

Computer Controlled Wind Tunnel – C30

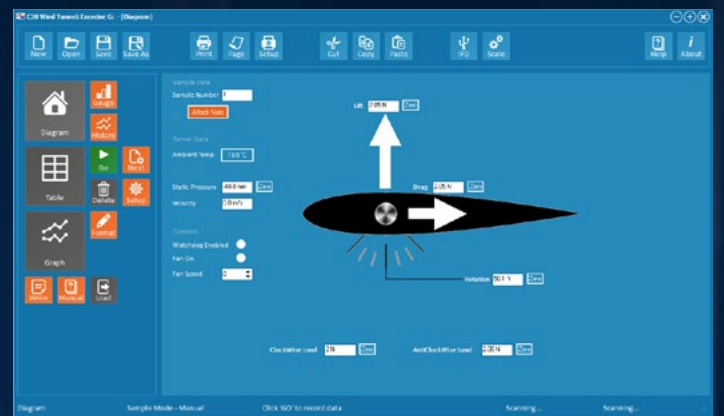
C
SERIES

The C30 - Computer Controlled Wind Tunnel enables the user to carry out advanced studies in the Aerodynamics fields including boundary layer experiments, flow visualisation, pressure distribution, study of turbulence and offering the possibility of developing self-design aerodynamics profiles to be tested.

The wind tunnel comprises outstanding features such as computer control, remote operation, datalogging and diagrams plotting in real time.

The system also benefits from clear visualisation of every model under test due to the architecture of the working section in transparent material and the compact design of all components.

Flow velocity can be achieved up to 40m/s.



C-SMOKE - Probe smoke generator over a wing profile



Experimental content

Investigation of the development of the boundary layer on a flat plate by measurement of the total head distribution*

- ▶ Flow visualisation studies around an aerofoil
- ▶ Measurement of pressure distribution around an aerofoil at various angles of attack
- ▶ Measurement of pressure distribution around a cylinder
- ▶ Measurement of lift and drag on an aerofoil with leading edge slot and trailing edge flap
- ▶ Velocity and pressure distribution measurements using a Pitot static tube and yaw probe
- ▶ Measurement of drag for a selection of models of different shapes but common equatorial diameter
- ▶ Demonstration of flutter of an aerofoil
- ▶ Calibration of the wind tunnel velocity indicator using a Pitot static tube and inclined or electronic manometer
- ▶ Investigation of the wake behind a cylinder or aerofoil using a wake survey rake
- ▶ Demonstration of the boundary layer phenomena

*additional accessory required dependant on experiment

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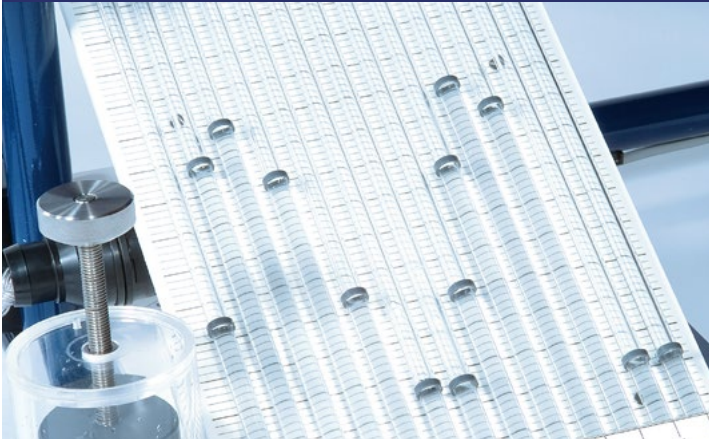
URL: <http://www.armfield.co.uk/c30>

Applications

ChE ME CE IP

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C30-11: Inclined Manometer Bank


The bank of 13 transparent tubes inclined at 30° to measure small pressure differences (0–160mm H₂O).

It includes a water reservoir with screw operated displacer to allow rapid adjustment of the datum level in the manometer, and is fitted with quick release connectors for rapid connection to models and instruments.

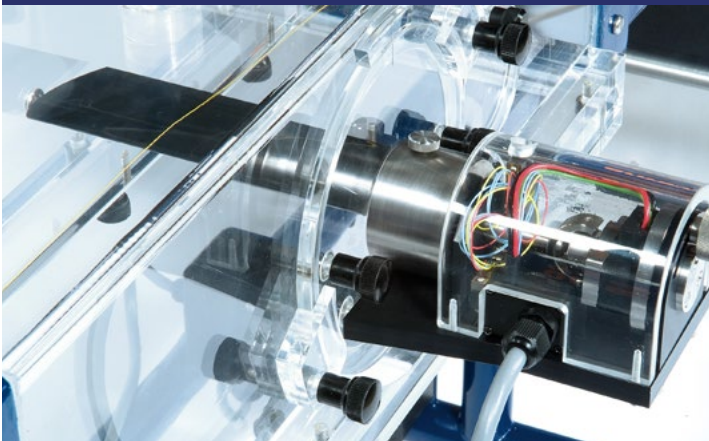
Water is used as the manometer fluid for safety and convenience in use.

