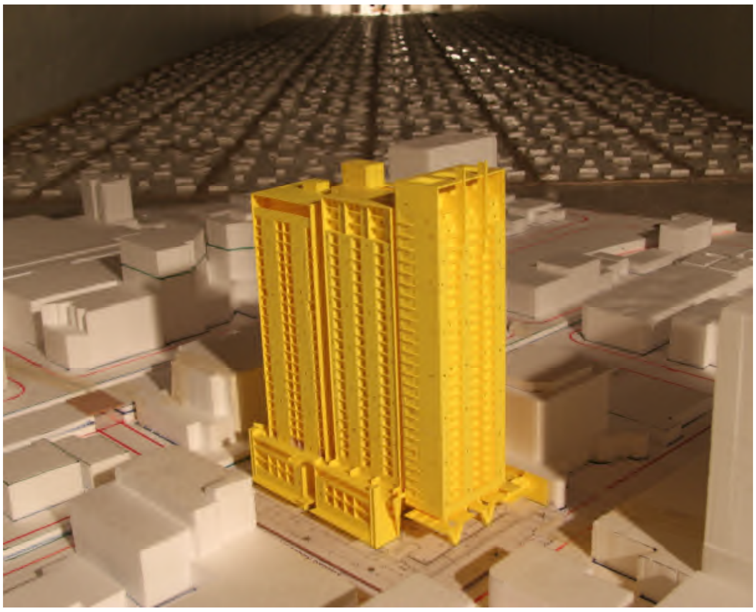


V BY CROWN, PARRAMATTA

NATURAL VENTILATION STUDY

WA714-13F03(REV0)- NV REPORT

10 JULY 2014

Prepared for:

Crown International Holdings Group

Level 11, 68 Alfred Street

Milsons Point NSW 2061

Attention: Mr Michael Esber

Sydney (Head Office) · **Melbourne** · **Singapore** · **Abu Dhabi** · **Mumbai** · **Shanghai**

19 Willis Street WOLLI CREEK NSW 2205 P: +61 2 9567 0722 F: +61 2 9567 0733

Windtech Consultants Pty Ltd ABN: 72 050 574 037 reception@windtech.com.au www.windtech.com.au

DOCUMENT CONTROL

Date	Revision History	Non-Issued Revision	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
10/07/2014	Initial	-	0	TH	TR	TH

The work presented in this document was carried out in accordance with the Windtech Consultants Quality Assurance System, which is based on International Standard ISO 9001.

This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for our Client's particular requirements which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Windtech Consultants Pty Ltd. This report should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

The information contained herein is for the purpose of wind-induced structural loads and building motion effects only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the scope of this report.

EXECUTIVE SUMMARY

This report presents the results from the detailed investigation into the natural ventilation performance of the residential apartments for the proposed development known as V by Crown, located at 45 Macquarie Street, Parramatta.

Testing was performed using Windtech's boundary layer wind tunnel facility, which has a 2.6m wide working section and has a fetch length of 14m. Measurements were carried out using a 1:300 scale model of the development. The study model has been constructed based on architectural drawings prepared the project architect Allen Jack+Cottier, received June 2011. The proximity model extends to a radius of approximately 375m from the centre of the subject site and includes all of the significant surrounding buildings and topographical effects.

The study model was fitted with a total of 414 individual pressure sensors spread across the entire external façade of the development which represent the opening locations to the residential units and central atrium of the building. A total of 332 different internal flow paths have been considered for the residential apartments in this study. Pressure coefficient measurements are made in the wind tunnel for 36 wind directions, at 10 degree increments for this study. The reference wind climate data used in this study is based on an analysis of 70 years of recorded mean wind speed data obtained at the meteorological recording station located within Kingsford Smith Airport in Sydney, from 1939 to 2008.

For this development, the Australian Standard, Ventilation Design for Indoor Air Contaminant Control, AS1668.2-2002 requires a minimum of 2 air changes per hours (ACH) for air quality due to occupant and material related contaminants. As there are no deemed-to-comply apartments as stipulated in the Residential Flat Design Code, SEPP65, the benchmark used was the airflow velocity through the main living space opening to achieve a directionally weighted average velocity of 0.4m/s, which is sufficient to provide thermal cooling effects. Consideration has also been made for the internal apartment layout; including internal openings, on the natural ventilation performance of each unit to ensure the main living areas achieve adequate natural ventilation.

The results of the study show that 63.6% (375 out of 590) of the apartments will satisfy the requirements for natural ventilation. SEPP65 suggests that for a development to be considered naturally ventilated, 60% of the units of the entire development need to satisfy the requirements for natural ventilation. Therefore, based on the current design of the subject development, the requirements for natural ventilation will be satisfied.

CONTENTS

Executive Summary iii

1 Wind Climate for the Sydney Region 1

2 Model Setup 3

2.1 Wind Model 3

2.2 Study Model 8

3 Test Procedure 11

4 Designing for Natural Ventilation 13

4.1 Natural Ventilation Guidelines 13

4.2 Types of Natural Ventilation Openings 15

4.3 External Openings 15

4.4 Internal Openings 15

4.5 Roof Ventilators and Skylights 16

4.6 Stacks 16

5 Method of Analysis 17

5.1 Measurement of Pressure Coefficients in the Wind Tunnel 17

5.2 Natural Ventilation Driving Mechanisms 17

5.2.1 Wind Driven Ventilation 18

5.2.1.1 Openings in Series 19

5.2.1.2 Openings in Parallel 19

5.2.2 Thermal Effects 19

6 Criteria for Acceptance 21

6.1 Air Changes per Hour (ACH) 21

6.2 Air-Speed 22

6.3 National Construction Code (NCC) 23

6.4 State Environmental Planning Policy (SEPP65) 23

7 Results and Discussion 24

7.1 Natural Ventilation Performance 24

8 Conclusion 40

References 41

APPENDIX A - Plots of Wind Tunnel Test Results

APPENDIX B - Layout of Pressure Sensors

APPENDIX C - Apartment Opening Locations and Layout

APPENDIX D - Apartment Opening Parameters

APPENDIX E - Wind Tunnel Profiles for the Velocity and Turbulence Intensity

1 WIND CLIMATE FOR THE SYDNEY REGION

The wind climate data used in this study is based on an analysis of 70 years of recorded 10-minute mean wind speeds obtained at the meteorological recording station located at Kingsford Smith Airport in Sydney, from 1939 to 2008. A plot of the wind speed observation data is presented in Figure 1 below, referenced to a height of 10m above ground in open terrain and converted to hourly means. This data is also presented in Table 1, which also presents the corresponding daily average hourly mean wind speeds. The frequency of occurrence of the regional winds is also shown in Figure 1 for each wind direction. The recurrence intervals examined in this study are for the daily average winds.

The data indicates that the maximum wind speeds for the region are governed by southerly, north-easterly and westerly winds. These wind directions also correspond to the directions of the most frequent winds for the region.

Table 1: Regional Directional Wind Speeds for the Sydney Region (daily average hourly mean wind speeds and percentage of observations of wind direction, referenced to 10m height in open terrain)

Wind Direction	Percentage of Observation of Wind Direction (%)	Daily Average Hourly Mean Wind Speed V_{ref} (m/s)
N	6.5	4.2
NNE	7.2	6.1
NE	7.1	5.5
ENE	3.8	4.9
E	4.5	4.3
ESE	3.3	4.4
SE	5.0	4.7
SSE	7.0	5.4
S	13.8	6.4
SSW	5.0	6.3
SW	3.3	5.2
WSW	4.9	5.8
W	8.9	5.6
WNW	6.4	4.6
NW	7.8	3.8
NNW	5.4	3.9

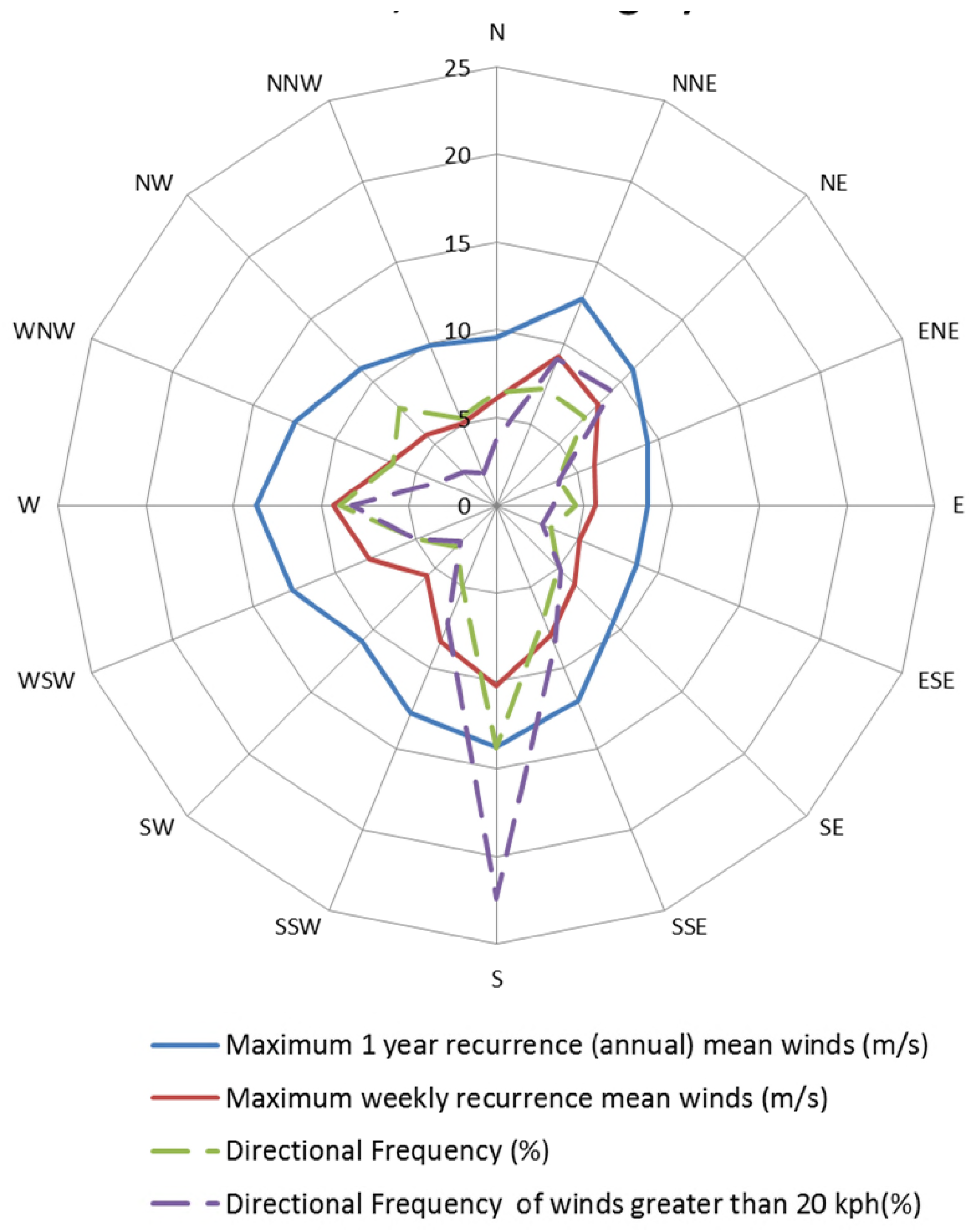


Figure 1: Annual and Weekly Maximum Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (referenced to open terrain at 10m)

2 MODEL SETUP

2.1 Wind Model

Testing was performed using Windtech's boundary layer wind tunnel, which has a 2.6m wide working section and has a fetch length of 14m. The model was placed in the appropriate boundary layer wind flow for each of the prevailing wind directions for the wind tunnel testing. The type of wind flow used in a wind tunnel study is determined by a detailed analysis of the surrounding terrain types around the subject site.

The roughness of the earth's surface has the effect of slowing down the prevailing wind near the ground. This effect is observed up to what is known as the boundary layer height, which can range between 500m to 3km above the earth surface depending on the roughness of the surface (ie: oceans, open farmland, dense urban cities, etc). Within this range, the prevailing wind forms what is known as a *boundary layer wind profile*.

Various wind codes and standards classify various types of boundary layer wind flows depending on the surface roughness. However, it should be noted that the wind profile does not change instantly due to changes in the terrain roughness. It can take many kilometres (at least 100km) of a constant surface roughness for the boundary layer profile to achieve a state of equilibrium. However, for regions governed by thunderstorm winds, the strong winds are far more localised, and in these situations it is only relevant to analyse the nearby surrounding terrain types.

Description of the standard boundary layer wind profiles for various terrain types are summarised as follows:

- **Terrain Category 1.0**: Extremely flat terrain. Examples include inland water bodies such as lakes, dams, rivers, etc.
- **Terrain Category 1.5**: Relatively flat terrain. Examples include oceans and desert.
- **Terrain Category 2.0**: Open terrain. Examples include grassy fields and plains and open farmland (without buildings or trees)
- **Terrain Category 2.5**: Relatively open terrain. Examples include farmland with scattered trees and buildings and very low-density suburban areas.
- **Terrain Category 3.0**: Suburban and forest terrain. Examples include suburban areas of towns and areas with dense vegetation such as forests, bushland, etc.
- **Terrain Category 3.5**: Relatively dense suburban terrain. Examples include centres of small cities, industrial parks, etc.

- **Terrain Category 4.0**: Dense urban terrain. Examples include centres of large cities with many high-rise towers, and also areas with many closely-spaced mid-rise buildings.

For this study, the shape of the boundary layer wind flows over standard terrain types is defined as per ISO4354:2009. These are summarised in Table 1, referenced to the study reference height of 53.6m above ground. An analysis of the effect of changes in the upwind terrain roughness was carried out for each of the wind directions studied. This has been undertaken based on the method given in ESDU-82026:2002 and ESDU-83045:2002 over a fetch length of 50km, which is appropriate for regions where the extreme winds are governed by typhoons. An aerial image showing the surrounding terrain is presented in Figures 2a and 2b for a radius of 5km and 50km respectively (measured from the edge of the wind tunnel proximity model, which is centred on the development site and represents an area with a radius of 375m).

For each of the 36 wind directions tested in this study, the approaching boundary layer wind profiles modelled in the wind tunnel matched the model scale and the overall surrounding terrain characteristics beyond the 375m radius of the proximity model.

Table 2: Terrain and Height Multipliers and Turbulence Intensities, and the Corresponding Roughness Lengths, for the Standard ISO4354:2009 Boundary Layer Profiles

Terrain Category	Terrain and Height Multipliers (at 102.2m above ground)			Turbulence Intensity	Roughness Length (m)
	$k_{tr,T=3600s}$ *(hourly)*	$k_{tr,T=600s}$ *(10-minute)*	$k_{tr,T=3s}$ *(3-second)*	$I_{v,102.2m}$	$z_{0,r}$
1.0	1.04	1.06	1.33	0.095	0.003
1.5	0.99	1.02	1.31	0.111	0.01
2.0	0.93	0.97	1.29	0.128	0.03
2.5	0.86	0.90	1.26	0.153	0.1
3.0	0.79	0.83	1.23	0.184	0.3
3.5	0.69	0.74	1.18	0.232	1
4.0	0.59	0.64	1.12	0.302	3

The hourly mean wind speed and turbulence profiles, as well as the normalised power spectral density function, that were modelled in the wind tunnel match the full-scale equivalent values for the terrains being modelled for each wind direction tested, as indicated in Appendix E.

The reference wind speeds were corrected for changes in the upstream land topography and referenced to the tower reference height for each wind direction tested. These are presented in

Table 3 below. Note that the reference height of the tower used for this study is 102.2m above ground.

Table 3: Mean Reference Wind Speeds at the Site (at 102.2m)

Wind Direction (degrees)	Mean Terrain and Height Factors at 102.2m $k_{tr,T=3600s}$	Percentage of Observations (%)	Mean Wind Speeds at the Site, Referenced to 102.2m (m/s) $\overline{V}_{daily@102.2m}$
N	0.79	6.5	5.1
NNE	0.81	7.2	7.6
NE	0.82	7.1	6.9
ENE	0.82	3.8	6.1
E	0.81	4.5	5.4
ESE	0.83	3.3	5.6
SE	0.84	5.0	6.0
SSE	0.83	7.0	6.9
S	0.82	13.8	8.0
SSW	0.81	5.0	7.8
SW	0.81	3.3	6.4
WSW	0.81	4.9	7.3
W	0.82	8.9	7.0
WNW	0.79	6.4	5.6
NW	0.79	7.8	4.6
NNW	0.79	5.4	4.7

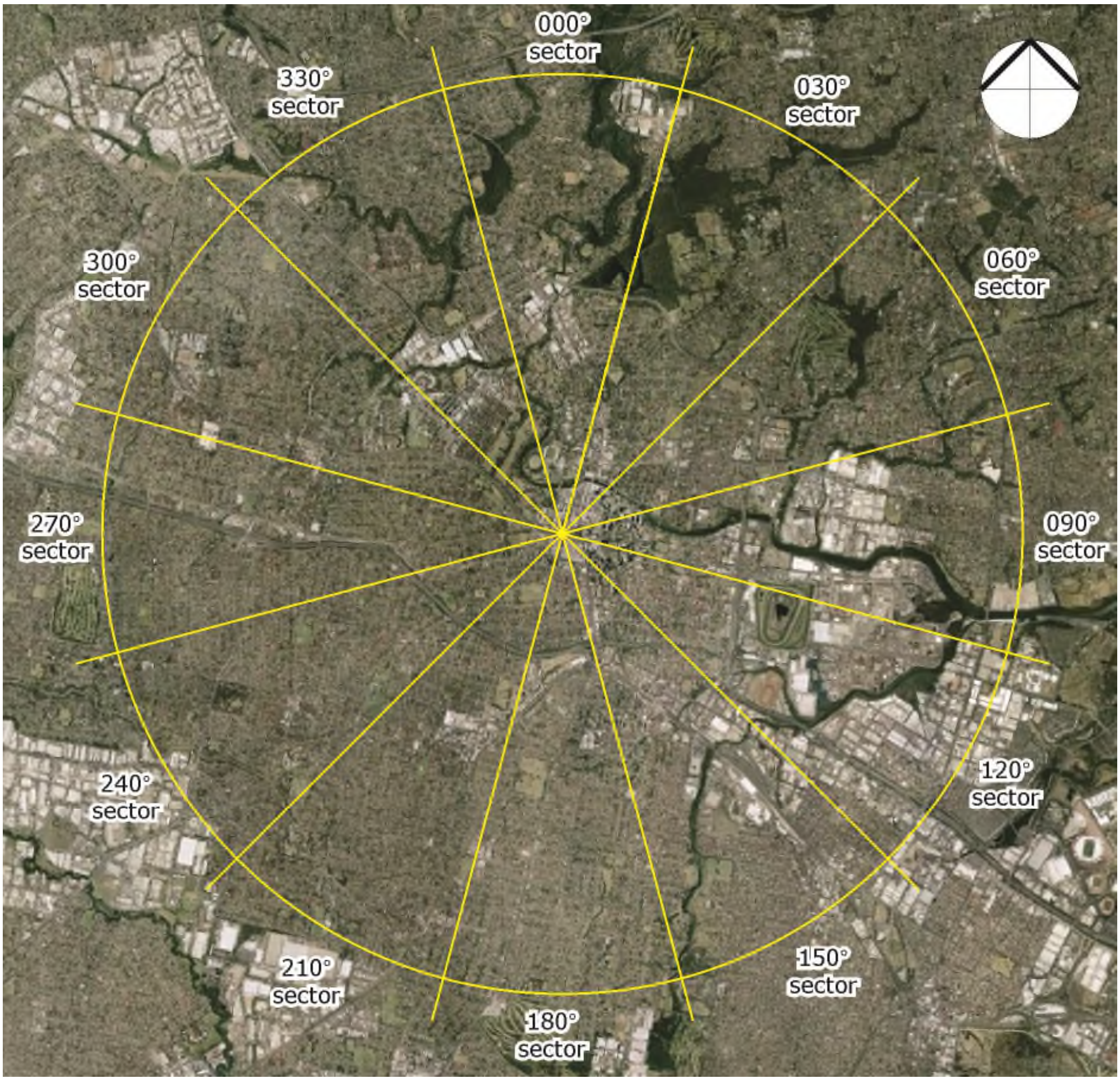


Figure 2a: Aerial Image showing the Surrounding Terrain
(radius of 5km from the edge of the proximity model, which is coloured red)

Figure 2b: Aerial Image showing the Surrounding Terrain (within a radius of 50km from the edge of the proximity model)

2.2 Study Model

Wind tunnel testing was carried out using a 1:300 scale model of the proposed development. The study model incorporates all of the necessary architectural features on the facades to ensure an accurate wind model is achieved in the wind tunnel. The model was constructed using a Computer Aided Manufacturing (CAM) process to ensure a high level of detail and accuracy were achieved in the study model. The effect of nearby buildings and land topography has been accounted for through the use of a proximity model, which represents a radius of approximately 375m from the development site. Photographs of the model used for the wind tunnel testing of this project are presented in Figures 3a to 3e on the following pages.

The study model was fitted with a total of individual 414 pressure sensors spread across the entire external façade of the development measuring the pressure coefficients at each of the opening locations to the residential units and central atrium of the building. The layout of pressure sensors used on the model is shown in Appendix B of this report in the form of marked-up elevation and plan drawings. The opening locations used to determine the internal air flow for the natural ventilation study are presented in Appendix C. A total of 332 different internal flow path pairings have been considered for the residential units of the building for this study.

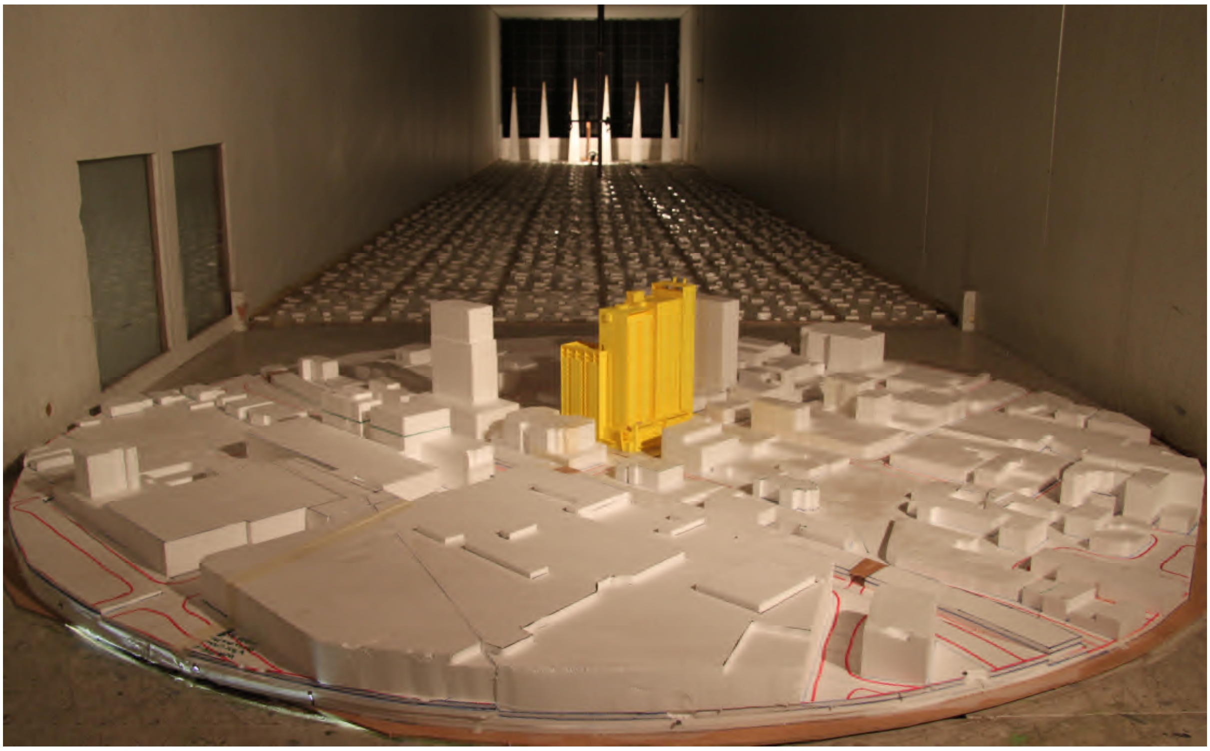


Figure 3a: Photograph of the Wind Tunnel Model (view from the south-east)

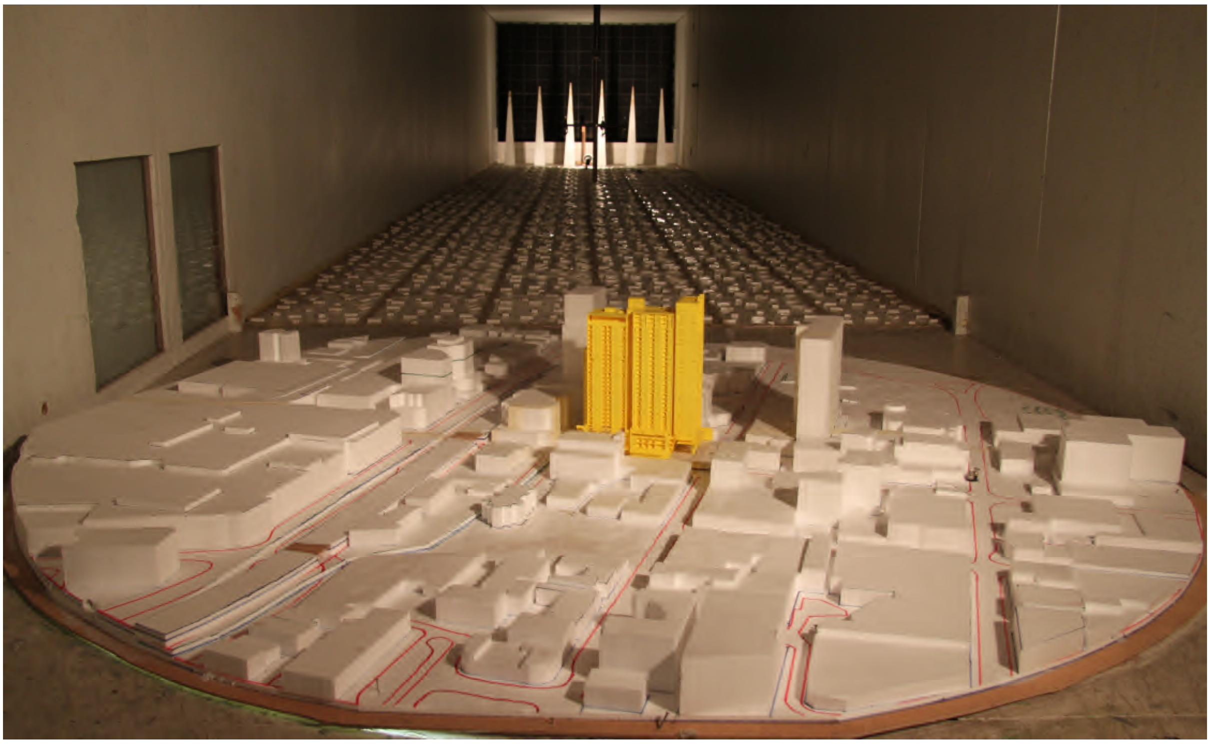


Figure 3b: Photograph of the Wind Tunnel Model (view from the east)

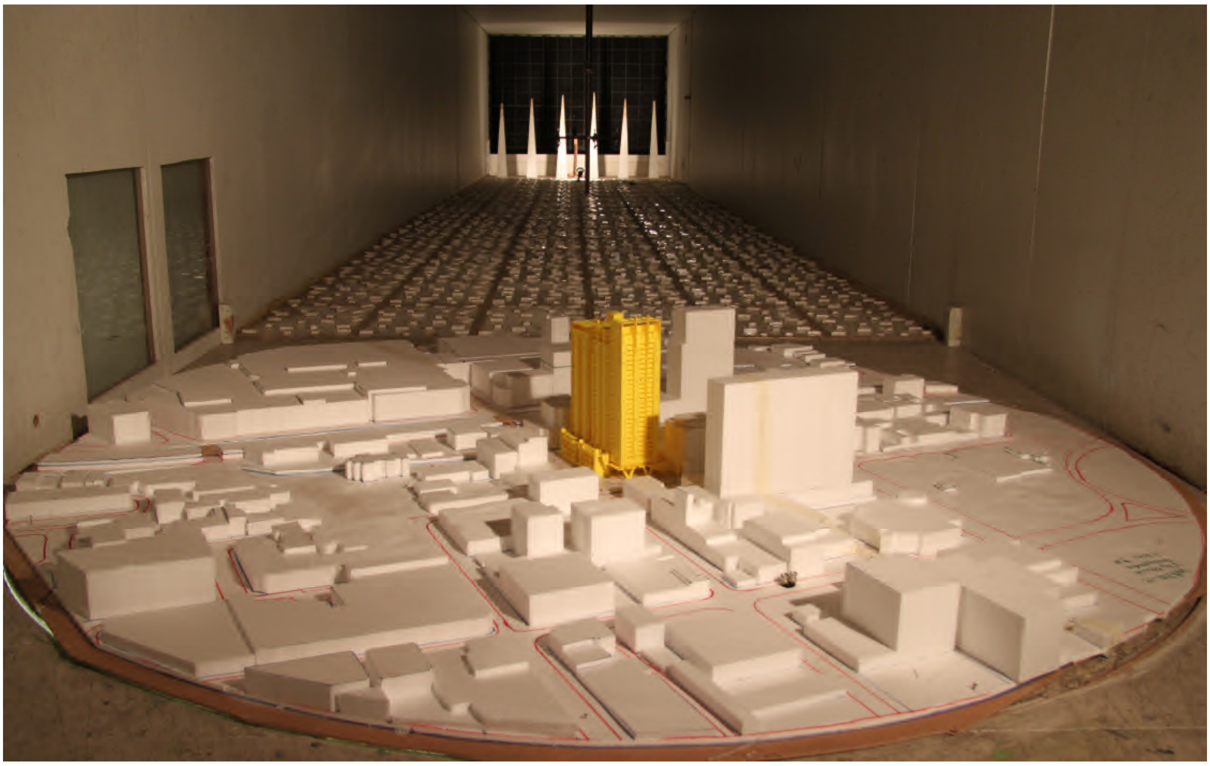


Figure 3c: Photograph of the Wind Tunnel Model (view from the north-east)

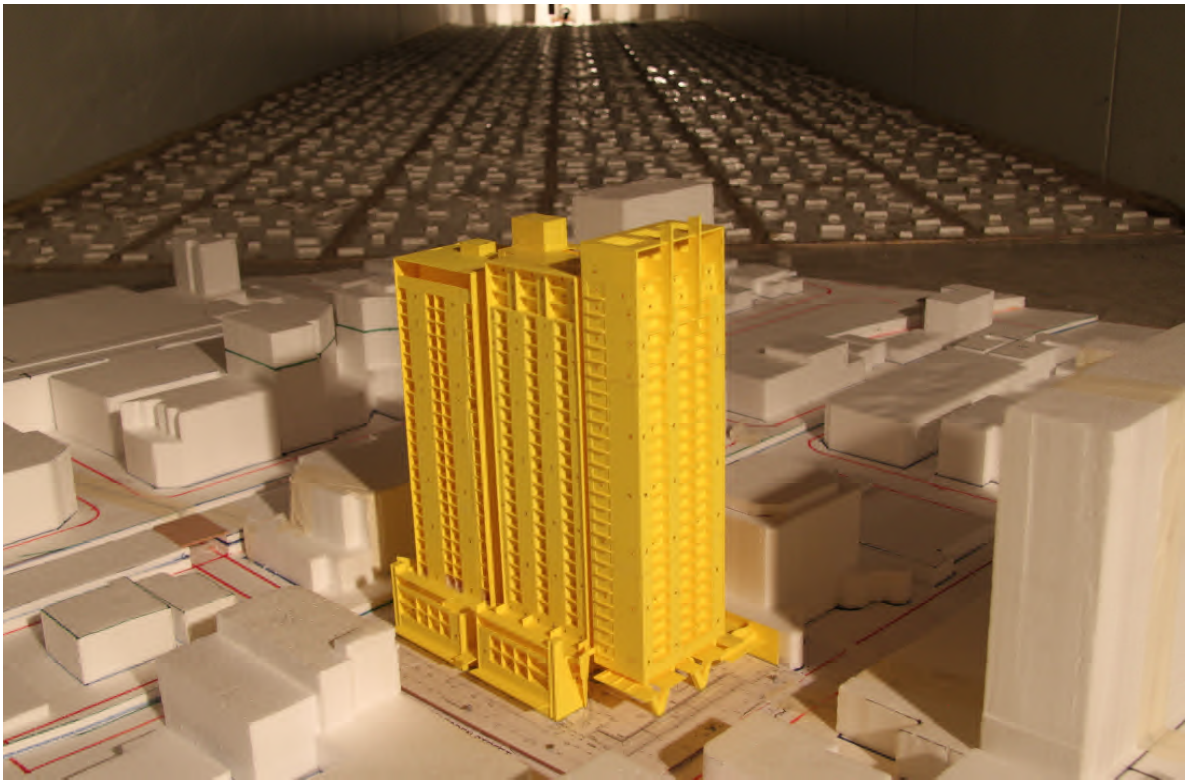


Figure 3d: Photograph of the Wind Tunnel Model (close-up view from the north-east)

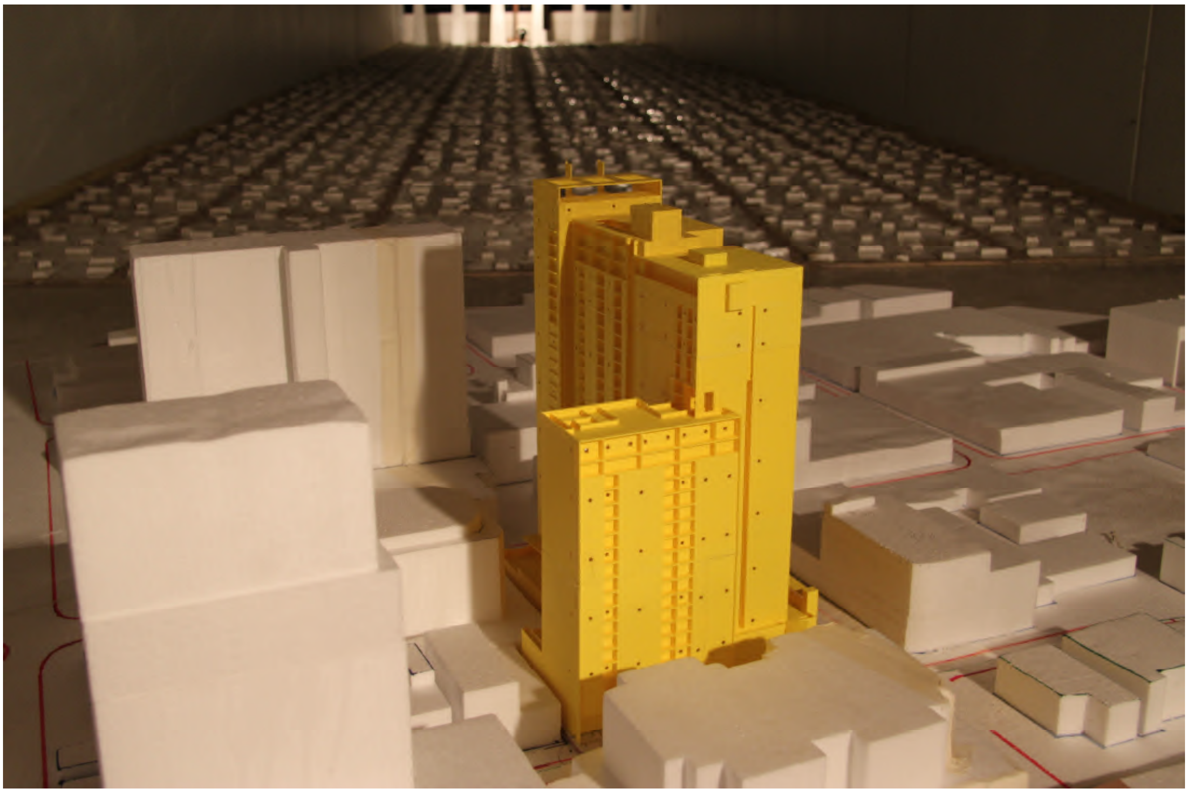


Figure 3e: Photograph of the Wind Tunnel Model (close-up view from the south-west)

3 TEST PROCEDURE

The test procedures followed for the wind tunnel tests performed for this study generally adhere to the guidelines set out in the Australasian Wind Engineering Society Quality Assurance Manual (AWES-QAM-1-2001) and ASCE-7-10 (Chapter C31). The testing was performed in Windtech's blockage tolerant boundary layer wind tunnel facility. The good agreement between Windtech's wind tunnel cladding pressure results and full-scale data from the Texas Tech Experimental Building provides some indication of the accuracy of Windtech's wind tunnel results (Rofail, 1995). Due to the effective design of Windtech's blockage tolerant wind tunnel facility, no corrections for blockage generated by the model were required for this study.

The reference pressure was measured 3m upstream of the study building, at a height of 1.5m in the wind tunnel. This is to ensure that the pitot-static probe, the instrument used to measure the static and total pressure during testing, is located in a low turbulence region of the approaching boundary layer wind profile in the wind tunnel. This height also avoids any interference with the wind flow onto the model. The mean velocity measured at this reference position was measured to be approximately 15.1m/s. A sample time of 32 seconds (model scale time) was used which corresponds to a minimum full-scale sample time of at least 63 minutes, which is suitable for this type of study.

The pressure coefficients measured in the wind tunnel require an adjustment factor to be applied or the difference in the velocity pressure between the reference location and the model reference height. However, note that the pressure coefficients presented in this report have already had this adjustment factor applied, and no further corrections are necessary. The reference pressure is related to the reference mean wind speed by the following equation;

$$\text{Reference Pressure (kPa)} = \frac{1}{2}\rho V^2 = \left(0.6\times10^{-3}\right)V^2 \qquad (3.1)$$

where the air density ρ is taken to be 1.2 kg/m^3, which is typical for sea-level atmospheric conditions.

Mean, standard deviation, maximum and minimum pressures were obtained from the wind tunnel measurements, which were made from 36 wind directions at 10 degree increments. Peak, maximum and minimum pressure coefficients were obtained using the standard upcrossing technique. In this method the pressure range of each signal is divided into very small bands. The data consists of the number of crossings of the various bands by the pressure signal in a positive slope (or negative slope for minimum pressures). This data is used to carry out a statistical analysis of the pressure signal, assuming a Poisson distribution for the number of crossings. The upcrossing analysis of the peak pressures is performed on-line. The peak maximum and minimum pressures are derived from Fisher Tippett Type I parameters (Holmes, 2001). This method produces peak pressures that are more repeatable than simply adopting the measured extreme value and is more efficient than the other statistical techniques as it requires only 30 minutes of sampling time (in full-scale) (Rofail & Kwok, 1991).

The pressure signal was first low-pass filtered at 500Hz and then digital filtering was applied over this range to provide an unbiased response from the pressure measurement system (Rofail et al., 2004). This corresponds to a full-scale frequency range of approximately 0 to 4 Hz in full-scale. The pressure signal was sampled at a rate of 1,024Hz per channel.

The application of wind tunnel testing for the modelling of natural ventilation has been reported previously by Rofail and Aurelius (2004) and Peddie and Rofail (2010 and 2011).

4 DESIGNING FOR NATURAL VENTILATION

Natural ventilation is a primary design concept to reduce or remove the requirement for mechanical ventilation and/or air-conditioning of a building. This provides an environmental benefit by reducing greenhouse gas emissions due to the constant demand for mechanical ventilation and air-conditioning by the occupants. It has also been found that a natural ventilated building will generally reduce the reliance of artificial lighting due to window opening locations to provide ventilation, also providing additional lighting aspects. It is not only environmentally that natural ventilation is beneficial, one other aspects is the financial benefit, both in construction and running costs of the development. Although a naturally ventilated designed building will require more window openings, the benefit of not having to install mechanical ventilation units greatly outweighs this cost. Running costs are also reduced with no ongoing mechanical ventilators and benefits from reduced reliance on artificial lighting. (Peddie and Rofail, 2010)

Furthermore, it has been found that a naturally ventilated building reduces what is commonly known as Sick Building Syndrome (SBS). (Chenvidyakarn, 2010 and Awbi, 2010). Occupants of mechanical or air-conditioned buildings are known to be susceptible to symptoms including itchy eyes, coughs, sneezes and drowsiness. This commonly leads to lower productivity or more people being off sick then when compared to naturally ventilated buildings.

4.1 Natural Ventilation Guidelines

The implementation of natural ventilation into the design of a building is something that should be incorporated from the early stages of the design process to ensure an effective design solution. There are several design guidelines, detailed below, which should be considered in the initial design process when designing for natural ventilation. Some of these may conflict with other climate responsive strategies (such as orientation and shading devices to minimise solar gain) or other design considerations. It is important to understand the general nature of natural ventilation and these guidelines provide some insight to the concept of natural ventilation.

1. In hot, humid climates, maximize air velocities in the occupied zones for bodily cooling. In hot, arid climates, night time ventilation for structural cooling, when the temperature is low is more advantageous.

2. Take advantage of topography, landscaping, and surrounding buildings to redirect airflow and give maximum exposure to breezes. Use vegetation to funnel breezes and avoid wind dams, which reduce the driving pressure differential around the building. Site objects should not obstruct inlet openings.

3. Shape the building to expose maximum surface area to breezes.

4. Use architectural elements such as wing-walls, parapets, and overhangs to promote airflow into the building interior.

5. The long facade of the building and the majority of the door and window openings should be oriented with respect to the prevailing summer breezes. If there is no prevailing direction, openings should be sufficient to provide ventilation regardless of wind direction.

6. Windows should be located in opposing pressure zones. Two openings on opposite sides of a space will increase the area ventilated. Openings on adjacent sides force air to change direction, providing ventilation to a greater area depending on window opening locations. The benefits of the window arrangement depend also on the internal layout of the room.

7. If a room has only one external wall, better airflow is achieved with two widely spaced windows to maximise pressure differentials.

8. If the openings are at the same level and near the ceiling, much of the flow may bypass the occupied level and be ineffective in diluting occupant level contaminants.

9. The stack effect requires sufficient vertical distance between openings be advantageous; the greater the vertical distance, the greater the ventilation potential.

10. Openings in the vicinity of the Neutral Pressure Level (NPL) are least effective for thermally induced ventilation. If the building has only one large opening, the NPL tends to move to that level, reducing the pressure potential across the opening.

11. Greatest flow per unit area of total opening is obtained by inlet and outlet openings of nearly equal areas. An inlet window smaller than the outlet creates higher inlet velocities. An outlet smaller than the inlet creates lower but more uniform air speed through the room.

12. Openings with areas much larger than calculated are sometimes desirable when anticipating increased occupancy or very hot weather.

13. Horizontal windows are generally better than square or vertical windows. This is because they enable airflow over a wider range of wind directions and are most beneficial in locations of shifting prevailing winds.

14. Window openings should be accessible to and operable by occupants to enable control of their environment conditions and comfort levels.

15. Inlet openings should not be obstructed by indoor partitions. Partitions can be placed to split and redirect airflow, but should not restrict flow between the building's inlets and outlets.

16. Vertical airshafts or open staircases can be used to increase and take advantage of stack effects. However, enclosed stair-cases intended for evacuation during a fire should not be used for ventilation.

17. Internal openings should make use of common walls either side of the opening to minimise restriction of the airflow through the opening.

4.2 Types of Natural Ventilation Openings

Natural ventilation openings include: (1) windows, doors; (2) roof ventilators and skylights; (3) stacks; and (4) specially designed inlet or outlet openings.

Windows transmit light and provide ventilation when open and can be operated by sliding vertically or horizontally; by tilting on horizontal pivots at or near the centre; or by swinging on pivots at the top, bottom, or side. The type of pivoting used is important for weather protection and airflow rate. For optimal weather protection a top pivoting window would most suitable, however a horizontal or vertically sliding window will provide the most beneficial airflow rate due to minimal resistance flow path through the opening.

4.3 External Openings

The natural ventilation of a unit is dependent on several factors, some of which are the location, size and type of external opening to the unit. As describe above, there are numerous types of external openings including windows, doors, louvres and vents. The efficiency of these openings to allow airflow into and out of the apartment is dependent on the type of opening and the effective opening area, and also the opening area in relation to the associated wall area.

This efficiency of the opening to allow airflow is known as the discharge coefficient C_d and for a standard window opening is approximately 0.65. Aynsley (1977) has also detailed the variance of the discharge coefficient of an opening which is dependent on the outlet area to wall area ratios.

4.4 Internal Openings

The internal layout of a unit is critical on the natural ventilation performance of the internal flow path. When considering the internal layout of a unit, two key factors need to be taken into account, including:

- Flow path through a unit;
- Internal openings between external openings of the unit.

The flow path through an apartment between two external openings will affect any potential energy loses of the airflow as it travels between two pressure potential areas (external openings). The amount of energy loss which will occur is dependent on the amount of contractions or funnelling of the airflow through the unit. This includes passing through doors and corridors, as well as bends in the internal flow path. Aynsley(1977) provides details for a typical range of discharge coefficients for different internal opening configurations depending on the location and size of the opening.

4.5 Roof Ventilators and Skylights

Roof ventilators provide a weatherproof opening to an internal space and generally operate as an air outlet. Capacity is determined by the ventilator's location on the roof; resistance the ventilator and its ductwork offer to airflow; its ability to use kinetic wind energy to induce flow by centrifugal or ejector action; and the height of the draft.

Natural draft or gravity roof ventilators can be stationary, pivoting, oscillating, or rotating. Selection criteria include ruggedness, corrosion resistance; storm proofing features, dampers and operating mechanisms, noise, cost, and maintenance. Natural ventilators can be supplemented with power-driven supply fans; the motors need only be energized when the natural exhaust capacity is too low. Gravity ventilators can have manual dampers or dampers controlled by thermostat or wind velocity.

A roof ventilator should be positioned so that it unrestricted to the prevailing winds. Turbulence created by surrounding obstructions, including higher adjacent buildings, impairs a ventilator's ejector action. The ventilator inlet should be conical or bell mouthed to give a high flow coefficient. The opening area at the inlet should be increased if screens, grilles, or other structural members cause flow resistance. Building air inlets at lower levels should be larger than the combined throat areas of all roof ventilators.

4.6 Stacks

Stacks or vertical flues should be located where wind can act on them from any direction. Without wind, the roof stacks are still able to remove internal air stack effect alone remove air from the room with the inlets. The resistance to airflow should be minimised to improve the effective ventilation due to stack effect.

A combination of above types of openings can be used to optimise the natural ventilation potential.

5 METHOD OF ANALYSIS

5.1 Measurement of Pressure Coefficients in the Wind Tunnel

The results are first reduced into the form of pressure coefficients with respect to a reference mean velocity pressure at the building reference height. These external pressure coefficients can be defined by the following equations:

$$C_{p_{mean}} = \frac{\overline{p} - p_0}{\frac{1}{2}\rho \overline{V}_{BH}^{\,2}} \quad (5.1) \qquad C_{p_\sigma} = \frac{p'}{\frac{1}{2}\rho \overline{V}_{BH}^{\,2}} \quad (5.2)$$

$$C_{p_{\max}} = \frac{p_{\max} - p_0}{\frac{1}{2}\rho \overline{V}_{BH}^{\,2}} \quad (5.3) \qquad C_{p_{\min}} = \frac{p_{\min} - p_0}{\frac{1}{2}\rho \overline{V}_{BH}^{\,2}} \quad (5.4)$$

Definitions of the terms above are described as follows:

$C_{p_{mean}}$	mean pressure coefficient	$\overline{p}$	mean pressure (Pa)
C_{p_σ}	standard deviation pressure coefficient	p'	standard deviation pressure (Pa)
$C_{p_{\max}}$	maximum pressure coefficient	$p_{\max}$	maximum pressure (Pa)
$C_{p_{\min}}$	minimum pressure coefficient	$p_{\min}$	minimum pressure (Pa)
ρ	air density (kg/m3)	p_0	reference static pressure (Pa)
$\overline{V}_{BH}$	mean velocity at the building reference height (m/s)		

The directional results of these coefficients are plotted in Appendix A within this report. All coefficient data presented in this report is referenced to the mean velocity pressure at the building reference height.

5.2 Natural Ventilation Driving Mechanisms

Natural ventilation is driven by pressure differences across the openings caused by ambient pressure and temperature differences between different openings within a unit. Alternatively, the differences can be between the internal pressure in a unit and the roof pressure in the case of a room having an auxiliary ventilation system using roof vents (stack effect). For a mid-wall unit the internal pressure is dominated by the pressure at the dominant opening to the unit from the balcony etc.

Natural ventilation is the intentional flow of outdoor air due to wind and thermal pressures through controllable openings and can be used to effectively control both temperature and contaminants, particularly in mild climates. Temperature control by natural ventilation is often the only means of providing cooling when mechanical air-conditioning is not available. The arrangement, location, and control of ventilation openings should combine the driving forces of wind and temperature to achieve desired ventilation rate and good distribution of fresh air through the building.

Our experience is that thermally driven components in natural ventilation are negligible when compared with the pressure driven components. Thermal driven ventilation is becomes more dominant with large, multi-storey internal voids with purpose designed solar/thermal walls.

5.2.1 Wind Driven Ventilation

The characteristics and locations of the external and internal openings determine the above wind driven pressure differences and the resultant flow of air. The wind pressures acting on different openings will determine the internal static pressure of the tunnel in order to maintain the continuity equation (mass flow rate of air into the tunnel is equal to the mass flow rate of air out of the tunnel).

The equivalent air-speed within the unit has then been determined from Equation 6.6 below. The air-speed which would be experienced by the occupant of the apartment has been determined based on a nominal internal area of 2.0m^2. A nominal size internal area of approximately an internal corridor open has been taken as this provides a more suitable internal air-speed. It is assumed that the external doors and windows will be opened completely to achieve natural ventilation, however the occupants would not necessarily want to stand adjacent to a window opening to experience this affect.

$$v_{\mathrm{int}\,ernal} = \frac{Q}{A_{\mathrm{int}\,ernal}} \qquad (5.5)$$

The average airflow through the internal space is taken as the weighted average of the airflow for all wind directions weighted based on the daily average percentage of occurrence of observations for Sydney. Note that the percentage of occurrence for each wind direction also takes into account the percentage of calm events for the Sydney region.

Full-scale testing and comparison with wind tunnel measurements has also been undertaken by Peddie and Rofail (2011). They provide a direct comparison between the measured natural ventilation performance of a residential building, including between windows and also ventilation shafts. Their paper provided a very close comparison between the two and enabled a far better understanding of the effect of the internal flow path on natural ventilation performance.

5.2.1.1 Openings in Series

The wind driven ventilation between three or more openings in series can be determined by the following:

$$Q = \left[\frac{\left(C_{p_1} - C_{p_{n+1}}\right) v_h^2}{\frac{1}{C_{d_1}^2 A_1^2} + \frac{1}{C_{d_2}^2 A_2^2} + \frac{1}{C_{d_3}^2 A_3^2} + \ldots + \frac{1}{C_{d_n}^2 A_n^2}} \right]^{\frac{1}{2}} \tag{5.6}$$

C_{p_1}	mean pressure coefficient at Opening 1	v_h	Reference mean wind speed at building height, h (m/s)
C_d	discharge coefficient of the opening	A	openable area of the opening (m^2)
Q	mass flow rate along the flow path through the unit (m^3/s)	v_1	average air speed at opening 1 (m/s)

5.2.1.2 Openings in Parallel

The wind driven ventilation between three or more openings in parallel can be determined by determining the internal pressure for the volume linking the various openings. This is obtained by simultaneously equating the flow rate for the various openings using Equation 5.7 while ensuring that the continuity of mass flow is maintained:

$$Q_1 = A_1 C_{d_1} \sqrt{\frac{2(p_1 - p_i)}{\rho}} \tag{5.7}$$

$$\sum Q_n = 0 \tag{5.8}$$

p_1	mean pressure at Opening 1	p_i	mean internal pressure of volume
C_d	discharge coefficient of the opening	A	openable area of the opening (m^2)
Q	mass flow rate along the flow path through opening 1 (m^3/s)	ρ	air density (kg/m3)

5.2.2 Thermal Effects

Temperature differences between indoors and outdoors cause density differences, and therefore pressure differentials that drive natural ventilation. During the heating season, the warmer inside air rises and flows out of the building near its top. It is replaced by colder outdoor air that enters the building near its base. During the cooling season, the flow directions are reversed and generally lower, because the indoor outdoor temperature difference is smaller.

The height at which the interior and exterior pressures are equal is called the Neutral Pressure Level (NPL) (Tamura and Wilson 1966, 1967). Above this point (during heating season), the interior pressure is greater than the exterior; below this point, greater exterior pressure causes airflow into the building.

The pressure difference due to the stack effect at height h is;

$$\Delta P_s = (\rho_o - \rho_i) g (h - h_{NPL}) \quad (5.9)$$

$$= \rho_i g (h - h_{NPL}) \frac{(T_i - T_o)}{T_o} \quad (5.10)$$

$$= \frac{1}{2} \rho_i V^2 . C_d \quad (5.11)$$

ΔP_s	Pressure difference due to stack effect	T	Average absolute temperature ($^\circ C$)
ρ	Air density (kg/m^3)	C_d	Discharge Coefficient
g	Gravity constant (m^2/s)	V	Average airflow velocity through the opening (m/s)
h	Height of observation (m)	h_{NPL}	Height of neutral pressure level (m)
i	inside	o	outside

Available data on the NPL in various kinds of buildings is limited. The NPL in tall buildings varies from 0.3 to 0.7 of total building height (Tamura and Wilson 1966,67). A value of 0.5 of the height provides adequate accuracy in most applications.

6 CRITERIA FOR ACCEPTANCE

The requirements for natural ventilation is focused on two main facets of flow through a room, these are the air quality within an associated room and the flow rate or velocity through a room. The requirement for air quality is associated with improving the 'health' of a building and reducing what is commonly known as Sick Building Syndrome (SBS). This is encouraged by the circulation and replacement of air within a building with fresh outdoor air. The second facet is associated with a cooling sensation of airflow over a persons' body. The ability to generate a comfortable rate of airflow over the occupants of a room reduces the reliance of mechanical ventilation or air-conditioning to cool the occupants of a room.

The below criteria provide guidance on the mean wind speed and air-changes per hour within a residential apartment without discussing how frequently these should occur. It is not possible for an apartment to be naturally ventilated at all times, as the external wind speed and wind direction varies throughout the day and year. In this study, residential apartments are deemed to be naturally ventilated should it meet the required criteria for more than 50% of the time. To calculate this frequency of occurrence, wind data speed and wind direction data recorded at metrological measuring stations have been combined with the measured wind tunnel results.

6.1 Air Changes per Hour (ACH)

The requirement for air quality within a given room is detailed in the Australian Standard AS1668.2-2002 and the American Standard ANSI/ASHRAE 62.1-2010. Both of these standards consider the need for air quality due to the following two reasons:

- *Occupant Related Contaminants* – This relates to contaminants produced by the occupants of the specified space and is dependent on the type of room, metabolic rate of activity conducted in the room and the number of occupants expected at any time in the room.
- *Material Related Contaminants* – This relates to the expected contaminants generated by the materials associated with specific rooms and the expected uses.

Both of these standards provide general expected contaminant production and number of occupants for the specified room. It should be noted that the required number of air changes per hour is significantly higher for mechanically ventilated rooms as mechanical systems recycle the existing internal air, while natural ventilation incorporates 'fresh' outside air. The required air changes per hour based on the two abovementioned standards is presented in Table 4. These criteria have been based on the worse-case apartment of the development (smallest apartment).

Further to this the American Standard ANSI/ASHRAE 62.1-2010 stipulates the maximum distance which an internal space can be from an operable opening that can be considered to be naturally ventilated. This is determined as a function of the ceiling height along an associated internal flow path between openings and also as a function of the type of opening arrangement:

Single Sided, Double Sided or Corner apartment. These distances have been taken into account when determining the flow paths to be analysed for this report.

Table 4: Comparison of the Requirements for Air Changes Per Hour for the Various Ventilation Codes

Outdoor Air Requirements	AS1668.2-2002	ANSI/ASHRAE 62.1-2010
Required ACH for Occupant Related Contaminants	2.0	-
Required ACH for Material Related Contaminants	0.5	-
Required ACH for both Occupants and Material Related Contaminants	-	1.0

6.2 Air-Speed

Current research (Selkowitz, 2004) suggests that the assessment of the adequacy of natural ventilation should be based on the air-speed within the unit rather than solely the amount of air-changes per hour, as the human body reacts to the flow of air rather than just the quality of the air. It is considered that an optimum range for the average daily air speed in a room is of the order of 0.8-1m/s. Airflow in excess of 1m/s starts to impact on occupant comfort due to high air speeds causing papers etc. to move due to the airflow. The relationship between air-speed and cooling sensation is well documented (for example Aynseley and Su, 2005). Figure 4a shows how the movement of air over one's body can induce a cooling sensation. Note that this relies on the person feeling hot such that there is humidity present on the surface of the body.

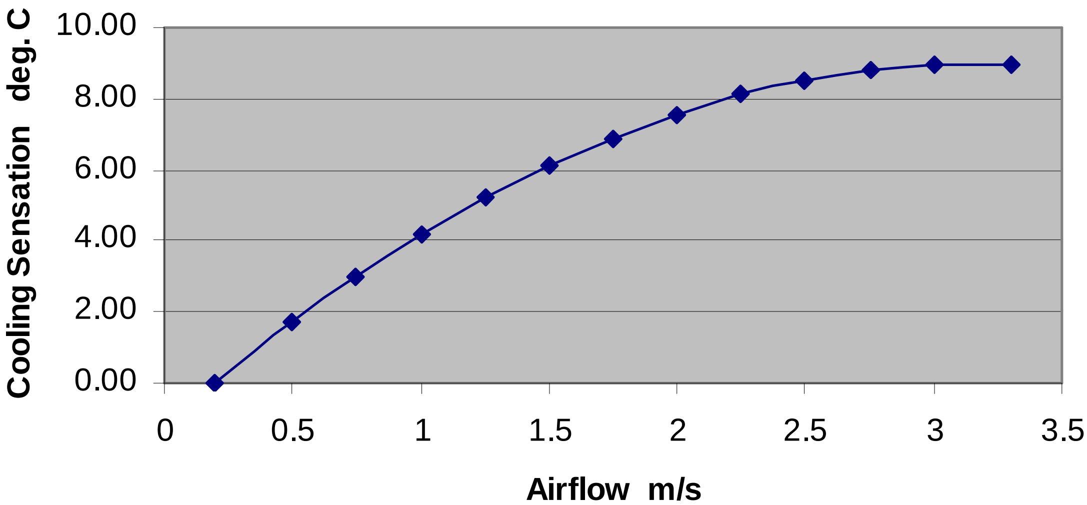


Figure 4a: Cooling Sensation of Air Flow (Aynsley and Su, 2005)

6.3 National Construction Code (NCC)

Reference is made for Deemed-to-Satisfy provision for natural ventilation in Volume 1, Sections F4.5 and F4.6. The code makes mention of providing aggregate opening or openable size of not less than 5% of the floor area of the room required to be ventilated. Furthermore, guidance is provided as to the space which an opening should be connected to for it to be considered as part of this assessment. No mention is made as to the number of apartments or rooms required to comply with these ventilation requirements. The code does not require openings to be fixed ventilation or permanent openings.

6.4 State Environmental Planning Policy (SEPP65)

SEPP 65 defines that a development to be considered naturally ventilated, it is required that 60% of the units of the development be naturally ventilated. For a unit to be considered naturally ventilated, it is required that they perform to the minimum performance of the double-end units or corner units of the development. A double-ended unit is considered a unit with operable access to the living areas of the units on two opposite aspects of the development. It should be noted that due to external and/or internal obstructions potentially reducing the effectiveness of a double-end or corner unit, a lower-end limit of 0.4m/s has been incorporated to ensure sufficient occupant comfort.

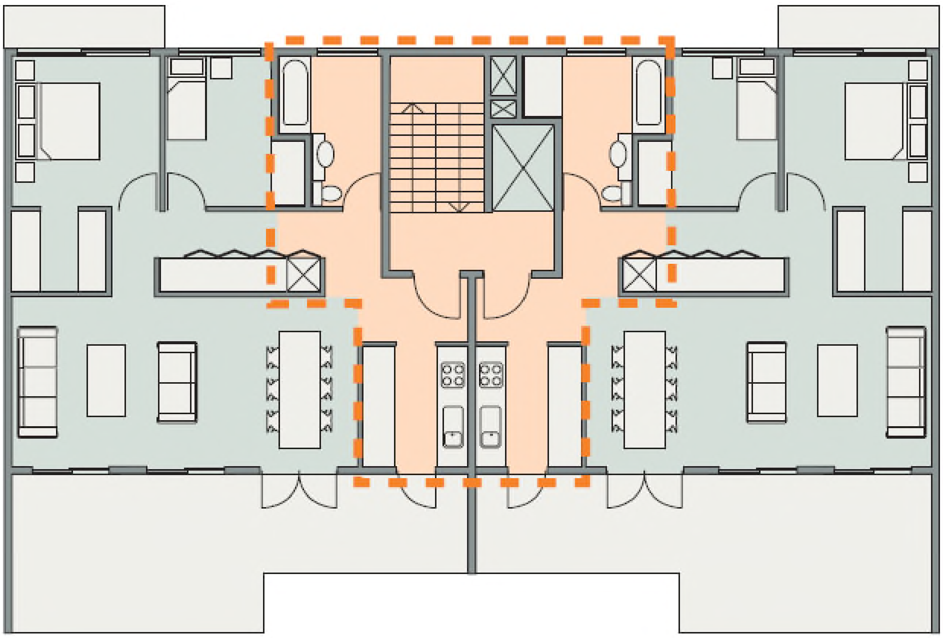


Figure 4b: Living Spaces of a Typical Unit (SEPP 65 RFDC, 2002)

7 RESULTS AND DISCUSSION

A detailed study of the natural ventilation performance of the residential units of the proposed development known as V by Crown, located at 45 Macquarie Street, Parramatta has been undertaken. A total 590 units have been investigated as part of this study.

The residential units of the development consist of corner and single aspect units. Due to the various possible configurations that could be achieved for each unit depending on window openings configuration, up to 4 critical flow paths through the living space of the units have been investigated. In this study it has been assumed that the occupants of the residential units would not necessarily know the optimal window opening configuration to maximum natural ventilation. As such, it has been assumed that a window is either completely open or completely closed.

The criteria outlined in Section 6 states that the natural ventilation flow through corner rooms should meet a minimum daily average of 2 ACH for air quality in the room, and an internal airflow that is equivalent to the worst corner or double ended apartments for the development. As this development does not consist of any deemed-to-comply corner or double ended apartments, a minimum requirement for internal airflow has been established to provide a cooling sensation of approximately 1.5°C for the occupants is 0.4m/s, from Section 6.2. This airflow is determined from a nominal area along the flow path where the occupant of the apartment would be able to experience the air flow. If an occupant would like to experience a large air flow, their instinct would be to move towards an opening where the air flow would be more apparent. The nominal area taken is $2.0m^2$, which is approximately the cross-sectional area of a typical corridor.

The performance of the units of the development is reliant of the pressure potential between the various openings connected to each residential apartment. Section 6 of this report describes the general requirements of ACH and recommended flow velocity through a room for natural ventilation.

7.1 Natural Ventilation Performance

As discussed in Section 6 of this report, the required criteria to satisfy the requirements for natural ventilation 2 ACH and an internal airflow velocity through the living space of 0.4m/s. It was found from the results of the study, 63.6% (375 out of 590) of the apartments will satisfy the requirements for natural ventilation. Note, that for a development to be considered naturally ventilated, 60% of units for the entire development need to satisfy the requirements for natural ventilation. Table 5 presents the results of the study, detailing the number of air changes and internal flow velocity experienced by the apartment's occupants.

Table 5: Natural Ventilation Performance

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
1.01	1.13	85%	YES
1.02	0.14	85%	NO
1.03	0.14	85%	NO
1.04	0.47	80%	YES
1.05	0.54	77%	YES
1.06	0.12	85%	NO
1.07	0.12	85%	NO
1.08	1.03	85%	YES
2.01	1.13	85%	YES
2.02	1.48	85%	YES
2.03	1.48	85%	YES
2.04	0.47	79%	YES
2.05	0.54	75%	YES
2.06	1.55	85%	YES
2.07	1.55	85%	YES
2.08	1.03	85%	YES
2.09	1.18	85%	YES
3.01	0.38	79%	NO
3.02	0.42	73%	YES
3.03	0.39	80%	YES
3.04	0.54	85%	YES
3.05	0.89	85%	YES
3.06	0.48	75%	YES
3.07	0.80	85%	YES
3.08	0.62	82%	YES
3.09	0.41	68%	YES
3.11	0.63	82%	YES
3.12	0.41	80%	YES
3.13	0.45	81%	YES
3.14	0.65	77%	YES
3.15	1.00	83%	YES
3.16	1.18	85%	YES
3.17	0.04	84%	NO
4.01	0.38	79%	NO
4.02	0.42	73%	YES
4.03	0.39	80%	YES
4.04	0.54	85%	YES
4.05	0.89	85%	YES
4.06	0.48	75%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
4.07	0.80	85%	YES
4.08	0.62	82%	YES
4.09	0.37	74%	NO
4.10	0.42	69%	YES
4.11	0.35	70%	NO
4.12	0.41	80%	YES
4.13	0.45	81%	YES
4.14	0.65	77%	YES
4.15	1.00	83%	YES
4.16	1.18	85%	YES
4.17	0.04	84%	NO
5.01	0.43	82%	YES
5.02	0.37	74%	NO
5.03	0.28	69%	NO
5.04	0.38	78%	NO
5.05	0.89	85%	YES
5.06	0.50	72%	YES
5.07	1.73	85%	YES
5.08	0.31	67%	NO
5.09	0.37	74%	NO
5.10	0.42	69%	YES
5.11	0.35	70%	NO
5.12	0.39	78%	YES
5.13	0.42	77%	YES
5.14	0.74	80%	YES
5.15	1.00	85%	YES
5.16	0.35	83%	NO
5.17	0.03	85%	NO
6.01	0.43	82%	YES
6.02	0.37	74%	NO
6.03	0.28	69%	NO
6.04	0.38	78%	NO
6.05	0.89	85%	YES
6.06	0.50	72%	YES
6.07	1.73	85%	YES
6.08	0.31	67%	NO
6.09	0.37	74%	NO
6.10	0.42	69%	YES
6.11	0.35	70%	NO
6.12	0.39	78%	YES
6.13	0.42	77%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
6.14	0.74	80%	YES
6.15	1.00	85%	YES
6.16	0.35	83%	NO
6.17	0.03	85%	NO
7.01	0.43	82%	YES
7.02	0.37	74%	NO
7.03	0.28	69%	NO
7.04	0.38	78%	NO
7.05	0.89	85%	YES
7.06	0.50	72%	YES
7.07	1.73	85%	YES
7.08	0.31	67%	NO
7.09	0.37	74%	NO
7.10	0.42	69%	YES
7.11	0.35	70%	NO
7.12	0.39	78%	YES
7.13	0.42	77%	YES
7.14	0.74	80%	YES
7.15	1.00	85%	YES
7.16	0.35	83%	NO
7.17	0.03	85%	NO
8.01	0.43	82%	YES
8.02	0.37	74%	NO
8.03	0.28	69%	NO
8.04	0.38	78%	NO
8.05	0.89	85%	YES
8.06	0.50	72%	YES
8.07	1.73	85%	YES
8.08	0.31	67%	NO
8.09	0.37	74%	NO
8.10	0.42	69%	YES
8.11	0.35	70%	NO
8.12	0.39	78%	YES
8.13	0.42	77%	YES
8.14	0.74	80%	YES
8.15	1.00	85%	YES
8.16	0.35	83%	NO
8.17	0.03	85%	NO
9.01	0.37	81%	NO
9.02	0.31	72%	NO
9.03	0.27	72%	NO

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
9.04	0.33	83%	NO
9.05	1.00	92%	YES
9.06	0.55	88%	YES
9.07	1.87	85%	YES
9.08	0.29	67%	NO
9.09	0.31	73%	NO
9.10	0.38	76%	NO
9.11	0.39	76%	YES
9.12	0.42	84%	YES
9.13	0.44	82%	YES
9.14	0.73	88%	YES
9.15	0.99	84%	YES
9.16	0.27	75%	NO
9.17	0.04	85%	NO
10.01	0.37	81%	NO
10.02	0.31	72%	NO
10.03	0.27	72%	NO
10.04	0.33	83%	NO
10.05	1.00	92%	YES
10.06	0.55	88%	YES
10.07	1.87	85%	YES
10.08	0.29	67%	NO
10.09	0.31	73%	NO
10.10	0.38	76%	NO
10.11	0.39	76%	YES
10.12	0.42	84%	YES
10.13	0.44	82%	YES
10.14	0.73	88%	YES
10.15	0.99	84%	YES
10.16	0.27	75%	NO
10.17	0.04	85%	NO
11.01	0.37	81%	NO
11.02	0.31	72%	NO
11.03	0.27	72%	NO
11.04	0.33	83%	NO
11.05	1.00	92%	YES
11.06	0.55	88%	YES
11.07	1.87	85%	YES
11.08	0.29	67%	NO
11.09	0.31	73%	NO
11.10	0.38	76%	NO

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
11.11	0.39	76%	YES
11.12	0.42	84%	YES
11.13	0.44	82%	YES
11.14	0.73	88%	YES
11.15	0.99	84%	YES
11.16	0.27	75%	NO
11.17	0.04	85%	NO
12.01	0.37	81%	NO
12.02	0.31	72%	NO
12.03	0.27	72%	NO
12.04	0.33	83%	NO
12.05	1.00	92%	YES
12.06	0.55	88%	YES
12.07	1.87	85%	YES
12.08	0.29	67%	NO
12.09	0.31	73%	NO
12.10	0.38	76%	NO
12.11	0.39	76%	YES
12.12	0.42	84%	YES
12.13	0.44	82%	YES
12.14	0.73	88%	YES
12.15	0.99	84%	YES
12.16	0.05	85%	NO
12.17	0.05	85%	NO
13.01	0.26	75%	NO
13.02	0.58	88%	YES
13.03	0.30	75%	NO
13.04	0.30	76%	NO
13.05	1.01	85%	YES
13.06	0.56	86%	YES
13.07	2.04	85%	YES
13.08	0.47	76%	YES
13.09	0.56	87%	YES
13.10	0.48	77%	YES
13.11	0.56	84%	YES
13.12	0.45	88%	YES
13.13	0.90	85%	YES
13.14	1.17	85%	YES
13.15	1.09	87%	YES
13.16	0.05	85%	NO
13.17	0.05	85%	NO

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
14.01	0.26	75%	NO
14.02	0.58	88%	YES
14.03	0.30	75%	NO
14.04	0.30	76%	NO
14.05	1.01	85%	YES
14.06	0.56	86%	YES
14.07	2.04	85%	YES
14.08	0.47	76%	YES
14.09	0.56	87%	YES
14.10	0.48	77%	YES
14.11	0.56	84%	YES
14.12	0.45	88%	YES
14.13	0.90	85%	YES
14.14	1.17	85%	YES
14.15	1.09	87%	YES
14.16	0.05	85%	NO
14.17	0.05	85%	NO
15.01	0.26	75%	NO
15.02	0.58	88%	YES
15.03	0.30	75%	NO
15.04	0.30	76%	NO
15.05	1.01	85%	YES
15.06	0.56	86%	YES
15.07	2.04	85%	YES
15.08	0.47	76%	YES
15.09	0.56	87%	YES
15.10	0.48	77%	YES
15.11	0.56	84%	YES
15.12	0.45	88%	YES
15.13	0.90	85%	YES
15.14	1.17	85%	YES
15.15	1.09	87%	YES
15.16	0.05	85%	NO
15.17	0.05	85%	NO
16.01	0.26	75%	NO
16.02	0.58	88%	YES
16.03	0.30	75%	NO
16.04	0.30	76%	NO
16.05	1.01	85%	YES
16.06	0.56	86%	YES
16.07	2.04	85%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
16.08	0.47	76%	YES
16.09	0.56	87%	YES
16.10	0.48	77%	YES
16.11	0.56	84%	YES
16.12	0.45	88%	YES
16.13	0.90	85%	YES
16.14	1.17	85%	YES
16.15	1.09	87%	YES
16.16	0.05	85%	NO
16.17	0.05	85%	NO
17.01	0.31	73%	NO
17.02	0.36	82%	NO
17.03	0.37	77%	NO
17.04	0.35	78%	NO
17.05	1.00	92%	YES
17.06	0.59	87%	YES
17.07	1.16	88%	YES
17.08	0.33	86%	NO
17.09	0.46	80%	YES
17.10	0.39	76%	NO
17.11	0.44	70%	YES
17.12	0.46	83%	YES
17.13	0.42	83%	YES
17.14	0.76	92%	YES
17.15	1.13	88%	YES
17.16	0.06	88%	NO
17.17	0.06	88%	NO
18.01	0.31	73%	NO
18.02	0.36	82%	NO
18.03	0.37	77%	NO
18.04	0.35	78%	NO
18.05	1.00	92%	YES
18.06	0.59	87%	YES
18.07	1.16	88%	YES
18.08	0.33	86%	NO
18.09	0.46	80%	YES
18.10	0.39	76%	NO
18.11	0.44	70%	YES
18.12	0.06	88%	NO
18.13	0.06	88%	NO
19.01	0.31	73%	NO

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
19.02	0.36	82%	NO
19.03	0.37	77%	NO
19.04	0.35	78%	NO
19.05	1.00	92%	YES
19.06	0.59	87%	YES
19.07	1.16	88%	YES
19.08	0.33	86%	NO
19.09	0.46	80%	YES
19.10	0.39	76%	NO
19.11	0.44	70%	YES
19.12	0.46	83%	YES
19.13	0.42	83%	YES
19.14	0.76	92%	YES
19.15	1.13	88%	YES
19.16	1.17	88%	YES
19.17	0.06	88%	NO
19.18	0.06	88%	NO
20.01	0.31	73%	NO
20.02	0.36	82%	NO
20.03	0.37	77%	NO
20.04	0.35	78%	NO
20.05	1.00	92%	YES
20.06	0.59	87%	YES
20.07	1.16	88%	YES
20.08	0.33	86%	NO
20.09	0.46	80%	YES
20.10	0.39	76%	NO
20.11	0.44	70%	YES
20.12	0.46	83%	YES
20.13	0.42	83%	YES
20.14	0.76	92%	YES
20.15	1.13	88%	YES
20.16	1.17	88%	YES
20.17	0.06	88%	NO
20.18	0.06	88%	NO
21.01	0.26	76%	NO
21.02	0.32	63%	NO
21.03	0.32	74%	NO
21.04	1.98	89%	YES
21.05	0.56	81%	YES
21.06	1.80	92%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
21.07	0.49	76%	YES
21.08	0.38	64%	NO
21.09	0.46	70%	YES
21.10	0.52	86%	YES
21.11	0.36	74%	NO
21.12	0.65	79%	YES
21.13	1.15	86%	YES
21.14	0.96	84%	YES
21.15	0.56	80%	YES
21.16	0.07	83%	NO
21.17	0.07	83%	NO
22.01	0.26	76%	NO
22.02	0.32	63%	NO
22.03	0.32	74%	NO
22.04	1.98	89%	YES
22.05	0.56	81%	YES
22.06	1.80	92%	YES
22.07	0.49	76%	YES
22.08	0.38	64%	NO
22.09	0.46	70%	YES
22.10	0.52	86%	YES
22.11	0.36	74%	NO
22.12	0.65	79%	YES
22.13	1.15	86%	YES
22.14	0.96	84%	YES
22.15	0.56	80%	YES
22.16	0.07	83%	NO
22.17	0.07	83%	NO
23.01	0.26	76%	NO
23.02	0.32	63%	NO
23.03	0.32	74%	NO
23.04	1.98	89%	YES
23.05	0.56	81%	YES
23.06	1.80	92%	YES
23.07	0.49	76%	YES
23.08	0.38	64%	NO
23.09	0.46	70%	YES
23.10	0.52	86%	YES
23.11	0.36	74%	NO
23.12	0.65	79%	YES
23.13	1.15	86%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
23.14	0.96	84%	YES
23.15	0.56	80%	YES
23.16	0.07	83%	NO
23.17	0.07	83%	NO
24.01	0.26	62%	NO
24.02	0.30	62%	NO
24.03	0.30	57%	NO
24.04	1.90	89%	YES
24.05	0.61	80%	YES
24.06	1.82	91%	YES
24.07	0.51	73%	YES
24.08	0.39	80%	NO
24.09	0.43	71%	YES
24.10	0.56	79%	YES
24.11	0.40	82%	YES
24.12	0.58	84%	YES
24.13	1.15	82%	YES
24.14	1.00	84%	YES
24.15	0.40	74%	YES
24.16	0.07	79%	NO
24.17	0.07	79%	NO
25.01	0.26	62%	NO
25.02	0.30	62%	NO
25.03	0.30	57%	NO
25.04	1.90	89%	YES
25.05	0.61	80%	YES
25.06	1.82	91%	YES
25.07	0.51	73%	YES
25.08	0.39	80%	NO
25.09	0.43	71%	YES
25.10	0.56	79%	YES
25.11	0.40	82%	YES
25.12	0.58	84%	YES
25.13	1.15	82%	YES
25.14	1.00	84%	YES
25.15	0.40	74%	YES
25.16	0.07	79%	NO
25.17	0.07	79%	NO
26.01	0.78	85%	YES
26.02	0.86	85%	YES
26.03	0.86	84%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
26.04	1.90	89%	YES
26.05	0.61	80%	YES
26.06	1.82	91%	YES
26.07	0.84	84%	YES
26.08	0.78	81%	YES
26.09	2.18	86%	YES
27.01	0.78	85%	YES
27.02	0.86	85%	YES
27.03	0.86	84%	YES
27.04	1.69	90%	YES
27.05	0.93	75%	YES
27.06	2.06	91%	YES
27.07	0.84	83%	YES
27.08	0.78	81%	YES
27.09	2.18	86%	YES
28.01	2.26	85%	YES
28.02	0.84	77%	YES
28.03	0.97	90%	YES
28.04	6.78	92%	YES
28.05	1.41	90%	YES
28.06	3.95	89%	YES
2.10	0.04	84%	NO
3.10	0.50	66%	YES
S10.01	0.67	85%	YES
S10.02	0.45	79%	YES
S10.03	0.59	77%	YES
S10.04	0.59	84%	YES
S10.05	0.06	73%	NO
S10.06	0.37	83%	NO
S10.07	0.28	73%	NO
S10.08	0.36	83%	NO
S10.09	0.57	85%	YES
S11.01	0.67	85%	YES
S11.02	0.45	79%	YES
S11.03	0.59	77%	YES
S11.04	0.59	84%	YES
S11.05	0.06	73%	NO
S11.06	0.37	83%	NO
S11.07	0.28	73%	NO
S11.08	0.36	83%	NO
S11.09	0.57	85%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
S12.01	0.67	85%	YES
S12.02	0.45	79%	YES
S12.03	0.59	77%	YES
S12.04	0.59	84%	YES
S12.05	0.06	73%	NO
S12.06	0.37	83%	NO
S12.07	0.28	73%	NO
S12.08	0.36	83%	NO
S12.09	0.42	90%	YES
S12.10	0.65	85%	YES
S13.01	0.72	85%	YES
S13.02	0.46	74%	YES
S13.03	0.67	83%	YES
S13.04	0.74	82%	YES
S13.05	0.07	76%	NO
S13.06	0.31	83%	NO
S13.07	0.34	85%	NO
S13.08	0.62	86%	YES
S13.09	0.42	90%	YES
S13.10	0.65	85%	YES
S14.01	0.72	85%	YES
S14.02	0.46	74%	YES
S14.03	0.67	83%	YES
S14.04	0.74	82%	YES
S14.05	0.07	76%	NO
S14.06	0.31	83%	NO
S14.07	0.34	85%	NO
S14.08	0.62	86%	YES
S14.09	0.42	90%	YES
S14.10	0.65	85%	YES
S15.01	0.72	85%	YES
S15.02	0.46	74%	YES
S15.03	0.67	83%	YES
S15.04	0.74	82%	YES
S15.05	0.07	76%	NO
S15.06	0.31	83%	NO
S15.07	0.34	85%	NO
S15.08	0.62	86%	YES
S15.09	0.42	90%	YES
S15.10	0.65	85%	YES
S16.01	0.72	85%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
S16.02	0.46	74%	YES
S16.03	0.67	83%	YES
S16.04	0.74	82%	YES
S16.05	0.07	76%	NO
S16.06	0.31	83%	NO
S16.07	0.34	85%	NO
S16.08	0.62	86%	YES
S16.09	0.42	90%	YES
S16.10	0.65	85%	YES
S17.01	0.83	76%	YES
S17.02	0.93	86%	YES
S17.03	0.91	85%	YES
S17.04	1.09	82%	YES
S17.05	0.34	85%	NO
S17.06	0.31	78%	NO
S17.07	0.65	85%	YES
S17.08	0.37	81%	NO
S17.09	0.65	85%	YES
S18.01	0.83	76%	YES
S18.02	0.93	86%	YES
S18.03	0.91	85%	YES
S18.04	1.09	82%	YES
S18.05	0.31	78%	NO
S18.06	0.65	85%	YES
S18.07	0.37	81%	NO
S18.08	0.65	85%	YES
S18.09	0.47	74%	YES
S18.10	1.30	84%	YES
S2.01	0.70	85%	YES
S2.02	0.70	85%	YES
S2.03	0.76	84%	YES
S2.04	0.58	82%	YES
S2.05	0.56	78%	YES
S2.06	0.46	84%	YES
S2.07	0.46	84%	YES
S2.08	0.53	84%	YES
S2.09	0.31	73%	NO
S3.01	0.70	85%	YES
S3.02	0.70	85%	YES
S3.03	0.76	85%	YES
S3.04	0.58	84%	YES

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
S3.05	0.04	81%	NO
S3.06	0.46	85%	YES
S3.07	0.46	85%	YES
S3.08	0.61	85%	YES
S3.09	0.31	77%	NO
S4.01	0.70	85%	YES
S4.02	0.70	85%	YES
S4.03	0.76	85%	YES
S4.04	0.58	84%	YES
S4.05	0.04	81%	NO
S4.06	0.46	85%	YES
S4.07	0.46	85%	YES
S4.08	0.61	85%	YES
S4.09	0.31	77%	NO
S5.01	0.60	83%	YES
S5.02	0.39	74%	NO
S5.03	0.67	85%	YES
S5.04	0.49	79%	YES
S5.05	0.06	71%	NO
S5.06	0.56	85%	YES
S5.07	0.32	82%	NO
S5.08	0.35	84%	NO
S5.09	0.33	82%	NO
S6.01	0.60	83%	YES
S6.02	0.39	74%	NO
S6.03	0.67	85%	YES
S6.04	0.49	79%	YES
S6.05	0.06	71%	NO
S6.06	0.56	85%	YES
S6.07	0.32	82%	NO
S6.08	0.35	84%	NO
S6.09	0.33	82%	NO
S7.01	0.60	83%	YES
S7.02	0.39	74%	NO
S7.03	0.67	85%	YES
S7.04	0.49	79%	YES
S7.05	0.06	71%	NO
S7.06	0.56	85%	YES
S7.07	0.32	82%	NO
S7.08	0.35	84%	NO
S7.09	0.33	82%	NO

Apartment Number	Weighted Air Flow Through The Apartment (m/s)	Percentage of Time Above ACH Criteria	Complies
S8.01	0.60	83%	YES
S8.02	0.39	74%	NO
S8.03	0.67	85%	YES
S8.04	0.49	79%	YES
S8.05	0.06	71%	NO
S8.06	0.56	85%	YES
S8.07	0.32	82%	NO
S8.08	0.35	84%	NO
S8.09	0.33	82%	NO
S9.01	0.67	85%	YES
S9.02	0.45	79%	YES
S9.03	0.59	77%	YES
S9.04	0.59	84%	YES
S9.05	0.06	73%	NO
S9.06	0.37	83%	NO
S9.07	0.28	73%	NO
S9.08	0.36	83%	NO
S9.09	0.57	85%	YES

8 CONCLUSION

A detailed investigation has been undertaken into the natural ventilation performance of the residential apartments of the proposed development known as V by Crown, located at 45 Macquarie Street, Parramatta.

