.99	2.76	7.25	2.49	8.1	3100
				(24,690)	**(6'6")**	**(9'1")**	**(23'9")**	**(8'2")**	**(26'7")**	**(6800)**
311C U	(CKE)	01-07	79	11 980	1.99	2.77	6.92	2.49	8.225	1295
				(26,410)	**(6'6")**	**(9'1")**	**(22'8")**	**(8'2")**	**(27'0")**	**(2900)**
	CLK	01-07	79	11 500	1.99	2.765	6.88	2.49	7.7	1453
				(25,350)	**(6'6")**	**(9'1")**	**(22'7")**	**(8'2")**	**(25'3")**	**(3200)**
311D RR	AKW(JPN)	08-14	80	11 930	1.99	2.86	6.84	2.49	8.1	3350
				(26,310)	**(6'6")**	**(9'5")**	**(22'5")**	**(8'2")**	**(26'7")**	**(7150)**
311D LRR	CLA(OSJ)	08-13	80	12 480	1.99	2.86	6.91	2.49	8.1	3900
	DDW	08-09		**(27,520)**	**(6'6")**	**(9'5")**	**(22'8")**	**(8'2")**	**(26'7")**	**(8350)**
	(PNJ)	10-13								
	LKA	09-12								
	KRM(OSJ)	10-14								
312	6BL	93-97	84	12 600	1.99	2.76	7.6	2.49	8.63	4200
	6GK(OSJ)	93-96		**(27,780)**	**(6'6")**	**(9'1")**	**(24'11")**	**(8'2")**	**(28'4")**	**(9300)**
	7DK(JPN)	93-96	84	12 000	1.99	2.76	7.6	2.49	8.63	4050
				(26,460)	**(6'6")**	**(9'1")**	**(24'11")**	**(8'2")**	**(28'4")**	**(8900)**
312B	6SW	98-01	84	13 000	1.99	2.91	7.59	2.49	8.3	4590
				(28,660)	**(6'6")**	**(9'7")**	**(24'11")**	**(8'2")**	**(27'3")**	**(10,110)**
	9GR(OSJ)	98-01	84	12 440	1.99	2.76	7.595	2.495	8.625	4170
				(27,430)	**(6'6")**	**(9'1")**	**(24'11")**	**(8'2")**	**(28'4")**	**(9200)**
	9HR(JPN)	98-00	84	12 150	1.99	2.76	7.595	2.49	8.625	4050
				(26,790)	**(6'6")**	**(9'1")**	**(24'11")**	**(8'2")**	**(28'4")**	**(8900)**
	9NW(blade)	98-01	66/88	13 785	1.99	2.91	7.59	2.49	8.3	4940
				(30,390)	**(6'6")**	**(9'7")**	**(24'11")**	**(8'2")**	**(27'3")**	**(10,900)**
	2NS(blade)	98-01	66/88	13 200	1.99	2.76	7.595	2.495	8.625	4230
	(OSJ)			**(29,100)**	**(6'6")**	**(9'1")**	**(24'11")**	**(8'2")**	**(28'4")**	**(9300)**
	3ES(blade)	98-00	84	12 900	1.99	2.76	7.595	2.49	8.625	4200
	(JPN)			**(28,440)**	**(6'6")**	**(9'1")**	**(24'11")**	**(8'2")**	**(28'4")**	**(9300)**
312B L	9FS	97-01	84	13 270	1.99	2.91	7.59	2.59	8.3	5000
				(29,260)	**(6'6")**	**(9'7")**	**(24'11")**	**(8'6")**	**(27'3")**	**(11,000)**
	8JR(OSJ)	98-01	66/88	12 940	1.99	2.76	7.595	2.59	8.625	4930
				(28,530)	**(6'6")**	**(9'1")**	**(24'11")**	**(8'6")**	**(28'4")**	**(10,900)**
	2KW(blade)	97-01	84	14 055	1.99	2.91	7.59	2.59	8.3	5050
				(30,990)	**(6'6")**	**(9'7")**	**(24'11")**	**(8'6")**	**(27'3")**	**(11,100)**
	3FS(blade)	98-01	66/88	13 720	1.99	2.76	7.595	2.59	8.625	4920
	(OSJ)			**(30,250)**	**(6'6")**	**(9'1")**	**(24'11")**	**(8'6")**	**(28'4")**	**(10,800)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
312C	BNN(FDS)	01-07	90	12 860 **(28,350)**	1.99 **(6'6")**	2.76 **(9'1")**	7.57 **(24'10")**	2.59 **(8'6")**	8.74 **(28'8")**	1402 **(3100)**
	CAE	00-	90	12 200 **(26,900)**	1.99 **(6'6")**	2.75 **(9'0")**	7.57 **(24'10")**	2.49 **(8'2")**	8.3 **(27'3")**	1448 **(3200)**
	BNN	01-	71/96	13 000 **(28,665)**	1.99 **(6'6")**	2.91 **(9'6")**	7.59 **(24'11")**	2.49 **(8'2")**	8.3 **(27'3")**	4350 **(10,120)**
312C L	CBT(CBA)	01-07	90	13 140 **(28,970)**	1.99 **(6'6")**	2.76 **(9'1")**	7.57 **(24'10")**	2.59 **(8'6")**	8.74 **(28'8")**	1439 **(3200)**
	CBT	01-	71/96	13 270 **(29,260)**	1.99 **(6'6")**	2.91 **(9'6")**	7.59 **(24'11")**	2.59 **(8'6")**	8.3 **(27'3")**	5040 **(11,025)**
312D	HCW(OSJ)	08-12	90	13 120 **(28,930)**	1.99 **(6'6")**	2.83 **(9'3")**	7.61 **(25'0")**	2.49 **(8'2")**	8.62 **(28'3")**	4300 **(9250)**
	HJX	08-11								
	PHH	09-11								
	DLP(CHN)	08-12								
	LRK(CHN)	10-12								
	RHL(OSJ)	10-14								
312D L	JBC(OSJ)	08-12	90	13 650 **(30,100)**	1.99 **(6'6")**	2.83 **(9'3")**	7.61 **(25'0")**	2.49 **(8'2")**	8.62 **(28'3")**	5000 **(10,750)**
	(XGK)	10-11								
	KCD	08-11								
	TGY	08-08								
	SKA	11-11								
	RKF	09-11								
	KES(OSJ)	10-14								
313B CR	BAS(OSJ)	00-02	89	13 225 **(29,160)**	1.99 **(6'6")**	2.82 **(9'3")**	7.17 **(23'6")**	2.49 **(8'2")**	8.55 **(28'1")**	3900 **(8600)**
	AEX(JPN)	99-02	89	12 750 **(28,110)**	1.99 **(6'6")**	2.82 **(9'3")**	7.17 **(23'6")**	2.49 **(8'2")**	8.24 **(27'0")**	3900 **(8600)**
313C CR	HGF(JPN)	01-08		12 600 **(27,780)**	1.99 **(6'6")**	2.82 **(9'3")**	7.28 **(23'11")**	2.49 **(8'2")**	8.63 **(28'4")**	3600 **(7700)**
313C SR	WSA(JPN)	02-08		13 900 **(30,650)**	1.99 **(6'6")**	2.82 **(9'3")**	7.48 **(24'7")**	2.49 **(8'2")**	7.23 **(23'9")**	3400 **(7250)**
313D	KXD(CHN)	12-12	90	13 430 **(29,610)**	1.99 **(6'6")**	2.83 **(9'3")**	7.61 **(25'0")**	2.49 **(8'2")**	8.22 **(27'0")**	4150 **(8900)**
	WPK(CHN)	12-13								
313D SR	LBR(JPN)	08-12	77	14 400 **(31,750)**	1.99 **(6'6")**	2.8 **(9'3")**	7.49 **(24'7")**	2.49 **(8'2")**	7.23 **(23'9")**	3450 **(7400)**
314C CR	(KJA)	02-02	90	14 610 **(32,210)**	1.99 **(6'6")**	2.81 **(9'3")**	7.28 **(23'11")**	2.59 **(8'6")**	8.765 **(28'9")**	1351 **(3000)**
	KHB	01-	90	13 500 **(29,760)**	1.99 **(6'6")**	2.81 **(9'3")**	7.28 **(23'11")**	2.49 **(8'2")**	8.32 **(27'4")**	1527 **(3400)**
314C LCR	(PCA)	02-02	90	14 810 **(32,650)**	1.99 **(6'6")**	2.73 **(9'0")**	7.41 **(24'4")**	2.59 **(8'6")**	8.765 **(28'9")**	1372 **(3000)**
314D CR	PDP(OSJ)	08-13	87	14 000 **(30,870)**	1.99 **(6'6")**	2.91 **(9'7")**	7.27 **(23'10")**	2.49 **(8'2")**	8.63 **(28'4")**	4250 **(9100)**
	MFK(JPN)	08-12								
	WLN(OSJ)	10-14								
314D LCR	BYJ(OSJ)	08-13	87	14 100 **(31,090)**	1.99 **(6'6")**	2.91 **(9'7")**	7.27 **(23'10")**	2.49 **(8'2")**	8.63 **(28'4")**	4950 **(10,600)**
	SBP	08-09								
	(SSZ)	10-12								
	TXN	10-12								
	XHR(OSJ)	10-14								

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
315	3ZM	95-98	99	15 920 **(35,100)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.49 **(8'2")**	8.21 **(26'11")**	5300 **(11,700)**
	4YM(OSJ)	94-97	99	16 330 **(36,000)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.49 **(8'2")**	9.14 **(30'0")**	5290 **(11,700)**
	6XM(JPN)	94-97	99	15 330 **(33,800)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.49 **(8'2")**	9.14 **(30'0")**	—
315 L	6YM(OSJ)	94-97	99	15 920 **(35,100)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.59 **(8'6")**	8.74 **(28'8")**	6320 **(13,900)**
315B	1SW(OSJ)	97-01	99	16 300 **(35,940)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.49 **(8'2")**	9.14 **(30'0")**	5500 **(12,100)**
	2DW(JPN)	97-01	99	15 850 **(34,940)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.49 **(8'2")**	9.14 **(30'0")**	—
315B L	5SW	98-	99	16 700 **(36,820)**	1.995 **(6'7")**	3.0 **(9'10")**	8.41 **(27'7")**	2.49 **(8'2")**	9.02 **(29'7")**	6720 **(14,800)**
	3AW(OSJ) 7RZ(forest) (OSJ)	97-01	80/107	16 700 **(36,820)**	1.99 **(6'6")**	2.88 **(9'5")**	8.47 **(27'10")**	2.59 **(8'6")**	9.14 **(30'0")**	6600 **(14,600)**
315C	(CFB)	01-02	110	16 400 **(36,160)**	1.99 **(6'6")**	2.99 **(9'10")**	8.52 **(27'11")**	2.59 **(8'6")**	9.29 **(30'6")**	1675 **(3700)**
	CFL	01-	110	16 000 **(35,270)**	1.99 **(6'6")**	2.95 **(9'8")**	8.52 **(27'11")**	2.49 **(8'2")**	8.9 **(29'2")**	1840 **(4100)**
	AKE	03-07	110	16 399 **(36,160)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.49 **(8'2")**	9.14 **(30'0")**	5650 **(12,100)**
315C L	(CFT)	01-02	110	16 750 **(36,930)**	1.99 **(6'6")**	2.99 **(9'10")**	8.52 **(27'11")**	2.59 **(8'6")**	9.29 **(30'6")**	1719 **(3800)**
	CJC	03-07	110	16 748 **(36,930)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.59 **(8'6")**	9.14 **(30'0")**	6750 **(14,450)**
	ANF	03	83/111	16 770 **(36,970)**	1.99 **(6'6")**	2.76 **(9'0")**	8.39 **(27'6")**	2.49 **(8'2")**	9.09 **(29'9")**	7110 **(15,675)**
315D L	CJN(OSJ) BYK(JPN) NCM KBD (JGS) TLE BZN(OSJ) JHA(CHN) YTB	07-12 07-11 07-11 07-09 10-11 09-11 09-13 10-12 09-12	113	17 280 **(38,100)**	1.99 **(6'6")**	3.03 **(9'9")**	8.54 **(28'0")**	2.59 **(8'6")**	9.24 **(30'3")**	7100 **(15,100)**
317	4MM	95-98	99	17 260 **(38,050)**	2.15 **(7'1")**	2.88 **(9'5")**	8.5 **(27'11")**	2.75 **(9'0")**	8.62 **(28'3")**	4210 **(9300)**
317B L	9WW	98-	81/109	17 300 **(38,146)**	2.2 **(7'3")**	3.04 **(9'10")**	8.41 **(27'6")**	2.8 **(9'2")**	9.1 **(29'8")**	7100 **(15,655)**
317 N	9SR	96-98	99	17 220 **(37,960)**	1.99 **(6'6")**	2.88 **(9'5")**	8.5 **(27'11")**	2.75 **(9'0")**	8.62 **(28'3")**	6450 **(14,200)**
317B LN	6DZ	98-	81/110	17 300 **(38,146)**	1.995 **(6'5")**	3.04 **(9'10")**	8.41 **(27'6")**	2.49 **(8'2")**	9.1 **(29'8")**	7100 **(15,655)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
318B L	9WW	98-	86/115	17 700 **(39,020)**	2.2 **(7'3")**	3.02 **(9'11")**	8.67 **(28'5")**	2.8 **(9'2")**	8.94 **(29'4")**	8440 **(18,600)**
	3LR(OSJ)	99-02	86/115	18 390 **(40,540)**	2.2 **(7'3")**	3.05 **(10'0")**	8.72 **(28'7")**	2.8 **(9'2")**	9.77 **(32'0")**	7650 **(16,900)**
	ADC	99-	86/115	18 500 **(40,792)**	2.2 **(7'3")**	3.04 **(9'10")**	8.69 **(28'6")**	2.8 **(9'2")**	9.6 **(31'6")**	7600 **(16,760)**
	(3LR)	01-02	86/115	18 360 **(40,480)**	2.2 **(7'3")**	2.83 **(9'3")**	8.69 **(28'6")**	2.8 **(9'2")**	9.78 **(32'1")**	2200 **(4900)**
318B LN	6DZ	98-	86/115	17 160 **(37,830)**	1.995 **(6'7")**	3.02 **(9'11")**	8.67 **(28'5")**	2.495 **(8'2")**	8.94 **(29'4")**	7590 **(16,700)**
	7KZ(OSJ)	99-02	86/115	18 260 **(40,260)**	2.2 **(7'3")**	3.05 **(10'0")**	8.72 **(28'7")**	2.59 **(8'6")**	9.77 **(32'1")**	7600 **(16,800)**
	AEJ	99-	86/115	18 500 **(40,792)**	1.995 **(6'7")**	3.04 **(9'10")**	8.69 **(28'6")**	2.49 **(8'2")**	9.6 **(31'6")**	7580 **(16,710)**
	(7KZ)	01-02	86/115	17 990 **(39,660)**	1.995 **(6'7")**	3.05 **(10'0")**	8.72 **(28'7")**	2.49 **(8'2")**	9.78 **(32'1")**	2200 **(4900)**
318C	BTG	03	94/127	19 560 **(43,120)**	2.2 **(7'2")**	2.9 **(9'9")**	8.9 **(29'2")**	2.8 **(9'2")**	9.66 **(31'8")**	7850 **(17,305)**
318C L	DAH(MDY)	02-07	94/127	20 160 **(44,445)**	2.2 **(7'2")**	2.9 **(9'9")**	8.9 **(29'2")**	2.8 **(9'2")**	9.66 **(31'8")**	8950 **(19,730)**
318C N	FAA(GPA)	02-07	94/127	19 280 **(42,505)**	1.99 **(6'6")**	2.9 **(9'9")**	8.9 **(29'2")**	2.49 **(8'2")**	9.66 **(31'8")**	7730 **(17,040)**
318D L	ZKJ(CHN)	12-13	113	17 620 **(38,850)**	1.99 **(6'6")**	3.03 **(9'9")**	8.54 **(28'0")**	2.59 **(8'6")**	8.96 **(29'5")**	6850 **(14,700)**
319C LN	KGL	04	94/127	20 080 **(44,269)**	1.99 **(6'6")**	2.9 **(9'9")**	8.9 **(29'2")**	2.49 **(9'2")**	9.66 **(31'8")**	7730 **(17,040)**
319D L	EAW(OSJ)	08-13	121	19 460 **(42,910)**	2.2 **(7'3")**	3.15 **(10'4")**	8.82 **(28'11")**	2.8 **(9'2")**	9.82 **(32'3")**	9150 **(19,700)**
	BZH	07-09								
	(ZCA)	10-12								
	ZGZ	09-11								
	AYF	11-12								
	KRM(OSJ)	11-13								
319D LN	FMH(OSJ)	08-13	121	19 170 **(42,270)**	1.99 **(6'6")**	3.15 **(10'4")**	8.82 **(28'11")**	2.49 **(8'2")**	9.82 **(32'3")**	9150 **(19,700)**
	DAY	08-09								
	(KFM)	10-12								
	WBJ	09-11								
	RJP	11-12								

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
320	7WK(OSJ) 2DL(OSJ) 8LG(OSJ) 7GJ(JPN) 3XM(JPN) 4ZJ(GOS)	91-96	128	19 120 **(42,150)**	2.2 **(7'3")**	2.93 **(9'7")**	9.37 **(30'9)**	2.8 **(9'2")**	10.63 **(34'9")**	6200 **(17,700)**
320 L	1TL(OSJ) 9KK(OSJ) 8HJ(JPN) 4JM(JPN) 3XK(GOS)	91-96	128	20 370 **(44,910)**	2.38 **(7'10")**	2.93 **(9'7")**	9.37 **(30'9")**	3.18 **(10'5")**	10.63 **(34'9")**	8150 **(17,600)**
320 N	1XM(OSJ) 9WG(GOS)	94-96	128	20 050 **(44,150)**	1.90 **(6'6")**	2.93 **(9'7")**	9.37 **(30'9")**	2.59 **(8'6")**	10.63 **(34'9")**	8150 **(17,600)**
320 S	6KM									
320B	3MR 5BR 1XS	96-00	128	19 400 **(42,770)**	2.2 **(7'2.6")**	3.01 **(9'10.5")**	9.46 **(31'.4")**	2.8 **(9'2.2")**	10.77 **(35'4")**	8600 **(19,000)**
320B L	4MR 6CR 7JR	96-00	128	20 720 **(45,680)**	2.38 **(7'9.7")**	3.01 **(9'10.5")**	9.46 **(31'.4")**	3.18 **(10'5.2")**	10.77 **(35'4")**	9200 **(20,300)**
320B N	4NR 2AS	96-00	128	19 930 **(43,940)**	2.2 **(7'2.6")**	3.01 **(9'10.5")**	9.46 **(31'.4")**	2.5 **(8'2.4")**	10.77 **(35'4")**	9100 **(20,100)**
320B LN	3YZ	96-00	128							
320C	MAB	03-06	103	20 870 **(46,010)**	2.2 **(7'3")**	3.01 **(9'11")**	9.39 **(30'10")**	2.8 **(9'2")**	9.71 **(31'10")**	8810 **(19,423)**
320C L	ANB PAB TBR SAH	99-07	103	21 415 **(47,212)**	2.38 **(7'10")**	3.01 **(9'11")**	9.39 **(30'10")**	2.98 **(9'9")**	9.71 **(31'10")**	9550 **(21,054)**
320C U	MAC	03-05	103	22 300 **(49,163)**	2.2 **(7'3")**	3.01 **(9'11")**	8.73 **(28'8")**	2.8 **(9'2")**	9.86 **(32'4")**	9300 **(20,503)**
320C LU	PAC	02-07	103	23 000 **(50,706)**	2.38 **(7'10")**	3.01 **(9'11")**	8.92 **(29'3")**	2.98 **(9'9")**	9.86 **(32'4")**	9600 **(21,164)**
320D	AZR CXY EBT BWZ FAL A6F BZP JFZ SNS KLM KTF PCM KHN MZD	05-15	103	21 000 **(46,300)**	2.2 **(7'3")**	3.03 **(9'10")**	9.46 **(31'0")**	2.8 **(9'2")**	10 **(32'10")**	9000† **(19,800)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Without bucket.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
320D L	BWP	05-15	103	21 900	2.38	3.03	9.46	2.98	10.0	10 250†
	DHK			**(48,300)**	**(7'10")**	**(9'10")**	**(31'0")**	**(9'9")**	**(32'10")**	**(22,600)**
	MDE									
	FNA									
	DFB									
	KGF									
	A8F									
	MGG									
	PHX									
	A9F									
	WJN									
	TDH									
	SPN									
	GDP									
	KZF									
320D LN	KAF	06-11	103	21 200	2.0	3.03	9.49	2.5	9.78	N/A
	WBN			**(46,700)**	**(6'7")**	**(9'10")**	**(31'2")**	**(8'2")**	**(32'1")**	
	PCX									
320D RR	AMR	05-15	103	22 700	2.2	3.01	8.77	2.8	9.78	9050
	RBL			**(50,045)**	**(7'3")**	**(9'11")**	**(28'9")**	**(9'2")**	**(32'1")**	**(19,952)**
	GKL									
	GMX									
	YDS									
	WFD									
320D LRR	CWN	05-15	103	23 300	2.38	3.01	8.96	2.98	9.78	10 600
	SCW			**(51,368)**	**(7'10")**	**(9'11")**	**(29'5")**	**(9'9")**	**(32'1")**	**(23,369)**
	FXK									
	HJC									
	EBY									
	TAE									
	XCK									
	DHE									
	ZGB									
	EJT									
320E	SHX	13-14	107	20 900	2.2	3.15	9.54	2.8	9.86	9450†
				(46,100)	**(7'3")**	**(10'3")**	**(31'4")**	**(9'9")**	**(32'4")**	**(20,350)**
320E L	WBK	10-16	114	21 700	2.38	3.15	9.54	2.98	9.86	11 650†
	TNJ			**(47,800)**	**(7'10")**	**(10'3")**	**(31'4")**	**(9'9")**	**(32'4")**	**(25,700)**
	NAZ	10-16	107	21 700	2.38	3.15	9.54	2.98	9.86	11 650†
				(47,800)	**(7'10")**	**(10'3")**	**(31'4")**	**(9'9")**	**(32'4")**	**(25,700)**
320E LN	DFG	11-14	107	22 500	2.0	3.15	9.57	2.54	9.85	10 600†
				(49,500)	**(6'7")**	**(10'3")**	**(31'5")**	**(8'4")**	**(32'4")**	**(22,900)**
320E LRR	PNL	11-15	114	23 800	2.38	3.15	8.97	2.98	9.86	11 550†
				(52,470)	**(7'10")**	**(10'3")**	**(29'5")**	**(9'9")**	**(32'4")**	**(24,800)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Without bucket.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
321B CR	AKG(JPN)	98-01	128	19 400	2.2	3.1	8.6	2.98	9.68	8250
				(42,770)	**(7'3")**	**(10'2")**	**(28'3")**	**(9'9")**	**(31'9")**	**(18,200)**
321B LCR	9CZ(JPN)	98-01	128	22 500	2.38	3.1	8.8	2.98	9.68	10 300
				(49,600)	**(7'10")**	**(10'2")**	**(28'11")**	**(9'9")**	**(31'9")**	**(22,700)**
	KGA(OSJ)	02-02	128	23 100	2.38	3.1	8.8	2.98	9.68	10 300
				(50,930)	**(7'10")**	**(10'2")**	**(28'11")**	**(9'9")**	**(31'9")**	**(22,700)**
321C CR	DAX	03-06	103	22 830	2.2	3.17	8.64	2.8	9.69	9050
				(50,332)	**(7'3")**	**(10'5")**	**(28'4")**	**(9'2")**	**(31'9")**	**(19,952)**
321C LCR	KBB	02-07	103	24 000	2.38	3.17	8.83	2.98	9.69	11 000
	MCF			**(52,911)**	**(7'10")**	**(10'5")**	**(29'0")**	**(9'9")**	**(31'9")**	**(24,251)**
	KCR									
321D CR	JCX	07-14	103	23 000	2200	3.03	8.69	2.8	9.71	N/A
				(50,700)	**(7'3")**	**(9'11")**	**(28'6")**	**(9'2")**	**(31'10")**	
321D L CR	KBH	07-15	103	23 780	2.38	3.03	8.83	2.98	9.71	11 150
	KBZ			**(52,400)**	**(7'10")**	**(9'11")**	**(29'0")**	**(9'9")**	**(31'10")**	**(24,000)**
	MDT									
	MPG									
	NAS									
	PBD									
	TXA									
322*	7WL(OSJ)	93-96	153	22 650	2.39	3.12	9.95	2.99	10.47	10 400
	7WL(JPN)			**(50,000)**	**(7'10")**	**(10'3")**	**(32'8")**	**(9'10")**	**(34'4")**	**(22,500)**
322B	8MR	96-01	153	22 760	2.39	3.28	10.0	2.99	10.47	10 650
	3NR	96-00		**(50,180)**	**(7'10")**	**(10'9")**	**(32'10")**	**(9'10")**	**(34'4")**	**(23,500)**
322 L*	8CL(OSJ)	93-96	153	23 950	2.59	3.12	9.95	3.39	10.47	10 400
	8CL(JPN)			**(52,800)**	**(8'6")**	**(10'3")**	**(32'8")**	**(11'1")**	**(34'4")**	**(22,500)**
322B L	8NR	96-01	153	23 990	2.59	3.28	10.0	3.39	10.47	11 600
	5CR	96-00		**(52,890)**	**(8'6")**	**(10'9")**	**(32'10")**	**(11'1")**	**(34'4")**	**(25,600)**
322C	DAA	03-05	121	23 000	2.39	3.12	9.96	2.99	10.01	10 750
				(50,706)	**(7'10")**	**(10'3")**	**(32'8")**	**(9'10")**	**(32'10")**	**(23,700)**
322C L	BGR	01-02	165	24 200	2.59	3.12	9.96	3.39	10.47	11 500
	BFK	02-06		**(53,400)**	**(8'6")**	**(10'3")**	**(32'8")**	**(11'1")**	**(34'4")**	**(24,900)**
	FED	02-05	121	24 200	2.59	3.12	9.96	3.19	10.01	12 000
				(53,352)	**(8'6")**	**(10'3")**	**(32'8")**	**(10'6")**	**(32'10")**	**(26,455)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
323D	WNE	10-11	110	22 200 **(48,900)**	2.2 **(7'3")**	3.12 **(10'3")**	9.46 **(31'0")**	2.8 **(9'2")**	9.83 **(32'3")**	N/A
323D L	PBM SDC BYM WGC JLG LFL PBE YSD NDE ZMF GTF NTF NZF	06-11	110	23 200 **(51,100)**	2.38 **(7'10")**	3.12 **(10'3")**	9.46 **(31'0")**	2.98 **(9'9")**	9.83 **(32'3")**	10 330 **(22,800)**
323D LN	CYD RAC CWG	05-11	110	23 200 **(50,700)**	2.0 **(6'7")**	3.12 **(10'3")**	9.46 **(31'0")**	2.5 **(8'2")**	9.83 **(32'3")**	10 330 **(22,800)**
323D S	DKW	05-07	103	22 500 **(49,600)**	1.9 **(6'3")**	3.1 **(10'2")**	9.46 **(31'0")**	2.5 **(8'2")**	9.44 **(31'0")**	N/A
323D SA	NES SED	06-11	110	23 500 **(51,800)**	1.9 **(6'3")**	3.12 **(10'3")**	9.5 **(31'2")**	2.5 **(8'2")**	9.98 **(32'9")**	10 360 **(22,800)**
323E L	RAP	10-16	114	22 600 **(49,800)**	2.38 **(7'10")**	3.15 **(10'3")**	9.54 **(31'4")**	2.98 **(9'9")**	9.86 **(32'4")**	11 450† **(24,800)**
323E LN	TDW	10-16	114	23 300 **(51,300)**	2.0 **(6'7")**	3.15 **(10'3")**	9.56 **(31'4")**	2.54 **(8'4")**	9.85 **(32'4")**	11 450† **(24,800)**
323E SA	YRP	10-16	114	24 300 **(53,500)**	1.9 **(6'3")**	3.23 **(10'7")**	9.57 **(31'5")**	2.54 **(8'2")**	9.84 **(32'3")**	11 300† **(24,450)**
324D	MND CJX JZR AWN ECH	06-14	140	24 550 **(54,100)**	2.39 **(7'10")**	3.43 **(11'3")**	10.05 **(34'5")**	2.99 **(9'10")**	10.55 **(34'7")**	N/A
324D L	JAT SYM PYT GPK DFP TSN T2D LKN BTK JJG LAB BYE	06-14	140	25 870 **(57,000)**	2.59 **(8'6")**	3.43 **(11'3")**	10.05 **(34'5")**	3.39 **(11'1")**	10.55 **(34'7")**	11 400 **(25,100)**
324D LN	NPC TRH EJC	06-11	140	25 300 **(55,800)**	2.39 **(7'10")**	3.17 **(10'5")**	10.06 **(33'0")**	2.99 **(9'10")**	10.05 **(34'5")**	13 970 **(30,800)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Without bucket.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
324E	JCZ	11-16	142	24 750 **(54,600)**	2.39 **(7'10")**	3.22 **(10'7")**	10.06 **(33'0")**	2.99 **(9'10")**	10.11 **(33'2")**	12 350† **(26,450)**
324E L	KTE PNW TLF	10-16	145	26 310 **(58,000)**	2.59 **(8'6")**	3.22 **(10'7")**	10.06 **(33'0")**	3.38 **(11'1")**	10.11 **(33'2")**	15 350† **(32,900)**
324E LN	LDG	10-15	145	25 130 **(55,400)**	2.39 **(7'10")**	3.41 **(11'2")**	10.1 **(33'2")**	2.99 **(9'10")**	10.11 **(33'2")**	15 100† **(32,300)**
325*	5WK(OSJ) 8NL(OSJ)	91-95	168	25 520 **(56,270)**	2.39 **(7'10")**	3.24 **(10'8")**	10.27 **(33'8")**	2.99 **(9'10")**	11.50 **(37'7")**	11 100 **(24,000)**
	8JG(JPN) 5WK(JPN)	91-95	168	25 520 **(56,270)**	2.39 **(7'10")**	3.24 **(10'8")**	10.27 **(33'8")**	2.99 **(9'10")**	11.50 **(37'7")**	11 000 **(24,000)**
325 L*	6KK(OSJ) 9KL(OSJ)	91-95	168	27 010 **(59,560)**	2.59 **(8'6")**	3.24 **(10'8")**	10.27 **(38'8")**	3.39 **(11'1")**	11.50 **(37'7")**	11 650 **(25,150)**
	7CJ(JPN) 6KK(JPN)	91-95	168	27 010 **(59,560)**	2.59 **(8'6")**	3.24 **(10'8")**	10.27 **(38'8")**	3.39 **(11'1")**	11.50 **(37'7")**	11 650 **(25,150)**
325B L	6DN(GOS)	96-01	168	28 890 **(63,690)**	2.59 **(8'6")**	3.21 **(10'6")**	10.35 **(33'11")**	3.39 **(11'1")**	10.57 **(34'8")**	15 460 **(34,080)**
325B LN	8FN(GOS)	96-01	168	27 670 **(61,000)**	2.39 **(7'10")**	3.21 **(10'6")**	10.35 **(33'11")**	2.99 **(9'10")**	10.57 **(34'8")**	15 030 **(33,140)**
325C L	CBR CSJ	01-06	188	28 600 **(63,100)**	2.59 **(8'6")**	3.26 **(10'8")**	10.34 **(33'11")**	3.39 **(11'1")**	10.51 **(34'6")**	15 600 **(33,750)**
325D L	A3R	06-08	204	29 240 **(64,460)**	2.59 **(8'6")**	3.04 **(10'0")**	10.42 **(34'2")**	3.39 **(11'1")**	11.15 **(36'7")**	15 450 **(33,400)**
326D L	PJM	12-14	140	25 560 **(56,400)**	2.59 **(8'6")**	3.17 **(10'5")**	10.06 **(33'0")**	3.39 **(11'1")**	10.03 **(32'11")**	13 900 **(30,600)**
328D L CR	RMX JTC MKR GTN SWF BYH	06-15	152	36 200 **(79,800)**	2.59 **(8'6")**	3.37 **(11'1")**	9.82 **(32'3")**	3.44 **(11'3")**	10.56 **(34'8")**	12 300 **(28,000)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Without bucket.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
329D	BBF	08-14	158	28 010	2.39	3.33	10.36	2.99	10.72	13 750
	WDK			**(61,620)**	**(7'10")**	**(10'11")**	**(34'0")**	**(9'10")**	**(35'2")**	**(29,450)**
	BYS									
	DTZ									
329D L	TAY	08-15	158	29 970	2.59	3.33	10.36	3.39	10.72	16 200
	MNB			**(65,920)**	**(8'6")**	**(10'11")**	**(34'0")**	**(11'1")**	**(35'2")**	**(35,050)**
	DJF									
	JHJ									
	BFC									
	LFW									
	RSK									
	TPM									
	J9D									
	J8D									
	L5G									
	L5H									
	TFW									
	XDB									
	CZF									
	WLT									
	TZL									
329D LN	SCY	08-11	152	28 860	2.39	3.18	10.41	2.99	10.6	13 050
	EBM			**(63,600)**	**(7'10")**	**(10'5")**	**(34'2")**	**(9'10")**	**(34'9")**	**(28,800)**
329E	PTY	10-15	170	27 700	2.39	3.37	10.39	2.99	10.68	14 300†
				(61,100)	**(7'10")**	**(11'1")**	**(34'1")**	**(9'10")**	**(35'0")**	**(30,650)**
329E L	RDX	10-16	170	29 060	2.59	3.37	10.39	3.39	10.68	18 150†
	WJK			**(64,100)**	**(8'6")**	**(11'1")**	**(34'1")**	**(11'1")**	**(35'0")**	**(3,300)**
	ZCD									
	PLW									
	TST									
329E LN	RLD	10-15	170	28 720	2.39	3.37	10.39	2.99	10.68	18 150†
				(63,300)	**(7'10")**	**(11'1")**	**(34'1")**	**(9'10")**	**(35'0")**	**(39,300)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.
†Without bucket.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
330	2ZM	92-95	222	32 100	2.59	3.29	11.01	3.19	12.37	14 600
	6ZK			**(70,600)**	**(8'6")**	**(10'10")**	**(36'1")**	**(10'6")**	**(40'6")**	**(31,500)**
	8RL									
	9NG									
	9PG									
	9WJ									
330 L	2EL	92-95	222	33 500	2.59	3.29	11.01	3.34	12.43	14 600
	5YM			**(73,700)**	**(8'6")**	**(10'10")**	**(36'1")**	**(10'11")**	**(40'9")**	**(31,500)**
	6SK									
	6WJ									
	8FK									
	9ML									
330 LN	8CK	92-95	222	32 740	2.39	3.29	11.01	2.99	12.37	14 600
				(72,030)	**(7'10")**	**(10'10")**	**(36'1")**	**(9'10")**	**(40'6")**	**(31,500)**
330B	2RR	96-01	222	32 500	2.59	3.29	11.06	3.19	11.62	16 450
	4YW			**(71,650)**	**(8'6")**	**(10'10")**	**(36'3")**	**(10'6")**	**(38'1")**	**(35,200)**
	5EZ									
	8SR									
	9HN									
330B L	1JS	96-01	222	33 800	2.59	3.29	11.06	3.34	11.69	17 000
	1KS			**(74,520)**	**(8'6")**	**(10'10")**	**(36'3")**	**(10'11")**	**(38'4")**	**(36,750)**
	3YR									
	3ZZ									
	4RS									
	5LS									
	6DR									
	8TR									
330B LN	5LR	96-01	222	33 200	2.39	3.29	11.06	2.99	11.62	16 950
				(73,190)	**(7'10")**	**(10'10")**	**(36'3")**	**(9'10")**	**(38'1")**	**(36,600)**
330C	BTM	01-06	247	33 300	2.59	3.35	11.14	3.19	11.64	16 900
	GAG			**(73,410)**	**(8'6")**	**(11')**	**(36'7")**	**(10'6")**	**(38'2")**	**(36,550)**
	HAA									
	JCD									
	JNK									
	MCA									
	MKM									
	RBH									
330C L	CAP	01-06	247	34 800	2.59	3.35	11.14	3.34	11.64	16 900
	CYA			**(76,720)**	**(8'6")**	**(11')**	**(36'7")**	**(10'11")**	**(38'2")**	**(36,550)**
	DKY									
	GKX									
	JAB									
	KDD									
330C LN	CGZ	01-06	247	34 400	2.39	3.35	11.14	2.99	11.64	16 900
				(75,840)	**(7'10")**	**(11')**	**(36'7")**	**(9'10")**	**(38'2")**	**(36,550)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
330D	EAH	06-08	270	33 900	2.59	3.34	11.15	3.19	11.64	17 000
	JJM			**(74,740)**	**(8'6")**	**(10'11")**	**(36'7")**	**(10'6")**	**(38'2")**	**(36,550)**
	KAB									
	LCJ									
	MEY									
	PCK									
	PFC									
330D L	B6H	06-08	270	35 100	2.59	3.34	11.15	3.29	11.64	17 000
	EDX			**(77,380)**	**(8'6")**	**(10'11")**	**(36'7")**	**(10'10")**	**(38'2")**	**(36,700)**
	ERN									
	FFK									
	GBC									
	HAS									
	JLP									
	LDR									
	LRM									
	MAG									
	MWP									
	NBD									
	NEF									
	R2D									
	RAS									
	RDA									
	RDK									
	T2Y									
	THJ									
330D LN	GGE	06-08	270	34 900	2.39	3.34	11.15	2.99	11.64	17 000
				(76,940)	**(7'10")**	**(10'11")**	**(36'7")**	**(9'10")**	**(38'2")**	**(36,700)**
336D	EMX	09-13	270	33 900	2.59	3.34	11.15	3.19	11.64	17 000
	JBT			**(74,740)**	**(8'6")**	**(10'11")**	**(36'7")**	**(10'6")**	**(38'2")**	**(36,550)**
	JER									
	KKT									
	PGW									

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
336D L	DTS	09-13	270	35 100	2.59	3.34	11.15	3.29	11.64	17 000
	J2F			**(77,380)**	**(8'6")**	**(10'11")**	**(36'7")**	**(10'10")**	**(38'2")**	**(36,700)**
	JBF									
	JWR									
	KDJ									
	LMG									
	M2P									
	M4T									
	MDS									
	MPL									
	NLS									
	PPN									
	PRF									
	PTB									
	SKE									
	W3K									
	WET									
	WRK									
	ZML									
336D LN	L5K	09-13	270	34 900	2.39	3.34	11.15	2.99	11.64	17 000
	MYG			**(76,940)**	**(7'10")**	**(10'11")**	**(36'7")**	**(9'10")**	**(38'2")**	**(36,700)**
	MYP									
336E	CMR	11-16	306	34 600	2.59	3.51	11.16	3.19	11.72	
	KED			**(76,280)**	**(8'6")**	**(11'6")**	**(36'7")**	**(10'6")**	**(38'5")**	
336E L	BMH	11-16	306	37 300	2.59	3.51	11.16	3.29	11.72	20 100
	BZY			**(82,200)**	**(8'6")**	**(11'6")**	**(36'7")**	**(10'10")**	**(38'5")**	**(43,450)**
	DPX									
	FJH									
	GTJ									
	JRJ									
	TEG									
	YCE									
	YEP									
336E LN	TMZ	11-16	306	35 700	2.39	3.51	11.16	2.99	11.72	20 550
				(78,700)	**(7'10")**	**(11'6")**	**(36'7")**	**(9'10")**	**(38'5")**	**(44,550)**
336E H	HDW	13-16	306	34 800	2.59	3.51	11.19	3.19	11.72	
				(76,720)	**(8'6")**	**(11'6")**	**(36'9")**	**(10'6")**	**(38'5")**	
336E L H	GNY	13-16	306	37 200	2.59	3.51	11.19	3.29	11.72	19 250
	JEA			**(82,000)**	**(8'6")**	**(11'6")**	**(36'9")**	**(10'10")**	**(38'5")**	**(41,650)**
	RZA									
336E LN H	SSL	13-16	306	35 500	2.39	3.51	11.19	2.99	11.72	19 850
				(78,300)	**(7'10")**	**(11'6")**	**(36'9")**	**(9'10")**	**(38'5")**	**(42,950)**
340D L	JTN	11-13	270	38 200	2.92	3.59	11.15	3.52	11.08	18 520
				(84,220)	**(9'7")**	**(11'9")**	**(36'7")**	**(11'7")**	**(36'4")**	**(40,830)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
345B	4SS	97-00	290	44 050 **(97,100)**	2.74 **(9'0")**	3.76 **(12'4")**	11.79 **(33'8")**	3.49 **(11'5")**	13.0 **(42'8")**	20 850 **(45,000)**
345B L	7KS(GOS) 2SW(GOS)	98-00	290	47 665 **(105,080)**	2.39 **(7'10")**	3.68 **(12'1")**	11.74 **(38'6")**	2.99 **(9'10")**	12.97 **(42'6")**	21 000 **(46,300)**
345B L Series II	CCC(VG) FEE(FG) DET(MH)	01-05	321	48 960 **(107,960)**	2.39 **(7'10")**	3.87 **(12'8")**	11.46 **(37'7")**	2.99 **(9'10")**	11.69 **(38'4")**	19 250 **(42,450)**
345C L	ELS(FG) GCL(VG)	05-08	325	50 500 **(111,350)**	2.39 **(7'10")**	3.74 **(12'3")**	11.84 **(38'10")**	2.99 **(9'10")**	11.70 **(38'5")**	20 100 **(44,320)**
345C L	LYS(FG) GPH(VG) FPC(VG)	05-08	325	50 500 **(111,350)**	2.39 **(7'10")**	3.74 **(12'3")**	11.84 **(38'10")**	2.99 **(9'10")**	11.70 **(38'5")**	20 100 **(44,320)**
345D	NEG BYW, FES		380	44 490 **(98,084)**	2.89 **(9'6")**	3.94 **(13'0")**	11.90 **(39'1")**	3.49 **(11'5")**	11.70 **(38'5")**	9050 **(19,500)**
345D L	PBT RAE BYC YEE DPA, HLC EEH, RAJ RGG RDC, MLK RBT, RGD			47 200 **(104,060)**	2.89 **(9'6")**	3.94 **(13'0")**	11.90 **(39'1")**	3.49 **(11'5")**	11.70 **(38'5")**	9050 **(19,500)**
349D	MEN GKF	11-14	380	44 490 **(98,084)**	2.89 **(9'6")**	3.94 **(13'0")**	11.9 **(39'1")**	3.49 **(11'5")**	11.7 **(38'5")**	9050 **(19,500)**
349D L	NNF KLH PZG WTD) JGB KHS RBJ	11-14	380	47 200 **(104,060)**	2.89 **(9'6")**	3.94 **(13'0")**	11.9 **(39'1")**	3.49 **(11'5")**	11.7 **(38'5")**	9050 **(19,500)**
349E L (FG)	TFG MPZ	11-14	317	48 500 **(106,900)**	2.74 **(9'0")**	3.73 **(12'3")**	11.92 **(39'1")**	3.49 **(11'5")**	12.12 **(39'9")**	23 850 **(55,200)**
349E L (VG)	KCN DGE	11-14	317	51 200 **(112,900)**	2.89 **(9'6")**	3.55 **(11'8")**	11.82 **(38'9")**	3.64 **(11'11")**	12.09 **(39'8")**	24 100 **(55,700)**
350	7RK	93-99	286	48 040 **(105,910)**	2.55 **(8'4.4")**	3.75 **(12'3.6")**	12.2 **(40'.3")**	3.2 **(10'6")**	13.45 **(44'1.5")**	17 750 **(39,100)**
	2ZL	93-99	286	50 094 **(110,210)**	2.55 **(8'4.4")**	3.75 **(12'4")**	12.2 **(40'0")**	3.3 **(10'10")**	13.49 **(44'3")**	17 750 **(39,100)**
350 L	9DK	93-99	286	49 010 **(108,050)**	2.55 **(8'4.4")**	3.75 **(12'3.6")**	12.2 **(40'.3")**	3.3 **(10'9.9")**	13.45 **(44'1.5")**	17 750 **(39,100)**
	3ML	93-99	286	51 126 **(112,450)**	2.55 **(8'4.4")**	3.75 **(12'4")**	12.2 **(40'0")**	3.3 **(10'10")**	13.49 **(44'3")**	17 600 **(40,900)**
365B L	9PZ(GOS)	99-02	385	66 245 **(146,050)**	2.75 **(9'0")**	4.57 **(15'0")**	12.17 **(39'11")**	3.50 **(11'6")**	14.04 **(46'1")**	29 200 **(64,370)**
365B L Series II	JMB(EAME) DER(NACD) PEG(FS)	02-04	404	70 250 **(154,900)**	2.75 **(9'0")**	4.7 **(15'5")**	12.54 **(41'2")**	3.42 **(11'3")**	14.09 **(16'3")**	13 040 **(28,750)**

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Track) (cont'd)

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
374D L	PJA PAX PAP PAS PAC	Sep 2010	355 kW **(476 hp)**	71 132 **(156,819)** Reach Boom R3.6 **(11'10")** Stick 3.8 m^3 **(5.0 yd^3)** Bucket 650 mm **(26 in)** Shoe	2.75 **(9'0")** Shipping 3.41 **(11'2")** Working	4.48 **(14'8")** Reach Boom R3.6 **(11'10")** Stick	13.32 **(43'8")** Reach Boom R3.6 **(11'10")** Stick	3.5 **(11'6")** Transpor-tation 750 mm **(30 in)** Shoe	14.23 **(46'8")** Reach Boom R4.67m **(15'4")** Stick 3.8 m^3 **(5.0 yd^3)** Bucket	17 300 **(39,900)** Reach Boom R4.67m **(15'4")** Stick 900 mm **(36 in)** Shoe Ground Level 4.5 m **(15'0")** Over Front
375	8WJ	92-01	428	81 190 **(178,800)**	2.75 **(9'0")**	5.24 **(17'2")**	14.3 **(46'11")**	3.5 **(11'6")**	15.96 **(52'4")**	30 300 **(65,600)**
	6NK(GOS)	92-02	428	79 807 **(175,940)**	2.75 **(9'0")**	5.24 **(17'2")**	13.14 **(43'1")**	3.48 **(11'5")**	15.67 **(51'5")**	23 620 **(52,070)**
375 L	1JM	93-01	428	82 380 **(181,500)**	2.94 **(9'7")**	5.24 **(17'2")**	14.3 **(46'11")**	3.84 **(12'7")**	15.96 **(52'4")**	29 550 **(64,400)**
	9WL(GOS)	92-02	428	80 700 **(177,910)**	2.75 **(9'0")**	5.24 **(17'2")**	14.29 **(46'11")**	3.48 **(11'5")**	15.67 **(51'5")**	23 620 **(52,070)**
385B L	FDL(EAME) RCD(NACD) CLS(EAME) MYA(NACD)	01-04	513	89 130 **(196,530)**	2.75 **(9'0")**	5.16 **(16'11")**	14.6 **(47'11")**	3.73 **(12'3")**	15.61 **(51'2")**	13 810 **(30,450)**
390D L	WAG WBT WAP	Nov 2010	390 kW **(523 hp)**	86 190 **(190,016)** GP Boom **(27'7")** R4.4m **(14'5")** Stick 4.6 m^3 **(6.0 yd^3)** HD Bucket 650 mm **(26 in)** Shoe	2.75 **(9'0")** Shipping 3.51 **(11'6")** Working	5.16 **(16'11")** GP Boom **(27'7")** GP3.4m **(11'2")** Stick	14.72 **(48'4")** GP Boom **(27'7")** GP3.4m **(11'2")** Stick	4.26 **(14'0")** Transpor-tation 750 mm **(30 in)** Shoe	17.25 **(56'7")** Reach Boom R5.5m **(18'1")** Stick 3.9 m^3 **(5.1 yd^3)** Bucket	11 350 **(25,900)** Reach Boom R5.5m **(18'1")** Stick 900 mm **(36 in)** Shoe –1.5 m **(–5.0 ft)** 4.5 m **(15'0")** Over Front
5090B	CLD EAME SJY NACD	01-04	512	87 500 **(192,937)**	3.5 **(11.51)**	4.63 **(15.19)**	14.26 **(46.77)**	3.47 **(11.38)**	10.35 **(33.95)**	— —

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick (6.1 m **(20'0")** over front for 375/375 L).

HYDRAULIC EXCAVATORS (Wheel)

Model	Product Ident. No. Prefix (USA)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)	Standard Tire Size
206	(2RC)	84-90	Deutz-67	12 185	3.11	7.38	2.40	8.14	3360	Dual 9.00-20 12PR
	(3GC)		Perkins-71	**(26,863)**	**(10'2")**	**(24'2.5")**	**(7'10")**	**(26'9")**	**(7400)**	
212	(3JC)	84-90	Deutz-84	13 700	3.15	8.00	2.49	9.86	3850	Dual 10.00-20 12PR
	(5DC)		Perkins-94	**(30,423)**	**(10'4")**	**(26'3")**	**(8'2")**	**(32'4")**	**(8490)**	
212B	(3PJ)	90-95	110	14 000	3.04	8.28	2.49	9.48	3900	Dual 10.00-20 12PR
				(30,870)	**(10'0")**	**(27'2")**	**(8'2")**	**(31'1")**	**(8600)**	
214	(9MB)	84-88	Deutz-101	15 600	3.06	8.28	2.49			Dual 10.00-20 12PR
	(1KB)		Perkins-102	**(34,175)**	**(10'0")**	**(27'2")**	**(8'2")**			
214B	4CF	88-94	110	18 700	3.06	8.28	2.49	10.41	4200	Dual 10.00-20 12PR
				(41,230)	**(10'0")**	**(27'2")**	**(8'2")**	**(34'2")**	**(9260)**	
214B FT	9NF	88-94	135	18 700	3.06	8.28	2.49	10.41	4200	Dual 10.00-20 12PR
				(41,230)	**(10'0")**	**(27'2")**	**(8'2")**	**(34'2")**	**(9260)**	
224	(2JC)	84-89	Deutz-143	19 000	3.42	8.98	2.49	10.61	4800	Dual 10.00-20 12PR
	(5TC)		Perkins-124	**(41,890)**	**(11'3")**	**(29'6")**	**(8'2")**	**(34'10")**	**(10,600)**	
224B	7WF	89-95	135	21 000	3.95	9.08	2.65	10.75	4800	Dual 11.00-20 14PR
				(46,297)	**(13'0")**	**(29'9")**	**(8'8")**	**(35'3")**	**(10,582)**	

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Hydraulic Excavators (Wheel) (cont'd)

Model	Product Ident. No. Prefix (USA)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)	Standard Tire Size
M312	6TL	96-02	114	13 425 **(29,602)**	3.07 **(10'1")**	8.62 **(28'3")**	2.5 **(8'2")**	8.9 **(29'2")**	4300 **(9482)**	10-20.00 14PR
M313C	H2A BDR	05-06 02-05	118	13 100-14 750 **(28,886-35,524)**	3.12 **(10'2")**	8.08 **(26'6")**	2.55 **(8'4")**	8.77 **(28'9")**	4800 **(10,584)**	10.00-20 16PR
M313D	J3A W3H	12-13 07-12	127	14 000-16 200 **(30,870-35,721)**	3.12 **(10'3")**	8.08 **(26'6")**	2.55 **(8'4")**	8.77 **(28'10")**	4800 **(10,582)**	10.00-20 16PR
M315	7ML	95-02	117	15 570 **(34,332)**	3.08 **(10'1")**	8.84 **(29'0")**	2.5 **(8'2")**	9.26 **(30'5")**	5100 **(11,246)**	10-20.00 14PR
M315C	H2B BDM	05-06 02-05	129	15 000-16 650 **(33,075-36,713)**	3.15 **(10'4")**	8.33 **(27'4")**	2.55 **(8'4")**	9.17 **(30'1")**	5600 **(12,348)**	10.00-20 16PR
M315D	J5B W5M	12-13 07-12	136	16 100-18 300 **(35,501-40,352)**	3.15 **(10'4")**	8.33 **(27'4")**	2.55 **(8'4")**	9.17 **(30'1")**	5700 **(12,566)**	10.00-20 16PR
M316C	H2C BDX	05-06 02-05	138	16 300-18 200 **(35,942-40,131)**	3.17 **(10'5")**	8.40 **(27'7")**	2.55 **(8'4")**	9.17 **(30'1")**	6500 **(14,330)**	10.00-20 16PR
M316D	D6W W6A	11-13 07-11	158	17 000-19 200 **(37,478-42,329)**	3.17 **(10'5")**	8.4 **(27'7")**	2.55 **(8'4")**	9.17 **(30'1")**	6400 **(14,110)**	10.00-20 16PR
M318	8AL	95-02	131	17 870 **(39,403)**	3.1 **(10'2")**	8.97 **(29'5")**	2.6 **(8'6")**	10.55 **(34'7")**	6400 **(14,112)**	10-20.00 14PR
M318C	H2D BCZ	05-06 02-05	151	17 800-19 700 **(39,249-43,439)**	3.21 **(10'6")**	8.96 **(29'5")**	2.55 **(8'4")**	9.60 **(31'6")**	6600 **(14,550)**	10.00-20 16PR
M318D	D8W W8P	11-13 07-11	166	18 200-20 100 **(40,124-44,312)**	3.17 **(10'5")**	8.96 **(29'5")**	2.55 **(8'4")**	9.6 **(31'6")**	6600 **(14,550)**	10.00-20 16PR
M320	6WL	97-02	131	20 200 **(44,541)**	3.21 **(10'6")**	9.55 **(31'4")**	2.75 **(9'0")**	11.18 **(36'8")**	7500 **(16,538)**	11-20.00 14PR
M322C	H2E BDK	05-06 02-05	164	20 500-22 700 **(45,203-50,054)**	3.25 **(10'8")**	9.64 **(31'7")**	2.75 **(9'0")**	10.32 **(33'10")**	7300 **(16,093)**	11.00-20 16PR
M322D	D2W W2S	11-13 07-11	164	20 500-22 500 **(45,195-49,604)**	3.20 **(10'6")**	9.64 **(31'7")**	2.75 **(9'0")**	10.32 **(33'10")**	7200 **(15,873)**	11.00-20 16PR

*When shipped with medium stick and bucket curled under, one-piece boom.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, rear dozer up, one-piece boom, longest stick.

5000 SERIES EXCAVATORS AND FRONT SHOVELS

Model	Product Ident. No. Prefix COSA (US)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Track Gauge m (ft)	Height* m (ft)	Length* m (ft)	Width m (ft)	Max. Reach** m (ft)	Lift Capacity*** kg (lb)
5080	6XK(GOS)	94-02	428	83 800 **(184,750)**	2.75 **(9'0")**	4.73 **(15'6")**	13.76 **(45'2")**	3.48 **(11'5")**	9.76 **(32'0")**	—
5090B	CLD(EAME) SJY(NACD)	01-04	512	87 500 **(192,940)**	3.51 **(11'6")**	4.63 **(15'2")**	14.26 **(46'9")**	3.47 **(11'5")**	10.35 **(33'11")**	—

*When shipped with medium stick and bucket curled under.
**Maximum reach at ground level, one-piece boom, longest stick.
***Lift capacity at 4.6 m **(15'0")** over front, one-piece boom, longest stick.

Model	Product Ident. No. Prefix (USA)	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Rated* Capacity m^3 (yd^3)	Breakout Force kN (lb)	Crowd Force kN (lb)	Track Gauge m (ft)	Max. Reach* m (ft)	Max. Load Height m (ft)	Max. Digging Depth m (ft)
5110B ME	AAA	00-03	696	127 000 **(280,000)**	7.6 **(9.9)**	501 **(112,600)**	439 **(98,800)**	4.1 **(13.4')**	13.9 **(45.7')**	8.6 **(28.0')**	7.9 **(25.9')**
5110B L	AAK	02-03	696	129 000 **(284,000)**	4.6 **(6.0)**	463 **(104,175)**	377 **(84,825)**	4.1 **(13.4')**	16.39 **(53.8')**	10.06 **(33.0')**	10.51 **(34.5')**
5130 ME	5ZL	92-97	755	180 000 **(397,000)**	10.0 **(13.0)**	615 **(138,400)**	624 **(140,300)**	4.72 **(15'6")**	14.9 **(48'11")**	9.1 **(29'10")**	8.4 **(27'7")**
5130 FS	5ZL	92-97	755	179 000 **(395,000)**	10.5 **(13.7)**	715 **(161,000)**	770 **(173,000)**	4.72 **(15'6")**	12.4 **(40'8")**	9.1 **(29'10")**	—
5130B ME	4CS	97-03	800	182 000 **(401,000)**	10.5 **(13.7)**	672 **(151,100)**	624 **(140,300)**	4.72 **(15.5')**	14.9 **(48.9')**	9.1 **(29.8')**	8.4 **(27.6')**
5130B FS	4CS	97-03	800	181 000 **(399,000)**	11.0 **(14.5)**	715 **(161,000)**	770 **(173,000)**	4.72 **(15.5')**	12.4 **(40.7')**	9.1 **(29.8')**	—
5230 ME	7LL	94-00	1470	316 600 **(698,000)**	16.0 **(21.0)**	873 **(196,260)**	874 **(196,480)**	5.2 **(17'0")**	17.7 **(58'0")**	9.8 **(32'2")**	9.4 **(30'10")**
5230 FS	7LL	94-00	1470	318 422 **(702,000)**	17.0 **(22.2)**	1125 **(253,000)**	1250 **(281,000)**	5.2 **(17'0")**	14.8 **(48'7")**	10.3 **(33'10")**	—
5230B ME	4HZ	01-04	1550	328 100 **(723,400)**	16.0 **(21.0)**	855 **(192,083)**	885 **(198,848)**	5.196 **(17.0')**	17.8 **(58.4')**	9.8 **(32.0')**	9.5 **(31.3')**
5230B FS	4HZ	01-04	1550	327 000 **(721,000)**	17.0 **(22.2)**	1162 **(261,145)**	1145 **(257,324)**	5.196 **(17.0')**	14.9 **(48.8')**	10.4 **(34.1')**	—

*Standard boom and stick.

6000 SERIES HYDRAULIC MINING SHOVELS

Model	Product Ident. No. Prefix	Years Built	Approx. Operating Weight kg (lb)	Flywheel Horsepower kW (hp)	Rated Capacity m³ (yd³)	Breakout Force kN (lb)	Tearout/ Crowd Force kN (lb)	Track Gauge m (ft)	Max. Reach m (ft)	Max. Load Height m (ft)	Max. Digging Depth m (ft)
6015	DHB	95-16	106 100	496	6.0	380	375	3.8	13.5	9.0	7.3
			(233,910)	**(665)**	**(7.8)**	**(85,400)**	**(84,270)**	**(12'6")**	**(44'3")**	**(29'6")**	**(23'11")**
6015 ME*	DHB	96-16	106 000	496	7.0	410	390	3.8	12.6	9.2	6.0
			(233,690)	**(665)**	**(9.2)**	**(92,140)**	**(87,640)**	**(12'6")**	**(41'4")**	**(30'2")**	**(19'8")**
6015 FS	DHF	95-16	104 900	496	7.0	480	645	3.8	10.5	8.8	–
			(231,260)	**(665)**	**(9.2)**	**(107,870)**	**(144,950)**	**(12'6")**	**(34'5")**	**(28'10")**	
6018	DHT	86-16	186 000	824	10.0	510	540	4.5	15.6	8.9	8.5
			(410,060)	**(1104)**	**(13.1)**	**(114,610)**	**(121,350)**	**(14'9")**	**(51'2")**	**(29'2")**	**(27'11")**
6018 FS	DHD	86-16	183 400	824	10.0	730	910	4.5	12.9	10.1	–
			(404,320)	**(1104)**	**(13.1)**	**(164,050)**	**(204,500)**	**(14'9")**	**(42'4")**	**(33'2")**	

*Mass Excavation backhoe attachment.

WHEEL MATERIAL HANDLERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Approx. Operating Weight kg (lb)	Max. Reach m (ft)	Lift Capacity* kg (lb)
M318 MH	6ES	98-02	104	19 500	10.5	2100
			(140)	**(43,000)**	**(34'8")**	**(4630)**
	8SS	98-02	104	19 500	10.5	2100
			(140)	**(43,000)**	**(34'8")**	**(4630)**
M318C MH	BEB	02-05	113	21 460	11.0	2100
			(151)	**(47,311)**	**(36'1")**	**(4630)**
	H2F	05-06	113	21 460	11.0	2100
			(151)	**(47,311)**	**(36'1")**	**(4630)**
M318D MH	D9X	11-13	124	18 200-20 100	11.0	2150
	W8R	07-11	**(166)**	**(40,124-44,312)**	**(36'1")**	**(4740)**
M320 MH	9PS	98-02	104	21 150	11.6	3200
			(140)	**(46,600)**	**(38'0")**	**(7055)**
M322C MH	BDY	02-05	122	24 690	12.5	2300
			(164)	**(54,432)**	**(41'0")**	**(5070)**
	H2G	05-06	122	24 690	12.5	2300
			(164)	**(54,432)**	**(41'0")**	**(5070)**
M322D MH	D3X	11-13	122	20 500-22 500	12.5	2050)
	W2T	07-11	**(164)**	**(45,195-49,604)**	**(41'0")**	**(4519)**
325 WMH	2SL	98	125	35 100	13.4	4200
			(168)	**(77,400)**	**(43'11")**	**(9400)**
325B WMH	2JR	98	132	34 958	13.4	4700
			(177)	**(77,000)**	**(43'11")**	**(10,400)**
M325B MH	2JR	99-00	125	37 200	15.5	3040
			(168)	**(82,040)**	**(50'10")**	**(6700)**
	BGN	01-04	125	37 200	15.5	3040
			(168)	**(82,040)**	**(50'10")**	**(6700)**
M325C MH	XJA	03-06	128	31 500	15.65	2960
			(173)	**(69,450)**	**(51'4")**	**(6526)**
M325C LMH	PAN	03-06	140	37 000	15.65	3510
			(189)	**(81,570)**	**(51'4")**	**(7738)**
W330B MH	AME	00-02	165	52 800	14.4	4800
			(222)	**(116,300)**	**(47'3")**	**(10,700)**
W345B MH	ANJ	02	216	64 250	16.5	5300
			(290)	**(141,650)**	**(54'0")**	**(11,800)**
	CDY	02-04	239	66 040	16.5	5300
			(321)	**(145,288)**	**(54'0")**	**(11,800)**
W345C MH	R5K	05	257	64 745	18.0	5150
			(345)	**(142,740)**	**(59'1")**	**(11,400)**
350 WMH	9FL	98	213	68 812	17.1	6300
			(286)	**(151,800)**	**(56'3")**	**(13,889)**
	3ML	99	213	68 812	17.1	6300
			(286)	**(151,800)**	**(56'3")**	**(13,889)**

*Lift at maximum reach over front at 3 m **(10 ft)** elevation from stick pin, no tool.

TRACK MATERIAL HANDLERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Approx. Operating Weight kg (lb)	Max. Reach m (ft)	Lift Capacity* kg (lb)
320 MH	3XK	-99	96 **(128)**	23 030 **(50,670)**	12.4 **(40'8")**	2910 **(6400)**
	9KK	-99	96 **(128)**	23 030 **(50,670)**	12.4 **(40'8")**	2910 **(6400)**
320B MH	6LS	99-01	100 **(134)**	23 030 **(50,670)**	12.4 **(40'8")**	3150 **(6900)**
320C MH	BGB	01-02	103 **(138)**	25 530 **(56,283)**	12.4 **(40'8")**	3150 **(6900)**
	SAH	03-07	103 **(138)**	25 530 **(56,283)**	12.4 **(40'8")**	3150 **(6900)**
325 MH	2SL	-98	125 **(168)**	31 400 **(69,237)**	13.4 **(43'11")**	4130 **(9100)**
325B MH	2JR	98-02	132 **(177)**	33 236 **(73,120)**	13.4 **(43'11")**	4200 **(9200)**
325C MH	S2C	03-05	140 **(188)**	34 630 **(76,350)**	15.5 **(50'10")**	3000 **(6600)**
325D MH	RJK	05-12	152 **(204)**	35 526 **(78,321)**	15.5 **(50'11")**	3010 **(6630)**
	C4H	05-12	152 **(204)**	35 526 **(78,321)**	15.5 **(50'11")**	3010 **(6630)**
330 MH	5YM	-98	166 **(222)**	39 100 **(86,215)**	14.4 **(47'3")**	4080 **(9000)**
330B MH	6DR	98-02	165 **(222)**	41 430 **(91,350)**	14.4 **(47'3")**	4900 **(10,800)**
330C MH	D3C	03-05	184 **(247)**	43 815 **(96,595)**	15.9 **(52'2")**	3900 **(8600)**
330D MH	LEM	05-13	200 **(268)**	44 627 **(98,386)**	16.0 **(52'6")**	3670 **(8090)**
	C5K	05-13	200 **(268)**	44 627 **(98,386)**	16.0 **(52'6")**	3670 **(8090)**
345B MH	2NW	97-00	216 **(290)**	55 705 **(122,550)**	16.5 **(54'0")**	5300 **(11,600)**
345BII MH	APB	00-05	239 **(321)**	56 100 **(123,420)**	16.5 **(54'0")**	5300 **(11,600)**
345C MH	M2R	05-13	257 **(345)**	57 431 **(126,615)**	18.0 **(59'1")**	5000 **(11,000)**
	D3S	05-13	257 **(345)**	57 431 **(126,615)**	18.0 **(59'1")**	5000 **(11,000)**
350 MH	8KZ	-00	213 **(286)**	61 576 **(135,630)**	17.1 **(56'3")**	5350 **(11,800)**
	9FL	-00	213 **(286)**	61 576 **(135,630)**	17.1 **(56'3")**	5350 **(11,800)**
365B MH	CTY	02-03	287 **(385)**	74 470 **(164,177)**	18.9 **(61'11")**	6320 **(13,540)**
365BII MH	SDL	04	302 **(404)**	74 470 **(164,177)**	18.9 **(62'3")**	6320 **(13,540)**
365C MH	GWC	05-06	302 **(404)**	79 263 **(174,744)**	19.8 **(65'1")**	5400 **(11,905)**
375 MH	8SL	00	319 **(428)**	92 081 **(203,000)**	21.1 **(69'3")**	5900 **(13,200)**
	1JM	00-05	319 **(428)**	92 081 **(203,000)**	21.1 **(69'3")**	5900 **(13,200)**

*Lift at maximum reach over front at 3 m **(10 ft)** elevation from stick pin, no tool.

LOGGING AND FOREST PRODUCT MACHINES

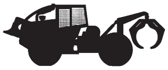
Model	Product Ident. No. Prefix	Years Built	Flywheel Power kW (hp)	Overall Track Length m (ft)	Overall Length m (ft)	Overall Width m (ft)	Operating Weight kg (lb)
320B Stroke Delimber	9JS	—	96 **(128)**	–	11.96 **(39'3")**	3.66 **(12'0")**	30 390 **(67,000)**
FB221	8XD	1986	147 **(197)**	4.47 **(14'8")**	9.78 **(32'1")**	3.20 **(10'6")**	28 180 **(62,000)**
FB227	10W	1983-93	100/134 **(135/180)**	4.55 **(14'11")**	11.88 **(39'0")**	3.35 **(11'0")**	31 769 **(69,892)**
DL221	8YD	1987	98 **(132)**	4.47 **(14'8")**	–	–	22 816 **(50,300)**
LL216	8JD	1986	95 **(128)**	–	10.70 to 11.23 **(35'1" to 36'10")**	2.64 **(8'8")**	17 577 **(38,750)**
LL228	8MD	1986	131 **(176)**	–	9.7 to 11.6 **(32'0" to 38'0")**	2.62 **(8'7")**	30 391 **(67,000)**
LL231	8PD	1986	175 **(235)**	5.03 **(16'6")**	10.6 to 11.6 **(35'0" to 38'0")**	3.56 **(11'8")**	39 146 **(86,300)**
320B LL	6LS/9JS	96-01	96 **(128)**	4.48 **(14'8")**	–	3.29 **(10'10")**	28 610 **(63,100)**
320C LL	BGB/BKK	01-03	96 **(128)**	4.5 **(14'8")**	–	3.3 **(10'10")**	25 900 **(57,100)**
320C LL	SAH/TBR	02-07	103 **(138)**	4.6 **(14'9")**	–	3.3 **(10'10")**	27 200 **(59,965)**
320D LL	GKS	07-14	110 **(147)**	4.6 **(14'9")**	–	3.3 **(10'10")**	30 300 **(66,812)**
320D GF	BZF/EAX	06-14	110 **(147)**	4.6 **(14'9")**	–	3.3 **(10'10")**	26 900 **(59,315)**
322B LL	1YS	96-02	114 **(153)**	4.66 **(15'3")**	–	3.72 **(12'3")**	32 970 **(72,686)**
322C FM GF (HD/LC)	BPH	01-06	125 **(168)**	4.66 **(15'4")**	9.96 **(32'8")**	3.29 **(10'10")**	28 229 **(62,245)***
322C FM GF (HW)	CAM	01-06	125 **(168)**	4.69 **(15'5")**	9.91 **(32'6")**	3.62 **(11'11")**	30 710 **(67,716)***
322C FM LL (U/U)	CBY	01-06	125 **(168)**	4.69 **(15'5")**	14.10 **(46'3")**	3.62 **(11'11")**	33 607 **(74,103)***
322C FM LL (O/U)	CBY	01-06	125 **(168)**	4.69 **(15'5")**	15 **(49'3")**	3.62 **(11'11")**	33 896 **(74,741)***

*Operating Weight without bucket or grapple and with the new FM Cab/Riser with integrated guarding (available in July 2004).