C30-12: Electronic Manometer Bank


An electronic console incorporating 16 differential pressure sensors, each with a range of 0-178mm H₂O.

(It connects to the control PC using a second USB port, and the readings are fully integrated with the wind tunnel control software.)

A common tapping allows all sensors to be referenced to atmospheric pressure. Quick release connectors allow for rapid connection to models and instruments.

C30-13: Lift and Drag Balance (requires C30-20 or C30-22)


A 2-component, electronic balance used to measure the lift and drag on appropriate models. The lift and drag models connect to the balance using a simple fixing that ensures correct orientation of the model.

Electronic sensors are used to measure the lift and drag forces, the drag being measured directly, and the lift by a reduction in the model weight.

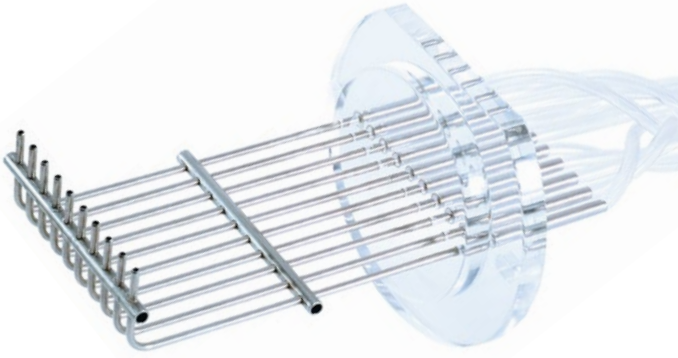
The model being tested can also be rotated on the mounting and the angle of rotation measured electronically. The readings from the lift and drag sensors and the rotation sensor are displayed on the control software screen running on the PC, and are available for data logging.

C30-14: Pitot Static Tube (requires C30-11 or C30-12)


A miniature Pitot Static Tube mounted in a support plug that can be located in the roof of the working section at three alternative positions, i.e. the start of the working section and upstream and downstream of the model mounting position.

The support plug incorporates an 'O' ring to retain the Pitot Tube where it is positioned and allows the tube to traverse over the full height of the working section to measure the velocity profile inside the working section of the tunnel.

C30-15: Wake Survey Rake (requires C30-11 or C30-12)



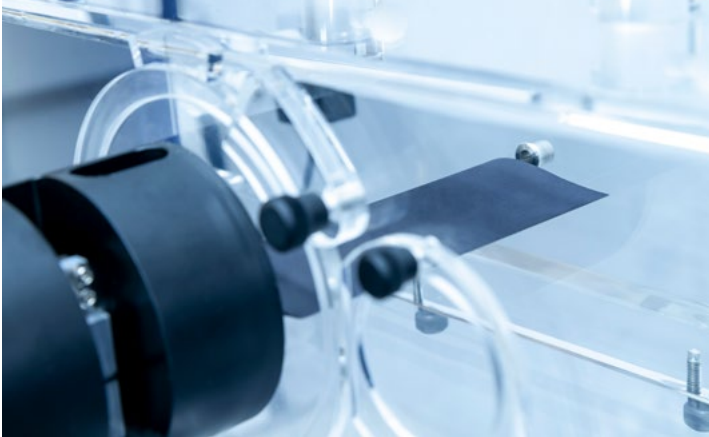
The rake consists of 10 tubes positioned vertically in a row and pointing towards the airflow.

The rake is mounted downstream of the model being used.

The tubes are mounted at a fixed pitch of 5mm but the assembly can be displaced 2.5mm allowing measurements at intervals of 2.5mm by interlacing two sets of readings.

The tubes are connected via flexible tubing to a multi-way quick release connector.

C30-16-Asoft: 3-Component Balance



A 3-component balance used to measure lift, drag and moment forces on appropriate models.

The models connect to the balance using a simple fixing that ensures correct orientation of the model.

The system is designed to work with a series of Armfield models and also enables the user to manufacture and test their own 3D printed or fabricated wings to test and evaluate for project work.