For this development, the Australian Standard, Ventilation Design for Indoor Air Contaminant Control, AS1668.2-2002 requires a minimum of 2 air changes per hours (ACH) for air quality due to occupant and material related contaminants. As there are no deemed-to-comply apartments as stipulated in the Residential Flat Design Code, SEPP65, the benchmark used was the airflow velocity through the main living space opening to achieve a directionally weighted average velocity of 0.4m/s, which is sufficient to provide thermal cooling effects. Consideration has also been made for the internal apartment layout, including internal openings, on the natural ventilation performance of each unit to ensure the main living areas achieve adequate natural ventilation.

The results of the study show that 63.6% (375 out of 590) of the apartments will satisfy the requirements for natural ventilation. SEPP65 suggests that for a development to be considered naturally ventilated, 60% of the units of the entire development need to satisfy the requirements for natural ventilation. Therefore, based on the current design of the subject development, the requirements for natural ventilation will be satisfied.

REFERENCES

ANSI/ASHRAE Standard 62.1-2004 "Ventilation for Acceptable Indoor Air Quality"

AS1668.2-2002, "The use of Ventilation and Airconditioning in Buildings".

Awbi, H, 2010, "Basic Concepts for Natural Ventilation of Buildings", CIBSE BSG Seminar: Natural and Mixed-Mode Ventilation Modelling.

Aynsley, R.M., Melbourne, W., Vickery, B.J., 1977, "Architectural Aerodynamics", Applied Science Publishers.

Aynsley, R. and Su, B., 2005, Insulation of Roofs in Warm Climates, 2005 CIB W92/W107 International Symposium on Procurement Systems, February 7-10, 2005, Las Vegas, NV, USA

Chenvidyakarn, T, 2010, "Part1B Environmental Design: The Physics of Natural Ventilation and Passive Heating/Cooling", Section 1.

Deaves, D. M. and Harris, R. I. 1978, "A mathematical model of the structure of strong winds." Construction Industry and Research Association (U.K), Report 76

Holmes, J., 2001, "Wind Loading of Structures", Spon Press, London.

ISO/FDIS 4354:2008(E), "Wind Actions on Structures".

Lawson, T.V., 1975, "The determination of the wind environment of a building complex before construction", Bristol University, Department of Aeronautical Engineering.

Melbourne, W.H., 1978, "Wind Environment Studies in Australia", Journal of Wind Engineering and Industrial Aerodynamics, vol.3, pp.201-214.

NCC2012 Building Code of Australia – Volume 1.

NISTIR 6781 "Natural Ventilation Review and Plan for Design and Analysis Tools"

Peddie K.M., Rofail A.W., 2011, "Designing for Natural Ventilation in Tall Residential Buildings", CTBUH 2011 World Conference, Seoul, Korea, October 10-12, 2011.

Peddie K.M., Rofail A.W., 2010, "Application of Natural Ventilation for Commercial Developments", 14th Australasian Wind Engineering Workshop, Canberra, August 5-6, 2010.

Penwarden, A.D., and Wise A.F.E., 1975, "Wind Environment Around Buildings", Building Research Establishment Report, London.

Rofail A.W., Aurelius L.J., 2004, "Performance of an auxiliary natural ventilation system", Australasian Wind Engineering Workshop, Darwin, June 28-29, 2004.

Rofail AW and Aurelius, LJ, 2004, "A Wind Tunnel Modelling Methodology for the determination of the Internal and Net Design Pressures for Tall Buildings having operable facades", International Conference on Building Envelope Systems and Technologies, Sydney, 29th March to 2nd April.

Rofail AW, Tonin R and Hanafi D, 2004, “Sensitivity of frequency response to type of tubing”, Australasian Wind Engineering Workshop, Darwin, June 28-29, 2004.

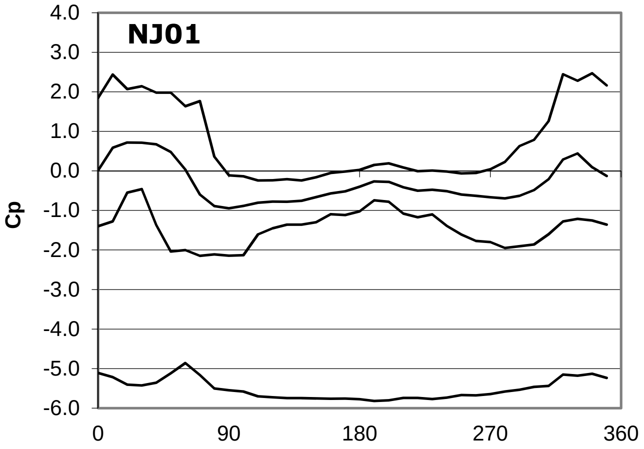
Rofail AW, 1995, "Full-scale/ Model-scale comparisons of Wind Pressures on the TTU Building", Proceedings of the 9th International Conference on Wind Engineering, India, January, 1995.

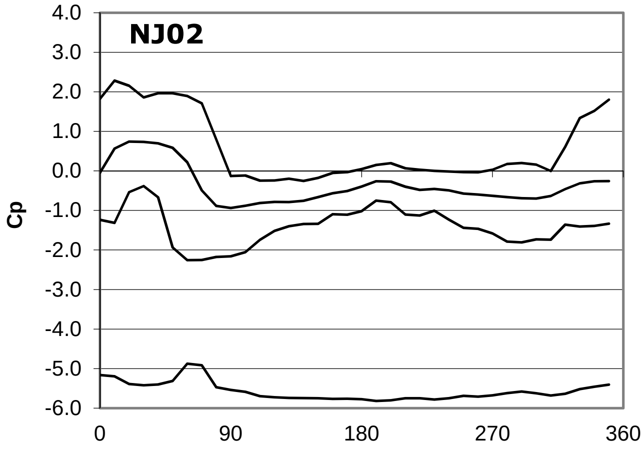
Rofail AW and Kwok KCS, 1991, "A Reliability Study of Wind Tunnel Results of Cladding Pressures", Proceedings of the 8th International Conference on Wind Engineering, Canada, July, 1991.

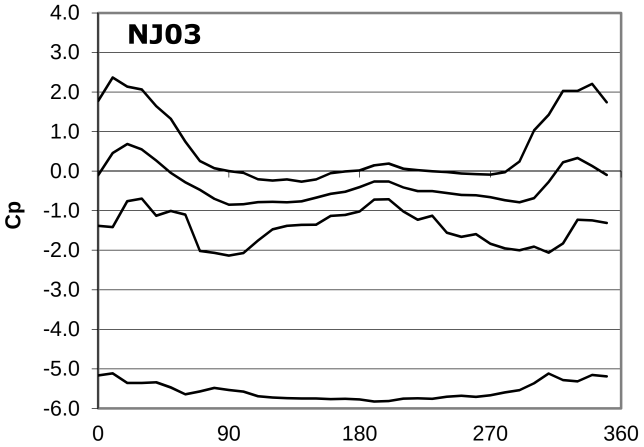
Selkowitz, S., 2004 (Head of Building Technologies, Lawrence Berkley National Laboratories, California, USA) – Private Communication

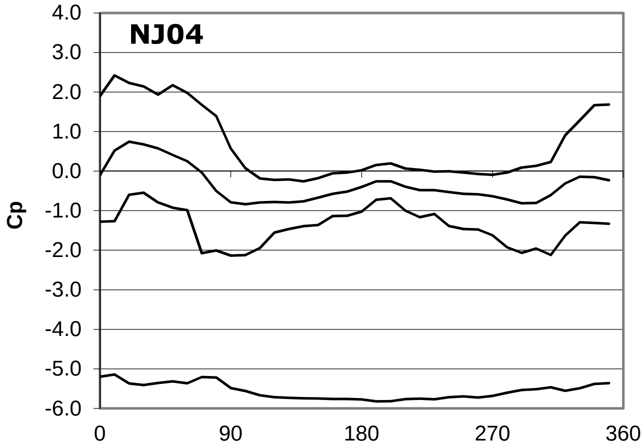
Vickery BJ and Karakatsanis C, 1987, "External Wind Pressure Distributions and Induced Internal Ventilation Flow in Low-Rise Industrial and Domestic Structures", ASHRAE Transactions Vol.93, Pt2.

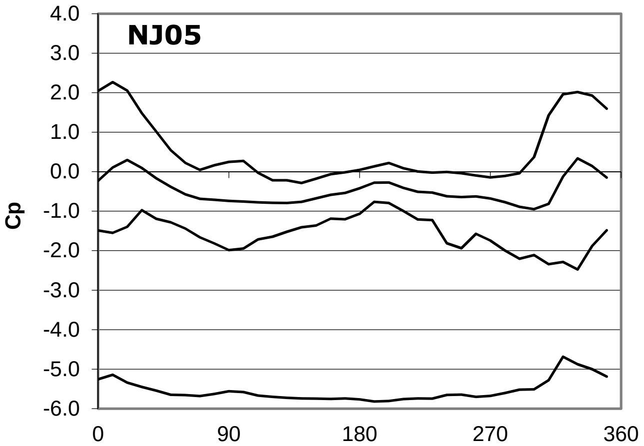
APPENDIX A - PLOTS OF WIND TUNNEL TEST RESULTS