Logging and Forest Product Machines (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Power kW (hp)	Overall Track Length m (ft)	Overall Length m (ft)	Overall Width m (ft)	Operating Weight kg (lb)
324D FM LGP	JGK	07-10	140 **(188)**	4.7 **(15.3)**	13 **(42.7)**	3.62 **(11.9)**	32 886 **(72,500)**
325B LL	2JR	96-01	124 **(166)**	4.66 **(15'3")**	–	3.62 **(11'11")**	36 916 **(81,400)**
325C FM GF (HD/LC)	G1L	02-06	140 **(188)**	4.70 **(15'5")**	10.34 **(33'11")**	3.44 **(11'3")**	31 942 **(70,432)***
325C FM GF (HW)	M2K	02-06	140 **(188)**	4.70 **(15'5")**	10.29 **(33'9")**	3.62 **(11'11")**	33 078 **(72,937)***
325C FM LL (U/U)	S3M	02-06	140 **(188)**	4.70 **(15'5")**	14.87 **(48'9")**	3.62 **(11'11")**	37 644 **(83,005)***
325C FM LL (O/U)	S3M	02-06	140 **(188)**	4.70 **(15'5")**	15.75 **(51'8")**	3.62 **(11'11")**	38 219 **(84,273)***
330B LL	6DR	96-02	160 **(214)**	5.02 **(16'6")**	–	3.62 **(11'11")**	44 172 **(97,400)**
330C FM GF (HD/LC)	B3M	02-06	184 **(247)**	5.08 **(16'8")**	11.19 **(36'9")**	3.52 **(11'6")**	39 347 **(86,760)***
330C FM GF (HW)	B4N	02-06	184 **(247)**	5.07 **(16'7")**	11.19 **(36'9")**	3.62 **(11'11")**	40 778 **(89,915)***
330C FM LL (U/U)	B1K	02-06	184 **(247)**	5.07 **(16'7")**	16.67 **(54'8")**	3.62 **(11'11")**	44 430 **(97,968)***
330C FM LL (O/U)	B1K	02-06	184 **(247)**	5.07 **(16'7")**	17.36 **(57'0")**	3.62 **(11'11")**	44 965 **(99,148)***
330D FM GF	L2K	06-10	200 **(268)**	5.06 **(16'7")**	111.15 **(36'7")**	3.65 **(11'11")**	41 426 **(91,344)**
330D FM LL (U/U)	H3K	06-10	200 **(268)**	5.06 **(16'7")**	166.3 **(54'7")**	3.65 **(11'11")**	45 801 **(100,991)**
330D FM LL (O/U)	H3K	06-10	200 **(268)**	5.06 **(16'7")**	173.2 **(56'10")**	3.65 **(11'11")**	46 261 **(102,005)**

*Operating Weight without bucket or grapple and with the new FM Cab/Riser with integrated guarding (available in July 2004).



WHEEL SKIDDERS

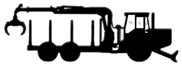
Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Operating Weight kg (lb)	Ground Clearance mm (in)	Wheel Base m (ft/in)
508 Cable	9NC	87-89	71 **(95)**	7770 **(17,130)**	521 **(20.5)**	2.8 **(9'2")**
508 Grapple	2HD	87-89	71 **(95)**	8766 **(19,308)**	521 **(20.5)**	2.8 **(9'2")**
518 FB	8ZC	86-89	96 **(130)**	11 612 **(25,600)**	587 **(23.1)**	3.25 **(10'8")**
518 PS Cable	50S	71-83	90 **(120)**	7718 **(17,000)**	505.4 **(19.8976)**	2895.6 **(9'6")**
518 PS Grapple	55U	1-80/81-83	90/97 **(120/130)**	9307 **(20,500)**	505.4 **(19.8976)**	2895.6 **(9'6")**
518 Cable	94U	3-84/85-92	90/97 **(120/130)**	9988 **(22,000)**	470 **(18.5039)**	3251 **(10'8.4")**
518 Grapple	95U	81-90	97 **(130)**	11 259 **(24,800)**	470 **(18.5039)**	3251 **(10'8.4")**
518 Series II Cable	94U	91-92	dual 97/108 **dual (130/145)**	10 260 **(22,600)**	470 **(18.5039)**	3251 **(10'8.4")**
518 Series II Grapple	95U	91-92	dual 97/108 **dual (130/145)**	12 031 **(26,500)**	470 **(18.5039)**	3251 **(10'8.4")**
518C Cable	1CL	93-95	115 **(154)**	11 528 **(25,391)**	450.7 **(17.74406)**	3251 **(10'8.4")**
518C Grapple	9HJ	93-95	115 **(154)**	12 587 **(27,725)**	463.4 **(18.24406)**	3251 **(10'8.4")**
525	–	–	119 **(160)**	13 558 **(29,891)**	527 **(20.7)**	3.5 **(11.5)**
525B	–	02-06	119 **(160)**	18 325 **(40,400)**	463 **(18.2)**	3.5 **(11.5)**
525C	–	06-14	146 **(196)**	17 711 **(39,045)**	581 **(22.9)**	3534 **(11'7")**
535B	–	6-Feb	134 **(180)**	19 006 **(41,900)**	463 **(18.2)**	3.5 **(11.5)**
535C	–	06-14	162 **(218)**	18 044 **(39,780)**	581 **(22.9)**	3534 **(11'7")**
545 Grapple	–	6-Feb	149.1 **(225)**	20 230 **(44,600)**	606.4 **(23.9)**	3.8 **(12.5)**
545C	–	06-14	173 **(232)**	19 198 **(42,325)**	581 **(22.9)**	3939 **(12'11")**

TRACK SKIDDERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Operating Weight kg (lb)	Gauge m (ft/in)
D4TSK Series II	8ZF	90-92	78 **(105)**	12 909 **(28,400)**	2.00 **(6'6")**
D4TSK Series III	7PK	92-96	78 **(105)**	14 000 **(30,900)**	2.00 **(6'6")**
D5HTSK Series II	7EG	92-96	97 **(130)**	18 800 **(41,360)**	2.16 **(7'11")**

TRACK FELLER BUNCHERS

Model	Product Ident. No. Prefix	Years Built	Gross Power kW (hp)	Overall Track Length m (ft)	Overall Length m (ft)	Overall Width m (ft)	Operating Weight kg (lb)
511	511	06-12	184.2 **(247)**	4.6 **(15.0)**	8.5 **(27.7)**	3.2 **(10.5)**	24 362 **(53,710)**
521	521	06-12	211.8 **(284)**	4.8 **(15.8)**	8.6 **(28.3)**	3.2 **(10.5)**	27 084 **(59,710)**
522	522	06-12	211.8 **(284)**	4.8 **(15.8)**	8.6 **(28.3)**	3.5 **(11.4)**	30 410 **(67,040)**
532	532	06-12	211.8 **(284)**	4.9 **(16.1)**	8.6 **(28.3)**	3.5 **(11.4)**	31 620 **(69,710)**
541	541	06-11	227.4 **(305)**	4.9 **(16.1)**	9.4 **(30.9)**	3.6 **(11.8)**	30 191 **(66,560)**
551	551	06-11	227.4 **(305)**	4.9 **(16.1)**	9.4 **(30.9)**	3.6 **(11.8)**	31 057 **(68,468)**
552	552	06-11	227.4 **(305)**	4.9 **(16.1)**	9.4 **(30.9)**	3.6 **(11.8)**	35 680 **(78,660)**



FORWARDERS

Model	Product Ident. No. Prefix	Years Built	Number of Wheels	Engine	Gross Power kW (hp)	Operating Weight kg (lb)	Load Capacity kg (lb)	Transmission	Std. Wheel Base mm (in)
534	HF	06-11	4	C4.4 ACERT	93 **(125)**	12 247 **(27,000)**	7258 **(16,000)**	Electric Powershift	3835 **(151)**
544	HF	06-11	6	C4.4 ACERT	93 **(125)**	14 062 **(31,000)**	10 866 **(24,000)**	Electric Powershift	5334 **(210)**
584	PAK	09-14	8	C7 ACERT	204 **(274)**	22 498 **(49,600)**	18 000 **(39,683)**	2 Speed Hydrostatic	6096 **(240)**

TRACK HARVESTER

Model	Product Ident. No. Prefix	Years Built	Engine	Gross Power kW (hp)	Track Pitch mm (in)	Overall Height m (ft)	Overall Width m (ft)	Operating Weight kg (lb)
501	PH	06-12	C6.6 ACERT	122 **(163)**	171.4 **(6.7)**	3.33 **(11.9)**	2.59 **(8.5)**	15 900 **(35,000)**

WHEEL HARVESTER

Model	Product Ident. No. Prefix	Years Built	Number of Wheels	Engine	Gross Power kW (hp)	Transmission	Boom Reach m (ft)	Std. Wheel Base mm (in)	Operating Weight kg (lb)
550	PH	06-13	6	C7 ACERT	147 **(197)**	Hydrostatic	8.2 **(27)**	4160 **(164)**	21 319 **(47,040)**

BACKHOE LOADERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Operating Weight kg (lb)	Digging Depth mm (ft/in)	GP Bucket Capacity m³ (yd³)	MP Bucket Capacity m³ (yd³)
416	5PC	85-90	46 **(62)**	6156 **(13,574)**	4420 **(14'6")**	0.76 **(1.0)**	0.76 **(1.0)**
416 Series II	5PC	90-92	46 **(62)**	6217 **(13,708)**	4420 **(14'6")**	0.76 **(1.0)**	0.76 **(1.0)**
416B	8ZK(8SG)	92-95	59 **(79)**	6227 **(13,700)**	4420 **(14'6")**	0.76 **(1.0)**	0.96 **(1.25)**
416C	4ZN(5YN)	96-00	56 **(75)**	6330 **(13,957)**	4420 **(14'6")**	0.76 **(1.0)**	0.96 **(1.25)**
416C (IT)	1WR(1XR)	96-00	56 **(75)**	6666 **(14,698)**	4420 **(14'6")**	0.96 **(1.25)**	0.96 **(1.25)**
416D	BFP, BKG, BGJ, CXP	00-05	58 **(78)**	6900 **(15,257)**	4390 **(14'5")**	0.76 **(1.0)**	0.96 **(1.25)**
420D	FDP, BKC	00-05	69 **(93)**	7150 **(15,772)**	4390 **(14'5")**	0.96 **(1.25)**	0.96 **(1.25)**
420D (IT)	BLN, BMC, MBH	00-05	69 **(93)**	7150 **(15,772)**	4390 **(14'5")**	0.96 **(1.25)**	0.96 **(1.25)**
424D	RXA, CJZ	01-05	56 **(75)**	7502 **(16,539)**	4854 **(15'9")**	1.0 **(1.31)**	0.96 **(1.25)**
426	7BC	86-90	52 **(70)**	6549 **(14,626)**	4720 **(15'6")**	0.96 **(1.25)**	0.76 **(1.0)**
426 Series II	7BC	90-92	52 **(70)**	7315 **(15,126)**	4720 **(15'6")**	0.96 **(1.25)**	0.76 **(1.0)**
426B	6KL(5YJ)	92-95	59 **(79)**	6790 **(14,970)**	4720 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
426C	6XN(7WN)	96-98	60 **(80)**	7051 **(15,548)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
426C	6XN3616 and up (7WN939 and up)	99-00	63 **(85)**	7051 **(15,548)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
(AWS) 426C	1CR(1ER)	96-98	60 **(80)**	7051 **(15,548)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
(AWS) 426C	1CR864 and up (1ER864 and up)	99-00	63 **(85)**	7051 **(15,548)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
426C (IT)	1YR(1ZR)	96-98	60 **(80)**	7387 **(16,289)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
426C (IT)	1YR1517 and up (1ZR926 and up)	99-00	63 **(85)**	7387 **(16,289)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
(AWS) 426C (IT)	1MR(1NR)	96-98	60 **(80)**	7387 **(16,289)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**
(AWS) 426C (IT)	1MR956 and up (1NR954 and up)	99-00	63 **(85)**	7387 **(16,289)**	4721 **(15'6")**	0.96 **(1.25)**	0.96 **(1.25)**

Backhoe Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Operating Weight kg (lb)	Digging Depth mm (ft/in)	GP Bucket Capacity m³ (yd³)	MP Bucket Capacity m³ (yd³)
428	6TC	86-90	52 **(70)**	6963 **(15,350)**	4790 **(15'9")**	1.0 **(1.31)**	0.92 **(1.2)**
428 Series II	6TC	90-92	52 **(70)**	7143 **(15,750)**	4750 **(15'7")**	1.0 **(1.31)**	0.92 **(1.2)**
428B	7EJ	92-95	60 **(80)**	7254 **(15,992)**	4810 **(15'9")**	1.0 **(1.31)**	0.92 **(1.2)**
428C	8RN	96-00	56 **(75)**	7279 **(16,047)**	4811 **(15'9")**	1.0 **(1.31)**	1.03 **(1.35)**
428C (IT)	2CR	96-00	56 **(75)**	7615 **(16,788)**	4811 **(15'9")**	1.0 **(1.31)**	1.03 **(1.35)**
428D	DSX, BXC, MBM	01-05	61 **(82)**	7738 **(17,059)**	4854 **(15'9")**	1.0 **(1.31)**	1.03 **(1.35)**
430D	BNK	00-05	75 **(101)**	7355 **(16,217)**	4639 **(15'3")**	1.0 **(1.31)**	0.96 **(1.25)**
430D (IT)	BML	00-05	75 **(101)**	7355 **(16,217)**	4639 **(15'3")**	1.0 **(1.31)**	0.96 **(1.25)**
432D	TDR, WEP	01-05	69 **(93)**	7809 **(17,216)**	4854 **(15'9")**	1.0 **(1.31)**	1.03 **(1.35)**
436	5KF	88-90	57 **(77)**	6831 **(15,062)**	4960 **(16'3")**	0.76 **(1.0)**	0.76 **(1.0)**
436 Series II	5KF	90-92	57 **(77)**	6878 **(15,166)**	4950 **(16'3")**	0.76 **(1.0)**	0.76 **(1.0)**
436B	7FL(6MJ)	92-95	63 **(84)**	6857 **(15,086)**	4950 **(16'3")**	0.96 **(1.25)**	0.96 **(1.25)**
436C	8TN(9JN)	96-98	63 **(85)**	7118 **(15,694)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**
436C	8TN925 and up (9JN884 and up)	99-00	70 **(93)**	7118 **(15,694)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**
(AWS) 436C	1FR(1GR)	96-98	63 **(85)**	7118 **(15,694)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**
(AWS) 436C	1FR1416 and up (1GR916 and up)	99-00	70 **(93)**	7118 **(15,694)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**
436C (IT)	2AR(2BR)	96-98	63 **(85)**	7454 **(16,435)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**
436C (IT)	2AR1604 and up (2BR911 and up)	99-00	70 **(93)**	7454 **(16,435)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**
(AWS) 436C (IT)	1PR(1RR)	96-98	63 **(85)**	7454 **(16,435)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**
(AWS) 436C (IT)	1PR1599 and up (1RR998 and up)	99-00	70 **(93)**	7454 **(16,435)**	4953 **(16'3")**	1.0 **(1.31)**	0.96 **(1.25)**

Backhoe Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Operating Weight kg (lb)	Digging Depth mm (ft/in)	GP Bucket Capacity m^3 (yd^3)	MP Bucket Capacity m^3 (yd^3)
438	3DJ	88-90	63 **(84)**	7900 **(17,420)**	4810 **(15'9")**	1.0 **(1.31)**	0.92 **(1.2)**
438 Series II	3DJ	90-92	57 **(77)**	7364 **(16,237)**	4810 **(15'9")**	1.0 **(1.31)**	0.92 **(1.2)**
438B	3KK	92-95	62.7 **(84)**	8331 **(18,367)**	4870 **(16'0")**	1.0 **(1.31)**	0.92 **(1.2)**
438C	9KN	96-98	63 **(85)**	7384 **(16,279)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
438C	9KN1061 and up	99-00	70 **(93)**	7384 **(16,279)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
(AWS) 438C	1JR	96-98	63 **(85)**	7384 **(16,279)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
(AWS) 438C	1JR1107 and up	99-00	70 **(93)**	7384 **(16,279)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
438C (IT)	2DR	96-98	63 **(85)**	7720 **(17,020)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
438C (IT)	2DR2717 and up	99-00	70 **(93)**	7720 **(17,020)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
(AWS) 438C (IT)	1TR	96-98	63 **(85)**	7720 **(17,020)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
(AWS) 438C (IT)	1TR1284 and up	99-00	70 **(93)**	7720 **(17,020)**	4873 **(16'0")**	1.0 **(1.31)**	1.03 **(1.35)**
442D	SMJ, TBD	01-05	75 **(101)**	7809 **(17,216)**	4854 **(15'9")**	1.0 **(1.31)**	1.03 **(1.35)**
446	6XF	89-95	71 **(95)**	8892 **(19,603)**	5220 **(17'2")**	1.15 **(1.5)**	1.10 **(1.5)**
446B			76 **(102)**	8890 **(19,600)**	5220 **(17'2")**	1.15 **(1.5)**	1.05 **(1.375)**
446D	DBL	04-06	76 **(102)**	8939 **(19,666)**	5142 **(16'10")**	1.15 **(1.5)**	1.25 **(1.63)**

PIPELAYERS

Model	Tractor Product Ident. No. Prefix	Years Built	Engine HP	Approx. Weight kg (lb)	Counter-weight kg (lb)	Max. Lift Capacity 1.2 m (4'0") Overhang kg (lb)	Speed Range km/h (mph) Forward	Speed Range km/h (mph) Reverse	Ground Clearance mm (in)	Ground Contact m² (in²)
MD6	9U39C	52-57	93	12 375	1590	12 035	2.7—10.6	3.2—10.0	321	1.77
				(27,820)	**(3500)**	**(26,530)**	**(1.7—6.6)**	**(2.0—6.2)**	**(13)**	**(2744)**
561B	62A	59-66	90	14 560	2270	17 500	2.7—10.6	1.8—9.9	267	2.02
				(32,100)	**(5000)**	**(38,800)**	**(1.7—6.6)**	**(2.0—6.2)**	**(11)**	**(3130)**
561B	62A	66-67	93	14 350	2270	17 600	2.7—10.9	3.4—10.3	267	2.02
				(31,637)	**(5000)**	**(38,800)**	**(1.7—6.8)**	**(2.1—6.4)**	**(11)**	**(3130)**
561C	85H	66-67	93	14 700	2450	18 000	2.7—11.1	3.4—10.1	395	2.02
				(32,500)	**(5400)**	**(40,000)**	**(1.7—6.9)**	**(2.1—6.3)**	**(16)**	**(3130)**
561C	92J	67-77	105	14 700	2450	18 100	2.7—11.1	3.4—10.1	395	2.02
				(32,500)	**(5400)**	**(40,000)**	**(1.7—6.9)**	**(2.1—6.3)**	**(16)**	**(3130)**
561D	54X	78-89	105	15 800	2990	18 100	3.5—10.1	4.2—12.2	395	2.02
				(35,000)	**(6600)**	**(40,000)**	**(2.2—6.3)**	**(2.6—7.6)**	**(16)**	**(3130)**
561H	6NL	93-97	105	15 700	2128	18 100	3.4—10.2	4.1—12.4	363	2.67
				(34,600)	**(4690)**	**(40,000)**	**(2.1—6.4)**	**(2.6—7.7)**	**(14.3)**	**(4120)**
561M		01	110	16 240	3260	18 100	3.3—9.9	4.0—12.1	438	2.67
				(35,800)	**(7200)**	**(40,000)**	**(2.0—6.2)**	**(2.5—7.5)**	**(17.2)**	**(4120)**
561M CB*	1KW	97-02	110	16 240						
(US)				**(35,800)**						
561N	CPH	03-08	123	16 851	3270	18 145	3.1—9.1	3.8—11.3	422	2.93
				(37,150)	**(7210)**	**(40,000)**	**(1.9—5.6)**	**(2.3—6.9)**	**(16.6)**	**(4542)**
561N	TAD	03-08	123	16 851	3270	18 145	3.1—9.1	3.8—11.3	422	2.93
				(37,150)	**(7210)**	**(40,000)**	**(1.9—5.6)**	**(2.3—6.9)**	**(16.6)**	**(4542)**
571E PS	64A	61-67	160	22 680	2360	7 490	3.7—10.3	4.3—12.1	400	3.04
				(50,000)	**(5200)**	**(60,600)**	**(2.3—6.4)**	**(2.7—7.5)**	**(16)**	**(4710)**
571E PS	64A	66-72	180	23 100	2360	27 500	3.7—10.1	4.3—11.9	400	3.04
				(51,000)	**(5200)**	**(60,600)**	**(2.3—6.3)**	**(2.7—7.4)**	**(16)**	**(4710)**
571F	95N	72-74	180	22 800	4350	27 500	3.5—9.7	4.2—11.4	400	3.04
				(50,300)	**(9600)**	**(60,600)**	**(2.2—6.0)**	**(2.6—7.1)**	**(16)**	**(4710)**
571G	16W	75-81	200	23 040	4350	27 500	3.7—10.0	4.5—11.9	399	3.04
	52D(JPN)	87-96	200	**(50,800)**	**(9600)**	**(60,600)**	**(2.3—6.2)**	**(2.8—7.9)**	**(15.7)**	**(4710)**
MD7	17A	51-57	140	16 200	3400	24 585	2.4—9.5	2.9—8.7	394	3.12
				(35,815)	**(7500)**	**(54,200)**	**(1.5—5.9)**	**(1.8—5.4)**	**(16)**	**(4840)**

*Gauge 2.0 m **(6'7")**, Width 3.19 m **(10'5")**, Length 3.73 m **(12'3")**, Height 3.12 m **(10'3")**, PS Transmission.
Forward Speed: 1st gear 3.27 km/h **(2.03 mph)**
2nd gear 5.81 km/h **(3.61 mph)**
3rd gear 9.93 km/h **(6.17 mph)**

Pipelayers (cont'd)

Model	Tractor Product Ident. No. Prefix	Years Built	Engine HP	Approx. Weight kg (lb)	Counter-weight kg (lb)	Max. Lift Capacity 1.2 m (4'0") Overhang kg (lb)	Speed Range km/h (mph)		Ground Clearance mm (in)	Ground Contact m^2 (in^2)
							Forward	Reverse		
572C	21A	57-61	128	26 200	4720	39 000	3.2—7.7	3.9—6.1	483	3.30
				(57,820)	**(10,405)**	**(86,000)**	**(2.0—4.8)**	**(2.4—3.8)**	**(19)**	**(5109)**
572D	21A	59	140	26 500	4940	39 000	4.2—9.7	4.8—7.7	483	3.30
				(58,520)	**(10,900)**	**(86,000)**	**(2.6—6.0)**	**(3.0—4.8)**	**(19)**	**(5109)**
572E PS	65A	61-69	180	28 000	6000	40 800	3.7—10.1	4.3—11.9	480	3.45
				(62,000)	**(13,000)**	**(90,000)**	**(2.3—6.3)**	**(2.7—7.4)**	**(19)**	**(5345)**
572F PS	96N	70-74	180	27 600	6440	40 800	3.5—9.7	4.2—11.4	480	3.45
				(61,000)	**(14,200)**	**(90,000)**	**(2.2—6.0)**	**(2.6—7.1)**	**(19)**	**(5345)**
572G	40U	75-86	200	27 800	6400	40 800	3.7—10.0	4.5—11.9	480	3.45
				(61,300)	**(14,200)**	**(90,000)**	**(2.3—6.2)**	**(2.8—7.4)**	**(19)**	**(5345)**
572G	8PC	84-89	200	27 800	6400	40 800	3.7—10.0	4.5—11.9	480	3.45
				(61,300)	**(14,200)**	**(90,000)**	**(2.3—6.2)**	**(2.8—7.4)**	**(19)**	**(5345)**
572R	2HZ	98-04	230	30 110	5055	40 825	3.5—11.1	4.8—14.2	414	4.19
				(66,250)	**(11,150)**	**(90,000)**	**(2.3—6.9)**	**(3.0—8.8)**	**(16.3)**	**(6500)**
578	8HB	89-97	300	46 580	11 777	70 307	3.8—10.8	4.7—13.8	452	5.17
				(102,690)	**(25,963)**	**(155,000)**	**(2.35—6.7)**	**(2.9—8.6)**	**(17.8)**	**(8020)**
583C	16A	55-58	190	35 440	8470	58 970	3.9—8.7	3.9—8.7	533	4.24
				(78,132)	**(18,676)**	**(130,000)**	**(2.4—5.4)**	**(2.4—5.4)**	**(21)**	**(6580)**
583H TC	38A	59-60	235	38 000	9030	62 140	4.5—10.3	4.5—10.3	537	4.66
				(83,840)	**(19,900)**	**(137,000)**	**(2.8—6.4)**	**(2.8—6.4)**	**(22)**	**(7220)**
583H PS	61A	60-74	191	35 600	8470	58 970	3.9—8.7	3.9—8.7	533	4.55
				(78,500)	**(18,676)**	**(130,000)**	**(2.4—5.4)**	**(2.4—5.4)**	**(21)**	**(7050)**
583H PS	61A	60-67	225	38 200	9000	62 140	4.1—11.1	4.6—12.8	537	4.66
				(84,270)	**(19,900)**	**(137,000)**	**(2.5—6.9)**	**(8.9—8.0)**	**(22)**	**(7220)**
583H PS	61A	61	235	38 900	10 400	62 140	3.9—10.1	4.8—12.6	537	4.66
				(85,720)	**(22,880)**	**(137,000)**	**(2.4—6.3)**	**(3.0—7.8)**	**(22)**	**(7220)**
583H	61A	74	270	40 600	10 300	63 500	3.9—10.5	4.8—13.0	533	4.65
				(89,500)	**(22,700)**	**(140,000)**	**(2.4—6.5)**	**(3.0—8.1)**	**(21)**	**(7220)**
583K	78V	74-89	300	40 960	7840	63 500	4.0—10.9	5.0—13.5	530	4.65
				(90,300)	**(17,290)**	**(140,000)**	**(2.5—6.8)**	**(3.1—8.4)**	**(21)**	**(7220)**
583R	2XS	98-05	228 kW	44 748	9036	63 504	3.5—10.8	4.7—3.8	537	5.10
			(305)	**(98,650)**	**(19,920)**	**(140,000)**	**(2.3—6.8)**	**(2.9—8.6)**	**(21.1)**	**(7896)**
583T	CMX	06-11	231 kW	45 359	9036	63 504	3.5-10.8	4.7-13.8	470	5.10
			(310)	**(100,000)**	**(19,920)**	**(140,000)**	**(2.3-6.8)**	**(2.9-8.6)**	**(18.5)**	**(7896)**
587R	BXL	06-11	273 kW	53 070	12 900	91 625	3.2-10.0	4.3-12.9	457	6.2
			(366)	**(117,000)**	**(28,440)**	**(202,000)**	**(2.0-6.2)**	**(2.7-8.0)**	**(18)**	**(9613)**
587T	FAT	06-11	262 kW	53 442	12 900	91 625	3.2-9.7	4.3-12.6	457	6.2
			(351)	**(117,820)**	**(28,440)**	**(202,000)**	**(2.0-6.0)**	**(2.7-7.8)**	**(18)**	**(9613)**
589	31Z	82-06	313 kW	65 366	11 854	104 330	3.5—10.9	4.3—13.7	625	6.96
			(420)	**(151,212)**	**(26,134)**	**(230,000)**	**(2.2—6.8)**	**(2.7—8.5)**	**(24.6)**	**(12,148)**
594	62H	74	385	55 400	12 600	90 700	3.9—10.5	4.8—12.7	640	5.72
				(122,000)	**(27,800)**	**(200,000)**	**(2.4—6.5)**	**(3.0—7.9)**	**(25)**	**(8865)**
594H	96V	74-82	410	56 065	12 555	90 700	4.0—10.8	5.0—13.2	630	6.48
				(123,600)	**(27,680)**	**(200,000)**	**(2.5—6.7)**	**(3.1—8.2)**	**(25)**	**(10,050)**

WHEEL TRACTOR-SCRAPERS

Model	Product Ident. No. Prefix	Years Built	Horse-power Max/ Rated	Capacity Struck/ Heaped m³ (yd³)	Approx. Shipping Weight kg (lb)	Dimensions m (ft)				Tire Size (Standard) & ply rating Tractor & Scraper	Turning Circle m (ft)
						Length	Width	Height	Width of Tread		
DW10 Tractor	1N	41-46	100/*	—	6550	4.57	2.24	1.93	1.73	10.0 × 20-12	—
					(14,350)	**(15'0")**	**(7'4")**	**(6'4")**	**(5'8")**	18.0 × 24-16	
DW10 Tractor	6V	46-47	100/*	—	6850	4.57	2.24	1.93	1.73	10.0 × 20-12	—
					(15,100)	**(15'0")**	**(7'4")**	**(6'4")**	**(5'8")**	18.0 × 24-16	
DW10 Tractor	1V	47-53	115/*	—	7540	4.70	2.34	1.93	1.79	12.0 × 20-14	—
					(16,610)	**(15'5")**	**(7'8")**	**(6'4")**	**(5'10")**	21.0 × 25-20	
DW10 &	1V	47-51	115/*	6.7/8.4	15 980	11.23	3.02	2.69	1.88	12.0 × 20-14	7.92
No. 10 Scraper	3C			**(8.7/11)**	**(35,240)**	**(37'0")**	**(9'11")**	**(8'10")**	**(6'2")**	21.0 × 25-20	**(26'0")**
DW10 &	1V	52-53	115/*	5.3/6.9	15 130	10.72	2.87	2.36	1.80	12.0 × 20-14	11.23
No. 10 Scraper	19C			**(7/9)**	**(33,365)**	**(35'2")**	**(9'5")**	**(7'9")**	**(5'11")**	21.0 × 25-20	**(37'0")**
									Scraper	16.0 × 21-20	
DW15 &	45C	54-55	/150	5.3/6.9	15 960	11.10	2.87	2.36	1.80	12.0 × 20-14	10.36
No. 10 Scraper	19C			**(7/9)**	**(35,180)**	**(36'5")**	**(9'5")**	**(7'9")**	**(5'11")**	21.0 × 25-20	**(34'0")**
									Scraper	16.0 × 21-20	
DW15 &	45C	54-55	/150	7.7/9.2	9400	11.84	3.18	2.69	1.93	12.0 × 20-14	11.23
No. 15 Scraper	4W			**(10/12)**	**(20,720)**	**(38'10")**	**(10'5")**	**(8'10")**	**(6'4")**	21.0 × 25-20	**(37'0")**
DW15 Tractor	45C	54-55	/150	—	9510	5.08	2.39	2.69	1.98	12.0 × 20-14	—
					(20,960)	**(16'8")**	**(7'10")**	**(8'10")**	**(6'6")**	21.0 × 25-20	
DW15C &	59C or 70C	55-57	186/*	7.7/9.5	19 220	11.84	3.18	2.69	1.98	12.0 × 12-14	10.36
No. 15 Scraper				**(10/12.5)**	**(42,370)**	**(38'10")**	**(10'5")**	**(8'10")**	**(6'6")**	21.0 × 25-20	**(34'0")**
DW15E &	75D or 76D	57-59	200/172	10/14	20 280	12.22	3.30	3.05	1.98	12.0 × 20-14	—
No. 428 Scraper				**(13/18)**	**(44,711)**	**(40'1")**	**(10'10")**	**(10'0")**	**(6'6")**	26.5 × 25-20	
DW15F &	75D or 76D	58-59	200/172	10/14	20 280	12.22	3.30	3.05	1.98	12.0 × 20-14	—
No. 428 Scraper				**(13/18)**	**(44,711)**	**(40'1")**	**(10'10")**	**(10'0")**	**(6'6")**	26.5 × 25-20	
DW20 &	21C	51-55	225/*	14/7.6	12 750	13.23	3.53	3.10	2.29	24.0 × 29-4	11.23
No. 20 Scraper	11C			**(18/23)**	**(28,100)**	**(43'5")**	**(11'7")**	**(10'2")**	**(7'6")**		**(37'0")**
DW20 Tractor	6W	51-55	225/*	—	11 620	5.39	2.79	2.41	2.18	14.0 × 24-16	—
(For W20 Wagon)					**(25,610)**	**(17'8")**	**(9'2")**	**(7'11")**	**(7'2")**	24.0 × 29-24	
DW20E &	57C	55-57	300/*	14/19	26 040	13.36	3.58	3.45	2.24	14.0 × 24-16	11.58
No. 456 Scraper	67C			**(18/25)**	**(57,400)**	**(43'10")**	**(11'9")**	**(11'4")**	**(7'4")**	29.5 × 29-22	**(38'0")**
DW20F &	87E	58-60	320/*	14/19	26 870	13.36	3.58	3.45	2.24	14.0 × 24-16	11.58
No. 456 Scraper	88E			**(18/25)**	**(59,240)**	**(43'10")**	**(11'9")**	**(11'4")**	**(7'4")**	29.5 × 29-22	**(38'0")**
DW20G &	87E	58-60	345/*	15/21	27 200	13.36	3.58	3.45	2.24	14.0 × 24-16	11.58
No. 456 Scraper	88E			**(19.5/27)**	**(59,960)**	**(43'10")**	**(11'9")**	**(11'4")**	**(7'4")**	29.5 × 29-28	**(38'0")**
DW20G &	87E	58-60	345/*	18.5/26	31 070	14.05	3.91	3.81	2.39	14.0 × 24-16	11.58
No. 482 Scraper	88E			**(24/34)**	**(68,500)**	**(46'1")**	**(12'10")**	**(12'6")**	**(7'10")**	29.5 × 29-28	**(38'0")**

*Maximum HP only available.

Wheel Tractor-Scrapers (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power Max/ Rated	Capacity Struck/ Heaped m³ (yd³)	Approx. Shipping Weight kg (lb)	Dimensions m (ft) Length	Width	Height	Width of Tread	Tire Size (Standard) & ply rating Tractor & Scraper	Turning Circle m (ft)
DW21 &	8W	51-55	225/*	11.5/15	24 790	12.37	3.53	3.28	2.13	24.0 × 29-24	10.67
No. 21 Scraper	8			**(15/20)**	**(54,650)**	**(40'7")**	**(11'7")**	**(10'9")**	**(7'0")**		**(35'0")**
DW21C &	58C	55-58	300/*	14/19	26 610	12.67	3.58	3.35	2.24	29.5 × 29-22	11.00
No. 470 Scraper	69C			**(18/25)**	**(58,670)**	**(41'7")**	**(11'9")**	**(11'0")**	**(7'4")**		**(36'0")**
DW21D &	85E	58-58	320/*	14/19	26 310	12.78	3.58	3.35	2.24	29.5 × 29-22	11.00
No. 470 Scraper	86E			**(18/25)**	**(58,010)**	**(41'11")**	**(11'9")**	**(11'0")**	**(7'4")**		**(36'0")**
DW21G &	85E	58-60	345/*	14.9/20.6	27 210	12.78	3.58	3.48	2.24	29.5 × 29-28	11.00
No. 470 Scraper	86E			**(19.5/27)**	**(59,980)**	**(41'11")**	**(11'9")**	**(11'5")**	**(7'4")**		**(36'0")**
611	6SZ	99-03	265	11	23 900	12.02	3.27	3.24	2.06	29.5R25	10.2
				(15)	**(52,640)**	**(39'5")**	**(10'9")**	**(10'8")**	**(6'9")**		**(33'5")**
613A	71M	69-76	/150	8.4	13 334	9.67	2.44	2.85	1.89	18.0 × 25-12	9.04
				(11)	**(29,395)**	**(31'9")**	**(8'0")**	**(9'4.5")**	**(6'2.5")**		**(29'8")**
613B	38W	76-84	/150	8.4	14 155	9.78	2.44	2.85	1.89	18.0 × 25-12	8.94
				(11)	**(31,210)**	**(32'1")**	**(8'0")**	**(9'4.5")**	**(6'2.5")**		**(29'4")**
613C		84-93	175	8.4	14 670	10.0	2.44	3.06	1.89	18.00-25,	8.9
				(11)	**(32,340)**	**(32'9")**	**(8'0")**	**(10'0")**	**(6'2.5")**	16 PR (E-2)	**(29'4")**
613C Series II	8LJ	93-08	175	6.8/8.4	15 264	10.14	2.44	3.01	1.80	23.5R25★	9.0
				(8.9/11)	**(33,650)**	**(33'3")**	**(8'0")**	**(9'10")**	**(5'11")**		**(29'6")**
613G	ESB	08-10	181	6.8/8.4	16 887	10.41	2.43	3.01	1.80	23.5R25★	9.0
				(8.9/11)	**(37,229)**	**(34'2")**	**(8'0")**	**(9'11")**	**(5'11")**		**(29'6")**
615	46Z	81-87	/250	12.23	23 400	11.6	3.048	3.590	2.21	26.5-25,	9.63
				(16)	**(51,590)**	**(38'1")**	**(10'0")**	**(11'8")**	**(7'3")**	26 PR (E-2)	**(31'7")**
615C		87-93	265	12.23	23 860	11.6	3.048	3.59	2.21	26.5-25,	9.63
				(16)	**(52,600)**	**(38'1")**	**(10'0")**	**(11'9")**	**(7'3")**	26 PR (E-2)	**(31'7")**
615C Series II	9XG	93-08	265	11/13	25 605	11.6	3.05	3.5	2.1	29.5R25★	10.8
				(14/17)	**(56,450)**	**(38'1")**	**(10'0")**	**(11'0")**	**(6'9")**		**(35'6")**
619B DD	89E	59-60	/225							Turbocharged, Electric start	
DD	90E									Turbocharged, Gas start	
619C PS	61F	60-66	280/250	10.8/14	21 550	11.05	3.30	3.76	2.00	26.5 × 29-22	9.14
DD	62F			**(14/18)**	**(47,500)**	**(36'3")**	**(10'11")**	**(12'2")**	**(6'7")**		**(30'0")**
619**	43F	64-65	/250	15.3/12.6	27 400	11.89	3.60	3.45	2.30	26.5 × 29-26	10.20
				(20/16.5)	**(60,390)**	**(40'0")**	**(11'10")**	**(11'4")**	**(7'7")**		**(33'6")**
621	43H	65-72	/300	10.7/15.3	28 400	12.00	3.60	3.45	2.19	29.5 × 29-22	11.50
				(14/20)	**(62,600)**	**(39'5")**	**(11'10")**	**(11'4")**	**(7'3")**		**(37'8")**
621	23H	65-74	/300	10.7/15.3	24 900	11.60	3.50	3.40	2.10	29.5 × 29-22	13.00
				(14/20)	**(55,000)**	**(38'1")**	**(11'7")**	**(11'2")**	**(6'10")**		**(42'6")**
621B	45P	73-86	/330	10.7/15.3	30 205	12.7	3.45	3.63	2.21	29.5-29,	11.10
				(14/20)	**(66,590)**	**(41'7")**	**(11'4")**	**(11'11")**	**(7'3")**	28 PR (E-3)	**(36'6")**
621E	6AB	86-93	/330	10.7/15.3	30 480	12.93	3.47	3.71	2.21	33.25-29,	10.9
	2PD			**(14/20)**	**(67,195)**	**(42'5")**	**(11'4")**	**(12'2")**	**(7'3")**	26 PR (E-3)	**(35'8")**

*Maximum HP only available.
**Johnson Manufacturing Company built the J619 Elevating Scraper for Caterpillar in 1964.

Wheel Tractor-Scrapers (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power Max/ Rated	Capacity Struck/ Heaped m³ (yd³)	Approx. Shipping Weight kg (lb)	Dimensions m (ft)				Tire Size (Standard) & ply rating Tractor & Scraper	Turning Circle m (ft)
						Length	Width	Height	Width of Tread		
621F	4SK	93-00	330	10.7/15.3 **(14/20)**	32 090 **(70,740)**	12.93 **(42'5")**	3.47 **(11'4")**	3.71 **(12'2")**	2.21 **(7'3")**	33.25-29 ★★ (E-2/E-3)	10.2 **(33'5")**
621G	ALP	00-03	330/365	10.7/15.3 **(14/20)**	32 250 **(71,090)**	12.93 **(42'5")**	3.47 **(11'4")**	3.71 **(12'2")**	2.20 **(7'3")**	33.25R29	11.7 **(38'5")**
621G	CEN	03-05	330/365	12/17 **(15.7/22)**	32 563 **(71,790)**	12.93 **(42'5")**	3.47 **(11'4")**	3.71 **(12'2")**	2.20 **(7'3")**	33.25R29	11.7 **(38'5")**
621G	DBB	05-10	330/365	12/17 **(15.7/22)**	33 995 **(74,946)**	12.88 **(42'3")**	3.58 **(11'9")**	3.71 **(12'3")**	2.23 **(7'4")** Tractor 2.20 **(7'3")** Scraper	33.25R29 ★★ (E-3)	11.7 **(38'5")**
621H	DBK EAZ	10-13	407	13/18.4 **(17.1/24)**	36 185 **(79,787)**	14.02 **(45'10")**	3.57 **(11'7")**	4.03 **(13'2")**	2.29 **(7'5")** Tractor 2.28 **(7'4")** Scraper	33.25R29 ★★ (E-3)	11.8 **(38'7")**
623	52U	72-74	/300	16.8 **(22)**	29 900 **(66,000)**	11.90 **(39'0")**	3.50 **(11'7")**	3.70 **(12'1")**	2.20 **(7'3")**	29.5 × 29-28	13.70 **(44'11")**
623B	46P	73-86	/330	16.8 **(22)**	32 546 **(71,750)**	12.5 **(41'1")**	3.55 **(11'8")**	3.81 **(12'6")**	2.18 **(7'2")**	29.5-29, 28 PR (E-2)	8.90 **(29'4")**
623E	6CB	86-89	/330	16.8 **(22)**	33 317 **(73,450)**	12.61 **(41'4")**	3.55 **(11'8")**	3.81 **(12'6")**	2.21 **(7'3")**	29.5-29, 34 PR (E-2)	10.9 **(35'9")**
623E	6YF	89-93	/365	13.8/17.6 **(18/23)**	35 290 **(77,800)**	12.61 **(41'4")**	3.55 **(11'8")**	3.94 **(12'11")**	2.18 **(7'2")**	29.5R25	10.9 **(35'8")**
623F	6BK	93-98	365	13.8/17.6 **(18/23)**	35 305 **(77,830)**	12.61 **(41'4")**	3.55 **(11'8")**	3.94 **(12'11")**	2.18 **(7'2")**	29.5-29, 34 PR (E-2)	10.9 **(35'8")**
623F Series II	5EW	98-00	365	13.8/17.6 **(18/23)**	37 122 **(81,840)**	13.28 **(43'7")**	3.55 **(11'8")**	3.55 **(11'8")**	2.21 **(7'3")**	33.25-R29 ★★ (E-2)	8.6 **(28'5")**
623G	ARW	00-02	330/365	13.8/17.6 **(18/23)**	37 120 **(81,840)**	13.21 **(43'4")**	3.55 **(11'8")**	3.68 **(12'1")**	2.2 **(7'3")**	33.25R29	10.9 **(35'8")**
623G	CES	03-05	330/365	13.8/17.6 **(18/23)**	37 120 **(81,840)**	13.21 **(43'4")**	3.55 **(11'8")**	3.68 **(12'1")**	2.2 **(7'3")**	33.25R29	10.9 **(35'8")**
623G	DBC	05-10	330/365	13.8/17.6 **(18/23)**	37 510 **(82,695)**	13.17 **(43'2")**	3.58 **(11'9")**	3.71 **(12'3")**	2.23 **(7'4")** Tractor 2.20 **(7'3")** Scraper	33.25R29 ★★ (E-3)	12.0 **(39'4")**
623H	DBF EJD	10-13	407	14.4/17.6 **(18.8/23)**	39 937 **(88,061)**	13.77 **(45'2")**	3.57 **(11'7")**	3.77 **(12'3")**	2.29 **(7'5")** Tractor 2.28 **(7'4")** Scraper	33.25R29 ★★ (E-3)	11.8 **(38'7")**

Wheel Tractor-Scrapers (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power Max/ Rated	Capacity Struck/ Heaped m³ (yd³)	Approx. Shipping Weight kg (lb)	Dimensions m (ft) Length	Width	Height	Width of Tread	Tire Size (Standard) & ply rating Tractor & Scraper	Turning Circle m (ft)
627	54K	68-74	T/225 S/225	10.7/15.3 **(14/20)**	29 900 **(66,000)**	12.00 **(36'9")**	3.50 **(11'7")**	3.60 **(11'8")**	2.20 **(7'3")**	29.5 × 29-28	13.30 **(43'9")**
627B	14S	73-86	T/225 S/225	10.7/15.3 **(14/20)**	34 610 **(76,300)**	13.3 **(43'9")**	3.45 **(11'4")**	3.63 **(11'11")**	2.18 **(7'2")**	29.5-29, 28 PR (E-3)	11.10 **(36'6")**
627E	6EB	86-90	T/225 S/225	10.7/15.3 **(14/20)**	34 670 **(76,435)**	12.89 **(42'3")**	3.47 **(11'4")**	3.71 **(12'2")**	2.21 **(7'3")** 2.18 **(7'2")**	33.25-29, 26 PR (E-3)	10.90 **(35'9")**
627E	7CG	90-93	T/330 S/225	10.7/15.3 **(14/20)**	35 160 **(77,500)**	12.93 **(42'5")**	3.47 **(11'4")**	3.71 **(12'2")**	2.21 **(7'3")**	33.25-29, 26 PR (E-3)	10.9 **(35'8")**
627F Series II	1DL	93-00	T/330 S/225	10.7/15.3 **(14/20)**	37 060 **(81,640)**	12.9 **(42'5")**	3.47 **(11'4")**	3.71 **(12'2")**	2.21 **(7'3")**	33.25-R29 ★★ (E-2/E-3)	10.9 **(35'9")**
627B/PP	15S	73-86	T/225 S/225	10.7/15.3 **(14/20)**	35 660 **(78,620)**	14.91 **(48'11")**	3.45 **(11'4")**	3.63 **(11'11")**	2.18 **(7'2")**	29.5-29, 28 PR (E-3)	11.1 **(36'6")**
627E/PP	6GB	86-89	T/225 S/225	10.7/15.3 **(14/20)**	36 130 **(79,655)**	12.89 **(42'3")**	3.47 **(11'4")**	3.71 **(12'2")**	2.21 **(7'3")** 2.18 **(7'2")**	33.25-29, 26 PR (E-3)	10.90 **(35'9")**
627E/PP	7CG	90-93	T/330 S/225	10.7/15.3 **(14/20)**	36 620 **(80,735)**	15.2 **(49'7")**	3.47 **(11'4")**	3.71 **(12'2")**	2.21 **(7'3")**	33.25-29, 26 PR (E-3)	10.9 **(35'8")**
627F/PP Series II	1DL	93-00	T/330 S/225	10.7/15.3 **(14/20)**	38 103 **(84,000)**	15.2 **(49'7")**	3.47 **(11'4")**	3.71 **(12'2")**	2.21 **(7'3")**	33.25-R29 ★★ (E-2/E-3)	10.9 **(35'9")**
627G/PP	AXF	00-02	T/330/365 S/225	10.7/15.3 **(14/20)**	38 140 **(84,075)**	15.2 **(49'7")**	3.47 **(11'4")**	3.71 **(12'2")**	2.20 **(7'3")**	33.25R29	11.7 **(38'5")**
627G/PP	CEX	02-05	T/330/365 S/225/249	12/17 **(15.7/22)**	39 186 **(86,390)**	15.2 **(49'7")**	3.47 **(11'4")**	3.71 **(12'2")**	2.20 **(7'3")**	33.25R29	11.7 **(38'5")**
627G P/P	DBD	05-10	T/330/365 S/239/266	12/17 **(15.7/22)**	39 443 **(86,957)**	15.2 **(49'7")**	3.58 **(11'9")**	3.81 **(12'6")**	2.23 **(7'4")** Tractor 2.20 **(7'3")** Scraper	33.25R29 ★★ (E-3)	11.7 **(38'5")**
627H	DBW LCT	10-13	T/407 S/290	13/18.4 **17.1/24**	26 127 **(90,213)**	14.02 **(45'10")**	3.57 **(11'7")**	4.03 **(13'2")**	2.29 **(7'5")** Tractor 2.28 **(7'4")** Scraper	33.25R29 ★★ (E-3)	11.8 **(38'7")**
630A & 482C Scraper	52F	60-62	420/335	21/27 **(27/35)**	35 830 **(79,000)**	14.63 **(48'0")**	3.91 **(12'10")**	4.01 **(13'2")**	2.39 **(7'10")** Scraper	16.0 × 25-16 29.5 × 35-28 33.5 × 33-26	11.89 **(39'0")**
630A	52F	60-62	420/335	16/21.4 **(21/28)**	31 430 **(69,300)**	13.82 **(45'4")**	3.58 **(11'9")**	3.73 **(12'3")**	2.21 **(7'3")**	16.0 × 25-16 29.5 × 35-28	11.89 **(39'0")**
630B	14G	62-63	420/335	16/23 **(21/30)**	33 520 **(73,900)**	14.12 **(46'4")**	3.81 **(12'6")**	3.71 **(12'2")**	2.41 **(7'11")**	16.0-25, 16 29.5-35, 28	13.36 **(43'10")**
630B	14G	63-66	400/360	16/23 **(21/30)**	33 570 **(74,000)**	14.30 **(46'11")**	3.81 **(12'6")**	3.94 **(12'11")**	2.41 **(7'11")**	16.0-25, 16 29.5-35, 34	13.36 **(43'10")**
630B	10G	62-69	/400	16/23 **(21/30)**	35 750 **(78,800)**	14.35 **(47'1")**	3.81 **(12'6")**	3.94 **(12'11")**	2.40 **(7'10")**	16.0-25, 16 29.5-35, 34	13.36 **(43'10")**

T — Tractor Engines
S — Scraper Engines

Wheel Tractor-Scrapers (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power Max/ Rated	Capacity Struck/ Heaped m^3 (yd^3)	Approx. Shipping Weight kg (lb)	Dimensions m (ft)				Tire Size (Standard) & ply rating Tractor & Scraper	Turning Circle m (ft)
						Length	Width	Height	Width of Tread		
631A	51F	60-62	420/335	16/21.4	30 250	12.88	3.58	3.56	2.21	29.5-35, 28	11.00
				(21/28)	**(66,700)**	**(42'3")**	**(11'9")**	**(11'8")**	**(7'3")**		**(36'0")**
631B	13G	62-62	420/335	16/23	31 620	13.05	3.81	3.45	2.39	29.5-35, 28	11.31
				(21/30)	**(69,700)**	**(42'10")**	**(12'6")**	**(11'5")**	**(7'10")**		**(37'5")**
631B	13G	62-66	420/360	16/23	31 840	13.29	3.81	3.63	2.41	29.5-35, 34	11.31
				(21/30)	**(70,200)**	**(43'7")**	**(12'6")**	**(11'11")**	**(7'11")**		**(37'5")**
631C	67M	69-75	/415	16/23	36 350	13.54	3.45	3.91	2.39	29.5-35, 34	11.45
				(21/30)	**(80,150)**	**(44'5")**	**(11'4")**	**(12'10")**	**(7'10")**		**(37'7")**
631D	24W	75-85	473/450	16/23.7	42 370	14.25	3.96	4.17	2.46	33.25-35,	12.2
				(21/31)	**(93,410)**	**(46'9")**	**(13'0")**	**(13'8")**	**(8'1")**	38 PR (E-3)	**(40'1")**
631E	1AB	85-91	473/450	16.1/23.7	43 365	14.28	3.94	4.29	2.46	37.25-35, 30	12.2
				(21/31)	**(95,600)**	**(46'10")**	**(12'11")**	**(14'1")**	**(8'1")**		**(40'1")**
631E Series II	1AB	91-01	473/450	16.1/23.7	44 210	14.56	3.94	4.29	2.46	37.25R35	12.2
				(21/31)	**(97,460)**	**(47'9")**	**(12'11")**	**(14'1")**	**(8'1")**		**(40'1")**
631G	AWK	00-02	450/485	16.1/23.7	46 475	14.56	3.94	4.29	2.46	37.25R35	12.2
				(21/31)	**(102,460)**	**(47'9")**	**(12'11")**	**(14'1")**	**(8'1")**		**(40'1")**
631G	CLR	03-05	450/485	18.3/26	46 475	14.56	3.94	4.29	2.46	37.25R35	12.2
				(24/34)	**(102,460)**	**(47'9")**	**(12'11")**	**(14'1")**	**(8'1")**		**(40'1")**
631G	DFA	05-16	462/500	18.3/26	47 628	14.71	3.94	4.29	2.46	37.25R35	12.2
				(24/34)	**(105,002)**	**(48'3")**	**(12'11")**	**(14'1")**	**(8'1")**		**(40'1")**
632	14G	62-63	420/335	21.4/29	37 650	15.21	4.04	4.00	2.44	16.0-25, 16	13.36
				(28/38)	**(83,000)**	**(49'11")**	**(13'3")**	**(13'1")**	**(8'0")**	29.5-35, 34	**(43'10")**
632	14G	63-66	420/360	21.4/29	39 420	15.30	4.04	4.00	2.44	16.0-25, 16	13.36
				(28/38)	**(86,910)**	**(50'2")**	**(13'3")**	**(13'1")**	**(8'0")**	29.5-35, 34	**(43'10")**
633C	66M	69-75	/415	24.5	41 750	13.36	3.45	3.96	2.39	33.2-35, 32	11.78
				(32)	**(92,050)**	**(43'10")**	**(11'4")**	**(13'0")**	**(7'10")**		**(38'8")**
633D	25W	75-85	450	17.7/23	47 570	14.40	3.96	4.24	2.46	33.25-35,	12.4
				(23/34)	**(104,870)**	**(47'3")**	**(13'0")**	**(13'11")**	**(8'1")**	38 PR (E-3)	**(40'7")**
633E	1AB	92-96	475	17.7/23	50 800	14.40	3.96	4.24	2.46		13.15
				(23/34)	**(112,000)**	**(47'3")**	**(13'0")**	**(13'11")**	**(8'1")**	37.25R35	**(43'2")**
633E Series II	2PS	96-00	490	17.7/23	51 100	14.8	3.96	4.24	2.46	37.25R35	13.15
				(23/34)	**(112,670)**	**(48'7")**	**(13'0")**	**(13'11")**	**(8'1")**		**(43'2")**

Wheel Tractor-Scrapers (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power Max/ Rated	Capacity Struck/ Heaped m^3 (yd^3)	Approx. Shipping Weight kg (lb)	Dimensions m (ft) Length	Width	Height	Width of Tread	Tire Size (Standard) & ply rating Tractor & Scraper	Turning Circle m (ft)
637	65M	70-75	T/415 S/225	16/23 **(21/30)**	41 300 **(91,050)**	13.65 **(44'9.5")**	3.45 **(11'4")**	3.93 **(12'11")**	2.39 **(7'10")**	33.25-35, 32	11.68 **(38'4")**
637/PP	79P	70-75	T/415 S/225	16/23 **(21/30)**	43 700 **(96,350)**	15.82 **(51'11")**	3.45 **(11'4")**	3.93 **(12'11")**	2.39 **(7'10")**	33.25-35, 32	11.68 **(38'4")**
637D	26W	75-85	T/450 S/250	16/23 **(21/31)**	46 987 **(103,590)**	14.8 **(48'8")**	3.96 **(13'0")**	4.17 **(13'8")**	2.46 **(8'1")**	33.25-35, 38 PR (E-3)	12.2 **(40'1")**
637D/PP	27W	75-85	T/450 S/250	16/23 **(21/31)**	48 531 **(106,990)**	14.8 **(48'8")**	3.96 **(13'0")**	4.17 **(13'8")**	2.46 **(8'1")**	33.25-35, 38 PR (E-3)	12.2 **(40'1")**
637E	1FB	85-91	T/450 S/250	16/23 **(21/31)**	49 940 **(110,100)**	14.28 **(46'10")**	3.94 **(12'11")**	4.29 **(14'1")**	2.46 **(8'1")**	37.25-35, 30	12.2 **(40'1")**
637E Series II	1FB	91-01	T/450 S/250	16/23 **(21/31)**	50 990 **(112,320)**	14.56 **(47'9")**	3.94 **(12'11")**	4.29 **(14'1")**	2.46 **(8'1")**	37.25R35	12.2 **(40'1")**
637E/PP	1FB	85-91	T/450 S/250	16/23 **(21/31)**	51 485 **(113,500)**	15.88 **(52'1")**	3.94 **(12'11")**	4.29 **(14'1")**	2.46 **(8'1")**	37.25-35, 30	12.2 **(40'1")**
637E Series II/PP	1FB	91-01	T/450 S/250	16/23 **(21/31)**	52 385 **(115,490)**	16.49 **(54'1")**	3.94 **(12'11")**	4.29 **(14'1")**	2.46 **(8'1")**	37.25R35	12.2 **(40'1")**
637G/PP	AXT	00-02	T/450/485 S/249	16.1/23.7 **(21/31)**	53 590 **(118,150)**	16.49 **(54'1")**	3.94 **(12'11")**	4.29 **(14'1")**	2.46 **(8'1")**	37.25R35	12.2 **(40'1")**
637G/PP	CEH	02-05	T/450/485 S/249/274	18.3/26 **(24/34)**	53 562 **(118,084)**	16.49 **(54'1")**	3.94 **(12'11")**	4.29 **(14'1")**	2.46 **(8'1")**	37.25R35	12.2 **(40'1")**
637G/PP	DFJ	06-16	T/462/500 S/266/283	18.3/26 **(24/34)**	54 005 **(119,060)**	16.64 **(54'7")**	3.94 **(12'11")**	4.29 **(14'1")**	2.46 **(8'1")**	37.25R35	12.2 **(40'1")**
639D	99X	79-84	T/450 S/250	26 **(34)**	55 030 **(121,318)**	14.53 **(47'8")**	3.96 **(13'0")**	4.06 **(13'4")**	2.46 **(8'1")**	37.25-35, 42 37.25-35, 42	12.4 **(40'7")**
641	64F	62-65	560/450	21.4/29 **(28/38)**	43 200 **(95,300)**	14.73 **(48'4")**	4.04 **(13'3")**	4.00 **(13'1")**	2.44 **(8'0")**	33.5-39, 38	12.68 **(41'7")**
641B	65K	69-81	/550	21.4/29 **(28/38)**	53 070 **(117,000)**	14.96 **(49'1")**	4.04 **(13'3")**	4.24 **(13'11")**	2.55 **(8'4")**	37.5-39, 36	13.00 **(42'9")**
650	63F	62-64	560/450	24.5/33.6 **(32/44)**	45 130 **(99,500)**	16.31 **(53'6")**	4.24 **(13'11")**	4.01 **(13'2")**	2.54 **(8'4")S**	18.0-25, 20 33.5-39, 32 37.5-39, 36	13.87 **(45'6")**
650B	22G	62-72	/550	24.5/33.6 **(32/44)**	46 100 **(101,700)**	17.00 **(55'10")**	3.80 **(12'6")**	4.30 **(14'1")**	2.65 **(8'9")S**	18.0-25, 20 37.5-39, 28 37.5-30, 36	14.00 **(46'0")**

T — Tractor Engines
S — Scraper Engines

Wheel Tractor-Scrapers (cont'd)

Model	Product Ident. No. Prefix	Years Built	Horse-power Max/ Rated	Capacity Struck/ Heaped m^3 (yd^3)	Approx. Shipping Weight kg (lb)	Dimensions m (ft)				Tire Size (Standard) & ply rating Tractor & Scraper	Turning Circle m (ft)
						Length	Width	Height	Width of Tread		
651	33G	62-68	560/450	24.5/33.6	43 730	14.93	4.24	4.01	2.54	37.5-39, 36	13.29
				(32/44)	**(96,400)**	**(49'0")**	**(13'11")**	**(13'2")**	**(8'4")**		**(43'7")**
651B	67K	69-84	/550	24.5/33.6	56 340	15.34	4.32	4.29	2.72	37.5-39, 36	13.5
				(32/44)	**(124,200)**	**(51'4")**	**(14'2")**	**(14'1")**	**(8'11")S**	37.5-39, 36	**(44'2")**
651E	89Z	82-96	550	24.5/33.6	59 420	16.13	4.37	4.7	2.64	37.5R39	14.5
				(32/44)	**(131,000)**	**(52'11")**	**(14'4")**	**(15'5")**	**(8'8")**		**(47'7")**
651E	4YR	96-06	550/605	24.5/33.6	61 126	16.18	4.37	4.7	2.64	40.5/75R39	15.1
				(32/44)	**(134,760)**	**(53'1")**	**(14'4")**	**(15'5")**	**(8'8")**		**(49'8")**
657	31G	62-68	T/450	24.5/33.6	56 550	15.39	4.24	4.09	2.62	37.5-39, 44	13.29
			S/335	**(32/44)**	**(124,700)**	**(50'6")**	**(13'11")**	**(13'5")**	**(8'7")**		**(43'7")**
657	46M	68-69	T/500	24.5/33.6	56 820	15.39	4.24	4.09	2.67	37.5-39, 44	14.57
			S/400	**(32/44)**	**(125,155)**	**(50'6")**	**(13'11")**	**(13'5")**	**(8'8")**		**(47'10")**
657B	68K	69-84	T/550	24.5/33.6	63 100	15.7	4.32	4.21	2.67	37.5-39, 44	13.7
			S/400	**(32/44)**	**(139,100)**	**(51'8")**	**(14'2")**	**(13'10")**	**(8'9")S**	37.5-39, 44	**(45'1")**
657E	90Z	82-95	T/550	24.5/33.6	68 720	17	4.37	4.7	2.64	37.5R39	14.5
			S/400	**(32/44)**	**(151,500)**	**(55'10")**	**(14'4")**	**(15'5")**	**(8'8")**		**(47'7")**
657E	6TR	96-06	T/550/605	24.5/33.6	69 078	16.2	4.37	4.7	2.64	40.5/75R39	15.1
			S/400/440	**(32/44)**	**(152,290)**	**(53'1")**	**(14'4")**	**(15'5")**	**(8'8")**		**(49'8")**
657E/PP	91Z	82-95	T/550	24.5/33.6	72 120	18.01	4.37	4.7	2.64	37.5R39	14.5
			S/400	**(32/44)**	**(159,000)**	**(59'1")**	**(14'4")**	**(15'5")**	**(8'8")**		**(47'7")**
657E/PP	5YR	96-06	T/550/605	24.5/33.6	72 857	18.01	4.37	4.7	2.64	40.5/75R39	15.1
			S/400/440	**(32/44)**	**(160,623)**	**(59'1")**	**(14'4")**	**(15'5")**	**(8'8")**		**(49'8")**
660	90F	62-64	560/450	30.6/41.3	49 130	17.04	4.24	4.37	2.59	18.0 × 25-20	13.87
				(40/54)	**(108,300)**	**(55'11")**	**(13'11")**	**(14'4")**	**(8'6")**	37.5 × 39-28	**(45'6")**
									Scraper	37.5 × 51-36	
660B	58K	70-78	/550	30.6/41.3	59 875	17.27	3.81	4.37		18.0 × 25-20	14.00
				(40/54)	**(132,000)**	**(56'8")**	**(14'2")**	**(14'4")**		37.5 × 39-28	**(46'0")**
666	77F	63-69	T/450	30.6/41.3	56 700	17.04	4.24	4.37	2.59	18.0 × 25-20	13.87
			S/335	**(40/54)**	**(125,000)**	**(55'11")**	**(13'11")**	**(14'4")**	**(8'6")**	37.5 × 39-28	**(45'6")**
									Scraper	37.5 × 51-36	
666	64H	67-69	T/500	30.6/41.3	58 800	17.27	4.24	4.37	2.59	18.0 × 25-20	13.87
			S/400	**(40/54)**	**(129,645)**	**(56'8")**	**(13'11")**	**(14'4")**	**(8'6")**	37.5 × 39-28	**(45'6")**
									Scraper	37.5 × 51-51	
666B	66K	69-78	T/550	30.6/41.3	67 630	17.27	4.31	4.37	2.59	18.0 × 25-20	14.00
			S/400	**(40/54)**	**(149,500)**	**(56'8")**	**(14'4")**	**(14'4")**	**(8'9")**	37.5 × 39-28	**(46'0")**

T — Tractor Engines
S — Scraper Engines

TRACTOR-TOWED SCRAPERS

Model	Product Ident. No. Prefix	Years Built	Capacity Struck/ Heaped m³ (yd³)	Weight kg (lb)	Width m (ft)	Length m (ft)	Height m (ft)	Width of Cut m (ft)
40	1W	49-59	2.8/3.4 **(3.6/4.5)**	3348 **(7380)**	2.27 **(7'6")**	6.40 **(21'0")**	1.68 **(5'6")**	1.82 **(6'0")**
60	1D	47-53	4.6/6.1 **(6.0/8.0)**	5579 **(12,300)**	2.65 **(8'9")**	8.43 **(27'8")**	2.36 **(7'9")**	2.13 **(7'0")**
60	2W	52-72	5.4/7.0 **(7.0/9.0)**	6100 **(13,500)**	2.85 **(9'5")**	8.52 **(28'3")**	2.36 **(7'9")**	2.40 **(7'11")**
70	8C	46-53	6.7/8.4 **(8.7/11.0)**	8527 **(18,800)**	3.02 **(10'0")**	9.50 **(31'2")**	2.56 **(8'5")**	2.43 **(8'0")**
70	3W	51-57	7.8/9.9 **(10.2/13.0)**	9140 **(20,150)**	3.16 **(10'5")**	9.53 **(31'4")**	2.61 **(8'7")**	2.59 **(8'6")**
80	2D	46-52	10.3/13.8 **(13.5/18.0)**	11 793 **(26,000)**	3.38 **(11'2")**	10.82 **(35'6")**	2.92 **(9'7")**	2.74 **(9'0")**
80	5W	50-56	11.5/15.3 **(15.0/20.0)**	13 533 **(29,836)**	3.50 **(11'6")**	10.92 **(35'0")**	3.09 **(10'2")**	2.89 **(9'6")**
90	9V	51-55	16.2/20.6 **(21.2/27.0)**	17 208 **(37,937)**	3.65 **(12'0")**	12.19 **(40'0")**	3.20 **(10'6")**	3.04 **(10'0")**
435C	45D	56-61	9.9/13.8 **(13.0/18.0)**	10 659 **(23,500)**	3.28 **(10'10")**	10.16 **(33'4")**	3.01 **(9'11")**	2.84 **(9'4")**
435D	45D	59-61	11.5/14.5 **(15.0/19.0)**	11 521 **(25,400)**	3.29 **(10'10")**	10.16 **(33'4")**	3.01 **(9'11")**	2.84 **(9'4")**
435E	85F	61-72	9.2/13.0 **(12.0/17.0)**	10 400 **(22,900)**	3.29 **(10'10")**	10.06 **(33'1")**	3.07 **(10'1")**	2.84 **(9'4")**
435F	45D	62-72	10.7/13.8 **(14.0/18.0)**	11 300 **(24,900)**	3.29 **(10'10")**	10.06 **(33'1")**	3.02 **(9'11")**	2.84 **(9'4")**
435G	27G	63-73	9.2/13.0 **(12.0/17.0)**	10 400 **(22,900)**	3.27 **(10'9")**	10.08 **(33'1")**	2.97 **(9'9")**	2.84 **(9'4")**
463	62C	55-60	13.8/29.1 **(18.0/25.0)**	14 061 **(31,000)**	3.58 **(11'9")**	11.58 **(38'0")**	3.39 **(11'2")**	3.15 **(10'4")**
463C	62C	59-60	16.8/21.4 **(22.0/28.0)**	15 785 **(34,800)**	3.58 **(11'9")**	11.58 **(38'0")**	3.39 **(11'2")**	3.15 **(10'4")**
463E	86F	60-71	13.8/20.0 **(18.0/26.0)**	15 600 **(34,400)**	3.58 **(11'9")**	11.65 **(38'3")**	3.28 **(10'10")**	3.15 **(10'4")**
463F	62C	63-71	16.0/21.4 **(21.0/28.0)**	15 700 **(34,600)**	3.58 **(11'9")**	11.65 **(38'3")**	3.28 **(10'10")**	3.15 **(10'4")**
463G	28G	63-71	13.8/20.0 **(18.0/26.0)**	13 200 **(29,200)**	3.58 **(11'9")**	11.52 **(37'10")**	3.14 **(10'4")**	3.15 **(10'4")**
491	98C	56-64	20.6/26.0 **(27.0/34.0)**	16 964 **(37,400)**	3.65 **(12'0")**	12.13 **(39'10")**	3.96 **(13'0")**	3.16 **(10'5")**
491B	9A	61-63	20.6/26.8 **(27.0/35.0)**	20 902 **(46,060)**	3.91 **(12'10")**	12.49 **(41'0")**	3.96 **(13'0")**	3.30 **(10'10")**
491C	47E	63-70	20.6/26.8 **(27.0/35.0)**	21 600 **(47,500)**	3.91 **(12'10")**	12.64 **(41'6")**	3.96 **(13'0")**	3.30 **(10'10")**
TS180 Lead	E1J	09-13	11/14.5 **(14.4/19)**	11 748 **(25,900)**	3.378 **(11.08)**	8.915 **(29.25)**	2.362 **(7.75)**	3.2 **(10.5)**
TS180 Trail	E1K	09-13	11/14.5 **(14.4/19)**	12 748) **(25,900)**	3.378 **(11.08)**	8.915 **(29.25)**	2.362 **(7.75)**	3.2 **(10.5)**
TS185 Lead	E1R	09-13	11/14.5 **(14.4/19)**	11 748 **(25,900)**	3.988 **(13.08)**	9.119 **(29.92)**	2.515 **(8.25)**	3.785 **(12.4)**
TS185 Trail	E1S	09-13	11/14.5 **(14.4/19)**	12 748 **(25,900)**	3.988 **(13.08)**	9.119 **(29.92)**	2.515 **(8.25)**	3.785 **(12.4)**
TS220 Lead	E1L	09-13	13/18 **(17/23.5)**	13 145 **(28,980)**	3.683 **(12.08)**	9.677 **(31.75)**	2.464 **(8.08)**	3.480 **(11.4)**
TS220 Trail	E1N	09-13	13/18 **(17/23.5)**	14 145 **(28,980)**	3.683 **(12.08)**	9.677 **(31.75)**	2.464 **(8.08)**	3.480 **(11.4)**
TS225 Lead	E1T	09-13	13/18 **(17/23.5)**	15 250 **(33,620)**	3.988 **(13.08)**	10.287 **(33.75)**	2.515 **(8.25)**	3.785 **(12.4)**
TS225 Trail	E1W	09-13	13/18 **(17/23.5)**	16 250 **(33,620)**	3.988 **(13.08)**	10.287 **(33.75)**	2.515 **(8.25)**	3.785 **(12.4)**

