THIS FOLDER WAS CHECKED BY ARUP ON

21.3.03

The checking process was to ensure that 3 identical sets of each Volume of the Operating and Maintenance Manuals existed

5-7 CARLTON GARDENS
LONDON SW1

OPERATING & MAINTENANCE INSTRUCTIONS
for the
MECHANICAL SERVICES

VOLUME 1
1.3.2 – Section H (H17 – 29)

Collated By :
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Fax : 01206 761932

MASTER INDEX

Volume 1 Mechanical Services

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1. Schedule of Record Drawings
2. Record Drawings *(reduced to A3 size)*

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SECTION H MANUFACTURERS LITERATURE

Supplier / Manufacturer	Plant/System/Item
Aquatanks	C.W.STORAGE TANKS
Armstrong Via Preussag	HOSEREEL BOOSTERS
Contract Components Ltd.	DUCT ACCESS DOORS
Diffussion Environmental Ltd.	FAN COIL UNITS
ACL Drayton	THERMOSTATIC RADIATOR VALVES
Estec Environmental Ltd.	CHLORINATION & WATER TREATMENT
F.E. Cole & Son Ltd.	DUCTWORK
Fire Protection Ltd.	FIRE DUCTS
Grundfos Pumps Ltd	SUMP PUMPS
Guntner UK	DRY COOLER
Hamworthy	BOILERS
Holden & Brooke Ltd	PUMPS, PRESSURISATION UNITS & COLD WATER BOOSTERS
Holmes	VALVES
Hudevad Britain	RADIATORS
IMI Rycroft Ltd	CALORIFIERS
Liff Industries	WATER CONDITIONERS
McQuay International AAF Ltd.	AIR HANDLERS &CHILLERS
Matthew & Yates	FANS
Minikin & Sons Ltd	FLEXIBLE CONNECTIONS
Noico Ltd.	INERTIA BASES
Preussag Fire Protection Ltd.	SPRINKLERS, HOSEREELS DRY RISERS
SPC	HEATING COILS
Stepspeed Ltd.	THERMAL INSULATION
Waterloo Air Management	DAMPERS, PRESSURE CONTROL VALVES
Woods Air Movement	FANS
Set Point	ROOM A/C UNIT

VOLUME 1.4

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1. Lower Ground Floor
2. Basement
3. Ground Floor
4. First Floor
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9. East Riser
10. South-West Riser
11. Plumbing Risers

SECTION J **COMMISSIONING FILE**

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BEARINGS		E.6.1	
BELTS		E.6.2	
BOILERS (Hamworthy)	D.1.1.1 D.3.1.1.	E.6.12 / E.7.1.1.1 E.7.2.1.1/ E.7.3.1 E.7.5.1.1 / E.7.6.1	H.8
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LTHW PIPEWORK		E.6.7 / E.7.5.1.3 E.7.6.1	
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STRAINERS		E.6.9 / E.7.5.1.3	
WATER TREATMENT		E.7.4.1	H5
TRACE HEATING		E.7.6.1	
CHILLERS (McQuay)	D.1.2.1 D.3.2.1	E.6.13 / E.7.1.2 E.7.2.2 / E.7.3.2 E.7.4.2.1 / E.7.6.2	H.2
DRY COOLERS	D.3.2.1	E.7.4.2.1	H.7
CHW PUMPS (H&B)	D.3.2.2	E.6.5 / E.7.2.2.2 E.7.5.2.2	H.9
CHW PRESS. UNITS (H & B)	D.3.2.3	E.7.2.2.3 / E.7.5.2.3	H.9
CHW PIPEWORK		E.6.7 / E.7.5.2.3	
INSULATION		E.6.8	
STRAINERS		E.6.9 / E.7.5.2.3	
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AIR HANDLING UNITS (McQuay)	D.1.3.1	E.6.10(Filters) E.7.2.3.1 / E.7.3.3 E.7.5.3.1	
FAN COIL UNITS (Diffusion)	D.1.3.2 D.3.3.2	E.7.4.3 / E.7.6.3.3	H.4
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TANKS		E.6.6	H.2
CW BOOSTER SETS (Holden & Brooke)	D.1.4.3 D.3.4.3	E.7.4.4 / E.7.5.4.2/3	H.9
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STRAINERS		E.6.9 / E.7.5.4.4	
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CONTROLS & BMS (Synchronised Systems)	D.8	E.6.4 / E.7.2.8 E.7.5.8 / E.7.6.8	

H MANUFACTURERS INFORMATION

Supplier / Manufacturer	Plant / System / Item
1. Advanced Air (UK) Ltd. 3/4 Cavendish Road, Bury St. Edmunds Suffolk IP33 3TE Tel: 01284 701 356 Fax: 01284 701 357 Maun Way, Boughton Ind Est.	**FIRE, VOLUME CONTROL & NON-RETURN DAMPERS**
2.. A1 Bridge Flues Nr. Newark, Nottingham NG22 9ZD Tel: 01623 860 578 Fax: 01623 835 548	**HEATING BOILERS FLUE**
3. Aquatank Unit 3, Westcombe Trading Estate Station Road, Ilminister Somerset TA19 9DW Tel: 01460 556 64 Fax:01460 533 38	**C.W. STORAGE TANKS**
4. Armstrong Pumps Ltd. (Via Preussag) Peartree Rd. Stanway, Colchester Essex CD3 5JX Tel: 01206 579 491 Fax: 01206 760 532	**HOSEREEL BOOSTERS**
5. Contract Components Ltd. 10 Woodall Road Redburn Industrial Estate, Enfield Middx. EN3 4LE Tel: 0181 805 3656 Fax:0181 805 0558	**DUCT ACCESS DOORS**

Supplier / Manufacturer	Plant / System / Item
6.Delta T (Trace Heating) Ltd Unit 7, Alston works, Barnet Herts EN5 4EL Tel: 0181 441 9499 Fax 0181 441 4459	**TRACE HEATING**
7. Diffusion Environmental Ltd. 47 Central Avenue West Molesley Surrey KT8 2QZ Tel: 0181 783 0033 Fax::0181 783 0140	**FAN COIL UNITS**
8. ACL Drayton Chantry Close, West Drayton Middx UB7 7SB Tel: 01895 444 012 Fax: 01895 421 901	**THERMOSTATIC RADIATOR VALVES**
9. Estec Environmental Ltd. Old Pump House , Elmer Works Hawks Hill, Leatherhead Surrey KT22 9DA Tel: 01372 361 451 Fax:01372 361 453	**CHLORINATION & WATER TREATMENT**
10. Eurocoils Ltd Unit D3, Eurolink Commercial Park Boham Drive, Sittingbourne Kent ME10 3RX Tel: 01795 475 275 Fax:01795 422 210	**HEATER BATTERIES (LTHW & Electric)**

Supplier / Manufacturer	Plant / System / Item
11. Fire Protection Ltd. Millars 3, Southmill Road Bishops Stortford Herts. CM23 3DH Tel: 01279 367 077 Fax:01279 466 994	FIRE RESISTANT DUCTWORK
12. Grundfos Pumps Ltd Grovebury Rd Leighton Buzzard Beds LU7 8TL Tel: 01525 850 000 Fax:01525 850 011	SUMP PUMPS
13. Guntner UK Sandhurst House 297 Yorktown Road College Town, Sndhurst Berks. GU47 0QA Tel: 01276 600 817 Fax:01276 331 29	DRY COOLER
14. Hamworthy Fleet Corner, Poole Dorset BH17 7LA Tel: 01202 665 566 Fax::01202 665 111	BOILERS
15.Holden & Brooke Ltd Wenlock Way Manchester M12 5JL Tel: 0161 223 2223 Fax::0161 220 9660	PUMPS, PRESSURISATION UNITS & COLD WATER BOOSTERS

Supplier / Manufacturer	Plant / System / Item
16.Holmes Hardwick Grange, Woolstone Warrington WA1 4Rf Tel:01925 827 505 Fax:01925 810 589	VALVES
17.Hudevad Britain 130 - 132 Terrace Road Walton - on - Thames Surry KT12 2EA Tel: 01932 247 835 Fax:01932 247 694	RADIATORS
18.IMI Rycroft Ltd Duncombe Road Bradford BD8 9TB Tel: 01274 490 911 Fax:01274 498 580	CALORIFIERS
19.Liff Industries Bay Hall, Miln Road Huddersfield W. Yorks. HD1 5EJ Tel: 01484 512 537 Fax:01484 513 597	WATER CONDITIONERS
20.Matthew & Yates Peartree Road Stanway Colchester Essex CO3 5LD Tel: 01206 543 311 Fax:01206 760 497	FANS

Supplier / Manufacturer	Plant / System / Item
21. Minikin & Sons Ltd Spa House, Hookstone Park Harrogate HG2 7DB Tel: 01423 889 845 Fax:01423 880 724	**FLEXIBLE CONNECTIONS**
22. McQuay International, AAF Ltd. Bassington Lane Cramlington Northumberland NE23 8AF Tel: 01670 566 159 Fax:01670 566 206	**AIR HANDLERS** See Stand alone Manual
23. McQuay International, AAF Ltd. 15 Greycoat Place, Victoria London SW1P 1SB Tel: 0171 799 3330 Fax:0171 799 3411	**CHILLERS** See Stand alone Manual
24. Noico Ltd. London Road Hook Hampshire RG27 9EQ Tel: 01256 766 207 Fax:01256 768 413	**INERTIA BASES**
25. Preussag Fire Protection Ltd. 220 Stockport Road Cheadle Heath Stockport SK3 0LX Tel: 0161 428 3662 Fax 0161 428 3662	**SPRINKLERS, HOSEREELS** **DRY RISERS** (See Stand alone Manual)

Supplier / Manufacturer	Plant / System / Item
26.SETPOINT Unit 5 B Bernard Road Danes Park Industrial Estate Romford, Essex Tel: 01708 756 888 Fax:01708 756 999	VRV A/C UNITS
27.SGD Engineering Services Ltd. Imex Technology Park, Longton Road Trentham Stoke on Trent ST4 8LJ Tel: 01782 658 8767 Fax:01782 658 899	GLASS CONDENSATE TRAPS
28.Stepspeed Ltd. Audley House, Northbridge Road, Berhamstead Herts. HP4 1EH Tel: 01442 876 888 Fax; 01442 876 860	THERMAL INSULATION
29.Waterloo Air Management Quarry Wood Ind. Est. Mills Rd., Aylesford South Kent ME20 7NB Tel: 01622 717861 Fax: 01622 719291	SMOKE DAMPERS & ATTENUATORS
30.Woods Air Movement Tufnell Way Colchester CO4 5AR Tel: 01206 544 122 Fax:01206 574 434	FANS

17

P5 and Symphony radiators feature the classic Hudevad flat front and rebated, bevelled edge. Designed to complement the Plan range, they offer good looks and robust construction, and provide the perfect option in locations where the high output of Plan convector radiators is not required.

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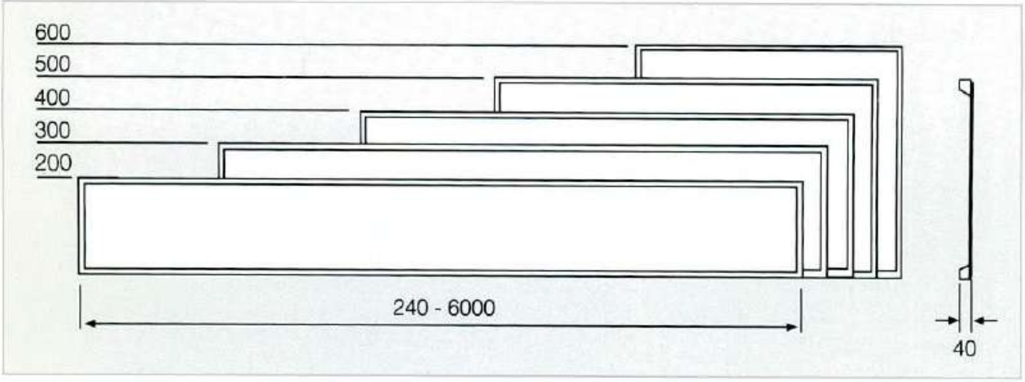
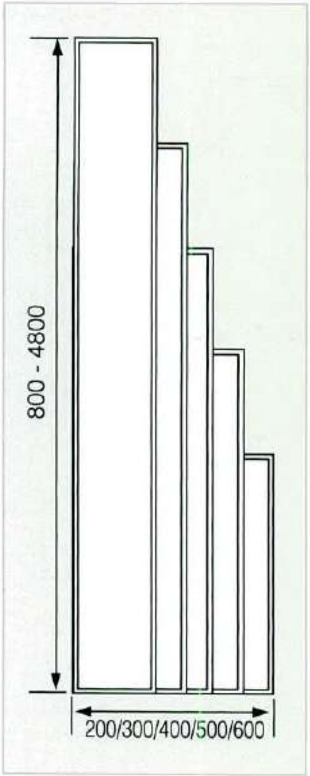
Size range

P5 radiators



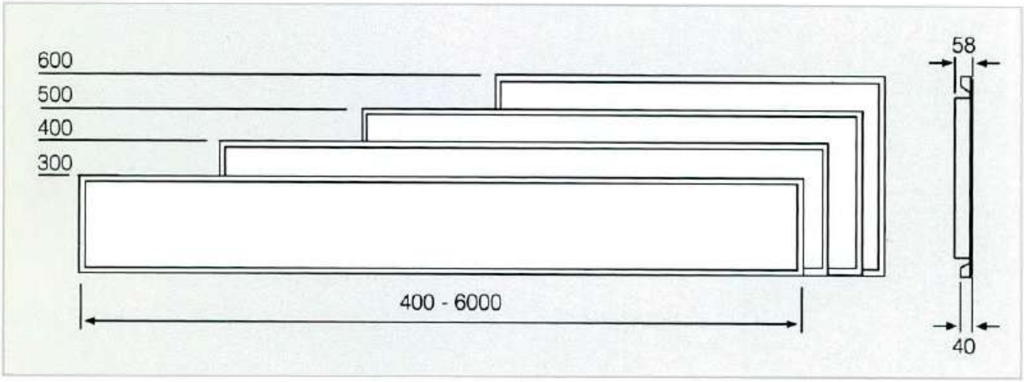


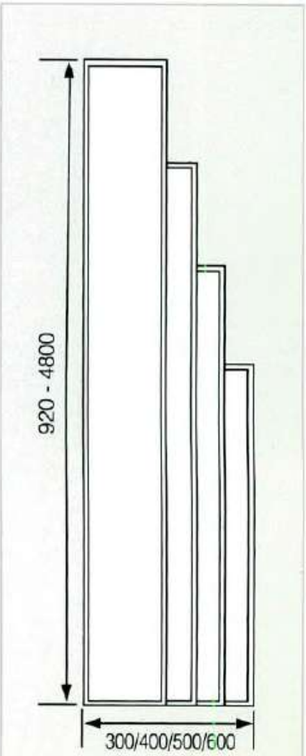
Mounted horizontally: heights are 200, 300, 400, 500 and 600mm; lengths are 240 - 6000mm in 40mm increments.

Mounted vertically, heights are 800 - 4800mm in 40mm increments. Widths are 200, 300, 400, 500 and 600mm.

Front to back measurement is 40mm. When wall-mounted, outreach is 68 or 88mm, using conventional Plan brackets.

Symphony radiators





Mounted horizontally: heights are 300, 400, 500 and 600mm; lengths are 400 - 6000mm in 40mm increments.

Mounted vertically, heights are 920 - 4800mm in 40mm increments. Widths are 300, 400, 500 and 600mm.

Front to back measurement is 58mm. When wall-mounted, outreach is 68 or 88mm, using dedicated brackets.

Hudevad Britain, 130-132 Terrace Road, Walton-on-Thames, Surrey KT12 2EA. Tel: Walton-on-Thames (01932) 247835 Fax: Walton-on-Thames (01932) 247694

Construction

Fabrication is from steel plate: 2mm at front and 1.25mm at rear. Hanging straps are provided at rear for wall-mounting.

- On Symphony radiators only, rear convection fins are formed from 0.75mm mild steel, spot-welded to the vertical waterways.

Finish

The factory standard finish for P5 and Symphony radiators is white to RAL 9010. Radiators are powder coated to provide a high quality durable finish.

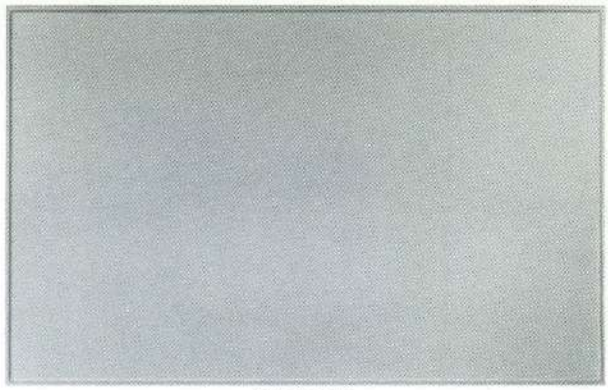
- Symphony radiators are also available in primer, or in a wide range of BS or RAL colours.

Weight

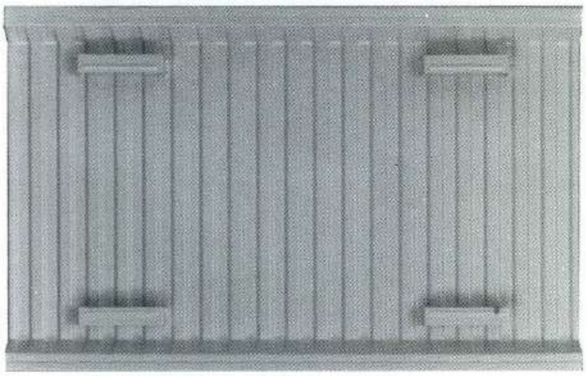
Approximately 12.5 kg per m^2 of heating surface. Maximum radiator weight is 250 kg.

Test pressure

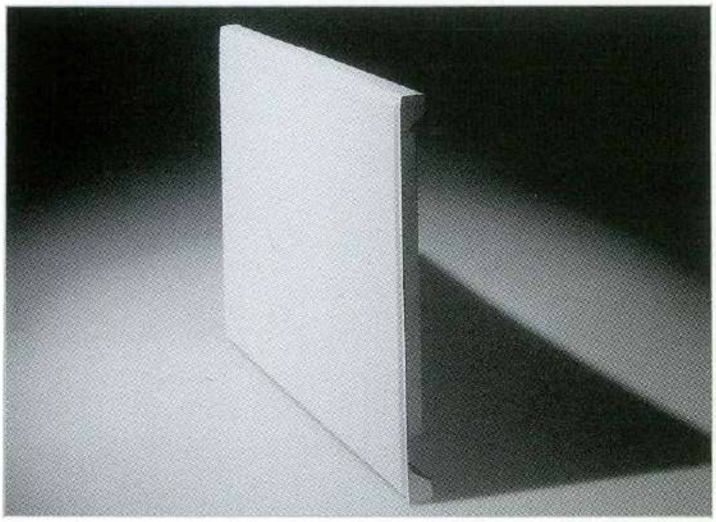
Standard test presure is 10 bar for all radiators. Maximum operating pressure, in accordance with BS EN 442, is 7.7 bar.



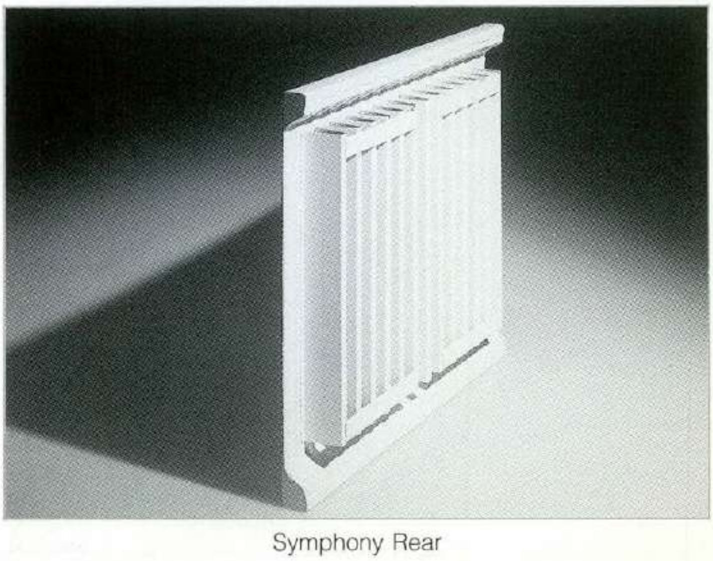
P-5 front



P-5 rear



Symphony Front



Symphony Rear

Water resistance

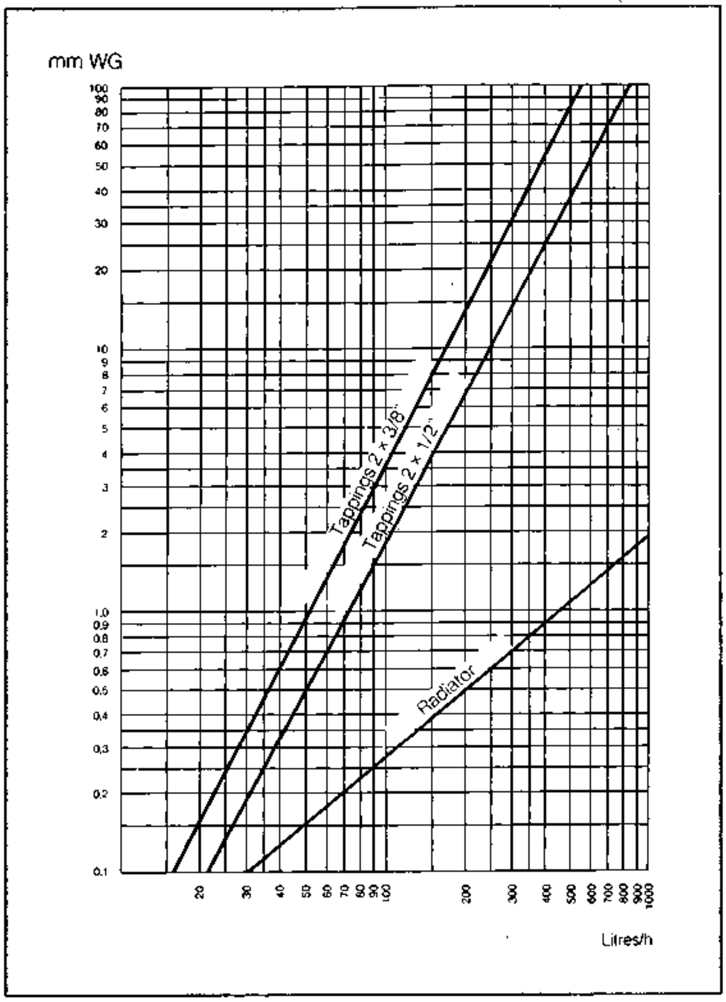
Water resistance through the P5 and Symphony radiators and various tapping sizes is shown at right.

Example: radiator P5 500mm H x 3600mm L
tappings 2 x ½ inch BSP
Heat output at $\Delta t = 60°C$ is 2296 Watt

$$\text{Water flow} = \frac{\text{Watt}}{(Tf - Tr) \times 1.163}$$

$$= \frac{2296}{20 \times 1.163} = 98.7 \text{ litre/hour}$$

Resistance: ½ inch tappings	=	1.80mm WG
Radiator: 0.25 x 1.61 (length in m)	=	0.90mm WG
Total resistance	=	2.70mm WG



Linear expansion

The linear expansion of length L can be calculated as follows:

$$\Delta L = L \times 0.000012 \times (Tm - 10°C)$$

Where L = radiator length in mm
Tm = mean water temperature

Example:

Radiator length	=	3500mm
Flow temperature Tf	=	80°C
Return temperature Tr	=	40°C
Mean temperature Tm	=	$\frac{80 + 40}{2} = 60°C$

$$\Delta L = 3500 \times 0.000012 \times (60 - 10) = 2.1\text{mm}$$

Hudevad Britain, 130-132 Terrace Road, Walton-on-Thames, Surrey KT12 2EA. Tel. Walton-on-Thames (01932) 247835 Fax: Walton-on-Thames (01932) 247694

P5 and Symphony radiators can be mounted horizontally on wall or floor. They can both also be mounted vertically.

Wall mounting, horizontal

All radiators are supplied with the necessary mounting brackets, spacers, fixing bolts and wall plugs.

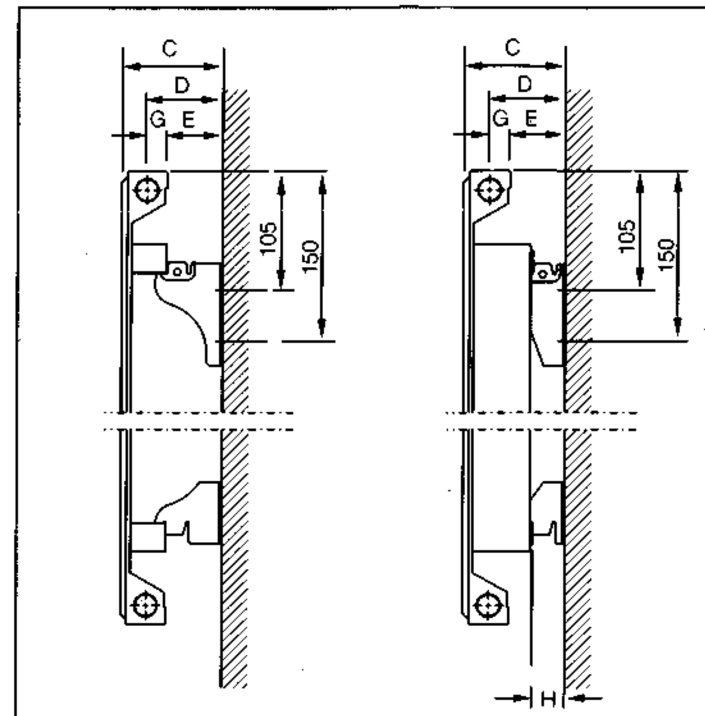
The radiator is hung from its upper mounting strap, supported by the wall bracket. The lower strap carries the spacer. These straps are 'goal posts' on the P5, flat rails on the Symphony.

The fixing slot in the bracket allows adjustment for height. This is shown at right together with outreach, clearance and tapping centre - keyed to the table below.

Type	C	D	E	G	H
Symphony	68/88	46/66	28/48	18	10-30
P5	68/88	46/66	28/48	18	-

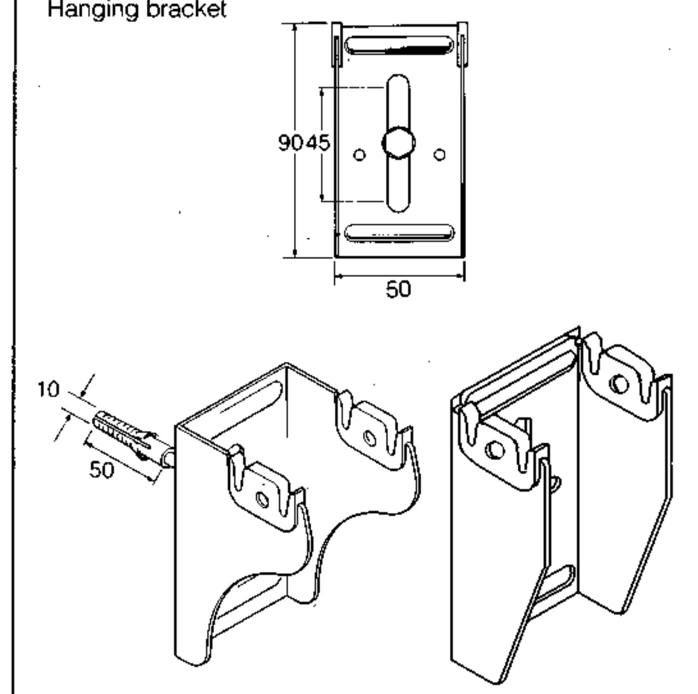
Mounting brackets have nylon inserts at bearing points to cope with linear expansion and contraction of the radiator.

Spacers (see bottom right) are seldom fixed, and therefore not normally supplied with bolts and wall plugs. Fig 1 shows conventional usage. Figs 2 and 3 show procedure for tamperproof fixing. It is also possible to bolt the spacer with some of the slot proud of the rail, so the radiator can be lifted clear of its top brackets and then disengaged from the spacer.



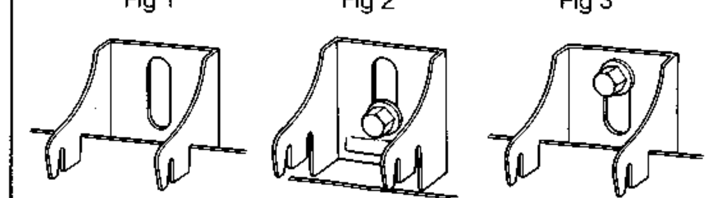
P5 Symphony

Hanging bracket



P5 Symphony

Fig 1 Fig 2 Fig 3



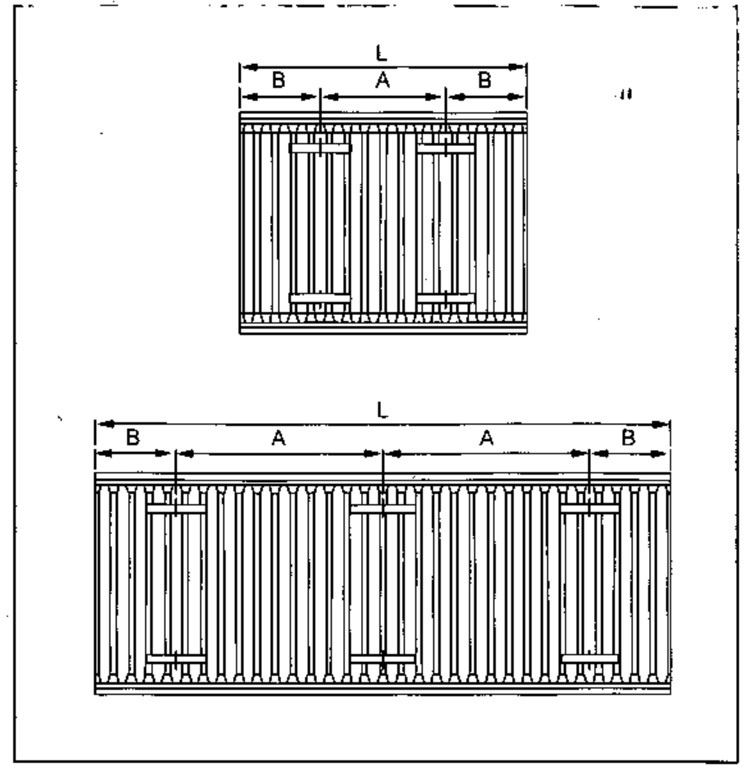
Spacer

Hudevad Britain, 130-132 Terrace Road, Walton-on-Thames, Surrey KT12 2EA. Tel: Walton-on-Thames (01932) 247835 Fax: Walton-on-Thames (01932) 247694

P5 radiators

The number of brackets required and their fixing positions depend on the length of the radiator. This is shown at right and keyed to the following table.

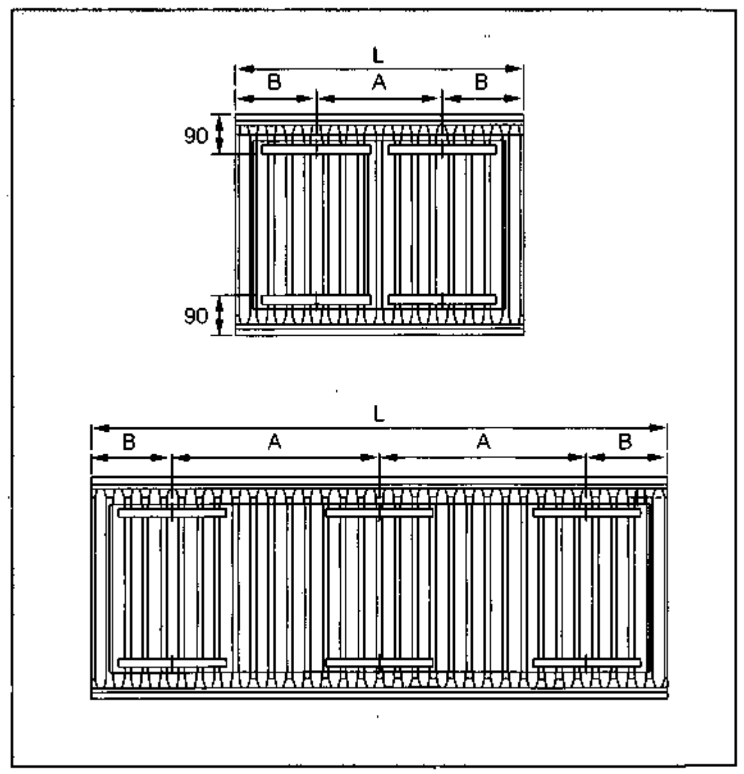
No of sections	Length mm	Bracket/ spacer sets	A mm	B mm
6-11	240 - 440	2	N/A	L / 2
12-45	480 - 1800	2	L-320	160
46-90	1840 - 3600	3	L-320/2	160
91-131	3640 - 5240	4	L-320/3	160
132-150	5280 - 6000	5	L-320/4	160



Symphony radiators

The number of brackets required and their fixing positions depend on the length of the radiator. This is shown at right and keyed to the following table.

No of sections	Length mm	Bracket/ spacer sets	A mm	B mm
10-45	400 - 1800	2	L-360	180
46-90	1840 - 3600	3	L-360/2	180
91-131	3640 - 5240	4	L-360/3	180
132-150	5280 - 6000	5	L-360/4	180



Floor mounting

There are various floor-mounting options:

- Fixed, adjustable and demountable feet in heights of 80 - 350mm
- Waterway feet containing flow and return services - see Section 4/8.

The waterway foot is intended for areas with raised access flooring.

Wall mounting, vertical

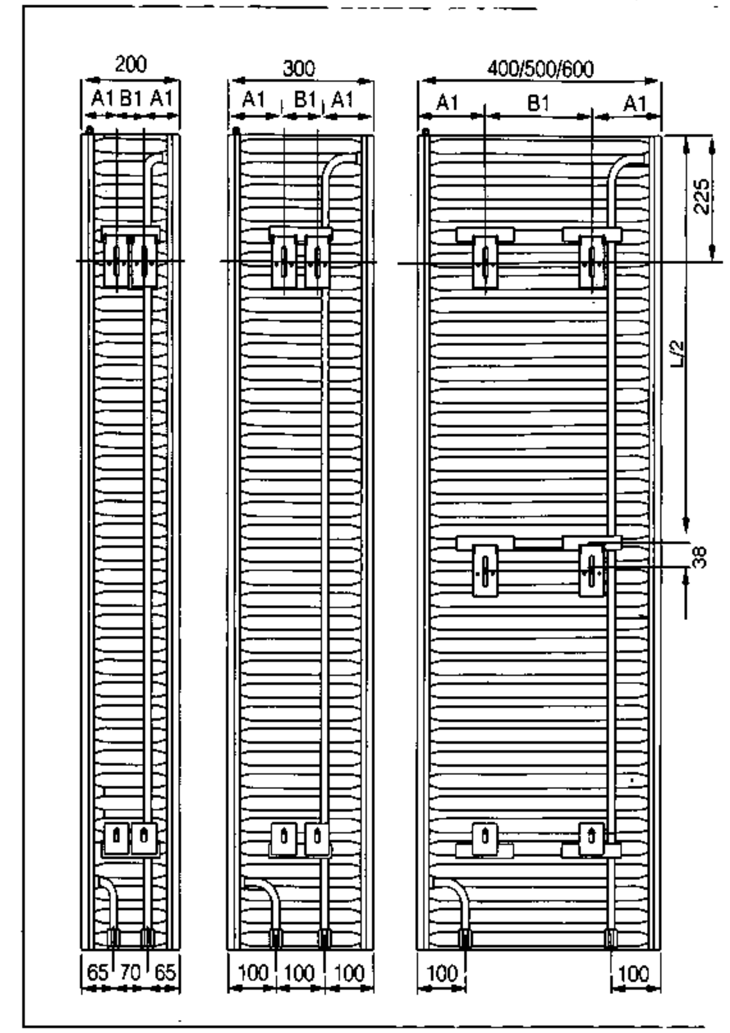
P5 radiators

P5 radiators up to 4800mm long can be mounted vertically if specified. The mounting straps are turned through 90°. Their number and position depend on radiator height and length (which become width and height in the new format). In addition to top and bottom straps there will be intermediate straps where length (height) exceeds 2000mm. This is shown at right and is keyed to the table below.

Radiator height (width) mm	A1 mm	B1 mm
200	71	58
300	115	70
400	140	120
500	140	220
600	140	320

Vertical mounting may reduce heat output, depending on tapping positions, approximately as follows:

TT	Top Top	NIL
TBOS	Top/Bottom Opposite Sides	NIL
TBSS	Top/Bottom Same Side	14%
BOS	Bottom Opposite Sides	8%
BU	Bottom Underneath	NIL

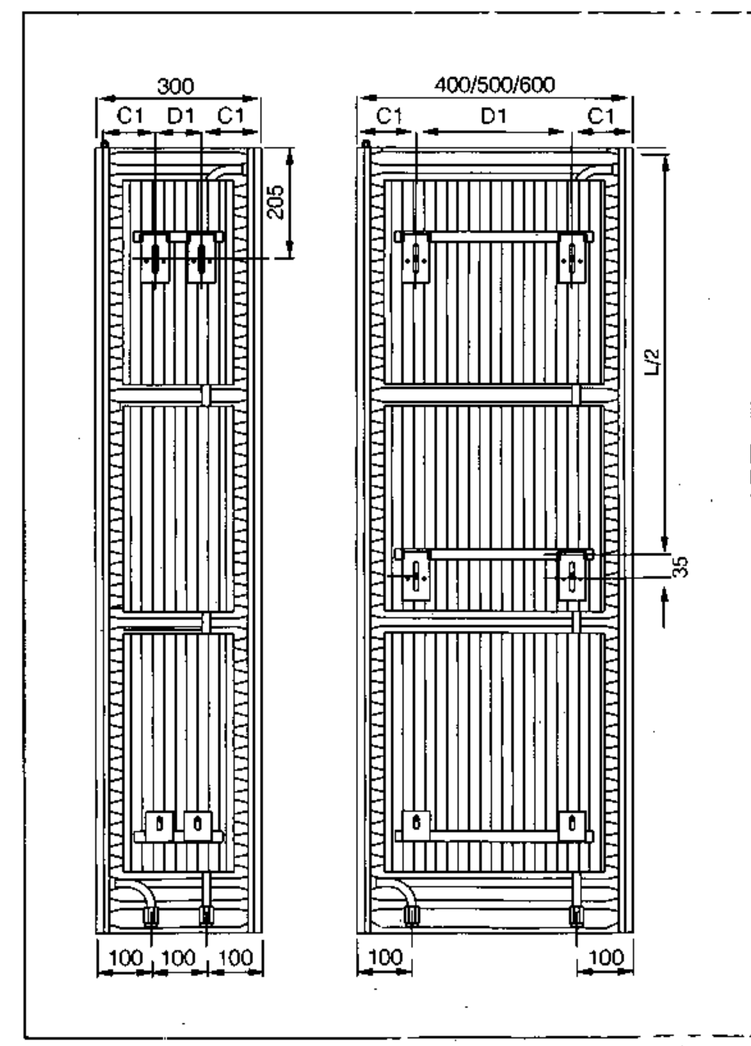


Symphony radiators

Vertical Symphony radiators are available up to 4800mm high (120 sections) and have vertically aligned convector fins at rear.

The number and position of mounting rails depend on radiator width and height. In addition intermediate mounting straps are fitted where the height exceeds 2000mm (50 sections).

Radiator height (width) mm	C1 mm	D1 mm
300	108	84
400	118	164
500	108	284
600	118	364



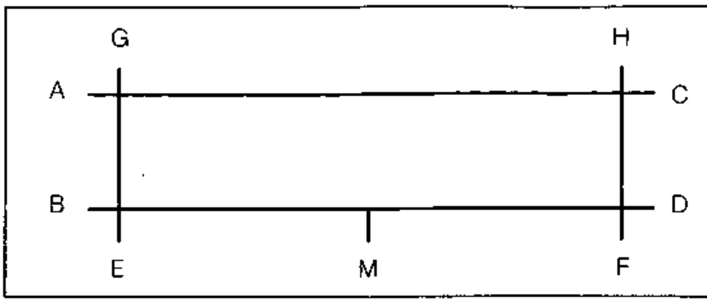
Fifteen tapping positions are available on P5 and Symphony radiators. Tappings can be supplied in 1/8, 3/8, 1/2 and 3/4 inch BSP sizes. Internal tappings are provided at A, B, C and D. Other tappings project approximately 8mm.

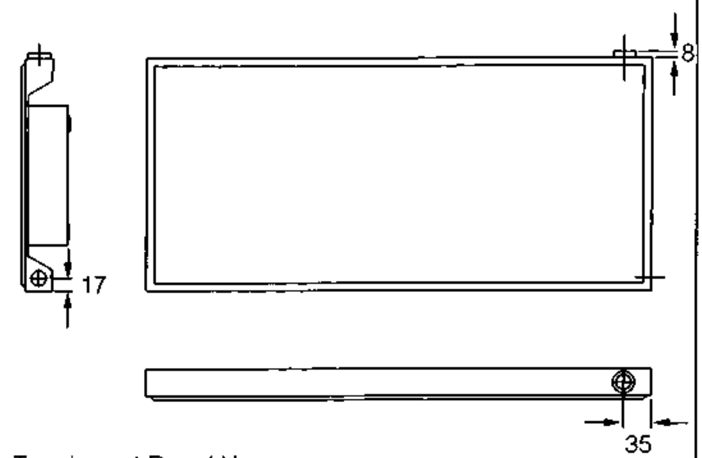
- The 3/4 inch tapping is only available at positions A, B, C or D, and in the form of an external tapping boss.
- Air vent. The radiator is supplied with 1/8 inch tapping at position A or C unless otherwise specified.

Examples of the nine standard tappings are shown at right.

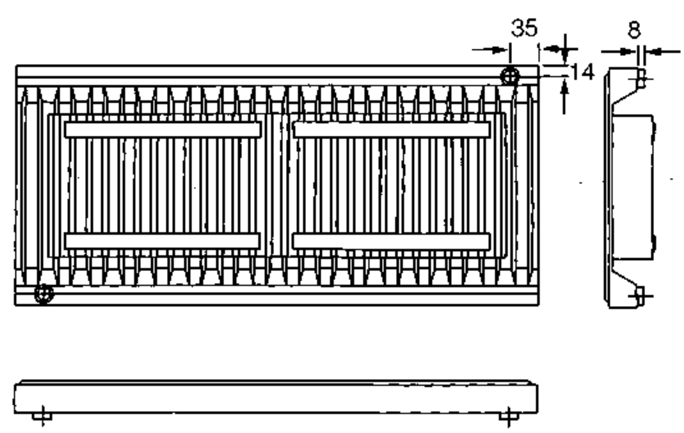
- P5 and Symphony radiators are suitable for single or two pipe systems.
- P5 and Symphony radiators over 2480mm (62 sections) length and with same end tappings are fitted with an internal tube to achieve full radiator performance.

Six special tappings can be supplied. These include rear tappings at each corner. Same end bottom connections are possible with the addition of tapping positions 80mm in from E and F (known as 2E and 2F). Flow should be at the outer position.

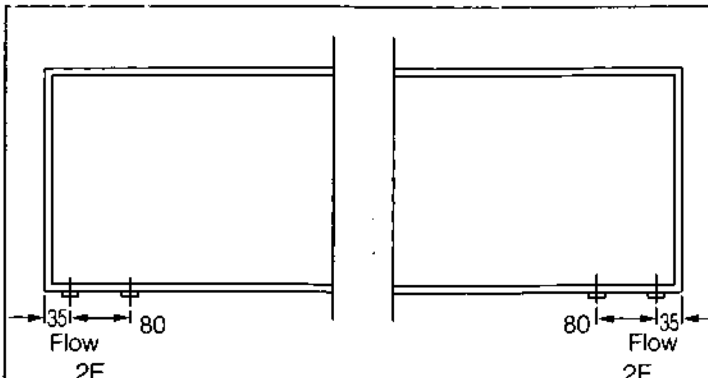




Tappings at D and H



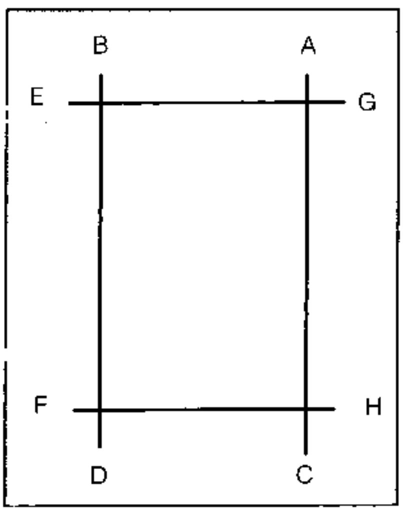
Tappings at A rear and D rear



Tappings 2E and 2F

Vertically mounted

When the P5 or Symphony radiator is mounted vertically the standard tapping positions are as shown below.



Where both connections are at the top or at the bottom of the unit, performance is maintained by means of a factory fitted tube. Where required an additional tapping can be provided for a drain connection.

When ordering please specify the flow tapping; its position will be factory-stamped with a 'T.'

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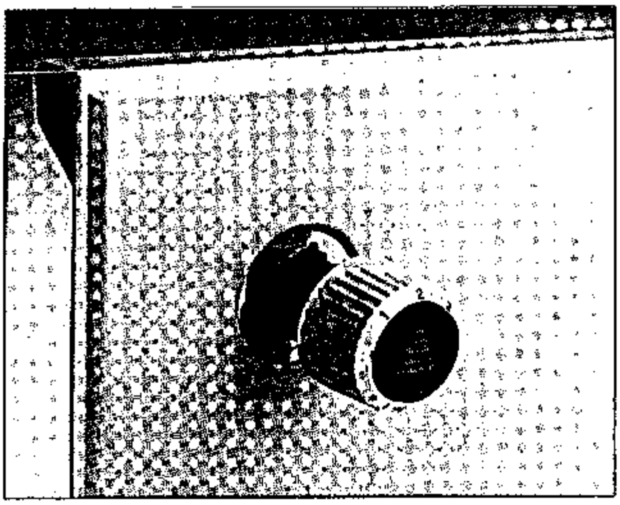
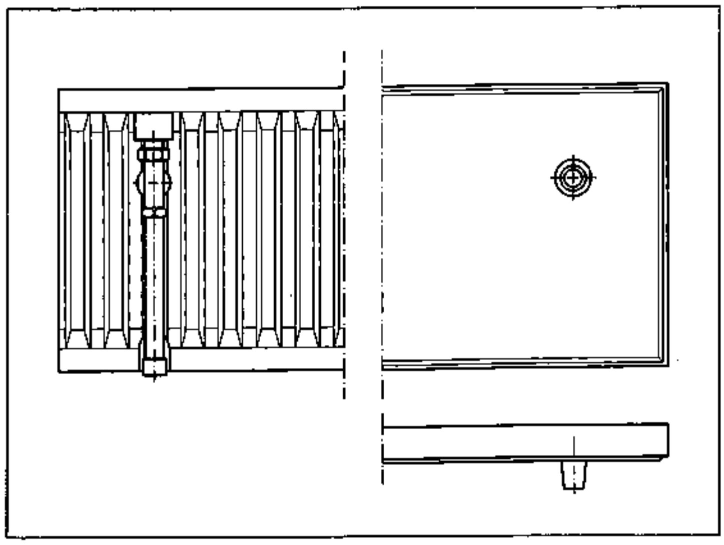
P5 and Symphony radiators are available with integral control valves. Standard solutions include forward- and side- facing Danfoss RA 2000 type thermostats, incorporating a Kv limiting device for pre-setting the maximum water flow.





The following information must be specified with order.

Type of valve

Manual or thermostatic.

Hole diameter

The hole through which the head of the regulator passes is 48mm diameter as standard; or 58mm.

Position of valve

This will normally be at top right or top left as shown in the illustrations.

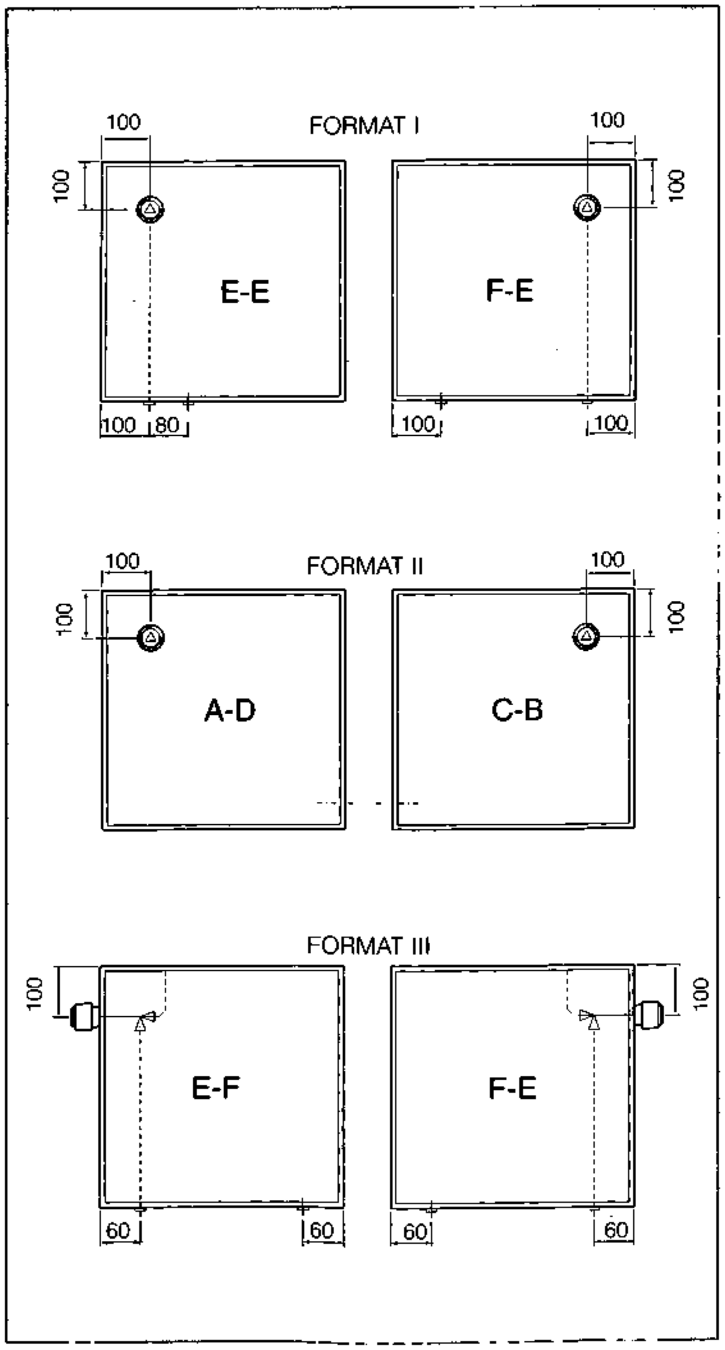
Tapping positions

Examples are given.

If same end tappings are chosen (AE or CF) radiator length should be limited to 2500mm.

Notes

- Built-in valves do not isolate the radiator for removal.
- For additional information or alternative solutions, please contact our Technical Department.



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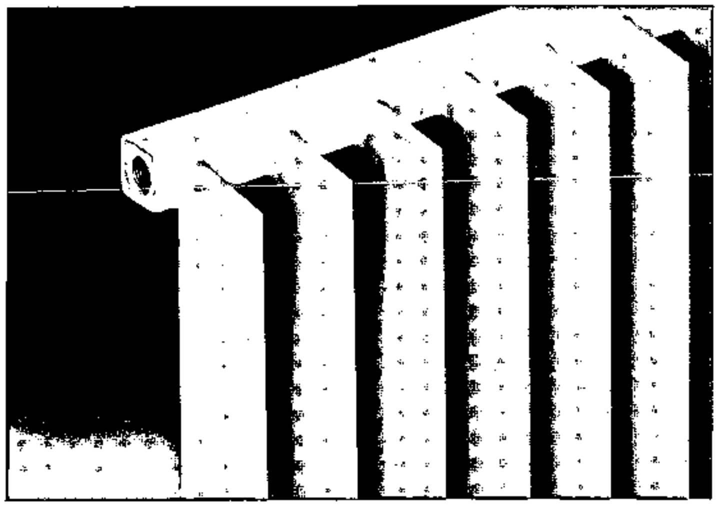
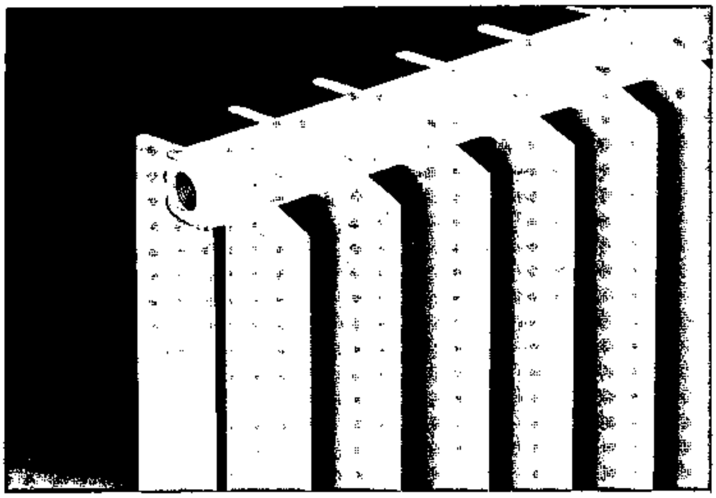
Hudevad S-Series emitters are column radiators of sectional design. Hot water runs through vertical elements and along square tube headers at top and bottom, giving radiant and convected heating.





Six types

The single radiator has heating elements on one side of the headers only.

The double radiator has matching elements on both sides of the headers.

All radiators are available in a choice of three element spacings: 40mm, 60mm or 80mm centre to centre.

- Element spacing at 120mm is available to special order. Full details are not included in this catalogue.

Applications

S-Series radiators are typically used in bath-rooms or stairwells where high output is required from a small 'foot print', in front of glazed walls for 'see-through' or security, as room dividers or as ballustrades, and in situations where frequent/thorough cleaning is vital.

Size range

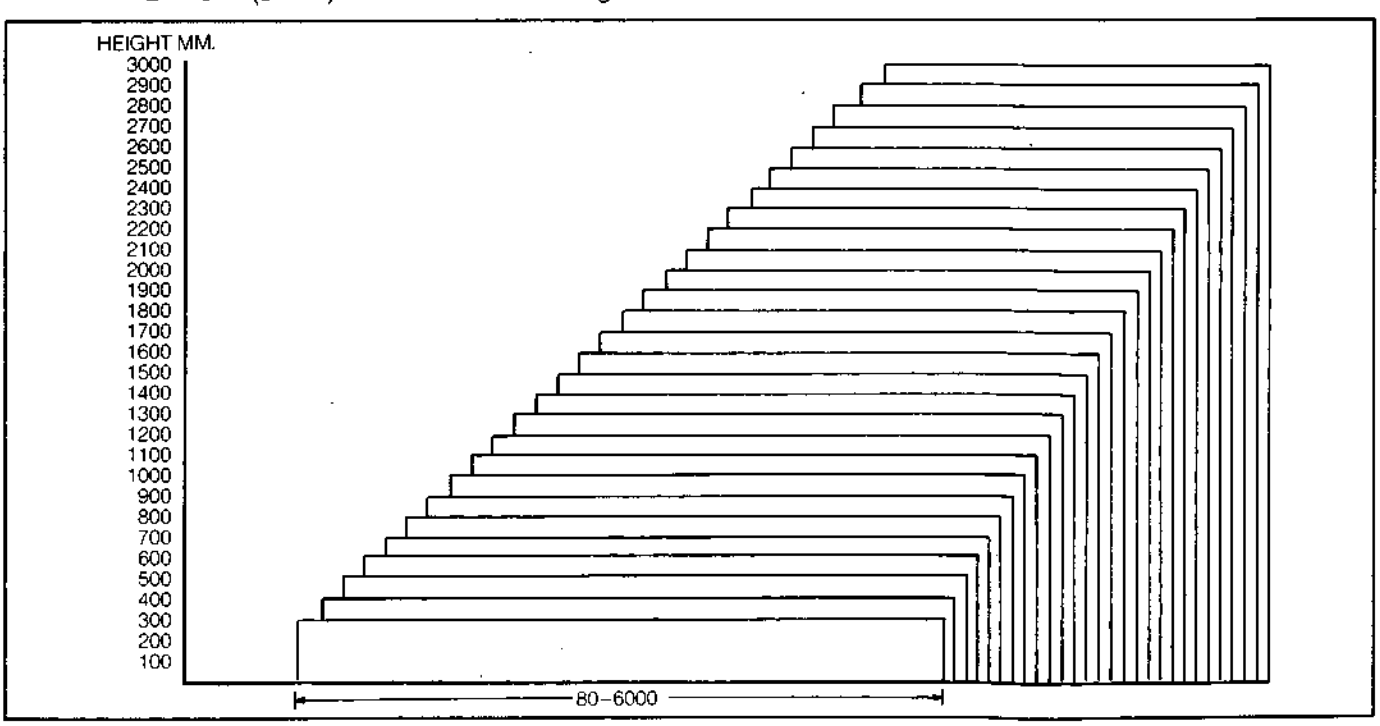
All S-Series radiators are available in heights of 300 – 3000 mm in increments of 100mm.

- Increments of 50mm to special order only.
- Heights up to 6000mm to special order only.