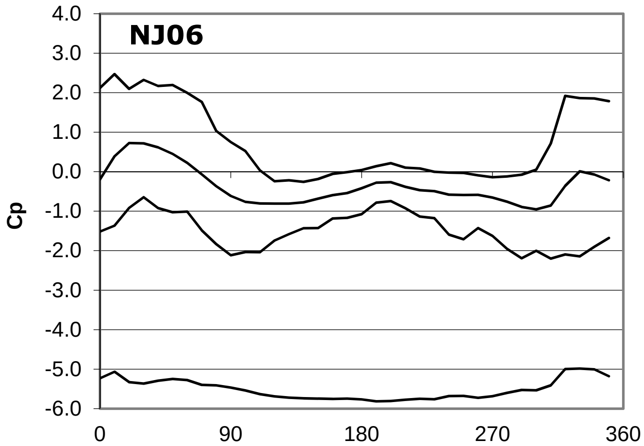

NJ01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

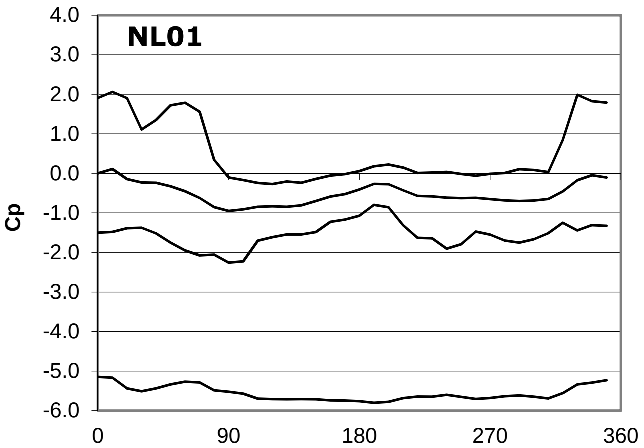

NJ02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

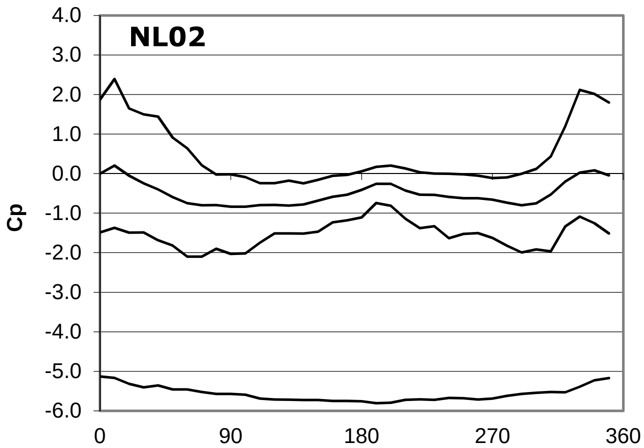

NJ03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

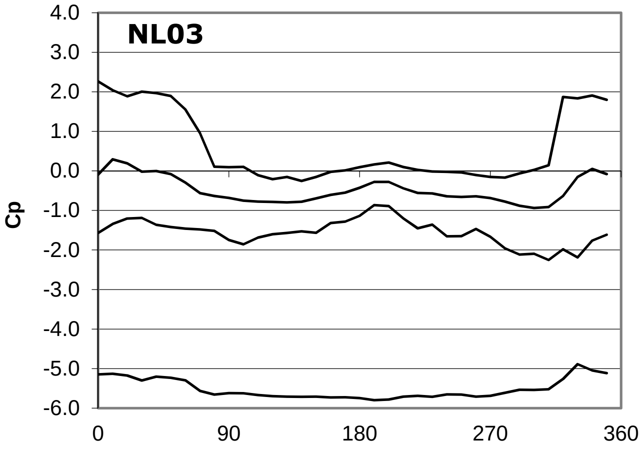

NJ04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

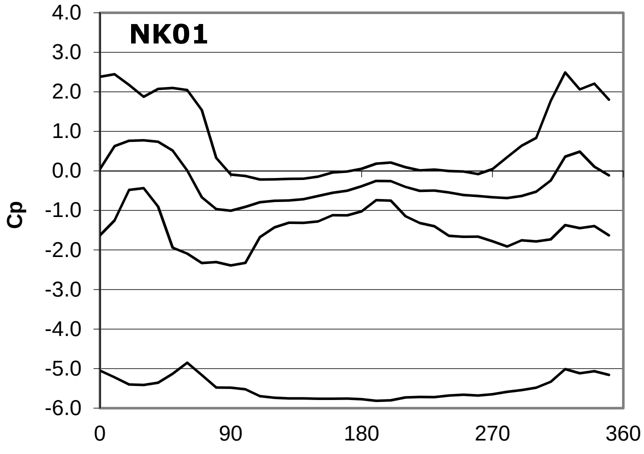

NJ05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

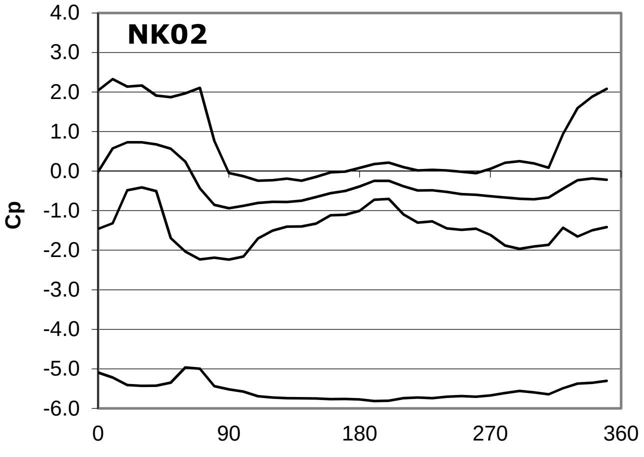

NJ06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

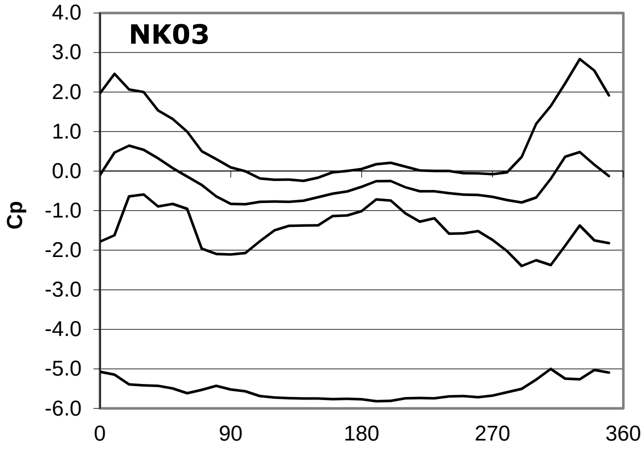

NL01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

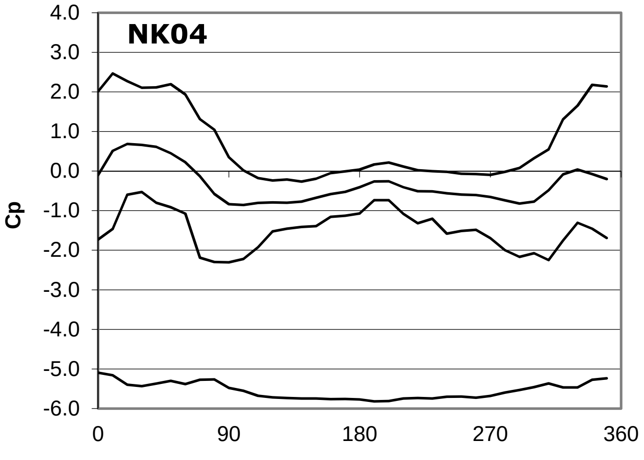

NL02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

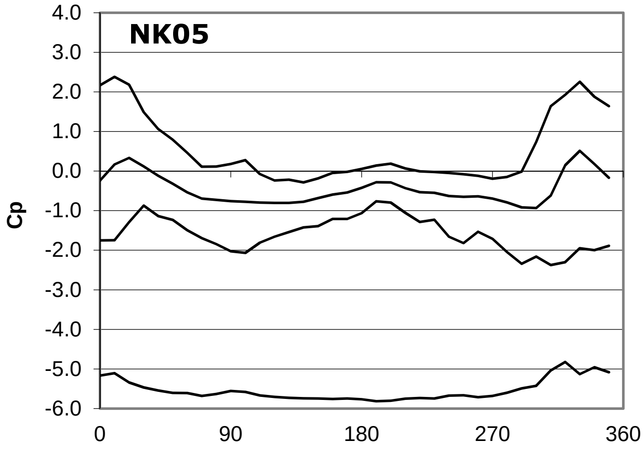

NL03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

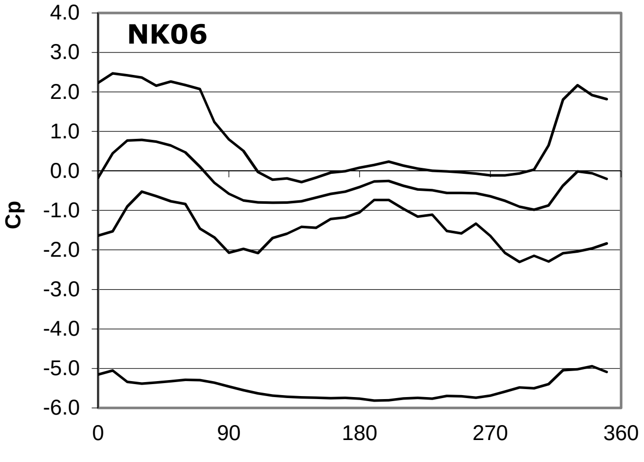

NK01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

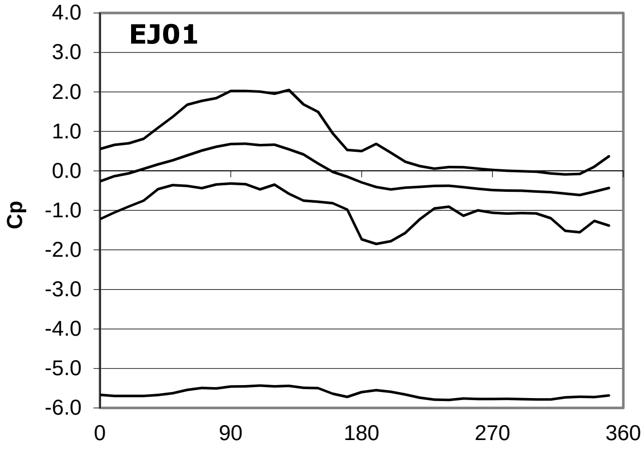

NK02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

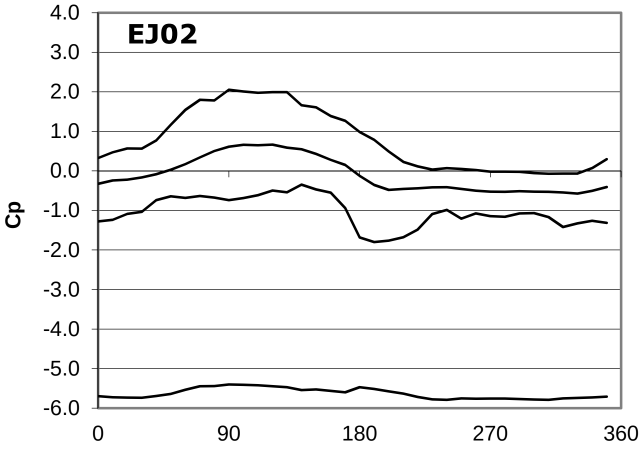

NK03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

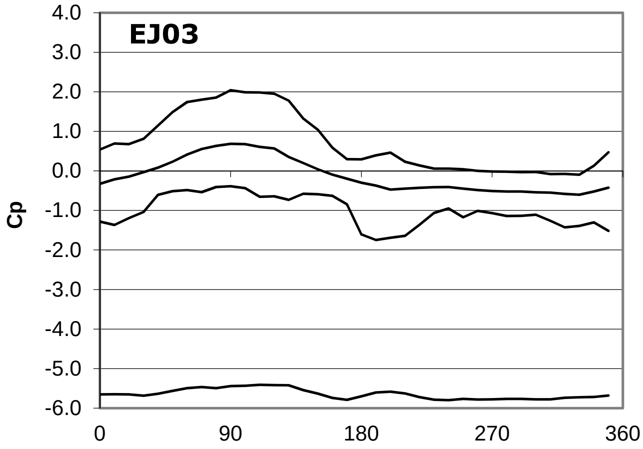

NK04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

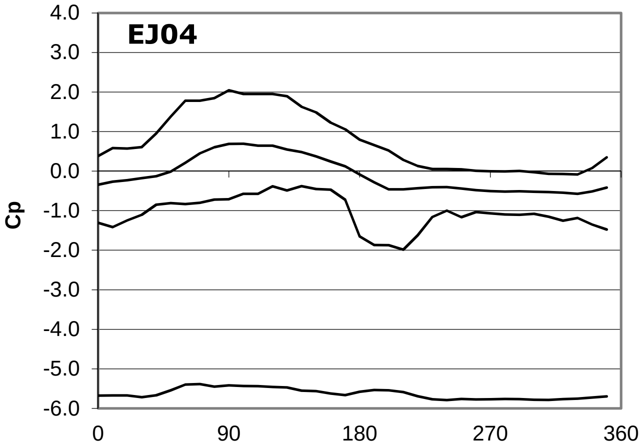

NK05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

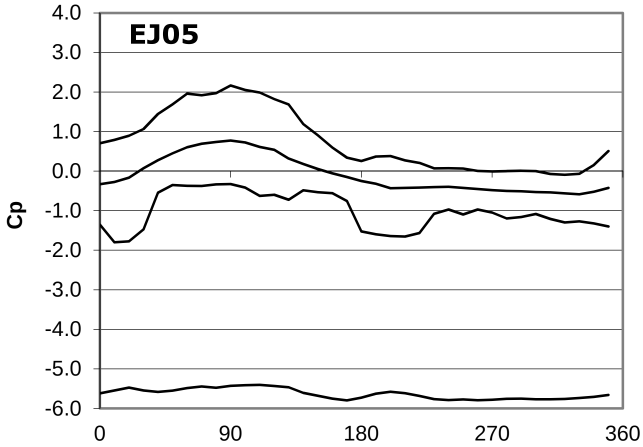

NK06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

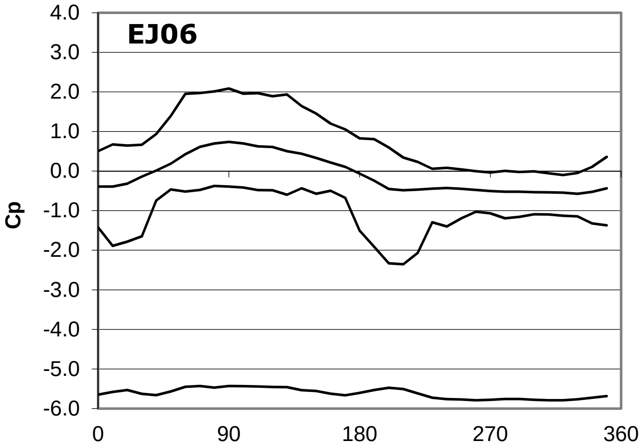

EJ01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

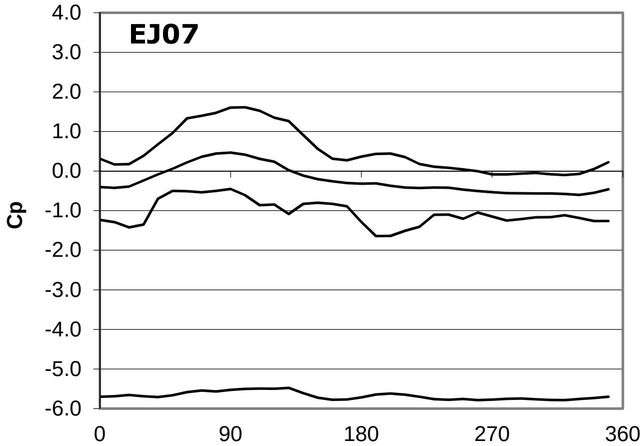

EJ02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

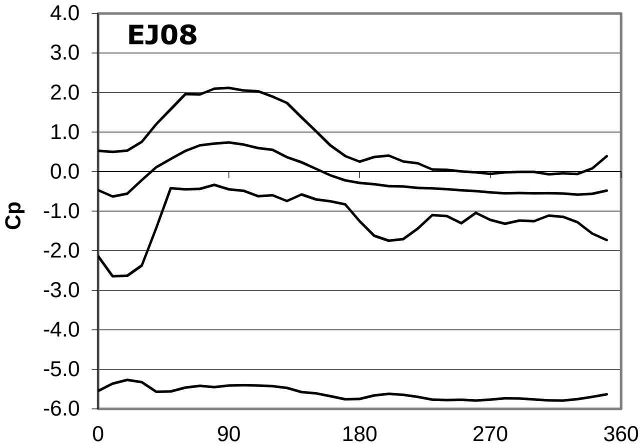

EJ03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

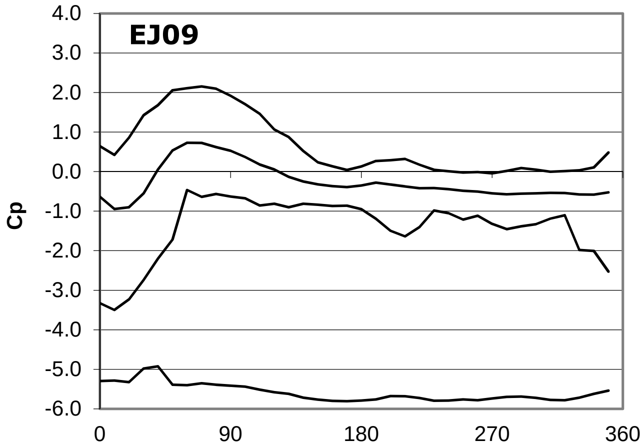

EJ04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

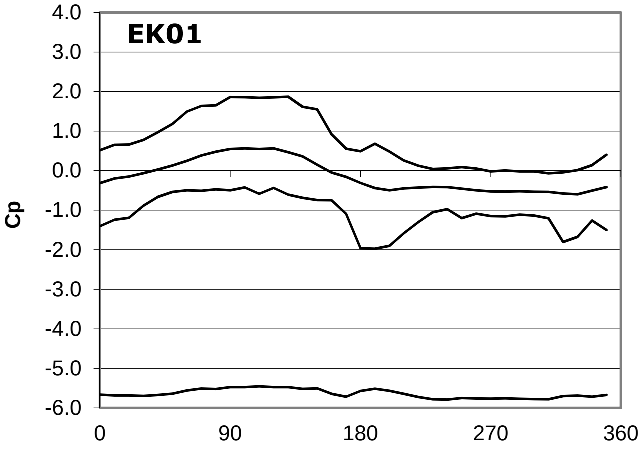

EJ05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

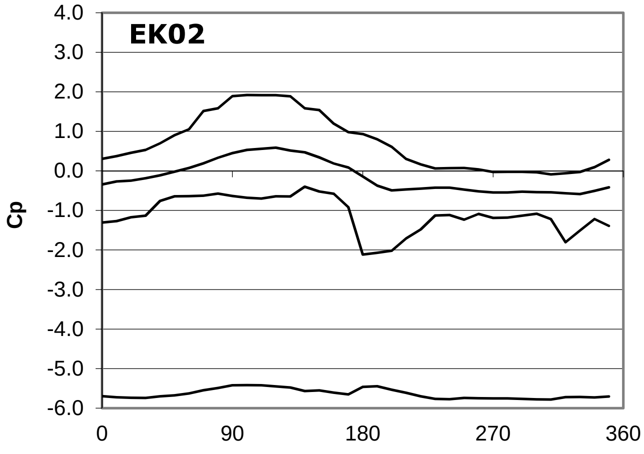

EJ06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

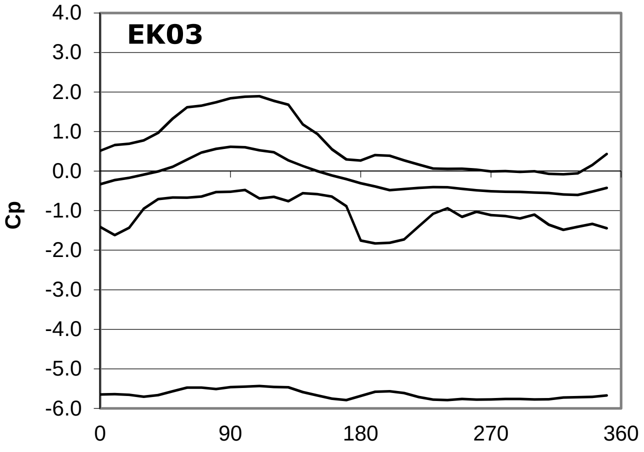

EJ07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

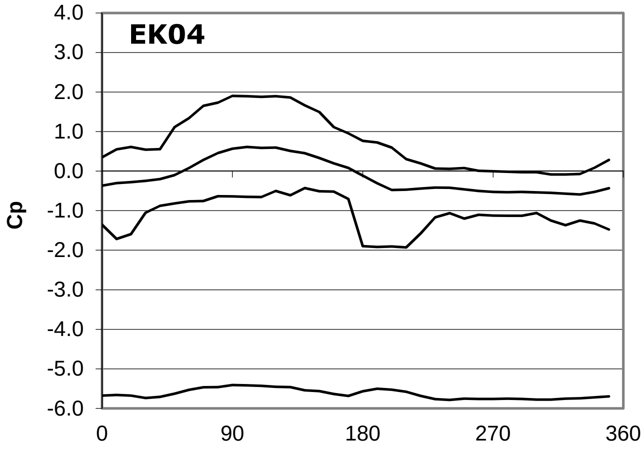

EJ08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

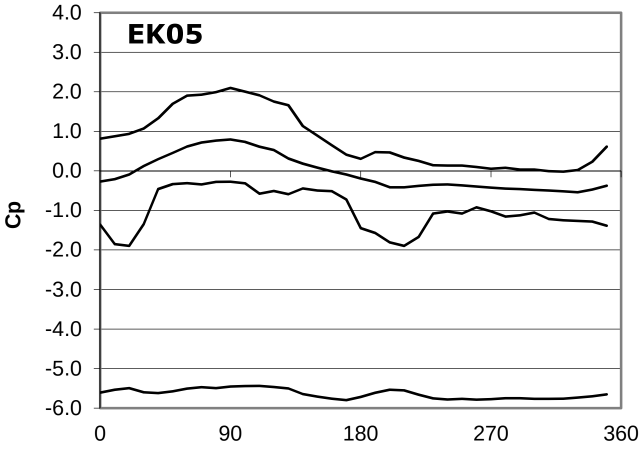

EJ09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

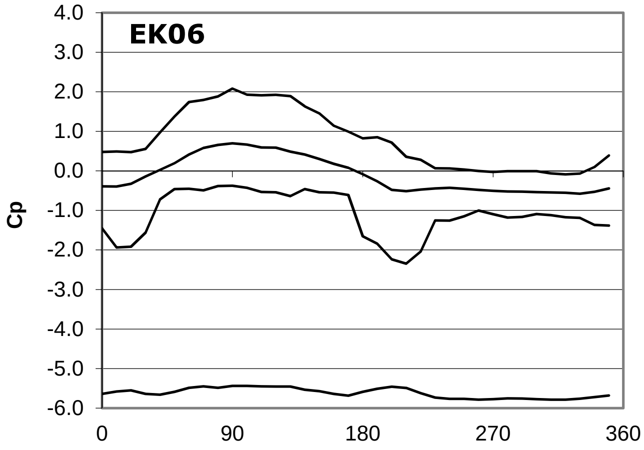

EK01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

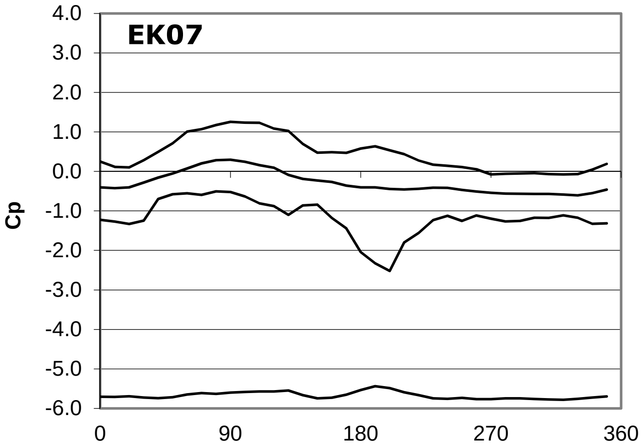

EK02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

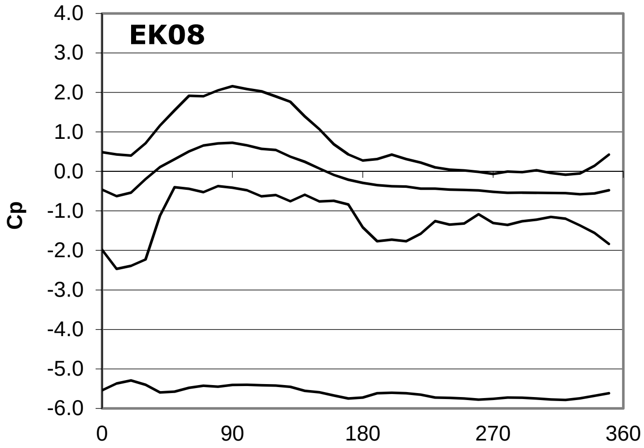

EK03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

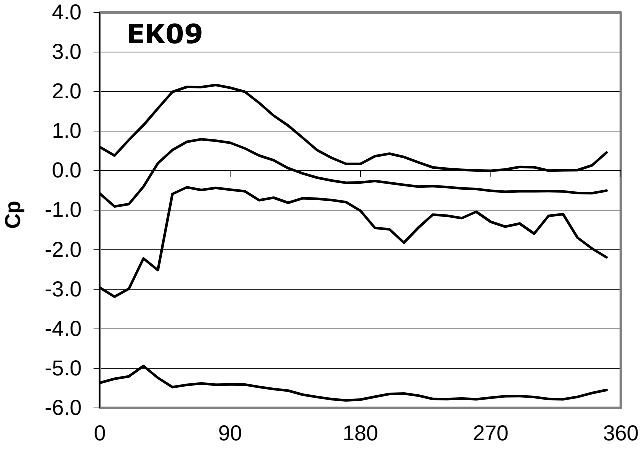

EK04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

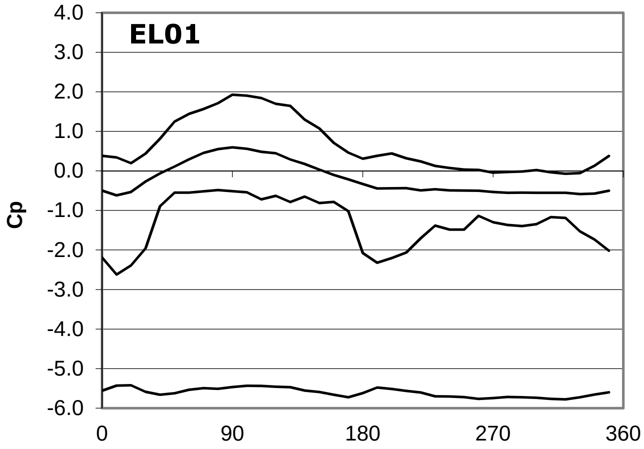

EK05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

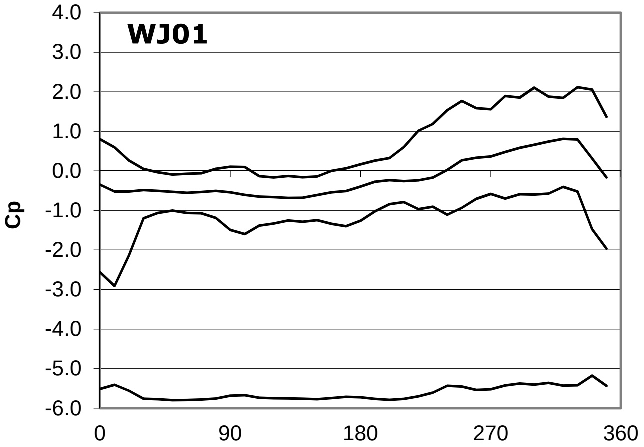

EK06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

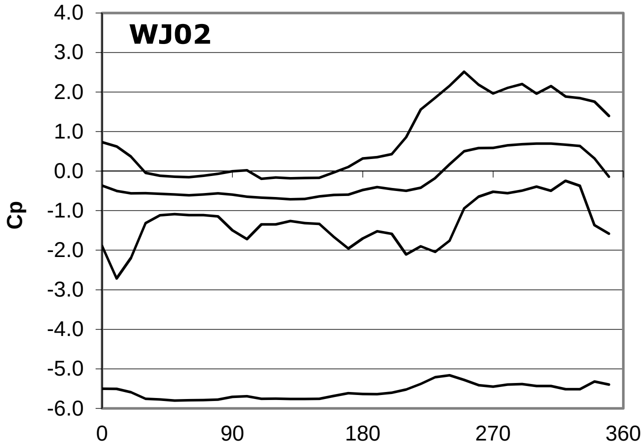

EK07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

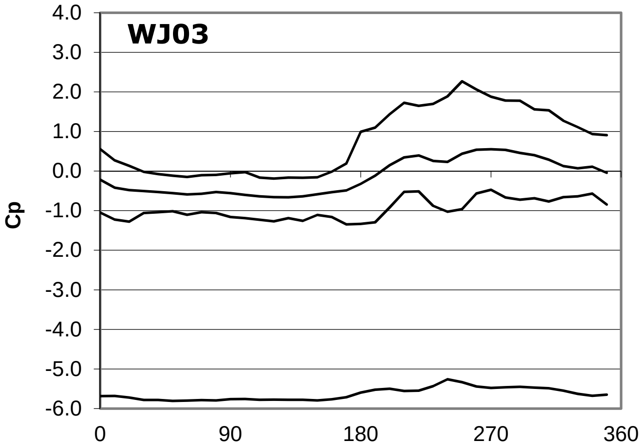

EK08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

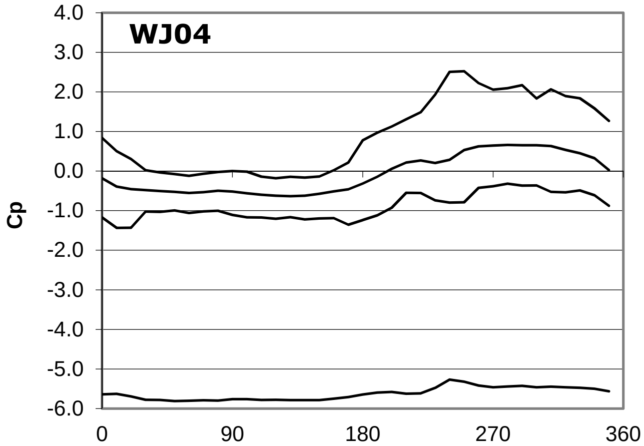

EK09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

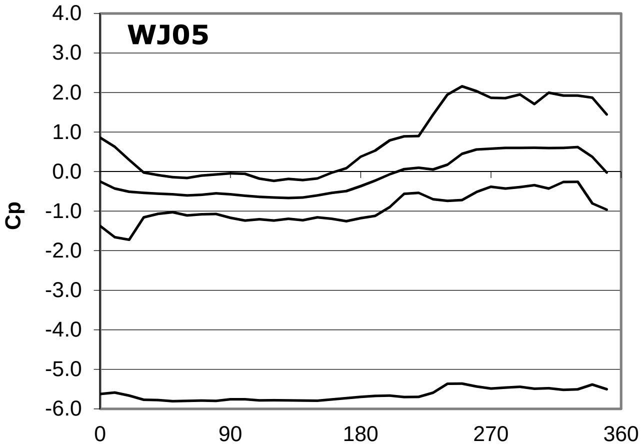

EL01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

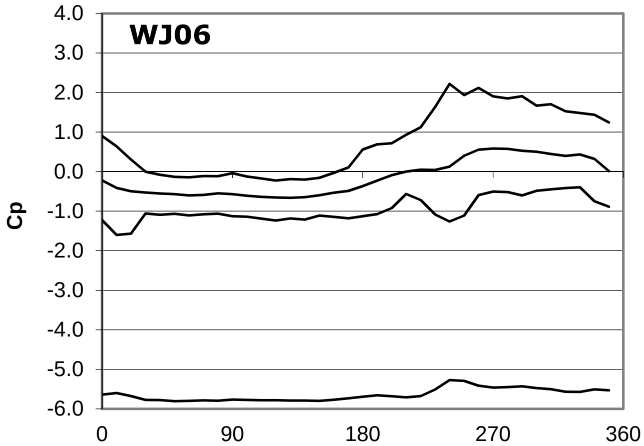

WJ01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

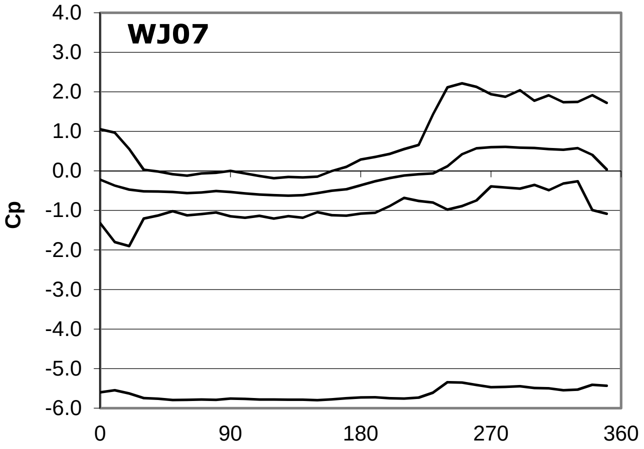

WJ02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

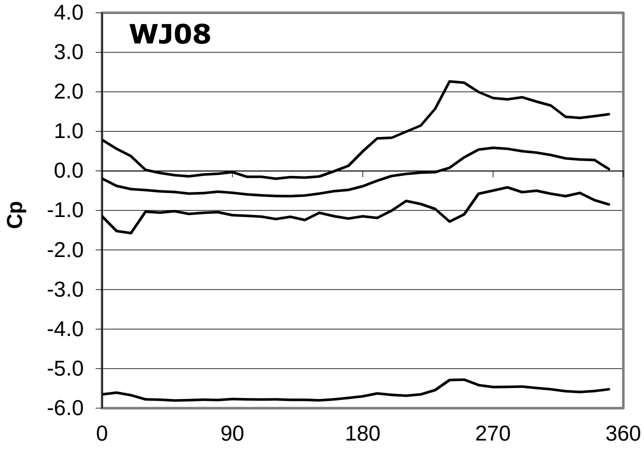

WJ03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

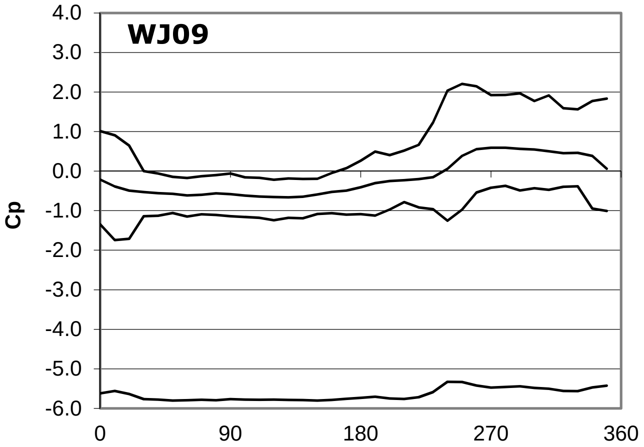

WJ04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

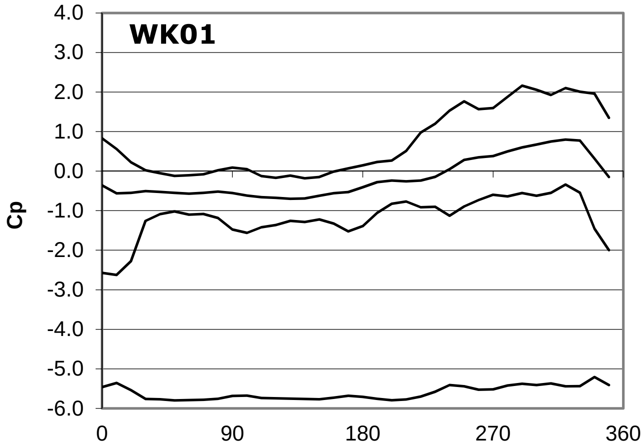

WJ05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

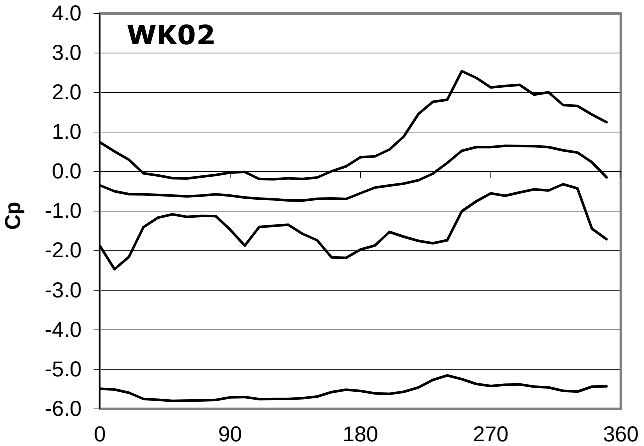

WJ06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

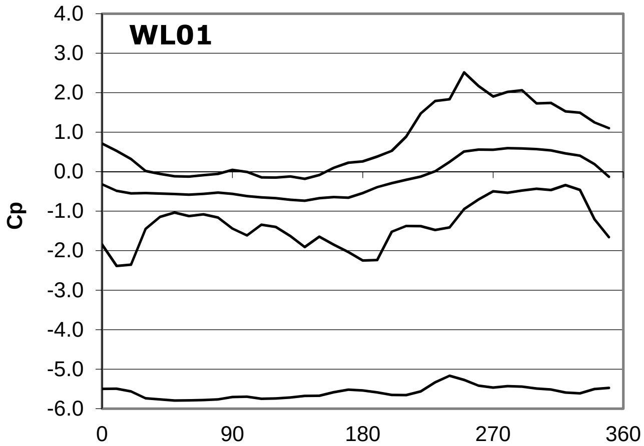

WJ07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

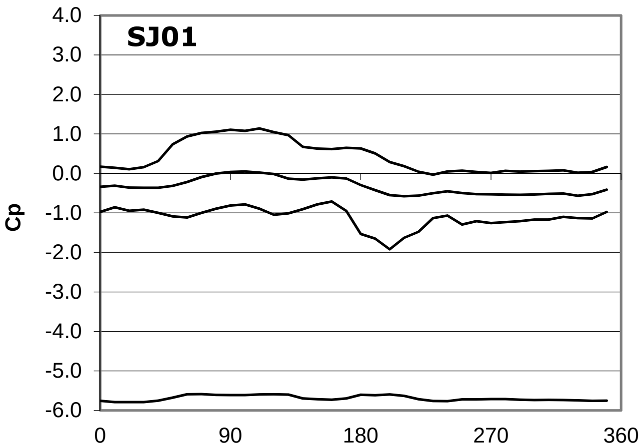

WJ08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

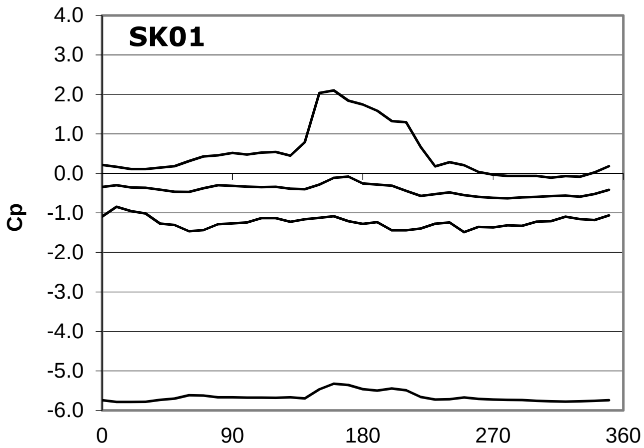

WJ09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

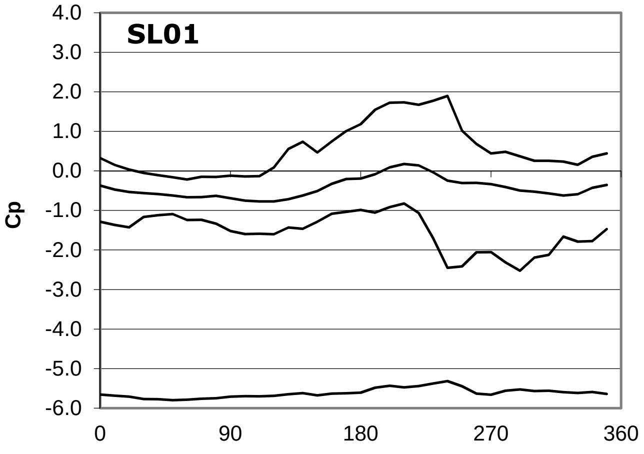

WK01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

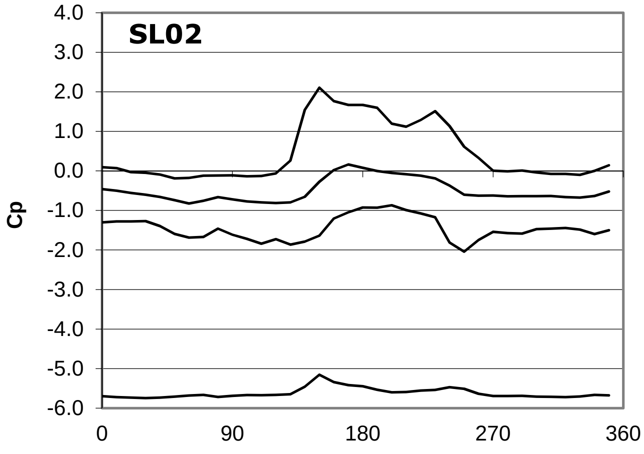

WK02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

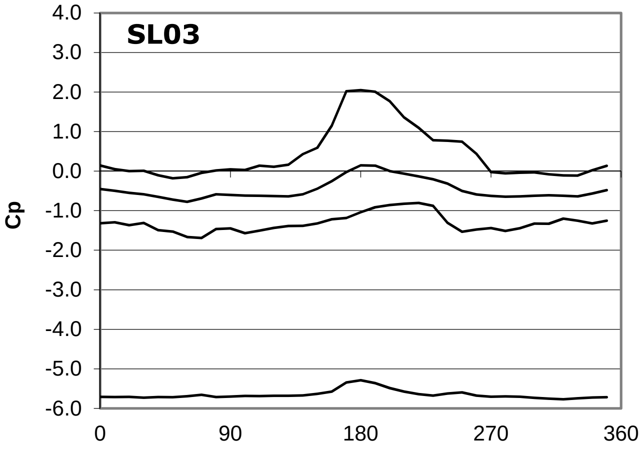

WL01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

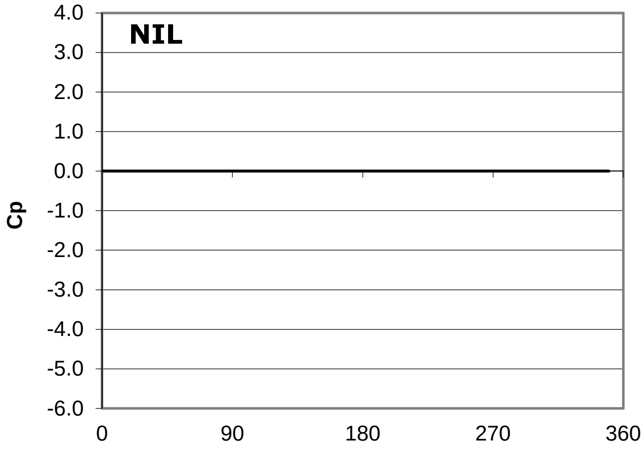

SJ01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

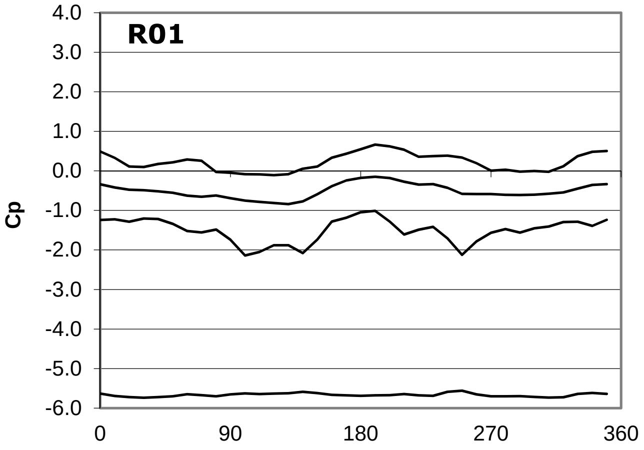

SK01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

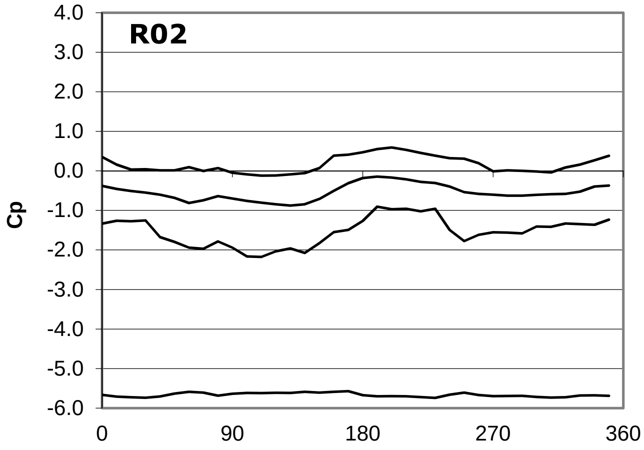

SL01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

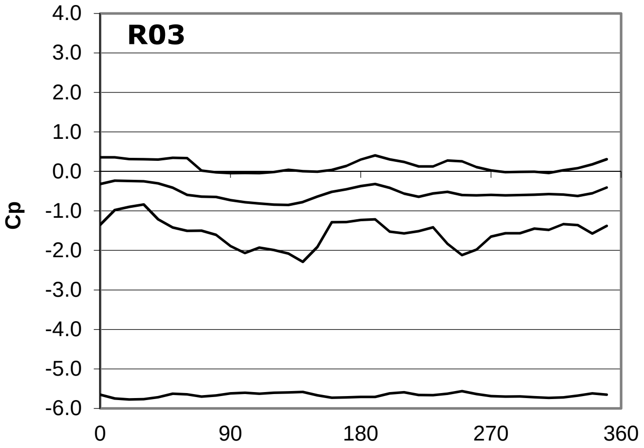

SL02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

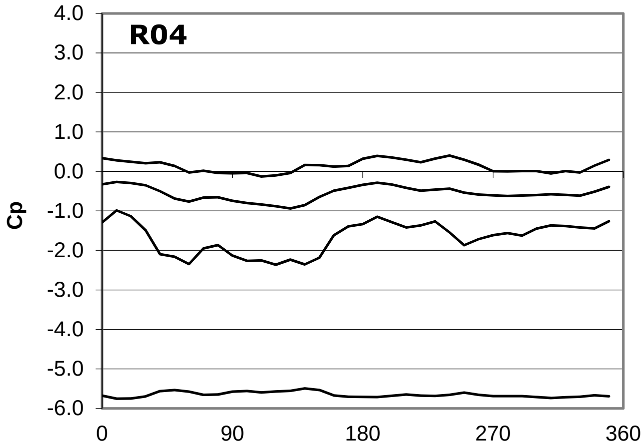

SL03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

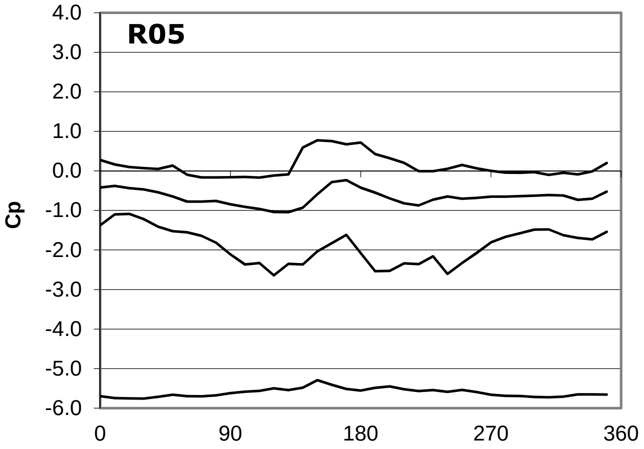

NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

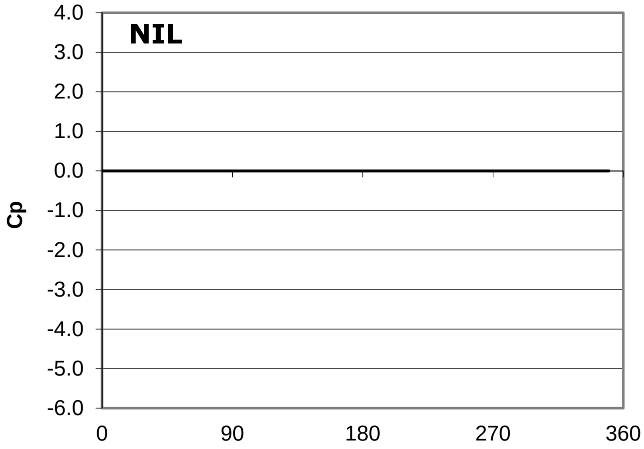

R01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

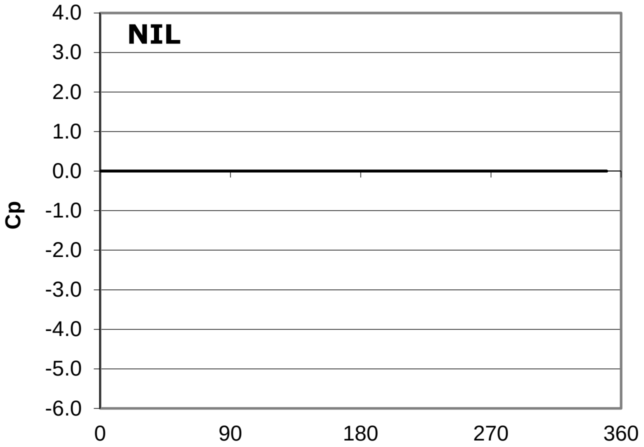

R02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

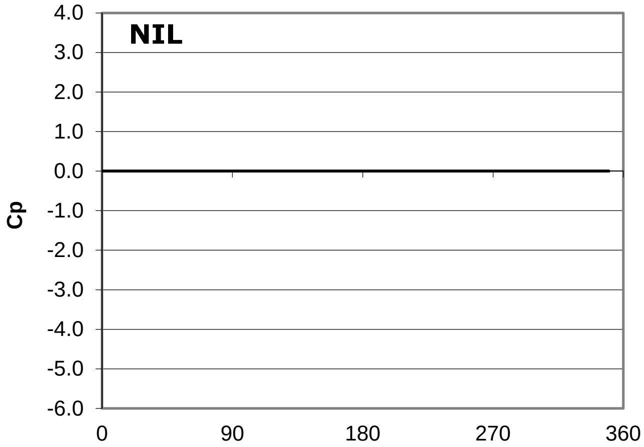

R03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

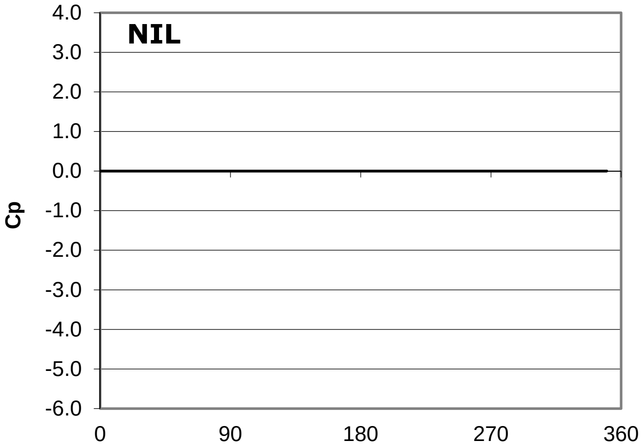

R04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

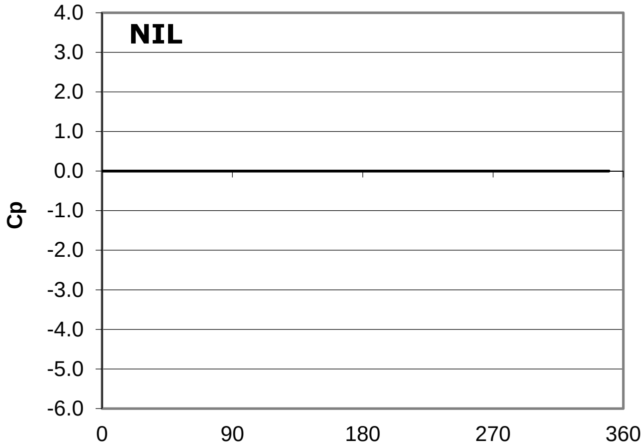

R05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

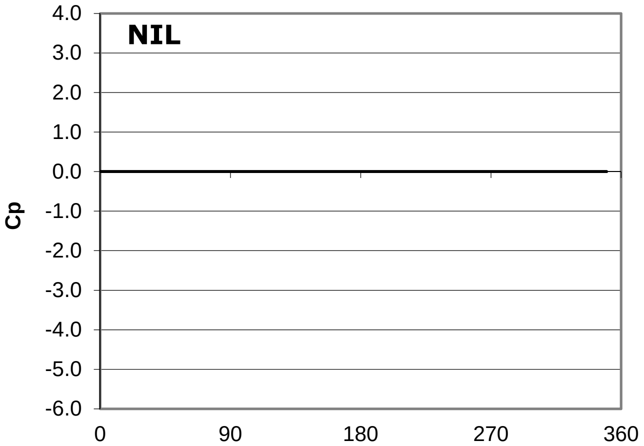

NIL
Cp

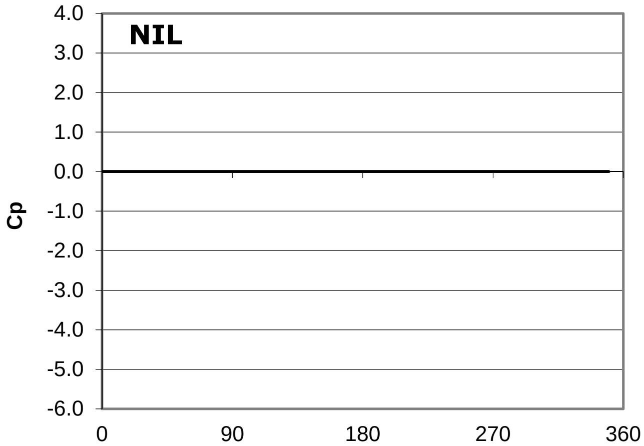

NIL
Cp

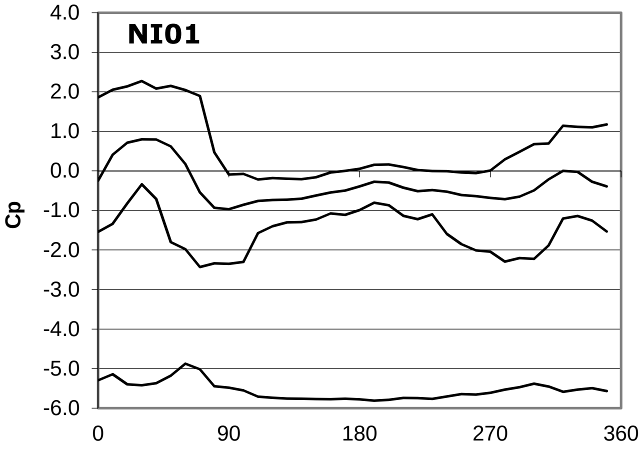

NIL
Cp

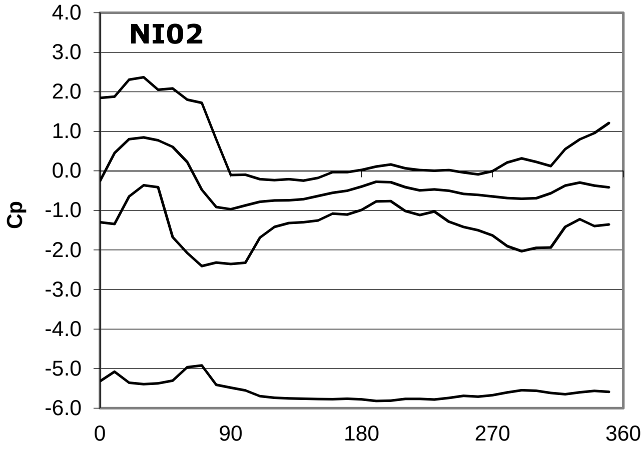

NIL
Cp

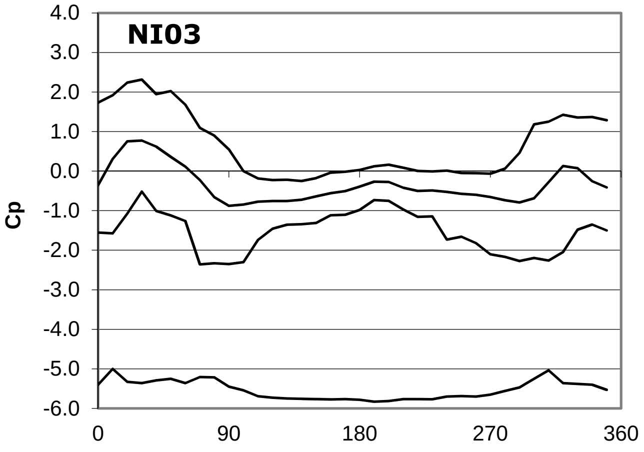

NIL
Cp

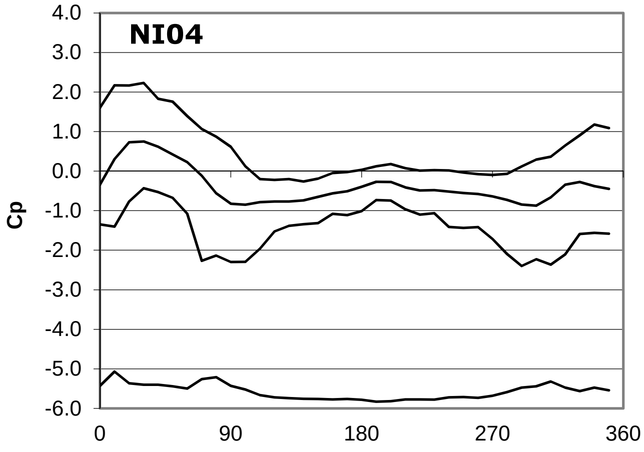

NIL
Cp

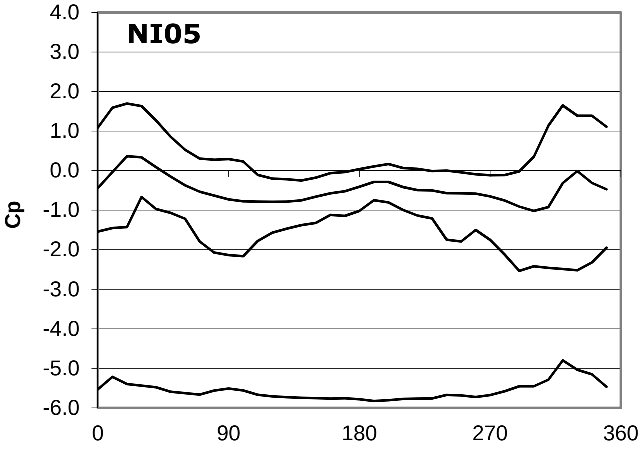

NIL
Cp

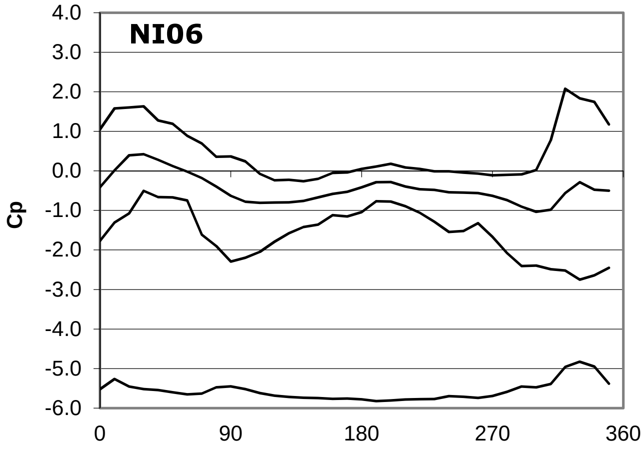

NI01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

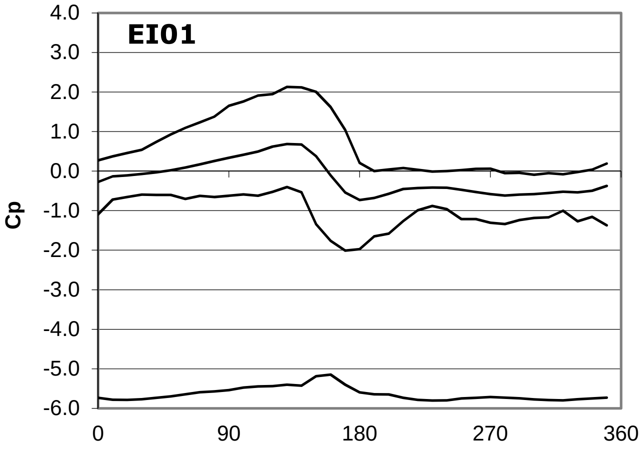

NI02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

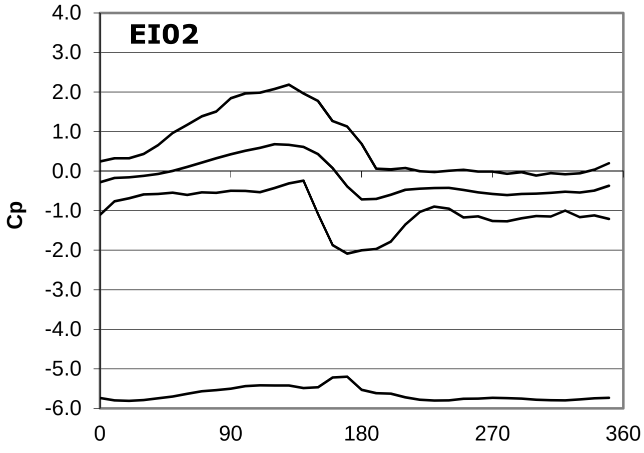

NI03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

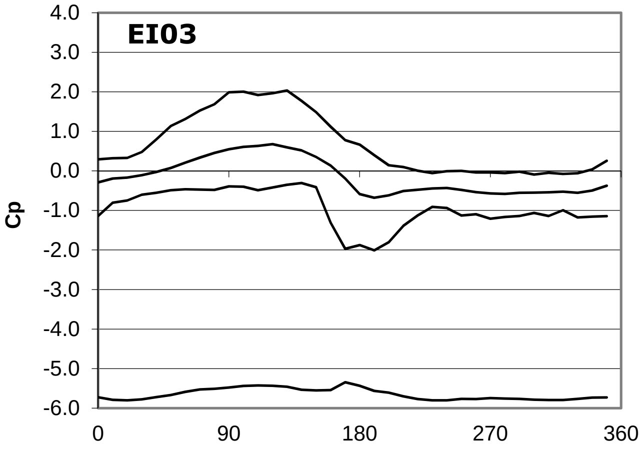

NI04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

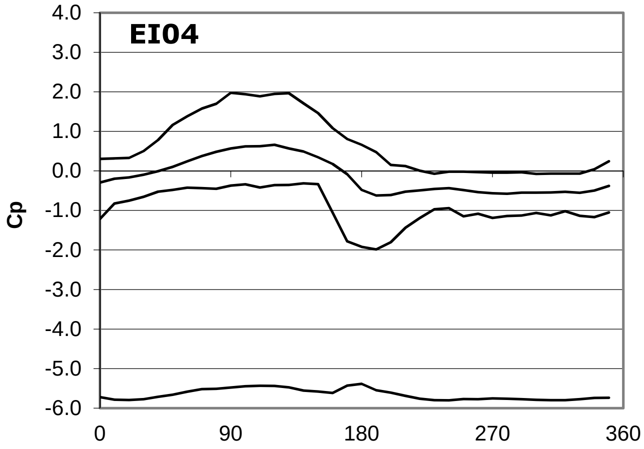

NI05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

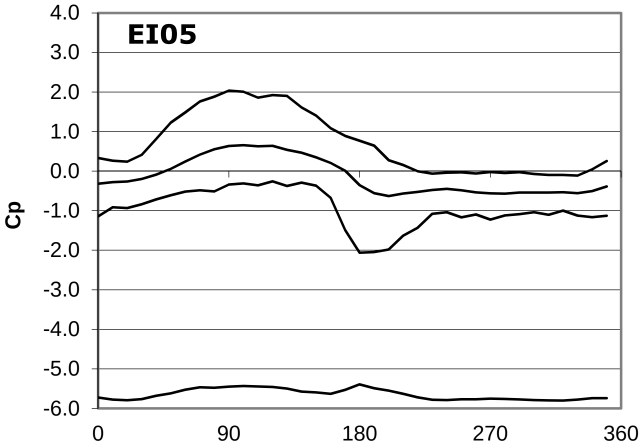

NI06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

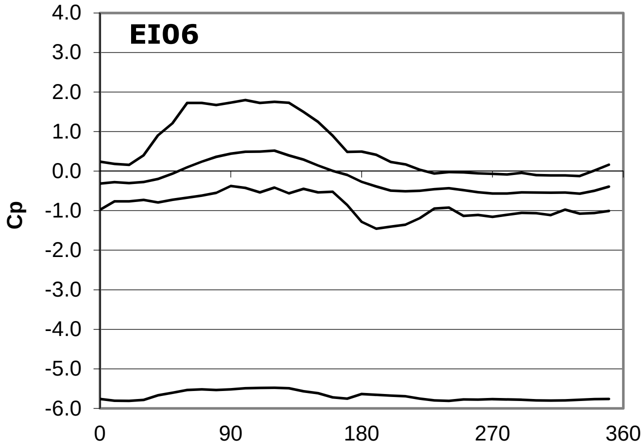

EI01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

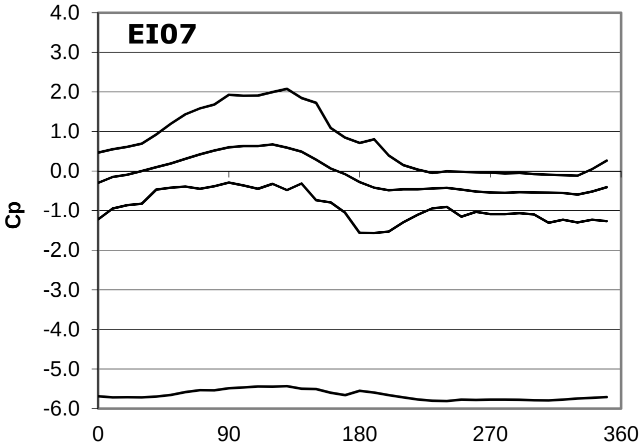

EI02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

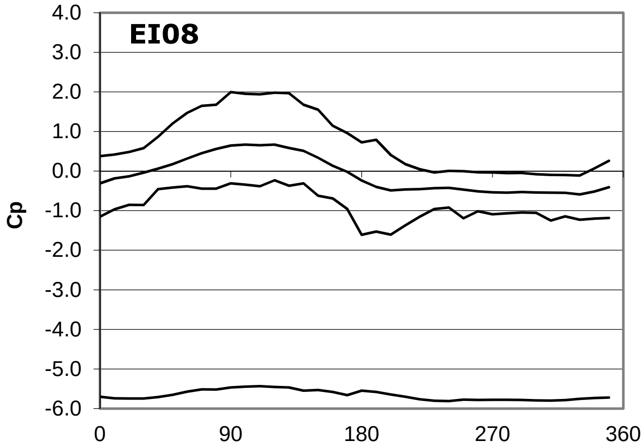

EI03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

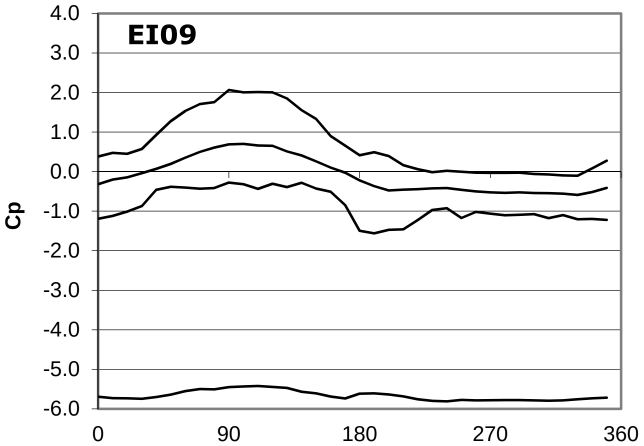

EI04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

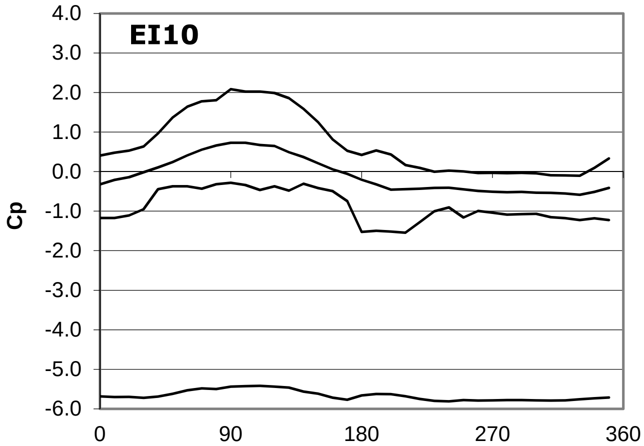

EI05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

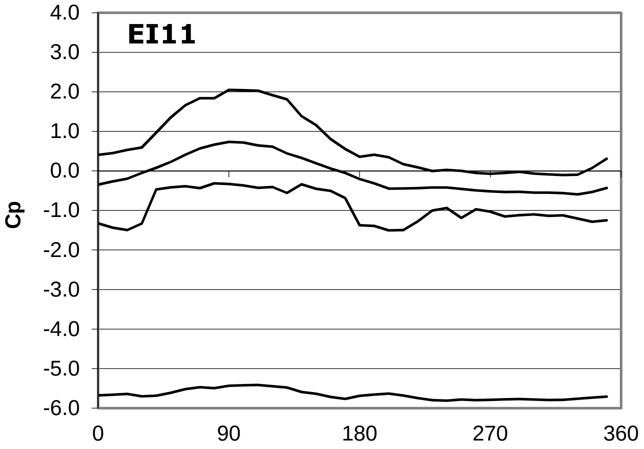

EI06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

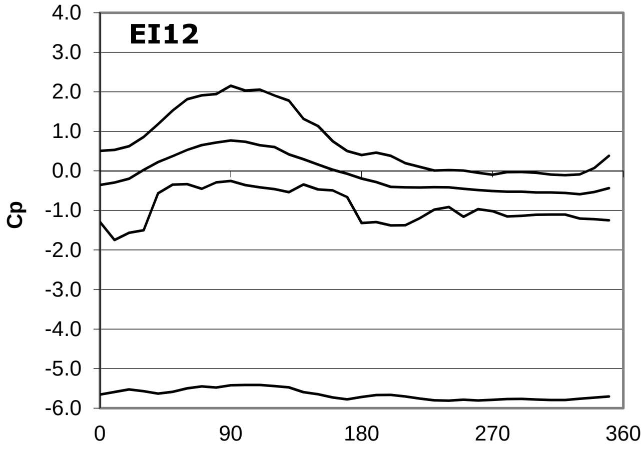

EI07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

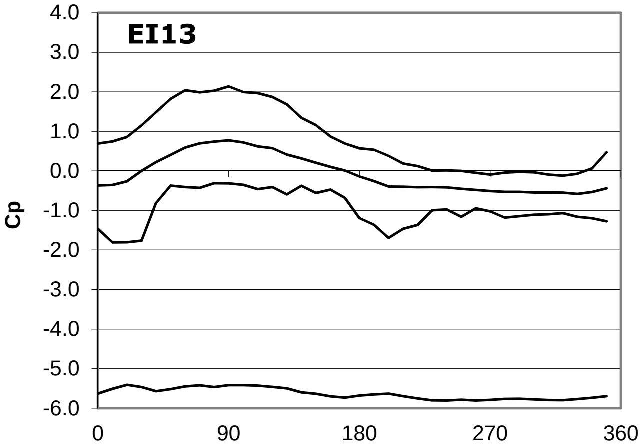

EI08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

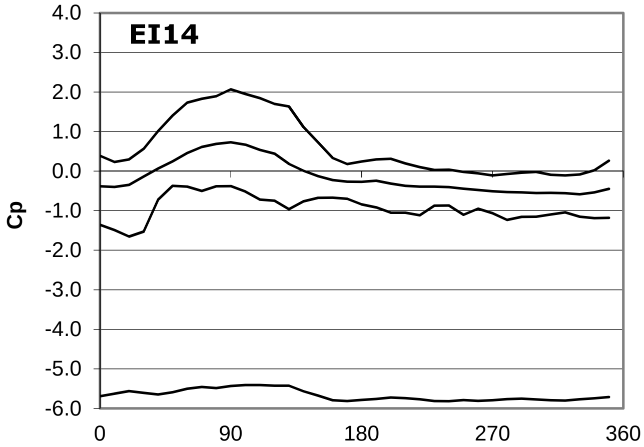

EI09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

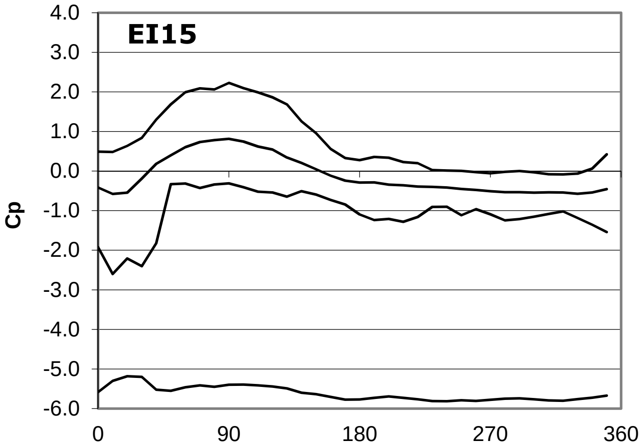

EI10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

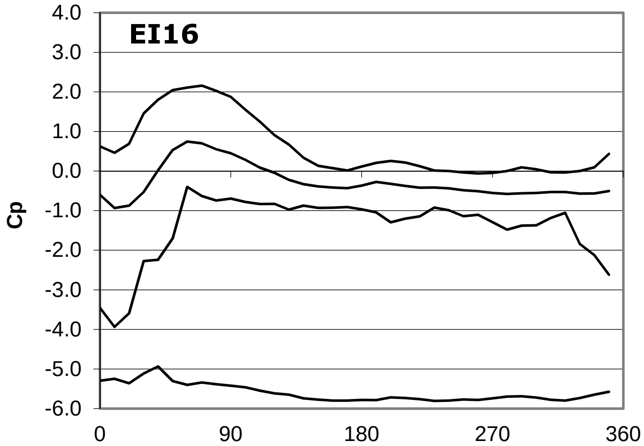

EI11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

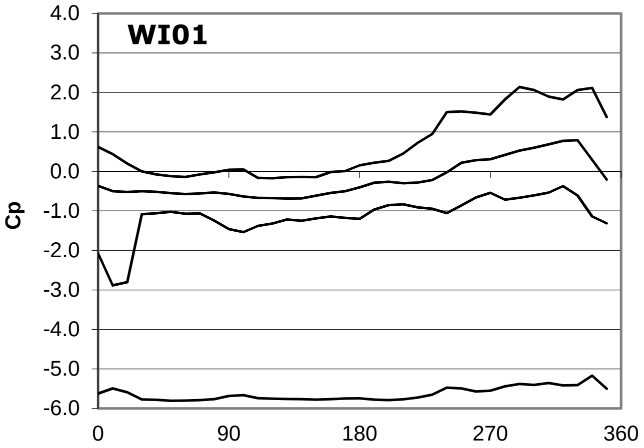

EI12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

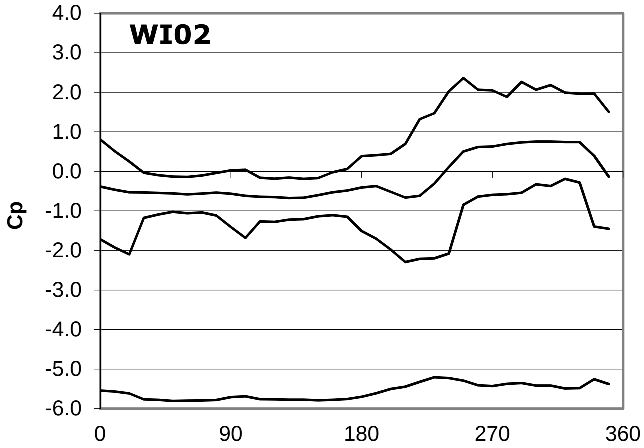

EI13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

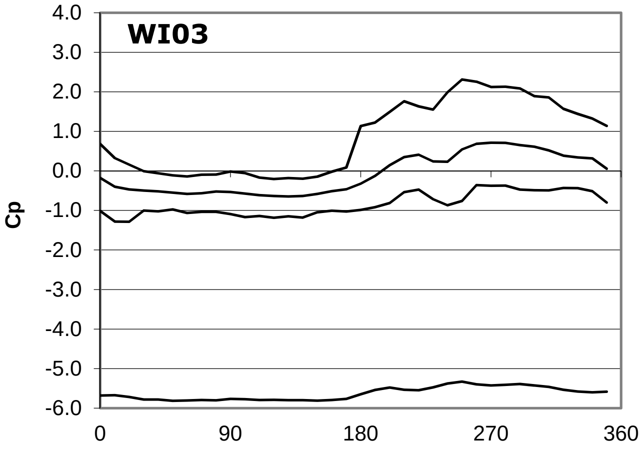

EI14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

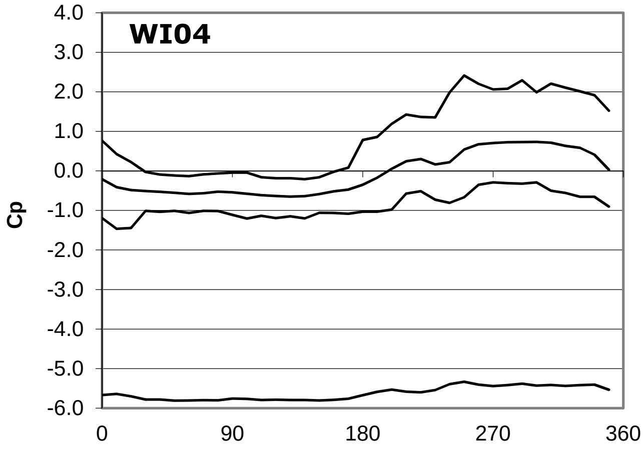

EI15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

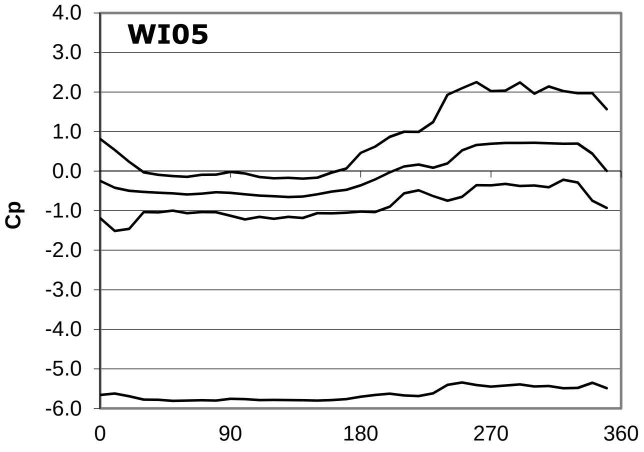

EI16
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

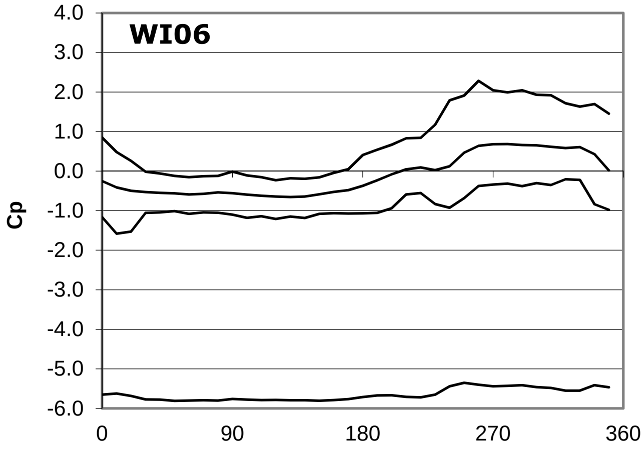

WI01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

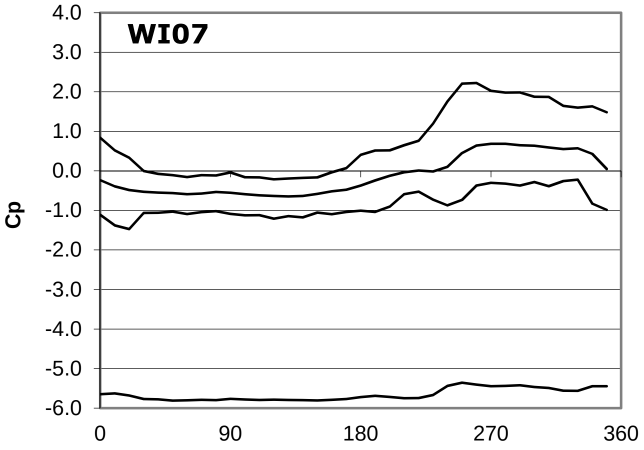

WI02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

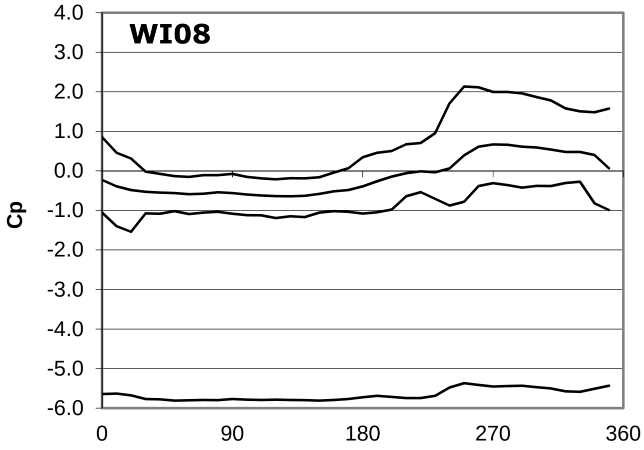

WI03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

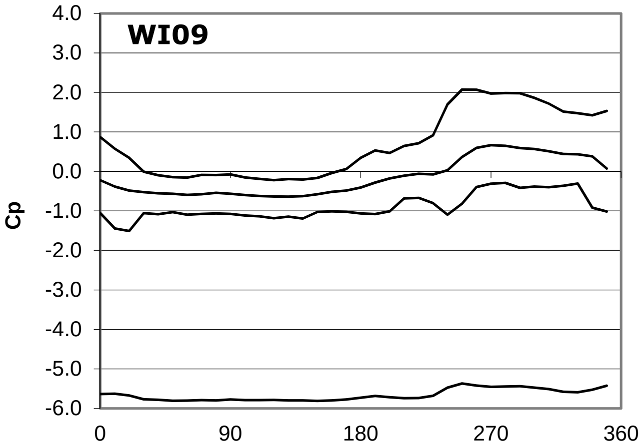

WI04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