MINING & OFF-HIGHWAY TRUCKS/TRACTORS

						Dimensions m (ft)						
Model	Product Ident. No. Prefix	Years Built	Flywheel Kilowatts (Horse-power)	Capacity Metric Tons (U.S. Tons)	Approx. Weight kg (lb)	Width	Length	Height	Loading Height	Dumping Height (55°)	Turning Circle	Tire Size
768B	79S	71-78	309	—	22 000	3.61	6.55	3.48	—	—	18.0	18.00 × 33—24 PR
			(415)	**—**	**(48,500)**	**(11'10")**	**(21'6")**	**(11'5")**	**—**	**—**	**(59'1")**	
768C	02X	78-95	336	—	24 624	4.70	8.00	3.56	—	—	18.5	18.00R33 E-4
			(450)	**—**	**(54,285)**	**(15'5")**	**(26'3")**	**(11'8")**	**—**	**—**	**(60'8")**	
769	99F	62-67	298	31.8	25 365	3.63	7.64	4.05	3.07	7.18	16.5	18.00 × 25—32 PR
			(400)	**(35.0)**	**(55,870)**	**(11'11")**	**(25'1")**	**(13'4")**	**(10'1")**	**(26'7")**	**(54'5")**	
769B	99F	67-78	309	32.0	28 000	3.64	7.85	3.89	3.15	7.24	18.0	18.00 × 25—32 PR
			(415)	**(35.0)**	**(61,800)**	**(11'11.5")**	**(25'9")**	**(12'9")**	**(10'4")**	**(23'9")**	**(59'1")**	E-3
769C	01X	78-95	336	36.9	30 675	4.70	8.00	3.85	3.24	7.68	18.5	18.00R33 E-4
			(450)	**(40.6)**	**(67,855)**	**(15'5")**	**(26'3")**	**(12'8")**	**(10'7")**	**(25'2")**	**(60'8")**	
769D	5TR, 5SS,	95-06	363	36.4	33 875	5.07	8.24	4.03	3.14	7.71	17	18.00R33
	BBB		**(487)**	**(40.0)**	**(74,682)**	**(16'8")**	**(27'0")**	**(13'3")**	**(10'4")**	**(25'4")**	**(55'9")**	
770	BZZ	07-14	355	36.5	34 642	4.75	8.74	4.14	3.12	8.28	20.2	18.00R33 (E-4)
			(476)	**(40.3)**	**(76,372)**	**(15'8")**	**(28'9")**	**(13'7")**	**(10'3")**	**(27'2")**	**(66'3")**	
771C	3BJ	92-95	336	40.0	34 170	4.74	8.20	4.00	3.30	7.68	18.5	18.00R33 E-4
			(450)	**(44.0)**	**(75,345)**	**(15'7")**	**(26'11")**	**(13'1")**	**(10'10")**	**(25'2")**	**(60'8")**	
771D	6JR, 6YS,	96-06	363	41	33 784	5.07	8.40	4.02	3.40	7.74	17	18.00R33
	BCA		**(487)**	**(45)**	**(74,482)**	**(16'8")**	**(27'7")**	**(13'2")**	**(11'1")**	**(25'5")**	**(55'9")**	
772	RLB	07-14	399	46.2	35 864	4.75	8.74	4.22	3.50	8.36	21.6	21.00R33 (E-4)
			(535)	**(51.0)**	**(79,066)**	**(15'8")**	**(28'9")**	**(13'10")**	**(11'6")**	**(27'5")**	**(70'10")**	
772	80S	71-78	447	—	32 100	4.06	7.11	3.68	—	—	22.1	24.00 × 35—36 PR
			(600)	**—**	**(70,800)**	**(13'4")**	**(23'4")**	**(12'1")**	**—**	**—**	**(72'6")**	
772B	64W	78-95	485	—	32 909	4.86	9.12	4.52	—	—	23.5	24.00R35 E-4
			(650)	**—**	**(72,550)**	**(15'11")**	**(29'11")**	**(14'10")**	**—**	**—**	**(77'0")**	
773	63G	70-78	447	45.4	37 800	4.06	8.71	4.27	3.61	8.36	22.1	21.00 × 35—32 PR
			(600)	**(50.0)**	**(83,360)**	**(13'4")**	**(28'7")**	**(14'0")**	**(11'10")**	**(27'5")**	**(72'6")**	E-3
773B	63W	78-95	485	54.3	38 321	4.86	9.12	4.31	3.77	8.72	23.5	24.00R35 E-4
			(650)	**(59.8)**	**(84,500)**	**(15'11")**	**(29'11")**	**(14'2")**	**(12'5")**	**(28'7")**	**(77'0")**	
773D	7CS, 7ER	96-01	485	52.9	43 600	5.08	9.21	4.42	3.79	8.82	22.0	24.00R35
			(650)	**(58.4)**	**(96,000)**	**(16'8")**	**(29'11")**	**(14'6")**	**(12'5")**	**(28'11")**	**(72'2")**	
773E	BDA (U.S.)	01-06	501	54.4	45 480	5.08	9.21	4.42	3.79	8.82	22.0	24.00R35
			(671)	**(60.0)**	**(100,180)**	**(16'8")**	**(29'11")**	**(14'6")**	**(12'5")**	**(28'11")**	**(72'2")**	
773E	ASK (India)	09-16	501	54.4	45 480	5.08	9.21	4.42	3.79	8.82	22.0	24.00R35
			(671)	**(60.0)**	**(100,180)**	**(16'8")**	**(29'11")**	**(14'6")**	**(12'5")**	**(28'11")**	**(72'2")**	
773F	EED, EXD	06-11	524	54.4	45 069	5.43	10.33	4.44	3.77	9.26	26.1	24.00R35 (E-4)
			(703)	**(60.0)**	**(99,360)**	**(17'10")**	**(33'11")**	**(14'7")**	**(12'5")**	**(30'5")**	**(85'8")**	
775B	7XJ	92-95	485	59.5	42 324	4.91	9.33	4.31	3.86	8.72	23.5	24.00R35 E-4
			(650)	**(65.5)**	**(93,325)**	**(16'2")**	**(30'7")**	**(14'2")**	**(12'8")**	**(28'8")**	**(77'7")**	
775D	6KR, 8AS	95-01	517	63.4	43 200	5.08	9.30	4.42	3.91	8.82	22.0	24.00R35
			(693)	**(69.9)**	**(95,300)**	**(16'8")**	**(30'6")**	**(14'6")**	**(12'10")**	**(28'11")**	**(72'2")**	
775E	BEC	01-06	544	63.5	43 470	5.08	9.21	4.42	3.91	8.82	22.0	24.00R35
			(730)	**(70.0)**	**(95,810)**	**(16'8")**	**(29'11")**	**(14'6")**	**(12'10")**	**(28'11")**	**(72'2")**	
775F	DLS, EYG	06-11	552	63.5	45 620	5.43	10.33	4.44	3.97	9.26	26.1	24.00R35 (E-4)
			(740)	**(70.0)**	**(100,575)**	**(17'10")**	**(33'11")**	**(14'7")**	**(13'0")**	**(30'5")**	**(85'8")**	

Mining & Off-Highway Trucks/Tractors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Kilowatts (Horse-power)	Capacity Metric Tons (U.S. Tons)	Approx. Weight kg (lb)	Dimensions m (ft)						Tire Size
						Width	Length	Height	Loading Height	Dumping Height (55°)	Turning Circle	
776	14H	75-84	649	—	49 686	3.51	8.06	3.40	—	—	26.8	27.00 × 49—36 PR
			(870)	**—**	**(109,540)**	**(11'6")**	**(26'5.5")**	**(11'2")**	**—**	**—**	**(88'0")**	E-3
776B	6JC	84-92	649	—	49 896	3.51	8.06	3.40	—	—	25.8	27.00 × 49—36 PR
			(870)	**—**	**(110,000)**	**(11'6")**	**(26'6")**	**(11'2")**	**—**	**—**	**(84'6")**	E-3
776C	2TK	92-96	649	—	49 896	3.51	8.06	4.55	—	—	25.8	27.00R49
			(870)	**—**	**(110,000)**	**(11'6")**	**(26'5.5")**	**(14'11")**	**—**	**—**	**(84'6")**	
777	84A	74-84	649	77.1	58 886	5.463	9.78	4.90	4.14	9.29	26.8	24.00 × 49—42 PR
			(870)	**(85.0)**	**(129,820)**	**(17'11")**	**(32'1")**	**(16'1")**	**(13'7")**	**(30'6")**	**(88'0")**	E-3
777B	4YC	84-92	649	86.2	60 055	5.463	9.79	4.97	4.17	9.42	25.8	24.00 × 49—48 PR
			(870)	**(95.0)**	**(132,422)**	**(17'11")**	**(32'1")**	**(16'4")**	**(13'8")**	**(30'11")**	**(84'6")**	E-3
777C	4XJ	92-96	649	86.2	61 790	5.463	9.79	4.97	4.17	9.42	25.8	27.00R49
			(870)	**(95.0)**	**(136,227)**	**(17'11")**	**(32'1")**	**(16'4")**	**(13'8")**	**(30'11")**	**(84'6")**	
777D	3PR, AGC	96-06	699	90.9	72 575	6.11	9.78	5.15	4.38	10.06	25.3	27.00R49
(Decatur)	(U.S.)		**(938)**	**(100.0)**	**(160,000)**	**(20'0")**	**(32'1")**	**(16'10")**	**(14'4")**	**(33'0")**	**(83'0")**	
777D	FKR	06-16	699	90.9	72 575	6.11	9.78	5.15	4.38	10.06	25.3	27.00R49
(Decatur)	(India)		**(938)**	**(100.0)**	**(160,000)**	**(20'0")**	**(32'1")**	**(16'10")**	**(14'4")**	**(33'0")**	**(83'0")**	
777F	JRP, JXP	06-11	700	90.9	72 739	6.49	10.54	5.17	4.38	10.33	28.4	27.00R49 (E4)
			(938)	**(100.0)**	**(160,360)**	**(21'4")**	**(34'7")**	**(17'0")**	**(14'4")**	**(33'11")**	**(93'2")**	
784B	5RK	93-98	962	—	89 280	6.74	9.34	5.47	—	—	33.5	36.00R51 E-3
			(1290)	**—**	**(196,825)**	**(22'2")**	**(30'8")**	**(17'1")**	**—**	**—**	**(109'10")**	
784C	2PZ	98-09	1005	—	88 746	7.00	9.34	5.47	—	—	33.8	36.00R51
			(1348)	**—**	**(195,651)**	**(23'0")**	**(30'8")**	**(17'1")**	**—**	**—**	**(110'11")**	
785	8GB	85-92	962	136.0	96 353	6.64	11.02	5.77	4.98	11.20	30.5	33.00 × 51
			(1290)	**(150.0)**	**(212,458)**	**(21'9")**	**(36'2")**	**(18'11")**	**(16'4")**	**(36'9")**	**(100'4")**	
785B	6HK	92-98	962	136.0	96 353	6.64	11.02	5.77	4.98	11.20	30.2	33.00R51
			(1290)	**(150.0)**	**(212,458)**	**(21'9")**	**(36'2")**	**(18'11")**	**(16'4")**	**(36'9")**	**(99'2")**	
789	9ZC	86-92	1272	177.0	121 922	7.67	12.18	6.15	5.21	11.91	30.2	37.00R57
			(1705)	**(195.0)**	**(268,837)**	**(25'2")**	**(39'11")**	**(20'2")**	**(17'1")**	**(39'1")**	**(99'2")**	
789B	7EK	92-98	1272	177.0	121 922	7.67	12.18	6.15	5.21	11.91	30.2	37.00R57
			(1705)	**(195.0)**	**(268,837)**	**(25'2")**	**(39'11")**	**(20'2")**	**(17'1")**	**(39'1")**	**(99'2")**	
789C	2BW	98-12	1417	180.7	132 845	7.67	12.18	6.15	5.21	11.90	30.2	37.00R57
			(1900)	**(199.2)**	**(292,873)**	**(25'2")**	**(39'11")**	**(20'2")**	**(17'1")**	**(39'1")**	**(99'2")**	
793	3SJ	90-92	1534	218.0	376 482	7.60	12.86	6.43	5.86	13.21	30.2	40.00-57
			(2057)	**(240.0)**	**(830,000)**	**(24'11")**	**(42'3")**	**(21'1")**	**(19'3")**	**(43'4")**	**(99'2")**	
793B	1HL	92-96	1534	218.0	376 482	7.60	12.86	6.43	5.86	13.21	30.2	40.00R57
			(2057)	**(240.0)**	**(830,000)**	**(24'11")**	**(42'3")**	**(21'1")**	**(19'3")**	**(43'4")**	**(99'2")**	
793C	4AR,	96-04	1615	218.0	383 739	7.41	12.87	6.43	5.86	13.21	32.4	40.00R57
	4GZ,		**(2166)**	**(240.0)**	**(846,000)**	**(24'4")**	**(42'3")**	**(21'1")**	**(19'3")**	**(43'4")**	**(106'4")**	
	ATY											
797	5YW	98-02	2395	326.0	557 820	9.14	14.63	7.24	7.05	14.94	32.86	55/80R63
			(3211)	**(360.0)**	**(1,230,000)**	**(30'0")**	**(48'0")**	**(27'6")**	**(26'10")**	**(49'0")**	**(104'10")**	
797B	JSM	02-09	2513	354.0	623 583	9.66	14.4	7.72	7.15	15.34	40.5	59/80/R63
			(3370)	**(394.0)**	**(1,375,000)**	**(31'9")**	**(47'3")**	**(25'4")**	**(23'6")**	**(50'4")**	**(132'10")**	

ON-HIGHWAY TRUCKS

Engine	Horsepower (BHP @ 1700 RPM)	Torque Peak (lbf-ft @ 1000 RPM)	Gov. Speed (RPM)	Clutch Engagement Torque (lbf-ft at 800 RPM)
CT11	330/1250	1250	2100	686
	365/1250	1250	2100	686
	370/1350	1350	2100	770
	390/1450	1450	2100	811
CT15	450/1550	1550	2100	1150
	450/1750	1750	2100	1150
	475/1850	1850	2100	1150
	500/1650	1650	2100	1150
	500/1850	1850	2100	1150
	550/1850	1850	2100	1150

ARTICULATED TRUCKS

						Dimensions m (ft)						
Model	**Product Ident. No. Prefix**	**Years Built**	**Flywheel Kilowatts (Horse-power)**	**Capacity Metric Tons (U.S. Tons)**	**Approx. Weight kg (lb)**	**Width**	**Length**	**Height**	**Loading Height**	**Dumping Height (55°)**	**Turning Circle**	**Tire Size**
D20D	9MG	92-94	134	18.0	15 000	2.75	8.43	3.30	2.40	5.00	7.25	23.5R25
			(180)	**(20.0)**	**(33,070)**	**(9'0")**	**(27'8")**	**(10'10")**	**(7'11")**	**(16'5")**	**(24'0")**	
D22	*	80-82	175	20.0	17 700	3.00	7.85	3.09	2.44	5.03	7.87	26.5R25
			(235)	**(22.0)**	**(39,000)**	**(9'10")**	**(25'9")**	**(10'2")**	**(8'0")**	**(16'6")**	**(25'10")**	
D25	*	80	175	22.7	17 300	3.00	7.85	3.09	2.44	5.03	7.87	26.5R25
			(235)	**(25.0)**	**(38,000)**	**(9'10")**	**(25'9")**	**(10'2")**	**(8'0")**	**(16'6")**	**(25'10")**	
D25B	*	80-83	190	22.7	17 900	3.00	7.99	3.25	2.44	5.03	7.87	26.5R25
			(255)	**(25.0)**	**(39,400)**	**(9'10")**	**(26'2")**	**(10'8")**	**(8'0")**	**(16'6")**	**(25'10")**	
D25C	9YC	85-89	194	22.7	19 233	3.00	8.73	3.27	2.56	5.28	16.14	26.5R25
			(260)	**(25.0)**	**(42,400)**	**(9'10")**	**(28'8")**	**(10'9")**	**(8'5")**	**(17'4")**	**(52'11")**	
D25D	1HK	89-01	194	22.7	19 450	3.00	8.79	3.34	2.63	5.19	7.95	26.5R25
			(260)	**(25.0)**	**(42,880)**	**(9'10")**	**(28'10")**	**(10'11")**	**(8'8")**	**(17'0")**	**(26'1")**	
D30C	7ZC	85-89	194	27.2	21 320	3.30	8.86	3.33	2.85	5.46	16.33	29.5R25
			(260)	**(30.0)**	**(47,000)**	**(10'10")**	**(29'1")**	**(10'11")**	**(9'4")**	**(17'11")**	**(53'7")**	
D30D	3AJ	89-01	213	27.2	21 690	3.30	8.89	3.40	2.83	5.46	8.20	29.5R25
			(285)	**(30.0)**	**(47,320)**	**(10'10")**	**(29'2")**	**(11'2")**	**(9'3")**	**(17'11")**	**(26'11")**	
D35	*	81-83	190	31.8	20 000	3.27	8.44	3.25	2.91	5.46	7.87	26.5R25
			(255)	**(35.0)**	**(44,000)**	**(10'9")**	**(27'8")**	**(10'8")**	**(9'7")**	**(17'11")**	**(25'10")**	33.25R29
D35C	2GD	85-89	194	31.8	23 860	3.50	9.44	3.34	2.93	5.32	16.00	Front 29.5R25
			(260)	**(35.0)**	**(52,600)**	**(11'6")**	**(31'0")**	**(10'11")**	**(9'7")**	**(17'5")**	**(52'5")**	Rear 33.5R29
D35 HP	3FD	85-89	287	31.8	24 950	3.50	9.80	3.51	2.93	5.32	15.78	Front 29.5R25
			(385)	**(35.0)**	**(55,000)**	**(11'6")**	**(32'2")**	**(11'6")**	**(9'7")**	**(17'5")**	**(51'9")**	Rear 33.5R29
D40D	2JJ	89-94	287	36.3	28 027	3.48	9.76	3.56	3.20	6.00	7.90	Front 29.5R25
			(385)	**(40.0)**	**(61,800)**	**(11'5")**	**(32'0")**	**(11'8")**	**(10'7")**	**(19'8")**	**(25'11")**	Rear 33.25R29
D44	*	81-86	336	40.0	28 000	3.66	10.05	3.86	2.90	6.35	9.96	33.25R29
			(450)	**(44.0)**	**(61,600)**	**(12'0")**	**(33'0")**	**(12'8")**	**(9'6")**	**(20'10")**	**(32'8")**	
D44B	4LD	86-87	343	40.0	32 296	3.73	10.05	3.98	2.98	6.40	9.08	33.25R29
			(460)	**(44.0)**	**(71,200)**	**(12'3")**	**(33'0")**	**(13'1")**	**(9'9")**	**(21'0")**	**(29'9")**	
D250	*	75-78	175	25.0	18 500	2.66	8.82	3.04	2.61	6.22	7.67	23.5R25
			(235)	**(27.5)**	**(40,700)**	**(8'9")**	**(29'0")**	**(10'0")**	**(8'7")**	**(20'5")**	**(25'2")**	
D250B	5WD	85-91	163	22.7	17 963	2.50	9.60	3.18	2.55	6.23	7.65	20.5R25
			(218)	**(25.0)**	**(39,600)**	**(8'2.5")**	**(31'8.5")**	**(10'5")**	**(8'4.5")**	**(20'5")**	**(25'1")**	
D250D	6NG	92-94	160	22.8	17 300	2.50	9.60	3.21	2.59	6.22	7.61	20.5R25
			(214)	**(25.0)**	**(38,150)**	**(8'2")**	**(31'6")**	**(10'7")**	**(8'6")**	**(20'5")**	**(25'0")**	
D250E	5TN	95-98	194	22.7	20 135	2.74	9.94	3.35	2.70	6.20	7.44	23.5R25
			(260)	**(25.0)**	**(44,397)**	**(9'0")**	**(32'7")**	**(11'0")**	**(8'10")**	**(20'4")**	**(24'5")**	
D250E	4PS	98-00	201	22.7	21 600	2.88	10.00	3.35	2.75	6.39	7.44	23.5R25
Series II			**(270)**	**(25.0)**	**(47,628)**	**(9'5")**	**(32'10")**	**(11'0")**	**(9'0")**	**(20'11")**	**(24'5")**	
725	AFX	00-05	209	23.6	22 730	2.88	9.92	3.44	2.75	6.43	7.26	23.5R25
			(280)	**(26.0)**	**(50,120)**	**(9'5")**	**(32'7")**	**(11'3")**	**(9'0")**	**(21'1")**	**(23'10")**	
725	B1L	05-13	230	23.6	22 260	2.88	9.92	3.44	2.75	6.41	7.25	23.5R25
			(309)	**(26.0)**	**(49,075)**	**(9'5")**	**(32'6")**	**(11'3")**	**(9'0")**	**(21'0")**	**(23'10")**	
725C	TFB	14-16	239	23.6	23 220	3.7	10.45	3.47	2.73	6.31	16.2	23.5R25
			(320)	**(26)**	**(51,191)**	**(12'2")**	**(34'3")**	**(11'4")**	**(8'9")**	**(20'7")**	**(53'0")**	
725C	LFB	14-16	239	23.6	22 950	3.7	10.45	3.47	2.73	6.31	16.2	23.5R25
			(320)	**(26)**	**(50,596)**	**(12'2")**	**(34'3")**	**(11'4")**	**(8'9")**	**(20'7")**	**(53'0")**	

*Information not available — DJB models.

Articulated Trucks (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Kilowatts (Horse-power)	Capacity Metric Tons (U.S. Tons)	Approx. Weight kg (lb)	Dimensions m (ft) Width	Length	Height	Loading Height	Dumping Height (55°)	Turning Circle	Tire Size
D275	*	78-80	175	25.0	18 700	2.66	8.82	3.17	2.61	6.22	7.75	23.5R25
			(235)	**(27.5)**	**(41,000)**	**(8'9")**	**(29'0")**	**(10'7")**	**(8'7")**	**(20'5")**	**(25'3")**	
D275B	*	80-82	190	25.0	19 200	2.66	8.96	3.21	2.61	6.22	7.75	23.5R25
			(255)	**(27.5)**	**(42,400)**	**(8'9")**	**(29'5")**	**(10'7")**	**(8'7")**	**(20'5")**	**(25'5")**	
D300	*	76-78	190	30.0	19 500	2.80	8.82	3.04	2.68	6.22	7.67	23.5R25
			(255)	**(33.0)**	**(42,900)**	**(9'2")**	**(29'0")**	**(10'0")**	**(8'10")**	**(20'5")**	**(25'2")**	
D300B	4SD	85-91	194	27.2	19 800	2.50	9.60	3.18	2.55	6.23	7.76	23.5R25
			(260)	**(30.0)**	**(43,520)**	**(8'2.5")**	**(31'8.5")**	**(10'5")**	**(8'4.5")**	**(20'5")**	**(25'6")**	
D300D	5MG	92-95	213	27.2	20 680	2.88	9.87	3.28	2.66	6.42	7.76	23.5R25
			(285)	**(30.0)**	**(45,600)**	**(9'6")**	**(32'5")**	**(10'9")**	**(8'9")**	**(21'1")**	**(25'5")**	
D300E	7FN	95-98	212	27.2	21 940	2.89	9.94	3.35	2.85	6.26	7.60	23.5R25
			(285)	**(30.0)**	**(48,369)**	**(9'6")**	**(32'7")**	**(11'0")**	**(9'4")**	**(20'6")**	**(24'10")**	
D300E	5KS	98-00	212	27.2	22 793	2.91	10.00	3.35	2.89	6.44	7.60	23.5R25
Series II			**(285)**	**(30.0)**	**(50,235)**	**(9'7")**	**(32'10")**	**(11'0")**	**(9'6")**	**(21'2")**	**(24'10")**	
730	AGF	00-05	228	28.1	23 230	2.88	9.92	3.44	2.89	6.50	7.26	23.5R25
			(305)	**(31.5)**	**(51,222)**	**(9'5")**	**(32'7")**	**(11'3")**	**(9'6")**	**(21'4")**	**(23'10")**	
730	B1M	05-13	242	28.1	22 850	2.88	9.92	3.44	2.90	6.50	7.25	23.5R25
			(325)	**(31.0)**	**(50,376)**	**(9'5")**	**(32'6")**	**(11'3")**	**(9'5")**	**(21'3")**	**(23'0")**	
730	B1W	05-13	242	28.1	25 550	3.24	9.73	3.45	3.05	—	7.25	750/65/R25
Ejector			**(325)**	**(31.0)**	**(56,328)**	**(10'6")**	**(31'9")**	**(11'3")**	**(10'0")**	**—**	**(23'10")**	
730C	TFF	14-16	280	28	24 100	3.7	10.45	3.48	2.91	6.46	16.2	23.5R25
			(375)	**(31)**	**(53,131)**	**(12'2")**	**(34'3")**	**(11'4")**	**(9'6")**	**(21'2")**	**(53'0")**	
730C	LFF	14-16	k280	28	23 700	3.7	10.45	3.48	2.91	6.46	16.2	23.5R25
			(375)	**(31)**	**(52,250)**	**(12'2")**	**(34'3")**	**(11'4")**	**(9'6")**	**(21'2")**	**(53'0")**	
730C EJ	TFH	14-16	280	28	26 800	3.7	10.38	3.45	3.03	—	15.2	750/65
			(375)	**(31)**	**(59,084)**	**(12'2")**	**(34'0")**	**(11'3")**	**(9'9")**	**—**	**(49'9")**	
730C EJ	LFH	14-16	280	28	26 400	3.7	10.38	3.45	3.03	—	15.2	750/65
			(375)	**(31)**	**(58,202)**	**(12'2")**	**(34'0")**	**(11'3")**	**(9'9")**	**—**	**(49'9")**	
D330	*	78-80	190	30.0	20 000	2.80	8.82	3.17	2.68	6.22	7.80	23.5R25
			(255)	**(33.0)**	**(43,000)**	**(9'2")**	**(28'11")**	**(10'5")**	**(8'9")**	**(20'5")**	**(25'7")**	
D330B	*	80-83	190	30.0	20 200	2.76	9.08	3.25	2.68	6.33	7.92	23.5R25
			(255)	**(33.0)**	**(44,400)**	**(9'1")**	**(29'9")**	**(10'8")**	**(8'9")**	**(20'9")**	**(26'0")**	
D350	*	78-80	190	31.8	21 000	3.00	8.95	3.21	2.82	6.35	7.95	26.5R25
			(255)	**(35.0)**	**(46,000)**	**(9'10")**	**(29'4")**	**(10'7")**	**(9'3")**	**(20'10")**	**(26'1")**	
D350B	*	80-83	190	31.8	21 400	3.00	9.09	3.25	2.85	6.40	7.95	26.5R25
			(255)	**(35.0)**	**(47,200)**	**(9'10")**	**(29'10")**	**(10'8")**	**(9'4")**	**(21'0")**	**(26'1")**	
D350C	8XC	85-89	194	31.8	23 315	3.00	9.93	3.27	2.91	6.52	16.16	26.5R25
			(260)	**(35.0)**	**(51,400)**	**(9'10")**	**(32'7")**	**(10'9")**	**(9'6")**	**(21'5")**	**(53'0")**	
D350D	9RF	89-94	213	31.8	24 595	3.00	9.95	3.34	2.93	6.52	16.06	26.5R25
			(285)	**(35.0)**	**(54,221)**	**(9'10")**	**(32'7")**	**(11'0")**	**(9'7")**	**(21'5")**	**(52'8")**	
D350E	9LR	96-99	253	31.7	27 871	3.26	10.38	3.51	2.94	6.60	8.21	26.5R25
			(340)	**(35.0)**	**(61,455)**	**(10'8")**	**(34'1")**	**(11'6")**	**(9'8")**	**(21'8")**	**(26'11")**	
D350E	2XW	99-01	265	31.8	30 190	3.26	10.65	3.51	2.92	6.83	8.45	26.5R25
Series II			**(355)**	**(35.0)**	**(66,560)**	**(10'8")**	**(35'1")**	**(11'6")**	**(9'7")**	**(20'5")**	**(27'8")**	

*Information not available — DJB models.

Articulated Trucks (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Kilowatts (Horse-power)	Capacity Metric Tons (U.S. Tons)	Approx. Weight kg (lb)	Dimensions m (ft)						Tire Size
						Width	Length	Height	Loading Height	Dumping Height (55°)	Turning Circle	
735	AWR	02-05	272	32.7	29 858	3.31	10.89	3.70	2.97	6.96	8.14	26.5R25
			(365)	**(36)**	**(65,825)**	**(10'10")**	**(35'9")**	**(12'2")**	**(9'10")**	**(22'10")**	**(26'9")**	
735	B1N	05-10	324	32.7	31 391	3.43	10.89	3.70	2.98	6.81	16.27	26.5R25
			(435)	**(36)**	**(69,206)**	**(11'3")**	**(35'7")**	**(12'1")**	**(9'8")**	**(22'3")**	**(53'4")**	
735B	T4P	11-14	326	32.7	32 549	3.43	11.00	3.70	2.98	6.81	16.27	26.5R25
			(437)	**(36)**	**(71,758)**	**(11'3")**	**(36'1")**	**(12'1")**	**(9'8")**	**(22'3")**	**(53'4")**	
735B	L4D	11-14	326	32.7	32 549	3.43	11.00	3.70	2.98	6.81	16.27	26.5R25
			(437)	**(36)**	**(71,758)**	**(11'3")**	**(36'1")**	**(12'1")**	**(9'8")**	**(22'3")**	**(53'4")**	
D400	IMD	85-89	287	36.3	25 765	3.00	10.42	3.45	3.00	6.53	16.07	26.5R25
			(385)	**(40.0)**	**(56,800)**	**(9'10")**	**(34'2")**	**(11'4")**	**(9'10")**	**(21'5")**	**(52'9")**	
D400D	8TF	89-95	287	36.3	28 027	3.30	10.62	3.56	2.98	6.60	8.26	29.5R25
			(385)	**(40.0)**	**(61,800)**	**(10'8")**	**(34'10")**	**(11'8")**	**(9'9")**	**(21'8")**	**(27'2")**	
D400E	2YR	96-99	302	36.3	29 263	3.30	10.52	3.58	3.07	6.58	8.26	29.5R25
			(405)	**(40.0)**	**(64,495)**	**(10'10")**	**(34'6")**	**(11'9")**	**(10'1")**	**(21'7")**	**(27'1")**	
D400E	8PS	99-01	302	36.3	31 650	3.43	10.65	3.58	3.10	6.92	8.45	29.5R25
Series II			**(405)**	**(40.0)**	**(69,760)**	**(11'2")**	**(35'1")**	**(11'9")**	**(10'2")**	**(23'0")**	**(27'8")**	
D400E II	APF	99-01	302	36.3	32 840	3.50	11.00	3.58	3.07	N/A	8.45	29.5R25
Ejector			**(405)**	**(40.0)**	**(72,380)**	**(11'6")**	**(36'1")**	**(11'9")**	**(10'1")**		**(27'8")**	
740	AXM	01-05	309	38.1	32 693	3.43	10.89	3.75	3.18	7.07	8.14	29.5R25
			(415)	**(42)**	**(72,075)**	**(11'3")**	**(35'9")**	**(12'4")**	**(10'5")**	**(23'2")**	**(26'9")**	
740	B1P	05-10	350	39.5	33 100	3.52	10.89	3.75	3.24	7.09	16.27	29.5R25
			(469)	**(43.5)**	**(72,973)**	**(11'5")**	**(35'7")**	**(12'3")**	**(10'6")**	**(23'4")**	**(53'4")**	
740	AZZ	01-05	309	38.1	35 270	3.50	11.59	3.75	3.07	3.07	8.63	29.5R25
Ejector			**(415)**	**(42)**	**(77,770)**	**(11'6")**	**(38'0")**	**(12'4")**	**(10'0")**	**(10'0")**	**(28'4")**	
740	AZZ	01-05	309	38.1	35 270	3.50	11.59	3.75	3.07	3.07	8.63	29.5R25
Ejector			**(415)**	**(42)**	**(77,770)**	**(11'6")**	**(38'0")**	**(12'4")**	**(10'0")**	**(10'0")**	**(28'4")**	
740B	T4R	11-14	354	39.5	34 408	3.52	11.00	3.75	3.24	7.09	16.27	29.5R25
			(474)	**(43.5)**	**(75,857)**	**(11'5")**	**(36'1")**	**(12'3")**	**(10'6")**	**(23'4")**	**(53'4")**	
740B	L4E	11-14	352	39.5	34 408	3.52	11.00	3.75	3.24	7.09	16.27	29.5R25
			(472)	**(43.5)**	**(75,857)**	**(11'5")**	**(36'1")**	**(12'3")**	**(10'6")**	**(23'4")**	**(53'4")**	
740B EJ	T4S	11-14	354	38	36 984	3.53	11.70	3.75	3.07	—	17.28	29.5R25
			(474)	**(42)**	**(81,536)**	**(11'6")**	**(38'4")**	**(12'3")**	**(10'0")**	**—**	**(56'7")**	
740B EJ	L4F	11-14	352	38	36 984	3.53	11.70	3.75	3.07	—	17.28	29.5R25
			(472)	**(42)**	**(81,536)**	**(11'6")**	**(38'4")**	**(12'3")**	**(10'0")**	**—**	**(56'7")**	
D550	*	78-86	336	50.0	37 800	3.66	11.35	3.86	3.30	7.83	9.65	33.25R29
			(450)	**(55.0)**	**(83,400)**	**(12'0")**	**(37'3")**	**(12'8")**	**(10'10")**	**(25'8")**	**(31'8")**	
D550B	8SD	86-87	343	50.0	40 370	3.72	11.74	3.97	3.22	8.28	8.73	33.25R29
			(460)	**(55.0)**	**(89,000)**	**(12'2.5")**	**(38'6")**	**(13'0")**	**(10'6")**	**(27'2")**	**(28'8")**	

*Information not available — DJB models.

WHEEL DOZERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Kilowatts (Horsepower)	Approx. Oper. Wt. kg (lb)	Length (Dozer on ground) m (ft)	Tread m (ft)	Wheelbase m (ft)	Ground Clearance mm (in)	Trans-mission	Maximum Speeds km/h (mph) Fwd.	Rev.	
814B	90P	70-81	127	18 780	6.49	2.16	3.10	356	PS	32.7	39.3	*
			(170)	**(41,400)**	**(21'3")**	**(7'1")**	**(10'2")**	**(14)**	4F-4R	**(20.3)**	**(24.4)**	
814B	16Z	81-95	161	20 927	6.82			459	PS	29.9	34.1	*
			(216)	**(46,137)**	**(22'5")**			**(18)**	4F-4R	**(18.6)**	**(21.2)**	
814F	9DM	96-02	164	22 780		2.20	3.35	448	PS	29.9	34.1	
			(220)	**(50,115)**		**(7'3")**	**(11'0")**	**(18)**	4F-4R	**(18.6)**	**(21.2)**	
814F	BGF	03-06	179	21 713	6.82	2.20	3.35	448	PS	29.9	34.1	
			(240)	**(47,877)**	**(22'5")**	**(7'3")**	**(11'0")**	**(18)**	4F-4R	**(18.6)**	**(21.2)**	
814F II	BXG	06	173	20 755	6.90	2.20	3.60	366	PS	31	34.9	
			(232)	**(45,765)**	**(22'6")**	**(7'3")**	**(11'8")**	**(14)**	4F-4R	**(19.3)**	**21.8**	
824	29G	63-65	224	31 700	7.04	2.37	3.35	470	PS	34.1	34.1	
			(300)	**(70,000)**	**(23'1")**	**(7'10")**	**(11'8")**	**(18.2)**	3F-3R	**(21.2)**	**(21.2)**	
824B	36H	65-78	224	33 330	7.40	2.32	3.55	490	PS	29.8	29.8	
			(300)	**(73,480)**	**(24'3.5")**	**(7'7.5")**	**(11'8")**	**(19.4)**	3F-3R	**(18.5)**	**(18.5)**	
824C	85X	78-95	235	30 380	7.69	2.36	3.53	477	PS	33.2	37.8	
			(315)	**(66,975)**	**(25'2")**	**(7'7.5")**	**(11'7")**	**(18.8)**	4F-4R	**(20.6)**	**(23.5)**	
824G	4SN	96-02	235	26 620	8.02	2.44	3.70	383	PS	33	37.8	
			(315)	**(58,697)**	**(26'4")**	**(8'0")**	**(12'2")**	**(15)**	4F-4R	**(20.4)**	**(23.5)**	
824G II	AXB	03-04	253	28 724	8.02	2.44	3.70	383	PS	32.1	36.6	
			(339)	**(63,325)**	**(26'4")**	**(8'0")**	**(12'2")**	**(15)**	4F-4R	**(20)**	**(22.7)**	
824H	ASX	05-14	264	28 724	8.20	2.44	3.70	358	PS	32.1	36.6	
			(354)	**(63,325)**	**(26'9")**	**(8'0")**	**(12'2")**	**(14)**	4F-4R	**(20)**	**(22.7)**	
834	43E	63-74	298	40 300	7.75	2.54	3.80	510	PS	32.8	35.7	
		96-00	**(400)**	**(88,800)**	**(25'5")**	**(8'4")**	**(12'6")**	**(20.0)**	3F-3R	**(20.4)**	**(22.2)**	
834B	7BR	74-00	336	46 350	8.72		3.81	466	PS	34.1	41.8	
			(450)	**(102,200)**	**(28'7")**		**(12'6")**	**(18)**	4F-4R	**(21.2)**	**(25.9)**	
834G	6GZ	98-01	359	44 680	10.40	2.59	4.55	541	PS	38.5	23.0	**
			(481)	**(98,500)**	**(34'2")**	**(8'6")**	**(14'11")**	**(21)**	4F-3R	**(23.9)**	**(14.3)**	
834G	BPC	02-04	359	47 106	10.40	2.59	4.55	541	PS	38.5	23.0	
			(481)	**(103,849)**	**(34'2")**	**(8'6")**	**(14'11")**	**(21)**	4F-3R	**(23.9)**	**(14.3)**	
834H	BTX	05-13	372	47 106	10.42	2.59	4.55	531	PS	35.4	21.4	
			(489)	**(103,849)**	**(34'2")**	**(8'6")**	**(14'11")**	**(21)**	4F-3R	**(22)**	**(13.3)**	
844	2KZ	98-01	466	69 230	10.90	3.10	4.60	552	PS	22.5	25.0	***
			(625)	**(152,620)**	**(35'9")**	**(10'0")**	**(15'1")**	**(22)**	3F-3R	**(14.0)**	**(15.5)**	
844	BBN	01-05	466	70 815	10.90	3.10	4.60	552	PS	22.5	25.0	
			(625)	**(156,120)**	**(35'9")**	**(10'0")**	**(15'1")**	**(22)**	3F-3R	**(14.0)**	**(15.5)**	
844H	BTW	05-14	468	70 815	10.94	3.10	4.60	475	PS	21	23	
			(627)	**(156,120)**	**(35'9")**	**(10'0")**	**(15'1")**	**(19)**	3F-3R	**(13)**	**(14.3)**	
854G	1JW	97-99	597	99 400	13.40	3.30	5.89	691	PS	20.5	22.7	****
			(800)	**(219,125)**	**(44'0")**	**(10'10")**	**(19'3")**	**(27)**	3F-3R	**(12.7)**	**(14.1)**	
854G	AMP	00-04	597	99 400	13.40	3.30	5.39	691	PS	20.5	22.7	
			(800)	**(219,125)**	**(44'0")**	**(10'10")**	**(19'3")**	**(27)**	3F-3R	**(12.7)**	**(14.1)**	
854G	A4W	04-08	597	99 400	13.40	3.30	5.39	691	PS	20.5	22.7	
			(800)	**(219,125)**	**(44'0")**	**(10'10")**	**(19'3")**	**(27)**	3F-3R	**(12.7)**	**(14.1)**	
854K	221	08-11	597	98 100	13.45	3.30	5.89	691	PS	21.2	23.5	
			(801)	**(216,273)**	**(44'0")**	**(10'10")**	**(19'3")**	**(27)**	3F-3R	**(13.2)**	**(14.6)**	
854K	H9K	11-16	597	98 100	13.45	3.30	5.89	691	PS	21.2	23.5	
	H8M		**(801)**	**(216,273)**	**(44'0")**	**(10'10")**	**(19'3")**	**(27)**	3F-3R	**(13.2)**	**(14.6)**	

*Turbocharged, Articulated Steering.
**Move to "G" Series.
***New model from Tiger (590).
****New model from Tiger (790).

COMPACTORS

Model	Product Ident. No. Prefix	Years Built	Flywheel Kilowatts (Horsepower)	Approx. Oper. Wt. kg (lb)	Drum Width m (ft)	Articulated Steering Angle, Maximum	Transmission	Maximum Speeds km/h (mph) Fwd.	Rev.	
815	91P	70-81	127	17 300	0.97	44°	Power Shift	30.1	35.7	*
			(170)	**(38,200)**	**(3'2")**	Either Side	4F-4R	**(18.7)**	**(22.2)**	
815B	17Z	81-95	161	20 035	0.98	45°	Power Shift	37.5	42.9	*
			(216)	**(44,175)**	**(3'2")**	Either Side	4F-4R	**(23.3)**	**(26.6)**	
815F	1GN	96-02	164	20 952	0.98	36°	Power Shift	37.6	43.0	
			(220)	**(46,096)**	**(3'2")**	Either Side	4F-4R	**(23.3)**	**(26.7)**	
815F	BKL	03-06	179	20 755	0.98	36°	Power Shift	17.9	19.5	
			(240)	**(45,765)**	**(3'2")**	Either Side	3F-3R	**(11.1)**	**(12.1)**	
815F II	BYN	06	173	20 755	0.99	42°	Power Shift	17.6	19.5	
			(232)	**(45,756)**	**(3'3")**	Either side	3F-3R	**(11.0)**	**(12.2)**	
816	57U	72-81	127	18 550	1.02	44°	Power Shift	30.1	35.7	**
			(170)	**(40,900)**	**(3'4")**	Either Side	4F-4R	**(18.6)**	**(22.4)**	
816B	15Z	81-95	161	20 628	1.02		Power Shift	35.3	40.4	**
			(216)	**(45,477)**	**(3'4")**		4F-4R	**(22.0)**	**(25.1)**	
816F	5FN	96-02	164	20 879	1.02	42°	Power Shift	36.3	41.4	
			(220)	**(45,934)**	**(3'4")**	Either Side	4F-4R	**(22.5)**	**(25.7)**	
816F II	BZR	06	173	23 748	1.016	42°	Power Shift	9.5	10.6	
			(232)	**(52,364)**	**(3'4")**	Either side	2F-2R	**(5.9)**	**(6.6)**	
825B	43N	70-78	224	30 075	1.13	44°	Power Shift	29.8	29.8	
			(300)	**(66,300)**	**(3'8")**	Either Side		**(18.5)**	**(18.5)**	
825C	86X	78-96	231	32 400	1.13	42°	Power Shift	29.8	33.9	
			(310)	**(71,432)**	**(3'8")**	Either Side	4F-4R	**(18.5)**	**(21.1)**	
825G	6RN	96-02	235	31 740	1.13	42°	Power Shift	15.6	17.2	
			(315)	**(69,828)**	**(3'8")**	Either Side	3F-3R	**(9.7)**	**(10.7)**	
825G II	AXB	03-04	253	32 734	1.13	42°	Power Shift	15.6	17.2	
			(339)	**(72,164)**	**(3'8")**	Either Side	3F-3R	**(9.7)**	**(10.7)**	
825H	AZW	05-14	264	32 734	1.125	42°	Power Shift	15.6	17.2	
			(354)	**(72,164)**	**(3'7")**	Either side	3F-3R	**(9.7)**	**(10.7)**	
826C	87X	78-95	235	34 920	1.20	42°	Power Shift	32.5	37.2	
			(315)	**(76,990)**	**(3'11")**	Either Side	4F-4R	**(20.2)**	**(23.1)**	
826G	7LN	96-02	235	33 350	1.20	42°	Power Shift	11.2	13.5	
			(315)	**(73,537)**	**(3'11")**	Either Side	2F-2R	**(6.9)**	**(8.4)**	
826H	AWF	05-14	264	36 967	1.20	42°	Power Shift	9.7	10.6	
			(354)	**(81,498)**	**(3'11")**	Either side	2F-2R	**(6.03)**	**(6.59)**	
835	44N	70-74	298	35 900	1.22	44°	Power Shift	32.2	34.8	
			(400)	**(79,100)**	**(4'0")**	Either Side	3F-3R	**(20.0)**	**(21.6)**	
836	3RL	93-95	336	45 450	1.40	35°	Power Shift	11.3	14.0	*
	7FR	95-98	**(450)**	**(100,000)**	**(4'7")**	Either Side	2F-2R	**(7.0)**	**(8.7)**	
836G	7MZ	98-01	351	53 680	1.40	35°	Power Shift	6.0	10.2	
			(471)	**118,348**	**(4'7")**	Either Side	2F-2R	**(3.7)**	**(6.3)**	
836H	BXD	05-13	372	53 682	1.40	35°	Power Shift	10.9	11.4	
			(499)	**(118,348)**	**(4'7")**	Either side	2F-2R	**(6.8)**	**(7.1)**	

*Turbocharged, Articulated Steering.
**Turbocharged, ROPS Cab, Sleeve Metering Fuel System.

WHEEL LOADERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horse-power	Approx. Shipping Wt. kg (lb)	Rated Capacity m^3 (yd^3)	Breakout Force kg (lb)	Width Over Tires m (ft)	Ground Clearance mm (in)	Max. Reach at max. height mm (ft)	Dump Clearance at max. height m (ft)	Maximum Speeds km/h (mph) Fwd.	Rev.	Remarks
903C	MW4	14-16	42	4300	0.6	2345	1.71	395	885	2.43	16.0	16.0	
				(9500)	**(0.8)**	**(5171)**	**(5'7")**	**(16)**	**(2'11")**	**(8'0")**	**(10.0)**	**(10.0)**	
904B	B4L	05-08	52	4368	0.6	3633	1.70	218	664	2.38	20.0	20.0	
				(9630)	**(0.8)**	**(8009)**	**(5'7")**	**(8.6)**	**(2'2")**	**(7'10")**	**(12.4)**	**(12.4)**	
906H		07-12	70	5630	0.9	4283	1.84	300	810	2.40	35.0	35.0	
				(12,412)	**(1.2)**	**(9442)**	**(6'0")**	**(11.8)**	**(2'8")**	**(7'10")**	**(22.0)**	**(22.0)**	
906H2		12-15	71	5630	0.9	4283	1.84	300	810	2.40	35.0	35.0	
				(12,412)	**(1.2)**	**(9442)**	**(6'0")**	**(11.8)**	**(2'8")**	**(7'10")**	**(22.0)**	**(22.0)**	
907H		07-12	70	5810	1.0	4283	1.84	300	810	2.40	35.0	35.0	
				(12,809)	**(1.3)**	**(9442)**	**(6'0")**	**(11.8)**	**(2'8")**	**(7'10")**	**(22.0)**	**(22.0)**	
907H2		12-15	71	5810	1.0	4283	1.84	300	810	2.40	35.0	35.0	
				(12,809)	**(1.3)**	**(9442)**	**(6'0")**	**(11.8)**	**(2'8")**	**(7'10")**	**(22.0)**	**(22.0)**	
908H		07-12	79	6465	1.1	4793	1.99	340	855	2.50	35.0	35.0	
				(14,253)	**(1.4)**	**(10,566)**	**(6'6")**	**(13.0)**	**(2'10")**	**(8'3")**	**(22.0)**	**(22.0)**	
908H2		12-15	71	6465	1.1	4793	1.99	340	855	2.50	35.0	35.0	
				(14,253)	**(1.4)**	**(10,566)**	**(6'5")**	**(13.0)**	**(2'10")**	**(8'3")**	**(22.0)**	**(22.0)**	
910	80V	73-79	65	6100	1.0	4530	2.07	405	860	2.46	24.1	10.6	
				(13,400)	**(1.25)**	**(10,000)**	**(6'10")**	**(16)**	**(2'10")**	**(8'1")**	**(15.0)**	**(6.6)**	
910	40Y	79-89	65	6658	1.0	5838	2.07	405	930	2.40	23.9	10.6	
				(14,679)	**(1.25)**	**(12,870)**	**(6'10")**	**(16)**	**(3'0.6")**	**(7'10")**	**(14.8)**	**(6.6)**	
910	41Y	79-89	65	6658	1.0	5838	2.07	405	930	2.40	23.5	24.9	
				(14,679)	**(1.25)**	**(12,870)**	**(6'10")**	**(16)**	**(3'0.6")**	**(7'10")**	**(14.6)**	**(15.5)**	
910E	1SF	89-92	78	7298	1.3	6503	2.15	343	1000	2.57	34.0	22.4	3114 Engine
				(16,062)	**(1.7)**	**(14,339)**	**(7'0")**	**(13.5)**	**(3'3.4")**	**(8'5")**	**(21.1)**	**(13.9)**	Z Bar Linkage
910F	1SF	92-95	80	7009	1.3	6443	2.15	370	981	2.60	34.0	22.4	3114 Engine
				(15,452)	**(1.7)**	**(14,207)**	**(7'0")**	**(14.6)**	**(3'3")**	**(8'6")**	**(21.1)**	**(13.9)**	Z Bar Linkage
910K	AY4	14-16	74	7470	1.2	6741	2.26	348	820	2.81	40.0	40.0	
				(16,463)	**(1.6)**	**(14,857)**	**(7'5")**	**(13)**	**(2'8")**	**(9'2")**	**(25.0)**	**(25.0)**	
914G	7ZM	95-14	95	7950	1.2-1.4	6200	2.258	456	973	2.659	35.0	35.0	C4.4 ACERT Engine
	9WM			**(17,530)**	**(1.6-1.8)**	**(14,007)**	**(7'5")**	**(16.3)**	**(3'2")**	**(8'9")**	**(22.0)**	**(22.0)**	Z Bar Linkage
	PDF												Hystat Transmission
914G2	KNP	12-14	95	7950	1.2-1.4	6200	2.258	456	973	2.659	35.0	35.0	C4.4 ACERT Engine
				(17,530)	**(1.6-1.8)**	**(14,007)**	**(7'5")**	**(16.3)**	**(3'2")**	**(8'9")**	**(22.0)**	**(22.0)**	Z Bar Linkage
													Hystat Transmission
914K	CD2	14-16	74	8467	1.4	7357	2.26	405	847	2.78	40.0	40.0	
				(18,663)	**(1.8)**	**(16,214)**	**(7'5")**	**(15)**	**(2'9")**	**(9'1")**	**(25.0)**	**(25.0)**	
916	2XB	86-92	85	8554	1.4	9124	2.33	322	926	2.65	24.8	25.0	3204 Engine
				(18,857)	**(1.75)**	**(20,115)**	**(7'8")**	**(12.7)**	**(3'0.5")**	**(8'9")**	**(15.4)**	**(15.5)**	Z Bar Linkage
918F	3TJ	92-94	98	8973	1.5	9795	2.33	318	802	2.78	37.0	24.5	3114 Engine
				(19,785)	**(2.0)**	**(21,598)**	**(91.6")**	**(13)**	**(2'8")**	**(9'1")**	**(23.0)**	**(15.2)**	Z Bar Linkage
920	62K	69-84	80	8440	1.2	7901	2.16	335	740	2.77	43.8	23.2	
				(18,600)	**(1.5)**	**(17,419)**	**(7'1")**	**(13)**	**(2'5")**	**(9'1")**	**(27.2)**	**(14.4)**	
922A	59A	60-62	80	7350	0.93	6850	2.12	368	655	2.60	30.4	32.8	
				(16,200)	**(1.25)**	**(15,100)**	**(7'0")**	**(15)**	**(2'2")**	**(8'7")**	**(18.9)**	**(20.4)**	
922B	88J	62-68	80	7670	1.15	9000	2.25	390	680	2.60	33.6	42.9	
				(16,900)	**(1.5)**	**(19,900)**	**(7'5")**	**(16)**	**(2'3")**	**(8'7")**	**(20.9)**	**(26.7)**	

Wheel Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horse-power	Approx. Shipping Wt. kg (lb)	Rated Capacity m^3 (yd^3)	Breakout Force kg (lb)	Width Over Tires m (ft)	Ground Clearance mm (in)	Max. Reach at max. height mm (ft)	Dump Clearance at max. height m (ft)	Maximum Speeds km/h (mph) Fwd.	Rev.	Remarks
924F	5NN	94-99	105	9025	1.7	9553	2.33	318	855	2.70	38.2	23.6	
				(19,900)	**(2.25)**	**(21,067)**	**(7'6")**	**(12.5)**	**(2'8")**	**(8'10")**	**(23.6)**	**(14.8)**	
924G	9SW	99-02	120	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924G	3PZ	99-02	120	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924G	AAN	99-02	120	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924G	DDA	02-07	129	9977	1.8	11 452	2.36	370	1451	2.918	38.5	21.8	
				(21,996)	**(2.3)**	**(25,247)**	**(7'9")**	**(15)**	**(4'10")**	**(9'7")**	**(23.9)**	**(13.5)**	
924G	RBB	02-07	129	9977	1.8	11 452	2.36	370	1451	2.918	38.5	21.8	
				(21,996)	**(2.3)**	**(25,247)**	**(7'9")**	**(15)**	**(4'10")**	**(9'7")**	**(23.9)**	**(13.5)**	
924G	WMB	02-07	129	9977	1.8	11 452	2.36	370	1451	2.918	38.5	21.8	
				(21,996)	**(2.3)**	**(25,247)**	**(7'9")**	**(15)**	**(4'10")**	**(9'7")**	**(23.9)**	**(13.5)**	
924Gz	6YW	99-02	120	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924Gz	3DZ	99-03	120	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924Gz	AAB	99-04	120	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924Gz	DFZ	02-04	129	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924Gz	RTA	02-07	129	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924Gz	WGX	02-07	129	9615	1.8	9876	2.36	370	1318	2.828	38.5	21.8	
				(21,197)	**(2.3)**	**(21,772)**	**(7'9")**	**(15)**	**(4'4")**	**(9'4")**	**(23.9)**	**(13.5)**	
924H	HXC	07-13	132	11 635	2.1	9003	2.49	436	1060	2.759	39.7	22.9	
				(25,651)	**(2.7)**	**(19,848)**	**(8'2")**	**(17)**	**(3'6")**	**(9'1")**	**(24.7)**	**(14.2)**	
924Hz	JZZ	10-13	132	11 021	2.1	8975	2.49	436	859	2.757	39.7	22.9	
				(24,297)	**(2.7)**	**(19,787)**	**(8'2")**	**(17)**	**(2'10")**	**(9'1")**	**(24.7)**	**(14.2)**	
924K	PWR	11-15	146	12 868	1.9	10 223	2.54	400	1024	2885	40.0	40.0	
				(28,360)	**(2.5)**	**(22,531)**	**(8'4")**	**(15.7)**	**(3'4")**	**(9'5")**	**(25.0)**	**(25.0)**	
924K	HJF	13-15	141	11 550	1.7	12 273	2.54	397	950	2857	40.0	40.0	
	ENC			**(25,464)**	**(2.2)**	**(27,057)**	**(8'4")**	**(15.7)**	**(3'1")**	**(9'4")**	**(25.0)**	**(25.0)**	
926	94Z	84-87	105	8800	1.21	5070	2.33	341	924	2.67	30.3	32.3	
				(19,400)	**(1.75)**	**(11,179)**	**(7'8")**	**(13.5)**	**(3'0")**	**(8'9")**	**(18.8)**	**(20.0)**	
926E	94Z	87-92	110	9432	1.7	10 044	2.33	341	1003	2.75	34.2	36.8	3204 Engine
				(20,794)	**(2.25)**	**(22,143)**	**(7'8")**	**(13.5)**	**(3'3.5")**	**(9'0")**	**(21.2)**	**(22.9)**	Z Bar Linkage
928F	2XL	93-96	120	10 870	2.1	10 090	2.43	318	956	2.74	36.5	21.1	3116 Engine
				(23,920)	**(2.75)**	**(22,200)**	**(8'0")**	**(13)**	**(3'2")**	**(9'0")**	**(22.6)**	**(13.1)**	Z Bar Linkage
928G	6XR	96-02	125	11 250	2.0	11 723	2.44	408	1455	2.879	37.7	25.8	
				(24,802)	**(2.6)**	**(25,849)**	**(8'0")**	**(16)**	**(4'9")**	**(9'5")**	**(23.4)**	**(16)**	
928G	7SR	96-02	125	11 250	2.0	11 723	2.44	408	1455	2.879	37.7	25.8	
				(24,802)	**(2.6)**	**(25,849)**	**(8'0")**	**(16)**	**(4'9")**	**(9'5")**	**(23.4)**	**(16)**	
928Gz	DJD	02-07	143	11 250	2.0	11 723	2.44	408	1455	2.879	37.7	25.8	
				(24,802)	**(2.6)**	**(25,849)**	**(8'0")**	**(16)**	**(4'9")**	**(9'5")**	**(23.4)**	**(16)**	
928Gz	WLG	02-07	143	11 250	2.0	11 723	2.44	408	1455	2.879	37.7	25.8	
				(24,802)	**(2.6)**	**(25,849)**	**(8'0")**	**(16)**	**(4'9")**	**(9'5")**	**(23.4)**	**(16)**	
928Hz	CXK	07-13	152	12 618	2.3	9002	2.57	408	963	2.842	37.6	26.7	
				(27,818)	**(3.0)**	**(19,846)**	**(8'5")**	**(16)**	**(3'2")**	**(9'4")**	**(23.4)**	**(16.6)**	

Wheel Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horse-power	Approx. Shipping Wt. kg (lb)	Rated Capacity m³ (yd³)	Breakout Force kg (lb)	Width Over Tires m (ft)	Ground Clearance mm (in)	Max. Reach at max. height mm (ft)	Dump Clearance at max. height m (ft)	Maximum Speeds km/h (mph)		Remarks
											Fwd.	Rev.	
930	41K	68-85	100	9660	1.7	7900	2.39	348	1350	2.79	44.2	23.3	Z Bar Linkage
				(21,300)	**(2.25)**	**(17,410)**	**(7'10")**	**(13.7)**	**(3'9")**	**(9'2")**	**(27.5)**	**(14.5)**	
930G	TWR	05-07	149	12 756	2.3	14 567	2.41	421	1542	2.917	38.3	24.1	
				(28,122)	**(3.0)**	**(32,115)**	**(7'11")**	**(16)**	**(5'1")**	**(9'7")**	**(23.8)**	**(15)**	
930G	TFR	05-07	149	12 756	2.3	14 567	2.41	421	1542	2.917	38.3	24.1	
				(28,122)	**(3.0)**	**(32,115)**	**(7'11")**	**(16)**	**(5'1")**	**(9'7")**	**(23.8)**	**(15)**	
930H	DHC	07-13	152	13 174	2.3	12 852	2.57	411	995	2.773	39.7	22.9	
				(29,044)	**(3.0)**	**(28,334)**	**(8'5")**	**(16)**	**(3'3")**	**(9'1")**	**(24.7)**	**(14.2)**	
930K	RHN	11-15	160	13 829	2.1	12 366	2.54	400	1064	2828	40.0	40.0	
				(30,479)	**(2.7)**	**(27,254)**	**(8'4")**	**(15.7)**	**(3'5")**	**(9'3")**	**(25.0)**	**(25.0)**	
930K	EYE	13-15	160	13 135	2.1	12 366	2.54	397	1033	2855	40.0	40.0	
	DYB			**(28,958)**	**(2.7)**	**(27,254)**	**(8'4")**	**(15.7)**	**(3'4")**	**(9'4")**	**(25.0)**	**(25.0)**	
936	33Z	83-87	125	11 884	2.1	12 514	2.56	329	1055	2.80	34.4	38.4	
				(26,200)	**(2.75)**	**(28,708)**	**(8'4.5")**	**(13)**	**(3'0")**	**(9'2")**	**(21.4)**	**(23.9)**	
936E	33Z	87-92	135	12 300	2.3	12 920	2.56	379	1026	2.87	40.6	45.3	
				(27,000)	**(3.0)**	**(28,483)**	**(8'5")**	**(14.9)**	**(2'11")**	**(9'2")**	**(25.2)**	**(28.2)**	
936F	8AJ	92-94	140	12 300	2.3	12 920	2.58	379	997	2.84	42.3	46.7	Box Frame
				(27,060)	**(3.0)**	**(28,483)**	**(8'5")**	**(14.9)**	**(3'3")**	**(9'4")**	**(26.3)**	**(29.6)**	
938F		94-97	140	13 030	2.5	12 330	2.61	400	1004	2.85	37.9	22.0	Wet Disc Brakes
				(28,730)	**(3.25)**	**(27,180)**	**(8'7")**	**(16)**	**(3'4")**	**(9'4")**	**(23.6)**	**(13.7)**	
938G	4YS	97-02	160	12 962	2.8	11 227	2.60	400	1055	2.72	39.4	23.4	
				(28,578)	**(3.65)**	**(24,770)**	**(8'6")**	**(16)**	**(3'6")**	**(8'11")**	**(24.5)**	**(14.5)**	
938G	CRD	02-07	160	13 452	2.8	11 156	2.60	400	1068	2.771	38.8	23.3	
Series II				**(29,656)**	**(3.66)**	**(24,594)**	**(8'6")**	**(16)**	**(3'6")**	**(9'1")**	**(24.1)**	**(14.5)**	
938H	MJC	05-12	197	14 919	2.5	13 751	2.65	397	1019	2.849	41.1	25.0	
				(32,881)	**(3.3)**	**(30,316)**	**(8'8")**	**(16)**	**(3'4")**	**(9'4")**	**(25.5)**	**(15.5)**	
938K	SWL	11-15	173	15 928	2.5	13 170	2.675	390	1146	2834	40.0	40.0	
				(35,104)	**(3.3)**	**(29,027)**	**(8'9")**	**(15.3)**	**(3'9")**	**(9'3")**	**(25.0)**	**(25.0)**	
938K	XXT	13-15	188	15 146	2.5	13 170	2.675	286	1108	2869	40.0	40.0	
	HFW			**(33,301)**	**(3.3)**	**(29,027)**	**(8'9")**	**(11.2)**	**(3'7")**	**(9'4")**	**(25.0)**	**(25.0)**	
944	87J	59-68	100	10 100	1.53	9800	2.40	450	905	2.96	38.5	46.6	
				(22,000)	**(2.0)**	**(21,700)**	**(7'10")**	**(18)**	**(3'0")**	**(9'9")**	**(23.9)**	**(28.9)**	
950	81J	68-81	130	12 930	1.53	10 320	2.41	381	740	2.82	35.9	42.5	Articulated Steering,
				(28,500)	**(2.07)**	**(22,760)**	**(7'11")**	**(15)**	**(2'5")**	**(9'3")**	**(22.3)**	**(26.4)**	4 Wheel Drive
950B	22Z	81-87	155	14 650	2.9	15 680	2.67	427	1125	2.95	36.4	39.4	Z Bar Linkage
				(32,300)	**(3.75)**	**(35,895)**	**(5'9")**	**(16.8)**	**(3'8")**	**(9'8")**	**(22.6)**	**(24.5)**	
950E	22Z	87-91	160	15 856	3.1	13 586	2.76	400	1160	2.85	36.2	39.9	23.5-25 Std. Tires
				(34,883)	**(4.0)**	**(29,925)**	**(9'0")**	**(15.7)**	**(3'10")**	**(9'4")**	**(22.4)**	**(24.7)**	
950F	7ZF	90-92	170	16 086	3.1	14 954	2.76	474	1160	2.85	39.3	43.0	Wet Disc Brakes
				(35,463)	**(4.0)**	**(32,974)**	**(9'0")**	**(18.7)**	**(3'10")**	**(9'4")**	**(24.4)**	**(26.7)**	
950F	5SK	93-98	170	16 880	3.1	14 960	2.76	460	1180	2.83	38.7	42.7	Integral ROPS
Series II				**(37,220)**	**(4.0)**	**(32,980)**	**(9'0")**	**(18.1)**	**(3'10")**	**(9'3")**	**(24.0)**	**(26.5)**	Electronic Shift
950G	3JW	98-02	183	16 904	3.5	14 888	2.89	400	1270	2.89	37.0	40.7	
	4BS			**(37,266)**	**(4.5)**	**(32,810)**	**(9'6")**	**(16)**	**(4'2")**	**(9'6")**	**(23.0)**	**(25.3)**	
950G	AXX	02-05	183	17 780	3.1	15 724	2.89	412	1202	2.92	37.0	40.0	
Series II	AXR			**(39,198)**	**(4.05)**	**(34,666)**	**(9'6")**	**(16.2)**	**(3'11")**	**(9'7")**	**(23.0)**	**(24.9)**	

Wheel Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horse-power	Approx. Shipping Wt. kg (lb)	Rated Capacity m^3 (yd^3)	Breakout Force kg (lb)	Width Over Tires m (ft)	Ground Clearance mm (in)	Max. Reach at max. height mm (ft)	Dump Clearance at max. height m (ft)	Maximum Speeds km/h (mph) Fwd.	Rev.	Remarks
960F	9ZJ	94-98	200	18 070	3.5	14 500	2.77	454	1030	2.92	39.4	43.2	Material Handler
				(39,840)	**(4.5)**	**(31,970)**	**(9'1")**	**(17.9)**	**(3'5")**	**(9'6")**	**(24.5)**	**(26.8)**	
962G	4PW	98-02	200	17 941	3.8	14 480	2.90	400	1250	2.77	37.0	40.7	
	5AS			**(39,553)**	**(5.0)**	**(31,950)**	**(9'8")**	**(16)**	**(4'2")**	**(9'2")**	**(23.0)**	**(25.3)**	
962G	AXY	02-05	204	18 547	3.5	14 072	2.89	412	1308	2.81	37.0	40.0	
Series II	AXS			**(40,889)**	**(4.58)**	**(31,024)**	**(9'6")**	**(16.2)**	**(4'2")**	**(9'2")**	**(23.0)**	**(24.9)**	
966A	33A	60-63	140	13 060	2.10	13 470	2.70	450	900	2.95	43.0	51.5	
				(28,800)	**(2.75)**	**(29,700)**	**(8'10")**	**(18)**	**(3'0")**	**(9'8")**	**(26.7)**	**(32.3)**	
966B	75A	63-68	150	14 300	2.29	14 000	2.70	400	900	2.95	38.5	46.3	
				(31,500)	**(3.0)**	**(31,000)**	**(8'10")**	**(16)**	**(3'0")**	**(9'8")**	**(23.9)**	**(28.8)**	
966C	76J	68-81	170	16 730	3.1	11 600	2.77	400	1420	2.95	38.0	45.1	
				(36,890)	**(4.0)**	**(25,578)**	**(9'1")**	**(15.7)**	**(4'8")**	**(9'8")**	**(23.6)**	**(28.0)**	
966D	99Y	80-87	200	19 730	3.3	20 972	2.86	451	1230	3.14	34.3	38.1	Z Bar Linkage
				(43,500)	**(4.25)**	**(48,150)**	**(9'4.8")**	**(17.8)**	**(4'0")**	**(10'3.5")**	**(21.3)**	**(23.7)**	
966E	99Y	87-90	216	20 324	3.8	18 939	2.94	476	1290	2.97	38.2	43.6	26.5-25 Std. Tires
				(44,767)	**(5.0)**	**(41,715)**	**(9'8")**	**(18.7)**	**(4'3")**	**(9'9")**	**(23.7)**	**(27.0)**	
966F	4YG	90-93	220	20 466	3.8	20 493	2.94	476	1280	2.98	37.6	42.6	
				(45,119)	**(5.0)**	**(45,187)**	**(9'8")**	**(18.7)**	**(4'2")**	**(9'9")**	**(23.4)**	**(26.4)**	Wet Disc Brakes
966F	1SL	93-98	220	21 290	3.8	20 490	2.94	476	1277	2.98	38.8	43.9	Integral ROPS
Series II				**(46,950)**	**(5.0)**	**(45,180)**	**(9'8")**	**(18.7)**	**(4'2")**	**(9'9")**	**(24.1)**	**(27.3)**	Electronic Shift
966G	3SW	98-02	235	22 068	4.0	19 986	2.97	565	1295	3.10	37.1	42.2	
	3ZS			**(48,651)**	**(5.25)**	**(44,120)**	**(9'9")**	**(22)**	**(4'3")**	**(10'2")**	**(23.1)**	**(26.2)**	
966G	ANZ	01-05	246	22 870	4.25	19 273	3.04	471	1328	3.07	37.2	38.5	
Series II	ANT			**(50,400)**	**(5.5)**	**(42,477)**	**(9'11")**	**(18.5)**	**(4'4")**	**(10'0")**	**(23.1)**	**(23.9)**	
966K XE	NGX	12-14	299	24 189	4.2	17 641	2.99	475	1388	2.99	40.0	28.0	Advanced
				(53,311)	**(5.5)**	**(38,984)**	**(9'9")**	**(18.7)**	**(4'6")**	**(9'9")**	**(24.9)**	**(17.4)**	Power Train
970F	7SK	93-98	250	23 690	4.7	16 510	2.94	482	1357	3.22	37.3	42.7	Material Handler
				(52,240)	**(6.0)**	**(36,400)**	**(9'8")**	**(19)**	**(4'5")**	**(10'6")**	**(23.2)**	**(26.5)**	New Model
972G	4WW	98-02	265	24 468	4.7	21 618	2.97	565	1255	3.15	37.0	41.9	
	7LS			**(53,942)**	**(6.0)**	**(47,580)**	**(9'9")**	**(22)**	**(4'1")**	**(10'4")**	**(22.9)**	**(26.0)**	
972G	AWP	01-05	270	25 490	4.7	22 036	2.95	565	1325	3.23	36.9	38.8	
Series II	ANY			**(56,180)**	**(6.0)**	**(48,554)**	**(9'9")**	**(22.2)**	**(4'4")**	**(10'7")**	**(22.9)**	**(24.0)**	
980	42H	66-70	235	20 000	3.06	18 860	2.87	399	1190	3.07	42.0	26.7	
				(44,000)	**(4.0)**	**(41,570)**	**(9'5")**	**(16)**	**(3'11")**	**(10'1")**	**(26.1)**	**(16.6)**	
980B	89P	70-78	260	23 360	3.44-4.21	15 900	3.11	—	1120	3.20	43.0	27.4	
				(51,500)	**(4.5-5.5)**	**(35,100)**	**(10'2")**	**—**	**(3'8")**	**(10'6")**	**(26.7)**	**(17.0)**	
980C	63X	79-91	270	27 559	5.2	23 188	3.15	417	1480	3.19	34.6	39.6	Dual
				(60,755)	**(6.75)**	**(51,121)**	**(10'4")**	**(16.4)**	**(4'10")**	**(10'6")**	**(21.5)**	**(24.5)**	Z Bar Linkage
980F	8JN	91-92	275	27 580	5.3	23 188	3.15	469	1500	3.16	37.4	42.8	Electronic Shift
				(60,800)	**(7.0)**	**(51,121)**	**(10'4")**	**(18.5)**	**(4'11")**	**(10'5")**	**(23.2)**	**(26.6)**	
980F	4RN	92-95	275	27 580	5.3	23 188	3.15	469	1500	3.16	37.4	42.8	
Series II				**(60,800)**	**(7.0)**	**(51,121)**	**(10'4")**	**(18.5)**	**(4'11")**	**(10'5")**	**(23.2)**	**(26.6)**	
980G	2KR	95-01	300	29 480	5.4	23 760	3.25	467	1540	3.27	37.4	42.8	
				(65,000)	**(7.0)**	**(52,390)**	**(10'8")**	**(18.4)**	**(5'1")**	**(10'8")**	**(23.2)**	**(26.6)**	
980G	AWH	01-05	311	30 207	5.7	21 414	3.25	467	1545	3.27	37.4	42.8	
Series II				**(66,576)**	**(7.5)**	**(47,277)**	**(10'8")**	**(18.4)**	**(5'1")**	**(10'9")**	**(23.2)**	**(26.6)**	