Width of single radiators is 98mm; that of double radiators is 160mm.

All radiators are available in lengths of up to 6000mm unless height and length both exceed 2200 mm and subject to maximum weight of 250kg.
Calculated length is the total Spacing between Elements plus header projections of 20mm at each end. Hence:

$L = S \times (E - 1) + 40.$ Minimum length is 2 elements.



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Construction

The square tube headers are fabricated from normalised 2.5mm steel and are of 35mm x 35mm section.

The vertical elements are fabricated from cold rolled 1.9mm steel, electro-welded to form a flat tube of 70mm width and 11mm depth. Exposed edges are smoothed and rounded. Connections to the headers are brazed.

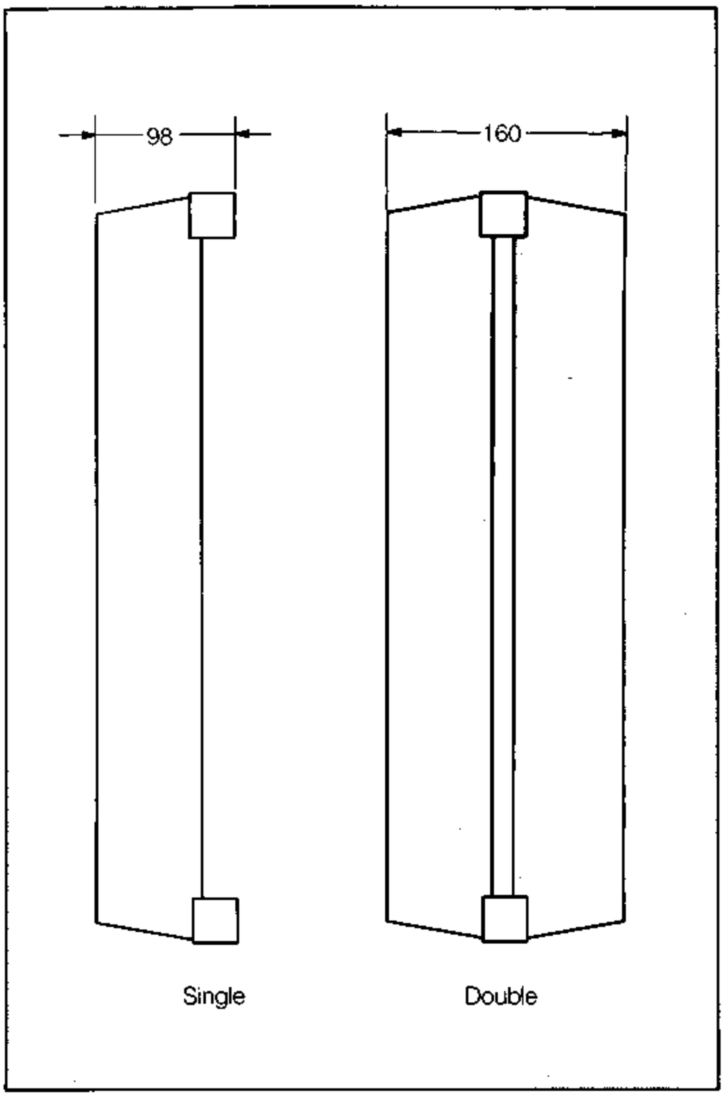
For radiators exceeding 2100mm height one or more horizontal bracing straps are welded to the back of the heating elements to prevent resonance and assist handling. The strap is 3mm steel plate, 16mm wide, for single elements; 16mm square tube for double elements.

Weight

Approximately 15kg per m^2 of heating surface. Maximum radiator weight is 250kg.

Test pressure

Standard test pressure is 10 bar. Maximum operating pressure of 7.7 bar.



18

CALORIFIER PERFORMANCE TESTING

When a calorifier has been in service for several months the user may wish to check that efficiency is being maintained.

A Simple Test

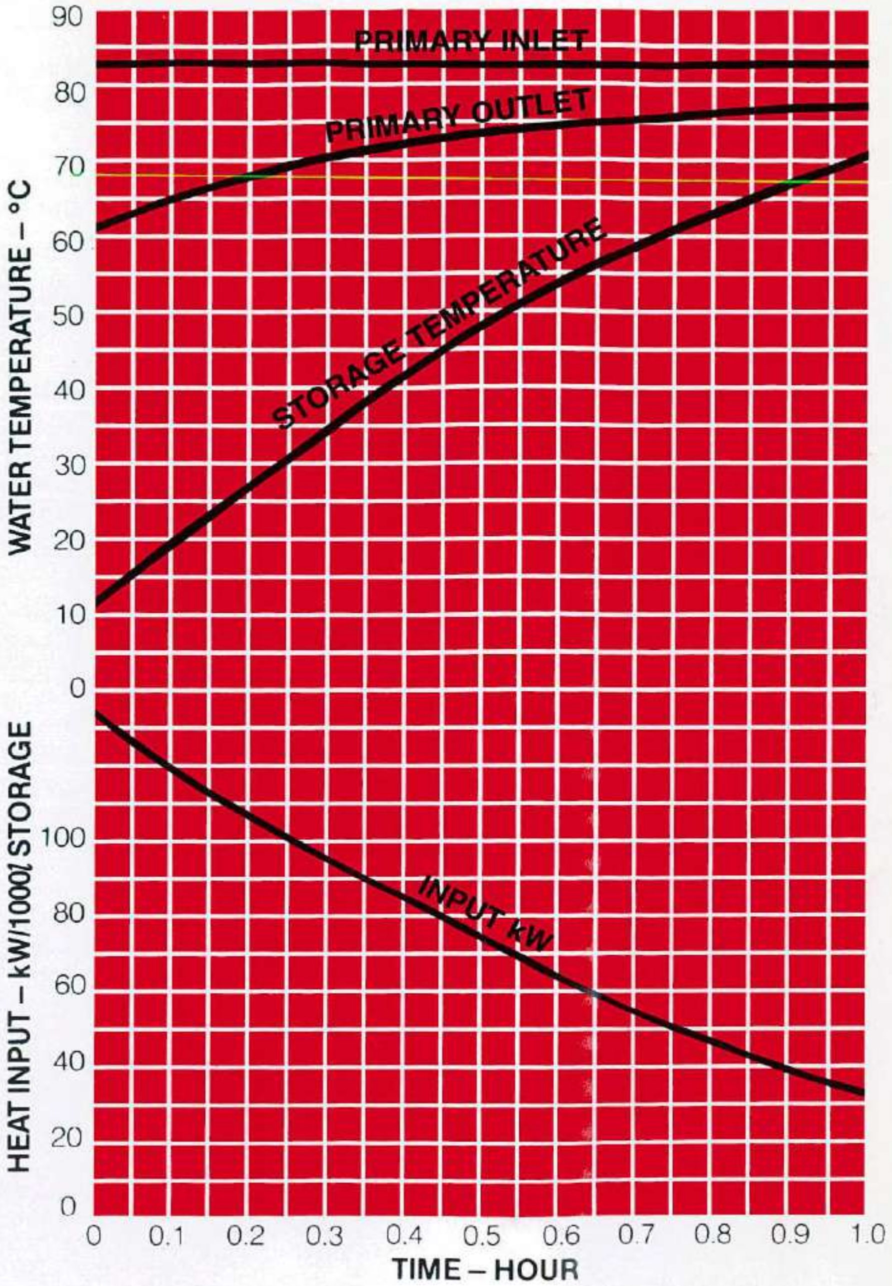
The output of a storage calorifier is normally defined by the time taken to heat the contents from cold feed temperature to storage temperature. The performance can therefore readily be checked by isolating the secondary flow and return and recording the time taken to reach storage temperature from cold.
For this to be a reliable test it is necessary to see the primary flow temperature does not fall below the specified figure. Where possible the primary circulating rate should be checked against the calculated figure using a flow balancing valve or other measuring device.

The Heat Up Cycle

As can be seen from the curves opposite the primary temperature drop and the calorifier output both vary throughout the cycle. They are greatest when the cylinder is cold and least when the storage temperature is reached. This change in output from the calorifier is reflected in the temperature rise of the secondary water, which is steep at low temperatures and flattens out as the storage temperature approaches the primary temperature.

A Quick Estimate

It is clear from these curves that any estimate of the calorifier's output based on the primary figures would be misleading. When primary inlet and outlet temperatures are specified the outlet temperature is only an average figure to enable the primary circulation rate to be calculated.
It would also be inaccurate to estimate the heat up time by recording part of the cycle and projecting the time scale in a linear manner. However the logarithmic curve for secondary rise printed with this leaflet can be a useful guide to the heat up time, using the appropriate portion of the graph for the temperature rise recorded. Remember no draw-off or secondary recirculation can be allowed whilst these measurements are being taken.



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- Calorifiers
- Heat exchangers
- Plate and frame heat exchangers
- High output semi-storage calorifiers
- Un-vented hot water packages
- Expansion vessels
- Skid mounted packaged units
- Pressure booster sets

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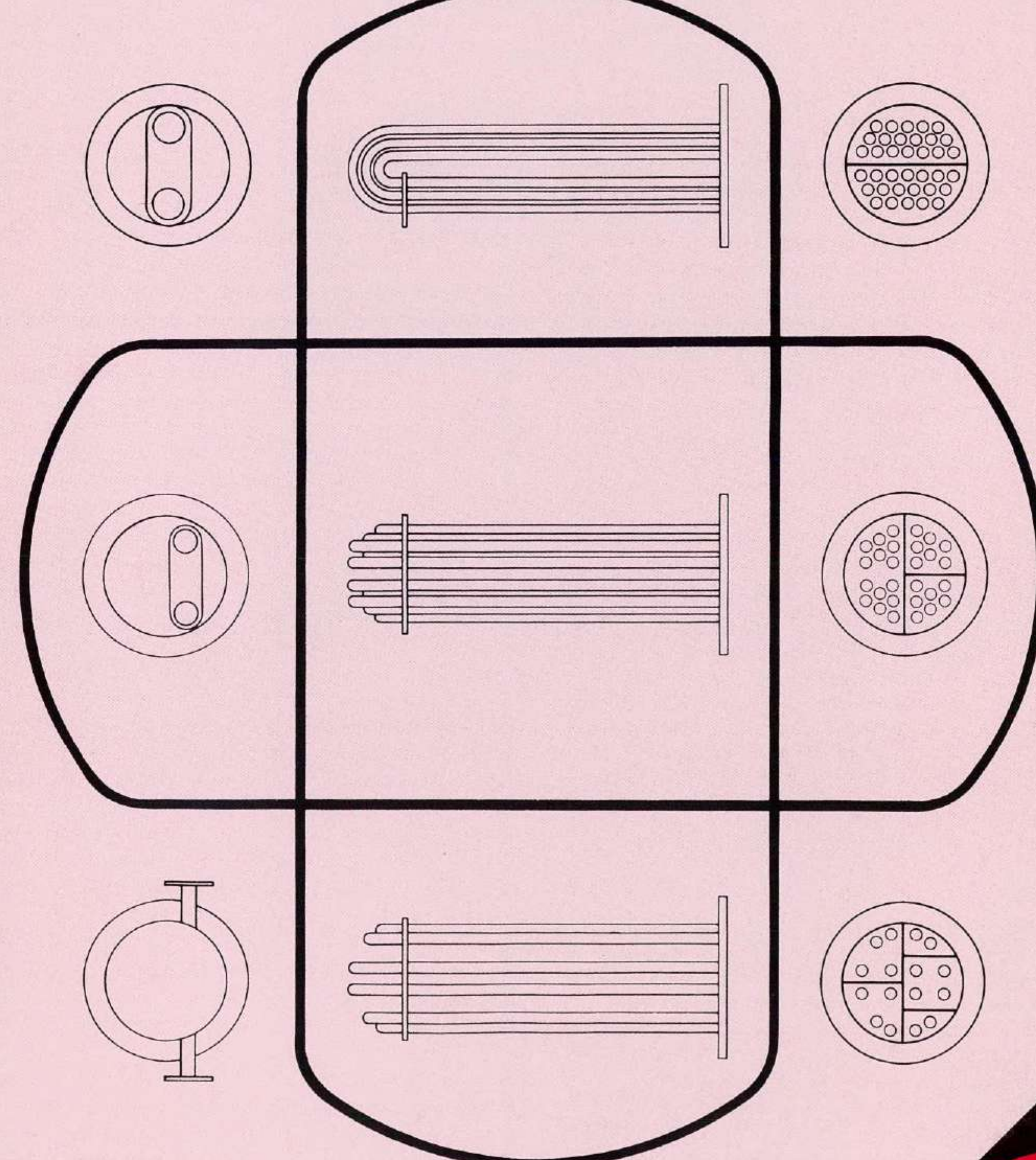
STORAGE CALORIFIERS



RYCO

STORAGE CALORIFIERS

Introduction

Rycroft storage calorifiers are water heaters fitted with U-tube batteries capable of high working pressures and designed mainly for industrial and commercial use. The battery is a very compact design allowing great flexibility in the number of tubes fitted. The arrangement is suitable for a wide variety of primary heating sources and extremely large volumes of water can be heated.

Low Pressure Hot Water

The use of primary hot water at 82°C is the most common heating medium for calorifiers because of the low operating pressure of the boiler and the simplicity of control. With the primary temperature below boiling point the system is inherently safe and easy to maintain.
In order to minimise the size of battery it is normally constructed from small bore tube and requires pumped primary circulation. The primary flow is usually based on a temperature drop of 11°C (from 82 to 71°C) and the pressure drop in the tubes rarely exceeds 1m. The pressure drop is clearly stated on all Rycroft quotations.

Medium & High Pressure Hot Water

When primary hot water reaches 100°C it is no longer classed as low pressure hot water, and above 120°C it is termed high pressure hot water. The reason for the higher pressure is that the primary system must be maintained well above the boiling point of the water to prevent it flashing into steam.
Although the boiler plant may be more sophisticated the calorifier design is only marginally affected. If the primary hot water comes from a district heating supply there may be a temperature limiting valve on the primary return. This valve should be fitted close to the calorifier if it is to sense a drop in temperature across the battery when the primary flow has been stopped.
With high pressure hot water it is advisable to use flanges instead of screwed fittings for primary connections. If the design pressure of the calorifier shell is less than the primary pressure it is recommended that a bursting disc is fitted to the shell.
The primary temperature drop is in the order of 20°C for medium temperature hot water systems and 50°C for high temperature systems. The quantity of water circulating is therefore less than an equivalent low pressure hot water system and the number of passes through the U-tube battery may need to be increased. This will raise the pressure drop slightly but is done to maintain a good heat transfer rate.

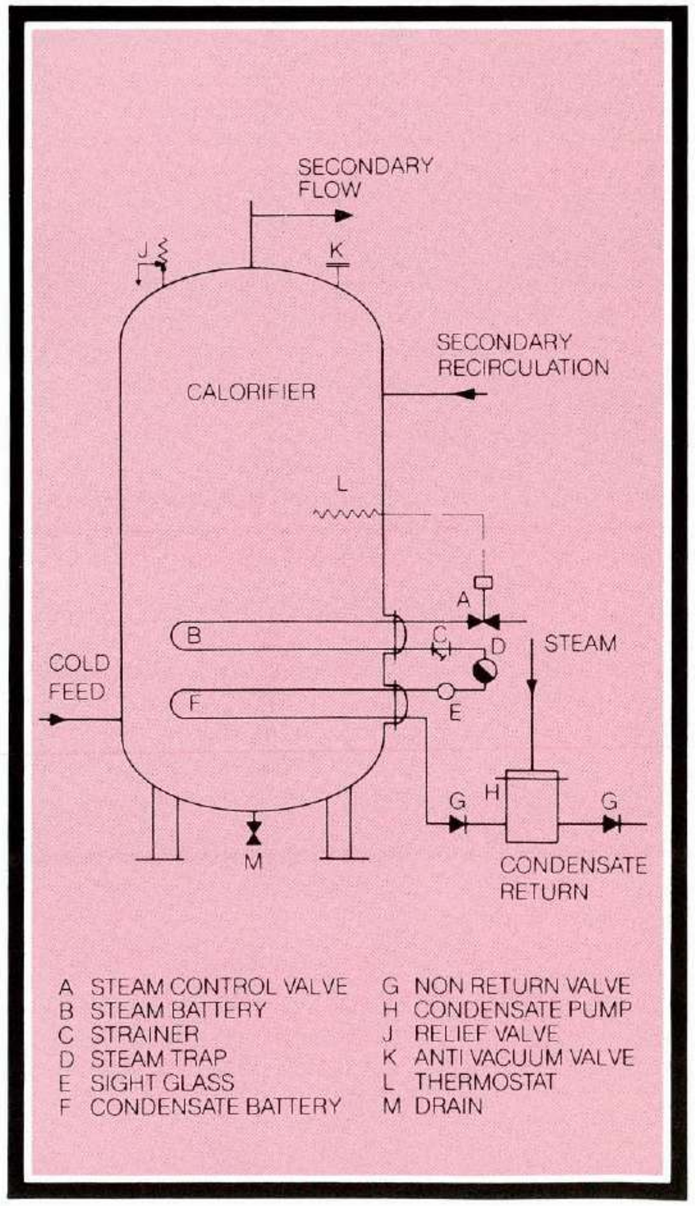
Steam

The difference in temperature between steam and stored water makes it an ideal heating medium and calorifiers can be readily designed for a wide range of steam pressures. Naturally the higher the steam pressure the shorter the heat up period for the water, but most users prefer to have their calorifiers operating with steam below 10 bar. Superheat can be readily accommodated but the degree of superheat should always be quoted in case higher grade materials have to be used.
With low pressure steam it must be remembered that fluctuations in demand can produce a complete loss of pressure within the heater battery. This may be the result of the control valve just cracking open or the effect of a severe overload with an undersized valve. High back pressures in the condensate line should therefore be avoided and consideration given to the need for a condensate return pump.

Condensate

Considerable energy remains in the condensate from a high pressure steam plant and a saving in the order of 10% can be made if the heat is extracted from the condensate before it is returned to the boiler hotwell. In the case of a steam heated calorifier this can be achieved by adding a condensate battery which is connected in series with the steam battery. A steam trap is located between the two batteries as shown in Fig.1 A condensate pump is used to return the cooled condensate to the boiler plant unless a gravity run is possible.
Where the condensate from other equipment is available this may be added to the calorifier condensate as a further energy saver. If there is sufficient surplus condensate the steam heater may be unnecessary and the calorifier can operate entirely on waste heat.

Fig.1 Steam Calorifier with condensate battery.



Standards

Rycroft have developed a Commercial Standard for calorifiers based upon many years of experience and personal success. The designs are economical without detriment to performance or reliability and reflect techniques and knowledge specific to the Company. When an International Standard is demanded for public or prestige reasons the preferred standard is BS 853/1981. Rycroft are fully qualified to meet all the requirements of this code and will undertake special contracts with full certification. Other standard including ASME Section 8 will be considered.
Normally materials used for calorifiers are selected from BS 853 and conform to the following specifications.

Shell	copper	BS 2870 / C106
	steel	BS 1501 / 151
	galvanising	BS 729
	zinc spray	BS 2569
Tubes	copper	BS 2871 / C106
Tubeplate	brass	BS 2875 CZ 123 / CZ 112
	steel	BS1501 / 151
Chest	cast iron	BS 1452 / 220
	steel	BS 1501 / 151
Screwed fittings	brass	BS1400 / SCB6
	steel	BS 1502 / 151
Flanges	gun metal	BS 1400 / LG 2
	steel	BS1503 / 161
		BS1501 / 151

All calorifiers are fitted with connections for cold feed, secondary flow and return, primary flow and return, drain, thermometer, thermostat, pressure gauge and safety valve. Additional connections will be supplied on request for a high limit thermostat, vent and bursting disc. An anti-vacuum valve is ALWAYS fitted to copper lined steel calorifiers. The provision of a manhole is an optional extra.

Maximum Working Pressure

When specifying a maximum working head or pressure this is assumed to be the highest pressure that can be reached in the cylinder under any condition. This is the pressure used as the design pressure when calculating the shell thickness.
Allowance should therefore be made for any rise over and above the static head in the cylinder caused by circulating pressure from a pump. Alternatively, if a relief valve is fitted this is assumed to limit the maximum working pressure in the cylinder and is taken as the design pressure.

Typical Order or Enquiry Specification

Type

2000 litre horizontal copper storage calorifier type CF2000 complete with loose cradles lead lined.

Duty

To raise 2000 litre from 10 to 65°C in 1 hour using saturated steam at 4 bar after the control valve.

Design Pressures

The maximum working pressure in the shell 2.7 bar and design the primary side for a maximum working pressure of 7 bar.

Connections

Cold feed, secondary flow and return to be flanged BS 4504. Remaining shell connections to be screwed female for drain, thermometer, pressure gauge, safety valve and thermostat as shown on attached sketch. Steam and condensate connections to be screwed female.

Extras

Cylinder to be fitted with 455mm manhole and 'M' type lagging.

Standards

Design to Ryco commercial standard with copper finned tubes. Supply hydraulic test certificates but no independent inspection. Drawings to be forwarded for approval before manufacture commences.

Check List

When preparing an enquiry or order for a calorifier the following check list will help to ensure all relevant data is received for a prompt service.

- Storage capacity
- Vertical or horizontal cylinder
- Shell material
- Any critical dimensions – height or length
- Storage temperature
- Cold feed temperature
- Time to heat contents or hourly draw off rate
- Primary hot water or thermal oil inlet and outlet temperature
- Steam pressure after the control valve
- Maximum pressure of primary system
- Maximum pressure on secondary side including any additional pump head on the cylinder.
- Alternatively the design pressure at which any safety valve will be set.
- Size, type and position of any critical connections
- Details of connections for mountings and whether mountings or controls are to be supplied with the calorifier
- Requirements for a manhole
- Supply of loose cradles for horizontal cylinder
- Design to Ryco standard or other standard
- Use of finned or plain tubes
- Requirements for test certificates or independent inspection at Ryco Works
- Details of water if aggressive, brackish or impure and need for anode
- Supply of insulation and type of lagging
- Any additional heating capacity to allow for recirculation losses in secondary pipework.

ACCESSORIES

Control Valve

A thermostatic valve to control the primary supply to the heater battery is essential in most cases. This is particularly so for steam or high temperature hot water which could seriously overheat the stored water if not properly controlled. Waste heat recovery batteries using low temperature hot water to preheat the cold feed may not require regulation.

The thermostat is located in the side of the cylinder and will open the control valve when the cold water reaches the level of the thermostat pocket. The valve is then required to remain fully open until the water has reached the set temperature. The control of a storage calorifier is therefore not normally required to modulate and a simple but reliable direct acting thermostatic valve is sufficient. The valve should be adequately sized to avoid undue pressure drop when handling the primary flow rates for the hourly duty. For steam heated calorifiers it is advisable to select a valve with a pressure drop in the order of 10%. This will make allowance for the extra flow of steam demanded by the calorifier when the valve initially opens to heat the cold water.

With a primary hot water system the control valve may have two or three ports. By careful selection a 3-way valve can offer practically the same resistance whether it is passing water through the calorifier battery or on bypass. It is therefore ideal for carefully balanced primary systems. The 2-way valve is satisfactory for most circuits where the flow to the calorifier is only a small proportion of the system demand.

Where possible a single seat valve should be fitted in preference to a double seat valve. The tight shut off obtainable with a good single seat valve offers greater protection against overheating during periods of low demand.
Rycroft will be pleased to recommend and supply suitable control valves on request.

Safety Valve

When the calorifier is coupled to an open vent and the total length including horizontal sections does not exceed 25m a safety valve is not considered essential. However local regulations or mandatory pressure vessel codes may require such a valve. For secondary working pressures above 2.5 bar a safety valve should always be fitted.

If the primary working pressure is below the secondary design pressure a ¾" (20mm) safety valve is adequate. When the primary pressure exceeds the secondary design pressure the size of safety valve becomes a function of the primary conditions and the output rating of the heater battery.

The main purpose of a safety valve is to protect the calorifier shell from excessive pressure should the secondary water become overheated or even boil. It will not protect the cylinder from shock in the unlikely event of a tube failing under primary water pressure. For this reason some standards insist that a bursting disc is fitted as additional protection, when the primary hot water pressure is known to exceed the shell design pressure. This condition is not experienced with high pressure steam.

Anti-Vacuum Valve

Copper lined calorifiers must be protected against partial vacuum in the cylinder and all "Rycolyna" cylinders are fitted with an Anti-Vacuum valve as standard equipment. This should not be removed except for periodic inspection. Light gauge copper calorifiers also risk damage if the pressure in cylinder falls below atmospheric pressure, since they can only withstand internal pressure and not external pressure.
A partial vacuum may be caused by improper drain down procedures, excessive draw off at low level or an inadequate venting system. Water hammer or a sudden release of pressure can also induce negative pressure.

High Limit Thermostat

There is a risk that at some time in the calorifier's life the control valve or thermostat may fail to operate correctly. This could result in very high storage temperatures, particularly when the primary medium is steam or high temperature hot water.
It is therefore a wise precaution to fit a high limit thermostat connected to an independent isolating valve. Alternatively a high temperature switch connected to an alarm system would attract the attention of operating personnel.

Insulation

Many orders are received for Rycroft calorifiers to be lagged before despatch with 'M' type insulation. This consists of a glass wool mattress protected with a galvanised steel case and finished with one coat of gloss paint. An alternative cheaper form of insulation using urethane granules encased in galvanised steel is now available. It is known as 'G' type lagging. Both forms of insulation are 50mm thick unless otherwise specified.

The benefit of prelagged calorifiers is the reduction in site costs and the superior finish possible under factory conditions.

However there is a limit to the size of calorifier which can be transported in the lagged condition without damage to the exterior casing. Cylinders over 7,000 litres should be insulated on site.

Access

The heater tubes can be inspected by withdrawing the battery from the shell. This also provides an opening for limited examination of the shell internals. Alternatively access can be arranged by the addition of a manhole in the side of the shell. The manhole is usually positioned near the battery so that the tubes can be examined without disturbing the chest or pipework.

Enquiries or orders should state if a manhole is required and its position should be checked for site access. Plant layout should also be checked for battery withdrawal. It is advisable to allow for a full length battery unless the length has been confirmed.

Heat Transfer Oil

One other liquid heating source is heat transfer oil which has the benefit of a very high temperature and a low operating pressure. All primary connections should be flanged and oil resistant joints are required. Certain thermal oils deteriorate in the presence of copper so that stainless steel or cupro-nickel tubes may be necessary for the calorifier battery. Multi-pass batteries are generally essential for optimum heater output with thermal oil.

Refrigerant

Storage calorifiers can now be offered with U-tube batteries or coil heaters using waste heat from refrigeration systems. Refrigerant is passed through the calorifier heater after it leaves the compressor and before it reaches the conventional condenser. A by-pass should be incorporated in the pipework so that the calorifier can be isolated or short circuited from the refrigerant if the need arises.

The direct transfer of heat from the refrigerant to the stored water uses the maximum temperature difference between the two fluids. It also avoids incidental losses associated with an intermediate heat exchanger.
The battery can be designed to remove superheat or liquify the refrigerant.

Waste Heat

Storage calorifiers are a useful means of recovering waste heat from a variety of liquids or vapours and Rycroft offer a special design service for this purpose, (see separate leaflet). Where the temperature or quantity of waste heat is insufficient for the desired output, supplementary heating can be incorporated into the cylinder to boost the storage temperature. The cylinder should be sized to absorb the maximum quantity of waste heat during the time it is available.

Immersion Heaters

Electric immersion heaters can be fitted to provide an alternative heating supply when the primary heating service is not available or to boost the output during peak loads. The size and position of electric heaters will depend on the duty requirements and these should be specified at an early stage so that suitable provision is made during the initial design (see Electric Calorifier leaflet).

Control panels are arranged for wall mounting or they can be fitted direct onto the cylinder and wired up to the heaters before despatch.

All electric immersion heaters are thoroughly dried out and tested before despatch. However they may be subject to damp or humid conditions before the plant is installed. Provision should therefore be made to retest and if necessary dry out the heaters on low voltage when they are commissioned. Normally once the plant is operational the hot water in the cylinder will prevent further ingress of moisture into the immersion heaters.

Secondary Circuit Recirculation

It is customary for domestic hot water to be circulated round the secondary pipework to maintain the temperature throughout the system. The secondary circulation should be quite small and the pump may be mounted close to the secondary return. A check valve is normally fitted to prevent reverse flow through the pump.

For a large distribution network the hot water may be intentionally drawn from the cylinder at both the secondary flow and secondary return connections. In this case the flow and return connections are the same size and the circulating pump is mounted in a by-pass loop as shown in Fig. 2

Secondary Vent

An atmospheric vent on a storage calorifier serves many purposes including

- Release of air when it is displaced from the heated water.
- Free movement of air when the cylinder is filled or drained down.
- Change in volume of stored water when it is heated or allowed to cool down.
- The safe release of steam should the water become overheated due to malfunction of the heater control system.

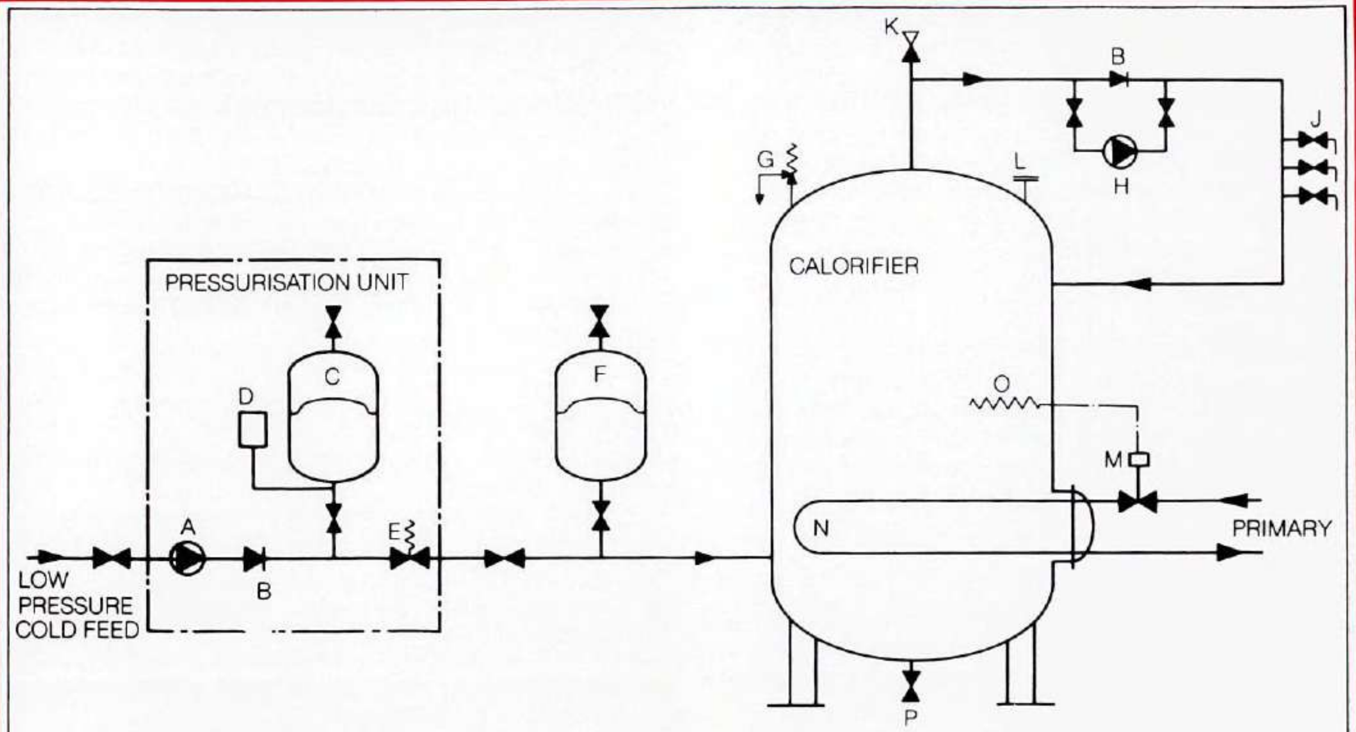
Ideally the vent pipe should extend vertically upwards from the cylinder but if horizontal displacement is necessary at some point an upward gradient should be maintained and the horizontal displacement kept as short as possible. No isolating valve or other device should be fitted in the vent pipe which can obstruct the free passage of air or water.

It is not always possible to use an open vent. For example the secondary system may be artificially pressurised for distribution of hot water and an atmospheric vent would be considerably higher than the building structure. An automatic air vent must then be fitted to release trapped air and an anti-vacuum valve or manual vent cock is required for draining down the cylinder.

When a hot water system is pressurised without an open vent it is essential that suitable equipment is fitted to accommodate the changes in water volume associated with temperature. The safety valve should not be considered sufficient protection for this purpose. A separate expansion vessel may be used with an internal diaphragm and pressure chamber as shown in Fig. 2. See Rycroft Expansion Vessel leaflet. Alternatively the top of the calorifier may be extended above the secondary outlet connection to form an air cushion. This arrangement is known as a BUBBLE-TOP CALORIFIER. Purpose built bubble-top calorifiers can be supplied by Rycroft to suit specified pressures and temperatures. A typical bubble-top arrangement is shown in Fig. 3

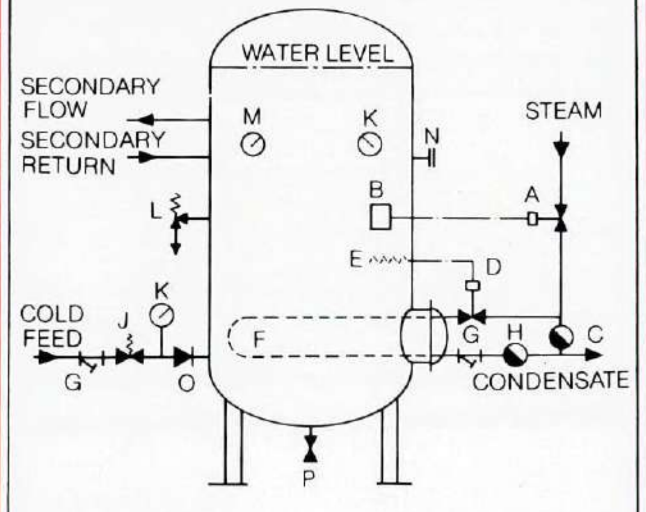
SECONDARY SYSTEMS

Fig.2 Pressurised Secondary system.



A PRESSURISATION PUMP
B NON RETURN VALVE
C PNEUMATIC PRESSURE VESSEL
D PRESSURE SWITCH
E PRESSURE REDUCING VALVE
F EXPANSION VESSEL
G RELIEF VALVE
H SECONDARY RECIRCULATION PUMP
J DRAW OFF POINTS
K AUTOMATIC AIR VENT
L ANTI VACUUM VALVE
M PRIMARY CONTROL VALVE
N HEATER BATTERY
O THERMOSTAT
P DRAIN

Fig.3 Bubble Top Calorifier



A SOLENOID VALVE
B PRESSURE STAT
C PIPELINE TRAP
D STEAM CONTROL VALVE
E THERMOSTAT
F HEATER BATTERY
G STRAINER
H STEAM TRAP
J PRESSURE REDUCING VALVE
K PRESSURE GAUGE
L RELIEF VALVE
M THERMOMETER
N ANTI VACUUM VALVE
O NON RETURN VALVE
P DRAIN

Storage Pattern

Unlike an indirect cylinder heater a calorifier U-tube battery is normally located entirely in the bottom of the cylinder. When the contents are heated from cold, water surrounding the tubes is continually displaced by convection currents and the temperature throughout the calorifier rises uniformly.

When hot water is drawn off the top and cold feed enters the bottom, the heater warms the cold layer at the bottom. It does this without raising the temperature of the hot water above. Consequently a storage calorifier will maintain a steady output temperature providing the storage volume and heater are correctly sized.

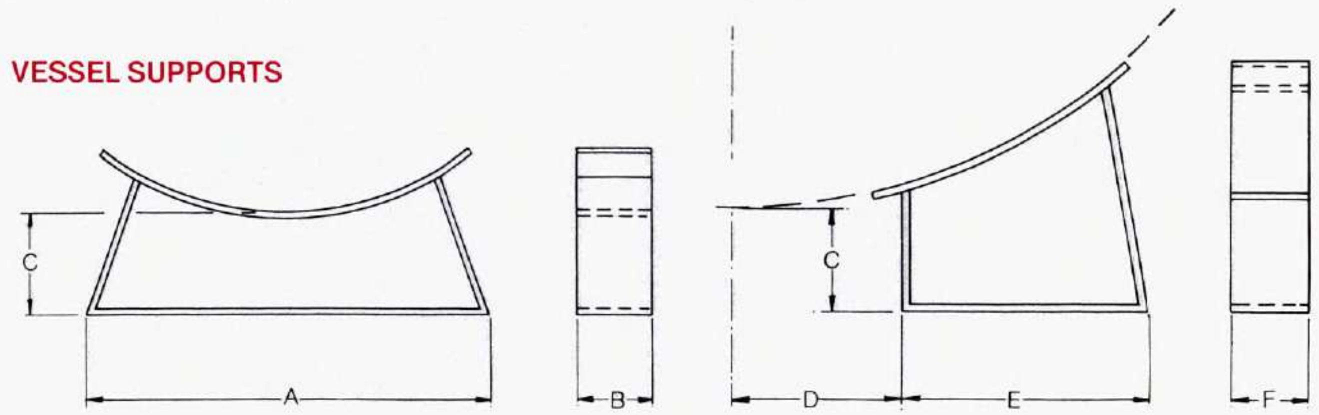
If the calorifier is overdrawn no further hot water will be available until the entire content is reheated. It is therefore important to establish the pattern of usage before specifying a calorifier output and size.

Notes
★Standard height 150mm.
Anti-Vacuum valve fitted as standard on all copper lined vessels.
Dimension 'D' is the minimum distance.
For size of secondary connections see Table 1 on page 7.
Weights are approximate and for guidance only.
Metric/Imperial equivalents are approximate.
Flanges to BS10 or BS4504.
Screwed connections to BS21.

Rycroft References for Storage Calorifiers

CE	**Copper vertical calorifier.**
CF	**Copper horizontal calorifier.**
ZE	**Steel vertical calorifier.**
ZF	**Steel horizontal calorifier.**
CZE	**Copperlined steel vertical calorifier.**
CZF	**Copperlined steel horizontal calorifier.**
SSE	**Stainless steel vertical calorifier.**
SSF	**Stainless steel horizontal calorifier.**

VESSEL SUPPORTS



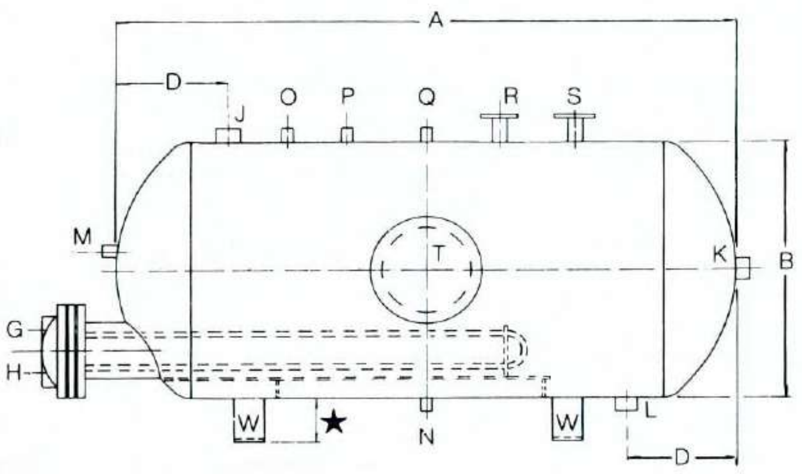
CRADLES   LEGS FOR COPPER VESSELS

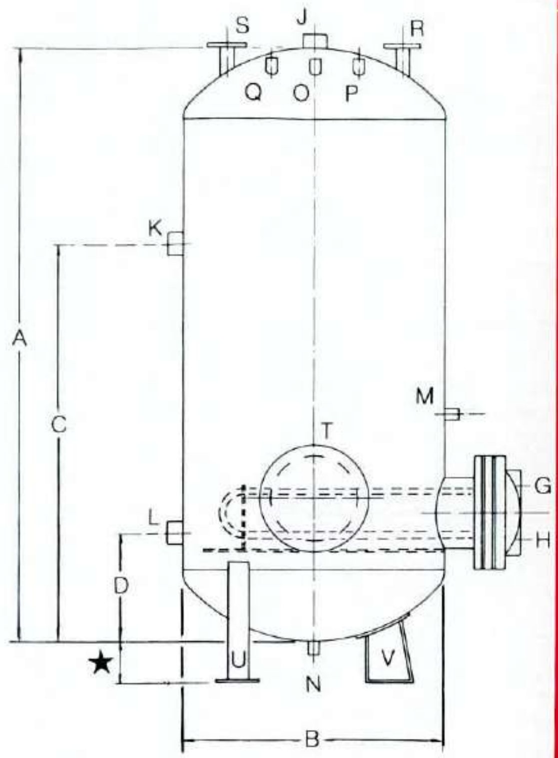
Shell Diameter		**DIMENSIONS mm**					
mm	ins	**A**	**B**	**C**	**D**	**E**	**F**
600	24	620	80	150	85	200	80
675	27	640	125	150	120	220	80
750	30	715	125	150	140	235	80
800	32	750	125	150	150	240	80
850	33	780	125	150	205	215	80
900	36	845	150	150	200	230	80
1050	42	980	150	150	230	280	80
1150	45	1050	150	150	305	250	100
1200	48	1120	150	150	330	250	100
1350	54	1250	150	150	410	250	100
1450	57	1300	150	150	285	445	150
1680	66	1500	150	150	380	445	150
1830	72	1750	150	150	460	445	150

DIMENSIONS & WEIGHTS

STANDARD CONNECTIONS
G PRIMARY FLOW OR STEAM
H PRIMARY RETURN OR CONDENSATE
J SECONDARY FLOW
K SECONDARY RETURN
L COLD FEED
M THERMOSTAT
N DRAIN
O THERMOMETER
P PRESSURE GAUGE
Q SAFETY VALVE

OPTIONAL CONNECTIONS
R BURSTING DISC
S ANTI VACUUM VALVE
T MANHOLE
U TYPICAL LEG FOR STEEL VESSEL
V LEG FOR COPPER VESSEL
W CRADLES





CAPACITY	DIMENSIONS mm/ins								DRY WEIGHTS kg/lb							
LITRES	A		B		C		D		COPPER Test 1.5 bar Design 1.0 bar		COPPER Test 2.5 bar Design 1.7 bar		COPPER Test 4.0 bar Design 2.7 bar		STEEL Test 4.0 bar Design 2.7 bar	
440	**1800**	71	**600**	24	**1350**	54	**250**	10	**115**	255	**125**	275	**140**	305	**250**	550
550	**1700**	67	**675**	27	**1150**	45	**300**	12	**130**	285	**140**	305	**160**	350	**240**	530
700	**1750**	69	**750**	30	**1150**	45	**300**	12	**155**	340	**155**	340	**190**	420	**280**	615
800	**1950**	77	**750**	30	**1300**	52	**300**	12	**160**	350	**160**	350	**200**	440	**300**	660
900	**2000**	79	**800**	32	**1350**	54	**330**	13	**185**	410	**195**	430	**225**	495	**335**	740
1000	**1950**	77	**850**	33	**1300**	52	**330**	13	**195**	430	**205**	450	**250**	550	**340**	750
1200	**2100**	83	**900**	36	**1400**	56	**345**	14	**225**	495	**240**	530	**280**	615	**395**	870
1350	**2350**	93	**900**	36	**1550**	62	**345**	14	**240**	530	**250**	550	**300**	660	**420**	925
1500	**1950**	77	**1050**	42	**1300**	52	**395**	15	**285**	630	**305**	670	**365**	805	**500**	1100
1800	**2300**	91	**1050**	42	**1550**	62	**395**	15	**315**	695	**335**	740	**405**	895	**565**	1245
2000	**2500**	98	**1050**	42	**1650**	66	**395**	15	**325**	715	**345**	760	**430**	950	**600**	1320
2300	**2400**	94	**1150**	45	**1600**	64	**410**	16	**370**	820	**370**	820	**500**	1100	**640**	1410
2500	**2450**	96	**1200**	48	**1650**	66	**430**	17	**380**	840	**405**	895	**510**	1125	**685**	1510
3000	**2900**	114	**1200**	48	**1950**	77	**430**	17	**435**	960	**460**	1010	**585**	1290	**985**	2170
3500	**2700**	106	**1350**	54	**1800**	71	**475**	19	**555**	1225	**555**	1225	**715**	1575	**1025**	2260
4000	**3050**	120	**1350**	54	**2050**	81	**475**	19	**580**	1280	**600**	1320	**770**	1700	**1135**	2500
4500	**3400**	134	**1350**	54	**2250**	89	**475**	19	**615**	1355	**645**	1420	**845**	1860	**1240**	2735
5000	**3200**	126	**1450**	57	**2400**	94	**500**	20	**685**	1510	**755**	1665	**964**	2125	**1245**	2745
6000	**3800**	150	**1450**	57	**2850**	112	**500**	20	**800**	1765	**885**	1950	**1130**	2490	**1460**	3220
7000	**3300**	130	**1680**	66	**2475**	97	**475**	19	**925**	2040	**1010**	2230	**1355**	2985	**1830**	4035
8000	**3700**	146	**1680**	66	**2850**	112	**475**	19	**1020**	2250	**1120**	2470	**1510**	3330	**2050**	4520
9000	**4200**	165	**1680**	66	**3150**	124	**475**	19	**1100**	2425	**1210**	2670	**1590**	3505	**2230**	4920
10000	**4600**	181	**1680**	66	**3600**	142	**475**	19	**1215**	2680	**1340**	2955	**1820**	4015	**2490**	5490
12500	**5000**	197	**1830**	72	**3750**	148	**550**	22	**1510**	3330	**1780**	3925	**2335**	5150	**2825**	6230
15000	**6000**	236	**1830**	72	**4500**	177	**550**	22	**1775**	3910	**2100**	4630	**2760**	6085	**3310**	7300

SHELL MATERIALS

Copper Shells

Solid copper has proved to be a reliable and economical non ferrous metal for the construction of hot water storage vessels. It is used extensively throughout the world due to its long life and an ability to withstand most concentrations of corrosive elements found in domestic hot water. Modern fabricating techniques have further improved the quality of welded joints and copper alloy fittings can be selected to avoid dezincification.
The mechanism which protects copper from corrosion is the formation of a copper oxide on the metal surface. There are very few sources of fresh water which are sufficiently aggressive to prevent the formation of this oxide film. However where such conditions do exist they are generally known locally and preventive action can be taken when the unit is first installed. The correct procedure is to fit an aluminium anode in the base of the cylinder. This sacrificial anode deposits an aluminium compound on the copper surface, which gives permanent protection and does not require further anodes to be fitted.

Steel Copper Lined

The fabrication of large high pressure cylinders from solid copper is normally considered uneconomical and has generally been superseded by the alternative construction of steel shells lined with copper. This arrangement combines the strength of a steel vessel with the superior corrosion resistance of copper.
It is essential that the copper lining is absolutely waterproof and the "Rycolyna" technique developed by Rycroft has proved most reliable for many years. The minimum recommended thickness of lining for the shell is 1.2mm and this increases with shell diameter. The lining is attached to the steel shell at points around the circumferance and is pulled back by vacuum during manufacture to produce a good fit. Joint construction is such that longitudinal and lateral movement due to temperature and pressure changes can be accommodated without additional compensation.
Because the copper lining is not mechanically attached to the steel shell at all points an anti-vacuum valve is fitted to all "Rycolyna" cylinders. This prevents the formation of a partial vacuum within the shell which might separate a section of the lining from the steel. Such a vacuum may be produced by unusual draw off conditions or drain down procedures. The anti-vacuum valve should therefore not be removed except for periodic inspection.

Galvanised Steel Shells

The coating of steel with zinc by hot dipped galvanising or by metal spray has proved good protection for hot water storage cylinders over many years providing the water is hard. It is essential that a deposit of lime forms rapidly on the surface of the galvanised parts before the zinc is dissolved or deposited in other parts of the system by electrolytic action. Local knowledge will generally decide whether a galvanised cylinder is suitable for the water conditions on site, but guidance from the water supply authority should be sought if there is any doubt.
To extend the life of the zinc coating and allow further time for the scale deposit to form it may be advisable to order the cylinder with a magnesium anode.
This disposable element is mounted inside the shell to be sacrificed by electrolytic action in preference to the galvanised surface. Once a satisfactory scale has formed the electrolytic action ceases and this can be checked by the continued presence of the wasted magnesium anode.
Hot dipped galvanised cylinders are coated by immersing the steel shell in a molten bath of zinc. When the vessel is too large for this dipping process the zinc can be applied by hot metal spray. The technique is well proved and conforms to BS2569. The life of a steel calorifier sprayed with zinc is comparable to a galvanised unit. The use of copper pipework in association with a galvanised cylinder is to be avoided, particularly on the hot water side if there is a secondary return to the shell. Apart from electrolytic action between copper and galvanised steel connections there is a serious risk of pitting corrosion. This is caused by minute particles of dissolved copper settling on the galvanised surface and producing local cells which dissolve the zinc coating and expose the steel shell beneath.

Less than 0.1 part per million of copper in the water is suficient to cause pitting corrosion and the degree of copper solvency is increased with hot water. The risk of pitting corrosion with hard water can be reduced by fitting a sacrificial anode.

The use of a copper heater with a galvanised cylinder does not present the same problem because the heated element is quickly oxidised and coated with a deposit of hardness salts. It is therefore quite normal for copper heaters to be fitted to galvanised cylinders.
Galvanised steel is not suitable for use with soft water.

Stainless Steel

Unless local experience has shown that stainless steel is suitable for storing hot water this material should be avoided. Hot water containing quite small quantities of chlorides has been found corrosive to a variety of stainless steels. Attack may take the form of crevice corrosion, where screwed fittings and joint faces occur, or as stress corrosion if the vessel has not been correctly stress relieved after fabrication. The cost of this post weld treatment generally makes a stainless steel hot water storage vessel uneconomical. Chlorides occur naturally in most water supplies.
One exception to the general rule is heating deionized water or other pretreated water known to be free of chlorides. The passivity of stainless steel is well known and required for certain process work and Rycroft can readily supply storage cylinders for such purposes.

STORAGE CAPACITY

The table of Demand Factors printed below is a guide to the maximum hourly demand for various fittings in different environments. The load factors given in the end column indicate typical distribution of demand. For example although a hotel may possess 100 baths it is unlikely they will all be used in one hour.

A storage capacity sufficient for one hour with a corresponding heater output is considered adequate for the majority of calorifier applications. If there is insufficient space for one hour storage volume the heater hourly rating should be increased slightly. Below ½ hour capacity consideration should be given to the installation of a Rycroft Hi-Stor heater.

Where space permits additional storage volume, it provides a useful reserve of hot water for service and maintenance. Dividing the load between two or more calorifiers is another means of safeguarding the supply and allows part of the system to be shut down during off peak periods.

Certain applications have no draw off for long periods and then experience a short heavy demand. The storage capacity in these circumstances is generally sized for the complete demand volume while the heater is rated for the long recovery period.

Showers

Where the shower demand represents the major proportion of an hourly consumption, efforts should be made to obtain an accurate estimate of the total usage and the time span.

Example:

A factory employs 20 men who all take a shower at the end of the shift. Each man uses approximately 50 litres of hot water at 65°C mixed with 30 litres of cold water at 10°C, and the entire shower takes 10 minutes.

Total shower demand = 20 x 50
= 1000 litre

If other hot water demands only amount to 500 l/hr. a storage capacity of 1500 litre would be sufficient. It would be no use installing a storage calorifier with only a ½ hour capacity of 750 litre and a battery rated at 1500 l/hr.

Maximum Demand Rates (litres/hour)

Installation	Private Hand Basin	Public Hand Basin	Shower *	Bath	Slop Sink	Bar Sink	Kitchen Sink	Pantry Sink	Laboratory Sink	Load Factor
Hospital	10	15	70	60	50		80			0.7
Hotel and Residential Hall	10	15	50	50	50	100	80			0.5
Day School	5	20	180		40		80			0.8
Sports Centre	5	15	220		40	100	80			1.0
Restaurant	5	25			100	100	140	120		1.0
University	5	20	220		40		80		40	0.8
Offices	5	10			40		40		40	1.0
Factory	5	20	120		50		80		40	1.0

*Where a shower and bath are combined in a single cubicle it is only necessary to use one demand rate and the total number of cubicles.

Example

200 Bedroom Hotel with Restaurant attached:-

200 combined bath/showers	50 x 200	=	10000
200 private hand basins	10 x 200	=	2000
12 public hand basins	15 x 12	=	180
5 Hotel slop sinks	50 x 5	=	250
5 Hotel kitchen sinks	80 x 5	=	400
1 Restaurant slop sink	100 x 1	=	100
4 Restaurant kitchen sinks	140 x 4	=	560
10 washing machines 50 l/hr	50 x 10	=	500
	TOTAL	=	13990 l/hr
Load Factor 0.5	Hourly Rate	=	13990 x 0.5
		=	6995 l/hr

Using the estimated hourly demand of 6995 litres a calorifier with a storage capacity of 7000 litres and a battery rated at 7000 l/hr. would be considered adequate. Greater flexibility would be achieved with two calorifiers, each 4500 litres and with heater batteries of 4500 l/hr. output.

If storage space was limited to one calorifier of only 3500 litres capacity the battery rating should be increased to approximately 9000 l/hr.

CONNECTIONS

Secondary Connections

All shell connections should be adequately sized to avoid disturbing the stratification, which retains hot water at the top of the cylinder. Under conditions of random usage it is recommended that the secondary flow and cold feed connections are based on the calculated hourly demand figures as listed in Table 1.

Where the demand is known to be short and heavy the secondary flow and cold feed connections should be sized from Table 1 using the expected peak demand figures in litres/second.

It is generally bad practice for the cold feed to be smaller than the secondary flow.

Avoid excessive secondary recirculation. The heat loss from a properly lagged service is quite small and the recirculation rate can be based on a temperature drop of approximately 5°C. The return connection should not be smaller that that obtained from Table 1 using the pump rate in litres/second. It should not be positioned too low down in the cylinder.

Table 1

Maximum Flow Rates for Secondary Connections

Connection size ins	mm	Hourly Demand l/hr	Peak Demand l/s
1	25	150	0.1
1½	40	400	0.3
2	50	850	0.6
2½	65	1,400	1.0
3	80	2,500	1.5
4	100	5,500	2.5
5	125	11,000	4.0
6	150	20,000	6.0

Primary Connections

The size of primary pipework is determined by the flow rate and length of run between the boiler and calorifier. The connection to the calorifier chest however is frequently governed by the size of control valve fitted.

Wherever possible the chest connection is made to suit the plant layout but for primary water the inlet velocity should not exceed 2 m/s.

Dimensions

The table of sizes given on pages 8 and 9 represent the standard range of Rycroft calorifiers. They have the most economical dimensions and capacities but alternative sizes can be supplied for special purposes.

Floor area or limited head room may dictate the shell size. Where access is extremely limited it may be possible to supply a sectionalised cylinder for final assembly on site. Capacities beyond the range listed are readily available and the most economical dimensions will be supplied on request.

Supports

Vertical calorifiers have fixed legs. They are welded to the bottom of steel shells but generally bolted to copper calorifiers with a lead lining to separate the steel from the copper.

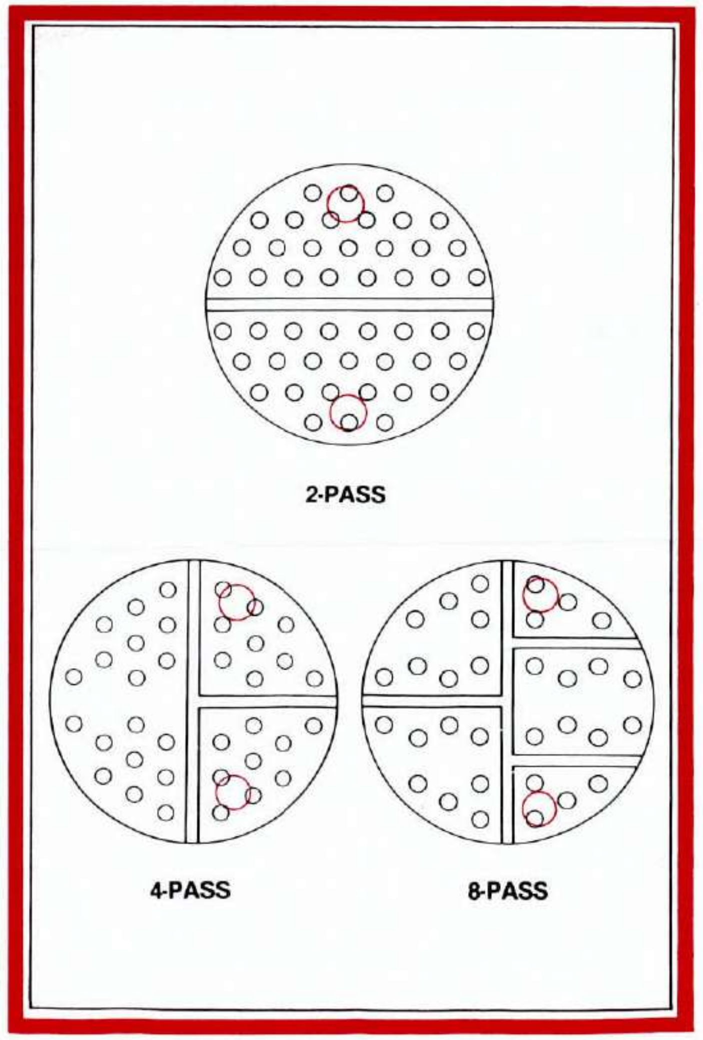
Horizontal calorifiers normally use loose steel cradles, which are lead lined for copper cylinders. There are exceptions including prelagged units and heavy steel cylinders which may have fixed cradles for ease of transportation.