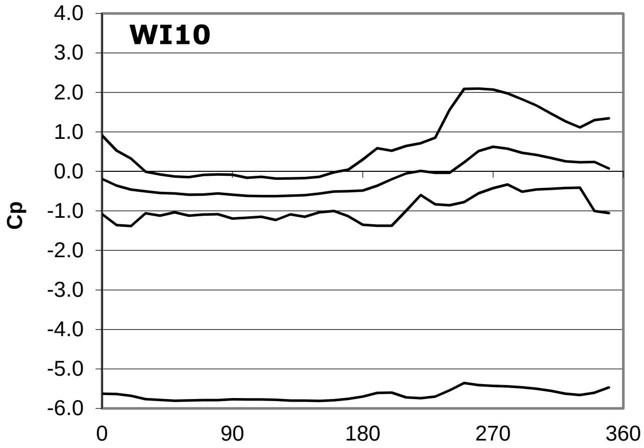

WI05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

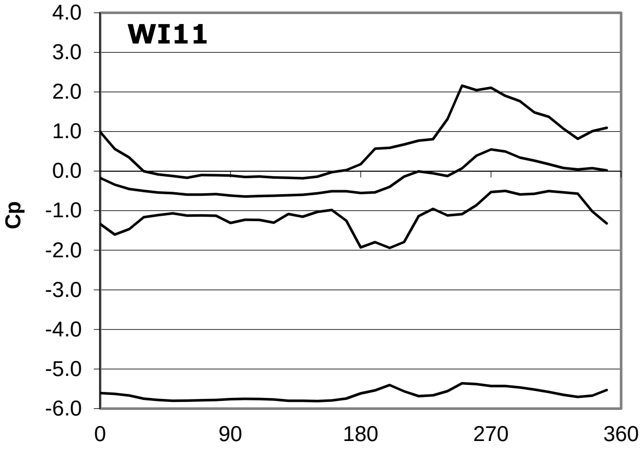

WI06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

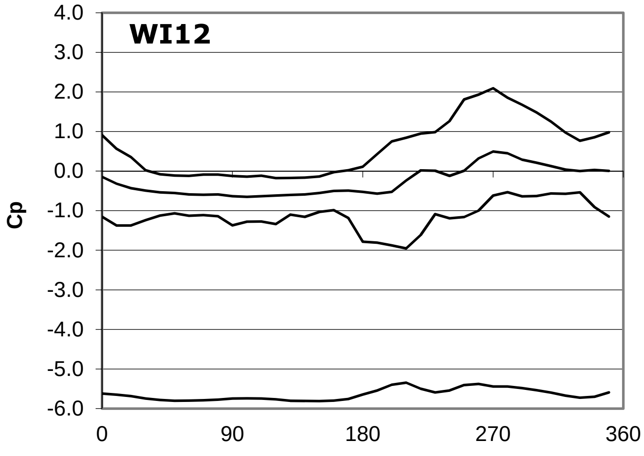

WI07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

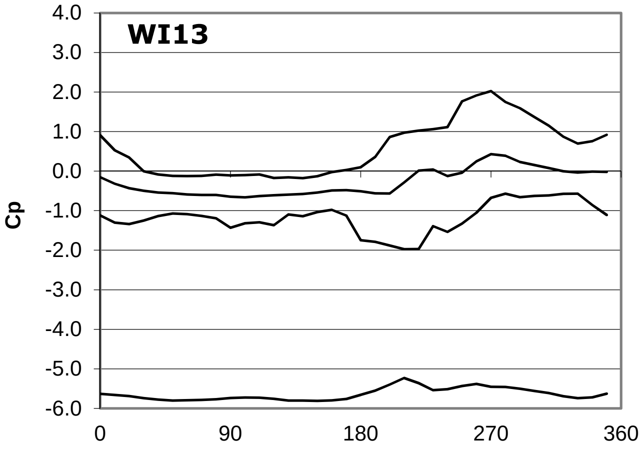

WI08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

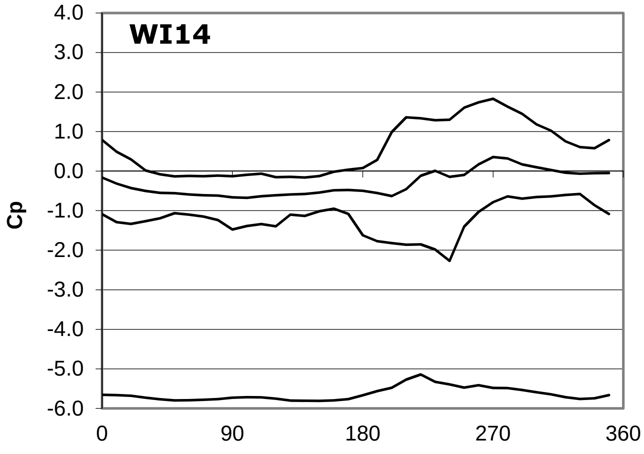

WI09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

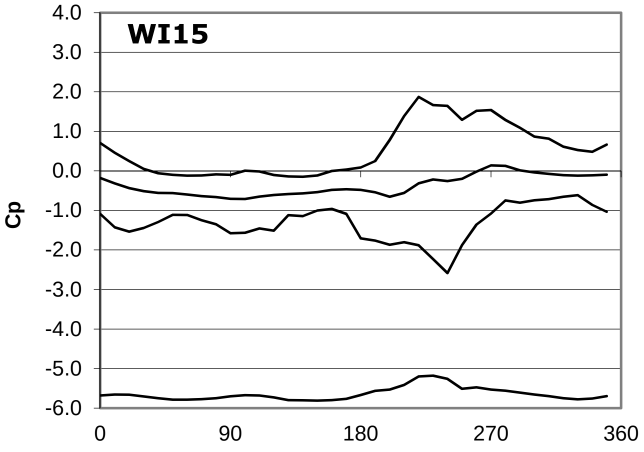

WI10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

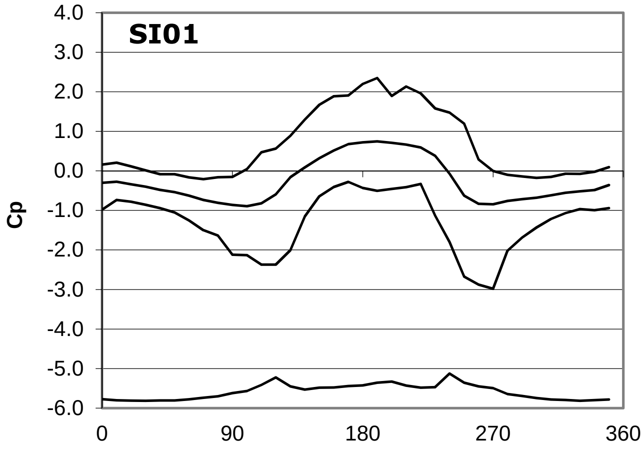

WI11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

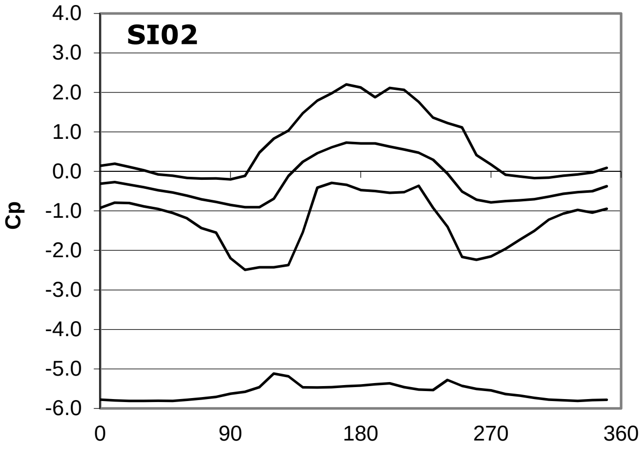

WI12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

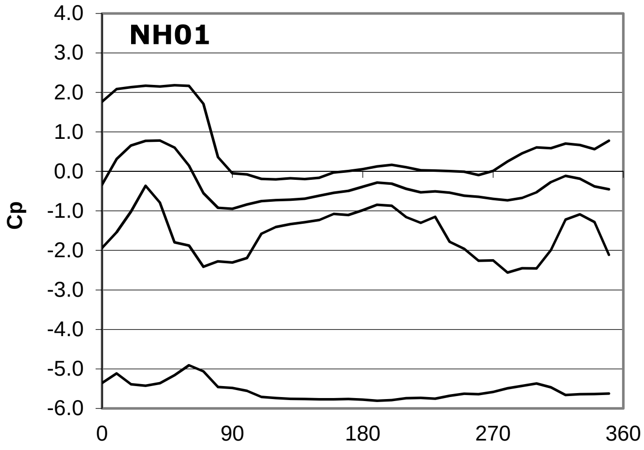

WI13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

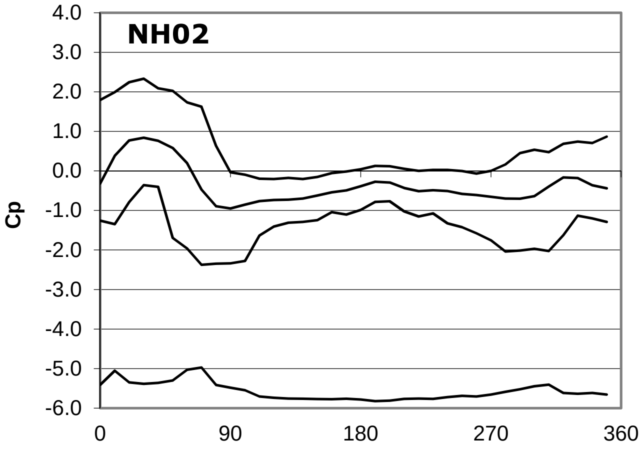

WI14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

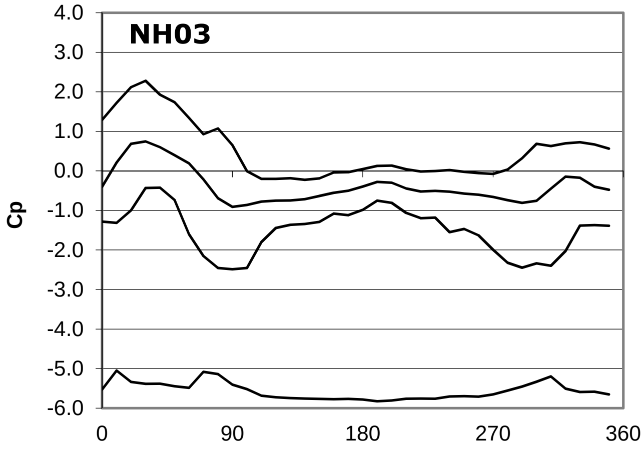

WI15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

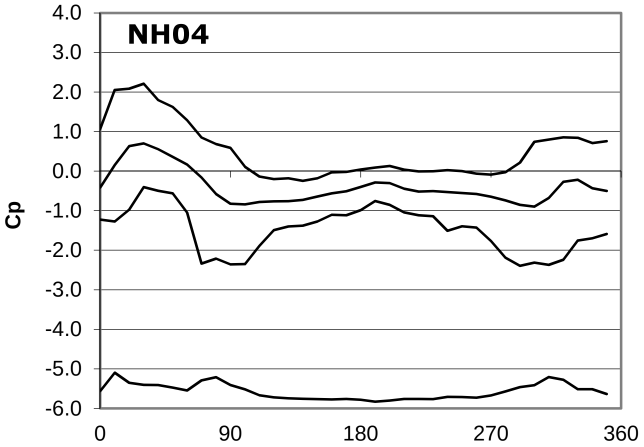

SI01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

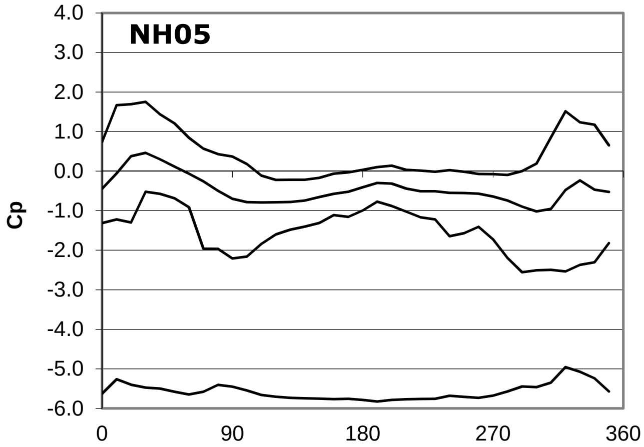

SI02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

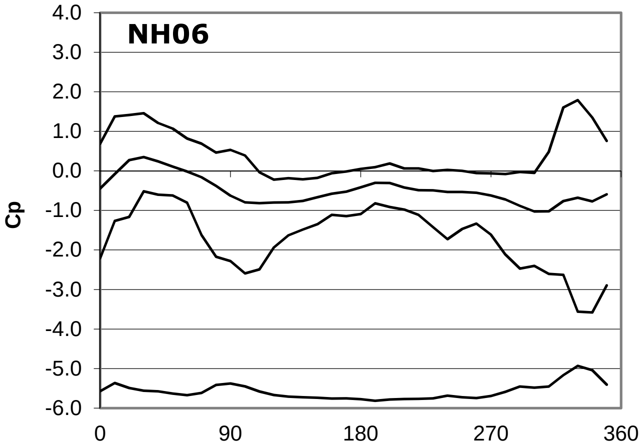

NH01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

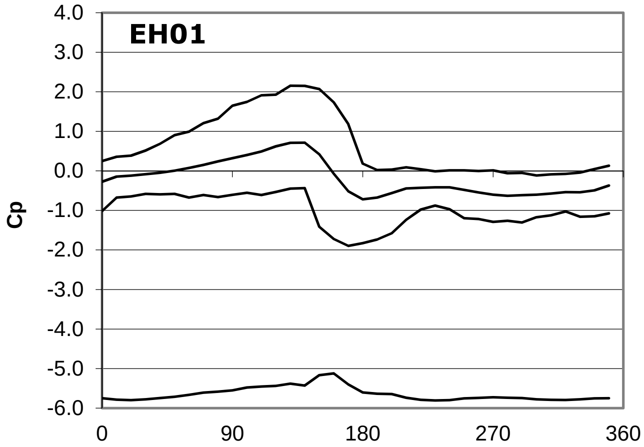

NH02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

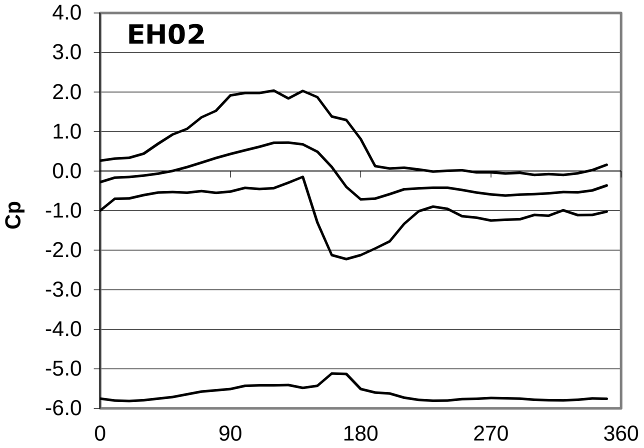

NH03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

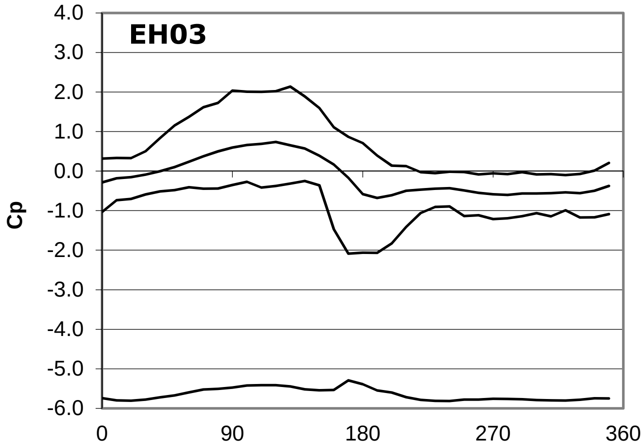

NH04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

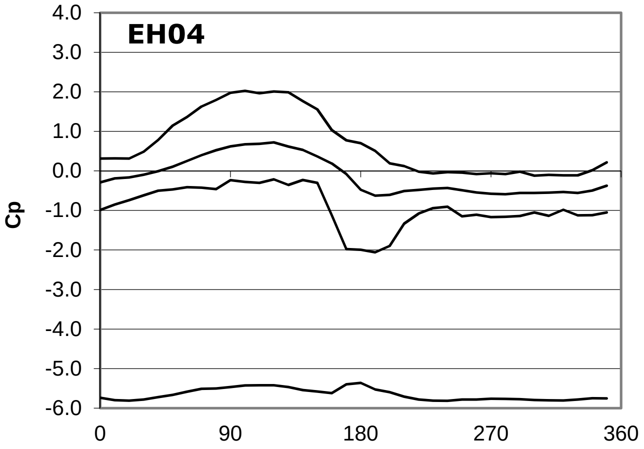

NH05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

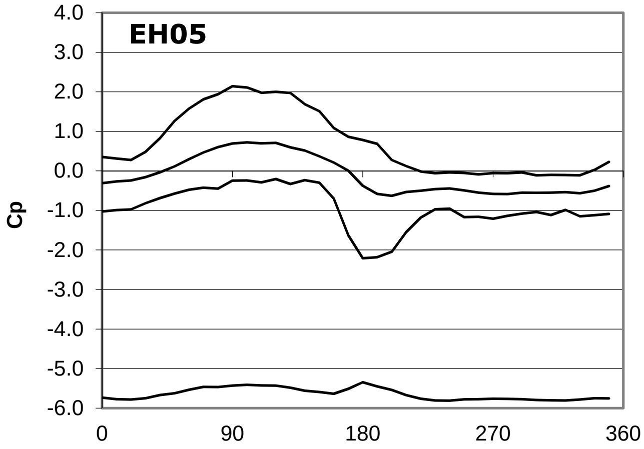

NH06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

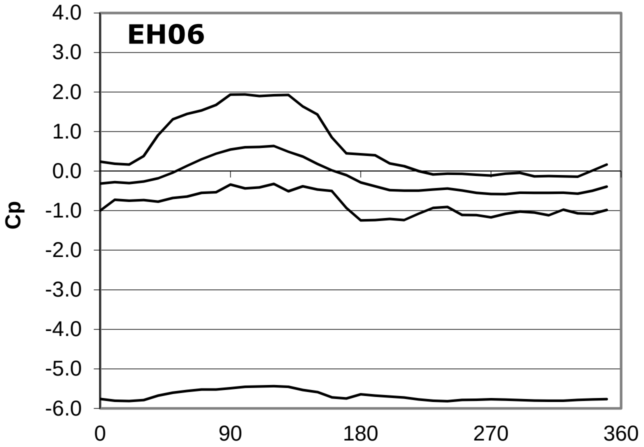

EH01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

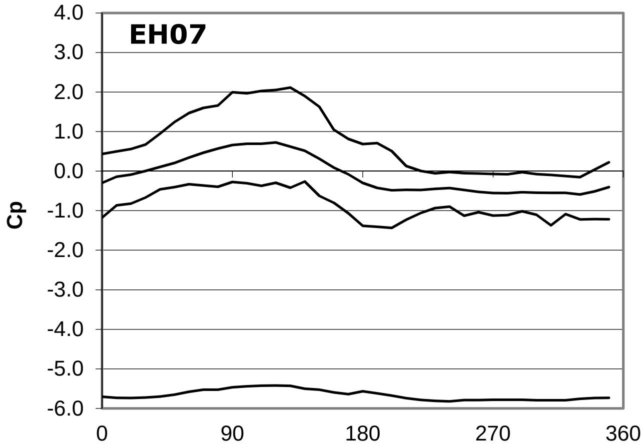

EH02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

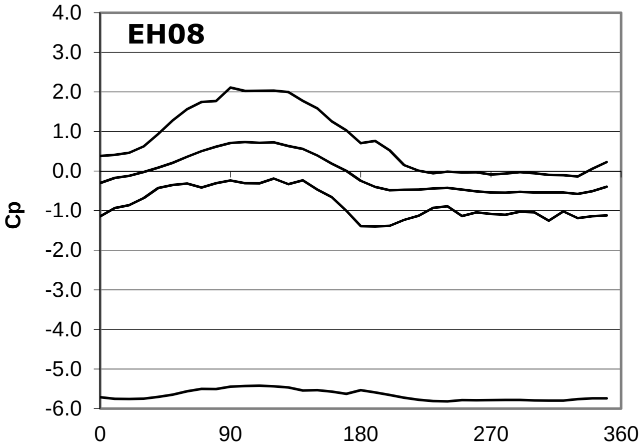

EH03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

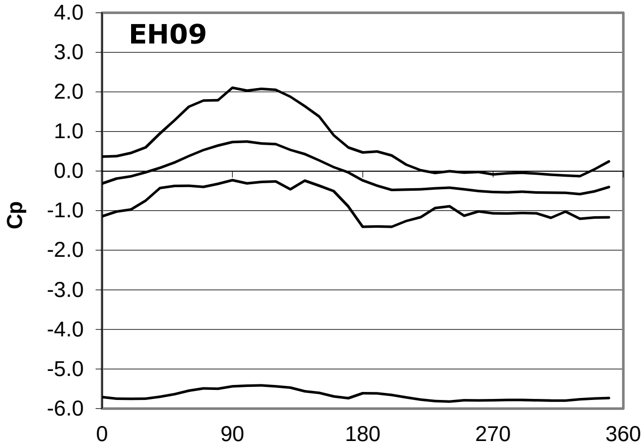

EH04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

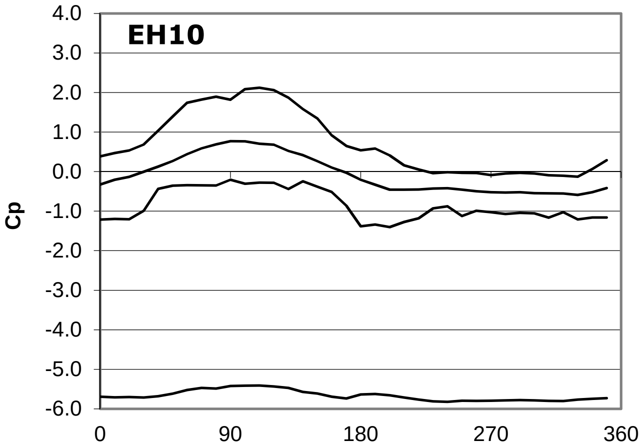

EH05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

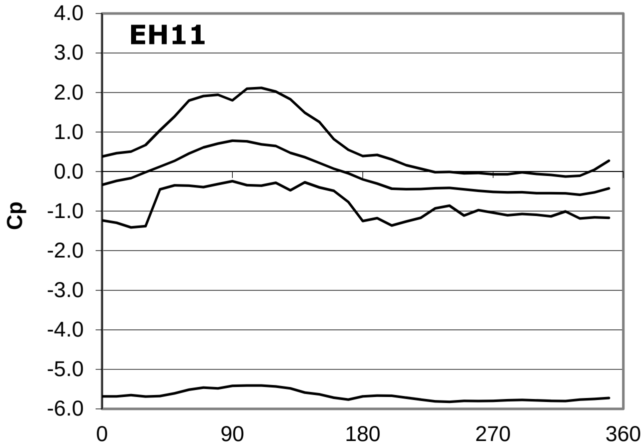

EH06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

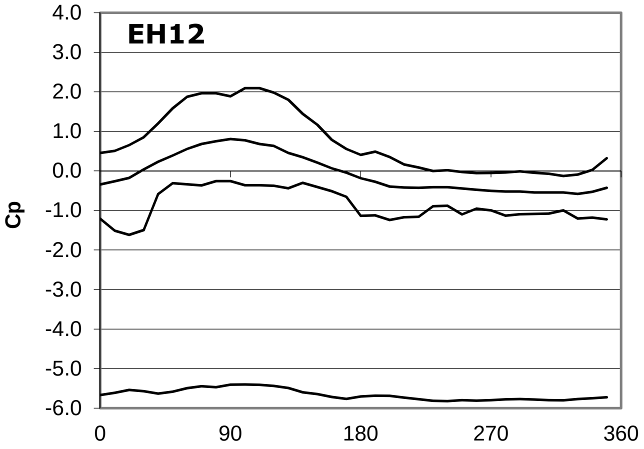

EH07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

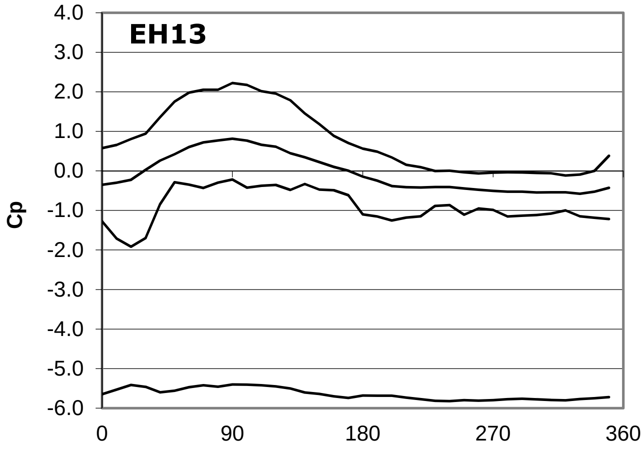

EH08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

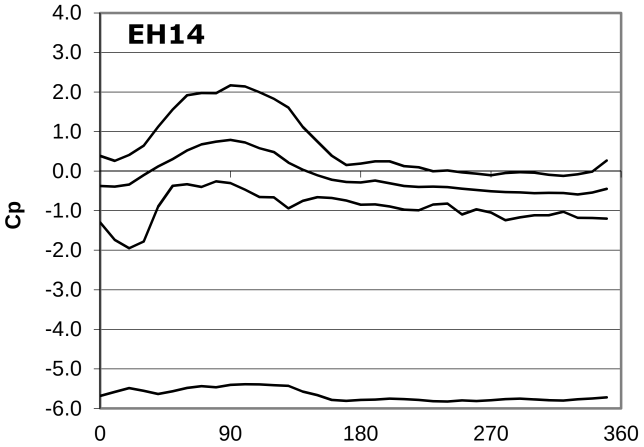

EH09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

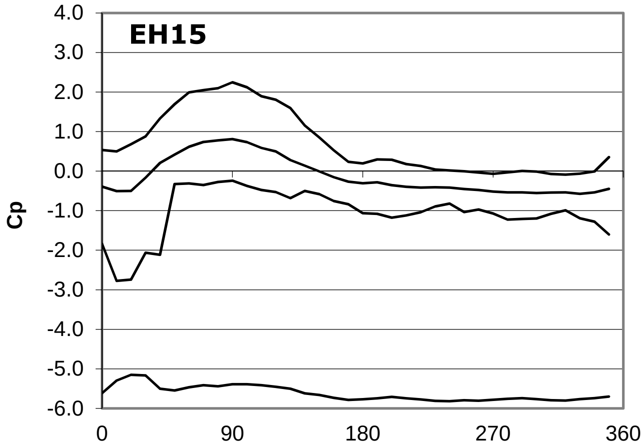

EH10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

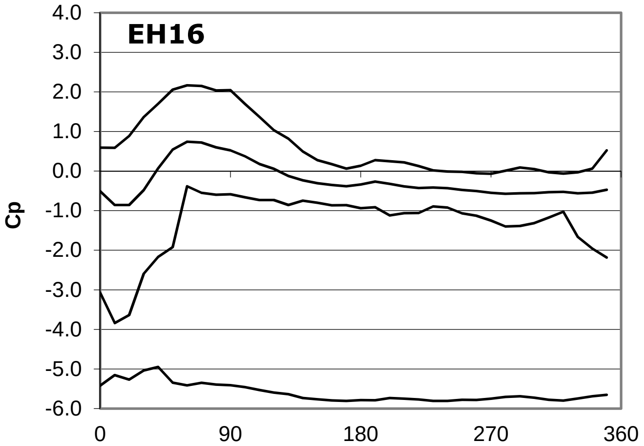

EH11
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

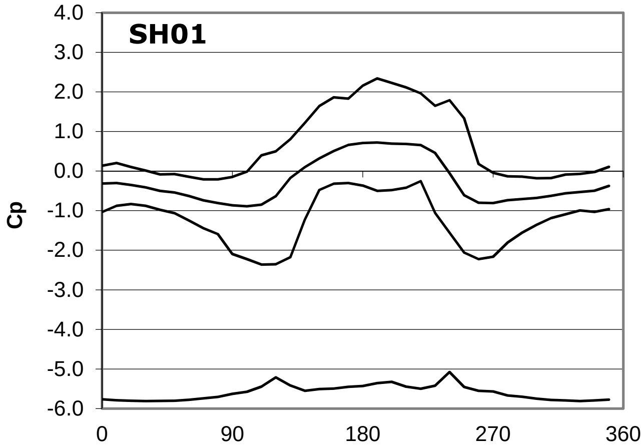

EH12
Cp

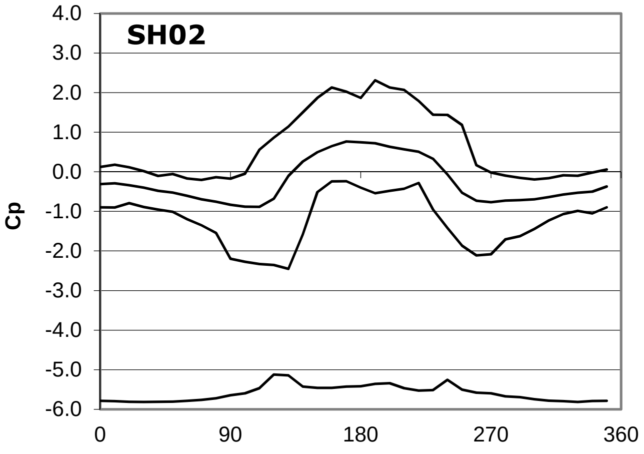

EH13
Cp

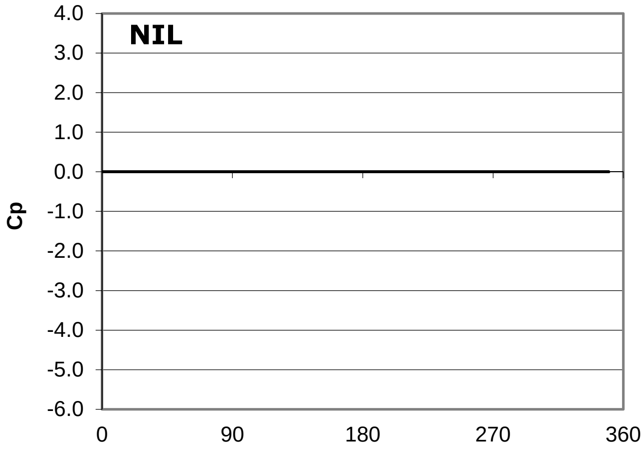

EH14
Cp

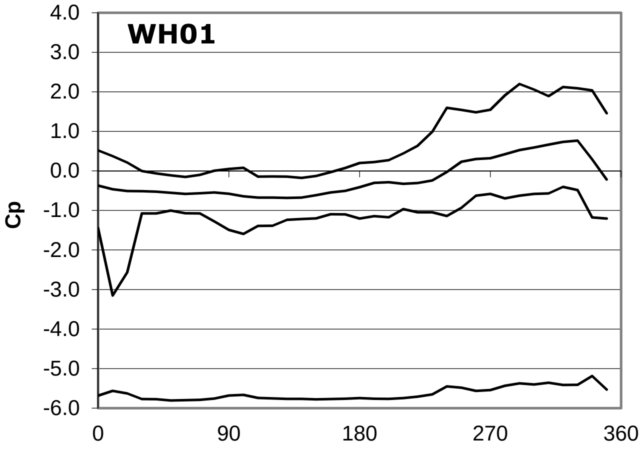

EH15
Cp

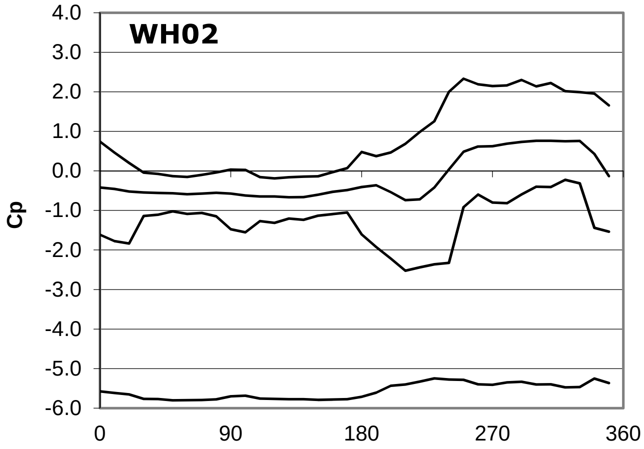

EH16
Cp

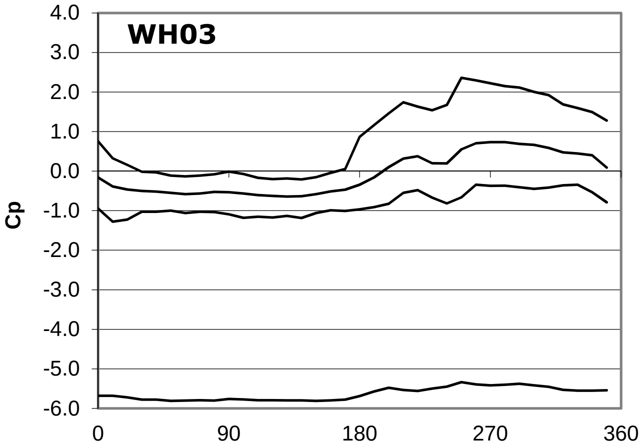

SH01
Cp

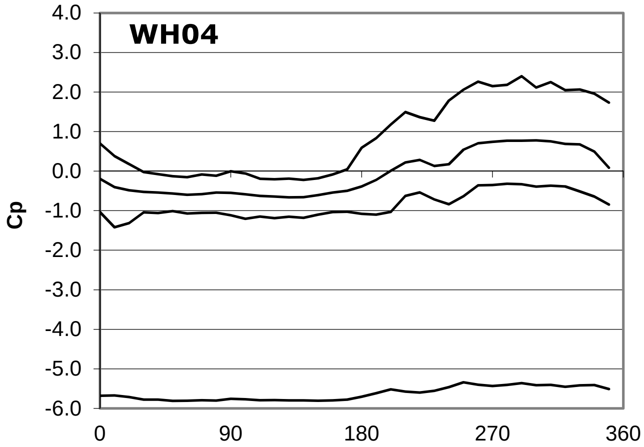

SH02
Cp

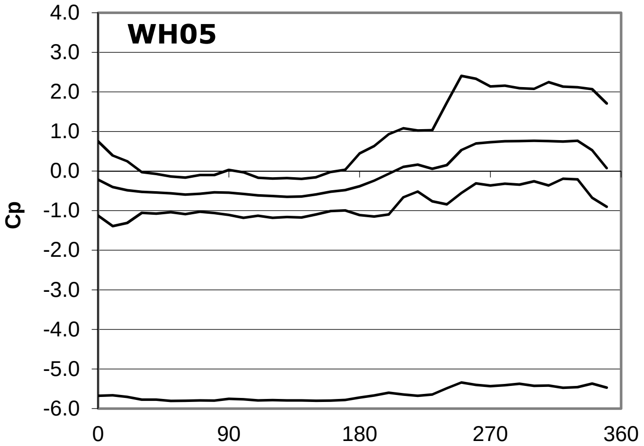

NIL
Cp

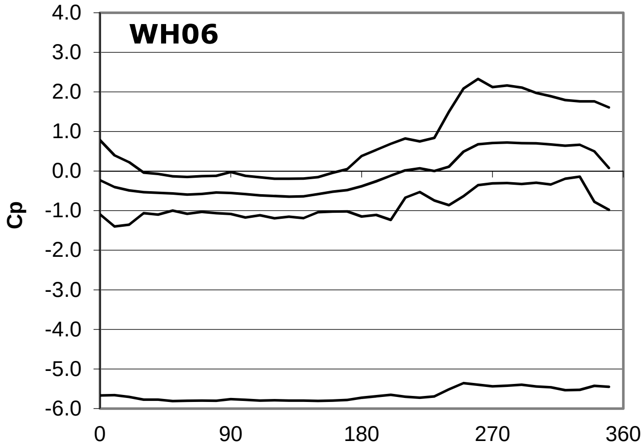

WH01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

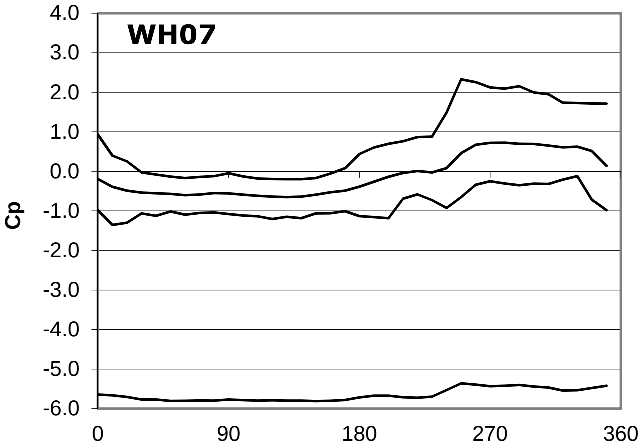

WH02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

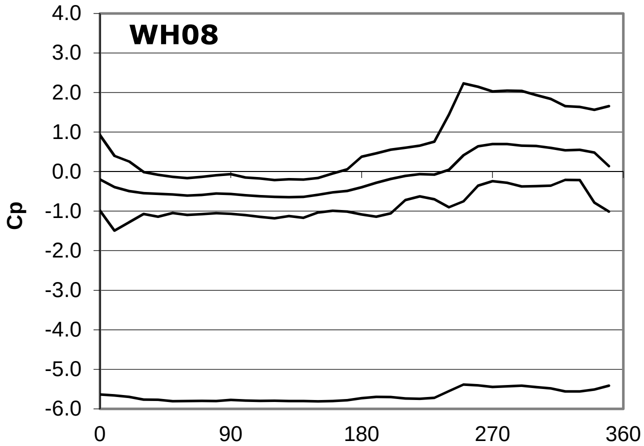

WH03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

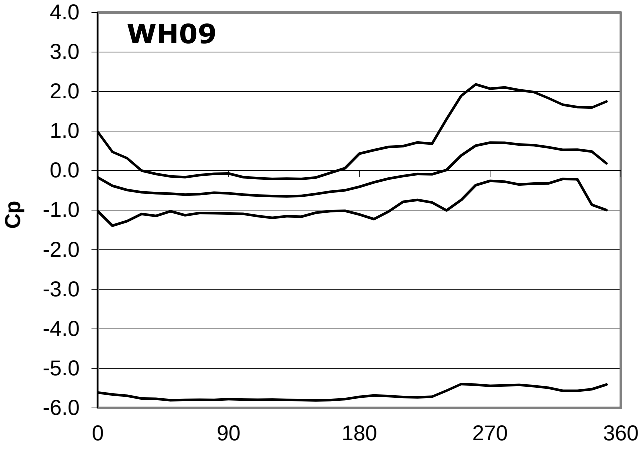

WH04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

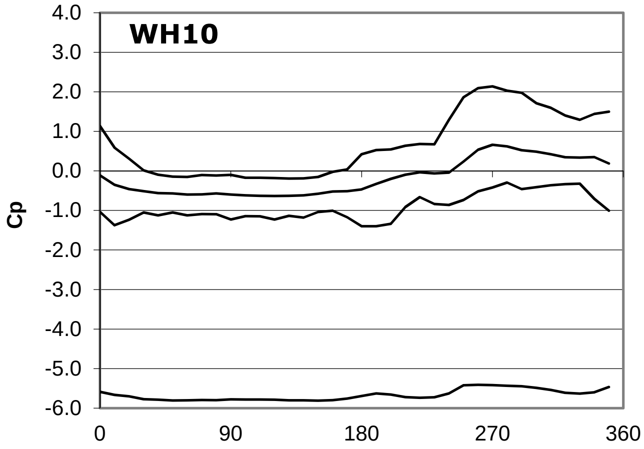

WH05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

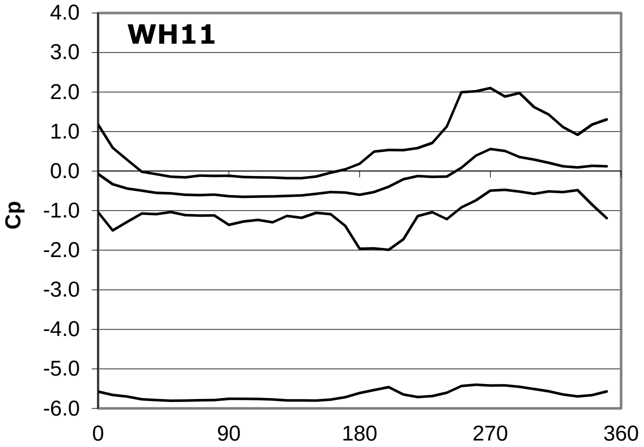

WH06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

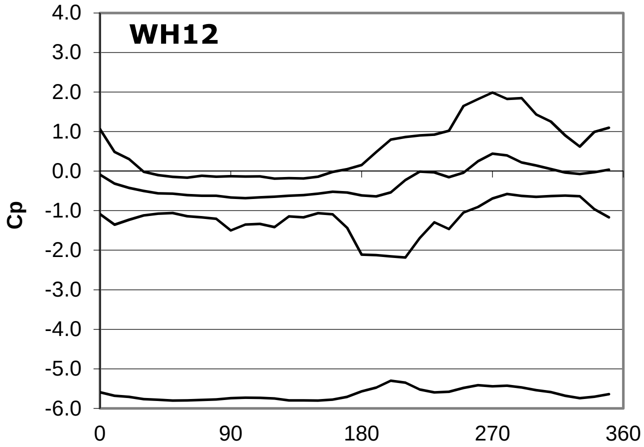

WH07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

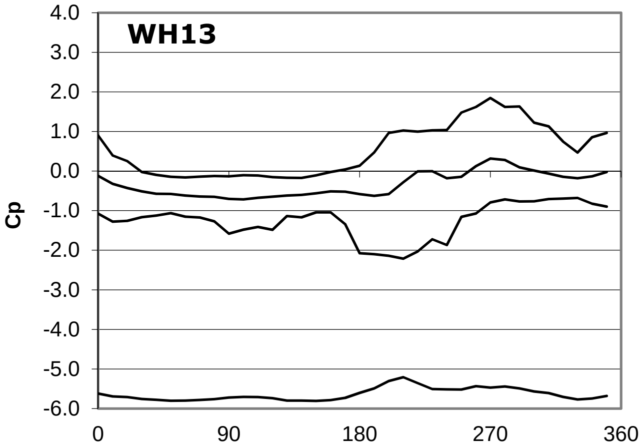

WH08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

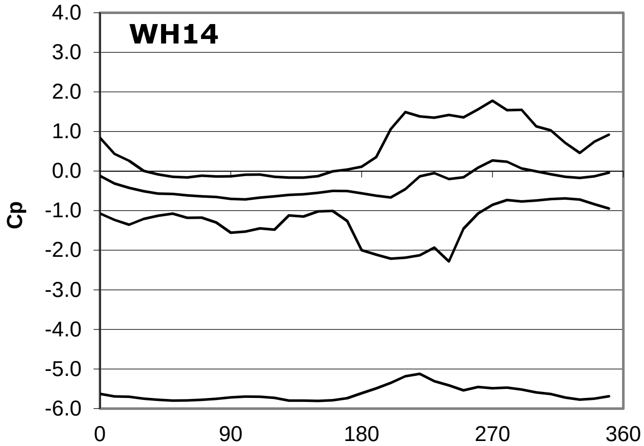

WH09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

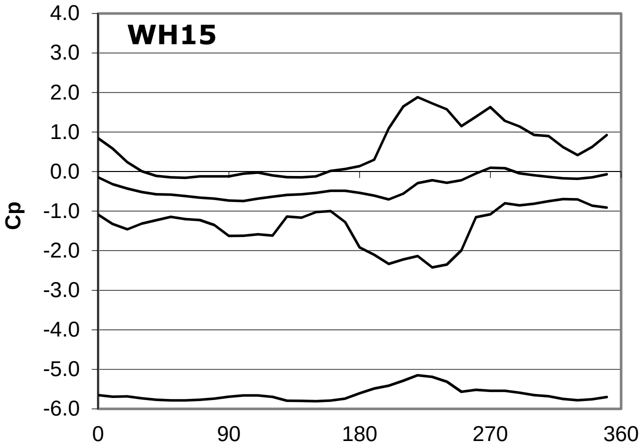

WH10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

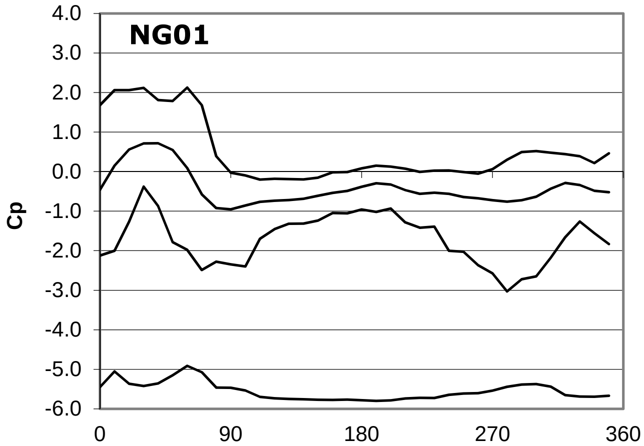

WH11
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

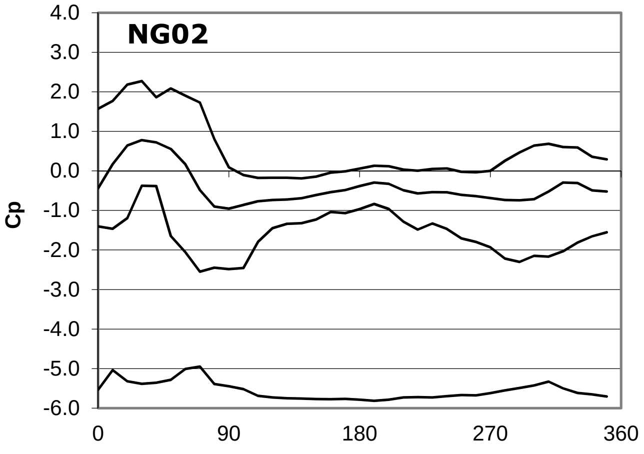

WH12
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

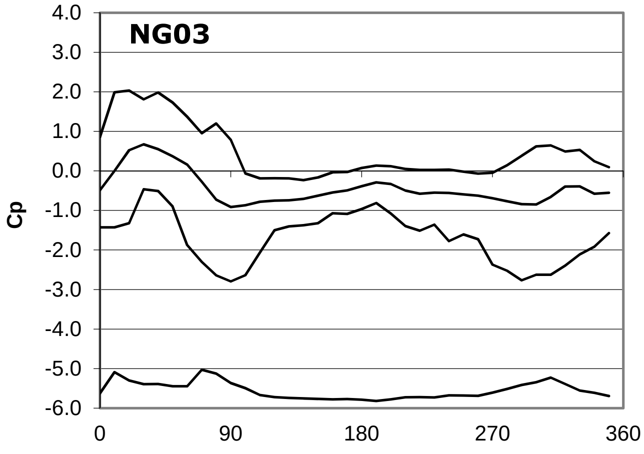

WH13
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

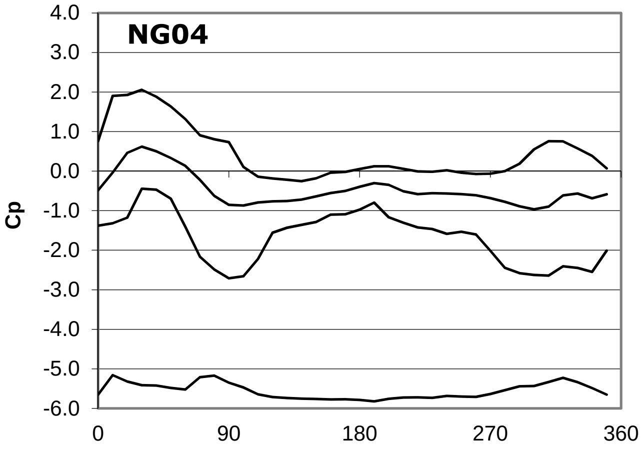

WH14
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

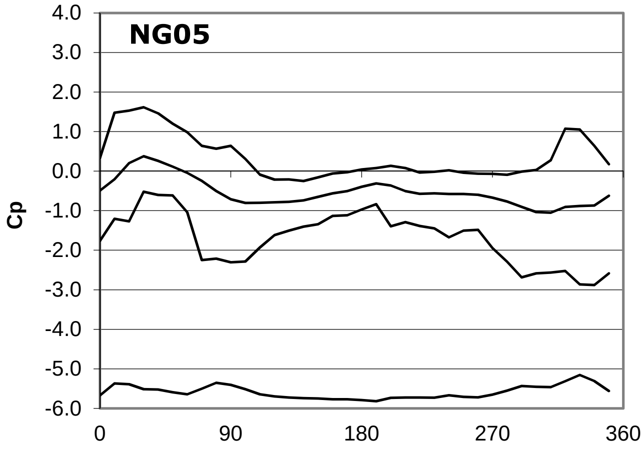

WH15
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

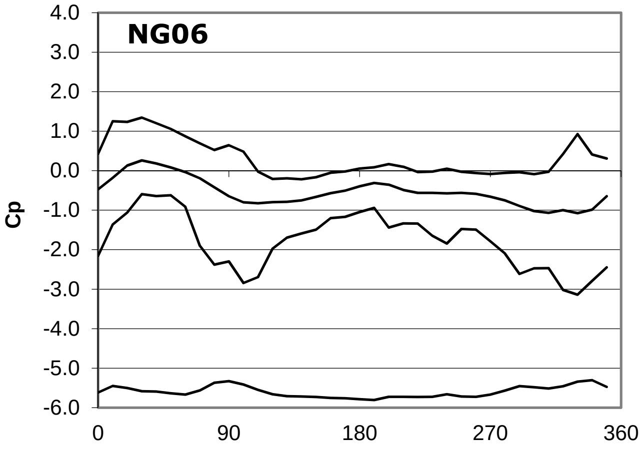

NG01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

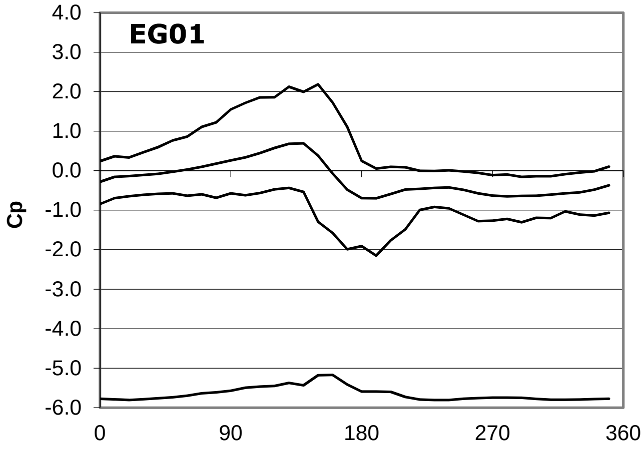

NG02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

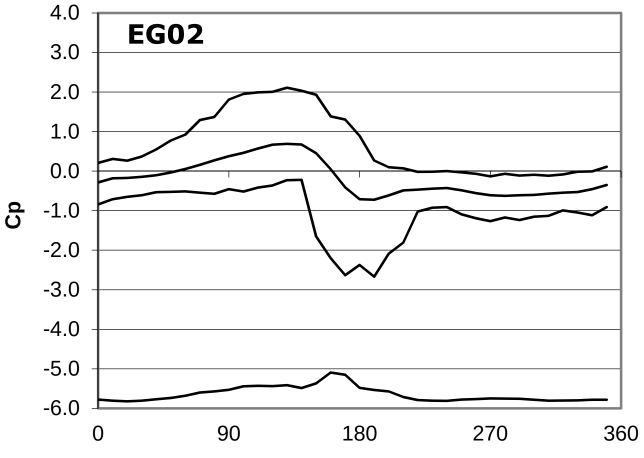

NG03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

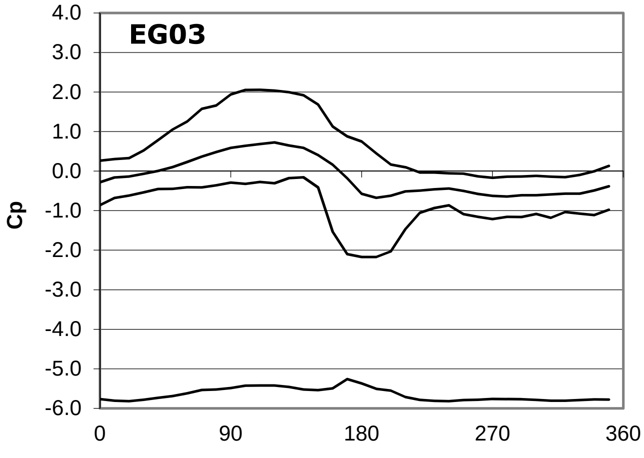

NG04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

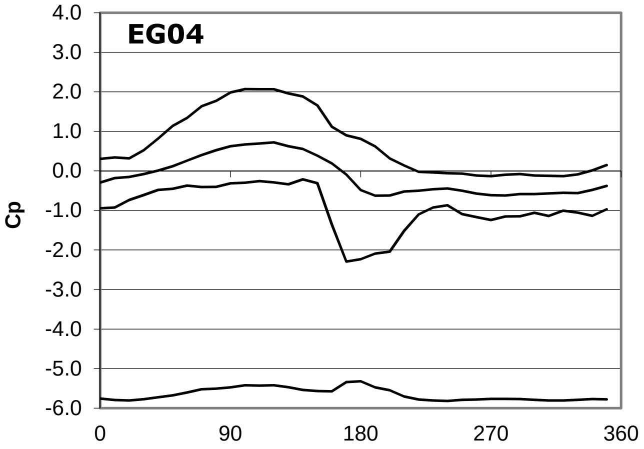

NG05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

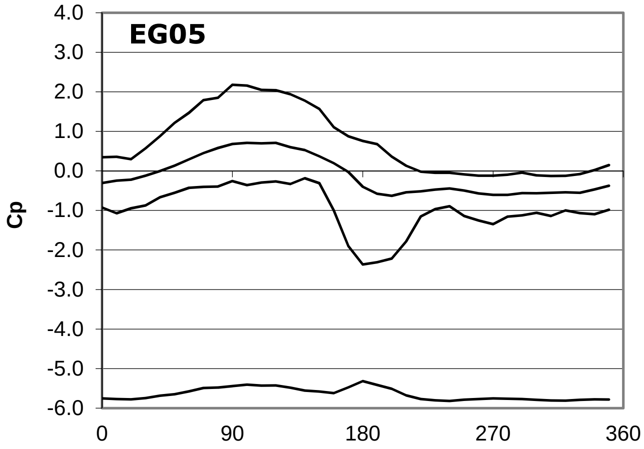

NG06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

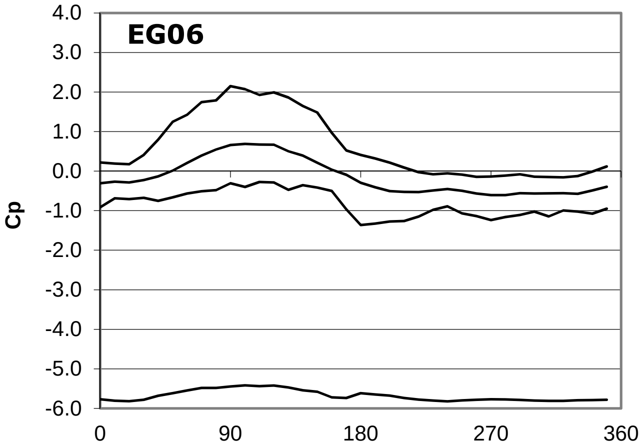

EG01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

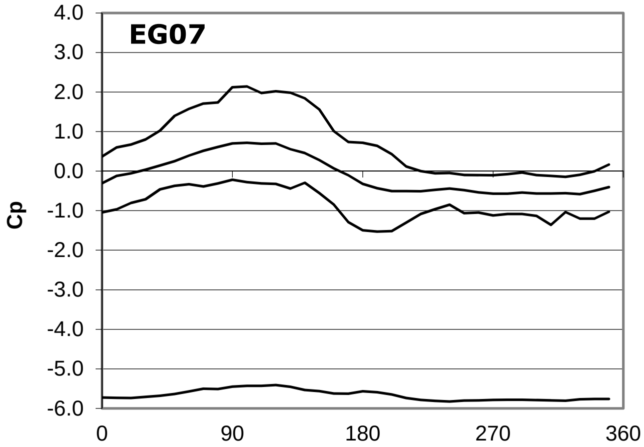

EG02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

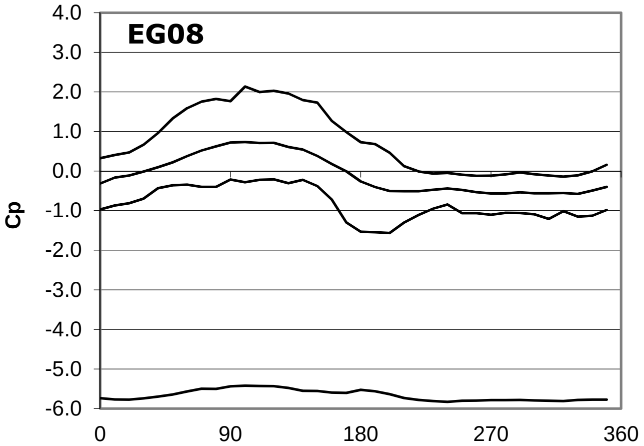

EG03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

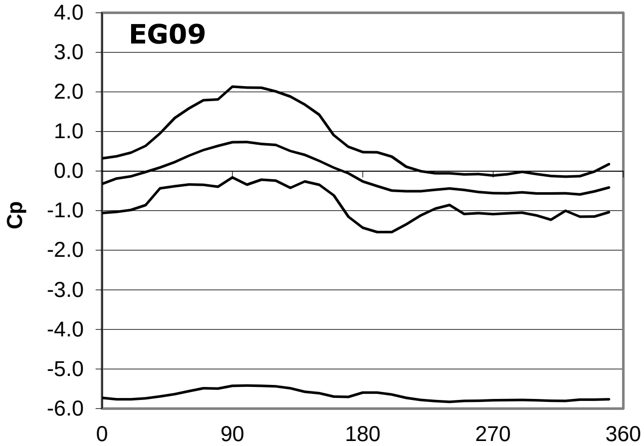

EG04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

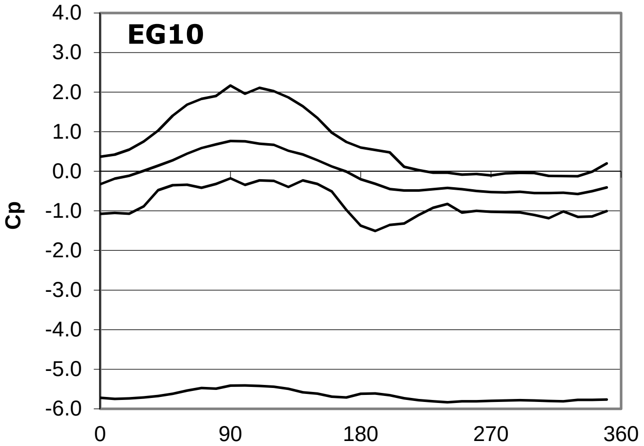

EG05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

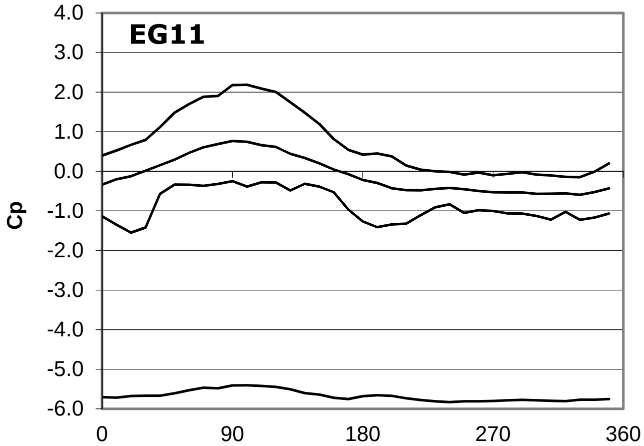

EG06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

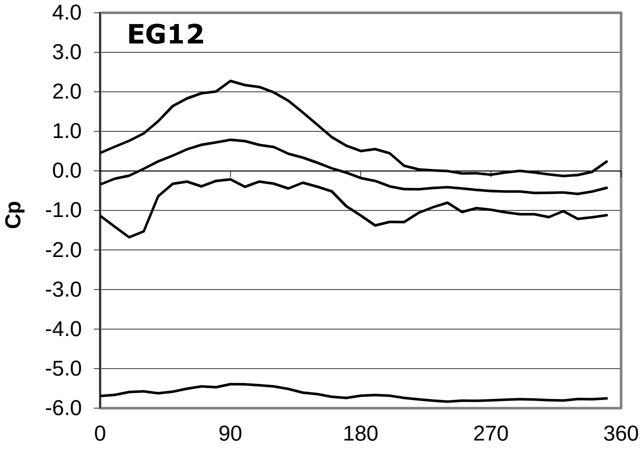

EG07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

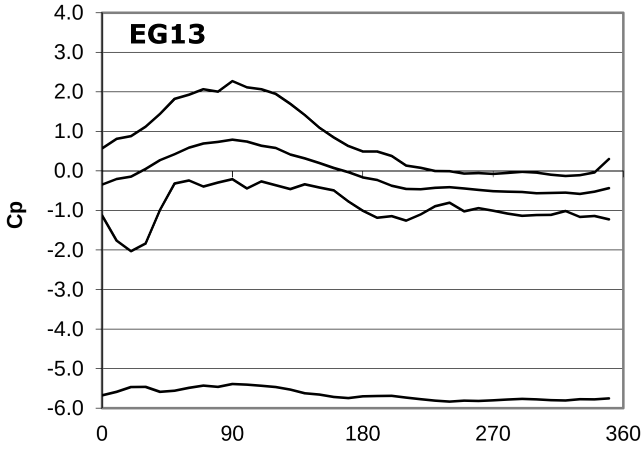

EG08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

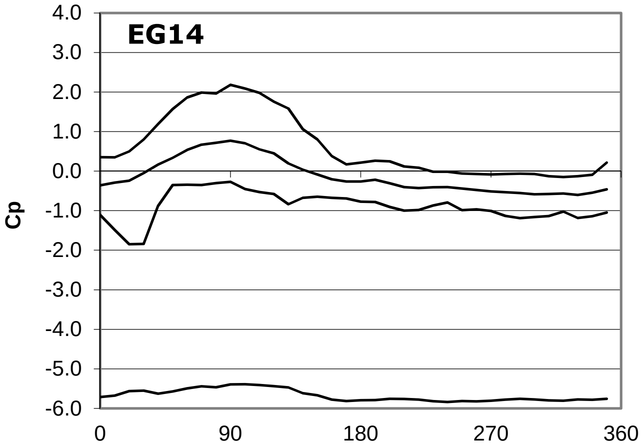

EG09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

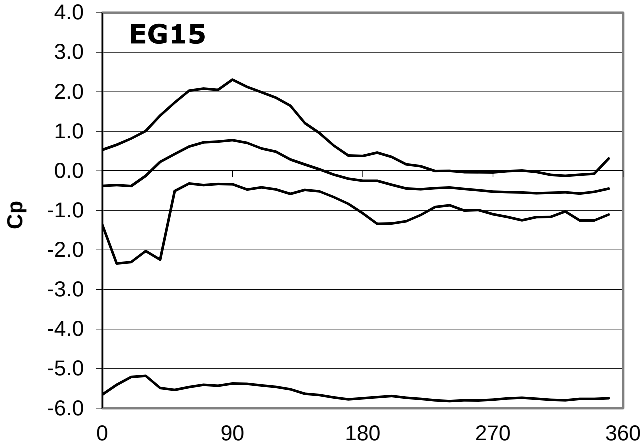

EG10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

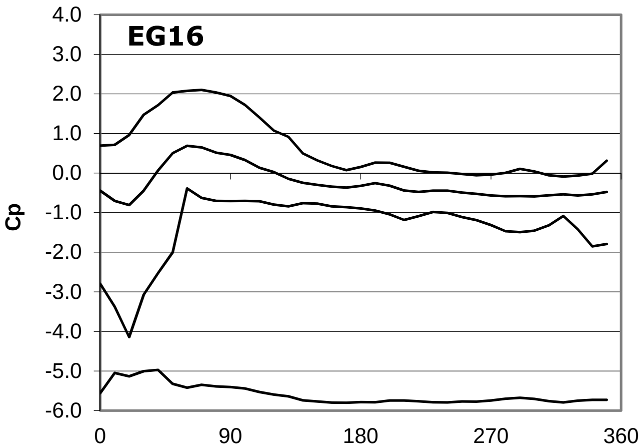

EG11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

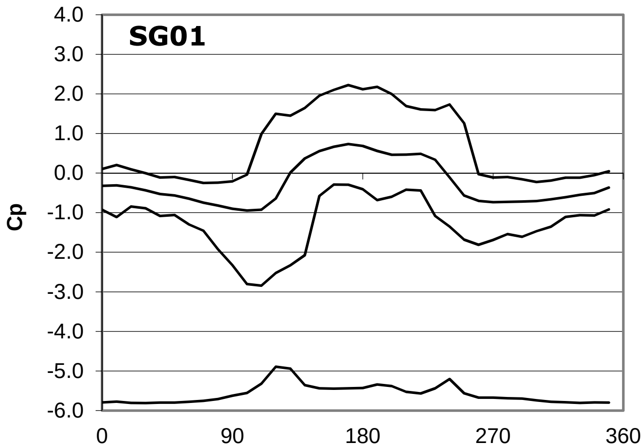

EG12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

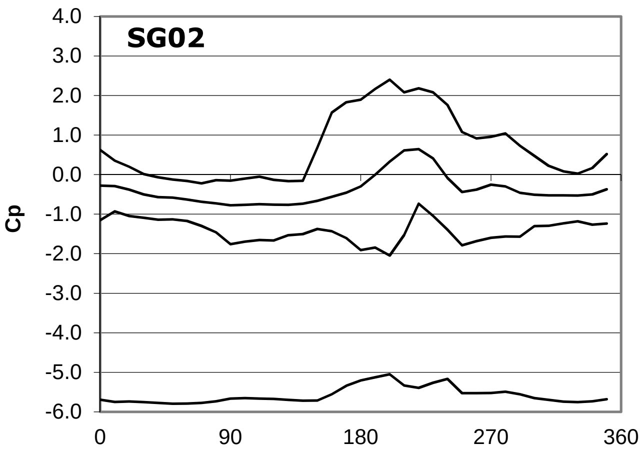

EG13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

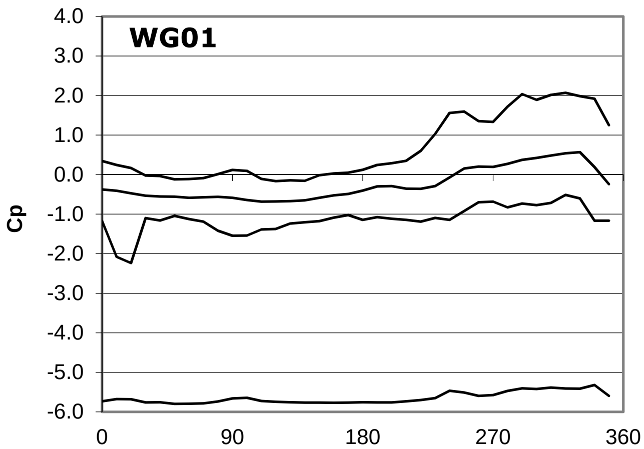

EG14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

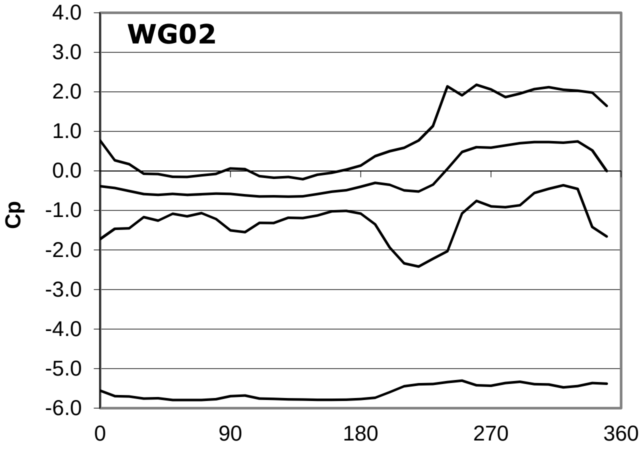

EG15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

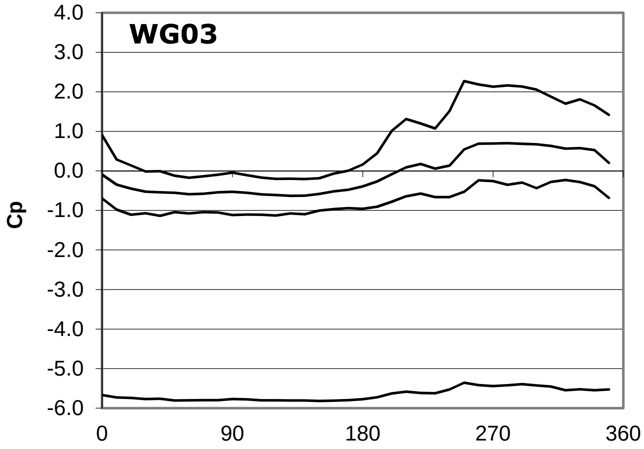

EG16
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

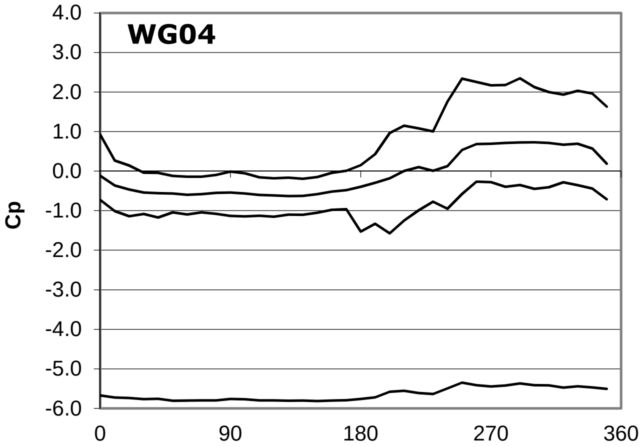

SG01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

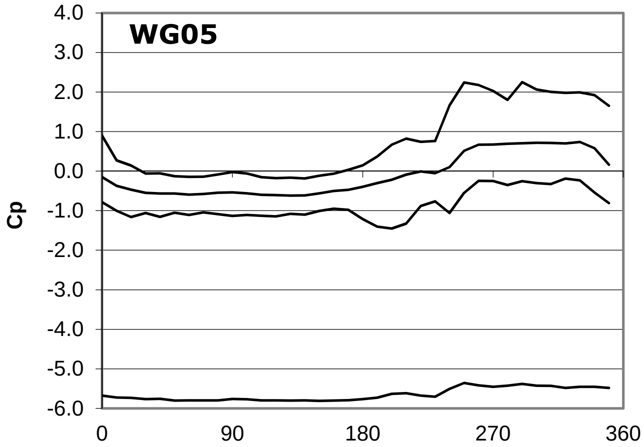

SG02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

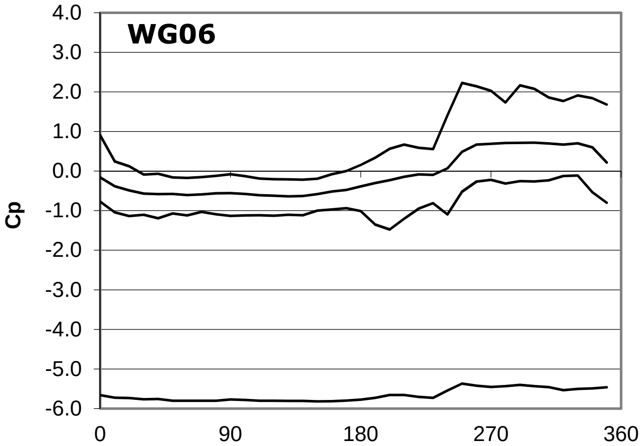

WG01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

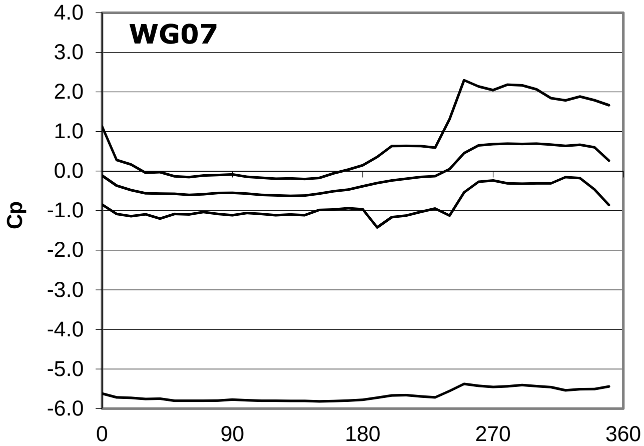

WG02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

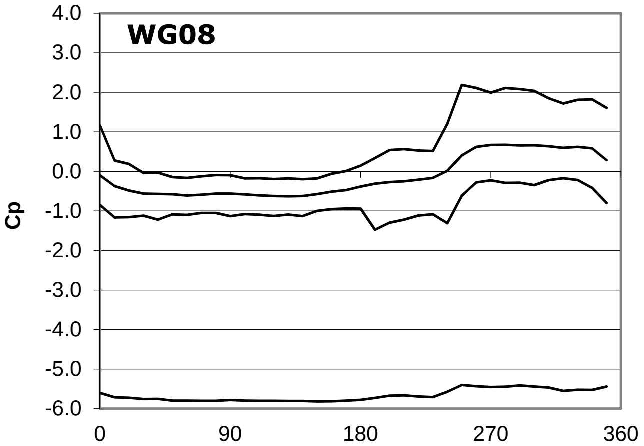

WG03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

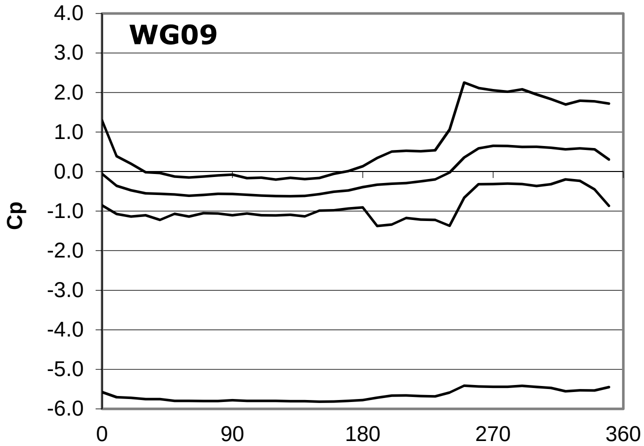

WG04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

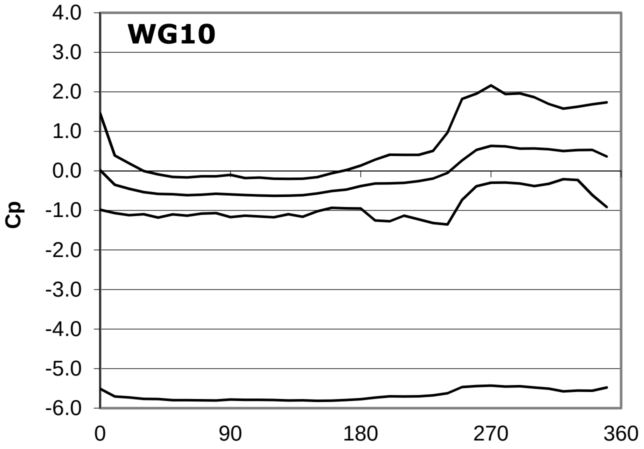

WG05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

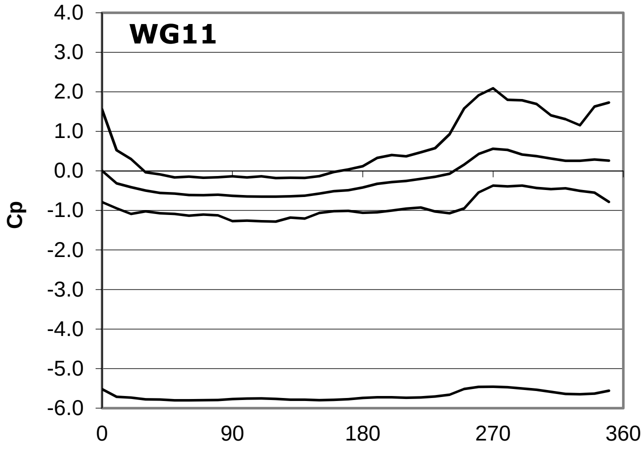

WG06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360


WG07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

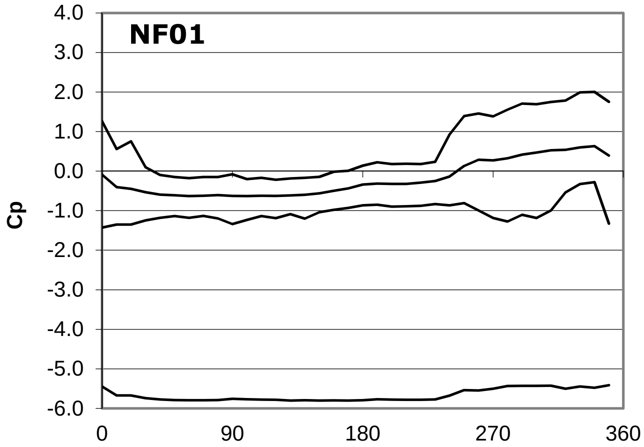

WG08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

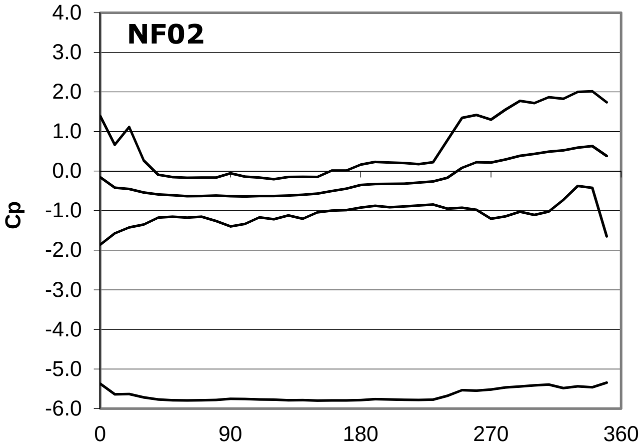

WG09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

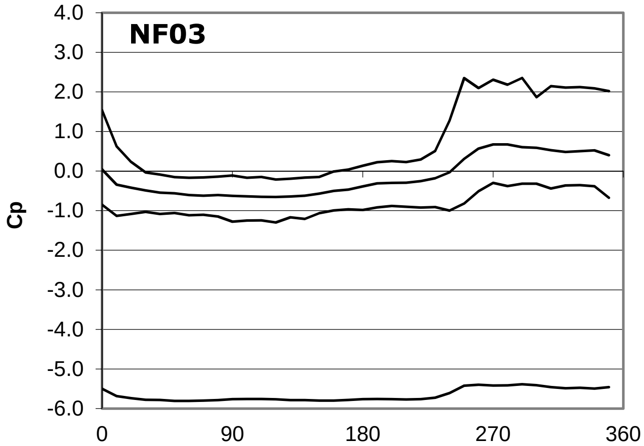

WG10
Cp

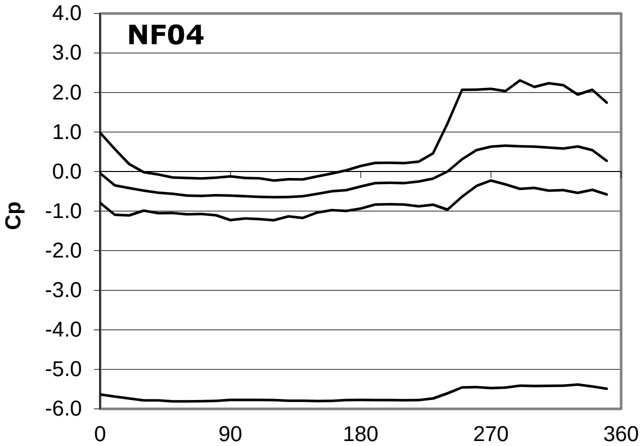

WG11
Cp

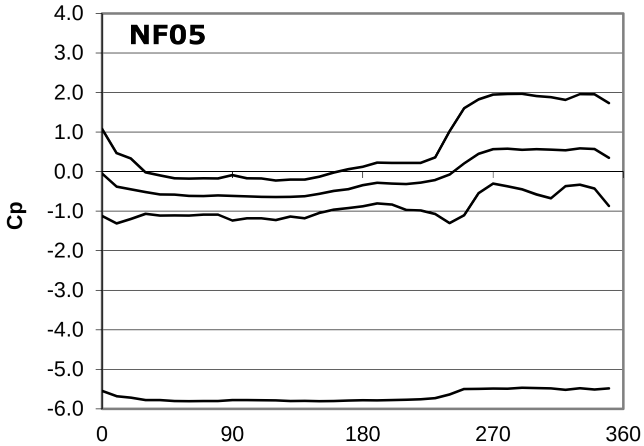

WG12
Cp

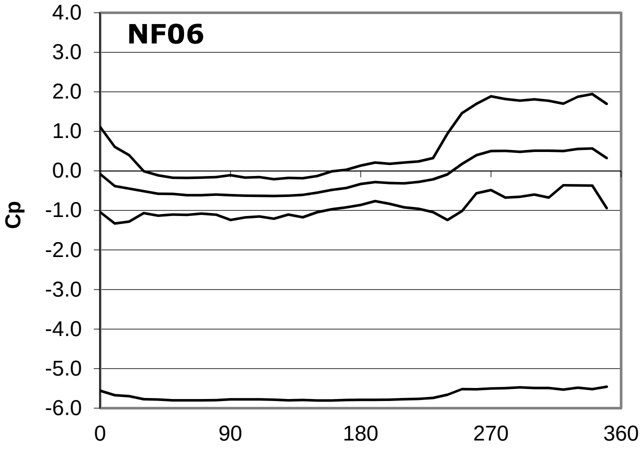
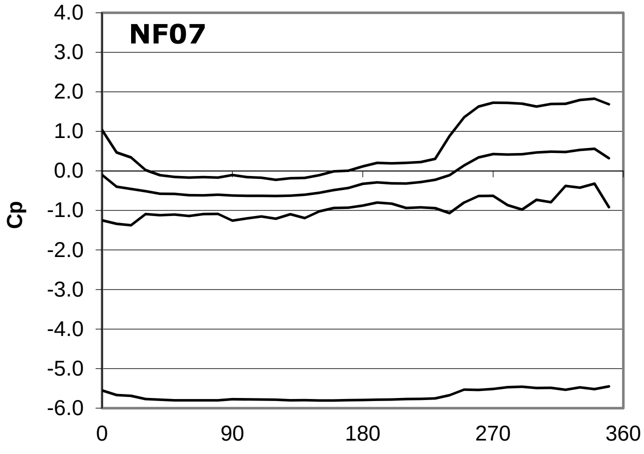
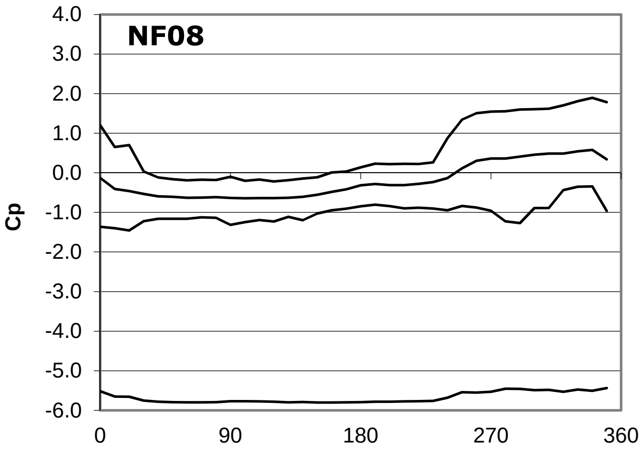
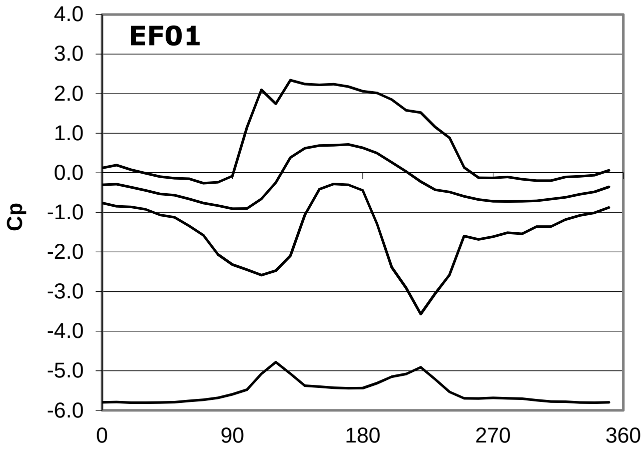
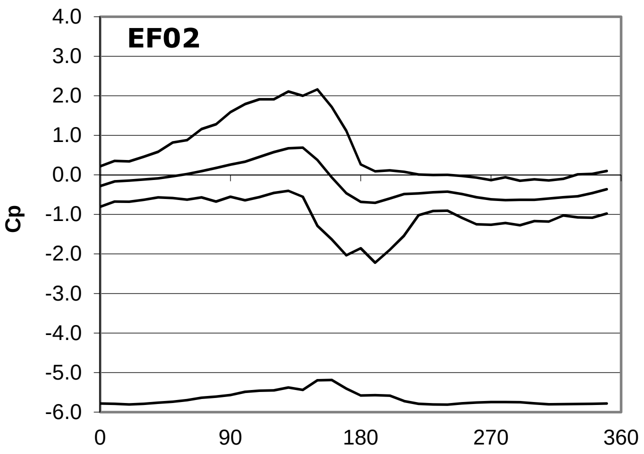
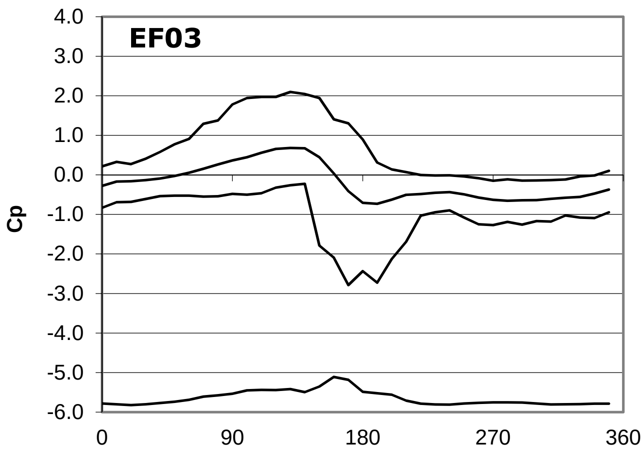
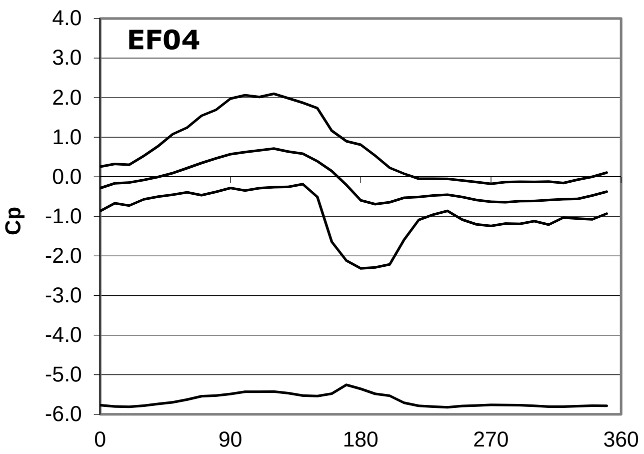
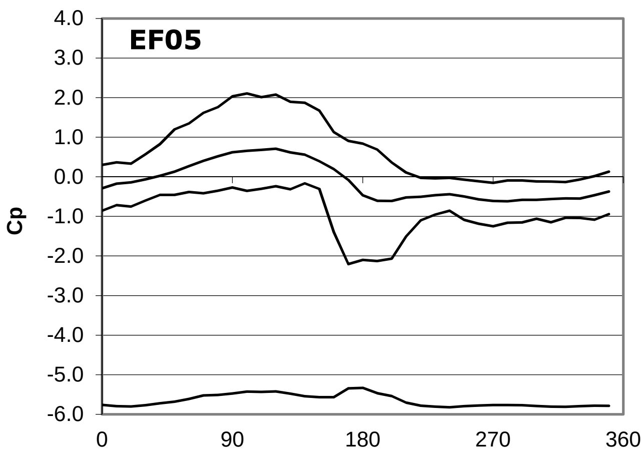