Wheel Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horse-power	Approx. Shipping Wt. kg (lb)	Rated Capacity m^3 (yd^3)	Breakout Force kg (lb)	Width Over Tires m (ft)	Ground Clearance mm (in)	Max. Reach at max. height mm (ft)	Dump Clearance at max. height m (ft)	Maximum Speeds km/h (mph) Fwd.	Rev.	Remarks
988	87A	63-76	325	35 800	4.6-5.4	21 380	3.20	570	1450	3.33	30.6	30.6	
				(79,000)	**(6.0-7.0)**	**(47,130)**	**(10'7")**	**(22.5)**	**(4'9")**	**(10'11")**	**(19.0)**	**(19.0)**	
988B	50W	76-93	375	43 365	5.4-6.3	36 330	3.52	474	2150	3.19	36.2	41.4	3408 Engine
				(95,600)	**(7.0-8.25)**	**(80,100)**	**(11'7")**	**(18)**	**(7'1")**	**(10'5")**	**(22.5)**	**(25.7)**	Z Bar Linkage
988F	8YG	93-95	400	43 540	5.4-6.1	37 363	3.52	496	1830	3.21	35.1	23.5	Bucket/HP increase
				(95,900)	**(7.0-8.0)**	**(82,371)**	**(11'7")**	**(19)**	**(6'0")**	**(10'6")**	**(21.8)**	**(14.6)**	STIC™ Steer
988F	2ZR	95-00	475	45 678	6.1-6.9	37 400	3.52	496	1611	3.22	35.1	23.5	3408E Engine
Series II				**(100,492)**	**(8.0-9.0)**	**(82,282)**	**(11'7")**	**(19)**	**(5'3")**	**(10'7")**	**(21.8)**	**(14.6)**	Axle Shaft Brakes
988G	2TW	01-05	475	50 040	6.3-7.0	46 950	3.47	549	2113	4.00	38.7	22.3	4.25 m
	BNH			**(110,320)**	**(8.2-9.2)**	**(103,500)**	**(11'5")**	**(21.6)**	**(6'11")**	**(13'1")**	**(24.0)**	**(13.8)**	6 Bar Linkage
988H	BXY	05-15	501	50 144	6.4-7.7	41 531	3.47	549	2153	3.31	38.6	25.1	3.88 m
	A7A			**(110,549)**	**(8.3-10)**	**(91,560)**	**(11'5")**	**(21.6)**	**(7'1")**	**(10'10")**	**(24.0)**	**(15.6)**	6 Bar Linkage
990	7HK	93-95	610	72 910	8.6	59 776	4.13	552	2070	3.99	22.5	25.0	ICTC &
				(160,600)	**(11.2)**	**(131,784)**	**(13'6")**	**(21.7)**	**(6'10")**	**(13'1")**	**(14.0)**	**(15.5)**	New Model
990	4FR	96-05	625	72 200	8.4-9.2	63 100	4.00	490	1990	4.05	22.5	25.0	3412E Engine
Series II				**(159,170)**	**(11-12)**	**(138,800)**	**(13'1")**	**(19.3)**	**(6'6")**	**(13'3")**	**(14.0)**	**(15.5)**	
990H	BWX	05-14	627	77 842	8.6-9.2	602	4.16	478	8.07	4220	22.4	24.8	Standard Lift
				(171,642)	**(11.25-12)**	**(135,429)**	**(13'3")**	**(18.8)**	**(26'6")**	**(13'10")**	**(13.92)**	**(15.41)**	8.6 m^3/**11.2 yd^3** Bucket
992	25K	68-73	550	47 670	7.65	36 900	3.93	530	2820	4.52	35.6	38.5	
				(105,100)	**(10.0)**	**(81,360)**	**(12'11")**	**(21)**	**(8'3")**	**(14'10")**	**(22.1)**	**(23.8)**	
992B	25K	73-77	550	64 320	7.65	29 330	—	—	1930	4.34	40.2	43.6	
				(141,800)	**(10.0)**	**(84,660)**	**—**	**—**	**(6'4")**	**(14'3")**	**(25.0)**	**(27.1)**	
992C	42X	77-81	690	85 640	9.6	66 240	4.55	533	2310	4.17	21.1	23.3	3412 PCT Engine
				(188,800)	**(12.5)**	**(146,030)**	**(14'11")**	**(21)**	**(7'7")**	**(13'8")**	**(13.1)**	**(14.5)**	Z Bar Linkage
992C	49Z	81-92	690	88 430	10.4	66 285	4.50	544	2310	4.17	21.0	22.9	3412 DIT Engine
				(194,950)	**(13.5)**	**(146,132)**	**(14'9")**	**(21)**	**(7'7")**	**(13'8")**	**(13.0)**	**(14.2)**	
992D	7MJ	92-97	710	88 690	10.7	62 670	4.50	544	2300	4.17	21.0	22.9	
				(195,125)	**(14.0)**	**(137,870)**	**(14'9")**	**(21)**	**(7'7")**	**(13'8")**	**(13.0)**	**(14.2)**	
992G	7HR	98-00	800	91 540	11.5-12.3	62 650	4.50	691	2300	4.60	20.2	22.7	6 Bar Linkage
				(201,810)	**(15-16)**	**(137,840)**	**(14'9")**	**(27.2)**	**(7'7")**	**(15'3")**	**(12.5)**	**(14.1)**	"G" Series
992K	H4C	07-11	801	97 294	10.7-12.3	584.66	—	682	9313	4480	20.6	22.4	10.7 m^3/**14 yd^3**
				(214,535)	**(14-16)**	**(128,917)**	**—**	**(26)**	**(30'6")**	**(14'8")**	**(12.8)**	**(13.9)**	Bucket
992K	ZMX	11-16	801	97 294	10.7-12.3	584.66	—	682	9313	4480	20.6	22.4	10.7 m^3/**14 yd^3**
	880			**(214,535)**	**(14-16)**	**(128,917)**	**—**	**(26)**	**(30'6")**	**(14'8")**	**(12.8)**	**(13.9)**	Bucket
993K	Z9K	07-12	945	133 637	12.8-14.5	72 347	4.93	783	9313	4849	20.1	12.5	12.8 m^3/**16.7 yd^3**
				(294,800)	**(16.7-19)**	**(159,500)**	**(16'2")**	**(30.8)**	**(30'7")**	**(15'11")**	**(22.1)**	**(13.7)**	Bucket
994	9YF	90-98	1250	177 000	10.3	103 420	5.20	662	2692	6.20	24.7	26.6	
				(390,300)	**(13.4)**	**(228,000)**	**(17'1")**	**(26)**	**(8'10")**	**(20'4")**	**(15.0)**	**(16.5)**	
994D	3TZ	98-05	1250	191 200	17.0	96 939	5.4	676	2157	5698	24.1	26.6	
				(420,640)	**(22.5)**	**(213,265)**	**(17'8")**	**(26)**	**(7'1")**	**(18'8")**	**(15.0)**	**(16.5)**	
994F	442	05-11	1577	195 434	18.0	104 082	5.4	811	2721	6002	24	25.6	Ext. High Lift
				(429,955)	**(23.5)**	**(229,305)**	**(17'8")**	**(32)**	**(8'11")**	**(19'8")**	**(14.9)**	**(15.9)**	Available
994H	DWC	11-14	1577	195 434	18.0	104 082	5.4	811	2721	6002	24	25.6	Ext. High Lift
				(429,955)	**(23.5)**	**(229,305)**	**(17'8")**	**(32)**	**(8'11")**	**(19'8")**	**(14.9)**	**(15.9)**	Available

TRACK LOADERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Rated Capacity m^3 (yd^3)	Dimensions Length** m (ft)	Width m (ft)	Height m (ft)	Remarks
931	78U	72-79	62	6940	0.77	2.74	1.78	1.96	
				(15,300)	**(1.0)**	**(9'0")**	**(5'10")**	**(6'5")**	
931 LGP	10N	75-79	62	7498	1.15	2.74	2.29	1.98	
				(16,530)	**(1.5)**	**(9'0")**	**(7'6")**	**(6'6")**	
931B	29Y	79-88	65	7362	0.8	4.13	1.84	2.68	
				(16,230)	**(1.0)**	**(13'9")**	**(6'0.5")**	**(8'10")**	
931B LGP	30Y	79-88	65	8089	0.8	3.84	2.41	2.68	
				(17,834)	**(1.0)**	**(12'7")**	**(7'11")**	**(8'10")**	
931C	2BJ1		67	7595	0.77	2.74	1.78	2.68	
	7HF			**(16,743)**	**(1.0)**	**(9'0")**	**(5'10")**	**(8'10")**	
931C LGP	6RF1		67	8170	0.77	2.74	1.78	2.68	
	8AF			**(18,012)**	**(1.0)**	**(9'0")**	**(5'10")**	**(8'10")**	
931C Series II	9AG	90-93	70	8047	0.83	4.14	1.97	2.68	
	6AJ			**(17,742)**	**(1.08)**	**(13'1")**	**(6'5")**	**(8'10")**	
933C	11A	55-58	50	7030	0.77	4.22	1.77	1.91	Integral loader
				(15,500)	**(1.0)**	**(13'10")**	**(5'10")**	**(6'4")**	
933E	11A	58-65	50	7640	0.77	4.22	1.77	1.40	Integral loader
				(16,850)	**(1.0)**	**(13'10")**	**(5'10")**	**(6'3")**	
933G	42A	65-68	60	7900	0.86	4.31	1.77	2.15	Sealed Track
				(17,500)	**(1.125)**	**(14'2")**	**(5'10")**	**(7'1")**	
935B	30F	87-88	75	7899	1.0	4.19	1.96	2.68	
				(17,414)	**(1.25)**	**(13'9")**	**(6'5")**	**(8'10")**	
935C	8CF		78	8205	1.0	4.19	1.96	2.68	
				(18,089)	**(1.3)**	**(13'9")**	**(6'5")**	**(8'10")**	
935C Series II	SDJ	90-93	80	8759	1.0	4.37	1.97	2.68	
				(19,311)	**(1.3)**	**(14'4")**	**(6'5")**	**(8'10")**	
939C	6DS	96-01	90	9578	1.2	4.36	1.96	2.77	
				(21,072)	**(1.5)**	**(14'4")**	**(6'5")**	**(9'1")**	
941	80H	68-72	70	8900	0.96	4.50	1.86	2.75	
				(19,700)	**(1.25)**	**(14'10")**	**(6'1")**	**(9'0")***	Electric Start
941B	80H	68-81	80	11 294	1.15	4.50	1.98	2.75	HP Increase,
				(24,900)	**(1.5)**	**(14'10")**	**(6'6")**	**(9'0")***	Hydraulic Track Adjusters
943	31Y	80-85	80	11 750	1.15	5.426	2.21	3.02	Hydrostatic drive
				(25,900)	**(1.5)**	**(17'10")**	**(8'7")**	**(9'11")**	
943	19Z	80-92	80	11 750	1.15	5.426	2.21	3.02	Hydrostatic drive
				(25,900)	**(1.5)**	**(17'10")**	**(8'7")**	**(9'11")**	made in France

*Height to top of stack. Others to top of seat back.
**Overall length to tip of smallest General Purpose bucket.

Track Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Rated Capacity m^3 (yd^3)	Dimensions Length** m (ft)	Width m (ft)	Height m (ft)	Remarks
951B	79H	67-71	85	10 025 **(22,100)**	1.14 **(1.5)**	4.70 **(15'6")**	1.98 **(6'6")**	2.75 **(9'0")***	Pedal Steering
951C	86J	71-81	95	12 338 **(27,200)**	1.34 **(1.75)**	4.77 **(15'8")**	1.98 **(6'6")**	2.75 **(9'0")***	HP Increase, Sealed & Lubricated Track
953	5Z	81-85	110	14 050 **(31,000)**	1.5 **(2.0)**	5.87 **(19'3")**	2.38 **(7'10")**	3.08 **(10'1")**	Hydrostatic drive
953	20Z	81-92	110	14 050 **(31,000)**	1.5 **(2.0)**	5.87 **(19'3")**	2.38 **(7'10")**	3.08 **(10'1")**	Hydrostatic drive
953	76Y	81-85	110	13 800 **(30,500)**	1.5 **(2.0)**	5.87 **(19'3")**	2.38 **(7'10")**	3.08 **(10'1")**	Hydrostatic drive
953	77Y	81-85	110	13 800 **(30,500)**	1.5 **(2.0)**	5.87 **(19'3")**	2.38 **(7'10")**	3.08 **(10'1")**	Hydrostatic drive
953B	5MK	92-96	120	14 400 **(31,800)**	1.75 **(2.25)**	4.23 **(13'4")**	2.38 **(7'10")**	3.08 **(10'1")**	Hydrostatic drive
953C	2ZN	96-03	121	14 680 **(32,360)**	2.3 **(3.0)**	4.35 **(14'3")**	2.30 **(7'7")**	3.08 **(10'1")**	
953C	BBX	03-07	128	15 145 **(33,389)**	1.75 **(2.25)**	4.35 **(14'3")**	2.30 **(7'7")**	3.16 **(10'4")**	SystemOne™ U/C
HT4	7U	50-55	54	2607 **(5748)**	0.96 **(1.25)**	4.32 **(14'2")**	2.03 **(6'8")**	1.83 **(6'0")**	
955C	12A	55-60	70	9590 **(21,145)**	1.15 **(1.5)**	4.60 **(15'2")**	2.03 **(6'8")**	2.08 **(6'11")**	Integral loader
955E	12A	58-60	70	10 160 **(22,400)**	1.15 **(1.5)**	4.60 **(15'2")**	2.03 **(6'8")**	2.09 **(6'11")**	Improved undercarriage
955H	60A	60-66	100	11 320 **(24,950)**	1.34 **(1.75)**	4.79 **(15'9")**	1.90 **(6'3")**	2.65 **(8'8")***	Power shift, Turbo, oil cooled brakes
955K	61H	66-71	115	12 700 **(28,000)**	1.34 **(1.75)**	5.00 **(16'6")**	2.06 **(6'9")**	2.80 **(9'3")***	Horsepower and bucket capacity increase
955L	85J	71-75	130	15 330 **(33,800)**	1.53 **(2.0)**	5.30 **(16'1")**	2.18 **(7'2")**	2.95 **(9'8")***	ROPS Cab, Sealed & Lubricated Track
955L	13X	75-81	130	15 853 **(34,950)**	1.72 **(2.25)**	5.26 **(17'3")**	2.18 **(7'2")**	2.95 **(9'8")**	

*Height to top of stack. Others to top of seat back.
**Overall length to tip of smallest General Purpose bucket.

Track Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Rated Capacity m³ (yd³)	Dimensions Length** m (ft)	Width m (ft)	Height m (ft)	Remarks
963	6Z	81-85	150	18 250 **(40,250)**	2.0 **(2.6)**	6.35 **(20'10")**	2.50 **(8'2")**	3.30 **(10'10")**	Hydrostatic drive
963	11Z	81-85	150	18 370 **(40,490)**	2.0 **(2.6)**	6.35 **(20'10")**	2.50 **(8'2")**	3.30 **(10'10")**	Hydrostatic drive
963	18Z	82-86	150	18 250 **(40,250)**	2.0 **(2.6)**	6.35 **(20'10")**	2.50 **(8'2")**	3.30 **(10'10")**	Hydrostatic drive made in France
963	21Z	82-95	150	18 370 **(40,490)**	2.0 **(2.6)**	6.35 **(20'10")**	2.50 **(8'2")**	3.30 **(10'10")**	Hydrostatic drive made in France
963B	9BL	95-99	160	19 620 **(43,270)**	2.45 **(3.2)**	6.60 **(21'8")**	2.50 **(8'2")**	3.31 **(10'10")**	3116 engine
963C	2DS	99-03	160	19 020 **(41,940)**	1.75 **(2.25)**	4.61 **(15'2")**	2.40 **(7'11")**	3.32 **(10'11")**	
963C	BBD	03-07	158	19 589 **(43,096)**	2.45 **(3.2)**	4.61 **(15'2")**	2.40 **(7'11")**	3.39 **(11'2")**	SystemOne U/C
973	86G	81-00	210	25 040 **(55,200)**	3.2 **(4.2)**	7.12 **(23'4")**	2.85 **(9'4")**	3.42 **(11'3")**	
973C	3RZ	99-01	210	27 006 **(59,548)**	3.2 **(4.19)**	7.36 **(24'2")**	2.58 **(8'6")**	3.50 **(11'6")**	
973C	BCP	01-05	230	27 006 **(59,548)**	3.2 **(4.19)**	7.36 **(24'2")**	2.58 **(8'6")**	3.50 **(11'6")**	
No. 6	10A	53-55	80	13 229 **(29,165)**	1.5 **(2.0)**	4.90 **(16'1")**	2.44 **(8'1")**	2.11 **(6'11")**	
977D	20A	55-60	100	14 430 **(31,795)**	1.72 **(2.25)**	5.19 **(18'0")**	2.44 **(8'0")**	2.22 **(7'4")**	
977E	20A	58-60	100	15 850 **(34,910)**	1.72 **(2.25)**	5.19 **(18'0")**	2.44 **(8'0")**	2.29 **(7'7")**	Improved undercarriage
977H	53A	60-66	150	17 000 **(37,500)**	1.90 **(2.5)**	5.28 **(17'4")**	2.44 **(8'0")**	2.29 **(7'7")**	Power shift, Turbo, oil cooled brakes
977K	46H	66-78	170	19 100 **(42,000)**	1.90 **(2.5)**	5.50 **(18'0")**	2.38 **(7'10")**	3.05 **(10'0")***	Walk-through compartment, longer roller frame
977L	14X	78-82	190	21 780 **(48,010)**	2.10 **(2.75)**	5.59 **(18'4")**	2.38 **(7'10")**	3.32 **(10'11")***	Horsepower and bucket capacity increase
983	38K	69-78	275	34 460 **(75,980)**	3.82 **(5.0)**	6.78 **(22'3")**	2.90 **(9'6")**	2.79 **(11'10")***	
983B	58X	78-82	275	35 620 **(78,530)**	3.82 **(5.0)**	6.78 **(22'3")**	2.90 **(9'6")**	3.68 **(12'1")***	DI engine

*Height to top of stack. Others to top of seat back.
**Overall length to tip of smallest General Purpose bucket.

INTEGRATED TOOLCARRIERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower	Approx. Operating Weight kg (lb)	Rated Capacity m^3 (yd^3)	Breakout Force kg (lb)	Width Over Tires m (ft)	Ground Clearance mm (in)	Max. Reach at Max. Height mm (in)	Dump Clearance at Max. Height m (ft)	Maximum Speeds km/h (mph) Fwd.	Rev.	Remarks
IT12	2YC	84-89	65	7393	1.0	7193	2.3	405	873	2.84	23.6	24.9	
				(16,299)	**(1.25)**	**(15,858)**	**(7'8")**	**(15.9)**	**(34)**	**(9'4")**	**(14.6)**	**(15.4)**	
IT12B	1KF	89-93	78	7950	1.2	6160	2.15	343	958	2.69	34.0	22.4	
				(17,530)	**(1.6)**	**(13,583)**	**(7'1")**	**(13.5)**	**(37.7)**	**(8'10")**	**(21.1)**	**(13.9)**	
IT12F	1KF	93-95	80	7893	1.3	6479	2.15	365	917	2.74	34.0	22.4	
				(17,401)	**(1.7)**	**(14,247)**	**(7'1")**	**(14)**	**(37)**	**(8'11.8")**	**(21.1)**	**(13.9)**	
IT14B	3NJ	89-93	85	8333	1.2	7525	2.15	344	958	2.70	37.3	24.4	
				(18,374)	**(1.6)**	**(16,593)**	**(7'1")**	**(13.6)**	**(37.7)**	**(8'11")**	**(23.2)**	**(15.2)**	
IT14F	4EL	93-95	85	7999	1.3	7170	2.15	365	918	2.74	37.3	24.4	
				(17,635)	**(1.7)**	**(15,808)**	**(7'1")**	**(14)**	**(37)**	**(9'0")**	**(23.2)**	**(15.2)**	
IT14G	1WN	95-14	95	8450	1.2-1.4	7700	2.258	456	787	2.921	32.0	32.0	C4.4 ACERT Engine
	8ZM			**(18,632)**	**(1.6-1.8)**	**(17,342)**	**(7'5")**	**(16.3)**	**(31)**	**(9'7")**	**(20.0)**	**(20.0)**	IT Linkage
	FWL												Hystat Transmission
	KZN												
IT14G2	ERP	12-14	95	8450	1.2-1.4	7700	2.258	456	787	2.921	32.0	32.0	C4.4 ACERT Engine
				(18,632)	**(1.6-1.8)**	**(17,342)**	**(7'5")**	**(16.3)**	**(31)**	**(9'7")**	**(20.0)**	**(20.0)**	IT Linkage
													Hystat Transmission
IT18	9NB	84-86	85	8660	1.2	9105	2.4	285	990	2.84	25.0	25.0	
				(19,092)	**(1.5)**	**(20,108)**	**(7'10")**	**(11.2)**	**(39)**	**(9'4")**	**(15.5)**	**(15.5)**	
IT18B	4ZD	86-92	95	9770	1.3	10 500	2.28	324	993	2.89	26.4	27.7	
				(21,540)	**(1.75)**	**(21,350)**	**(7'6")**	**(12.8)**	**(39)**	**(9'6")**	**(16.4)**	**(17.2)**	
IT18F	6ZF	92-94	105	9959	1.6	8880	2.33	321	1089	2.75	37.0	24.5	
				(21,960)	**(2.0)**	**(19,580)**	**(7'8")**	**(13)**	**(43)**	**(9'0")**	**(23.0)**	**(15.2)**	
IT24F	4NN	94-99	105	9989	1.7	8782	2.33	321	1088	2.75	38.0	23.4	
				(20,022)	**(2.5)**	**(19,361)**	**(7'6")**	**(12.6)**	**(42)**	**(9'0")**	**(23.6)**	**(14.8)**	
IT28	2KC	84-86	105	9560	1.5	9505	2.4	285	1044	2.82	30.8	32.3	
				(21,076)	**(2.0)**	**(20,955)**	**(7'10")**	**(11.2)**	**(41)**	**(9'3")**	**(18.8)**	**(20.0)**	
IT28B	1HF	86-93	110	10 580	1.7	10 456	2.32	324	1091	2.73	34.4	37.2	
				(23,325)	**(2.25)**	**(23,050)**	**(7'7")**	**(12.8)**	**(43)**	**(8'11")**	**(21.4)**	**(23.1)**	
IT28F	3CL	93-96	125	11 430	2.0	9840	2.43	317	1093	2.72	35.4	21.4	
				(25,200)	**(2.6)**	**(21,700)**	**(8'0")**	**(12)**	**(43)**	**(8'11")**	**(21.9)**	**(13.5)**	
IT28G	DBT	02-04	146	12 640	2.0	10 631	2.54	407	958	2.97	37.7	25.8	
				(27,860)	**(2.6)**	**(23,437)**	**(8'4")**	**(16)**	**(38)**	**(9'9")**	**(23.4)**	**(16.0)**	
IT28G	EWF	02-05	131	11 250	2.0	11 723	2.44	408	1455	2.879	37.7	25.8	
				(24,802)	**(2.6)**	**(25,849)**	**(8'0")**	**(16)**	**(57)**	**(9'5")**	**(23.4)**	**(16.0)**	
IT28G	WAC	02-05	131	11 250	2.0	11 723	2.44	408	1455	2.879	37.7	25.8	
				(24,802)	**(2.6)**	**(25,849)**	**(8'0")**	**(16)**	**(57)**	**(9'5")**	**(23.4)**	**(16.0)**	
IT38G	CSX	02-07	160	14 583	2.8	11 216	2.6	400	1224	2.733	38.8	23.3	
Series II				**(32,156)**	**(3.66)**	**(24,729)**	**(102)**	**(16)**	**(48)**	**(108)**	**(24.1)**	**(14.5)**	
IT38H	JNJ	07-12	200	16 000	3.0	12 797	2.67	400	1152	2.81	43.2	25.5	
				(35,274)	**(3.92)**	**(28,214)**	**(8'9")**	**(16)**	**(45)**	**(9'2")**	**(26.8)**	**(15.8)**	
950F CT	5SK	94-98	170	16 600	3.1	13 590	2.87	460	1714	2.845	38.7	42.7	
				(36,580)	**(4.0)**	**(29,950)**	**(9'5")**	**(18)**	**(68)**	**(9'4")**	**(24.0)**	**(26.5)**	

TELEHANDLERS

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower kW (hp)	Operating Weight kg (lb)	Engine	Maximum Lift Height m (ft/in)	Maximum Reach m (ft/in)	Maximum Lift Capacity kg (lb)
TH62	4TM	00-02	72 **(105)**	6840 **(15,080)**	Cat 3054T	7.6 **(25'0")**	4.2 **(13'9")**	2725 **(6000)**
TH63	5WM	00-02	72 **(105)**	9260 **(20,420)**	Cat 3054T	12.5 **(41'0")**	8.1 **(26'7")**	3000 **(6615)**
TH82	3JN	00-02	72 **(105)**	7470 **(16,470)**	Cat 3054T	7.6 **(25'0")**	4.2 **(13'9")**	3635 **(8000)**
TH83	3RN	00-02	72 **(105)**	10 000 **(22,050)**	Cat 3054T	12.5 **(41'0")**	8.2 **(27'0")**	3635 **(8000)**
TH103	3PN	00-02	72 **(105)**	12 500 **(27,500)**	Cat 3054T	13.5 **(44'0")**	8.8 **(28'9")**	4536 **(10,000)**
TH210	MHT	03-06	60 **(80)**	5000 **(11,023)**	Cat 3054B DI	5.18 **(17'0")**	2.8 **(9'2")**	2200 **(4840)**
TH215	MHS	03-06	60 **(80)**	5500 **(12,100)**	Cat 3054B DI	5.54 **(18'2")**	3.1 **(10'2")**	2500 **(5500)**
TH220B	SLA/TBF	03-07	74.5 **(100)**	6700 **(14,774)**	Cat 3054E	6.1 **(20'0")**	3.3 **(10'9")**	3500 **(7718)**
TH330B	SLB/TBG	03-07	74.5 **(100)**	7200 **(15,876)**	Cat 3054E	7.2 **(23'7")**	3.8 **(12'6")**	3600 **(7938)**
TH340B	SLC	03-06	74.5 **(99.9)**	7700 **(17,000)**	Cat 3054E	9.0 **(29'6")**	6.5 **(21'4")**	3000 **(6600)**
TH350B	SLD	03-06	74.5 **(99.9)**	8480 **(18,100)**	Cat 3054E	11.0 **(36'0")**	7.4 **(24'0")**	3000 **(6600)**
TH360B	SLE/TBH	03-07	74.5 **(100)**	9970 **(21,984)**	Cat 3054E	13.5 **(44'3")**	9.2 **(30'2")**	3500 **(7718)**
TH460B	SLF	03-06	74.5 **(99.9)**	10 500 **(21,600)**	Cat 3054E	13.5 **(44'4")**	9.2 **(30'0")**	4000 **(8800)**
TH560B	SLG/TBP	03-07	74.5 **(99.9)**	12 000 **(26,500)**	Cat 3054E	13.5 **(44'0")**	9.2 **(30'0")**	5000 **(11,000)**
TH580B	SLH/TBJ	03-07	74.5 **(99.9)**	13 670 **(30,100)**	Cat 3054E	17 **(56'0")**	12.7 **(42'0")**	5000 **(11,000)**

PAVING PRODUCTS — COLD PLANERS

Model	Product Ident. No. Prefix	Years Built	kW Flywheel (Horsepower)	Approximate Operating Weight kg (lb)	General Dimensions (Shipping) Height mm (ft)	Length mm (ft)	Width mm (ft)
PR-75		85-92	52 **(77)**	5900 **(13,000)**	2690 **(8'10")**	3050 **(10'0")**	2130 **(7'0")**
PR-105		85-92	67 **(90)**	7711 **(17,000)**	2921 **(9'7")**	3581 **(11'9")**	2515 **(8'3")**
PR-275	6RC	—	201 **(270)**	17 237 **(38,000)**	2896 **(9'6")**	5740 **(18'10")**	2438 **(8'0")**
PR-450		85-92	336 **(450)**	28 308 **(58,000)**	4270 **(14'0")**	13 280 **(43'8")**	2870 **(9'5")**
PR-450C		92-97	336 **(450)**	28 308 **(58,000)**	3810 **(12'6")**	13 200 **(43'6")**	2490 **(8'2")**
PR-750B		85-92	559 **(750)**	42 638 **(94,000)**	3734 **(12'3")**	16 500 **(54'0")**	3575 **(11'9")**
PR-1000			Cutter 559 **(750)** Track 186 **(250)**	46 780 **(103,130)**	3810 **(12'6")**	16 590 **(54'5")**	4877 **(16'0")**
PM-465	5ZS	97-03	353 **(473)**	14 333 **(31,600)**	2820 **(9'3")**	13 716 **(45'0")**	2489 **(8'2")**
PM-565		xx-05	466 **(625)**	38 595 **(85,100)**	5040 **(16'6")**	15 100 **(49'5")**	2790 **(9'2")**
PM201		05-14	485 **(650)**	39 165 **(86,360)**	5040 **(16'6")**	15 100 **(49'5")**	2810 **(9'2")**

PAVING PRODUCTS — RECLAIMERS & STABILIZERS

Model	Product Ident. No. Prefix	Years Built	kW Flywheel (Horsepower)	Approximate Operating Weight kg (lb)	General Dimensions (Shipping) Height mm (ft)	Length mm (ft)	Width mm (ft)
SS-250	6DD	85-96	250 **(335)**	13 300 **(29,300)**	3220 **(10'7")**	8780 **(28'10")**	2900 **(9'7")**
SS-250B	5GR	96-01	250 **(335)**	14 340 **(31,600)**	2600 **(8'6")**	8560 **(28'1")**	2900 **(9'6")**
RR-250	6ED	85-96	250 **(335)**	17 876 **(39,300)**	3220 **(10'7")**	8780 **(28'10")**	2900 **(9'7")**
RR-250B	3RR	96-01	250 **(335)**	19 260 **(42,470)**	2600 **(8'6")**	8560 **(28'1")**	2900 **(9'6")**
RM-250C			250 **(335)**	16 780 **(37,000)**	3220 **(10'7")**	8780 **(28'10")**	2921 **(9'7")**
RM-350	5FK	92-97	321 **(430)**	21 440 **(47,200)**	3404 **(11'2")**	9577 **(31'5")**	2997 **(9'10")**
SM-350	1RM	92-97	321 **(430)**	18 440 **(40,600)**	3404 **(11'2")**	9577 **(31'5")**	2997 **(9'10")**
RM-350B			373 **(500)**	24 040 **(53,000)**	3404 **(11'2")**	9980 **(32'9")**	2997 **(9'10")**
RM500		06-14	403 **(540)**	28 145 **(62,060)**	3480 **(11'4")**	9680 **(31'8")**	2980 **(9'7")**

PAVING PRODUCTS — UNITIZED VENTURI-MIXERS & UNITIZED DRUM-MIXERS

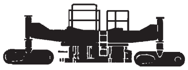
	Drum Dimensions			Performance	
Model	**Diameter mm (ft)**	**Length m (ft)**	**Gross Volume m^3 (ft^3)**	**Production Range/hr. metric tons (tons)**	**Air Flow m^3/min (ft^3/min)**
UVM-500	1829/1524 **(6'0"/5'0")**	7.9 **(26'0")**	14.17 **(500)**	68-109 **(75-120)**	300-481 **(10,600-17,000)**
UDM-600	1829 **(6'0")**	6.7 **(22'0")**	17.00 **(600)**	82 **(89)**	354.25 **(12,500)**
UDM-900	2134/1829 **(7'0"/6'0")**	9.1 **(30'0")**	25.48 **(900)**	68-227 **(75-250)**	311-793 **(11,000-28,000)**
UVM-1000	2134 **(7'0")**	9.754 **(32'0")**	28.34 **(1000)**	82-272 **(90-300)**	425-1076 **(15,000-38,000)**
UVM-1400	2286 **(7'6")**	10.973 **(36'0")**	39.64 **(1400)**	100-358 **(110-395)**	481-1274 **(17,000-45,000)**
UVM-1700	2591 **(8'6")**	11.582 **(38'0")**	48.14 **(1700)**	122-480 **(135-450)**	651-1614 **(23,000-57,000)**

PAVING PRODUCTS — PORTABLE VENTURI-MIXERS

	Drum Dimensions			Performance	
Model	**Diameter mm (ft)**	**Length m (ft)**	**Gross Volume m^3 (ft^3)**	**Production Range/hr. metric tons (tons)**	**Air Flow m^3/min (ft^3/min)**
PVM-1100	2134 **(7'0")**	10.97 **(36'0")**	31.15 **(1100)**	82-295 **(90-325)**	425-1133 **(15,000-40,000)**
PVM-1500	2286 **(7'6")**	12.19 **(40'0")**	42.48 **(1500)**	100-363 **(110-400)**	510-1274 **(18,000-45,000)**
PVM-2000	2591 **(8'6")**	12.80 **(42'0")**	56.64 **(2000)**	122-454 **(135-500)**	680-1699 **(24,000-60,000)**
PVM-2500	2896 **(9'6")**	12.80 **(42'0")**	70.79 **(2500)**	136-499 **(150-550)**	793-2110 **(28,000-74,500)**
PVM-2900	3048 **(10'0")**	13.41 **(44'0")**	82.12 **(2900)**	168-553 **(185-610)**	906-2265 **(32,000-80,000)**
PVM-3300	3200 **(10'6")**	13.41 **(44'0")**	93.45 **(3300)**	181-612 **(200-675)**	991-2464 **(35,000-87,000)**

PAVING PRODUCTS — STATIONARY VENTURI-MIXERS

	Drum Dimensions			Performance	
Model	**Diameter mm (ft)**	**Length m (ft)**	**Gross Volume m³ (ft³)**	**Production Range/hr. metric tons (tons)**	**Air Flow m³/min (ft³/min)**
SVM-1100	2134 **(7'0")**	10.97 **(36'0")**	31.15 **(1100)**	82-295 **(90-325)**	425-1133 **(15,000-40,000)**
SVM-1500	2286 **(7'6")**	12.19 **(40'0")**	42.48 **(1500)**	100-363 **(110-400)**	510-1274 **(18,000-45,000)**
SVM-2000	2591 **(8'6")**	12.80 **(42'0")**	56.64 **(2000)**	122-454 **(135-500)**	680-1699 **(24,000-60,000)**
SVM-2500	2896 **(9'6")**	12.80 **(42'0")**	70.79 **(2500)**	136-499 **(150-550)**	793-2110 **(28,000-74,500)**
SVM-2900	3048 **(10'0")**	13.41 **(44'0")**	82.12 **(2900)**	168-553 **(185-610)**	906-2265 **(32,000-80,000)**
SVM-3600	3200 **(10'6")**	14.63 **(48'0")**	101.94 **(3600)**	190-623 **(210-685)**	1020-2565 **(36,000-90,000)**



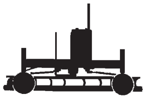
PAVING PRODUCTS — SLIPFORM PAVERS

Model	**Product Ident. No. Prefix**	**Years Built**	**Flywheel Horsepower**	**Approx. Operating Weight kg (lb)**	**Standard Paving Width m (ft)**	**Shipping Dimensions (Min.) Length m (ft)**	**Shipping Dimensions (Min.) Width m (ft)**	**Shipping Dimensions (Min.) Height m (ft)**	**Remarks**
SF-175	5ZC	—	142	9072 **(20,000)**	2.1 **(7'0")**	6.6 **(21'6")**	2.4 **(8'0")**	2.8 **(9'4")**	
SF-250	6XC	—	208	24 494 **(54,000)**	3.6 **(12'0")**	3.0 **(10'0")**	3.7 **(12'0")**		
SF-250B	—	—	250	27 216 **(60,000)**	3.7-7.3 **(12'0"-24'0")**	1.5 **(5'0")**	3.66 **(12'0")**	3.20 **(10'6")**	
SF-350	—	—	290	40 824 **(90,000)**	3.6-7.3 **(12'0"-24'0")**	1.04 **(3'5")**	3.0 **(10'0")**	2.9 **(9'8")**	
SF-450	7GC	73-83	400	43 546* **(96,000)** 53 525** **(118,000)**	3.66-7.62 **(12'0"-25'0")**	9.35 **(30'8")**	3.05 **(10'0")**	2.90 **(9'6")**	
SF-500	8DC	—	400	52 164 **(115,000)**	7.6 **(25'0")**	8.9 **(29'2½")**	3.0 **(10'0")**	3.0*** **(10'2")**	
SF-550	5PD	—	400	52 164 **(115,000)**	5.5-8.5 **(18'0"-28'0")**	7.0 **(23'0")**	3.7 **(12'0")**	2.9 **(9'8")**	

*Weight of 7.62 m **(25'0")** machine.
Weight of 11.58 m **(38'0") machine.
***Machine legs and track shipped separately.

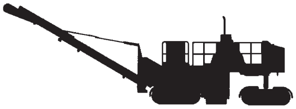
PAVING PRODUCTS — PLACER-SPREADER-TRIMMER, BELT PLACER

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower	Approximate Operating Weight kg (lb)	General Dimensions		
					Height m (ft)	Length m (ft)	Width m (ft)
PST-300	8EC	—	250	38 193 **(84,200)**	2.64 **(8'8")**	10.57 **(34'8")**	9.02 **(29'7")**
BP-100	1EF	—	102	11 340 **(22,000)**	3.27 **(10'9")**	2.49 **(8'2")**	2.49 **(8'2")**



PAVING PRODUCTS — TUBE FINISHER, TEXTURING/CURING

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower	Approximate Operating Weight kg (lb)	General Dimensions (Shipping)		
					Height mm (ft)	Length mm (ft)	Width mm (ft)
TF-250	6YC	—	52	5897 **(13,000)**	2489 **(8'2")**	8484 **(27'10")**	2438 **(8'0")**
TC-250	7HC	—	56	5897 **(13,000)**	2489 **(8'2")**	8484 **(27'10")**	2438 **(8'0")**



PAVING PRODUCTS — TRIMMER-RECLAIMER

Model	Product Ident. No. Prefix	Years Built	Flywheel Horsepower	Approximate Operating Weight kg (lb)	General Dimensions (Shipping)		
					Height mm (ft)	Length m (ft)	Width mm (ft)
TR-225B	6WC	—	250	21 319 **(47,000)**	3200 **(10'6")**	13.9 **(45'9.5")**	2896 **(9'6")**
TR-500	8CC	—	375	46 267 **(102,000)**	3099 **(10'2")**	8.9 **(29'2¾")**	3048 **(10'0")**

PAVING PRODUCTS — ASPHALT PAVERS & WINDROW ELEVATORS

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Screed Width mm (ft)	Hopper Capacity m^3 (ft^3)	Maximum Op. Speed m/min (ft/min)
AP-200	2NK	86-01	26 **(35)**	4080 **(9000)**	Track	2743 **(9'0")**	5.4 t **(6 T)**	53.6 **(176)**
AP-200	6AD	85-91	26 **(35)**	4080 **(9000)**	Track	2743 **(9'0")**	5.4 t **(6 T)**	0-54 **(0-177)**
AP-650B		-08	97 **(130)**	13 917 **(30,655)**		2400 **(8'0")**	5 t **(177 T)**	67 **(220)**
AP755	B2T - B3T	06-12	149 **(202)**	21 600 **(47,620)**	Track	9100 **(29'10")**	7.0 **(247)**	26 **(85)**
AP-800	1BF	86-89	76 **(102)**	11 903 **(26,350)**	Wheel	2438 **(8'0")**	5.8 **(206)**	95 **(312)**
AB-800B	1BF	89-93	76 **(102)**	11 903 **(26,350)**	Wheel	2438 **(8'0")**	5.8 **(206)**	95 **(312)**
AP-800C			80 **(107)**	12 115 **(26,700)**	Wheel	2438 **(8'0")**	5.5 **(195)**	76 **(250)**
AP-800D			80 **(107)**	12 115 **(26,700)**	Wheel	2400 **(8'0")**	5.5 **(195)**	76 **(250)**
AP-900		-06	114 **(153)**	14 445 **(31,850)**	Wheel	3000 **(10'0")**	6.1 **(215)**	122 **(400)**
AP-1000B		-05	130 **(174)**	15 490 **(34,150)**	Wheel	3000 **(10'0")**	6.1 **(215)**	114 **(374)**
AP-1000D	N/A	05-11	167 **(224)**	17 851 **(39,320)**	Wheel	7320 **(24'2")**	6.1 **(215)**	91 **(300)**
AP-1050	1JG	89-96	116 **(155)**	14 878 **(32,800)**	Track	3048 **(10'0")**	6.2 **(215)**	57 **(186)**
AP-1050B			130 **(174)**	16 015 **(35,300)**	Track	3048 **(10'0")**	6.1 **(215)**	61 **(200)**
AP-1055B			130 **(174)**	16 556 **(36,500)**	Track	3048 **(10'0")**	6.1 **(215)**	61 **(200)**
AP-1055D	N/A	05-11	167 **(224)**	20 330 **(44,780)**	Track	7320 **(24'2")**	6.1 **(215)**	78 **(225)**
AP-1200	2JD	85-89	108 **(145)**	13 608 **(30,000)**	Wheel	3048 **(10'0")**	6.2 **(220)**	21.4 **(13.3)**
WE601B	TEC	85-91	78 **(102)**	3856 **(8500)**	N/A	1524 **(5'0")**	N/A	N/A
BG-200A	N/A	89-91	35 **(47)**	6750 **(14,900)**	Wheel	1803 **(5'11")**	3.26 **(116)**	56 **(180)**
BG-210	N/A	90-91	79 **(106)**	10 192 **(22,500)**	Wheel	2438 **(8'0")**	4.76 **(170)**	84 **(275)**
BG-210B	N/A	91-01	80 **(107)**	11 793 **(26,000)**	Wheel	2438 **(8'0")**	4.8 **(170)**	0-21.7 **(0-13.5)**
BG-220	N/A	84-87	58 **(78)**	9752 **(21,500)**	Wheel	2438 **(8'0")**	3.7 **(130)**	88 **(289)**
BG-220B	4ZM	91-94	80 **(108)**	12 483 **(27,525)**	Wheel	2438 **(8'0")**	4.3 **(155)**	88 **(289)**

Paving Products — Asphalt Pavers & Windrow Elevators (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Screed Width mm (ft)	Hopper Capacity m³ (ft³)	Maximum Op. Speed m/min (ft/min)
BG-225	N/A	84-87	58 **(78)**	11 339 **(25,000)**	Track	2438 **(8'0")**	3.7 **(130)**	58 **(188)**
BG-225B	N/A		118 **(158)**	16 400 **(36,200)**	Track	2438 **(8'0")**	4.3 **(155)**	57 **(189)**
BG-225C			97 **(130)**	13 917 **(30,655)**	Track	2400 **(8'0")**	5 **(177)**	67 **(220)**
BG-230			80 **(107)**	12 111 **(26,700)**	Wheel	2438 **(8'0")**	5.5 **(195)**	76 **(250)**
BG500E		10-13	106 **(142)**	15 520 **(34,220)**	Wheel	2440 **(8'0")**	6.2 **(219)**	61 **(200)**
BG600D		08-13	129 **(174)**	17 122 **(37,747)**	Wheel	2440 **(8'0")**	6.5 **(230)**	61 **(200)**
BG-230D			97 **(130)**	13 307 **(29,310)**	Wheel	2400 **(8'0")**	5.5 **(195)**	76 **(250)**
BG-240	N/A	85-86	72 **(96)**	13 154 **(29,000)**	Wheel	3048 **(10'0")**	3.7 **(130)**	81 **(265)**
BG-240B	7RL	87-99	86 **(115)**	15 200 **(33,500)**	Wheel	3048 **(10'0")**	6.5 **(230)**	81 **(265)**
BG-245	N/A	85-87	72 **(96)**	14 514 **(32,000)**	Track	3048 **(10'0")**	5.8 **(206)**	58 **(189)**
BG-245B	3XL	87-96	116 **(155)**	16 080 **(35,450)**	Track	3048 **(10'0")**	5.8 **(206)**	55 **(182)**
BG-245C	N/A		130 **(174)**	16 015 **(35,300)**	Track	3048 **(10'0")**	6.1 **(215)**	60.1 **(200)**
BG-2455C	N/A		130 **(174)**	16 555 **(36,500)**	Track	3048 **(10'0")**	6.1 **(215)**	61 **(200)**
BG555E		10-13	106 **(142)**	16 240 **(35,810)**	Track	2440 **(8'0")**	6.2 **(219)**	61 **(200)**
BG655D		08-13	129 **(174)**	18 250 **(40,234)**	Track	2440 **(8'0")**	6.5 **(230)**	61 **(200)**
BG1055E		11-13	168 **(225)**	20 076 **(44,167)**	Track	3000 **(10'0")**	7.1 **(251)**	61 **(200)**
BG-2455D	N/A	05-11	167 **(224)**	20 330 **(44,780)**	Track	7320 **(24'2")**	6.1 **(215)**	78 **(225)**
AP600D		08-14	129 **(174)**	17 122 **(37,749)**	Wheel	2440 **(8'0")**	6.5 **(230)**	61 **(200)**
AP655D		07-14	129 **(174)**	18 245 **(40,225)**	Track	2440 **(8'0")**	6.5 **(230)**	61 **(200)**

Paving Products — Asphalt Pavers & Windrow Elevators (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Screed Width mm (ft)	Hopper Capacity m^3 (ft^3)	Maximum Op. Speed m/min (ft/min)
BG-260	N/A	85-87	106 **(142)**	14 514 **(32,000)**	Wheel	3048 **(10'0")**	5.8 **(206)**	77 **(253)**
BG-260B	N/A		116 **(155)**	14 740 **(32,500)**	Wheel	3048 **(10'0")**	5.8 **(206)**	90 **(296)**
BG1000E		11-13	168 **(225)**	18 427 **(40,539)**	Wheel	3000 **(10'0")**	7.1 **(251)**	61 **(200)**
BG-260D	N/A	05-11	167 **(224)**	17 851 **(39,320)**	Wheel	7320 **(24'2")**	6.1 **(215)**	91 **(300)**
BG-265	N/A	85-87	106 **(142)**	16 782 **(37,000)**	Track	3048 **(10'0")**	5.8 **(206)**	50 **(164)**
BG-265B	7XK	87-98	145 **(195)**	18 380 **(40,570)**	Track	3048 **(10'0")**	5.8 **(206)**	50 **(164)**
BG-270B	N/A		145 **(195)**	15 510 **(34,200)**	Wheel	3048 **(10'0")**	6.5 **(230)**	90 **(296)**
BG-610	N/A	85	58 **(78)**	4394 **(9700)**	N/A	1524 **(5'0")**	N/A	N/A
BG-610A	N/A	86-90	58 **(78)**	4911 **(10,840)**	N/A	1524 **(5'0")**	N/A	N/A
BG-650	N/A		80 **(107)**	7984 **(17 600)**	N/A	N/A	N/A	N/A
BG-710	N/A		111 **(149)**	13 380 **(29,500)**	Wheel	3048 **(10'0")**	10.0 **(80)**	98 **(320)**
BG-730	N/A	87-02	114 **(153)**	14 061 **(31,000)**	Wheel	3048 **(10'0")**	10.0 **(80)**	0-24.1 **(0-15.0)**
BG-750	N/A	87-97	116 **(155)**	17 010 **(37,500)**	Wheel	4270 **(14'0")**	10.0 **(80)**	0-24.1 **(0-15.0)**
MTP-1260	N/A	86-90	58 **(78)**	4911 **(10,840)**	N/A	3048 **(10'0")**	7.7 **(275)**	58 **(189)**
MTP-1265	N/A	88-91	167 **(224)**	25 368 **(56,000)**	N/A	3048 **(10'0")**	11.2 **(400)**	50 **(164)**
AP300		06-14	52 **(70)**	7300 **(16,094)**	Wheel	1700 **(5'7")**	3.8 **(134)**	85 **(279)**
AP1000E		11-14	168 **(225)**	18 427 **(40,539)**	Wheel	3048 **(10'0")**	7.1 **(251)**	61 **(200)**
AP1055E		11-14	168 **(225)**	20 076 **(44,167)**	Track	3048 **(10'0")**	7.1 **(251)**	61 **(200)**
AP300D	N/A		55.5 **(74.4)**	6300 **(13,889)**	Wheel	1700 **(5'7")**	3.8 **(134)**	30 **(98)**
AP500E	N/A	10-15	106 **(142)**	12 590 **(27,760)**	Wheel	2440 **(8'0")**	6.2 **(219)**	61 **(200)**
AP555E	N/A	10-15	106 **(142)**	13 305 **(29,335)**	Track	2440 **(8'0")**	6.2 **(219)**	61 **(200)**

PAVING PRODUCTS — SINGLE DRUM VIBRATORY COMPACTORS

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Drum Width mm (in)	Centrifugal Force kg (lb)	Maximum Op. Speed km/h (mph)
CS-323	1TM	85-95	57 **(77)**	4173 **(9200)**	Wheel/ Drum	1219 **(48)**	5760 **(12,700)**	0-10.9 **(0-6.8)**
CS-323C		04-10	62 **(83)**	4390 **(9680)**	Wheel/ Drum	1270 **(50)**	6804 **(15,000)**	8.9 **(5.5)**
CP-323	6JD	85-95	57 **(77)**	4218 **(9300)**	Wheel/ Drum	1219 **(48)**	5760 **(12,700)**	0-10.9 **(0-6.8)**
CP-323C		04-10	62 **(83)**	4745 **(10,440)**	Wheel/ Drum	1270 **(50)**	6804 **(15,000)**	8.9 **(5.5)**
CS-431	6MD	85-87	52 **(70)**	6110 **(13,480)**	Wheel	1680 **(66)**	7260 **(16,000)**	21.0 **(13.0)**
CS-431B	1XF	88-94	76.5 **(102)**	6312 **(13,915)**	Wheel	1680 **(66)**	11 235 **(24,746)**	12.8 **(8.0)**
CS-431C	9XL	94-01	78 **(105)**	6509 **(14,349)**	Wheel/ Drum	1680 **(66)**	13 609 **(30,000)**	12.8 **(8.0)**
CS-433	6ND	85-87	60 **(80)**	6720 **(14,820)**	Wheel/ Drum	1524 **(60)**	7260 **(16,000)**	10.0 **(6.0)**
CP-433	6NP	85-87	60 **(80)**	6750 **(14,870)**	Wheel/ Drum	1524 **(60)**	7260 **(16,000)**	10.0 **(6.0)**
CS-433B	4FK	88-94	76.5 **(102)**	6448 **(14,215)**	Wheel/ Drum	1680 **(66)**	11 235 **(24,746)**	12.8 **(8.0)**
CS-433C	3TM	94-01	78 **(105)**	6773 **(14,931)**	Wheel/ Drum	1680 **(66)**	13 609 **(30,000)**	12.8 **(8.0)**
CS-433E		04-10	75 **(100)**	6745 **(14,875)**	Wheel/ Drum	1700 **(66)**	13 608 **(30,000)**	11.5 **(7.1)**
CP-433B	1MG	88-94	76.5 **(102)**	6668 **(15,225)**	Wheel/ Drum	1680 **(66)**	11 235 **(24,746)**	12.8 **(8.0)**
CP-433C	2JM	94-01	78 **(105)**	7075 **(15,597)**	Wheel/ Drum	1680 **(66)**	13 609 **(30,000)**	12.8 **(8.0)**
CP-433E		04-10	75 **(100)**	7145 **(15,750)**	Wheel/ Drum	1700 **(66)**	13 608 **(30,000)**	11.5 **(7.1)**
CS44	N/A		75 **(100)**	6900 **(15,212)**	Wheel/ Drum	1676 **(5'6")**	13 600 **(30,000)**	12.3 **(7.6)**
CP44	N/A		75 **(100)**	7295 **(16,083)**	Wheel/ Drum	1676 **(5'6")**	13 600 **(30,000)**	12.3 **(7.6)**
CS-531	3WM	93-95	108 **(145)**	9310 **(20,500)**	Wheel	2134 **(84)**	22 680 **(50,000)**	12.8 **(8.0)**
CS-531C	5ZN	95-00	108 **(145)**	9300 **(20,450)**	Wheel	2134 **(84)**	24 091 **(53,000)**	12.8 **(8.0)**
CS-531D	3AZ 4MZ AGH	98-99 99-04 01-03	108 **(145)**	9650 **(21,230)**	Rear Wheel	2130 **(84)**	27 124 **(60,000)**	12.7 **(7.8)**

Paving Products — Single Drum Vibratory Compactors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Drum Width mm (in)	Centrifugal Force kg (lb)	Maximum Op. Speed km/h (mph)
CS-533	3BL	93-95	108 **(145)**	10 110 **(22,500)**	Wheel/ Drum	2134 **(84)**	22 680 **(50,000)**	12.8 **(8.0)**
CS-533C	2WN	95-00	108 **(145)**	9500 **(20,900)**	Wheel/ Drum	2134 **(84)**	24 091 **(53,000)**	12.8 **(8.0)**
CS-533D	AET 5CZ	00-03 00-04	108 **(145)**	9960 **(21,912)**	Drum/ Rear Wheel	2130 **(84)**	27 124 **(60,000)**	12.7 **(7.8)**
CS54		07-13	97 **(130)**	10 840 **(23,898)**	Wheel/ Drum	2134 **(84)**	23 860 **(52,600)**	11.1 **(6.9)**
CP-533	3ZL	93-95	108 **(145)**	11 470 **(25,250)**	Wheel/ Drum	2134 **(84)**	22 680 **(50,000)**	12.8 **(8.0)**
CP-533C	3XN	95-00	108 **(145)**	10 180 **(22,400)**	Wheel/ Drum	2134 **(84)**	24 091 **(53,000)**	12.8 **(8.0)**
CP-533D	6AZ AFC	01-04 00-03	108 **(145)**	10 240 **(22,528)**	Drum/ Rear Wheel	2130 **(84)**	27 124 **(60,000)**	13.2 **(8.1)**
CP54		07-13	97 **(130)**	11 530 **(25,419)**	Wheel/ Drum	2134 **(84)**	23 860 **(52,600)**	11.1 **(6.9)**
CS-551	6ZD 8AD	85-89	115 **(155)**	10 428 **(22,990)**	Wheel	2130 **(84)**	18 150 **(40,000)**	12.1 **(7.5)**
CS-553	7AD	85-89	115 **(155)**	10 782 **(23,770)**	Wheel/ Drum	2130 **(84)**	18 150 **(40,000)**	10.5 **(6.5)**
CP-553	7BD	85-89	115 **(155)**	12 247 **(27,000)**	Wheel/ Drum	2130 **(84)**	22 680 **(50,000)**	10.5 **(6.5)**
CS-563	8XF	89-95	108 **(145)**	11 130 **(24,500)**	Wheel/ Drum	2134 **(84)**	22 680 **(50,000)**	12.8 **(8.0)**
CS-563C	4KN	95-00	108 **(145)**	11 215 **(24,700)**	Wheel/ Drum	2134 **(84)**	24 091 **(53,000)**	12.8 **(8.0)**
CS-563D	9MW	98-02	108 **(145)**	10 875 **(23,975)**	Wheel/ Drum	2130 **(84)**	27 216 **(60,000)**	12.7 **(7.8)**
CS56		07-13	116 **(156)**	11 414 **(25,164)**	Wheel/ Drum	2134 **(84)**	28 712 **(63,300)**	11.4 **(7.0)**
CP-563	1YJ	89-95	108 **(145)**	11 580 **(25,800)**	Wheel/ Drum	2134 **(84)**	22 680 **(50,000)**	12.8 **(8.0)**
CP-563C	5JN	95-00	108 **(145)**	11 670 **(25,700)**	Wheel/ Drum	2134 **(84)**	24 091 **(53,000)**	12.8 **(8.0)**
CP-563D	9ZW	98-02	108 **(145)**	11 275 **(24,856)**	Wheel/ Drum	2130 **(84)**	27 216 **(60,000)**	13.2 **(8.1)**
CP56		07-13	116 **(156)**	11 361 **(25,047)**	Wheel/ Drum	2134 **(84)**	28 712 **(63,300)**	11.4 **(7.0)**

Paving Products — Single Drum Vibratory Compactors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Drum Width mm (in)	Centrifugal Force kg (lb)	Maximum Op. Speed km/h (mph)
CS-573C	6LN	95-00	108 **(145)**	13 800 **(30,360)**	Wheel/ Drum	2134 **(84)**	24 091 **(53,000)**	12.8 **(8.0)**
CS-573D	CMK	00-02	108 **(145)**	12 180 **(29,060)**	Wheel/ Drum	2130 **(84)**	27 216 **(60,000)**	12.7 **(7.8)**
CS64		07-13	116 **(156)**	14 238 **(31,389)**	Wheel/ Drum	2134 **(84)**	28 712 **(63,300)**	11.4 **(7.0)**
CP64		07-13	116 **(156)**	14 311 **(31,550)**	Wheel/ Drum	2134 **(84)**	28 712 **(63,300)**	11.4 **(7.0)**
CS-583	8YJ	91-95	108 **(145)**	15 040 **(33,090)**	Wheel/ Drum	2134 **(84)**	22 680 **(50,000)**	12.8 **(8.0)**
CS-583C	7MN	95-00	108 **(145)**	15 230 **(33,500)**	Wheel/ Drum	2134 **(84)**	24 091 **(53,000)**	12.8 **(8.0)**
CS-583D	2CZ	98-02	108 **(145)**	14 850 **(32,740)**	Wheel/ Drum	2130 **(84)**	31 751 **(70,000)**	12.7 **(7.8)**
CS74		07-13	116 **(156)**	15 455 **(34,072)**	Wheel/ Drum	2134 **(84)**	33 840 **(74,600)**	11.4 **(7.0)**
CP74		07-13	116 **(156)**	15 333 **(33,804)**	Wheel/ Drum	2134 **(84)**	33 840 **(74,600)**	11.4 **(7.0)**
CS-643	7FD	85-87	100 **(134)**	14 900 **(32,855)**	Wheel/ Drum	2200 **(86)**	16 800 **(37,044)**	15.5 **(9.6)**
CP-643	7GD	85-87	100 **(134)**	16 300 **(35,942)**	Wheel/ Drum	2200 **(86)**	12 600 **(27,783)**	15.5 **(9.6)**
CS76		07-13	130 **(174)**	16 758 **(36,945)**	Wheel/ Drum	2134 **(84)**	33 840 **(74,600)**	11.4 **(7.0)**
CP76		07-13	130 **(174)**	16 896 **(37,249)**	Wheel/ Drum	2134 **(84)**	33 840 **(74,600)**	11.4 **(7.0)**
CS-653	7HD	85-91	100 **(134)**	17 100 **(37,690)**	Wheel/ Drum	2200 **(86)**	22 230 **(48,995)**	15.5 **(9.6)**
CS76 XT		07-13	130 **(174)**	18 611 **(41,030)**	Wheel/ Drum	2134 **(84)**	33 840 **(74,600)**	11.4 **(7.0)**
CP-653	7JD	85-91	100 **(134)**	18 500 **(40,774)**	Wheel/ Drum	2200 **(86)**	22 230 **(48,995)**	15.5 **(9.6)**
TSF-54	7KD	85-88	26 **(35)**	2131 **(4700)**	Towed	1370 **(54)**	6810 **(15,000)**	Towed
TSM-54	7LD	86-88	26 **(35)**	2160 **(4760)**	Towed	1370 **(54)**	6810 **(15,000)**	Towed

PAVING PRODUCTS — DOUBLE DRUM, COMBI AND PNEUMATIC TIRE COMPACTORS

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Drum Width mm (in)	Centrifugal Force kg (lb)	Maximum Op. Speed km/h (mph)
CB14	DTT	07-12	16.1 **(21.6)**	1620 **(3571)**	Hydraulic	800 **(31)**	1051 **(2318)**	8.5 **(5.0)**
CB14 XW	DTT	07-12	16.1 **(21.6)**	1840 **(4057)**	Hydraulic	1000 **(39)**	1164 **(2565)**	8.5 **(5.0)**
CB14 Full Flush	DTT	07-12	16.1 **(21.6)**	1600 **(3527)**	Hydraulic	900 **(35)**	1051 **(2318)**	8.5 **(5.0)**
CB-214	6FD	85-88	24 **(33)**	2300 **(5070)**	Drum (2)	1000 **(39.4)**	2041 **(4500)**	10.6 **(6.6)**
CB-214B	6LF	88-93	24 **(33)**	2300 **(5072)**	Drum (2)	990 **(39)**	2018 **(4450)**	10.4 **(6.5)**
CB-214C	6LF	93-00	25 **(33)**	2320 **(5115)**	Drum (2)	1000 **(39.4)**	2592 **(5715)**	10.5 **(6.5)**
CB-214D	1TZ	99-03	23.5 **(31.5)**	2430 **(5355)**	Hydraulic	1000 **(39.4)**	2590 **(5710)**	10.0 **(6.2)**
CB-214E		-08	24.4 **(32.7)**	2450 **(5400)**	Hydraulic	1000 **(39)**	2751 **(6075)**	10.0 **(6.0)**
CB-224	6GD	85-88	24 **(33)**	2450 **(5400)**	Drum (2)	1200 **(47.2)**	2450 **(5400)**	10.6 **(6.6)**
CB-224B	6LF	88-93	24 **(33)**	2450 **(5402)**	Drum (2)	1199 **(47.2)**	2449 **(5400)**	10.4 **(6.5)**
CB-224C	6LF	93-00	25 **(33)**	2420 **(5335)**	Drum (2)	1200 **(47.2)**	2920 **(6570)**	10.5 **(6.5)**
CB-224D	8RZ	99-03	23.5 **(31.5)**	2610 **(5750)**	Hydraulic	1200 **(47.2)**	3039 **(6700)**	10.0 **(6.2)**
CB22		08-13	24.6 **(33)**	2500 **(5512)**	Hydraulic	1000 **(39)**	2817 **(6210)**	10.5 **(6.5)**
CB24		08-13	24.6 **(33)**	2700 **(5952)**	Hydraulic	1200 **(47)**	3195 **(7043)**	10.5 **(6.5)**
CB32		08-13	24.6 **(33)**	3230 **(7121)**	Hydraulic	1300 **(51)**	3195 **(7043)**	10.5 **(6.5)**
CC24		08-13	24.6 **(33)**	2400 **(5291)**	Hydraulic	1200 **(47)**	3195 **(7043)**	10.5 **(6.5)**
CB-224E		-08	24.4 **(32.7)**	2630 **(5800)**	Hydraulic	1200 **(47)**	3164 **(6975)**	10.0 **(6.0)**
CB-225D	9FZ	99-03	23.5 **(31.5)**	2390 **(5270)**	Hydraulic	1200 **(47.2)**	3039 **(6700)**	10.0 **(6.2)**
CB-225E		-08	24.4 **(32.7)**	2300 **(5070)**	Hydraulic	1200 **(47)**	3164 **(6975)**	10.0 **(6.0)**
CB-314	6HD	85-89	41 **(55)**	3357 **(7400)**	Drum	1120 **(44)**	2770 **(6100)**	8.0 **(5.0)**
CB-334D	3JZ 4CZ DCZ	98-03 98-02 02-04	32 **(43)**	3850 **(8490)**	Hydraulic	1300 **(51)**	3263 **(7250)**	11.0 **(7.0)**
CB-334E		-08	34.1 **(46)**	3940 **(8688)**	Hydraulic	1300 **(51)**	3378 **(7448)**	12.5 **(8.0)**

Paving Products — Double Drum, Combi and Pneumatic Tire Compactors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Drum Width mm (in)	Centrifugal Force kg (lb)	Maximum Op. Speed km/h (mph)
CB-335D	5PZ BBW D4E	98-03 00-03 02-03	32 **(43)**	3620 **(7980)**	Hydraulic	1300 **(51)**	3263 **(7250)**	11.0 **(7.0)**
CB34		07-13	34.1 **(46)**	3940 **(8688)**	Hydraulic	1300 **(51)**	3378 **(7448)**	12.5 **(8.0)**
CC34		07-13	34.1 **(46)**	3670 **(8091)**	Hydraulic	1300 **(51)**	3378 **(7448)**	12.5 **(8.0)**
CB-335E		-08	34.1 **(46)**	3670 **(8092)**	Hydraulic	1300 **(51)**	3378 **(7448)**	12.5 **(8.0)**
CB-414	6KD	85-89	52 **(70)**	5780 **(12,750)**	Drum	1397 **(55)**	6350 **(14,000)**	13.7 **(8.5)**
CB-424	6LD	85-89	54 **(73.5)**	6220 **(13,710)**	Drum (2)	1397 **(55)**	4485 **(9885)**	11.0 **(6.8)**
CB-434	3TF	89-94	60 **(80)**	6610 **(14,540)**	Drum (2)	1422 **(56)**	7620 **(16,800)**	11.6 **(7.2)**
CB-434B	6AL	94-95	60 **(80)**	6577 **(14,500)**	Drums	1422 **(56)**	7620 **(16,800)**	0-11.6 **(0-7.2)**
CB-434C	4DN	95-03	52 **(70)**	6485 **(14,300)**	Hydraulic	1422 **(56)**	7620 **(16,800)**	11.6 **(7.2)**
CB-434D		04-11	62 **(83)**	7500 **(16,535)**	Hydraulic	1500 **(59)**	7960 **(17,550)**	11.6 **(7.0)**
CB-434D XW		04-11	62 **(83)**	7700 **(16,975)**	Hydraulic	1700 **(67)**	7960 **(17,550)**	11.6 **(7.0)**
CB-514	6YD	85-88	68 **(91)**	9730 **(21,450)**	Drum (2)	1730 **(68)**	9073 **(20,000)**	11.0 **(7.0)**
CB-521	6RD	85-87	61 **(82)**	8800 **(19,404)**	Wheel	1700 **(67)**	5300 **(11,687)**	15.0 **(9.3)**
CB-522	6SD	85-87	45 **(62)**	10 100 **(22,271)**	Drum (2)	1700 **(67)**	10 350 **(22,822)**	8.0 **(5.0)**
CB-523	6TD	85-87	61 **(82)**	8800 **(19,404)**	Wheel/ Drum	1700 **(67)**	5300 **(11,687)**	13.0 **(8.0)**
CB-524	6WD	85-87	61 **(82)**	9500 **(20,948)**	Drum (2)	1700 **(67)**	10 350 **(22,822)**	11.0 **(6.8)**
CB-534	6EG2YF	87-93	93 **(125)**	9117 **(20,100)**	Drum (2)	1700 **(67)**	11 800 **(26,019)**	11.2 **(7.0)**
CB-534B	4JL	93-95	80 **(107)**	9117 **(20,100)**	Drums	1676 **(66)**	12 043 **(26,550)**	0-11.3 **(0-7.0)**
CB-534C	5HN	95-02	75 **(100)**	9195 **(20,270)**	Drums	1700 **(67)**	11 975 **(26,400)**	11.3 **(7.0)**
CB-534D			97 **(130)**	10 380 **(22,836)**	Drums	1700 **(67)**	11 434 **(25,208)**	13.0 **(8.0)**
CB54		09-12	102 **(137)**	10 804 **(23,818)**	Hydraulic	1700 **(67)**	11 300 **(24,929)**	13.0 **(8.0)**
CB-534D XW			97 **(130)**	11 300 **(24,860)**	Drums	2000 **(79)**	11 434 **(25,208)**	13.0 **(8.0)**
CB54 XW	N/A		102 **(137)**	11 898 **(26,230)**	Hydraulic	2000 **(6'7")**	11 308 **(24,929)**	13.0 **(8.0)**

Paving Products — Double Drum, Combi and Pneumatic Tire Compactors (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel kW (hp)	Approx. Op. Weight kg (lb)	Drive	Drum Width mm (in)	Centrifugal Force kg (lb)	Maximum Op. Speed km/h (mph)
CB-544	8FM	94-01	60 **(80)**	10 700 **(23,593)**	Drums	1700 **(67)**	8850 **(19,510)**	8.9 **(5.5)**
CB-545	2FS	96-01	60 **(80)**	9410 **(20,750)**	Wheel/ Drum	1700 **(67)**	8850 **(19,510)**	8.9 **(5.5)**
CB-564D			97 **(130)**	12 600 **(27,783)**	Drums	2130 **(84)**	10 085 **(22,234)**	13.0 **(8.0)**
CB-614	7CD	85-93	115 **(155)**	11 340 **(25,000)**	Drum (2)	1980 **(78)**	9525 **(21,000)**	11.2 **(7.0)**
CB-634	5CL	94-95	108 **(145)**		Drums	2134 **(84)**	12 043 **(26,550)**	0-9.2 **(0-5.7)**
CB-634C	3BR	95-01	108 **(145)**	11 680 **(25,750)**	Drums	2134 **(84)**	12 043 **(26,550)**	12.2 **(7.6)**
CB64	N/A		102 **(137)**	12 980 **(28,616)**	Hydraulic	1680 **(5'6")**	14 107 **(31,100)**	13.0 **(8.0)**
CD54		09-12	74.5 **(99.5)**	9500 **(20,944)**	Hydraulic	1700 **(67)**	8573 **(18,900)**	9.0 **(5.5)**
PF-200		85-92	49 **(66)**	7000 **(15,430)**	Wheel Pneumatic	1700 **(67)**	N/A	24.0 **(14.9)**
PS-110	7MD	85-96	57 **(77)**	12 500 **(27,550)**	Wheel Pneumatic	2134 **(84)**	N/A	38.6 **(24.0)**
PS-130	7ND	85-96	57 **(77)**	12 500 **(27,550)**	Wheel Pneumatic	1700 **(67)**	N/A	38.6 **(24.0)**
PS-150	7PD	85-96	57 **(77)**	15 050 **(37,300)**	Wheel Pneumatic	1700 **(67)**	N/A	38.6 **(24.0)**
PS-150B	3XR	95-04	52 **(70)**	12 940 **(28,535)**	Hydraulic	1743 **(69)**	N/A	25.6 **(15.9)**
PS150C	N/A		75 **(100)**	12 940 **(28,535)**	Hydraulic	1740 **(5'8")**	NA	25.6 **(15.9)**
PS-180	7PD	85-96	57 **(77)**	16 950 **(37,000)**	Wheel Pneumatic	1727 **(68)**	N/A	38.6 **(24.0)**
PS-200B	5JR	95-04	78 **(105)**	13 010 **(28,685)**	Hydraulic	1743 **(69)**	N/A	19.3 **(12.0)**
PS-300 PF-300	7TD 7WD	85-95 85-95	77 **(102)**	21 000 **(46,200)**	Wheel Pneumatic	1900 **(75)**	N/A	26.5 **(16.4)**
PS-300B PF-300B			74 **(105)**	14 000 **(30,860)**	Wheel Pneumatic	1920 **(77)**	N/A	19.0 **(11.8)**
PF-300C PS-300C			75 **(100)**	21 000 **(46,200)**	Wheel Pneumatic	1900 **(75)**		13.0 **(8.0)**
PS-360B			78 **(105)**	8500 **(18,740)**	Wheel Pneumatic	2275 **(90)**	N/A	18.0 **(11.0)**

SURFACE DRILLS — TRACK DRILLS

Model	Hole Diameter	Hole Depth	Air Compressor	Rock Drill	Engine	Years Built
MD5050	• Up to 102 mm **(4.0 in)**	• Up to 31.2 m **(102.5 ft)**	• 7.08 m³/min @ 10.2 bar **(250 ft³/min @ 150 psi)**	• HPR4519 19 kW **(25 hp)**	• 4HK* 150 kW **(203 hp)** at 2100 RPM	Up to 2016
MD5050T	• Up to 102 mm **(4.0 in)**	• Up to 31.2 m **(102.5 ft)**	• 7.08 m³/min @ 10.2 bar **(250 ft³/min @ 150 psi)**	• HPR4519 19 kW **(25 hp)**	• 4HK* 150 kW **(203 hp)** at 2100 RPM	Up to 2016
MD5075	• Up to 127 mm **(5 in)**	• Up to 31.2 m **(102.5 ft)**	• 9.78 m³/min @ 10.2 bar **(350 ft³/min @ 150 psi)**	• HPR4519 19 kW **(25 hp)**	• Cat C9 ACERT* 224 kW **(300 hp)** at 1800 RPM	Up to Aug. 2014
MD5090	• Up to 127 mm **(5 in)**	• Up to 22.1 m **(72.5 ft)**	• 8.5 m³/min @ 10.2 bar **(300 ft³/min @ 150 psi)**	• HPR4519 19 kW **(25 hp)**	• Cat C9 ACERT* 224 kW **(300 hp)** at 1800 RPM	Up to 2016
MD5125	• Up to 152 mm **(6 in)**	• Up to 30 m **(98.5 ft)**	• 11.3 m³/min @ 7 bar **(400 ft³/min @ 100 psi)**	• HPR5128 28 kW **(37 hp)**	• Tier 3 Cat C11 242 kW **(325 hp)** at 1800 RPM	Up to Aug. 2014

*This product emits equivalent to Tier 3, Stage IIIA, and Japan 2006 (Tier 3).