Integrated electronic sensors are used to measure the lift, drag and moment forces. The model being tested can also be rotated on the mounting and the angle of rotation measured electronically. The readings from the lift, drag, moment sensors and the rotation sensor are displayed on the control software screen running on the PC, and are available for data logging.

C30-17-Asoft: 3-Component Driven Balance (Requires C30-19)



A PC controlled Driven 3-component balance incorporates a closed loop stepper drive for precise driven rotation angles particularly beneficial for remote operation/ remote learning activities and repetitious test and development.

***requires essential accessory C30-19**

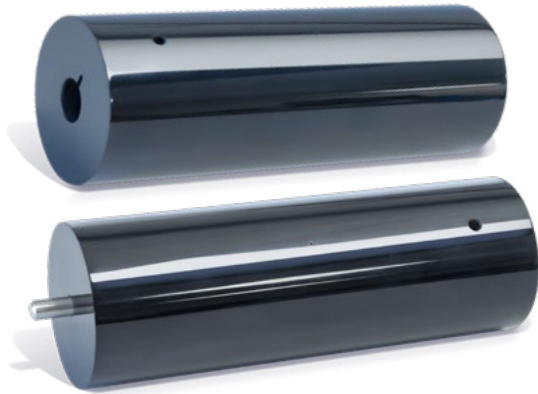
C30-18: Driven 360° Model Unit



A PC controlled driven 360-degree model interface with single pressure tapping take off to allow test models to be fitted with incorporated pressure tapping.

Suitable for use with C30-18-01 pressure cylinder or for users to manufacture and test their own 3D printed or fabricated samples to test and evaluate for project work. Particularly beneficial for remote operation/ remote learning activities and repetitious test and development.

***requires essential accessory C30-19**

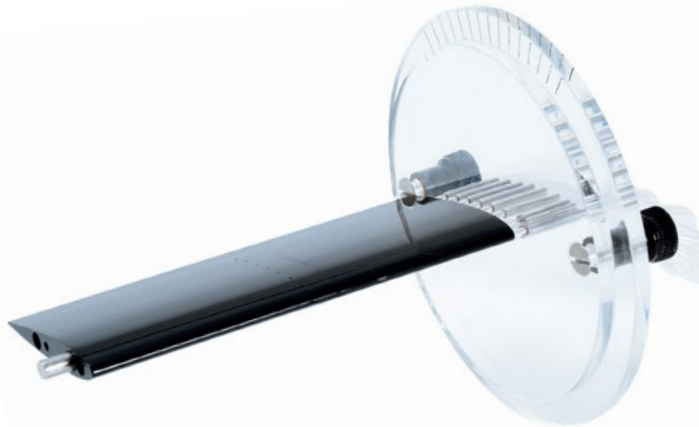
C30-18-01: Cylinder with pressure tapping for 360° drive


Cylinder with single pressure tapping to interface with the driven 360-degree model unit enabling the study of pressure acting on a cylinder at various velocities and angular positions.

C30-20: Lift & Drag Aerofoil (requires C30-13)


A plain symmetrical aerofoil to NACA 0015 profile, incorporating a mounting rod that allows it to be installed on the C30-13 Lift & Drag Balance, thus allowing the lift and drag to be measured with the aerofoil at different angles of attack.

The aerofoil has the same section as the C30-21 to allow direct comparison of lift characteristics with the pressure distribution.

C30-21: Pressure Wing (requires C30-11 or C30-12)


A symmetrical aerofoil incorporating 10 tapping points distributed along the wing profile on one side, which allows the pressure distribution to be measured from the leading edge to the trailing edge.

The pressure distribution on the upper and lower surface can be obtained by inclining the aerofoil at positive and negative angles of attack. Machined to NACA 0015 profile, the aerofoil has the same section as the C30-20 to allow direct comparison of pressure distribution with the lift characteristics.

The tapping points are all flush with the surface of the aerofoil and connected via flexible tubing to a multi-way quick release connector.

C30-22 Drag Models (requires C30-13)


Seven different models are provided for use with the C30-13 Lift and Drag Balance for investigations into the influence of shape on the drag forces.

Five models are supplied with a common equatorial diameter of 50mm, thus all presenting the same cross section to the airflow:

Sphere - Hemisphere, convex to airflow - Hemisphere, concave to airflow - Circular disk - Streamlined shape.

Additionally a dimpled golf ball and plain sphere demonstrate the difference in drag force due to the dimples.

C30-23: Pressure Cylinder (requires C30-11 or C30-12)



A plain cylinder, 30mm diameter, incorporating 10 equi-spaced tapping points around half of the circumference that allow the pressure distribution around the cylinder to be measured.