NF01
Cp

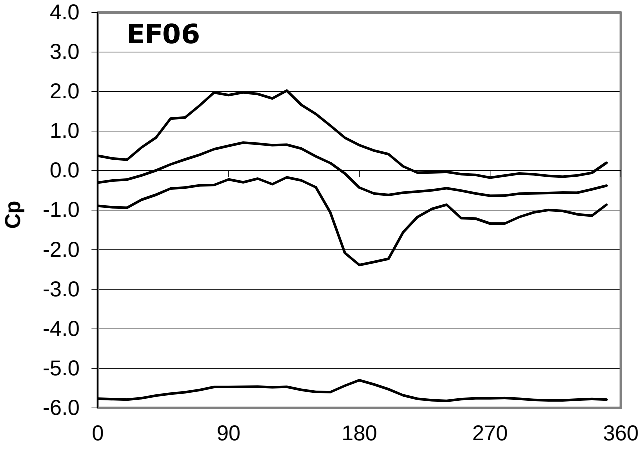

NF02
Cp

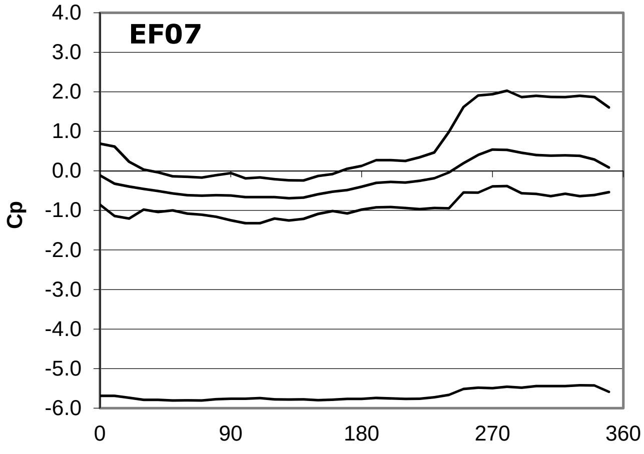

NF03
Cp

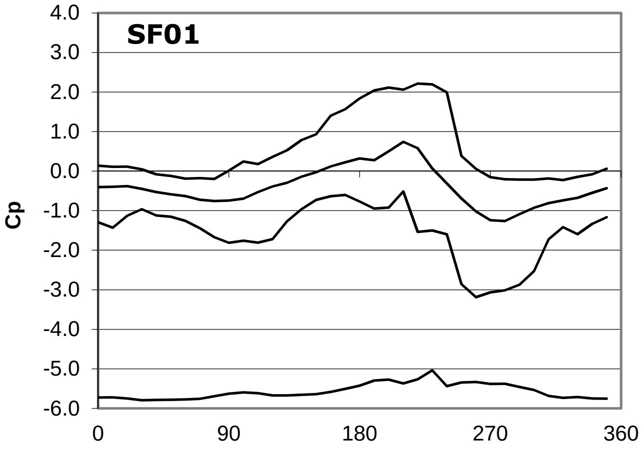

NF04
Cp

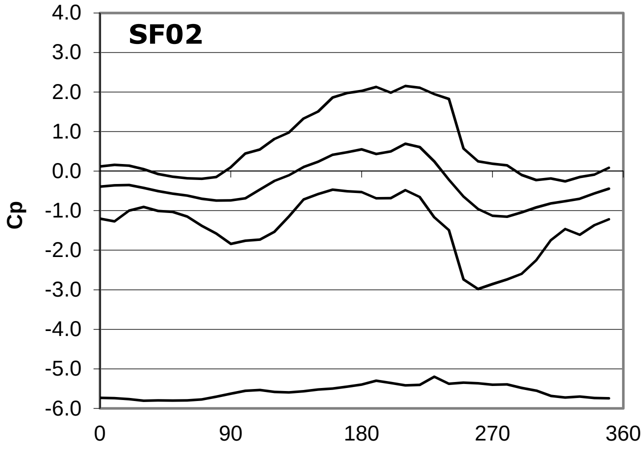

NF05
Cp

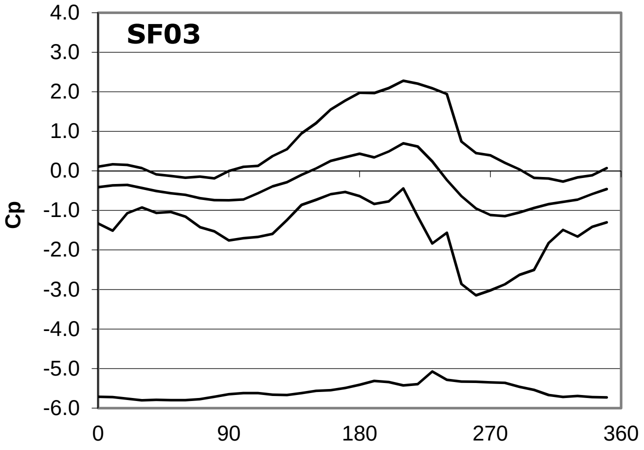

NF06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

NF07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

NF08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

EF01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

EF02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

EF03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

EF04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

EF05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

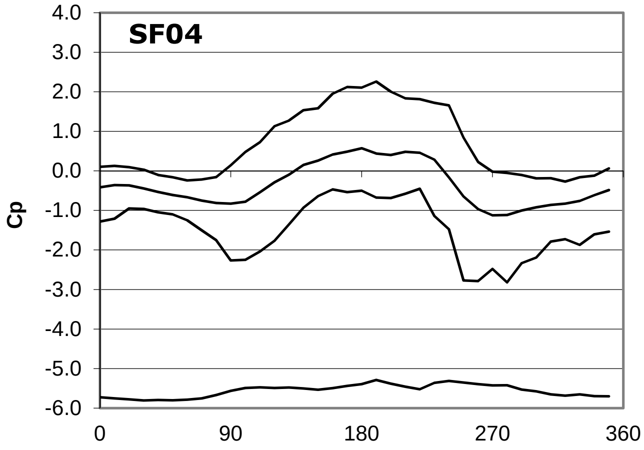

EF06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

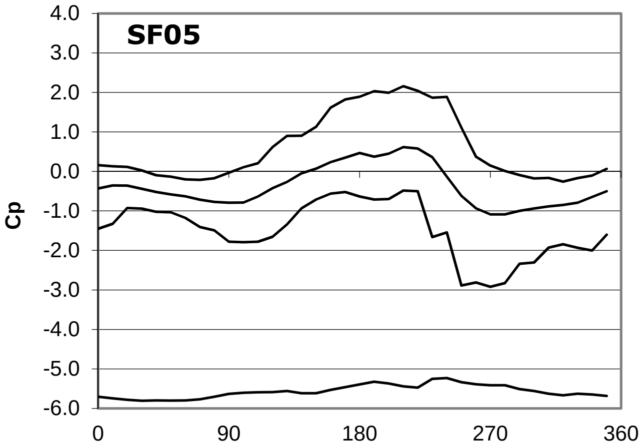

EF07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

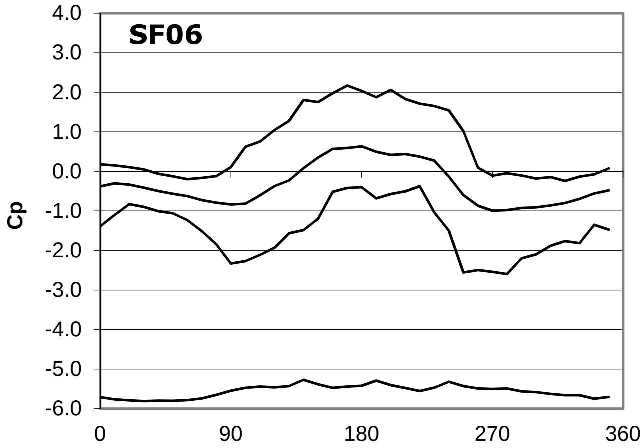

SF01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

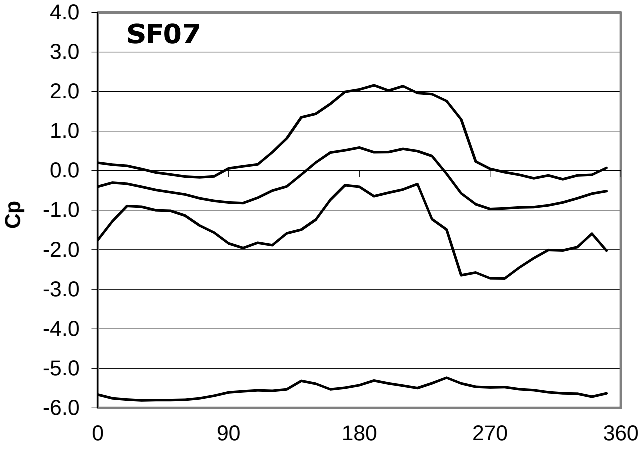

SF02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

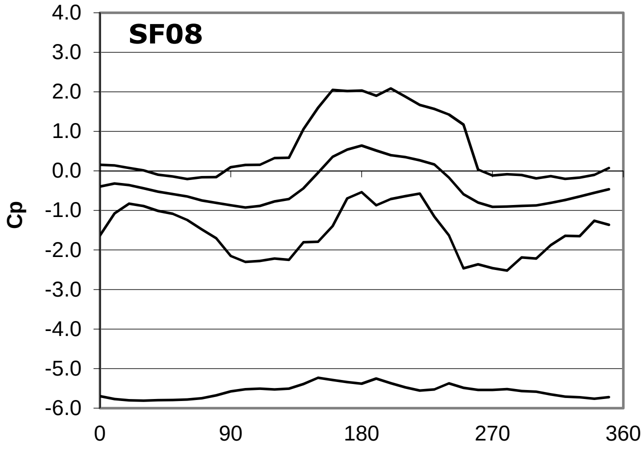

SF03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

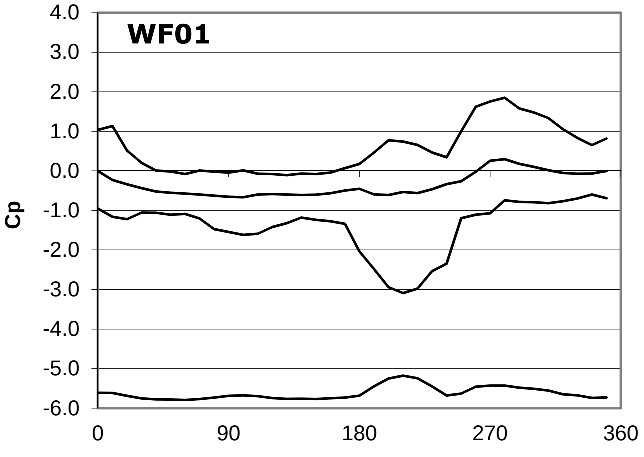

SF04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

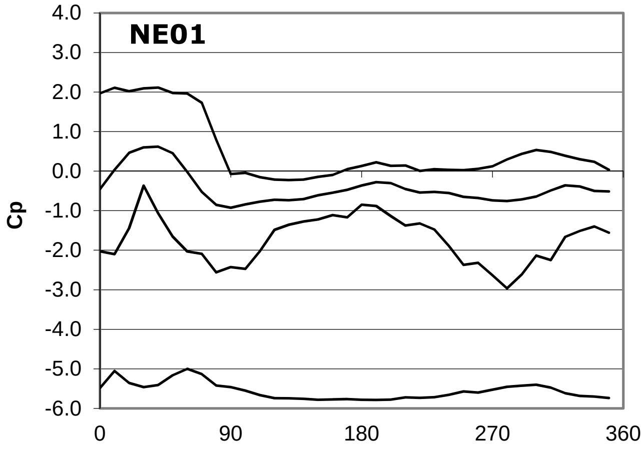

SF05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

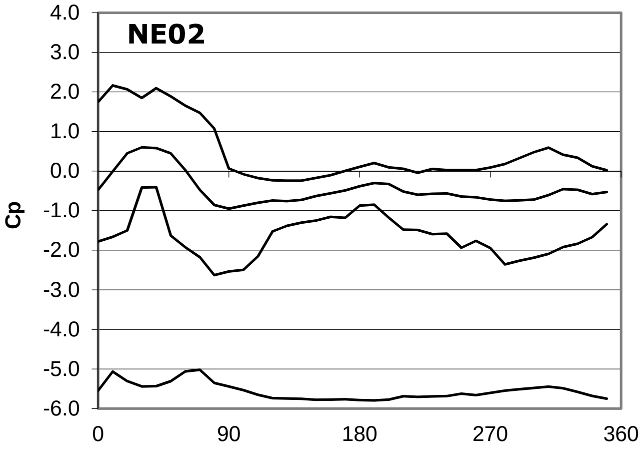

SF06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

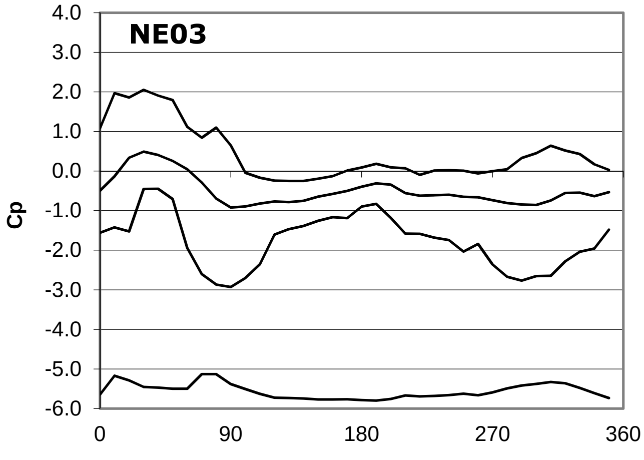

SF07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

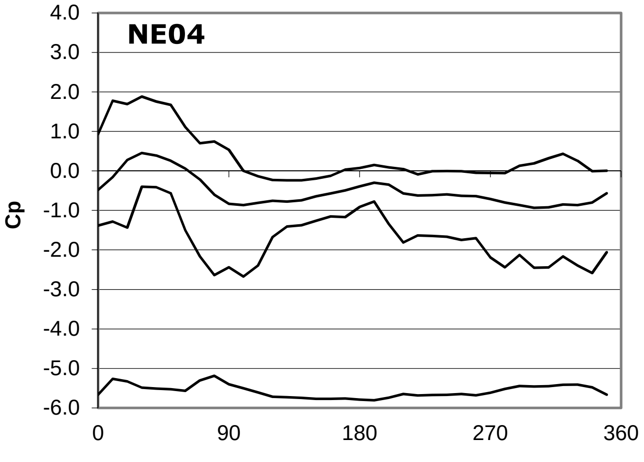

SF08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

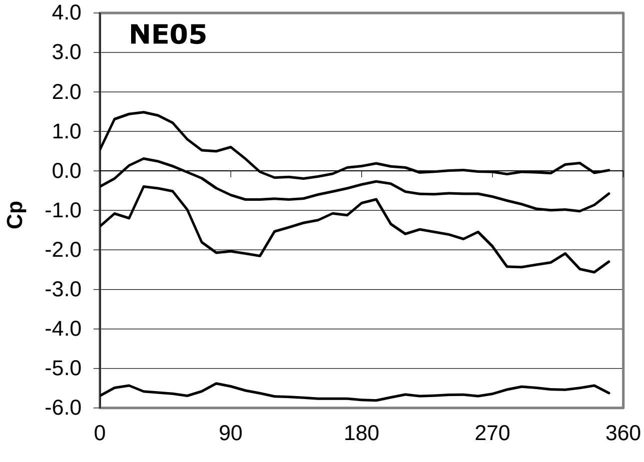

WF01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

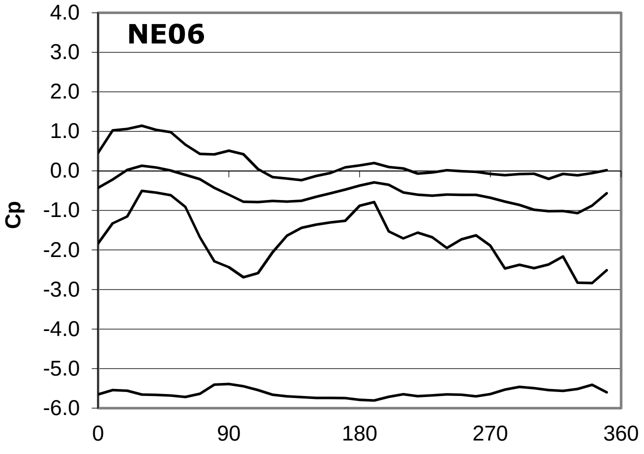

NE01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

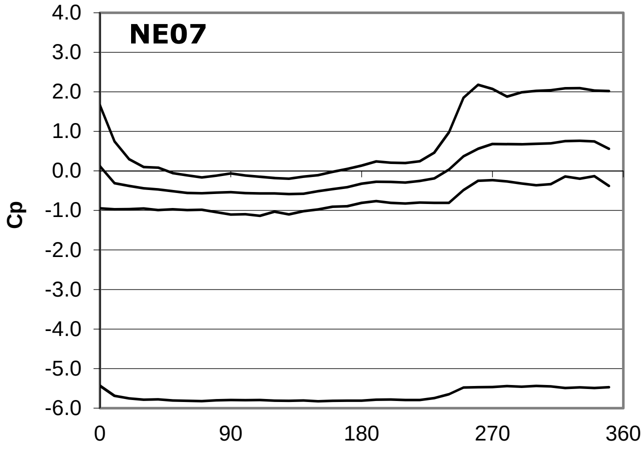

NE02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

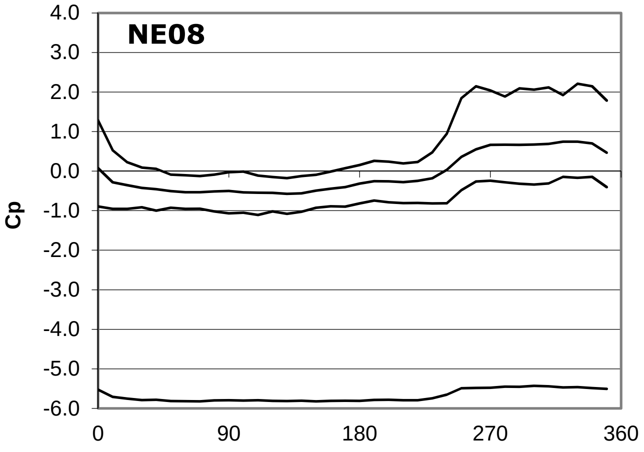

NE03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

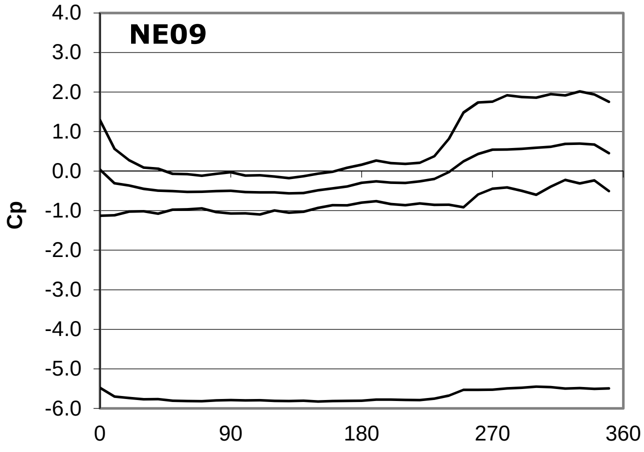

NE04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

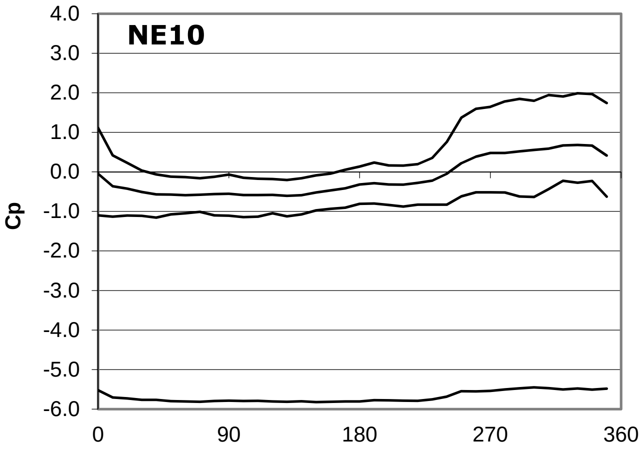

NE05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

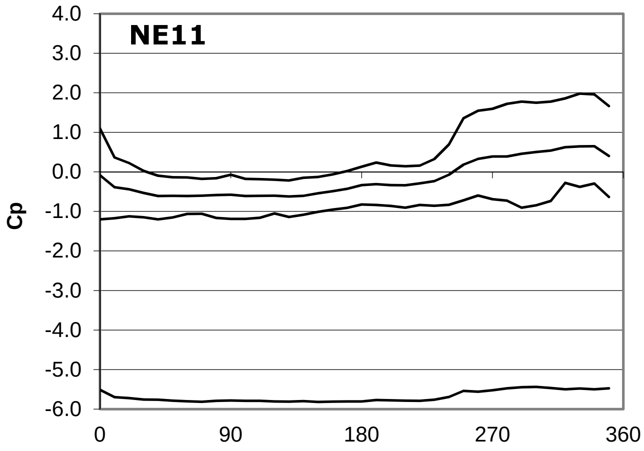

NE06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

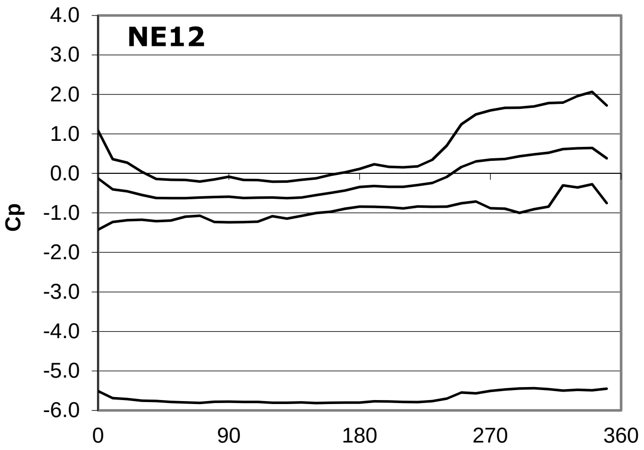

NE07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

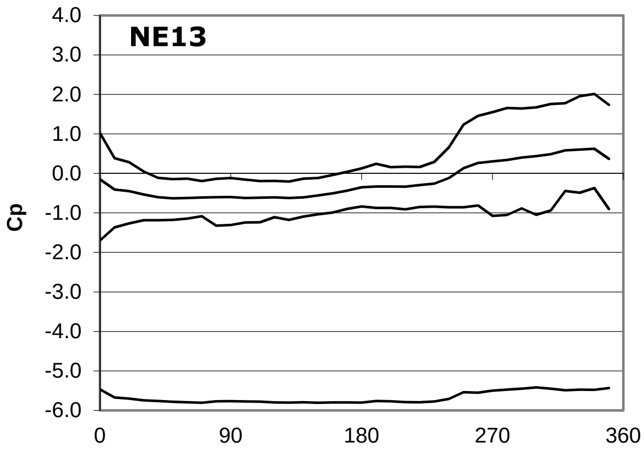

NE08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

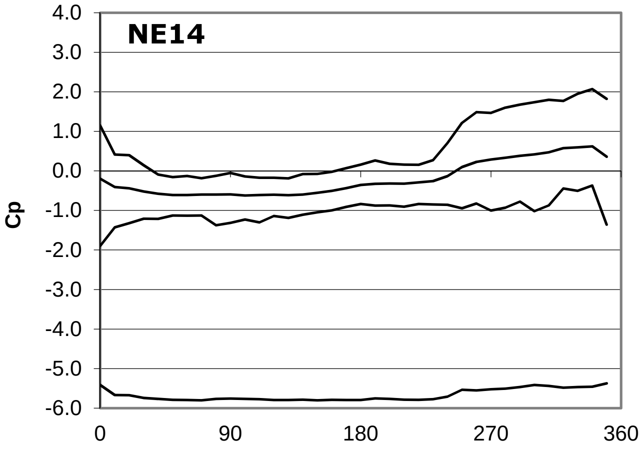

NE09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

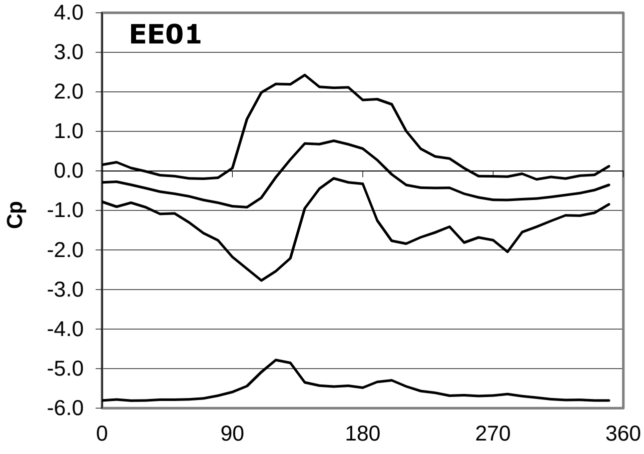

NE10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

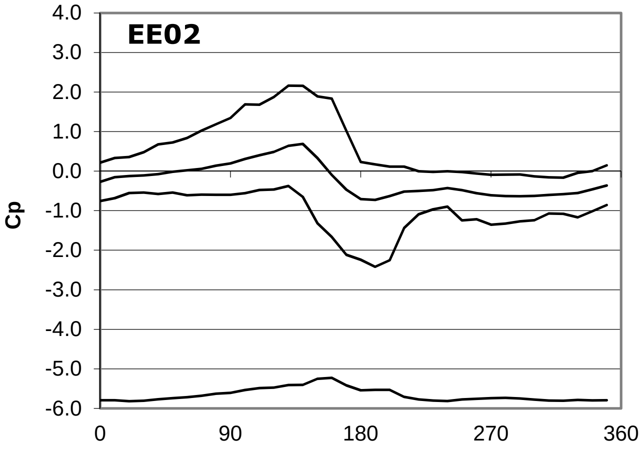

NE11
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

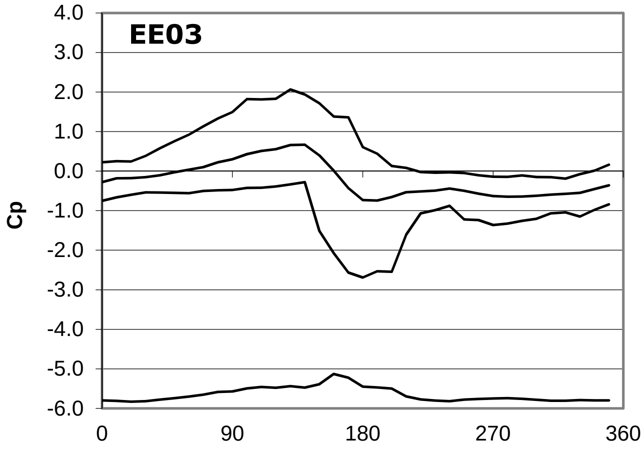

NE12
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

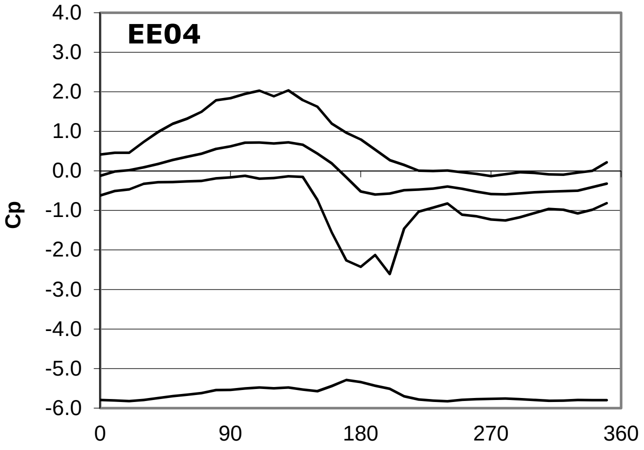

NE13
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

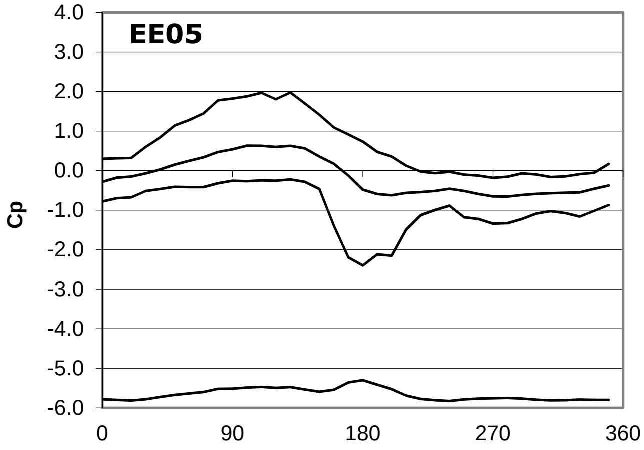

NE14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

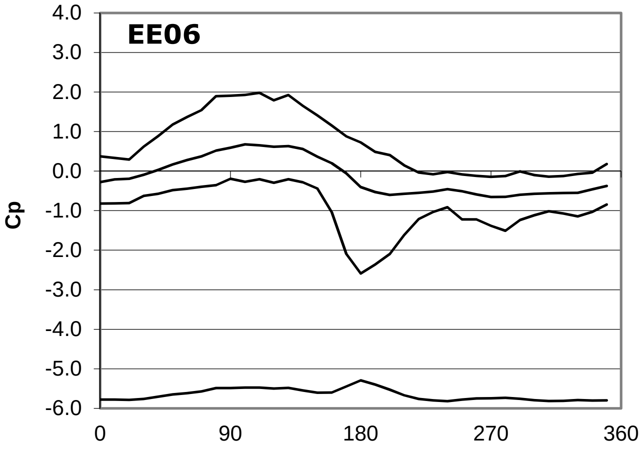

EE01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

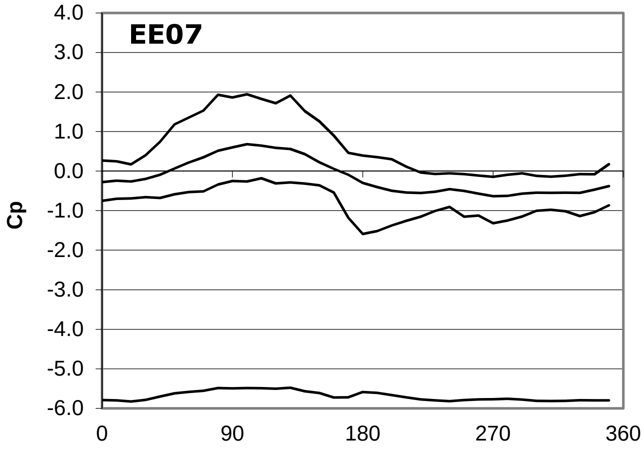

EE02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

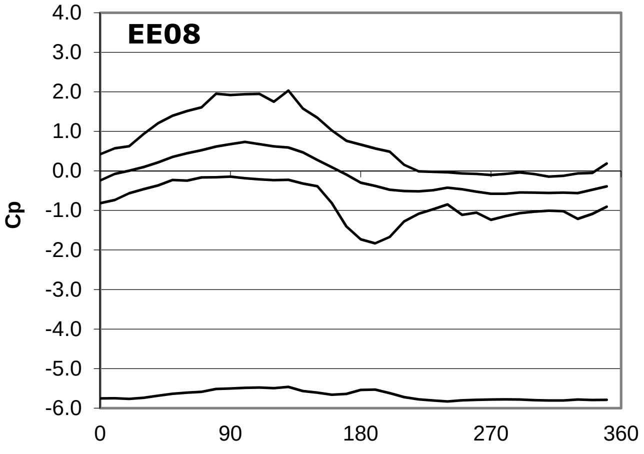

EE03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

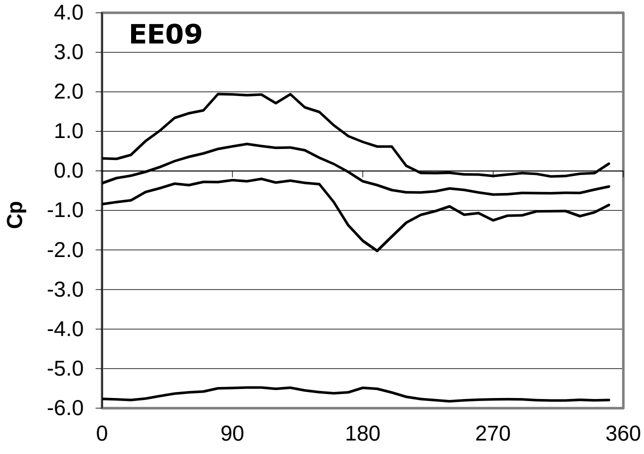

EE04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

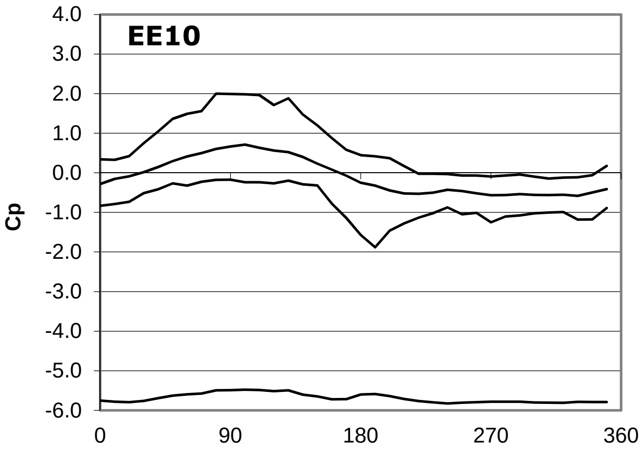

EE05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

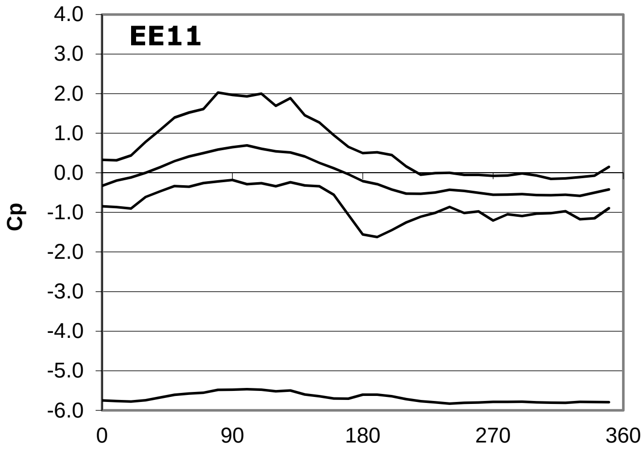

EE06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

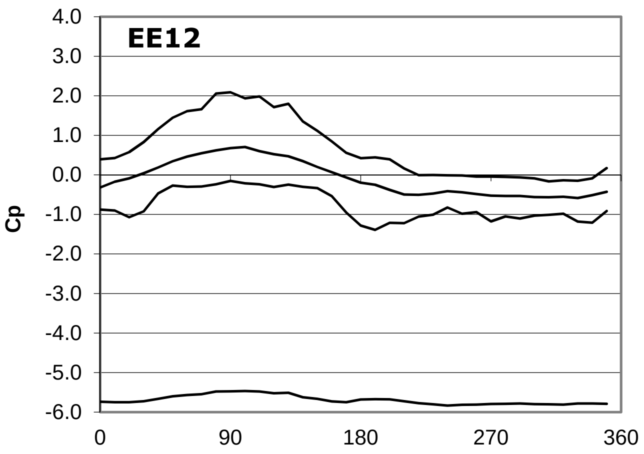

EE07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

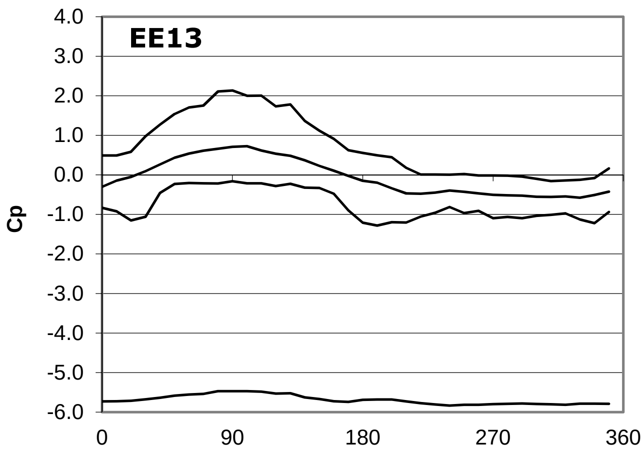

EE08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

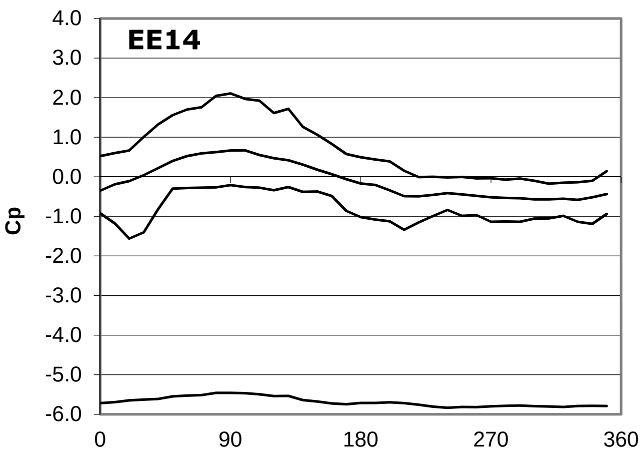

EE09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

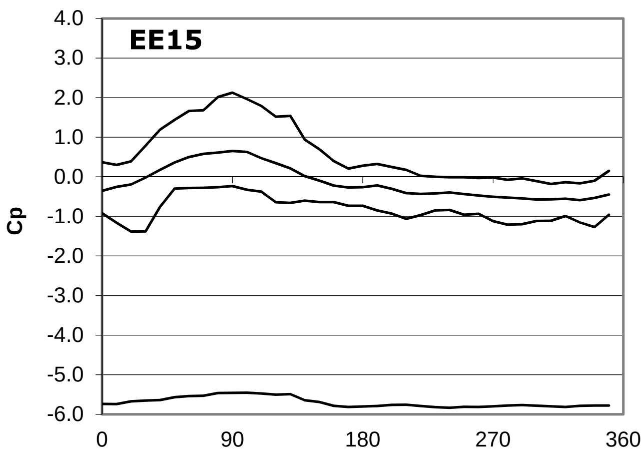

EE10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

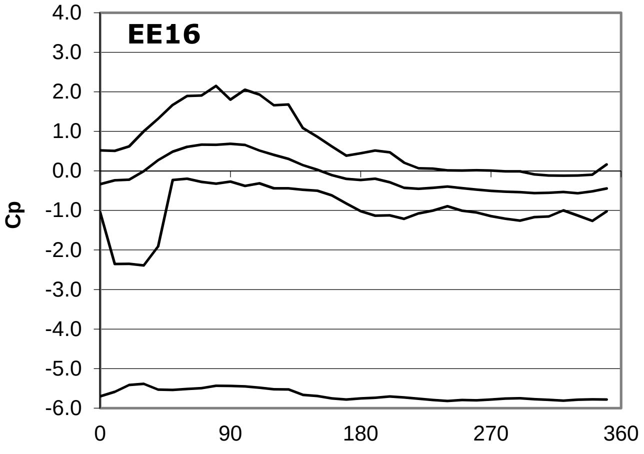

EE11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

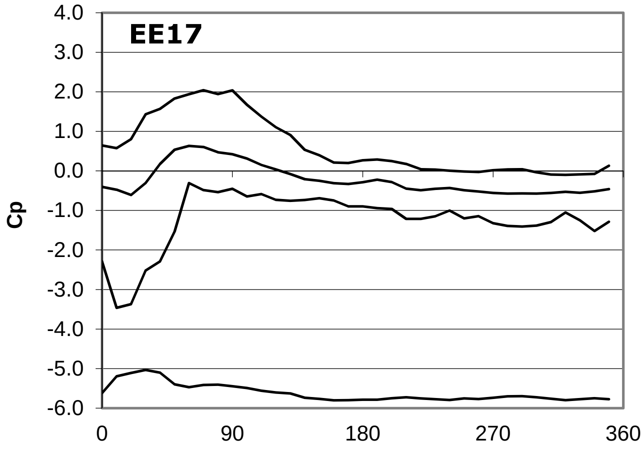

EE12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

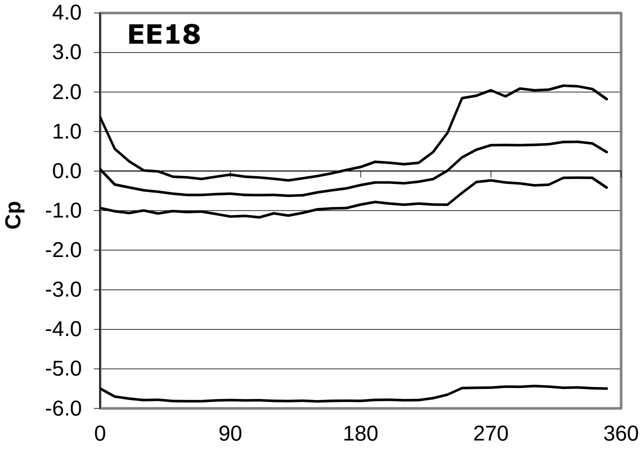

EE13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

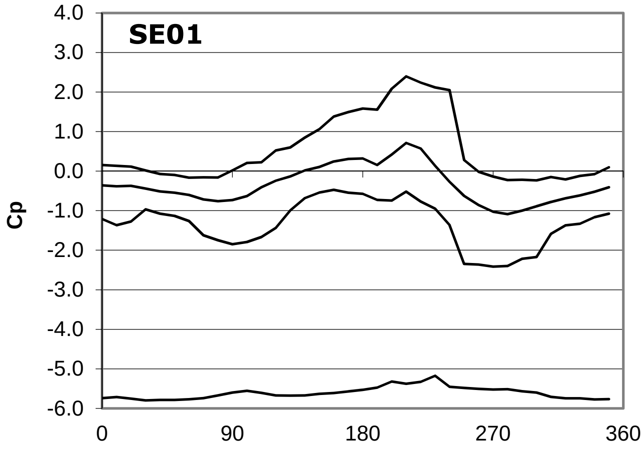

EE14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

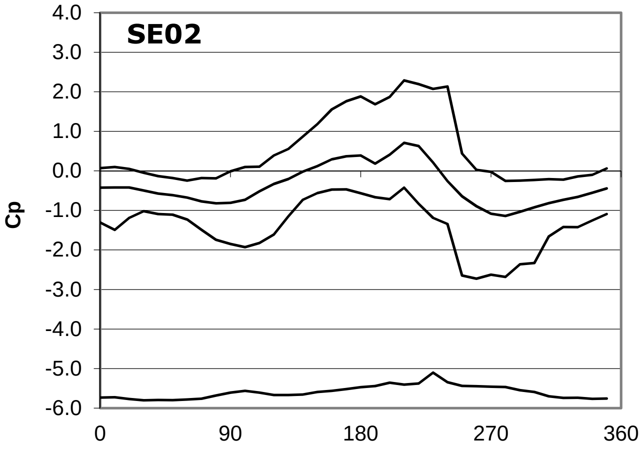

EE15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

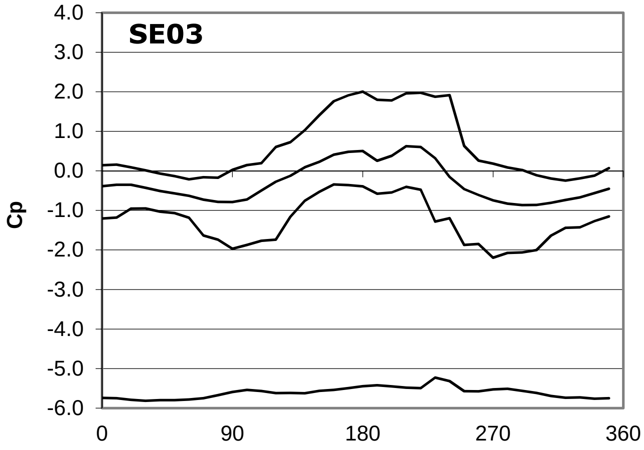

EE16
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

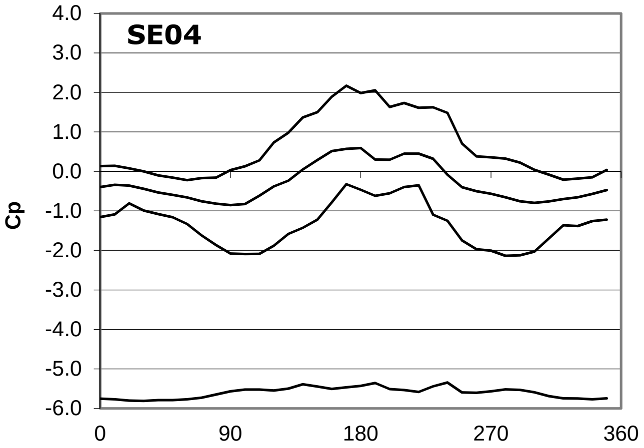

EE17
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

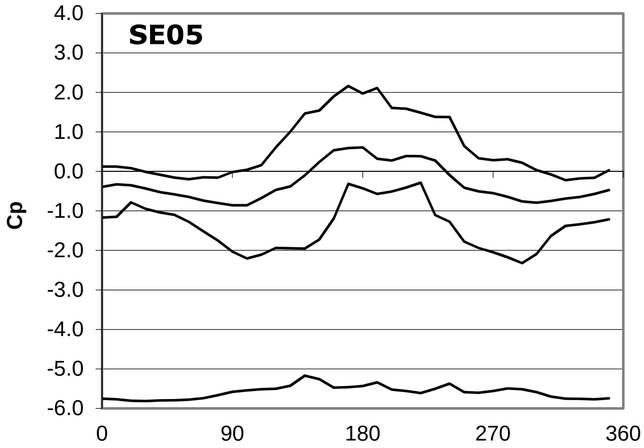

EE18
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

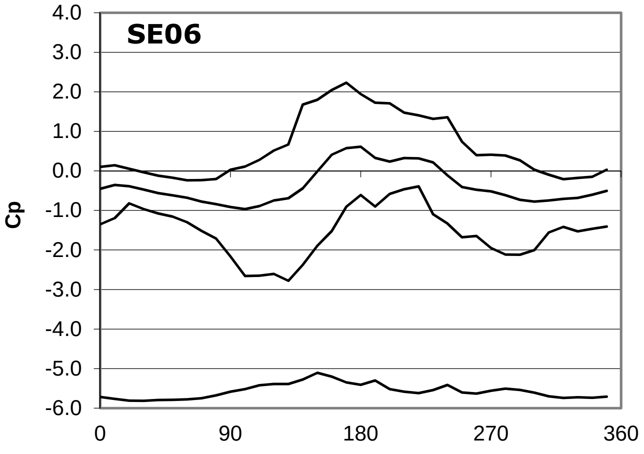

SE01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

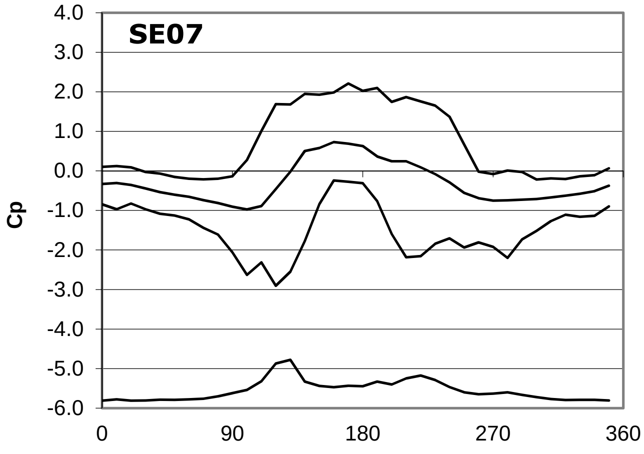

SE02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

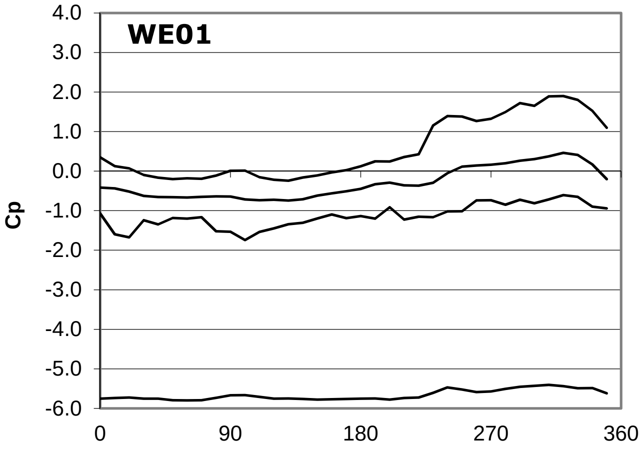

SE03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

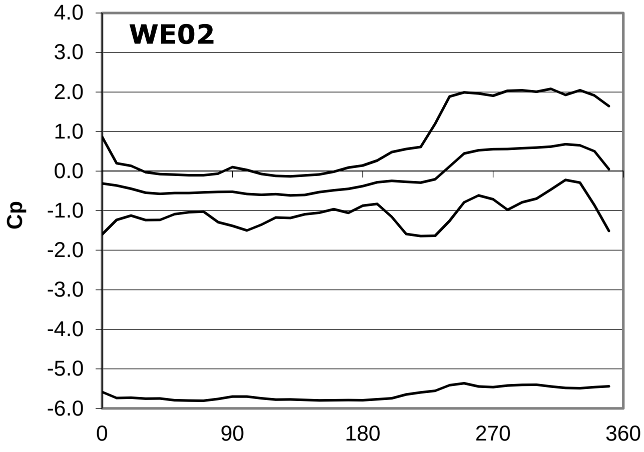

SE04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

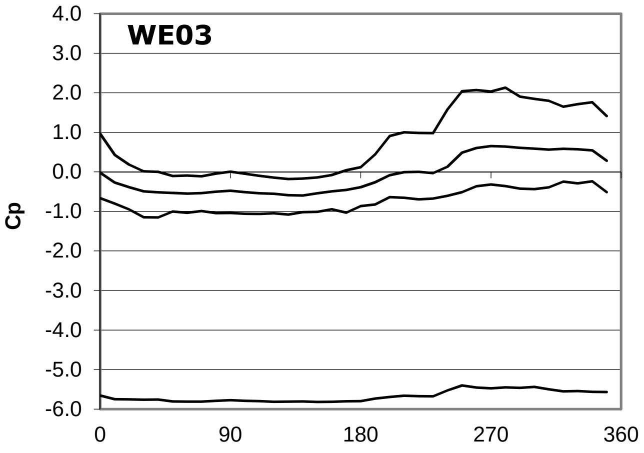

SE05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

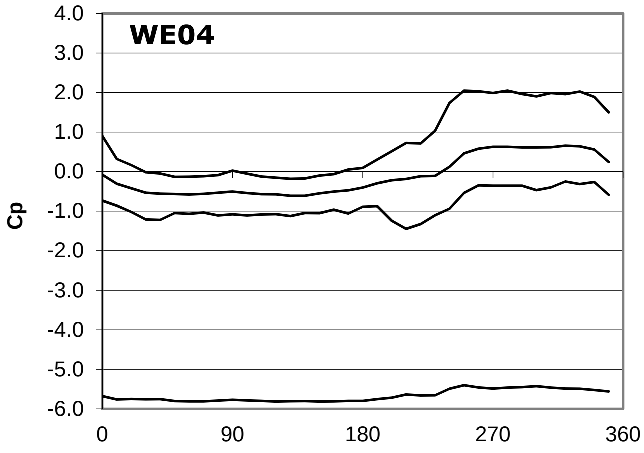

SE06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

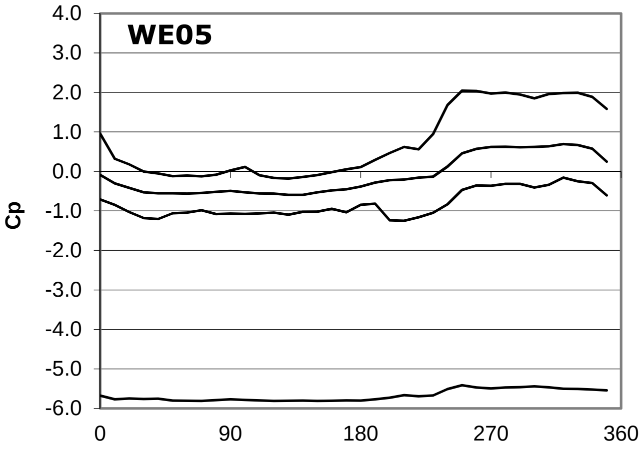

SE07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

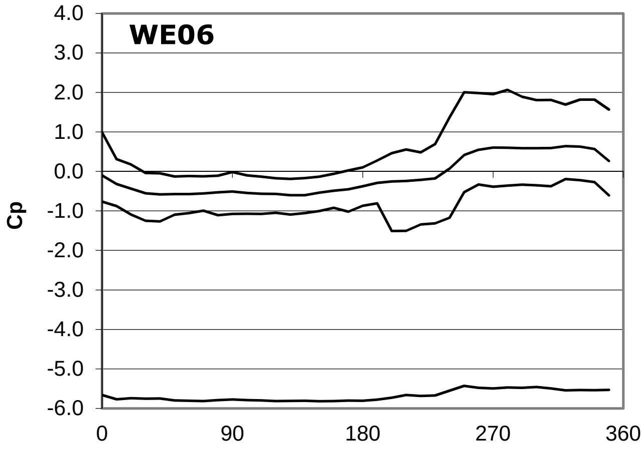

WE01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

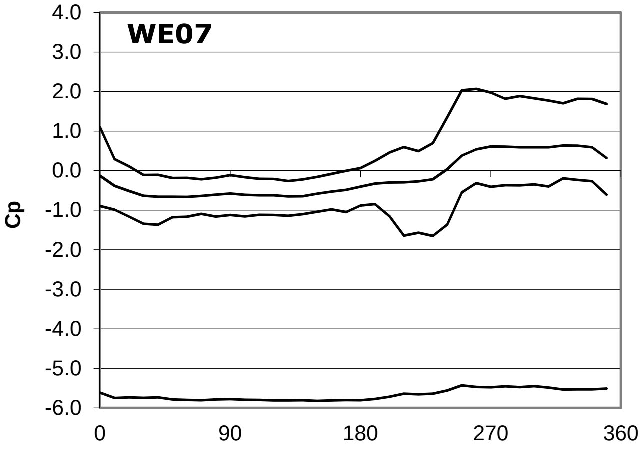

WE02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

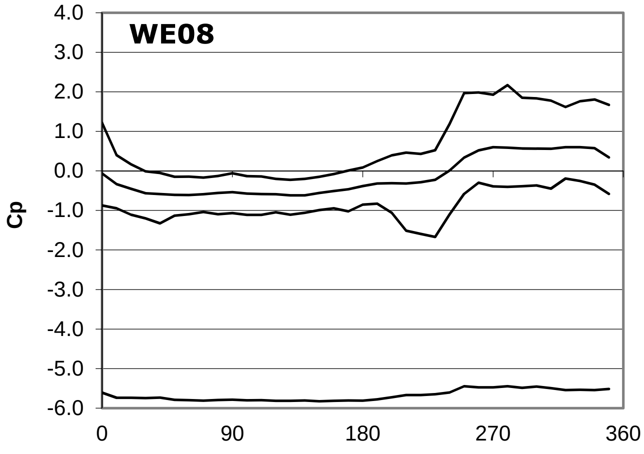

WE03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

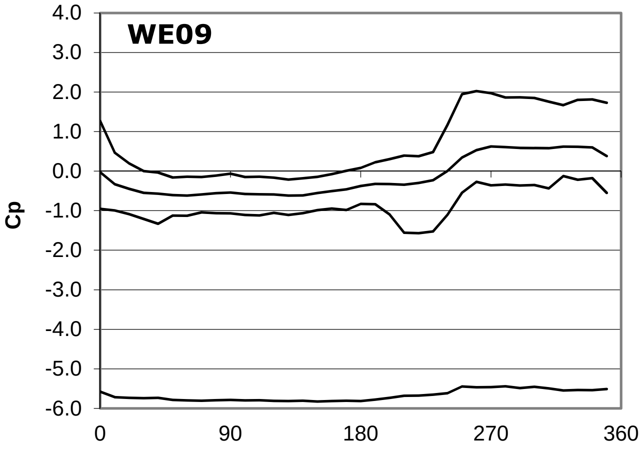

WE04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

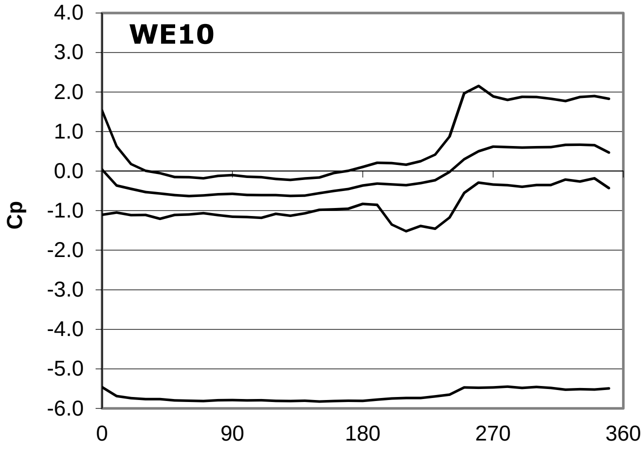

WE05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

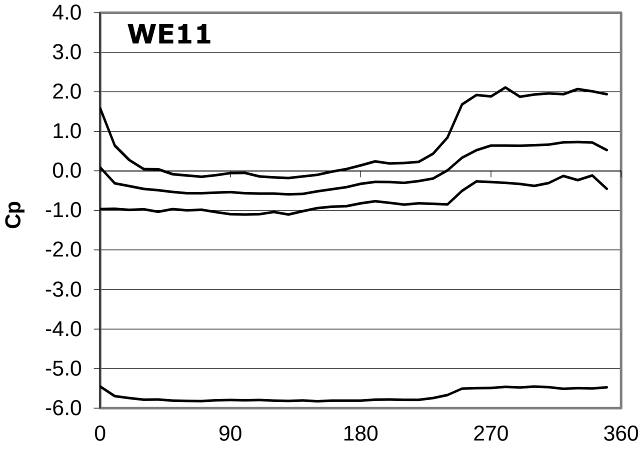

WE06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

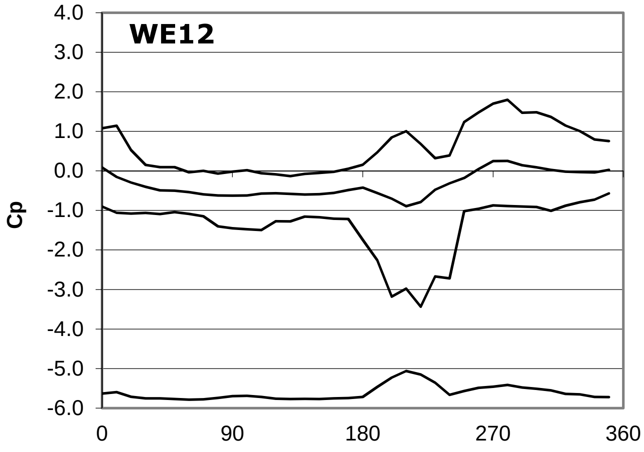

WE07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

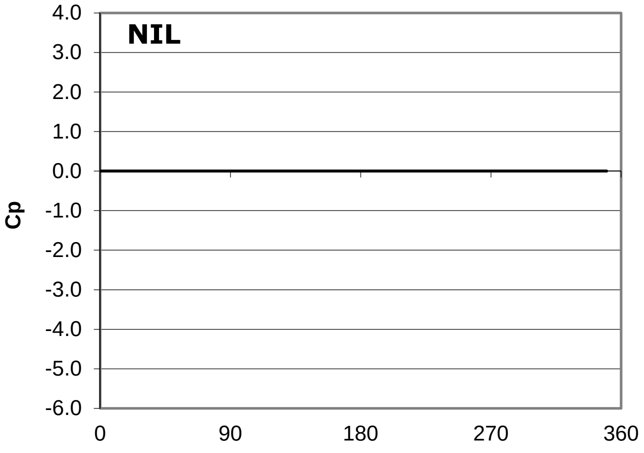

WE08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

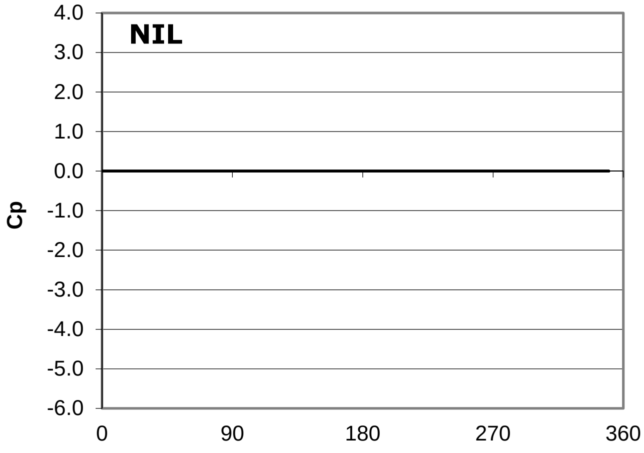

WE09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

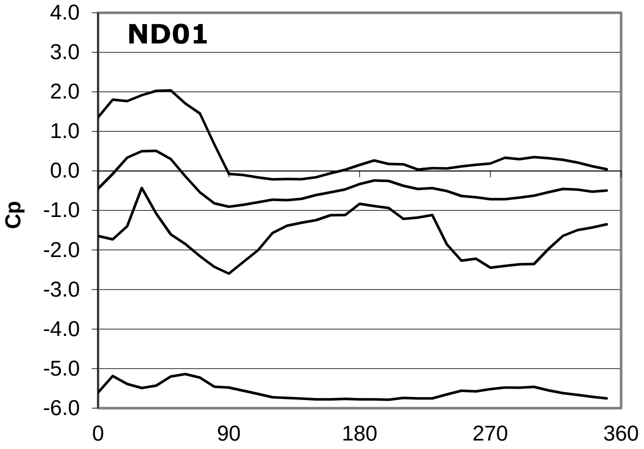

WE10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360


WE11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

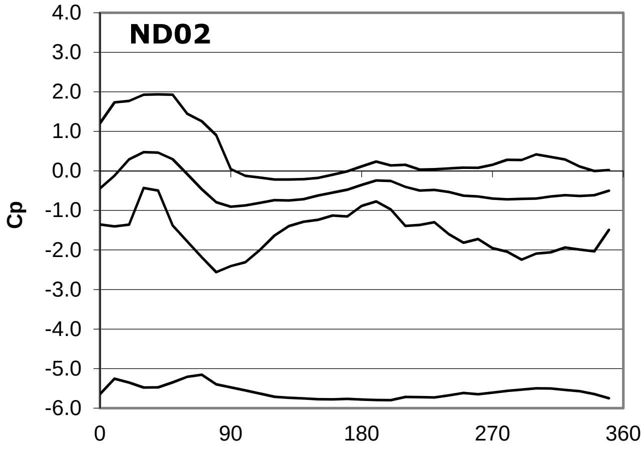

WE12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360


NIL
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

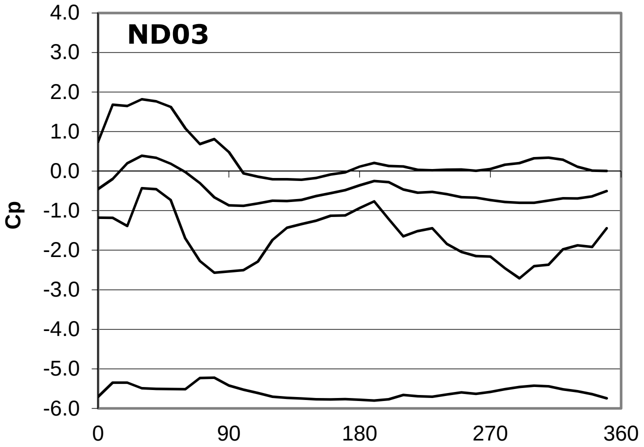

NIL
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360



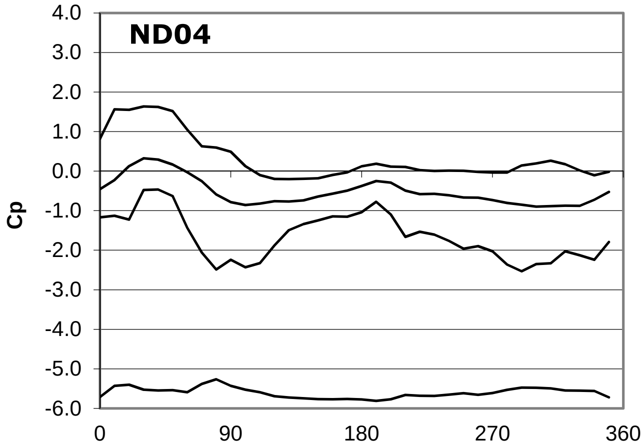
ND01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360



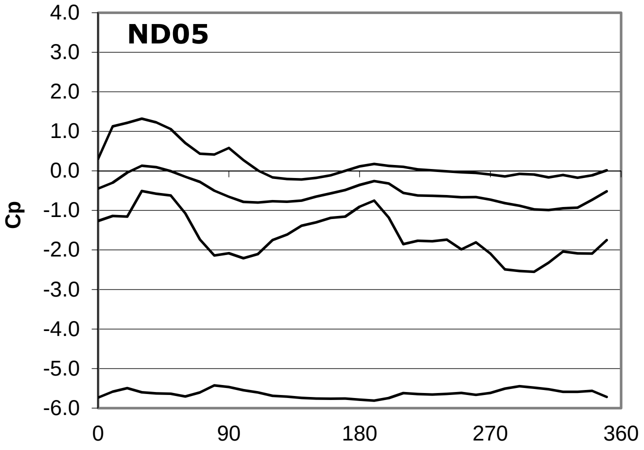
ND02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360



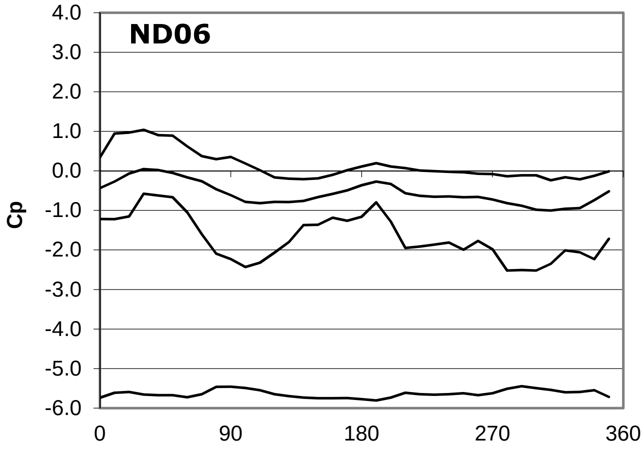
ND03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360



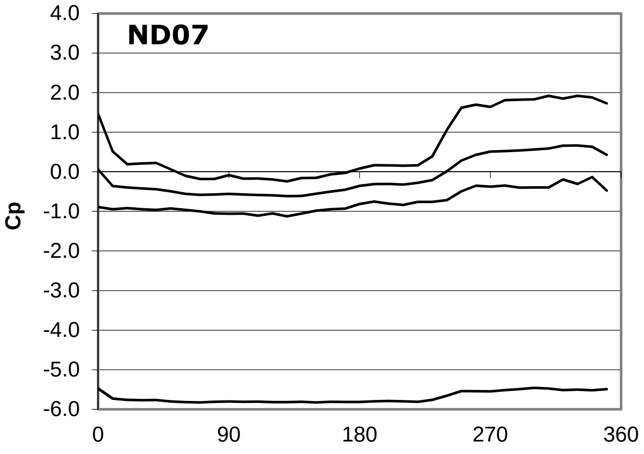
ND04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360



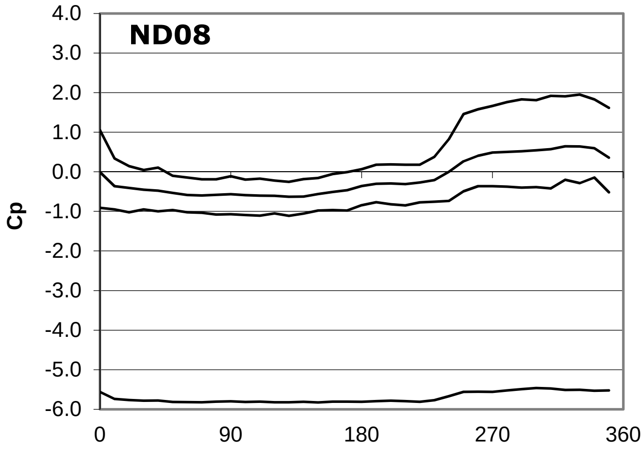
ND05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360



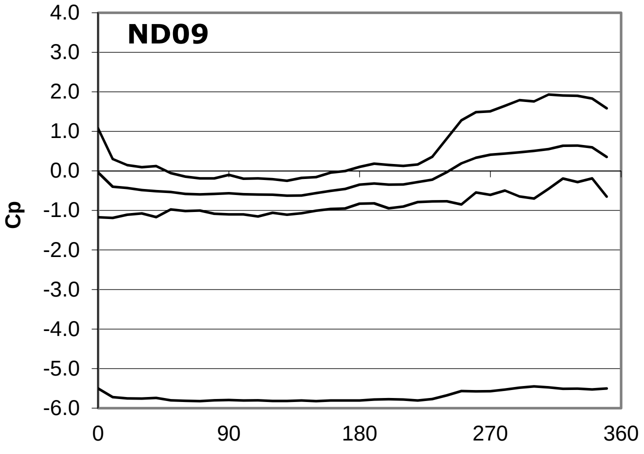
ND06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

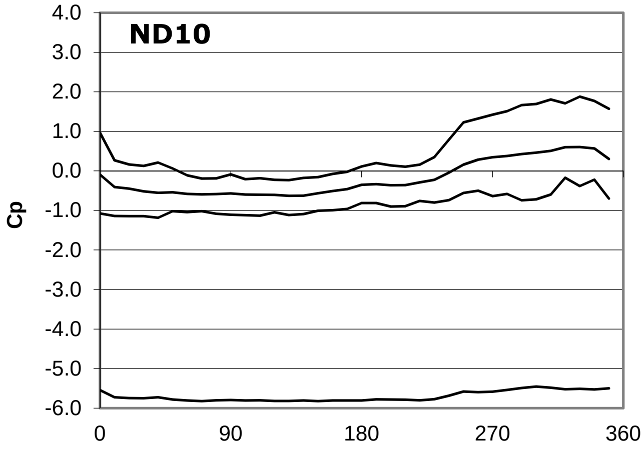


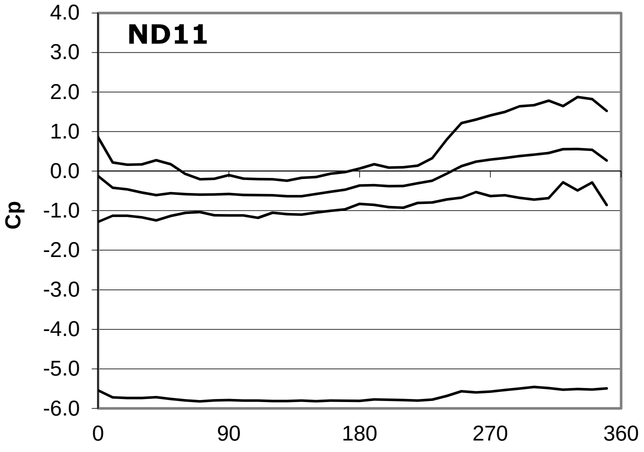
ND07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

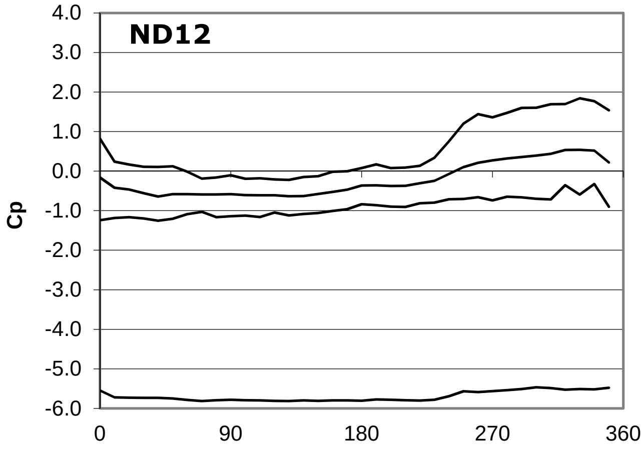


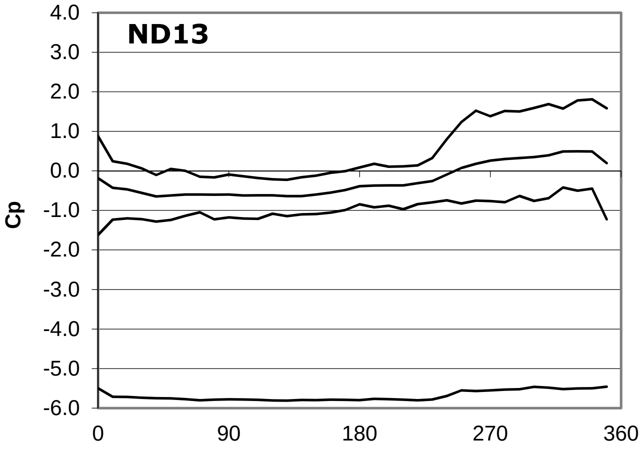
ND08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