SURFACE DRILLS — ROTARY DRILLS

Model	Hole Diameter	Hole Depth	Air Compressor	Engine	Years Built
MD6240	• Up to 244 mm **(9.625 in)**	• Depth single-pass (12 m mast) — Up to 12.80 m **(42 ft)** • Depth multi-pass — Up to 55.47 m **(182 ft)** • Depth single-pass (15 m mast) — Up to 15.85 m **(52 ft)** • Depth multi-pass — Up to 31.08 m **(102 ft)**	• 48 m³/min **(1700 ft³/min)** 6.9 bar **(100 psi)** • 32.6 m³/min **(1150 ft³/min)** 10.3/24.1 bar **(150/350 psi)** • 38.3 m³/min **(1350 ft³/min)** 10.3/24.1 bar **(150/350 psi)** • 43 m³/min **(1500 ft³/min)** 34.5 bar **(500 psi)**	• C27 ACERT* • 597 kW **(800 hp)** at 2100 RPM • 652 kW **(875 hp)** at 2100 RPM	Up to 2016
MD6420	• Up to 311 mm **(12.25 in)**	• Depth single pass (10 m mast) — Up to 10.29 m **(33 ft 9 in)** • Depth multi-pass — Up to 63.4 m **(208 ft)** • Depth single pass (13 m mast) — Up to 13.4 m **(44 ft)** • Depth multi-pass — Up to 74.4 m **(244 ft)** • Depth single pass (16 m mast) — Up to 16.46 m **(54 ft)** • Depth multi-pass — Up to 65.2 m **(214 ft)**	• 67.9 m³/min **(2400 ft³/min)** 6.9 bar **(100 psi)** • 42.5 m³/min **(1500 ft³/min)** 10.3/24.1/34.4 bar **(150/350/500 psi)** • 67.9 m³/min **(2400 ft³/min)** 6.9 bar **(100 psi)**	• C27 ACERT* • 597 kW **(800 hp)** at 2100 RPM • C27 ACERT* • 652 kW **(875 hp)** at 2100 RPM • Cummins QST30* 634 and 783 kW **(850 and 1050 hp)** 783 kW **(1050 hp)** at 2100 RPM	Up to 2016
MD6420B	• Up to 311 mm **(12.25 in)**	• Depth single pass (10 m mast) — Up to 10.29 m **(33 ft 9 in)** • Depth multi-pass — Up to 63.40 m **(208 ft)** • Depth single pass (13 m mast) — Up to 13.4 m **(44 ft)** • Depth multi-pass — Up to 74.4 m **(244 ft)** • Depth single pass (16 m mast) — Up to 16.46 m **(54 ft)** • Depth multi-pass — Up to 65.2 m **(214 ft)**	• 56.6 m³/min **(2000 ft³/min)** 6.9 bar **(100 psi)** • 67.9 m³/min **(2400 ft³/min)** 6.9 bar **(100 psi)** • 42.5 m³/min **(1500 ft³/min)** 34.4 bar **(500 psi)**	• 627 kW **(850 hp)** at 1800 RPM • QST30C* (non-cert with cense) 786 kW **(1050 hp)** at 2100 RPM • QST30* 627 kW **(850 hp)** at 1800 RPM • AST30C (non-cert with cense) 783 kW **(1050 hp)** at 2100 RPM	Up to 2016
MD6540	• Up to 381 mm **(15 in)**	• Depth single-pass (16 m mast) — Up to 16.15 m **(53 ft)** • Depth multi-pass — Up to 84.73 m **(278 ft)** • Depth single pass (20 m mast) • Depth multi-pass — Up to 65.7 m **(215.6 ft)**	• 102 m³/min **(3600 ft³/min)** 6.9 bar **(100 psi)**	• MTU Detroit Diesel Series 2000 16V* • 899 kW **(1205 hp)** at 1800 RPM	Up to 2016
MD6750	• Up to 444 mm **(17.5 in)**	• 19.81 m **(65 ft)**	• 107.6 m³/min **(3800 ft³/min)**	• AC Induction Motor • Dual Shaft • 597 kW **(800 hp)**	Up to 2014

*This product emits equivalent to Tier 2.

UNDERGROUND MINING — HARD ROCK LOAD-HAUL-DUMPS (LHD'S)

LHD Model	Product Ident. No. Prefix (USA)	Years Built	Flywheel Power kW (hp)	Approx. Shipping Weight kg (lb)	Max. Capacity kg (lb)	Length m (ft)	Height m (ft)	Bucket Width mm (ft)	Breakout Force kg (lb)	Maximum Speeds km/h (mph)	
										Forward	Reverse
R1300	6QW	96-03	123 **(165)**	20 150 **(44,430)**	6500 **(14,330)**	8.66 **(28'5")**	2.00 **(6'7")**	2000 **(6'7")**	12 020 **(26,500)**	26.1 **(16.2)**	23.8 **(14.6)**
R1300G	LJB	03-13	123 **(165)**	20 950 **(46,187)**	6800 **(14,991)**	8.71 **(28'7")**	2.12 **(6'11")**	2200 **(7'3")**	12 020 **(26,500)**	24.0 **(14.9)**	23.0 **(14.3)**
R1300GII	RSL	06-08	136 **(182)**	20 875 **(46,021)**	6800 **(14,991)**	8.71 **(28'7")**	2.12 **(6'11")**	2200 **(7'3")**	15 350 **(33,841)**	26.1 **(16.2)**	25.9 **(16.1)**
R1500	BAY	86-00	178 **(239)**	25 100 **(55,360)**	9000 **(19,850)**	9.19 **(30'2")**	2.30 **(7'7")**	2480 **(8'2")**	18 460 **(40,700)**	30.4 **(18.9)**	33.0 **(20.5)**
R1600	9EW	97-03	201 **(270)**	29 800 **(65,710)**	10 200 **(22,490)**	9.71 **(31'10")**	2.40 **(7'10")**	2600 **(8'6")**	19 280 **(42,510)**	30.6 **(19.0)**	34.0 **(21.1)**
R1600	9XP	01-03	201 **(270)**	29 800 **(65,710)**	10 200 **(22,490)**	9.71 **(31'10")**	2.40 **(7'10")**	2600 **(8'6")**	19 280 **(42,510)**	30.6 **(19.0)**	34.0 **(21.1)**
R1600G	9PP	03-08	201 **(270)**	29 800 **(65,700)**	10 200 **(22,490)**	9.71 **(31'10")**	2.40 **(7'10")**	2600 **(8'6")**	19 000 **(41,888)**	22.9 **(14.2)**	23.8 **(14.8)**
R1600G	9YZ	07-13	201 **(270)**	29 800 **(65,700)**	10 200 **(22,490)**	9.71 **(31'10")**	2.40 **(7'10")**	2600 **(8'6")**	19 000 **(41,888)**	22.9 **(14.2)**	23.8 **(14.8)**
R1700 Series II	4LZ	94-00	231 **(310)**	34 500 **(76,100)**	12 000 **(26,460)**	10.42 **(34'2")**	2.53 **(8'4")**	2820 **(9'3")**	23 430 **(51,660)**	29.3 **(18.2)**	33.3 **(20.7)**
R1700G	8XZ	99-06	262/241 **(351/323)**	38 500 **(84,878)**	14 000* **(30,865)***	10.59 **(34'9")**	2.56 **(8'5")**	2894 **(9'6")**	20 100 **(44,313)**	24.1 **(15.0)**	25.3 **(15.7)**
R1700G	SBR/XBR	06-19	242/263 **(324/353)**	38 500 **(84,878)**	14 000* **(30,865)***	10.74 **(35'3")**	2.56 **(8'5")**	2772 **(9'1")**	20 885 **(46,051)**	24.1 **(15.0)**	25.3 **(15.7)**
R2800	BBR	88-98	231 **(310)**	42 660 **(94,070)**	16 200 **(35,720)**	10.70 **(35'1")**	2.68 **(8'10")**	3000 **(9'10")**	26 540 **(68,530)**	29.3 **(18.2)**	33.3 **(20.7)**
R2900	5TW	95-03	269 **(361)**	48 850 **(107,710)**	17 200 **(37,920)**	10.97 **(36'0")**	2.89 **(9'6")**	3100 **(10'2")**	28 600 **(63,060)**	26.7 **(16.6)**	32.5 **(20.2)**
R2900G	GLK	02-05	306 **(410)**	50 100 **(110,451)**	17 200 **(37,920)**	11.3 **(37'1")**	2.89 **(9'6")**	3176 **(10'5")**	27 346 **(60,298)**	25.3 **(15.7)**	26.4 **(16.4)**
R2900G XTRA	GLK	02-05	306 **(410)**	53 100 **(117,065)**	20 000* **(44,092)***	11.3 **(37'1")**	2.89 **(9'6")**	3400 **(11'2")**	27 346 **(60,298)**	25.3 **(15.7)**	26.4 **(16.4)**
R2900G XTRA	JLK	05-13	333 **(447)**	55 575 **(122,522)**	20 000* **(44,092)***	11.3 **(37'1")**	2.99 **(9'10")**	3500 **(11'6")**	27 346 **(60,298)**	25.3 **(15.7)**	26.4 **(16.4)**

*Capacity is for tramming only. Truck loading capacity is lower.

UNDERGROUND MINING — HARD ROCK TRUCKS

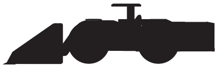
Articulated Trucks

Truck Model	Product Ident. No. Prefix (USA)	Years Built	Flywheel Power kW (hp)	Approx. Shipping Weight kg (lb)	Max. Capacity kg (lb)	Length m (ft)	Height m (ft)	Body Width mm (ft)	Maximum Speeds km/h (mph)	
									Forward	Reverse
AD30	CXR	02-05	304 **(408)**	28 870 **(63,647)**	30 000 **(66,139)**	10.2 **(33'4")**	2.60 **(8'6")**	2690* **(8'10")***	40.8 **(25.4)**	7.8 **(4.8)**
AD40	1YZ	94-02	380 **(510)**	38 100 **(84,000)**	40 000 **(88,200)**	10.7 **(35'0")**	2.70 **(8'10")**	3000 **(9'10")**	48.1 **(29.9)**	10.6 **(6.6)**
AD40 Series II	N/A	N/A	380 **(510)**	41 800 **(92,170)**	40 000 **(88,200)**	11.3 **(37'0")**	2.89 **(9'6")**	3200 **(10'5")**	41.7 **(25.9)**	9.6 **(6.0)**
AD45	BKZ	01-05	439 **(589)**	39 359 **(86,772)**	45 000 **(99,208)**	11.2 **(36'9")**	2.82 **(9'5")**	3000* **(9'10")***	52.0 **(32.3)**	10.7 **(6.6)**
AD55	ANW	01-03	485 **(650)**	47 000 **(103,617)**	55 000 **(121,254)**	11.6 **(37'11")**	3.20 **(10'6")**	3346* **(11'0")***	42.3 **(26.3)**	9.0 **(5.6)**
AD55B	JNW	07-13	600 **(805)**	50 000 **(110,231)**	55 000 **(121,254)**	12.0 **(39'0")**	3.4 **(11'2")**	3346* **(11'0")***	41.5 **(25.8)**	8.7 **(5.4)**
Rigid Frame Trucks										
69D Dump	9XS	00-04	380 **(510)**	30 100 **(66,371)**	38 000 **(83,790)**	8.1 **(26'8")**	3.4 **(11'4")**	3665 **(12'0")**	76.6 **(47.6)**	13.5 **(8.4)**
69D Ejector	9XS	00-04	380 **(510)**	34 700 **(78,514)**	36 200 **(79,821)**	7.8 **(25'8")**	3.4 **(11'4")**	3665 **(12'0")**	75.2 **(46.7)**	13.5 **(8.4)**

*Overall width less body.

UNDERGROUND MINING — ROOM & PILLAR — CONTINUOUS MINERS

Model	Prefix	Exit Year	Bucyrus Model	Total Power kW (hp)	Cutter Head Power kW (hp)	Loading Capacity tonnes/min (Tons/min)	Recommended Mining Range mm (in)	Machine Weight tonnes (lb)
CM235	GEG	2014	25C	701 **(940)**	2 × 205 **(2 × 275)**	14-29 **(15-32)**	914-3251 **(36-128)**	61.2 **(135,000)**
CM330	GEY	2014	30M2	698 **(930)**	2 × 104 **(2 × 280)**	24 **(26.5)**	up to 3170 **(up to 125)**	61.7 **(136,000)**
CM845	GE6	2015	30MB	674 **(904)**	2 × 173 **(2 × 232)**	31.5 **(35)**	2800-3900 **(110-153)**	92.0 **(202,800)**



UNDERGROUND MINING — ROOM & PILLAR — LHDs

Model	Prefix	Exit Year	Bucyrus Model	Bucket Payload kg (lb)	Fork Payload kg (lb)	Engine	Engine Power kW (hp)	Machine Weight kg (lb)
CL106		2014	N/A					
CL110	LH4	2014	N/A	8000 **(17,636)**	10 000 **(22,046)**	Cat C7 ACERT	171.5 **(230)**	21 500 **(47,400)**
CL115	LH6	2014	N/A					
CL215B		2014	MH15					

UNDERGROUND MINING — ROOM & PILLAR — SCOOPS

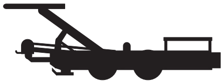
Model	Prefix	Exit Year	Bucyrus Model	Lift Capacity tonnes (Tons)	Engine	Engine Power kW (hp)	Tram Speed km/h (mph)	Weight with Battery kg (lb)
SU482 DN (diesel non permissible)	LAW	2014	482D	6.8 **(7.5)**	Duetz BF4L 2011	58 **(78)**	16.9 **(10.5)**	
SU482	LAP	2014	488XL	6.4 **(7.0)**	Battery		8.0 **(5.0)**	
SU488 DM (dual motor)	LA4	2014	488-6 DM	14.5 **(16.0)**	Battery		8.0 **(5.0)**	26 853 **(59,200)**
SU488 D XP (explosion proof)		2014	488D XP	14.5 **(16.0)**	Duetz	112 **(150)**	17.9 **(11.1)**	
SU488 LHD	LA6	2014	488D LHD XP	10.9 **(12.0)**	Duetz 1013 FC	112 **(150)**	17.9 **(11.1)**	
SU488 LHD N	LA7	2014	488D LHD	10.9 **(12.0)**	Duetz 1013 FC	112 **(150)**	17.9 **(11.1)**	
SU488 DM AC (alternating current)	LA4	2014	488-6 DM	14.5 **(16.0)**	Battery		8.0 **(5.0)**	26 853 **(59,200)**
SU636		2014						

UNDERGROUND MINING — ROOM & PILLAR — HAULAGE (FACE HAULERS, CONTINUOUS HAULAGE)

Model	Prefix	Exit Year	Bucyrus Model	Payload Capacity tonnes (Tons)	Machine Weight — empty kg (lb)	Minimum Operating Height mm (in)	Engine Type	Engine Power kW (hp)
FH110	FHM	2014	810C Un-a-trac	9.0 **(10.0)**	31 524 — with battery **(69,500)**	1066 **(42)**		
FH125 D	FHX	2014	FBR 15 Ram Car	20.0 **(22.0)**	25 000 — full tanks **(55,115)**	1900 **(74.8)**	Cat 3126	172 **(230)**
FH336 (Continuous Haulage)	FHZ	2014	36 CHH	27.0 **(30.0)**	27 216 **(60,000)**	965 **(38)**		

UNDERGROUND MINING — ROOM & PILLAR — FEEDER BREAKERS

Model	Prefix	Exit Year	Bucyrus Model	Capacity Throughput tonnes/hr (Tons/hr)	Minimum Operating Height mm (in)	Operating Weight kg (lb)	Total Power kW (hp)
FB75	FBP	2014	7MFBH-48A LOW GH-MFBHM-48CDL	717 **(790)** 1089 **(1200)**	1270 **(50)** 1219 **(48)**	31 751 **(70,000)** 27 215 **(60,000)**	151 **(200)** 151 **(200)**
FB75 P (permissible)	FBP	2014					
FB85	FBE	2014	7FB-56AL	860 **(950)**	836 **(34)**	31 750 **(70,000)**	150 **(200)**
FB85 P (permissible)	FBE	2014	7FB-56AL	860 **(950)**	837 **(34)**	31 750 **(70,000)**	151 **(200)**
FB110 P (permissible)	FBL	2014	7FB-48A	1146 **(1263)**	1219 **(48)**	31 750 **(70,000)**	151 **(200)**



UNDERGROUND MINING — ROOM & PILLAR — ROOF BOLTERS

Model	Prefix	Exit Year	Bucyrus Model	Drilling Torque N·m (lbf-ft)	Minimum Tram Height mm (ft)	Maximum ATRS Reach mm (ft)
RB120	RM9	2014	LRB-15AR	380 **(280)**	813 **(2'8")**	1930 **(6'4")**
RB230	RP9	2014	RB2-88A	420 **(310)**	1181 **(3'10.5")**	3048 **(10'0")**

UNDERGROUND MINING — ROOM & PILLAR — ROOF SUPPORT CARRIERS

Model	Prefix	Exit Year	Bucyrus Model	Lift Capacity – No Ballast tonnes (Tons)	Machine Weight kg (lb)	Tram Speed Level Unloaded km/h (mph)	Engine Type	Engine Power kW (hp)
SH650 VFD	RS6	2014	VT650	45.0 **(50.0)**	46 040 — with battery **(101,500)**	6.6 **(4.1)**	Battery	N/A
SH650 D	RS5	2014	VT650D	45.0 **(50.0)**	45 359 kg **(100,000)**	13.7 **(8.5)**	Cummins C8.3	179 **(240)**
SH660 D	JE3	2014	FBL-55	55.0 **(60.625)**	48 000 — tanks full **(105,821)**	19.5 **(12.1)**	Cat C7 ACERT	171.5 **(230)**

LAND CLEARING

CONTENTS

Land clearing must be treated more as an art than a science because production rates and methods vary greatly from one area to another. This section deals with the many variables in clearing and includes methods, equipment and procedures to determine productivity rates.

VARIABLES AFFECTING CLEARING OPERATIONS

Vegetative Growth — Factors affecting production and therefore cost, include the number of trees, size of trees, wood density, root systems, vines and undergrowth. These factors can be estimated by a "tree-count" as discussed under "Job Survey."

End Use of Land — Since different end uses require different degrees of clearing (i.e. highways, dams, tree crops, row crops, etc.), this is one of the most important factors to consider in choosing the proper clearing method and equipment.

Soil Conditions or Bearing Capacity — Factors affecting clearing operations include topsoil depth, soil type, moisture content, and the presence of rocks and stones.

Topography — Grade and terrain factors such as steep slopes, ditches, swampy areas, boulders and even ant hills greatly affect the normal operation of some equipment.

Rainfall and Climate — Usually all phases of land clearing from cutting to burning are concerned to some degree with temperature changes and the amount of rainfall during the clearing operation.

Job Specifications — Specifications dictate the degree of clearing to be done, area size, completion dates, method of debris disposal, soil conservation and other factors which affect method and equipment selection.

JOB SURVEYS

Knowledge of rainfall and climate, end use of the land, and job specifications can be obtained from records, surveys, engineering studies, and written specifications. You should personally review the land to be cleared to gain other necessary and valuable information.

The survey should include a study of general topography and soil conditions. Note such problem factors as hills, rocks, or swamps which would significantly affect production or which would require special treatment.

Cruise the area to be cleared and determine the acreage of each vegetative type (i.e. upland woods, low timberlands, swamps). Make at least three tree counts at random for each vegetation type. To conduct these counts, randomly locate two points 100 meters (328 feet) apart. Count and measure vegetative growth along a straight line between these points for a width of about 5 meters (16 feet) on both sides. This gives the population of 1/10 hectare (1/4 acre).

1. Density of vegetation less than 30 cm (12 in) diameter
   Dense — 1480 trees/hectare or more
   (600 trees/acre)
   Medium — 990-1480 trees/hectare
   (400-600 trees/acre)
   Light — less than 990 trees/hectare
   (400 trees/acre)
2. Presence of hardwoods expressed in percent
3. Presence of heavy vines
4. Average number of trees per hectare (2.47 acres) in each of the following ground level diameter size ranges:
   Less than 30 cm (1 ft)
   31 cm-60 cm (1-2 ft)
   61 cm-90 cm (2-3 ft)
   91 cm-120 cm (3-4 ft)
   121 cm-180 cm (4-6 ft)
5. Sum of diameter of all trees per hectare (2.47 acres) above 180 cm (6 ft) in diameter at ground level.

CLEARING METHODS AND EQUIPMENT

Methods for Initial Felling — There are several methods indicating the degree of clearing for initial felling and several types of equipment for use with each method. Equipment use in different size vegetation and different size areas is summarized in the table on the next page. This information should serve only as a rough guideline in selecting equipment. The economical land area for each type of equipment will vary with the capital cost of equipment and moving cost. It is also affected by whether there are alternate uses for equipment such as using tractors for other construction work or tillage.

Land Clearing Machines — Job size, severity of job such as tree size, and time limit to complete will influence machine selection. Some machines, such as purpose built forestry equipment and track-type tractors are more suited for this type of work than others, but imagination and resourcefulness can allow the use of other types of machines in specific applications. For example, loaders are used more today in raking and piling operations than ever before.

Operator Protection and Machine Guarding — Daily production has been estimated to increase 20% when cab guards are used. Cabs designed specifically for forestry and clearing applications are available on purpose built Cat® forestry equipment. Auxiliary equipment manufacturers such as Rome™ offer after market guard packages for non-purpose built units.

Locally designed and manufactured guarding for non-purpose built equipment is required. The radiator, engine, and underside of the tractor must be well protected. Perforated hoods, screens, crankcase guards and hydraulic cylinder guards are generally recommended.

Generally speaking lower cost clearing can be done with purpose built forestry equipment and larger tractors if the amount of clearing involved is sufficient to merit the initial investment of purpose built or if the amount of clearing involved is sufficient to merit the initial investment in the bigger machine. In applications where track-type tractors are used, power shift transmissions should be standard due to the frequent direction changes. The direct drive transmission tractor is recommended when the tractor is used principally in constant drawbar work such as chaining or pulling a disc harrow. In most applications, a winch should also be considered on one of every three tractors in a fleet.

EQUIPMENT SELECTION TABLE

	UPROOTING	CUTTING AT OR ABOVE GROUND LEVEL	KNOCKING TO THE GROUND	INCORPORATING INTO THE SOIL
LIGHT CLEARING — Vegetation up to 5 cm (2 in) diameter				
Small areas 4 hectares (10 acres)	Bulldozer blade; forestry machine road builder arrangement	Wheel-mounted circular saws	Bulldozer blade; forestry machine road builder arrangement	Moldboard plows, disc plows, disc harrows
Medium areas 40 hectares (100 acres)	Bulldozer blade; forestry machine road builder arrangement	Heavy duty sickle mowers [up to 3.7 cm (1½ in) diameter] tractor-mounted circular saws, suspended rotary mowers; site prep tractor with brush cutter or mulcher attachment	Bulldozer blade, rotary mowers; flail-type rotary cutters; rolling brush cutters; forestry machine road builder arrangement; site prep tractor with brush cutter or mulcher attachment	Moldboard plows; disc plows, disc harrows; site prep tractor with mulcher attachment
Large areas 400 hectares (1000 acres)	Bulldozer blade, root rake, grubber, root plow, anchor chain drawn between two crawler tractors; rails	Site prep tractor with brush cutter or mulcher attachment	Rolling brush cutter; flail-type cutter; anchor chain drawn between two crawler tractors; rails; site prep tractor with brush cutter or mulcher attachment	Undercutter with disc; moldboard plows; disc plows; disc harrows; site prep tractor with mulcher attachment
INTERMEDIATE CLEARING — Vegetation 5 to 20 cm (2 to 8 in) diameter				
Small areas 4 hectares (10 acres)	Bulldozer blade; forest machine road builder arrangement	Wheel-mounted circular saws	Bulldozer blade; forestry machine road builder arrangement	Heavy-duty disc plow; disc harrow
Medium areas 40 hectares (100 acres)	Bulldozer blade; forest machine road builder arrangement	Tractor-mounted circular saws, single scissor type tree shears; site prep tractor with brush cutter or mulcher attachment; wheel/track feller buncher with high speed saw head; forest machine with directional felling head	Bulldozer blade, rolling brush cutter [up to 12 cm (5 in) diameter], rotary mower [up to 10 cm (4 in) diameter]; forestry machine road builder arrangement; Site prep tractor with brush cutter or mulcher attachment	Heavy-duty disc plow; disc harrow; site prep tractor with mulcher attachment
Large areas 400 hectares (1000 acres)	Shearing blade, angling (tilted) bulldozer blade, rakes, anchor chain drawn between two crawler tractors, root plow	Shearing blade (angling or V-type); site prep tractor with brush cutter or mulcher attachment; wheel/track feller buncher with high speed saw head; forest machine with directional felling head	Bulldozer blade, flail-type rotary cutter, anchor chain; site prep tractor with brush cutter or mulcher attachment	Bulldozer blade with duty harrow; site prep tractor with mulcher attachment

NOTE: The most economical size area for each type of equipment will vary with the relative cost of capital equipment versus labor. It is also affected by whether there are alternate uses for equipment such as using tractors for tillage.

EQUIPMENT SELECTION TABLE

	UPROOTING	CUTTING AT OR ABOVE GROUND LEVEL	KNOCKING TO THE GROUND	INCORPORATING INTO THE SOIL
LARGE CLEARING — Vegetation 20 cm (8 in) diameter or larger				
Small areas 4 hectares (10 acres)	Bulldozer blade; forest machine road builder arrangement; Forest machine with directional felling head	—	Bulldozer blade; forest machine road builder arrangement; forest machine with directional felling head	—
Medium areas 40 hectares (100 acres)	Shearing blade, angling (tilted), knockdown beam, rakes, tree stumper; forest machine road builder arrangement; forest machine with directional felling head	Shearing blade (angling or V-type), tree shear [up to 70 cm (26 in) softwood; 35 cm (14 in) hardwood], shearing blade — power saw combination; wheel/track feller buncher with high speed saw head; forest machine with directional felling head	Bulldozer blade; forest machine road builder arrangement; forest machine with directional felling head	—
Large areas 400 hectares (1000 acres)	Shearing blade, angling (tilted), tree pusher, rakes, tree stumper, anchor chain with ball drawn between two crawler tractors; forest machine with directional felling head	Shearing blade (angling or V-type), shearing blade — power saw combination; wheel/track feller buncher with high speed saw head; forest machine with directional felling head	Anchor chain with ball drawn between two crawler tractors. [Use dozer blade for trees over 18 cm (7 in).]; forest machine road builder arrangement; forest machine with directional felling head	—

NOTE: The most economical size area for each type of equipment will vary with the relative cost of capital equipment versus labor. It is also affected by whether there are alternate uses for equipment such as using tractors for tillage.

PRODUCTION ESTIMATING

GENERAL — CONSTANT SPEED OPERATIONS

Production is the hourly clearing rate usually expressed in hectares or acres.

For many land clearing operations, production is calculated by multiplying the tractor speed by the width of cut and converting to hectares or acres per hour.

Metric system:

The base formula is:

$$\frac{\text{Width of cut (meters)} \times \text{speed (km/h)}}{10} = \text{hectares/h}$$

When an efficiency of 82.5% is used, the formula becomes:

$$\frac{\text{Width of cut (m)} \times \text{speed (km/h)} \times 0.825}{10} = \text{hectares/h}$$

English measure:

$$\frac{\text{Width of cut (ft)} \times \text{speed (mph)}}{43{,}560\ (\text{ft}^2)} = \text{acres/hr}$$

The American Society of Agricultural Engineers formula for estimating hourly production of a constant speed operation is based on 82.5% efficiency. With this efficiency, the formula becomes:

$$\frac{\text{Width of cut (ft)} \times \text{speed (mph)} \times 0.825}{43{,}560\ (\text{ft}^2)} = \text{acres/hr}$$

Width of cut is the effective working width of the equipment and may not be the same as its rated width. Working width should be measured on the job but can be estimated when necessary.

The actual machine speed can be determined by measuring the amount of time to travel a given distance. When using the metric system, the time to travel 16.7 meters or a multiple thereof, can be converted into kilometers per hour.

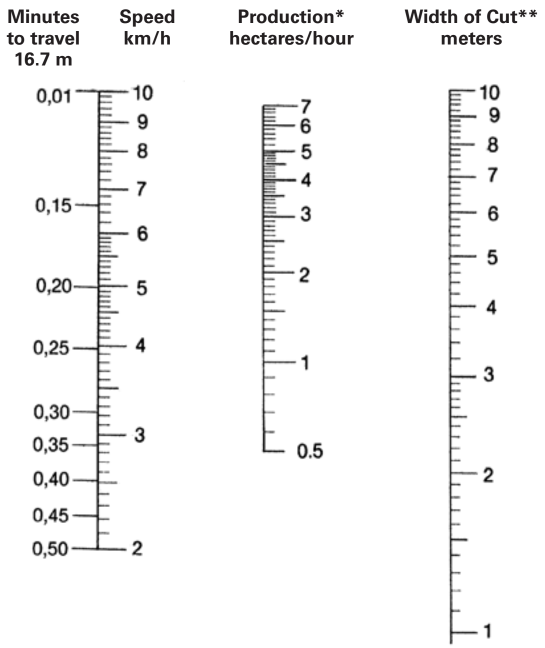
$$\frac{1.0}{\text{(Time in min. to travel 16.7 meters)}} = \text{speed (kmh)}$$

Since 88 ft/min. equals one mph, the lapsed time to travel 88 ft, or a multiple of 88 ft, can easily be converted into miles per hour.

$$\frac{1.0}{\text{(Time in min. to travel 88 ft)}} = \text{speed (mph)}$$

The following nomographs in both the Metric and English systems convert speed and width of cut directly into acres or hectares per hour at 82.5% efficiency without the need for calculations.

METRIC



*Based on 82.5% efficiency.
**When width of cut exceeds 10 meters, use a multiple of the width of cut and increase production proportionately.

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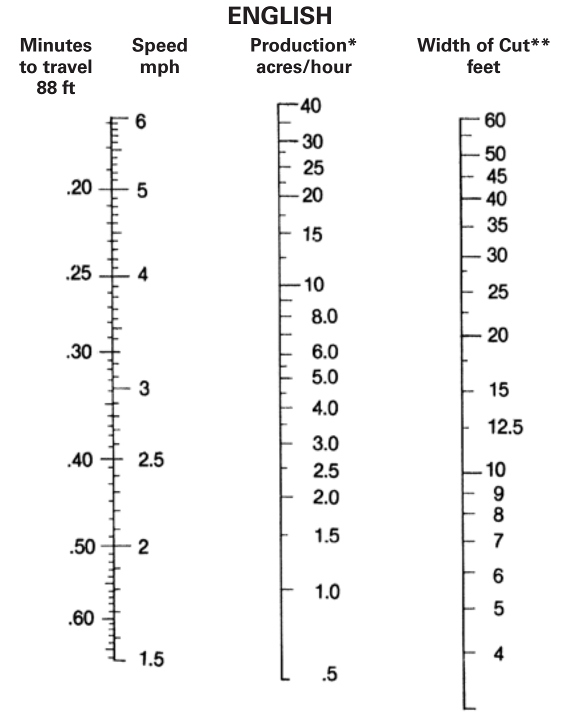

*Based on 82.5% efficiency.
**When width of cut exceeds 60 feet, use a multiple of the width of cut and increase production proportionately.

CUTTING PRODUCTION ESTIMATING

Most land clearing operations such as bulldozing, cutting, grubbing, raking and piling are not performed at constant speed. Because off-the-job production is difficult to estimate for these operations, Rome Industries has developed formulas for estimating cutting and piling time. These formulas take into consideration variable prime mover speeds through a factor, "B", the base time for each tractor to cover one hectare (2.47 acres) of light material.

To estimate **tractor cutting time per hectare** (2.47 acres) on a specific land clearing job, apply the factors shown in the following table, together with data obtained from the job survey, in the formula:

$$T = X\,[A(B)+M_1N_1+M_2N_2+M_3N_3+M_4N_4+DF]$$

where

T = Time per hectare (2.47 acres) in minutes
X = Hardwood or density factor affecting total time
A = Density or vine presence factor affecting base time
B = Base time for each tractor per hectare (2.47 acres)
M = Minutes per tree in each diameter range
N = Number of trees per hectare (2.47 acres) in each diameter range obtained from field survey
D = Sum of diameter in 30 cm (1 ft) increments of all trees per hectare (2.47 acres) above 180 cm (6 ft) in diameter at ground level obtained from field survey
F = Minutes per 30 cm (1 ft) of diameter for trees above 180 cm (6 ft) in diameter.

Hardwoods affect over-all or total time as follows:

75-100% hardwoods: Add 30% to total time (X = 1.3)
25-75% hardwoods: No change (X = 1.0)
0-25% hardwoods: Subtract 30% from total time (X = 0.7)

Production Factors for Felling with Rome K/G Blades

Tractor	Base Minutes per hectare (2.47 acres) "B"	Diameter Range 30-60 cm (1-2 ft) "M_1"	60-90 cm (2-3 ft) "M_2"	90-120 cm (3-4 ft) "M_3"	120-180 cm (4-6 ft) "M_4"	Dia. above 180 cm per 30 cm (6' per foot) "F"
165 hp	85	0.7	3.4	6.8	—	—
230 hp	58	0.5	1.7	3.3	10.2	3.3
305 hp	45	0.2	1.3	2.2	6.0	1.8
405 hp	39	0.1	0.4	1.3	3.0	1.0

Explanation of columns in table:

Tractor — Based on current model tractors (power shift when applicable) working on reasonably level terrain (below 10% grade) with good footing, no stones, average mixture of soft and hard woods. Tractor is in proper operating condition, blade is sharp, and properly adjusted.

Base Minutes — The base figures represent the number of minutes required for each tractor to cover a hectare (2.47 acres) of light material where no trees require splitting or other individual treatment. Time required is affected by the density of material less than 30 cm (1 ft) in diameter and the presence of vines.

a. dense — 1480 trees/hectare (600 or more trees/acre): Add 100% to base time (A = 2.0)
b. medium — 990-1480 trees/hectare (400-600 trees/acre): No change (A = 1.0)
c. light — less than 990 trees/hectare (400 trees/acre): Subtract 30% from total time (A = 0.7)

Presence of heavy vines: Add 100% to base time (A=2.0). *Very* heavy vines add 300% to base time. (A=3.0)

Dia. Range — M_1 represents minutes required to cut trees from 31-60 cm (1-2 ft) in diameter at ground level.

M_2 same for trees 61-90 cm (2-3 ft) diameter.

M_3 same for trees 91-120 cm (3-4 ft) diameter.

M_4 same for trees 121-180 cm (4-6 ft) diameter.

For Dia. above 180 cm (6 ft) — The figures in this column represent size the number of minutes required per 30 cm (1 ft) of diameter for each tractor to cut trees above 180 cm (6 ft) in diameter. Thus, to fell a 240 cm (8 ft) diameter tree would require 8 × 1.8 or approximately 14.4 minutes with a D8T.

Example problem:

Calculate the felling production of a D8T with K/G Blade in these conditions: reasonably level terrain, firm ground, well drained, 85% hardwoods with heavy vines and the following average tree count per hectare (2.47 acre):

Diameter Range	Less than 30 cm (1 ft) "B"	31-60 cm (1-2 ft) "N_1"	61-90 cm (2-3 ft) "N_2"	91-120 cm (3-4 ft) "N_3"	121-180 cm (4-6 ft) "N_4"	Sum Dia's Above 180 cm (6 ft) "D"
Number of Trees	1100	35	6	6	4	488 cm (16 ft)

Solution:

$$T = X\,[A(B)+M_1N_1+M_2N_2+M_3N_3+M_4N_4+DF]$$

$$T = 1.3\ [2.0\ (45)+0.2\ (35)+1.3\ (6)+2.2\ (6)+6\ (4)+16\ (1.8)]$$

$$= 1.3\ (90+7+7.8+13.2+24+28.8)$$

$$= 1.3\ (170.8)$$

$$= 222 \text{ minutes/hectare (90 min/acre)}$$

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Where the job requires grubbing trees and stumps greater than 30 cm (1 ft) in diameter at the same time the trees are sheared, use the same basic procedure as defined above including the variables for the presence of hardwoods. After time per hectare (acre) in minutes has been determined, increase the over-all or total time by 25%.

Where the job requires re-entering the area (after all trees have been sheared) to remove stumps with a tilted shearing blade or stumper, increase the total time by 50%.

PILING PRODUCTION ESTIMATING

A procedure has also been developed for estimating piling production for a tractor equipped with a K/G blade or rake.

To estimate tractor hours per hectare (acre) on a specific land clearing job, apply the factors shown in the following table with data obtained from the job survey, in the formula:

$$T = B+M_1N_1+M_2N_2+M_3N_3+M_4N_4+DF$$

where

T = Time per hectare (2.47 acre) in minutes.
B = Base time for each tractor per hectare (2.47 acre).
M = Minutes per tree in each diameter range.
N = Number of trees per hectare (2.47 acre) in each diameter range obtained from field cruise.
D = Sum of diameter in 30 cm (1 ft) increments of all trees per hectare (2.47 acre) above 180 cm (6 ft) in diameter at ground level obtained from field cruise.
F = Minutes per 30 cm (1 ft) of diameter for trees above 180 cm (6 ft) in diameter.

Production Factors for Piling in Windrows*

Tractor	Base Minutes per hectare (2.47 acres) "B"	Diameter Range				Dia. above 180 cm per 30 cm (6' per foot) "F"
		30-60 cm (1-2 ft) "M_1"	60-90 cm (2-3 ft) "M_2"	90-120 cm (3-4 ft) "M_3"	120-180 cm (4-6 ft) "M_4"	
165 hp	157	0.5	1.0	4.2	—	—
230 hp	125	0.4	0.7	2.5	5.0	—
305 hp	111	0.1	0.5	1.8	3.6	0.9
405 hp	97	0.08	0.1	1.2	2.1	0.3

*May be used with most types of raking tools and angled shearing blade. Windrows to be spaced approximately 61 meters **(200 feet)** apart.

Explanation of columns in table:

Tractor — Production with tractor working alone based on current model tractors (power shift when applicable) working on reasonably level (below 10% grade) terrain with good footing, no stones, average mixture of soft and hard woods. The tractor is in proper operating condition. Decrease total time by 25-50% depending on the number and size of trees when using three or more tractors in combination.

Base Minutes — The base figures represent the number of minutes required for each tractor to cover a hectare (2.47 acres) of light material.

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Dia. Range — M_1 represents minutes required to pile trees from 31-60 cm (1-2 ft) diameter at ground level.

M_2 same for trees 61-90 cm (2-3 ft) diameter.

M_3 same for trees 91-120 cm (3-4 ft) diameter.

M_4 same for trees 121-180 cm (4-6 ft) diameter.

For Dia. above 180 cm (6 ft) — The figures in this column represent for each tractor size the number of minutes required per 30 cm (1 ft) of diameter to pile trees above 180 cm (6 ft) in diameter. Thus, to pile a 240 cm (8 ft) diameter tree would require 8 × 0.9 or approximately 7.2 minutes with a D8T tractor.

Where the job requires piling of grubbed trees and stumps greater than 30 cm (1 ft) in diameter, use the same basic procedure defined above and then increase over-all or total time by 25%.

In dense small diameter brush with few or no large trees, or when cutting is vine entangled, reduce the base time by 30%.

Example problem:

Calculate the windrow piling production of a D7R Series 2 with Rake in level terrain, no grubbing, and average mixture of hardwoods and softwoods where the average tree count per hectare (2.47 acres) is:

Diameter Range	Less than 30 cm (1 ft) "B"	31-60 cm (1-2 ft) "N_1"	61-90 cm (2-3 ft) "N_2"	91-120 cm (3-4 ft) "N_3"	121-180 cm (4-6 ft) "N_4"	Sum Dia's Above 180 cm (6 ft) "D"
Number of Trees	1100	35	6	6	2	0

Solution:

$$\begin{aligned} T &= B+M_1N_1+M_2N_2+M_3N_3+M_4N_4+DF \\ &= 125+0.4\,(35)+0.6\,(6)+2.5\,(6)+5.0\,(2)+[DF=0] \\ &= 42.6 \\ &= 177.6 \text{ minutes/hectare (72 min/acre)} \end{aligned}$$

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To find the number of machines required for each operation, use the formula:

Hr/hectare (acre) × number of hectares (acres) = number of machines needed*

*Average machine production for all operation in hr/hectare (acre).

To cost estimate each method or phase of operation, use this calculation:

Owning and Operating cost/hr × hr/hectare (acre) × number of hectares (acres) = cost

Because of the many variables that increase or decrease production, these formulas should be considered only as guidelines in arriving at a rough production estimate. This estimate should be tempered by personal judgment based on past experience and personal knowledge of the area.

MINING AND EARTHMOVING

CONTENTS

INTRODUCTION

This section explains the earthmoving principles used to determine machine productivity. It shows how to calculate production on-the-job or estimate production off-the-job.

ELEMENTS OF PRODUCTION

Production is the hourly rate at which material is moved. Production can be expressed in various units:

Metric

Bank Cubic Meters	— BCM —	bank m^3
Loose Cubic Meters	— LCM —	loose m^3
Compacted Cubic Meters	— CCM —	compacted m^3
Tonnes		

English

Bank Cubic Yards	— BCY —	bank yd^3
Loose Cubic Yards	— LCY —	loose yd^3
Compacted Cubic Yards	— CCY —	compacted yd^3
Tons		

For most earthmoving and material handling applications, production is calculated by multiplying the quantity of material (load) moved per cycle by the number of cycles per hour.

Production = Load/cycle × cycles/hour

The load can be determined by
1) load weighing with scales
2) load estimating based on machine rating
3) surveyed volume divided by load count
4) machine payload measurement system

Generally, earthmoving and overburden removal for coal mines are calculated by volume (bank cubic meters or bank cubic yards). Metal mines and aggregate producers usually work in weight (tons or tonnes).

Volume Measure — Material volume is defined according to its state in the earthmoving process. The three measures of volume are:

BCM (BCY) — one cubic meter (yard) of material as it lies in the natural bank state.

LCM (LCY) — one cubic meter (yard) of material which has been disturbed and has swelled as a result of movement.

CCM (CCY) — one cubic meter (yard) of material which has been compacted and has become more dense as a result of compaction.

In order to estimate production, the relationships between bank measure, loose measure, and compacted measure must be known.

Swell — Swell is the percentage of original volume (cubic meters or cubic yards) that a material increases when it is removed from the natural state. When excavated, the material breaks up into different size particles that do not fit together, causing air pockets or voids to reduce the weight per volume. For example to hold the same weight of one cubic unit of bank material it takes 30% more volume (1.3 times) after excavation. (Swell is 30%.)

$$1 + \text{Swell} = \frac{\text{Loose cubic volume for a given weight}}{\text{Bank cubic volume for the same given weight}}$$

$$\text{Bank} = \frac{\text{Loose}}{(1 + \text{Swell})}$$

$$\text{Loose} = \text{Bank} \times (1 + \text{Swell})$$

Example Problem:

If a material swells 20%, how many loose cubic meters (loose cubic yards) will it take to move 1000 bank cubic meters (1308 bank cubic yards)?

Loose = Bank × (1 + Swell) =
1000 BCM × (1 + 0.2) = 1200 LCM
1308 BCY × (1 + 0.2) = 1570 LCY

How many bank cubic meters (yards) were moved if a total of 1000 loose cubic meters (1308 yards) have been moved? Swell is 25%.

Bank = Loose ÷ (1 + Swell) =
1000 LCM ÷ (1 + 0.25) = 800 BCM
1308 LCY ÷ (1 + 0.25) = 1046 BCY

Load Factor — Assume one bank cubic yard of material weighs 3000 lb. Because of material characteristics, this bank cubic yard swells 30% to 1.3 loose cubic yards when loaded, with no change in weight. If this 1.0 bank cubic yard or 1.3 loose cubic yards is compacted, its volume may be reduced to 0.8 compacted cubic yard, and the weight is still 3000 lb.

Instead of dividing by 1 + Swell to determine bank volume, the loose volume can be multiplied by the load factor.

If the percent of material swell is known, the load factor (L.F.) may be obtained by using the following relationship:

$$\text{L.F.} = \frac{100\%}{100\% + \%\ \text{swell}}$$

Load factors for various materials are listed in the Tables Section of this handbook.

To estimate the machine payload in bank cubic yards, the volume in loose cubic yards is multiplied by the load factor:

$$\text{Load (BCY)} = \text{Load (LCY)} \times \text{L.F.}$$

The ratio between compacted measure and bank measure is called shrinkage factor (S.F.):

$$\text{S.F.} = \frac{\text{Compacted cubic yards (CCY)}}{\text{Bank cubic yards (BCY)}}$$

Shrinkage factor is either estimated or obtained from job plans or specifications which show the conversion from compacted measure to bank measure. Shrinkage factor should not be confused with percentage compaction (used for specifying embankment density, such as Modified Proctor or California Bearing Ratio [CBR]).

Material Density — Density is the weight per unit volume of a material. Materials have various densities depending on particle size, moisture content and variations in the material. The denser the material the more weight there is per unit of equal volume. Density estimates are provided in the Tables Section of this handbook.

$$\text{Density} = \frac{\text{Weight}}{\text{Volume}} = \frac{\text{kg (lb)}}{\text{m}^3\,(\text{yd}^3)}$$

$$\text{Weight} = \text{Volume} \times \text{Density}$$

A given material's density changes between bank and loose. One cubic unit of loose material has less weight than one cubic unit of bank material due to air pockets and voids. To correct between bank and loose use the following equations.

$$1 + \text{Swell} = \frac{\text{kg/BCM}}{\text{kg/LCM}} \text{ or } \frac{\text{lb/BCY}}{\text{lb/LCY}}$$

$$\text{lb/LCY} = \frac{\text{lb/BCY}}{(1 + \text{Swell})}$$

$$\text{lb/BCY} = \text{lb/LCY} \times (1 + \text{Swell})$$

Fill Factor — The percentage of an available volume in a body, bucket, or bowl that is actually used is expressed as the fill factor. A fill factor of 87% for a hauler body means that 13% of the rated volume is not being used to carry material. Buckets often have fill factors over 100%.

Example Problem:

A 14 cubic yard (heaped 2:1) bucket has a 105% fill factor when operating in a shot sandstone (4125 lb/BCY and a 35% swell).

a) What is the loose density of the material?
b) What is the usable volume of the bucket?
c) What is the bucket payload per pass in BCY?
d) What is the bucket payload per pass in tons?

a) lb/LCY = lb/BCY ÷ (1 + Swell) = 4125 ÷ (1.35) = 3056 lb/LCY
b) LCY = rated LCY × fill factor = 14 × 1.05 = 14.7 LCY
c) lb/pass = volume × density lb/LCY = 14.7 × 3056 = 44,923 lb
BCY/pass = weight ÷ density lb/BCY = 44,923 ÷ 4125 = 10.9 BCY
or bucket LCY from part b ÷ (1 + Swell) = 14.7 ÷ 1.35 = 10.9 BCY
d) tons/pass = lb ÷ 2000 lb/ton = 44,923 ÷ 2000 = 22.5 tons

Example Problem:

Construct a 10,000 compacted cubic yard (CCY) bridge approach of dry clay with a shrinkage factor (S.F.) of 0.80. Haul unit is rated 14 loose cubic yards struck and 20 loose cubic yards heaped.

a) How many bank yards are needed?
b) How many loads are required?

a) $\text{BCY} = \frac{\text{CCY}}{\text{S.F.}} = \frac{10{,}000}{0.80} = 12{,}500 \text{ BCY}$

b) Load (BCY) = Capacity (LCY) × Load factor (L.F.) = 20 × 0.81 = 16.2 BCY/Load

(L.F. of 0.81 from Tables)

$$\text{Number of loads required} = \frac{12{,}500 \text{ BCY}}{16.2 \text{ BCY/Load}} = 772 \text{ Loads}$$

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Soil Density Tests — There are a number of acceptable methods that can be used to determine soil density. Some that are currently in use are:

Nuclear density moisture gauge
Sand cone method
Oil method
Balloon method
Cylinder method

All these except the nuclear method use the following procedure:

1. Remove a soil sample from bank state.
2. Determine the volume of the hole.
3. Weigh the soil sample.
4. Calculate the bank density kg/BCM (lb/BCY).

The nuclear density moisture gauge is one of the most modern instruments for measuring soil density and moisture. A common radiation channel emits either neutrons or gamma rays into the soil. In determining soil density, the number of gamma rays absorbed and back scattered by soil particles is *indirectly* proportional to the soil density. When measuring moisture content, the number of moderated neutrons reflected back to the detector after colliding with hydrogen particles in the soil is *directly* proportional to the soil's moisture content.

All these methods are satisfactory and will provide accurate densities when performed correctly. Several repetitions are necessary to obtain an average.

NOTE: Several newer methods have been successfully applied, along with weigh scales to determine volume and loose density of material moved in hauler bodies. These measurements include photogrammatic and laser scanning technologies.

FIGURING PRODUCTION ON-THE-JOB

Load Weighing — The most accurate method of determining the actual load carried is by weighing. This is normally done by weighing the haul unit one wheel or axle at a time with portable scales. Any scales of adequate capacity and accuracy can be used. While weighing, the machine must be level to reduce error caused by weight transfer. Enough loads must be weighed to provide a good average. Machine weight is the sum of the individual wheel or axle weights.

The weight of the load can be determined using the empty and loaded weight of the unit.

Weight of
load = gross machine weight – empty weight

To determine the bank cubic measure carried by a machine, the load weight is divided by the bankstate density of the material being hauled.

$$\text{BCY} = \frac{\text{Weight of load}}{\text{Bank density}}$$

Times Studies — To estimate production, the number of complete trips a unit makes per hour must be determined. First obtain the unit's cycle time with the help of a stop watch. Time several complete cycles to arrive at an average cycle time. By allowing the watch to run continuously, different segments such as load time, wait time, etc. can be recorded for each cycle. Knowing the individual time segments affords a good opportunity to evaluate the balance of the spread and job efficiency. The following is an example of a scraper load time study form. Numbers in the white columns are stop watch readings; numbers in the shaded columns are calculated:

Total Cycle Times (less delays)	Arrive Cut	Wait Time	Begin Load	Load Time	End Load	Begin Delay	Delay Time	End Delay
	0.00	0.30	0.30	0.60	0.90			
3.50	3.50	0.30	3.80	0.65	4.45			
4.00	7.50	0.35	7.85	0.70	8.55	9.95	1.00	10.95
4.00	12.50	0.42	12.92	0.68	13.60			

NOTE: All numbers are in minutes

This may be easily extended to include other segments of the cycle such as haul time, dump time, etc. Haul roads may be further segmented to more accurately define performance, including measured speed traps. Similar forms can be made for pushers, loaders, dozers, etc. *Wait Time* is the time a unit must wait for another unit so that the two can function together (haul unit waiting for pusher). *Delay Time* is any time, other than wait time, when a machine is not performing in the work cycle (scraper waiting to cross railroad track).

To determine trips-per-hour at 100% efficiency, divide 60 minutes by the average cycle time less all wait and delay time. Cycle time may or may not include wait and/or delay time. Therefore, it is possible to figure different kinds of production: measured production, production without wait or delay, maximum production, etc. For example:

Actual Production: includes all wait and delay time.

Normal Production (without delays): includes wait time that is considered normal, but no delay time.

Maximum Production: to figure maximum (or optimum) production, both wait time and delay time are eliminated. The cycle time may be further altered by using an optimum load time.

Example (English)

A job study of a Wheel Tractor-Scraper might yield the following information:

Average wait time	= 0.28	minute
Average load time	= 0.65	
Average delay time	= 0.25	
Average haul time	= 4.26	
Average dump time	= 0.50	
Average return time	= 2.09	
Average total cycle	= 8.03	minutes
Less wait & delay time	= 0.53	
Average cycle 100% eff.	= 7.50	minutes

Weight of haul unit empty — 48,650 lb
Weights of haul unit loaded —
Weighing unit #1 — 93,420 lb
Weighing unit #2 — 89,770 lb
Weighing unit #3 — 88,760 lb
271,950 lb;
average = 90,650 lb

1. Average load weight = 90,650 lb – 48,650 lb = 42,000 lb
2. Bank density = 3125 lb/BCY
3. Load = $\dfrac{\text{Weight of load}}{\text{Bank density}}$

   $= \dfrac{42{,}000 \text{ lb}}{3125 \text{ lb/BCY}} = 13.4 \text{ BCY}$
4. Cycles/hr =

   $\dfrac{60 \text{ min/hr}}{\text{Cycle time}} = \dfrac{60 \text{ min/hr}}{7.50 \text{ min/cycle}} = 80 \text{ cycles/hr}$
5. Production = Load/cycle × cycles/hr
   (less delays) = 13.4 BCY/cycle × 8.0 cycles/hr
   = 107.2 BCY/hr

Example (Metric)

A job study of a Wheel Tractor-Scraper might yield the following information:

Average wait time	= 0.28	minute
Average load time	= 0.65	
Average delay time	= 0.25	
Average haul time	= 4.26	
Average dump time	= 0.50	
Average return time	= 2.09	
Average total cycle	= 8.03	minutes
Less wait & delay time	= 0.53	
Average cycle 100% eff.	= 7.50	minutes

Weight of haul unit empty — 22 070 kg
Weights of haul unit loaded —
Weighing unit #1 — 42 375 kg
Weighing unit #2 — 40 720 kg
Weighing unit #3 — 40 260 kg
123 355 kg;
average = 41 120 kg

1. Average load weight = 41 120 kg – 22 070 kg = 19 050 kg
2. Bank density = 1854 kg/BCM
3. Load = $\dfrac{\text{Weight of load}}{\text{Bank density}}$

   $= \dfrac{19\,050 \text{ kg}}{1854 \text{ kg/BCM}} = 10.3 \text{ BCM}$
4. Cycles/hr =

   $\dfrac{60 \text{ min/hr}}{\text{Cycle time}} = \dfrac{60 \text{ min/hr}}{7.50 \text{ min/cycle}} = 80 \text{ cycles/hr}$
5. Production = Load/cycle × cycles/hr
   (less delays) = 10.3 BCM/cycle × 8.0 cycles/hr
   = 82 BCM/hrr

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ESTIMATING PRODUCTION OFF-THE-JOB

It is often necessary to estimate production of earthmoving machines which will be selected for a job. As a guide, the remainder of the section is devoted to discussions of various factors that may affect production. Some of the figures have been rounded for easier calculation.

Rolling Resistance (Mining/Quarry Applications)

Rolling Resistance (RR) is a measure of the force that must be overcome to roll or pull a wheel over the ground. The resistance has two major components: the tire and the terrain. The terrain resistance only is applicable when there is tire sinkage or road flexing, such that energy is being lost to the road through the deformation work done. The resistance due to sinkage will vary significantly based on the properties and condition of a given material. Regardless of the degree of surface interaction, the losses relating to the tire are based primarily on the heat generation due to the hysteresis for the rubber under cyclic deformation. The tire losses are sensitive to inflation pressure, tire temperature, tread pattern, compound, vertical load, tractive force, and velocity.

In practice, mining trucks' haul roads are in good condition and are not subject to terrain induced resistance such as sinkage or flexing. Mines often do have areas of rough ground conditions, but the interaction is limited to the load and dump areas or short seasonal changes. Performance studies have used speed traps to demonstrate that mining truck haul ramps present 1.25%-1.5% effective grade of resistance across a broad range of applications. Rolling resistance reference tables previously have been provided, but these have changed little in 50 years of publication despite the advances in tire technology, truck size and mining practices. Due to the applicability and variability of the terramechanics, these legacy tables are no longer included.

While determining which number to use for Rolling Resistance, it is important to consider the inherent application nuances and uncertainty. For example, if evaluating uphill propulsion performance, using a higher rolling resistance value would produce a conservative result. Conversely, for downhill retarding performance, a lower value would produce a conservative result as the Total Effective Resistance is calculated by subtracting Rolling Resistance for a downhill application, which is counterintuitive as Rolling Resistance helps downhill.

It is important to consider the impact of under or overestimating Rolling Resistance and how it can disproportionately affect performance estimates of trucks with different drive systems. In the case of Electric Drive machines, any change in Rolling Resistance will more than likely produce a relational change in performance (speed on grade) as their performance curves consist of constant power. Conversely, traditional Mechanical Drive machines will have a larger range of sensitivity, ranging from none to significant. For instance, when retarding downhill, generally the maximum power for a mechanical drive truck is at high idle speed in each gear, such that a decrease in Rolling Resistance may have no impact on speed on one extreme if there is additional capacity remaining in that gear, or the speed will decrease by an entire gear on the other extreme if capacity in that gear was exceeded. A similar effect can be seen in uphill propulsion where a truck narrowly may or may not make a shift point based on nominal numbers, which will have a sizable impact on speed.

The effect of the Rolling Resistance parameter is no different than Machine Weight and Geometric Grade, with the key difference being both of those are directly measurable at a high level of precision. It is due to this quantification complexity of Rolling Resistance that care should be taken when applying figures such that margin is included to ensure confidence in the predicted result.

Contact your local Caterpillar representative for support assessing Rolling Resistance in your application.

Rolling Resistance (Earthmoving and NON-Mining/Quarry Applications)

Rolling Resistance (RR) is a measure of the force that must be overcome to roll or pull a wheel over the ground. It is affected by ground conditions and load — the deeper a wheel sinks into the ground, the higher the rolling resistance. Internal friction and tire flexing also contribute to rolling resistance. Experience has shown that minimum resistance is 1%-1.5% (see Typical Rolling Resistance Factors in Tables section) of the gross machine weight (on tires). A 2% base resistance is quite often used as a conservative estimate. Larger tires and good underfoot conditions, typical of hard rock mining applications, would lead to estimates on the lower side of the minimum rolling resistance range.

Resistance due to tire penetration is approximately 1.5% of the gross machine weight for each inch of tire penetration (0.6% for each cm of tire penetration). Thus rolling resistance can be calculated using these relationships in the following manner:

RR = 2% of GMW + 0.6% of GMW per cm tire penetration

RR = 2% of GMW + 1.5% of GMW per inch tire penetration

It's *not* necessary for the tires to actually penetrate the road surface for rolling resistance to increase above the minimum. If the road surface flexes under load, the effect is nearly the same — the tire is always running "uphill." Only on very hard, smooth surfaces with a well compacted base will the rolling resistance approach the minimum.

When actual penetration takes place, some variation in rolling resistance can be noted with various inflation pressures and tread patterns.

NOTE: When figuring "pull" requirements for track-type tractors, rolling resistance applies only to the trailed unit's *weight on wheels*. Since track-type tractors utilize steel wheels moving on steel "roads," a tractor's rolling resistance is relatively constant and is accounted for in the Drawbar Pull rating.

Estimating Production Off-the-Job
- Grade Resistance
- Total Resistance
- Traction

Grade Resistance is a measure of the force that must be overcome to move a machine over unfavorable grades (uphill). Grade assistance is a measure of the force that assists machine movement on favorable grades (downhill).

Grades are generally measured in percent slope, which is the ratio between vertical rise or fall and the horizontal distance in which the rise or fall occurs. For example, a 1% grade is equivalent to a 1 m (ft) rise or fall for every 100 m (ft) of horizontal distance; a rise of 4.6 m (15 ft) in 53.3 m (175 ft) equals an 8.6% grade.

$$\frac{4.6 \text{ m (rise)}}{53.3 \text{ m (horizontal distance)}} = 8.6\% \text{ grade}$$

$$\frac{15 \text{ ft (rise)}}{175 \text{ ft (horizontal distance)}} = 8.6\% \text{ grade}$$

Uphill grades are normally referred to as adverse grades and downhill grades as favorable grades. Grade resistance is usually expressed as a positive (+) percentage and grade assistance is expressed as a negative (–) percentage.

It has been found that for each 1% increment of adverse grade an additional 10 kg (20 lb) of resistance must be overcome for each metric (U.S.) ton of machine weight. This relationship is the basis for determining the Grade Resistance Factor which is expressed in kg/metric ton (lb/U.S. ton):

Grade Resistance Factor = 10 kg/m ton × % grade
= 20 lb/U.S. ton × % grade

Grade resistance (assistance) is then obtained by multiplying the Grade Resistance Factor by the machine weight (GMW) in metric (U.S.) tons.

Grade Resistance = GR Factor × GMW in metric (U.S.) tons

Grade resistance may also be calculated using percentage of gross weight. This method is based on the relationship that grade resistance is approximately equal to 1% of the gross machine weight for 1% of grade.

Grade Resistance = 1% of GMW × % grade

Grade resistance (assistance) affects both wheel and track-type machines.

Total Resistance is the combined effect of rolling resistance (wheel vehicles) and grade resistance. It can be computed by summing the values of rolling resistance and grade resistance to give a resistance in kilogram (pounds) force.

Total Resistance = Rolling Resistance + Grade Resistance

Total resistance can also be represented as consisting completely of grade resistance expressed in percent grade. In other words, the rolling resistance component is viewed as a corresponding quantity of additional adverse grade resistance. Using this approach, total resistance can then be considered in terms of percent grade.

This can be done by converting the contribution of rolling resistance into a corresponding percentage of grade resistance. Since 1% of adverse grade offers a resistance of 10 kg (20 lb) for each metric or (U.S.) ton of machine weight, then each 10 kg (20 lb) of resistance per ton of machine weight can be represented as an additional 1% of adverse grade. Rolling resistance in percent grade and grade resistance in percent grade can then be summed to give Total Resistance in percent or Effective Grade. The following formulas are useful in arriving at Effective Grade.

Rolling Resistance (%) = 2% + 0.6% per cm tire penetration
= 2% + 1.5% per inch tire penetration

Grade Resistance (%) = % grade

Effective Grade (%) = RR (%) + GR (%)

Effective grade is a useful concept when working with Rimpull-Speed-Gradeability curves, Retarder curves, Brake Performance curves, and Travel Time curves.

Traction — is the driving force developed by a wheel or track as it acts upon a surface. It is expressed as usable Drawbar Pull or Rimpull. The following factors affect traction: weight on the driving wheel or tracks, gripping action of the wheel or track, and ground conditions. The coefficient of traction (for any roadway) is the ratio of the maximum pull developed by the machine to the total weight on the drivers.

$$\text{Coeff. of traction} = \frac{\text{Pull}}{\text{weight on drivers}}$$

Therefore, to find the usable pull for a given machine:
Usable pull = Coeff. of traction × weight on drivers

Example: Track-Type Tractor

What usable drawbar pull (DBP) can a 26 800 kg (59,100 lb) Track-type Tractor exert while working on firm earth? on loose earth? (See table section for coefficient of traction.)

Answer:

Firm earth — Usable DBP =
0.90 × 26 800 kg = 24 120 kg
(0.90 × 59,100 lb = 53,190 lb)

Loose earth — Usable DBP =
0.60 × 26 800 kg = 16 080 kg
(0.60 × 59,100 lb = 35,460 lb)

If a load required 21 800 kg (48,000 lb) pull to move it, this tractor could move the load on firm earth. However, if the earth were loose, the tracks would spin.

NOTE: Tractors may attain higher coefficients of traction due to their suspended undercarriage.

Example: Wheel Tractor-Scraper

What usable rimpull can a 621F size machine exert while working on firm earth? on loose earth? The total loaded weight distribution of this unit is:

Drive unit	Scraper unit
wheels: 23 600 kg (52,000 lb)	wheels: 21 800 kg (48,000 lb)

Remember, use weight on drivers only.