Heater Battery

For steam and condensate the battery is a simple 2 pass U-tube battery. For primary hot water and oil the number of passes may be increased to raise the velocity in the tubes for efficient heat transfer.

The majority of heater batteries are constructed from finned tube. This extended surface reduces the overall size of battery which helps to increase the velocity through the tubes. Plain tube can always be supplied, but it should be specified at the enquiry or order stage so that provision is made for fitting the larger battery. Plain tube will be recommended when the operating conditions are known to make it advisable.

Fig.4 Tube Arrangements



Operating and Maintenance Instructions

The following information has been prepared as a general guide for Rycroft storage and non-storage calorifiers.

Installation

Lifting. Lifting eyes are provided on the top of large calorifiers and those fitted with 'M' type lagging. This form of insulation is not suitable for lifting by straps, which can crush the outer casing .
Avoid the use of chains, particularly with light gauge copper vessels or where screwed connections may be damaged by the links.
When transporting or lifting storage calorifiers keep them in the upright position. If it is necessary to tip them through 90° first remove the battery.

Foundations. Calorifiers should be mounted on prepared foundations which are level. Even a slight tilt can cause an airlock inside the tubes, which will restrict the flow of heat. It is also important that the vessels stand firmly on the ground to prevent movement when batteries are removed or other forms of maintenance undertaken. Horizontal calorifiers are normally supported by loose cradles, which need to be positioned clear of the drain connection and leave access to any flanges for tightening bolts.

Pipework. Check for compatibility of materials between pipework and calorifier. In particular avoid a combination of copper and galvanised mild steel. Make sure pipework flanges are square with those on the calorifier and correctly spaced before bolting up. See that the weight of the pipework is taken by external supports and not by the vessel. Allowance should be made for expansion of the pipes either by suitable bends or flexible joints. Tighten the bolts in a diametrically opposite sequence and not consecutively round each flange.

Screwed Connections. Screwed connections may be sealed with hemp and paste, or PTFE tape, providing the male thread is tapered. However, parallel threads, such as are found on primary connections to double tube heaters, require a back nut and joint ring. Use TWO spanners when joining screwed connections to avoid undue torque on the calorifier fittings.

Relief Valve. It is recommended that a short length of pipe is fitted to the discharge side of any relief valve or bursting disc to deflect the fluid in a safe direction. A long pipe may restrict the discharge, raise the blow off pressure and prevent an operator from detecting a weeping valve.

Cold Feed. With storage calorifiers the pipe carrying the cold feed make up should be at least equal in size to the secondary flow and a check made to see that there are no unnecessary restrictions on the supply side.

Secondary Vent. Most calorifiers have their secondary outlet situated at the top of the cylinder, which prevents air collecting in the top of the shell. However, it is necessary to provide an atmospheric vent at the high point in the system. If the system is pressurised and an automatic air vent is fitted adequate provision must be made for air to enter when the system is drained down.

Primary Vent. It is equally important to make provision for venting the primary system, whether it is water or steam. The majority of steam traps are fitted with automatic air vents, but if the steam line is long and subject to frequent shut downs an additional vent is useful.

Liquid Expansion. Changes in volume with temperature of the secondary and primary water must not be overlooked. The system pressure will rise dramatically if there is nowhere for the water to expand. It is not advisable to use the relief valve as a means of releasing the excess water. Open systems use the atmospheric vent as an expansion pipe with discharge back into the make up tank. Closed systems require a separate expansion vessel partially filled with air or nitrogen to accommodate volume changes.

Thermostat. For non-storage calorifiers the correct position of the thermostat is on the secondary outlet, adjacent to the heat exchanger. If possible arrange for the primary medium to be cut off if the secondary pump fails with a non-storage unit.

Control Valve. Many control valves operate by direct action of liquid expansion in the thermostatic element. This method is simple and sufficiently accurate for most applications. However, the time lag associated with this class of equipment may produce temperature oscillations at reduced load. Under these conditions a more sophisticated, modulating valve is required. It is advisable to fit a strainer in front of the control valve and with wet steam the supply line should be kept free of condensate. This can be done with a separator or simply a T-piece and trap.

Steam Trap. The steam trap after a calorifier must be adequately sized and mounted below the heater battery. When starting from cold the quantity of condensate may well be twice the normal full load rating. It is recommended to fit a non-return valve after the trap, particularly if it is necessary to raise the level of condensate in the return line or overcome a measurable back pressure. With low pressure steam there may be insufficient pressure to return the condensate. In these circumstances a condensate pump should be fitted.

Filling. Before filling the secondary system with water, check the drain valve is closed and all air vents are open. *Do not fill the circuit too quickly* otherwise pockets of air may become trapped. Subsequent release of these air bubbles can cause violent shock waves which may exceed the working pressure of the calorifier. Similarly when filling a primary hot water circuit allow time for the air to vent freely. Flush out the system before installing the control valve to remove any foreign matter. Close any manual air vents and run the circulating pumps. Crack the vents to release air accumulated by motion of the water.

Anti-Vacuum Valve. All copper lined steel calorifiers must be protected from the risk of partial vacuum in the cylinder by fitting an anti-vacuum valve. Light gauge copper cylinders also risk damage since they can only withstand internal pressure and not external pressure. A partial vacuum may be caused by improper drain down procedures, excessive draw off at low level or an inadequate vent system. Water hammer or sudden release of pressure can also induce negative pressures.

Operation

Initial Running. During initial trials adjust the thermostatic control valve to maintain the correct secondary temperature. This is best done by raising the setting gradually so that the desired temperature is not exceeded. Clean out any strainers after preliminary running. Tighten bolts all round after the first heat up and again at regular intervals. Compare the working pressures on the primary and secondary sides with the data on the nameplate.

Steam Heaters. With steam heated calorifiers air in the tubes can delay steam reaching the heater. If this is a source of annoyance fit an automatic air eliminator or manual blow down adjacent to the trap. When starting from cold with low pressure steam plant there may be complete loss of pressure in the tubes. Under these circumstances the trap cannot discharge condensate and the tubes will become flooded. One solution is to fit a larger steam valve to cope with the overload conditions or alternatively fit a small vacuum breaker before the trap.

Noise. There are occasions when a high temperature primary medium will cause surface boiling which can be heard as a crackling sound inside the calorifier shell. Increasing the secondary circulation or raising the working head will help to eliminate this noise. Steam hammer associated with the control valve opening against a column of condensate is an indication of inadequate trap arrangements. This can be confirmed by removing the trap and discharging the condensate to atmosphere through a temporary drain.

Recovery Time. It is difficult to establish the output of a storage calorifier under normal working conditions. If it is desired to check the performance, isolate the secondary return and check the time to raise the contents from cold with no draw off from the system.

Primary Circulation. Both the primary inlet temperature and the circulation rate are important to achieve the design output. In many cases it is not sufficient to merely achieve the correct mean primary temperature. Similarly any reduction in the primary flow will give a corresponding reduction in heat transfer. During the recovery period of a storage calorifier the temperature drop of the primary water will exceed the design figure when the contents are cold but will be less as the final storage temperature is approached.

Maintenance

Inspection. Where possible a detailed examination of the calorifier after six months can give a good indication of the future maintenance requirements. If the internals are clean and there is no sign of corrosion it can be safely assumed an annual inspection will be sufficient for future service. However, deposits of scale or corrosive products on the heater will draw attention to the need for prompt treatment. Isolate the calorifier and drain the shell before attempting to remove bolts or equipment. If a manhole or end cover is fitted, a great deal can be learnt by removing this. Double tube heaters and coils are not normally withdrawn for cleaning but treated "in situ."

Chest Removal. When removing a large chest use the lifting ring provided to take the weight. There may be starting screws in the flange to break the seal between the chest and tubeplate, and collar bolts fitted to the tubeplate. These are readily identified because they are screwed into the tubeplate and cannot be withdrawn like the plain bolts. Leave the nuts on the back of the collar bolts until the chest has been pulled off.

Battery Withdrawal. Remove any thermometer or other insertion in the shell which may obstruct the withdrawal of the battery. Prise the tubeplate from the shell using a fine wedge piece driven into the joint at several points around the periphery. When the heater is partly withdrawn support may be shifted to a strap around the battery or a block of wood across the centre row of tubes.

Arrangement. Note the position of mid feather joints and whether the hairpins are vertical (2 pass) or horizontal (4 and 8 pass). Likewise make a note of any tube supports or baffles and their position relative to the connections. Large batteries are fitted with rollers to aid withdrawal and non-storage calorifiers with a 2 pass shell require brackets to act as supports between the upper and lower sections of the battery.

Refitting. Use fresh joints for re-assembly and clean all faces thoroughly. With copper calorifiers the joint face may be distorted during strip down. If so, refit the chest without the tubeplate or joints and pull up the bolts using the backing ring to flatten the copper face. Slip the joint ring over the battery before insertion and make sure the battery is the right way up. See the mid feather joint is secure before replacing the chest. Pull up the bolts diametrically opposite one another and not round in a circle.

Relief valve. The relief valve can be tested on the vessel by raising the working pressure to the set pressure or by transfer to a test line. If the valve does not reseat properly there is every possibility that foreign matter has become trapped under the seat. A further discharge using the easing lever may dislodge the offending particle or it may be necessary to strip and clean the valve.

Deposits. With very hard water, scale deposits will form on the tubes, particularly above 60°C.
Low finned tube used in the majority of Rycroft calorifiers will shed this scale if the tubes are subject to wide temperature changes. However, this is only effective with hard scale and high primary temperatures. Low temperature primary systems cannot provide the thermal shock necessary to crack the scale. Similarly, soft deposits are not easily shed. Under these circumstances the tubes may be cleaned, manually using "combing wire" or by chemical treatment. Other forms of deposit may collect on the tubes as a result of incorrect water treatment or from natural solids in suspension. These may prove injurious if they destroy the natural oxide film which normally protects copper. At the first signs of corrosion seek the advice of a water treatment expert.

Chemical Cleaning. Most scales can be removed by soaking the tubes in a dilute solution of hydrochloric acid or commercially available solvents. However, where possible a sample of scale should be removed manually and tested in the solution. If it does not readily react, advice should be obtained from a local expert. After de-scaling it is most important to neutralise the traces of solution left on the battery with alkali. Washing soda or slaked lime is most effective for this purpose.

Anodes. There are isolated cases of copper cylinders being attacked by aggressive water. However, such areas are generally well known to the installers and an aluminium rod can be fitted to new plant to produce a protective film over the copper. It is not necessary to replace the rod once the film has been formed. Sacrificial Magnesium anodes may be fitted to galvanised steel shells to protect the zinc coating. When these dissolve they should be replaced and it is advisable to monitor their life to ensure continuity of protection.

Electrical Calorifiers

Take all precautions against electric shock by switching off between tests and ensuring loose wires are not in contact with any metal work or in dangerous positions.

Insulation Resistance. All immersion heaters are thoroughly dried out and tested before leaving the factory. However storage conditions after despatch are not always ideal and some moisture may collect in the heater, particularly if it is several months before the equipment is commissioned. Before connecting the heaters to the mains carry out an insulation test across each element to earth. If the insulation resistance is less than 500,000 ohms the heater must be dried out by placing in a low temperature oven (100°C.) or by passing a low voltage through the elements in air. This voltage should not exceed 25% of the working voltage. Do not allow the heater sheath temperature to rise above 60°C. Switch off at intervals if necessary to prevent overheating.

Control Panel. Before putting the control panel into service check that all the control circuit and main circuit connections are tight using the appropriate size spanner or screwdriver. After connecting the mains ensure that the isolator protective cover is refitted in the correct position. Remove all cable ends and other extraneous matter from the bottom of the casing, together with any spare items that may be fastened to the cables. Ensure that the fuses are well seated.
Test the control system with the mains alive and the main isolator in the 'ON' position but with the main wires to the heater removed. Testing should be as follows:-

1) Switch on the main isolator and with the thermostats connected and the system cold the contactor should close and the plant working light come on. Remove one wire from the control thermostat and the contactor should open switching off the indicator light. Replace wire to the control thermostat and repeat with the safety thermostat (if fitted). During the period that the control thermostat is disconnected, and the contactor open, operate the test button and the contactor should close and the plant working light come on.

Ensure calorifier is full of water.

2) Reconnect heater. Check all the connections for tightness. When replacing the immersion heater lid ensure that this does not trap any wires or cause them to press against the thermostat adjustor. With the thermostat still disconnected, operate the contactor with the test button, this gives hand control of the main circuit, if satisfactory reconnect thermostat. Check that this switches off as the water heats up by reducing the thermostat setting.

Replaceable Elements. Some immersion heaters have replaceable elements which can only be changed after the calorifier has been drained and the heater removed from the cylinder. Others have a group of elements housed in a single sheath and these can be withdrawn without draining the calorifier. Do not withdraw them for inspection but only for replacement.

Thermostats. Ensure that these are set to correct temperature point and as far in the pocket as possible. They should be tested every twelve months by removing and testing the contact resistance and comparing switching point by immersion in hot water using a separate thermometer.

Level Switches. These should be checked for correct operation at regular intervals.

Make sure the floor is dry before handling electrical equipment.

Spares

When ordering spare parts always quote the reference number printed on the output plate. This will save time and ensure supply of the correct items.

IMI Rycroft Ltd

Heating the World's Water

Duncombe Road, Bradford
West Yorkshire BD8 9TB, England
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BS EN ISO 9001

FM No. 28819

Operating and Maintenance Instructions

The following information has been prepared as a general guide for Rycroft storage and non-storage calorifiers.

Installation

Lifting. Lifting eyes are provided on the top of large calorifiers and those fitted with 'M' type lagging. This form of insulation is not suitable for lifting by straps, which can crush the outer casing .
Avoid the use of chains, particularly with light gauge copper vessels or where screwed connections may be damaged by the links.
When transporting or lifting storage calorifiers keep them in the upright position. If it is necessary to tip them through 90° first remove the battery.

Foundations. Calorifiers should be mounted on prepared foundations which are level. Even a slight tilt can cause an airlock inside the tubes, which will restrict the flow of heat. It is also important that the vessels stand firmly on the ground to prevent movement when batteries are removed or other forms of maintenance undertaken. Horizontal calorifiers are normally supported by loose cradles, which need to be positioned clear of the drain connection and leave access to any flanges for tightening bolts.

Pipework. Check for compatibility of materials between pipework and calorifier. In particular avoid a combination of copper and galvanised mild steel. Make sure pipework flanges are square with those on the calorifier and correctly spaced before bolting up. See that the weight of the pipework is taken by external supports and not by the vessel. Allowance should be made for expansion of the pipes either by suitable bends or flexible joints. Tighten the bolts in a diametrically opposite sequence and not consecutively round each flange.

Screwed Connections. Screwed connections may be sealed with hemp and paste, or PTFE tape, providing the male thread is tapered. However, parallel threads, such as are found on primary connections to double tube heaters, require a back nut and joint ring. Use TWO spanners when joining screwed connections to avoid undue torque on the calorifier fittings.

Relief Valve. It is recommended that a short length of pipe is fitted to the discharge side of any relief valve or bursting disc to deflect the fluid in a safe direction. A long pipe may restrict the discharge, raise the blow off pressure and prevent an operator from detecting a weeping valve.

Cold Feed. With storage calorifiers the pipe carrying the cold feed make up should be at least equal in size to the secondary flow and a check made to see that there are no unnecessary restrictions on the supply side.

Secondary Vent. Most calorifiers have their secondary outlet situated at the top of the cylinder, which prevents air collecting in the top of the shell. However, it is necessary to provide an atmospheric vent at the high point in the system. If the system is pressurised and an automatic air vent is fitted adequate provision must be made for air to enter when the system is drained down.

Primary Vent. It is equally important to make provision for venting the primary system, whether it is water or steam. The majority of steam traps are fitted with automatic air vents, but if the steam line is long and subject to frequent shut downs an additional vent is useful.

Liquid Expansion. Changes in volume with temperature of the secondary and primary water must not be overlooked. The system pressure will rise dramatically if there is nowhere for the water to expand. It is not advisable to use the relief valve as a means of releasing the excess water. Open systems use the atmospheric vent as an expansion pipe with discharge back into the make up tank. Closed systems require a separate expansion vessel partially filled with air or nitrogen to accommodate volume changes.

Thermostat. For non-storage calorifiers the correct position of the thermostat is on the secondary outlet, adjacent to the heat exchanger. If possible arrange for the primary medium to be cut off if the secondary pump fails with a non-storage unit.

Control Valve. Many control valves operate by direct action of liquid expansion in the thermostatic element. This method is simple and sufficiently accurate for most applications. However, the time lag associated with this class of equipment may produce temperature oscillations at reduced load. Under these conditions a more sophisticated, modulating valve is required. It is advisable to fit a strainer in front of the control valve and with wet steam the supply line should be kept free of condensate. This can be done with a separator or simply a T-piece and trap.

Steam Trap. The steam trap after a calorifier must be adequately sized and mounted below the heater battery. When starting from cold the quantity of condensate may well be twice the normal full load rating. It is recommended to fit a non-return valve after the trap, particularly if it is necessary to raise the level of condensate in the return line or overcome a measurable back pressure. With low pressure steam there may be insufficient pressure to return the condensate. In these circumstances a condensate pump should be fitted.

Filling. Before filling the secondary system with water, check the drain valve is closed and all air vents are open. *Do not fill the circuit too quickly* otherwise pockets of air may become trapped. Subsequent release of these air bubbles can cause violent shock waves which may exceed the working pressure of the calorifier. Similarly when filling a primary hot water circuit allow time for the air to vent freely. Flush out the system before installing the control valve to remove any foreign matter. Close any manual air vents and run the circulating pumps. Crack the vents to release air accumulated by motion of the water.

Anti-Vacuum Valve. All copper lined steel calorifiers must be protected from the risk of partial vacuum in the cylinder by fitting an anti-vacuum valve. Light gauge copper cylinders also risk damage since they can only withstand internal pressure and not external pressure. A partial vacuum may be caused by improper drain down procedures, excessive draw off at low level or an inadequate vent system. Water hammer or sudden release of pressure can also induce negative pressures.

Operation

Initial Running. During initial trials adjust the thermostatic control valve to maintain the correct secondary temperature. This is best done by raising the setting gradually so that the desired temperature is not exceeded. Clean out any strainers after preliminary running. Tighten bolts all round after the first heat up and again at regular intervals. Compare the working pressures on the primary and secondary sides with the data on the nameplate.

Steam Heaters. With steam heated calorifiers air in the tubes can delay steam reaching the heater. If this is a source of annoyance fit an automatic air eliminator or manual blow down adjacent to the trap. When starting from cold with low pressure steam plant there may be complete loss of pressure in the tubes. Under these circumstances the trap cannot discharge condensate and the tubes will become flooded. One solution is to fit a larger steam valve to cope with the overload conditions or alternatively fit a small vacuum breaker before the trap.

Noise. There are occasions when a high temperature primary medium will cause surface boiling which can be heard as a crackling sound inside the calorifier shell. Increasing the secondary circulation or raising the working head will help to eliminate this noise. Steam hammer associated with the control valve opening against a column of condensate is an indication of inadequate trap arrangements. This can be confirmed by removing the trap and discharging the condensate to atmosphere through a temporary drain.

Recovery Time. It is difficult to establish the output of a storage calorifier under normal working conditions. If it is desired to check the performance, isolate the secondary return and check the time to raise the contents from cold with no draw off from the system.

Primary Circulation. Both the primary inlet temperature and the circulation rate are important to achieve the design output. In many cases it is not sufficient to merely achieve the correct mean primary temperature. Similarly any reduction in the primary flow will give a corresponding reduction in heat transfer. During the recovery period of a storage calorifier the temperature drop of the primary water will exceed the design figure when the contents are cold but will be less as the final storage temperature is approached.

● Maintenance

Inspection. Where possible a detailed examination of the calorifier after six months can give a good indication of the future maintenance requirements. If the internals are clean and there is no sign of corrosion it can be safely assumed an annual inspection will be sufficient for future service. However, deposits of scale or corrosive products on the heater will draw attention to the need for prompt treatment. Isolate the calorifier and drain the shell before attempting to remove bolts or equipment. If a manhole or end cover is fitted, a great deal can be learnt by removing this. Double tube heaters and coils are not normally withdrawn for cleaning but treated "in situ."

Chest Removal. When removing a large chest use the lifting ring provided to take the weight. There may be starting screws in the flange to break the seal between the chest and tubeplate, and collar bolts fitted to the tubeplate. These are readily identified because they are screwed into the tubeplate and cannot be withdrawn like the plain bolts. Leave the nuts on the back of the collar bolts until the chest has been pulled off.

Battery Withdrawal. Remove any thermometer or other insertion in the shell which may obstruct the withdrawal of the battery. Prise the tubeplate from the shell using a fine wedge piece driven into the joint at several points around the periphery. When the heater is partly withdrawn support may be shifted to a strap around the battery or a block of wood across the centre row of tubes.

Arrangement. Note the position of mid feather joints and whether the hairpins are vertical (2 pass) or horizontal (4 and 8 pass). Likewise make a note of any tube supports or baffles and their position relative to the connections. Large batteries are fitted with rollers to aid withdrawal and non-storage calorifiers with a 2 pass shell require brackets to act as supports between the upper and lower sections of the battery.

Refitting. Use fresh joints for re-assembly and clean all faces thoroughly. With copper calorifiers the joint face may be distorted during strip down. If so, refit the chest without the tubeplate or joints and pull up the bolts using the backing ring to flatten the copper face. Slip the joint ring over the battery before insertion and make sure the battery is the right way up. See the mid feather joint is secure before replacing the chest. Pull up the bolts diametrically opposite one another and not round in a circle.

Relief valve. The relief valve can be tested on the vessel by raising the working pressure to the set pressure or by transfer to a test line. If the valve does not reseat properly there is every possibility that foreign matter has become trapped under the seat. A further discharge using the easing lever may dislodge the offending particle or it may be necessary to strip and clean the valve.

Deposits. With very hard water, scale deposits will form on the tubes, particularly above 60°C.
Low finned tube used in the majority of Rycroft calorifiers will shed this scale if the tubes are subject to wide temperature changes. However, this is only effective with hard scale and high primary temperatures. Low temperature primary systems cannot provide the thermal shock necessary to crack the scale. Similarly, soft deposits are not easily shed. Under these circumstances the tubes may be cleaned, manually using "combing wire" or by chemical treatment. Other forms of deposit may collect on the tubes as a result of incorrect water treatment or from natural solids in suspension. These may prove injurious if they destroy the natural oxide film which normally protects copper. At the first signs of corrosion seek the advice of a water treatment expert.

Chemical Cleaning. Most scales can be removed by soaking the tubes in a dilute solution of hydrochloric acid or commercially available solvents. However, where possible a sample of scale should be removed manually and tested in the solution. If it does not readily react, advice should be obtained from a local expert. After de-scaling it is most important to neutralise the traces of solution left on the battery with alkali. Washing soda or slaked lime is most effective for this purpose.

Anodes. There are isolated cases of copper cylinders being attacked by aggressive water. However, such areas are generally well known to the installers and an aluminium rod can be fitted to new plant to produce a protective film over the copper. It is not necessary to replace the rod once the film has been formed. Sacrificial Magnesium anodes may be fitted to galvanised steel shells to protect the zinc coating. When these dissolve they should be replaced and it is advisable to monitor their life to ensure continuity of protection.

● Electrical Calorifiers

Take all precautions against electric shock by switching off between tests and ensuring loose wires are not in contact with any metal work or in dangerous positions.

Insulation Resistance. All immersion heaters are thoroughly dried out and tested before leaving the factory. However storage conditions after despatch are not always ideal and some moisture may collect in the heater, particularly if it is several months before the equipment is commissioned. Before connecting the heaters to the mains carry out an insulation test across each element to earth. If the insulation resistance is less than 500,000 ohms the heater must be dried out by placing in a low temperature oven (100°C.) or by passing a low voltage through the elements in air. This voltage should not exceed 25% of the working voltage. Do not allow the heater sheath temperature to rise above 60°C. Switch off at intervals if necessary to prevent overheating.

Control Panel. Before putting the control panel into service check that all the control circuit and main circuit connections are tight using the appropriate size spanner or screwdriver. After connecting the mains ensure that the isolator protective cover is refitted in the correct position. Remove all cable ends and other extraneous matter from the bottom of the casing, together with any spare items that may be fastened to the cables. Ensure that the fuses are well seated.
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Ensure calorifier is full of water.
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● Spares

When ordering spare parts always quote the reference number printed on the output plate. This will save time and ensure supply of the correct items.

IMI Rycroft Ltd

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REGISTERED FIRM
FM No. 28819

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Installation and Maintenance Instructions for copper lined calorifiers

- **This vessel has a copper lining.**
- **An anti-vacuum valve is fitted to help protect the lining from damage when draining down the cylinder.**
- **Do not cover the anti-vacuum valve with insulation or obstruct the free passage of air to the valve.**

As a precaution against damage to the lining the following procedures should be observed when draining down:

1. Isolate the primary supply to the calorifier.
2. Isolate the cold feed to the cylinder.
3. If the secondary flow and return are common to other calorifiers isolate the cylinder to be drained down.
4. REDUCE THE PRESSURE IN THE CYLINDER SLOWLY
   a) If the calorifier has its own open vent the pressure will fall naturally as the drain is gently opened and the head of water drops in the vent pipe.
   b) If the calorifier shares a common vent it will be fitted with a 3 port escape cock. Turn this cock very slowly to avoid a sudden release of pressure when isolating the cylinder from the system.
   c) If the calorifier is normally coupled to a pressurisation set and fitted with an automatic air vent open the drain very carefully to avoid a sudden release of pressure.
5. When the cylinder pressure has reduced to atmospheric pressure check the anti-vacuum valve is free to open by depressing it with a short stick or some other soft rod.
6. Empty the cylinder slowly through the drain cock. If a hose is coupled to the drain cock see the outlet remains at floor level and not below.
7. If the anti-vacuum valve is removed for maintenance make sure it is refitted before filling the calorifier.

This vessel has been hydraulically tested on the secondary and primary side before despatch. However after transportation and long standing some joints may relax and require further tightening after installation.

Always tighten bolts in a diametrically opposite sequence. Do not tighten them consecutively round the flange. If the wrong procedure has been adopted it may be necessary to drain the cylinder, relax all the bolts and retighten in the correct manner.

All pipework and valves connected to the vessel must be square and central before fitting the bolts. Support the pipework or valve at the flange face until the bolts are tight. **Remember to use a diametrically opposite sequence for tightening the bolts.**

PLEASE SEE THESE INSTRUCTIONS ARE SHOWN TO THE MAINTENANCE STAFF AND UNDERSTOOD EACH TIME THE CALORIFIER IS DRAINED DOWN.

WARNING

THIS CYLINDER HAS A COPPER LINING.
DO NOT OBSTRUCT THE ANTI-VACUUM VALVE.
PLEASE READ FULL INSTRUCTIONS BEFORE INSTALLATION AND BEFORE DRAINING DOWN CYLINDER.

RYCO

IMI Rycroft

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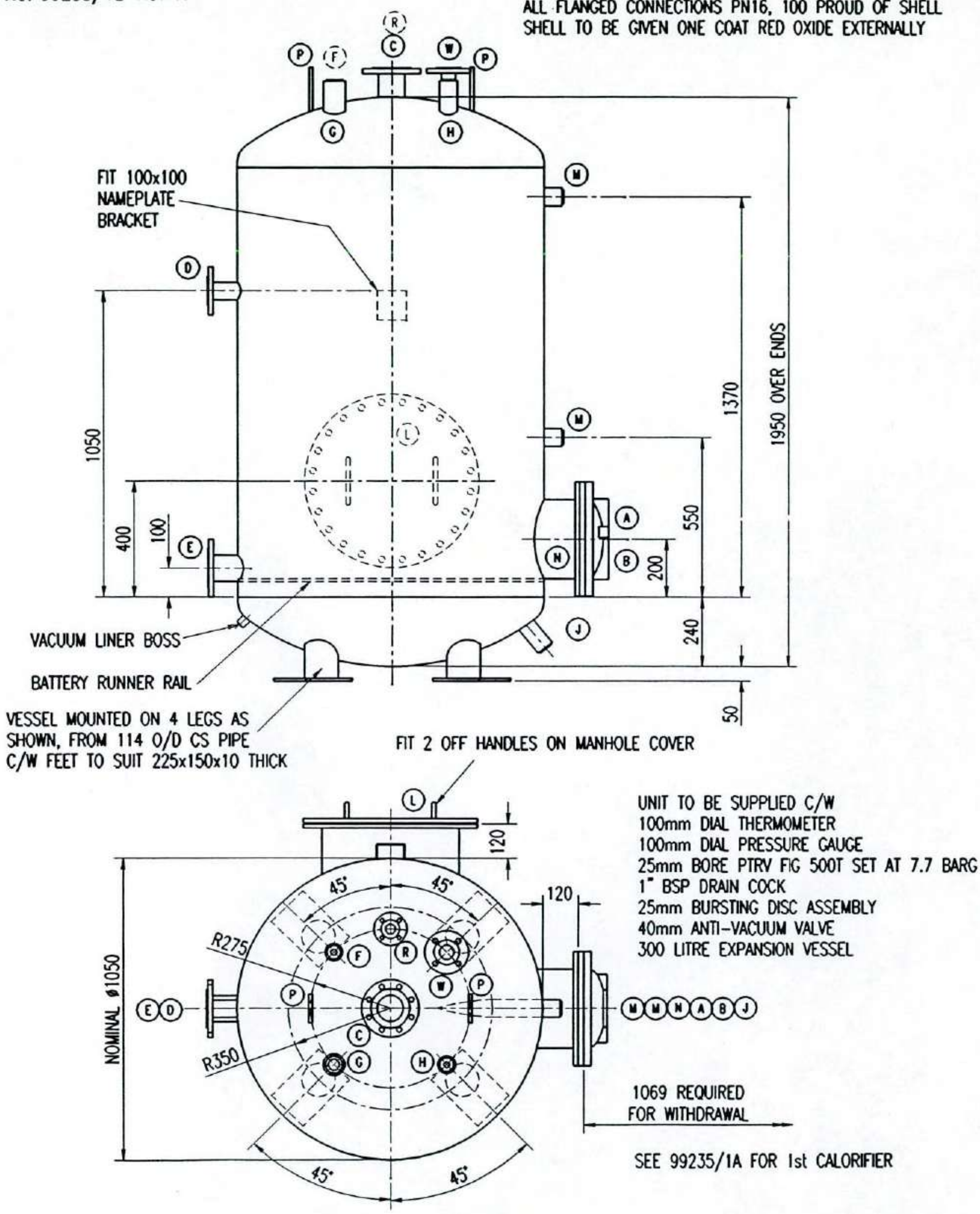
WO No. 99235/1B Rev A



UNIT TO BE SUPPLIED C/W
100mm DIAL THERMOMETER
100mm DIAL PRESSURE GAUGE
25mm BORE PTRV FIG 500T SET AT 7.7 BARG
1" BSP DRAIN COCK
25mm BURSTING DISC ASSEMBLY
40mm ANTI-VACUUM VALVE
300 LITRE EXPANSION VESSEL

SEE 99235/1A FOR 1st CALORIFIER

RevB

RevA:26/9/98–CALS NOW HANDED

Approx Dry Weight (Kg) = 525

A	Primary Inlet	G 3 INT	G	Safety Valve	G 1.1/4 INT	P	Lifting Lugs x2	LLMM ø40
B	Primary Outlet	G 3 INT	H	Altitude Gauge	G 3/8 INT	R	Bursting Disc	25mm Flange
C	Sec Flow	50mm Flange	J	Drain	G 1 INT	S	Imm Heater	N/A
D	Sec Return	50mm Flange	L	Manhole	455mm ZRMH	T	Pump	N/A
E	Cold Feed	50mm Flange	M	Thermostat x2	G 1 INT	W	Anti-Vac Valve	40mm Flange
F	Thermometer	G 1/2 INT	N	Neck NB	250mm	X	Vent	N/A

VESSEL TYPE: CZE COPPER-LINED STORAGE CALORIFIER	No.Off: 1	Scale: 1:20
Design Std: BS853:96:PART 1:GRADE A Capacity(l): 1500 Sec Tst(barg): 11.55 Pri Tst(barg): 11.55 Htg Sfc(m): 23.49	Drawn by: RJB Date: 14/9/98	W/O No: 99235/1B Rev A
Rycroft Ltd., Duncombe Rd, Bradford BD8 9TB, England.	Tel 01274 490911	Fax 01274 498580

19

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POWERMAG
Installation Instructions

QUALITY
WATER
PRODUCTS

LIFF

What is PowerMag™ Water Conditioning

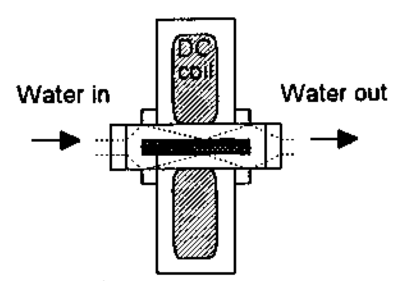
HARD WATER
In certain Geographic areas, Hardness in the water used for processes or secondary hot water systems will lead to inevitable problems with the build up of an insulating layer of Hard Scale. Water hardness varies considerably but in general ***hard*** *water has around 120 - 180 Mg / Litre (ppm) of hardness and very* ***hard*** *water will have more than 180 Mg / Litre.*
This layer, formed when hard water is heated and Calcium bicarbonate turns to carbonate, is deposited onto heat exchange surfaces. The Harder the water of course, the quicker and thicker the layer formed.
The result is:

EFFICIENCY LOSS
Just 1.6 mm of hard scale on a heat exchange surface will result in an 11% loss of efficiency.
Domestic Hot Water systems are particularly prone to this type of scale problem as there is always considerable water use and more hard water produces more scale.
Systems will therefore be very expensive to run, as more Primary Heat is required to produce the same hot water temperature and can eventually become so blocked that water flow is inhibited.
In these circumstances there is generally little alternative but to undertake:

DESCALING
This process involves the use of very harsh chemicals, usually Hydrochloric Acid, to eat away the hard deposit of scale. The system will have to be shut down and mostly dismantled to enable proper cleansing. If this is not possible then usually equipment is simply replaced with new.
A very expensive exercise.

POWERMAG™ provides an effective method for PREVENTING and REMOVING the build up of hard scale in various types of appliance and feeding pipework.

POWERMAG™ An electromagnetic water conditioning unit (of a type) that includes a pupose built shaft. The magnetic field generated by the internal coil interfaces with the water as it passes through the chamber, providing the maximum power to exposure ratio. This changes the crystallisation characteristics of the hardness salts in the water.



Section through PowerMag

The hardness salts simply remain suspended in the water flow as a fine micro sand which may be evident as a sediment at low points or low flow areas in systems being treated.

The POWERMAG™ is robustly manufactured with a fabricated steel body. The internal parts of the chamber and the exterior of the shaft are epoxy coated.

A 240v 50Hz electrical supply is required to the unit (see specifications for fuse ratings). A control circuit and transformer provide the DC current for the coil.

POWERMAG™ is available in several different sizes depending upon the size of pipework and the type of appliance being protected.

INSTALLATION
Units are best installed onto a cold feed to a specified appliance.

BENEFITS

- APPLIANCE PROTECTION
- 'BREAKS DOWN' existing scale
- 'PREVENTS' future build up
- 'EFFICIENT'
- 'IMPROVES' efficiency of badly scaled systems
- 'NON CHEMICAL'
- 'LOW RUNNING COST'
- 'NO MAINTENANCE'
- 'SAFE'
- 'COST EFFECTIVE'
- 'ENVIRONMENTALLY FRIENDLY'

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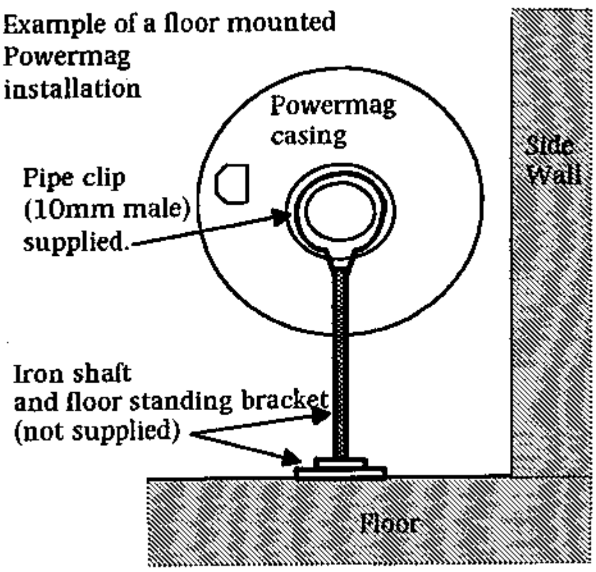
Quality Water Products

≈LIFF

Installation Instructions

POWERMAG OVERVIEW

The Powermag is designed to be installed "in line" on either Copper, PVC or Galvanised pipework To ensure that the unit is adequately supported (without placing excessive strain) on the pipework we recommend that the Powermag be installed using pipe clips.



INSTALLATION GUIDELINES

Using the pipe clips attached to the inlet and outlet of the Powermag (10mm male thread) the weight of the unit should be support by either floorstanding fixings (see schematic to the left), a fixing attached to an adjacent wall or fixings attached to the roof above the pipework.

NB Where the diameter of the Powermag body is greater than the distance of the pipework away from the wall (see table overleaf and refer to dimension D), it will be necessary for the fitter to install elbows and additional pipework.

To facilitate periodic inspection under Health and Safety guidelines we would recommend that isolating valves be installed before and after the Powermag. It should be noted that the Powermag needs no maintenance and the installation of these valves is left to the discretion of the fitter.

The Powermag should only be installed by a competent professional. Liff Industries are able to provide an installation service if required. Please contact our sales office for a competitive quote.

Unlike a water softener the Powermag does not introduce Sodium into the water, neither does it require a separate drain.

The unit takes up very little space and can be installed in confined spaces. There are no moving parts in the Powermag which means no routine servicing is required.

The Powermag is covered by a full two year warranty on all parts and labour.

If you require any additional information please contact our Technical Dept (01484) 512537

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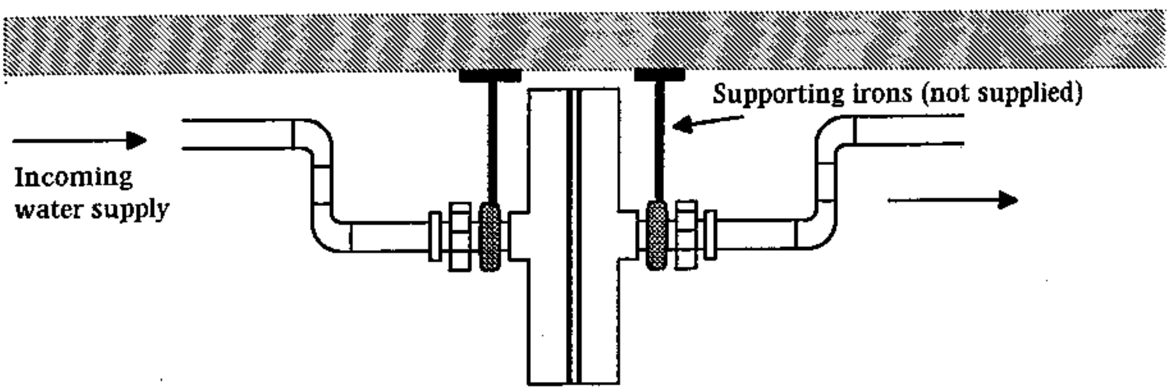
Quality Water Products

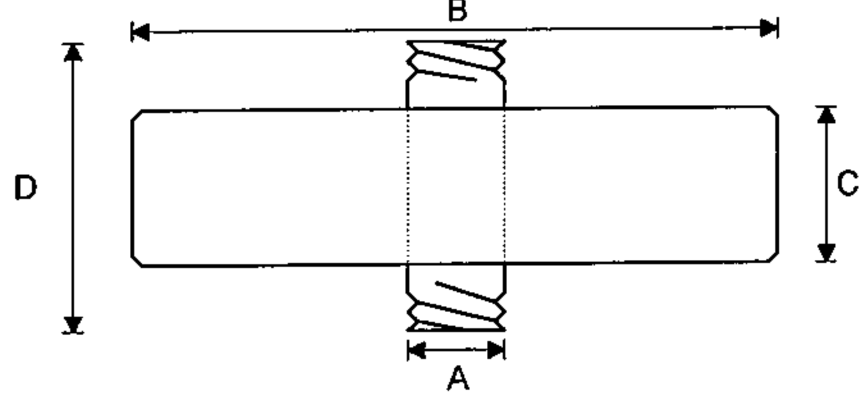
POWERMAG INSTALLATION (CONT)

When installing the Powermag on pipework close to a wall it may be necessary to introduce elbows and additional pipework to accomodate the width of the outer casing.

Example of installation needing additional elbows and pipework



Model	A	B	C	D
P100	1" BSP	190mm	110mm	185mm
P150	1½" BSP	360mm	145mm	240mm
P200	2" BSP	415mm	195mm	330mm
P300	3" BSP	415mm	195mm	330mm



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LIFF

What PowerMag™ Equipment is available

SPECIFICATION

Model	Pipe Size BSP (Male)	Max. Flow Rate L/ min*	Frictional Loss*	Power Supply	Power Consumption (Watts)	Fuse Rating (Amps)
P100	1"	45	0.2 Bar	240v 50Hz	250	5
P150	1 ½"	120	0.2 Bar	240v 50Hz	350	5
P200	2"	278	0.2 Bar	240v 50Hz	500	10
P300	3"	540	0.2 Bar	240v 50Hz	620	10

* Peak flow rates and nominal frictional loss measured at 5 BAR supply pressure

Max. working pressure all models 14 BAR. Max Temperature 80°C (175°F)
All fittings to BS1740. Tubes to BS1387. Power Supplies to BS3535.

We recommend that the PowerMag is connected to the following sized spur
P100 & P150, 1 x Double Pole Fused Switched Spur 5 AMP
P200 & P300, 1 x Double Pole Fused Switched Spur 10 AMP

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Quality Water Products

LIFF

romag

electromagnetic water conditioning system

REMOVES

EXISTING

SCALE,

STOPS

FUTURE

BUILD UP

SIZING

Seven different sized Rotomags enable flows from 0.38 to 19.7 litres per second to be correctly conditioned.
Sizing is based entirely on the flow rate of water passing through the unit.
Too few litres per second and the impeller will not rotate fast enough: too many, and there will be insufficient time exposure to the magnetic forces set up in the system.
A steady flow rate within the unit's tolerance is required.
To achieve flows for optimum performance, and overcome the frictional loss across the Rotomag unit, pumps should be used. Full details may be obtained from our technical department.

INSTALLATION

Full details appear in our installation and maintenance manual.
Advice on installation is available and trained staff are on hand to visit site or discuss any installation in detail. Comprehensive site surveys are undertaken and include detailed sizing and installation information.

COMMISSIONING

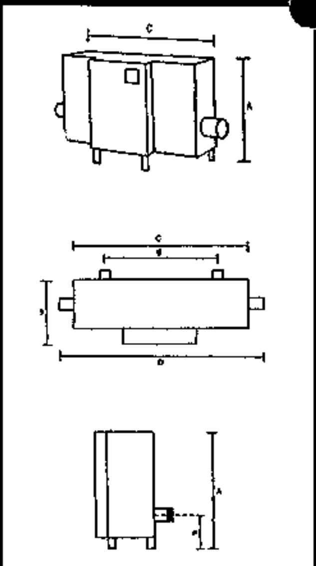
Following installation by the appointed contractor a Liff commissioning engineer will visit site to inspect the installation to ensure optimum results from the Rotomag system.

SERVICING

Routine inspection is recommended. This should take the form of a visual inspection to ensure that the system is operating correctly. Full service and repair back-up can be provided by our factory trained engineers.

ROTOMAG SPECIFICATION

Model No.	Pipe Size BSP Male	Operational Flow Rate		Frictional Loss Across Unit	Power Consumption Watts	Weight Kg	Sizes					
		L/Sec	gpm				A	B	C	D	E	F
R75	1"	0.38-0.68	5-9	0.3 bar	75	25	363	210	425	475	345	125
R100	1"	0.68-1.2	9-16	0.3 bar	200	33	450	210	425	475	345	160
R125	1 1/4"	1.2-1.9	16-25	0.3 bar	250	46	455	270	577	627	484	188
R150	1 1/2"	1.9-2.7	25-35	0.3 bar	350	71	530	270	613	668	525	200
R200	2"	2.7-4.9	35-65	0.75 bar	500	102	555	320	720	890	603	230
R300	3"	4.9-9.8	65-130	0.75 bar	620	115	680	390	967	1142	802	267
R400	4"	9.8-19.7	130-260	0.75 bar	800	165	758	415	1010	1185	786	295



Maximum working pressure all models 14 bar. All fittings to BS1740. Tubes to BS1387. Power supplies to BS3535.
All models WRC listed 8912031. Patent GB 2221173A TM 1205671.

TECHNICAL SERVICE

With thousands of successful installations in all types of applications and in a wide range of markets, Liff can offer practical advice on your scale problems.
Technicians will visit your site, examine any possible application, size the appropriate unit and advise on installation. No charge is made for this service.

LIFF

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E & OE 1995 Ref: **IRG 11695**

NAT. ASS. OF PLUMBING HEATING & MECHANICAL SERVICES CONTRACTORS

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ROTOMAG
Installation Instructions

QUALITY
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What is Rotomag™ Water Conditioning

In certain Geographic areas, Hardness in the water used for processes or secondary hot water systems will lead to inevitable problems with the build up of an insulating layer of Hard Scale.
*Water hardness varies considerably but in general **hard** water has around 120 - 180 Mg / Litre (ppm) of hardness and **very hard** water will have more than 180 Mg / Litre.*
This layer, formed when hard water is heated and Calcium bicarbonate turns to carbonate, is deposited onto heat exchange surfaces. The Harder the water of course, the quicker and thicker the layer formed.
The result is:

EFFICIENCY LOSS

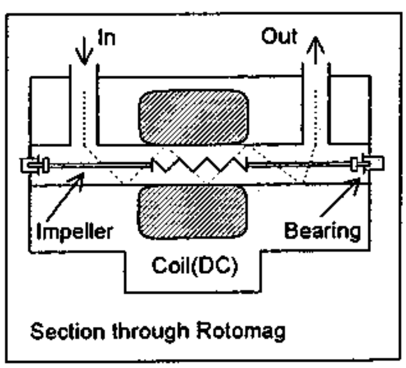
Just 1.6 mm of hard scale on a heat exchange surface will result in an 11% loss of efficiency.
Domestic Hot Water systems are particularly prone to this type of scale problem as there is always considerable water use and more hard water produces more scale.
Systems will therefore be very expensive to run, as more Primary Heat is required to produce the same hot water temperature and can eventually become so blocked that water flow is inhibited.
In these circumstances there is generally little alternative but to undertake:

DESCALING

This process involves the use of very harsh chemicals, usually Hydrochloric Acid, to eat away the hard deposit of scale. The system will have to be shut down and mostly dismantled to enable proper cleansing. If this is not possible then usually equipment is simply replaced with new.
A very expensive exercise.

ROTOMAG ELECTROMAGNETIC WATER CONDITIONING

provides a realistic, inexpensive and effective method of PREVENTING and REMOVING the build up of hard scale in various types of process.
ROTOMAG™ utilises the power of a large electromagnetic field to affect the ability of particles to form a hard crystalline structure. With its patented rotating impeller section, spinning inside a specially configured electromagnetic coil, there are continuous changes in direction of the fields and hardness elements contained in the water flow become magnetically similar in polarity thus rendering them unable to form together as a hard deposit under heat. The material simply remains suspended in the water flow as a fine micro sand which may be evident as a sediment at low points or low flow areas in systems being treated.



Section through Rotomag

Most important to the operation of ROTOMAG™ is impeller rotation which must be at a constant speed.
Without it there is no conditioning effect.
A Pump is required to produce water flow within the specified range for the unit and to turn the impeller at an adequate speed.

The ROTOMAG™ is robustly manufactured with a fabricated steel body and stainless steel and coated internal parts.
A 240v 50Hz electrical supply is required to the unit (see specifications for fuse ratings). An internal control circuit and transformer provide the DC current for the coil.
It is available in several different sizes depending upon the amount of water to be treated and all models carry WRC approval for use with potable water systems.

INSTALLATION

Units are installed together with a suitably sized pump, either into process pipework or simply to circulate water storage tanks, which then provide a reservoir of conditioned water. This is important in situations where there is significant fluctuation in demand i.e. Secondary Hot Water Systems so that impeller rotation within the ROTOMAG can be maintained at a constant speed.

BENEFITS

- 'EFFECTIVE'
- 'BREAKS DOWN' existing scale
- 'PREVENTS' future build up
- 'EFFICIENT'
- 'IMPROVES' efficiency of badly scaled systems
- 'NON CHEMICAL'
- 'LOW RUNNING COST'
- 'LOW MAINTENANCE'
- 'SAFE'
- 'COST EFFECTIVE'
- 'ENVIRONMENTALLY FRIENDLY'

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Quality Water Products

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Installation Guide

TANK RE-CIRCULATION

Demand for water in a secondary hot water systems is generally variable and maybe outside the flow range of a particular Rotomag. The most successful technique for overcoming this is to re-circulate the cold water storage cistern (CWSC) using a pump together with a properly sized Rotomag.
This will ensure;
a) A steady, accurate flow will pass through the Rotomag assuring optimum effect.
b) Freshly conditioned water will be available irrespective of varying demands.
c) The secondary hot water system will receive conditioned water as well as all other services drawing from the cold water tank.

Rotomag installation:- Submersible Pump Tank re-circulation
Tank re-circulation using a submersible pump can be beneficial. This type of installation will avoid cutting into the tank, reducing installation costs considerably.
Diagram 1 shows a schematic layout for this type of installation. The basic aim is to ensure that freshly conditioned water is discharged towards the down service.
Fig A shows the water being taken from the ball valve end and being discharged above the down service. Sometimes you may find that the ball valve and the down service are both at the same end of the tank in which case we recommend that water is taken from the opposite end of the tank to the ball valve and discharged towards the down service pipe. Please also note that it is very important that the water is discharged below the lowest possible water level to avoid the possibility of aeration.

Rotomag installation:- External Pump Tank re-circulation
It may not always be possible to use a submersible pump in which case we recommend an external pump be used.
Diagram 2 shows a schematic layout for this type of installation. The suction pipe should be as short as possible and should be positioned so as not to draw debris into the system from the bottom of the tank. Equally there should be sufficient flooded suction head above the inlet. (see sheet on installation overview). As in Diagram 1, if the ball valve and the down service are at the same end we recommend that water is taken from the opposite end of the tank to the ball valve and discharged towards the down service pipe.

Rotomag installation:- External Pump Twin-Tank re-circulation
Where two or more tanks need conditioning, proper circulation through the Rotomag system can be achieved by re-circulating each tank. Installation of each tank must be balanced using lockshield valves on the discharge pipes.
Diagram 3 shows this type of installation. The suction pipes should be as short as possible and should be positioned so as not to draw debris into the system from the bottom of the tank. Equally there should be sufficient flooded suction head above the inlet. (see sheet on installation overview).
Fig B shows the pipe layout for tanks where the down service and ball valves are at the same end.

NB. In all of the above installations, isolating valves are positioned either side of the pump and Rotomag to allow the units to be serviced and flows set accurately.
In general ALL Rotomag installations are intended to operate continuously. Pump motors are continuously rated and there is no ON / OFF switch on the equipment. For this reason, always consider carefuly where the items are to be positioned as some vibration and / or noise will be generated by the Rotomag and the pump.

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DIAGRAM 1

Rotmag Installation:- Submersible Pump Tank re-circulation.

Fig A

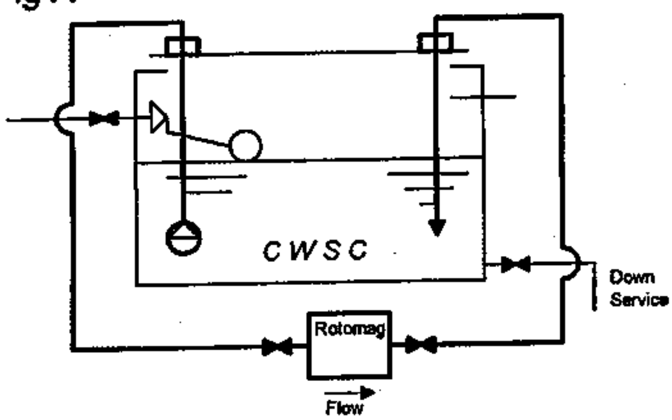

Fig B

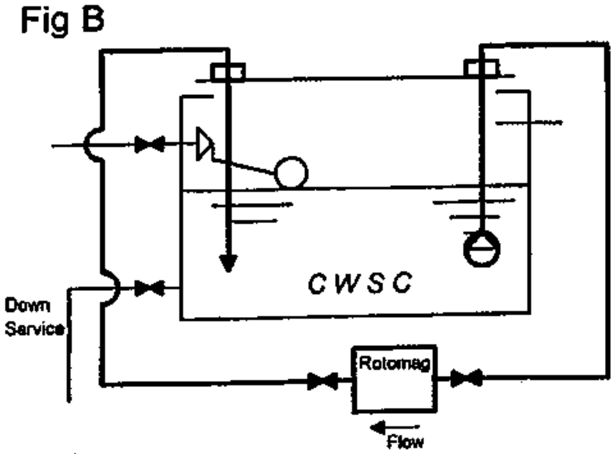

DIAGRAM 2

Rotmag Installation:- External Pump Tank re-circulation.

Fig A

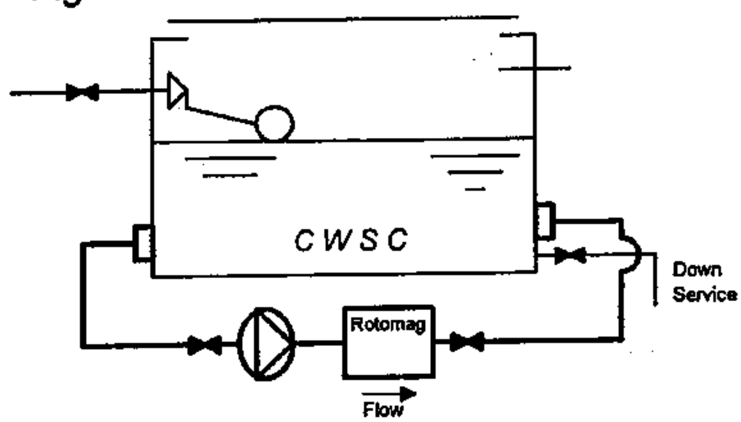

Fig B

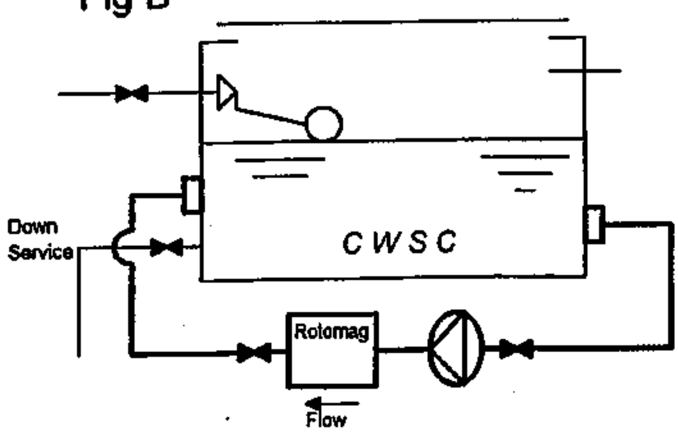

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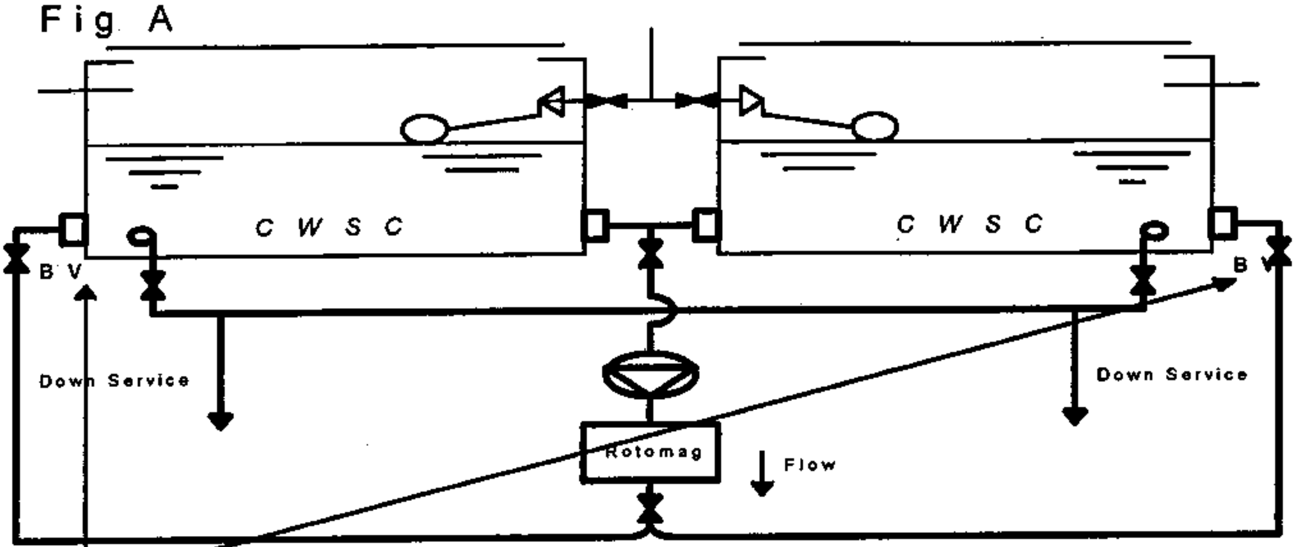
DIAGRAM 3

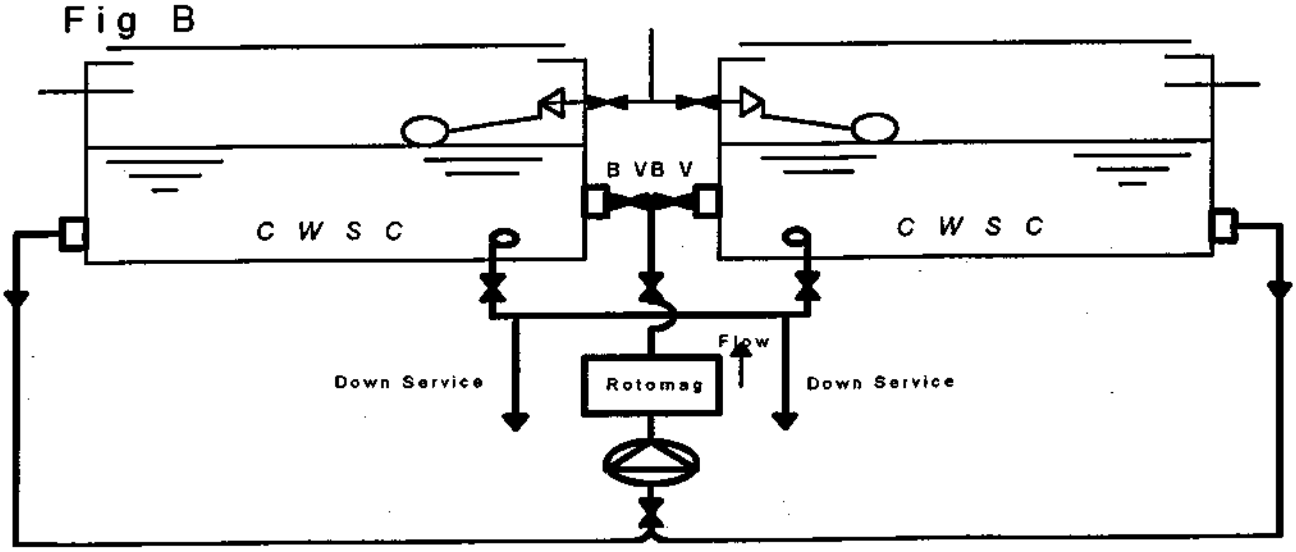
Rotomag Installation:- External Pump Twin-Tank re-circulation.