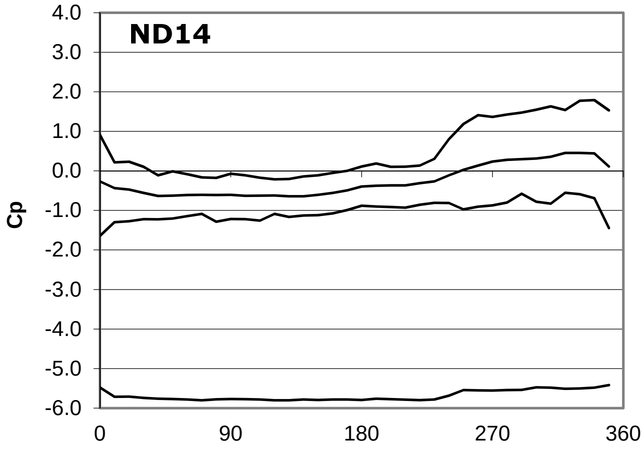

ND09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

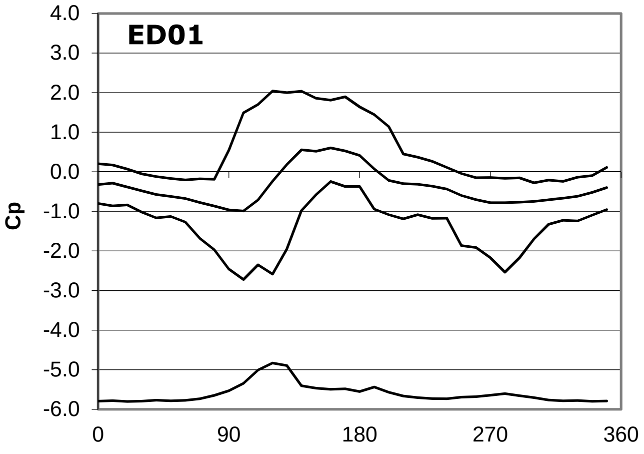

ND10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

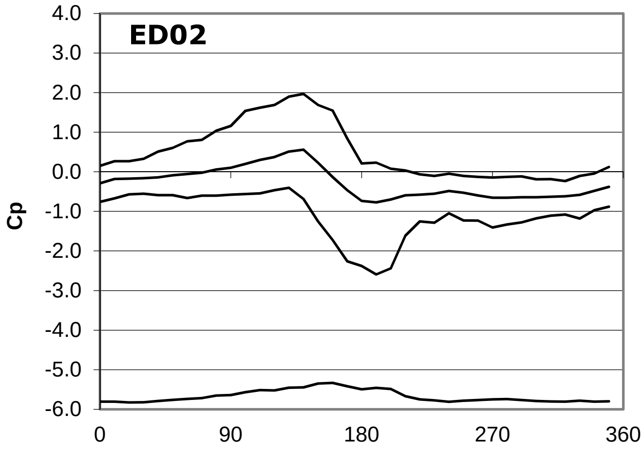

ND11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

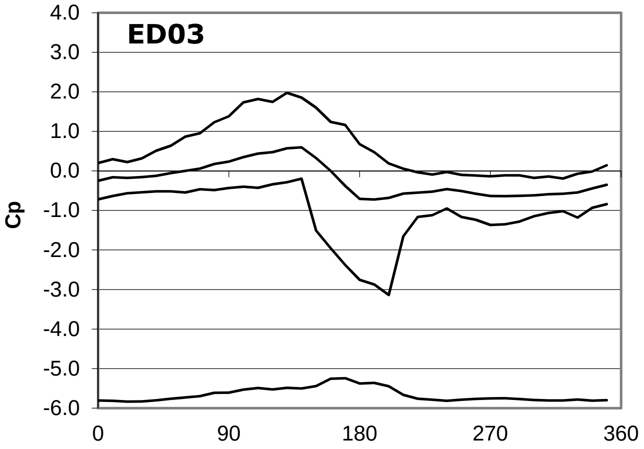

ND12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

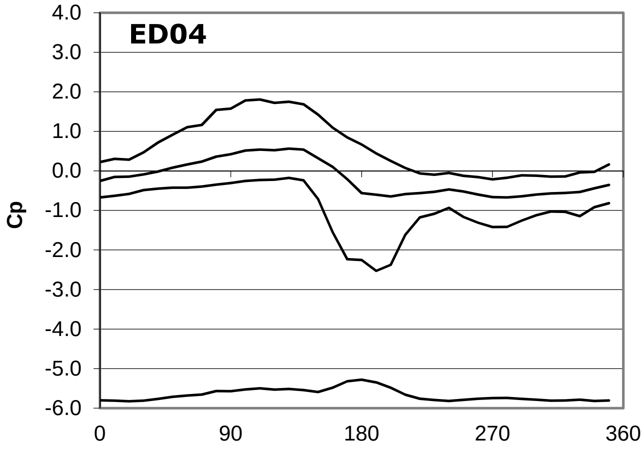

ND13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

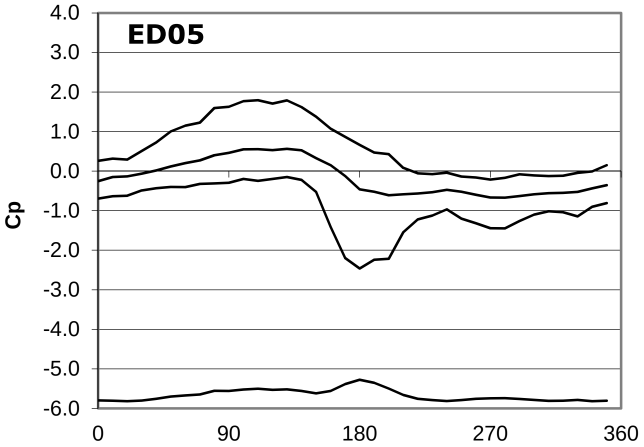

ND14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

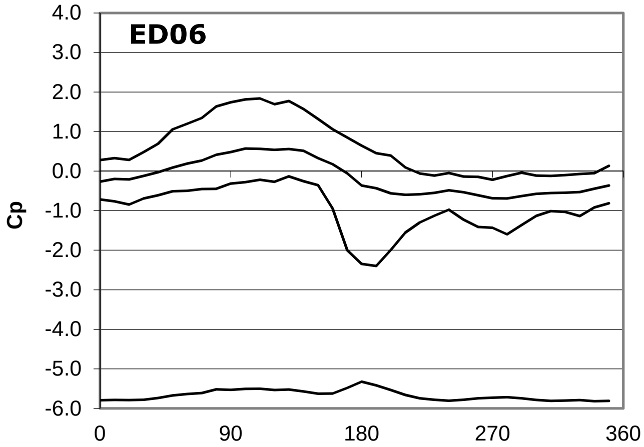

ED01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

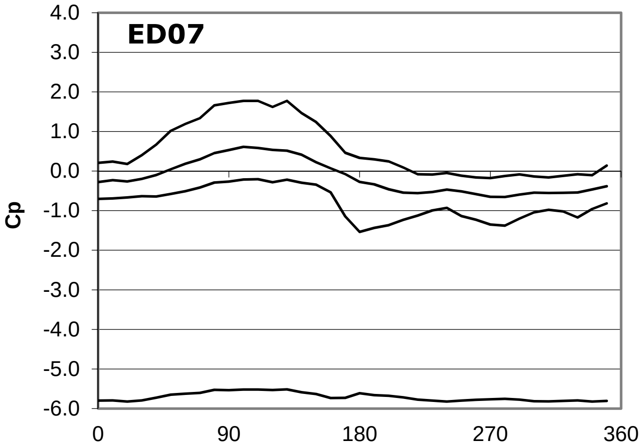

ED02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

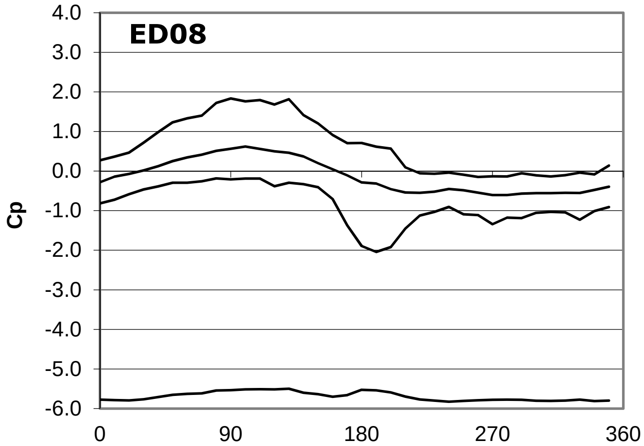

ED03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

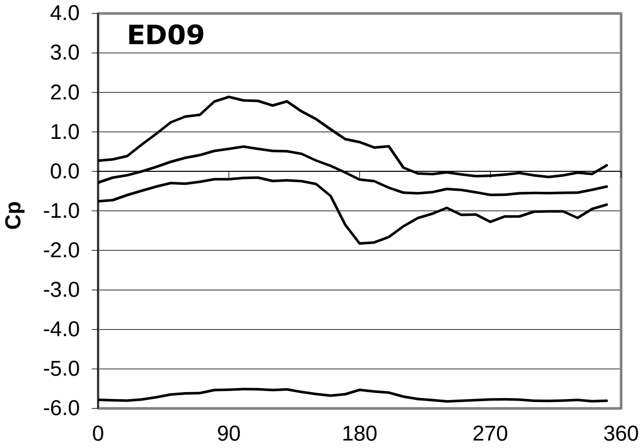

ED04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

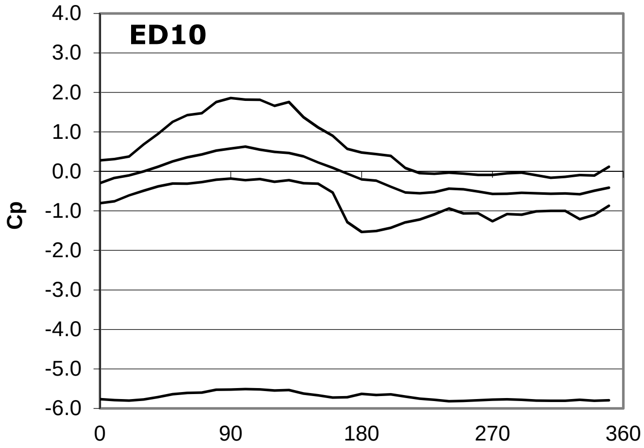

ED05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

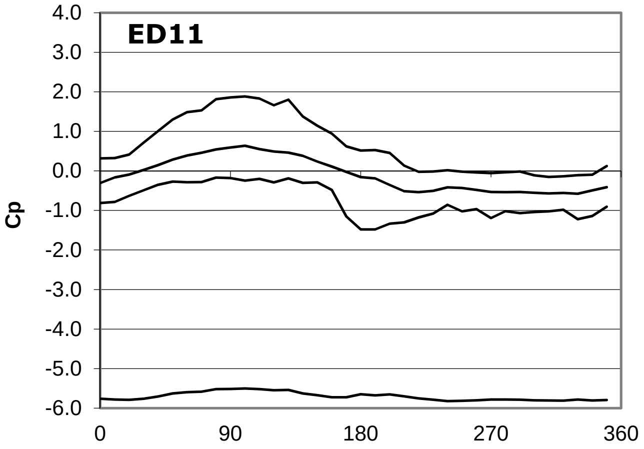

ED06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

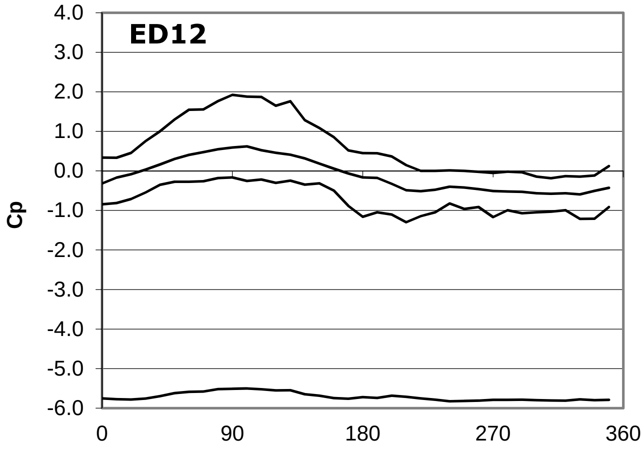

ED07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

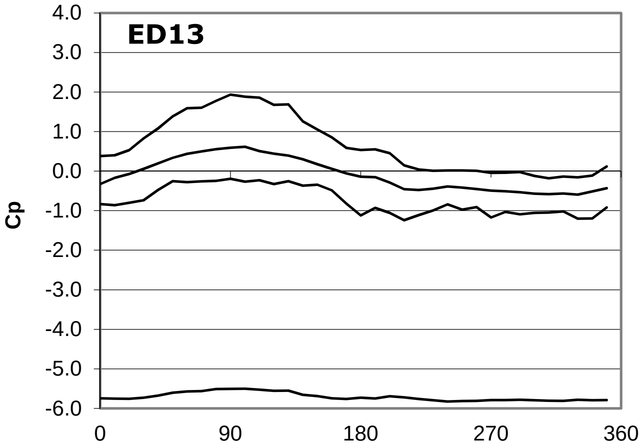

ED08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

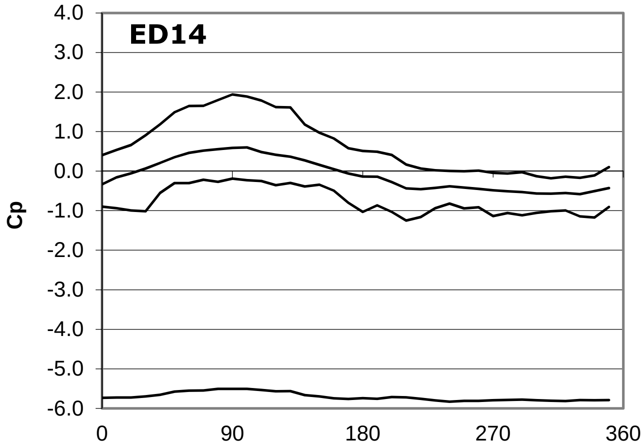

ED09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

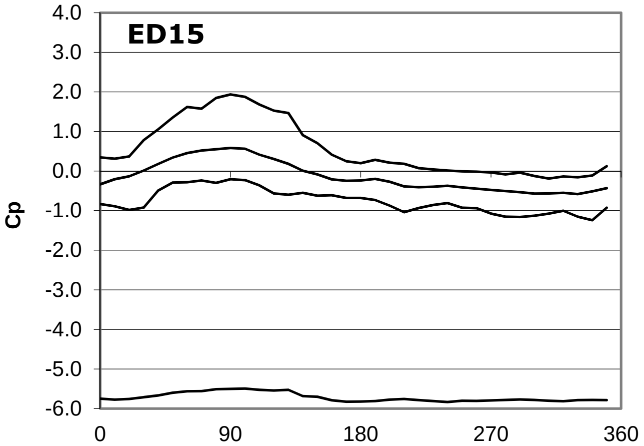

ED10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

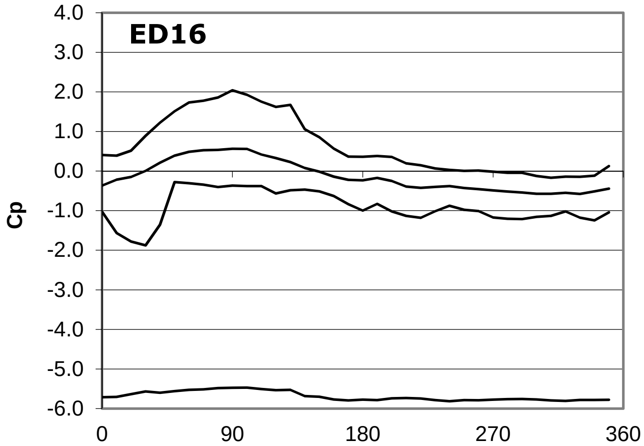

ED11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

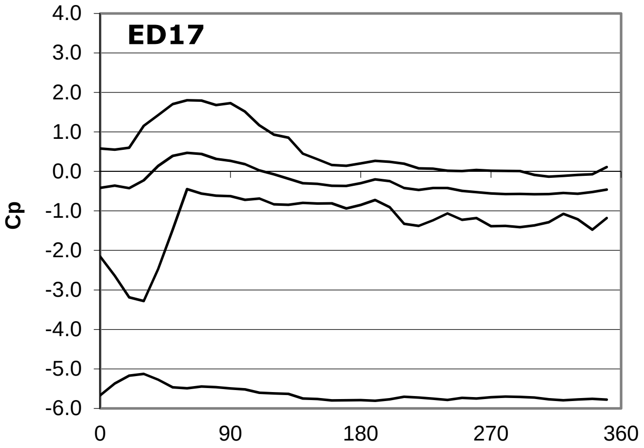

ED12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

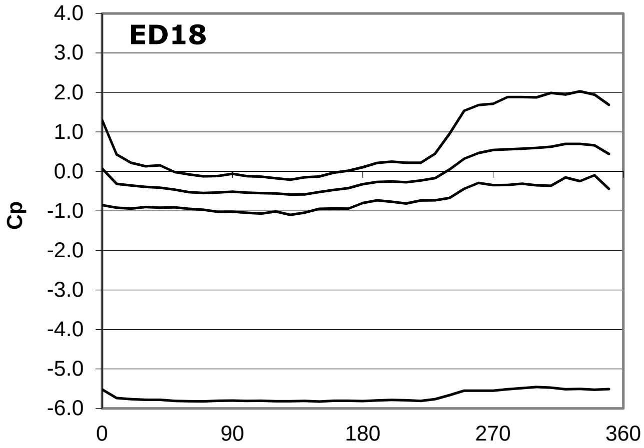

ED13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

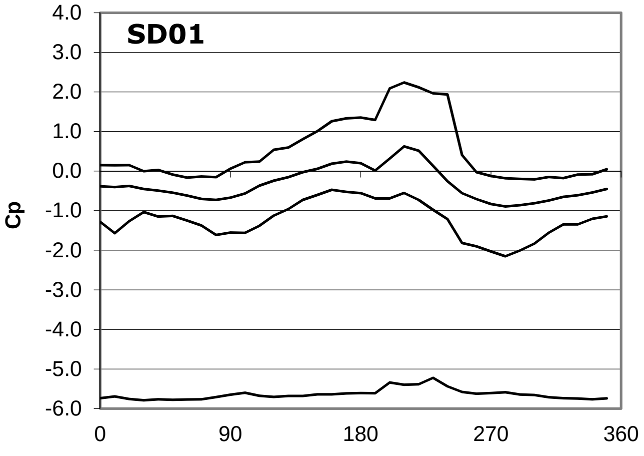

ED14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

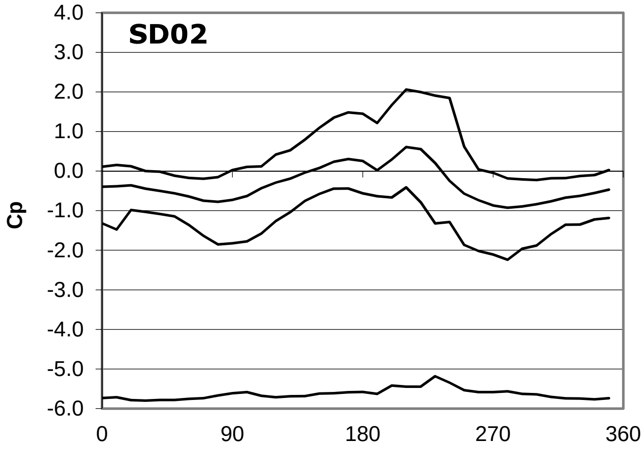

ED15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

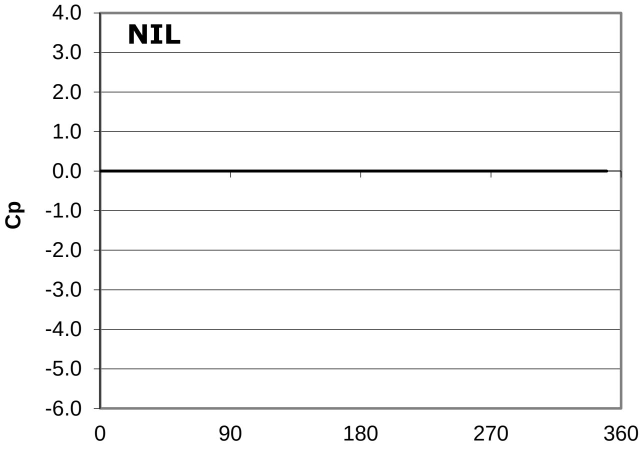

ED16
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

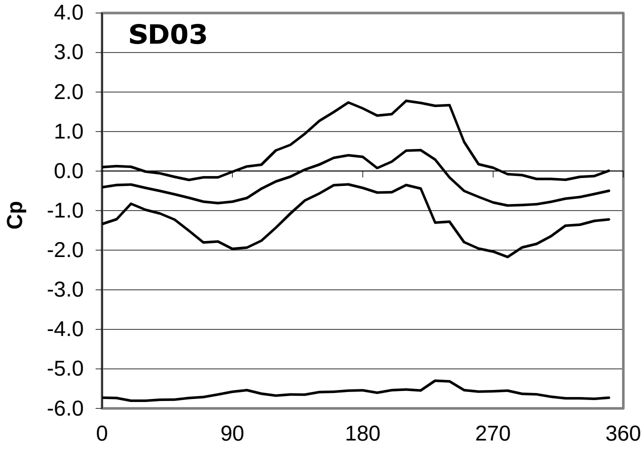

ED17
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

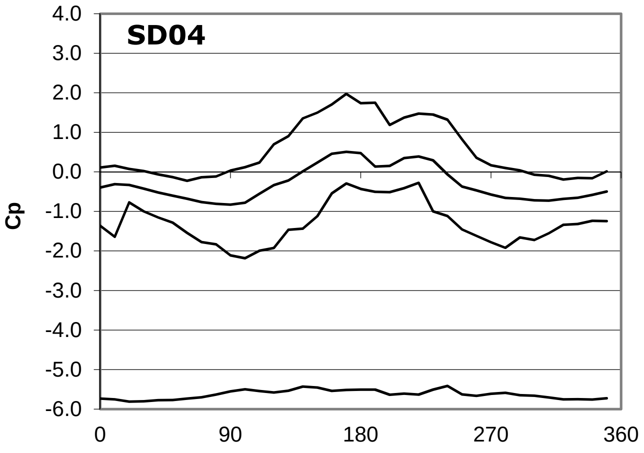

ED18
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

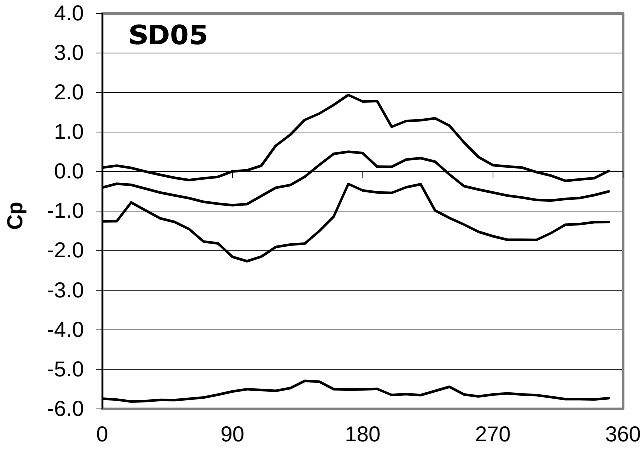

SD01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

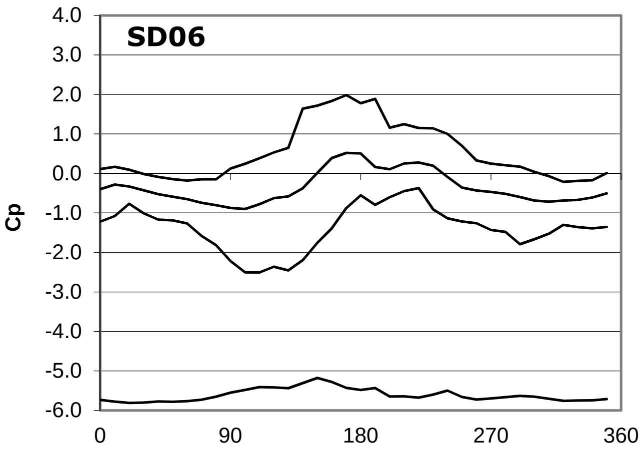

SD02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

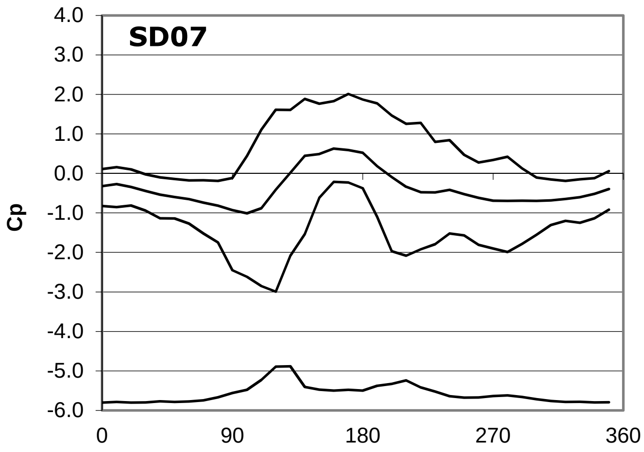

NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

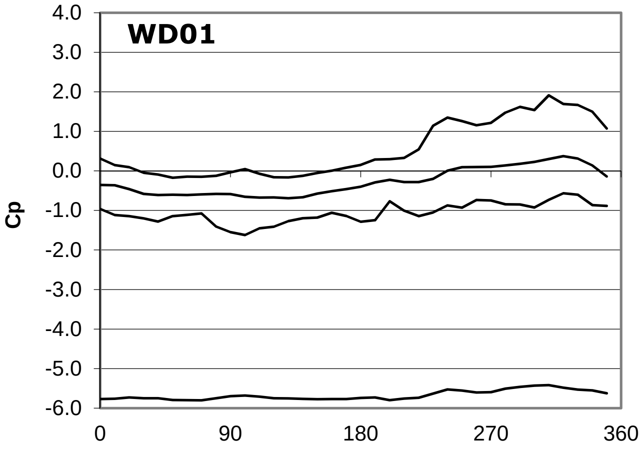

SD03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

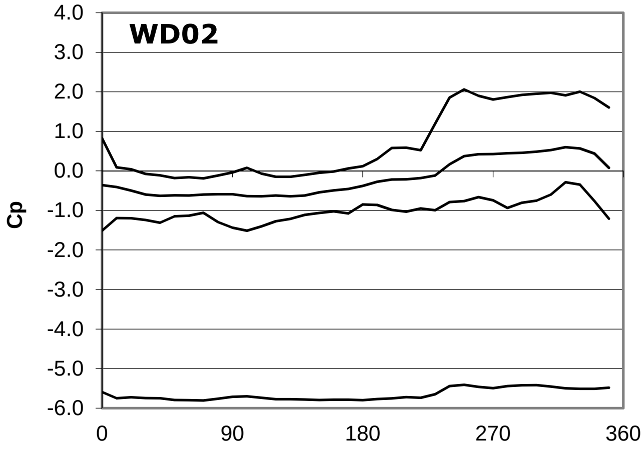

SD04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

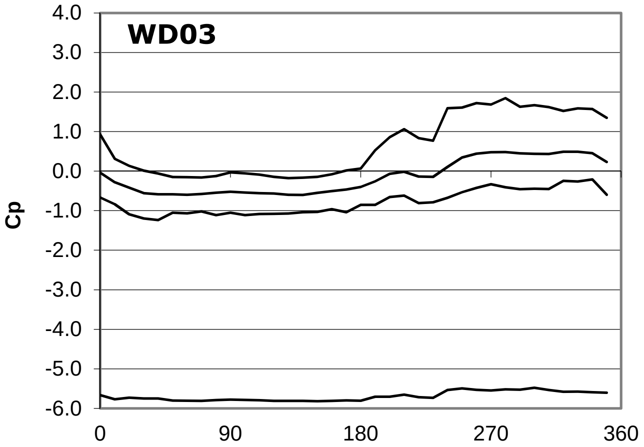

SD05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

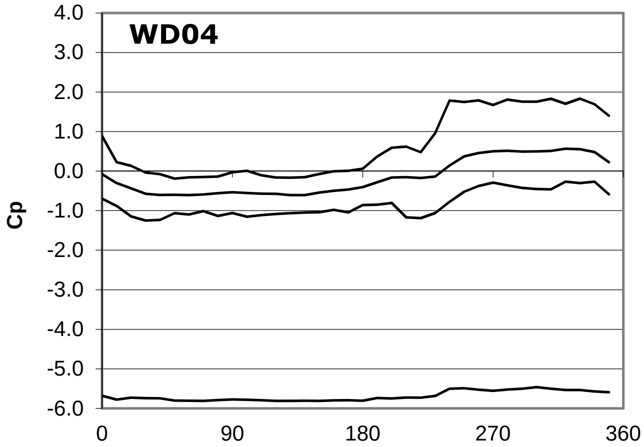

SD06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

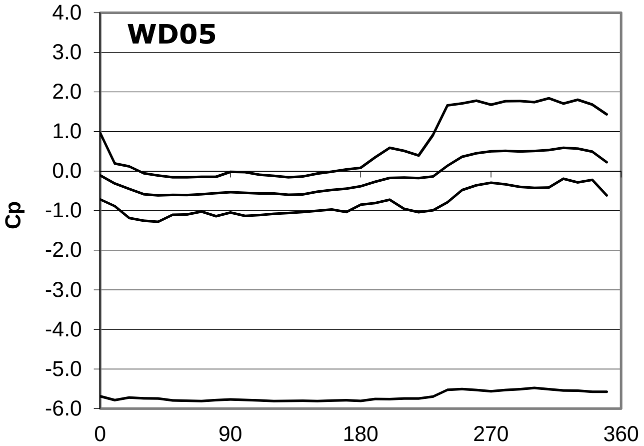

SD07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

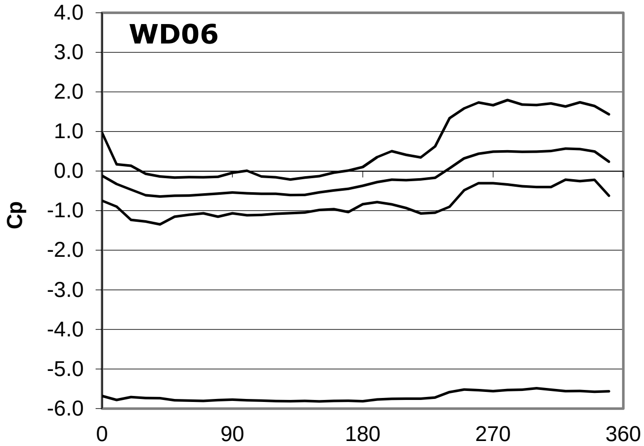

WD01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

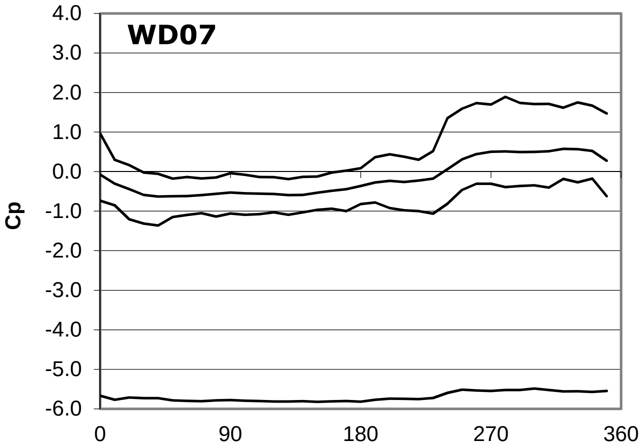

WD02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

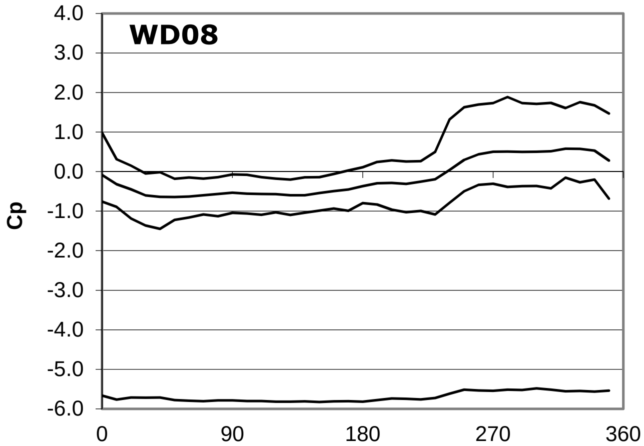

WD03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

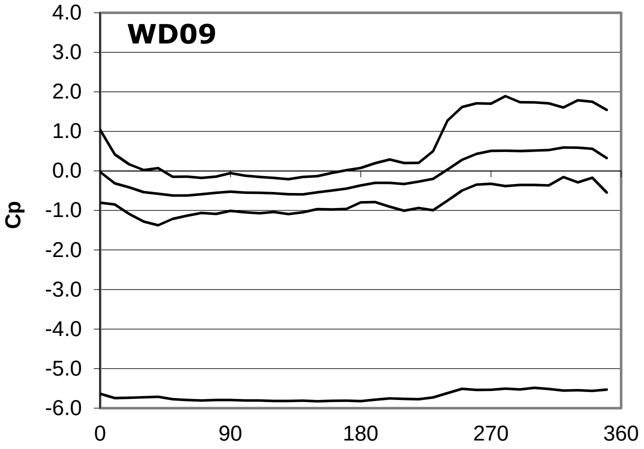

WD04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

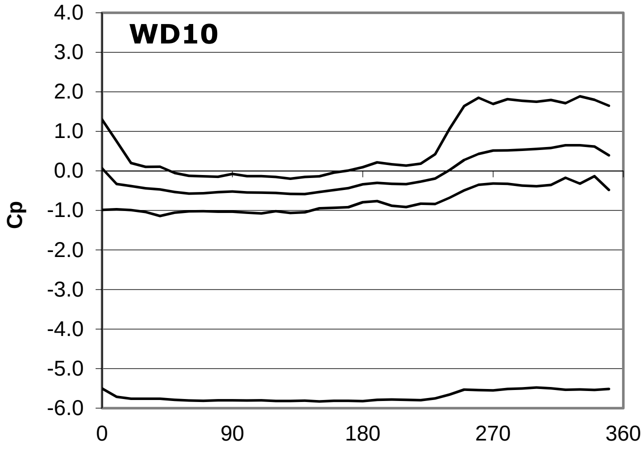

WD05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

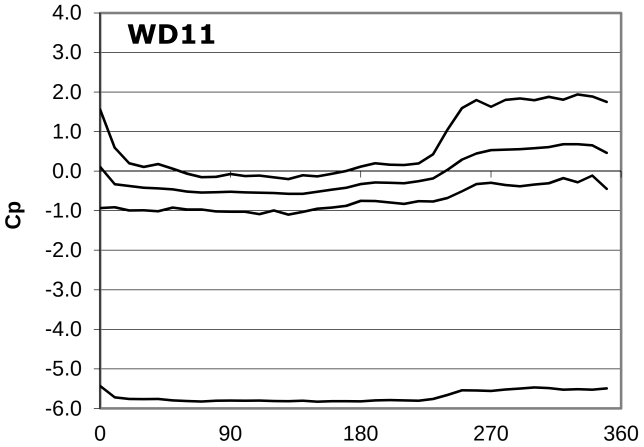

WD06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

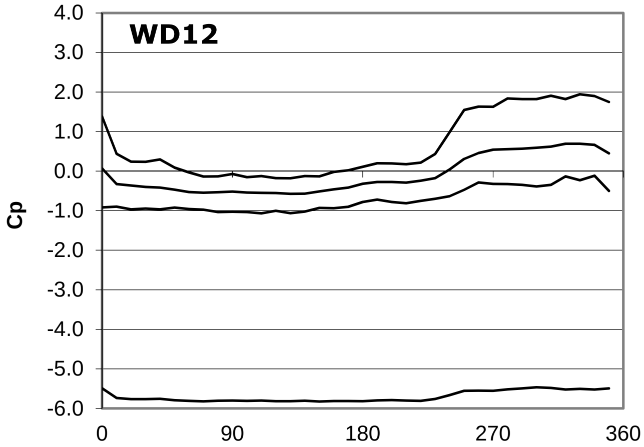

WD07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

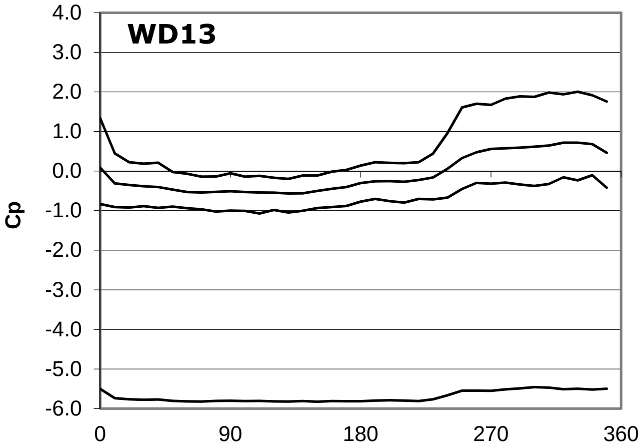

WD08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

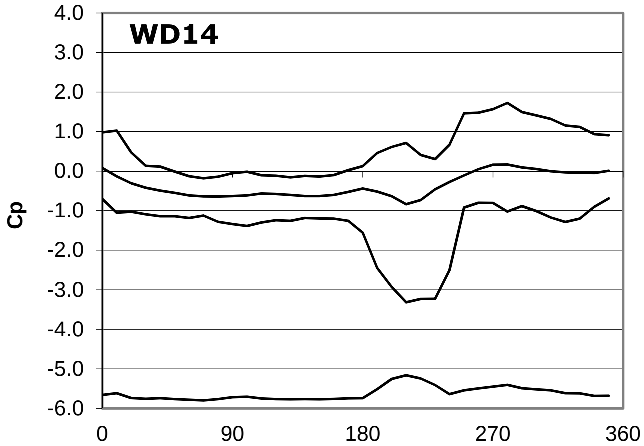

WD09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

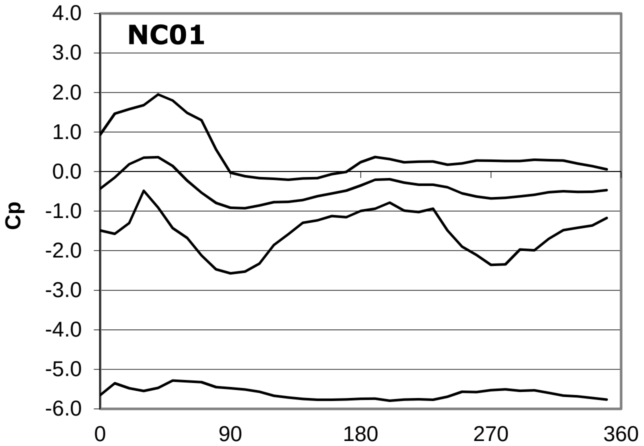

WD10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

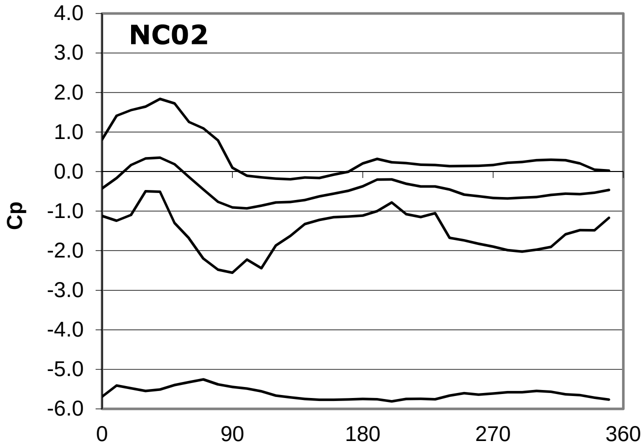

WD11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

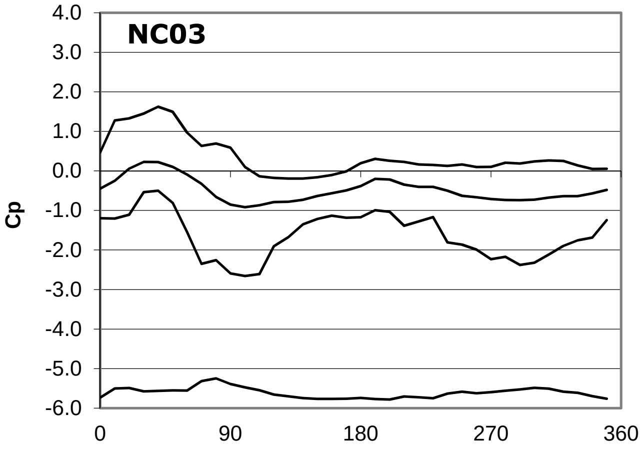

WD12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

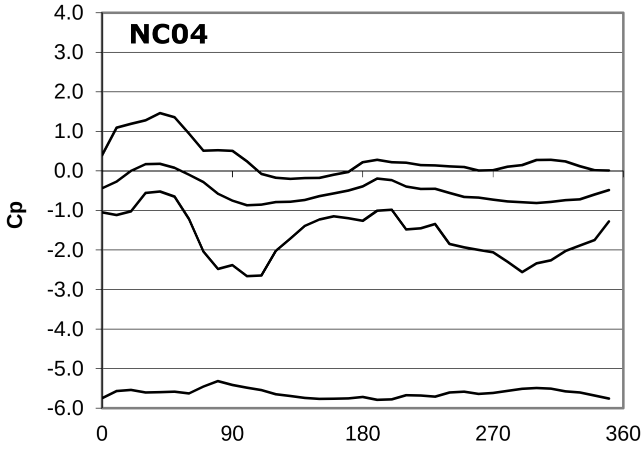

WD13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

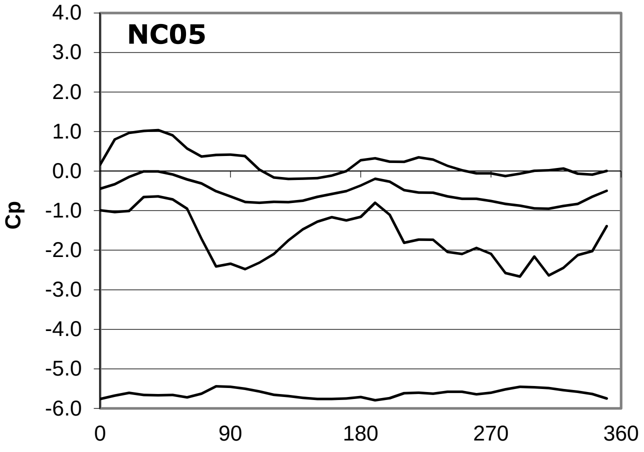

WD14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

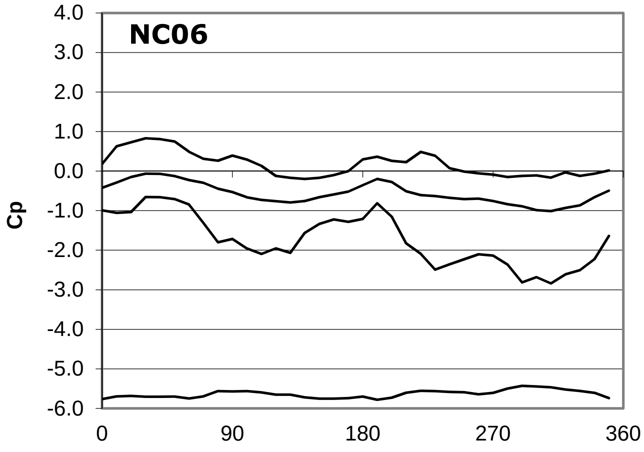

NC01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

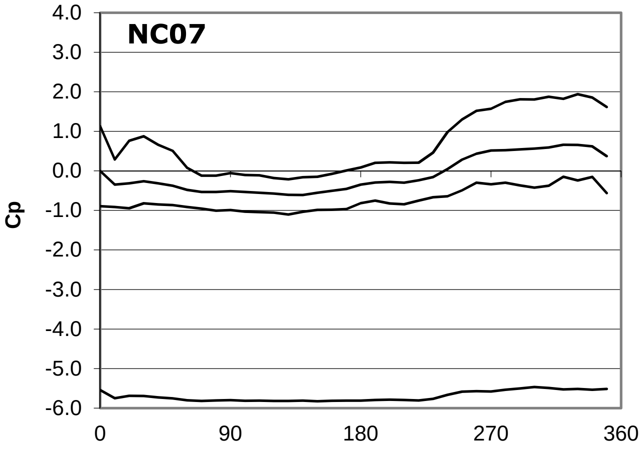

NC02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

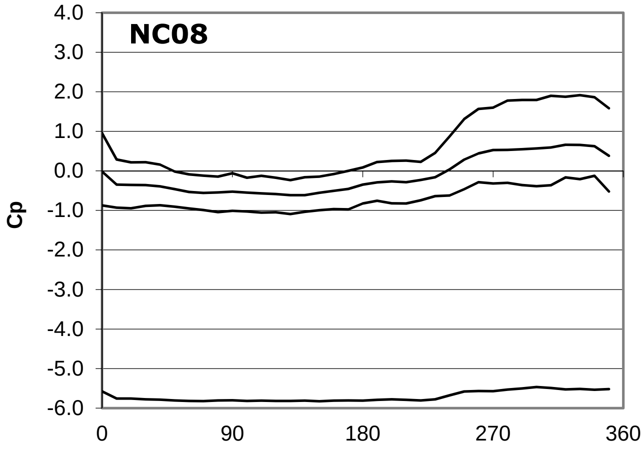

NC03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

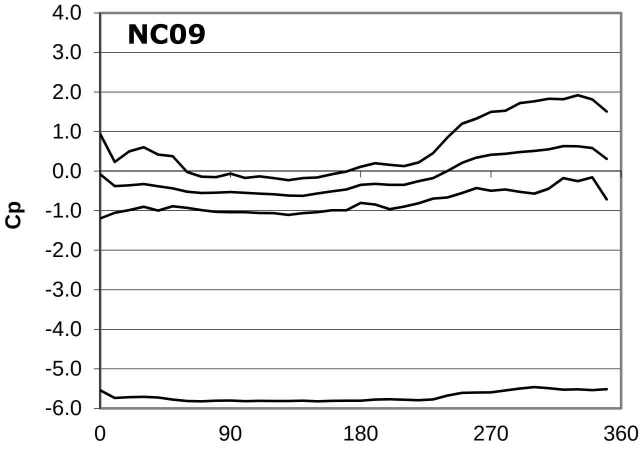

NC04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

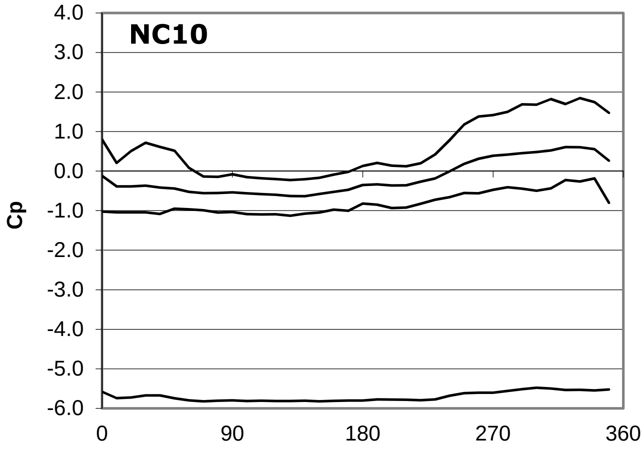

NC05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

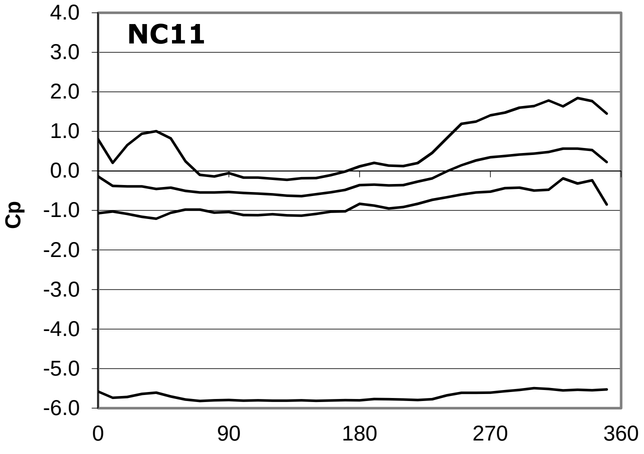

NC06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

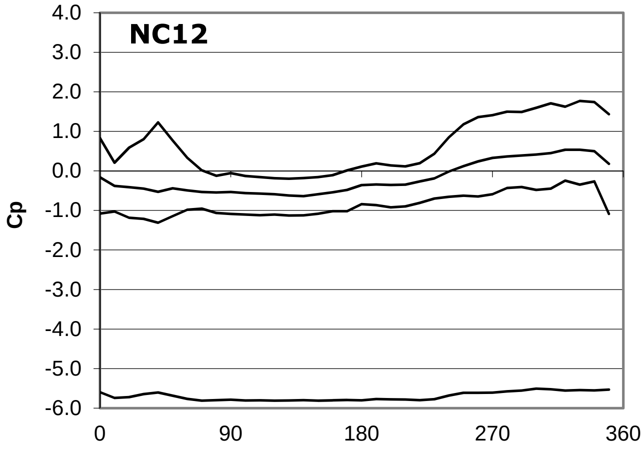

NC07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

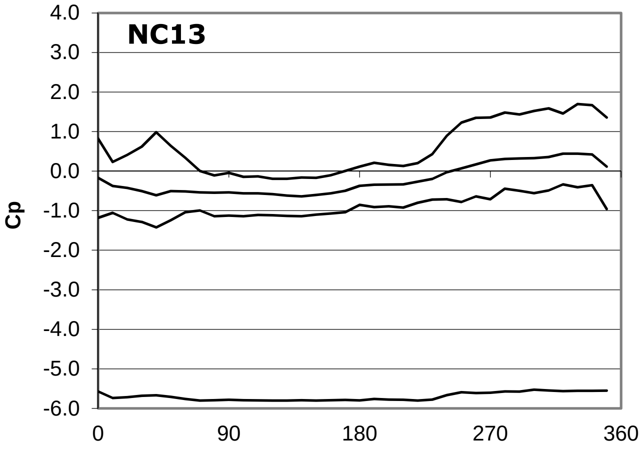

NC08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

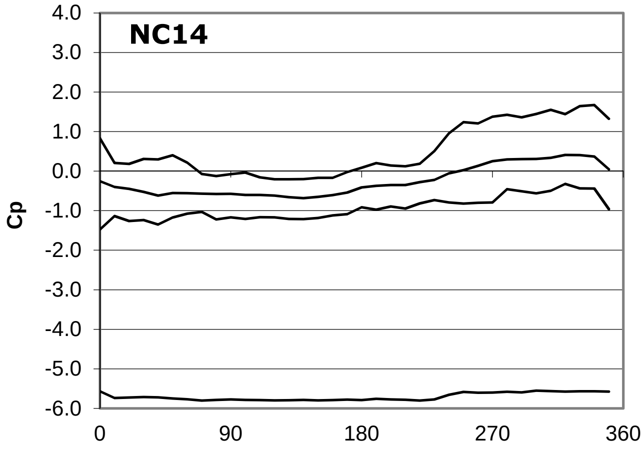

NC09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

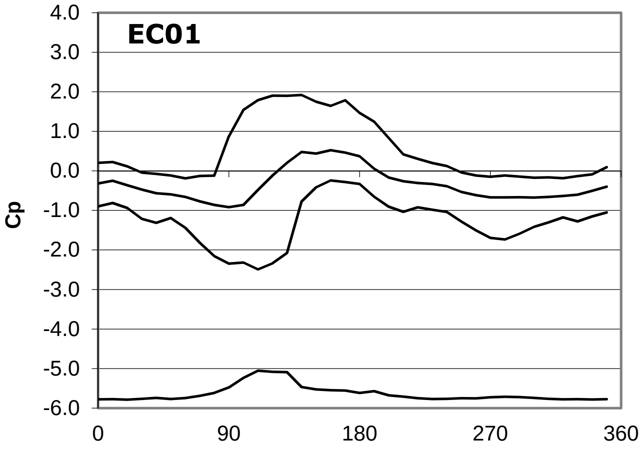

NC10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

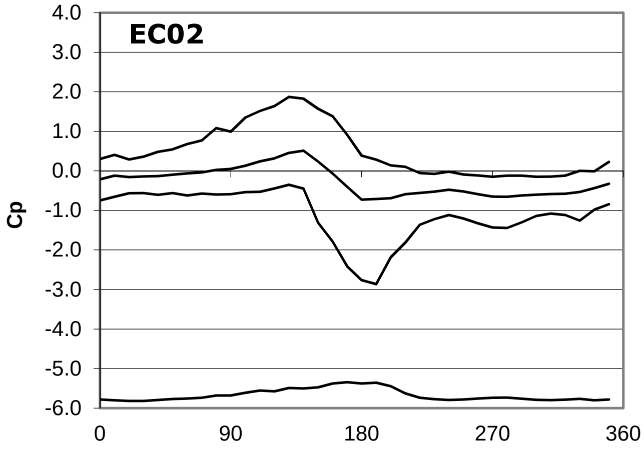

NC11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

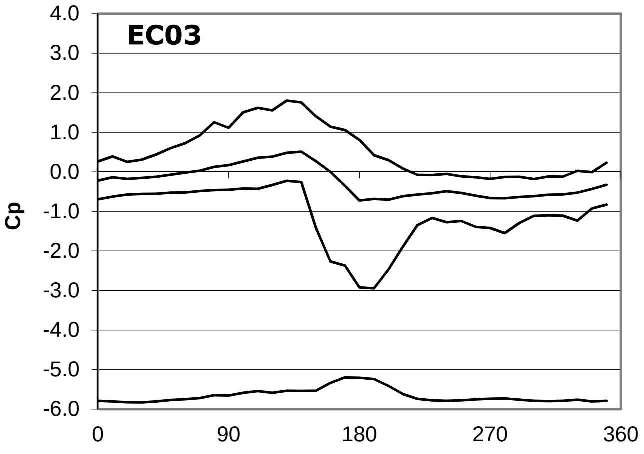

NC12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

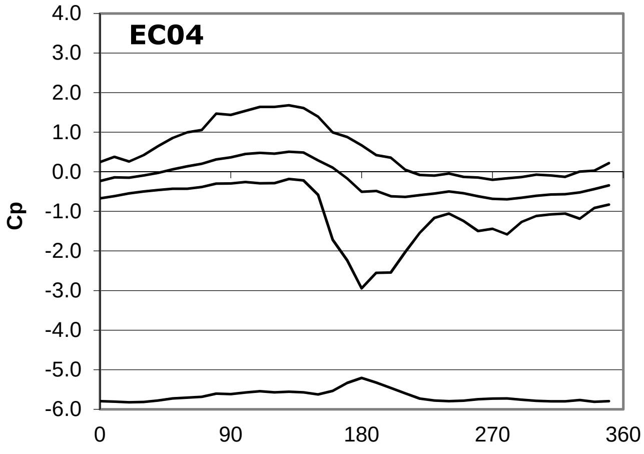

NC13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

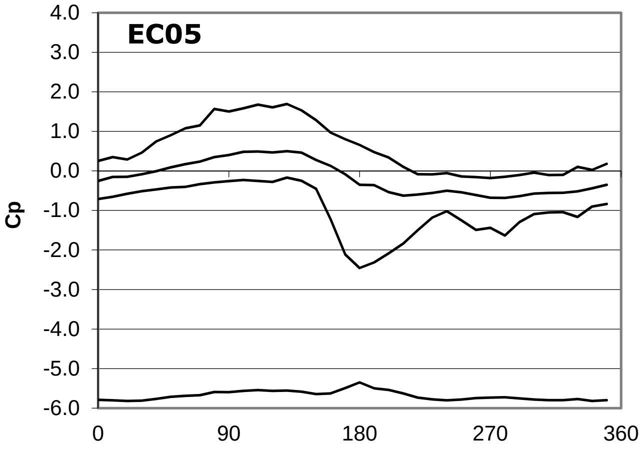

NC14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

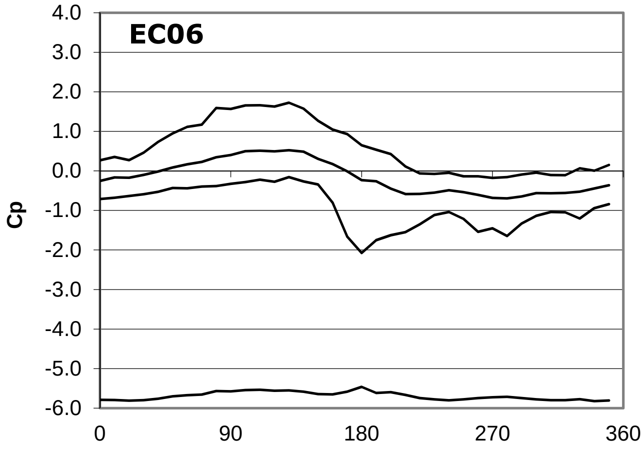

EC01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

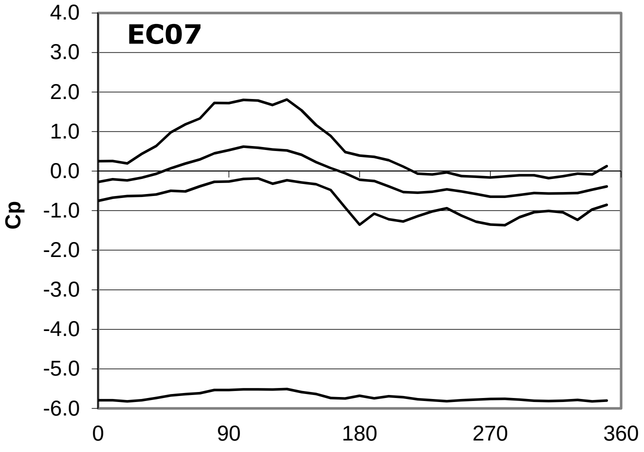

EC02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

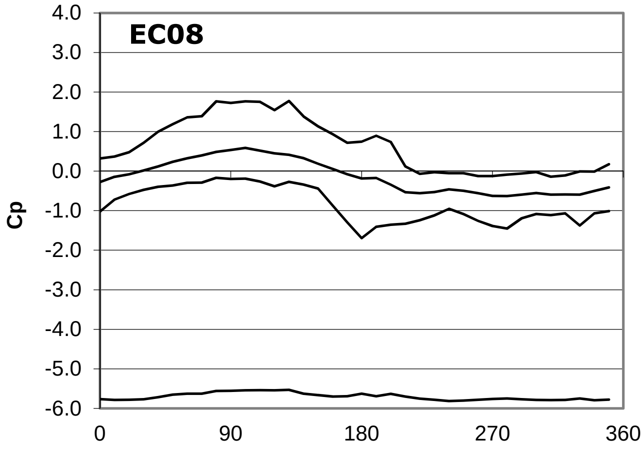

EC03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

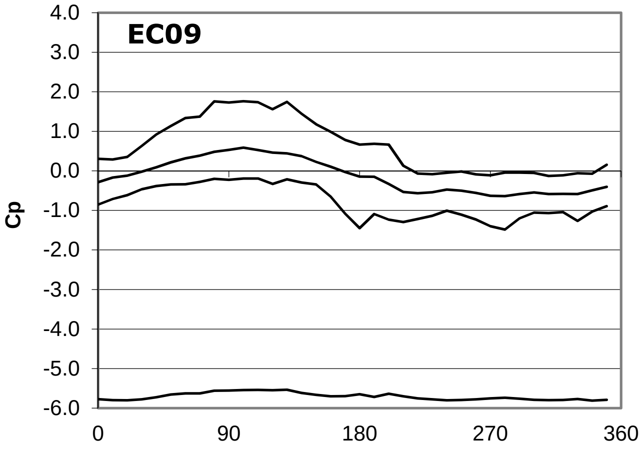

EC04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

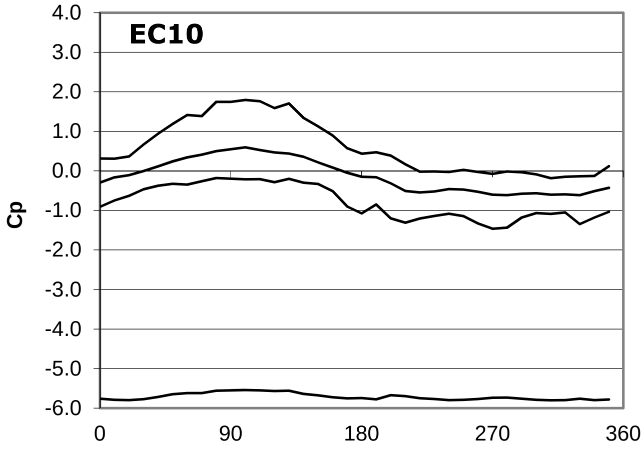

EC05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

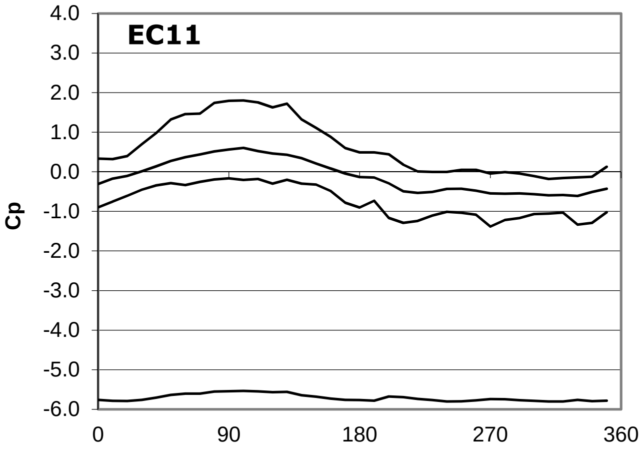

EC06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

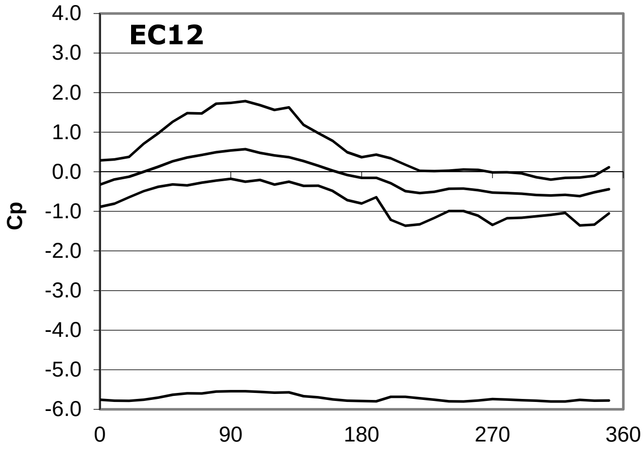

EC07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

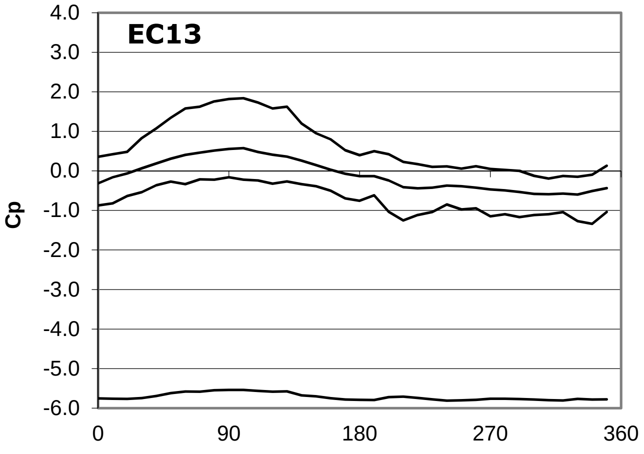

EC08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

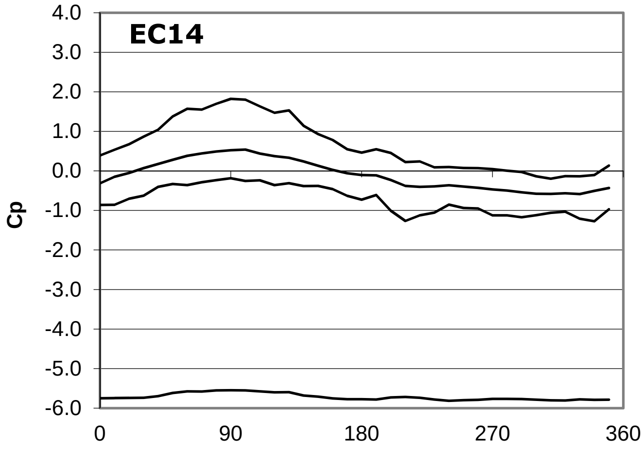

EC09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

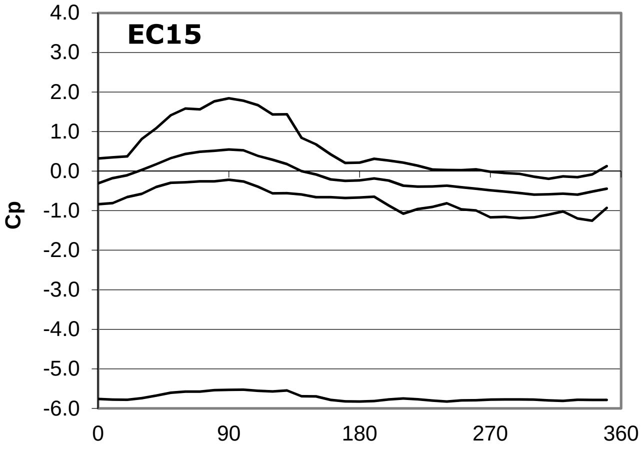

EC10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

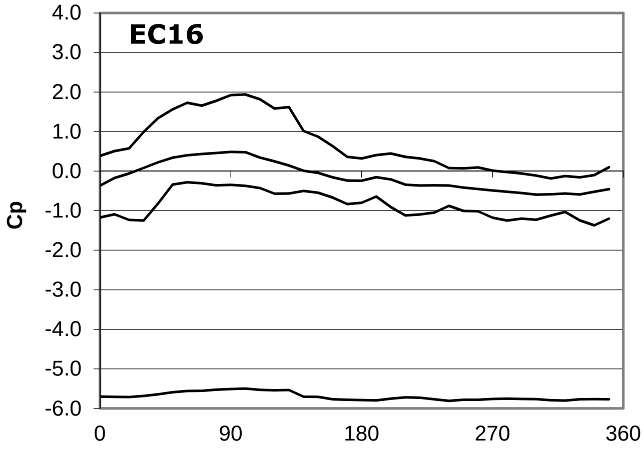

EC11
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

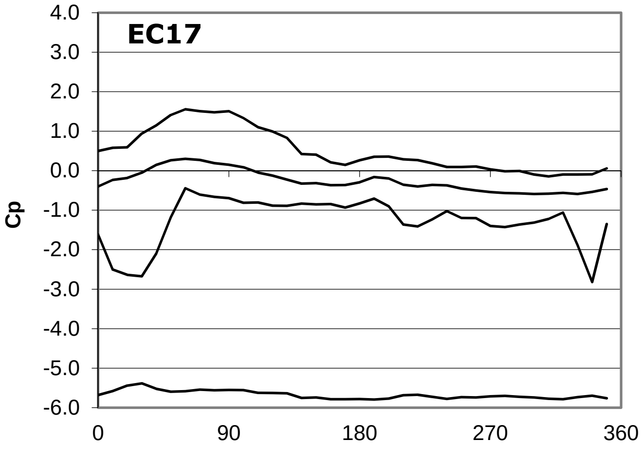

EC12
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

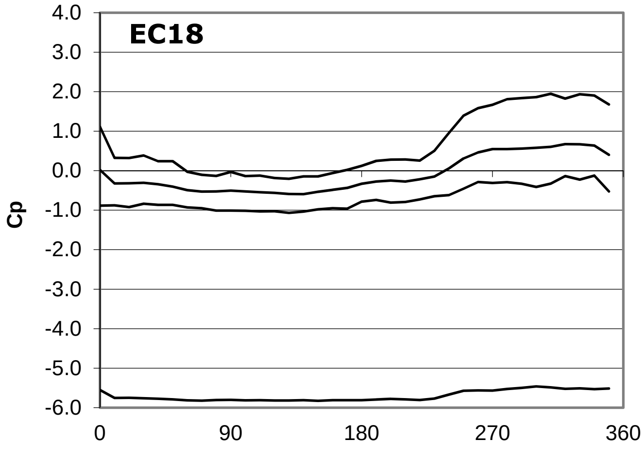

EC13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

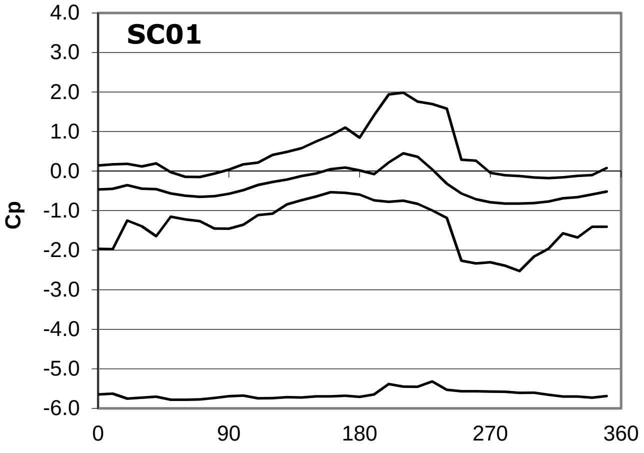

EC14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

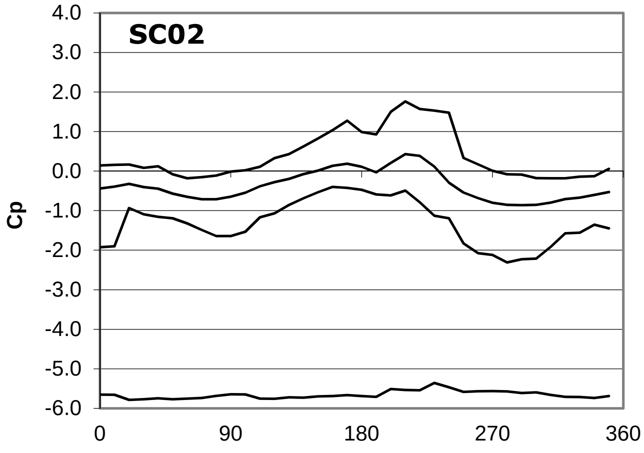

EC15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

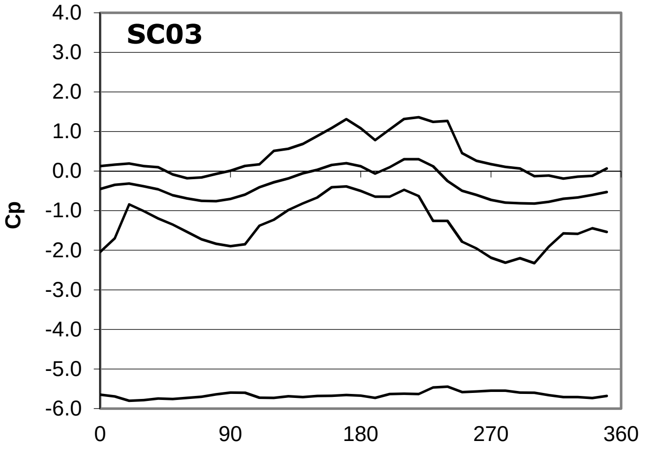

EC16
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

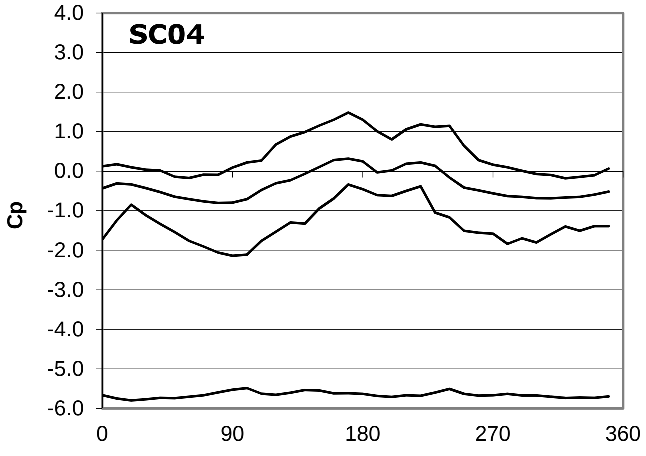

EC17
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

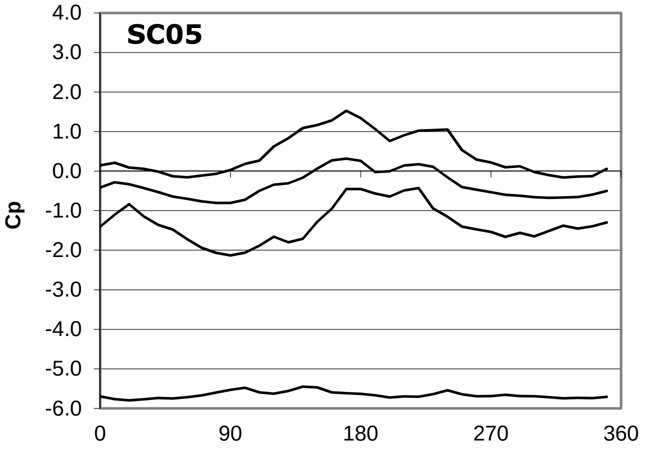

EC18
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

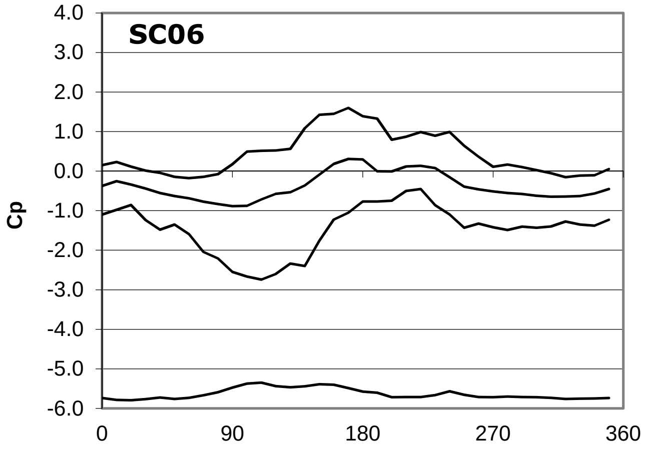

SC01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

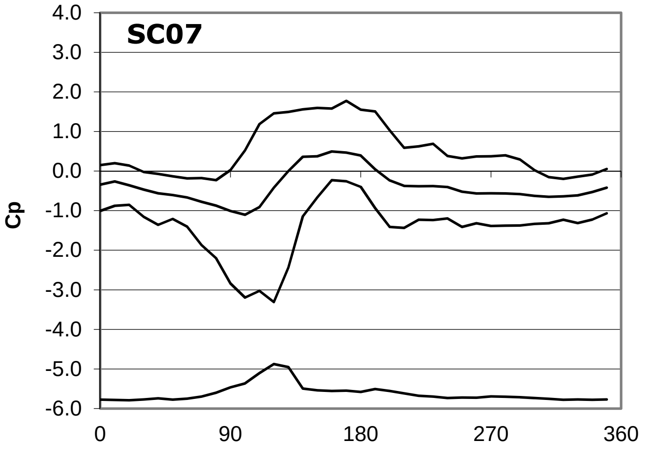

SC02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

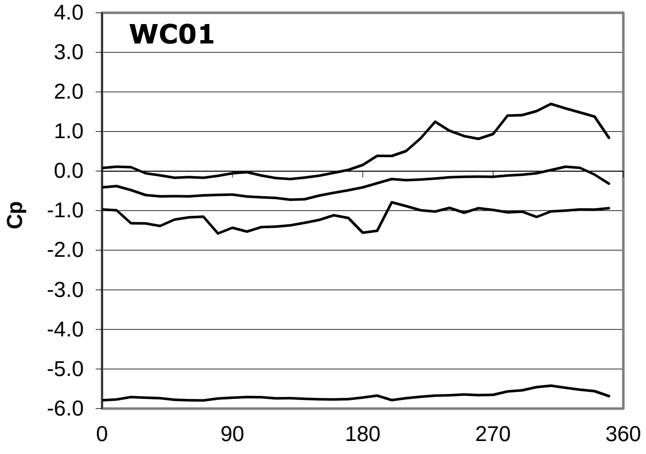

SC03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

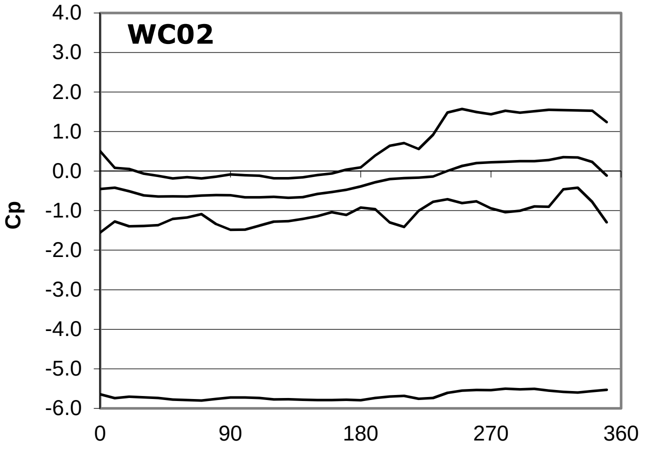

SC04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

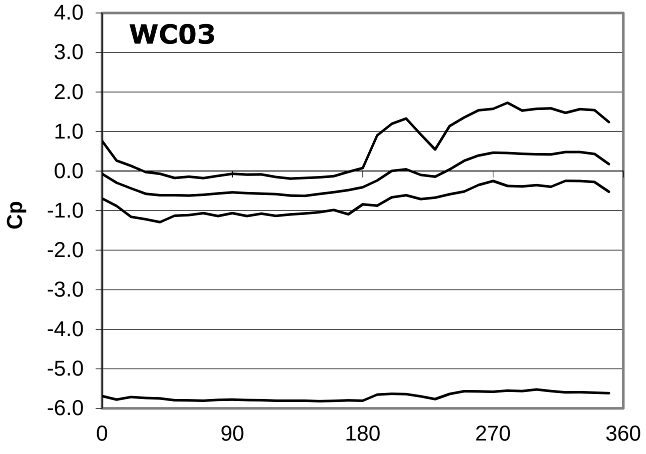

SC05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

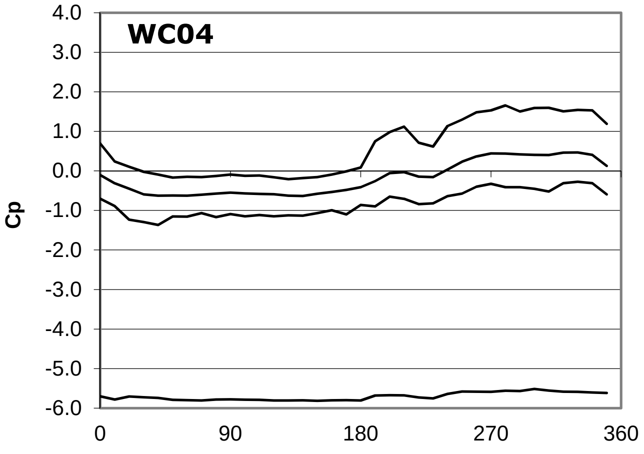

SC06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

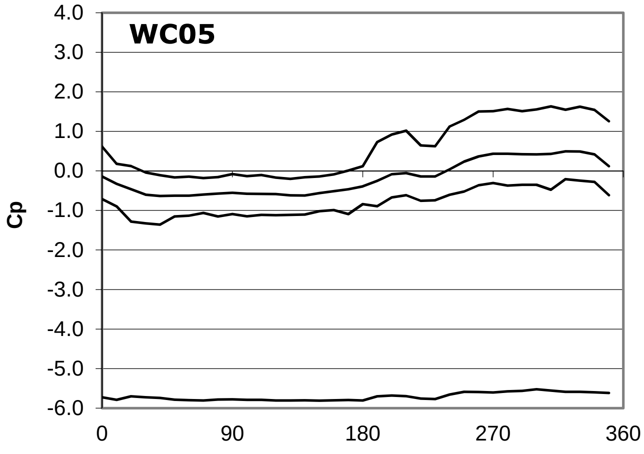

SC07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

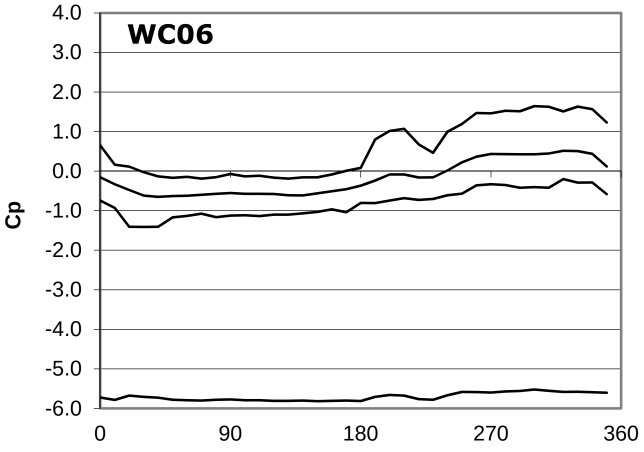

WC01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

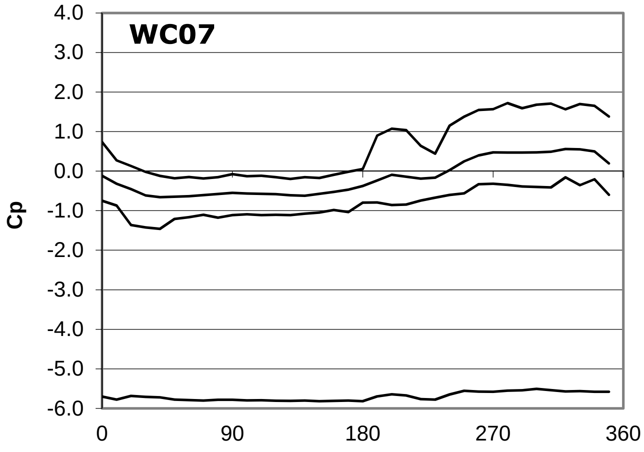

WC02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

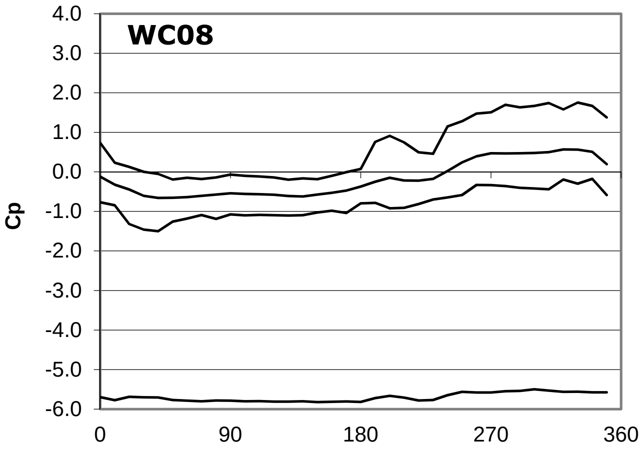

WC03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

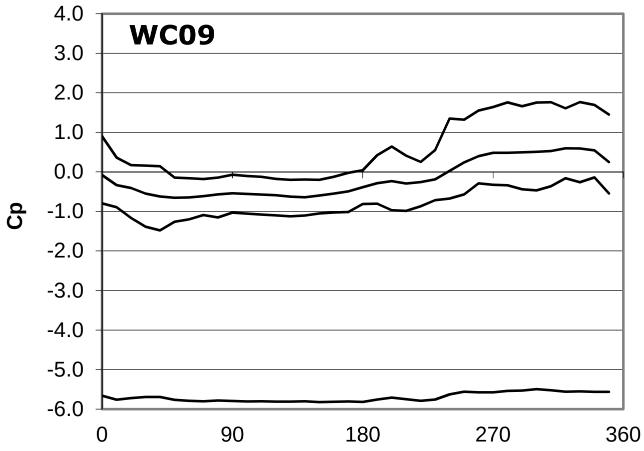

WC04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

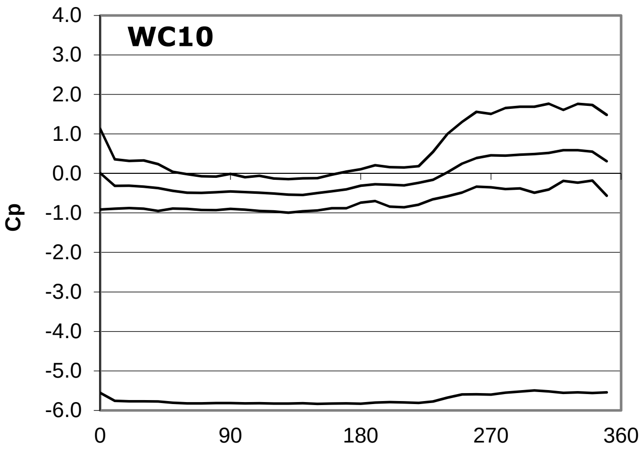

WC05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

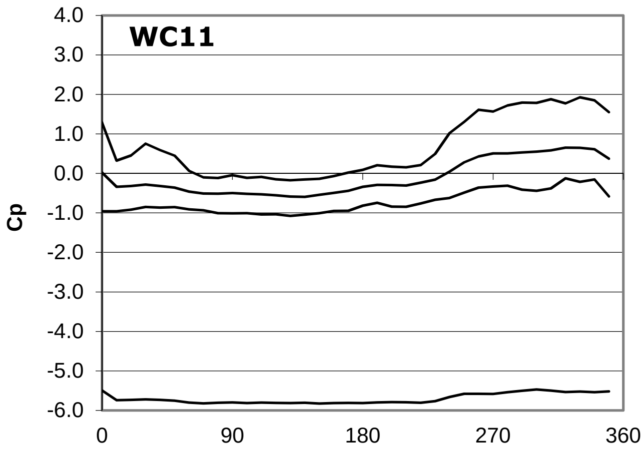

WC06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

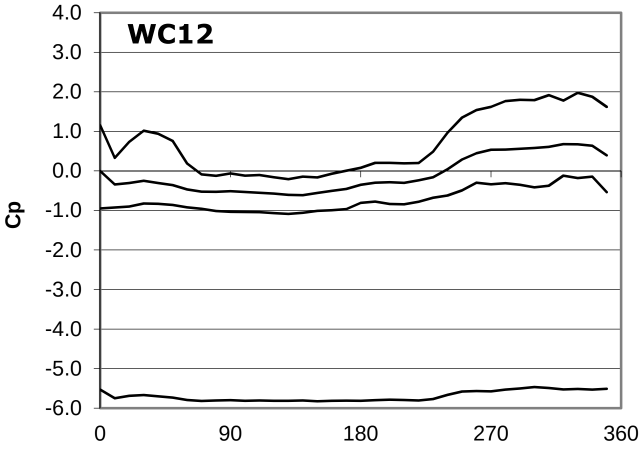

WC07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

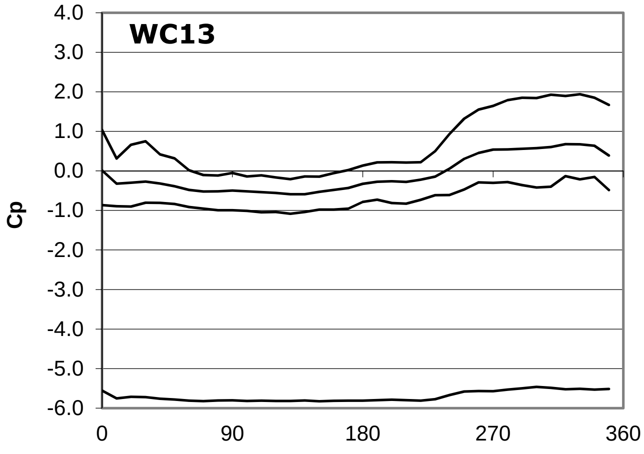

WC08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

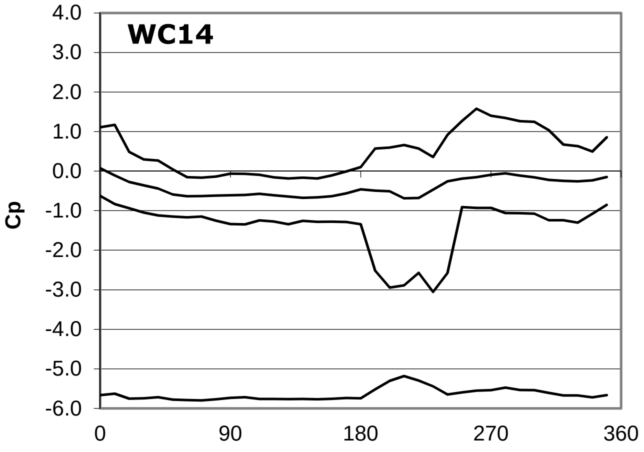

WC09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

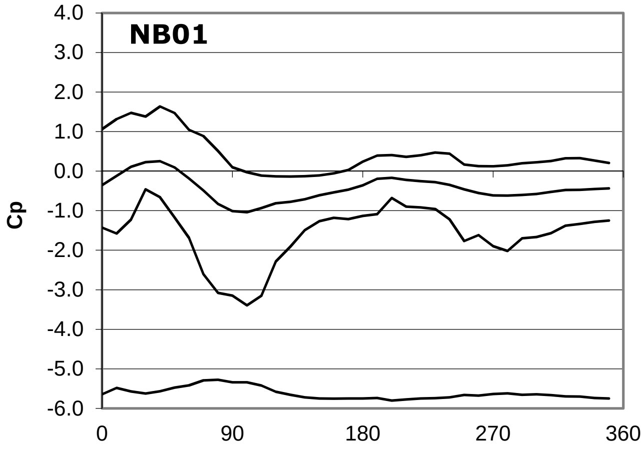

WC10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

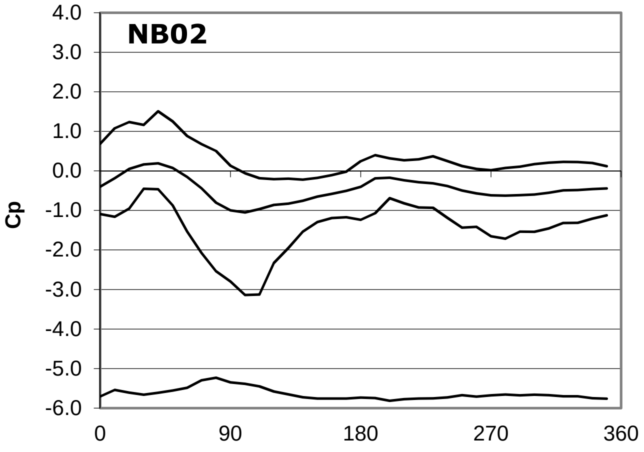

WC11
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

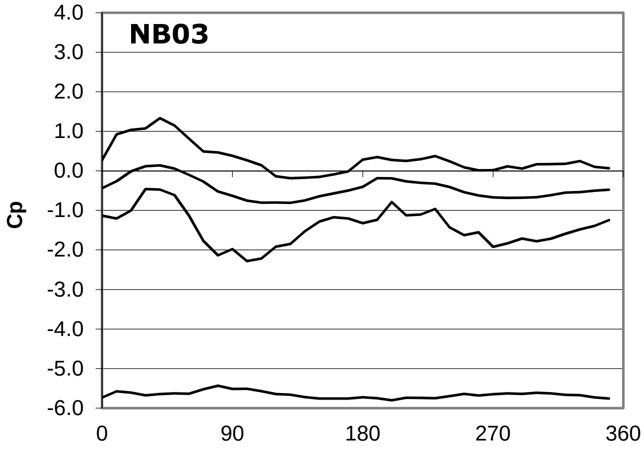

WC12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

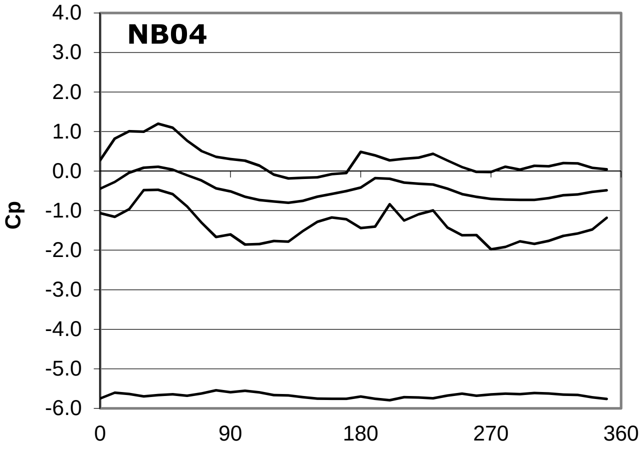

WC13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

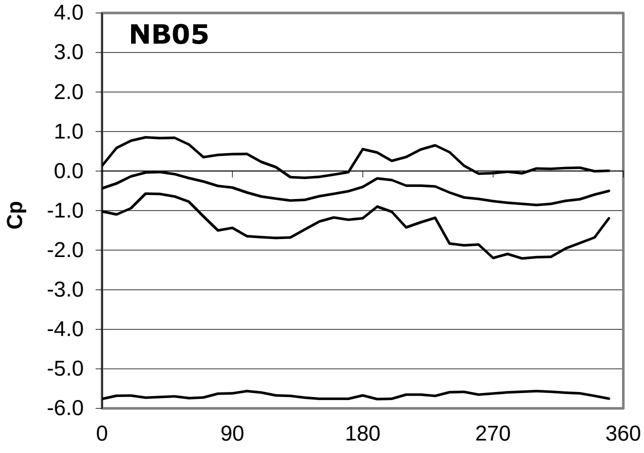

WC14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

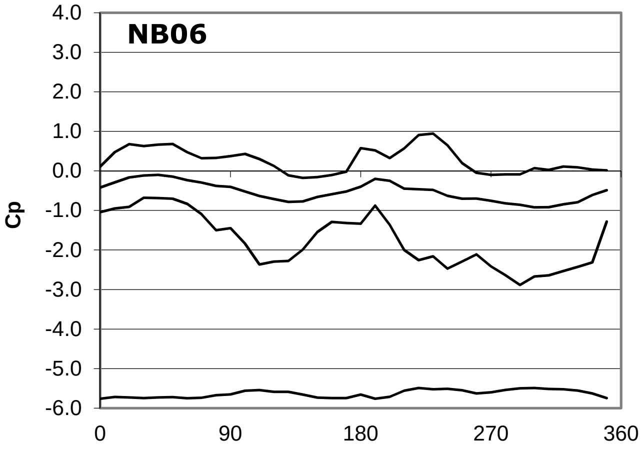

NB01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

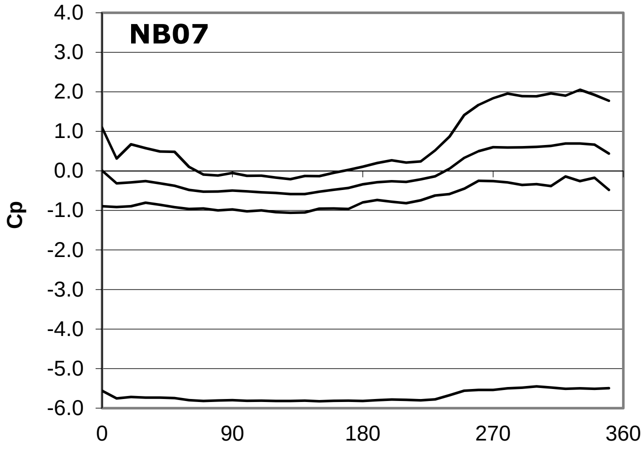

NB02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

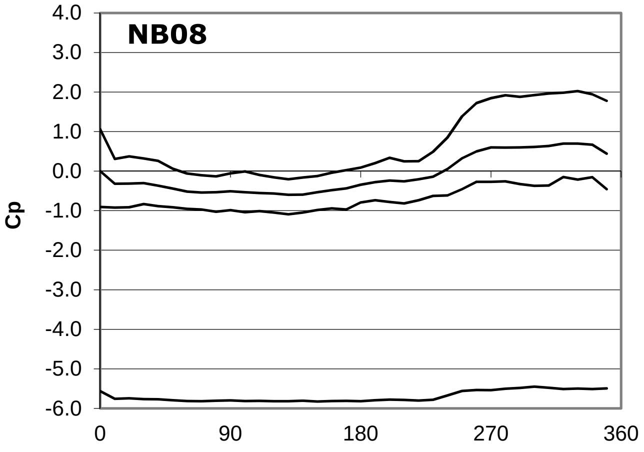

NB03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

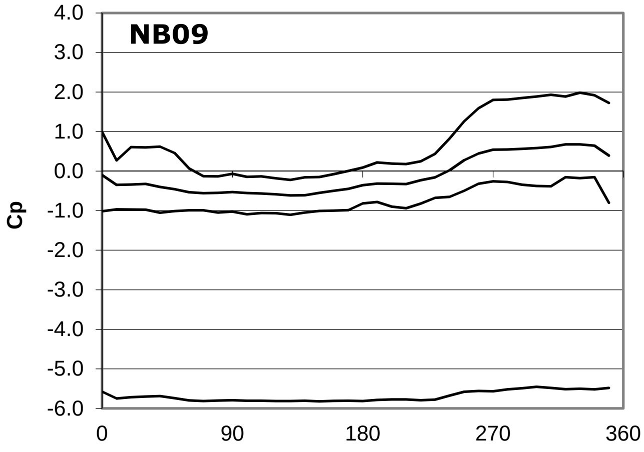

NB04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

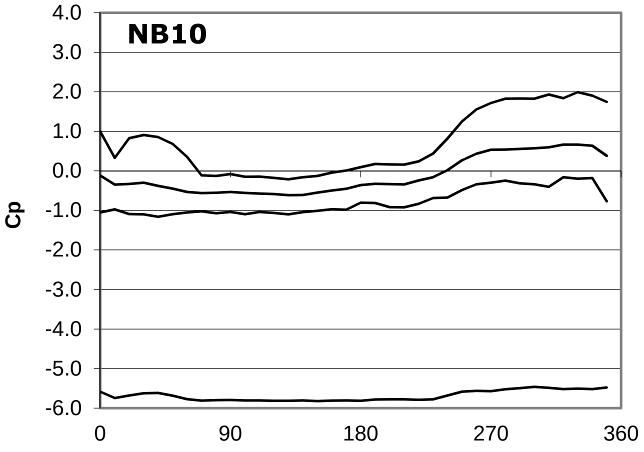

NB05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

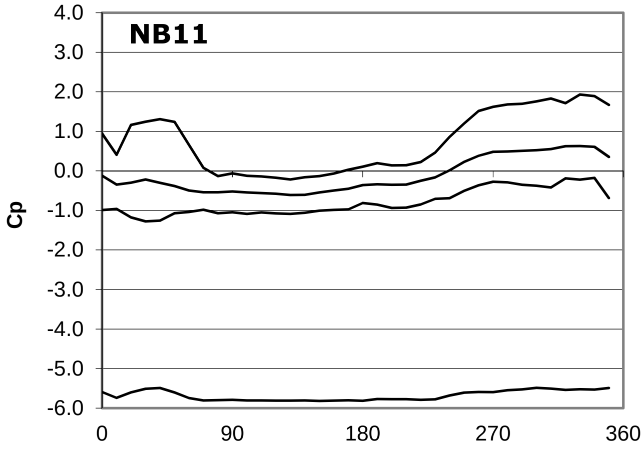

NB06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

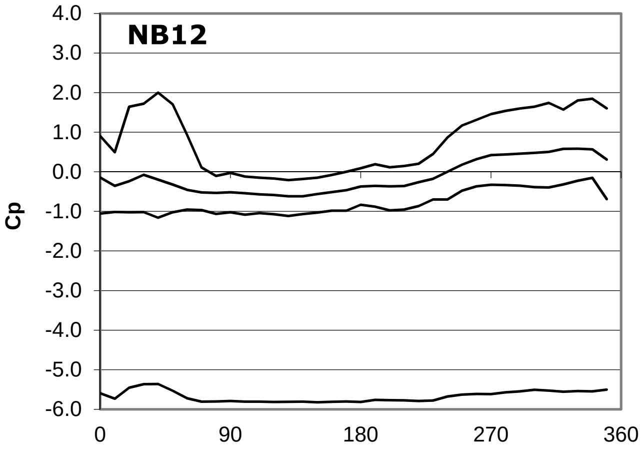

NB07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

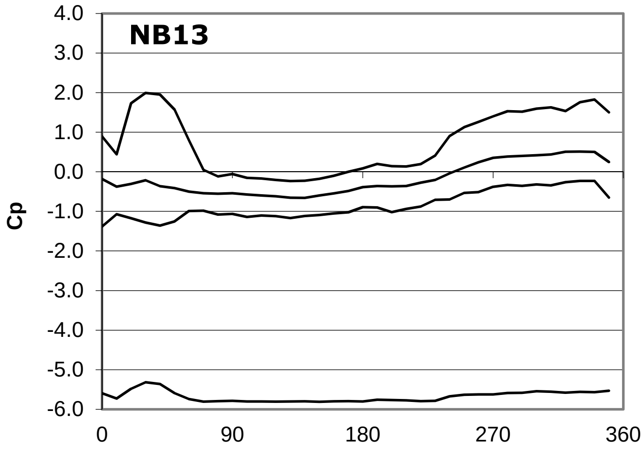

NB08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