Answer:

Firm earth — 0.55 × 23 600 kg = 12 980 kg
(0.55 × 52,000 lb = 28,600 lb)

Loose earth — 0.45 × 23 600 kg = 10 620 kg
(0.45 × 52,000 lb = 23,400 lb)

On firm earth this unit can exert up to 12 980 kg (28,600 lb) rimpull without excessive slipping. However, on loose earth the drivers would slip if more than 10 620 kg (23,400 lb) rimpull were developed.

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Altitude — Specification sheets show how much pull a machine can produce for a given gear and speed when the engine is operating at rated horsepower. When a standard machine is operated in high altitudes, the engine may require derating to maintain normal engine life. This engine deration will produce less drawbar pull or rimpull.

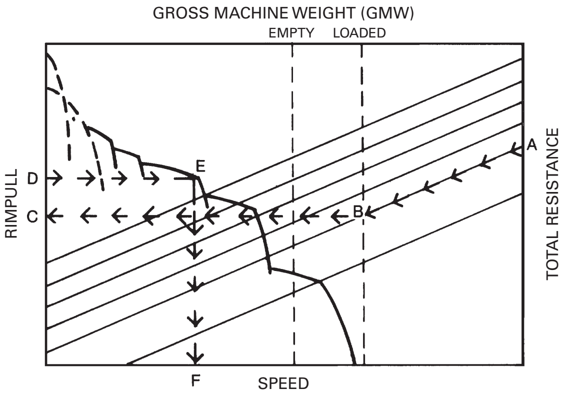
Manufacturers through engineering can provide the altitude deration in percent of flywheel horsepower for current machines. It should be noted that some turbocharged engines can operate up to 4570 m (15,000 ft) before they require derating. Most machines are engineered to operate up to 1500-2290 m (5000-7500 ft) before they require deration.

The horsepower deration due to altitude must be considered in any job estimating. The amount of power deration will be reflected in the machine's gradeability and in the load, travel, and dump and load times (unless loading is independent of the machine itself). Altitude may also reduce retarding performance. Consult a Cat representative to determine if deration is applicable. Fuel grade (heat content) can have a similar effect of derating engine performance.

The example job problem that follows indicates one method of accounting for altitude deration: by increasing the appropriate components of the total cycle time by a percentage equal to the percent of horsepower deration due to altitude. (i.e., if the travel time of a hauling unit is determined to be 1.00 minute at full HP, the time for the same machine derated to 90% of full HP will be 1.10 min.) This is an approximate method that yields reasonably accurate estimates up to 3000 m (10,000 feet) elevation.

Travel time for hauling units derated more than 10% should be calculated as follows using Rimpull-Speed-Gradeability charts.

1) Determine total resistance (grade plus rolling) in percent.



2) Beginning at point A on the chart follow the total resistance line diagonally to its intersection, B, with the vertical line corresponding to the appropriate gross machine weight. (Rated loaded and empty GMW lines are shown dotted.)

3) Using a straight-edge, establish a horizontal line to the left from point B to point C on the rim-pull scale.

4) Divide the value of point C as read on the rimpull scale by the percent of total horsepower available after altitude deration from manufacturer. This yields rimpull value D higher than point C.

5) Establish a horizontal line right from point D. The farthest right intersection of this line with a curved speed range line is point E.

6) A vertical line down from point E determines point F on the speed scale.

7) Multiply speed in kmh by 16.7 (mph by 88) to obtain speed in m/min (ft/min). Travel time in minutes for a given distance in feet is determined by the formula:

$$\text{Time (min)} = \frac{\text{Distance in m (ft)}}{\text{Speed in m/min (ft/min)}}$$

The Travel Time Graphs in sections on Wheel Tractor-Scrapers and Construction & Mining Trucks can be used as an alternative method of calculating haul and/or return times.

Job Efficiency is one of the most complex elements of estimating production since it is influenced by factors such as operator skill, minor repairs and adjustments, personnel delays, and delays caused by job layout. An approximation of efficiency, if no job data is available, is given below.

Operation	Working Hour	Efficiency Factor
Day	50 min/hr	0.83
Night	45 min/hr	0.75

These factors do not account for delays due to weather or machine downtime for maintenance and repairs. You must account for such factors based on experience and local conditions.

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The following example provides a method to manually estimate production and cost. Today, computer programs, such as Caterpillar's Fleet Production and Cost Analysis (FPC), provide a much faster and more accurate means to obtain those application results.

Example problem (English)

A contractor is planning to put the following spread on a dam job. What is the estimated production?

Equipment:
- 11 — 631G Wheel Tractor-Scrapers
- 2 — D9T Tractors with C-dozers
- 2 — 12H Motor Graders
- 1 — 825G Tamping Foot Compactor

Material:
- Description — Sandy clay; damp, natural bed
- Bank Density — 3000 lb/BCY
- Load Factor — 0.80
- Shrinkage Factor — 0.85
- Traction Factor — 0.50
- Altitude — 7500 ft

1. Estimate Payload:
Est. load (LCY) × L.F. × Bank Density = payload
31 LCY × 0.80 × 3000 lb/BCY = 74,400 lb payload

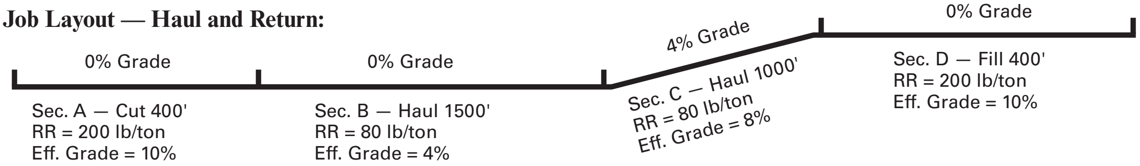
2. Establish Machine Weight:
Empty Wt. — 102,460 lb or 51.27 tons
Wt. of Load — 74,400 lb or 37.2 tons
Total (GMW) — 176,860 lb or 88.4 tons

3. Calculate Usable Pull (traction limitation):
Loaded: (weight on driving wheels = 54%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 176,860 lb × 54% = 47,628 lb
Empty: (weight on driving wheels = 69%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 102,460 lb × 69% = 35,394 lb

4. Derate for Altitude:
Check power available at 7500 ft from altitude deration percentage from manufacturer.

631G — 100%	12H — 83%
D9T — 100%	825G —100%

Job Layout — Haul and Return:



Total Effective Grade = RR (%) ± GR (%)
Sec. A: Total Effective Grade = 10% + 0% = 10%
Sec. B: Total Effective Grade = 4% + 0% = 4%
Sec. C: Total Effective Grade = 4% + 4% = 8%
Sec. D: Total Effective Grade = 10% + 0% = 10%

Then adjust if necessary:
Load Time — controlled by D9T, at 100% power, no change.
Travel, Maneuver and Spread time — 631G, no change.

5. Compare Total Resistance to Tractive Effort on haul:

Grade Resistance —
GR = lb/ton × tons × adverse grade in percent
Sec. C: = 20 lb/ton × 88.4 tons × 4% grade = 7072 lb

Rolling Resistance —
RR = RR Factor (lb/ton) × GMW (tons)
Sec. A: = 200 lb/ton × 88.4 tons = 17,686 lb
Sec. B: = 80 lb/ton × 88.4 tons = 7072 lb
Sec. C: = 80 lb/ton × 88.4 tons = 7072 lb
Sec. D: = 200 lb/ton × 88.4 tons = 17,686 lb

Total Resistance —
TR = RR + GR
Sec. A: = 17,686 lb + 0 = 17,686 lb
Sec. B: = 7072 lb + 0 = 7072 lb
Sec. C: = 7072 lb + 6496 lb = 14,144 lb
Sec. D: = 17,686 lb + 0 = 17,686 lb

Check usable pounds pull against maximum pounds pull required to move the 631G.
Pull usable … 47,628 lb loaded
Pull required … 17,686 lb maximum total resistance
Estimate travel time for haul from 631G (loaded) travel time curve; read travel time from distance and effective grade.
Travel time (from curves):
Sec. A: 0.60 min
Sec. B: 1.00
Sec. C: 1.20
Sec. D: 0.60
3.40 min

NOTE: This is an estimate only; it *does not account for all the acceleration and deceleration tim*e, therefore it is not as accurate as the information obtained from a computer program.

6. Compare Total Resistance to Tractive Effort on return:

Grade Assistance —
GA = 20 lb/ton × tons × negative grade in percent
Sec. C: = 20 lb/ton × 51.2 tons × 4% grade = 4096 lb

Rolling Resistance —
RR = RR Factor × Empty Wt (tons)
Sec. D: = 200 lb/ton × 51.2 tons = 10,240 lb
Sec. C: = 80 lb/ton × 51.2 tons = 4091 lb
Sec. B: = 80 lb/ton × 51.2 tons = 4091 lb
Sec. A: = 200 lb/ton × 51.2 tons = 10,240 lb

Total Resistance —
TR = RR – GA
Sec. D: = 10,240 lb – 0 = 10,240 lb
Sec. C: = 4096 lb – 4096 lb = 0
Sec. B: = 4096 lb – 0 = 4096 lb
Sec. A: = 10,240 lb – 0 = 10,240 lb

Check usable pounds pull against maximum pounds pull required to move the 631G.
Pounds pull usable … 35,349 lb empty
Pounds pull required … 10,240 lb
Estimate travel time for return from 631G empty travel time curve.
Travel time (from curves):
Sec. A: 0.40 min
Sec. B: 0.55
Sec. C: 0.80
Sec. D: 0.40
2.15 min

7. Estimate Cycle Time:

Total Travel Time (Haul plus Return)	= 5.55 min
Adjusted for altitude: 100% × 5.55 min	= 5.55 min
Load Time	0.7 min
Maneuver and Spread Time	0.7 min
Total Cycle Time	6.95 min

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8. Check pusher-scraper combinations:

Pusher cycle time consists of load, boost, return and maneuver time. Where actual job data is not available, the following may be used.

Boost time = 0.10 minute
Return time = 40% of load time
Maneuver time = 0.15 minute
Pusher cycle time = 140% of load time + 0.25 minute
Pusher cycle time = 140% of 0.7 min + 0.25 minute
= 0.98 + 0.25 = 1.23 minute

Scraper cycle time divided by pusher cycle time indicates the number of scrapers which can be handled by each pusher.

$$\frac{6.95 \text{ min}}{1.23 \text{ min}} = 5.65$$

Each push tractor is capable of handling five plus scrapers. Therefore the two pushers can adequately serve the eleven scrapers.

9. Estimate Production:

Cycles/hour = 60 min ÷ Total cycle time
= 60 min/hr ÷ 6.95 min/cycle
= 8.6 cycles/hr

Estimated load = Heaped capacity × L.F.
= 31 LCY × 0.80
= 24.8 BCY

Hourly unit production = Est. load × cycles/hr
= 24.8 BCY × 8.6 cycles/hr
= 213 BCY/hr

Adjusted production = Efficiency factor × hourly production
= 0.83 (50 min hour) × 213 BCY
= 177 BCY/hr

Hourly fleet production = Unit production × No. of units
= 177 BCY/hr × 11
= 1947 BCY/hr

10. Estimate Compaction:

Compaction requirement = S.F. × hourly fleet production
= 0.85 × 1947 BCY/hr
= 1655 CCY/hr

Compaction capability (given the following):
Compacting width, 7.4 ft (W)
Average compacting speed, 6 mph (S)
Compacted lift thickness, 7 in (L)
No. of passes required, 3 (P)

825G production =

$$\text{CCY/hr} = \frac{W \times S \times L \times 16.3}{P} \text{ (conversion constant)}$$

$$= \frac{7.4 \times 6 \times 7 \times 16.3}{3}$$

= 1688 CCY/hr

Given the compaction requirement of 1655 CCY/hr, the 825G is an adequate compactor match-up for the rest of the fleet. However, any change to job layout that would increase fleet production would upset this balance.

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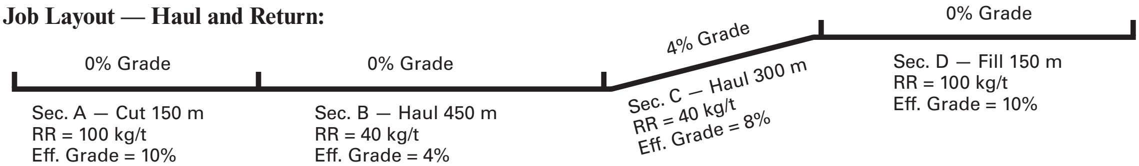
Example problem (Metric)

A contractor is planning to put the following spread on a dam job. What is the estimated production?

Equipment:
11 — 631G Wheel Tractor-Scrapers
2 — D9T Tractors with C-dozers
2 — 12H Motor Graders
1 — 825G Tamping Foot Compactor

Material:
Description — Sandy clay; damp, natural bed
Bank Density — 1770 kg/BCM
Load Factor — 0.80
Shrinkage Factor — 0.85
Traction Factor — 0.50
Altitude — 2300 meters

Job Layout — Haul and Return:



Total Effective Grade = RR (%) ± GR (%)
Sec. A: Total Effective Grade = 10% + 0% = 10%
Sec. B: Total Effective Grade = 4% + 0% = 4%
Sec. C: Total Effective Grade = 4% + 4% = 8%
Sec. D: Total Effective Grade = 10% + 0% = 10%

1. Estimate Payload:
Est. load (LCM) × L.F. × Bank Density = payload
24 LCM × 0.80 × 1770 kg/BCM = 34 000 kg payload

2. Machine Weight:
Empty Wt. — 46 475 kg or 46.48 metric tons
Wt. of Load — 34 000 kg or 34 metric tons
Total (GMW) — 80 475 kg or 80.48 metric tons

3. Calculate Usable Pull (traction limitation):
Loaded: (weight on driving wheels = 54%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 80 475 kg × 54% = 21 728 kg
Empty: (weight on driving wheels = 69%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 46 475 kg × 69% = 16 034 kg

4. Derate for Altitude:
Check power available at 2300 m from altitude deration percentage from manufacturer.
631G — 100% 12H — 83%
D9T — 100% 825G — 100%

Then adjust if necessary:
Load Time — controlled by D9T, at 100% power, no change.
Travel, Maneuver and Spread time — 631G, no change.

5. Compare Total Resistance to Tractive Effort on haul:
Grade Resistance —
GR = 10 kg/metric ton × tons × adverse grade in percent
Sec. C: = 10 kg/metric ton × 80.48 metric tons × 4% grade = 3219 kg

Rolling Resistance —
RR = RR Factor (kg/mton) × GMW (metric tons)
Sec. A: = 100 kg/metric ton × 80.48 metric tons = 8048 kg
Sec. B: = 40 kg/metric ton × 80.48 metric tons = 3219 kg
Sec. C: = 40 kg/metric ton × 80.48 metric tons = 3219 kg
Sec. D: = 100 kg/metric ton × 80.48 metric tons = 8048 kg

Total Resistance —
TR = RR + GR

Sec. A:	= 8048 kg	+	0	= 8048 kg
Sec. B:	= 3219 kg	+	0	= 3219 kg
Sec. C:	= 3219 kg	+	3219 kg	= 6438 kg
Sec. D:	= 8048 kg	+	0	= 8048 kg

Check usable kilogram force against maximum kilogram force required to move the 631G.
Force usable … 21 728 kg loaded
Force required … 8048 kg maximum total resistance
Estimate travel time for haul from 631G (loaded) travel time curve; read travel time from distance and effective grade.
Travel time (from curves):
Sec. A: 0.60 min
Sec. B: 1.00
Sec. C: 1.20
Sec. D: 0.60
3.40 min

NOTE: This is an estimate only; it *does not account for all the acceleration and deceleration tim*e, therefore it is not as accurate as the information obtained from a computer program.

6. Compare Total Resistance to Tractive Effort on return:
Grade Assistance —
GA = 10 kg/mton × metric tons × negative grade in percent
Sec. C: = 10 kg/metric ton × 46.48 metric tons × 4% grade = 1859 kg

Rolling Resistance —
RR = RR Factor × Empty Wt.

Sec. D: = 100 kg/metric ton × 46.48 metric tons
= 4648 kg
Sec. C: = 40 kg/metric ton × 46.48 metric tons
= 1859 kg
Sec. B: = 40 kg/metric ton × 46.48 metric tons
= 1859 kg
Sec. A: = 100 kg/metric ton × 46.48 metric tons
= 4648 kg

Total Resistance —
TR = RR – GA

Sec. D: = 4648 kg – 0 = 4648 kg
Sec. C: = 1859 kg – 1859 kg = 0
Sec. B: = 1859 kg – 0 = 1859 kg
Sec. A: = 4648 kg – 0 = 4648 kg

Check usable kilogram force against maximum force required to move the 631G.

Kilogram force usable … 16 034 kg empty
Kilogram force required … 4645 kg

Estimate travel time for return from 631G empty travel time curve.

Travel time (from curves):

Sec. A: 0.40 min
Sec. B: 0.55
Sec. C: 0.80
Sec. D: 0.40
2.15 min

7. Estimate Cycle Time:

Total Travel Time (Haul plus Return)	=	5.55 min
Adjusted for altitude: 100% × 5.55 min	=	5.55 min
Load Time		0.7 min
Maneuver and Spread Time		0.7 min
Total Cycle Time		6.95 min

8. Check pusher-scraper combinations:

Pusher cycle time consists of load, boost, return and maneuver time. Where actual job data is not available, the following may be used.

Boost time = 0.10 minute
Return time = 40% of load time
Maneuver time = 0.15 minute
Pusher cycle time = 140% of load time + 0.25 minute
Pusher cycle time = 140% of 0.7 min + 0.25 minute
= 0.98 + 0.25 = 1.23 minute

Scraper cycle time divided by pusher cycle time indicates the number of scrapers which can be handled by each pusher.

$$\frac{6.95\text{ min}}{1.23\text{ min}} = 5.65$$

Each push tractor is capable of handling five plus scrapers. Therefore the two pushers can adequately serve the eleven scrapers.

9. Estimate Production:

Cycles/hour = 60 min ÷ Total cycle time
= 60 min/hr ÷ 6.95 min/cycle
= 8.6 cycles/hr

Estimated load = Heaped capacity × L.F.
= 24 LCM × 0.80
= 19.2 BCM

Hourly unit production = Est. load × cycles/hr
= 19.2 BCM × 8.6 cycles/hr
= 165 BCM

Adjusted production = Efficiency factor × hourly production
= 0.83 (50 min hour) × 165 BCM
= 137 BCM/hour

Hourly fleet production = Unit production × No. of units
= 137 BCM/hr × 11 units
= 1507 BCM/hr

10. Estimate Compaction:

Compaction requirement = S.F. × hourly fleet production
= 0.85 × 1507 BCM/hr
= 1280 CCM/hr

Compaction capability (given the following):

Compacting width, 2.26 m	(W)
Average compacting speed, 9.6 km/h	(S)
Compacted lift thickness, 18 cm	(L)
No. of passes required, 3	(P)

825G production =

$$\text{CCY/hr} = \frac{W \times S \times L \times 10}{P} \text{ (conversion factor)}$$

$$= \frac{2.26 \times 9.6 \times 18 \times 10}{3}$$

$$= 1302$$

Given the compaction requirement of 1280 CCM/h, the 825G is an adequate compactor match-up for the rest of the fleet. However, any change to job layout that would increase fleet production would upset this balance.

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SYSTEMS

Caterpillar offers a variety of machines for different applications and jobs. Many of these separate machines function together in mining and earthmoving systems.

- Bulldozing with track-type tractors
- Load-and-Carry with wheel loaders
- Scrapers self-loading, elevator, auger, or push-pull configurations, or push-loaded by track-type tractors
- Articulated trucks loaded by excavators, track loaders or wheel loaders
- Off-highway trucks loaded by shovels, excavators or wheel loaders

Haul System Selection: In selecting a hauling system for a project, there may seem to be more than one "right" choice. Many systems may meet the distance, ground conditions, grade, material type, and production rate requirements. After considering all of the different factors, one hauling system usually provides better performance. This makes it critical for the dealer and customer to work together to get accurate information for their operation or project. Caterpillar is committed to providing the correct earthmoving system to match the customer's specific needs.

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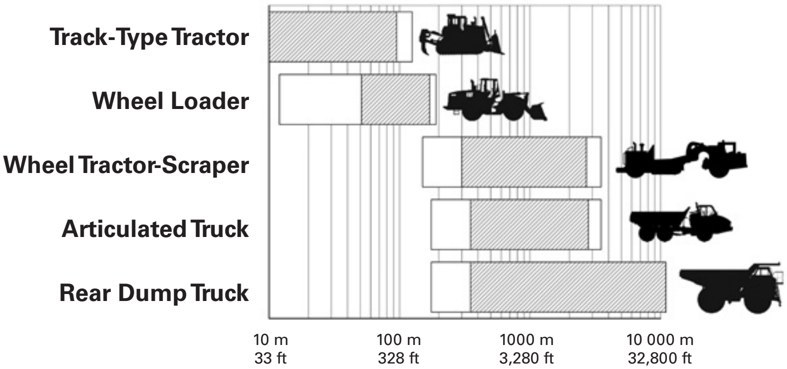
GENERAL LOADED HAUL DISTANCES FOR MOBILE SYSTEMS



LOADED HAUL DISTANCE

MODEL		Large Wheel Loader						Hydraulic Mining Shovel						Electric Rope Shovel				
		986	988	990	992	993	994	6015	6020	6030	6040	6060	6090	7295	7395	7495HD	7495	7495HF
Off-Highway Trucks	770	4	3					3										
	772	5	4					3-4										
	773	6	5	3				4-5	3									
	775		6	4	3			4-5	3-4									
	777			6	4-5	3-4		6-7	4-5	3-4								
Large Mining Trucks	785				7	6	3-4		6-7	4-5	4			3				
	789					7	4-5			5-6	5	3		4	3	3		
	793						5-6				6	4			4	3		
	794						7-8					5	3-4		4	4	3	3
	796											5-6	3-4			4	3	3
	797											6	4				4	4
	798											6	4				4	4

PRODUCTION ESTIMATING

Loading Match — Loading tools have a production range that varies with material, bucket configuration, target size, operator skill and load area conditions. The loader/truck matches given in the following table are with the typical number of passes and production range.

Your Cat® dealer can provide advice and estimates based on your specific conditions.

FUEL CONSUMPTION AND PRODUCTIVITY

Fuel efficiency is the term used to relate fuel consumption and machine productivity. It is expressed in units of material moved per volume of fuel consumed. Common units are cubic meters or tonnes per liter of fuel (cubic yards or tons/gal). Determining fuel efficiency requires measuring both fuel consumption and production.

Measuring fuel consumption involves tapping into the vehicle's fuel supply system — without contaminating the fuel. The amount of fuel consumed during operation is then measured on a weight or volumetric basis and correlated with the amount of work the machine has done. Most Cat machines can record fuel consumed with relative accuracy, given the engine is performing close to specifications.

Cat Earthmoving and Mining Systems Production/50 Min. Hr.

Please refer to the individual machine section for production targets.

Cat Aggregate Systems Production/50 Min. Hr.

Please refer to the individual machine section for production targets.

FORMULAS AND RULES OF THUMB

Production, hourly = Load (BCM)/cycle × cycles/hr

= Load (BCY)/cycle × cycles/hr

Load Factor (L.F.) $= \dfrac{100\%}{100\% + \%\ \text{swell}}$

Load (bank measure) = Loose cubic meters (LCM) × L.F.

= Loose cubic yards (LCY) × L.F.

Shrinkage Factor (S.F.) $= \dfrac{\text{Compacted cubic meters (or yards)}}{\text{Bank cubic meters (or yards)}}$

Density = Weight/Unit Volume

Load (bank measure) $= \dfrac{\text{Weight of load}}{\text{Bank density}}$

Rolling Resistance Factor
= 20 kg/t + (6 kg/t/cm × cm)
= 40 lb/ton + (30 lb/ton/inch × inches)

Rolling Resistance
= RR Factor (kg/t) × GMW (tons)
= RR Factor (lb/ton) × GMW (tons)

Rolling Resistance (general estimation)
= 2% of GMW + 0.6% of GMW per cm tire penetration
= 2% of GMW + 1.5% of GMW per inch tire penetration

$$\%\ \text{Grade} = \frac{\text{vertical change in elevation (rise)}}{\text{corresponding horizontal distance (run)}}$$

Grade Resistance Factor = 10 kg/m ton × % grade
= 20 lb/ton × % grade

Grade Resistance = GR Factor (kg/t) × GMW (tons)
= GR Factor (lb/ton) × GMW (tons)

Grade Resistance = 1% of GMW × % grade

Total Resistance
= Rolling Resistance (kg or lb) + Grade Resistance (kg or lb)

Total Effective Grade (%) = RR (%) + GR (%)

Usable pull (traction limitation)
= Coeff. of traction × weight on drivers
= Coeff. of traction × (Total weight × % on drivers)

Pull required = Rolling Resistance + Grade Resistance
= Total Resistance

Total Cycle Time = Fixed time + Variable time

Fixed time: See respective machine production section.

Variable time = Total haul time + Total return time

Travel Time $= \dfrac{\text{Distance (m)}}{\text{Speed (m/min)}}$

$= \dfrac{\text{Distance (ft)}}{\text{Speed (fpm)}}$

Cycles per hour $= \dfrac{60\ \text{min/hr}}{\text{Total cycle time (min/cycle)}}$

Adjusted production = Hourly production × Efficiency factor

No. of units required $= \dfrac{\text{Hourly production required}}{\text{Unit hourly production}}$

No. of scrapers a pusher will load $= \dfrac{\text{Scraper cycle time}}{\text{Pusher cycle time}}$

Pusher cycle time (min) = 1.40 Load time (min) + 0.25 min

Grade Horsepower $= \dfrac{\text{GMW (kg)} \times \text{Total Effective Grade} \times \text{Speed (km/h)}}{273.75}$

$= \dfrac{\text{GMW (lb)} \times \text{Total Effective Grade} \times \text{Speed (mph)}}{375}$

STOCKPILE COAL HANDLING

CONTENTS

INTRODUCTION

Efficient methods have been developed for handling and storing coal with mobile equipment. Generally, a power plant or other industrial facility which uses coal, meets its daily requirements with incoming coal shipments and will maintain an emergency stockpile or deadpile. The deadpile is designed to meet the burn requirements during any interruption of coal shipments. Interruptions may include inclement weather, carrier strikes, scheduling problems, etc.

The deadpile will contain approximately a 90 day supply of coal and is constructed by thoroughly compacting lifts, or layers, of coal approximately 15 cm (6 in) thick. Thorough compaction of the entire stockpile, including the sides, eliminates air spaces, reducing the possibility of spontaneous combustion.

Reclaiming the deadpiled coal is critical when incoming shipments are not able to satisfy the burn requirements. Four basic types of mobile equipment are available for stockpiling and reclaiming coal — track-type tractors, wheel dozers, wheel loaders, and wheel tractor-scrapers. Each type has its own specific advantages. The equipment selected must be able to meet the maximum hourly burn rate.

MACHINE SELECTION

Track-Type Tractors

Track-type tractors continue to be the most widely used machines for coal handling operations. Equipped with a U-shaped coal dozer, they are suitable for meeting high production requirements over dozing distances of less than 152 m (500 ft). Their tractive capabilities and gradeability permit them to operate on the sides of the stockpile and surge pile which often prove inaccessible to other types of equipment. They can also remove snow and frost penetrated coal from the stockpile surface so that rubber-tired equipment can work efficiently.

Wheel Dozers

These machines, with their long wheel base, low center of gravity, and articulated design, offer good stability and maneuverability. They have the ability to travel at a higher speed than the track-type tractor, moving easily from one area of operation to another, and provide greater compactive effort with fewer passes. They are capable of performing some utility functions. However, their coefficient of traction is less than that of track-type tractors. The most efficient dozing distance for the wheel dozers is usually less than 152 m (500 ft).

Coal scoop attachments are available for wheel dozers and can provide improved production due to the higher volume of the scoop.

Wheel Loaders

As dozing and hauling distances increase, wheel loaders are able to effectively move coal in load-and-carry operations. Since coal is a relatively light material, the loaders should be equipped with larger buckets sized for coal density. Versatility and mobility allow them to perform a variety of tasks, both on and off the stockpile. They can load trucks or railcars, dig out bottom ash and boiler slag from the ash storage areas, and move railcars within the vicinity of the power plant. Generally wheel loaders are more efficient than track or wheel dozers at distances of 122 m (400 ft) or more.

Coal Bowl Wheel Tractor-Scrapers

Coal Bowl Wheel Tractor-Scrapers are typically used for building and maintaining coal stockpiles and hauling coal to the supply system at coal power plants. The self-loading capability, large capacity, coal pile compaction, and haul speed of Coal Bowl Wheel Tractor-Scrapers make them the tool of choice for moving coal both short and long distances. Coal Bowl Wheel Tractor-Scrapers are available in the 637K and 657G twin engine models. Please reference Wheel Tractor - Scrapers section of this handbook for more information on Coal Bowl Wheel Tractor - Scrapers.

HOW TO EQUIP

Counterweighting

While larger blades or buckets allow for greater production, counterweighting is often necessary to improve the machine's balance and handling capability. For track-type tractors, a rear counterweight is recommended. Wheel machines use various methods to add weight. For example, wheel dozers use front counterweights, and wheel machines often use tire ballast. Below is a weight comparison of the Cat® standard U-Blade to the Coal U-Blade, along with the recommended counterweight for D11, D10T2, D9T, D8T, and 834K.

COAL STOCKPILE BLADE WEIGHT COMPARISON/ COUNTERWEIGHTING

	U-Blade		Coal U-Blade/ Scoop		Counterweight	
Model	kg	lb	kg	lb	kg	lb
D11	12 880	**28,396**	11 475	**25,298**	4989	**11,000**
D10T2	7918	**17,456**	7100	**15,653**	2928	**6456**
D9T	5634	**12,421**	4650	**10,252**	3142	**6926**
D8T	2825	**6228**	3200	**7050**	2749	**6060**
834K	2994	**6600**	3630	**8000**	75% $CaCl_2$ in all tires —	
*834K with Scoop			8700	**19,180**		
					5360	**11,816**

Weights include blade or scoop only. The change in machine weight is determined by adding or subtracting the difference between the two blades. Counterweight or ballast may also need to be considered.

Track Shoe Width

Track shoes are an important consideration since shoe width determines tractive capability and compaction. Depending on the coal being stockpiled, the utility company will often have a strong preference concerning track shoe width. Basically, utilities stockpiling low rank or sub-bituminous rank lignite coal usually prefer the standard shoe width for maximum compactive effort to reduce the possibility of spontaneous combustion.

Utilities burning medium or high rank bituminous coals are not as concerned with spontaneous combustion and sometimes prefer a wider shoe that allows increased tractive capability on loose or less densely compacted coal stockpiles.

Tires

Many utility companies have established a tire preference for wheel machines. Normally a radial tire allows for the maximum tire print in the stockpile surface providing the best traction.

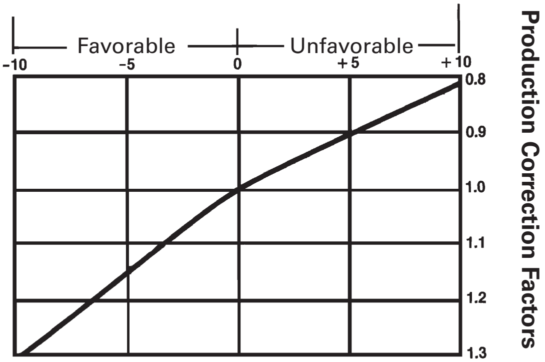
Other

The 834K's performance may be improved in the varying underfoot conditions of a coal stockpile with the use of a NoSPIN differential. This differential provides added tractive capability on all coal piles, particularly loose coal. Use of a NoSPIN differential should carefully be evaluated. The NoSPIN differential will also increase tire wear and decrease axle component life in applications with good traction.

PRODUCTION FACTORS

1. *The effect of grade* — dozer production will increase 3% for each 1% of favorable grade and decrease 2% for each 1% of adverse grade up to grades of 10%. The graph below exemplifies this point.

Effect of Grade on Production
% Grade



As a rule of thumb, track-type tractors can negotiate grades of about 60% in *loose* coal. Wheel dozers can negotiate grades up to 25% on fairly well *compacted* coal.

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2. *Slot dozing*, which consists of dozing repeatedly in the same tracks, will increase production. The deeper the slot, the greater the increase in production. Obviously this will disrupt the surface of the pile; however it does provide maximum production.

Slot Condition	Slot Depth	Increase in Production
Slight	60 cm ~ **2 ft**	10%
Consistent	60 cm-1.5 m ~ **2-5 ft**	25%
Very Consistent	Over 1.5 m ~ **Over 5 ft**	30% +

3. *Relative traction* — machines will provide greater tractive effort as the compaction beneath them increases.

Condition	Machine	Coefficient of Traction
Well Compacted Coal	Track-type	*0.75-0.80
	Wheel	0.40-0.50
Loose Coal	Track-type	*0.60
	Wheel	0.30-0.40

*Suspended undercarriage will often achieve a higher coefficient of traction.

4. *Rolling Resistance* of rubber tired equipment will decrease as the compaction of the coal beneath the machines increases. Here are total rolling resistances on various surfaces.

	kg/Metric Ton	lb/U.S. Ton
● Main travel area from loading area to stockpile traveled and maintained.	29	**65**
● Travel over the compacted deadpile.	36	**80**
● Travel over thin lifts of uncompacted coal on the deadpile.	54	**120**
● Travel on loose piles under stacking conveyor or on a windrow.	90-136	**200-300**

NOTE: Rolling Resistance (RR) is a measure of the force that must be overcome to roll or pull a wheel over the ground. It is affected by ground conditions and load — the deeper a wheel sinks into the ground, the higher the rolling resistance. Internal friction and tire flexing also contribute to rolling resistance.

5. *The degree of compaction required* — for medium and high rank bituminous coal, track-type tractors will normally provide ample compaction to prevent fires. For low rank coals, such as sub-bituminous and lignite, rubber tired machines, pneumatic compactors or sealing may be required to prevent fires. The following table illustrates the compaction that is possible if the coal is spread in thin lifts and the machine makes a sufficient number of passes over the entire lift surface.

Machine	kg/m^3	lb/ft^3	lb/yd^3
Track-Type Tractors	960-1160	**60-72**	**1620-1950**
Wheel Dozers	1040-1200	**65-75**	**1750-2030**
Wheel Loaders	1040-1250	**65-78**	**1750-2110**
Wheel Tractor-Scrapers	1100-1280	**68-80**	**1840-2160**

ESTIMATING HOURLY PRODUCTION

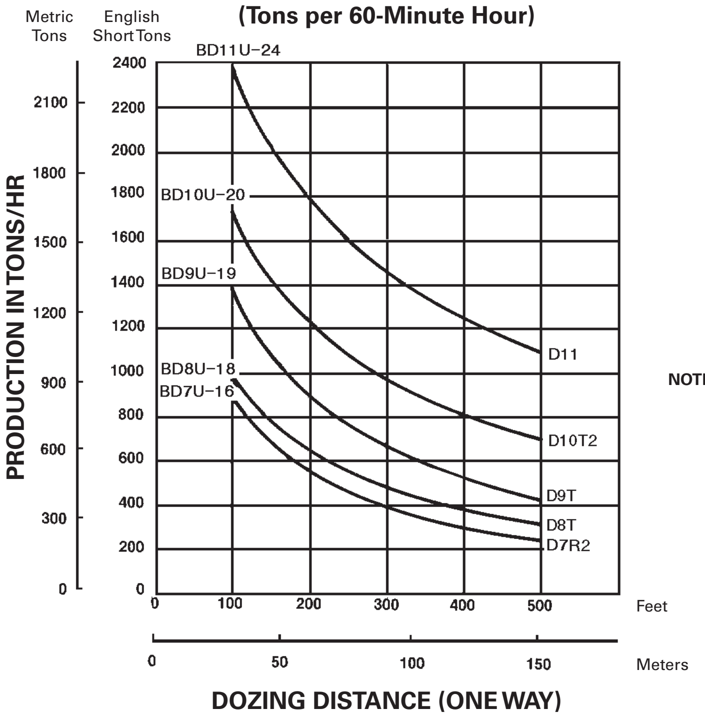
The following graphs may be used for estimating the hourly production of machines handling mixed bituminous coal. The graphs are based on 100% machine efficiency under normal job conditions and average operator; they do not take into account adverse grades, downtime, wait time, poor traction, etc. These production estimates should be evaluated in light of individual job conditions and efficiency. Moreover, a job efficiency correction factor should be applied to the production estimate shown when using these graphs.

To estimate travel times for a specific machine refer to the performance graphs or charts in the appropriate model section of this book.

NOTE: Capacities and production curves on the next pages are based on bituminous coal with a density of 890 kg/m^3 or 1500 lb/yd^3 or 55 lb/ft^3. For sub-bituminous coal with a density of 800 kg/m^3 or 1350 lb/yd^3 or 50 lb/ft^3 multiply tonnage figure by 0.90. For lignite with an average density of 710 kg/m^3 or 1200 lb/yd^3 or 45 lb/ft^3 multiply tonnage figure by 0.80.

Track-Type Tractors Estimated Production with U-Blade (Coal Dozer)

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**



NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

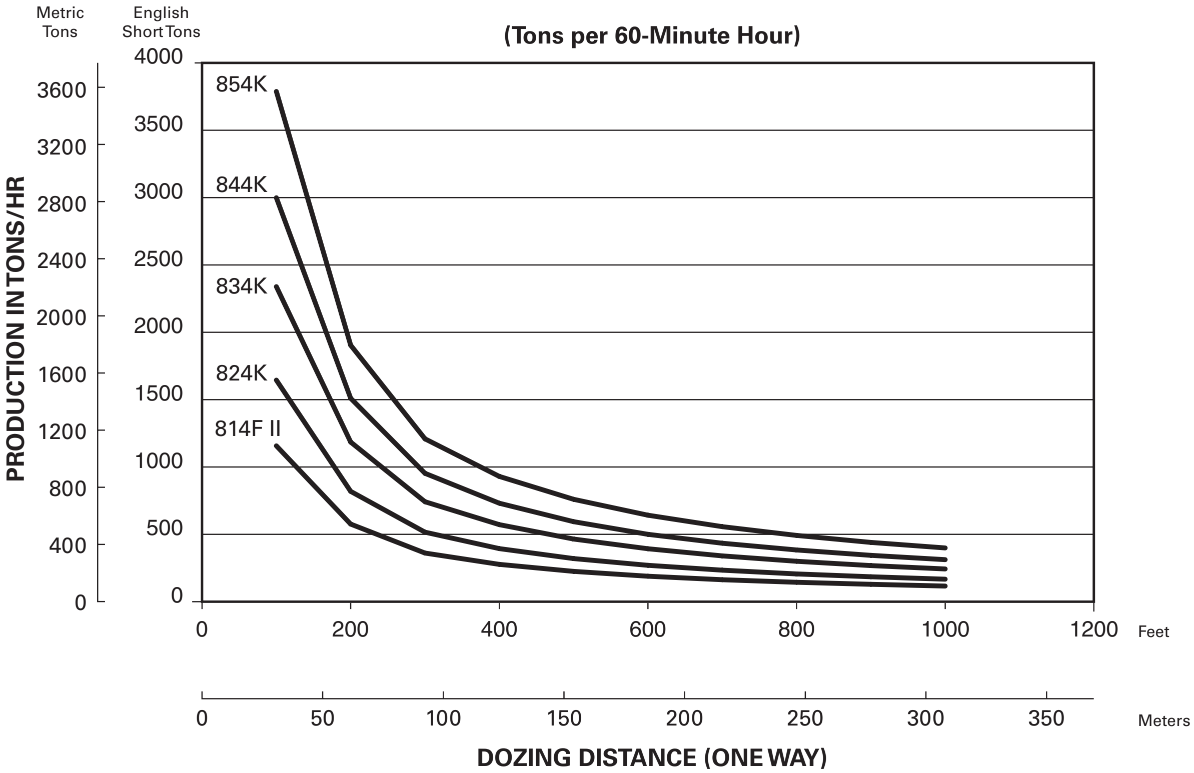
Tractor	U-Blade			Blade Capacities			
	Model	m	ft	Metric tons	U.S. tons	m³	yd³
D11	BD11U-24	7.32	**24'**	66.7	**73.5**	74.9	**98.0**
D10T2	BD10U-20	6.10	**20'**	40.85	**45.0**	45.9	**60.0**
D9T	BD9U-19	5.79	**19'**	32.6	**35.9**	37.0	**48.0**
D8T	BD8U-18	5.49	**18'**	19.0	**21.0**	21.4	**28.0**
D7R2	BD7U-16	4.88	**16'**	14.28	**15.75**	16.05	**21.0**
D6R	BD6U	4.27	**14'**	8.84	**9.75**	9.9	**13.0**

Refer to Track-Type Tractor/Bulldozer section for additional special attachment specifications.

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

Wheel Dozers Estimated Production with U-Blade (Coal Dozer)

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**



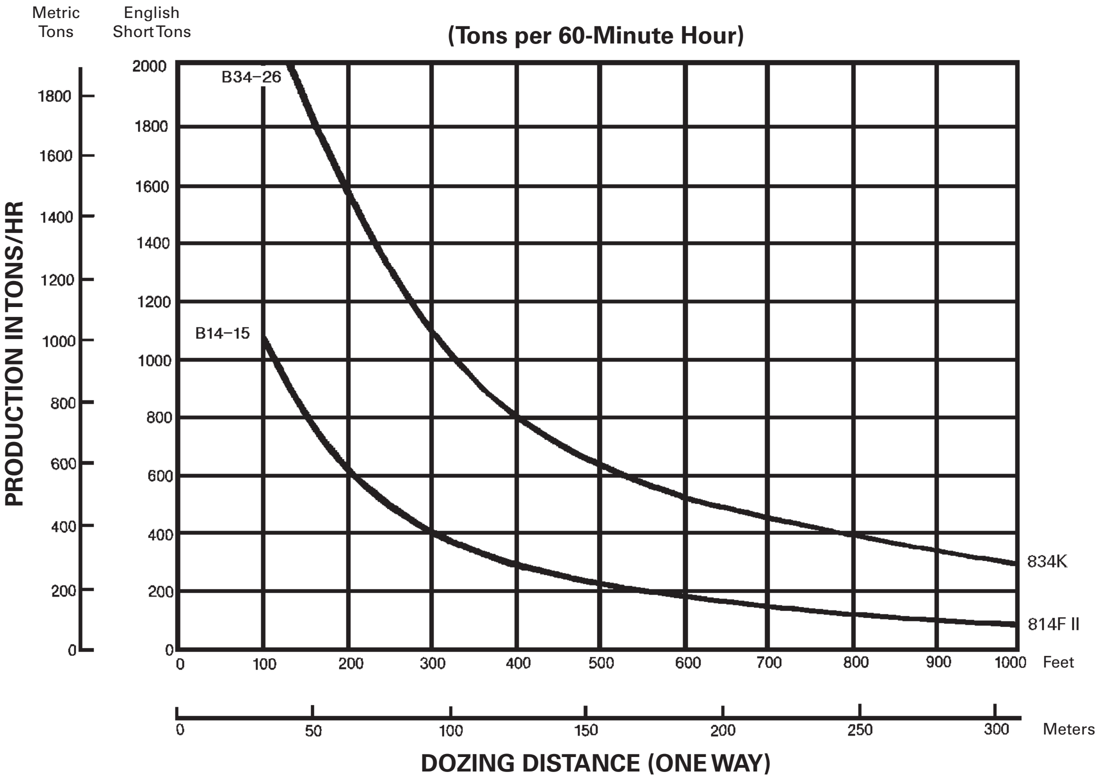
Tractor	U-Blade			Blade Capacities			
	Model	m	ft	Metric tons	U.S. tons	m^3	yd^3
854K	153-2113	7.20	**23'8"**	39.8	**43.65**	44.7	**58.2**
844K	153-2111	5.84	**19'2"**	27.3	**30.20**	30.7	**40.2**
834K	376-3845	6.17	**20'3"**	19.8	**21.80**	22.2	**29.0**
824K	BD824U-15	4.79	**15'7"**	14.2	**15.70**	16.2	**21.1**
814F II	BD814U-14	4.32	**14'2"**	9.4	**10.30**	11.0	**14.0**

NOTE: Blade capacities in tons figured using weight of coal at 890 kg/m^3 **(1500 lb/yd^3)**.

Refer to Track-Type Tractor/Bulldozer section for additional special attachment specifications.

Wheel Dozers Estimated Production with Coal Scoop

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**

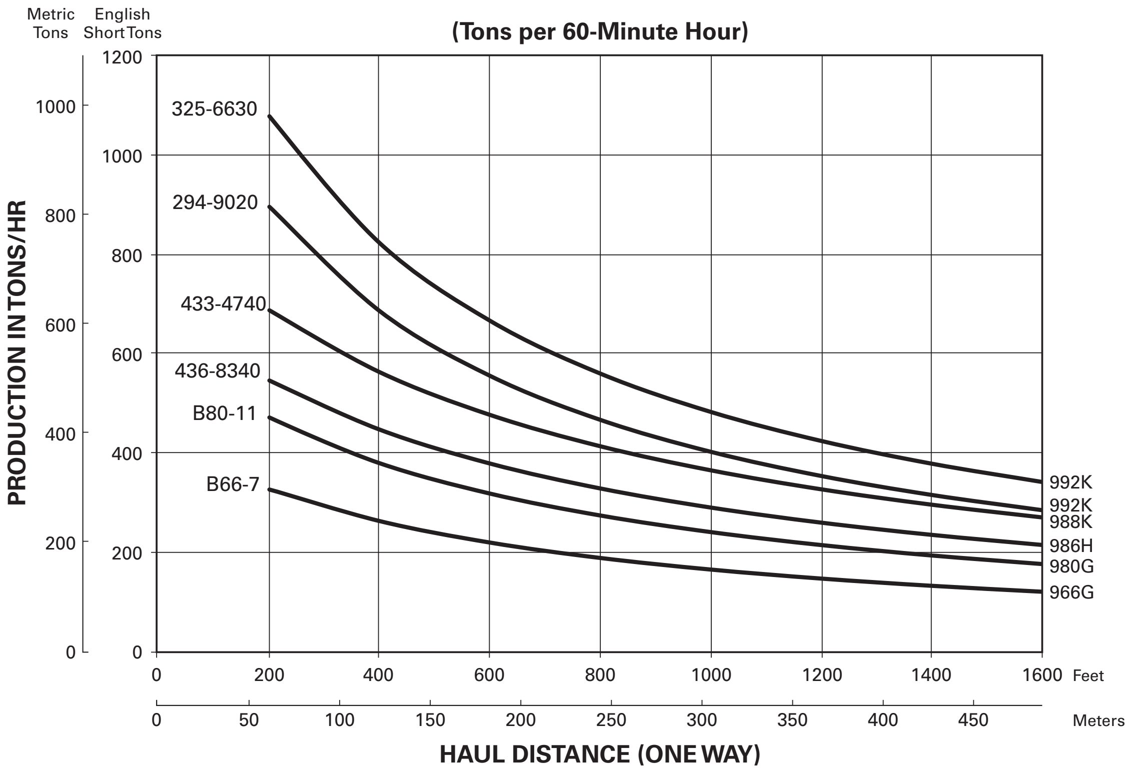


Tractor	Coal Scoop			Scoop Capacities (Lift and Carry)				Doze Capacities			
	Model	m	ft	Metric tons	U.S. tons	m³	yd³	Metric tons	U.S. tons	m³	yd³
834K	220-3648	4.9	**15'11"**	19.7	**21.8**	22.9	**30**	37.8	**41.2**	44.2	**57.8**
814F II	B14-15	3.7	**12'3"**	8.2	**9.0**	11.5	**15**	16.3	**18.0**	19.1	**25**

Refer to Track-Type Tractor/Bulldozer section for additional special attachment specifications.

Wheel Loaders Estimated Production with Coal Bucket

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.80 Coefficient of Traction**

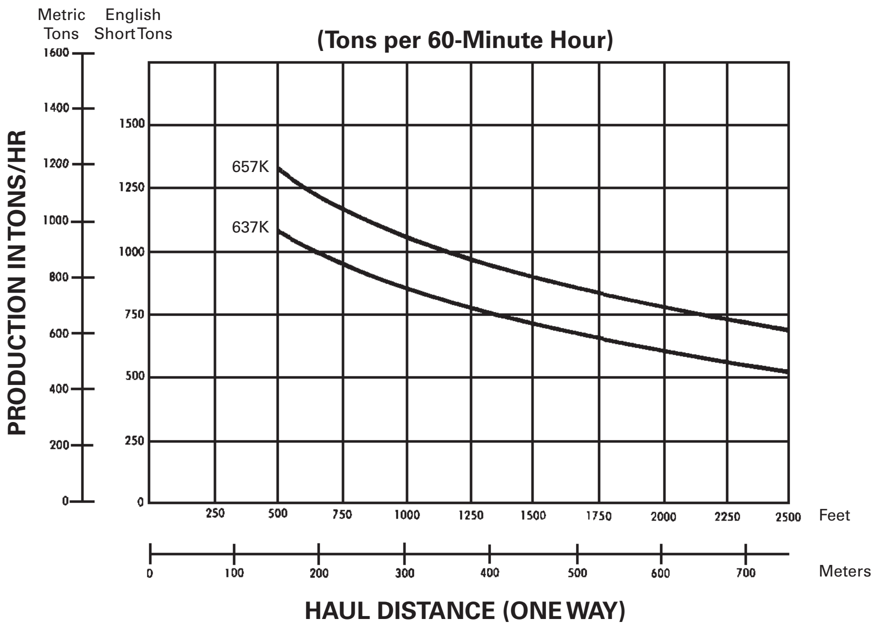


Loader	Coal Bucket Model	Bucket Capacities			
		Metric tons	U.S. tons	m³	yd³
992K	294-9020	17.0	**18.8**	19.1	**25.0**
992K	325-6630	20.4	**22.5**	22.9	**30.0**
988K	433-4740	11.6	**12.8**	13.0	**17.0**
986H	436-8340	9.2	**10.1**	10.3	**13.5**
980G	B80-11	7.3	**8.1**	8.2	**10.8**
966G	B66-7	4.9	**5.4**	5.5	**7.3**

NOTE: Bucket capacities include bottom cutting edge. Figured using weight of coal at 890 kg/m³ **(1500 lb/yd³)**.

Wheel Tractor-Scrapers Estimated Production

Factors:
- **Mixed Bituminous Coal**
- **Storage and Reclamation**
- **0% Grade**
- **0.50 Coefficient of Traction**



Coal Scraper	Bowl Capacities					
			Struck		Heaped	
	Metric tons	U.S. tons	m³	yd³	m³	yd³
657K	49.9	**55**	45	**59**	56	**73**
637K	34.5	**38**	31	**41**	38	**50**

Average fixed time to load, maneuver and dump:
657K — 1.12 min.
637K — 1.10 min.

NOTE:

- The 657K Coal Scraper is 1072 mm (42.2") longer, the bowl sides are 1010 mm (39.8") taller, the apron is 677 mm (26.7") taller, and the ejector is 944 mm (37.2") taller than its earthmoving counterpart.
- The 637K Coal Scraper is 736 mm (29.0") longer, the bowl sides are 476 mm (18.7") taller, and the apron is 499 mm (19.6") taller than its earthmoving counterpart.
- The rimpull, travel times, and retarder performance for the coal scrapers are the same as for the standard machines. See Wheel Tractor-Scrapers section for charts and graphs.

Example Problem

A coal-fired utility company has a coal requirement of approximately 315 metric tons (350 tons) per hour. Specify the coal handling machine that will satisfy this demand.

Conditions:

Lignite Coal 710 kg/m^3 (1200 lb/yd^3)
90 m (300 ft) push distance
5% adverse grade
50 minute hour operation efficiency

Solution:

Calculate the D9T's production equipped with the BD9U-19 Coal U-Blade by using the D9T production curve. Start at 90 m (300 ft) and read up to the D9T production line, then over to the left to determine its maximum hourly production of 612 metric tons (675 tons).

Since the graphs are based on a 890 kg/m^3 (1500 lb/yd^3) coal density, this production figure has to be adjusted to reflect lignite coal:

Coal density correction factor = 710/890 (1200/1500) = 0.8.

Obtain the production correction factor for the 5% adverse grade from the chart: 0.9.

The correction factor for the 50 minute hour is 50/60 = 0.83.

Now calculate the adjusted D9T hourly production using the correction factors:

Metric 612 × 0.8 × 0.9 × 0.83 = 366 tons/hour
English 675 × 0.8 × 0.9 × 0.83 = 403 tons/hour

The D9T falls in the required production range. For short periods of peak power capacity, production could be increased by slot dozing.

Production for the D10T2, 824K and 834K can be calculated using the same method.

D10T2
Metric 850 × 0.8 × 0.9 × 0.83 = 508 tons/hour
English 935 × 0.8 × 0.9 × 0.83 = 559 tons/hour

824K
Metric 400 × 0.8 × 0.9 × 0.83 = 239 tons/hour
English 440 × 0.8 × 0.9 × 0.83 = 263 tons/hour

834K
Metric 689 × 0.8 × 0.9 × 0.83 = 412 tons/hour
English 760 × 0.8 × 0.9 × 0.83 = 454 tons/hour

Therefore, the D9T or 834K could most economically satisfy the production requirements.

TABLES

CONTENTS

SWELL — VOIDS — LOAD FACTORS

SWELL (%)	VOIDS (%)	LOAD FACTOR
5	4.8	0.952
10	9.1	0.909
15	13.0	0.870
20	16.7	0.833
25	20.0	0.800
30	23.1	0.769
35	25.9	0.741
40	28.6	0.714
45	31.0	0.690
50	33.3	0.667
55	35.5	0.645
60	37.5	0.625
65	39.4	0.606
70	41.2	0.588
75	42.9	0.571
80	44.4	0.556
85	45.9	0.541
90	47.4	0.526
95	48.7	0.513
100	50.0	0.500

Throughout this document, references to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim) include U.S. EPA Tier 4 Interim, EU Stage IIIB, and Japan 2011 (Tier 4 Interim) equivalent emission standards. References to Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) include U.S. EPA Tier 4 Final, EU Stage V, and Japan 2014 (Tier 4 Final) emission standards. References to Tier 4 Final/Stage V include U.S. EPA Tier 4 Final and EU Stage V emission standards.

Throughout this document, references to Tier 1/Stage I include U.S. EPA Tier 1 and EU Stage I equivalent emission standards. References to Tier 2/Stage II/Japan 2001 (Tier 2) equivalent include U.S. EPA Tier 2, EU Stage II, and Japan 2001 (Tier 2) equivalent emission standards. References to Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent include U.S. EPA Tier 3, EU Stage IIIA, and Japan 2006 (Tier 3) equivalent emission standards.

BUCKET FILL FACTORS

Loose Material	Fill Factor
Mixed Moist Aggregates	95-100%
Uniform Aggregates up to 3 mm (1/8")	95-100
3 mm-9 mm (1/8"-3/8")	90-95
12 mm-20 mm (1/2"-3/4")	85-90
24 mm (1") and over	85-90
Blasted Rock	
Well Blasted	80-95%
Average Blasted	75-90
Poorly Blasted	60-75
Other	
Rock Dirt Mixtures	100-120%
Moist Loam	100-110
Soil, Boulders, Roots	80-100
Cemented Materials	85-95

NOTE: Loader bucket fill factors are affected by bucket penetration, breakout force, rack back angle, bucket profile and ground engaging tools such as bucket teeth or bolt-on replaceable cutting edges.

NOTE: For bucket fill factors for hydraulic excavators, see bucket payloads in the hydraulic excavator section.

NOTE: Above values are not valid for Hydraulic Mining Shovels.

ANGLE OF REPOSE OF VARIOUS MATERIALS

MATERIAL	ANGLE BETWEEN HORIZONTAL AND SLOPE OF HEAPED PILE: Ratio	Degrees
Coal, industrial	1.4:1—1.3:1	35-38
Common earth, Dry	2.8:1—1.0:1	20-45
Moist	2.1:1—1.0:1	25-45
Wet	2.1:1—1.7:1	25-30
Gravel, Round to angular	1.7:1—0.9:1	30-50
Sand & clay	2.8:1—1.4:1	20-35
Sand, Dry	2.8:1—1.7:1	20-30
Moist	1.8:1—1.0:1	30-45
Wet	2.8:1—1.0:1	20-45

TYPICAL ROLLING RESISTANCE FACTORS

NOTE: For Earthmoving and NON-Mining/Quarry Applications

Various tire sizes and inflation pressures will greatly reduce or increase the rolling resistance. The values in this table are approximate, particularly for the track and track + tire machines. These values can be used for estimating purposes when specific performance information on particular equipment and given soil conditions is not available. See Mining and Earthmoving Section for more detail.

UNDERFOOTING	ROLLING RESISTANCE, PERCENT*: Tires Bias	Tires Radial	Track **	Track +Tires
A very hard, smooth roadway, concrete, cold asphalt or dirt surface, no penetration or flexing	1.5%*	1.2%	0%	1.0%
A hard, smooth, stabilized surfaced roadway without penetration under load, watered, maintained	2.0%	1.7%	0%	1.2%
A firm, smooth, rolling roadway with dirt or light surfacing, flexing slightly under load or undulating, maintained fairly regularly, watered	3.0%	2.5%	0%	1.8%
A dirt roadway, rutted or flexing under load, little maintenance, no water, 25 mm (1") tire penetration or flexing	4.0%	4.0%	0%	2.4%
A dirt roadway, rutted or flexing under load, little maintenance, no water, 50 mm (2") tire penetration or flexing	5.0%	5.0%	0%	3.0%
Rutted dirt roadway, soft under travel, no maintenance, no stabilization, 100 mm (4") tire penetration or flexing	8.0%	8.0%	0%	4.8%
Loose sand or gravel	10.0%	10.0%	2%	7.0%
Rutted dirt roadway, soft under travel, no maintenance, no stabilization, 200 mm (8") tire penetration and flexing	14.0%	14.0%	5%	10.0%
Very soft, muddy, rutted roadway, 300 mm (12") tire penetration, no flexing	20.0%	20.0%	8%	15.0%

*Percent of combined machine weight.

**Assumes drag load has been subtracted to give Drawbar Pull for good to moderate conditions. Some resistance added for very soft conditions.

ROUND REINFORCED CONCRETE PIPE APPROXIMATE WEIGHT PER FOOT

INSIDE DIAMETER		WEIGHT PER FT.	
mm	ft/in	kg	lb
305	**12"**	42	**93**
380	**15"**	58	**127**
460	**18"**	76	**168**
530	**1'9"**	97	**214**
610	**2'0"**	120	**265**
685	**2'3"**	146	**322**
760	**2'6"**	174	**384**
840	**2'9"**	205	**452**
915	**3'0"**	238	**524**
1070	**3'6"**	311	**686**
1220	**4'0"**	393	**867**
1370	**4'6"**	485	**1069**
1525	**5'0"**	588	**1295**
1675	**5'6"**	699	**1542**
1830	**6'0"**	821	**1811**
1980	**6'6"**	952	**2100**
2135	**7'0"**	1093	**2409**
2285	**7'6"**	1242	**2740**
2440	**8'0"**	1402	**3090**
2590	**8'6"**	1578	**3480**
2740	**9'0"**	1753	**3865**

NOTE: Table courtesy of American Concrete Pipe Assn.

COEFFICIENT OF TRACTION FACTORS

MATERIAL	TRACTION FACTORS	
	Rubber Tires	Tracks
Concrete	0.90	0.45
Clay loam, dry.	0.55	0.90
Clay loam, wet	0.45	0.70
Rutted clay loam.	0.40	0.70
Dry sand	0.20	0.30
Wet sand	0.40	0.50
Quarry pit	0.65	0.55
Gravel road (loose not hard)	0.36	0.50
Packed snow	0.20	0.27
Ice	0.12	0.12
Semi-skeleton shoes		
Firm earth	0.55	0.90
Loose earth	0.45	0.60
Coal, stockpiled.	0.45	0.60

NOTE: The elevated sprocket design Track-Type Tractors (D11, D10T2, D9T, D9R, D8T, and D8R), with their suspended undercarriage, provide up to 15% more efficient tractive effort than rigid tracked Track-Type Tractors.

SPEED CONVERSION

km/h Equivalents in m/min				MPH Equivalents in FPM			
km/h	m/min	km/h	m/min	mph	fpm	mph	fpm
1	16.7	21	350.0	**1**	**88**	**21**	**1848**
2	33.3	22	366.7	**2**	**176**	**22**	**1936**
3	50.0	23	383.3	**3**	**264**	**23**	**2024**
4	66.7	24	400.0	**4**	**352**	**24**	**2112**
5	83.3	25	416.7	**5**	**440**	**25**	**2200**
6	100.0	26	433.3	**6**	**528**	**26**	**2288**
7	116.7	27	450.0	**7**	**616**	**27**	**2376**
8	133.3	28	466.7	**8**	**704**	**28**	**2464**
9	150.0	29	483.3	**9**	**792**	**29**	**2552**
10	166.7	30	500.0	**10**	**880**	**30**	**2640**
11	183.3	31	516.7	**11**	**968**	**31**	**2728**
12	200.0	32	533.3	**12**	**1056**	**32**	**2816**
13	216.7	33	550.0	**13**	**1144**	**33**	**2904**
14	233.3	34	566.7	**14**	**1232**	**34**	**2992**
15	250.0	35	583.3	**15**	**1320**	**35**	**3080**
16	266.7	36	600.0	**16**	**1408**	**36**	**3168**
17	283.3	37	616.7	**17**	**1496**	**37**	**3256**
18	300.0	38	633.3	**18**	**1584**	**38**	**3344**
19	316.7	39	650.0	**19**	**1672**	**39**	**3432**
20	333.3	40	666.7	**20**	**1760**	**40**	**3520**

NOTE: Since 1 km/h equals 16.7 m/min (1000 ÷ 60), to interpolate add 1.67 m/min for each 0.1 km/h.

NOTE: Since 1 mph equals 88 fpm (5280 ÷ 60), to interpolate add 8.8 fpm for every 0.1 mph.

1 mph = 26.9 m/min.

BEARING POWERS

MATERIAL	BEARING POWER Bar	lb/in²	Metric t/m²	U.S. tons/ft²
Rock (semi- shattered)	4.8	**70**	50	**5**
Rock (solid)	24.1	**350**	240	**24**
Clay, dry.	3.8	**55**	40	**4**
medium dry	1.9	**27**	20	**2**
soft	1.0	**14**	10	**1**
Gravel, cemented	7.6	**110**	80	**8**
Sand, compact dry	3.8	**55**	40	**4**
clean dry	1.9	**27**	20	**2**
Quicksand & alluvial soil . .	0.5	**7**	5	**0.5**

AGRICULTURAL COMMODITIES CONVERSION FACTORS

	lb	kg	Metric Ton
1 Bushel of Corn*	56	25.40	0.02540
1 Bushel of Soybean*	60	27.22	0.02721
1 Bushel of Oats*	32	14.51	0.01451
1 Bushel of Wheat*	60	27.22	0.02721
1 Bale of Cotton	478	216.81	0.21681

1 metric ton of Corn	39.37 Bushels*
1 metric ton of Soybean	36.75 Bushels*
1 metric ton of Oats	68.92 Bushels*
1 metric ton of Wheat	36.75 Bushels*
1 metric ton of Cotton	4.61 Bales

*Bushel is a volume measurement, 1 Bushel = 35.24 liters = 9.31 U.S. Gallons. In the agricultural mercantile exchange, the Bushel is widely used for grains as weight. For the above weights, the market assumes a standard density for each type of grain.

CURVE SUPERELEVATION IN PERCENT GRADE, TO PROVIDE NO LATERAL TIRE FORCE

Negotiating curves can generate high lateral tire forces. These forces contribute to high tire wear and ply separation. Superelevating the curve helps eliminate these forces. The amount of superelevation depends on the curve's radius and the speed at which it is negotiated.

The following table is a guide for providing the superelevation necessary to eliminate lateral forces.

Superelevated turns present a danger when slippery. For this reason, curves superelevated over 10% should be used with caution. Unless the proper speed is maintained, matching the elevation of the curve, a vehicle may slide off of the lower edge of the roadway. Superelevated curves should be maintained in good tractive conditions.

TURN RADIUS m	ft	Speed 16 km/h 10 mph	Speed 24 km/h 15 mph	Speed 32 km/h 20 mph	Speed 40 km/h 25 mph	Speed 48 km/h 30 mph	Speed 56 km/h 35 mph	Speed 64 km/h 40 mph	Speed 72 km/h 45 mph
15.2	**50**	13%	30%	—	—	—	—	—	—
30.5	**100**	7%	15%	27%	—	—	—	—	—
45.7	**150**	4%	10%	18%	28%	—	—	—	—
61.0	**200**	3%	8%	13%	21%	30%	—	—	—
91.5	**300**	2%	5%	9%	14%	20%	27%	—	—
152.4	**500**	1%	3%	5%	8%	12%	16%	21%	27%
213.4	**700**	1%	2%	4%	6%	9%	12%	15%	19%
304.9	**1000**	1%	2%	3%	4%	6%	8%	11%	14%

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MAXIMUM SPEED ON CURVES FOR VARIOUS SUPERELEVATION GRADES WITH A 0.20 LATERAL COEFFICIENT OF TRACTION

Another approach to superelevated curves is to determine the safe speed for negotiating a turn at a certain lateral tire force. In general, a 20% lateral coefficient of traction is conservative for all but ice and slippery conditions, making table values safe to use for most applications. The following table shows maximum speed with various superelevations to maintain a 0.20 lateral coefficient of traction.

A transition section may be necessary at higher speeds when entering or departing from a superelevated turn.

TURN RADIUS		Flat Curve		5% Super-elevation		10% Super-elevation	
m	ft	km/h	mph	km/h	mph	km/h	mph
7.6	**25**	14	**9**	16	**10**	17	**11**
15.2	**50**	20	**12**	22	**14**	24	**15**
30.5	**100**	28	**17**	31	**19**	34	**21**
45.7	**150**	34	**21**	38	**24**	42	**26**
61.0	**200**	39	**24**	44	**27**	48	**30**
91.5	**300**	48	**30**	54	**34**	59	**37**
152	**500**	62	**39**	70	**43**	76	**47**
213	**700**	74	**46**	—	—	—	—

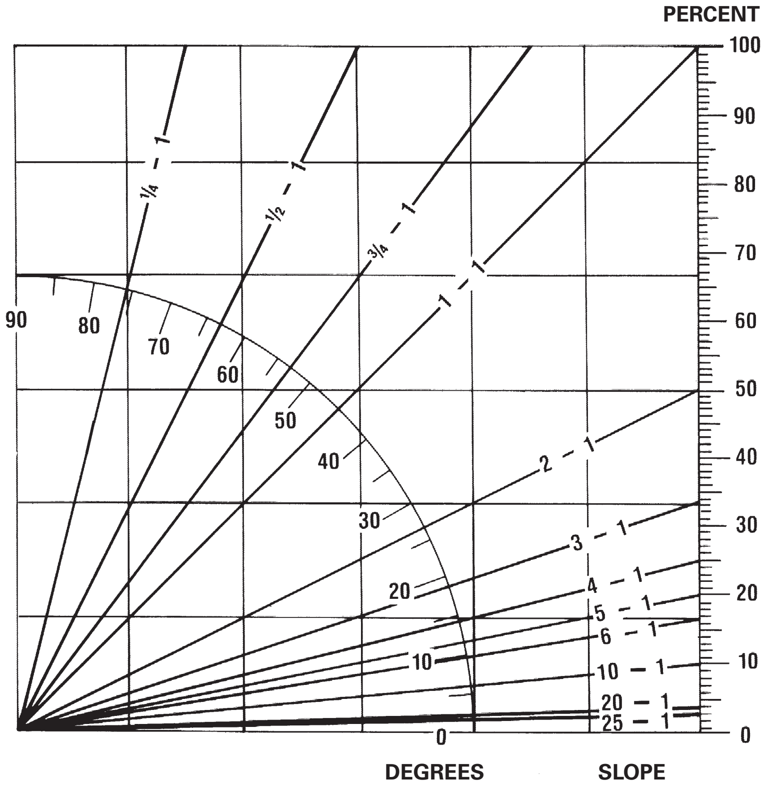
WEIGHT* OF MATERIALS	LOOSE kg/m³	LOOSE lb/yd³	BANK kg/m³	BANK lb/yd³	LOAD FACTORS
Basalt	1960	**3300**	2970	**5000**	0.67
Bauxite, Kaolin	1420	**2400**	1900	**3200**	0.75
Caliche	1250	**2100**	2260	**3800**	0.55
Carnotite, uranium ore	1630	**2750**	2200	**3700**	0.74
Cinders	560	**950**	860	**1450**	0.66
Clay — Natural bed	1660	**2800**	2020	**3400**	0.82
Dry	1480	**2500**	1840	**3100**	0.81
Wet	1660	**2800**	2080	**3500**	0.80
Clay & gravel — Dry	1420	**2400**	1660	**2800**	0.85
Wet	1540	**2600**	1840	**3100**	0.85
Coal — Anthracite, Raw	1190	**2000**	1600	**2700**	0.74
Washed	1100	**1850**			0.74
Ash, Bituminous Coal	530-650	**900-1100**	590-890	**1000-1500**	0.93
Bituminous, Raw	950	**1600**	1280	**2150**	0.74
Washed	830	**1400**			0.74
Decomposed rock —					
75% Rock, 25% Earth	1960	**3300**	2790	**4700**	0.70
50% Rock, 50% Earth	1720	**2900**	2280	**3850**	0.75
25% Rock, 75% Earth	1570	**2650**	1960	**3300**	0.80
Earth — Dry packed	1510	**2550**	1900	**3200**	0.80
Wet excavated	1600	**2700**	2020	**3400**	0.79
Loam	1250	**2100**	1540	**2600**	0.81
Granite — Broken	1660	**2800**	2730	**4600**	0.61
Gravel — Pitrun	1930	**3250**	2170	**3650**	0.89
Dry	1510	**2550**	1690	**2850**	0.89
Dry 6-50 mm (1/4"-2")	1690	**2850**	1900	**3200**	0.89
Wet 6-50 mm (1/4"-2")	2020	**3400**	2260	**3800**	0.89
Gypsum — Broken	1810	**3050**	3170	**5350**	0.57
Crushed	1600	**2700**	2790	**4700**	0.57
Hematite, iron ore, high grade	1810-2450	**4000-5400**	2130-2900	**4700-6400**	0.85
Limestone — Broken	1540	**2600**	2610	**4400**	0.59
Crushed	1540	**2600**	—	**—**	—
Magnetite, iron ore	2790	**4700**	3260	**5500**	0.85
Pyrite, iron ore	2580	**4350**	3030	**5100**	0.85
Sand — Dry, loose	1420	**2400**	1600	**2700**	0.89
Damp	1690	**2850**	1900	**3200**	0.89
Wet	1840	**3100**	2080	**3500**	0.89
Sand & clay — Loose	1600	**2700**	2020	**3400**	0.79
Compacted	2400	**4050**			
Sand & gravel — Dry	1720	**2900**	1930	**3250**	0.89
Wet	2020	**3400**	2230	**3750**	0.91
Sandstone	1510	**2550**	2520	**4250**	0.60
Shale	1250	**2100**	1660	**2800**	0.75
Slag — Broken	1750	**2950**	2940	**4950**	0.60
Snow — Dry	130	**220**			
Wet	520	**860**			
Stone — Crushed	1600	**2700**	2670	**4500**	0.60
Taconite	1630-1900	**3600-4200**	2360-2700	**5200-6100**	0.58
Top Soil	950	**1600**	1370	**2300**	0.70
Taprock — Broken	1750	**2950**	2610	**4400**	0.67
Wood Chips**	—	**—**	—	**—**	—

*Varies with moisture content, grain size, degree of compaction, etc. Tests must be made to determine exact material characteristics.