Fig A



BV = Balancing Valve used to balance discharge to each tank.
Lockshield type to be used to avoid the flow being accidently re-set.

Fig B



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Technical Data Sheet

WORLD CLASS WATER CONDITIONERS
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Pump loop configuration

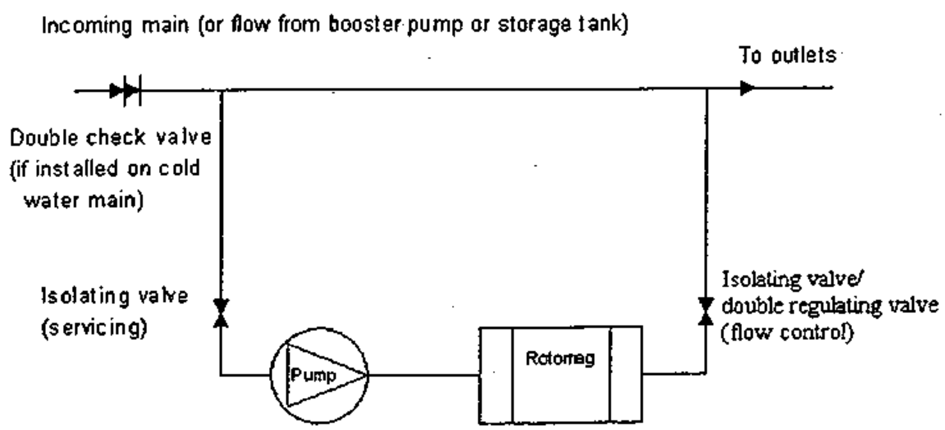
The schematic layout below shows a Pump Loop configuration containing a Liff Rotomag and Pump installed on the incoming main to a property. This configuration also applies to a boosted or down service supply.

This configuration has been independently tested by the Water Research Council to ensure that it does not contravene the requirements of the Water Byelaws (WRC listing 9707017) Installation requirement notes are as follows;

IRN 001
Pump loop consisting of Rotomag water conditioner and Pump. The system is to be installed on a by-pass to the existing incoming main (or following a Booster Pump), in such a way that should the incoming main not require flow, the pump loop configuration will continue to circulate the water through the Rotomag.

IRN 111 - Bylaws 29, 58 and 73
The pump loop system is to be so installed as to be readily accessible for examination, repair, replacement or operation

IRN 136 - Byelaw 69
A servicing valve shall be installed at the inlet to the Pump. A flow control valve shall be installed after the Rotomag to control the flow of water through the unit.



GENERAL MAINTENANCE INSTRUCTIONS

MODELS - R75 to R150 (with 'sealed for life' ball bearings)

With the fitting of a new ball bearing units there is not the requirement for regular maintenance as described previously.
The bearings are sealed and contain a packing of water resistant grease. They require no further lubrication.
An annual inspection MUST take place to ensure free rotation and cleanliness of the impeller.
Follow removal and cleaning instructions as for plain bearings.
At this time check also that ammeter reading and magnetic field are OK.

If any problems are experienced with impeller rotation after inspection then consult trouble shooting section or replace the bearings.
Normal life expectancy for the bearings is 2 years but this may be adversely affected by:
a. too high impeller speeds (water flow not adjusted properly)
b. too high water temperature. Max. 80°C

NOTE

Ball bearings cannot be inserted into Rotomag units which use plain bearing bushes.
New Stainless Steel end plugs are required with a larger bore which will accept the new ball bearing
See spare parts section for details

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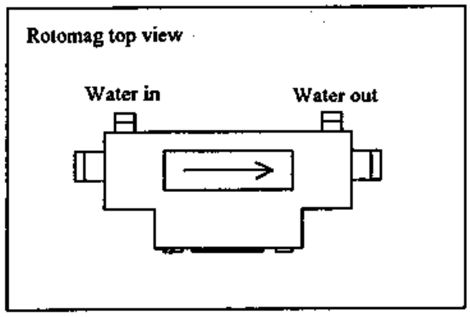
Rotomag™ Operating Instructions

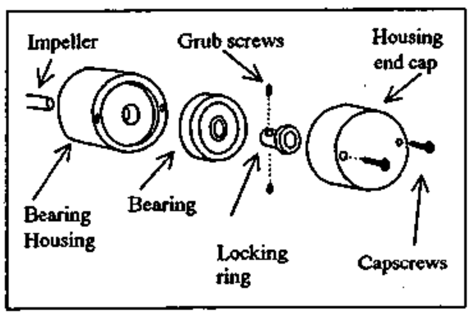
GENERAL MAINTENANCE INSTRUCTIONS

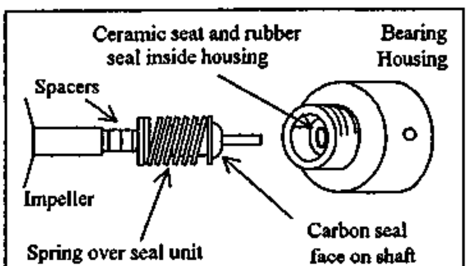
MODELS - R200 to R400 (with external bearing housings)

Basic maintenance needs to be carried out, even during the 12 month warranty period, to ensure proper rotation of the impeller. Without this rotation, the system will not function.
The maintenance MUST be carried out on a regular basis at 6 month intervals.

The following instructions will enable the work to be carried out by any competent personnel but Liff do provide competitively priced Service Contracts to take care of the work for you.
More detail can be obtained by contacting the Customer Service Department at the number below.







When removing or re-installing the impeller, be very careful not to damage the Ceramic seal face located inside the bearing housing.

MAINTENANCE SCHEDULE - 6 MONTHS

1. *Turn off the pump. Isolate Rotomag from electrical and water supplies*
2. *Remove the end cap retaining screws and remove the end caps. This reveals each of the Bearings. Check each for signs of wear or water damage.*
3. *Unscrew the locking ring retaining grub screws and remove the locking rings. Remove each bearing. Check and replace if necessary.*
4. *Using a large 'Pipegrip', 'Stilson' or 'Chain Dog', unscrew ONE of the bearing housings ensuring that any escaping water is collected. Remove the housing carefully as there is a ceramic seal inside which is easily damaged.*
5. *Make sure also that the Carbon face of the seal remains on the shaft.*
6. *Remove the other bearing housing. Withdraw impeller. Note that the seal units remain on the impeller shaft. DO NOT DAMAGE THEM.*
7. *Clean flight in centre with a wire brush to remove any build up of harmless iron deposit. Remove each of the seal and spring units retaining the spacer washers for re-installation. Check each rubber seal for wear or damage. Replace if damaged.*
8. *Inspect impeller ends for wear. If badly worn then fit new impeller.*
9. *Fit spacers to shaft ends in same order they were removed. Use a small amount of 'Washing up liquid' or similar lubricant and push each seal and spring assembly onto the shaft. NOTE direction. Carbon seal can be retained with 'Petroleum Jelly' or similar. NOTE correct position of face.*
10. *Slide impeller through Rotomag so one end is exposed. Place bearing housing over shaft end and tighten housing 1/2 way. Place bearing housing over other end and tighten 1/2 way. Slowly tighten each end alternately until fully tightened.*
11. *Fit bearings and locking rings. Check that impeller can be rotated.*
16. *Turn on the water flow, check for leaks. Purge any air from pump. Turn on electrical supply to Rotomag. Turn on pump and adjust water flow to give correct impeller speed. Replace the end caps.*
18. *Check ammeter reading and magnetic field are satisfactory. Consult trouble shooting section if not.*

****For Service or Contract Service contact Service Departmen***

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Quality
Water
Products

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What Rotomag™Equipment is available

SPECIFICATION

Model	Pipe Size BSP (Male)	Flow Rate L/ sec	Frictional Loss	Power Supply	Power Consumption (Watts)	Fuse Rating (Amps)
R75	1"	0.38 to 0.68	0.3 Bar	240v 50Hz	75	2
R100	1"	0.68 to 1.2	0.3 Bar	240v 50Hz	200	5
R125	1.25"	1.2 to 1.9	0.3 Bar	240v 50Hz	250	5
R150	1.5"	1.9 to 2.7	0.3 Bar	240v 50Hz	350	5
R200	2"	2.7 to 4.9	0.75 Bar	240v 50Hz	500	10
R300	3"	4.9 to 9.8	0.75 Bar	240v 50Hz	620	10
R400	4"	9.8 to 19.7	0.75 Bar	240v 50Hz	800	10

Max. working pressure all models 14 BAR. Max Temperature 80°C (175°F)
All fittings to BS1740. Tubes to BS1387. Power Supplies to BS3535.
All models WRC listed 8912031. Patent GB 2221173A TM 1205671

The frictional losses on the three larger units are greater because they have external ball bearings.

We recommend that the Rotomag and Pump are connected to the following spurs;
R 75 to R150, 2 x Double Pole Fused Switched Spur 5 AMP
R200 to R400, 1 x Double Pole Fused Switched Spur 10 AMP

NB Larger 1 phase and all 3 phase pumps use a Motor Starter and may require thermal overload protection.
(See pump manufacturers literature or discuss with Liff at time of purchase)

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Quality
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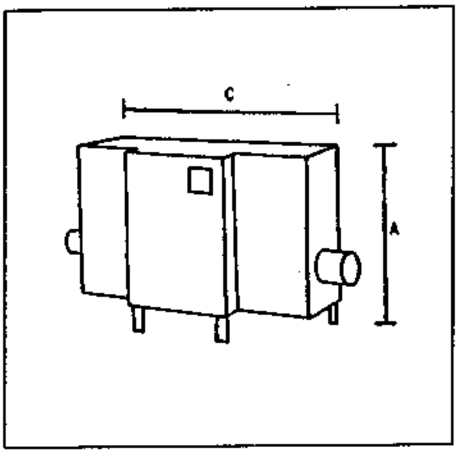
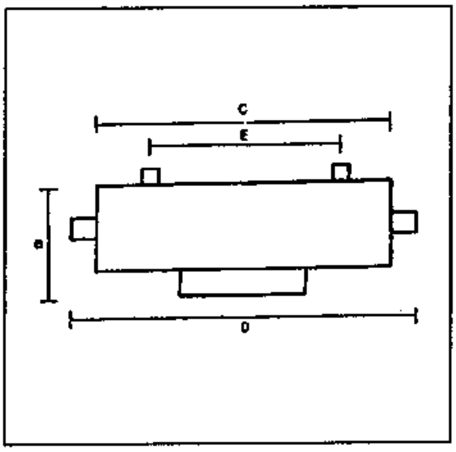
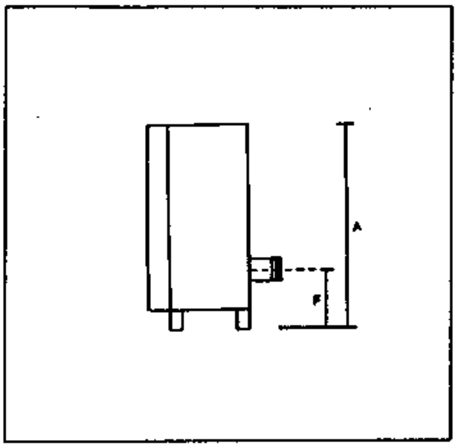
What Rotomag™Equipment is available

SPECIFICATION







Model	A Total Height	B Width of body	C Length of body	D Overall length	E In / Out centres	F Centre height in / out	Weight Kg (Lbs)
R75	363	210	425	475	345	125	25 (55)
R100	450	210	425	475	345	160	33 (73)
R125	455	270	577	627	484	188	46 (101)
R150	530	270	613	668	525	200	71 (156)
R200	555	320	720	890	603	230	102 (224)
R300	680	390	967	1,142	802	267	115 (253)
R400	758	415	1,010	1,185	786	295	165 (363)

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Rotomag™ Operating Instructions

TROUBLE SHOOTING GUIDE

PROBLEM	*POSSIBLE CAUSE*	*ACTION*
No 'Green Neon' on front of Rotomag	*Failure of power to Rotomag*	*Check fuse. Repair / replace. Check circuit.*
	Failure of Neon	*Isolate power. Remove front panel and tray. Replace neon.*
Green Neon 'ON' but no reading on Ammeter scale	*Fuse blown in control circuit*	*Isolate power. Remove fuse from holder in front of Rotomag. Check and replace if necessary.*
		If fuse blows again. Fault in control circuit or transformer. *Replace power pack required, call Engineer.*
	Coil may have condensation or water damage.	*Check coil resistance. If damaged, coil cannot be repaired and a new Rotomag will be required.*
Ammeter needle does not move	*Faulty Ammeter*	*Replace ammeter. Isolate power. Remove front panel and tray. Replace ammeter.*
Ammeter reading goes down slightly after a short time	*This is perfectly normal.*	*Electrical resistance of the coil changes as it warms up and ammeter reading will drop*
Rotomag makes a slight 'whirring' noise	*This is perfectly normal*	*As the impeller inside the Rotomag is spinning due to water flow from the pump this noise is normal.* *Commissioning Engineer will point this out.*
After Commissioning or Service, Rotomag makes a loud noise or vibration	*New bearings have 'bedded in' and impeller is turning too quickly*	*Reduce flow slightly from pump by regulating the valve until noise stops.*
	If noise occurs after a long period of time	*Replace bearing bushes. Isolate power and water before doing so.*
Rotomag makes NO noise	*Check water flow from pump*	*Make sure valves are open. Check power to pump. Repair if necessary. Replace if necessary.*
		If water flow is OK. Isolate, then remove front plug in Rotomag and check impeller rotates freely. If not, remove and clean. Replace bearing bushes.

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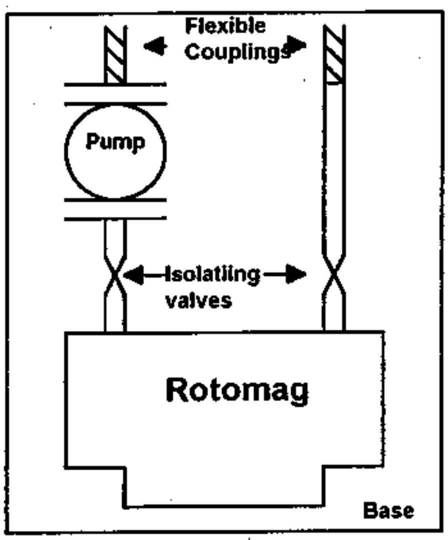
TROUBLE SHOOTING GUIDE

PROBLEM	*POSSIBLE CAUSE*	*ACTION*
Water leaks from around end plug	*Failure of 'O' ring seal*	*Replace 'O' ring seal*
SERVICE		
After service impeller does not turn	*Impeller is bent*	*Check straightness. Replace impeller.*
	Bearing bushes too small diameter	*Open out bore slightly with reamer.*
Impeller is wedged between end plugs. No 'end float".	*Length too short between bushes.*	*File down the bush face to increase end float. Check 3mm (1/8") end float.*
	Impeller not located in opposite end bush	*Carefully position impeller and ensure location in opposite end bush.*
When tightening end plug impeller 'snags' or moves up and down.	*Bearing bush is eccentric*	*Remove and replace bearing bush*
	Bearing plug is cross threaded.	*Check and replace if necessary*
	Thread in Rotomag is eccentric	*Return for repair or replace Rotomag*
R200, R300, R400 only:		
Water leaks from hole in external bearing housing	*Badly fitted or damaged Mechanical Seal on impeller shaft*	*Isolate powe and water. Remove both bearing housings. Check seals.* *Check spring loads and spacers are satisfactory.* *Fit more spacers if required*
Impeller 'NOT' turning	*Bearings seized*	*Fit new bearings.*
	No flow from pump	*Check power supply to pump* *Check all valves are properly open.* *Check pump for blockage* *Check pipework for blockage.*
	Impeller broken	*Isolate power and water. Replace damaged impeller*
	Too much friction in seals	*Adjust spacers on impeller shaft*
Impeller is difficult to remove for service.	*Power still 'ON' to Rotomag*	*Isolate power before servicing*

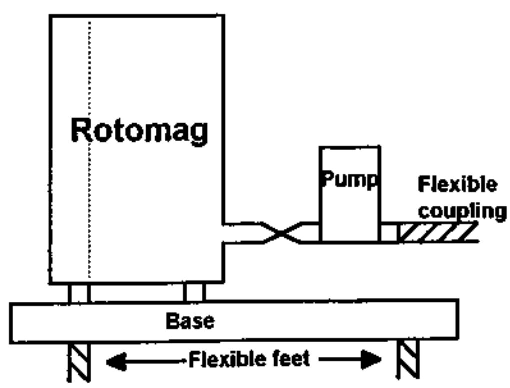
ANTI VIBRATION PACKAGE

Applications
The anti vibration package is sometimes required on cold water storage tank recirculation where noise transmission is an important consideration e.g.. if the installation is positioned above living accommodation.

Although the noise transmitted by the Rotomag and Pump is minimal, the vibrations may be amplified due to the location and type of fittings used e.g.. vibration may run through pipework, tank walls, roof joists etc.



Schematic of anti vibration installation



Method
The risk of noise caused by vibration through the floor or through joists is eliminated by installing the Rotomag and Pump on a base with flexible feet. The equipment is isolated from pipework by flexible couplings.

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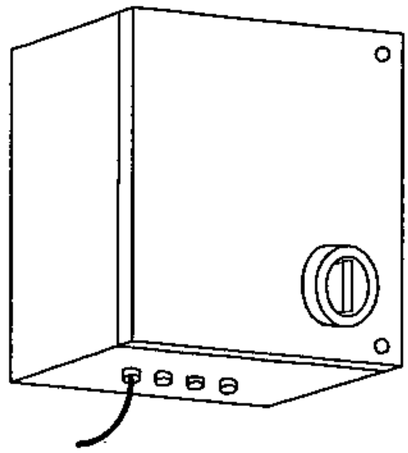
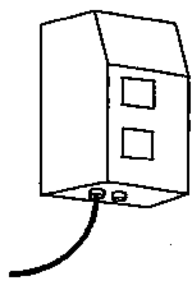
OPTIONAL EQUIPMENT

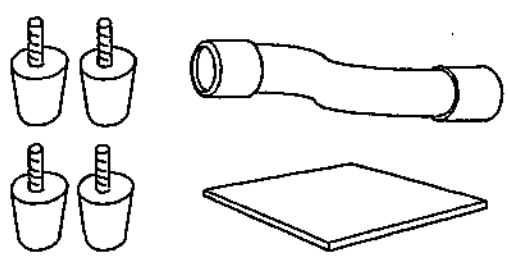


MODEL - RMV - 001 - 075 to 400

External Volt Free Contact Control Panel available for all sizes of ROTOMAG.™ (see electrical section for full detail and wiring diagrams).
Panel incorporates isolator, fuse, starter, thermal overload and volt free contacts for pump or rotomag failure. These contacts can be wired to any BMS system.



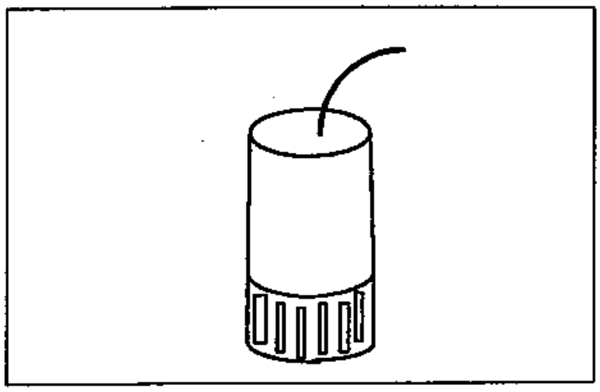
Motor Starter and thermal overload protection can be provided in a single housing ready for connection to the supplied pump. Consult Pump Manufacturers specifications for details.
(see electrical section for standard sizes and wiring diagrams.)



Anti Vibration Kit is available for inclusion in systems where either pump, rotomag or pipework is likely to cause a vibration or noise problem.
Kit comprises 4x anti vibration feet, flexible couplings, mounting board.
Kits are available for all units up to R150.
Larger sizes only available upon application.

OPTIONAL EQUIPMENT

Submersible pumps are available for Rotomag units R75 to R150. where it is easier to install or it is not possible to drain or cut into a water storage tank. (see pump selection chart for more details of sizes) All motors are 240v 50Hz



External 'In Line' pumps with unions or flanges are available for all sizes of Rotomag unit for use with both hot and cold water applications.
These pumps are easily fitted 'in line with the installed pipework.
Various motors are available in both 240v 50Hz single phase and 415v 50Hz three phase.

Liff Industries Ltd
Bayhall
Miln Road
Huddersfield
HD1 5EJ
Tel. 01484 512537 Fax. 01484 513597

Quality Water Products

Commissioning Schedule

WORLD CLASS WATER CONDITIONERS
Liff Industries Ltd
Bayhall, Miln Road
Huddersfield
West Yorkshire
HD1 5EJ, England
Tel; 01484 512537
Fax; 01484 513597
Email; sales@liffindustries.com

Rotomag™

To ensure the long term effectiveness of the Rotomag and to avoid problems immediately following installation, it is strongly recommended that the unit is commissioned by a Liff engineer. This service is provided free of charge and the person responsible for the installation should contact Liff at the above address to make arrangements for a commissioning date. Please note that we require a minimum of 14 days notice for commissioning.

It should be noted that the Liff commissioning engineer is responsible for commissioning the Rotomag and Pump only. We will of course make a brief inspection of the adjoining pipe-work, however it should be noted that the responsibility for the design and installation of this part of the system remains the responsibility of the installation engineer.

The adjoining pipe-work must have been leak tested prior to commissioning. The fused spur that will be used to power the Rotomag and Pump must also have been tested to ensure an appropriate supply.

The stages of commissioning are as follows;

1. Check the Rotomag and Pump unit for any visible sign of damage to the cabinets.
2. Check overall installation configuration to ensure that it complies with the Liff specification given in our Rotomag installation guidelines.
3. Check adjoining pipe-work and valves for leaks. Liff Industries cannot accept responsibility or liability for correcting existing or future leaks.
4. Ensure electrical supply is isolated. Connect Rotomag and Pump to spur if required.
5. Open inlet valve to Pump. Check for leaks.
6. Open outlet valve downstream of the Rotomag. Check for leaks.
7. Switch on the power supply to the pump and Rotomag. Check for the presence of a magnetic field using a magna-probe or similar device.
8. Using the valve downstream of the Rotomag, adjust the flow of water to a level where the impeller rotates without making excessive noise. It should be noted that the bearings that allow the impeller to rotate will free up over time and the flow through the valve should be set to accommodate this.
9. In situations where the Rotomag is installed in a tank re-circulation configuration and the conditioned water is being fed back into more than one tank, the commissioning engineer will balance the discharge valves accordingly.
10. Having completed the commissioning, the engineer will produce a site visit report, a copy of which is to be issued to the customer and a copy kept at Liff Industries Head Office for future reference.

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MATTHEWS & YATES LIMITED

A SAFETY STATEMENT

HEALTH & SAFETY AT WORK

EUROVENT CODES OF PRACTICE

DESCRIPTIONS

INSTALLATION

OPERATION & MAINTENANCE INSTRUCTIONS

for the Standard Range of

GENERAL PURPOSE & DUCT

AXIAL FLOW FANS

(Direct Driven - Belt Driven - Bifurcated)

CE

PUBLICATION: 2464 5866

Matthews & Yates Limited, Peartree Road, Stanway, Colchester, CO3 5LD
Telephone: 01206 543311 Telefax: 01206 760497
E-mail: sales@matthews-yates.co.uk
www.matthews-yates.co.uk

A Safety Statement

The Axial Flow Fan can present dangers - from live electrical parts and from rotating equipment - which may cause injury and/or damage. To prevent injury and/or damage, sufficient safety precautions must be taken.

Whilst the following instructions cannot cover every eventuality, if the information does not appear to be perfectly clear, or if there is any doubt that equipment might not be installed and electrically connected in the correct manner, Matthews & Yates Limited should be contacted.

1 The Matthews & Yates Axial Fan is intended for moving air and is only suitable for use in the environments and for the purposes specified in these instructions If used improperly, or for different purposes without the prior agreement of Matthews and Yates Limited, then such use would be outside the scope of reasonably foreseeable circumstances and may be unsafe

2 Whatever the application, access from either side to the rotating parts must be prevented whilst the fan is operating Guards are available for this purpose.

3 It is the **responsibility of the users** to satisfy themselves that the fan is suitable for the conditions of use and that installations and regular maintenance is carried out by personnel with the appropriate skills and in accordance with these instructions

4 If it is necessary to carry out any assembly operations before installing the fan, ensure that all fastenings are tightened correctly and propose use is made of lifting points

5 The fan must be earthed and no installation or maintenance work should be attempted **without first switching off and isolating the fan and its controls** from the electrical supply and allowing the rotating parts to come to rest.

6 The security of fastenings and the integrity of components should be checked regularly as part of the routine maintenance operation Particular attention should be paid to the impeller fastening screw Do not re-use locking devices

7 The operation of the Axial Flow Fan causes air to be drawn into the Inlet end of the fan case and to be discharged from the Outlet end. The standard range fan should be used, in designated safe areas, for this purpose only Included in the Matthews & Yates special application range are fans suitable for use in hazardous areas (explosive atmospheres) and for handling corrosive/toxic gases as well as for the ventilation of road and railway tunnels and high temperature smoke extraction (For details of our special application range of Axial fans, see the appropriate Publications)

Health & Safety At Work

The installer is required to ensure that the fans are suitable for the application and conditions of use and that a regular programme of maintenance is carried out by competent electrical and engineering staff - as failure to comply with these instructions may invalidate the guarantee All installers, users and maintenance personnel are reminded of their obligations and duties under the UK Health and Safety At Work Act, the European Community Workplace, Machinery & Construction Products Directive - and all other applicable National Legislations on Safety.

Eurovent Codes of Practice:

The General Purpose Fan

A fan for moving air (or other gas which is non-toxic, non-corrosive, non-flammable and free from abrasive particles), at a temperature which does not exceed 80°C - or, if the motor or fan bearings are in the airstream - 40°C

The Duct Fan

A fan, designed to be installed in conjunction with ductwork which may be connected to one of both sides of the fan.

Descriptions: Matthews & Yates General Purpose & Duct Fans

The Direct Driven Axial Flow (SL) Fan

Comprises a Standard Length duct case (complete with an inlet and discharge flange), within which a motor is rigidly located and where the impeller is mounted onto the motor's shaft A terminal box is fitted to the fan case and connection is required to be made into the fan case terminal box

The Direct Driven Axial Flow (SS) Fan

Comprises a Super Short fan case within which a motor is rigidly located and where the impeller is mounted onto the motor's shaft An earthing screw is fitted to the fan case and connection is required to be made into the motor terminal box

The Guide Vane Fan

Comprises an Inlet Guide Vane, bolted to an Axial Flow The Guide Vane comprises a short length fan case, within which is located a capped tube and vane assembly. The discharge end of the Inlet Guide Vane should be fitted to the inlet end of the Fan, with the capped end of the tube facing the incoming air

The Two Stage Fan

This fan comprises two Direct Driven Axial Flow Fans - bolted together to form one unit. Each fan should be mounted, horizontally, in Form B running (air is drawn into the impeller and is discharged over the motor). A Left Hand fan as the First Stage, is bolted via its discharge flange, onto the inlet end of a Right Hand fan. (Air volume can be regulated by switching off the First Stage). A terminal box is fitted to each fan case and connection is required to be made into the fan case terminal boxes.

The Belt Driven Fan

This fan comprises a long length fan case, within which a fanshaft and bearings assembly is rigidly located and where the impeller is mounted onto one end of the fanshaft and a drive pulley is mounted onto the other end. The fan case, slotted to accommodate drive belts, is provided with an external, adjustable, motor mounting plate. A motor is fitted onto the mounting plate and a drive pulley is mounted onto the motor's shaft. Drive belts are fitted, connecting the motor and fan drive pulleys and suitable drive guards are fitted. Connection is required to be made into the motor terminal box.

The Bifurcated Fan

This fan comprises a fan case, having a split airway which accommodates a motor compartment (which, in turn, protects the motor from the high temperature airs and gases, corrosive fumes and dust laden atmospheres). The motor compartment accommodates the motor (allowing the motor's shaft to protrude into the fan case area) and the impeller is mounted onto the motor shaft. Connection is required to be made into the motor terminal box.

Installation - The Motor

Power Supply

Ensure that your supply voltage and earthing connections to the fan are in accordance with the relevant Regulations or Codes of Practice of your Local or supply Authority. Ensure also that your voltage and frequency agrees with the voltage and frequency information stamped on the fan nameplate.

Connections - Terminals

The motor must be electrically connected to ensure that it rotates the fan's impeller in the correct direction. Check the connection diagram (a copy will be found in the terminal box) and ensure that earthing and correct terminal connection is made.

Connections - Earthing

Earthing screws/terminals are provided - in the SL fan case terminal box - on the SS fan case - and with the Belt Driven and the Bifurcated fans, in the motor terminal box. Ensure that correct earthing connection is made.

Protection - Overload

Fuses in the motor circuit are suitable only as a protection against short circuit and earth conditions - not against motor overload! Suitable overload protection must be provided. The overload protection should not exceed 110% of the Full Load Current (stamped on the motor nameplate).

Protection - Starting

Suitable starting protection, rated sufficiently to carry the starting current, must be provided. Where insufficient or non-specific information on starting current is available:

1 Check the Full Load Current

2 For DOL (Direct On Line) starting, select fuses

Three Phase - rated at 600% of the Full Load Current for 3 seconds

Single Phase - rated at 400% of the Full Load Current for 20 seconds.

3 For Star/Delta starting (motors normally rated 4.0KW and over), check the information given in the Tender Offer.

Protection - Other

Where motors are fitted with anti-condensation heaters, thermistors or thermostats, these items must be electrically connected in accordance with the connection diagram supplied.

Capacitors

The Single Phase motor is supplied complete with a capacitor. Some motors are supplied with the capacitor internally fitted. Others, where the capacitor is supplied loose, provide the customer with the options of mounting the capacitor to the motor, or to a suitable alternative surface.

Speed Control and Compatibility

A variety of motors (Three Phase and Single Phase), are suitable for speed control, either via voltage regulation or transformer control. Where a 2-speed motor is fitted, a compatible Change Speed Switch must be employed. Do not use incompatible speed controllers or speed change switches - they may damage the motors - and will invalidate any Warranty.

Starting and Insulation Resistance

All motors are suitable for direct-on-line starting and most are suitable for star-delta starting. Ensure, however, that all 3 phase starters have single phasing protection features and that the motor's resistance to earth is checked prior to starting. Ensure the insulation resistance is above 1 megohm and do not use a test voltage in excess of 500 Volts. (Do not apply this test to (if fitted) thermistors, thermostats or anti-condensation heaters - where, the continuity checking should not exceed 6 volts). All motors may be automatically started - but prolonged starting times should be avoided.

Where more than 10 starts per hour are required - refer to Matthews and Yates Limited

Installation - The Fan

Rotation and Airflow

The directions - rotation of the impeller (standard is RH) and the airflow (standard is Form B) - are shown by an arrowplate attached to the fan case

Mounting and Forms of Running

Check the fan nameplate and the direction of rotation arrowplate Mount the fan in the correct form of running (Form B - horizontal airfow - IN through the impeller and OUT over the motor - is the standard form of running) Ensure any Guide Vane or 2nd Stage Fan, together with the appropriate mounting feet and matching flanges are securely and correctly attached to the fan guide vane flanges Remove the appropriate plugs from drainholes in the motor and from the drain holes(s) in the duct mounted terminal (box(es) Ensure no damage is caused in the fitting of any Anti Vibration Mounts A qualified electrician should select cables and make connections - and seal conduit entries, etc

Additional Information:

Fitting the Guide Vane

Ensure the Inlet Guide Vane is bolted correctly to the Axial fan

Assembling the Two Stage Fan

Ensure the LH fan (the First Stage) is bolted correctly to the RH fan (the Second Stage) and that the fan case mounted terminal boxes are positioned suitably (for ease of installation and maintenance)

Checking the Belt Driven Fan

Ensure the motor is secure and correctly located on its (adjustable) mounting platform Ensure the drive pulley grooves are free from oil, grease and burrs Ensure the drive belts are matched, free from oil and grease and are not damaged Ensure the drive belts are tensioned correctly (the use of a Belt Tension Indicator will be of assistance to you) Place a straight-edge over the faces of the drive pulleys and ensure they are correctly aligned Ensure all drive guards are correctly and securely fitted

Mounting the Bifurcated Fan

Ensure the fan is mounted with the motor compartment in a horizontal position - to provide both easy access to (and ventilation of) the motor

Impellers

Standard impellers are manufactured in die cast aluminium, suitable for use at 350°C (at 400°C for short period use) and are balanced to the Standard Commercial Grade of G6 3

TENV Motors

The Totally Enclosed Non-Ventilated motor - cooled by the passage of air over the motor - is fitted to the Direct Driven Axial Flow (SL) and (SS) Fans

TEFV Motors

The Totally Enclosed Fan Cooled motor - cooled by the motor's integral cooling fan - is fitted to the Belt Driven Axial and the Bifurcated Axial Flow Fans

Operation

Power Off

Switch the power off

Isolate the Fan and Motor

Isolate the fan and its control gear from the electrical supply and ensure than any rotating equipment has come to rest Ensure, also, that no ducted (or free) air will cause any equipment to rotate

Check the Fan and Motor

Ensure the fan/motor unit is correctly installed, correctly connected to an electrical supply, that all fixings, ancillaries and safety guards are secure and that the impeller rotates freely and is in the correct form of running Check any drive assembly for correct pulley ratio, alignment and belt tension

Protect the Fan

Ensure that there are no foreign bodies or articles which might obstruct the operation of the fan or the free flow of air in either the fan or its ancillaries and inlet and/or outlet ducting

Protect the Motor

Ensure a qualified electrician has correctly selected cables, made correct earthing and terminal connections and that adequate control gear has been provided for the protection (starting and overload) of the motor

Power On

Return the electrical supply

Flick-Test

Momentarily start the motor and check to ensure that the fan impeller rotates in the correct direction. If the impeller rotates in the wrong direction, the direction of rotation can be changed as follows

With a single speed 3 Phase motor, interchange any two supply leads

With a single speed 1 Phase motor, consult the connection diagram

With a two speed motor, consult the connection diagram

Start the Fan

When you are satisfied that all is in order, close down any dampers in the system and start the fan. When the fan reaches full speed, check the Amps drawn by the fan at the motor - then whilst progressively opening the system dampers, continually check and ensure that the fan does not draw excessively high Amps

Maintenance

Power Off

Switch the power off

Isolate the Fan and Motor

Isolate the fan and its control gear from the electrical supply and ensure that any rotating equipment has come to rest. Ensure also that no ducted (or free) air will cause any equipment to rotate

Check and Clean the Fan

Check the fan case for signs of damage. Check the impeller for signs of wear/damage, for security of fixing and for even clearances at the blade tips. Check for signs of lateral movement of the motor shaft. Clean the impeller and hub assembly and the internal surfaces of the fan case. Ensure all fixings are correctly tightened and that all safety guards are securely attached. Check the supply cables, conduits and connections and ensure that no water has ingressed into either the fan case terminal box or the motor terminal box.

Check and Clean the Motor

Check the motor for signs of wear and/or damage. With the TENV motor, clean the external surfaces and cooling fins. With the TEFV motor, clean the external surfaces and ensure the ventilation slots in the end cover (which protects the integral cooling fan) are free from debris

Lubrication - Fans

The Light and Medium Duty Belt Driven fans are generally fitted with Simple Units ("sealed for life" fanshaft bearings), which should be replaced at the following regular intervals

Fan speed - 1750 rpm... after 30,000 hours operation

Fan speed - 1440 rpm... after 33,000 hours operation

The Heavy Duty Belt Driven fans are fitted with Carrier Units, which are normally provided with a "through greasing" facility. A lithium based grease - Essso Unirex N3 (or other compatible) - should be used for re-lubrication. Where Carrier Units are mounted within an Axial Flow Fan's Case, extended lubricators can be provided. Particular instructions for the lubrication of the Drive End (DE) and (NDE) Non-Drive End bearings of these Carrier Units accompanies each fan/motor unit.

Lubrication - Motors

The smaller size motors (Fame Sizes D63 - D160) are fitted with "sealed for life" bearings, which should be replaced at the following regular intervals

Motor speed - 2P... after 24,000 hours operation

Motor speed - 4P... after 33,000 hours operation

Motor speed - 6P..... after 35,000 hours operation

Motor speed - 8P..... after 35,000 hours operation

The larger size motors (Frame Sizes D180 and over), are normally provided with a "through greasing" facility. A lithium based grease - Essso Unirex N3 (or other compatible) - should be used for re-lubrication. Where such motors are mounted within an Axial Flow Fan's Case, extended lubricators can be provided. Particular instructions for the lubrication of the Drive End (DE) and (NDE) Non-Drive End bearings of these motors accompanies each fan/motor unit

Check the Belt Drives

Always use a matched set of new drive belts. Ensure the pulleys are free from oil and grease and that any burrs have been removed from the grooves. Do not force the belts into the pulley grooves. Check the belt tension with the aid of a Belt Tension Indicator and ensure the pulleys are correctly aligned, with shafts parallel. After the drive has been running for a few hours - and thereafter at regular intervals - re-check (and adjust if necessary) belt tension and alignment

Check the Ancillaries

Check for correct fitting operation of

- Mounting Feet
- Anti Vibration Mounts
- Bellmouth (Inlet) Entries
- Matching Flanges
- Flexible Connectors and Worm Drive Clips
- Air Operated Dampers (Lubricate spindles as necessary)

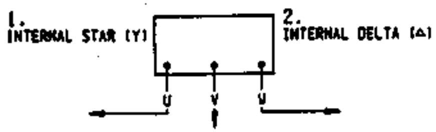
Check the Electrics

Check connections, conduits and seals

Completion Checking

Check the Fans on completion of any maintenance, ensure that all tools or any other items which may cause obstruction are removed from the fan, its ancillaries or ducting, before returning the electrical supply and putting the fan into operation

CONNECTION DIAGRAM FOR 3 PHASE SINGLE SPEED 3 WIRE INDUCTION MOTOR



SUPPLY TO U.V.W

TO REVERSE DIRECTION OF ROTATION CHANGE OVER ANY 2 SUPPLY LEADS

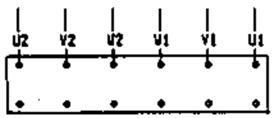
CD 0327

CONNECTION DIAGRAM FOR 3 PHASE SINGLE SPEED INDUCTION MOTOR

6 LEADS FOR STAR (Y) OR DELTA (Δ)

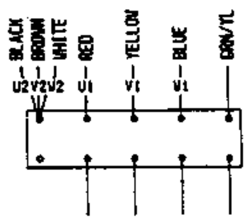
1. STAR DELTA (Y-Δ) STARTING: CONNECT ALL 6 LEADS TO STAR-DELTA STARTER

2. DIRECT-ON DELTA (Δ) LINK W2 TO U1, U2 TO V1, V2 TO W1. SUPPLY TO U1.V1.W1



CD 0324

WIRING DIAGRAM FOR THREE PHASE ZT FANS 380 - 420 VOLTS

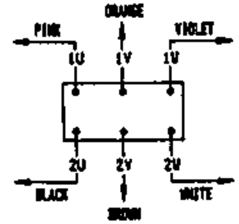


TO REVERSE DIRECTION OF ROTATION INTERCHANGE ANY TWO SUPPLY LINES

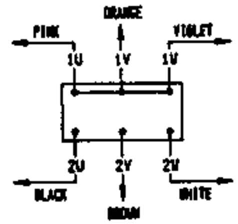
CD 0343

CONNECTION DIAGRAMS FOR 3 PHASE TWO SPEED INDUCTION MOTOR

SINGLE WINDING VARIABLE TORQUE (FAN TYPE)



SUPPLY TO 1U.1V.1W



SUPPLY TO 2U.2V.2W

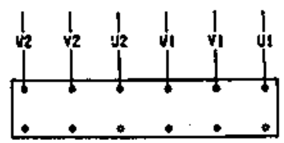
TO REVERSE DIRECTION OF ROTATION INTERCHANGE ANY TWO SUPPLY LINES

CD 0323

CONNECTION DIAGRAM FOR 3 PHASE INDUCTION MOTOR

1. LOW SPEED (Y) SUPPLY TO U1.V1.W1

2. HIGH SPEED (Y) SUPPLY TO U2.V2.W2



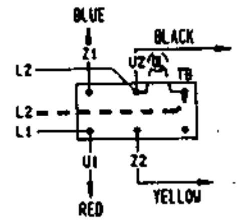
TO REVERSE DIRECTION OF ROTATION INTERCHANGE ANY TWO SUPPLY LINES

CD 0325

CONNECTION DIAGRAM FOR SINGLE VOLTAGE 1 PHASE INDUCTION MOTORS

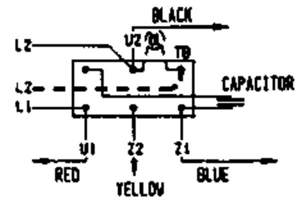
INTERNALLY CONNECTED CAPACITORS

1. SPLIT PHASE (NO CAPACITOR)
2. CAP START INDUCTION RUN
3. CAP START AND RUN (PERM)



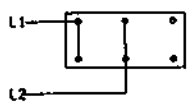
EXTERNALLY CONNECTED CAPACITORS

4. CAP START INDUCTION RUN
5. CAP START AND RUN (PERM)

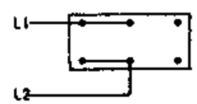


THERMAL PROTECTORS (IF FITTED) ARE CONNECTED AS SHOWN DOTTED

LINKING FOR APPROPIATE ROTATION - ALL TYPES



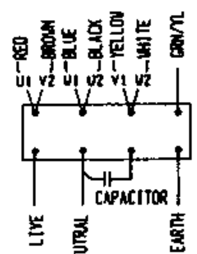
FORWARD



REVERSE

CD 0326

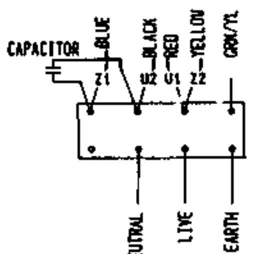
WIRING DIAGRAMS FOR SINGLE PHASE V63 ZT FANS 220 - 240 VOLTS



TO REVERSE ROTATION CHANGE NEUTRAL TO V1 V2

CD 0352

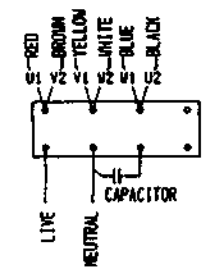
WIRING DIAGRAMS FOR SINGLE PHASE ZTI FANS



TO REVERSE DIRECTION OF ROTATION INTERCHANGE U1-U2

CD 0356

WIRING DIAGRAMS FOR SINGLE PHASE V90 ZT FANS 220 - 240 VOLTS

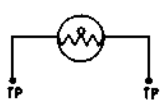


TO REVERSE ROTATION CHANGE NEUTRAL TO U1 U2

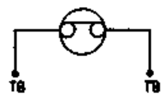
CD 0347

AUXILIARIES (WHEN FITTED) ARE MARKED AS SHOWN BELOW

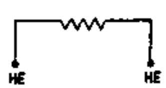
T THERMISTOR



TB THERMOSTATS



H HEATER



Matthews & Yates fans can be found in diverse applications such as community projects like hospitals, e[illegible]strial projects, factories, warehouses, office block[illegible] & civil applications like tunnels, generating plants, airport terminals and many other military and government uses. A very small selection is shown below:

POWER STATIONS & NUCLEAR PROJECTS

BC Hydro Project	Canada
Jubal Ali Power Station	Dubai
Power Station A Mileyan	Egypt
Sizewell B Nuclear Plant	England
Sellafield Nuclear Plant	England
Heysham Nuclear Plant	England
Karun Nuclear Power Station	Iraq
Kori Nuclear Power Station (Korea)	Korea
Norsk Hydro	Norway
Al Khobar & Al Khardy Power Station	Saudi Arabia
Peterhead Power Station	Scotland
Torness Nuclear Plant	Scotland
Bukit Batok Transmission Station	Singapore

EDUCATION

University of British Columbia	Canada
University of Cambridge	England
University of Liverpool	England
University College of London	England
University of Manchester	England
University of Oxford	England
Yarmouk University	Jordan
Rehabilitation College	Saudi Arabia
Nautical College	Scotland
Ngee Ann Technical College	Singapore
Vocational and Technical Training Board	Singapore
SIA Training Centre	Singapore
United World College	Singapore

TUNNELS

Autoway E3	Belgium
Great Bell of Charleroi	Belgium
Leopold II Tunnel	Belgium
M25 Motorway	England
Blackwall Tunnel	England
Kandovan Mountains	Iran
Milan Underground	Italy
South Italy Railway Tunnels	Italy
Telecom Cable Tunnels	Malaysia
Mecca Inner Ring Road	Saudi Arabia
Muna Walkway	Saudi Arabia
Taif Conference Underpass	Saudi Arabia
Clearwater Tunnel	Sicily
Pulau Seraya Tunnel	Singapore
Mass Road Transit	Singapore
Arsenal in Rocourt	Switzerland
Izmir Road Tunnel	Turkey

PETROCHEMICAL

Ranhoc	Malaysia
JFP Well Service	North America
Sunoco Exploration	North America
Texas Eastern Gas Pipeline	North America
Taywood Santa Fe Platform	North Sea
Upper Zakum Gas	Saudi Arabia
Yanbu Petrochemical	Saudi Arabia
Gas Project 1000	Saudi Arabia
Siberian Gas Pipeline	USSR
Methanol Plant Tomsk & Ormsk	USSR

MEDICAL

St Pauls Hospital	Canada
Chilliwack Hospital	Canada
Langley Hospital	Canada
Pyramid Hospital	Egypt
North Manchester General Hospital	England
East Birmingham Hospital	England
Queen Mary Hospital	Hong Kong
Pamela Youde Hospital	Hong Kong
Tuen Mun Hospital	Hong Kong
Queen Elizabeth Hospital	Kota Kinabalu
Royal Hospital	Oman
Qaboos University Hospital	Oman
Group A Hospital	Saudi Arabia
Border District Hospital	Scotland
Gleneagles Hospital	Singapore

MARINE

Ferry Boats	Denmark
Royal Hellenic Navy	Greece
Container Ships for Snamprogetti	Italy
Rosyth Dockyard	Scotland
Cargo Boats	United Arab Emirates
Ice Breaker Ship	USSR

AIRPORTS

Bahrain International	Bahrain
London - Heathrow International	England
London - Gatwick International	England
Roissy Airport	France
Fumic International	Italy
Queen Ali Airport	Jordan
RAF Kinloss	Scotland
RAF Leuchars	Scotland
Changi Airport	Singapore
Al Ain Airport	United Arab Emirates
Abu Dhabi International	United Arab Emirates

COMMERCIAL

Munitions Factory	Belgium
Motor Building	Borneo
City Square	Canada
Robson Square	Canada
Buckingham Palace	England
House of Commons	England
British Telecom Research Centre	England
London Wembley Arena	England
National Indoor Arena NEC	England
H M Prison Blundeston	England
Brooks Shopping Centre	England
Abbey National Headquarters	England
Philip Morris Factory	Holland
National Textile Factory	Iran
Macau Incinerator	Macau
Textile Mills	Pakistan
PVC Complex	Poland
Military Factories	Saudi Arabia
Edinburgh City Car Parks	Scotland
Parkhead Forge Shopping Centre	Scotland
Princes Square Shopping Centre	Scotland
Glasgow Concert Hall	Scotland
Allied Cocoa Factory	Singapore
Dupont Electronics Factory	Singapore
Hitachi TV Assembly Plant	Singapore
Sanyo Industries	Singapore
Sumitomo Chemical Plant	Singapore
Lkab Iron Ore Mines	Sweden
Taiwan Glass	Taiwan

HOTELS

Birmingham Novotel Hotel	England
Ritz Carlton	Hong Kong
Peninsular	Hong Kong
Shangri-la	Malaysia
Al Bustan Palace	Oman
Ramada	Qatar
Half Moon Bay	Saudi Arabia
Glasgow Moathouse Hotel	Scotland
Hilton Hotel	Singapore
Holiday Inn	Singapore
Mandarin Hotel	Singapore
Goodwood Hotel	Singapore
Raffles City	Singapore
Sheraton	Singapore
Abu Dhabi Sheraton	United Arab Emirates

CUSTOMERS WHO HAVE USED OUR FANS

ADNOC	HYATT
AGGREKO	HYUNDAI
ALCAN	ICI
ANSALDO	IMI MARSTON
A P V	KELLOGGS INTERNATIONAL
ARAMCO	KENTUCKY FRIED CHICKEN
ATOMIC WEAPONS ESTABLISHMENTS	LEVI
BABCOCK POWER	MARKS & SPENCER
BINLADEN	MARS CONFECTIONERY
BLUE CIRCLE	MATTHEW HALL
BRITISH LEYLAND	MOBIL
BRITISH NUCLEAR FUELS LTD	MURPHY CONSTRUCTION
BRITISH PETROLEUM	NEWTON COLLINS
BRITISH STEEL	NISSAN U K
CIBA GEIGY	N N C
CONOCO	PILKINGTON GLASS
CROWN HOUSE	PIZZA HUT
DAELIM	RAMADA
EXXON	ROLLS ROYCE
EATON CUTLER HAMMER	RUSTON GAS
FISONS	SADHELM
FORD MOTOR CO	SAFEWAYS
FOSTER WHEELER	SANYO
GENERAL ELECTRIC	SELLAFIELD NUCLEAR
GENERAL MOTORS	SIZEWELL B NUCLEAR
GEORGE WIMPEY	SHELL
HAWKER SIDDELEY	SNAMPROGETTI
HADEN YOUNG	STANDARD CHARTERED BANK
HEWLETT PACKARD	SUMITOMO
HITACHI	TAYLOR WOODROW
HONG KONG BANK	TAYMECH
HONEYWELL	TREBOR-BASSET CONFECTIONERY

The Company reserves the right to alter prices and specifications without prior notice E & O E.

Matthews & Yates

MY International

Peartree Road, Stanway, Colchester, CO3 5LD
Tel: 01206 543311 Fax: 01206 760497
E-mail: sales@matthews-yates.co.uk
www.matthews-yates.co.uk

Matthews & Yates

ENGINEERS IN AIR

Peartree Road, Stanway,
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CO3 5LD

Telephone: (01206) 543311
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E-Mail: sales@my.prestel.co.uk

Date: 13 January 1999

Drake & Scull Engineering Limited
Chiltern Region
1 Shenley Pavilions
Chalkdell Drive
Shenley Wood
Milton Keynes
MK5 6LB

For the attention of: Mr C.JONES

Dear Sirs,

Our Ref:86732 - Your P/O:W083609 1215192

This is to confirm NONE of the goods supplied by MATTHEWS & YATES against the above reference and/or purchase order contain any componants that require to be "Year 2000 Compliant".

Yours faithfully

For & on behalf of
MATTHEWS & YATES LTD

M.D.WADMORE
Technical Support Engineer

Matthews & Yates

REFERENCE	H10/M55702/R1/B
UNIT REFERENCE	(3) EXH04
QUANTITY	2 RUN & STANDBY IN SERIES

DUTY REQUIRED

Volume (M3/S)	5.5
Pressure (Pa Static)	750
Selection Pressure	1048 (Including idling losses)
Altitude (M)	Sea Level
Temperature (C)	20

UNIT SELECTED

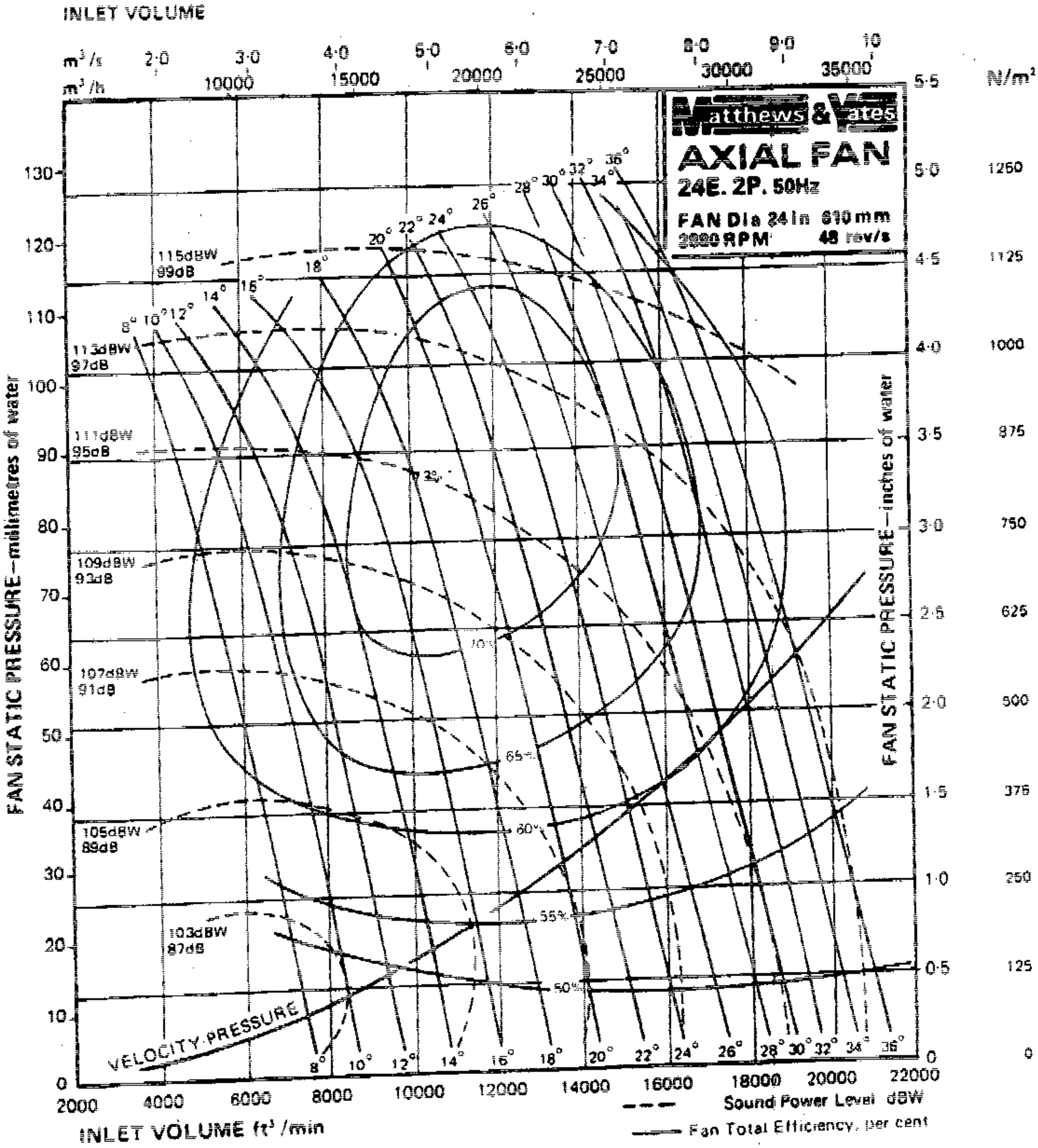
Product	STANDARD AXIAL
Product Code	24E.2P
Diameter (IN)	24
Casing Type	Standard Length
Pitch Angle (Degrees)	24
Total Efficiency (%)	70
Static Efficiency (%)	58
Sound Level (DBA)	87.85 in a free field at 3 metres

SOUND POWER SPECTRUM (IN DUCT)

OCTAVE BAND	63	125	250	500	1000	2000	4000	8000
DB	103	105	103	106	103	102	97	93

MOTOR DETAILS

Motor Type	STANDARD PAD MOUNTED MOTOR
Fumex Classification	Standard & Emergency duty,60 mins at 400 C
Motor Code	DFNV132MP
Frame Size	132
Insulation	CLASS H3
Enclosure	IP55
Motor Speed (RPM)	2880
Motor Power (KW)	12.00 (16.09 bhp)
Fan Power Absorbed (KW)	9.91 (13.28 bhp)
Fan Peak Power Abs. (KW)	10.44 (13.99 bhp)
Full Load Current	22.00
Start Current D.O.L(Amps)	165
Start Current Star/Delta	95
Power Supply	415 V 3 Phase 50 Hz



THREE PHASE 415v

ANGLE	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	34°	36°
PHASE	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
kW Peak absorbed Per Stage	3.47	4.00	4.55	5.37	6.19	7.42	8.65	9.54	10.44	11.63	12.75	13.80	14.78	16.33	17.90
hp Peak absorbed Per Stage	4.65	5.37	6.10	7.20	8.30	9.95	11.6	12.8	14.0	15.6	17.1	18.5	19.8	21.9	24.0

ACOUSTIC ANALYSIS

	OCTAVE BAND MID-FREQUENCY Hz					
IN DUCT SPECTRUM	125	250	500	1000	2000	4000
CONSTANTS	7	9	6	9	10	15
To obtain Spectrum subtract above constants from Sound Power level of the fan selected						

FOR MOTOR DETAILS SEE MOTOR DATA SHEET.