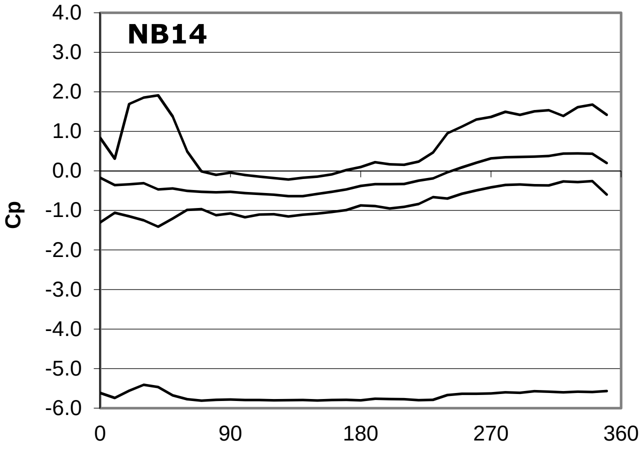

NB09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

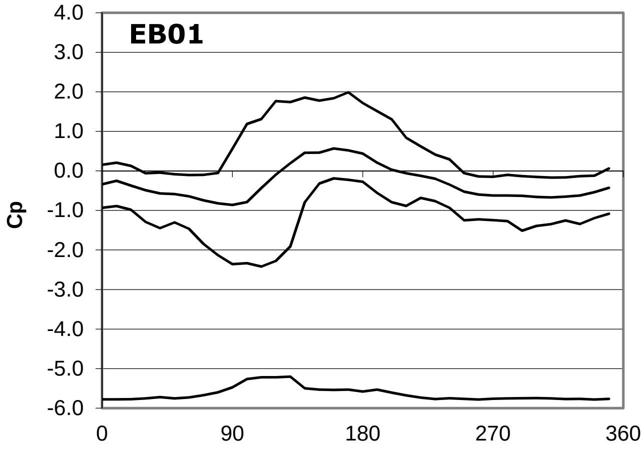

NB10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

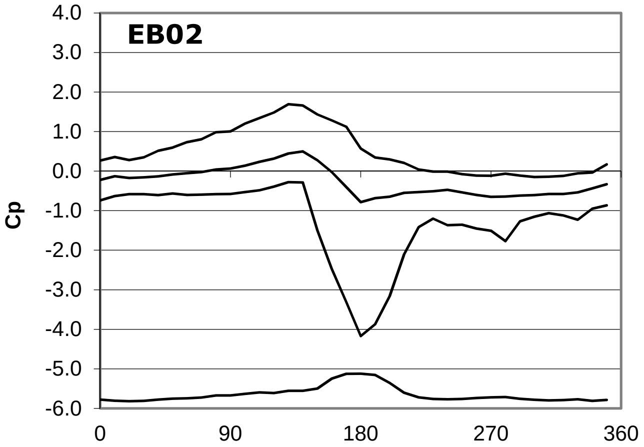

NB11
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

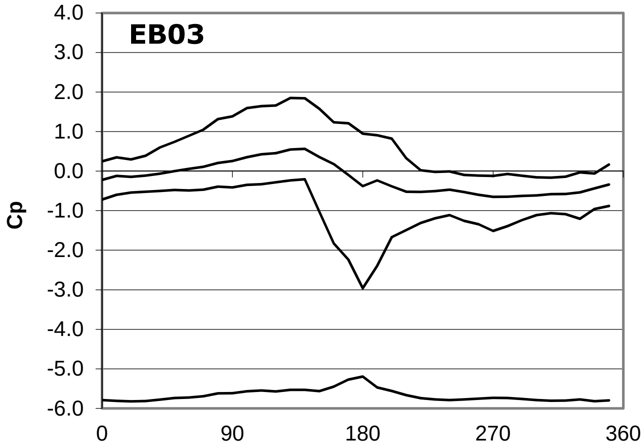

NB12
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

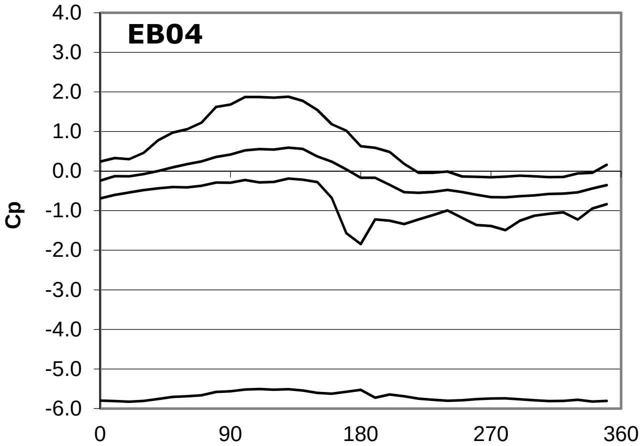

NB13
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

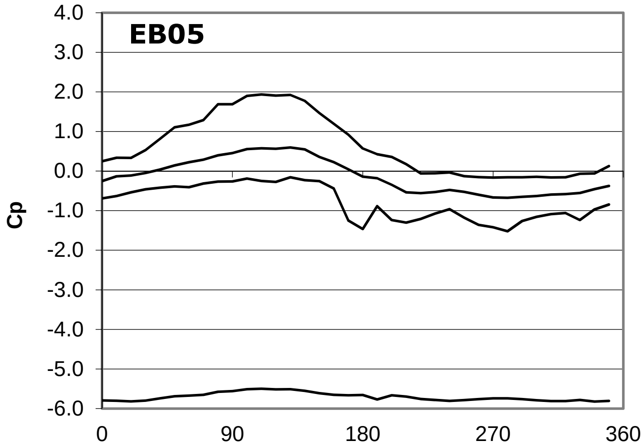

NB14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

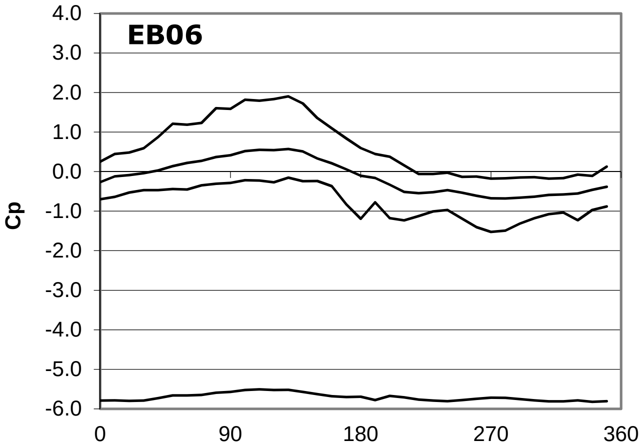

EB01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

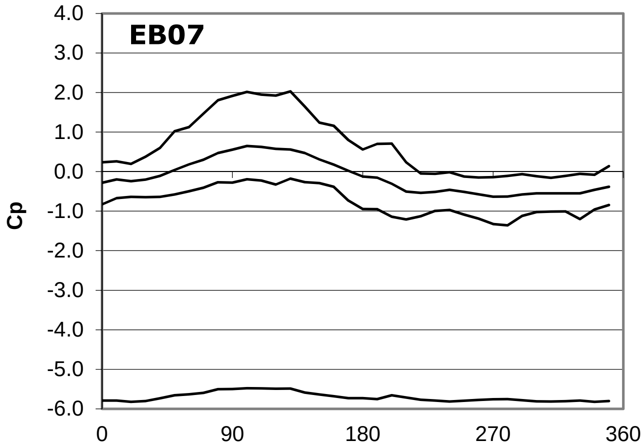

EB02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

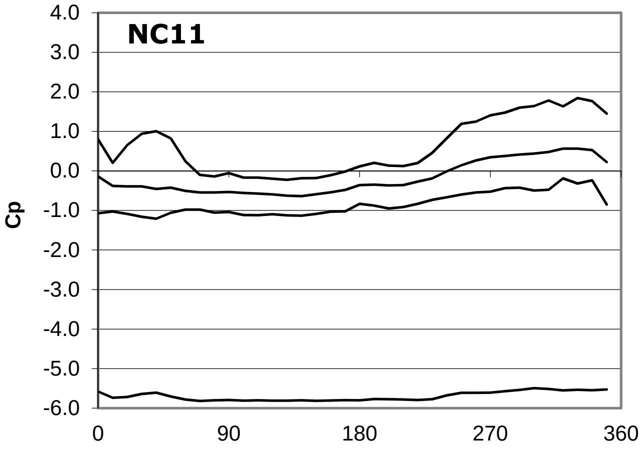

EB03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

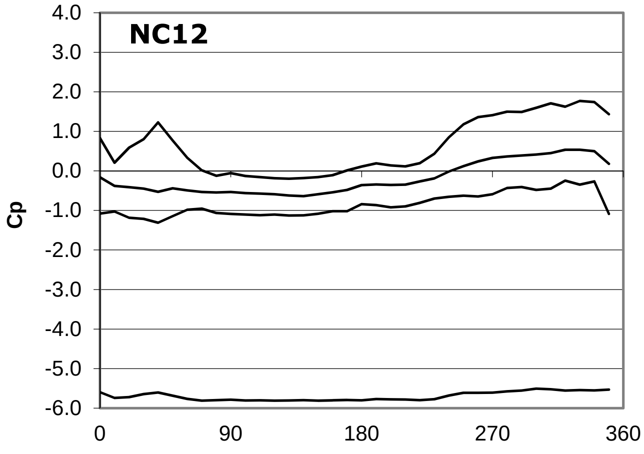

EB04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

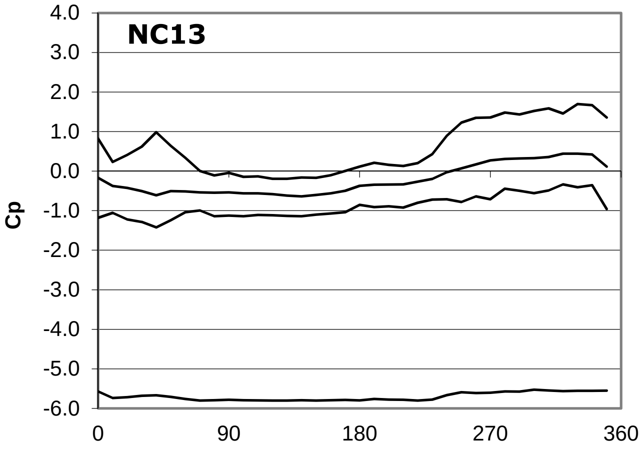

EB05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

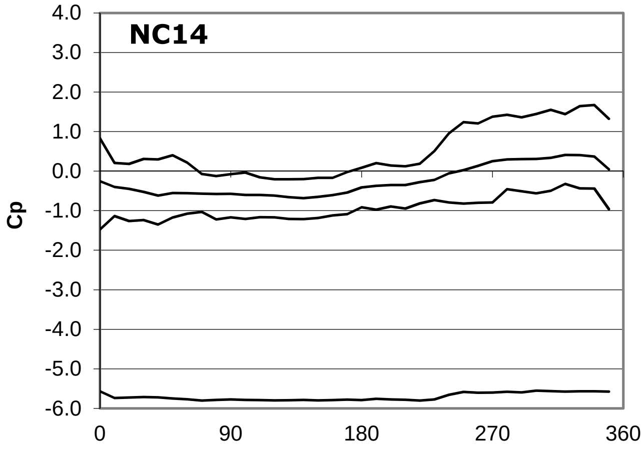

EB06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

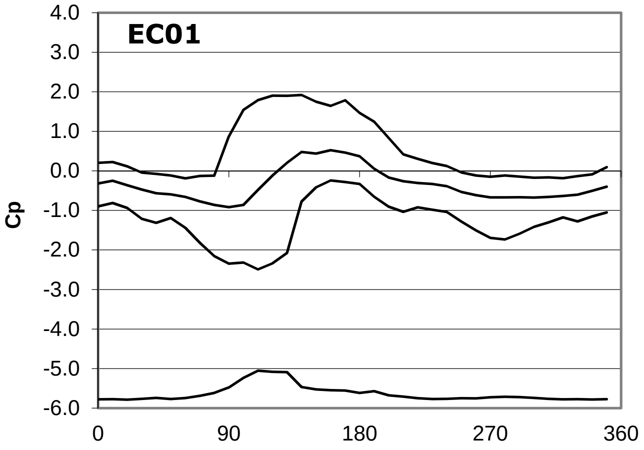

EB07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

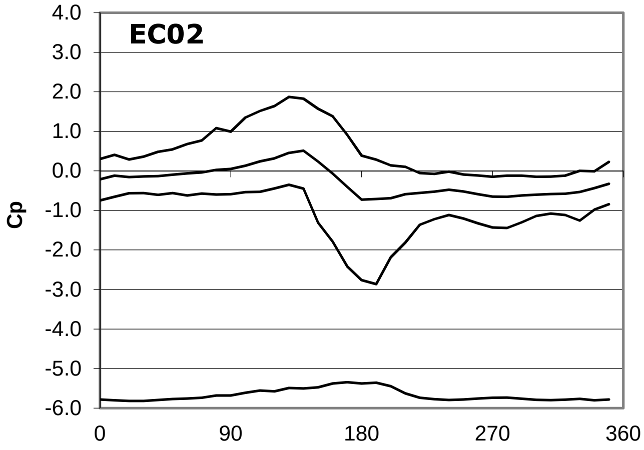

NC11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

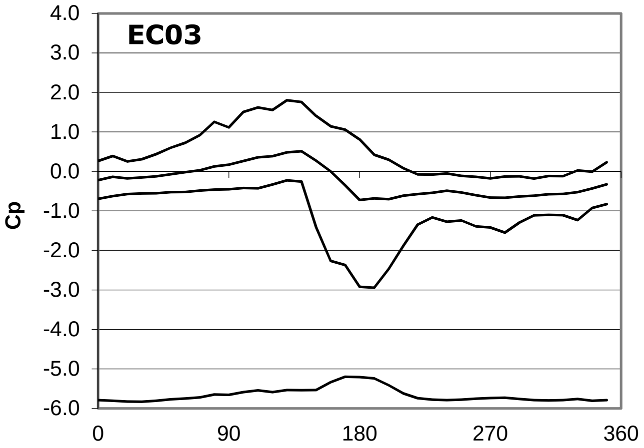

NC12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

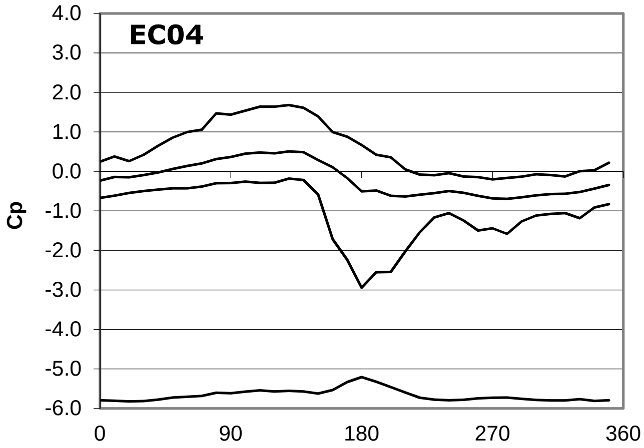

NC13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

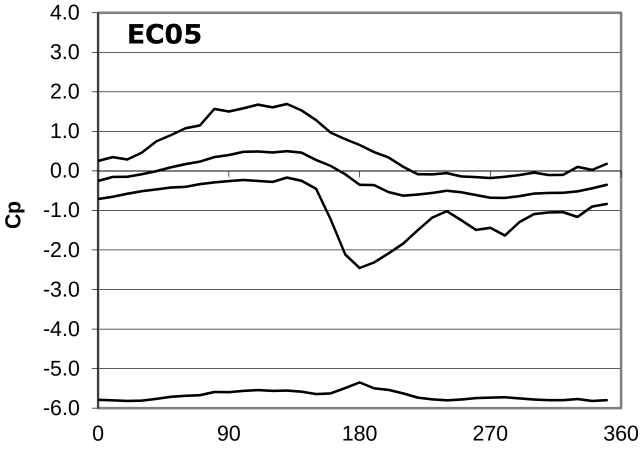

NC14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

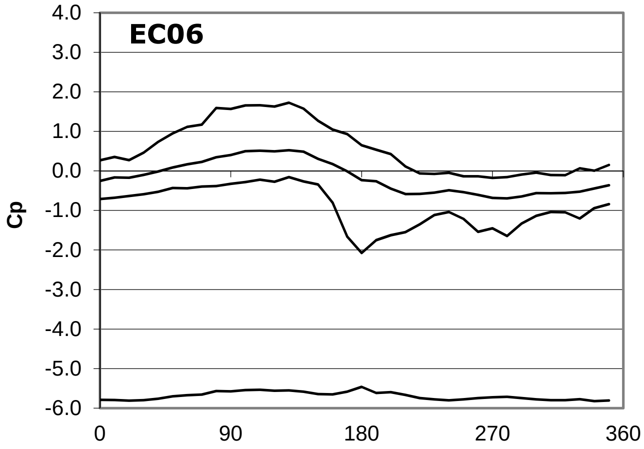

EC01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

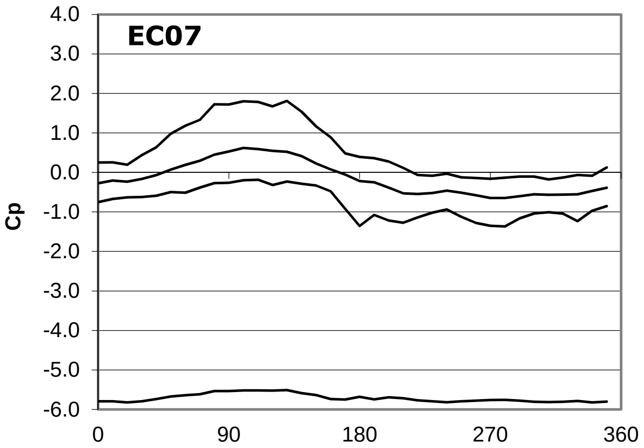

EC02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

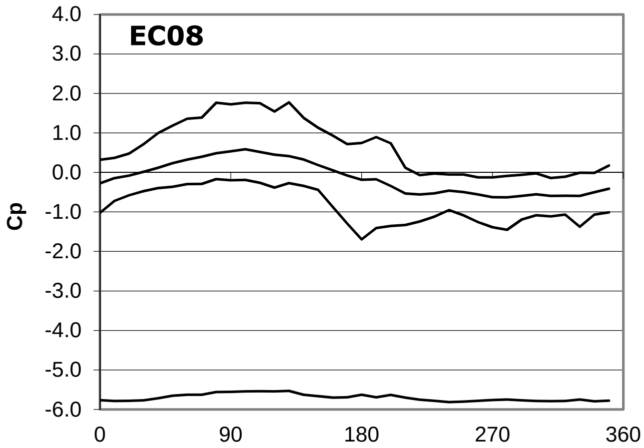

EC03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

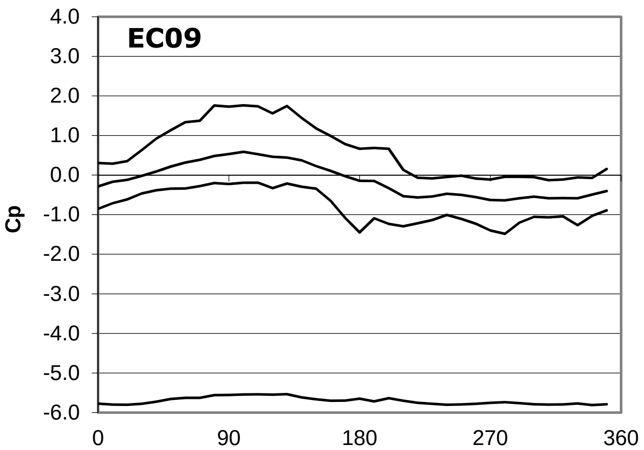

EC04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

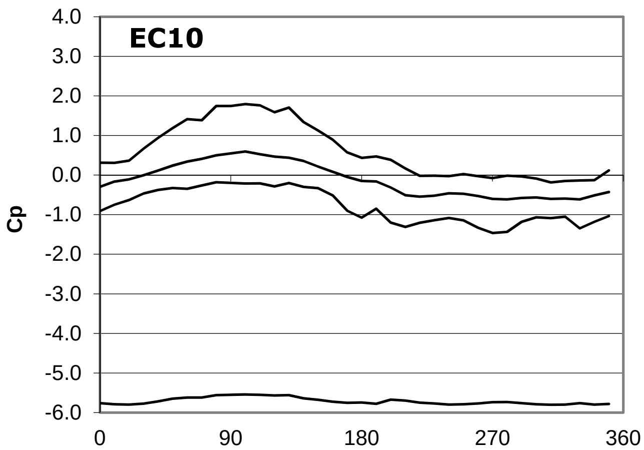

EC05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

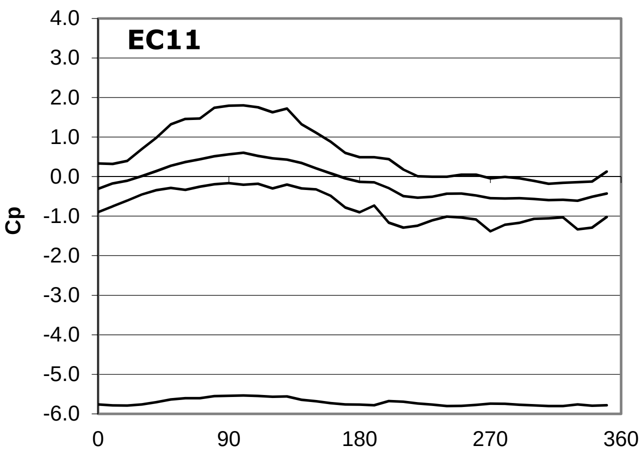

EC06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

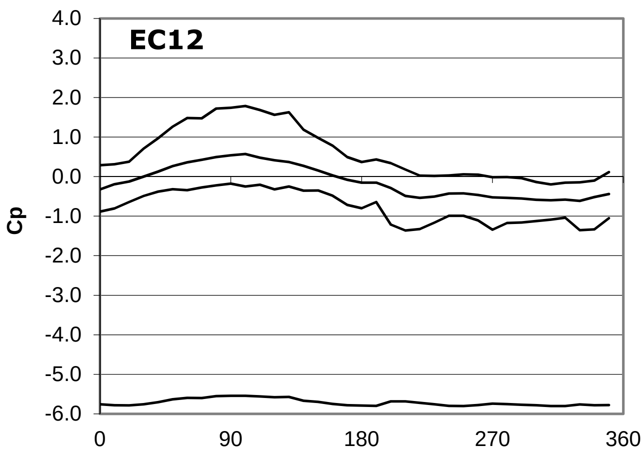

EC07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

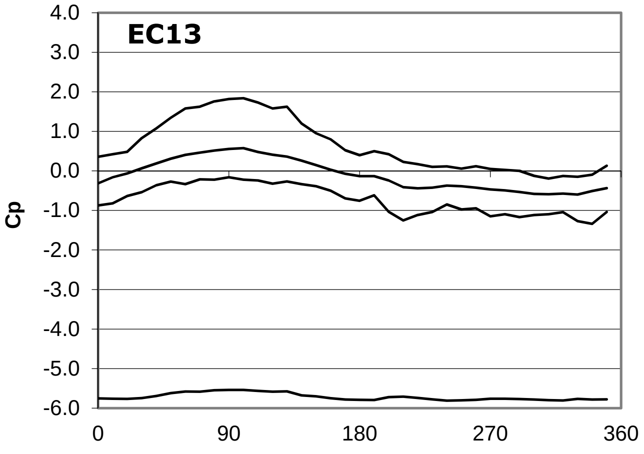

EC08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

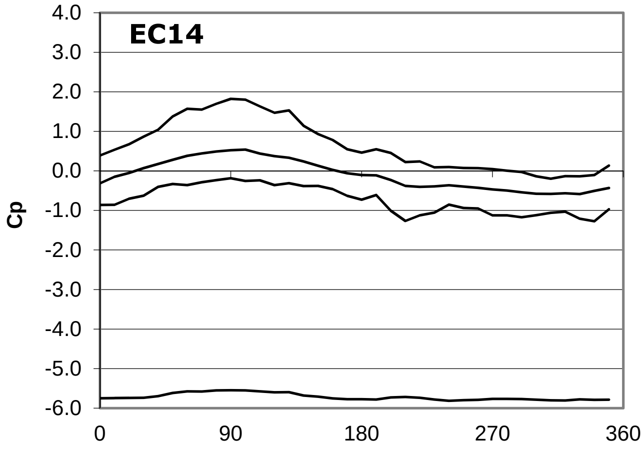

EC09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

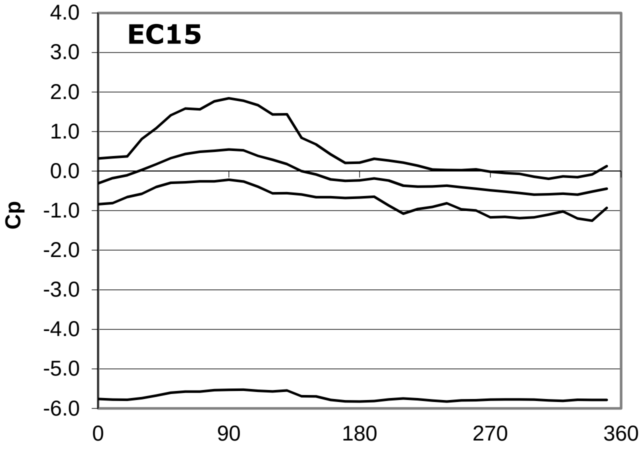

EC10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

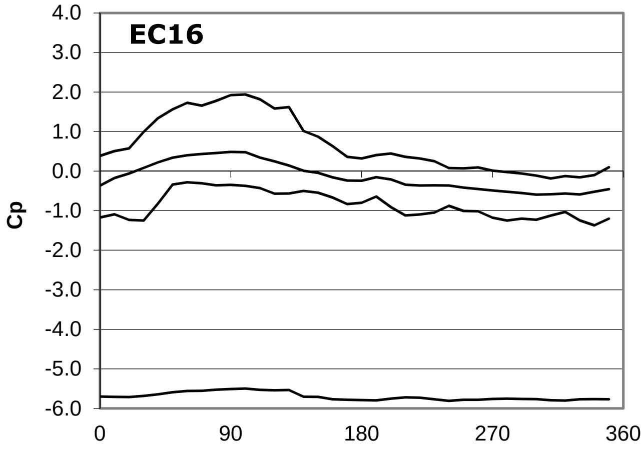

EC11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

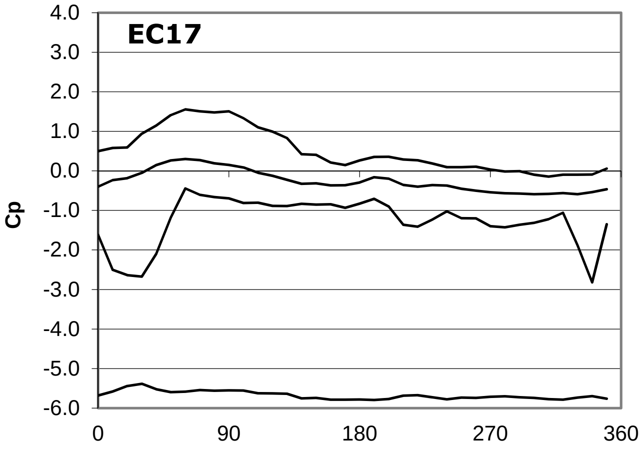

EC12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

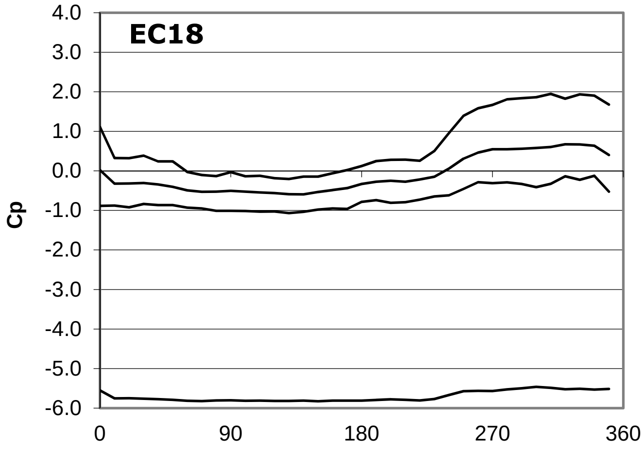

EC13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

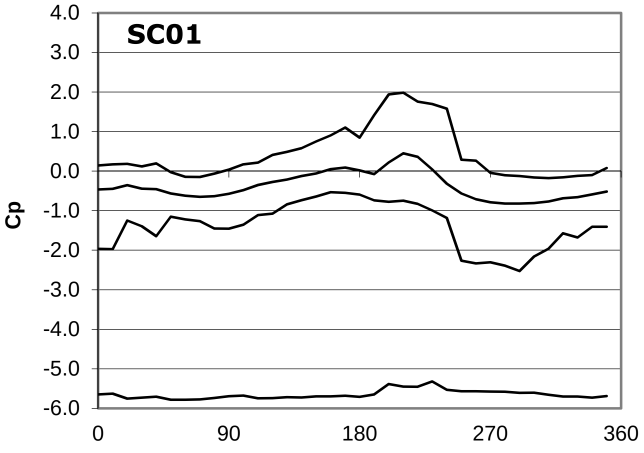

EC14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

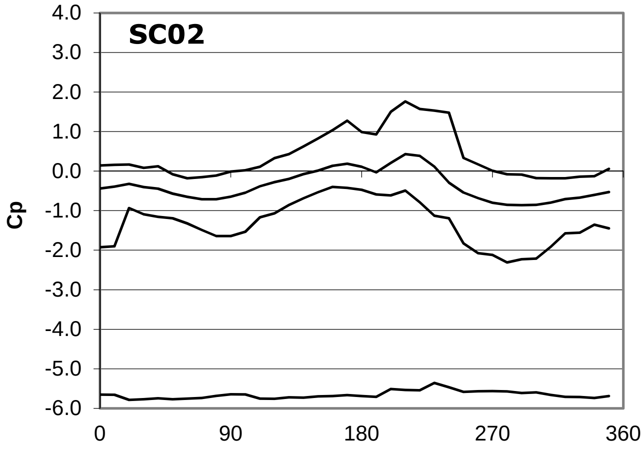

EC15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

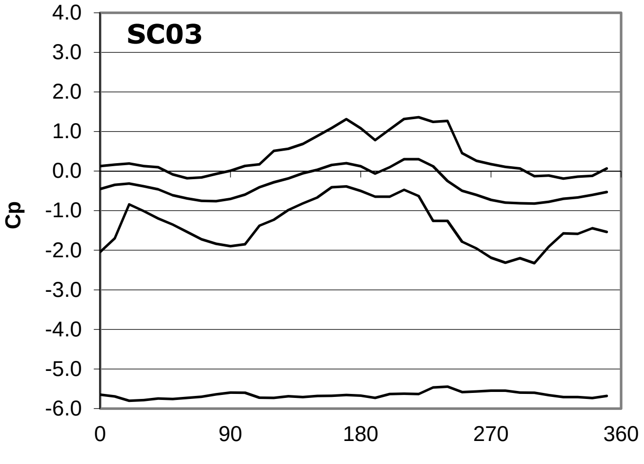

EC16
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

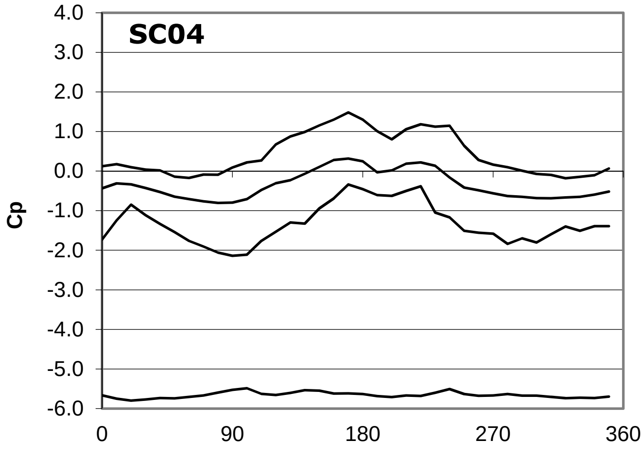

EC17
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

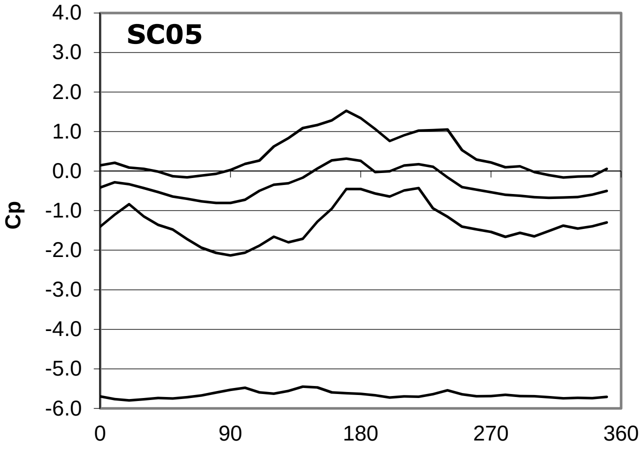

EC18
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

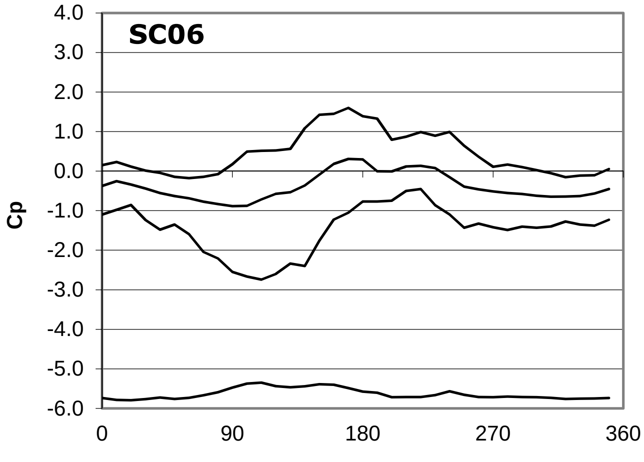

SC01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

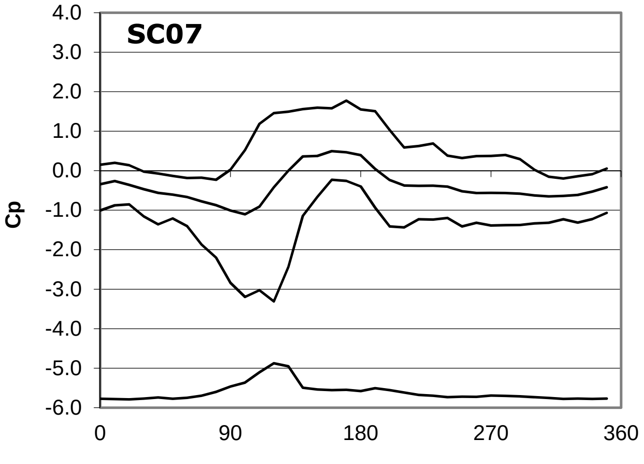

SC02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

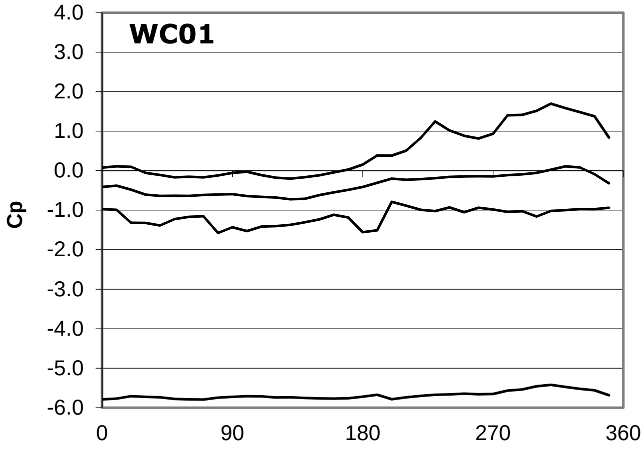

SC03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

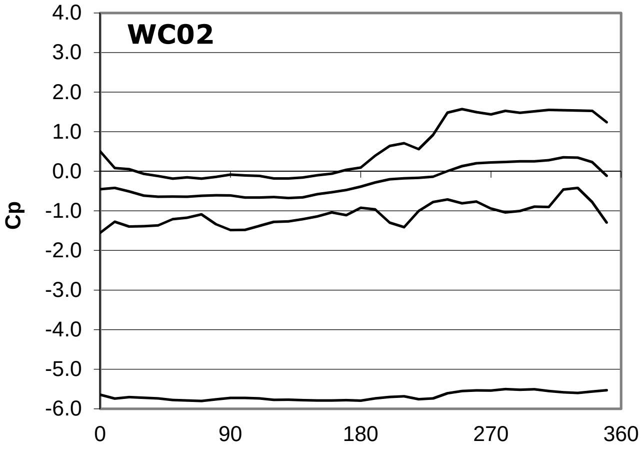

SC04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

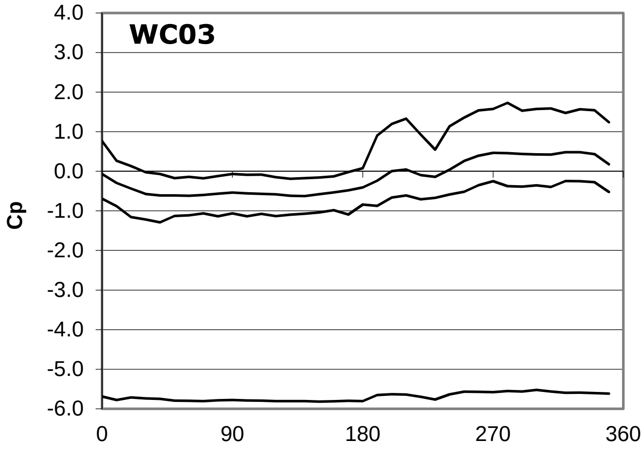

SC05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

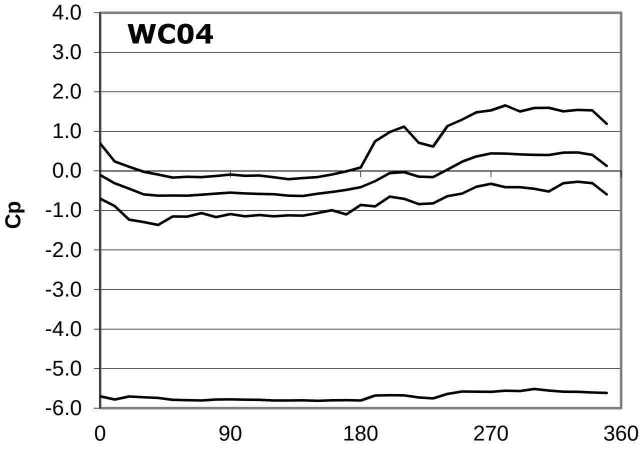

SC06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

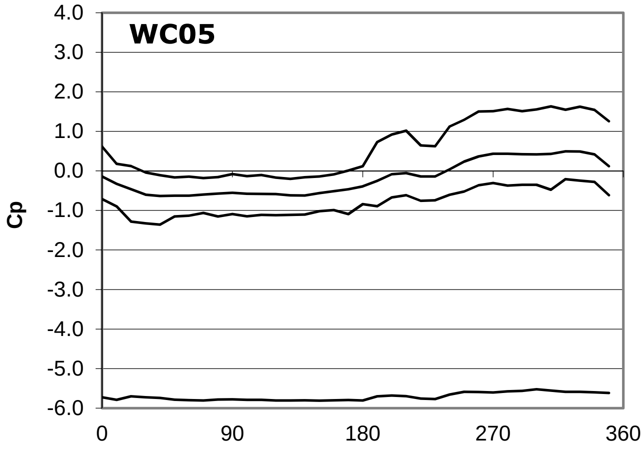

SC07
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

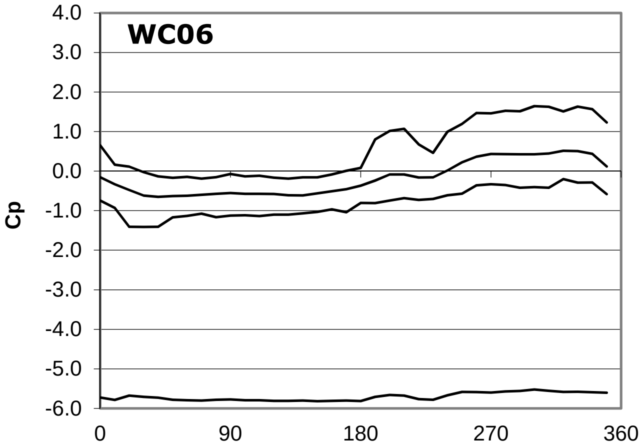

WC01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

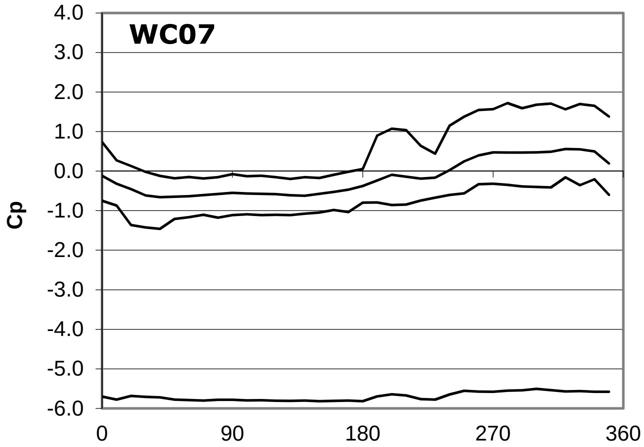

WC02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

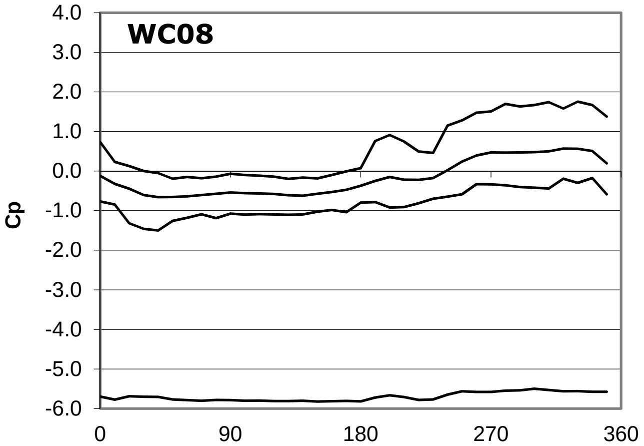

WC03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

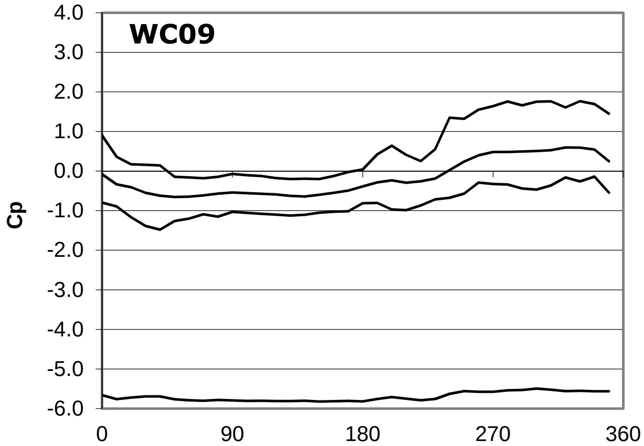

WC04
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

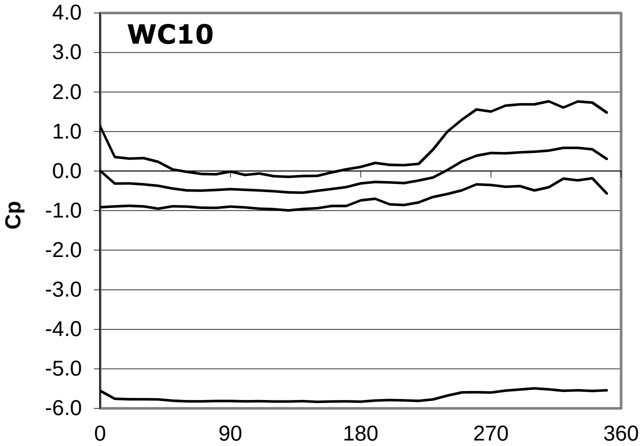

WC05
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

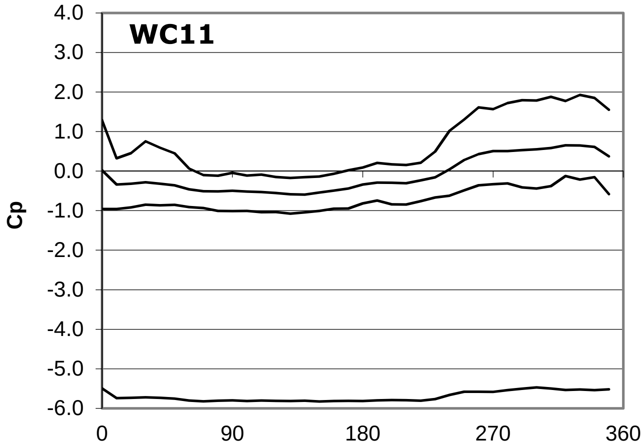

WC06
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

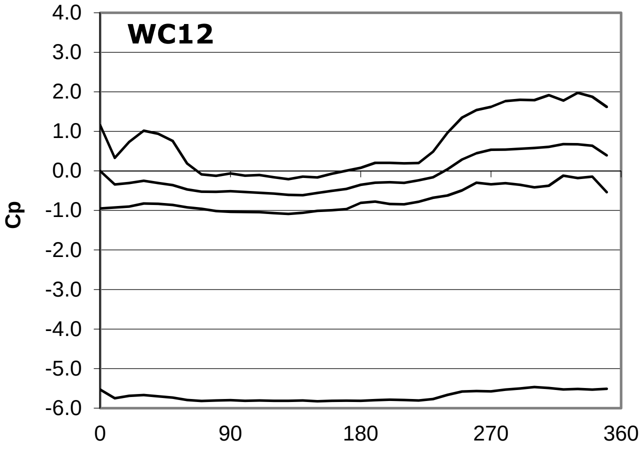

WC07
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

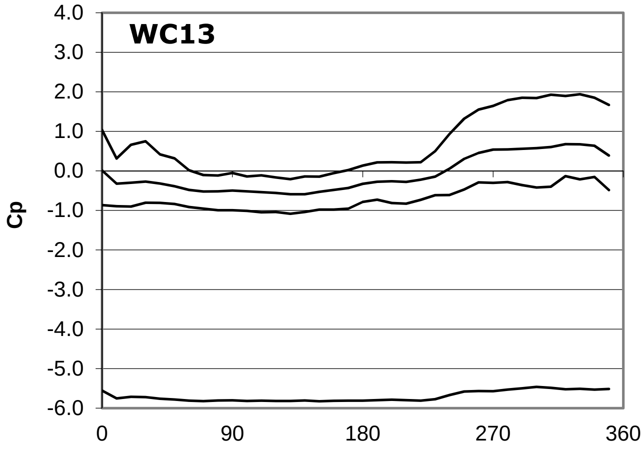

WC08
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

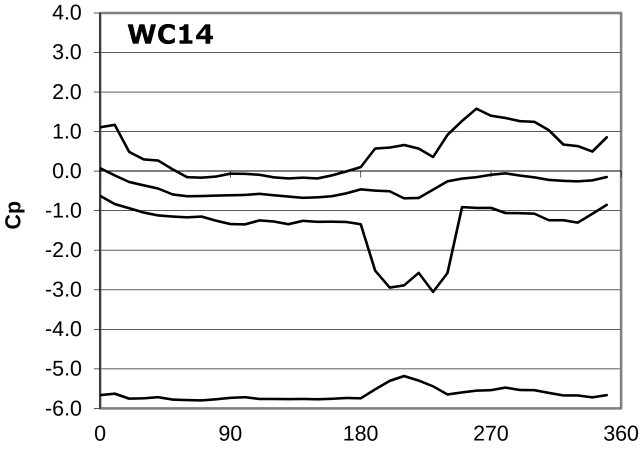

WC09
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

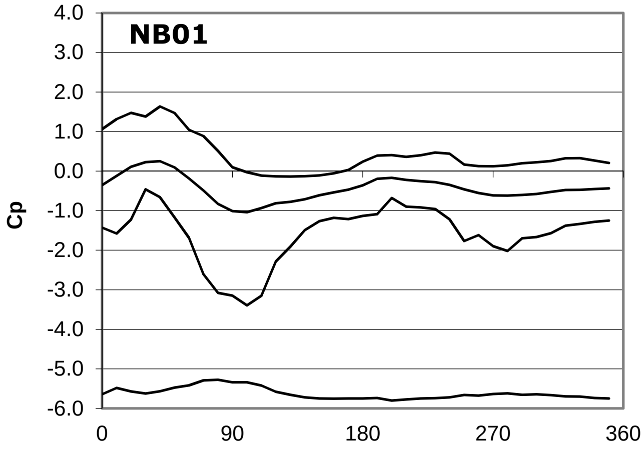

WC10
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

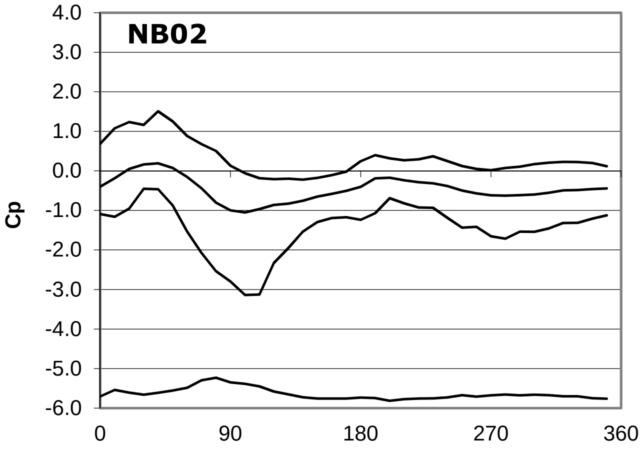

WC11
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
Cp
0
90
180
270
360

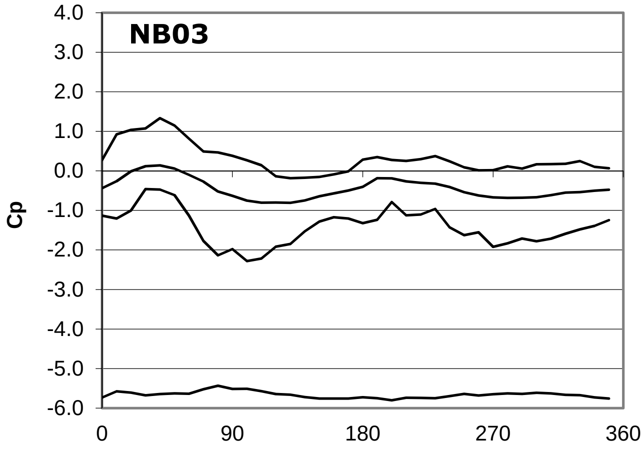

WC12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

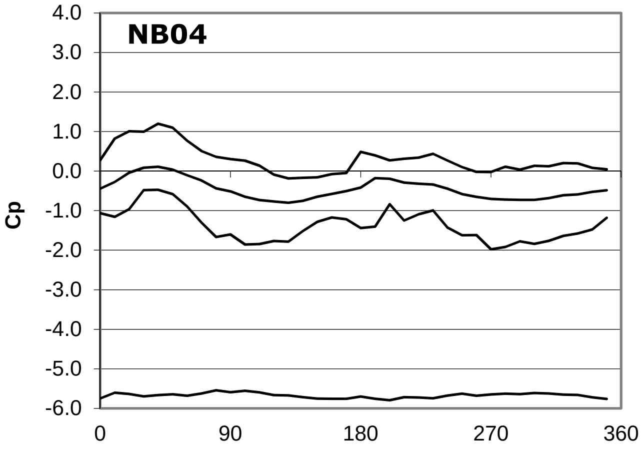

WC13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

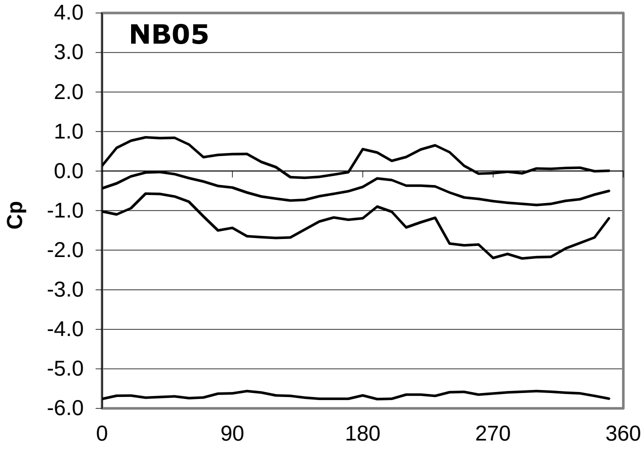

WC14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

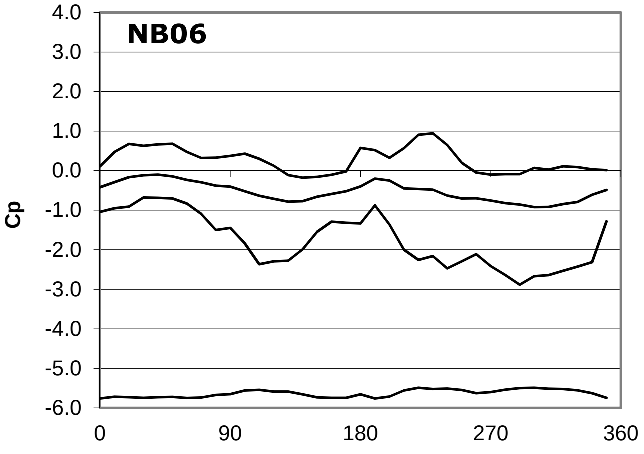

NB01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

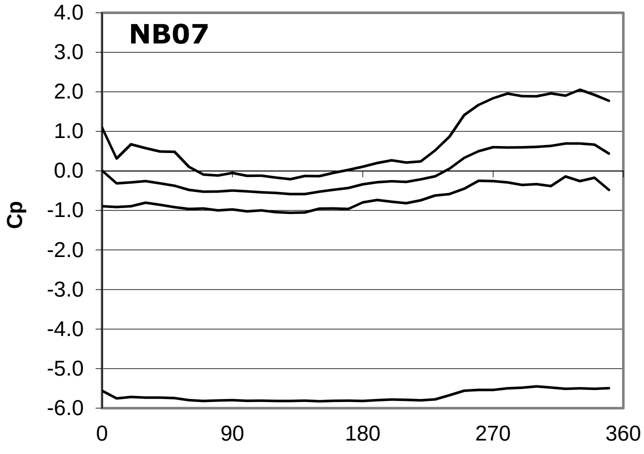

NB02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

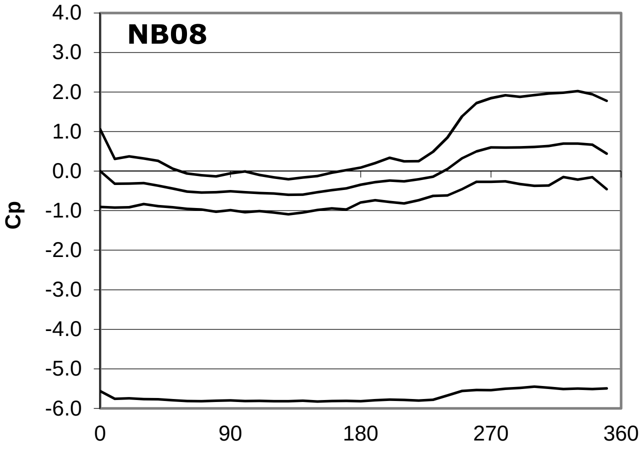

NB03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

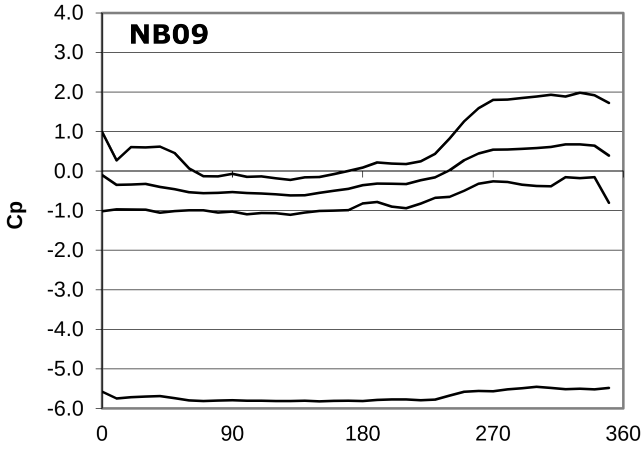

NB04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

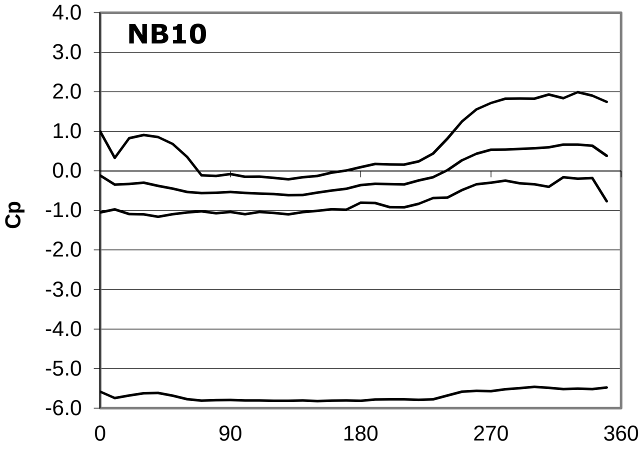

NB05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

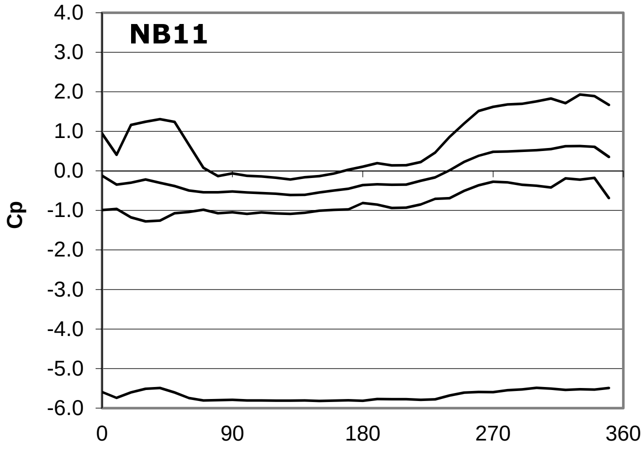

NB06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

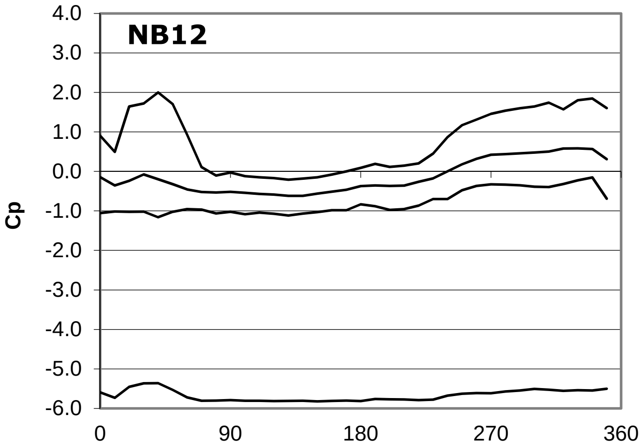

NB07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

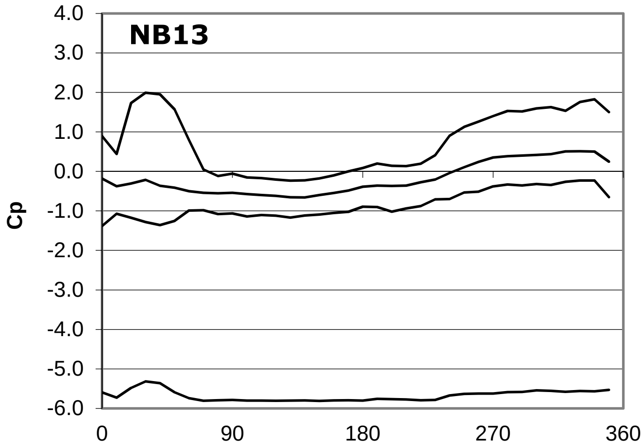

NB08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

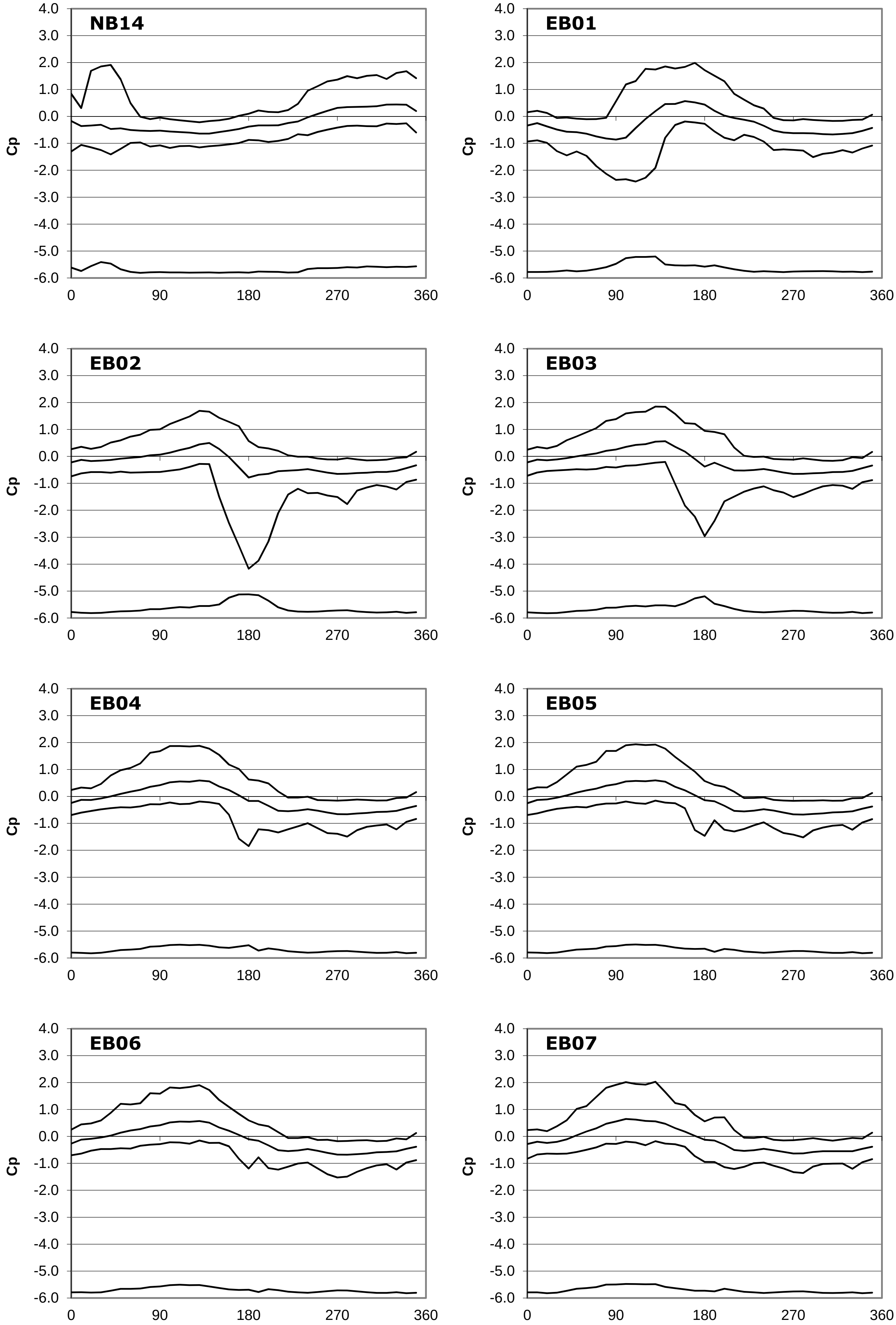

NB09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

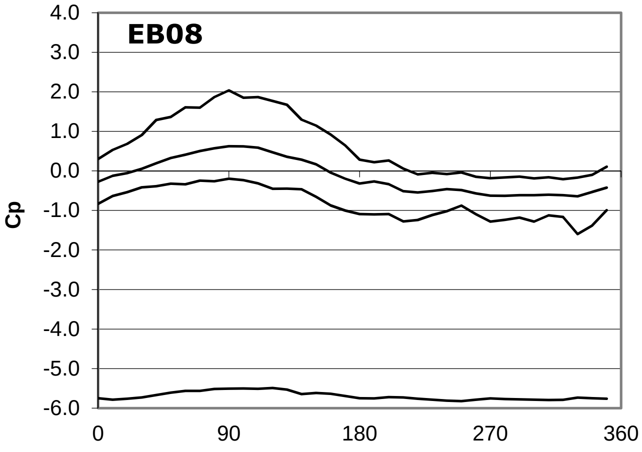

NB10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

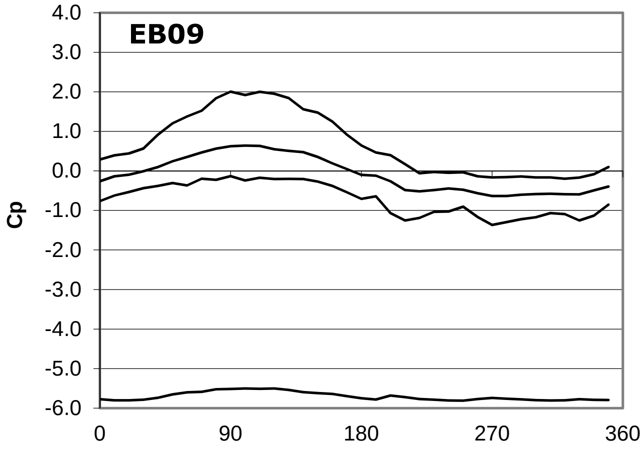

NB11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

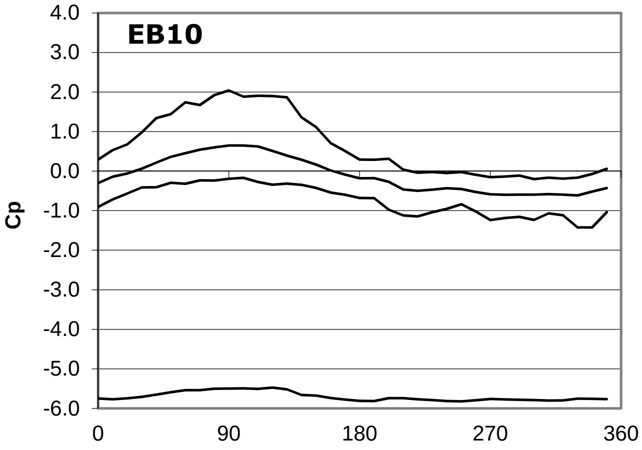

NB12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

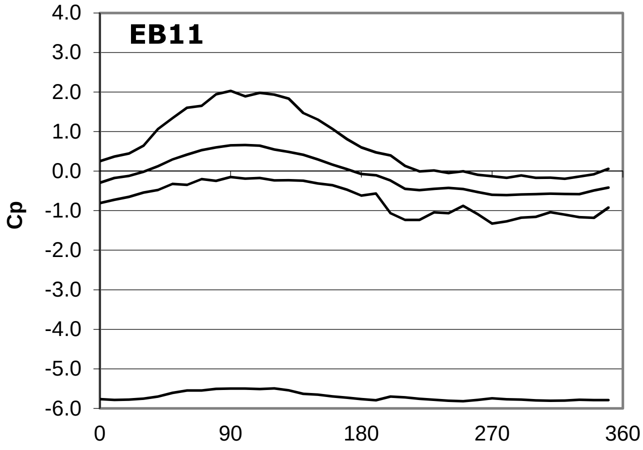

NB13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

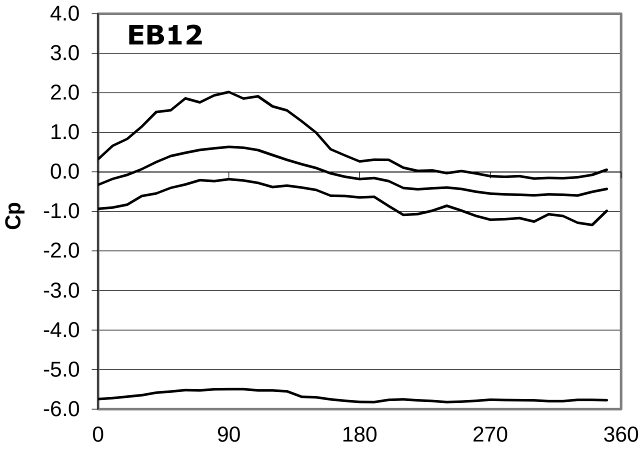

NB14
EB01
EB02
EB03
EB04
EB05
EB06
EB07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

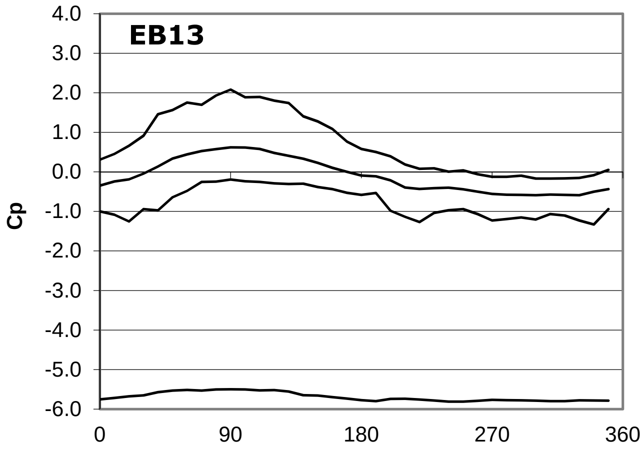

EB08
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

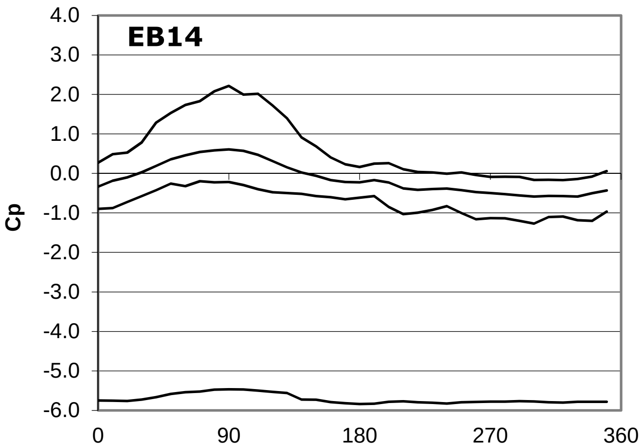

EB09
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

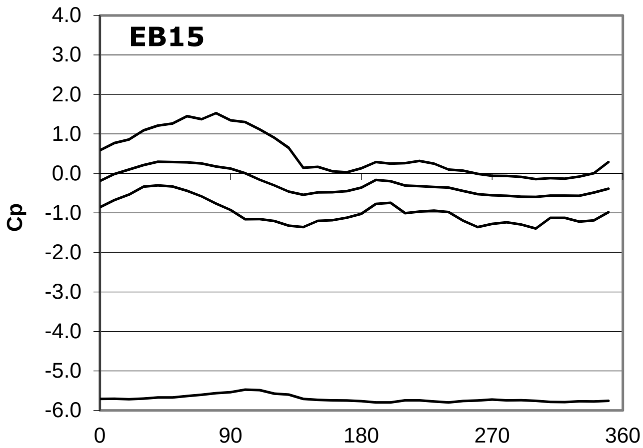

EB10
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

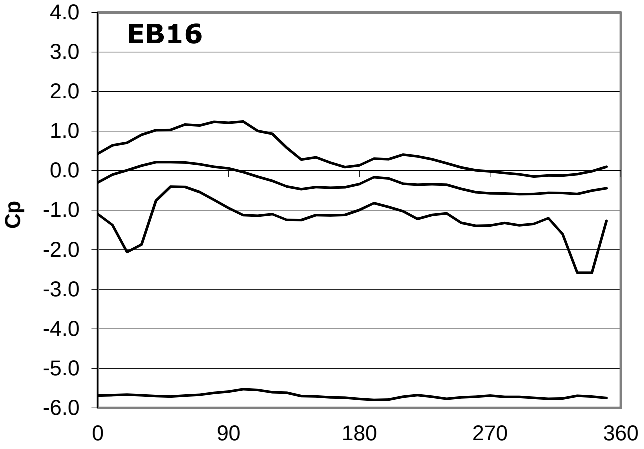

EB11
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

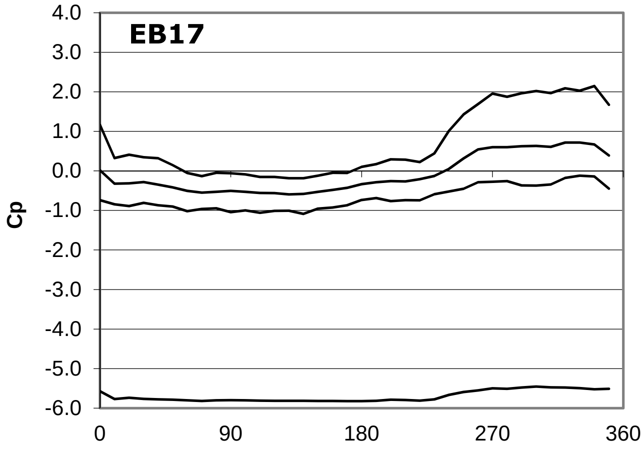

EB12
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

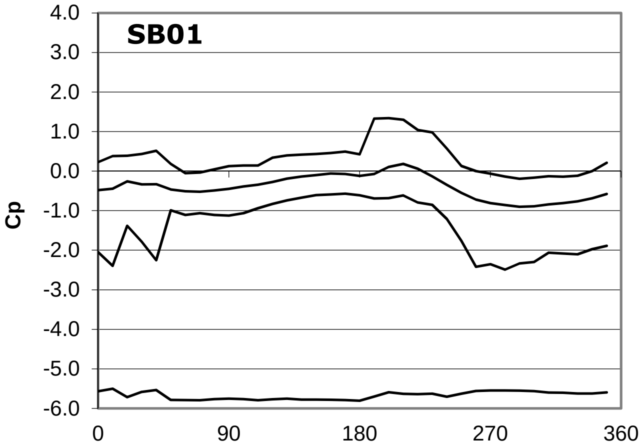

EB13
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

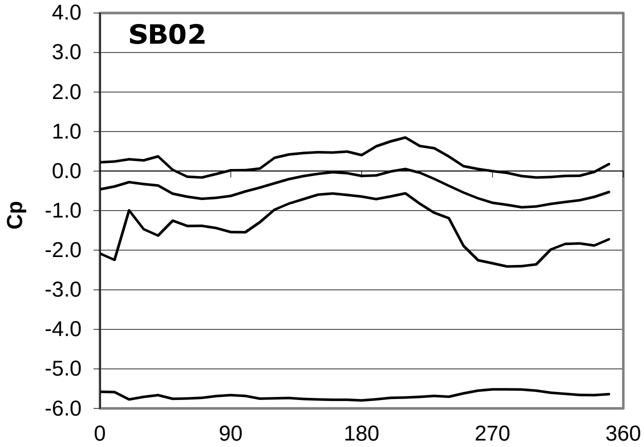

EB14
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

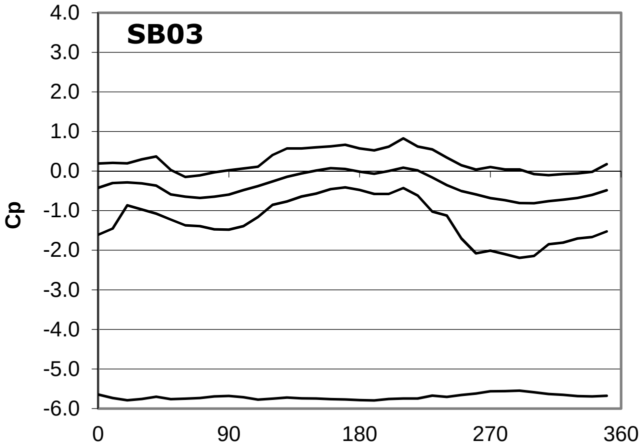

EB15
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

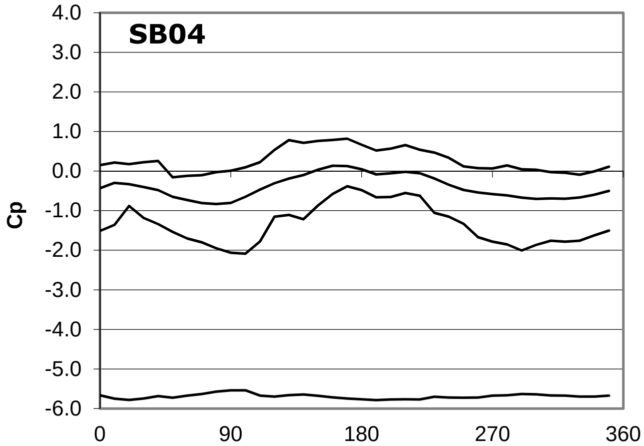

EB16
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

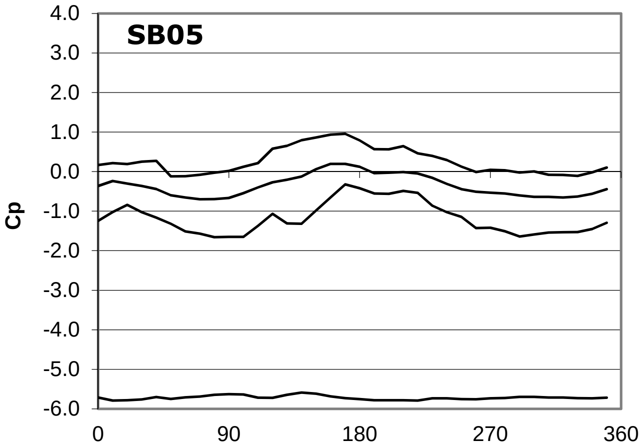

EB17
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

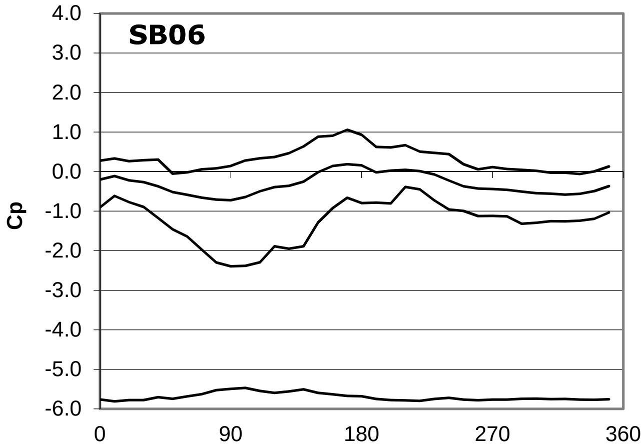

SB01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

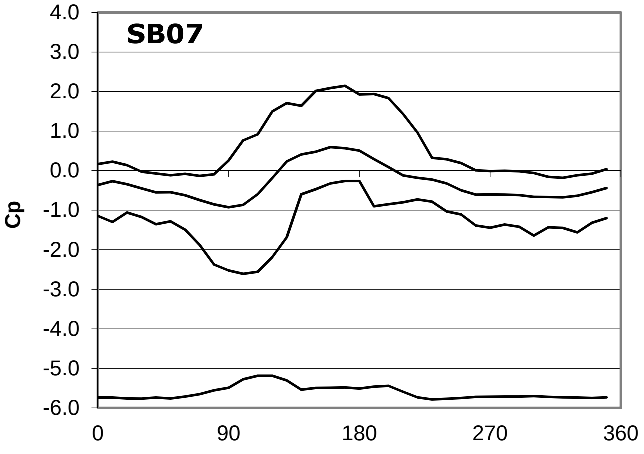

SB02
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

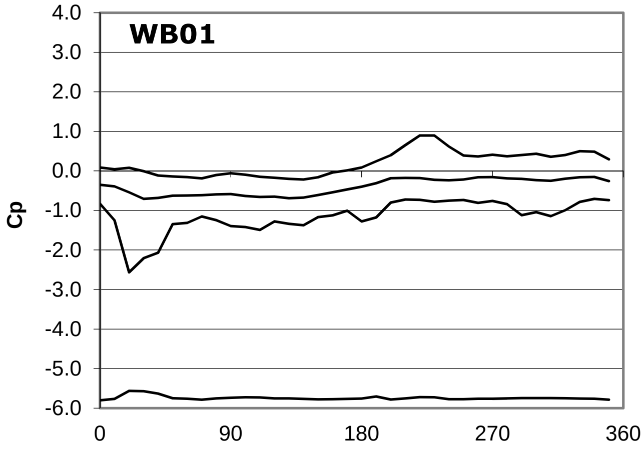

SB03
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

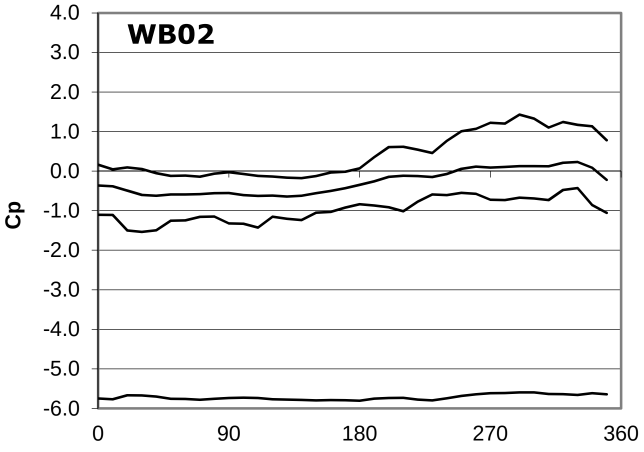

SB04
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

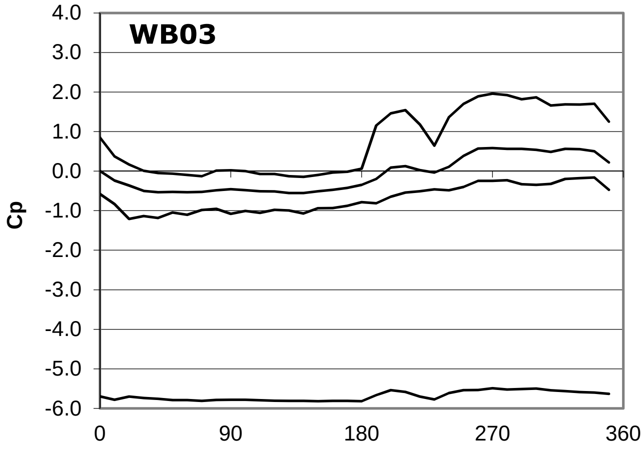

SB05
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

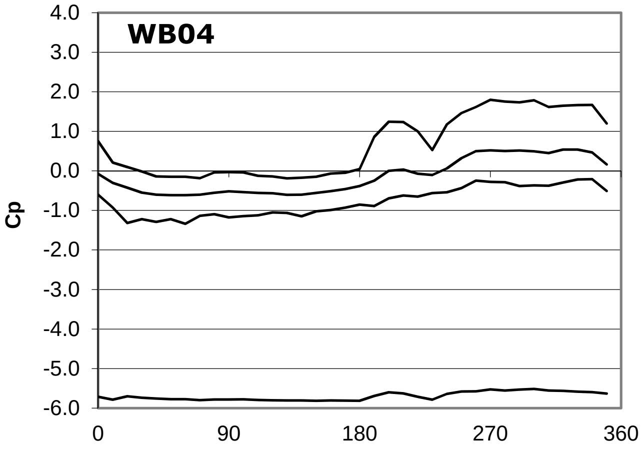

SB06
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

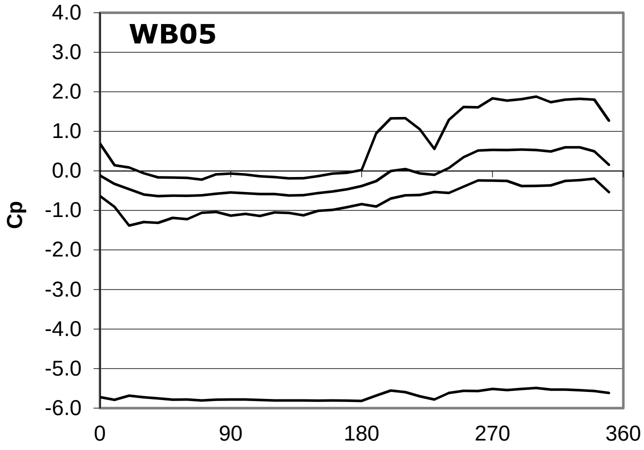

SB07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

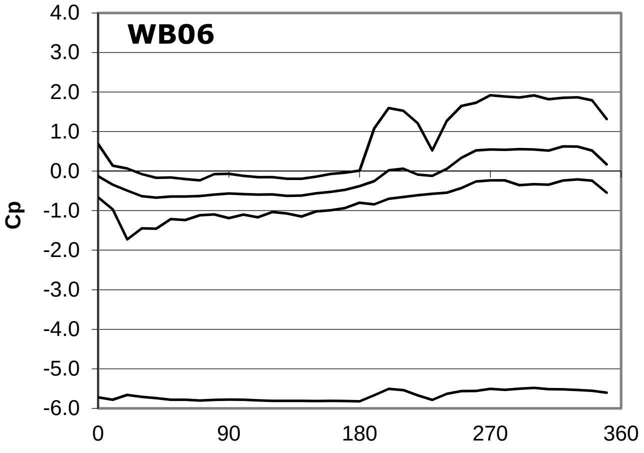

WB01
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

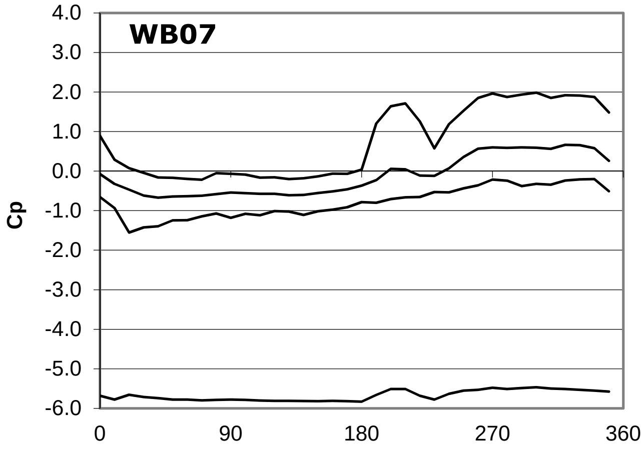

WB02
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

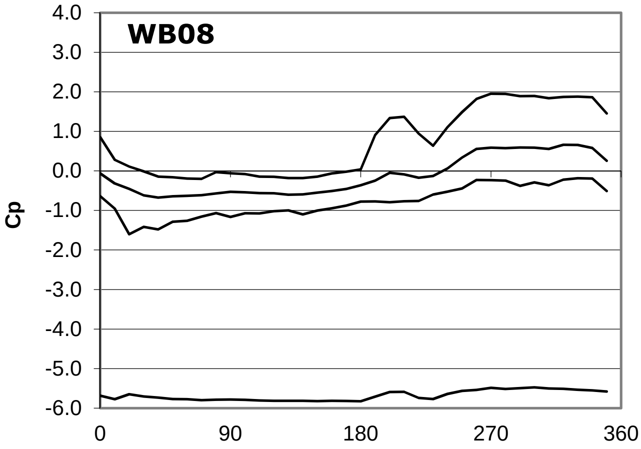

WB03
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

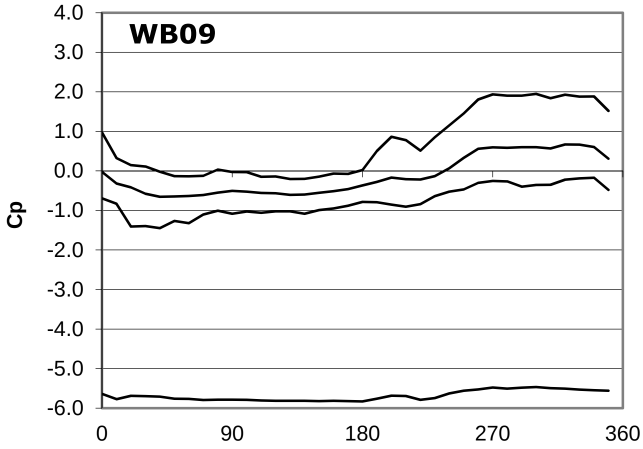

WB04
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

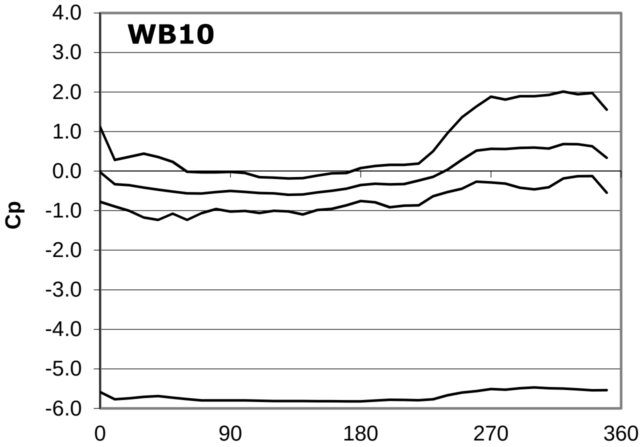

WB05
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

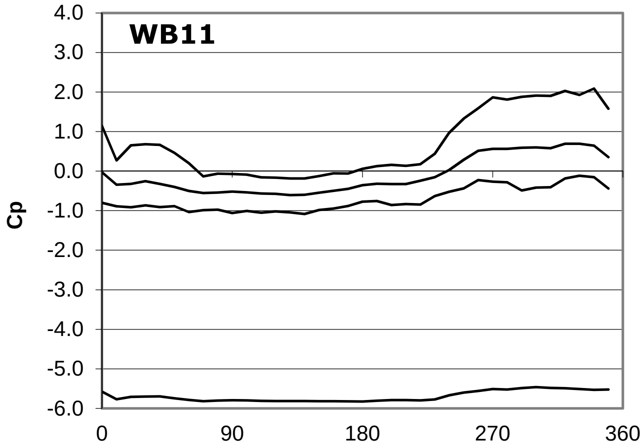

WB06
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

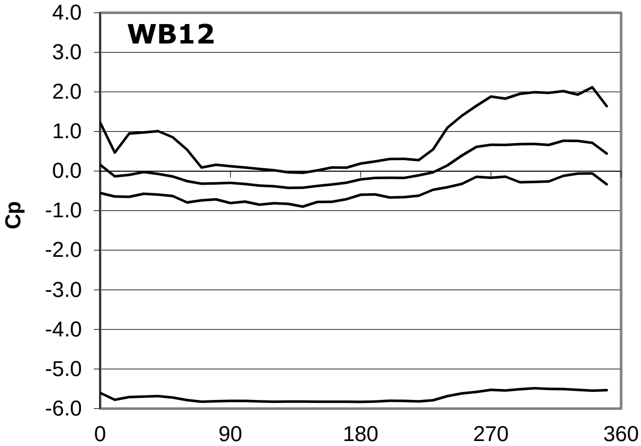

WB07
Cp
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
0
90
180
270
360

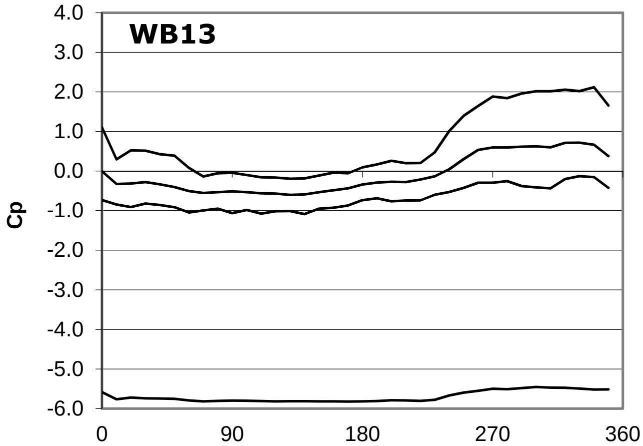

WB08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

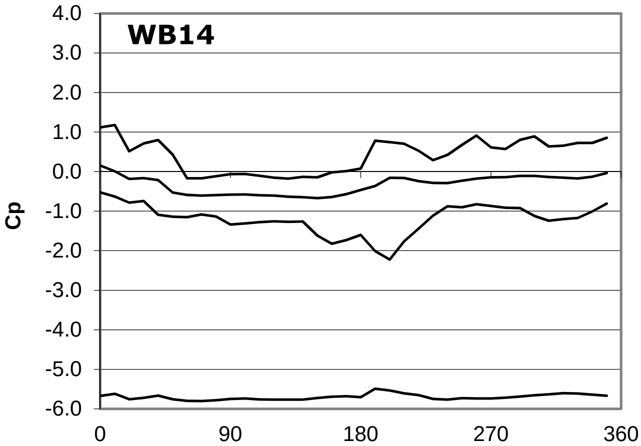

WB09
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

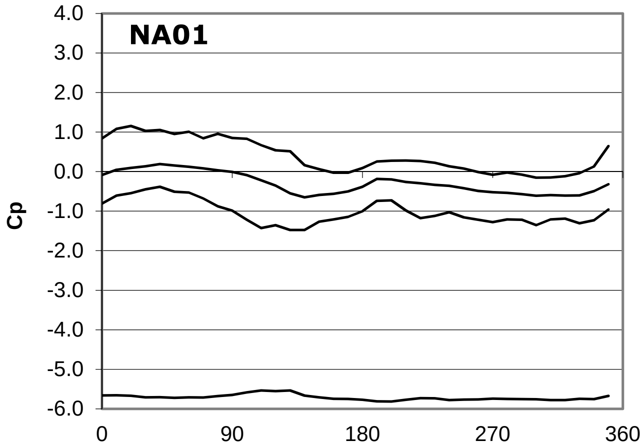

WB10
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

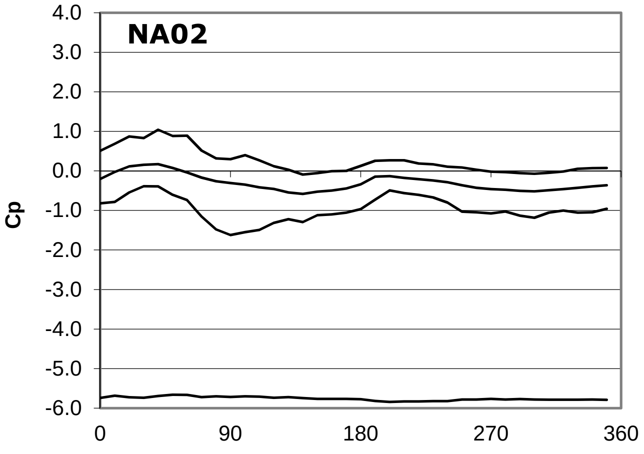

WB11
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

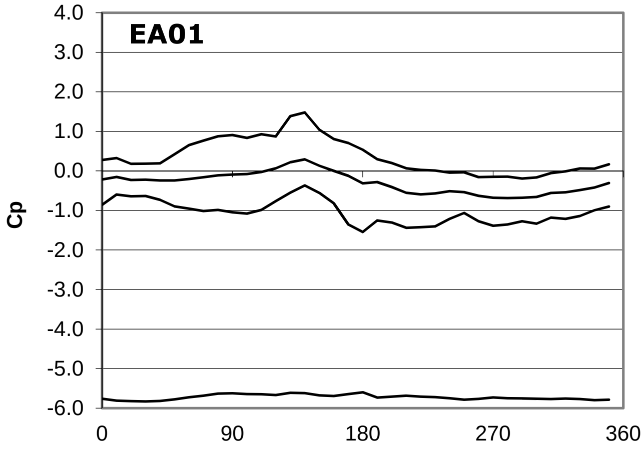

WB12
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

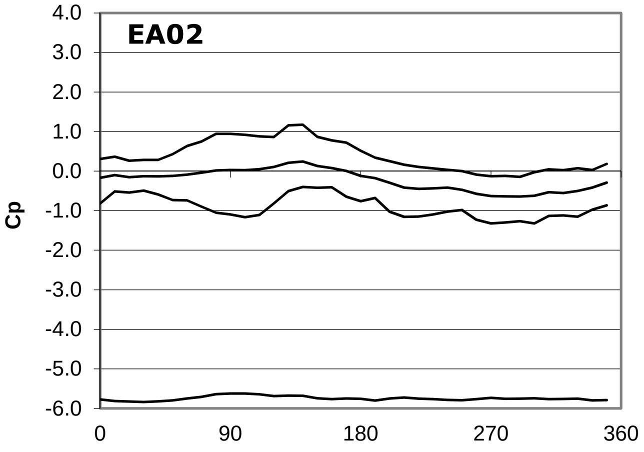

WB13
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

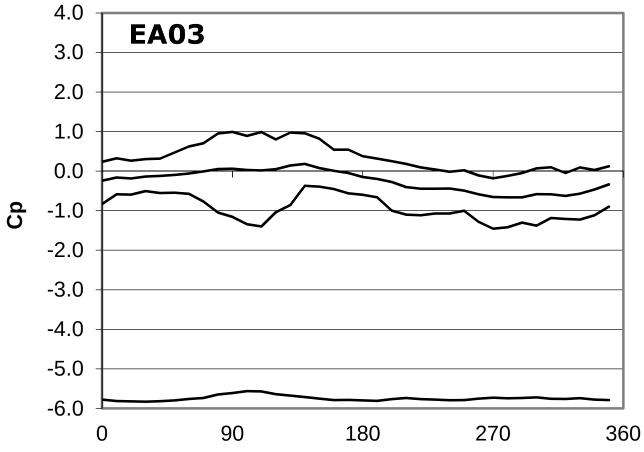

WB14
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

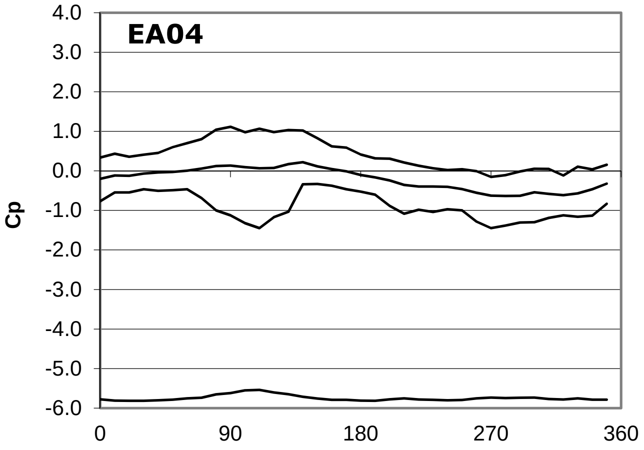

NA01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

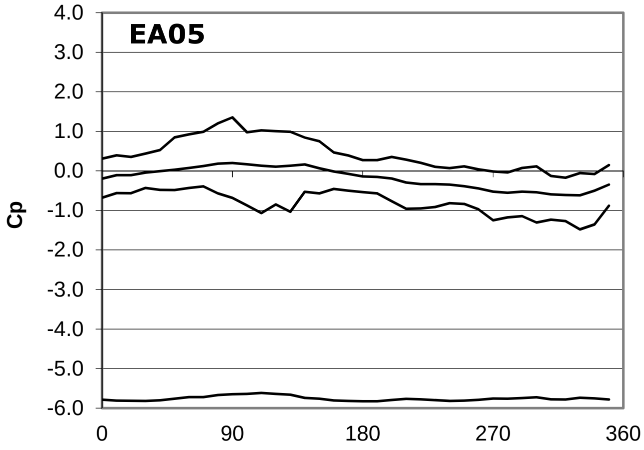


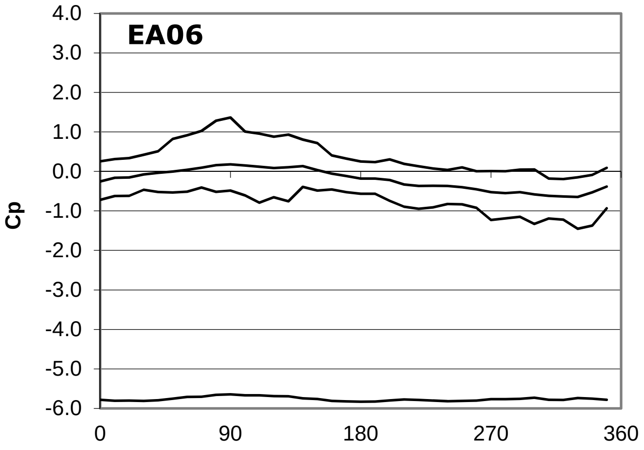


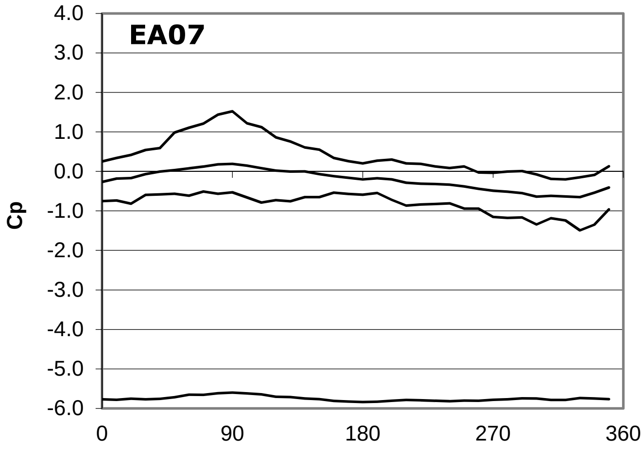




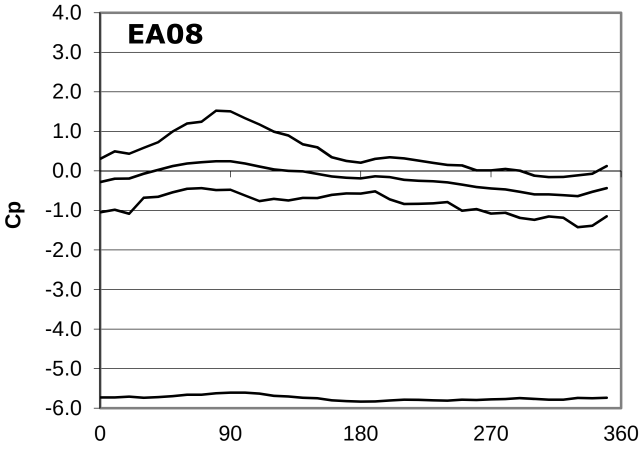


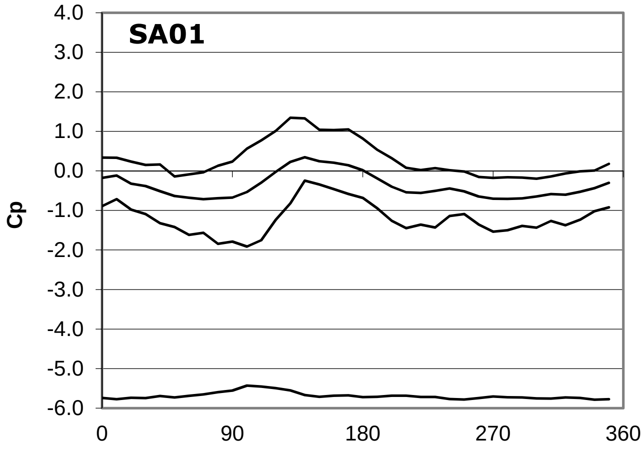


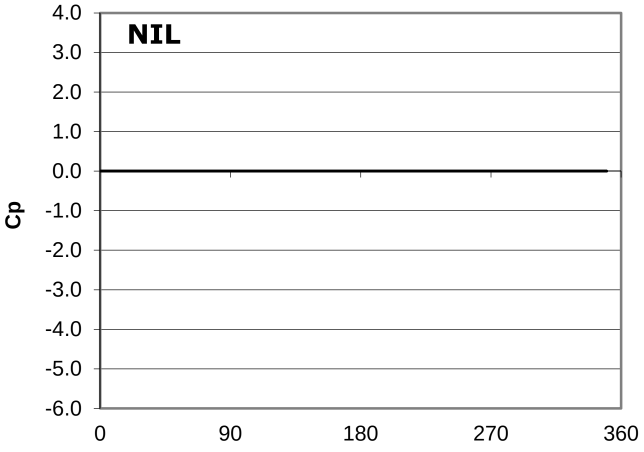


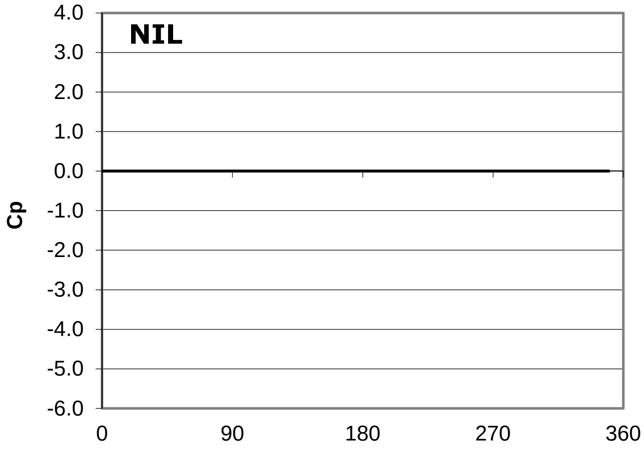


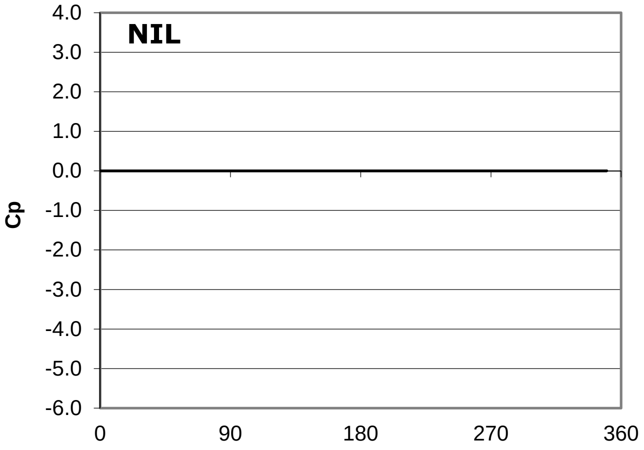
WA714-13 V by Crown, Parramatta 22/11/2012