The cylinder can be rotated through 180° to plot the pressure distribution over the whole circumference.

C30-24: Bernoulli Apparatus (requires C30-11 or C30-12)



A Venturi profile that is installed in the working section of the tunnel via the removable floor. The Venturi incorporates 11 pressure tappings in the floor, connected via flexible tubing to quick release connectors.

The Venturi occupies the full height of the working section and the width varies from 150mm (full width of the working section) at the inlet and outlet to 100mm at the throat. It is manufactured from clear acrylic for full visualisation.

C30-25: Boundary Layer Plate (requires C30-11 or C30-12)

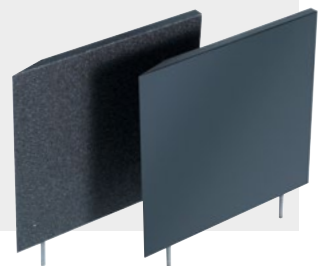


A flat plate, with a bevelled leading edge, that is mounted vertically in the working section via the removable floor. A flattened Pitot tube, mounted on a traversing micrometer, allows the air velocity to be measured at different distances from the surface of the plate.

A smooth plate and artificially roughened plate (above) are included to show the difference between laminar and turbulent boundary layers. The flexible tubing from the Pitot tube incorporates a quick release connector.

C30-26: Project Kit

A selection of components that allow alternative models to be constructed by the user. Includes a floor panel, a circular hatch and a set of connectors with appropriate flexible tubing.



C-Smoke: Probe smoke Generator



The probe smoke generator allows for easy visualisation of the air flow.

C30-30-01: C30 Wing model type 1 Gottingen 535
(requires C30-13 or C30-16)



Wing model designed with a **Gottingen 535 Air foil** profile, as used on a slingsby T21b glider. The high camber profile is designed into an air foil to maximise its lift coefficient.

C30-30-02: C30 Wing model type 2 NACA 633-618
(requires C30-13 or C30-16)



Wing model designed with a **NACA 633-618** profile, as used on the Schleicher Ka6b Glider. The profile is less cambered than the Gottingen 535 allowing direct comparison.

C30-30-03: C30 Wing model type 3 NACA 64-212
(requires C30-13 or C30-16)



Wing model designed with a **NACA 64-212** profile, as used on the MDM-1 Fox aerobatic glider. The profile is almost symmetrical and cuts through the air evenly.

C30-30-04: C30 Wing model type 4-Fauvel F2
(requires C30-13 or C30-16)




Wing model designed with a **Fauvel F2** as used on the FV-36 Flying Wing. The profile is a reflexed camber air foil where the camber line curves back up near the trailing edge. Such an air foil is useful in certain situations such as with tailless aircraft.

Ordering specification

C30-10 Subsonic wind tunnel	C30-21 Pressure Wing (requires C30-11 or C30-12)
C30-11 Inclined manometer bank	C30-22 Drag Models (requires C30-13 or C30-16)
C30-12 Electronic manometer bank	C30-23 Pressure Cylinder (requires C30-11 or C30-12)
C30-13 Lift and drag balance (requires C30-20 or C30-22)	C30-24 Bernoulli Apparatus (requires C30-11 or C30-12)
C30-14 Pitot Static Tube (requires C30-11 or C30-12)	C30-25 Boundary Layer Plate (requires C30-11 or C30-12)
C30-15 Wake Survey Rake (requires C30-11 or C30-12)	C30-30-01 C30 Wing model type 1 Gottingen 535 (requires C30-13 or C30-16)
C30-16-Asoft 3-Component Balance	C30-30-02 C30 Wing model type 2 NACA 633-618 (requires C30-13 or C30-16)
C30-17-Asoft 3-Component Driven Balance (Requires C30-19)	C30-30-03 C30 Wing model type 3 NACA 64-212 (requires C30-13 or C30-16)
C30-18 Drive Unit (Requires C30-19)	C30-30-04 C30 Wing model type 4-Fauvel F2 (requires C30-13 or C30-16)
C30-18-01 360° Pressure Cylinder (Requires C30-19)	C-SMOKE Probe Smoke Generator
C30-19 Wind Tunnel Accessory PSU (Power supply unit required to operate either driven model C30-17 or C30-18)	
C30-20 Lift & Drag Aerofoil (requires C30-13 or C30-16)	



Requirements	Scale
<div> <div>PC</div> <div>USB</div> </div>	
Electrical supply: <ul style="list-style-type: none"> ▶ C30-10-C: 400V/3ph/50Hz ▶ C30-10-D: 208-220V/3ph/60Hz/32A <p>The user must have a PC with a USB port, running Windows 7 above. An additional USB port will be required when using the optional C30-12</p>	