REFERENCE H10/M55702/R1/B
UNIT REFERENCE (4) EXH05
QUANTITY 2 RUN & STANDBY IN SERIES

DUTY REQUIRED

Volume (M3/S)	14.5
Pressure (Pa Static)	750
Selection Pressure	1048 (Including idling losses)
Altitude (M)	Sea Level
Temperature (C)	20

UNIT SELECTED

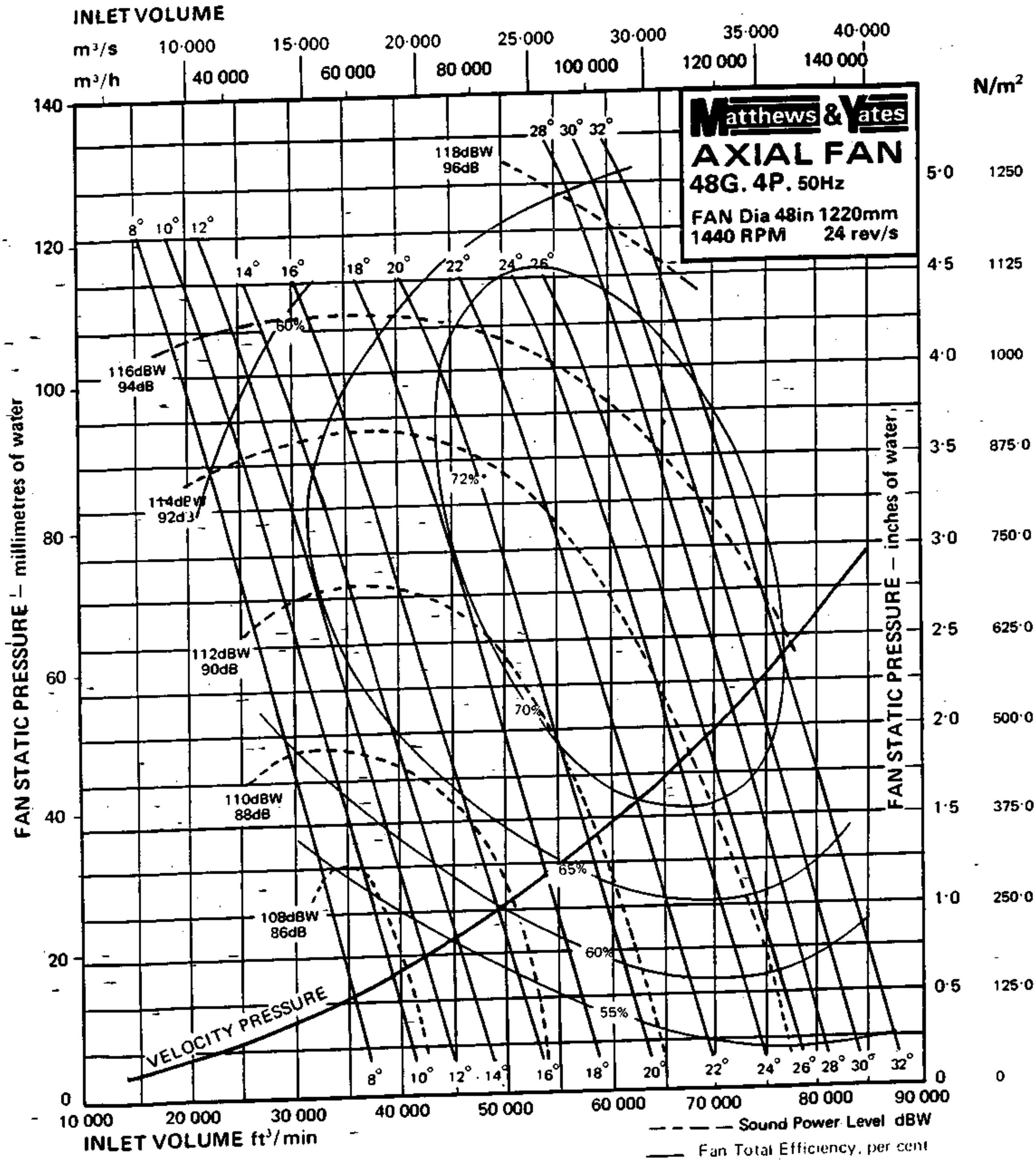
Product	STANDARD AXIAL
Product Code	48G.4P
Diameter (IN)	48
Casing Type	Standard Length
Pitch Angle (Degrees)	16
Total Efficiency (%)	62
Static Efficiency (%)	57
Sound Level (DBA)	89.27 in a free field at 3 metres

SOUND POWER SPECTRUM (IN DUCT)

OCTAVE BAND	63	125	250	500	1000	2000	4000	8000
DB	103	101	108	106	105	103	98	93

MOTOR DETAILS

Motor Type	STANDARD PAD MOUNTED MOTOR
Fumex Classification	Standard & Emergency duty,60 mins at 400 C
Motor Code	4IC
Frame Size	160
Insulation	CLASS H3
Enclosure	IP55
Motor Speed (RPM)	1440
Motor Power (KW)	32.00 (42.90 bhp)
Fan Power Absorbed (KW)	26.89 (36.05 bhp)
Fan Peak Power Abs. (KW)	29.46 (39.49 bhp)
Fan Peak Power Abs. (NTP)	29.46 (39.49 bhp)
Full Load Current	56.00
Start Current D.O.L(Amps)	420
Start Current Star/Delta	243
Power Supply	415 V 3 Phase 50 Hz



THREE PHASE 415v

ANGLE	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
PHASE	3	3	3	3	3	3	3	3	3	3	3	3	3
kW Peak absorbed Per Stage	17.52	19.76	22.37	25.73	29.46	34.68	39.15	43.25	46.98	52.57	57.42		
hp Peak absorbed Per Stage	23.5	26.5	30.0	34.5	39.5	46.5	52.5	58.0	63.0	70.5	77.0		

ACOUSTIC ANALYSIS

	OCTAVE BAND MID-FREQUENCY Hz					
IN DUCT SPECTRUM	125	250	500	1000	2000	4000
CONSTANTS	14	7	9	10	12	17

To obtain Spectrum subtract above constants from Sound Power level of the fan selected

FOR MOTOR DETAILS SEE MOTOR DATA SHEET.

REFERENCE	H10/M55702/R2/B
UNIT REFERENCE	(12) EXH06
QUANTITY	2 RUN & STANDBY IN PARALLEL

DUTY REQUIRED

Volume (M3/S)	0.24
Pressure (Pa Static)	290
Altitude (M)	Sea Level
Temperature (C)	20

UNIT SELECTED

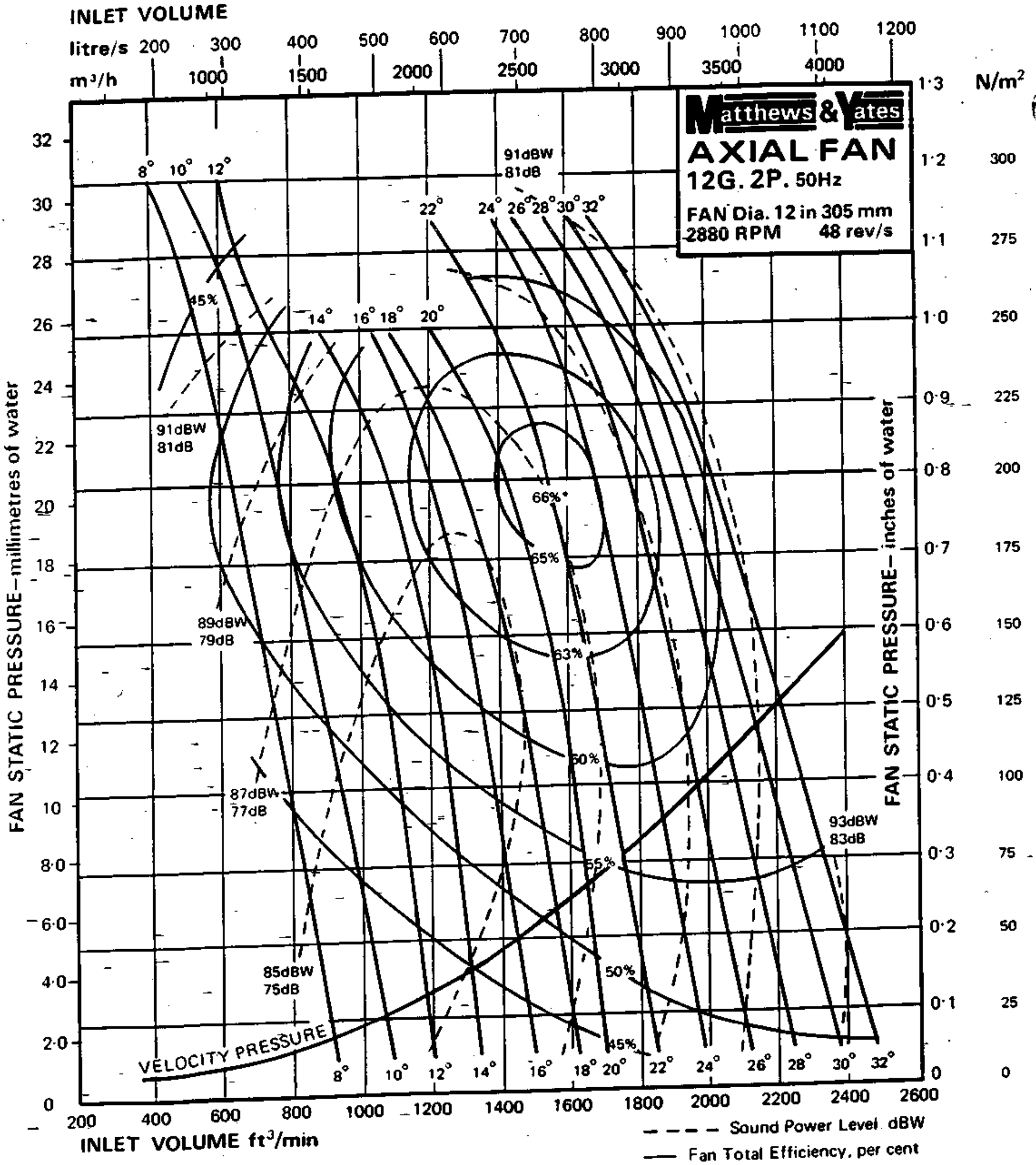
Product	STANDARD AXIAL
Product Code	12G.2P
Diameter (IN)	12
Casing Type	Standard Length
Pitch Angle (Degrees)	10
Total Efficiency (%)	42
Static Efficiency (%)	42
Sound Level (DBA)	66.66 in a free field at 3 metres

SOUND POWER SPECTRUM (IN DUCT)

OCTAVE BAND	63	125	250	500	1000	2000	4000	8000
DB	88	85	87	85	83	79	73	71

MOTOR DETAILS

Motor Type	STANDARD PAD MOUNTED MOTOR	
Fumex Classification	Standard & Emergency duty,60 mins at 400 C	
Motor Code	2DE	
Frame Size	80	
Insulation	CLASS H3	
Enclosure	IP55	
Motor Speed (RPM)	2880	
Motor Power (KW)	0.72	(0.97 bhp)
Fan Power Absorbed (KW)	0.17	(0.22 bhp)
Fan Peak Power Abs. (KW)	0.17	(0.23 bhp)
Full Load Current	2.15	
Start Current D.O.L(Amps)	11	
Power Supply	415 V 3 Phase 50 Hz	



SINGLE PHASE 220v

THREE PHASE 415v

ANGLE	8°		10°		12°		14°		16°		18°		20°		22°		24°		26°		28°		30°		32°	
PHASE	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
kW Peak absorbed Per Stage	0.14		0.17		0.19		0.21		0.23		0.25		0.27		0.31		0.34		0.37		0.40		0.44		0.48	
hp Peak absorbed Per Stage	0.19		0.23		0.25		0.28		0.31		0.34		0.36		0.42		0.46		0.50		0.54		0.59		0.65	

ACOUSTIC ANALYSIS

	OCTAVE BAND MID-FREQUENCY Hz					
IN DUCT SPECTRUM	125	250	500	1000	2000	4000
CONSTANTS	8	6	8	10	14	20
To obtain Spectrum subtract above constants from Sound Power level of the fan selected						

FOR MOTOR DETAILS SEE MOTOR DATA SHEET.

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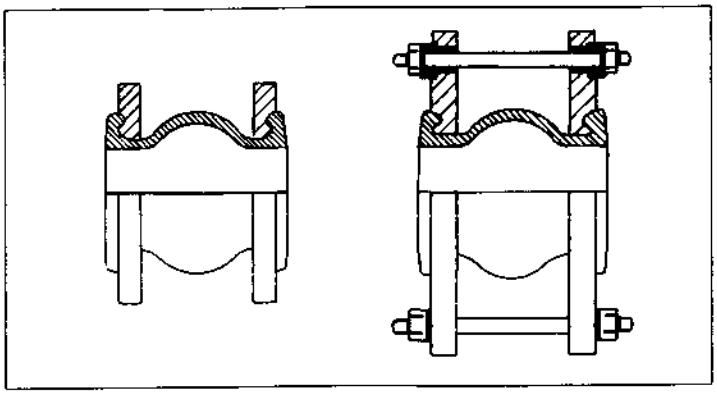
EMFLEX
EPDM Rubber Flexible Connectors

EMFLEX EPDM (Ethylene Propylene Diene Monomer) rubber flexible connectors are comprised of a synthetic rubber membrane reinforced with nylon. The collars are wire reinforced and the unit is complete with carbon steel flanges. They are capable of absorbing movement in several directions; axial compression, axial elongation and lateral deflection. A small amount of angular movement may also be allowed. They are normally installed in the pipework to isolate various items of plant which produce noise and vibration. These flexible connectors effectively dampen the transmission of sound and vibration from plant items in air conditioning and heating installations.



Type EE Untied

EPDM rubber membrane with untied flanges. Suitable for use with hot water and chilled water at 4 bar working pressure with temperature up to 100°C.

Type EE Tied

EPDM rubber membrane with tied flanges. Suitable for use with hot water and chilled water; recommended for use when the working pressure exceeds 4 bar. Temperature up to 100°C.

Nominal Size	Installed Overall Length	Axial Compression	Axial Elongation	Lateral Deflection
mm	mm	mm	mm	mm
25	125	12	9	12
32	125	12	9	12
40	125	12	9	12
50	125	12	9	12
65	125	12	9	12
80	125	12	9	12
100	125	14	9	12
125	125	14	9	12
150	125	14	9	12
200	125	14	9	12
250	125	14	9	12

For larger sizes refer to Full Face units.
Vacuum support rings are available.
A range of rubber flexible connectors is available in EPDM at installed lengths of 150mm and in Chlorobutyl at varying installed lengths.

Working Pressure:
4 bar (400 kPa) for Untied.
10 bar (1000 kPa) for Tied with top hat washers.
16 bar (1600 kPa) for Tied with hemispherical washers.

Test Pressure: 1.5 x Working Pressure.

Working Temperature: -10°C to 100°C.

Quality Assurance to
BS EN ISO 9002 - 1994
Certificate No. 5468

Design Consideration:

Rubber flexible connectors are subject to the same internal pressure force as metal expansion joints and the force is equal to the internal pressure multiplied by the maximum internal area. This force causes the connector to lengthen and tied units are recommended where the working pressure exceeds 4 bar, unless the pipework is secured to restrict movement.

Tie-rods are fitted through oval flanges and to isolate the tie-rods from the flanges special neoprene top hat washers are used to prevent any metal to metal contact whatsoever, effectively preventing noise transmission.

After installation of TIED UNITS the tie-rod nuts should be checked to have 1mm clearance over the steel washers.

On high pressure applications over 10 bar working pressure, we recommend that the tie-rods are secured using a hemispherical washer assembly which allows no extension of the unit.

When using with plant items mounted on vibration isolators, such as springs or inertia bases, then TIED UNITS must be installed.

22

Operating
&
Maintenance
Instructions

For

HVAC Equipment

Comprising of

New Easdale Air Handling Units

Installation at

5-7 CARLTON GARDENS

INDEX

VOLUME 1

SECTION 1

FOREWARD

FOREWORD

The Purpose of this manual is to clearly identify all of the equipment supplied within the Contract Package and to provide comprehensive information to ensure the safe and efficient installation,operation and maintenance of the equipment.

The basic information contained within this manual provides clear and consise written instructions on the operational functions of the equipment,identifies maintenance requirements and sets out procedures for the correct and safe installation and commissioning of the equipment.

SECTION 2

NAMES & ADDRESSES

NAMES AND ADDRESSES

ITEM	NAME
Panels / Hardware	**McQuay International** **Bassington Industrial Estate** **Cramlington** **Northumberland** **NE23 8AF** **Tel. 0191 2010412** **Fax. 0191 2010411**
Fans	**Nicotra Ltd.** **Masbrough Street** **Rotherham** **Yorkshire** **S60 1ER** **Tel. 01709 376747** **Fax. 01709 362031**
Motors	**Brook Hansen** **Nasmyth Building** **NEL Technology Park** **East Kilbride** **Glasgow** **G74 1LP** **Tel. 013552 33911** **Fax. 013552 43202**
Filters	**AAF Ltd** **Bassington Indust. Est.** **Cramlington** **Northumberland** **NE23 8AF** **Tel - 01670 713477** **Fax - 01670 714370**

Coils	**SPC Ltd.** **SPC House** **Evington Valley Road** **Leicester** **LE5 5LU** **Tel. 0116 249 0044** **Fax. 0116 249 0033**
Heat Cube	**Hoval Ltd** **Nothgate** **Newark** **Notts.** **NG24 1JN** **Tel. 01636 672711** **Fax. 01636 673532**

SECTION 3

SAFETY

SAFETY INFORMATION

- All Electrical work carried out on the Air Handling Units, must be in accordance with the Manufacturers instructions and relevant codes & practices.
- All work carried out on or in the Air Handling Units, must be carried out under the clients permit to work system.
- Before starting the Air Handling Units for the first time ensure that all earthing bonds have been made and securely fastened.
- Before working on or in the Air Handling Units, ensure that all electrical connections have been isolated and isolators padlocked in the OFF position.
- Before staring the Air Handling Units, ensure that all access doors and panels are closed and clamped shut.
- When works is required inside that Air Handling Units allow 5 minutes after switching off, for the fan speed to totally stop, before entering the Air Handling Units.

  Do not remove drive guards unless the equipment is isolated and stationary.
- Ensure that all guards are correctly replaced and secured before restarting the Air Handling Units.

SECTION 4

CDM NOTES

DISPOSAL OF REDUNDANT MATERIALS

At the end of its useful life most of the equipment can be broken up and disposed of by normal methods.

However, the casing and panels of the Air Handling Unit should be disposed of in Land-fill Dumps. Do NOT subject the pultruded frame to cutting by an abrasive disc. It can be cut up easily using a hand saw. Do NOT subject the foam filled panels to excessive heat or cutting by flame due to possible fire hazard.

Dirty filters can be disposed of in Land-fill sites providing the dust burden is not toxic.

EMERGENCY TELEPHONE NUMBER

In the event of any queries regarding the equipment supplied on this project, or in the event of plant breakdowns which can not be resolved by the clients own maintenance Personnel or resources, a 24 hour Emergency Cover is available from McQuay on the following telephone number : 0191 239 2438

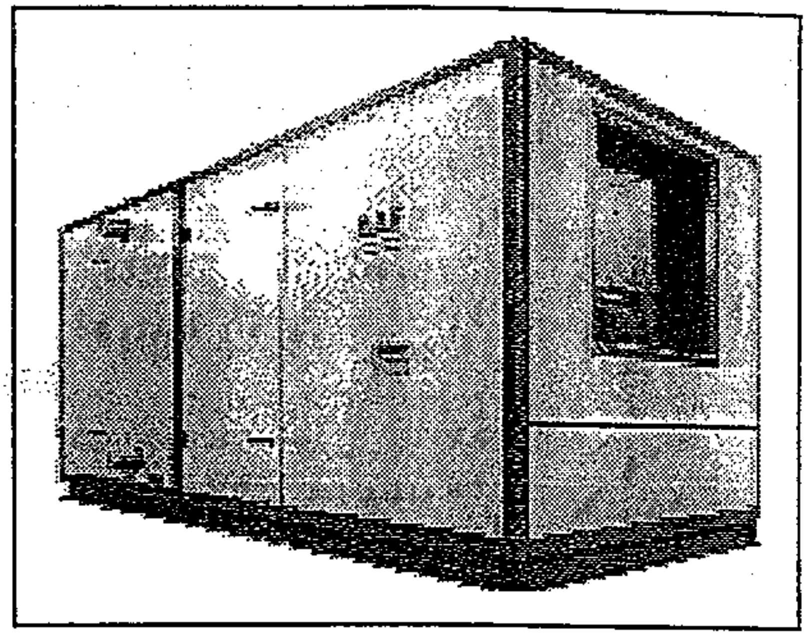
SECTION 5

AHU INSTALLATION & MAINTENANCE

New Easdale

Air Handling Unit

Installation and Maintenance



AAF INTERNATIONAL

New **AAF** Easdale

Air Handling Unit

SHIPPING

Unless stated on the General Arrangement (GA) drawing to the contrary, each unit is shipped to site in individual sections.

Each section is dispatched covered in shrink wrapped polythene sheeting. Sections are normally supplied complete with an integral channel base. Should these not be required eg. in the case of small ceiling hung units, then the sections will be shipped on wooden pallets.

Any variation to the above will have cost implications. Should special arrangements or packing be required then AAF must be notified in sufficient time.

Upon arrival check that no visible damage has occurred during transit and that all pieces listed on the packing list have been received. Any damage or shortages must be noted on the carrier's delivery note and reported to AAF head office, Cramlington, immediately.

OFFLOADING

Care should be taken during all handling of equipment to prevent damage. Weights of shipped sections are shown on the GA drawings.

It is recommended that the shrink wrapping and any wooden pallets be left in place until the unit has been correctly sited. This will help prevent site damage and aid handling.

When lifting or manhandling units the following general procedures must be observed:

1) All work must be in accordance with the Health and Safety at Work Act 1974, relevant H.S.E. Guidance Notes and Codes of Practice. When cranes are used we recommend that the requirements of BS 7121 be observed.

Lifting Section

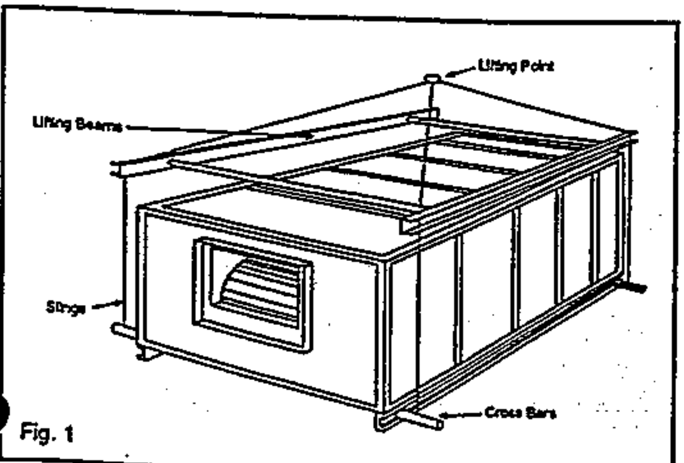


Fig. 1

2) Non-metal slings only must be used. These must be used in conjunction with a lifting frame/beam to ensure even load distribution and correct positioning of slings. Wooden packing pieces must be inserted between the sling and the framework to avoid damage.

3) Where units are mounted on a wooden pallet, they may be lifted either by a crane or fork lift truck provided, in the case of the latter, it is within the limits of normal good handling procedures.

4) The channel base fitted underneath sections is drilled to accept a lifting bar. Where a bar is used it must be mechanically locked in position to ensure it cannot move. The bar itself must be adequately sized and tested to ensure it is capable of safely handling the weight of the section.

5) All sections, particularly fan sections must remain level during lifting or manhandling.

Under no circumstances should they be tilted onto their side

STORAGE

For external storage, or storage in partly built plantrooms, the units must be protected to stop the ingress of foreign material or water into the unit. Although covered in shrink wrapped plastic sheeting this is not intended for long term storage. Units therefore should be more permanently protected, by tarpaulins or similar.

The units must not be used as site storage chambers, or be used as work platforms. Failure to prevent this can result in the unit becoming damaged.

Every 2 months the fan impeller/motor drive must be rotated by a third of a turn. Failure to do this can invalidate the AAF warranty.

Should the units be unused for a period exceeding 6 months then it is recommended that the drive belts be removed and stored separately. The fan and motor shafts must be rotated a third of a turn every 2 months as before.

LOCATION & ASSEMBLY

Location

Ensure that:

1) Sufficient space exists around the unit to enable the filters to be removed and access gained where required. It is recommended that full unit width access be provided on one side of the unit adjacent to the fan and coil sections, to enable the fans and coils to be removed should ever a fault develop.

New **AAF** Easdale

Air Handling Unit

For new assembly drawings refer to:
A4-920021,
A4-920057,
A4-921039,
further on in document.

2) The unit is installed at a height that allows the installation of a condensate drain trap.
3) Supports are adequate for the weight of the unit.
4) The plinth or fixing frame upon which the unit is to sited is firm and level.

Assembly

All fixing hardware, gasket materials, etc, for connecting the sections together are supplied by AAF. These are boxed separately and are placed inside the fan section for shipment.

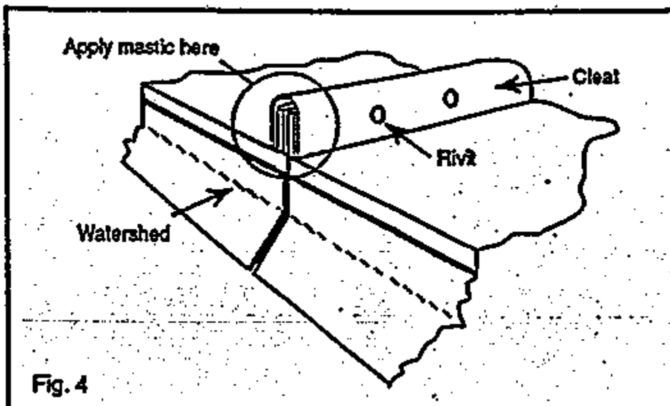


Fig. 4

The assembly procedure is as follows:

1) Referring to the GA drawing, ensure the sections are in the correct order of air flow, are correctly orientated and are central to each other.

4) Remove a side panel adjacent to the joint, if the joint is not accessible via an access door.

8) Replace the access panels upon completion.

Removing Temporary Restraints

Fans are supplied with a fan discharge flexible connector and anti-vibration mounts factory installed. To prevent damage to these during transport, temporary restraints are fitted. **These must be removed after installation and before commissioning.** They will be found inside all fan sections.

Weatherproof Units

Weatherproof units are factory fitted with flat weathercovers bonded to the top of each section. These covers have upstands at the section joints. Loose capping cleats are provided for the erector to fit over and cover the upstands. The cleats should be rivetted at a maximum of 500mm pitch, using the rivets provided. Mastic is supplied by AAF for sealing the ends of the joints, to stop water penetrating. Refer to fig 4.

New **AAF** Easdale

Air Handling Unit

Watershed strips are factory fitted along the top edges of the unit and above access doors. If these should have been damaged they must be straightened out.

Ductwork Connections

Duct connections do not require flexible duct connections since the fan/motor assembly is isolated from the cabinet. (However, where abnormal loads from the ductwork could be transferred to the unit, then flexible connections must be used).

Connections to the unit cabinet are made by site drilling into the frame on the unit inlet or fan discharge flange. These flanges are left blank, for drilling by the ductwork installer.

Electrical Connections

Flexible conduit must be used when wiring up to fan motors, to allow the fan/motor assembly to move freely on its anti-vibration mounts.

All holes must be cut neatly using a suitably sized proprietary cutter. Glands must be used to protect the wires where they pass through the unit.

Where control wires pass through the unit, holes may be drilled in the framing at the position where the inner wings meet. The holes should be cut with the appropriate angled drill suitable for glass reinforced composite. To ensure a neat hole a pilot drill must be used. The maximum hole size must not exceed 8mm diameter.

P.V.C. cable must not be used when connecting internally to electrical heating coils or gas burners. Cable with heat resistant insulation must be used.

All field wiring must be carried out in accordance with the current I.E.E. Regulations. The sizes of the cables and contactors must be suitable for the load carried.

Motor connection details are contained in the cover box of the motors.

An electrical isolator should be fitted adjacent to each electrical component ie. fan motor, pumps, heaters etc., except in the case of motor controlled by inverter controls. Special Instructions will be given separately for the latter.

Pipe Connections

The connecting pipe sizes for coils, drains etc, are as shown on the GA drawing. It is important that coils are correctly piped, eg. the supply pipe is taken to the coil supply connection.

External pipework must be adequately supported to ensure no weight is taken by the coil connections. Neither must piping expansion cause load on the coils. Failure to comply will result in damage to the coil headers. See later paragraphs covering the specific requirements of steam and cooling coils.

Care must be taken when connecting pipework to ensure no undue force is applied to the coil connections.

Steam Coils

Ensure that the steam trap fitted to the coil outlet is sized to handle at least twice the maximum condensate flow given for the coil and that there is a free fall back to the condensate receiver. If condensate lift is unavoidable then a condensate pump should be fitted. Coils banked in series must be separately trapped.

Steam mains should be adequately trapped and vented prior to connection to the coil. A vacuum break must be fitted when using modulating valves.

Note that failure to correctly pipe, trap and vent steam coils will result in premature coil failure.

Electric Heating Coils

Ensure that the safety cut out fitted to the coil is correctly wired into the controls circuit to ensure complete shutdown of the heaters in the event of overheating.

The fan control must be interlocked with the heater control to ensure that the fan is running before the heater can be switched on. Likewise it is advisable that the fan should be left running on timer control for a short time after the elements are switched off, thus clearing any static heat that might build up in the system and cause the safety device to trip out.

It is essential that a good earth connection is made to the coil section for safety reasons.

Chilled Water/Direct Expansion Coils

The section must be mounted level not only to ensure correct operation but also to avoid 'ponding' in the drain pan.

Condensate connections must be suitably trapped. Failure to do so can result in flooding. See figure 3 & 4 for minimum recommendations.

The condensate drain pipe must be at least the same diameter as the unit's drain connection. There must be a continuous fall, without dips, between the trap and the drain pipe discharge. If the nearest open gully or tundish is more than 3m away then the pipe diameter may have to be increased.

Gas Fired Air Handling Units

A set of Operating and Maintenance Instructions for the gas burner will be provided separately.

Before the burner is commissioned the client must ensure that the correct gas pressure is available and is

New **AAF** Easdale

Air Handling Unit

Drain Trap Arrangement for Cooling Coils on Suction Side of Fan

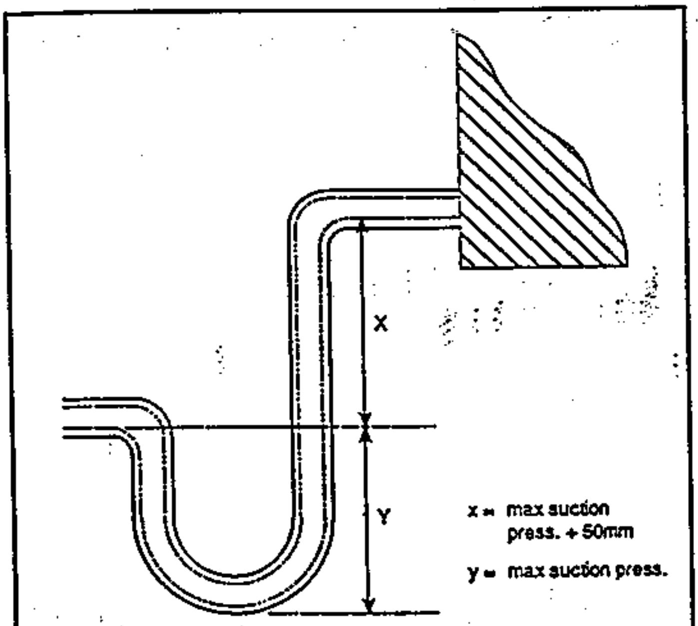


Fig. 5

Drain Trap Arrangement for Cooling Coils on Discharge Side of Fan

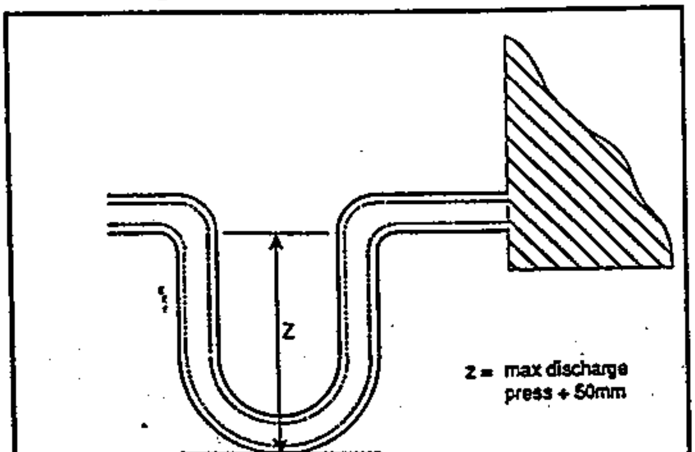


Fig. 6

connected, and that all electrical and control supplies and connections are made. The duct system must be balanced cold to provide the correct design air flowrate from the AHU before the burner is commissioned.

In the case of indirect fired burners all flue connections must be made (by others) before commissioning.

Please note:- if the above checks are not carried out then abortive site visits will be incurred, the cost of which will be invoiced by AAF.

Dampers

Should shut-off or face dampers be incorporated on the negative pressure side of fan, whether they be integral with the central plant or associated ductwork, care must be taken to ensure such dampers cannot be closed while the fan is operating.

COMMISSIONING

Pre-run Check

With the unit electrically isolated the following work should be done:

1) Although the fan section will have been factory checked prior to despatch it is always possible for components to loosen during shipment. The section must be therefore inspected to ensure there are no loose components.
2) The fan impeller must rotate freely by hand and be clear of all foreign materials. Check also the pulley alignment and tension.
3) Ensure that the unit is clear of all debris. Clean out as necessary.
4) Remove all temporary restraints fitted inside the fan section at AAF works for transport purposes.
5) Ensure the anti-vibration mounts and flexible connectors allow the fan to move freely and that movement is not constrained by any cabling etc.
6) Check the pipework to coils is correctly connected and that the fins are free from foreign matter and not damaged.
7) Prime drain traps.
8) Zero filter manometers.
9) Fit the filters into position. (It is recommended that initially only the first stage filters be fitted where there is more than one stage of filters and that the secondary filters be fitted after the initial run).

   The size, type and quantity of filter cells required, will be stated on the general arrangement drawing and confirmed by a list fixed to inside the filter access door.

   Ensure that the filter cells are installed correctly and that the airflow arrows point the correct way. Where applicable, ensure that side sealing strips are fitted to prevent the filters being by-passed.
10) Check that all dampers are operating correctly, and that they will be fully open when the fan starts.
11) Ensure all access panels are in position and securely fastened.

New **AAF** Easdale

Air Handling Unit

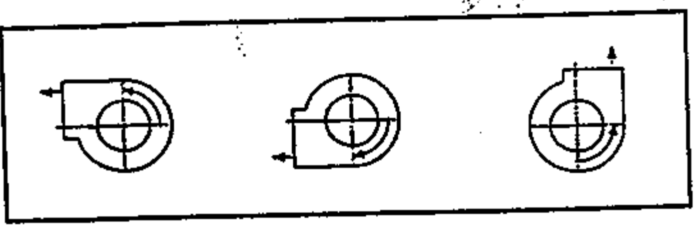
Start-up Checks

To carry out some of these checks it may be necessary to start the fan with the access door open or side panel removed.

Strict attention to personal safety must be adhered to at all times. All work must comply with the Health and Safety at Work Act 1974.

Competent, well trained personnel must be employed in the following operations:

Rotation of Fan Impeller



1) Check the rotation of the fan impeller. If required, the fan speed may be checked using a strobe light.
2) Check that there is no untoward vibration. Stop the fan and investigate if found.
3) Measure the voltage and drawn current of the motor while all panels are in position. The drawn current must not exceed the full load current stamped on the motor nameplate.
4) As drive belts stretch the most during the first 48 hours of operation the tension of the belts must be checked and adjustment made after this time. The alignment of the pulleys must also be checked to ensure the motor fixing is properly secure and not allowing the motor to twist round.

It is recommended that a close inspection be performed after the unit has been running for approximately 7 days from original start up. A check should be made to ensure:-

1) The drive belts and pulleys are still correctly tensioned and aligned (correct as necessary).
2) There are no loose components within the unit.
3) No foreign matter is blocking the coil fins, filters or fan impeller.

MAINTENANCE PROCEDURES

General

All maintenance work should be carried out with the highest regard for safety. All work must comply with the Health and Safety at Work Act 1974, all relevant H.S.E. Guidance Notes and Codes of Practice. Only competent personnel must be employed in the maintenance of the unit.

Ensure that:-

1) All electrical equipment is electrically isolated before any panel is removed, e.g. fan, control panels, electric coils etc.
2) The fan has stopped rotating prior to anyone entering the unit. At least two minutes should be allowed for this.
3) Under no circumstances must externally driven fans be allowed to run with the drive guard removed.
4) When checking the fan speed on internally driven fans it is recommended that a strobe light be used.
5) In the case of electrostatic filters, that the cells have been earthed in line with the instructions supplied with the equipment.

Door handles must not be used as footholds, otherwise damage or injury may result.

Note that the control system may allow live steam or hot water to coils and humidifiers, even though the fan is switched off. Precautions should therefore be taken whilst entering or inside the unit.

The frequency of maintenance will vary depending upon the environment in which the unit is used. Failure to carry out regular maintenance will result in poor performance in terms of unit and filter efficiency and could lead to early and costly breakdowns.

Adequate precautions should be taken to prevent freeze up of water coils and humidifiers, if they are not used during freezing weather. Frost can cause severe and expensive damage to undrained coils. It is recommended that coils should be thoroughly drained if they are not used, or that they are filled with a suitable antifreeze solution.

Monthly Checks

1) Check all moving parts for wear and tightness.
2) Check condition and tightness of drive belts and pulleys.

   If replacing drive belts ensure a matched set of new belts are fitted. New and used belts must not be employed on the same drive.

   The replacement belts must be of the same size and pitch length as were originally furnished with the unit. The new belts should be tensioned and the belt guard, where provided, must be replaced.
3) Check filter pressure drops and replace filters as necessary. It is recommended that only AAF filters

New AAF Easdale

Air Handling Unit

are fitted to the unit. When replacements are needed contact your local AAF office to enable us to discuss your requirements and thus ensure that the correct grade of media is supplied.

Under no circumstances must the filters be removed while the fan is still running. Likewise the fan must not be switched on without filters fitted or the access panel removed.

4) Monitor overall vibration levels. An increase in level is an indication of potential trouble which must be seen to.

5) Top up all drain traps. (This may have to be done more frequently, especially during Winter).

6) Inspect for coil leaks.

Six Monthly Checks

Carry out checks as described under monthly and also:-

1) Check condition of bearings and ensure they are not excessively noisy.

Note: Faulty bearings must be replaced immediately. Failure to comply may result in the fan shaft becoming damaged.

2) Grease bearings - only one stroke of the grease gun is required per 6 months continuous operation. To apply more grease than recommended may lead to early failure of the bearing.

Note that the fan bearings are already precharged for the first 6 months operation, motor bearings for the first 2 years.

Recommended lubricant for normal operations is Shell Alvania R.A.

Annual Checks

1) Check coils to ensure the fins are not blocked nor have become dirty. Fins should be cleaned using a brush and a vacuum cleaner. Failure to keep a coil clean will result in loss of performance.

Any damage to the fin edges can usually be realigned using a 'fin comb'. These can be supplied by AAF if required.

Caution: Fin edges are very sharp.

2) Clean and check condensate drain pans to ensure the outlet is not blocked and that water will drain away.

3) Check electric heating coil elements to assure insulation resistance and continuity readings are constant.

4) Check operation of gas burner controls and safety devices.

5) Check for signs of corrosion and treat as necessary.

6) Check operation of all dampers, ensuring that these operate and shut properly.

7) Check that all controls are operating satisfactorily.

8) Clean units internally and externally with warm water. Note, do not use a solvent cleaner on pre-coated mild steel.

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DESCRIPTION	WORK ORDER NUMBER
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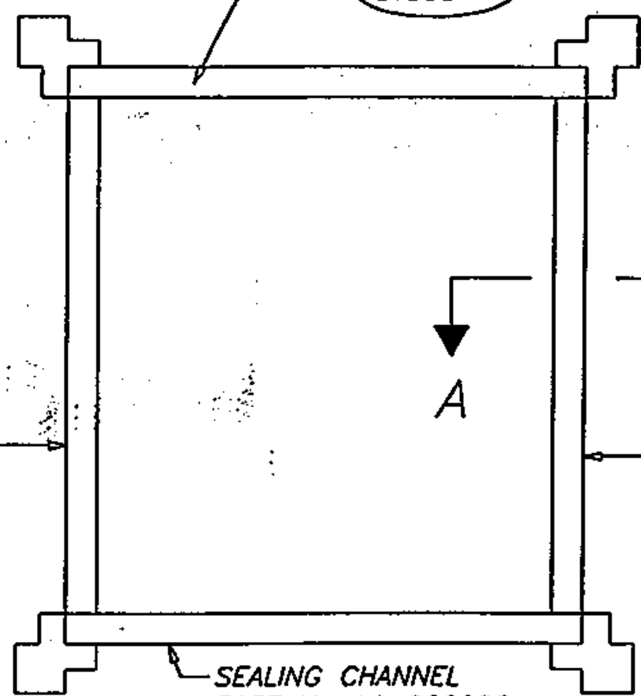
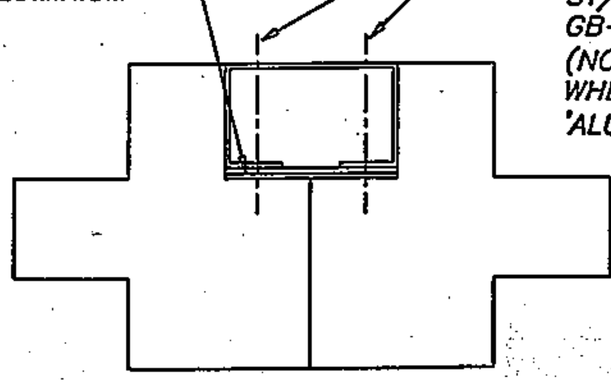
MATERIAL TH'K/TYPE	SHT THIS OF THAT
ROUTE ROUTE	QUANTITY NO?OFF



SECTION IN WAY OF CABINET JOINTS



SECTION A–A

REVISIONS	DRAWN BY	DATE
'H' AMENDED TO SUIT FRAMEWORK OPTIONS	L.LAMB	MAY 98
'G' SPAX SIZES UPDATED	C.A.Miller	NOV 97
'F' POSITION TAPE CLARIFIED	L. LAMB	SEP 97

MN09.01.92:REV F

JOB NO. 670****	UNIT NO. UN	SECT. NO. SN	BUBBLE BUB01**

AAF European Group
AAF–Ltd.,
BASSINGTON LANE,
CRAMLINGTON,
NORTHUMBERLAND
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DRAWN BY	DATE
J.B	JUNE 96
CHECK BY	DATE
L.LAMB	JUNE 96

DRAWING NUMBER A4–920021 H

DESCRIPTION	SECTION TO SECTION JOINING ARRGT. – STYLE 2	WORK ORDER NUMBER WO*****	
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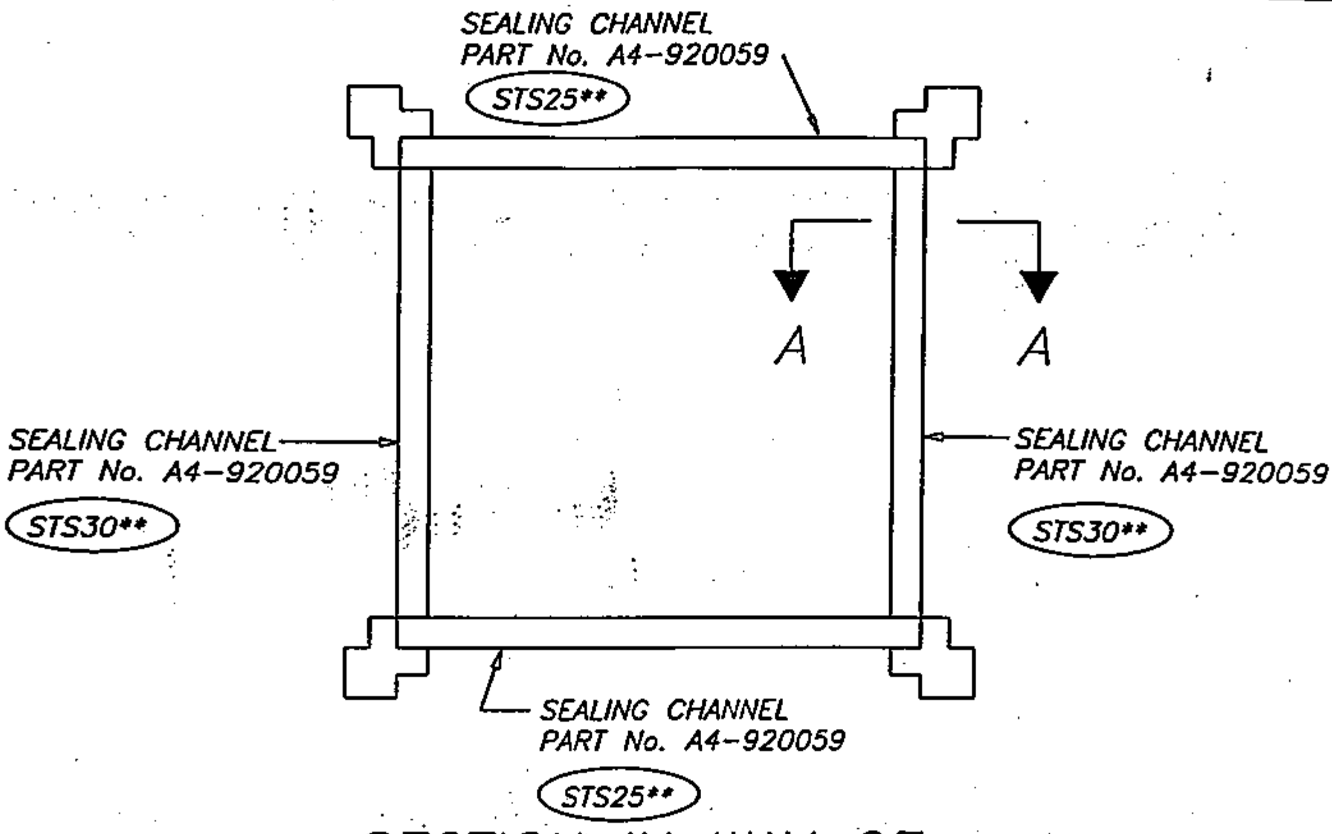
ROUTE ROUTE		QUANTITY	NO?OFF



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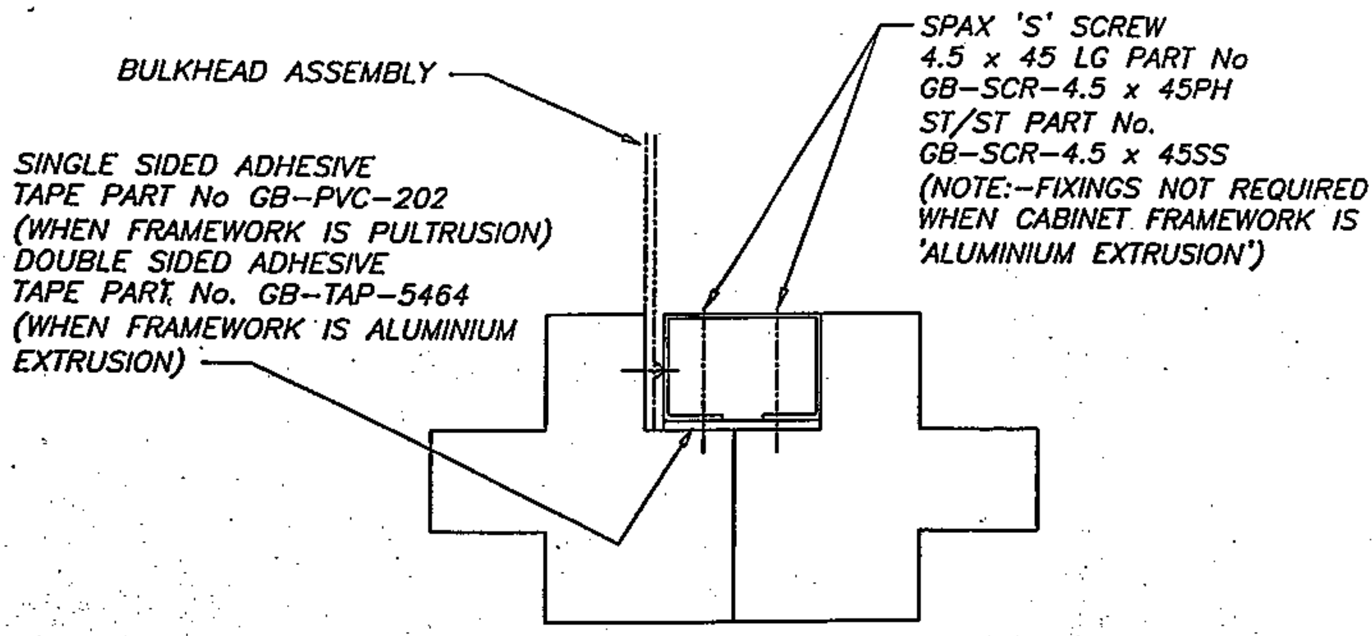

SECTION A-A

REVISIONS

	DRAWN BY	DATE
F TAPE POSIT' CLARIFIED	L. LAMB	SEP 97
G SPAX SIZES UPDATED	C.A.Miller	NOV 97
'H' AMENDED TO SUIT FRAMEWORK OPTIONS	L.LAMB	MAY 98

JOB NO. 670****	UNIT NO. UN	SECT. NO. SN	BUBBLE BUB01**

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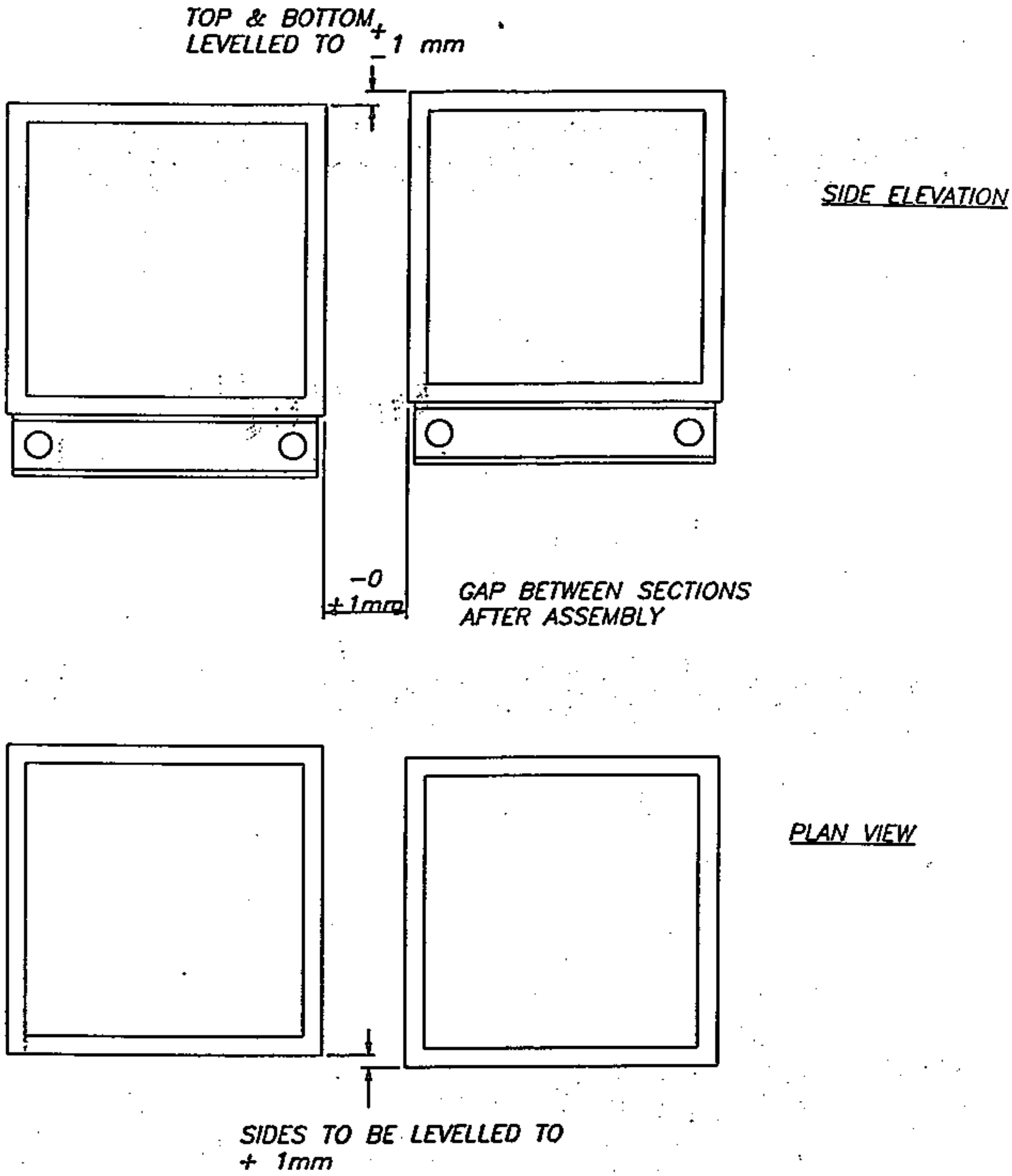
DRAWN BY	DATE
J.B	JUNE 96
CHECK BY	DATE
L.LAMB	JUNE 96

DRAWING NUMBER H

A4-920057

UN:09.01.92:REV F

AIR HANDLING UNITS TO BE ASSEMBLED AS IN THE ATTACHED SECTION TO SECTION ASSEMBLY DRAWINGS. NOTE: PRIOR TO INSTALLATION OF SECTION TO SECTION SEALING CHANNELS AHU SECTIONS TO BE ALIGNED AND LEVELLED AS SHOWN



REVISIONS	DRAWN BY	DATE
DISTA BETWEEN CABIN WAS 0 TO 3mm	J.H	1.11.97

TITLE. SECTION TO SECTION ASSEMBLY			FIRST ORDER NUMBER. STANDARD
AAF INTERNATIONAL — AAF-Ltd. Bassington Lane Cramlington Northumberland United Kingdom NE23 8AF Tel.: 01670 713477 Fax.: 01670 714370 Telex: 53491	DRAWN BY J.H	DATE 17/06/97	DRAWING NUMBER A4-921039 REV A
	CHECKED BY	DATE	

SECTION 6

MAINTENANCE SCHEDULE

Weekly

1. Inspect Fans. Clean as necessary(using warm water),and inspect the fan impeller for signs of dust build up on the blades, should and back plate at regular intervals, otherwise out of balance will result, refer to detailed bearing information and lubricate accordingly.