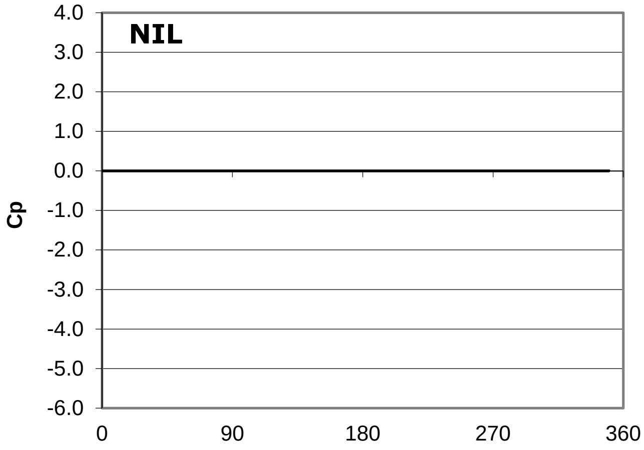

EA08
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

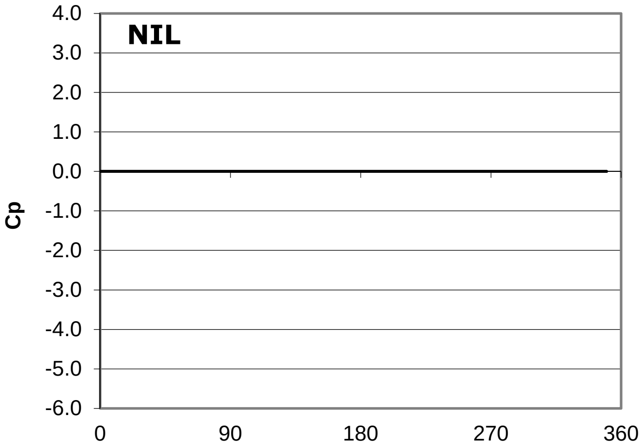

SA01
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

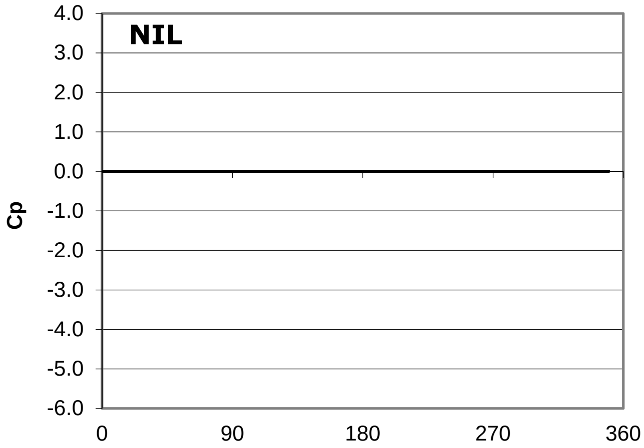

NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360


NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360


NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360


NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360


NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360


NIL
Cp
4.0 3.0 2.0 1.0 0.0 -1.0 -2.0 -3.0 -4.0 -5.0 -6.0
0 90 180 270 360

APPENDIX B - LAYOUT OF PRESSURE SENSORS

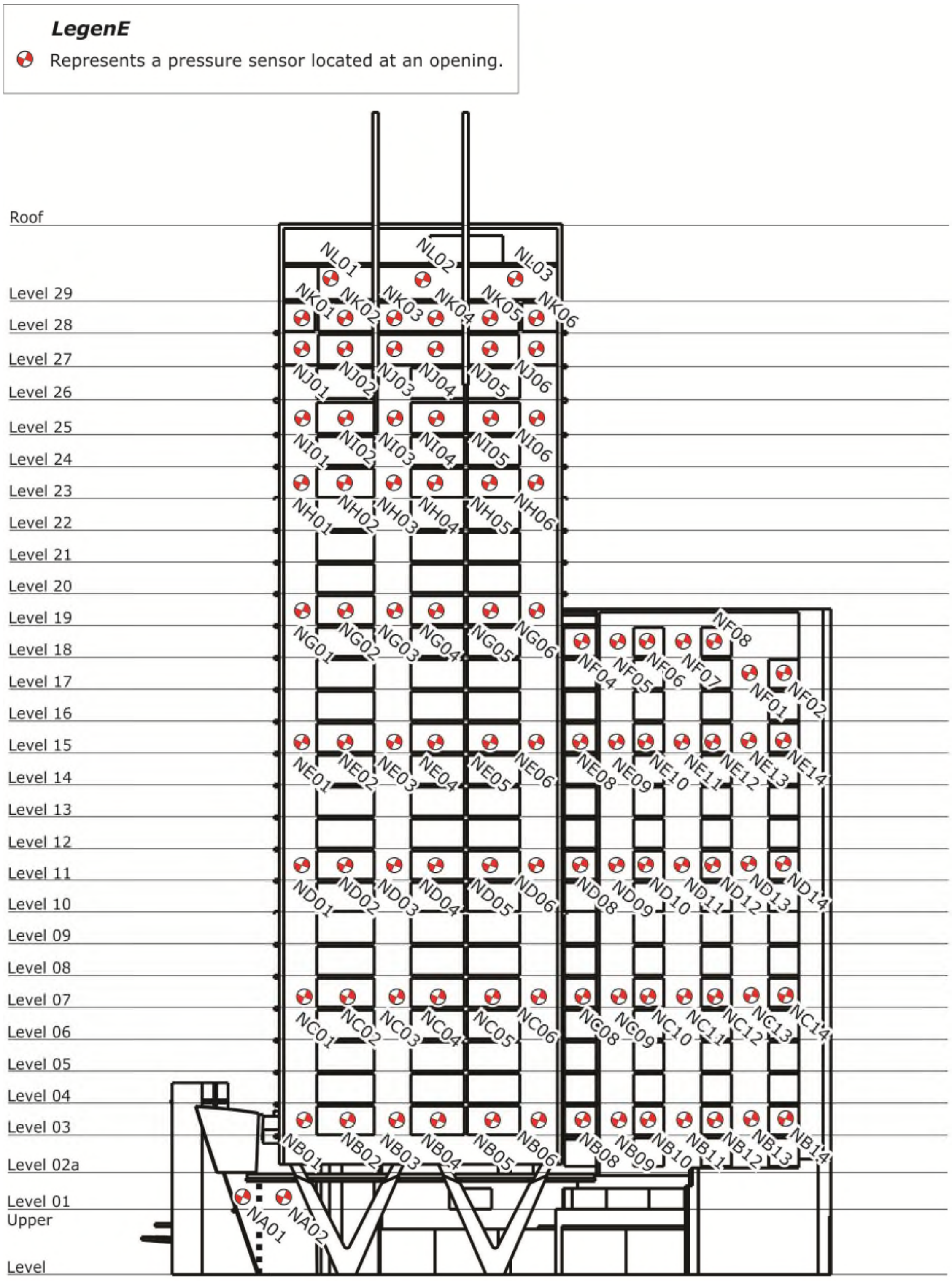


Figure B1: Pressure Sensor Layout – North Elevation

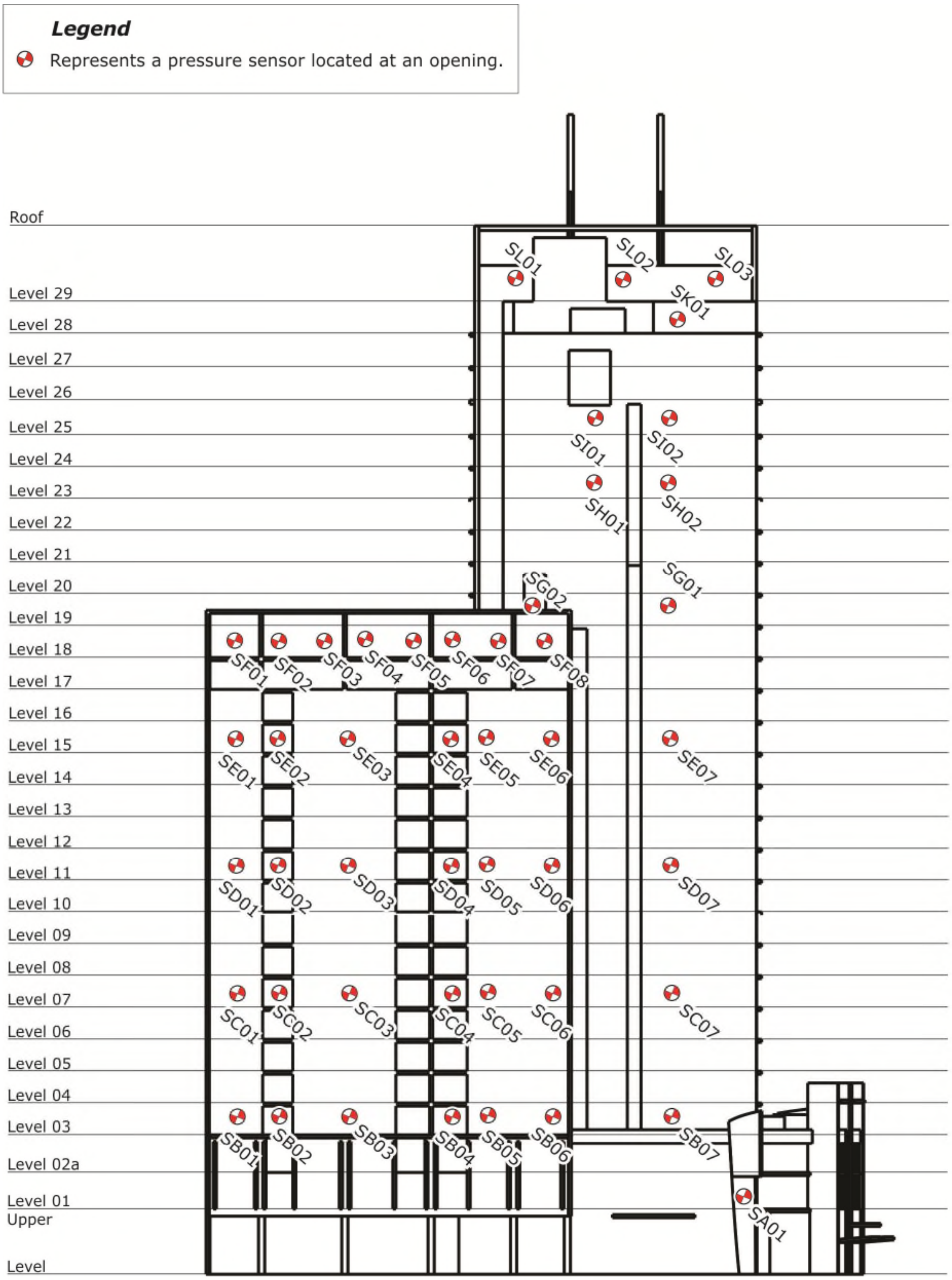


Figure B2: Pressure Sensor Layout – South Elevation

Figure B3: Pressure Sensor Layout – East Elevation

Figure B4: Pressure Sensor Layout – West Elevation

APPENDIX C - APARTMENT OPENING LOCATIONS AND LAYOUT

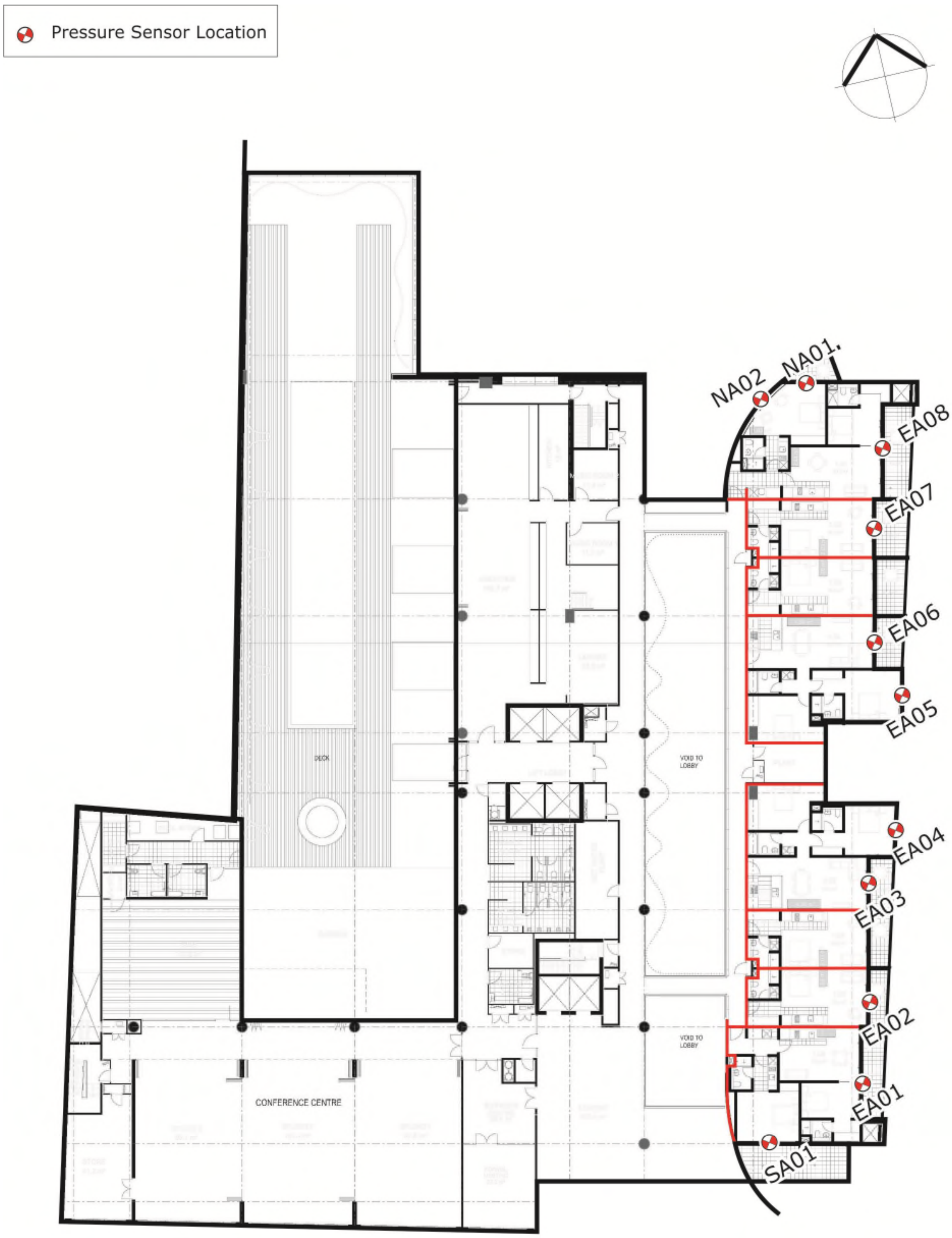


Figure C1: Opening Locations and Internal Apartment Layout – Level 1

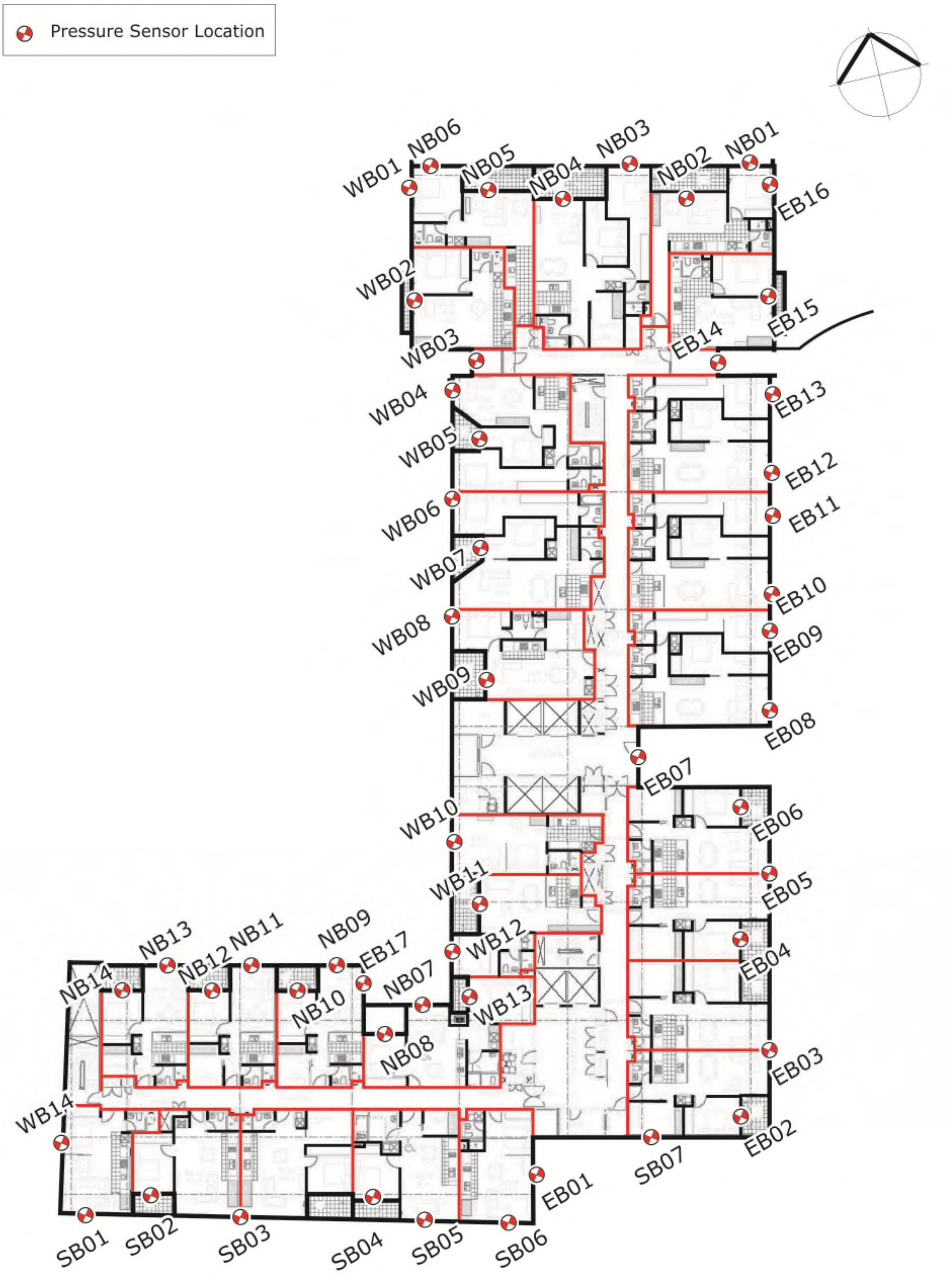


Figure C2: Opening Locations and Internal Apartment Layout – Level 3

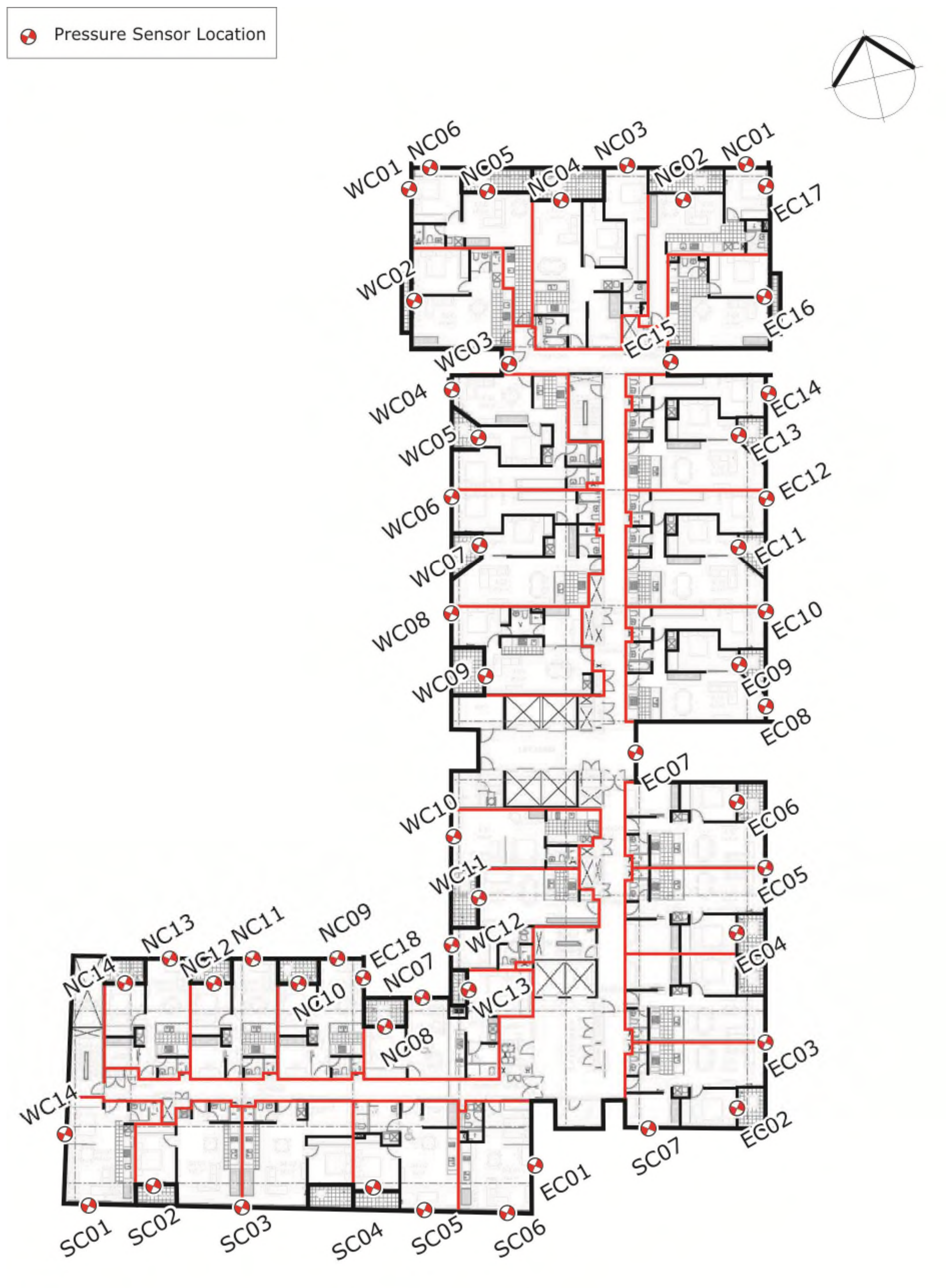


Figure C3: Opening Locations and Internal Apartment Layout – Level 7

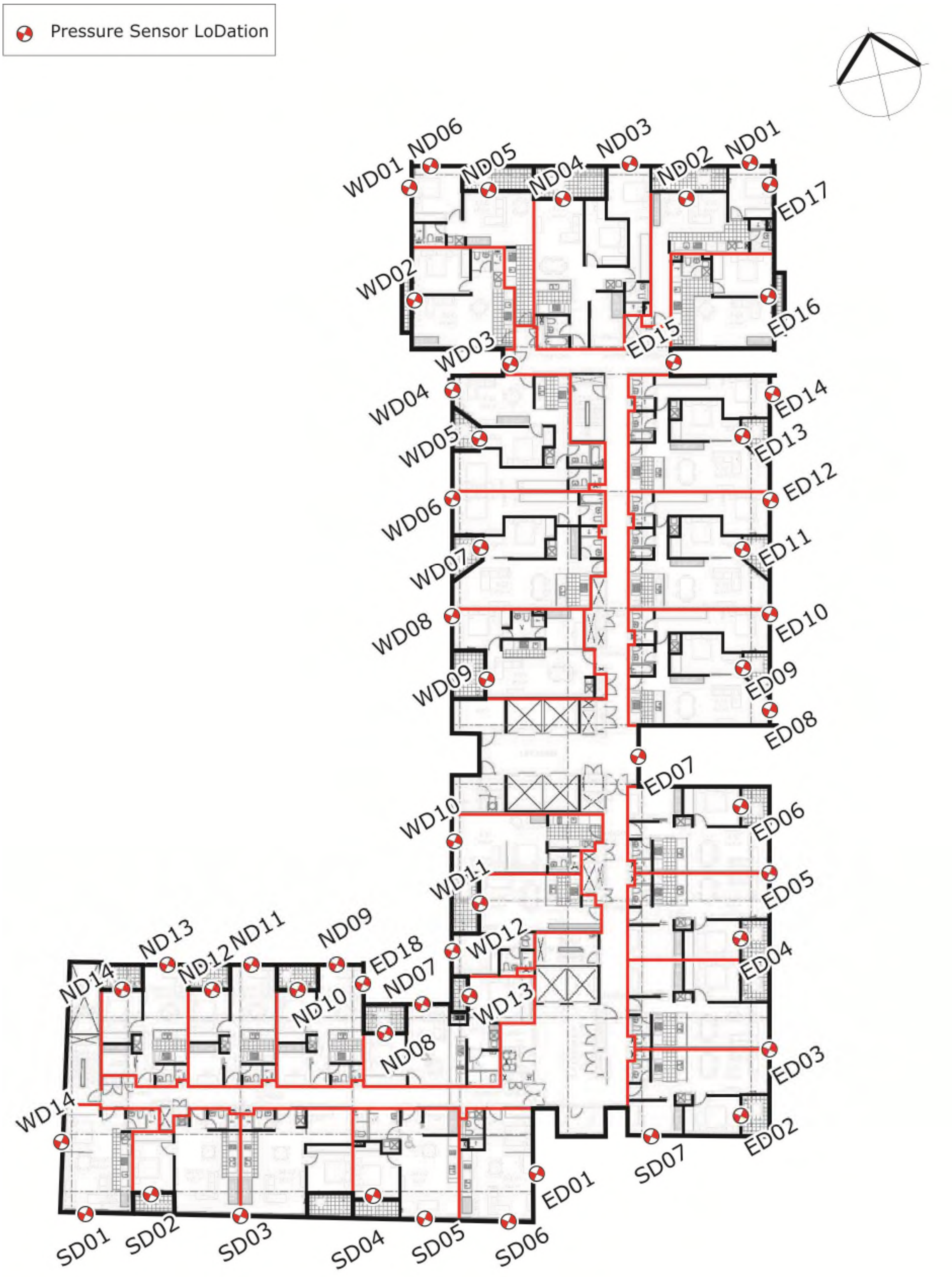


Figure C4: Opening Locations and Internal Apartment Layout – Level 11

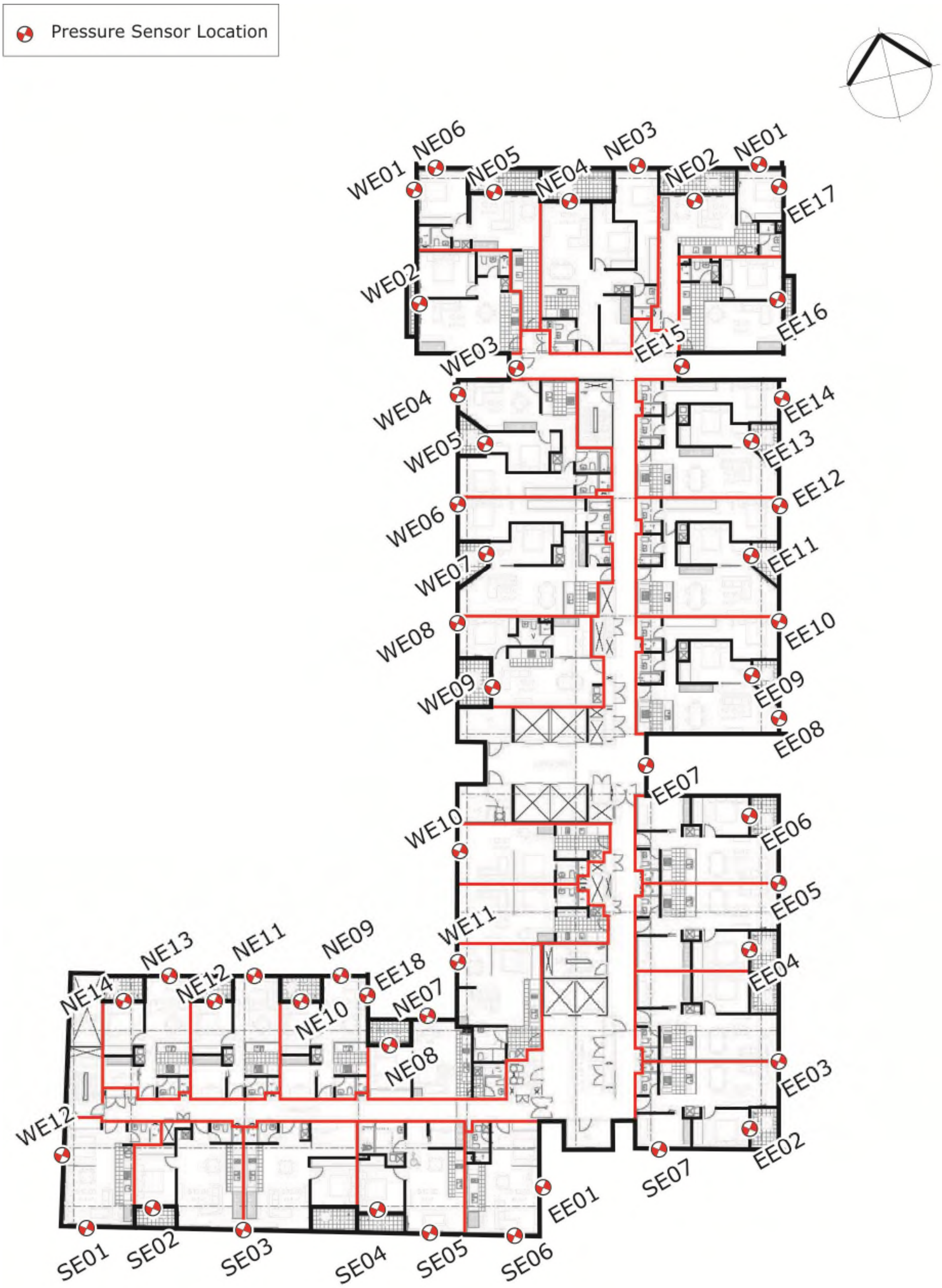


Figure C5: Opening Locations and Internal Apartment Layout – Level 15

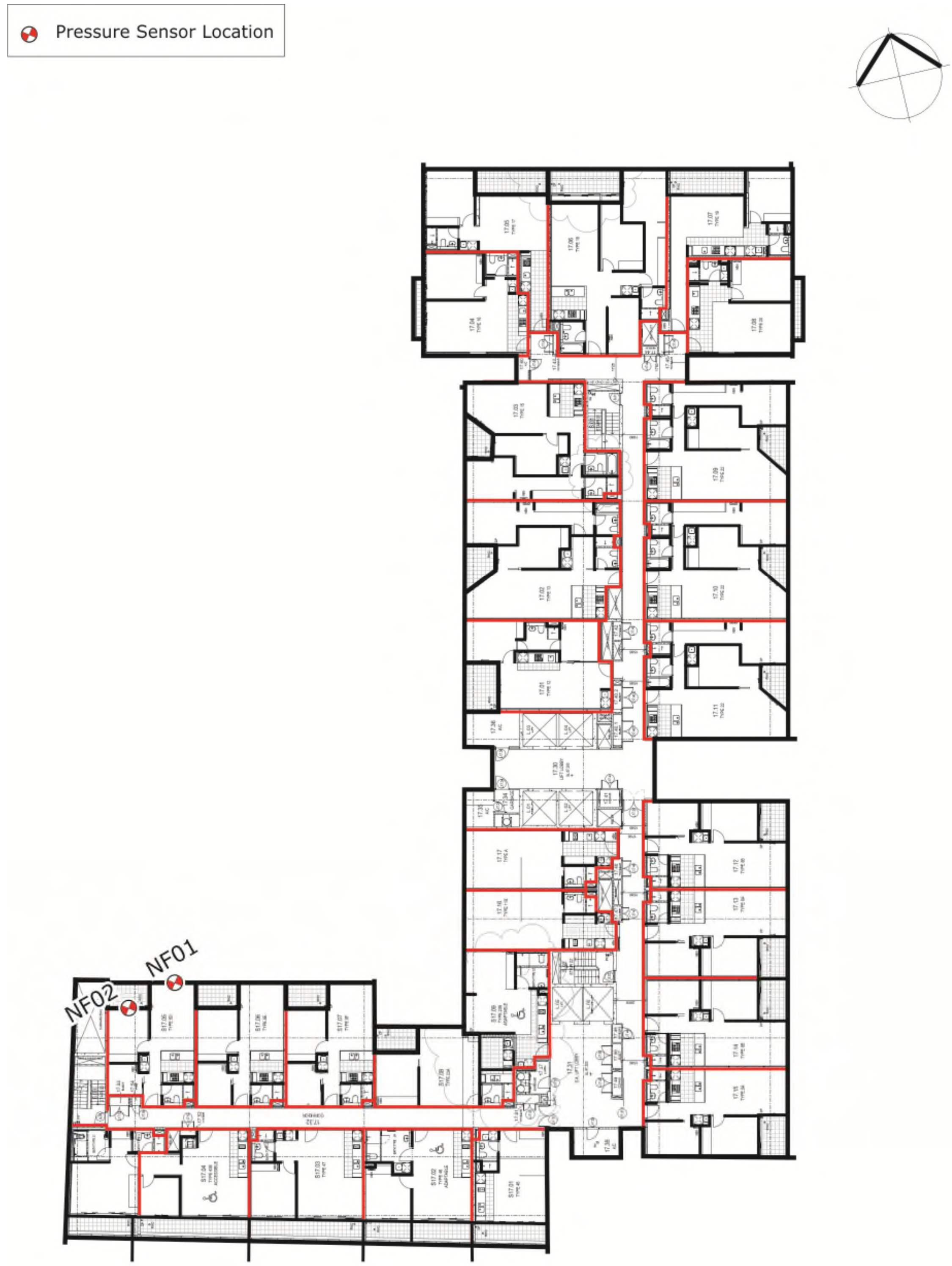


Figure C6: Opening Locations and Internal Apartment Layout – Level 17

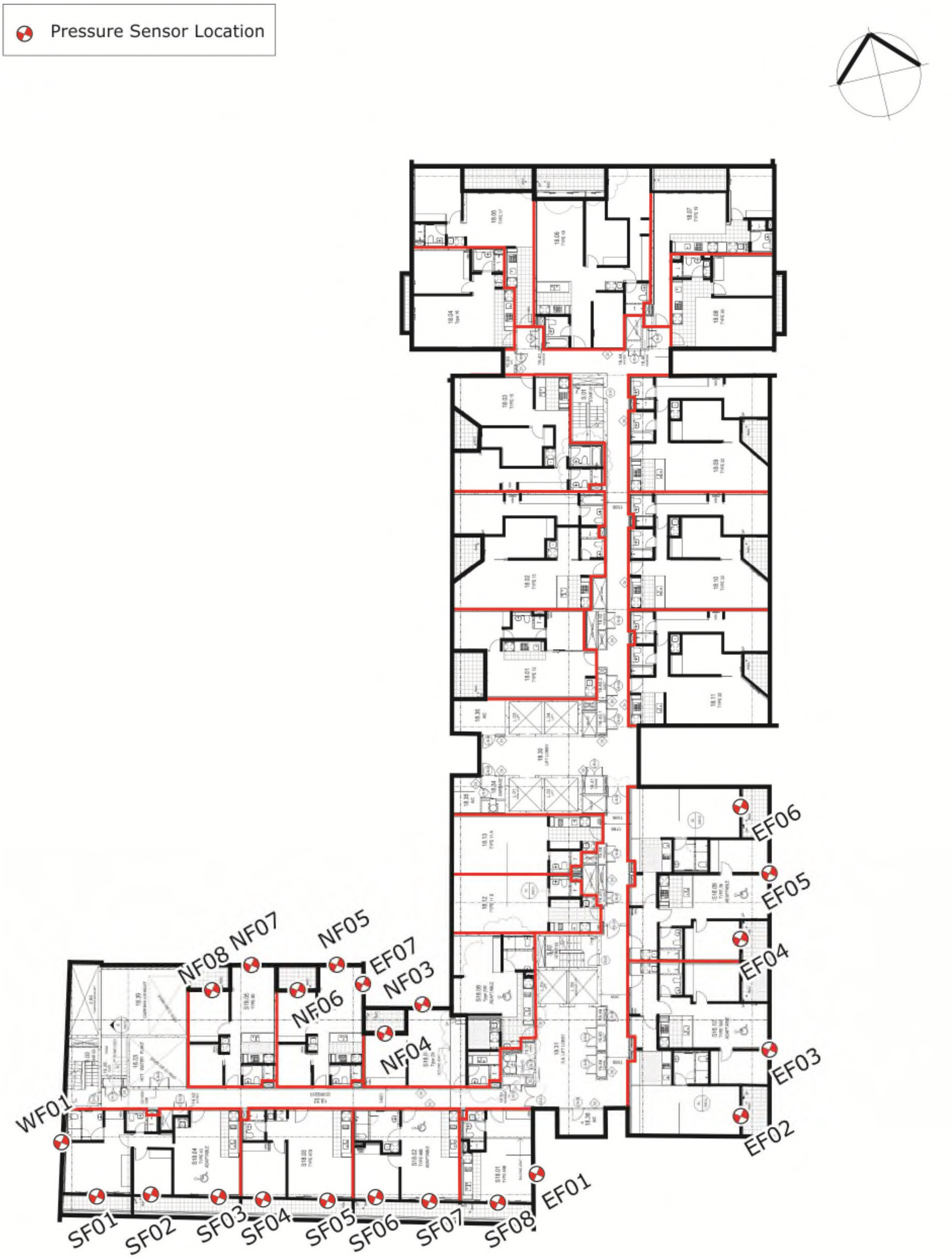


Figure C7: Opening Locations and Internal Apartment Layout – Level 18

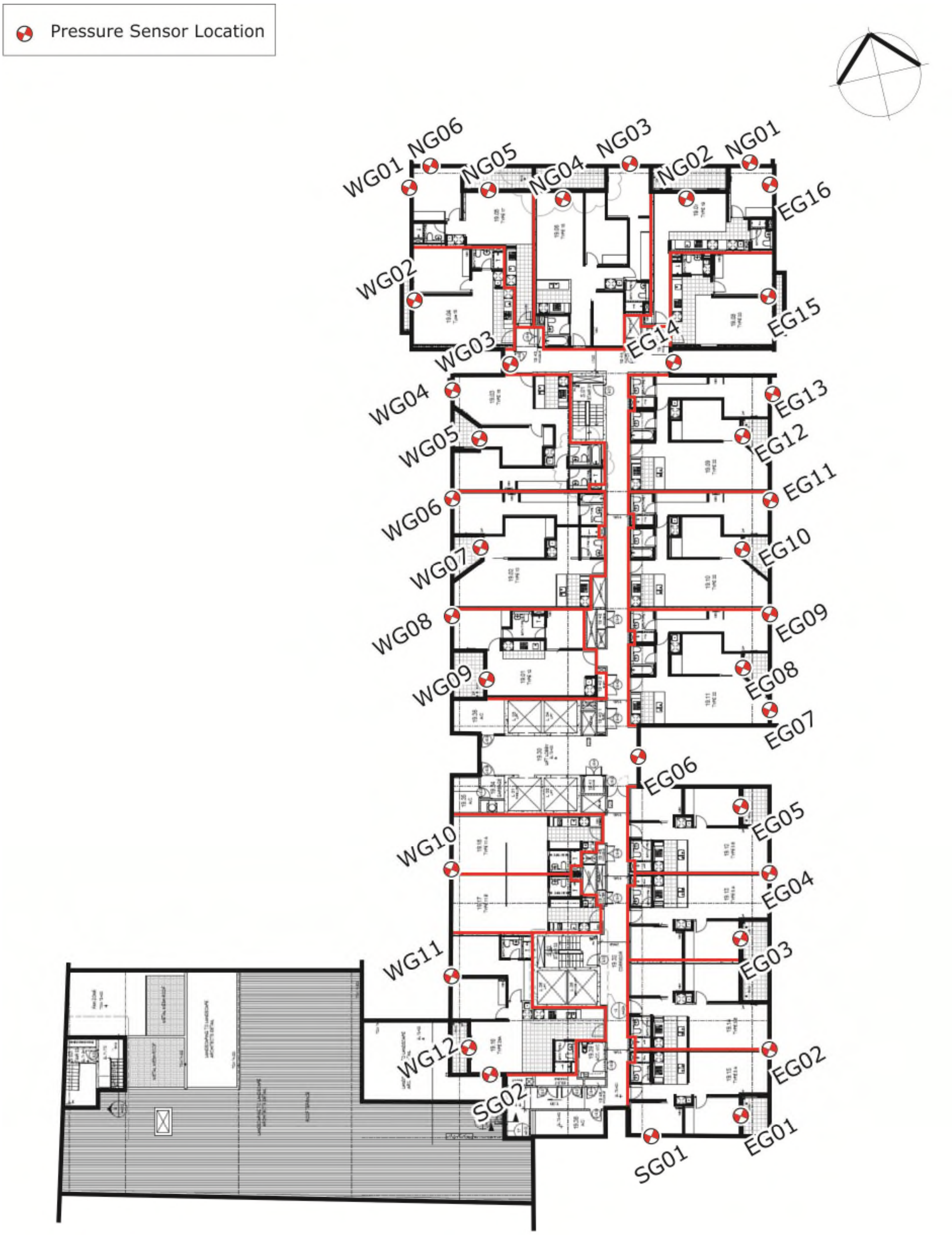


Figure C8: Opening Locations and Internal Apartment Layout – Level 19

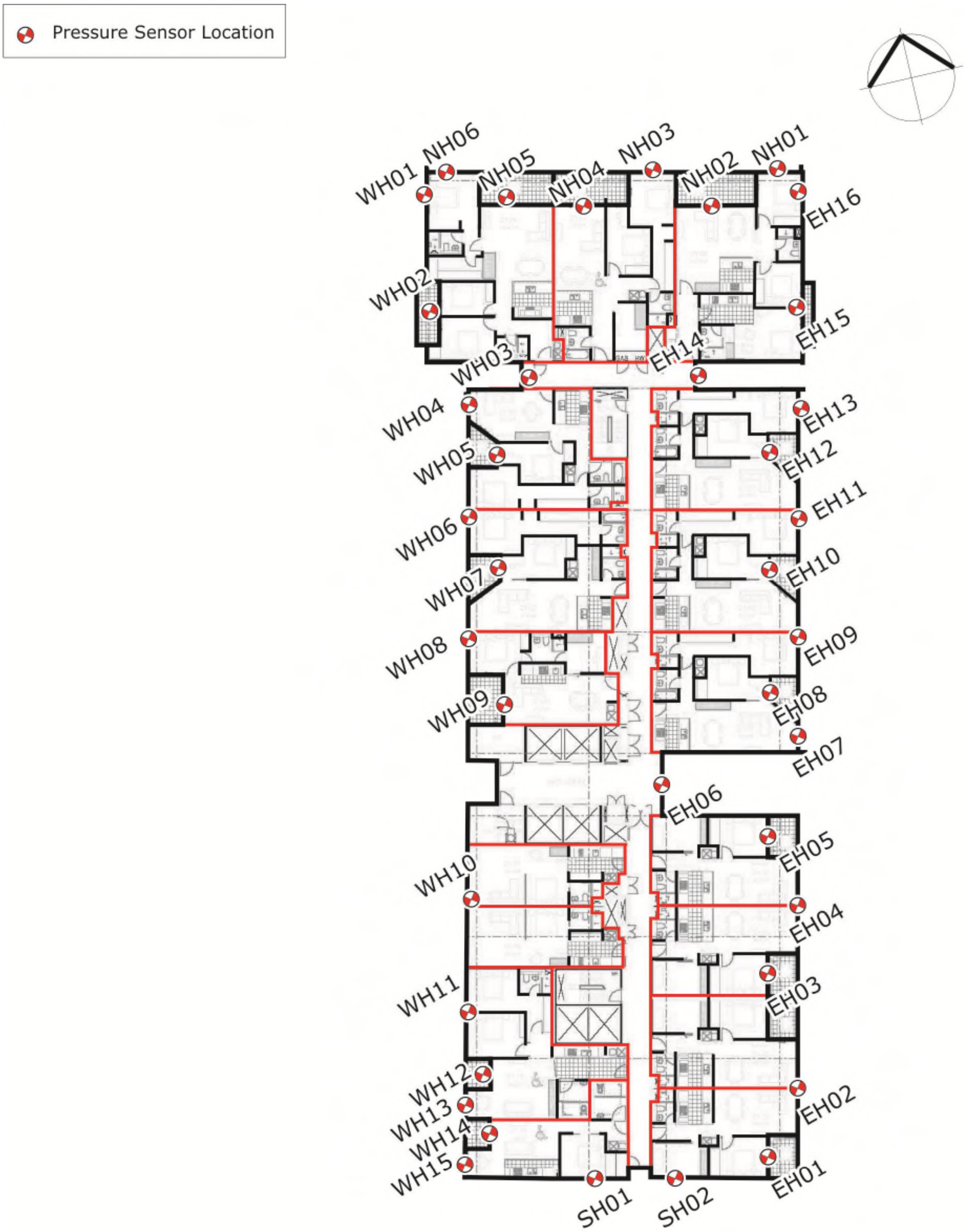


Figure C9: Opening Locations and Internal Apartment Layout – Level 23

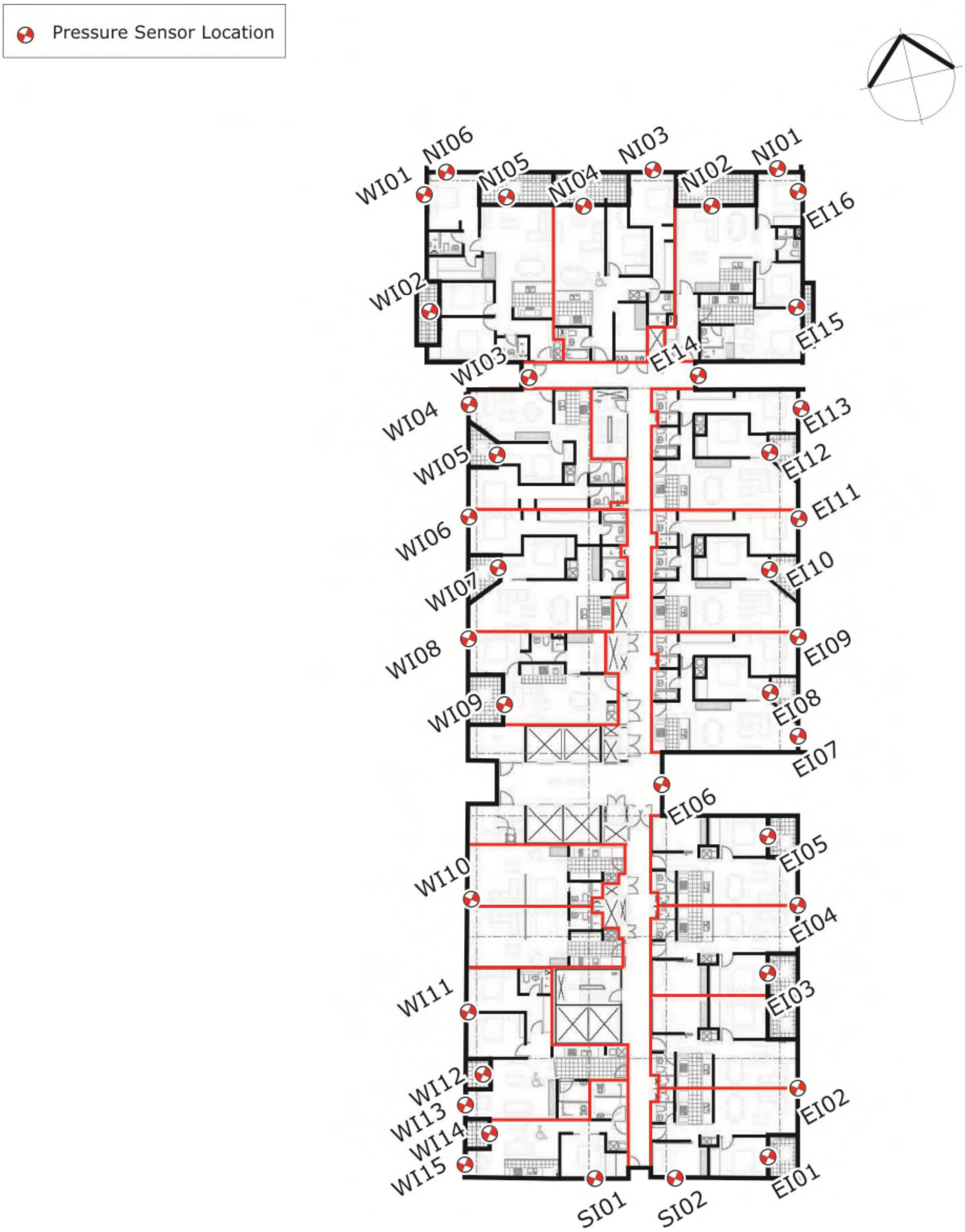


Figure C10: Opening Locations and Internal Apartment Layout – Level 25

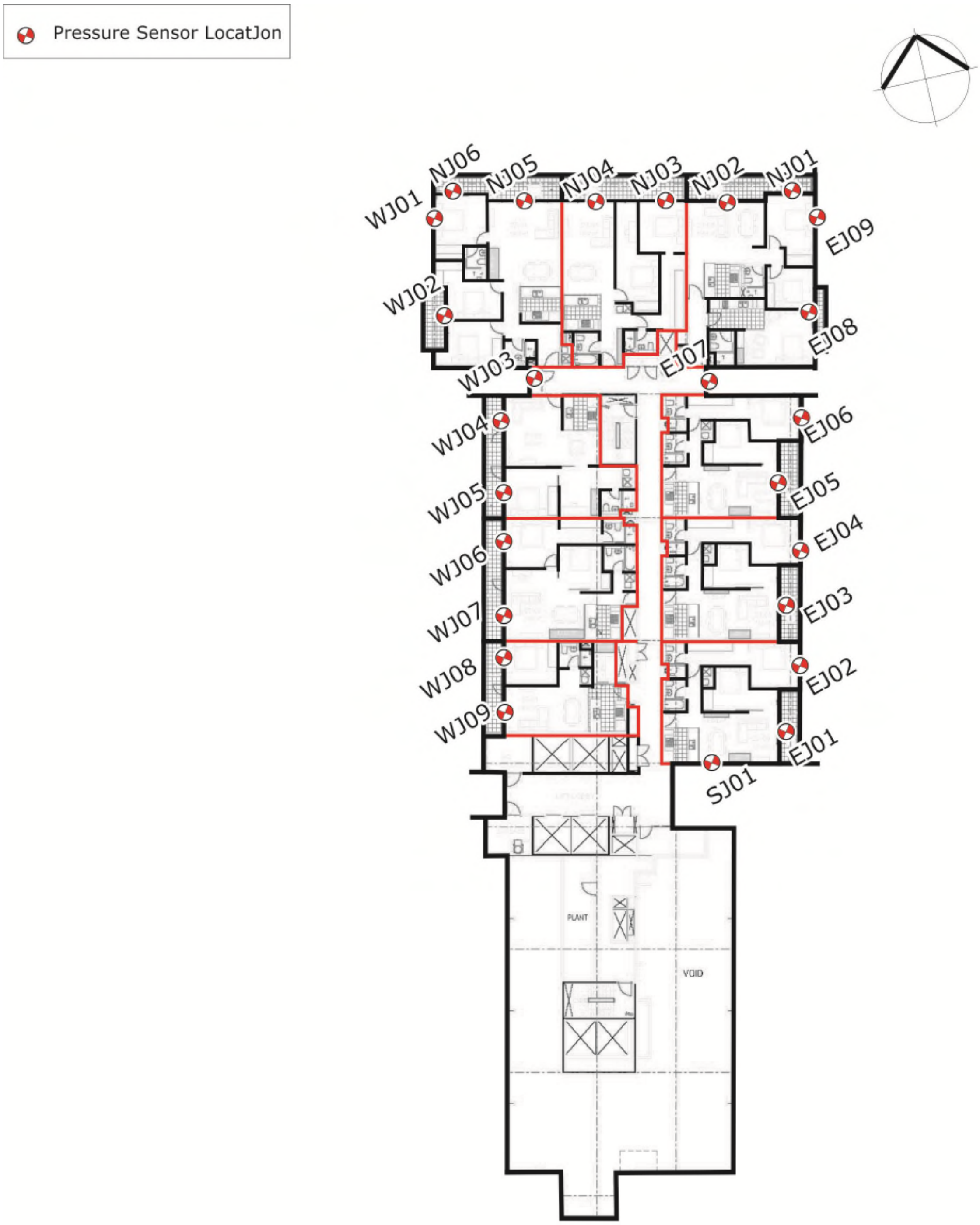


Figure C11: Opening Locations and Internal Apartment Layout – Level 27

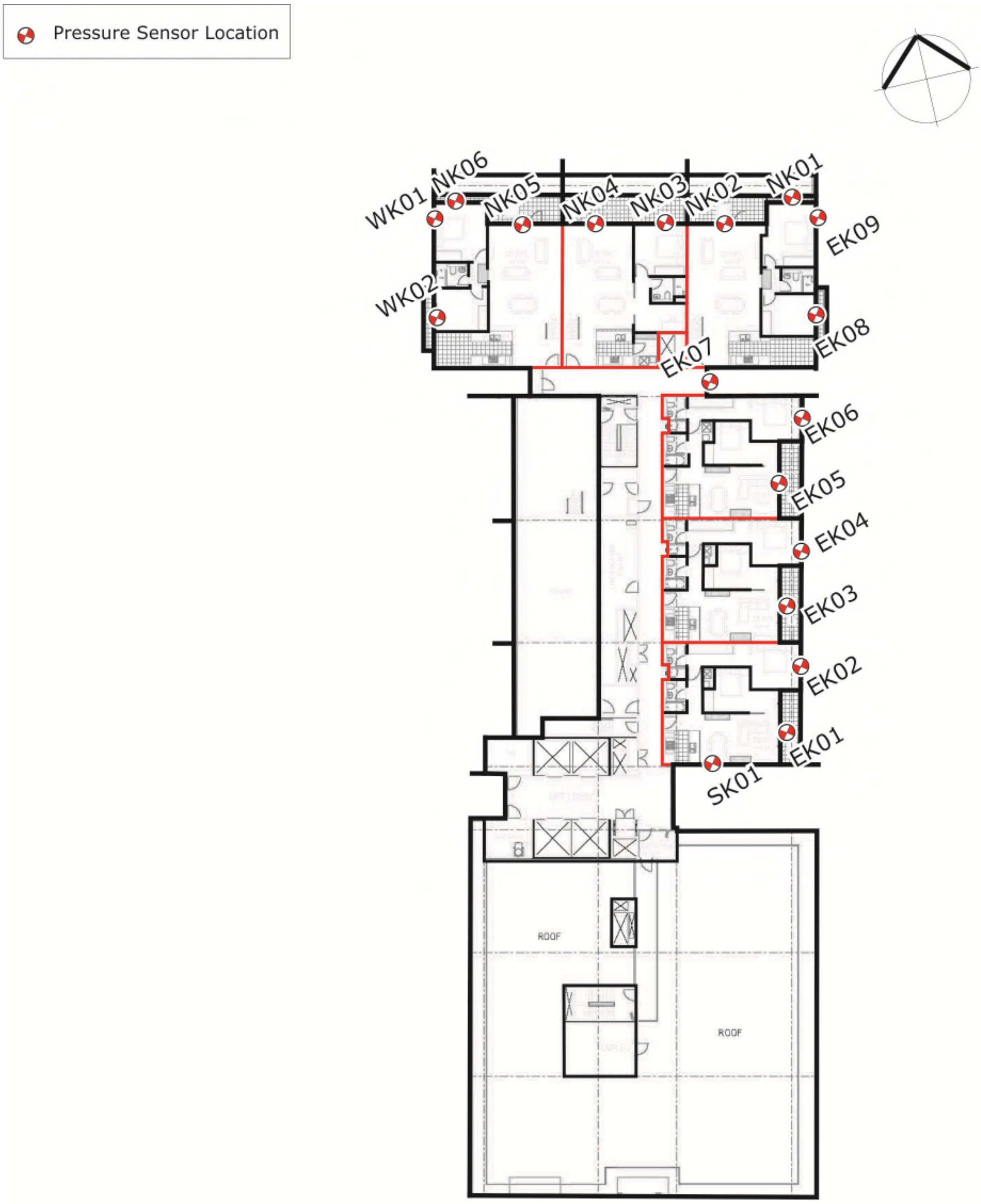


Figure C12: Opening Locations and Internal Apartment Layout – Level 28

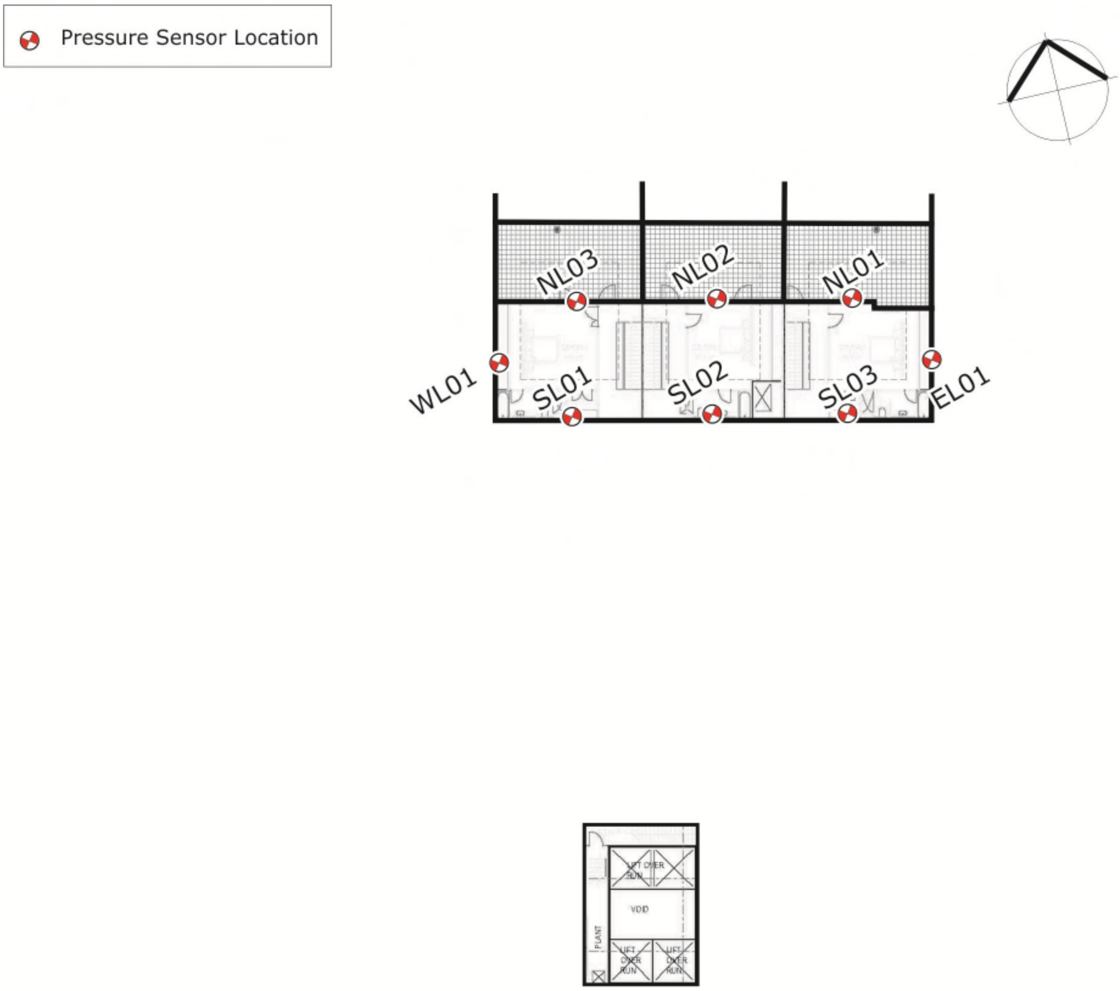


Figure C13: Opening Locations and Internal Apartment Layout – Level 29

APPENDIX D - APARTMENT OPENING PARAMETERS

Tap id	Configuration 1		Configuration 2	
	Opening Area (m^2)	Internal Wall Area (m^2)	Opening Area (m^2)	Internal Wall Area (m^2)
NJ01	5.19	8.49		
NJ02	9.20	14.78		
NJ03	5.31	8.63	1.82	4.04
NJ04	4.59	9.67		
NJ05	8.53	13.50		
NJ06	5.97	9.73		
NL01	5.21	8.30	6.42	10.11
NL02	5.46	8.69	2.68	5.67
NL03	5.74	9.07	5.89	9.40
NK01	5.19	8.53		
NK02	6.50	13.93		
NK03	6.00	9.48		
NK04	6.30	13.20		
NK05	6.40	13.64		
NK06	5.97	9.73		
EJ01	6.16	9.74	1.84	4.27
EJ02	2.00	8.48	3.90	8.48
EJ03	6.16	9.74	1.84	4.33
EJ04	2.00	8.48	3.90	8.48
EJ05	6.16	9.80	1.84	4.27
EJ06	2.00	8.40	3.90	8.48
EJ07	1.00	9.23		
EJ08	4.95	13.60	2.41	7.59
EJ09	1.00	13.31		
EK01	6.16	9.74	1.84	4.27
EK02	2.00	8.48		
EK03	6.16	9.82	1.84	4.27
EK04	2.00	8.48		
EK05	6.16	9.82	1.84	4.33
EK06	2.00	8.48		
EK07	1.00	13.50		
EK08	6.73	13.60		
EK09	1.00	11.55		
EL01	2.42	7.53	3.02	6.45
WJ01	1.00	12.23		
WJ02	2.81	10.94	2.63	8.37
WJ03				
WJ04	6.33	13.11		
WJ05	5.95	9.35		
WJ06	5.68	8.96		
WJ07	6.54	13.69		
WJ08	4.95	7.82		
WJ09	5.67	9.03		
WK01	1.00	10.48		
WK02	5.54	14.85		
WL01	2.95	6.32	2.49	8.18

SJ01	2.00	21.81		
SK01	2.00	21.81		
SL01				
SL02				
SL03				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NIL				
NI01	2.00	8.53		
NI02	9.20	14.74	2.07	4.95
NI03	2.00	8.53		
NI04	4.56	9.63	1.84	4.06
NI05	8.63	13.50		
NI06	2.00	9.74		
EI01	4.54	7.72	2.33	5.68
EI02	2.00	8.88	2.00	8.91
EI03	4.54	7.70	4.54	7.70
EI04	2.00	8.91	2.00	8.91
EI05	2.33	5.68	4.54	7.72
EI06	0.68	10.26	0.68	27.76
EI07	1.00	4.86		
EI08	4.60	7.44	1.87	4.62
EI09	2.00	8.37	1.00	4.86
EI10	4.60	7.44	1.87	4.62
EI11	2.00	8.37	1.00	4.86
EI12	4.60	7.44	1.87	4.62
EI13	2.00	8.37		
EI14	1.00	22.95	0.68	15.39
EI15	4.83	10.42	1.82	7.59
EI16	1.00	10.26		
WI01	1.00	11.12		
WI02	3.06	7.03	2.38	8.10
WI03	0.68	13.92	0.68	17.40
WI04	2.00	5.30		
WI05	4.46	7.36	1.79	4.27
WI06	2.00	8.26	2.00	8.29
WI07	1.87	4.62	5.12	8.35
WI08	2.00	4.53	2.00	7.80
WI09	3.06	7.43	5.43	9.02
WI10	2.00	11.42	2.00	11.42

WI11	2.00	7.32	2.00	8.61
WI12	2.62	5.98	1.98	4.25
WI13	2.00	5.44		
WI14	2.50	5.59	1.98	4.25
WI15	2.00	5.62		
SI01	1.00	10.53		
SI02	1.00	10.68		
NH01	2.00	8.53		
NH02	9.20	14.74	2.07	4.95
NH03	2.00	8.53		
NH04	4.56	9.63	1.84	4.06
NH05	8.63	13.50		
NH06	2.00	9.74		
EH01	4.54	7.72	2.33	5.68
EH02	2.00	8.88	2.00	8.91
EH03	4.54	7.70	4.54	7.70
EH04	2.00	8.91	2.00	8.91
EH05	2.33	5.68	4.54	7.72
EH06	0.68	10.26	0.68	27.76
EH07	1.00	4.86		
EH08	4.60	7.44	1.87	4.62
EH09	2.00	8.37	1.00	4.86
EH10	4.60	7.44	1.87	4.62
EH11	2.00	8.37	1.00	4.86
EH12	4.60	7.44	1.87	4.62
EH13	2.00	8.37		
EH14	1.00	22.95	0.68	15.39
EH15	4.83	10.42	1.82	7.59
EH16	1.00	10.26		
SH01	1.00	10.53		
SH02	1.00	10.68		
NIL				
WH01	1.00	11.12		
WH02	3.06	7.03	2.38	8.10
WH03	0.68	13.92	0.68	17.40
WH04	2.00	5.30		
WH05	4.46	7.36	1.79	4.27
WH06	2.00	8.26	2.00	8.29
WH07	1.87	4.62	5.12	8351.10
WH08	2.00	4.53	2.00	7.80
WH09	3.06	7.43	5.43	9.02
WH10	2.00	11.42	2.00	11.42
WH11	2.00	7.32	2.00	8.61
WH12	2.62	5.98	1.98	4.25
WH13	2.00	5.44		
WH14	2.50	5.59	1.98	4.25
WH15	2.00	5.62		
NG01	2.00	8.56		
NG02	9.09	14.43		
NG03	2.00	8.56		

NG04	1.84	4.06	4.56	9.71
NG05	4.20	13.43	2.11	11.03
NG06	2.00	9.69		
EG01	4.54	7.29	2.33	5.82
EG02	2.00	8.88	2.00	8.88
EG03	4.54	7.72	4.66	7.72
EG04	2.00	8.96	2.00	8.96
EG05	4.54	7.72	2.33	5.49
EG06	0.68	10.80	0.68	27.76
EG07	1.00	5.02		
EG08	4.60	7.27	1.87	4.62
EG09	2.00	7.44	1.00	5.02
EG10	4.60	7.18	1.87	4.62
EG11	2.00	8.37	1.00	5.02
EG12	4.60	7.27	1.87	4.59
EG13	2.00	8.37		
EG14	1.00	19.55	0.68	20.30
EG15	3.36	9.91	2.03	7.53
EG16	1.00	10.30		
SG01	1.00	10.68		
SG02				
WG01	1.00	11.34		
WG02	3.64	10.26	1.83	8.82
WG03	0.68	25.23	0.68	21.75
WG04	2.00	5.59		
WG05	4.46	7.34	1.79	4.27
WG06	2.00	8.29	2.00	8.29
WG07	1.87	4.61	5.12	8.34
WG08	2.00	4.53	2.00	7.80
WG09	3.06	7.56	5.43	9.32
WG10	2.00	11.43	2.00	11.33
WG11	2.00	8.37	2.00	8.10
WG12	4.73	10.31		
NF01	2.00	8.88		
NF02	4.54	8.13	1.93	4.83
NF03	2.00	8.45		
NF04	3.94	8.48	2.31	5.09
NF05	2.00	7.90		
NF06	4.54	8.13	1.93	4.82
NF07	2.00	8.91		
NF08	4.54	7.37		
EF01	1.00	18.27		
EF02	4.56	9.99		
EF03	2.00	6.68	2.00	8.91
EF04	4.54	7.45	4.54	7.45
EF05	2.00	8.91	2.00	6.68
EF06	4.54	9.98		
EF07	2.00	19.44		
SF01	8.42	13.37		
SF02	5.03	7.38		

SF03	5.67	13.10		
SF04	3.09	8.91		
SF05	6.09	12.80		
SF06	5.85	9.10		
SF07	5.67	11.59		
SF08	8.94	14.30		
WF01				
NE01	2.00	3.17		
NE02	9.09	14.50		
NE03	2.00	8.60		
NE04	4.56	9.59	1.84	4.05
NE05	8.39	13.43		
NE06	2.00	9.67		
NE07	2.00	8.45		
NE08	3.94	8.53		
NE09	2.00	8.91		
NE10	4.54	7.37		
NE11	2.00	8.88		
NE12	4.54	7.29		
NE13	2.00	8.92		
NE14	4.54	7.29		
EE01	1.00	22.41		
EE02	4.54	7.72		
EE03	2.00	8.86	2.00	8.88
EE04	4.54	7.72		
EE05	2.00	8.88	2.00	8.88
EE06	4.54	7.29	2.15	4.54
EE07	0.68	10.80	0.68	27.76
EE08	1.00	4.94		
EE09	4.58	7.44	1.87	4.59
EE10	2.00	8.37	1.00	4.86
EE11	4.45	7.44	1.87	4.62
EE12	2.00	8.34	1.00	4.86
EE13	4.60	7.43	1.87	4.62
EE14	2.00	8.37		
EE15	1.00	9.18	0.68	20.30
EE16	3.36	10.04	2.03	8.13
EE17	1.00	10.23		
EE18	2.00	19.53		
SE01	1.20	13.61		
SE02	3.77	7.29		
SE03	2.00	12.69	2.00	12.96
SE04	4.68	9.18		
SE05	2.00	11.56		
SE06	1.20	14.31		
SE07	1.00	10.53		
WE01	1.00	11.07		
WE02	4.74	10.31	1.82	8.64
WE03	0.68	25.23	0.68	21.75
WE04	2.00	5.72		

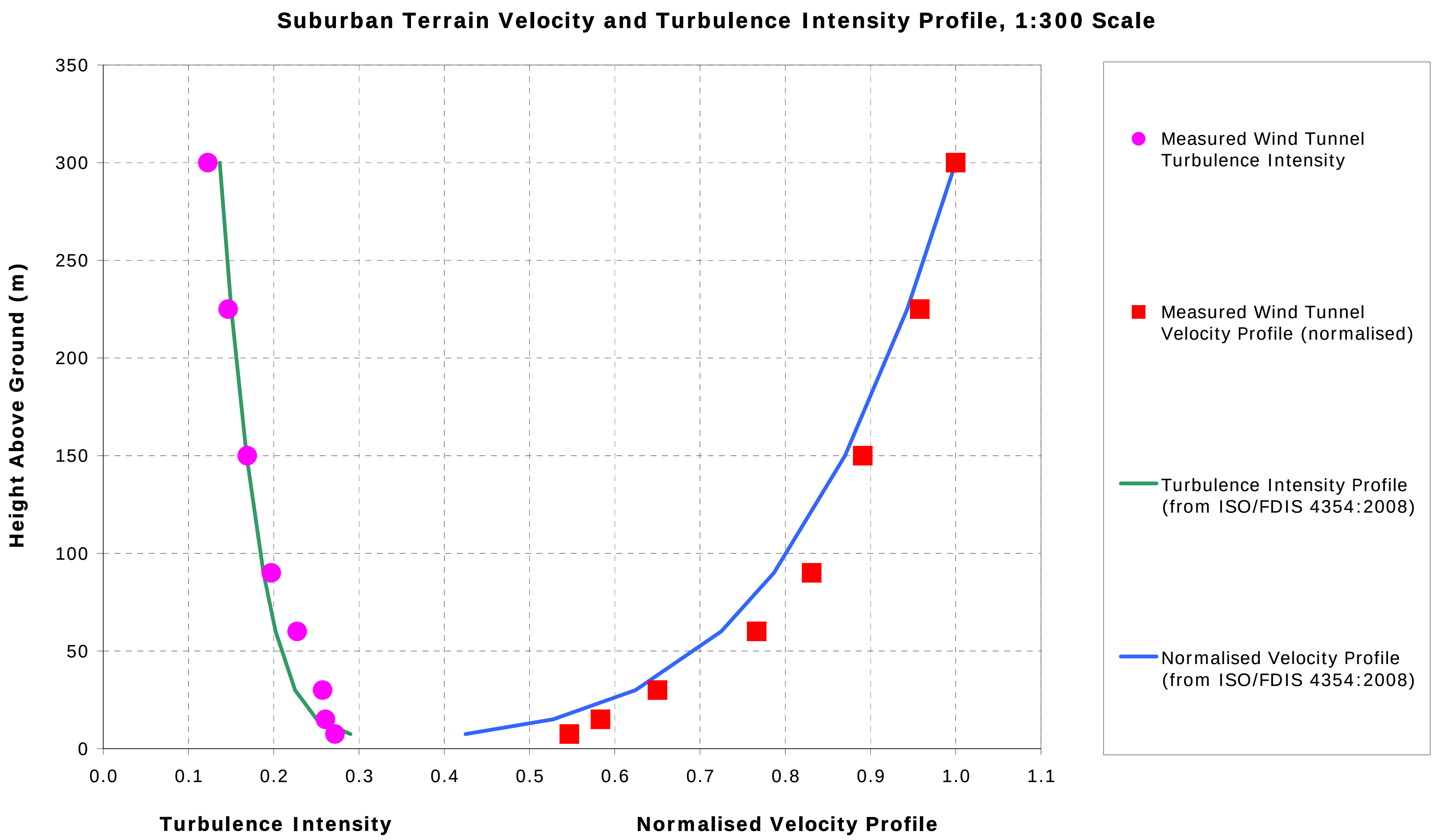
WE05	1.74	4.27	4.46	7.29
WE06	2.00	8.29	2.00	8.37
WE07	5.12	8.37	1.87	4.59
WE08	2.00	8.10	2.00	4.83
WE09	5.20	9.32		
WE10	2.00	11.61		
WE11	2.00	8.10	2.00	8.10
WE12				
NIL				
NIL				
ND01	2.00	3.17		
ND02	9.09	14.50		
ND03	2.00	8.60		
ND04	4.56	9.59	1.84	4.05
ND05	8.39	13.43		
ND06	2.00	9.67		
ND07	2.00	8.61		
ND08	3.94	8.24		
ND09	2.00	8.91		
ND10	4.54	7.37		
ND11	2.00	8.88		
ND12	4.54	7.29		
ND13	2.00	8.92		
ND14	4.54	7.29		
ED01	1.00	22.41		
ED02	4.54	7.72		
ED03	2.00	8.86	2.00	8.88
ED04	4.54	7.72		
ED05	2.00	8.88	2.00	8.88
ED06	4.54	7.29	2.15	4.54
ED07	0.68	10.80	0.68	27.76
ED08	1.00	4.94		
ED09	4.58	7.44	1.87	4.59
ED10	2.00	8.37	1.00	4.86
ED11	4.45	7.44	1.87	4.62
ED12	2.00	8.34	1.00	4.86
ED13	4.60	7.43	1.87	4.62
ED14	2.00	8.37		
ED15	1.00	9.18	0.68	20.30
ED16	3.36	10.04	2.03	8.13
ED17	1.00	10.23		
ED18	2.00	19.35		
SD01	1.20	13.61		
SD02	3.77	7.29		
NIL				
SD03	2.00	12.69	2.00	12.96
SD04	4.68	9.18		
SD05	2.00	11.56		
SD06	1.20	14.31		
SD07	1.00	10.53		

WD01	1.00	11.07		
WD02	4.74	10.31	1.82	8.64
WD03	0.68	25.23	0.68	21.75
WD04	2.00	5.72		
WD05	1.74	4.27	4.46	7.29
WD06	2.00	8.29	2.00	8.37
WD07	5.12	8.37	1.87	4.59
WD08	2.00	8.10	2.00	4.83
WD09	5.20	9.32		
WD10	2.00	11.61		
WD11	5.30	11.50		
WD12	2.00	7.29		
WD13	4.00	6.70		
WD14				
NC01	2.00	3.17		
NC02	9.09	14.50		
NC03	2.00	8.60		
NC04	4.56	9.59	1.84	4.05
NC05	8.39	13.43		
NC06	2.00	9.67		
NC07	2.00	8.61		
NC08	3.94	8.24		
NC09	2.00	8.91		
NC10	4.54	7.37		
NC11	2.00	8.88		
NC12	4.54	7.29		
NC13	2.00	8.92		
NC14	4.54	7.29		
EC01	1.00	22.41		
EC02	4.54	7.72		
EC03	2.00	8.86	2.00	8.88
EC04	4.54	7.72		
EC05	2.00	8.88	2.00	8.88
EC06	4.54	7.29	2.15	4.54
EC07	0.68	10.80	0.68	27.76
EC08	1.00	4.94		
EC09	4.58	7.44	1.87	4.59
EC10	2.00	8.37	1.00	4.86
EC11	4.45	7.44	1.87	4.62
EC12	2.00	8.34	1.00	4.86
EC13	4.60	7.43	1.87	4.62
EC14	2.00	8.37		
EC15	1.00	9.18	0.68	19.55
EC16	3.36	10.04	2.03	8.13
EC17	1.00	10.23		
EC18	2.00	19.35		
SC01	1.20	13.61		
SC02	3.77	7.29		
SC03	2.00	12.69	2.00	12.96
SC04	4.68	9.18		

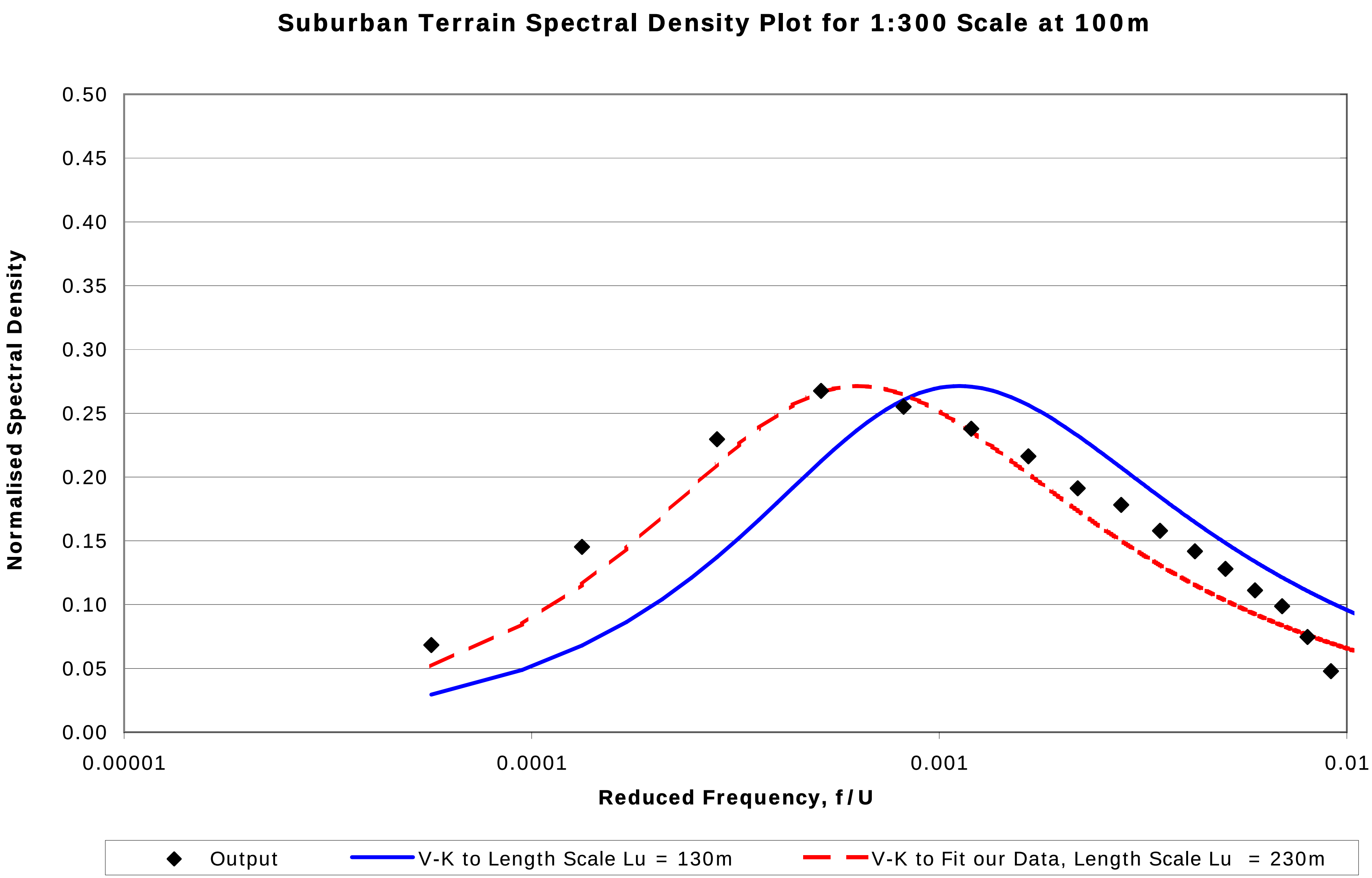
SC05	2.00	11.56		
SC06	1.20	14.31		
SC07	1.00	10.53		
WC01	1.00	11.07		
WC02	4.74	10.31	1.82	8.64
WC03	0.68	25.23	0.68	21.75
WC04	2.00	5.72		
WC05	1.74	4.27	4.46	7.29
WC06	2.00	8.29	2.00	8.37
WC07	5.12	8.37	1.87	4.59
WC08	2.00	8.10	2.00	4.83
WC09	5.20	9.32		
WC10	2.00	11.61		
WC11	5.30	11.50		
WC12	2.00	7.29		
WC13	4.00	6.70		
WC14				
NB01	2.00	3.17		
NB02	9.09	14.50		
NB03	2.00	8.60		
NB04	4.56	9.59	1.84	4.05
NB05	8.39	13.43		
NB06	2.00	9.67		
NB07	2.00	8.61		
NB08	3.94	8.24		
NB09	2.00	8.91		
NB10	4.54	7.37		
NB11	2.00	8.88		
NB12	4.54	7.29		
NB13	2.00	8.92		
NB14	4.54	7.29		
EB01	1.00	22.44		
EB02	4.54	7.72		
EB03	2.00	8.86	2.00	8.88
EB04	4.54	7.72		
EB05	2.00	8.88	2.00	8.88
EB06	4.54	7.29	2.15	4.54
EB07	0.68	10.80	0.68	27.76
EB08	4.68	9.64		
EB09	2.00	8.32	2.00	4.34
EB10	4.68	9.64		
EB11	2.00	8.32	2.00	4.34
EB12	4.68	9.64		
EB13	2.00	8.32	2.00	4.32
EB14	1.00	9.18	0.68	20.30
EB15	2.03	8.10	3.35	9.94
EB16	1.00	10.37		
EB17	2.00	19.58		
SB01	1.20	13.61		
SB02	3.77	7.29		

SB03	2.00	12.69	2.00	12.96
SB04	4.68	9.18		
SB05	2.00	11.56		
SB06	1.20	14.31		
SB07	1.00	10.53		
WB01	1.00	11.07		
WB02	4.74	10.31	1.82	8.64
WB03	0.68	21.75	0.68	25.23
WB04	2.00	5.72		
WB05	1.74	4.27	4.46	7.29
WB06	2.00	8.29	2.00	8.37
WB07	5.12	8.37	1.87	4.59
WB08	2.00	8.10	2.00	4.83
WB09	5.20	9.32		
WB10	2.00	11.61		
WB11	5.30	11.50		
WB12	2.00	7.29		
WB13	4.00	6.70		
WB14				
NA01	3.12	7.29		
NA02	2.00	13.50		
EA01	4.99	10.45	4.47	7.24
EA02	5.20	11.07		
EA03	4.68	10.26	1.74	3.51
EA04	2.00	9.72		
EA05	2.00	9.72		
EA06	4.78	10.26	1.98	4.05
EA07	5.20	11.07		
EA08	4.94	7.29	4.68	10.26
SA01	3.30	12.69		

APPENDIX E - WIND TUNNEL PROFILES FOR THE VELOCITY AND TURBULENCE INTENSITY



Suburban Terrain Velocity and Turbulence Intensity Profile, 1:300 Scale
Height Above Ground (m)
0
50
100
150
200
250
300
350
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
Turbulence Intensity
Normalised Velocity Profile
Measured Wind Tunnel Turbulence Intensity
Measured Wind Tunnel Velocity Profile (normalised)
Turbulence Intensity Profile (from ISO/FDIS 4354:2008)
Normalised Velocity Profile (from ISO/FDIS 4354:2008)



Suburban Terrain Spectral Density Plot for 1:300 Scale at 100m
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Normalised Spectral Density
0.00001
0.0001
0.001
0.01
Reduced Frequency, f / U
Output
V-K to Length Scale Lu = 130m
V-K to Fit our Data, Length Scale Lu = 230m