Technical specifications	
<ul style="list-style-type: none"> ▶ A stand-alone subsonic wind tunnel for conducting experiments in aerodynamics ▶ The wind tunnel is mounted on a steel base on wheels for mobility ▶ Working section of 310mm by 310mm and 600mm long ▶ The unit operates as an open circuit system ▶ Inverter controlled AC suction fan to drag the air flow through the working section ▶ Accurate speed control up to 40 m/s ▶ The duct incorporates a honeycomb flow straightener to even the direction of flow ▶ The working section incorporates three tappings on its top section to incorporate pitot tubes. These are located at the start of the working section, upstream and downstream of the model under test location ▶ All the optional and self-built models are inserted through a circular hatch of 160mm diameter. Each of the accessories supplied are built into individual hatches which incorporate an angular scale, enabling the models to be manually rotated to known angles 	
Linear speed	0-40m/s
Working section	Length: 600mm
	Width: 310mm
	Height: 310mm
Axial fan power	Approx. 4kW
Fan turning speed	3000rpm
Measuring ranges	Manometer: 0-250mm H2O
	Wind speed: 0-40m/s
	Angle of inclination: +/- 180°
	Lift force: +/- 10N
	Drag force: +/- 10N
	Pitching moment: +/- 3N

Overall dimensions	
Dimensions	
Length	3.785m
Width	0.990m
Height	1.930m
Packed and crated shipping specifications (for 2 cases)	
Volume	7.95m ³
Gross weight	665kg

Features
<ul style="list-style-type: none"> ▶ Robust design, manufactured in high quality materials for long life of the product ▶ Connections to main base unit via flexible hoses and quick release fittings ▶ The unit is supplied on wheels for ease of movement; these can be removed and the unit bolted to the floor for permanent installation ▶ Unit supplied with a complete manual including the following sections: Safety, Installation, Equipment Diagrams and Specifications, Routine Maintenance, Operation and Guided Experiments

Software
<p>The wind tunnel incorporates a software package as standard including the following features:</p> <ul style="list-style-type: none"> ▶ Diagram of the unit with all the sensors allocated across the diagram ▶ Graph plotting menu enabling data to be represented graphically in real times ▶ "Insert Comment" feature for operation conditions change registration ▶ Access to electronic version of the manual at all time ▶ Calibration screens to enable adjustment of individual sensor scaling ▶ USB data interface, which can connect to a PC running Windows 7 or above ▶ Multi-lingual interface ▶ Remote control operation available

Optional accessories	
▶ C30-11	Inclined Manometer Bank
▶ C30-12	Electronic Manometer Bank
▶ C30-13	Lift and Drag Balance (requires C30-20 or C30-22)
▶ C30-14	Pitot Static Tube (requires C30-11 or C30-12)
▶ C30-15	Wake Survey Rake (requires C30-11 or C30-12)
▶ C30-16-Asoft	3-Component Balance
▶ C30-17-Asoft	3-Component Driven Balance (requires C30-19)
▶ C30-18	Driven 360 degree model unit
▶ C30-18-01	Cylinder with pressure tapping for 360° drive
▶ C30-19	Wind Tunnel Accessory PSU
▶ C30-20	Lift & Drag Aerofoil (requires C30-13 or C30-16)
▶ C30-21	Pressure Wing (requires C30-11 or C30-12)
▶ C30-22	Drag Models (requires C30-13 or C30-16)
▶ C30-23	Pressure Cylinder (requires C30-11 or C30-12)
▶ C30-24	Bernoulli Apparatus (requires C30-11 or C30-12)
▶ C30-25	Boundary Layer Plate (requires C30-11 or C30-12)
▶ C30-30-01	C30 Wing model type 1 Gottingen 535 (requires C30-13 or C30-16)
▶ C30-30-02	C30 Wing model type 2 NACA 633-618 (requires C30-13 or C30-16)
▶ C30-30-03	C30 Wing model type 3 NACA 64-212 (requires C30-13 or C30-16)
▶ C30-30-04	C30 Wing model type 4-Fauvel F2 (requires C30-13 or C30-16)
▶ C-SMOKE	Probe Smoke Generator

Ordering codes
C30

Armfield standard warranty applies with this product

Knowledge base

- > 28 years expertise in research & development technology
- > 50 years providing engaging engineering teaching equipment

Benefit from our experience, just call or email to discuss your laboratory needs, latest project or application.



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Aftercare

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