2. Check Fan Bearings are not running at elevated temperatures.

3. Check that there is no excessive vibration from the Fan unit.

4. Check Flexible connections are in good condition.(check for deterioration).

5. Check that the vibration isolators are free to operate.

6. Check components in Fan section are secure.

7. Inspect coils for signs of leakage.

8. Check general cleanliness and clean. Ensure no foreign material is left inside.

Monthly

1. Check all moving parts for wear and tightness.

2. Check condition and tightness of drive belts and pulleys.

   If replacing drive belts ensure a matched set of new belts are fitted. New and used belts must not be employed on the same drive. The replacement belts must be of the same size and pitch length that were originally furnished with the unit. The new belts should be tensioned and the belt guard replaced.

3. Check the Filter pressure drops and replace filters as necessary, it is recommended that only AAF-McQuay filters are fitted to the unit. When replacing are needed contact your local AAF-McQuay office to enable us to discuss your requirements and ensure that the correct grade of media is supplied.

4. Monitor overall vibration levels. An increase in level is an indication of potential trouble which must be seen to.

5. Top up all drain traps(this may have to be done more frequently especially during winter).

6. Inspect for coil leaks.

7. Inspect dampers, check gears/linkages for dirt or wear. Remove dirt with a clean damp cloth. Inspect the blades and case. Clean with cloth if required.

8. Check operation of manometers, pressure switches etc. Inclined manometers must be set to zero while the fan is switched off. Additional fluid for topping up purposes can be supplied.

3 Monthly

1. Ensure that all panels fit correctly and replace any gasket material found to be defective.
2. Clean cabinets as required with warm water. Do not use a solvent cleaner on pre-coated mild steel panels. A mild detergent can be used.
3. Touch up any damage to the paint work.
4. The paint work(where applicable)is part of the anti-corrosion treatment, and must be maintained, this is particularly important on units in a swimming pool environment. Where any damage is evident, this must be promptly and correctly treated.
5. Check effective operation of all control switches.
6. Check alignment of vee belts and belt tensions.
7. Check tightness of all bolts and equipment.
8. Check filter resistance, replace as necessary.
9. Check adjustment of AVM's

6 Monthly

Carry out checks as described under previous schedules and:

1. Check condition of motor and fan bearings and ensure they are not excessively noisy.
   Note: Faulty bearings must be replaced immediately. Failure to comply may result in the shaft becoming damaged.
2. Grease bearings.(excluding sealed for life type)Only one stroke of the grease gun is required per 6 months continuous operation, to apply more grease than recommended may lead to early failure of the bearing.
   Note: The fan bearings are precharged for the first 6 months operation, motor bearings for the first 2 years.

   Recommended lubricant for normal operations is Shell Alvania R.A
3. Dampers should be actuated to check on the operating torque and smooth operation.

If the torque is increasing then the unit is to be internally inspected, and cleaned as highlighted on the Monthly schedules.

4. Check the drive alignment and tension belts.
5. Check motor cowl intake vents are not obstructed, this would restrict the flow of cooling air to the motor and cause overheating.
6. Ensure that the motor runs smoothly and at not more than the specified temperature rise.
7. Check the security of all electrical connections with the supply isolated.
8. Check that the holding down bolts are secure.

Annual

Carry out checks described under previous schedules and:

1. Check coil(s)to ensure the fins are not blocked nor have they become dirty. Fins should be cleaned using a brush ,a vacuum cleaner or an air hose. Failure to keep coil clean will result in loss of performance.

   Any damage to the fin edges can usually be realigned using a 'fin comb', these can be supplied by AAF-McQuay if required-contact McQuay Spares Department.
   Caution: Fin edges are very sharp, tough industrial gloves must be worn.

2. Clean and check condensate drain pans to ensure the outlet is not blocked and that water will drain away.

3. Check for signs of corrosion and treat as necessary.

4. Check operation of all dampers, ensuring that these operate and shut properly and smoothly.

5. Check that all controls are operating satisfactorily.

6. Clean units internally and externally with warm water. Note: Do not use a solvent cleaner on pre-coated mild steel. A mild detergent may be used.

7. Fans - Inspection for wear.

   (a)Examine impeller(remove all traces of deposit before carrying out this examination).Should there be evidence of severe abrasion, the impeller should be repaired/replaced.If there is no severe abrasion and the impeller is to be used again with repairs, check balance before re-use.

   (b)Examine fan casings and inlet cowls for signs of wear.

   (c)Examine bearings and replace/re-lubricate where necessary.

   (d)Check position of impeller in casing of fan shaft and alignment of driving unit and make adjustments as necessary.

8. Generally check, clean and overhaul all motors, fans and starters, see manufacturers data.

9. Check operation, calibration and settings of all instruments and controls.

10. Check spare parts inventory(re-order parts needed).

SECTION 7

LUBRICATION SCHEDULE

Lubrication Schedule

Component Description	Lubrication Facility	Type of Lubricant	Frequency of Lubrication
Fan Bearings(sealed for Life)	None	None	None
Fan Bearings	2 No Grease Nipples on Fan	Shell Avania RV	Every 6 Months
Motor Bearings(Sealed for Life)	No Lubrication Points	Shell Avania 3	Every 2 years, single shielded bearings should be removed, cleaned and regreased. Double shielded bearings should be replaced
Motor Bearings	2 No grease nipples on motor casing	Shell Alvania 3	Inject grease as per manufacturers recommendations

SECTION 8

FAULT FINDING

Fault Finding

Symptom	Causes	Remedy
Failure of Fan to Start	Electrical Supply Fault to Motor	Check Voltage at Motor T/Box Observing Safety Precautions. Check Starting Gear and Fuses.
Low Volume after Start Up	(a) Fan Rotating in Wrong Direction	(a) Reverse any Two Phase in the Supply
	(b) Dampers in System not Properly Set	(b) Ensure System Correctly Balanced on Commissioning
	(c) Filter Blocked above Recommended Level	(c) Change Filters - Complete Bank not Individually
Excessive Vibration from Unit	(a) Fan Impeller out of Balance	(a) Consult Manufacturer
	(b) AVM's not set Correctly	(b) Check Working Height of AVM's. Failure to Correct Fault Signifies Suspect Spring.
Excessive Noise from Unit	(a) Bearing Failure on Fan or Motor	(a) Check Bearings
	(b) Fan Impeller Fouling Inlet	(b) Check Clearances
	(c) Drive Belts Incorrectly Tensioned	(c) Check Tension
Reduced Drive Belt Life	(a) Pulleys out of Alignment	(a) Check Pulley Alignment
	(b) Drive Belts Incorrectly Tensioned	(b) Check Tension
	(c) Incorrectly Matched Belts	(c) Replace Belts as a Complete Set
Water Present in Cooling Coil Drain Pans	(a) Drain Traps	(a) Check for Obstruction by Removing Traps
	(b) Incorrect Sized Traps	(b) Check Trap Size
Excessive Water in Unit	Coil Leakage	Identify Source of Leak and Rectify or Consult Manufacturer

Transmissions

(a) Small cracks on V-Belt sides and base.	(a) Shortage of belt tension, excessive heat and/or chemicals.	(a) Replace belts, re-tension. Identify source of problem.
(b) V-Belt swelling or softening	(b) Excessive contamination by oil, certain cutting fluids or rubber solvent.	(b) Replace belts. Eliminate source of contaminate.
(c) Whipping during running	(c) Incorrect tensioning	(c) Re-tension belts & pulleys

SECTION 9

MOTORS

CONTENTS

*Warning **

The handling and lifting of electric motors must only be undertaken by skilled personnel using the correct equipment

(* *All safety notices are boxed, and in italics).*

1 RECEIPT

Before any motor is accepted on site it should be inspected carefully for damage or loss incurred during transit.

Packing materials may be damaged including sheeting and crate timbers.

Handling operations may have damaged fan cowls, terminal boxes or auxiliaries.

Where an instance of droppage or loss is evident or suspected, it may be necessary to unpack the goods to establish the full extent of the problem.

Wherever possible damage should be recorded, photographed and witnessed.

Report any damage to the carrier and Brook Hansen as soon as possible, quoting the motor number and consignment note reference. The insurance company's agent as shown on the insurance certificate should also be advised.

Note: Bolts are always included with the slide rails but foundation bolts are not.

2 LIFTING

The lifting of motors must be carried out by skinned personnel working in accordance with safe working practices. If in doubt please refer to Brook Hansen. Example: HSE Manual Handling Operations Regulations 1992

Before lifting motors the correct equipment must be available. Cranes, jacks, slings and lifting beams must be capable of carrying the weight of motor to be lifted. See Appendix A for approximate motor weights. On large motors refer to the weight on the nameplates.

Where an eyebolt is provided with the motor, this should be screwed down until its shoulder is against the face of the stator frame to be lifted. The motor eyebolt should be used for lifting the motor only, unless otherwise agreed. Eyebolts are normally designed for a vertical lift.

Where two eyebolts/lifting lugs are provided, a suitable twin booked lifting chain with a spreader bar should be used.

Where pairs of eyebolts/lifting lugs are used with inclined loading, the maximum safe working loads of BS 4278 : 1984 should not be exceeded.

2.1 TRUNNIONS

Pairs of lifting trunnions/ eyebolts/lifting lugs should not load individual points to more than 25% of the safe working load (SWL).

Care should be exercised with respect to the centre of gravity of the motor. Normally the tendency is for the motor to be heavier towards the fan end.

2.2 VERTICAL MOUNTING

Motors for vertical mounting positions (See Appendix B) are provided with sufficient lifting points, either fitted or loose, to aid controlled rotation from a horizontal to a vertical shaft position.

On large motors it may be necessary to use several lifting points to provide the necessary stability, particularly for shaft down mountings.

Note
Vertical shaft down motors should have a drip proof/impact cover fitted to prevent small falling objects hitting the fan. This is a mandatory requirement on Type N motors.

2.3 INSPECTION

Eyebolts and lifting lugs should be inspected regularly.

Attention should be paid to the following areas:-

- Legibility of markings
- Threads free from wear and corrosion
- No debris on the underside of the collar
- No distortion in the eyebolt
- No nicks, cracks, corrosion

3 STORAGE

If motors have to be stored before installation, precautions should be taken to prevent deterioration.

3.1 ENVIRONMENT

Depending on the site conditions it may be necessary to create a suitable stores area to hold the motor prior to installation. Packing cases are not waterproof.

Motors should be stored in a dry, vibration free and clean area at normal ambients (-20°C to 40°C), unless other arrangements have been agreed with Brook Hansen.

Where low temperature ambient storage is anticipated, special precautions should be taken with the type of grease, no plastic parts etc. To ensure trouble free start-up.

Motors must be stored away from corrosive or chemically damaging fumes.

Before placing motors into storage, machined components should be carefully inspected. Bearings and shafts are normally covered with a corrosion resistive barrier. If this coating is damaged it should be made good. The component should be cleaned and the protective coating reapplied.

Under no circumstances should rust be merely covered over.

3.2 DRAIN HOLES

Motors provided with drain holes have drain plugs provided loose in the terminal box up to frame size 180, and fitted on frame size 200 and above. Position the drain holes at the lowest point.

3.3 BEARINGS

To avoid static indentation the storage area should be vibration free. If this is not possible it is strongly recommended that the motors be stood on thick blocks of rubber or other soft material.

Shafts should be rotated by hand one quarter of a revolution weekly.

Where the exposure to some vibration is unavoidable the shaft should be locked in position to avoid static indentation of the bearings.

Roller bearings may be fitted with a shaft locking device. This should be kept in place during storage.

3.4 GREASE

Factory fitted bearings use a lithium based grease with a recommended shelf life of two years. If stored for a longer period, greaser may need to be replaced.* Shielding bearings have a storage life of five years and a further two years operational life following installation.

* Wash all bearing parts with a non-contaminating solvent, Lightly pack the bearings with grease applying a 33% fill by volume into the bearing and housings. See paragraph 4.3.5 for grease details.

3.5 HEATERS

Where space heaters are fitted, and the storage environment has wide humidity and temperature variations, it is strongly recommended they be energised.

Warning should be placed on the motors to make operatives aware of the live heaters.

Supplies are normally 220-240 volt single phase, from a 380-415 volt three phase supply. See terminal box lid for details.

A low voltage DC supply could be used as an alternative (see 4.4.2)

3.6 INSULATION RESISTANCE

During extended storage a three monthly insulation lengthy drying out periods when installing,. Use a 500 volt d.c. Megger.

The insulation resistance between phases and between the windings and the frame should be checked.

The insulation resistance should be maintained above 10 megohm.

If a lower reading is measured, use one of the drying out methods recommended in section 4.4,2 until an acceptable reading is obtained. If heaters are fitted but not energised, they should be used in future. See also note in section 4.4.5.

3.7 WOUND ROTORS

Ideally, wound rotor motor brushes should not be in contact with the slip-rings during storage as there is a risk of corrosion. Brushes should either be lifted off the slip-rings or stored separately. This may not be possible with small motors (up to frame DW180).

4. INSTALLATION

Work on Hazardous area motors should only be carried out by Brook Hansen trained personnel or those trained to an equivalent standard. Reference should be made to:-

a) Constructional standards EN50014, EN50018 (Eexd), EN 50019 (Eex e), BS 5000 Part 16
b) The approval certificate
c) Codes of practice (BS 5345, IEC 79 Part 14)

All warning instructions and labels must be observed and retained with the motor.

Health & Safety at Work etc. Act 1974
It is essential equipment is installed, earthed and guarded in accordance with current legislation.

4.1 CHECKLIST

General
- Location
- Nameplate details

Mechanical
- Drain holes
- Alignment
- Free rotation
- Bearings and grease
- Cable termination
- Motor bolts
- Slide rails
- Pulley fitment
- Wound rotor slip-rings and brushes
- Overspeed limits

Electrical
- Insulation resistance
- Drying out procedures
- Supply
- Earthing
- Protection
- Heater continuity
- Thermistor
- Auxiliaries
- Connection diagrams
- Rotation
- Wound rotors
- Starting

4.2 GENERAL

4.2.1 Location

The motor must be provided with adequate access for operation and maintenance. The fan inlet must be at least 20mm from any obstruction on frame sizes up to 180, and 50mm on frame size 200 and above. A minimum working distance of 0.75m around the motor is recommended.

Where several motors are located together care must be taken to ensure there is no re-circulation of exhausted warm air.

Foundations must rigid and level.

4.2.2 NAMEPLATE DETAILS

The information on the nameplate should be checked to ensure it is correct in all details. i.e. kW, amps, volts, speed, etc. It is a wise precaution to take nothing for granted.

4.3 MECHANICAL

4.3.1 Drain Holes

Prior to installation remove drain plugs if fitted. If any water has accumulated, the integrity of all gaskets, sealants etc. Should be checked. Drain plugs should be put back into place after draining.

4.3.2 Alignment

When the application calls for direct coupling, the shafts must be correctly aligned in all three planes. Bad alignment can be a major source of noise and vibration.

Allowance must be made for shaft endfloat and thermal expansion in both axial and vertical planes. It is preferable to use flexible drive couplings.

4.3.3 Noise Levels

The noise levels published in current Sales Specification are equal to or less than the limiting values for rotating machines specified in European and International Standards BS EN 60034 and IEC 34-9.

In most cases noise levels also meet limiting value for exposure to noise in the work place i.e. Guidance on regulations for Noise at Work issued by HMSO.

It is the responsibility of the purchaser to ensure that other overriding lower noise levels if required, e.g. Machinery Directive, are specified at the time of order, or that the installation incorporates noise attenuating measures.

See Appendix C for standard noise levels on a 50 Hz supply.

4.3.4 Free Rotation

The rotor must be free to rotate within its housing. Where uneven or bumpy rotation occurs the bearings should be inspected to establish that they have not been damaged during transportation or storage.

4.3.5 Bearings, Grease, Bearing Change

Grease

Bearings are pre-packed with a lithium or lithium complex based grease.

Other lithium based greases of a similar consistency would be compatible, See Table 1 for some alternatives.

Table 1
Alternative lithium complex greases

Grease	Reference	Manuf.
Energrease	LC2	B.P.
Castrol	LMS	Castrol
Luplex M2	Century	
Unirex N2	Esso	
Sovereign	LS	Gulf
Mobilgrease	HP	Mobil
Liplex	EP2	Shell
Hytex	EP2	Texaco
Retinax	LX	Shell
LGHT3	SKF	

When a special grease has been supplied this will be indicated on the motor nameplate.

Regreasing

Standard regreasing facilities, where provided, are situated on the periphery of the drive end and non drive end end-shields.

Grease relief is via a:-

a) diaphragm relief valve
b) rotating grease relief flinger
c) plugged grease chute

Standard regreasing facilities:-

Frame Size	Regreasing Facility
63/180*	On request
200/355	Standard

* Bearings are double shielded and pre-packed with great for life.

Recommended re-lubrication intervals are shown in Appendix D. Motors without grease nipples have sealed for life bearings and the intervals in Appendix D should be considered as bearing replacement recommendations.

An overgreased bearing will cause overheating of the bearing with the possible escape of the grease, loss of lubrication qualities, leading to ultimate bearing failure. See Appendix E for grease quantities.

Lubrication procedure

The following procedure should be adopted.

1. Wipe clean the grease gun fitting and the regions around the motor grease fittings.

2. Remove the grease relief plug if fitted. Some motors 2. Remove the grease relief plug if fitted. Some motors will have one way grease valves which should be left in place.

3. Add a small quantity of grease, approximately 4 to 10 shots depending on frame size (see Appendix E).

4. Allow motor to run for about ten minutes in order that excess grease may be expelled before refitting the relief plug. Bearings fitted with rotating grease relief or through grease valves will relieve automatically.

5. On initial start up or after re-lubrication, 'bearing noise' may result from the new grease moving around the bearing. This noise is normal and will disappear after a few hours of running.

Bearing Change

When fitting new bearings the parts should be light lubricated with grease.

The bearing should be driven onto the shaft by pressure on the INNER RACE ONLY using a short length of tube placed over the motor shaft.

On larger motors it is easier to raise the temperature of the bearing using an oil bath, or induction heating. The temperature must be controlled to 120°C maximum.

The bearing should then be quickly slipped into place, ensuring that the bearing is in contact with the shaft shoulder.

When cool, ensure that the bearing is clean and charge the bearing with the recommended quantity of grease, (see Appendix E).

Bearings and housings should be one third full.

4.3.6 Cable Termination/Terminal Box Sealing
All cable terminations must be screwed down tightly.

Customers' leads should be in face to face contact with the motor leads.

Lockwashers and nuts should be screwed down over the connection.

There should be no nuts or lockwashers between the mains and motor lead terminations as these are not current carrying components.

The installer must ensure maximum clearance in the terminal box by placing connections onto the studs carefully. Conduit and gland entries to the terminal box must be correctly fitted. The integrity of the terminal box gasket must be checked to ensure the terminal box lid can maintain the correct sealing level.

> *Eexd terminal boxes are despatched with a non-setting sealant on the terminal box/lid/gland joint faces to provide protection during transit and storage.*
>
> *All joint faces must be cleaned and a sealant applied after the fitting of the supply cables.*

4.3.7 Motor Bolts

All accessible motor bolts and screws should be checked for tightness. Typical bolt torques for endshield, flange and bearing cap bolts are shown in Table 2.

Table 2
(See Appendix F for cast iron W)

Bolt Size	Torque Nm
MD	6
M6	10
M8	18
M10	40
M12	70
M16	100
M20	150

The torques of bolts used to fit the motor to equipment and baseplates depend on the strength of the bolt and the fastener. No safe generalisations can be made and manufacturers' figures must be obtained.

'Multi-Mount' and 'W' bolts
Aluminium 'Multi-Mount' motors which have had their terminal box position changed, should have their foot to frame bolts torqued to the figures in Table 3.

Table 3
'Multi-Mount' foot bolt torques

Frame Size	Bolt	Torque Nm)
D63/71	M5	7
D80/90	M8	25
D100/132	M8	32-35
D160	M10	68-72
D180	M12	88-92

Special thread forming bolts are used. The Belville washers where supplied must be fitted under the bolt heads.

W Cast Iron fasteners torques
Cast iron 'W' Range motors use special high tensile socket head screws. Motors subjected to modifications should have their bolts tightened to the figures in the Appendix F.

> *On no account must standard mild steel bolts be used on the W Cast Iron Range foot and endshield fixings.*

4.3.8 Slide Rails

for belt or chain drives, slide rails which permit tensioning should be used. The slide rails must be fixed to the mounting base by appropriate bolts.

The rail at the driving end of the motor should have the adjusting screw between the motor and the motor pulley. The other rail is positioned the opposite way round. The drive should be through the lower part of the bet or chain.

> *Belts which can become charged electrostatically should not be used in hazardous atmosphere.*

4.3.9 Pulley Fitment

The bores of shaft fitments should be fully machined and half key balanced in accordance with Appendix G. The fitting process should be carried out by skilled personnel.

During fitting, the opposite end of the shaft should be supported to take the axial load off the bearings.

The pulley must always be positioned up to the shaft shoulder to minimise the overhung loading.

Excessive force can permanently damage the motor bearings.

Shaft keys should be a good fit but with adequate top clearance.

Ensure belts are not over tightened. Refer to the manufacturer's recommendations.

4.3.10 Wound Rotor Motors

The slip rings and associated brush gear are a vulnerable feature of a wound rotor motor. It is essential that correct procedures are used for storage, commissioning and regular maintenance of these motors.

Commissioning
Prior to installation the brushes and brush gear should be checked to ensure they have not deteriorated in transport and storage. The brushes should be free to slide in their brush holders.

For correct operation the brush spring tension should be as listed in Table 4. The tension is readily checked using a spring balance.

Table 4
Brush Spring Tension

Frame Size	N
132	6.7
160	6.7
180	6.7
200	6.7
225	11.3
250	11.3
280	11.3
315	17.7
355	17.7

Bedding In Brushes
New brushes should be checked for freedom of movement in the brush holders.

Brushes should be 'bedded in' on initial fitment to ensure a good contact with the rings. The whole cross section of the brush requires attention.

The most effective method is to place a sheet of emery paper face upwards between the rings and brushes. The rotor should then be rocked, moving the emery cloth with the rotor. Remove the resultant carbon dust by using a vacuum cleaner if possible.

4.4 ELECTRICAL

Electrical installation must be carried out within the framework of the 'Electricity of Work Regulation 1st April 1990'.

The supply must be isolated before any installation or fault finding work is carried out.

4.4.1 Insulation Resistance

Note: When checking insulation resistance the heater circuit must be isolated.

If an insulation resistance lower than 10 megohms is measured between phases and to earth, the windings must be dried out until an acceptable reading is obtained. See 4.4.2. below.

During a megger test on the motor windings the thermistor circuit should be earthed.

4.4.2 Drying Out Procedures

It is preferable to dismantle the motor to the point where the rotor is removed. This is not essential but the drying out process will take longer in the assembled state.

The temperature of the windings and the insulation resistance should be monitored at regular intervals. On initial application of heat the insulation resistance will drop quickly and then start to rise slowly until level. On discontinuation of the drying process, a further rise in resistance will occur.

There are several methods which can be used:-

1. Place the motor in a warm (typically 40°C), dry airstream (fan or convector heater) or in a warm oven with a temperature not exceeding 80°C. This method is preferred if the motor is dismantled.

2. Connect the motor to a low voltage* three phase supply and inject a current not exceeding 50% of the full load current into the stator winding. (* approximately 10% of the line voltage). If this is carried out on an assembled motor, it is possible though unlikely that the motor will turn. If so the rotor should be locked in position.

3. Connect two phases in parallel, and the third in series. Inject a low voltage a.c. or d.c. supply up to a maximum of 50% of full load current The stator winding temperature must not be allowed to exceed 80°C. In practice the frame should not be hot to the touch, to guard against internal overheating and consequent damage to the insulation.

4. Where heaters are fitted these can be energised.

4.4.3 Supply

It is important that a motor is operated within the limits of its design voltage and frequency.

Standard motors for the UK will operate without damage on any voltage in the range 94% to 106% of the nameplate voltage.

The supply cables must be capable of carrying the full load current of the motor (see motor nameplate) without overheating or excessive voltage drop under starting conditions.

4.4.4 Earthing

All motors are fitted with an earthing terminal,. In or adjacent to the terminal box, to enable connection to an effective earthing bond. The terminal is designed for connecting the correct size of copper earth connector. If a different material is to be used please refer to Brook Hansen.

The motor must be earthed by connecting the shortest possible length of cable to the earth screws. The cable must have a capacity at least that of the main connections up to 16mm² phase conductors. Between 16 and 35mm² phase conductors, the earth should be a minimum of 16mm². Above 35mm² phase conductors, the earth conductor should be a minimum of half the phase conductor.

Phase Conductor mm²	Earth Conductor mm²
up to 16	at least equal
16-35	16 minimum
above 35	at least half

An earthing bond should not be terminated under the motor fixture bolts or terminal cover screws. The earth lead could be overlooked on reconnection after maintenance.

4.4.5 Heater Continuity

Heaters should be checked for continuity prior to connection to the control circuitry.

Note: When checking insulation resistance the heater circuit must be isolated.

4.4.6 Thermistors Continuity

If fitted, it is recommended that thermistors be connected to the control circuit. Thermistors provide good thermal overload protection.

The use if thermistors is mandatory on explosion proof motors supplied from an inverter.

Thermistors should be checked for continuity prior to installation using a maximum voltage of 6 volts.

DO NOT APPLY A MEGGER TEST TO THERMISTORS FOR A CONTINUITY CHECK

During a megger test on the motor windings the thermistor circuit should be earthed.

4.4.7 Auxiliaries

When auxiliaries are fitted, the characteristics should be checked. Example: RTD's (Resistance Temperature Detectors) should have their resistances checked against manufacturer's figures.

4.4.8 Control Gear

Ensure all control gear and associated metering/protection circuits have been checked fully.

It is imperative that any overload trips and emergency shutdown circuits are working correctly before the motor is energised. All covers must be in position.

Where a motor is fitted with a separately driven fan unit, the interlocks and thermal overload protection circuits must be operative.

INSTALLATION AND MAINTENANCE OF
A.C. ELECTRIC INDUCTION MOTORS

5. CONNECTION DIAGRAMS

Refer to the connection diagram supplied with the motor for supply details and the required winding connection.

5.1 ROTATION

Before coupling the motor to the drive, run the motor briefly to check rotation.

All covers must be in place.

Motors fitted with angular contact or duplex bearings must be run in the correct mounting position e.g., vertical.

To reverse rotation interchange any two supply leads.

5.2 WOUND ROTORS

The stator of a wound rotor motor is similar to a cage motor but the rotor circuit is connected to a starting resistance. Take care to ensure that the brushes are in contact with the slip rings and that the rotor resistances are connected in the 'START' position.

5.3 STARTING

Motors are rated by the output required, the number of starts per hour, the load curve/inertia, and environmental considerations.

Operating outside the contractual parameters may thermally overload the motor e.g. too many components e.g. overspeeding.

Refer to starter literature for method of start and safety precautions to be taken.

6. RUNNING

After one hour of running, check the general vibration levels. If these are excessive, check alignment (and belt tensioning if belt driven).

Some initial bearing noise may e present during the running in period. This is normal because the grease has to settle down within the bearing. The noise should disappear after a few hours of operation.

Check that the motor runs up smoothly and within the permitted run-up time. Note that repeated starting in quick succession may lead to a thermal overload of the motor.

7. MAINTENANCE

7.1 GENERAL

Induction motors by their very nature require very little maintenance. However a regular regime of inspection is recommended to ensure minor problems do not escalate to breakdowns. Typical intervals would be 2000 hours of operation or 3 months, whichever is the sooner.

Checklist

- No visible damage i.e. fans cracked, fan cowls bent, foot cracked etc.
- No accumulation of dust or fibres on the frame or around the fan inlet.
- No significant corrosion of the lifting lugs/eyebolts
- No excessive vibration
- No loose fasteners
- Cables and earths are sound
- Sealing of the motor and gland plate in good condition
- Insulation resistance adequate, imperative this is checked after a prolonged shutdown

  Note: Fumex smoke extraction motors should be rewound after 5 years of operation. See specification sheet 26E.
- Regrease required, particularly large output 2 pole motors
- Bearing condition

7.2 WOUND ROTOR

Inspection

Brushes should be inspected every 1000 running hours or at three monthly intervals if this is a shorter period of time. The inspection should be removed using a suitable dust extraction unit.

Replacement of brushes is recommended when the brush is approximately a quarter of the way down the brush holder. On calliper type designs the brushes should be replaced when 1/4" (5mm) of brush remains.

It is important that the correct grade of brush be used as this significantly affects operation. If in doubt please refer to Brook Hansen.

7.3 HAZARDOUS AREA MOTORS

In addition to the conditions referred to in paragraph 7.1, special requirements apply to motor types Ex N, Eex e, Eex d, Eex de. Refer to the approval certificate and appropriate codes of practice e.g. BS 5435.

8. ENQUIRIES

Please contact Brook Hansen or its Agents for information on any aspects of the motor performance that need clarifying.

CONTACT MUST BE MADE PRIOR TO ANY REMEDIAL ACTION BEING TAKEN UNDER GUARANTEE.

Please quote the motor number in all such cases with full details of the problem.

SECTION 10

FANS

Centrifugal and Axial Flow Fans

Note: Ensure that the fan is stopped and electrically isolated before any inspection is carried out.

Installation Instructions

1. On receipt check the fan for any damage in transit.

2. Bolt the fan to a level base and ensure that no undue load is placed on the fan casing by unsupported ducting.

3. Belt drive pulleys should be fitted as close to the bearing as possible, correctly aligned, with the belts tensioned correctly.

4. Remove all dust from the bearings and check that no foreign items have been left in the fan casing.

5. Ensure that all moving parts can rotate freely and that no fouling occurs.

6. Test run the fan to check:-

   a) the direction of rotation
   b) belt slip does not occur
   c) there is no excessive vibration or overheating

   When test running forward curved fans the system dampers should be closed to prevent overloading the motor, or either the inlet or outlet should be closed off.

7. If the fan is not commissioned immediately, it should be stored in a clean dry area, and the fan shaft should be rotated at least once per week to minimise bearing damage. If the fan is in storage for six months or more, then the bearings should be completely cleaned and lubricated.

Maintenance Instructions

1. Frequent inspection should be made of the fan, in particular the belt tension, during the first 48 hours of operation.

2. General inspection of the fan will depend on how essential the service, the application, operating environment, and the number of hours run, but should not be more than 3 monthly intervals.

3. On fans operating under normal ventilation conditions, the bearings will only need to be flushed out and replenished with grease every 12 months.

4. On fans operating in dusty atmospheres or exposed to the weather, then the bearings will need to be flushed out and replenished every 6 months.

GUIDE BOOK FOR INSTALLATION AND MAINTENANCE

Fan Series Nicotra Belt Driven and Direct Driven Series.

REMARKS

The safety recommendations contained herein aim to support the installer, maintenance engineers and other technicians who operate the ventilation equipment as listed below. These recommendations cannot represent totally the methods or procedures required for safe operation. Care should always be taken when working in close proximity to equipment or moving parts. Total safety depends on acquired skill, experience and reasonable care in all operations.

In issuing this guide book maximum attention has been paid to ensure correct information. Nicotra Spa do not accept any responsibility for any eventual errors or omissions.

PRELIMINARIES

This guide is to assist the engineer in the installation and maintenance of the ventilation units, and to ensure the correct installation of the equipment and so remove possibility of incorrect operation or of serious accidents.

The operation, installation and maintenance must always be carried out by experienced and fully trained staff.

These staff should be fully aware of the safety regulations and associated laws in force in the country of installation.

SAFETY ACCESSORIES

Some safety devices are already included in the equipment as standard components whilst some are offered as optional extra items. This is due to the fact that the system, fan arrangement and operation are often unknown at the time of order.

PROTECTION OF MOVING COMPONENTS

All fans have moving parts, particularly requiring protection against contact. Centrifugal fans are usually connected to ductwork affording protection against contact with moving parts. In the case of free inlet or discharge protection must be provided by means of proper guards or grilles. In addition to the protection of inlet and outlet it is necessary to provide protection from the fan shaft, belts and pulleys and all other external moving parts by means of suitable protection guards., (Ref: UNI 9219).

ELECTRICAL ISOLATION

Each fan must be protected with a local isolator.

Many fans are controlled by remote control systems or are controlled automatically and therefore to ensure complete safety it is necessary to provide a power interlock close to the fan in order to enable maintenance staff to isolate the fan independently from the main control system.

INSTALLATION OPERATIONS

INSPECTION ON RECEIPT

On receipt of the equipment it is recommended you carry out the following inspection:-

a) Inspect for damage or defective parts. In case of damage found to the unit a written report should be sent immediately to the supplier and transport company.

b) Check if the wheel turns freely and has no signs of excessive imbalance and is firmly located on the shaft.

c) Check if all external fixing screws are tight.

d) Check if the bearing locking screws are fitted correctly.

INSTALLATION

Correct installation of the fan will ensure correct operation and avoid problems in the future. For this reason we list below various points to check prior to assembly.

a) Check that the application is suitable for the fan to be installed and that necessary safety devices have been provided.

b) Check that the fan is complete, that the wheel turns freely and is balanced correctly, and that the bearing collars are tight (for belt driven only).

c) When the fan is fitted satisfactorily within the unit proceed to fit pulleys to the drive and fan shaft, with reference to the belt drive calculation table. Usage of drives in excess of those limits mentioned is not advised.

d) Verify the alignment of pulleys before finally fixing the motor.

e) Ensure the pulley grooves are clean and smooth.

f) Fit the belts by slackening the motor base so that the belts can be fitted by hand to avoid damage to the belt section.

g) Proceed with the tensioning of the belts by gradual tensioning of the motor base. Correct running of the fan is determined by the correct tensioning. To ensure correct tensioning it is necessary to measure the belt deflection "T" for each belt by means of a dynamometer. When measuring in the middle of "T" a perpendicular force able to deflect "f" arrow 1.5mm for each 100mm of "T" should then be compared with the dynamometer values F^1 and F^2 in the following table.

Belt Section	External Diameter Minor Pulley (mm)	RPM Minor Pulley	Minimum F^1 Newton	Maximum F^2 Newton
SPZ	50 - 90 100 - 150 155 - 180	1200 - 5000 900 - 1800 600 - 1200	10 20 25	15 30 35
SPA	90 - 145 150 - 195 200 - 250	900 - 1800 600 - 1200 400 - 900	25 30 35	35 45 50
SPB	170 - 235 250 - 320 330 - 400	900 - 1800 600 - 1500 400 - 900	35 40 45	45 60 65
SPC	250 320 330 - 400 440 - 520	900 - 1800 600 - 1200 400 - 900	70 80 90	100 115 130

Remarks

1) The table refers to belt drives with ratio in the limits 2 : 4. If $F<F^1$, a higher belt tension is required. If $F>F^2$, the belts are too tight.

2) During the running in period of the fan belts an early decrease in tension takes place. It is therefore necessary at the initial assembly to tension the belts 1.3 times the "f" arrow shown in the tables. Belt tensions should be checked regularly.

INSTALLATION /continued

h) Install any necessary protection devices, guards etc.

I) Connect the electric motor in accordance with the wiring diagram supplied.

j) Start the fan and ensure rotation corresponds to the direction arrow on the fan casing. Inspect for any excessive vibration, noise and also that the voltage and current does not exceed that stated for the motor.

MAINTENANCE

Maintenance of the ventilating equipment should only be carried out by skilled and adequately trained staff. To ensure complete safety do not start any maintenance procedure or inspection without having disconnected the unit from the power supply and the fan and motor have completely stopped turning.

After the initial installation the fan should be observed during the following eight hours to ensure no excessive vibrations, abnormal noise, excessive power absorbed. It is also suggested that the following items be checked after a period of running.

a) Check and tighten all screws and locking bolts.

b) Check the clamping of the bearing locking collars.

c) Check belt alignment and tension preferably after 40 hours running of the fan.

ROUTINE MAINTENANCE

With standard applications with clean air the fan, and especially the wheel, require cleaning once a year to prevent powder deposits causing wheel imbalance with subsequent negative effect on bearing life and on vibration and noise levels. A further check on points a), b) and c) above are also recommended at this time.

During this period of shutdown it is suggested to also check for any corrosion on the unit structure, and especially on moving parts to avoid unforeseen failures. A check should also be made on drive belts in respect of tension and wear. Where damage is suspected or particles of belt and belt dust are present new belts should be fitted.

LUBRICATION

Belt driven fan units manufactured by Nicotra can be fitted with two bearing arrangements, one inserted within a bearing spider and rubber mount, the other solid mounted to upright supports.

LUBRICATION /continued

The bearings are estimated to have an operating life of 30,000 working hours when selected within the operating limits mentioned in the catalogue, and they require no further lubrication.

Bearings inserted in rubber mounts or on upright supports, without lubrication point are sealed for life. Bearings mounted on upright supports with lubricator point can be further lubricated when required for special application.

Many factors can determine when relubrication of the bearings is required. The type and dimension of bearing, it's operating speed, the working temperature, the type of grease and the working environment. It is therefore only possible to give some indication on statistical data available.

For these reasons the re-lubrication intervals can only be ascertained taking into account the rotational speed and diameter. This is valid only for bearings on horizontal shafts with normal loads and for temperatures not higher than 70°C. For higher temperatures we suggest halving the period between re-lubrication for each 15°C increase in bearing ambient temperature, whilst not exceeding the stated maximum working temperature as shown in the catalogue.

To re-lubricate it is necessary to use the same grease as that employed at the initial lubrication such as a lithium based grease as Standards DIN 51823, K3N, or ISO XM2. These are suitable for all bearings fitted to standard fans. For all special version fans please contact Nicotra.

GUARANTEE

Nictora guarantee it's products against any failure caused by manufacturing faults for one year from the delivery date; during this time it undertakes to repair or replace at no charge and in the shortest possible time all parts that due to poor quality of raw materials or production failure appear to be defective, unless caused by normal wear and tear, by failure caused by modification or carelessness of the purchaser, by exceeding of published limits, or of unauthorised modifications or maintenance. This guarantee period ends twelve months after the supply even if the units have not been installed. The labour for repairs made under the guarantee are at the purchasers cost, as are the transport and travelling costs.

SECTION 11

WATER COILS

Installation and Maintenance Instructions
Hot Water and Chilled Water Coils

Installation

When the unit is installed the air volume must be correct and evenly distributed over the fins.

Unless otherwise specified coils are designed to have entering water at the lowest point and leaving at the highest point. With the air in counterflow to the water.

Coils which may see ambient air must be protected from frost by one of the following methods:-

a)Use a coolant containing a freezing inhibitor such as Ethylene Glycol or Propylene Glycol in sufficient concentration in water to protect at the minimum temperature.

b)Arrange to keep a pump running at some small flow rate and fit electric heaters in the flow-line(or alternatively in the headers).A thermostat should be fitted, bringing the heaters into operation who the inlet temperature drops below 3 deg C.

c)Arrange for dump valves to empty the water from the system before freezing can occur. Inhibition switches should be fitted to prevent start-up without the system being refilled.

Maintenance

It is important to regularly inspect the coils for possible damage or operational disturbances. In the event of damage contact the supplier and/or service department.

No repairs are to be undertaken without our prior instruction, whilst units are under warranty.

On inspection the following must be carefully checked:-

a)Corrosion damage to housing, tubes and fins.

b)Dust or foreign particles in the fins.

c)Liquid leakage.

Corrosion on case-work can generally be repaired and painted before significant damage is caused.

Significant corrosion on the fins should be investigated before complete failure occurs. It must be established that the correct choice of material has been made and that any air-bourne contaminants can be prevented.

Dust on the fins will eventually reduce the coils efficiency. Fins can be cleaned by blowing with low pressure compressed air or by steam blasting. This must be followed by rinsing with clean water.

Grease can be removed by jet washing with a proprietary foaming agent added to the wash. Again this must be followed by rinsing with clean water. Caustic soda must not be used on aluminium fins.

The power supply must be turned off before commencing any cleaning operations and care should be taken to avoid wetting or dampening of electrical connections.

Mechanical damage to the fins can be corrected by combing the fins with an appropriate fin-comb.

Leakage to the tubes or return bends caused by freezing can be repaired if the damage is minor. In any event the leak must be corrected before water shortage affects other items of equipment.

Other Recommendations

It is recommended that isolating valves be positioned close to the unit in both inlet and outlet lines so that the circuit can be shut down for service without emptying the complete system.

SECTION 12

TRANSMISSIONS

Transmissions

Method of Belt Tensioning Using Fenner Belt Tension Indicator

1. Calculate the deflection distance in mm on a basis of 16mm per mere of centre distance.
   Centre distance (m) x 16 = Deflection (mm)

2. Set the lower marker ring at the deflection distance required in mm on the lower scale.

3. Set the upper marker ring against the bottom edge of the top tube.

4. Place the belt tension indicator on the top of the belt at the centre of span and apply a force at right angles to the belt deflecting it to the point where the lower marker ring is level with the top of the adjacent belt.*
5. Read off the force value indicated by the top edge of the upper marker ring.

6. Compare the force to the kgf value shown in the table overleaf.

7. If a Fenner Belt Tension Indicator is not available, a spring balance and rule will suffice

   *Note: For single belt drives a straight edge should be placed across the two pulleys to act as a datum for measuring the amount of deflection.
   If the measured force falls within the values given, the drive should be satisfactory. A measured force below the lower value indicates under tensioning.
   A new drive should be tensioned to the higher value to allow for the normal drop in tension during the running-in period.
   After the drive has been running for 30 minutes, the tension should be checked and re-adjusted to the higher value, if necessary.

Tensioning Forces

Belt Section	Force required to deflect belt 16 mm per metre of span		
	Small Pulley Dia (mm)	Newton (N)	Kilogram force(kgf)
SPZ	56 to 95	13 to 20	1.3 to 2.0
	100 to 140	20 to 25	2.0 to 2.5
SPA	80 to 132	25 to 35	2.5 to 3.6
	140 to 200	35 to 45	3.6 to 4.6
SPB	112 to 224	45 to 65	4.6 to 6.6
	236 to 315	65 to 85	6.6 to 8.7
SPC	224 to 355	85 to 115	8.7 to 11.7
	375 to 560	115 to 150	11.7 to 15.3

Installation and take-up allowance table

<table>
<tr><th colspan="6">Installation Allowance</th></tr>
<tr><th>Belt Pitch Length (mm)</th><th>SPZ</th><th>SPA</th><th>SPB</th><th>SPC</th><th>Take-Up (mm)</th></tr>
<tr><td>410 to 530</td><td rowspan="10">20</td><td rowspan="11">25</td><td rowspan="12">30</td><td rowspan="15">50</td><td>5</td></tr>
<tr><td>530 to 840</td><td>10</td></tr>
<tr><td>850 to 1160</td><td>15</td></tr>
<tr><td>1170 to 1500</td><td>20</td></tr>
<tr><td>1510 to 1830</td><td>25</td></tr>
<tr><td>1840 to 2170</td><td>30</td></tr>
<tr><td>2180 to 2830</td><td>40</td></tr>
<tr><td>2840 to 3500</td><td>50</td></tr>
<tr><td>3520 to 4160</td><td>60</td></tr>
<tr><td>4170 to 5140</td><td>70</td></tr>
<tr><td>5220 to 6150</td><td rowspan="5"></td><td>85</td></tr>
<tr><td>6180 to 7500</td><td rowspan="4"></td><td>105</td></tr>
<tr><td>7600 to 8500</td><td>125</td></tr>
<tr><td>8880 to 10170</td><td rowspan="2"></td><td>145</td></tr>
<tr><td></td><td></td></tr>
</table>

The take-up figures in the above tables are less than the recommendations of ISO 155 because of the characteristics of the Fenner Belts.

Belt Matching

All Belts are manufactured within the internationally accepted length tolerance bands and therefore do not require a matching code number.

Storage

V-Belts should be stored in a dry stock-room and contact with hot pipes and direct sunlight carefully avoided. Where possible, handle the belts loosely in single coils. Always avoid tying them with thin string.

Trouble Shooting

Small cracks on V-Belt side and base
Generally caused by shortage of belt tension but excessive heat and/or chemical fumes can also give same failure.

V-Belt swelling or Softening
Caused by excessive contamination by oil, certain cutting fluids or rubber solvent.

Whipping during running
Usually caused by incorrect tensioning, principally on long centre drives. If a slightly higher (or lower) tension does not cure the cure the problem there may be a critical vibration frequency in the system which requires re-design or a banded belt. Consult the manufacturer.

Alignment
Good alignment of pulleys is important to avoid belt flank wear.

Taper Lock Bushes.

Installation

1. Remove the protective coating from the bore and outside of bush and bore of hub. After ensuring that the mating tapered surfaces are completely clean and free from oil or dirt, insert bush in hub so that holes line up.

2. Sparingly oil thread and point of grub screws, or thread and under head of cap screws. Place screws loosely in holes threaded in hub.

3. Clean shaft and hub to shaft as one unit and locate in position desired, remembering that bush will nip the shaft first and then hub will be slightly drawn on to the bush.

4. Using a hexagon wrench tighten screws gradually and alternately to torque shown in the table overleaf.

5. Hammer against large-end of bush using a block or sleeve to prevent damage.(This will ensure that the bush is seated squarely in the bore.)Screws will now turn a little more. Repeat this alternate hammering and screw tightening once or twice to achieve maximum grip on the shaft.

6. If a key id to be fitted place it in the shaft keyway before fitting the bush. It is essential that it is a parallel key and side fitting only and has TOP CLEARANCE.

7. After drive has been running under load for a short time stop and check tightness of screws.

To Remove

1. Slacken all screws by several turns. Remove one or two according to number of jacking off holes. Insert screws in jacking off holes after oiling thread and point of grub screws or thread and under head of cap screws.

2. Tighten screws alternately until bush is loosened in hub and assembly is free on the shaft.

3. Remove assembly from shaft.

Bush Size	1008	1108	1210	1610	2012	2517	3020
Screw Tightening (Nm)	5.6	5.6	20	20	30	50	90
Screw Dtls							
Qty	2	2	2	2	2	2	2
Size(BSW)	¼"	¼"	¼"	¼"	¼"	¼"	¼"
Large End Dia	35	38	47.5	57	70	85.5	108
Approx Mass (kg)	0.1	0.1	0.2	0.3	0.7	1.5	2.7

SECTION 13

FILTERS

FILTERS

All filter codes and quantities are scheduled on the individual GA drawings.

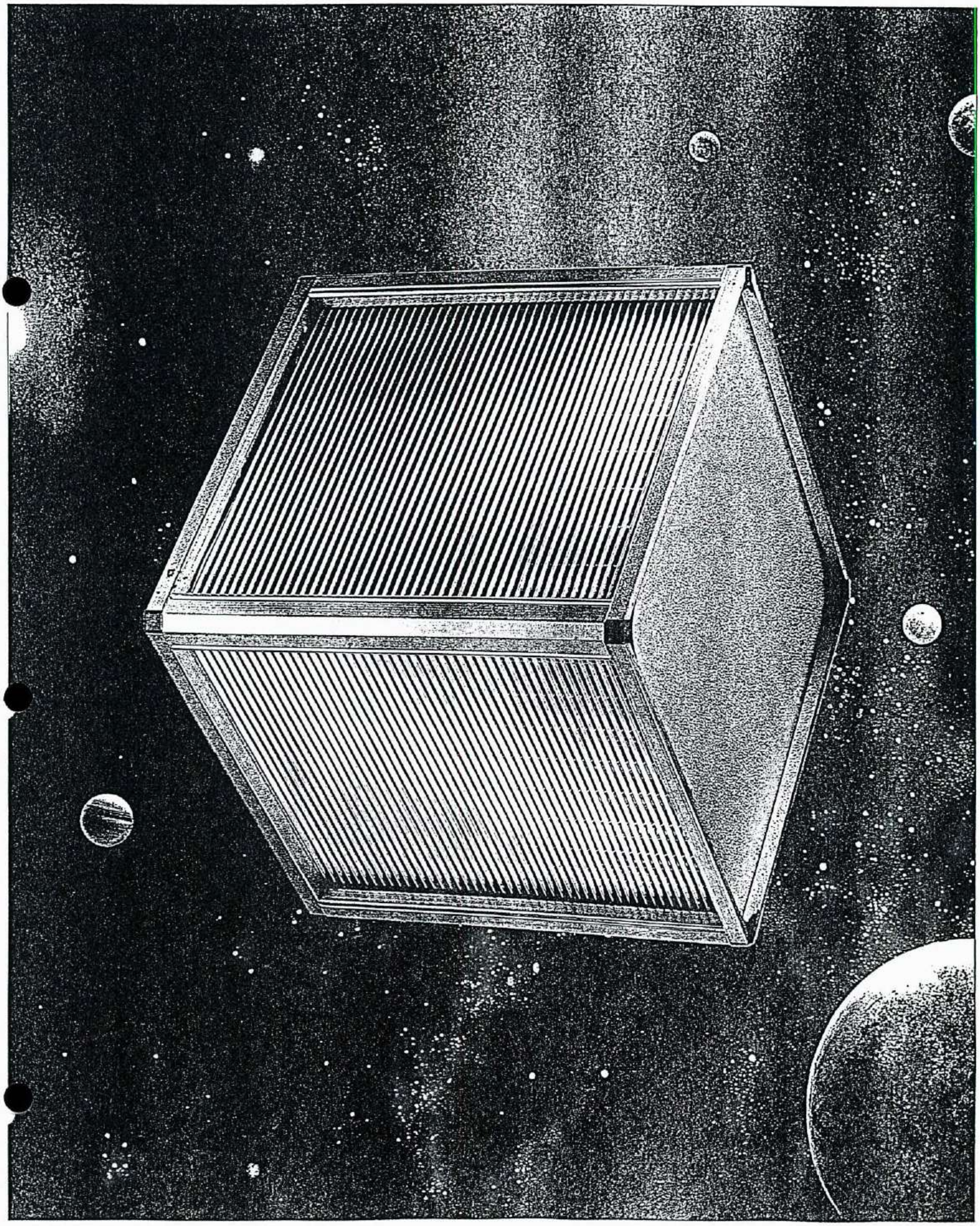
SECTION 14

HEAT CUBE

Hoval® PWT

Aluminium Plate Heat Exchangers for Heat Recovery in Ventilation Systems

Hoval



Cut-away view of design N

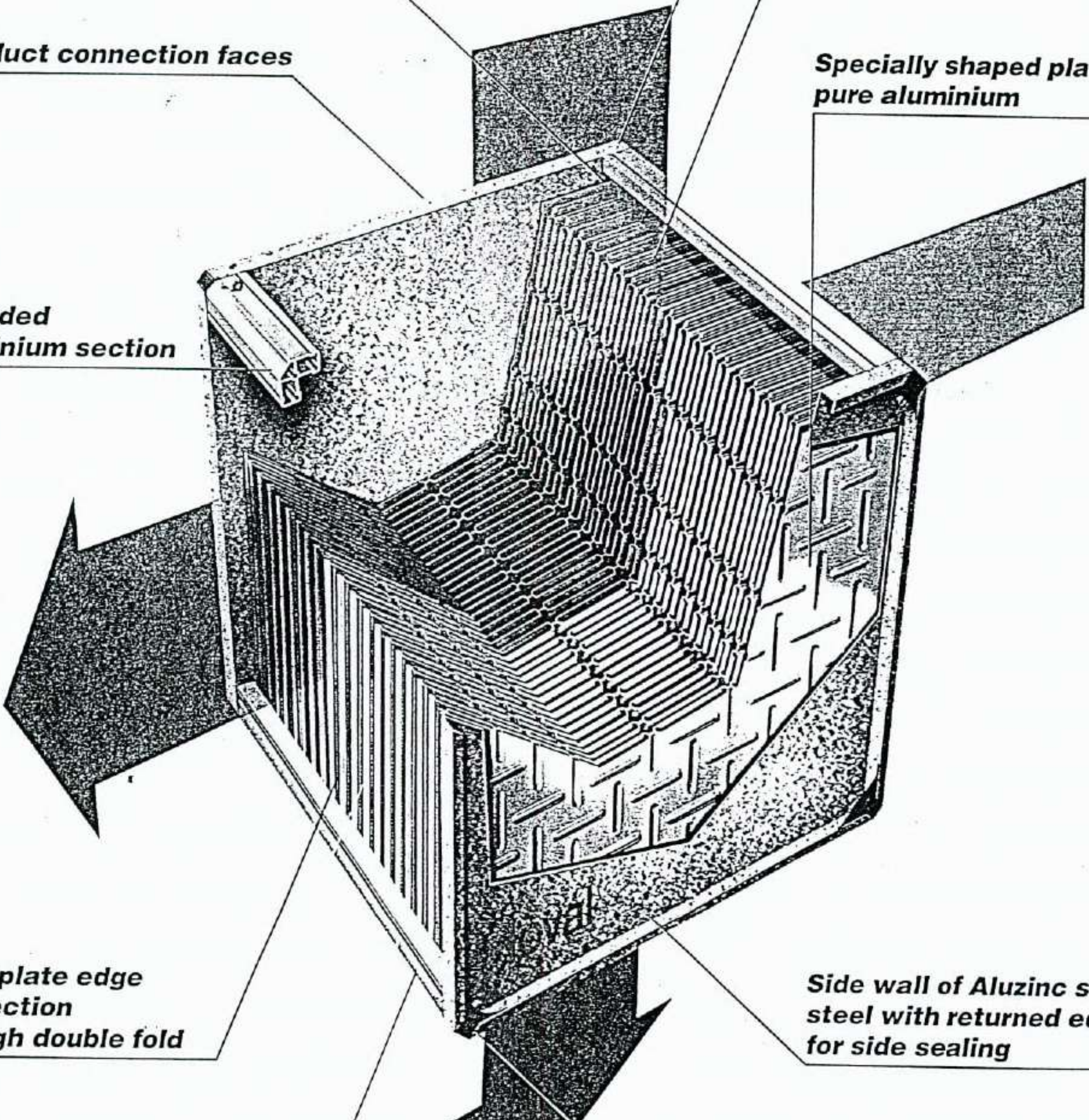


Table of contents

Hoval

PWT • Handbook for Design, Installation and Operation
Edition 09/97

Subject to technical alterations.

At a glance

Heat recovery reduces costs and protects the environment

Hoval plate heat exchangers are important elements in saving energy in industry, commerce, hotels, hospitals, sports halls, office buildings, seminar rooms, swimming pools, drying processes, paint spray booths, extraction plants, etc. They are used in air handling units, ductwork systems and in process technology.

This investment pays off in several ways:
- lower energy consumption
- lower investment for heat generation and distribution
- less damage to the environment

No cross contamination of the air streams

In the Hoval plate heat exchanger the warm extract air and the cool fresh air, separated by aluminium plates, pass each other in cross flow. No mixing of the two air streams takes place. Therefore, the transmission of dirt, odours, moisture, bacteria, etc. is impossible. Heat is transmitted from extract air to fresh air purely by conduction as a result of the temperature difference between the two air streams. The warm extract air is cooled down, the cool fresh air is heated.

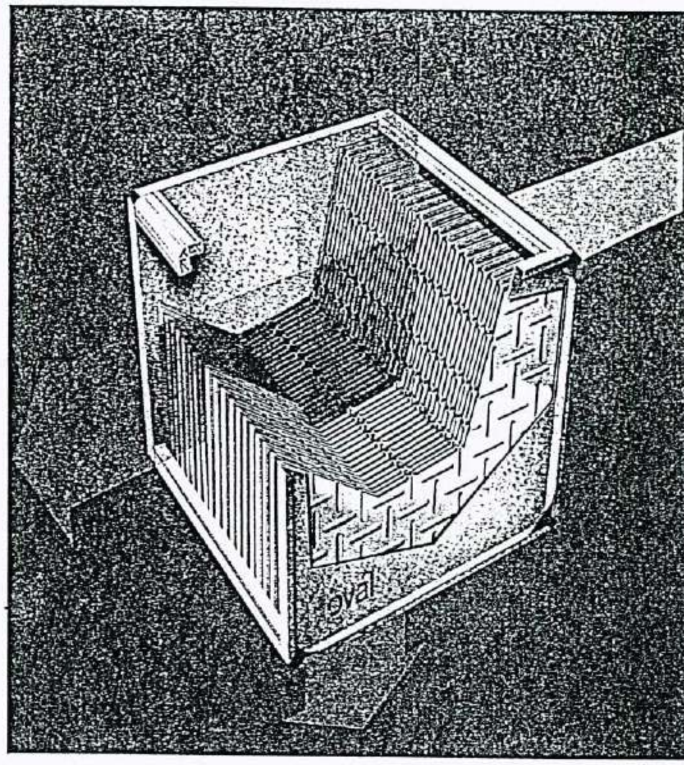


Fig. 2: Cut-away view of design N

Two designs

To satisfy technical demands on the exchanger package (dimensions, plate spacing, rigidity) mainly depending on the air flowrate, Hoval manufactures two designs:

Design N	Design F
for "normal" applications in air handling installations with air flowrates up to about 50000 m³/h	for applications in process technology and in air handling installations with higher air flowrates (up to 100000 m³/h)

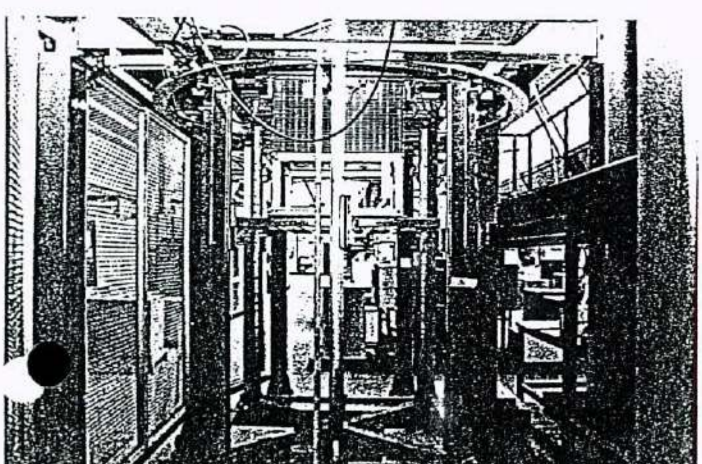


Fig. 1: Automated production machinery ensures constant high manufacturing quality.