**Weights of commercially important wood species can be found in the last pages of the Logging & Forest Products section. To obtain wood weights use the following equations: $lb/yd^3 = (lb/ft^3) \times .4 \times 27$

$kg/m^3 = (kg/m^3) \times .4$

GRADE COMPARISON CHART
DEGREES — PERCENT — SLOPE



GRADE IN DEGREES AND PERCENTS

DEGREES	PERCENT
1	1.8
2	3.5
3	5.2
4	7.0
5	8.8
6	10.5
7	12.3
8	14.0
9	15.8
10	17.6
11	19.4
12	21.3
13	23.1
14	24.9
15	26.8
16	28.7
17	30.6
18	32.5
19	34.4
20	36.4
21	38.4
22	40.4
23	42.4
24	44.5
25	46.6
26	48.8
27	51.0
28	53.2
29	55.4
30	57.7
31	60.0
32	62.5
33	64.9
34	67.4
35	70.0
36	72.7
37	75.4
38	78.1
39	81.0
40	83.9
41	86.9
42	90.0
43	93.3
44	96.6
45	100.0

CONVERSION FACTORS

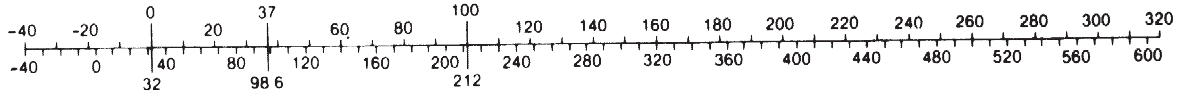
Multiply Metric Unit	By	To Obtain English Unit
kilometer (km)	0.6214	mile
meter (m)	1.0936	yard
meter (m)	3.28	foot
centimeter (cm)	0.0328	foot
millimeter (mm)	0.03937	inch
sq kilometer (km^2)	0.3861	square mile
hectare (ha)	2.471	acre
sq meter (m^2)	10.764	square foot
sq meter (m^2)	1550	square inch
sq centimeter (cm^2)	0.1550	square inch
cu centimeter (cm^3)	0.061	cubic inch
cu meter (m^3)	1.308	cubic yard
liter (L)	61.02	cubic inch
liter (L)	0.001308	cubic yard
km/h	0.621	mph
liter (L)	0.2642	U.S. gallon
liter (L)	0.22	Imperial gallon
metric ton (t)	0.984	long ton
metric ton (t)	1.102	short ton
kilogram (kg)	2.205	pound, avdp.
gram (g or gr)	.0353	ounce, avdp.
kilonewton (kN)	225	pound (force)
newton (N)	0.225	pound (force)
cu centimeter (cm^3)	0.0338	fluid ounce
kilograms/cu meter	1.686	pounds/cu yd
kilograms/cu meter	0.062	pounds/cu ft
kilograms/sq cm (kg/cm^2)	14.225	pounds/sq in
kilocalorie (kcal)	3.968	Btu
kilogram-meter (kg•m)	7.233	foot-pound
meter-kilogram (m•kg)	7.233	pound-foot
metric horsepower (CV)	0.9863	hp
kilowatt (kW)	1.341	hp
kilopascal (kPa)	0.145	psi
bar	14.5	psi
tons/m^3	1692	pounds/cu yd
decaliter	0.283	bushel

Multiply English Unit	By	To Obtain Metric Unit
mile, statute (m)	1.609	kilometer
yard (yd)	0.9144	meter
foot (ft)	0.3048	meter
inch (in)	25.4	millimeter
sq mile ($mile^2$)	2.590	sq kilometer
acre	0.4047	hectare
sq foot (ft^2)	0.0929	sq meter
sq inch (in^2)	0.000645	sq meter
cu yard (yd^3)	0.7645	cu meter
cu inch (in^3)	16.387	cu centimeter
cu foot (ft^3)	0.0283	cu meter
cu inch (in^3)	0.0164	liter
cubic yard (yd^3)	764.55	liter
mph	1.61	km/h
Ton — mph	1.459	tkm/h
U.S. gallon (US Gal)	3.785	liter
U.S. gallon	0.833	Imperial gallon
long ton (lg ton)	1.016	metric ton
short ton (sh ton)	0.907	metric ton
pound (lb)	0.4536	kilogram
ounce (oz)	28.35	gram
pound (lb) (force)	0.00445	kilonewton
pound (lb) (force)	4.45	newton
fluid oz (fl oz)	29.57	cu centimeter
lb/cu ft (lb/ft^3)	16.018	kg/cu meter
lb/cu yd (lb/yd^3)	0.5933	kg/cu meter
pounds/sq. in.	0.0703	kilogram/sq cm
psi	0.0689	bar
psi	6.89	kilopascal
Btu	0.2520	kilogram-calorie
foot-pound (ft-lb)	0.1383	kilogram-meter
horsepower (hp)	1.014	metric horsepower
horsepower (hp)	0.7457	kilowatt
pounds/cu yd	0.0005928	tons/m^3
pounds (No. 2 diesel fuel)	0.1413	U.S. gallon
bushel	3.524	decaliter

NOTE: Some of the above factors have been rounded for convenience. For exact conversion factors please consult International System of Units (SI) table.

Temperature conversion

Degree C



Degree F

°C = (°F – 32) ÷ 1.8

°F = (C × 1.8) + 32

METRIC UNIT EQUIVALENTS

1 km	=	1000 m
1 m	=	100 cm
1 cm	=	10 mm
1 km^2	=	100 ha
1 ha	=	10,000 m^2
1 m^2	=	10,000 cm^2
1 cm^2	=	100 mm^2
1 m^3	=	1000 liters
1 liter	=	1000 cm^3
1 metric ton	=	1000 kg
1 quintal	=	100 kg
1 N	=	0.10197 kg•m/s^2
1 kg	=	1000 g
1 g	=	1000 mg
1 bar	=	14.504 psi
1 cal	=	427 kg•m
	=	0.0016 cv•h
	=	0.00116 kw•h
torque unit		
1 CV	=	75 kg•m/s
1 kg/cm^2	=	0.97 atmosph.

ENGLISH UNIT EQUIVALENTS

1 mile	=	1760 yd
1 yd	=	3 ft
1 ft	=	12 in
1 sq mile	=	640 acres
1 acre	=	43,560 sq ft
1 sq ft	=	144 sq in
1 cu ft	=	7.48 gal liq
1 gal	=	231 cu in
	=	4 quarts liq
1 quart	=	32 fl oz
1 fl oz	=	1.80 cu in
1 sh ton	=	2000 lb
1 lg ton	=	2240 lb
1 lb	=	16 oz, avdp
1 Btu	=	778 ft lb
	=	0.000393 hph
	=	0.000293 kwh
1 mechanical hp	=	550 ft-lb/sec
1 atmosph.	=	14.7 lb/in^2

POWER UNIT EQUIVALENTS

kW	=	Kilowatt
hp	=	Mechanical Horsepower
CV	=	Cheval Vapeur (Steam Horsepower)
		French Designation For **Metric** Horsepower
PS	=	Pferdestärke (Horsepower)
		German Designation For **Metric** Horsepower
1 hp	=	1.014 CV = 1.014 PS
	=	0.7457 kW
1 PS	=	1 CV = 0.986 hp
	=	0.7355 kW
1 kW	=	1.341 hp
	=	1.36 CV
	=	1.36 PS

MACHINE/ENGINE CROSS REFERENCE

NOTE: This list stopped being updated since PHB49.

Machine Model	Engine Model
Track-Type Tractors	
D3K XL/LGP	C4.4 ACERT™
D4K XL/LGP	C4.4 ACERT
D5K XL/LGP	C4.4 ACERT
D5R	C6.6 ACERT
D5R2 XL/LGP	C7.1 ACERT
D5T XL	C7.1 ACERT
D6K2 XL/LGP[2]	C7.1 ACERT
D6K2 XL/LGP	C4.4 ACERT
D6N XL/LGP	C6.6 ACERT
D6R2	C9 ACERT
D6T	C9 ACERT
D6T[1]	C9.3 ACERT
D7E	C9.3 ACERT
D7R	C9 ACERT
D8R/D8R LGP	3406C TA
D8T/D8T LGP	C15 ACERT
D9R	3408C TA
D9T	C18 ACERT
D10T2	C27 ACERT
D11/D11 CD	C32 ACERT
Motor Graders	
120K	C7 ACERT
120K2	C7 ACERT
120M	C6.6 ACERT
120M AWD	C6.6 ACERT
120M2	C7.1 ACERT
120M2 AWD	C7.1 ACERT
12K	C7 ACERT
12M	C7 ACERT
12M2	C9.3 ACERT
12M2 AWD	C9.3 ACERT
12M3	C9.3 ACERT
12M3 AWD	C9.3 ACERT
140K	C7 ACERT
140K2	C7 ACERT
140M	C7 ACERT
140M AWD	C9 ACERT
140M2	C9.3 ACERT
140M2 AWD	C9.3 ACERT
140M3	C9.3 ACERT
140M3 AWD	C9.3 ACERT
160K	C7 ACERT
160M	C9 ACERT
160M AWD	C9 ACERT
160M2	C9.3 ACERT
160M2 AWD	C9.3 ACERT
160M3	C9.3 ACERT
160M3 AWD	C9.3 ACERT
14M3	C13 ACERT
16M3	C13 ACERT
18M3	C13 ACERT
24M	C18 ACERT

Machine Model	Engine Model
Excavators	
311F L	C3.4B
312D2/312D2 L	3054C
312D2 GC	3054C
312E	C4.4 ACERT
313D2	3054C
313D2/313D2 L	C4.4 ACERT
313D2 GC	C4.4 ACERT
313F L	C4.4 ACERT
313F L GC	C4.4 ACERT
314E/314E L	C4.4 ACERT
315F L	C4.4 ACERT
316E L	C4.4 ACERT
316F L	C4.4 ACERT
318D2 L	3054C
318D2 L	C4.4 ACERT
318F L	C4.4 ACERT
M313D	C4.4 ACERT
M315D	C4.4 ACERT
M315D2	C4.4 ACERT
M316D	C6.6 ACERT
M317D2	C4.4 ACERT
M318D	C6.6 ACERT
M318F	C7.1 ACERT
M320D2	C7.1
M320F	C7.1 ACERT
M322D	C6.6 ACERT
320D	C7.1 ACERT
320D2 GC	C4.4 ACERT
323D2	C7.1 ACERT
320E	C6.6 ACERT
320E RR	C6.6 ACERT
320F	C4.4 ACERT
323F	C7.1 ACERT
323F N	C4.4 ACERT
325F	C4.4 ACERT
326D2	C7.1 ACERT
326F	C7.1 ACERT
330D2	C7.1 ACERT
330F	C7.1 ACERT
335F	C7.1 ACERT
336F/336F XE	C9.3 ACERT
336D2/340D2	C9 ACERT
336D2 XE	C9 ACERT
349D2/349D2 L	C13 ACERT
349F L/352F	C13 ACERT
349F L XE/352F XE	C13 ACERT
374F L	C15 ACERT
390F L	C18 ACERT
5110B	3412B HEUI™
5130B	3508B (EUI) TA
5230B	3516B (EUI) TA

Machine Model	Engine Model
Pipelayers	
PL61	C6.6 ACERT
PL72	C9.3 ACERT
PL83	C15 ACERT
PL87	C15 ACERT
Wheel Tractor-Scrapers	
621K, 623K, 627K Tractor	C13 ACERT
627K Scraper	C9 ACERT
631K	C18 ACERT
637K Tractor	C18 ACERT
637K Scraper	C9 ACERT
657G Tractor	C18 ACERT
657G Scraper	C15 ACERT
Forest Machines	
320D Series 2 FM[2]	C7.1 ACERT
320D Series 2 FM LL[2]	C7.1 ACERT
538[1]	C7.1 ACERT
538 LL[1]	C7.1 ACERT
324D FM[2]	C7 ACERT
324D FM LL[2]	C7 ACERT
325D FM[2]	C7 ACERT
325D FM LL[2]	C7 ACERT
558 LL[1]	C7.1 ACERT
568[3]	C9.3 ACERT
568 LL[3]	C9.3 ACERT
Track Harvesters	
501HD[2]	C6.6 ACERT
521B[2]	C9 ACERT
522B[2]	C9 ACERT
541 Series 2[2]	C9 ACERT
552 Series 2[2]	C9 ACERT
Wheel Harvester	
550	C7 ACERT
Wheel Skidders	
525D	C7.1 ACERT
535D	C7.1 ACERT
545D	C7.1 ACERT
555D	C7.1 ACERT
Track Skidders	
517	3304 TA
527	3304 TA

[1] Meets Tier 4 Final/Stage V/Japan 2014 (Tier 4 Final) emission standards.
[2] Emits equivalent to Tier 3/Stage IIIA/Japan 2006 (Tier 3).
[3] Emits equivalent to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim).

MACHINE/ENGINE CROSS REFERENCE (Continued)

Machine Model	Engine Model	Machine Model	Engine Model	Machine Model	Engine Model
Forwarders		**Articulated Trucks**		**Wheel Loaders/Integrated Toolcarriers**	
564	C6.6 ACERT	725	C11 ATAAC	950 GC	C7.1 ACERT
574	C6.6 ACERT	730	C11 ATAAC	950H	C7 ACERT
584	C7 ACERT	730 Ejector	C11 ATAAC	950K	C7.1 ACERT
584HD	C7 ACERT	735	C15 ATAAC	950L	C7.1 ACERT
		740	C15 ATAAC	950M	C7.1 ACERT
Track Feller Bunchers		740 Ejector	C15 ATAAC	962H	C7 ACERT
521B[2]	C9 ACERT			962K	C7.1 ACERT
522B[2]	C9 ACERT	**Wheel Dozers**		962L	C7.1 ACERT
541 Series 2[2]	C9 ACERT	814F[3]	3176C ATAAC	962M	C7.1 ACERT
552 Series 2[2]	C9 ACERT	814F II[2]	C9 ACERT	966H	C11 ACERT
		824H[2]	C15 ACERT	966K	C9.3 ACERT
Knuckleboom Loaders		824K[1]	C15 ACERT	966L	C9.3 ACERT
519[2]	C6.6	834K	C18 ACERT	966M	C9.3 ACERT
529[2]	C6.6	844K	C27 ACERT	966M XE	C9.3 ACERT
559C	C6.6 ACERT	854K	C32 ACERT	972H	C13 ACERT
569[2]	C6.6			972K	C9.3 ACERT
579C	C6.6 ACERT	**Soil Compactors**		972L	C9.3 ACERT
		815F II[2]	C9 ACERT	972M	C9.3 ACERT
Wheel Feller Bunchers		815K[1]	C7.1 ACERT	972M XE	C9.3 ACERT
553	C6.6 ACERT	825H[2]	C15 ACERT	980H	C15 ACERT
563	C7 ACERT	825K[1]	C15 ACERT	980K	C13 ACERT
573	C7 ACERT			980L	C13 ACERT
		Landfill Compactors		980M	C13 ACERT
Mining & Off-Highway Trucks		816F	3176 TA	982M	C13 ACERT
770G[1]	C15 ACERT	816F II	C9 ACERT	986H	C15 ACERT
770G	C15 ACERT	826G Series II	3406E TA	988K	C18 ACERT
772G[1]	C18 ACERT	**826H**	C15 ACERT	990K	C27 ACERT
772G	C18 ACERT	836G	3456 TA	992K	C32 ACERT
773G[1]	C27 ACERT	836H	C18 ACERT	993K	C32 ACERT
773G	C27 ACERT			994K	3516E HD MUI
775G[1]	C27 ACERT				
775G	C27 ACERT			**Track Loaders**	
777D	3508B (EUI) TA			953D	C6.6 ACERT
777G[1]	C32 ACERT			953K	C7.1 ACERT
777G	C32 ACERT			963D	C6.6 ACERT
785C	3512B (EUI) TA			963K	C7.1 ACERT
785D	3512C HD (EUI) ATAAC			973C	C9 ATAAC
789C	3516B (EUI) TA				
793D	3516B (EUI) TA				
793F	C175-16 (EUI) ATAAC				
797F	C175-20 (EUI) ATAAC				

[1] Meets Tier 4 Final/Stage V/Japan 2014 (Tier 4 Final) emission standards.
[2] Emits equivalent to Tier 3/Stage IIIA/Japan 2006 (Tier 3).
[3] Emits equivalent to Tier 2/Stage II/Japan 2001 (Tier 2).
NOTE: All machines are not available in all regions. Contact your local Cat dealer for product availability.

MACHINE/ENGINE CROSS REFERENCE (Continued)

Machine Model	Engine Model
Wheel Material Handlers	
M318D MH	**C6.6 ACERT**
M322D MH	C6.6 ACERT
M325D MH	C7 ACERT
M325D LMH	C7 ACERT
MH3037[2]	C7.2 ACERT
MH3037[1]	C7.1 ACERT
MH3049	C9 ACERT
MH3059	C9 ACERT
Track Material Handlers	
385C MH	C18 ACERT
Paving Products	
Cold Planers	
PM102	C7 ACERT
PM620	C18 ACERT
PM622	C18 ACERT
Reclaimer/Soil Stabilizers	
RM300	C11 ACERT
RM500B	C15 ACERT
Asphalt Pavers	
AP255E	C2.2
AP300F	C3.3B
AP355F	C3.3B
AP500F	C4.4 ACERT
AP555F	C4.4 ACERT
AP600F	C4.4 ACERT
	C7.1 ACERT
AP655F	C4.4 ACERT
	C7.1 ACERT
AP1000F	C7.1 ACERT
AP1055F	C7.1 ACERT

Machine Model	Engine Model
Paving Products (continued)	
Single Drum Vibratory Soil Compactors	
CS34	C3.4B
CP34	C3.4B
CS423E	3054C
CS44	C4.4 ACERT
CP44	C4.4 ACERT
CS44B	C3.4B
CP44B	C3.3B
CS533E	3054C
CS533E XT	3054C
CP533E	3054C
CS54B	C4.4B ACERT
CP54B	C4.4B ACERT
CS56B	C4.4B ACERT
	C6.6 ACERT
CP56B	C4.4B ACERT
	C6.6 ACERT
CS64B	C4.4B
CS66B	C4.4B
CS68B	C4.4B ACERT
	C6.6 ACERT
CP68B	C4.4B ACERT
	C6.6 ACERT
CS74B	C4.4B ACERT
	C6.6 ACERT
CP74B	C4.4B ACERT
	C6.6 ACERT
CS76B	C4.4B ACERT
CS78B	C4.4B ACERT
	C6.6 ACERT
CS79B	C6.6 ACERT

Machine Model	Engine Model
Paving Products (continued)	
Double Drum and Combi	
CB14B	KDW1003
CB22B	KDW1003
CB24B XT	C1.5
CC24B	C1.5
CB32B	C1.5
CB34B	C2.2
CC34B	C2.2
CB36B	C2.2
CB44B	C3.4B
	C4.4 ACERT
CD44B	C3.4
	C4.4 ACERT
CB46B	C3.4B
CB54B	C4.4 ACERT
CD54B	C3.4
CB64B	C4.4 ACERT
CB66B	C4.4 ACERT
CB68B	C4.4 ACERT
Pneumatic Tire Compactors	
CW14	C3.4B
CW16	C3.4B
	C4.4 ACERT
PS150C	3054C
CW34	C4.4 ACERT

[1] Meets Tier 4 Final/Stage V/Japan 2014 (Tier 4 Final) emission standards.
[2] Emits equivalent to Tier 3/Stage IIIA/Japan 2006 (Tier 3).

ENGINE/MACHINE CROSS REFERENCE

Engine Model and (Cylinders)	Machine	Aspiration	Fuel Injection System	Bore × Stroke mm	Bore × Stroke in	Displacement L	Displacement in³
3013C (3)	CB-214E, CB-224E, CB-225E	NA	DI	75 × 72	**2.95 × 3.54**	1.50	**91.3**
C1.3	303E	NA	DI	78 × 88	**3.1 × 3.5**	1.3	**77**
C1.7	303.5E2 CR	NA	DI	87 × 92.4	**3.4 × 3.6**	1.7	**104**
C1.8	303.5E, 901C2 (Japan)	NA	DI	87 × 102.4	**3.4 × 4.0**	1.8	**111.4**
C2.2	CB-334E, CB-335E, 216B3	NA	DI	84 × 100	**3.31 × 3.94**	2.22	**135**
	226B3, 226D	T					
C2.4	304E2 CR, 304.5E2 XTC, 305E2 CR, 305.5E2 CR, 902C2 (Japan), 903C2	NA	DI	87 × 102.4	**3.4 × 4.0**	2.4	**146**
	307E2, 306E2	T					
C2.6	307E, 307E2 (China)	T	DI	87 × 110	**3.4 × 4.3**	2.6	**159.6**
C3.3B	308E2 CR, 308E2 VAB, 906K/M, 907K/M, 908K/M, 236D, 242D, 246D, 257D, 259D, 262D, 277D, 279D, 287D, 289D	T	DI	94 × 120	**3.7 × 4.7**	3.3	**203.3**
C3.8	272D2, 272D2 XHP, 297D2, 297D2 XHP, 299D2, 299D2 XHP	T	DI	100 × 120	**3.9 × 4.7**	3.8	**230**
Yanmar 3TNV70	300.9D	NA	IDI	70 × 74	**2.8 × 2.9**	0.854	**52.1**
Yanmar 3TNV76	301.4C, 301.7D, 301.7D CR, 302.2D, 302.4D, 302.7D	NA	IDI	76 × 82	**3.0 × 3.2**	1.12	**68.1**
3046 (I-6)	D3G XL, D3G LGP, D4G XL, CS-533E, D4G LGP, D5G XL, D5G LGP, CP-533E, 315C/315C L*, 939C	NA	DI	94 × 120	**3.7 × 4.7**	5.0	**305**
		T	DI				
3054C (I-4)	416E, 416F, 420F, 430F, 450F, 422F, 428F, 432F, 434F, 444F	NA/T***	DI	105 × 127	**4.13 × 5.0**	4.4	**268**
3054C	312D2/312D2 L, 313D2	T	DI	105 × 127	**4.13 × 5.0**	4.4	**268**
	318D2 L	TA					
3054E (I-4)	CB-434D, CS-323C, CS-423E, CP-323C, PS-150C	NA	DI	105 × 127	**4.13 × 5.0**	4.4	**268**
	AP-800C, BG-230, BG-650, 908, PS-360B, PF-300B, PS-300B, CS-433E, CP-433E, CB-534C	T (optional)					
	M313C, M315C, AP-650B, 315C L**, BG-225C	TA					
3056 (I-6)	CS-563E, CS-573E, CS-583E, CS-663E, AP-655C, CS-683E, CP-563E, CP-573E, CP-583E, CP-663E, M316C, M318C, M322C	ATAAC	DI	100 × 127	**3.94 × 5.0**	6.0	**365**
3066 (I-6)	320C, 320C L, 320C LN, 320C S, 321C LCR	T	DI	102 × 130	**4.0 × 5.1**	6.4	**391**

*Japan sourced.
**France sourced.
***Turbo optional on some models.

DI — Direct Injection
IDI — Indirect Injection
T — Turbocharged
TA — Turbocharged and Aftercooled
NA — Naturally Aspirated
ATAAC — Air/Air Aftercooled

NOTE: Materials and specifications subject to change without notice. Component commonality of Cat engines for all applications does not imply complete interchangeability. Contact your Cat dealer for specific information.

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ENGINE/MACHINE CROSS REFERENCE (Continued)

Engine Model and (Cylinders)	Machine	Aspiration	Fuel Injection System	Bore × Stroke mm	Bore × Stroke in	Displacement L	Displacement in³
3116 (I-6)	CB-634D, BG-240C, AP-900B	T	DI	105 × 127	**4.13 × 5.0**	6.6	**402**
	BG-260C, BG-245C, AP-1050B, AP-1055B, 120H STD, 135H STD, BG-2455C, AP-1000B	TA	DI				
3126 (I-6)	D5*, D6N*, 561N, 953C, 963C	T	DI	110 × 127	**4.33 × 5.0**	7.2	**442**
	525B, 535B	TA					
	325C LN	ATAAC					
3304 (I-4)	527, 517	TA	DI	121 × 152	**4.75 × 6.0**	7.0	**425**
C3.4B	311F L, 313F L GC	T	DI	99 × 110	**3.90 × 4.33**	3.4	**207**
C4.4 ACERT	D3K, D4K, D5K, D6K2, 416F, 420F, 430F, 450F, 428F, 432F, 434F, 444F, 910K/M, 914K/M, 918M	T	DI	105 × 127	**4.13 × 5.0**	4.4	**268**
	318D2 L, 320D2 GC	TA					
	312E, 313D2/313D2 L, 313D2 GC, 313F L, 314E/314E L, 315F L, 316E L, 316F L, 318F L, 320F, 323F N, 325F	ATAAC					
C6.6	R1300G II	ATAAC	DI	105 × 127	**4.13 × 5.0**	6.6	**402**
C6.6 ACERT	D6N, 953D, 963D, 120M, PL61, M318D MH, M322D MH, 120M, 120M AWD, 501HD, 320E, 320E RR	TA	DI	105 × 127	**4.13 × 5.0**	6.6	**402**
C7 ACERT (I-6)	950H, 962H, IT62H, M325D MH, M325D LMH, 120K, 120K2, 12K, 12M, 140K, 140K2, 140M, 160K, 324D FM[2], 324D FM LL[2], 325D FM[2], 325D FM LL[2]	ATAAC	DI	110 × 127	**4.33 × 5.0**	7.2	**442**
C7.1 ACERT	320D Series 2 FM[2], 320D Series 2 FM LL[2], 538[1], 538 LL[1], 558 LL[1], 924K, 926M[1], 930K, 930M[1], 938K, 938M[1], 950 GC, 950K, 950L, 950M, 962K, 962L, 962M, MH3037[1], 120M2, 120M2 AWD, D5R2, D5T, 953K, 963K, 320D2, 323D2, 326D2, 330D2, 326F, 330F, 335F	ATAAC	DI	105 × 135	**4.1 × 5.3**	7.01	**427.8**
C7.2 ACERT	MH3037[2]	ATAAC	DI	110 × 127	**4.33 × 5.0**	7.2	**442**
C9 ACERT (I-6)	336D2, 336D2 XE, 340D2, 814F II, 815F II, D6T, MH3049, MH3059, 521B, 522B, 541 Series 2, 552 Series 2	ATAAC	DI	112 × 149	**4.4 × 5.9**	8.8	**537**
C9 ACERT (I-6)	627G Sc., 637G Sc., 973C, 140M AWD, 160M, 160M AWD, D6R2, D7R	TA	DI	112 × 149	**4.4 × 5.9**	8.8	**537**

[1] Meets Tier 4 Final/Stage V/Japan 2014 (Tier 4 Final) emission standards.
[2] Emits equivalent to Tier 3/Stage IIIA/Japan 2006 (Tier 3).
*Not sold in U.S., Canada or Europe.

DI — Direct Injection
T — Turbocharged
TA — Turbocharged and Aftercooled
ATAAC — Air/Air Aftercooled

NOTE: Materials and specifications subject to change without notice. Component commonality of Cat engines for all applications does not imply complete interchangeability. Contact your Cat dealer for specific information.

ENGINE/MACHINE CROSS REFERENCE (Continued)

Engine Model and (Cylinders)	Machine	Aspiration	Fuel Injection System	Bore × Stroke mm	Bore × Stroke in	Displacement L	Displacement in³
3176 (I-6)	572R2, 345B L Series II, D7R, 814F, 815F, 816F	ATAAC	DI	125 × 140	**4.92 × 5.5**	10.2	**629**
C9.3 ACERT	D6T[1], D7E, 568[2], 568 LL[2], 966K, 966L, 966M, 966M XE, 972K, 972L, 972M, 972M XE, 336F, 336F XE, 12M2, 12M2 AWD, 12M3, 12M3 AWD, 140M2, 140M2 AWD, 140M3, 140M3 AWD, 160M2, 160M2 AWD, 160M3, 160M3 AWD, PL72	ATAAC	DI	115 × 149	**4.53 × 5.87**	9.3	**567.5**
3306 (I-6)	R1300G, 12H STD, 140H STD, 160H STD	T	DI	121 × 152	**4.75 × 6.0**	10.5	**638**
	D7G	TA	DI				
	545	ATAAC	DI				
3196 (I-6)	365B L Series II	ATAAC	DI	130 × 150	**5.1 × 5.9**	12.0	**732**
3406 (I-6)	RM-250C, RM-350B, D8R, D8R LGP	TA	DI	137 × 165	**5.4 × 6.5**	14.6	**893**
	826G Series II, 825G Series II, 824G Series II, AD30	ATAAC	DI				
C11 (I-6)	725, 730, 730 Ejector	ATAAC	DI	130 × 140	**5.1 × 5.5**	11.2	**680**
C11 ACERT (I-6)	R1600H, AD22, 966H	TA	DI	130 × 140	**5.12 × 5.51**	11.1	**680**
		ATAAC					
C13 ACERT (I-6)	R1700, 14M3, 16M3, 18M3, 349D2, 349F, 352F, 349F XE, 352F XE, 621K, 623K, 627K Tr, 972H, 980K, 980L, 980M, 982M	TA	DI	130 × 157	**5.12 × 6.18**	12.5	**763**
C15 ACERT (I-6)	D8T, D8T LGP, PL83, PL87, 657G Sc., 770G[1], 770G, 986H, 374F	TA	DI	137 × 172	**5.4 × 6.75**	15.2	**928**
	R2900G, R3000H, AD30, 735, 740, 740 Ejector, 824K, 825K, 826H, 980H	ATAAC	DI	137 × 171.5	**5.4 × 6.75**	15.2	**928**
3456 (I-6)	834G, 836G, 988G, 385B, 385B L, 5090B	ATAAC	DI	140 × 171	**5.5 × 6.75**	15.8	**966**
3408 (V-8)	D9R, 589, PM-565B	TA	DI	137 × 152	**5.4 × 6.0**	18.0	**1099**
		ATAAC					
C18 ACERT	AD45B, AD55, D9T, 631G, 637G Tr., 657G Tr., 988H, 988K, 772G[1], 772G, 834H, 834K, 836H, 385C MH, 24M, 390F	TA	DI	145 × 183	**5.7 × 7.2**	18.1	**1106**

[1] Meets Tier 4 Final/Stage V/Japan 2014 (Tier 4 Final) emission standards.
[2] Emits equivalent to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim).

DI — Direct Injection
T — Turbocharged
TA — Turbocharged and Aftercooled
ATAAC — Air/Air Aftercooled

NOTE: Materials and specifications subject to change without notice. Component commonality of Cat engines for all applications does not imply complete interchangeability. Contact your Cat dealer for specific information.

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ENGINE/MACHINE CROSS REFERENCE (Continued)

Engine Model and (Cylinders)	Machine	Aspiration	Fuel Injection System	Bore × Stroke		Displacement	
				mm	in	L	in^3
C27 ACERT (V-12)	AD60, D10T2, 773G[1], 773G, 775G[1], 775G, 990H, 990K, 844H, 844K, 6015B, 6030, 6030 FS	TA	DI	137 × 152	**5.4 × 6.0**	27.0	**1648**
3412 (V-12)	D10R, 5110B	TA	DI	137 × 152	**5.4 × 6.0**	27.0	**1649**
	844, 773E	ATAAC	DI				
3508 (V-8)	D11R, 5130B, 992G, 854G, 777D	TA	DI	170 × 190	**6.7 × 7.5**	34.5	**2105**
3512 (V-12)	785C, 6060, 6060 FS	TA	DI	170 × 190	**6.7 × 7.5**	51.8	**3158**
3512 HD (V-12)	785D	ATAAC	DI	170 × 215	**6.7 × 8.5**	58.6	**3574**
3516 (V-16)	789C, 994D, 5230B	TA	DI	170 × 190	**6.7 × 7.5**	51.8	**3158**
3516 HD (V-16)	789D, 994K	ATAAC	DI	170 × 215	**6.7 × 8.5**	78.1	**4765**
	793D, 994F, 994H	TA	DI	170 × 215	**6.7 × 8.5**	78.1	**4765**
C32 ACERT	777G[1], 777G, 854K, 992K, 993K, D11, D11 CD, 6020B, 6040, 6040 FS	TA	DI	145 × 162	**5.7 × 6.4**	32.1	**1959**
C175-16 (V-16)	793F, 794 AC, 795F	ATAAC	DI	175 × 220	**6.9 × 8.7**	84.7	**5167**
C175-16 (V-20)	797F	ATAAC	DI	175 × 220	**6.9 × 8.7**	105.8	**6458**

[1] Meets Tier 4 Final/Stage V/Japan 2014 (Tier 4 Final) emission standards.

DI — Direct Injection

ATAAC — Air/Air Aftercooled

TA — Turbocharged and Aftercooled

NOTE: Materials and specifications subject to change without notice. Component commonality of Cat engines for all applications does not imply complete interchangeability. Contact your Cat dealer for specific information.

TECHNOLOGY PRODUCTS

CONTENTS

INTRODUCTION

Caterpillar has long been a leader in bringing innovation to Cat products. Today, one of our biggest differentiators isn't just in our equipment — it's in the technologies we are integrating into our products that are improving machine performance and productivity, and transforming the way customers work to manage their operations and business more efficiently and cost effectively.

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Construction Technology products deliver dramatic improvements on the job site to help customers manage their business more efficiently and cost effectively. Fully integrated into Cat machines and core systems, these technologies use advanced electronics to accurately measure and control productivity, monitor and manage machine health and maintenance, and provide more insight into your equipment fleet and operation.

Energy & Transportation Technology products simplify equipment management to help customers monitor and manage assets, operate at peak performance, and lower operating costs.

Cat Technologies combine the latest in technologies and dealer services to help customers improve in four key areas: Equipment Management, Productivity, Safety, and Sustainability to take optimum control of the job site. Whether running one machine, managing a fleet, or overseeing several job sites, Cat dealers can help customers with the right combination of technologies and services to meet the specific needs of their business and realize significant gains in productivity, efficiency and profitability.

- Cat Construction Technologies
  - Cat Grade
  - Cat Payload
  - Cat Compact
  - Cat Detect
  - Cat Link
  - Cat Command
- Cat Technologies
  - Equipment Management
  - Productivity
  - Safety
  - Sustainability

Mining Technology & Autonomy products continue to have a positive impact on mining operations around the world. Caterpillar offers a complete suite of technology products purpose built for the harsh mining environment. Our products combine the latest GNSS positioning technology with sophisticated electronic controls and software to help miners increase productivity, monitor fleet health and lower operating costs.

Cat MineStar provides the most comprehensive suite of mining technology products in the industry. It consists of a number of configurable capability sets that allow you to scale the system to your mine site needs. Cat MineStar helps manage everything from material tracking to sophisticated real-time fleet management, machine health systems, autonomous equipment systems and more. The capability sets — Fleet, Edge, Terrain, Detect, Health and Command — can be used in combination or individually to allow your operations the flexibility and scalability it needs to be more productive, efficient and safe.

MineStar Edge is a new platform that augments our current MineStar offerings and ensures we will be able to advance them for years to come. Edge delivers more connected, integrated, scalable and intuitive products that extend further up and down the value chain. Edge current offerings include Equipment Tracking and Production Recording.

- Cat MineStar
  - Fleet
  - Terrain
    - Terrain for Drilling
    - Terrain for Grading & Loading
  - Detect
    - Vision
    - Object Detection
    - Driver Safety System (DSS)
  - Health
    - Product Link Elite
    - Product Link Elite Data Streaming
    - VIMS Forwarder
    - VIMS Converter
    - VIMS Telemetry
    - VIMS Transmitter
    - Equipment Insights
    - Office
    - Technician Toolbox
    - PitLink
  - Command
    - Command for dozing
    - Command for underground
    - Command for hauling
    - Command for drilling
  - Edge
    - Equipment Tracking
    - Production Recording

PRODUCT	CONSTRUCTION TECHNOLOGY APPLICATIONS	EQUIPMENT
Cat Link Technology	**Cat Link** enables you to remotely monitor and manage your equipment so you can reduce costs, increase job site efficiency, and effectively manage your business.	All types of equipment.
Product Link™	**Product Link** wirelessly connects you to your equipment giving you valuable insight into how your machine or fleet is performing. The system communicates location hours, fuel usage, productivity, idle time, and diagnostics codes. Available with cellular and satellite connectivity.	Standard on many types of Cat equipment. Retrofits available on Cat or mixed fleet equipment.
VisionLink®	**VisionLink** is a telematics software application that enables you to remotely monitor your equipment so that you can make timely, fact-based decisions to maximize efficiency, improve productivity, and lower the cost of owning and operating your fleet.	Standard on many types of Cat equipment. Retrofits available on Cat or mixed fleet equipment.
Basic Health or Advanced Health (Formerly VIMS™)	Provides operators, maintenance, and fleet managers with vital machine health and production information.	Basic Health or Advanced Health is available on select Trucks, Track-Type Tractors, Wheel Loaders, Wheel Dozers, Motor Graders, and K Series 4-Drum Soil Compactors.
Cat Grade Technology	**Cat Grade** combines digital design data, in-cab guidance, and on some machines — automatic control — to help operators work more productively and accurately with less rework.	Select models of earthmoving, excavation, and paving equipment.
Cat AccuGrade™	**Cross Slope** systems are used for indicate-only guidance or to control one side of the blade to achieve accurate surface cross slope without any off-board infrastructure. This foundational system for motor graders can be combined with sonic, laser, GNSS or UTS technologies to make fine grading more efficient and productive. Machine mounted sensors are used to calculate necessary blade slope positioning. The system makes automatic adjustments to the left or right lift cylinder. The in-cab display delivers all of the cross slope information the operator needs to quickly and easily spread or cut material at the correct cross slope. The operator can select which side of the blade to control automatically and swap direction on the return pass without readjusting the settings. Elevation is controlled manually by matching grade or automatically by adding an elevation control device (sonic or laser). The cross slope systems are ideal for maintaining accurate cross slope over long distances without the need for infrastructure.	Motor Graders
	Global Navigation Satellite Systems (GNSS) use satellite technology to deliver precise 3D blade elevation and blade tip positioning information to the operator in the cab. Using machine-mounted components, an off-board GNSS base station and accuracy up to Real Time Kinematic (RTK) positioning, GNSS provides the information necessary for the system to accurately determine blade positioning with centimeter level accuracy. GNSS systems compute the positioning information on the machine compared to the position of the implement or machine relative to the design plane and delivers the information to the operator via an in-cab display. GNSS systems put all the information the operator needs to complete a job in the cab, resulting in a greater level of control. Provides precise location and elevation information for complex 3D contour applications, such as golf courses and highway super elevated curves.	Asphalt Compactors, Hydraulic Excavators, Motor Graders, Soil Compactors, Track-Type Tractors, Wheel Tractor-Scrapers, Landfill Compactors
	Laser systems provide precise 2D elevation control for grading with tight tolerances using a laser transmitter and receiver(s). A laser transmitter is set up on the work site to create a constant grade reference over the work area. A digital laser receiver is mounted on the blade of the machine and senses the laser signal as the machine moves across the work site. Laser systems are ideal for the fine grading on job sites with flat, single or dual slope surfaces, such as industrial, commercial or residential building sites.	Compact Track Loaders, Motor Graders, Multi Terrain Loaders, Skid Steer Loaders, Track-Type Tractors

PRODUCT	CONSTRUCTION TECHNOLOGY APPLICATIONS	EQUIPMENT
Cat AccuGrade	**Indicate-only** grade control systems for excavators provide in-cab guidance to indicate how much to cut or fill to achieve accurate grades and slopes. These systems can be combined with laser, GNSS or UTS technologies to make excavating more efficient and productive. Indicate-only systems provide the operator with precise real-time bucket positioning compared to an elevation reference to indicate how far the cutting edge is above or below desired grade. Using a combination of front linkage (stick, boom and bucket) sensors, the system calculates bucket tip position relative to a grade/survey stake or benchmark. When combined with a laser and receiver, the machine can travel after obtaining a reference benchmark from a laser transmitter to calculate the desired grade for elevation changes over large work sites, significantly increasing productivity. Indicate-only systems combined with laser are ideal for excavations, trenches, and general utility applications.	Hydraulic Excavators
	Sonic systems provide 2D "elevation" control using an ultrasonic sensor to maintain accurate blade height. The system traces a previous pass, string line, or curb and gutter and uses the elevation as a reference. The grade control system calculates blade adjustments based on the reference and desired elevation and automatically moves the blade to achieve grade. The operator simply steers the machine to maintain the sonic tracer over the external reference. Sonic systems are ideal for controlling elevation in fine grading applications where curb and gutter or stringlines are used as references such as road construction and road maintenance.	Motor Graders
	Sonic, Contact and Slope Sensors are combined to provide an elevation control system for paving and milling operations designed to control grade elevation and slope. The goal of grade and slope controls is to remove irregularities from the surface for maximum smoothness and control mat thickness for asphalt pavers and cutting depth for cold planers. The sonic system uses multiple transducers to provide an average of the reference surface while the contact sensor references the actual target to maintain the implement at the same relative vertical distance to an external reference such as a string line or a curb and gutter or even existing pavement. Slope Sensors complement these systems and are designed to control cross slope of the screed or cold planer. These sensors can work individually or together and make automatic elevation adjustments to maintain the appropriate targeted values. The operator simply steers the machine to maintain the sensor over the external reference and monitors the remaining job site variables to ensure a consistent product. Referencing beams are also available both as contact as well as non-contacting styles which help to provide better averaging of the existing surface to help customers achieve their smoothness targets.	Asphalt Pavers, Cold Planers
	Universal Total Station (UTS) systems use high-accuracy, dynamic tracking technology on the job site to track a target mounted on the implement of the machine to determine the most precise 3D positioning. The system uses active target technology to reliably lock onto and track the intended target, eliminating false lock-ons to other active machine targets, survey crews or reflective surfaces. The UTS instrument continuously measures the target's position and transmits real-time positioning data to the operator via the in-cab display, which shows the exact position of the implement in relation to the design. The system combines the position of the target with the known position of the implement, blade or tips, machine measurements and sensor outputs to calculate precise positioning of the blade tips. The system uses the positioning data to calculate desired elevation and cross slope. Cut and fill values are computed by comparing the positioning of the blade with the design file.	Asphalt Pavers, Hydraulic Excavators, Motor Graders, Track-Type Tractors, Cold Planers

PRODUCT	CONSTRUCTION TECHNOLOGY APPLICATIONS	EQUIPMENT
Cat Grade with Cross Slope	**Cross Slope** systems are used for indicate-only guidance or to control one side of the blade to achieve accurate surface cross slope without any off-board infrastructure. This foundational system for motor graders can be combined with sonic, laser, GNSS or UTS technologies to make fine grading more efficient and productive. Machine mounted sensors are used to calculate necessary blade slope positioning to achieve desired cross slope of the surface. The system makes automatic adjustments to the left or right lift cylinder, typically performed by the operator. Cat Grade Control Cross Slope systems are factory integrated and utilize the existing, standard machine display reducing the need for an additional grade control display for cross slope guidance. The in-cab display delivers all of the cross slope information the operator needs to quickly and easily spread or cut material at the correct cross slope. The operator can select which side of the blade to control automatically and swap direction on the return pass without readjusting the settings. Elevation is controlled manually by matching grade or automatically by adding an elevation control device (sonic or laser). The cross slope systems are ideal for maintaining accurate cross slope over long distances without the need for infrastructure.	Motor Graders
Cat Grade with 3D	**3D** systems use Global Navigation Satellite System (GNSS) satellite technology to deliver precise blade positioning and location information to the operator in the cab. Using machine-mounted components, position sensing hydraulic cylinders, an off-board GNSS base station, and Real Time Kinematic (RTK) positioning accuracy, these systems provide the information necessary to determine precise blade positioning with centimeter level accuracy. The system computes the positioning information on the machine compared to the position of the cutting edge relative to the design plane and delivers the information to the operator via the standard in-cab display. All the information the operator needs to complete a job is delivered to the cab display, resulting in a greater level of control. Cat Grade Control 3D systems also provide overcut protection and linkage to additional Caterpillar exclusive features like AutoCarry™, Automatic Ripper Control and Load Assist. These systems are ideal for high production dozing and cutting complex 3D contours, such as highway projects.	Track-Type Tractors, Wheel Tractor-Scrapers
Cat GRADE with Depth and Slope	The **2D indicate-only** system for excavators provides the operator with precise real-time bucket positioning relative to the desired grade. Using a combination of position sensing hydraulic cylinders and sensors on the stick and boom pins, the system calculates bucket tip position relative to a grade/survey stake or benchmark. When used with the included laser receiver, the machine can reference a benchmark and travel while maintaining the elevation reference, even on uneven terrain. The laser receiver references the laser from a transmitter on the job site and calculates the desired grade for elevation changes, significantly increasing productivity. The factory-integrated system uses the existing machine display, reducing the need for an additional display. Sensors are deeply integrated and protected from damage in rugged applications. Cat Grade Control Depth and Slope is ideal for maintaining accurate grades and slopes in excavations and trenching applications.	Hydraulic Excavators

PRODUCT	CONSTRUCTION TECHNOLOGY APPLICATIONS	EQUIPMENT
Cat Grade with Slope Assist	**Slope Assist** systems provide blade slope/angle control to the cutting edge to achieve accurate slopes with a quality surface finish in less time with less effort — without the need for off-board infrastructure. This integrated machine system uses a blade mounted sensor to calculate necessary blade slope position to achieve desired surface slope and main-fall. The system makes automated adjustments to the lift and tilt cylinders, typically performed by the operator. The in-cab display uses the existing machine display to deliver the information the operator needs to quickly and easily spread or cut material at the correct angle. Two modes are available: basic and advanced. Basic mode maintains the slope of the last given blade command. Advanced mode drives to and maintains a preset target slope. Elevation is controlled manually by matching grade or automatically by adding an elevation control device. This foundational system for dozers can be combined with laser, GNSS or UTS technologies to make grading even more efficient and productive.	Select Track-Type Tractors
Cat Grade and Slope	The **Grade and Slope** system for asphalt pavers and cold planers utilize a combination of sonic, contact and slope sensors to provide an elevation control system for paving and milling operations designed to control grade elevation and slope. The goal of grade and slope controls is to remove irregularities from the surface for maximum smoothness and control mat thickness for asphalt pavers and cutting depth for cold planers. The sonic system uses multiple transducers to provide an average of the reference surface while the contact sensor references the actual target to maintain the implement at the same relative vertical distance to an external reference such as a string line or a curb and gutter or even existing pavement. Slope Sensors complement these systems and are designed to control cross slope of the screed or cold planer. These sensors can work individually or together and make automatic elevation adjustments to maintain the appropriate targeted values. The operator simply steers the machine to maintain the sensor over the external reference and monitors the remaining job site variables to ensure a consistent product. Referencing beams are also available both as contact as well as non-contacting styles which help to provide better averaging of the existing surface to help customers achieve their smoothness targets. Cat Grade and Slope for asphalt pavers includes vandal protection of the display boxes. Both asphalt pavers and cold planers come factory calibrated, utilize robust harnesses with strain relief components for excellent reliability and durability — a crucial element for paving applications.	Asphalt Paver, Cold Planers
Cat Compact Technology	**Cat Compact** combines advanced compaction measurement, in-cab guidance and reporting capabilities to help consistently meet compaction targets faster, more uniformly, and in fewer passes — reducing rework and material costs in both soil and asphalt applications.	Available on select Cat compactors.

PRODUCT	CONSTRUCTION TECHNOLOGY APPLICATIONS	EQUIPMENT
Cat Compact	Compaction measurement is the foundation system for vibratory soil compactors. Compaction measurement is a real time indication of soil stiffness, provided by one of two available technologies: accelerometer based Compaction Meter Value (CMV) or Caterpillar exclusive energy based Machine Drive Power (MDP). The compaction measurement system outputs to the standard multipurpose display, providing the operator with real time data that helps them determine the state of compaction. The scalable compaction measurement system can be upgraded to include mapping. Mapping from the factory is an integrated SBAS accuracy GNSS which uses a satellite technology to deliver drum positioning information to the operator in the cab. The factory integrated design protects expensive and fragile components of the system from damage, theft or vandalism in a way that aftermarket systems cannot. The SBAS system from the factory does not require base stations or other off board hardware, but can be easily upgraded in the field with an AccuGrade RTK radio for greater accuracy. Mapping capability allows the operator to record and map compaction measurement values and pass counts, as well as other compaction application data for future analysis. Cat Compaction Control for asphalt compactors and the CW34 pneumatic tire roller provides mat temperature mapping and pass-count information to the operator, ensuring that compaction occurs at the optimum mat temperature and that uniform coverage is completed.	B Series Vibratory Soil Compactors, K Series 4-Drum Soil Compactors, A and B Series Asphalt Compactors, CW34 Pneumatic Tire Roller
Payload Technology	**Cat Payload** enables accurate weight measurement of material being loaded or hauled. Payload information is shared with loader operators in real-time to improve productivity, reduce overloading and record both weights and number of loads per shift.	Available on select Cat wheel loaders, trucks, excavators and scrapers.
Cat Payload	**Cat Payload** provides on-the-go payload weighing through an in-cab LCD display so operators can deliver exact loads with confidence and work more efficiently. Operators can fill trucks to capacity without overloading, increasing productivity and eliminating costly fines. The system records detailed data to track productivity, including time/date, weights, cycles, and more. An optional in-cab printer enables operators to print individual load tickets as well as truck and material summary reports. Daily summary reports in the *VisionLink* web portal and detailed payload reports in *VIMSpc* software are available for productivity reporting and analysis.	Wheel Loaders
Cat Payload with Production Measurement	**Production Measurement** brings on-the-go payload weighing to cab to help operators deliver exact loads with confidence and work more productively and accurately; without rework. The system is integrated at the factory into the standard cab display. Operators can track load weights in real time and know precisely how much material is in the bucket or truck. Instant payload feedback gives operators the confidence to know when loads are filled to target capacity, which reduces under and overloading, and maximizes the potential of the entire fleet. Payload information is stored in the display, enabling operators to track productivity such as weights, and totals per shift while in the cab. Productivity data can be accessed wirelessly through the VisionLink web portal giving the site supervisor a daily view of production totals and efficiency metrics.	Wheel Loaders, Articulated Trucks, Excavators

PRODUCT	CONSTRUCTION TECHNOLOGY APPLICATIONS	EQUIPMENT
Cat Payload with Estimator	**Payload Estimator** uses bowl lift cylinder pressure on the loaded haul segment to calculate payload. This integrated system provides on-the-go payload weighing through the standard machine display so operators can deliver exact loads with confidence and work more efficiently. Deep integration ensures reliable operation and accurate data (within ±5%). It is optimized to work with Sequence Assist or can be used in manual mode. Productivity data can be accessed wirelessly through VisionLink, giving the site supervisor a daily view of production totals.	Wheel Tractor-Scrapers
Cat Payload with Truck Production Management System (TPMS)	**Truck Production Management System (TPMS)** enhances truck and loader effectiveness for improved fleet productivity and reduced operating cost. TPMS offers external lights or an optional digital display to signal the loading tool operator when the proper load is reached. The on-board system provides a payload accuracy of ±5% and stores payload weight, cycle segment times, cycle segment distance and fuel, operator ID and actual clock time and date of each cycle.	Off-Highway Trucks
Cat Detect Technology	**Cat Detect** combines safety and monitoring systems to enhance operator awareness. By expanding your view of the working environment around your equipment, you can improve the safety and productivity of your entire operation and keep your people and assets safe.	Available on many models of Cat equipment.
Cat Detect with Rear Vision Camera	**Rear vision cameras** greatly enhance visibility behind the machine to help the operator work more productively. On many machines, the camera view is displayed through the standard display.	Standard on many types of Cat equipment. Retrofits available on most models.
Cat Detect with Work Area Vision System (WAVS)	**Work Area Vision System (WAVS)** is used on larger equipment in applications where there are multiple machines, such as in a quarry. WAVS uses up to three cameras to provide full coverage in areas of limited visibility. Views can be set up by camera location (front, rear, side) or programmed to switch automatically based on direction of travel.	Optional on larger trucks and wheel loaders.
Cat Detect with Tire Monitoring	**Tire Monitoring** uses sensors located on the rims to display tire pressures and temperatures on the in-cab monitor to help keep fleets running safely and productively. Operators can view real-time information via the Messenger display and work with confidence. Alerts enable operators to take immediate action before a tire failure occurs to reduce downtime. The system optimizes fuel consumption by operating at optimum tire pressures and reduces tire damage and frequent replacements due to high tire temperatures and under-inflation. Caterpillar designed and tested aftermarket kits work with multiple machine models and mixed fleets. Remote monitoring via VisionLink helps equipment managers schedule maintenance and make informed decisions.	All Cat and mixed fleet machines with tubeless tire rim sizes R29.5 and smaller.
Cat Detect with Machine Security System (MSS)	**Machine Security System (MSS)** prevents unauthorized personnel from starting the machine by using a uniquely coded key that is programmed to a computer chip in the MSS module on-board the machine. The system can be set to prevent unauthorized use outside of normal working hours, and protect from vandalism or theft.	Standard on many types of Cat equipment.

PRODUCT	ENERGY & TRANSPORTATION TECHNOLOGY APPLICATIONS	EQUIPMENT
	Energy & Transportation	
Product Link Web	Product Link Web provides features optimized for power systems equipment, including detailed engine parameters. An innovative tool for equipment management, the Product Link Web user-friendly interface enables communication between the customer and their equipment assets, and provides comprehensive information about the performance and condition of the equipment. It also enables the user to customize alerts so that critical operations can be prevented and or receive immediate attention.	Oil and Gas, Marine, Electric Power Generation, and Industrial installations
Cat AssetIQ™ Kits	AssetIQ Kits are field-installed solutions for collecting engine data and information on Cat or other manufacturers' mechanical or basic electronic equipment. Kits are available for Fuel Flow Monitoring Systems and Sensor Kits for basic engines and genset applications.	Oil and Gas, Marine, Electric Power Generation, and Industrial installations

PRODUCT	MINING TECHNOLOGY & AUTONOMY APPLICATIONS	EQUIPMENT
	Cat MineStar	
Fleet	Fleet is a comprehensive mine management system featuring an advanced truck assignment engine, health and operational event alarming, "what-if" analysis, productivity tracking, machine tracking, material management and a comprehensive reporting package. Integrating with other Cat MineStar capability sets, Fleet improves productivity by 10-15%, eliminates misdirected loads, improves information availability and provides greater flexibility to adjust for changing mine and market conditions.	Entire mining fleet
Terrain	Terrain for drilling increases hole placement and depth accuracy while removing the cost of drill pattern survey and staking. Position and status information of other drills working on the same pattern is provided to operators in real time on the in-cab display. Terrain for grading ensures accurate execution of the design plan and enables safe operating practices. It can be used on a variety of machines in numerous applications from production dozing to reclamation, all helping you mine more safely and productively. Terrain for loading provides grade indication for bench management and automatic material information on each pass helping operators to move the right amount of material with every bucket load. Safety, productivity and efficiency are positively impacted and the mine design plan accurately executed.	Blasthole Drills, Articulated Drills, Draglines, Scrapers, Loaders, Dozers, Shovels, Motor Graders, Hydraulic Excavators, Track-Type Tractors, Surface Miners, Terrain Levelers

PRODUCT	MINING TECHNOLOGY & AUTONOMY APPLICATIONS	EQUIPMENT
	Cat MineStar	
Detect	Vision is a camera system available on mobile surface equipment. It provides multiple camera views that improve the operator's awareness of the vicinity around working equipment.	Surface: Select models of Electric Rope Shovels, Hydraulic Shovels, Off-Highway Trucks, Medium Wheel Loaders, Large Wheel Loaders, Large Motor Graders, Medium Wheel Dozers, Large Wheel Dozers
	Object Detection uses cameras and radars to improve the operator's view of key areas around the machine, allowing operators to make informed decisions. The system works with several machine types increasing machine perimeter awareness during critical periods including startup, initial movement and reverse travel. The system consists of an interactive touch screen display, radars and cameras on the front, rear and sides of the machine. Radar and camera configuration will vary by machine type.	Select models of Off-Highway Trucks, Medium Wheel Loaders, Large Wheel Loaders, Large Motor Graders, Medium Wheel Dozers, Large Wheel Dozers
	The Driver Safety System (DSS) is a non-intrusive, in-cab fatigue detection technology that instantly alerts operators the moment fatigue or distraction is identified. Fatigue detection technology works by monitoring eye-closure duration and head pose. If the DSS detects a fatigue or distraction event the operator is immediately alerted through configurable in-vehicle seat vibration and/or audio alarm. The fatigue or distraction event is sent to a 24-hour monitoring center to classify and confirm the event. Caterpillar experts will analyze the data and provide customized reporting with site-level recommendations. By cross-referencing fatigue and distraction events against available equipment data, Caterpillar can provide suggestions to improve operational efficiency.	Surface and underground mining machines as well as On-Highway Trucks
Health	Health delivers critical event-based equipment condition and operating data for your entire fleet. It includes comprehensive, proactive health and asset monitoring capabilities, with a wide range of diagnostic, reporting tools, analytics and recommendations.	Cat mining equipment and select models of other brands of mining machines

PRODUCT	MINING TECHNOLOGY & AUTONOMY APPLICATIONS	EQUIPMENT
	Cat MineStar	
Command	Command for hauling enables total autonomous operation of large mining trucks. Advanced perception and sensing technologies enable self-driving trucks within the autonomous operating zone to work safely and productively alongside manually operated equipment, such as loading tools, cleanup and maintenance machines, and mine site personnel. Utilizing a virtual mine map and dynamic routes managed from a central command center, autonomous trucks respond to calls to the shovel, move into loading position, haul loads to the designated dump points, and even report to the maintenance bay, all without an operator on-board.	Select models of Large Mining Trucks
	Operator Machine Assist (OMA) automates the entire drill cycle for a single-row, including tramming between holes, while the operator remains in the cab of the machine. OMA delivers higher consistent productivity than a typical staffed operation. Semi-Autonomous Drilling System (S-ADS) autonomously drills an entire row without an operator in the cab monitoring from a remote operations center or from a tablet interface. Flexible and simple, the system makes drilling autonomy easy to implement and more accessible for all kinds of operations. Command for drilling takes a building block approach to autonomy allowing customers to enter at their own pace.	Caterpillar Diesel MD6250 and MD6310 Caterpillar Electric MD6640 (Bucyrus 49R/HR) and Komatsu Electric P&H 120A and P&H 320XPC
	Command for underground is designed to enhance safety and boost operator efficiency and effectiveness. The system allows the operator to work from a safe and ergonomic work station far from the Load Haul Dump (LHD) machine — either on the surface or underground without sacrificing machine productivity. The system can also have a significant impact through increased machine availability, decreased operating costs and extended machine life.	Available as an attachment for select models of Hard Rock Underground Mining Loaders
	Command for dozing enables remote operation from a safe location away from the machine. Removing operators from the cab of a machine working in hazardous conditions promotes safety and reduces operator exposure to dust, noise and vibration. Command for dozing can utilize either an over-the-shoulder operator console or a seated operator station for longer term operations. Either system utilizes line of sight communications for near machine operation. Or with the addition of an on board vision system, the operator station can be located anywhere on-site or from an off-site command center. Terrain's avoidance zone functionality (optional) can be utilized to further enhance safety. Semi-Autonomous Operation allows an operator to control up to four machines from a Remote Operator Station while semi-automating a push-to-edge or pivot-push (late 2018) application.	D8T, D10T, D11, D11 CD Track-Type Tractors
Edge Equipment Tracking	Equipment Tracking is a fleet management system that replaces pencil and paper with automatic tracking of all mobile assets. It provides highly accurate data that tells supervisors what the fleet is doing, who is operating which machine and how they are spending their time.	Entire Mining Fleet
Edge Production Recording	Production Recording pairs with Equipment Tracking to deliver an accurate and automated near-real-time solution that measures and reports on every aspect of the load-haul-dump cycle. It gives sites visibility to their entire mining operation and provides accurate, reliable and actionable data with no operator input required.	Loading and Hauling Mining Fleet

Cat Technologies

Cat Technologies combine the latest in construction technologies and services to help customers improve in four key areas: Equipment Management, Productivity, Safety, and Sustainability. Because every job site has its own unique challenges — whether running one machine, managing a fleet, or overseeing several job sites — Cat Technologies enable customers to combine technologies and services in ways that make the most sense for their business and realize significant gains in productivity, efficiency and profitability.

Cat Technologies offer the following technologies:

- Link
- Grade
- Compact
- Payload
- Detect

Cat Technologies offer the following services:

- Cat EMSolutions™
- Caterpillar Fleet Monitoring Center
- Productivity Services
- Job Site Solutions
- Safety Services

Cat Link Technology

Cat Link connects you to your assets (people or equipment) giving you access to essential information you need to know to run your business. Cat Link data can give you valuable insight into how your machine or fleet is performing so you can make timely, fact-based decisions that can boost job site efficiency and productivity.

Product Link

Product Link is the combination of GPS and telecommunications hardware used to communicate information about your assets so you can remotely monitor it. The GPS pinpoints the location while the integrated cellular or satellite radio enables data to be transmitted from many locations across the world. The data flows securely to the data servers at Caterpillar and then redistributed to you.

For Cat equipment, Product Link is designed as a factory standard or retrofit option for many models delivered to more than 50 countries. It is deeply integrated with engine, transmission and implement control systems to help you take the guesswork out of equipment management. Easy access to timely information can help you effectively manage your fleet and lower operating costs.

For other equipment brands, Product Link can communicate basic information — location, data derived from switches and switch inputs, and publicly available data on the other manufactures CAN bus.

The Product Link family provides you the ability to select the right fit options for your fleet operations.

VisionLink

VisionLink is a telematics software application that allows registered users to securely access information critical to their fleet and job site operations to:

- Manage assets using site boundaries, asset groups, shared asset views, etc.
- Manage scheduled maintenance, custom maintenance intervals, and major components.
- Monitor equipment health by monitoring fault codes, fluid analysis, tire monitoring and inspections.
- Maximize asset utilization and efficiency.
- Manage load counts.
- Create email or SMS alerts to remotely manage your fleet.
- Track payload data and fuel burn rates.
- Create reports
- Share data from or to other systems, i.e. ERP like SAP, accounting, or payroll.

Consult your dealer's Product Link specialist for more details or visit *cat.com/PL* or Link.

Basic Health or Advanced Health

Basic Health or Advanced Health is a fully integrated technology solution that uses sensors located throughout the machine to monitor crucial machine health, performance and productivity information. Basic Health or Advanced Health captures detailed, up-to-the minute data and displays it for the operator in real-time. The system alerts operators of abnormal machine conditions and provides instructions if action is needed. Data, such as historical trends, histograms, events and more can be transferred wirelessly or manually to the office for off-board analysis. Basic Health or Advanced Health software and the Health module within the Cat MineStar are predictive analysis tools used to analyze and interpret the data and provide reports that provide actionable information for informed decision making on machine performance, productivity issues, operations improvements, and fleet management. (Available data varies by machine model and type.)

Value of Basic Health or Advanced Health

- For the machine operator Basic Health or Advanced Health establishes two-way communication between the operator and the machine. Real-time machine information allows the operator to make informed decisions that directly affect safety, machine availability, and maximize productivity.
- For maintenance Basic Health or Advanced Health provides an in-depth view of operator and machine performance. This allows maintenance managers and technicians to maximize component life, reduce catastrophic failures, minimize unscheduled downtime and improve asset management.
- For production Basic Health or Advanced Health collects the information needed to monitor equipment usage, personnel performance, and productivity levels. Payload information can be used as an accounting tool, an indicator of cycle time efficiency and truck overloading or under loading.

Cat Grade Technology

Cat Grade combines digital design data, in-cab guidance, and automatic controls to enhance grading accuracy, reduce rework, and lower costs related to paving and earthmoving in rough, fine and finish grade applications.

Cat Grade increases increase productivity by moving material right the first time and achieving accurate grades without rework. These systems compute and track the location of the bucket or blade and compare this information with design parameters to guide to the operator to grade. In-cab displays with easy-to-use operator interface provide grade information in real time. Basic systems provide indicate-only information, while more enhanced systems can signal the machine hydraulics to move the blade to the desired design automatically. Cat Grade increases productivity, improves performance for less experienced operators, reduces operator fatigue, and enhances overall job site safety.

Cat Grade offers customers these advantages and cost-savings:

- Increase productivity
- Reduce fuel savings
- Reduce guesswork and costly rework
- Reduce survey costs
- Reduce staking, string lines and grade-checkers
- Increase material utilization
- Reduce owning and operating costs
- Reduce labor requirements and costs
- Finish jobs faster
- Work more confidently
- Extend the work day

Many aftermarket systems exist in the market today, but no system designed by someone other than the OEM can bring the advantages that integration makes possible.

Depending on the machine family and the specific application, many of the components necessary for automation are already present on a Cat machine. Cat Grade leverages these components and optimizes the design as only Caterpillar can. Whether it is a sensor, cylinder, display or software, Cat Grade integration is designed to reduce redundant components, protect sensors and allow productivity features to work together.

Cat Grade integrates traditional grade control with machine hardware and software in the factory to improve productivity, usability, reliability, job site safety and machine value. It is another example of Caterpillar innovation and technology leading the way for our customers to be more successful.

Cat Grade technology is comprised of the following:

- Cross Slope
- 3D
- Depth and Slope
- Slope Assist
- Grade and Slope

Cat Compact Technology

Cat Compact combines advanced compaction measurement, in-cab guidance and reporting capabilities to help you consistently meet compaction targets faster, more uniformly, and in fewer passes — reducing rework and material costs in both soil and asphalt applications.

Compaction is one of the most critical steps in the construction and road building process. Successful projects rely on achieving target compaction to stringent design specifications to ensure structural stability of the finished product.

Asphalt compaction technologies display mat temperature in the cab, indicating when and where operators need to work to quickly achieve consistent quality results. The system measures mat temperatures in real time, indicating the approach of tender zones and where the operator can work productively.

Soil compaction technologies give operators the information and instant feedback they need to achieve uniform results with maximum efficiency. Plus, it helps to identify hidden soil problems that can affect compaction quality.

Cat Compact offers customers these advantages and cost-savings:

- Increase productivity
- Reduce fuel savings
- Reduce guesswork and costly rework
- Increase material utilization
- Reduce owning and operating costs
- Reduce labor requirements and costs
- Provide Quality Control/Quality Assurance Documentation
- Finish jobs faster
- Work more confidently
- Extend the work day

Cat Compact provides information about the state of compaction to operators. The optional system comes with a choice of two different measurement technologies, Compaction Meter Value (CMV) and Machine Drive Power (MDP). CMV is an accelerometer-based system that displays a compaction value that indicates compaction quality. CMV is for smooth drum machines only and works well in granular applications and thick lifts. It is a Caterpillar exclusive technology that measures rolling resistance — with the vibratory system on or off — and correlates it with soil stiffness. MDP is for smooth and padfoot drums and works well in both cohesive or granular soils.

Optional 3D Mapping enables temperature or compaction measurements to be mapped to the precise location the operator is working, providing a real time view of progress. Mapping data is recorded to document compaction uniformity and job completion.

Cat Compact technology uses the following:

- Compaction Meter Value (CMV)
- Machine Drive Power (MDP)
- GNSS (SBAS)

Cat AccuGrade

Cat AccuGrade systems are dealer installed technologies that can be used to guide an operator to grade, manually using in-cab guidance, or automatically by controlling the blade movements to help operators get to grade faster, and more accurately. The systems use machine mounted sensors to calculate precise blade/tool location, slope and/or elevation information. The integrated electrohydraulic valve control module uses the information received from the sensors to control the machine's hydraulic system and automatically adjust the blade's cutting edge to maintain grade on select machines. Depending on the configuration, the operator can select which side of the blade/tool to control — right, left, or both sides. AccuGrade brings to the customer an increase in productivity by up to 40% while reducing their site costs dramatically.

Cat AccuGrade technologies include:

- Cross slope
- Sonic
- Site Reference
- Laser
- GNSS
- UTS

Cat Payload

Cat Payload enables accurate weight measurement of material being loaded or hauled. Payload information is shared with loader operators in real-time to improve productivity, reduce overloading and record both weights and number of loads per shift.