Wide variety of sizes available

Hoval plate heat exchangers are available in a wide range of sizes to suit every application:
- exchanger lengths from 0.4 to 2.4 metres
- packages from 0.1 to 3.0 metres wide
- air flowrates from 500 to 100000 m³/h

The individual exchanger packages can be supplied with different plate spacings and heat recovery efficiencies.

Materials which suit the application

Three series are available to suit a wide variety of applications:

Standard series V
with the exchanger package of pure aluminium, the casing of aluminium extrusions and Aluzinc sheet steel,

Corrosion-protected series G
where the exchanger package and the casing are coated,

High-temperature series T
with a special sealing agent resistant to temperatures up to 200 °C (only for design N, uncoated).

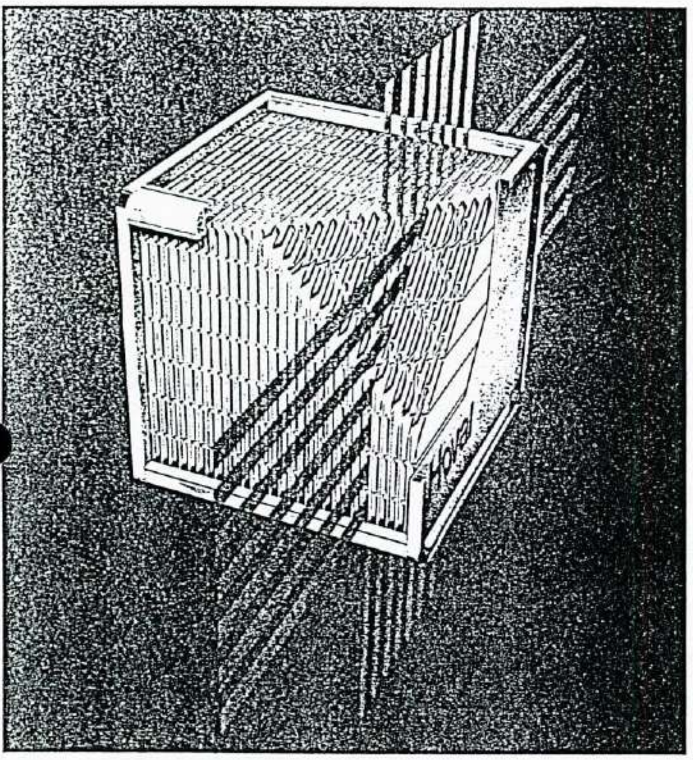


Fig. 3: Cut-away view of design F

Reliable in operation

Hoval plate heat exchangers have no moving parts. Their function requires no electrical connection. There are therefore no extra running costs and operation is always guaranteed: 100 % reliability.

Many years of operation in numerous applications have proved that Hoval plate heat exchangers are extraordinarily resistant to dirt build-up. Therefore no special maintenance is required.

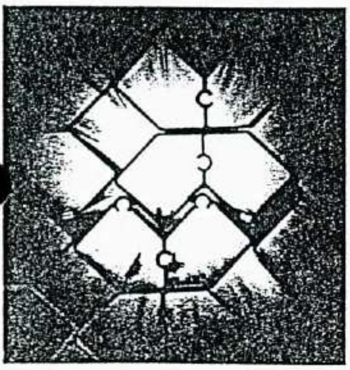


Fig. 4:
Special aluminium extrusions offer advantages in installation.

Wide range of accessories

The Hoval plate heat exchanger is available with the following well-proven accessories:

Bypass
This is built into the same casing as the exchanger package (at the side or in the middle).

Recirculation bypass
One more side of the bypass for performance control is open. Thus, with a damper, recirculation operation is also possible.

Bypass dampers
from aluminium extrusions; driven by plastic gear wheels, which are fitted in the middle; individual pieces, easily removable even after installation.

Protection strips
for the exchanger's leading and trailing edges, in applications where heavy dirt build-up is expected.

Reliable data

Hoval plate heat exchangers have been independently tested and measured on the test rig of the Zentralschweizerischen Technikum Luzern in Horw. All technical data (heat recovery efficiency, pressure drop) are based on these test results.

The Hoval computer calculation program CAPS (Computer Aided Plate Heat Exchanger Selection) allows calculation of all technical data as well as profitability.

Hoval plate heat exchangers offer many advantages:

- high heat recovery efficiency – low investment costs
- no moving parts – no wear, always ready for operation
- separate air streams – no cross-contamination
- no electrical connections – no extra running costs
- 2 designs, 3 series, 13 sizes, 17 plate spacings, any desired width – the optimum solution for every application
- lightweight, compact design – easy to install
- automated production – constant high quality
- extensive range of accessories – complete solutions

Principle and operation

1. Principle and operation

Hoval plate heat exchangers operate within the guidelines for heat recovery (e.g. VDI 2071, Eurovent 10) as **recuperators with joint faces** (category 1). The heat releasing and heat absorbing air streams pass along the joint face, through which the heat is directly transmitted. Supply and extract air must therefore be brought together and flow through the heat exchanger.

1.1 Heat transmission

Hoval plate heat exchangers operate on the **cross-flow principle.** Heat is transmitted via the plates from the warm to the cold air stream. A much simplified performance calculation is:

$$Q = k \cdot A \cdot \Delta t$$

When temperatures are given, the transmitted heat performance is assumed by design characteristics.

1.1.1 Heat transfer rate

The k-value is calculated from the thickness and heat conductivity of the plates, as well as heat transfer on both sides:

$$\frac{1}{k} = \frac{1}{\alpha_1} + \frac{d}{\lambda} + \frac{1}{\alpha_2}$$

Thin plates are used, for cost reasons, the influence of the material can be neglected. This is shown in table 1:

Material	Thickness [mm]	λ [W/mK]	$\alpha_1 = \alpha_2$ [W/m²K]	k [W/m²K]
Aluminium	0.125	200	40	19.9998
Aluminium	0.500	200	40	19.9990
Plastic	0.500	0.20	40	19.0476

Table 1: Plate thickness and material have only a slight effect on the efficiency.

For good heat transmission, the heat transfer α must be high on both sides of the plates. For this reason Hoval optimised the plate profiles by extensive tests. The results are **high efficiency**, relatively independent of the flow velocity.

1.1.2 Exchanger surface area

The amount of heat transmitted is directly dependent on the exchanger surface area. With the **number of plates**, i.e. their spacing, the efficiency is easily changed, optimised or selected to meet a particular specification.

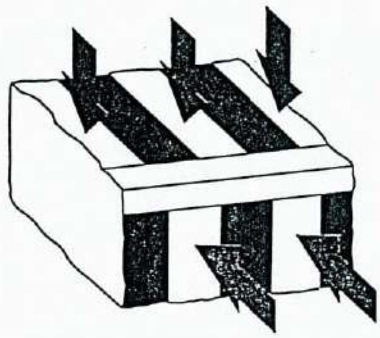


Fig. 5: Separated by the plates, the air streams pass each other.

Therefore **different plate spacings** are available for most types of Hoval plate heat exchangers. The optimum exchanger can only be selected with an economic calculation directly concerning a specific project.

1.2 Leakage

Components of air handling units, such as e.g. dampers, ducts or casings, are **not normally 100 % leakproof.** This is mainly because it is not necessary to ensure the correct function and it would be very expensive. In practical use, however, leakage must not exceed technically justifiable limits. Therefore, test specifications and limits exist for certain components, such as e.g. dampers. For heat recovery units, there is no such data at the moment. Nevertheless, actual values are known from tests. A difference has to be made between the following:

- leakage to outside (external)
- leakage between supply and extract air (internal)

While sealing to outside normally does not cause any problems (it is above all a question of assembly quality), the **internal leakage mainly depends on the system and exchanger construction.** The Hoval plate heat exchanger is particularly tight. Tests have shown the following leakage rates (relating to the nominal air flowrate and a pressure drop of 200 Pa):

– internal leakage: 0.0158 %
(at a pressure difference of 250 Pa)
– external leakage: 0.0014 %
(at a pressure difference of 400 Pa)

These are excellent results and far better than other manufacturer's data. Nevertheless, it must be noted that exchangers are not 100 % leakproof unless special measures are taken.

As an approximate value for the internal leakage of Hoval plate heat exchangers 0.1 % of the nominal air flowrate can be used (at a pressure difference of 250 Pa).

1.3 Moisture transmission

The two air streams are separated in the Hoval plate heat exchanger; transmission of moisture is therefore not possible. This is a special advantage when moisture is removed with the warm air, e.g. in swimming pools, drying processes, etc.

1.4 Condensation

Hoval plate heat exchangers do not transmit moisture but still can **use part of the latent heat of moist extract air**. At low outside temperatures, when there is a high heat demand, the extract air is cooled down to such a degree that the saturation temperature is reached and condensation is formed. Thus the latent heat of evaporation is released. This **reduces further cooling of the extract air**, i.e. the temperature difference between the air streams in the plate heat exchanger is greater than when there is no condensation. Also the heat transfer is better; consequently the **efficiency is raised significantly** (see diagram 3, page 27).

This can be seen clearly in the hx diagram. The cold air stream is heated more than the warm air is cooled. Nonetheless the enthalpy difference is the same, assuming equal water content.

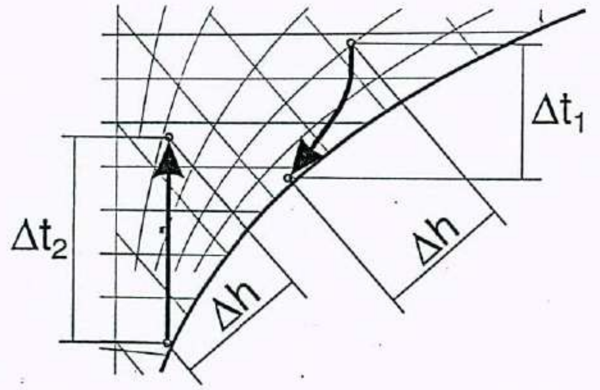


Fig. 6: Changes of condition in the hx diagram

Condensation in the extract air reduces the free area of the airway and is responsible for an increase in pressure drop. Therefore it is important that the **condensation can drain away**. This depends mainly on the fitting position of the heat exchangers and on the form of the plates. Hoval plate heat exchangers offer advantages because of their special profiles. Tests have proved that the increase of pressure drop is less than with other constructions.

If condensation occurs the **internal and external leakage** of the exchanger is of particular importance. Even with a leakage rate of only about 0.1 % of the nominal air flowrate (and lower) – as with the Hoval plate heat exchanger – **up to 3 litres condensate an hour** can leak out, even more in extreme cases.

The absolute value depends on the size of the exchanger, the number of plates, the amount of condensate and the pressure difference. An evaluation of the possible condensate leakage concerning a specific project can be made on request.

1.5 Temperature profile

With the cross-flow heat exchanger, the air streams are not heated and cooled evenly. This means that the temperatures vary along the cross section of the air stream. The computer graphic, calculated by the finite element method, indicates this (see Fig. 7).

Because of the temperature variation the verification of the efficiency under operating conditions is practically impossible. For this reason, the performance of Hoval plate heat exchangers has been empirically **tested, measured and agreed by independent test institutes** – to safeguard the consultant, installer and operator.

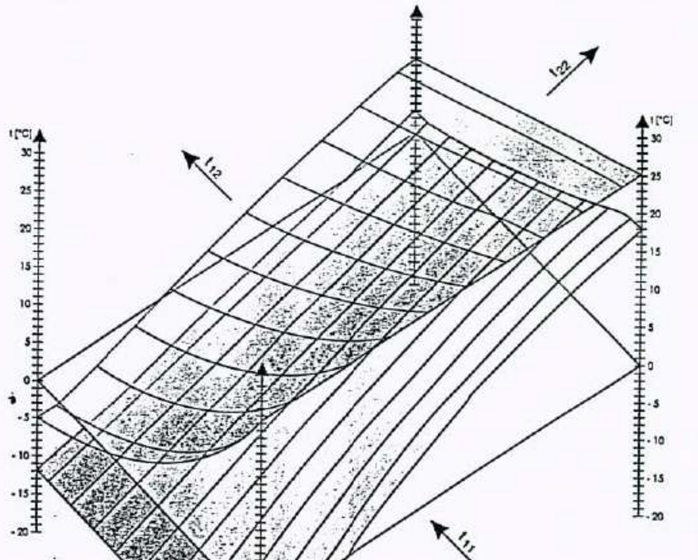


Fig. 7: Temperature profiles of the air streams (computer graphic)

Principle and operation

Zentralschweizerisches Technikum Luzern
Ingenieurschule HTL

HLK Prüfstelle

Untersuchungsbericht Nr: HP-9640

der Prüfstelle für

Heizungs-, Lüftungs- und Klimatechnik

Objekt: Luft / Luft Plattenwärmetauscher für Wärmerückgewinnung

Auftraggeber: Hovalwerk AG
Werk Schaan
Zollstrasse 91
FL-9494 Schaan

Datum: 1997-03-13

Dieser Bericht umfasst 22 Seiten.

Dieser Bericht HP-9640 ersetzt den Bericht HP-9514 in deutscher Sprache vollständig. Der Bericht HP-9514 in englischer Sprache ist identisch mit diesem Bericht HP-9640.

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Zentralschweizerisches Technikum Luzern
Ingenieurschule HTL

Prüfstelle HLK

Untersuchungsbericht Nr: 9323

der Prüfstelle für

Heizungs-, Lüftungs- und Klimatechnik

Objekt: Leckluftstrombestimmung an 5 Wärmetauschern

Auftraggeber: Hovalwerk AG Schaan, Zollstr. 91, FL-9494 Schaan

Datum: 93-11-24

Dieser Bericht umfasst 14 Seiten mit Anhang.

Eine Verwendung dieses Berichtes zu Werbezwecken irgendwelcher Art, der blosse Hinweis auf diesen Bericht eingeschlossen, bedarf der schriftlichen Genehmigung der Prüfstelle HLK.

Fig. 8: Measurements by independent institutes, verifying the technical data of Hoval plate heat exchangers.

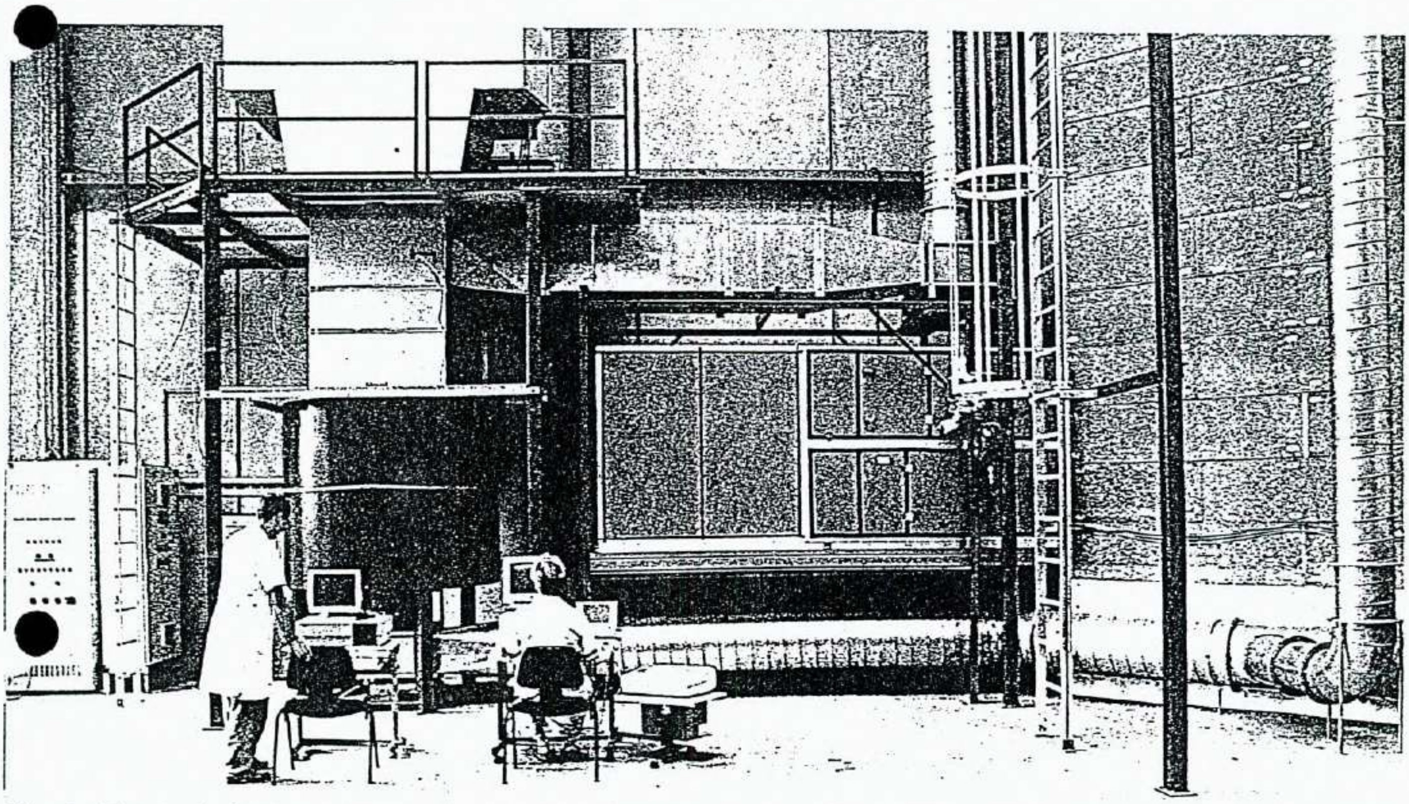

Fig. 9: The technical data are continually examined on the Hoval test rig.

1.6 Frost limit

If the warm air stream is severely cooled down, it is not only possible for condensation to form, but also to freeze. The cold air temperature at which freezing starts, is called the "frost limit". In practice this is rare as several factors must coincide:

- very low temperature of the cold air stream
- cold air volume is greater than warm air volume
- high efficiency of the exchanger
- relatively little condensation
- the condensation cannot drain away easily

If several of these circumstances occur simultaneously, the plate heat exchanger can ice up, starting at the cold corner. The Hoval plate heat exchanger is not damaged, but the pressure drop is increased and the air flowrate is reduced. In extreme cases the whole exchanger can slowly ice up. Long experience shows that this is very rarely the case. When designing under the following conditions, the frost limit need not be considered:

- mass flow ratio cold air to warm air $m_2/m_1 < 1$
- lowest cold air temperature > −15 °C (mostly the case when no night operation)
- normal installation of the heat exchanger, i.e. plates are vertical
- exhaust air flowrate can be reduced for short periods

If these conditions are not met, it is recommended to calculate the frost limit for each project with the computer program and to take necessary precautions (de-icing exhaust fan switch, preheating, bypass).

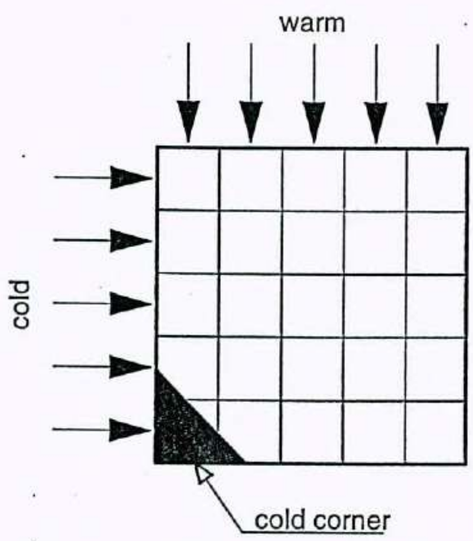

Fig. 10: Under extreme conditions, the exchanger can ice up, starting at the "cold corner".

1.7 Heat recovery efficiency

In principle, nearly any efficiency can be achieved if sized and designed to suit. For instance, the efficiency can be substantially raised by installing two exchangers in series. However, this increase in efficiency

- either is at the expense of a high pressure drop,
- or at the expense of a large space requirement,
- but in any case at the expense of costs.

The "correct" efficiency is a subjective decision and depends on the economic calculation, i.e. on operating data such as energy prices, useful life, running times, temperatures, maintenance costs, interest rates, etc.

It is important that the calculated optimum values for heat recovery efficiency and pressure drop are then put into practice. Even small deviations (a few percent less efficiency, a few pascals more pressure drop) can cause substantially worse values for the present value and pay-back period. With regard to profitability and environmental protection the heat recovery efficiency should be at least 50 %, or better 60 %.

1.8 Pressure drop

Heat recovery units cause additional pressure drop on the extract and fresh air sides; incurring higher running costs. Under present conditions the economical values range between 150 Pa and 250 Pa. However, to cut down costs, heat recovery units whose pressure drop exceeds these values are often installed. The profitability of heat recovery is thereby jeopardised. But there is also an economic limit: The efficiency for generation of electrical current ranging between only 35 % to 40 %, the expenditure for the additional pressure drop must not exceed this value in relation to the energy savings in total.

1.9 Pressure difference

A distinction is made between

- the internal pressure difference (between fresh air and extract air) and
- the external pressure difference (between inside and outside of the exchanger).

1.9.1 External pressure difference

This pressure difference has a major effect on the external leakage of the plate heat exchanger. Yet when the exchanger is properly and carefully installed in a ductwork system, its effect can be neglected. More important is the influence on mechanical resistance. Particularly the side walls are heavily stressed at big pressure differences. Hoval therefore strengthens the side walls of large plate heat exchangers with a special reinforcing section.

1.9.2 Internal pressure difference

Likewise, the internal pressure difference has a crucial influence on internal leakage between the two air streams. Although Hoval plate heat exchangers are very tight in comparison with other constructions, the following should be considered when designing:

- The pressure difference in the heat exchanger should be kept to a minimum.
- The pressure gradient and thus leakage should be from the supply air to the extract air side.

The internal pressure difference also may cause a deformation of the plates. The plate spacing is then narrowed and/or widened, resulting in corresponding variations of pressure drop.

Extensive tests have shown that the influence of deformation depends on the plate spacing. Fig. 11 shows that, at an internal overpressure exceeding the permissible value of 1500 Pa, the pressure drop strongly increases with small plate spacings whereas it hardly changes with big plate spacings.

The pressure difference depends on the position of fans. Overpressure on one side and underpressure on the other side add up.

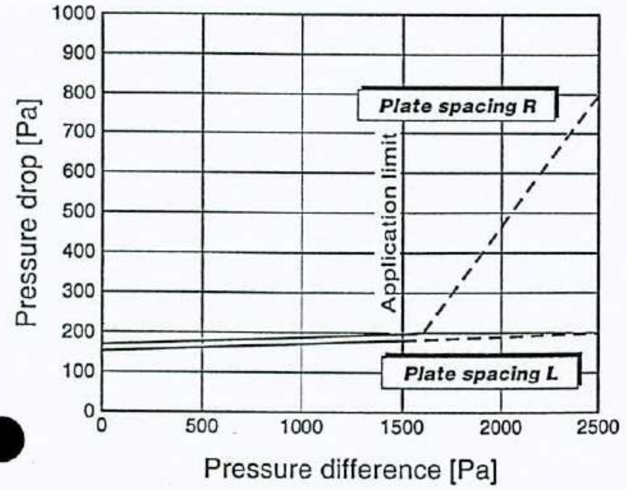

Fig. 11: The effect of the internal pressure difference on pressure drop depends on the plate spacing.

2. Performance control

The Hoval plate heat exchanger operates as a **temperature moderator** between the two air streams. The direction of the heat transmission is of no consequence, i.e. depending on the temperature difference between extract and fresh air, either heat recovery or cool recovery takes place. Therefore performance control of the Hoval plate heat exchanger is not necessary when **the extract air temperature is identical to the desired room temperature.** In this case, the outside temperature is always either heated or cooled through the plate heat exchanger in the direction of the set temperature.

In many cases, however, heat gains are present in the ventilated space (people, machinery, lighting, solar, process plants), which increase the room temperature, so that the **extract air temperature is higher than the set temperature.** In this case, at full performance of the heat exchanger, check at which outside temperature heat-up begins, and if this cannot be tolerated, the performance of the heat exchanger must be regulated.

Example:

In an industrial building the room air is heated from 18 °C to 24 °C through lighting and machinery. The heat recovery figure Φ_2 is 66 %. At which outside temperature t_{21} is the space heated only by heat recovery without additional heating?

$$t_{21} = \frac{t_{22} - (\Phi_2 \cdot t_{11})}{(1 - \Phi_2)}$$

$$t_{21} = \frac{18 - (0{,}66 \cdot 24)}{(1 - 0{,}66)} = 6\ °C$$

At an outside temperature of +6 °C the supply air temperature after the heat exchanger is 18 °C = set temperature. At higher outside temperatures the hall is heated above the desired room temperature, this means the performance of heat recovery should be controlled.

With the Hoval plate heat exchanger the **performance control through change of the mass flow ratio** is simply and economically accomplished with the bypass. All Hoval plate heat exchangers can therefore be supplied with integral bypass and regulation dampers. Exchanger and bypass width are automatically selected using the computer program in such a way that **pressure drop is equal.**

Whether a bypass is fitted on the side or in the middle depends on local conditions and on the width of the exchanger. The arrangement of further ventilation components after the bypass, e.g. air heater, moisture eliminator, etc., must take into consideration the fact that the velocity profile can be uneven.

There are two options for the fitting of the bypass:

Bypass in the fresh air

Depending on damper position, between 0 % and 100 % of the fresh air passes through the bypass. The extract air always flows through the heat exchanger and is cooled according to the fresh air flowrate. With this arrangement the cooling of the extract air and thus **freezing can be avoided.**

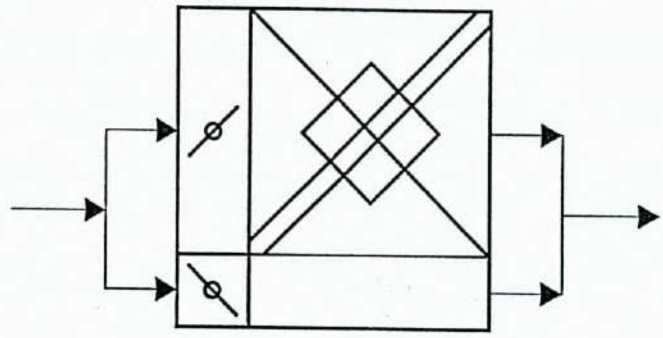

Fig. 12: The bypass is most effective for the control of performance.

Bypass in the extract air

Between 0 % and 100 % of the extract air passes through the bypass. The fresh air always passes through the plate heat exchanger. This arrangement is recommended **when the extract air is very dirty,** as during summer operation the extract air does not pass through the plate heat exchanger.

On our own account:

We would ask you for your assistance

This handbook has been written for you, the specifier, the installer, the user.

And certainly it can be improved.

Please help us to make it better. Inform us about errors and suggest improvements.

We would be grateful for every comment.

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Werk Schaan
Abteilung MVL
Zollstrasse 91
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Construction

3. Construction

Hoval plate heat exchangers consist of the exchanger package and the casing. Sizing of the exchanger package (plate size and plate spacing) depends mainly on the air flow-rate. To achieve an optimum result with regard to heat recovery efficiency, pressure drop and costs Hoval manufactures two different package designs:

- **design N**
  with plate spacings from around 2 mm to 6 mm
- **design F**
  with plate spacings from around 4 mm to 12 mm

Both designs use the same corner sections and side walls to form the casing.

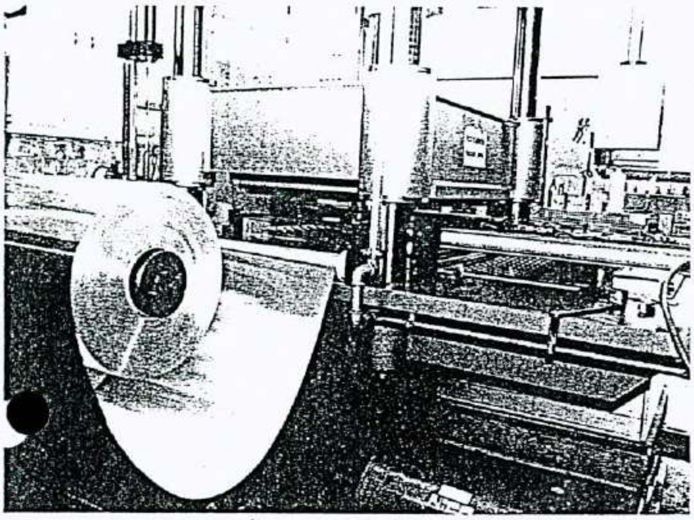


Fig. 13: The plates for design N are stamped from coil on automated presses.

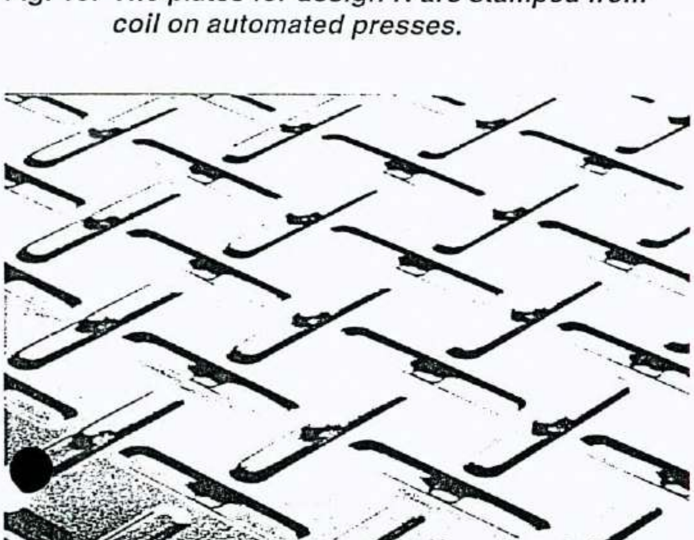


Fig. 14: The special profiles of Hoval plates are the result of extensive tests and measurements. (Design N shown here)

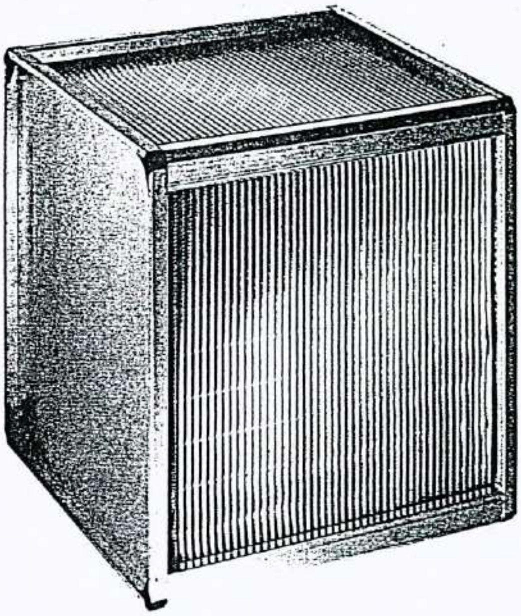


Fig. 15: Design N

3.1 Exchanger package in design N

The exchanger package consist of specially formed aluminium plates. The profile has been optimised by extensive tests for heat recovery efficiency, pressure drop and stability. The important advantages are:

- little dependency of the heat recovery efficiency on the air velocity
- exact spacing between the plates through positive/negative stamping
- high rigidity of the thin aluminium plates through the special arrangement of the vertical and horizontal ribs

The permitted pressure difference between the two air streams is limited to 1500 Pa. Measurements have shown that a plastic deformation of the plates is to be expected only with much higher pressure differences.

- The profiles are arranged in such a way that the condensation can drain in every direction.
- Uneven flow patterns can even out inside the heat exchanger.

There are five different plate sizes, which are formed with different profile depths, i.e. for different plate spacings. Thus **20 different exchanger packages** can be made, independent of width.

The connection of the plates is made by a **double fold**. This results in a sixfold material thickness for the leading and trailing edges, which gives good rigidity to the exchanger package. Also a **streamlined flow profile** is given, which reduces not only pressure drop but also the possibility of dirt deposits.

With casting of the corner sealants, the double fold is additionally sealed with epoxy resin. Thus the exchanger package is extremely leakproof.

When using coated corrosion resistant plates it is of particular advantage that the cut edge is inside the double fold and thus does not come into contact with the aggressive air streams.

Fig. 16: The double fold of design N connects the plates tightly and rigidly.

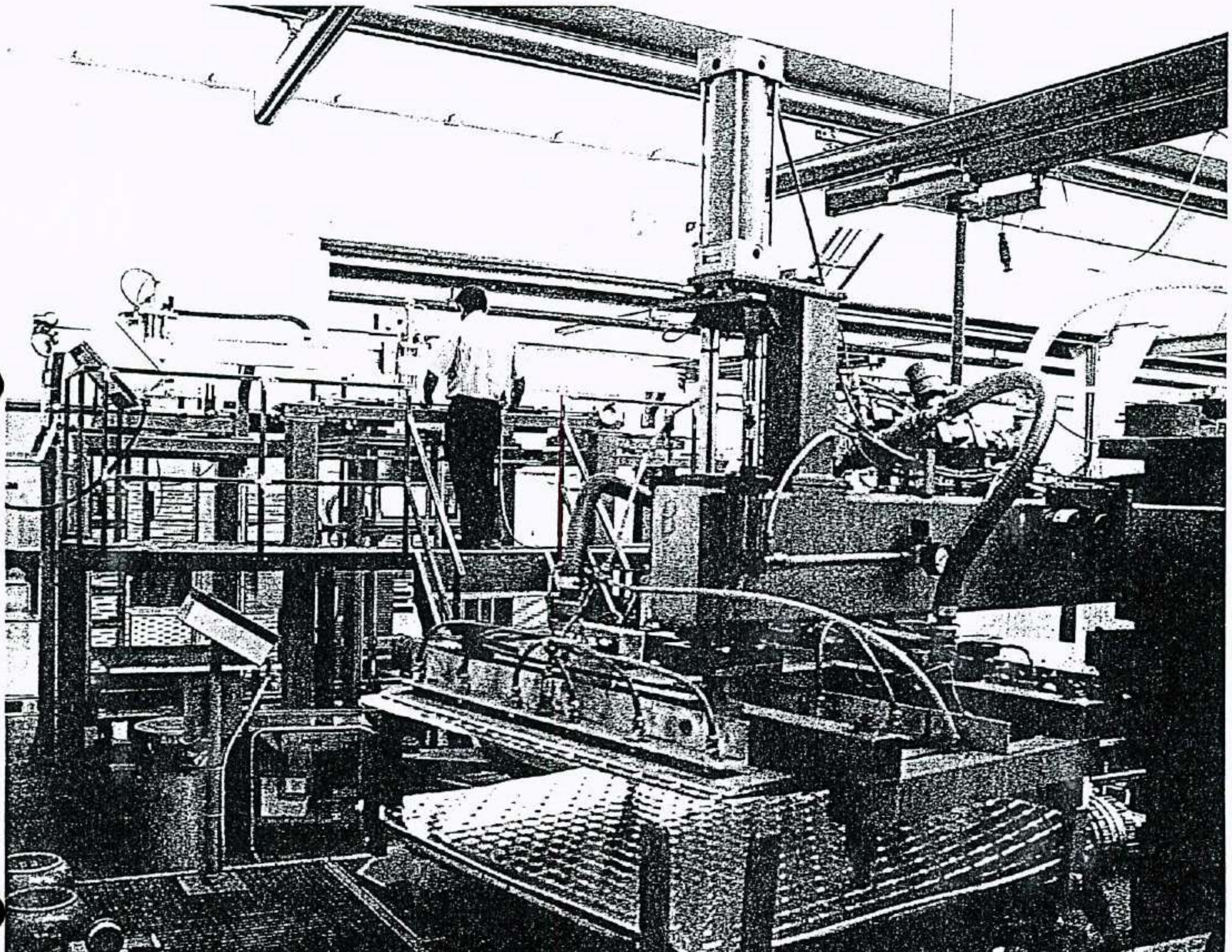


Fig. 17: The exchanger packages in design N are folded on automatic machinery.

3.2 Exchanger package in design F

The exchanger package consists of specially shaped aluminium plates. Their profile with **V-shaped spacing ribs** is an optimum design resulting from detailed tests for heat recovery efficiency, pressure drop and rigidity. The main advantages are:

- little dependency of the heat recovery efficiency on the air velocity
- exact spacing between the plates
- high rigidity through crosswise stacking of the spacing ribs

The permitted pressure difference between the two air streams is limited to 1500 Pa but plastic deformations are to be expected only with much higher pressure values.

- excellent flow profile at exchanger inlet
- condensate can drain freely in all directions

There are three different plate sizes, which are formed with different profile depths. Thus **9 different exchanger packages** can be made, independent of width.

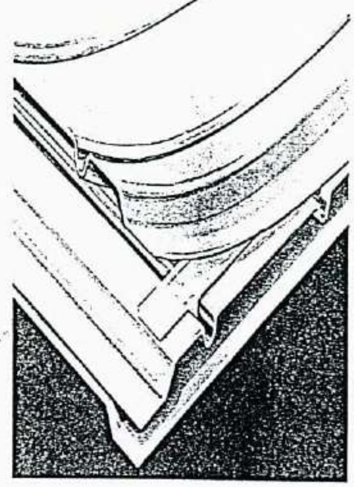


Fig. 18: The plates are glued with PU sealing compound and, in addition, sealed with epoxy resin.

The plates are **glued with PU sealing compound**. This is applied by machine, which guarantees constant high quality and tightness. With casting of the corner sealants, the glued plate connection is sealed additionally with epoxy resin. Thus the exchanger package is extremely leakproof. For corrosion-protected design the bare cut edges are treated with a coating.

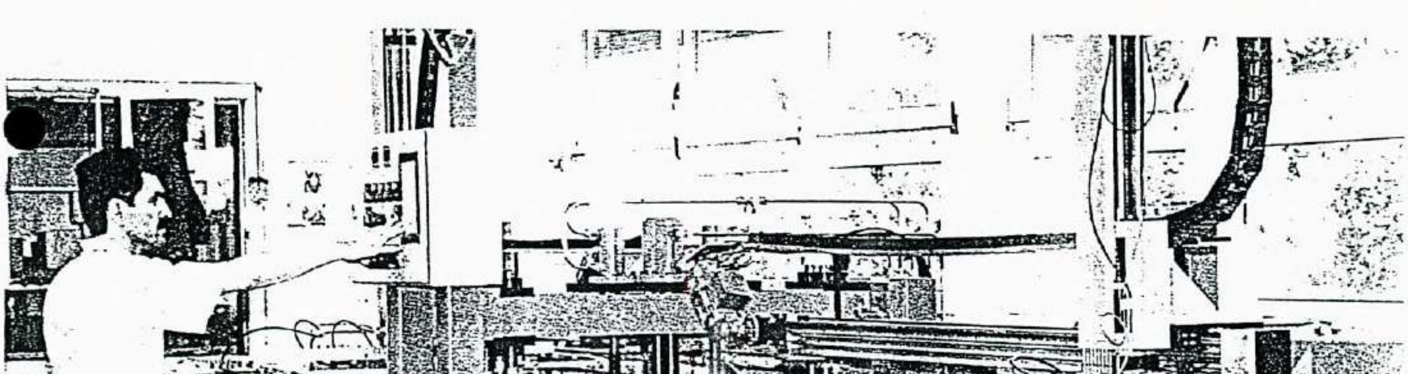


Fig. 19: The spacing ribs of plates in design F are impressed on special machinery.

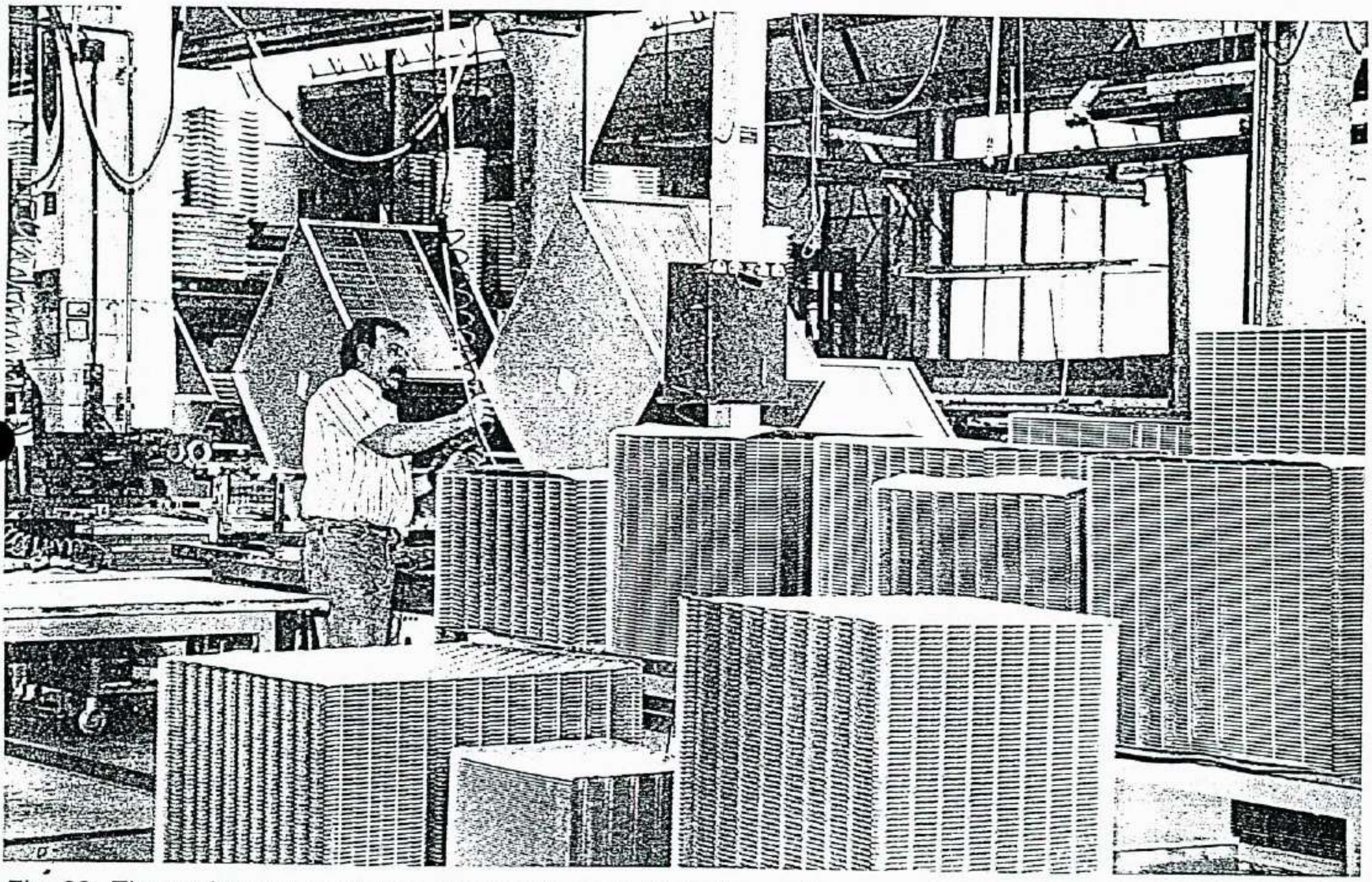


Fig. 20: The exchanger packages are tightly sealed into the casings.

3.3 Casing

The exchanger package is fitted into a casing of aluminium corner sections with side walls of Aluzinc sheet steel. The specially developed sections are particularly important:

- The edges of the exchanger package are cast into the sections with epoxy resin. This **technique, which is patented by Hoval**, ensures optimum integration of the package into the casing.

- Other components can be bolted or riveted directly to the **hollow sections** without affecting the rigidity of the exchanger or damaging the exchanger package.

- At the corners the sections are flattened by 45°, which facilitates installation of the plate heat exchanger and **reduces the diagonal dimension**.

The side walls are bolted to the corner sections (each with three screws). This creates **flat surfaces** for connecting ducts or other components. A punched seal between corner section and side wall ensures highest tightness. Attractively shaped plastic elbow pieces finish off the side walls. In addition, they allow installation of a side sealing all round together with the returned edge. This facilitates installation into a casing.

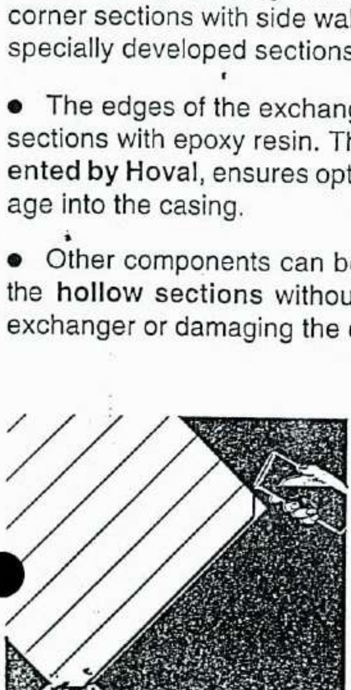


Fig. 21:
When casting the corner section the plate connection is sealed again.

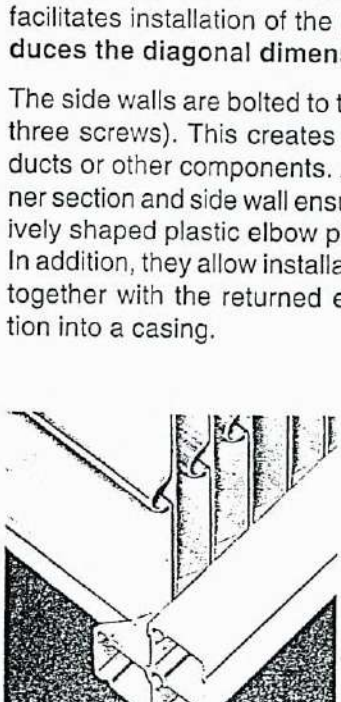


Fig. 22:
The specially developed aluminium corner sections offer many advantages.

With very wide exchangers, stability of the casing is additionally improved by the installation of intermediate walls at regular intervals.

The side walls of all compound plate heat exchangers have a special profile for a sealing bead. This together with the sealing bead in the corner section ensures tight connection of the individual exchanger blocks.

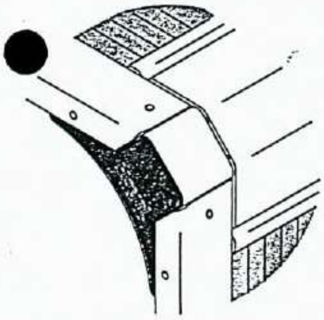


Fig. 23: The side walls are finished off with attractively shaped plastic elbow pieces.

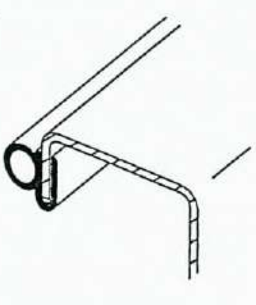


Fig. 24: A side sealing can be fastened to the returned edge of the side wall.

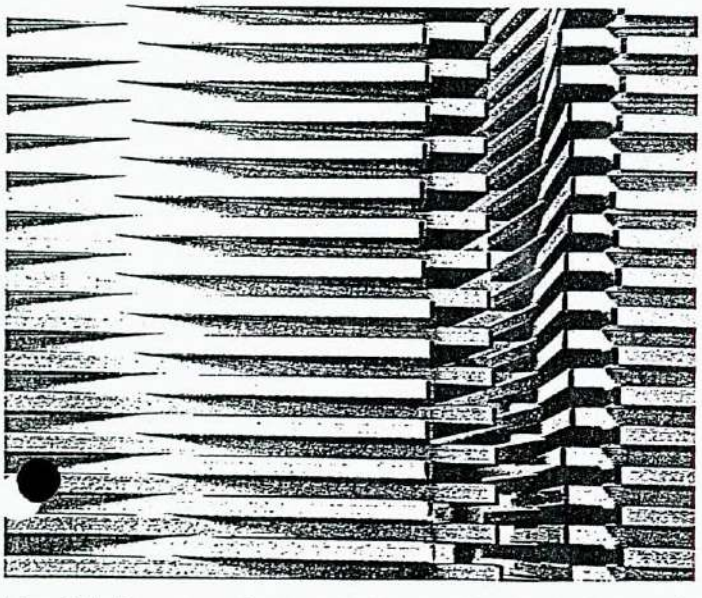


Fig. 25: Pre-manufactured side walls of Aluzinc sheet steel are ready for assembly.

4. Model range

To achieve the optimum solution for all applications, the Hoval plate heat exchanger is offered in different designs and sizes.

4.1 Designs

Depending on usage and air flowrate different design possibilities of Hoval plate heat exchangers are available.

4.1.1 Design N

This design mainly covers "normal" applications in air handling installations.

4.1.2 Design F

These exchangers have been developed for higher air flowrates. Plate size and plate spacing are therefore bigger than with design N.

4.1.3 Design D

On request exchangers of designs N and F can be built diagonally (i.e. standing on the corner) into a self-supporting casing, including two condensate drip trays with drains. With the diagonal design different air flow directions are possible. It is used for duct-mounting and fixing to other air handling components.

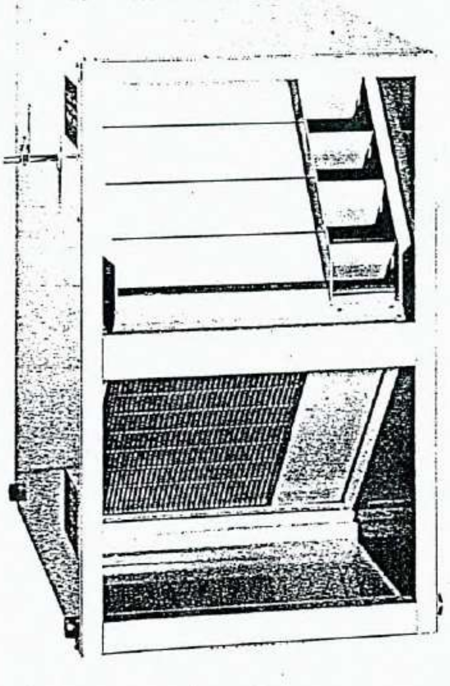


Fig. 26: Diagonally built-in plate heat exchangers are available on request.

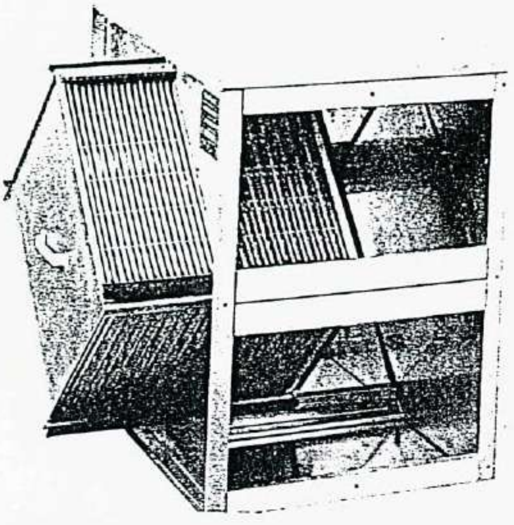


Fig. 27: Removable plate heat exchangers are available on request.

4.1.4 Removable plate heat exchangers

For special applications Hoval plate heat exchangers are built into a casing in such a way that they can be removed on rails from the side. These removable plate heat exchangers are not part of the standard range but manufactured only on request. They are used mainly for dirty air streams when regular cleaning is required.

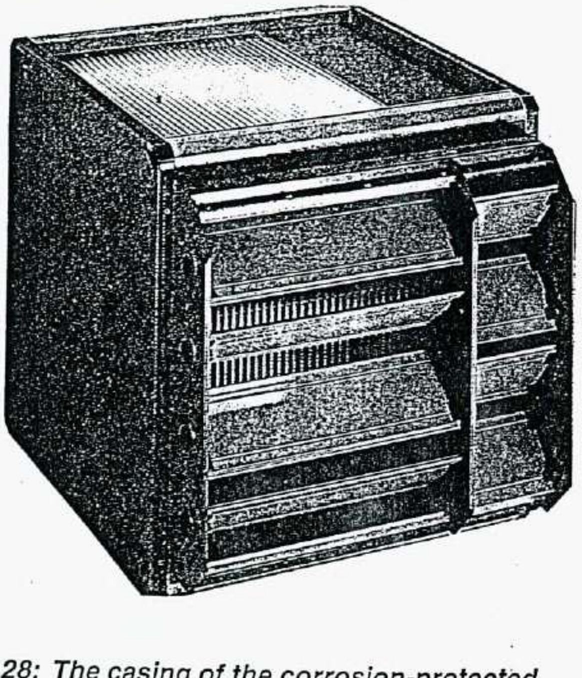


Fig. 28: The casing of the corrosion-protected series is painted red (RAL 3000) and orange (RAL 2008).

4.2 Series

Three different material types are available:

4.2.1 Series V (standard)

The exchanger package consist of aluminium plates of the quality Al99 (pure aluminium). This provides highest possible resistance against corrosion – better than with aluminium alloys.

The corner sections are made of aluminium extrusions. They are fastened to the rigid side walls of Aluzinc sheet steel. (This is sheet steel coated with an alloy of 55 % aluminium and 45 % zinc. Thus it is particularly resistant against corrosion.)

With design F, the connection of the plates is made with PU sealing compound.

The plate package is cast into the corner sections with permanent elastic epoxy resin. Thus Hoval plate heat exchangers of series V are silicone-free.

Pure aluminium is more resistant against corrosion than aluminium alloys. Aluzinc sheet steel has better resistance against corrosion than galvanised sheet steel.

4.2.2 Series T (high-temperature)

The construction is identical to series V, except instead of the permanent elastic epoxy resin a high-temperature silicone is used for sealing of the corner sections. Thus the heat exchanger is resistant to temperatures up to 200 °C.

Series T (high-temperature) is available only for design N.

4.2.3 Series G (corrosion-protected)

The basic materials correspond to those of series V, however, the complete casing and the plates are treated with a coating.

Hoval plate heat exchangers of series G are silicone-free.

This series is used when large amounts of condensate occur, in wet rooms, swimming pools, etc., and for mild corrosion (coastal locations, industry, process technology, etc.).

In design N the bare cut edges are inside the double fold and thus protected. In design F the cut edges are treated with a corrosion-resistant coating.

Model range
Options

4.3 Exchanger size

The exchanger package is responsible for the air performance (heat recovery efficiency, pressure drop, air flowrate). Depending on the design, different sizes are available.

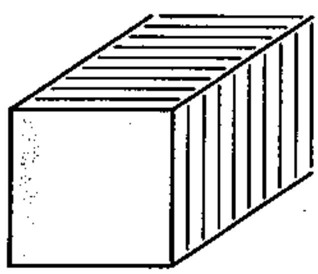
4.3.1 Exchanger sizes in design N

Hoval manufactures eight different sizes:

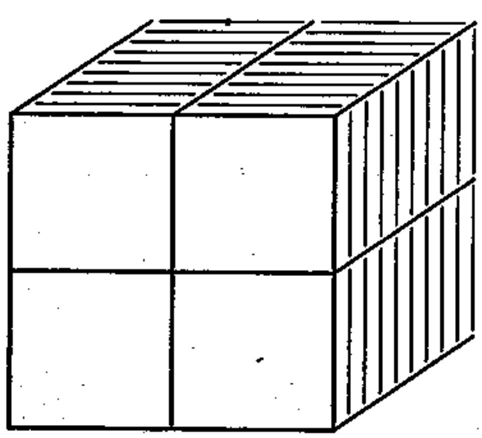
040   050   060   070   085   120   140   170

The designations are in conjunction with the exchanger lengths; the exchanger size is the dimension in cm.

Sizes 040 to 085 consist of one exchanger package, sizes 120 to 170 are made up of four exchanger packages sizes 060, 070 and 085.



Design N	040	050	060	070	085
Design F	100	120			



Design N	120	140	170
Design F	150	200	240

Fig. 29: Individual plate heat exchangers are constructed from different exchanger packages.

4.3.2 Exchanger sizes in design F

Hoval manufactures five different sizes:

100   120   150   200   240

For design F the size designations do not exactly correspond with the exchanger lengths.

Sizes 100 and 120 consist of one exchanger package, sizes 150 to 240 are made up of four exchanger packages.

4.4 Plate spacing

The plate spacing effects the surface area and thus the heat recovery efficiency, the pressure drop and the price. Hoval offers several spacings for most sizes so that an optimum solution can be achieved for each project.

R = small spacing = very high heat recovery efficiency
X = middle spacing = high heat recovery efficiency
L = large spacing = middle heat recovery efficiency
W = very large spacing = low heat recovery efficiency

The plate spacing is calculated from the width of the exchanger package b divided by the number of plates. Depending on the width, minor deviations from the nominal value are possible in practice.

Plate spacing	Design N							
	040	050	060	070	085	120	140	170
R	–	2.6	3.0	3.3	3.9	5.0	5.3	6.3
X	3.0	3.5	4.0	4.3	5.1	6.3	6.3	–
L	–	4.4	5.0	5.3	6.3	–	–	–
W	–	–	6.3	6.3	–	–	–	–

Plate spacing	Design F				
	100	120	150	200	240
X	4.0	5.6	6.2	9.5	12.0
L	5.6	7.2	9.5	12.0	–

Table 2: Nominal values of plate spacings (in mm)

4.5 Exchanger width

The width of the Hoval plate heat exchanger can be as desired. It can be selected according to local conditions and design criteria (e.g. pressure drop). For stability reasons, but also to simplify transport and installation, the maximum exchanger width is **limited to 3000 mm.**

5. Options

5.1 Bypass B

If performance control of the plate heat exchanger is necessary, a bypass is built into the casing besides the plate package. This can be **on the side or in the middle.**

To ensure good flow conditions, installation in the middle is strongly recommended for total widths of 1500 mm and more.