- Production Measurement
- Payload Estimator
- Truck Production Management System (TPMS)

Cat Production Measurement for Wheel Loaders, Excavators, and Articulated trucks is integrated from the factory and brings payload weighing to the cab to help operators work more productively and accurately; without rework. Operators can track load weights in real time on the in-cab monitor and know precisely how much material is in the bucket or truck. The system uses data from a series of onboard sensors that is processed by the onboard computer to calculate payload weight. Instant payload feedback through the display gives operators the confidence to work more efficiently and know when loads are filled to target capacity. Truck system also features external payload lights to indicate when the load is full.

Payload Estimator for Scrapers uses bowl lift cylinder pressure during the loaded haul segment to calculate payload. When working in manual operation, the system is optimized to work with Sequence Assist for increased productivity with less effort. Deep integration ensures reliable operation and accurate data (within ±5%).

Cat Payload maximizes the potential of the entire fleet:

- Enables operators to consistently fill to target payload
- Reduces under loading that reduces productivity, increases haul cycles, fuel usage, and operating costs
- Allows operators to track productivity such as weights and totals per shift
- Reduces overloading that can cause excessive wear on equipment and haul roads and lead to safety concerns

Truck Production Management System (TPMS) enhances truck and loader effectiveness to improve fleet productivity and reduce operating costs. TPMS offers external lights or an optional digital display to signal the loading tool operator when the proper load is reached. The on-board system provides a payload accuracy of ±5% and stores payload weight, cycle segment times, cycle segment distance and fuel, operator ID and actual clock time and date of each cycle.

Cat Detect Technology

Cat Detect combines safety and monitoring systems to enhance operator awareness. By expanding your view of the working environment around your equipment, you can improve the safety and productivity of your entire operation and keep your people and assets safe.

- Rear Vision cameras
- Work Area Vision System (WAVS)
- Tire Monitoring
- Machine Security System (MSS)

Rear vision cameras greatly enhance visibility behind the machine to help the operator work more productively. On many machines, the camera view is displayed through the standard display.

Work Area Vision System (WAVS) is used on larger equipment in applications where there are multiple machines, such as in a quarry. WAVS uses up to three cameras to provide full coverage in areas of limited visibility. Views can be set up by camera location (front, rear, side) or programmed to switch automatically based on direction of travel.

Tire Monitoring enables operators to monitor tire pressures and temperatures on the in-cab monitor. Alerts enable operators to take immediate action before a tire failure occurs and avoid unsafe operation.

Machine Security System (MSS) prevents unauthorized personnel from starting the machine by using a uniquely coded key that is programmed to a computer chip in the MSS module on-board the machine. The system can be set to prevent unauthorized use outside of normal working hours, and protect from vandalism or theft.

CAT MINESTAR

Cat MineStar is a comprehensive suite of technologies that allows you to see your entire operation at a glance, then drill down to the individual asset level as required. Its capability sets — Fleet, Terrain, Detect, Health and Command — enable you to define the size and scope of your management system based on the needs of your mining operation.

For more information on Mining Technology & Autonomy products, visit *cat.com/minestar*.

Fleet

With real-time machine tracking, assignment and productivity management, Fleet gives you a comprehensive overview of all your operations. Fleet enhances the management of all types of equipment operations and allows you to easily drill down for more detailed views and analysis. You can generate reporting on selectable groups of assets, equipment on a particular site or even individual machines.

Fleet works with data from all types of assets and equipment — including off-highway trucks, wheel loaders, motor graders, wheel dozers, shovels, light duty vehicles and equipment from other manufacturers — helping you reduce costs per ton, enhance productivity and boost overall site profitability.

Fleet is comprised of five capability packages, which can be purchased and configured based on a mine's particular needs.

- **Production** — Provides real-time visibility of production operations, delivers improved shovel loading performance and increases payload predictability.
- **Position & Material** — Monitors material movement and type, alerts operators and planners of misroutes to ensure material is moved to the proper location. Also monitors machine location for the entire fleet and incorporates playback function to analyze dump movement and haul road congestion.
- **Assignment & Optimization** — Schedules and assigns equipment, maximizes production and shovel utilization, minimizes truck wait time and manages shift changes and fueling.
- **Data Share** — Allows Fleet to share data made available via the licensed capability packages with other applications such as data reporting systems and position monitoring systems via an industry standard interface.

Fleet provides a proven solution suite based on a single trusted set of data for real-time KPI and for standard and ad-hoc reports. It provides the mine with information to:

- Identify and quantify performance improvement opportunities (within and post shift)
- Develop strategies to capture performance improvement initiatives
- Assign equipment and fleets for maximized production or achievement of material management goals. Capability scales from simple assignment to full truck assignment with linear programming to ensure maximal flexible loader, truck and material capacity utilization
- Blend materials in order to meet preparation plant quality, tonnage and timing requirements
- Track machines and materials to ensure correct delivery of materials from sources to planned sinks and to monitor equipment routing
- Manage operators (licensing, shift allocation and rostering)
- Manage equipment fluids and tires
- Track equipment productivity capability, consumption and variance
- Monitor equipment health including alarms and sensor channel monitoring, pre-start checklists
- Determine "what if" impacts of making specific changes to the product plan

Cost reduction of 10% and greater can be achieved and sustained using Fleet. Cost reductions are typically realized through reduced equipment, manning, lower fuel and service requirements, while achieving the same levels of productivity.

Terrain

Terrain enables high-precision management of drilling, grading and loading operations through the use of advanced guidance technology. It increases machine productivity and provides you real-time feedback for improved efficiency.

Along with providing detailed in-cab machine guidance and machine positional information for equipment operators, Terrain makes a wealth of data available to mine managers and site planners — including up-to-the-minute machine location and operational status, progress toward completion of work plans and more.

Terrain gives machine operators the real-time guidance they need to do their jobs more safely and efficiently, while providing mine site managers with timely information and advanced tools to help them increase mine productivity, output production and profitability.

Terrain capability packages include:

- **Productivity** — Productivity allows the mine to track and analyze machine utilization and productivity by machine type and operator. Reporting tools generate information on machine utilization, timelines, operator productivity and other parameters to help identify and correct operational inefficiencies. It also enables the assignment of job tasks to grading and loading tools. Operators can even request the creation and assignment of a task to another operator (such as clean-up a spill). The information about each task is tracked and stored for reporting purposes.
- **Position & Material** — The Position & Material capability package allows machines to share position and job status information both on-board and in the office. This knowledge helps reinforce safe operating practices when working in close proximity. The Position & Material capability package also enables machine-to-machine cut and fill status sharing within grading and loading applications in real-time including sharing cut/fill information from draglines to dozers.

- **Data Share** — Allows Terrain to share data made available via the licensed capability packages with other applications such as competitive fleet management systems, data reporting systems, and position monitoring systems via an industry standard interface.

Terrain for Drilling

Terrain for drilling is designed for installation on electric, hydraulic rotary blasthole, and articulated drills. It provides production and performance monitoring, strata recognition and GNSS guidance which replaces paint marks and paper patterns with centimeter accuracy and digital drill patterns. Provided as a field retrofit to machines already operating at mine sites, Terrain uses on-board computing integrated with sensors to monitor critical machine performance characteristics. System modules help the operator and site managers enhance drill performance and improve the drilling and blasting operation.

Production offers a graphical user interface to provide the operator with immediate feedback on drilling productivity and performance. The product minimizes operator input by an array of sensing hardware to detect:

- Hole depth
- Reaching target depth
- Drill pipe changes

Strata Recognition analyzes the monitored drilling variables in real-time, determining variability in the hole geology. The different strata horizons are presented on the display. The system provides useful and concise information from the start of drilling — not large amounts of raw data that typify traditional drill monitoring systems. A Blastability Index is determined by the Strata Module and approximates the hardness of the ground. The hole loading requirements and ore grindability predictions are then based on measured rock hardness enabling improved containment of explosive energy and more consistent fragmentation which impact downstream diggability, cycle times, fill factors and reduced costs for material movement. These enhance blending and optimized mill through put rates.

Combining Production with Strata Recognition logs:

- Bit rotary speed
- Penetration rate
- Depth
- Rotary torque or pressure
- Pull-down pressure
- Bailing air pressure

Drilling practice, efficiency and productivity can then be analyzed and assessed.

Guidance adds high precision GNSS to help precisely position a drill on a blast pattern without the need for surveying or staking. Guidance uses a moving map display that shows the 3D (Northing, Easting and Elevation) of the drill and drill bit relative to the designed position of the blastholes. Once the drill is positioned and leveled over a hole (hole parallelism), the system automatically determines collar elevation and then calculates the designed target depth. Guidance improves the drill's production and utilization, and the operator's ability to consistently drill to the plan. This leads to better rock fragmentation for easier loading. Since holes are drilled to the correct elevation leading to a flatter post-blast surface, the result is smoother pit floors. This helps eliminate rework, enhances the mobile equipment's performance and reduces its wear and tear.

Terrain for Grading & Loading

Terrain for grading & loading moves the material identification file and survey system into the machine, eliminating the need for survey stakes or pin flags. A touch screen monitor displays the location of pit boundaries, material type, bench height, and design grade, eliminating operator guesswork. With material types and locations displayed, ore identification and recovery are optimized.

The system is an ideal tool for mine planning, engineering, surveying, grade control and production monitoring applications. For example it can be used for:

- Haul road and bench construction and maintenance
- Production dozing
- Leach pad construction and maintenance
- Reclamation
- Task List Management
- Ore grade control and material identification
- Coal load out terminals

The system can be used on scrapers, loaders, dozers, shovels, motor graders, hydraulic excavators and track-type tractors.

Terrain features a mobile application for use in light vehicles. Mine supervisors can log in from a laptop or tablet to view progress updates from nearby machines, know the precise location of all Terrain-equipped machines, assign tasks and validate design plans without having to drive back to the mine office, improving the efficiency of your operations. Updates made on the mobile application are sent back to the office software and then communicated to the applicable machine onboard system in near real-time.

Detect

Operators often cannot see if another machine or vehicle is too close for safe operation. Detect helps alleviate this potential safety hazard and can also be configured to provide valuable information about site conditions and other assets working in the area.

At the most basic level, Detect enhances your operators' awareness of the immediate environment around their equipment. A simple touch screen display alerts operators when radars indicate that objects have entered critical areas near the machine. The system allows a quick visual check of these areas whenever the operator wants one.

Additional capability packages enable Detect to alert the operator to pre-programmed avoidance zones, known site hazards and speed limits. Positional information from Detect can also provide valuable feedback to central office systems and mine site managers.

Detect capability packages include:

- **Vision** — Vision offers multiple camera capabilities, allowing operators to select the view or views they need on the in-cab display to see what is happening close to their machines.
- **Object Detection** — Object Detection adds radars while reducing areas of limited visibility and increasing perimeter awareness. This robust system is scalable to site needs and machine types, providing optimal awareness around equipment.

Vision

Vision for surface equipment offers multiple camera capabilities, allowing operators to manually select the view or views they need on the in-cab display to see what is happening close to their machines. Certain Vision kits are configurable for manual or rotating camera views.

Object Detection

Object Detection is designed for machines ranging from large mining and quarry trucks to machines such as wheel loaders and motor graders. This robust system builds on Vision by adding radars to provide optimal awareness around the machine and notification when an object is detected. With both audible and visual indications, Object Detection helps prevent work area injuries caused by limited awareness. Using a combination of radars, cameras, and a high-resolution touch screen display, operators can view the areas immediately surrounding their machine, helping to prevent collisions and accidents.

Object Detection is highly integrated with the specific machine configuration to optimize radar and camera coverage. The system has been calibrated to provide appropriate fields of view and range. Unlike basic camera systems, Object Detection provides operators with audible and visual types of warnings that enable the operator to make informed decisions when moving or operating the machine. This system alerts the operator when an object is in close proximity so they can decide if action needs to be taken to avoid it.

Fatigue and Distraction Management

Fatigue, sleepiness and distraction impact each of us every day and losing focus on a mine site can have serious consequences. However, this risk can be managed and mitigated through a comprehensive Fatigue Risk Management System (FRMS) that incorporates all layers of protection against fatigue. These layers of protection include:

- Site fatigue assessments
- Training and education on managing fatigue for individuals, managers and supervisors
- Technology change management
- 24/7 monitoring
- Schedule/roster analysis and optimization

Caterpillar is the sole provider of a complete solution that brings visibility to risk factors never seen before and applies root cause data to a continuous improvement process that delivers sustainable culture change.

With specialized in-cab equipment that alerts an operator when a fatigue or distraction event is detected and data monitoring to identify risk trends, Caterpillar can help you prevent incidents in the moment and give line of sight to a host of factors that influence safety and operational performance. We also offer safety management consulting and training to help you build and sustain a culture that supports your fatigue management system.

Driver Safety System (DSS)

Fatigue and distraction are an inevitable force of nature. Their consequences can be costly, even fatal. Intervene before it's too late with a fatigue monitoring system. The Driver Safety System (DSS) is a non-intrusive, in-cab fatigue detection technology that instantly alerts operators the moment fatigue or distraction is identified.

Fatigue detection technology works by monitoring eye-closure duration and head pose. If the DSS detects a fatigue or distraction event the operator is immediately alerted through configurable in-vehicle seat vibration and/or audio alarm.

The fatigue or distraction event is sent to a 24-hour monitoring center to classify and confirm the event. Caterpillar experts will analyze the data and provide customized reporting with site-level recommendations. By cross-referencing fatigue and distraction events against available equipment data, Caterpillar can provide suggestions to improve operational efficiency.

Health

Cat® MineStar Health assists with improving the reliability of assets, reducing unplanned downtime, and preventing failures that can lead to lost productivity and costly machine repairs by providing a wide range of products and services that:

- Collect and transmit equipment data
- Monitor critical machine parameters
- Provide real-time alerts
- Identify operational trends and patterns
- Predict failures
- Provide repair recommendations

Health offers universal functionality that works with virtually any mine site asset including Surface and Underground, and Other Equipment Manufacturers (OEM) equipment.

Key Benefits of Health include:

- Lower maintenance costs
- Improved availability and reliability
- Saved component failures
- Extended component life

The MineStar Health portfolio set consists of the following:

- **Connectivity Enablers** – to collect, convert and transmit equipment data.
- **Applications** – to visualize, analyze and report health equipment data.

The Health portfolio also supports **Cat and Dealer provided condition monitoring services.**

Health connectivity products enable your equipment to collect and transmit machine electronic data into locally hosted or cloud-based applications.

Product Link Elite

Product Link Elite is the combination of GPS and telecommunications hardware used to securely collect and transmit machine electronic data into locally hosted or cloud-hosted applications for monitoring purposes.

Key Features:

- Dual data path – allowing data transfer to both the local server and the cloud simultaneously
- Cat or third-party radio compatibility – to suit site preferences
- Remote flash capability – for easy updating of firmware
- High-capacity memory storage – allowing for store-and-forward of data in the event of poor connectivity
- Ability to leverage Cat PL641 radio – for low precision GNSS needs

For Cat equipment, Product Link Elite is designed as a factory standard or as an aftermarket retrofit option for many models delivered to more than 50 countries.

For other equipment brands, Product Link Elite can communicate basic information — location, data derived from switches and switch inputs, and publicly available data on the other manufacturers' CAN bus.

Easy access to timely information can help you effectively manage your fleet and lower operating costs.

Product Link Elite Data Streaming

Product Link Elite Data Streaming is integrated with PLE and enables the transfer of over 150 machine health and operating data with up to 1 Hz sample rate.

The data transfer is completed via ethernet communication in an open and accessible format. Data is pushed out via an encrypted configuration into an off-board OSISoft® PI System™ to be consumed by third-party applications.

Data streaming has buffering capabilities to safeguard data in case of poor or no connectivity on site.

NOTE: A one-time Software Enabled Attachment (SEA) is required per machine to enable the Data Streaming functionality.

VIMS Forwarder

MineStar Health – VIMS Forwarder is a local site software application enabling data transfer from the local Dealer or Customer server to the Cat® Cloud at no cost.

It is designed to provide an easy and secure VIMS files processing and merging from Caterpillar and OEMs machines to enable MineStar Health Condition Monitoring applications and services, like Equipment Insights.

VIMS Forwarder is installed on a customer's computer (pc or laptop).

VIMS Converter

MineStar Health – VIMS Converter is a Windows Server based application allowing efficient conversion of VIMS data files from a proprietary format to a non-proprietary readable format (Comma Separated Value .csv) for ingestion into a system of choice.

VIMS Converter is compatible with all legacy and current VIMS files and systems:

- VIMS 68K with HIM or Product Link Elite
- VIMS ABL with HIM or Product Link Elite
- VIMS 3G
- Product Link Elite (ex-factory and aftermarket)

NOTE: Files are automatically sent to the Cat Cloud.

Health offers a variety of applications that visualize and report machine electronic data, such as VIMS and Product Link. These data visualization and reporting tools enable equipment reliability analysts, condition monitoring personnel, and/or maintenance managers to make better maintenance decisions.

VIMS Telemetry

The VIMS Telemetry port is a serial communication port available on many Cat machines at 1 Hz sample rate. VIMS Telemetry enables third-party access to Cat equipment health data by allowing a customer to receive about 92 machine operating parameters and events.

To activate VIMS Telemetry, Caterpillar requires customers and their third-party integrators to complete a Non-Disclosure Agreement (NDA) for each individual mine site before requesting:

- A Telemetry Port Events & Parameters document
- A VIMS Telemetry Port Description document

NOTE: A one-time Software Enabled Attachment (SEA) is required per machine to enable the VIMS Telemetry functionality.

VIMS Transmitter

MineStar Health – VIMS Transmitter enables the large scale and automated transmission of data from VIMS capable machines back to the Cat® Cloud. This process is followed by a data transfer into the Dealer back-office system via an Application Program Interface (API).

The API filters and transfers VIMS files only from machines with a VIMS Transmitter subscription activated in the Dealer Services Portal (DSP).

Health offers a variety of applications that visualize and report machine electronic data, such as VIMS and Product Link. These data visualization and reporting tools enable equipment reliability analysts, condition monitoring personnel, and/or maintenance managers to make better maintenance decisions.

Equipment Insights

MineStar Health – Equipment Insights is an off-board, cloud-based application that was developed to allow dealers and customers to view and analyze machine data from Cat and other brands of mining equipment.

Users have the option to visualize, analyze and report

- **Machine Electronic Data** (VIMS and Product Link) from Cat and select other OEMs
- **Fluids data** from Cat® S·O·S℠ or third-party fluid sampling providers
- **Inspection data** when Cat® Inspect is used

Users can customize or create their own dashboards by using more than 40 different widget options available. The system also provides options to generate automated e-mail reports.

Office

MineStar Health – Office is a server-based health application for customer sites and dealers.

It is a data visualization and reporting tool housed on the Dealer or Customer local server with various capabilities including but not limited to real-time event notification, real-time machine operating parameters visualization, remote log-in, as well as flexible and automated reporting system with more than 30 standard reports included.

Technician Toolbox

MineStar Health – Technician Toolbox is a PC software application that enables service technicians to perform machine configuration files to compatible payload and VIMS system parameters, and calibrate payload systems on the spot. Users can also trigger snapshots and activate VIMS dataloggers in order to gather critical machine health data.

In terms of machine troubleshooting, the VIMS Data can be downloaded and visualized in tables, graphs, and charts for one machine at a time through a customizable dashboard powered by 9 widgets.

PitLink

MineStar Health – PitLink is a client/server software application that forwards electronic data from a machine to the Caterpillar database (Cat Cloud) to enable a Cat application i.e. Equipment Insights, or a corporate MineStar Health – Office database.

PitLink also provides site personnel with the ability to perform live channel polling and visualize live machine events as they occur on the machine.

The MineStar Health product portfolio enables Cat Condition Monitoring Services for customers who desire a best-in-class predictive based condition monitoring program that delivers real value and cost reduction to an operation.

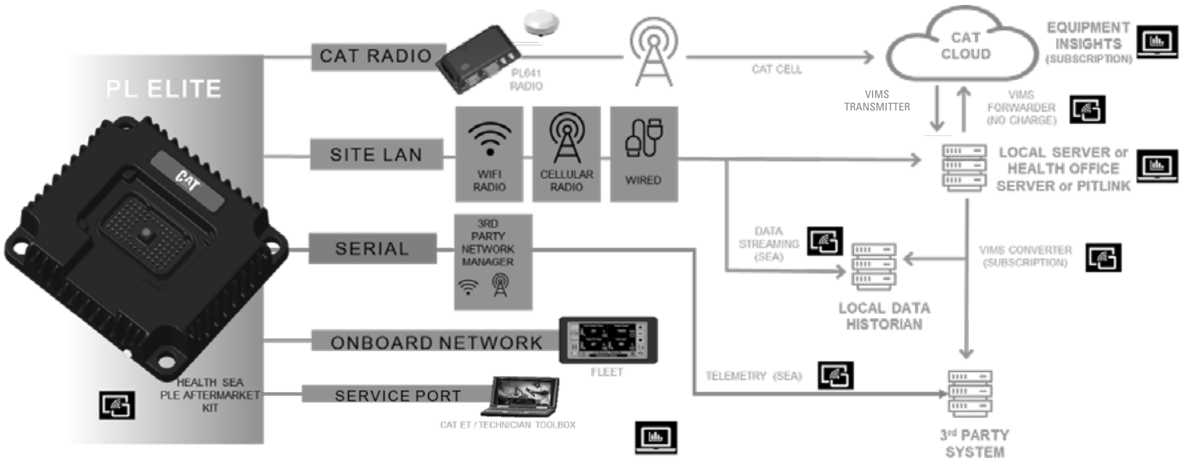
Condition Monitoring Service

Condition Monitoring Service is an offering that partners the maintenance and reliability organization of a mining operation with the strengths of the local Cat Dealer and MineStar Fleet Monitoring Center. The CM Service deploys a Predictive Maintenance Initiative through analytics with the goal of achieving the following objectives:

- Improve availability and reliability through predictive maintenance.
- Empower reliability engineers to improve maintenance planning.
- Extend machine life.
- Utilize machine condition monitoring data for analytics projects.

The service includes:

- Cat Condition Monitoring Advisor – Maintenance and health domain experts dedicated to the fleet and located in the MineStar Solutions' Fleet Monitoring Center to provide predictive maintenance recommendations.
- Predictive Analytical Software – Cloud hosted software designed specifically for the mining industry. Our solution uses advanced anomaly detection software resulting in highly confident correlation and causation determination. Our solution is supported by best in class analytical engines for condition monitoring data, including but not limited to electronic machine events, dataloggers, time series data, payloads, haul road conditions, work order histories, fluid sample results, and inspection results. Our Condition Monitoring Advisors work directly with a wide support group of Cat experts to include Data Scientists, Performance Engineers, and Product Group Engineers. These subject matter experts have knowledge of component design, component performance expectations, and have access to modeling and FMEA software for faster determination of root cause. Our software applications are maintained and supported within an agile development program, resulting in monthly quality improvements and feature introductions.
- Dynamic Health Data Visualization – Cloud hosted application providing real time visibility of machine, inspection, and fluids data at the mine site level, which is used by site reliability engineers and maintenance planners for PM planning, monitoring of critical machine parameters, and analysis of operational trends and patterns.
- Mentoring and Improvement Program – Resources deployed to site to support the local Maintenance Team make business process improvements to the maintenance programs.
- Data Connectivity – Hardware and software required to collect condition monitoring data from mining equipment at site and customer or dealer databases for transmission to the Fleet Monitoring Center.
- Application Program Interface – Real time data and information transfer between customer, dealer, and Caterpillar databases to affect the service.



PL ELITE
CAT RADIO
PL641 RADIO
CAT CELL
CAT CLOUD
EQUIPMENT INSIGHTS (SUBSCRIPTION)
VIMS TRANSMITTER
VIMS FORWARDER (NO CHARGE)
SITE LAN
WIFI RADIO
CELLULAR RADIO
WIRED
LOCAL SERVER or HEALTH OFFICE SERVER or PITLINK
SERIAL
3RD PARTY NETWORK MANAGER
DATA STREAMING (SEA)
VIMS CONVERTER (SUBSCRIPTION)
LOCAL DATA HISTORIAN
ONBOARD NETWORK
FLEET
TELEMETRY (SEA)
HEALTH SEA PLE AFTERMARKET KIT
SERVICE PORT
CAT ET / TECHNICIAN TOOLBOX
3rd PARTY SYSTEM

Command

Combining the Fleet, Terrain, Detect and Health capabilities of Cat MineStar, Command enables you to implement remote control, semi-autonomous or fully autonomous mining equipment systems for dozing and underground operations.

Taking advantage of proven technologies, as well as significant advances in remote sensing and guidance, Command helps you work more safely and productively in a wide range of harsh or challenging environments. And Command systems are proven to work safely and seamlessly with other mine site activities, equipment and personnel.

Command for Dozing

Command for dozing enables machine operation from a safe location with the operator removed from the cab. This system enhances operator safety by limiting exposure to full body vibration, dust and sound, and slips, trips and falls from machine ingress/egress. The machine can be operated by either an over-the-shoulder operator console or a seated operator station for longer term operations. The Console utilizes line of sight communications for near machine operation. With the addition of an on board vision system, the operator station can be located anywhere on-site or from an off-site command center. This system is integrated with engine, implement, and power train controls. Safety controls are built in which stop the machine in case of the loss of radio, transceiver, or ECM communications. The machine will also stop in the event the operator console is tipped. Additional protection features include the use of auto-brakes when in neutral and engine over-speed protection. Perhaps the most unique feature is the integration with the Terrain avoidance zone functionality, which prevents the machine from entering predefined avoidance zones.

Starting with a Remote Operator Station, a mine site can scale up to Semi-Autonomous dozing capability with the addition of our on-board planner system and MineStar Office. Command for dozing's semi-autonomous system is only available on the D11 (check your serial number for compatibility).

Semi-autonomous dozing allows an operator to sit comfortably and control multiple dozers from a Remote Operator Station while automating the dozer pivot push (late 2018) or push-to-edge processes for up to four machines simultaneously. This solution makes next-generation dozing a reality by allowing operation of dozers from a remote location either on the mine site or miles away, and reduces costs by tying multiple machines to a single operator and station.

Benefits of Command for dozing include:

- Enables control of machine from safe location when operating in hazardous conditions.
- Operator exposure to dust, noise and vibration can be minimized when operating remotely.
- Numerous emergency stop functions available in the following scenarios:
  - Operator Console is tipped.
  - Off-board transceiver loses power.
  - Radio communications are lost.
  - Communication to on-board transceiver or any electronic control module is lost.
- AutoBrake feature prevents machine from coasting while not being controlled.
- Avoidance Zone (optional) prevents a remotely controlled machine from entering predefined avoidance zones or 3-dimensional surfaces.
- AutoRetarder enables engine over-speed protection.
- Multiple emergency shutdown switches engaged in the cab, on the Operator Console, in the ground-level service center
- Meets ISO 15817 standards
- Meets AS/NZS 4240

Applications

- Machine recovery
- Unstable footings
- Aggressive ripping
- Misfires
- Stockpiles
- Bench slides
- Steep slopes

Command for Hauling

Command for hauling takes advantage of sophisticated technologies to enable Cat autonomous haul trucks to work safely and productively on busy mine sites. More than just an operator-free equipment system, Command for hauling is a complete, autonomous solution that delivers solid, bottom-line benefits for miners who need to work in challenging and remote locations. Highly advanced safety systems enable Cat autonomous haul trucks to operate reliably around other mining equipment, light vehicles and site employees.

Automation solves many problems faced by miners in today's competitive environment. With reserves being mined in more remote locations than ever, infrastructure requirements and labor shortages pose challenges that are difficult to overcome with manned mining operations. Automation resolves some of these challenges while making mines more safe, efficient and productive.

Benefits of Command for hauling include:

- Autonomous trucks work safely with other manned and light vehicles on the site.
- Multiple, redundant safety features ensure the system functions in a safe, predictable manner.
- High productivity through near continuous machine utilization.
- Reduction in process variability and better planning of maintenance and downtime improves operational efficiency.
- Supports your sustainability efforts by lessening infrastructure needs and operating the equipment as designed, reducing fuel burn, machine downtime and wear part replacement.

Command for Drilling

The Command for drilling automation solution offers a range of capabilities, so miners can configure and automate the drilling system to meet their budget and the needs of their site. Features and components serve as building blocks that allow customers to easily grow and add features and capabilities at their own pace. Command for drilling, a capability of the Cat MineStar technology suite, helps achieve excellent results through drill automation — which will ultimately reduce operating costs and improve productivity from predrill planning to blasting.

Semi-Autonomous Command for Drilling (S-ADS) automates the entire drilling cycle for one row, including autonomous tramming, without an operator in the cab. Flexible and simple, this system makes drilling automation easy to implement and more accessible for all kinds of operations. Autonomous drilling enables an operator to manage multiple drills across the mine from a Remote Operator Station (ROS) located on-site or off-site from a remote operating center.

Benefits of Command for drilling include:

- Improved accuracy
- Increased utilization
- Reduced operating costs
- Increased consistency
- Quality fragmentation
- Increased productivity
- Multiple redundant safety features ensure the system functions in a safe, predictable manner.
- Improved blasthole quality

Command for Underground

Developed out of the need to reduce human exposure to injury, the system removes the operator from dangerous situations and allows them to work in a more comfortable, ergonomic environment. The system uses technology to automate and enhance operations, by enabling full and semi-autonomous control of Cat LHD's. Command for underground will increase productivity and make a measurable impact on your mine's bottom line.

Command for underground consists of four major sub-systems that support the functionality of the system.

Remote Operator Station

The Operator Station allows machines to be operated from an ergonomically designed seat in a variety of locations. The operator can safely operate the machine from a mine control room or mobile office, either above or underground. This removes the operator from potentially dangerous environments in the mine drives underground. The Operator Station consists of three embedded PC displays, a Cat comfort seat and two joysticks, the other controlling the bucket.

Line of Sight Operator Console

With the line-of-sight Operator Console, operators have full control of basic machine functions and knowledge of critical machine diagnostics at the tip of their fingers — all at a safe distance from the machine. The ergonomic, durable, and modular over-the-shoulder harness allows for line-of-sight control of the LHD with communications on a 2.4 GHz frequency band. The remote control receiver is mounted on the machine and communicates with the operator console via the machine's electronic control module. The line of sight console can be used to control selected Load Haul Dumps equipped with a Cat line of sight receiver by switching the paired chip in the transmitter.

Machine Automation System

The Machine Automation System consists of the on-board hardware components that make the Command for underground system function. LADAR, cameras, lights, sensors, antennas, and control modules combine to create a system that provides safety and productivity for your underground mining operation.

Area Isolation System

Ensures that personnel cannot enter or equipment cannot leave the operations area while the machine is in autonomous mode. The operator has the ability to arm and disarm the system to compensate for changing business needs. A barrier control panel is located at each entry to the operations area. These are connected to barriers to ensure the area is secure. The status of each barrier control panel is reported to the programmable logic controller via the Local Area Radio Network (LARN). The programmable logic controller then determines whether the Operations Area should be armed.

Local Area Radio Network (LARN)

The LARN is a wireless Ethernet data network that enables communication between the machine and the Operator Station. The network uses the 802.11 b/g protocols and requires exclusive use of the 2.4 GHz RF spectrum. Signals from the Machine Automation System roam between LARN antennas as the machine moves within the operations area. The signals work primarily over line-of-sight, but can reach a short distance around corners. Video images and data are sent via the LARN.

Edge

MineStar Edge is a new technology platform that delivers more connected, integrated, scalable and intuitive products that extend further up and down the value chain. It creates an operational ecosystem that gives visibility to every aspect of an operation, allowing efficient execution of the mine plan and delivering optimal quality to the plant and to the surface. MineStar Edge makes it possible to measure, manage, analyze, and optimize the entire operation. And because it's delivered as a cloud-based, subscription managed application, it lowers costs and delivers a better user experience.

The best technology systems available today—when used to their full potential by personnel—deliver information that is about 80 to 90% accurate. MineStar Edge provides data that is 98% accurate. The platform makes use of Artificial Intelligence—data fusion and machine learning—to determine and communicate the accuracy of the information it is providing. Most data is automatically provided by the machines themselves, which eliminates the need for operator input and the risk of incorrect data entry. Near-real-time reporting is one of the most powerful features of MineStar Edge. Having access to the most up-to-date information allows mines to make quick adjustments to meet production goals rather than waiting until the end of the shift to determine if goals were realized. These decisions have an immediate impact on productivity.

MineStar Edge allows sites to start small and scale up to a full operational ecosystem. Users select an offering by role, function, or task—paying only for those functionalities they need. This model allows operations of all sizes to scale the technology in a cost effective and efficient manner. Because it is delivered as a cloud-based, subscription-managed application, MineStar Edge lowers network requirements as well as associated costs of deployment, service, and training. Mines are not required to invest capital in servers and database solutions that are sometimes required with mining technology solutions. The cloud-based platform also speeds the time from order to use, and allows automatic upgrades, updates, and fixes. In addition, sites have the option to have some applications hosted locally to ensure higher connectivity and less latency.

Equipment Tracking

Traditionally, sites have used pencil and paper to keep track of information on the majority of their equipment assets. Even if they leverage Production Recording technology to get data on the load/haul cycle, they have lacked access to the same information for non-production machines like water trucks, dozers, graders, drills, light vehicles, etc. MineStar Edge Equipment Tracking provides information on these mobile assets, no matter the manufacturer. It tells supervisors what the fleet is doing, who is operating which machine, and how they are spending their time. By replacing paper with accurate recording, supervisors can better understand utilization and make decisions about equipment investments and effectivity. Equipment Tracking provides insights that help mines better manage their assets, and as a result they deliver more value and mines enjoy a lower overall cost of ownership.

Equipment Tracking consistently provides a basic level of information on all assets, including data on locations and movements, velocity, payload, cycle times and fuel level, as well as Service Meter Readings and time utilization. Supervisors can view scheduled and unscheduled downtime along with scheduled and unscheduled operational stoppages. With fuel being one of a site's largest expenses, the ability to visualize and export fueling records is a key benefit of Equipment Tracking. This feature automatically measures fuel events—from when the machine was fueled to what was put in the tank and how long fueling took—allowing operations to manage the efficiencies of their fueling processes and fuel consumptions. It reduces or eliminates errors because data is collected automatically, and also lowers the cost of fuel.

Features and Benefits

- Gathers SMU data continuously from all assets. Data is no longer gathered manually through operators recording on paper or calling over the radio—eliminating incorrect entries.
- Delivers high-accuracy data recording, reducing downstream errors when the position is referenced for automatic collection of information.
- Provides the ability to replay shifts in great detail, helping sites answer Production Recording questions and providing information for incident investigation and material tracking investigation.
- Records the time that equipment is available, down, operating or stopped due to a nonoperating activity, providing accurate KPIs for use in time utilization models and leading to increased productivity and production.
- Automatically measures time when the equipment is not being productive and will attempt to classify with a machine-learning approach, reducing or eliminating missed or incorrect time measuring and giving operations information they can use to measure and manage their processes—specifically those that have production loss impacts.
- Helps sites measure and manage equipment downtime and classify it as scheduled or unscheduled, providing a key indication of the effectiveness of the site's maintenance and reliability programs, which can reduce downtime and lead to improved productivity.
- Allows operations to better manage and measure equipment operators, including allocating them to machines and tracking performance, and provides operators with KPIs about their personal performance—helping them improve and leading to a more consistent operation and reduced cost per ton.
- Helps operations improve equipment availability, reliability, and production by measuring, managing and ultimately reducing machine health events and making data easily accessible.

Production Recording

Every mining operation has opportunities hidden within every shift. But how do they find those opportunities if they're not accurately measuring what's happening during that shift? From payload to dig rates to operator breaks—every activity has an impact on productivity and an opportunity to be improved. MineStar Edge Production Recording helps sites find those opportunities by giving them visibility to the entire mining operation. When paired with Equipment Tracking, it delivers an accurate and automated near-real-time solution that measures and reports on every aspect of the load-haul-dump cycle without requiring any operator input. The result is a boost in productivity and a reduction in the overall operating costs of managed assets: mine, material, and machines. For many sites, traditional comprehensive fleet management systems can be too complex and cost-prohibitive, requiring significant investments in time and money to set up and maintain. Production Recording, however, is an easy-to-use subscription-based solution that delivers the key functionality all sites require: accurate, real-time production data.

Production Recording helps mines of all types and sizes improve the efficiency of their operations and increase their overall tons produced. The data it provides identifies opportunities, allows sites to make changes within the shift, and delivers insights on how those changes will impact production if implemented. The accuracy of the data gives personnel such as Pit Supervisors, Mine Managers, and Install Technicians the confidence they need to make quick, real-time decisions related to operational execution. Data can be accessed on a mobile tablet device as well as through a web-based application. A production dashboard provides information on the operation, including defined materials, active load and dump areas, active load and haul equipment, and active crushers. The dashboard enables viewing of hourly production metrics as well as cumulative shift-to-date production metrics for the site, material, load and dump areas, equipment, and the crusher. Beyond the shift, Production Recording allows sites to continually monitor and make operational decisions and implement training that will allow them take advantage of the opportunities they uncover.

Opportunities

- Missed production targets. Every mine has production goals such as total tons moved, dig rate, rate of material put through crusher, etc. All impact management's ability to measure progress toward production. Accurate information allows them to course-correct—in real time—to ensure the operation is on target.
- Payload compliance. Under-loading trucks means not getting maximum value from the truck or the cycle and impacts cost per ton. Over-loading can impact component life, boost maintenance costs, and increase unplanned downtime. Finding a balance equates to more effective machine utilization over the course of a shift.
- Shift changes/long operator breaks. The goal of an efficient mining operation is to effectively use all resources. Shift change and operator breaks, while necessary, must be managed to reduce the impact they have—keeping operators productive and reducing machine idle time.
- Misplaced loads. When material is dumped in the wrong location, mines take an immediate hit to their profitability. For example, if waste is dumped into the crusher or ore is dumped into the waste pile, the result is lost revenue. And if the blend is inaccurate, the finished product will result in less profit.

Features and Benefits:

- Monitors and provides highly accurate data on load and dump counts, tons moved and Bank Cost Per Meter/Bank Cost Per Yard.
- Provides the ability to track progress against plan in real time throughout the shift.
- Allows users to drill down to see the performance of entities such as individual machines, areas, routes, materials, and operators.
- Calculates and visualizes the expected production at the end of the shift for the site and individual entities including site, load and dump areas, routes, loading tools and trucks, and material.
- Enables sites to review production records from the point of view of the material transaction and movement from the load face to the dump, including the times, machines and operators involved.
- Delivers accurate transactional records that can be used as a source of truth for material movements.

TIRES

CONTENTS

SELECTION, APPLICATION, MAINTENANCE

Proper tire selection, application and maintenance continue to be the most important factors in earthmoving economics. Wheel tractors, loaders, scrapers, trucks, motor graders, etc. are earthmoving equipment whose productivity and payload unit cost may depend more on tire performance than any other factor.

Off-the-road tires must operate under a wide variety of conditions ranging from dry "potato dirt" through wet severe shot rock. Speed conditions vary from less than 1 mph average to 72 km/h (45 mph). Gradients may vary from 75% favorable to 30% adverse. Climatic conditions, operator skills, maintenance practices, etc. all may have a profound effect on tire life and unit costs.

Although one specific tire construction may be acceptable in a variety of applications, no one tire can meet all requirements on any one machine and perhaps not even one job. The many differences in tire requirements on earthmoving machines have resulted in a wide variety of tread and casing designs being made available. The optimum tire selection for a specific machine on a given job should be a joint decision between the user and tire supplier. Several tire manufacturers have technical and application representatives in the field for proper guidance in tire selection.

When job conditions change, it may be desirable to select a different tire configuration to meet the new requirements.

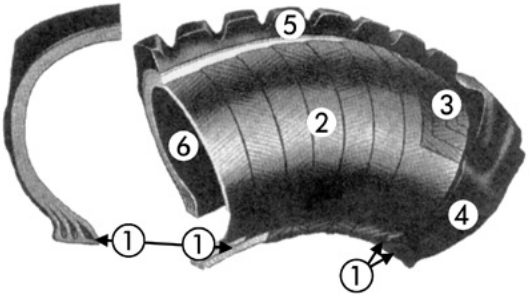
TIRE CONSTRUCTION

The pneumatic tire is essentially a flexible pressure vessel utilizing structural members (nylon, steel cable, etc.) to contain the hoop tension resulting from the inflation pressure. Rubber is utilized as a protective coating and sealant over the structural members and makes up the tread pattern which provides the wearing medium at the ground interface. The following brief explanation of the various tire constructions will assist you in selecting tires for your specific application.

Two distinct tire constructions approved on all Cat® machines are the BIAS PLY and RADIAL PLY tires. Radial tires are designated by an "R" while a "-" represents a Bias constructed tire. For example, a 45/65-45 tire would be of Bias construction and a 45/65R45 would be of Radial construction. The following is a brief explanation of the principal features of these two constructions.

Bias Ply

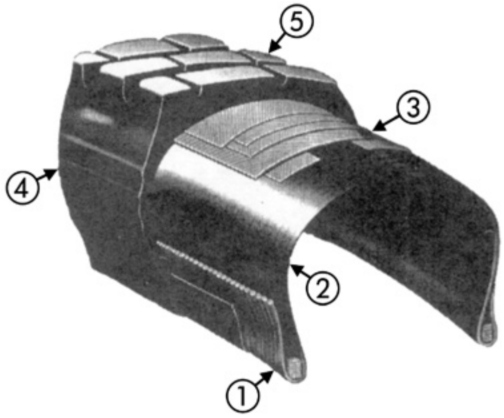
1. *Beads* — The tire beads consist of steel wirebundles (3 or 4 in larger tires) which are forced laterally by tire inflation pressure to wedge the tire firmly on the rim's tapered bead seat. The nylon plies tie into the bead bundles. The forces inherent in the tire are transmitted from the rim through the bead bundles into the nylon.
2. *Body plies* — Layers of rubber-cushioned nylon cord comprise the tire casing. Alternating plies of cord cross the tread centerline at an angle (bias). The term "ply rating" is an index of tire strength and not the actual number of tire plies.



Bias Ply Construction

3. *Breakers or tread plies* — These, if used, are confined to the tire's tread area and are intended to improve casing strength and provide additional protection to the body plies. Some "work" tires employ steel breakers or belts to further protect the casing.
4. *Sidewalls* — These are the protective rubber layers covering the body plies in the sidewall.
5. *Tread* — The wearing part of the tire that contacts the ground. It transmits the machine weight to the ground and provides traction and flotation.
6. *Inner liner* — This is the sealing medium that retains the air and, combined with the "O" ring seal and rim base, eliminates the need for inner tubes and flaps.
7. *Tubes and flaps (not shown)* — Required if the tire is not of tubeless construction with an inner liner.
8. *Undertread* — Protective rubber cushion lying between tread and body ply.

Radial Ply



Radial Ply Construction

1. *Beads* — A single bead bundle of steel cables or steel strip (spiraled like a clock spring) comprise the bead at each rim interface.
2. *Radial casing* — This consists of a single layer or ply of steel cables laid archwise (on the radian) bead to bead.
3. *Belts* — Several layers or plies of steel cable form the belts which underlie the tread area around the tire circumference. The cable in each belt crosses the tread centerline at an angle with the angle being reversed from the preceding belt.
4. *Sidewalls.*
5. *Tread.*
6. *Undertread* — Protective rubber cushion lying between tread and steel belts.

Bias and Radial Tire Advantages

	Bias	Radial
Tread Life		X
Heat Resistance		X
Cut Resistance — Tread		X
Cut Resistance — Side Wall	X	X
Traction		X
Flotation		X
Stability	X	
Fuel Economy		X
Repairability		X

TIRE TYPES

Off-the-road tires are classified by application in one of the following three categories:

1. *Transport tire* — For earthmoving machines that transport material such as trucks and wheel tractors.
2. *Work tire* — Normally applied to slow moving earthmoving machines such as graders and loaders.
3. *Load and carry* — Wheel loaders engaged in transporting as well as digging.

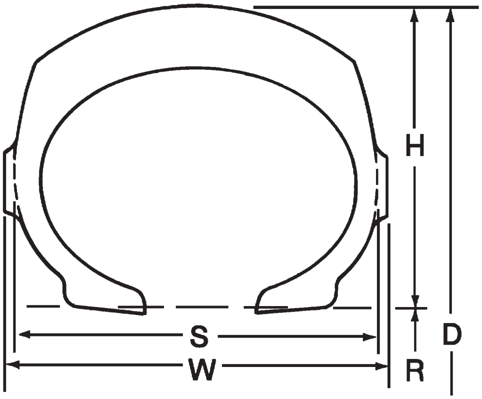
TIRE SIZE NOMENCLATURE

Tire size nomenclature is derived from the approximate cross section width and rim diameter typically in the format of Tire Width, Aspect Ratio, and Rim Diameter (example: 45/65-45). Available tire types include:

1. A wide base tire has a section height to section width ratio in the range of 0.83. As an example, a 29.5-25 tire has an approximate cross section width of 749 mm (29.5") (first number) and a rim diameter of 635 mm (25") (second number).
2. A conventional tire has a section height to section width ratio in the range of 0.96. As an example, a 24.00R35 tire has an approximate cross section width of 610 mm (24") (first number) and a rim diameter of 889 mm (35") (second number).
3. A low profile tire has a section height to section width ratio in the range of 0.65. As an example, a 45/65-45 tire has an approximate cross section width of 1143 mm (45") (first number), a 65% aspect ratio designated as 65 (second number), and a rim diameter of 1143 mm (45") (third number).

   If designated 45/65 R39, then the R denotes radial construction.

When comparing a wide base tire to a standard base tire, a larger first number on a wide base tire with the same rim diameter does not mean the wide base is larger in overall diameter. For example, the 18.00-25 conventional tire is larger in diameter than the 20.5-25 wide base tire. The 18.00-25 is comparable in overall diameter to the 23.5-25 wide base tire.



Tire cross-section

D = Tire Overall Diameter
R = Nominal Rim Diameter
H = Tire Section Height
S = Tire Section Width
W = Tire Width (includes ornamental ribs)
$\frac{H}{S}$ = Aspect Ratio

CODE IDENTIFICATION FOR OFF-HIGHWAY TIRES

The tire industry has adopted a code identification system to be used for off-the-road tires. This identification system will reduce the confusion caused by the trade names for each type of tire offered by each tire manufacturer. The industry code identification is divided into six main categories by types of service as follows:

C — Compactor Service
E — Earthmover Service
G — Grader Service
L — Loader and Dozer Service
LS — Log-Skidder Service
F — Industrial
R — Agricultural Tractor
I — Agricultural Implement

The sub-categories are designated by numerals, as follows:

Code Identification

		% Tread Depth
Compactor		
C-1	Smooth	100
C-2	Grooved	100
Earthmover		
E-1	Rib	100
E-2	Traction	100
E-3	Rock	100
E-4	Rock Deep Tread	150
E-7	Flotation	80
Grader		
G-1	Rib	100
G-2	Traction	100
G-3	Rock	100
G-4	Rock Deep Tread	150
Loader and Dozer		
L-2	Traction	100
L-3	Rock	100
L-4	Rock Deep Tread	150
L-5	Rock Extra Deep Tread	250
L-3S	Smooth	100
L-4S	Smooth Deep Tread	150
L-5S	Smooth Extra Deep Tread	250
L-5/L-5S	Half Tread Extra Deep	250
Log-Skidders		
LS-1	Regular Tread	100
LS-2	Intermediate Tread	125
LS-3	Deep Tread	150
HF-4	Extra Deep Tread	250
Industrial		
F-3	Traction Tread	
Agricultural Tractor		
R-1	Regular Tread	
R-3	Shallow Tread	
R-4	Industrial Tractor	
Agricultural Implement		
I-3	Tractor Tread	

For additional information about tire specifications, tread pattern, air pressure, TKPH, etc, please refer to the Manufacturer Website:

Michelin	MichelinEarthMover.com
Bridgestone	Bridgestone.com
Maxam	MaxamTire.com
Camso	Camso.co
Triange	TriangleTiresUS.com
Firestone	FirestoneTire.com
Titan	Titan-Intl.com
Continental	Continential-Tires.com
Yokohama	Y-Yokohama.com
Goodyear	GoodyearOTR.com

RADIAL TIRE IDENTIFICATION

Code Identification for Michelin Tires

All Michelin earthmover tires are radial construction, designated by the "X" marking. They contain a single steel radial ply with a series of steel belts placed around the tire's circumference which reinforce and stabilize the tread.

Following are the tread designs currently available from Michelin with the different internal constructions depending on the application.

Type A4 Particularly resistant to cuts, tread tearing and abrasion on very rough surfaces.

Type A Particularly resistant to cuts, tread tearing and abrasion at average speeds which are higher than those for A4 (above).

Type MB4 Compromise solution between abrasion resistance and average speed on rough surfaces (from 49 inches) with a higher wear resistance than the Type B4.

Type B4 Compromise solution between abrasion resistance and average speed on rough surfaces.

Type B Higher resistance to internal heat generation on surfaces which are not particularly rough.

Type MC4 Adapted to running on long cycles at high speeds on well-maintained roads with a higher wear resistance than the Type C4.

Type C4 Adapted to running on long cycles at high speeds on well-maintained roads.

Type C Very high resistance to high/average speeds on long cycles running on well-maintained roads.

Since Michelin radial tires contain a single steel casing ply, they utilize the industry method of designating radial tire strength in terms of "stars." Their system consists of a one star, two star, and three star rating as an indication of the tire's carrying capacity. The one star is the lightest construction, generally used on work and slow moving transport machines. Two star tires are used on most medium and high speed transport machines. Three star construction provides the greatest carrying capacity for a given size and is only available in small standard base tires.

This combination of tread designs and types of construction provides a range of radial tires which cover most earthmoving applications. We recommend that in applying steel radial tires to your machines you provide all site condition data to the tire manufacturer. Obtain their recommendations as to which tire will provide the most economical operation.

Code Identification for Goodyear Radial Tires

All Goodyear steel radial earthmover tires have been designated *Unisteel* followed by a three or four digit alpha-numeric code that identifies the particular tread. For example, for a RL-2+, RL stands for Rock Lug and indicates that the upper sidewall has rock protection. The number in the code corresponds to the tire industry identification system (2-traction, 3-rock, etc). The fourth digit, if any, is used to designate tread design differences for the same basic tread type.

Following are the radial tread designs currently available from Goodyear with the compound and construction types depending on the application.

Compound Description	Compound Code
High Heat Resistant	2
Heat Resistant	3
Standard Abrasion Resistant	4
Ultra Abrasion Resistant	6

Construction Description	Construction Code
Standard	S
Heavy Duty	H
Extra Heavy Duty	HW
Steel Breakers	J
Heavy Undertread	U
Low Angle Belts	SL

	Tread Compounds			
Tread Design	2S	4S	6S	Primary TRA Code(s)
AT-2A	X	X	X	E-3/L-3
GP-2B	X	X	X	E-3/G-3/L-3
GP-3D	X	X	X	E-3/L-3
GP-4B	X	X	X	E-4
GP-4B AT	X	X	X	E-4/G-4
GP-4C	X	X	X	E-4/G-4/L-4
GP-4D	X	X	X	E-4/L-4
RL-2+	X	X	X	E-3/G-3/L-3
RL-2F	X	X	X	E-2/G-2/L-2
RL-3+	X	X	X	E-3
RL-3A	X	X	X	E-3
RL-3J	X	X		E-3
RL-4	X	X	X	E-4
RL-4A	X	X	X	E-4
RL-4B	X	X	X	E-4
RL-4H	X	X	X	E-4
RL-4H II	X	X	X	E-4
RL-4J	X	X	X	E-4
RL-4J II	X	X	X	E-4
RL-4K		X	X	L-4
RL-4M+	X	X	X	E-4
RL-5K		X	X	L-5
RM-4A+	X	X	X	E-4
RM-4B+				
RT-3A+	X	X	X	E-3
RT-3B			X	L-3
RT-4A	X	X	X	E-4
RT-4A+	X	X	X	E-4
TL-3A+	X	X	X	E-3/L-3

A star rating system instead of the ply rating system indicates the casing strength of radial tires. These symbols indicate the recommended inflation for a particular tire load. Following the star rating code is Goodyear's Custom Compound and Construction code. For a tire designated "2S" the 2 indicates a heat resistant compound and the S indicates standard construction. The higher the number the greater the abrasion and cut resistance with a corresponding lower TKPH/TMPH rating.

Code Identification for Bridgestone Radial Tires

The Bridgestone steel radial earthmover has been designated as V-Steel. Following are the radial tread designs currently available from Bridgestone with the compound and construction types depending on the application.

Bridgestone Compound and Structure Codes

1A	Standard
2A	Cut-Resistant
2V	Special Cut Resistant (Steel Breaker)
2Z	Special Cut Resistant (Side Steel Breaker)
3A	Heat-Resistant
E	Earthmover
G	Grader
D	Loader and Dozer
S	Logging

Tread Design	Tread Name	Tread Compounds 1A	2A	2V	3A	Primary TRA Code(s)
VELS	V-Steel E-Lug S	X	X		X	E-4
VELSL	V-Steel E-Lug S				X	E-4
VFT	V-Steel F-Traction	X	X		X	E-2
VHS	V-Steel H-Service				X	E-2
VJT	V-Steel J-Traction		X			E-3/L-3
VKT	V-Steel K-Traction	X	X			E-2/G-2/L-2
VLT	V-Steel L-Traction	X	X		X	E-3/L-3
VLTS	V-Steel L-Traction S		X			E-4/L-4
VMT	V-Steel M-Traction	X	X		X	E-3/L-3
VMTP	V-Steel M-Traction Premium	X	X		X	E-4
VMTS	V-Steel M-Traction S	X	X		X	E-4/G-4
VRDP	V-Steel Rock Deep Premium	X	X		X	E-4
VREP	V-Steel Rock E-Premium	X	X		X	E-4
VRF	V-Steel Rock Fast	X			X	E-3
VRL	V-Steel R-Lug	X				E-3
VRLS	V-Steel R-Lug S	X	X		X	E-4
VRPS	V-Steel Rock Premium Service	X	X		X	E-4
VRQP	V-Steel Rock Quarry Premium		X			E-4
VSB	V-Steel S-Block		X			E-2
VSDL	V-Steel D-Lug		X			L-5
VSDT	V-Steel Super Deep Traction		X			L-5
VSMS	V-Steel Smooth Tread-MS		X	X		L-5S
VSNL	V-Steel N-Lug		X			L-4
VSNT	V-Steel N-Traction		X			E-4/L-4
VSW	V-Steel Snow Wedge		X			G-2/L-2
VTS	V-Steel Traction-Stability		X			L-3
VUT	V-Steel Ultra Traction		X			G-2/L-2
VZTP	V-Steel Z-Traction Premium	X	X		X	E-4
VZTS	V-Steel Z-Traction S	X	X		X	E-4

The casing strength, i.e., load carrying capacity of tire is indicated by star rating system; 1-star, 2-star and 3-star. Bridgestone's Off-the-Road tires are designed and produced to meet the commonly accepted international standards, those set by the TRA (Tire and Rim Association) in the U.S.A., by the ETRTO (European Tire and Rim Technical Organization) in Europe and/or by the JATMA (Japan Automobile Tire Manufacturers' Association) in Japan. Where differences exist between the TRA, ETRTO and JATMA standards, Bridgestone selects the most appropriate.

Code Identification for Eurotire Radial and Bias Tires

Eurotire manufactures a range of bias-ply and radial tires for use on mining equipment. Eurotire steel radial tires are designated with an "EU." The following are the radial tread designs currently available from Eurotire with the compound and construction types for a variety of applications.

Compound Description	Compound Code
Heat Resistant	H
Intermediate	S
Abrasion Resistant	A

Tread Design	Compound Code H	S	A	TRA Code(s)
EUROK	X	X	X	E4
EUTRAK	—	X	X	E3, E4, L4

Eurotire radial tires are marked with a star rating system to indicate casing strength. Eurotire manufactures 2 star radial tires.

It is important to understand the specific usage and operating conditions of your job site so that the most appropriate tire choice can be determined. Eurotire representatives can help you make the most informed decision regarding tire choice, including weighing the benefits of radial vs. bias, selecting between different tread designs and compounds and providing service solutions to best suit your specific needs.

TON-KILOMETER PER HOUR (TKPH)

Tire selection and machine operating practices have, in some cases, become the critical factors in the over-all success of earthmoving ventures. One of the most serious problems occur when tires are operated at temperatures above their capabilities. Separation and related failures occur. To help you avoid temperature related failures, Caterpillar has been instrumental in developing the *Ton-Kilometer Per Hour* (TKPH), also known as *Ton-Mile Per Hour* (TMPH), method of rating tires. The formula to convert a TKPH rating to a TMPH rating is:

$$\text{TMPH} = \text{TKPH} \times 0.685$$

Heat and Tire Failure

Tire manufacturing requires heat in the vulcanizing process converting crude rubber and additives into a homogeneous compound. The heat required is typically above 132° C (270° F).

A tire also generates heat as it rolls and flexes. Heat generated faster than it can be radiated into the atmosphere gradually builds within the tire and reaches maximum level at the outermost ply or belt.

Over time, enough heat can develop from overflexing to actually reverse the vulcanizing process or "revert" the rubber causing ply separation and tire failure. Only a brief time at reversion temperature initiates the failure. Experience shows that few pure heat separation cases occur. Most so-called heat separations are in tires operating below the reversion level.

As a tire's operating temperature increases the rubber and textiles within significantly lose strength. The tire becomes more susceptible to failures from cornering, braking, impact, cut through, fatigue and heat separation. If operating tires at higher temperatures is absolutely necessary, it is essential the machines be operated to reduce the probability of premature tire failure. No hard cornering without superelevation, no panic braking, etc.

The TKPH formula was developed to predict tire temperature buildup. The system is a method of rating tires in proportion to the amount of work they can do from a temperature standpoint. It utilizes the product of *load* × *speed* to derive an index of the tire temperature buildup. Even at or below a tire's TKPH, failures may be initiated by overstressing the tires.

It is possible by using a needle type pyrometer to measure temperature at any desired point within the tire casing. However, the instrumentation and the technique does not lend itself to general field use. The greatest difficulty is locating the thickest (therefore the hottest) tread bar in any given tire using giant calipers. The tire must then be drilled along the centerline of this bar from shoulder to shoulder at 52 mm (2") intervals. These 3.18 mm (1/8") diameter holes extend down through the tread and undertread to the topmost reinforcement. This procedure is fully described under SAE Recommended practice J1015.

The TKPH rating system as given in this SAE specification is approved by most tire manufacturers. Michelin, in addition to providing TKPH ratings has developed their own speed/load carrying rating system and we recommend that Michelin be consulted where high tire temperatures are a concern.

Heat generation in a specific tire at recommended pressure depends on three factors:

- the weight the tire is carrying (flex per revolution),
- the speed the tire is traveling over the ground (flexures over a period of time), and
- the air temperature surrounding the tire (ambient temperature) and road surface temperature.

Once a tire manufacturer has determined a tire's temperature characteristics and expressed them in TKPH, the above listed specific job conditions can be used to determine any tire's maximum work capacity. These conditions provide on site ability to predict and avoid costly tire separations.

Ton-Kilometer-Per-Hour Rating System

The tire TKPH can be matched to the site TKPH as well as compared with TKPH values of different makes and types of tires.

TKPH Job Rate

Average Tire Load × Average Speed for the shift

Average Tire Load

$$\frac{\text{“Empty” tire load + “loaded” tire load}}{2}$$

Average Speed

$$\frac{\text{Round trip distance in kilometers} \times \text{number of trips}}{\text{Total Hours (in the shift)}}$$

For excessive haul length (32 kilometers or more) consult your tire representative for modification to the TKPH value.

To use in the United States Customary System, change kilometers to miles and use short tons.

It should be noted that prolonged operation at high casing temperatures can fatigue the nylon at the flex points in the sidewalls.

The following are the most recent TKPH ratings as made available by Goodyear, Michelin and Bridgestone, and are subject to change on their part at any time. Other tire manufacturers' TKPH ratings will be included in future handbook editions when and if made available. For latest TKPH ratings, consult specific tire manufacturer at time of machine and/or tire purchase.

Load-and-Carry TKPH

The wheel loader, when used in load-and-carry applications, may encounter temperature problems similar to those normally associated only with tires on scrapers, trucks and wagons. **Do not place the vehicle in load-and-carry applications without first consulting the tire manufacturer, or obtaining maximum load and speed ratings and pressure recommendations from the tire manufacturer.**

Conventional and Radial Steel Cord Tire Options

Tire options now provide types to operate in conditions ranging from rock and abrasive materials, to jobs with high speed hauls in good materials.

The best tire type can be different for the drive tires than for other tires on the same machine. TKPH should be calculated for all tires.

TIRE DRIVE-AWAY RECOMMENDATIONS

Heat separation can be a problem during machine delivery and moving machines from one job to another. Whenever roading earthmoving machines, *check your supplier for the tire manufacturer's recommended speed limitations on the specific tires involved.*

Some tire manufacturers also recommend that vehicles equipped with extra tread depth or special compounded tires should not be roaded without their specific approval. Our tests support this recommendation, especially for L-3, L-4, E-4 and L-5 tires.

Because of the variance between specific tires it is recommended that at the time of purchase you check with your tire supplier for the manufacturer's specific TKPH ratings for the tires purchased.

TIRE AND RIM ASSOCIATION RATINGS

While the TKPH Rating System provides a method to determine the tire's work capacity, Tire and Rim Association Ratings provide a guide for evaluating a tire's structural capacity. These two rating systems should be used in conjunction to evaluate tire performance.

TIRE SELECTION

Selecting the optimum tire for a given application is particularly critical for earthmoving. The machines have the capability to outperform the tires and, unless proper practices are observed, very costly premature tire failures can occur. Job conditions vary greatly throughout the world, as well as within any given job site, and selecting the optimum tire requires careful consideration of all factors involved. In general, the tire manufacturer should be consulted before making the selection for any given application. In some cases, the tire manufacturer can fabricate tires specifically tailored for a given job site.

For those applications where wear is extremely slow, especially as a result of only occasional operation throughout the year, the cheapest lightweight tire needs to be given strong consideration.

As job conditions become severe, the following factors should be evaluated in selecting a tire:

Transport or Load-and-carry —

- TKPH (primary consideration)
- Minimum approved star/ply rating or greater
- Largest optional size
- Thickest tread commensurate with TKPH
- Most cut resistant tread commensurate with TKPH
- Belted construction

Grader —

- Tire load rating suitable for maximum equipped machine weight (See Tire Load Worksheet on next page)
- Application specific tire (snow, construction, road maintenance, mining, general purpose, all season)
- Bias or radial based on initial cost, puncture resistance, rolling resistance, life to retread/repair

Loader or Dozer —

- Minimum approved ply rating or greater
- Largest optional size
- Thickest tread
- Thickest available undertread
- Buttressed shoulder
- Most cut resistant tread
- Belted construction
- Lowest aspect ratio

All tires should be operated at the tire manufacturer's recommended inflation pressure for a given application. Inflation pressure should be checked every working day with an accurate gauge. This gauge should be checked against a known standard such as a dead weight tester at least once a month.

Excess loads may result from factors such as varying material density, field modifications to equipment, mud accumulation, load transfer, etc. Only under these conditions may the actual in service tire load exceed the rated machine load. When excess loads are encountered, cold inflation pressures **must** be increased to compensate for higher loads. Increase tire inflation pressure 2% for each 1% increase in load.

	Maximum Excess Load	Pressure
Bias Ply	15%	30%
Radial Ply	7%	14%

The above loads will result in reduced tire performance and must be approved by the tire manufacturer.

The use of chains is difficult to justify except under a few conditions. Chains are very costly and heavy, and require more maintenance than most operations can provide. On some models sufficient clearance does not exist for chains with all tire combinations. Extensive modifications may be required if chains are needed for the job.

Foam filling tires is normally not recommended due to high cost and lack of local filling facilities. Its use should be confined to loader and dozer applications where penetrations occur almost daily. If foam is used be sure to adhere to recommended equivalent pressures of nitrogen and use highest available ply rating. Consult tire manufacturer for specific warranty concerns.

TIRE SELECTION GUIDE

Material	Road or Ground Condition	Treads: Haul Trucks and Wheel Tractor-Scrapers	Treads: Wheel Tractors or Wheel Loaders	Treads: Graders*
Silt and clay: – No rock – High moisture content	– Good varying to poor – High rolling resistance	E-2 (Traction)	L-2 (Traction)	G-2 (Traction)
Silt and clay: – Some rock – Variable moisture content	– Good varying to poor	E-3 (Rock) E-2 (Traction)	L-3/L-4/L-5 (Rock) L-2 (Traction)	G-3/G-4 (Rock) G-2 (Traction)
Silt/clay/gravel/sand: – Low moisture content	– Excellent to good – Firm surface	E-3/E-4 (Rock)	L-3/L-4/L-5 (Rock)	G-3/G-4 (Rock) L-3/L-4/L-5 (Rock)
Silt/clay/gravel/sand: – High moisture content	– Poor – Rutted – Pot holes	E-3/E-4 (Rock)	L-3/L-4/L-5 (Rock)	G-3/G-4 (Rock) L-3/L-4/L-5 (Rock)
Blasted rock	Hard surface, rough	E-4 (Rock)	L-5 (Rock) L-5S (Smooth)	G4 (Rock) L-4/L-5 (Rock)
Sand: – Very low silt/clay content	Good to fair surface	E-3 (Rock) E-7 (Flotation)	L-3 (Rock) L-3S (Smooth)	G-3 (Rock) Low pressure

*NOTE: In some cases, an L type tire is appropriate for use on a Grader application, consult your tire supplier for proper tire selection.

Optimal pressures may vary depending on specific applications and working conditions. Always consult your local tire supplier for operating pressures.

	BIAS PLY TIRES						RADIAL PLY TIRES					
Tire Size	Weight Increase Per Tire		Mixing Proportions CaCl		Water		Weight Increase Per Tire		Mixing Proportions CaCl		Water	
	kg	lb	kg	lb	L	gal	kg	lb	kg	lb	L	gal
13.00 × 24TG	188	**414**	55	**122**	132	**35**	185	**407**	57	**125**	128	**34**
14.00 × 24TG	215	**475**	63	**140**	151	**40**	256	**565**	79	**173**	179	**47**
15.5 × 25	192	**423**	56	**125**	136	**36**	224	**493**	69	**151**	155	**41**
16.00 × 24TG	333	**735**	98	**217**	234	**62**	355	**783**	109	**240**	246	**65**
17.5 × 25	262	**577**	77	**170**	185	**49**	311	**686**	95	**210**	216	**57**
18.00 × 25	454	**1002**	134	**296**	322	**85**	502	**1107**	154	**340**	348	**92**
18.4 × 34	417	**919**	123	**272**	295	**78**	—	—	—	—	—	—
20.5 × 25	405	**892**	119	**263**	284	**75**	448	**987**	137	**303**	310	**82**
23.1 × 26	522	**1151**	154	**340**	367	**97**	—	—	—	—	—	—
23.5 × 25	585	**1291**	173	**382**	412	**109**	633	**1396**	194	**428**	439	**116**
24.5 × 32	703	**1549**	207	**458**	496	**131**	—	—	—	—	—	—
26.5 × 25	758	**1671**	224	**494**	533	**141**	841	**1853**	258	**568**	583	**154**
26.5 × 29	752	**1658**	222	**490**	530	**140**	928	**2045**	284	**627**	644	**170**
28L × 26	709	**1563**	209	**462**	500	**132**	—	—	—	—	—	—
29.5 × 25	970	**2139**	286	**632**	685	**181**	1073	**2368**	328	**723**	745	**197**
29.5 × 29	1050	**2315**	310	**684**	738	**195**	1190	**2623**	365	**804**	825	**218**
875/65 × 29	—	—	—	—	—	—	1445	**3186**	429	**946**	1016	**268**
29.5 × 35	1159	**2556**	344	**758**	821	**217**	1286	**2835**	394	**869**	892	**236**
30.5L × 32	874	**1928**	258	**570**	617	**163**	—	—	—	—	—	—
33.25 × 35	1485	**3275**	439	**968**	1048	**277**	1592	**3508**	487	**1074**	1105	**292**
37.25 × 35	1712	**3775**	505	**1115**	1211	**320**	2128	**4692**	653	**1439**	1476	**390**
38 × 39	1870	**4123**	552	**1218**	1317	**348**	—	—	—	—	—	—
35/65 × 33	1339	**2953**	396	**873**	942	**249**	1430	**3152**	438	**967**	992	**262**
40/65 × 39	2077	**4580**	614	**1353**	1465	**387**	2194	**4836**	673	**1483**	1522	**402**
41.25/70 × 39	1897	**4183**	561	**1236**	1336	**353**	—	—	—	—	—	—
45/65 × 45	2548	**5617**	753	**1659**	1794	**474**	—	—	—	—	—	—

NOTE: Ballast weight for bias ply tires from Goodyear data, radial ply weights from Michelin data. Contact your tire supplier for additional information. Under abnormal tire wear conditions, ballasting of rear tires may be desirable. Ballasting of front tires also should only be done where extremely rapid tire wear rates are encountered. Excessive weight will reduce machine performance.

NOTE: Fillage beyond 75% of tire enclosed volume is not recommended. With liquid ballasting, inflation pressure must be checked at least once per day.

NOTE: 1.6 kg **(3½ lb)** Calcium Chloride per gallon water. Solution weighs 4.6 kg **(10.15 lb)** per gallon.

NOTE: Total machine mass including all attachments in operating condition, all reservoirs at full capacity and ballasted tires must not exceed certification mass listed on the ROPS certification label.

NOTE: Special air to water valves are required for liquid filled tires.

Consult the tire manufacturer before adding Ballast to any tire.

SEBD0351-50