Dampers can be fitted directly to the flanges of the casing, in front of the exchanger face and bypass.

The width of the bypass is automatically calculated with the Hoval computer program CAPS in such a way that the bypass has approximately the same pressure drop as the plate heat exchanger. However, the width of the bypass can also be made to specification. For sizing, flow velocities of between 10 m/s and 14 m/s, depending on pressure drop, can be used.

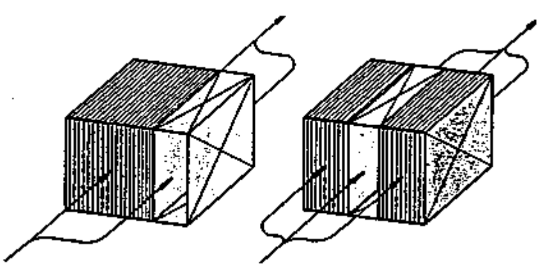


Fig. 30: Bypass built-in at the side or in the middle

5.2 Dampers K

To regulate the air flow through the bypass or the exchanger, **opposed dampers** are necessary. These are fitted by Hoval in a frame which is fastened directly on the casing, before the exchanger package and the bypass (seen in the direction of air flow).

The patented dampers have the following special features:

- The driving plastic gear wheels are fitted in the middle, i.e. between the bypass and the heat exchanger.
- The blades are made of a specially developed Hoval extruded aluminium section. Therefore they are particularly rigid and tight.
- Each damper blade can be removed and replaced individually.
- The maximum torque allowed is 20 Nm.
- The damper drive can be installed at any blade on either side of the damper. To ensure an optimum torque transfer

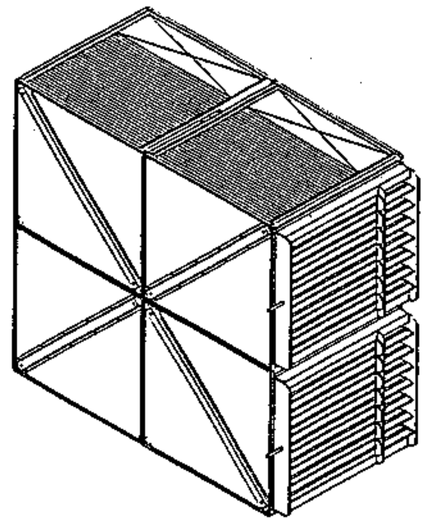


Fig. 31: For sizes 200 and 240 a damper section is installed in front of each exchanger package.

installation at a blade in the middle of the damper is recommended.

For sizes 200 and 240 of design F one damper section is fitted in front of each exchanger package, therefore, two damper drives are required.

The bypass dampers have a very free action if the plate heat exchanger is installed correctly (square). Extensive measurements have shown that in the first approximation the necessary torque depends only on the width. Diagram 1 shows the required torque as a function of the exchanger width, **assuming proper installation.** (The values apply up to a pressure difference of 500 Pa.)

The maximum blade width is 1200 mm; with bigger dimensions interim bearings are installed.

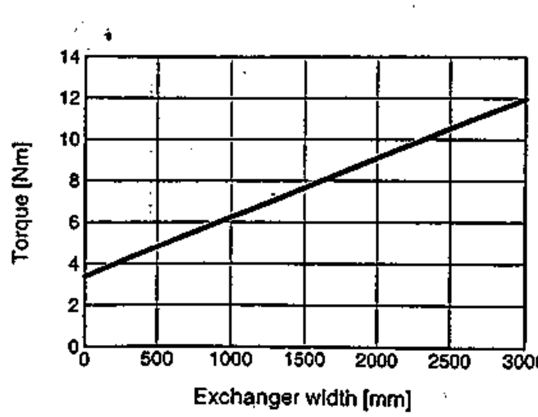


Diagram 1: Necessary torque for the bypass damper

5.3 Recirculation bypass U

A standard bypass with corresponding bypass damper (= opposed dampers in front of the bypass and exchanger face) is installed in the plate heat exchanger (in the middle or on the side). One side wall of the bypass damper is replaced by the additional recirculation damper. This arrangement is called recirculation bypass.

The width of the recirculation bypass is either made to specification or it is calculated with the PC program so that pressure drop through the bypass approximately corresponds to pressure drop through the exchanger package.

The construction of the recirculation damper is the same as the bypass damper. This applies for materials as well as dimensions.

The recirculation bypass installed in the plate heat exchanger allows for
– control of heat/cool recovery in fresh air operation,
– recirculation and mixed air operating modes.

Control is effected via the bypass damper by means of an actuator. The recirculation damper must be opposed to the fresh air and exhaust air dampers. For this, at least one further actuator is required.

5.3.1 Bypass in the fresh air

- Fresh air operation

The recirculation damper is closed; fresh air and exhaust air dampers are open. The bypass damper is used for control of heat recovery, depending on heat demand.

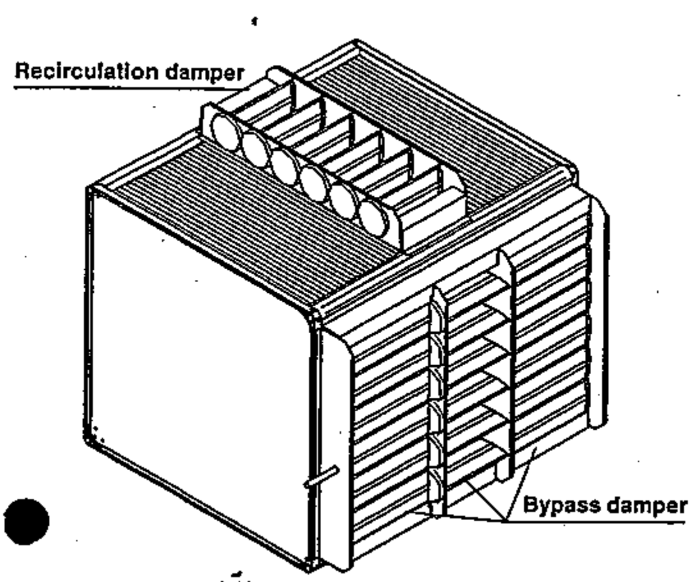


Fig. 32: Plate heat exchanger with middle recirculation bypass

- Recirculation

The recirculation damper is open; fresh air and exhaust air dampers are closed. (The position of the bypass damper can be as desired.) Extract air passes through the bypass of the plate heat exchanger and is supplied back into the room.

- Mixed air operation

Recirculation, fresh air and exhaust air dampers are partly open. The bypass damper is (usually) closed so that heat/cool recovery can be used to its full potential.

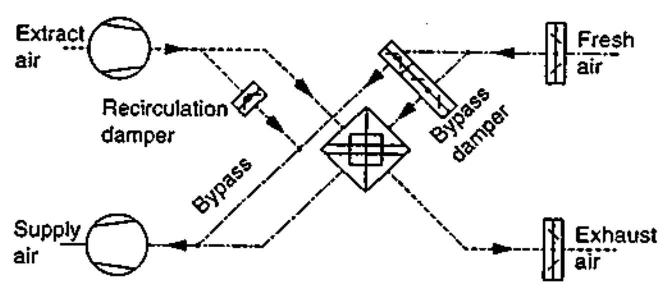


Fig. 33: Bypass in the fresh air stream

5.3.2 Bypass in the extract air

- Fresh air operation

The recirculation damper is closed; fresh air and exhaust air dampers are open. The bypass damper is used for control of heat recovery, depending on heat demand.

- Recirculation

The recirculation damper is open; fresh air and exhaust air dampers are closed. Extract air passes through the bypass of the plate heat exchanger and is supplied back into the room.

The bypass damper must be open!

- Mixed air operation

not possible

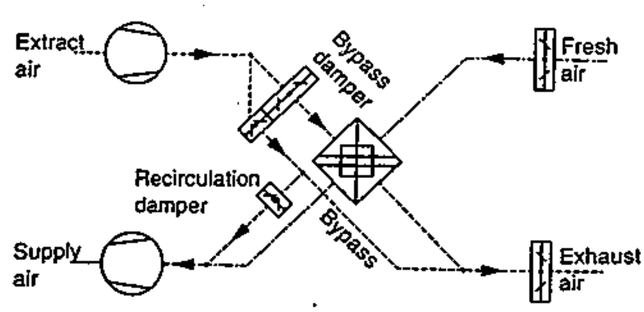
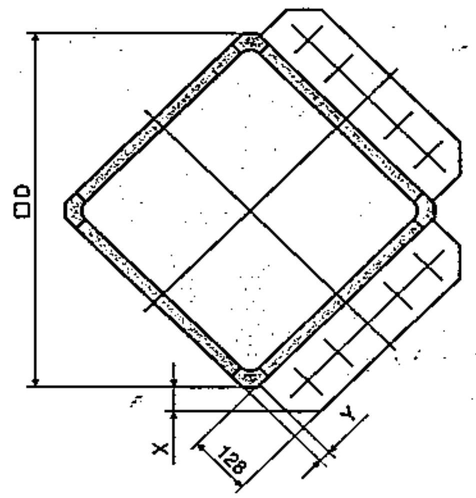


Fig. 34: Bypass in the extract air stream



Dimension	Design N								Design F				
	040	050	060	070	085	120	140	170	100	120	150	200	240
x	51	28	28	28	28	14	14	20	23	25.5	31.0	23	25.5
y	27	45	45	45	45	65	65	65	53	49.5	41.5	53	49.5

***Fig. 35:** For the recirculation bypass, a recirculation damper is required in addition to the bypass damper.*

5.4 Horizontal installation L

Normally the Hoval plate heat exchanger is installed in such a way that the plates are vertical. Horizontal installation is also possible, considering the following:

- There is a higher icing-up hazard because condensate can remain on the plates.
- Uncontrolled condensate drain.
- Condensate drops can be carried along with the air flow (drop eliminator recommended).
- The plate heat exchanger must be installed in such a way that
  – in design N the double fold is bent downwards,
  – in design F the spacing ribs stand upwards.

To increase stability, supports are fitted in the exchanger package.

For horizontally installed exchangers the width B in the unit type reference becomes the exchanger height.

During transport, the plates must be vertical.

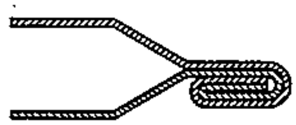


***Fig. 36:** If design N is installed horizontally, the double fold is bent downwards.*

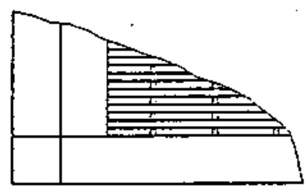


***Fig. 37:** If design F is installed horizontally the spacing ribs stand upwards.*

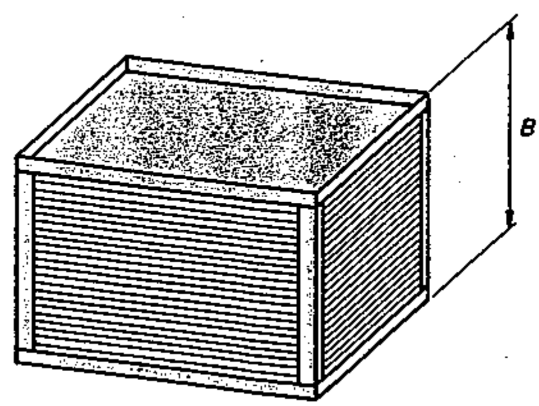


***Fig. 38:** Schematic view of a plate heat exchanger installed in horizontal position*

Options
Unit type reference

5.5 Leakage test P

As mentioned above (see chapter 1.2 and 1.4), plate heat exchangers are not 100 % leakproof unless special measures are taken. Yet with the leakage test Hoval can guarantee that the exchanger is delivered water tight in the tested installation position.

For this leakage test, the whole exchanger is immersed into a 150 mm deep water bath and, if necessary, re-sealed.

5.6 Protection strips Y for design F

The protection strips are put on the leading and/or trailing edges of the plate heat exchanger, preventing dirt build-up and damage to the plate edges.

In spite of the protection strips, improper use can cause damage to the exchanger.

The protection strips are shaped as shown in Fig. 39. They cover the total clear length of an exchanger block, exempting the spacing ribs of the plates. The plate skew in the inlet/outlet area is also covered for the most part.

The strip consists of aluminium. It is fixed with an angle on both sides and performs the following functions:

- Mechanical stabilisation of the plate connection, preventing damage e.g. during cleaning.
- The protection strips can be replaced by new ones if they are very dirty and impossible to clean.
- The protection strips extend the useful life of the plate heat exchanger and facilitate maintenance works.

Protection strips can be used only for series V (pure aluminium). The outside dimensions of the plate heat exchanger remain the same, however, the weight is slightly raised. Pressure drop is not measurably increased.

The use of protection strips is recommended for applications where heavy dirt build-up is to be expected. It is therefore reasonable to install them in the extract air flow (inlet and outlet). For cleaning and replacement, inspection openings are required.

Protection strips can also be retrofitted.

Cleaning with high-pressure devices is possible if
- a flat nozzle 40° is used (type WEG40/04),
- the max. water pressure is 200 bar.

5.7 Stronger packing Q

Normally, Hoval plate heat exchangers are delivered on tailor-made wooden pallets. The exchanger package is covered with three-layer corrugated cardboard. Shrink wrapping gives additional protection from dirt and moisture. This packing has proved to be sufficient for normal transportation for many years.

Stronger packing is available for cases where a "harsh" transport is expected (e.g. sea freight): The exchanger with corrugated cardboard is then strengthened on top with **two wood laths** and protection corners; only then the package is shrink-wrapped.

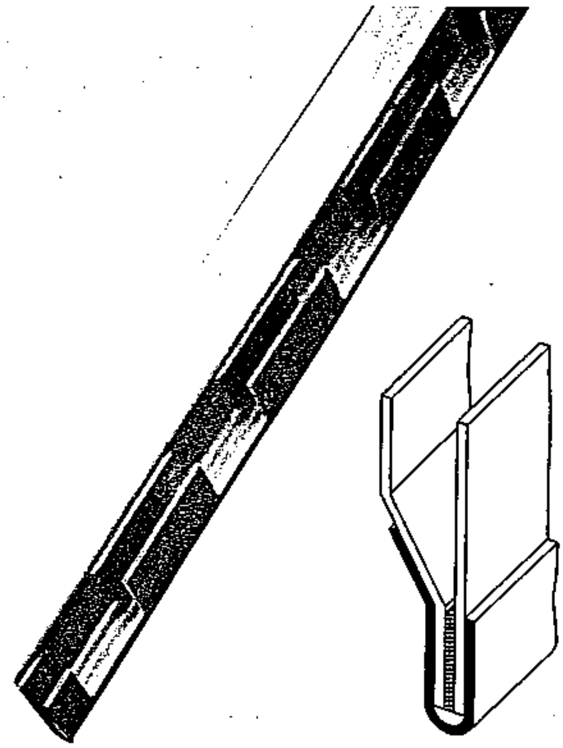


Fig. 39: Protection strip for plate heat exchanger

Hoval

6. Unit type reference, availability, application limits

Hoval plate heat exchangers are clearly defined with the unit type reference. This shows all possibilities for design and options.

Table 3 shows which options are available for various designs and sizes. Table 4 shows which limits are to be respected when planning, designing and operating.

7. Dimensions and weights

The following drawings show various designs and exchanger sizes. The dimensions given are those relevant for connection of the plate heat exchanger. For clarity, details of type sizes made up of four exchanger packages have been omitted. The stated weights are approximate.

Example unit type reference

NV - 060 / X - 084 - BSK 20, Q, ...

Design

N = Design N
F = Design F

Series

V = standard
G = corrosion-protected
T = high-temperature

Size

Code for the size of the exchanger plates

Plate spacing

R = small
X = middle
L = large
W = very large

Exchanger width in cm (outside dimension)

Options

P = Leakage test
L = Horizontal installation
Y = Protection strips
Q = Stronger packing
B = Bypass (BS or BM)
U = Recirculation bypass (US or UM)
K = Dampers for exchanger with bypass

e.g. BSK 25

- 25: inside bypass width in cm
- K: dampers
- S = side / M = middle
- B = bypass / U = recirculation bypass

Availability
Application limits
Dimensions and weights

Design	Design N			Design F	
Series	V (standard)	G (corrosion-protected)	T (high-temperature)	V (standard)	G (corrosion-protected)
Leakage test P	☑ 1)	☑ 1)	☑ 1)	☑ 1)	☑ 1)
Horizontal installation L	☑ 1)	☑ 1)	☑ 1)	☑ 1)	☑ 1)
Protection strips Y	☒	☒	☒	☑	☒
Stronger packing Q	☑	☑	☑	☑	☑
Bypass B	☑	☑	☑	☑	☑
Recirculation bypass U	☑	☑	☑	☑	☑
Dampers K	☑	☑	☑ 2)	☑	☑

1) no leakage test P possible with option L
2) on fresh air side (up to max. 100 °C)

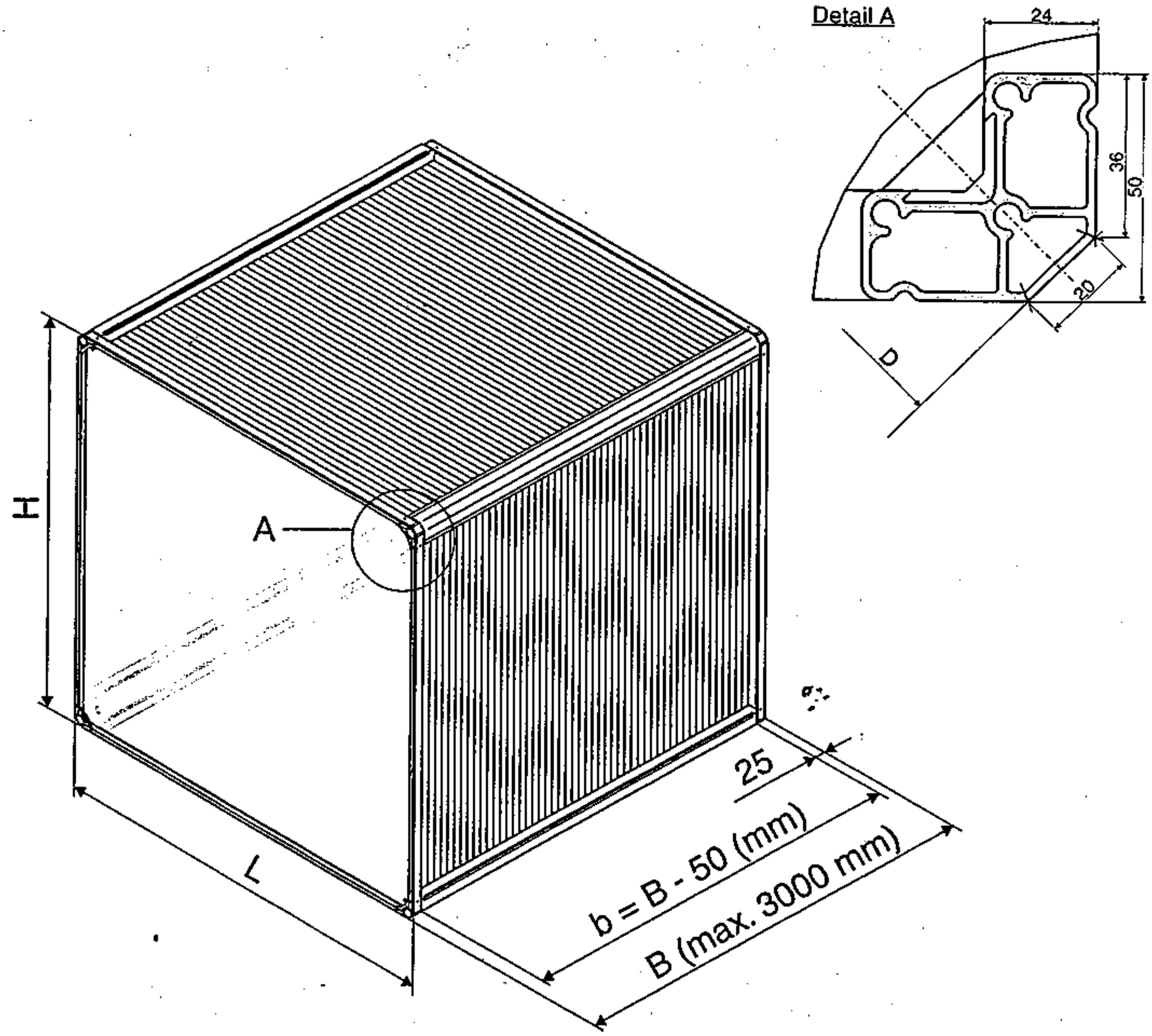
Table 3: Availability of options

	Temperature	Width	Pressure difference	Pressure diff. to outside	Pressure drop
Design N Series V and G	– 40 ... 100 °C	70 ... 3000 mm	max. 1500 Pa	max. 1500 Pa	Pressure drop should not exceed 300 Pa for economical reasons; recommended are 150 Pa to 200 Pa.
Design N Series T	– 40 ... 200 °C	70 ... 3000 mm	max. 1500 Pa	max. 1500 Pa	
Design F Series V and G	– 40 ... 80 °C	70 ... 3000 mm	max. 1500 Pa	max. 1500 Pa	
Dampers	– 40 ... 100 °C	30 ... 3000 mm 1)	max. 500 Pa	–	–

1) max. blade width = 1200 mm; with larger dampers interim bearings are installed (extra cost)

Table 4: Application limits

Hoval

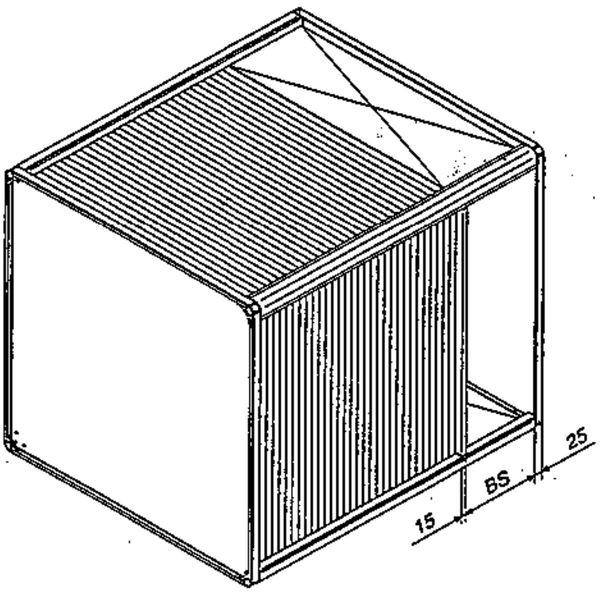


			Design N								Design F				
Exchanger size			040	050	060	070	085	120	140	170	100	120	150	200	240
Reinforcing section			no	no	no	no	no	no	no	no	yes	yes	no	yes	yes
Dim. [mm]	Height/Length	H = L	400	500	600	700	850	1200	1400	1700	968	1168	1438	1936	2336
Dim. [mm]	Diagonal	D (approx)	546	687	829	970	1182	1677	1960	2384	1349	1632	2014	2718	3284
Weights [kg] – Exchanger with/without bypass $f_1 + (B-50) \times f_2$ – Plate spacing	R	f_1	–	6.24	8.65	11.46	16.39	34.61	45.82	65.58	–	–	–	–	–
	R	f_2		0.036	0.041	0.050	0.062	0.106	0.132	0.162					
	X	f_1	4.23	6.24	8.65	11.46	16.39	34.61	45.82	–	25.9	35.9	49.4	103.5	143.6
	X	f_2	0.021	0.027	0.033	0.041	0.050	0.090	0.115		0.122	0.128	0.205	0.237	0.285
	L	f_1	–	6.24	8.65	11.46	16.39	–	–	–	25.9	35.9	49.4	10.35	–
	L	f_2		0.023	0.028	0.034	0.042				0.093	0.104	0.148	0.207	
	W	f_1	–	–	8.65	11.46	–	–	–	–	–	–	–	–	–
	W	f_2			0.024	0.030									
Weights [kg] – Dampers $f_3 + B \times f_4$		f_3	4.0	5.0	6.0	8.0	9.0	12.0	15.0	18.0	7.5	9.0	11.5	15.0	18.0
		f_4	0.005	0.006	0.007	0.008	0.0093	0.0123	0.0143	0.0172	0.0102	0.0123	0.0184	0.0204	0.0246

Dimensions and weights

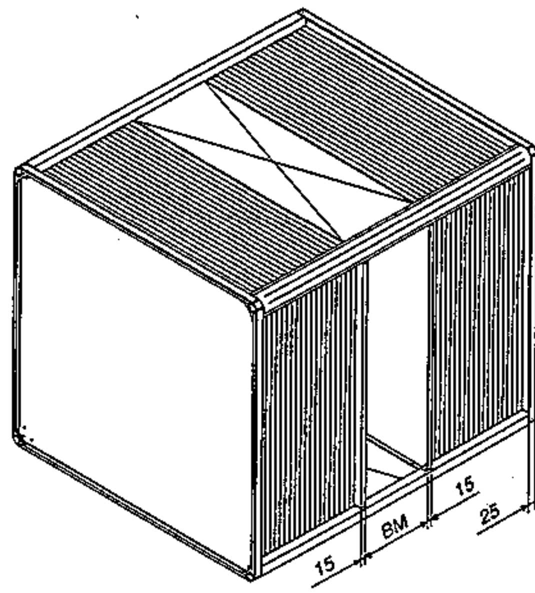
Side bypass
Package width b = B – BS – 65 [mm]

Design N: 040 050 060 070 085
Design F: 100 120

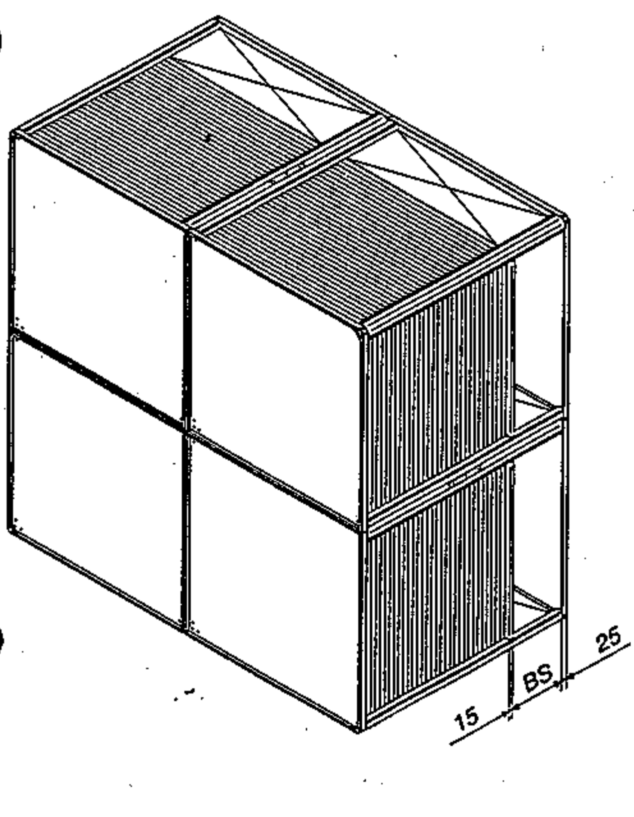


Middle bypass
Package width b = B – BM – 80 [mm]

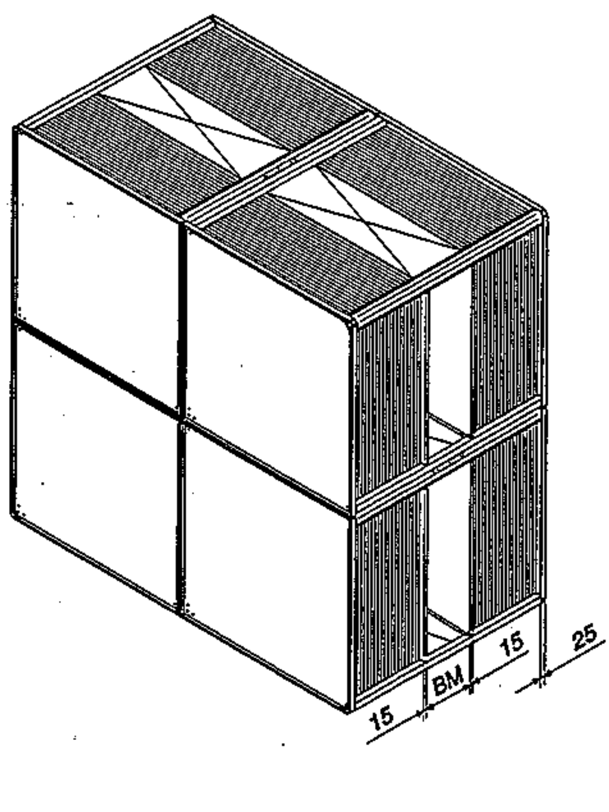
Design N: 040 050 060 070 085
Design F: 100 120



Design N: 120 140 170
Design F: 150 200 240



Design N: 120 140 170
Design F: 150 200 240

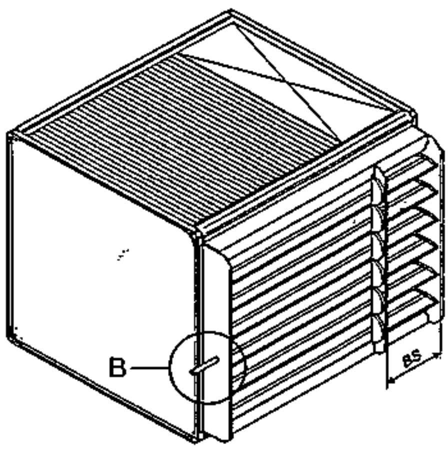


Hoval

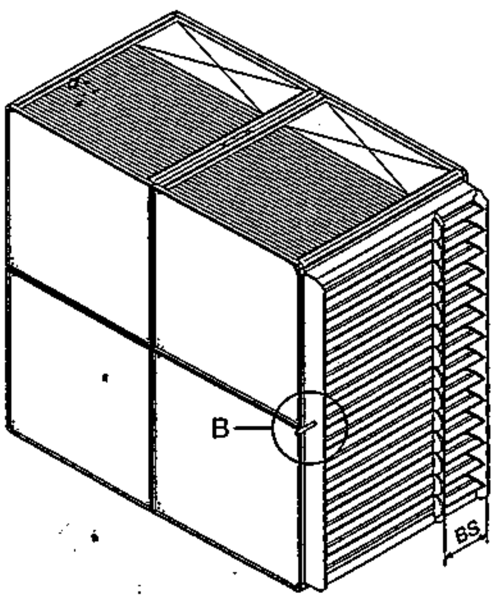
Side bypass and dampers

Package width b = B – BS – 65 [mm]

Design N: 040 050 060 070 085
Design F: 100 120



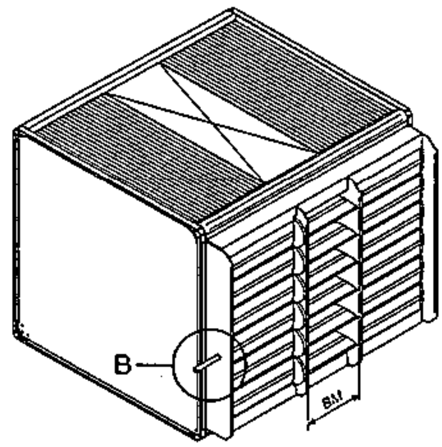
Design N: 120 140 170
Design F: 150 200 240



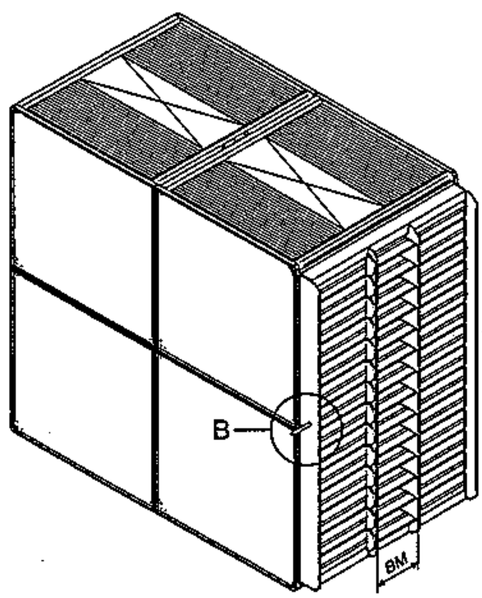
Middle bypass and dampers

Package width b = B – BM – 80 [mm]

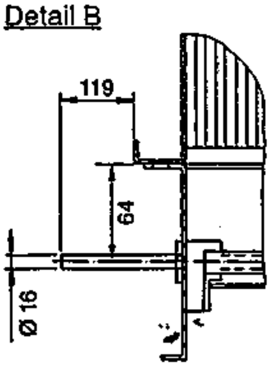
Design N: 040 050 060 070 085
Design F: 100 120

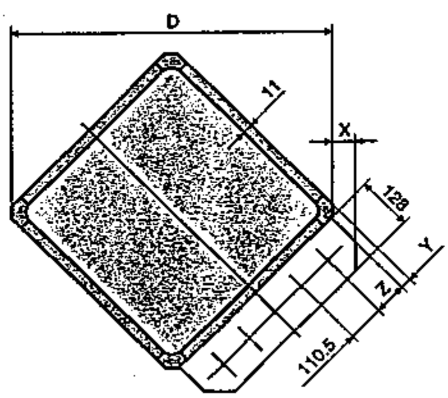


Design N: 120 140 170
Design F: 150 200 240



Detail B





Dim.	Design N							
	040	050	060	070	085	120	140	170
x	51	28	28	28	28	14	14	20
y	27	45	45	45	45	65	65	65
z	62	94	89	84	103	93	82	66

Dim.	Design F				
	100	120	150	200	240
x	23	26	31	23	26
y	53	50	42	53	50
z	68	93	72	68	93

8. Design and calculation

8.1 Design data

When designing, correct data is essential to achieve the desired values. This is often particularly difficult in air technology because the specific density and specific heat are dependent on temperature. Also the water vapour contained in the air is very important for the design. For an exact calculation of a plate heat exchanger the **air conditions at entry to the exchanger** are required (see also chapter 11.1).

Extract air

Air flowrate at exchanger entry	V_{11}	[m³/s]
Rel. humidity at exchanger entry	RH_{11}	[%]
Temperature at exchanger entry	t_{11}	[°C]
Max. pressure drop	Δp_1	[Pa]

Fresh air

Air flowrate at exchanger entry	V_{21}	[m³/s]
Temperature at exchanger entry	t_{21}	[°C]
Max. pressure drop	Δp_2	[Pa]

This data is required when fresh air is heated. When cooling the data is reversed, i.e. swap extract air for fresh air (corresponding to heat releasing and heat absorbing).

For an economic calculation the following data is required:

- desired temperature
- operation time
- location (region or climatic zone)
- energy costs (with increase rate)
- cost of electricity
- additional costs (installation and extra costs minus capital savings and subsidies)
- interest rate

8.2 Calculation with the Hoval computer program

The computer program Hoval CAPS (= Computer Aided Plate Heat Exchanger Selection) can be used with all systems operating with MS-DOS. It offers the following:

- exact calculation of a specific Hoval plate heat exchanger
- calculation of all appropriate plate heat exchangers for a specific project
- prices
- economic calculation to VDI 2071/2

The program makes it possible, not only to achieve accurate technical data, but also offers optimum selection regarding efficiency. It has been specially developed for Hoval plate heat exchangers and is available on disc.

8.3 Calculation with the Hoval performance graphs and design form

Calculation with the performance graphs is a shortened approximation method, whose accuracy, in most cases, is sufficient for temperatures between -15 °C and +25 °C. When designing with this method, please note that the graphs relate to an air density of 1.2 kg/m³ (20 °C, 50 % rel. humidity, 101.3 kPa).

Explanation of the form for the design of Hoval plate heat exchangers:

Design data
For the design the air conditions at entry to the plate heat exchanger are required. These values are often not known, therefore they are calculated or estimated. Note that the air flowrates as well as the relative humidity can alter with the temperature.

Line 6
The specific air flowrate v = V/b is necessary when using performance graphs. Calculation of the package width b can be seen from the dimensional drawings.

Line 7
The nominal heat recovery efficiency Φ_N applies
– at a mass flow ratio of $m_2/m_1 = 1$,
– without condensation.
This is a characteristic value of the plate heat exchanger. It can be read from the graph with the heat absorbing specific air flow v_{21} and the desired or selected type size. Please note that the appropriate graphs for the different plate spacings and designs are to be used.

Line 8
The volume flow ratio fresh air to extract air is required when using diagram 2. (The mass flow ratio = m_2/m_1 is more accurate.)

Line 9
The correction value due to the mass flow ratio $\Delta\Phi_1$ can be read from diagram 2.

Line 10
The dry heat recovery efficiency Φ_{2t} relates to the heat absorbing air flow V_2.

Line 11
For working with diagram 3, when condensation is present, the cooling figure is required. This can be calculated with data already known. (This applies only for $m_1 = m_2$; for other mass flow ratios calculation must be done with the Hoval computer program CAPS.)

Line 12
With the cooling figure and relative humidity the heat recovery increase with condensation $\Delta\Phi_2$ can be read from diagram 3.

Line 13
The effective heat recovery efficiency is calculated by adding the dry heat recovery figure to the heat recovery increase with condensation.

Line 14
The heat recovery performance is calculated with the given formula. For a rough calculation the following values can be used:
- 1.2 kg/m³ for density
- c = 2.79 · 10⁻⁴ kWh/kgK for specific heat.

Line 15
Calculation of the fresh air temperature after the plate heat exchanger can be found with the given formula. (The temperature of extract air after the plate heat exchanger can only be approximated with the hx diagram.)

Line 16
The extract air pressure drop without condensation is taken from the performance graph with the specific volume flow v_{11}.

Line 17
The correction factor f_1 for the increase of pressure drop with condensation is taken from diagram 3 with the cooling figure and the relative humidity.

Line 18
The actual extract air pressure drop is calculated by multiplication of the value without condensation and the correction factor.

Line 19
The fresh air pressure drop is directly taken from the performance graph with the specific fresh air volume flow v_{21}.

When designing with this approximation method, please note that the performance graphs are for an air temperature of 20 °C (and a density of 1.2 kg/m³). If the average temperature in the exchanger deviates, incorrect data is given. Within the valid range for this calculation (-15 °C to +25 °C) the error for the pressure drop is max. 5 % in normal applications. For the heat recovery figure the dependency is far smaller, the error is max. 2 %.

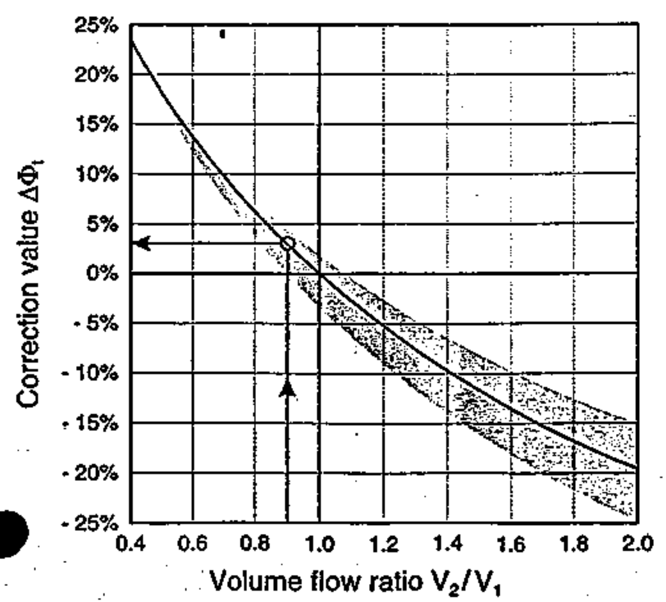


Diagram 2: Correction diagram for different mass flow ratios

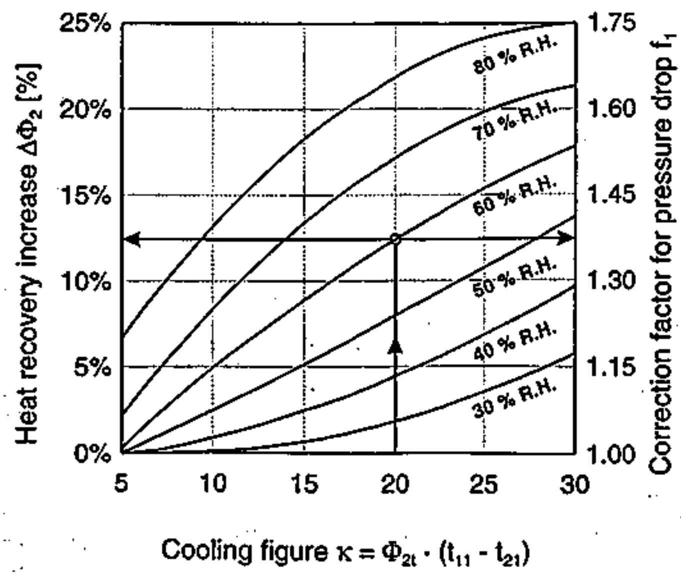


Diagram 3: Correction diagram for condensation

Design and calculation

This form is for the approximate selection of Hoval plate heat exchangers at temperatures between −15 °C and +25 °C.

Design data (at the plate heat exchanger entry):

1	Extract air volume flow	V_{11}	=	______	m^3/s
2	Extract air temperature	t_{11}	=	______	°C
3	Relative humidity of extract air	RH_{11}	=	______	%
4	Fresh air volume flow	V_{21}	=	______	m^3/s
5	Fresh air temperature	t_{21}	=	______	°C

Remarks:

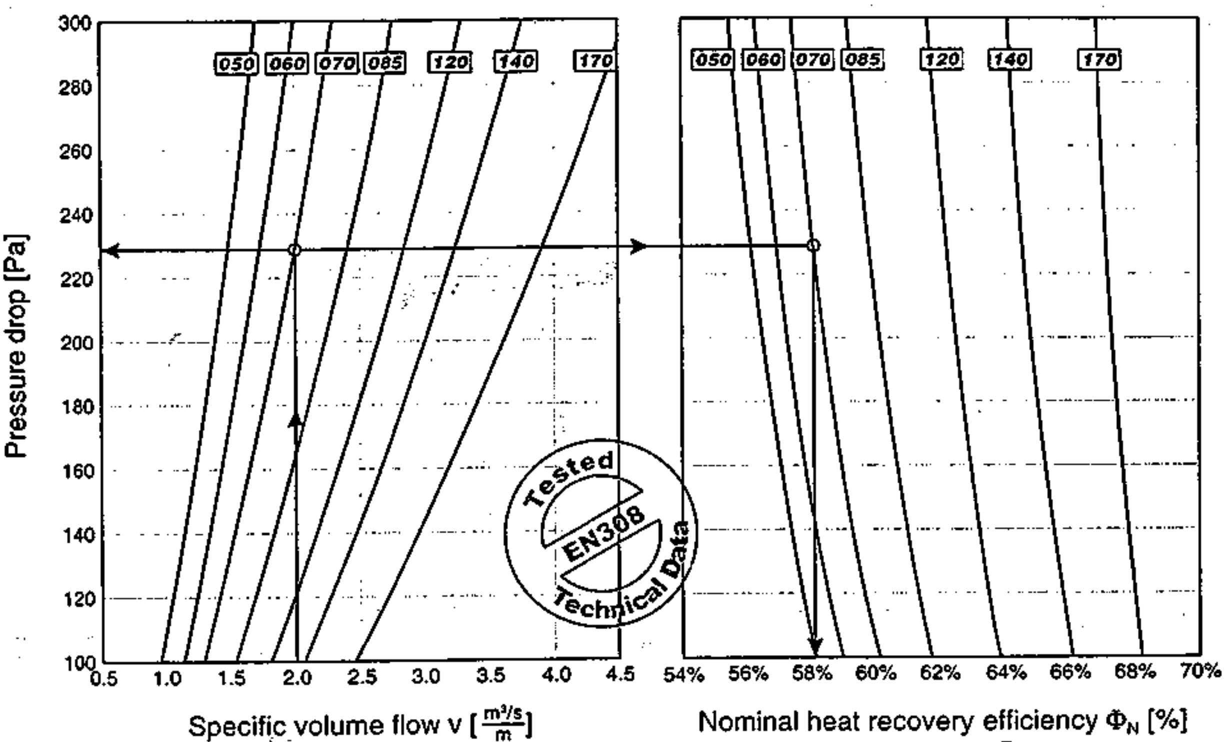
Calculation:

6	Specific volume flow cold air	$v_{21} = \frac{V_{21}}{b}$	=	______	$\frac{m^3/s}{m}$
	Specific volume flow warm air	$v_{11} = \frac{V_{11}}{b}$	=	______	$\frac{m^3/s}{m}$
7	Nominal heat recovery efficiency	Φ_N	=	______	%
8	Volume flow ratio fresh air/extract air	$\frac{V_{21}}{V_{11}}$	=	______	
9	Correction value due to the mass flow ratio	$\Delta\Phi_t$	=	______	%
10	Dry heat recovery efficiency	$\Phi_{2t} = \Phi_N + \Delta\Phi_t$	=	______	%
11	Cooling figure (only for $m_1 = m_2$)	$\kappa = \Phi_{2t} \cdot (t_{11} - t_{21})$	=	______	°C
12	Heat recovery increase with condensation	$\Delta\Phi_2$	=	______	%
13	Effective heat recovery efficiency	$\Phi_2 = \Phi_{2t} + \Delta\Phi_2$	=	______	%
14	Heat recovery performance	$Q_2 = V_{21} \cdot \rho_{21} \cdot c \cdot \Phi_2 \cdot (t_{11} - t_{21})$	=	______	kW
15	Fresh air exit temperature	$t_{22} = t_{21} + \Phi_2 \cdot (t_{11} - t_{21})$	=	______	°C
16	Extract air pressure drop without condensation	Δp_{1t}	=	______	Pa
17	Correction factor for pressure drop with condensation	f_1	=	______	
18	Extract air pressure drop	$\Delta p_1 = \Delta p_{1t} \cdot f_1$	=	______	Pa
19	Fresh air pressure drop	Δp_2	=	______	Pa

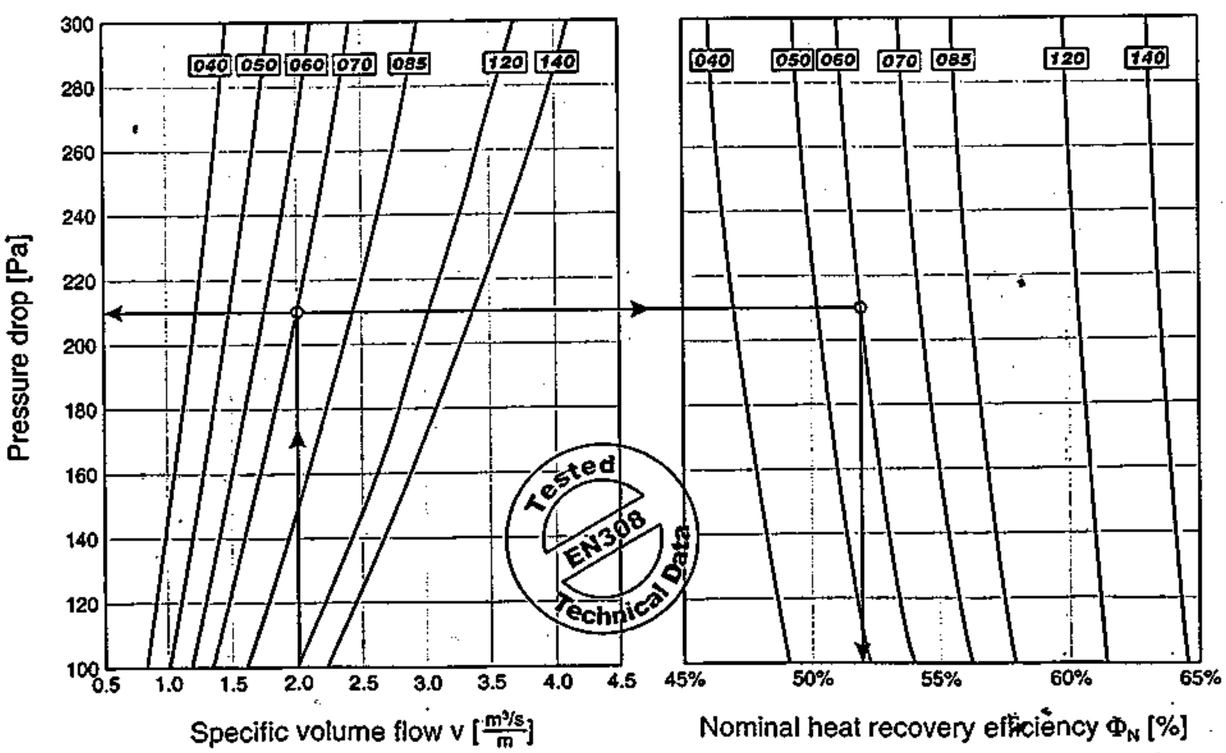
Remarks:

Performance graphs
Design N

Design N ***Plate spacing R***

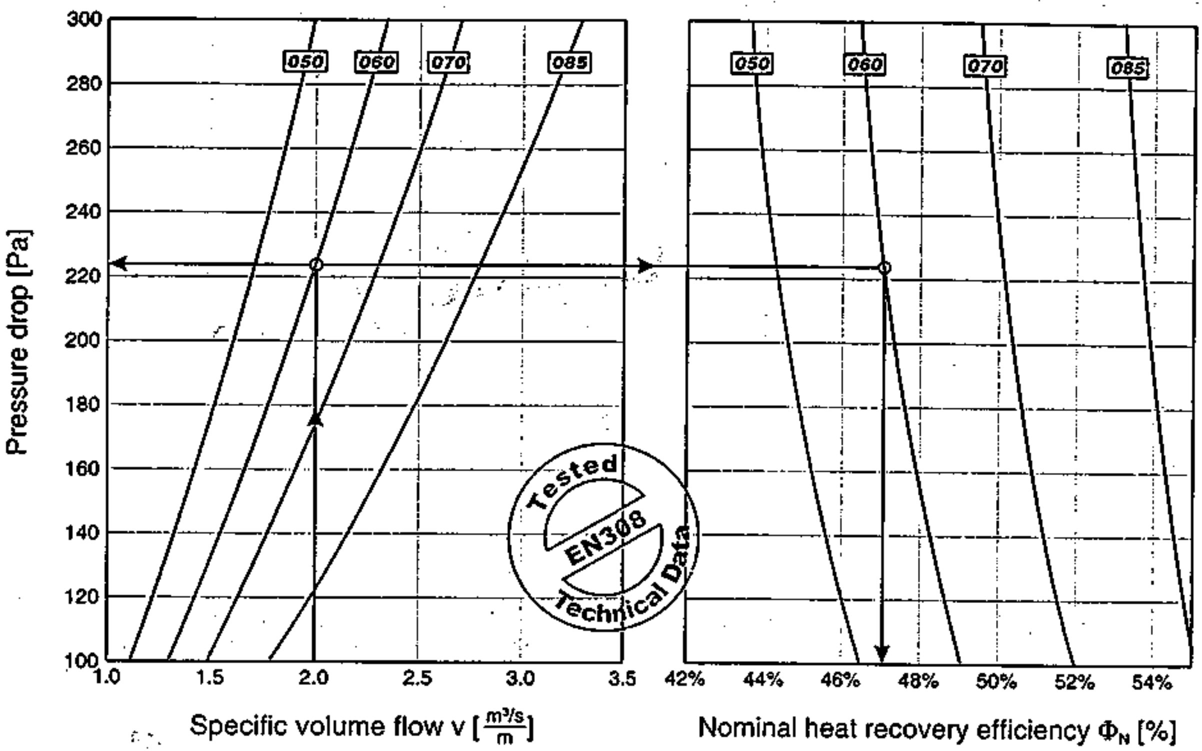


Design N ***Plate spacing X***

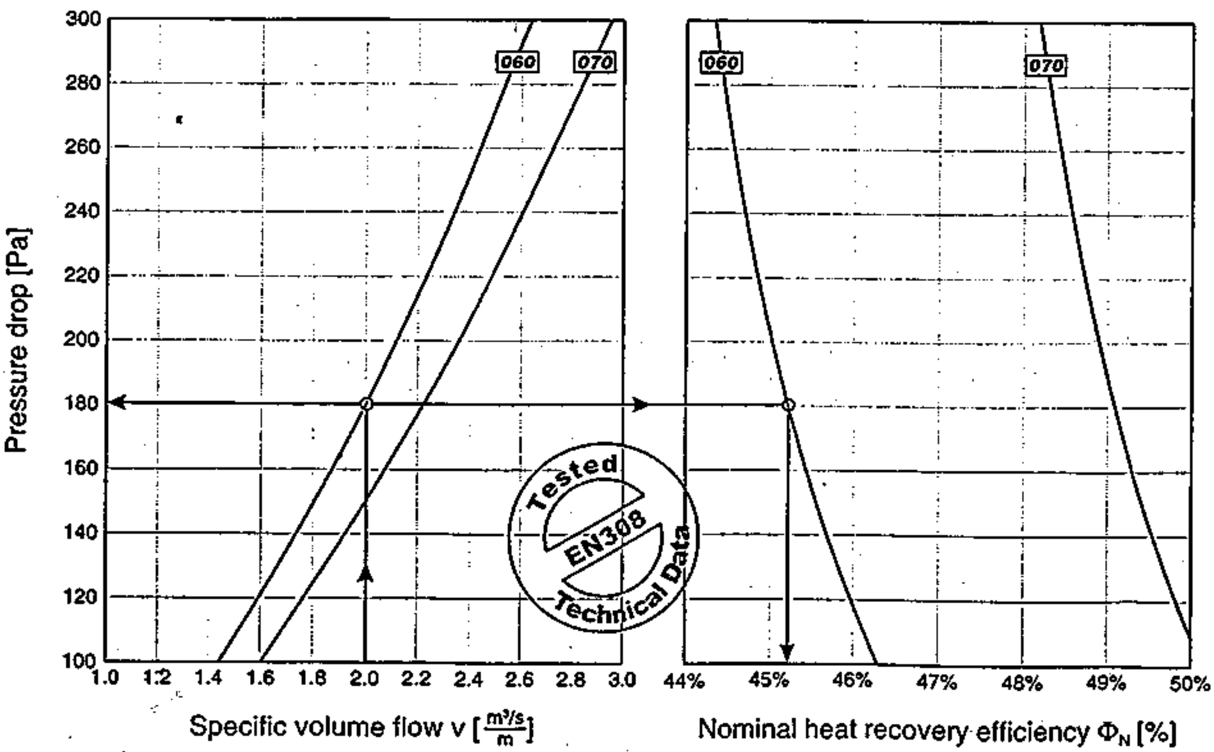


Performance graphs
Design N

Design N ***Plate spacing L***

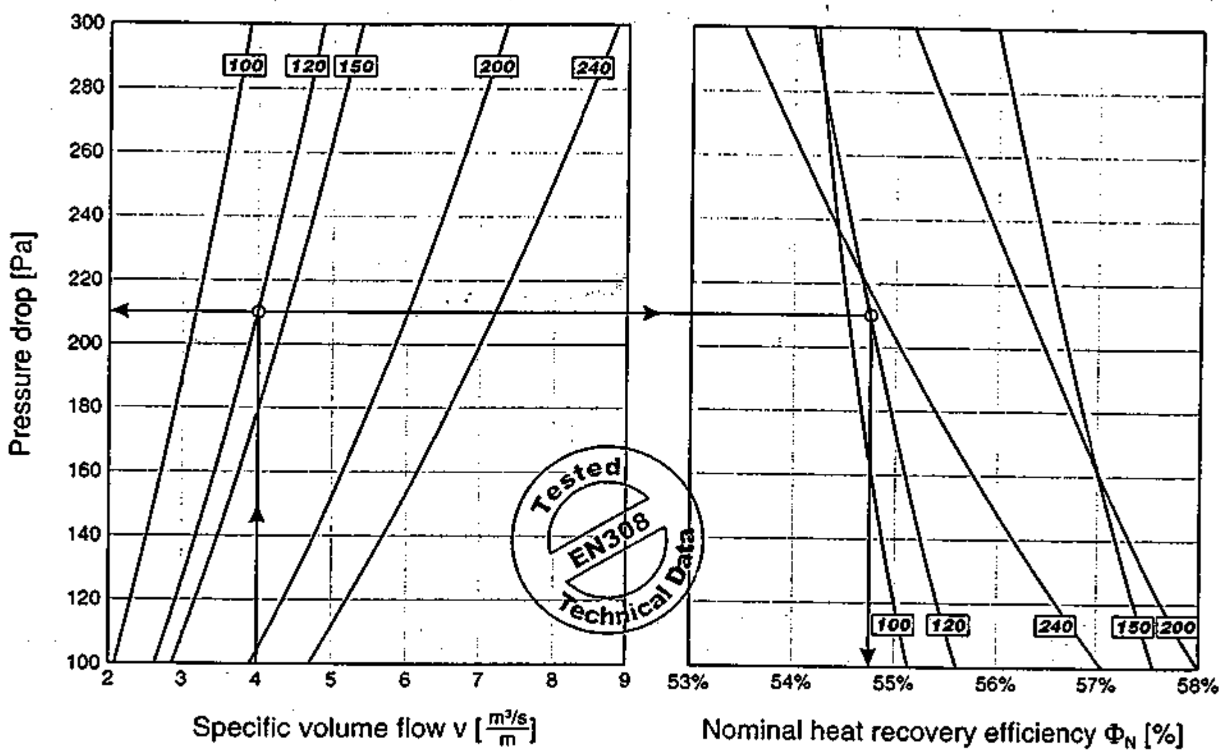


Design N ***Plate spacing W***

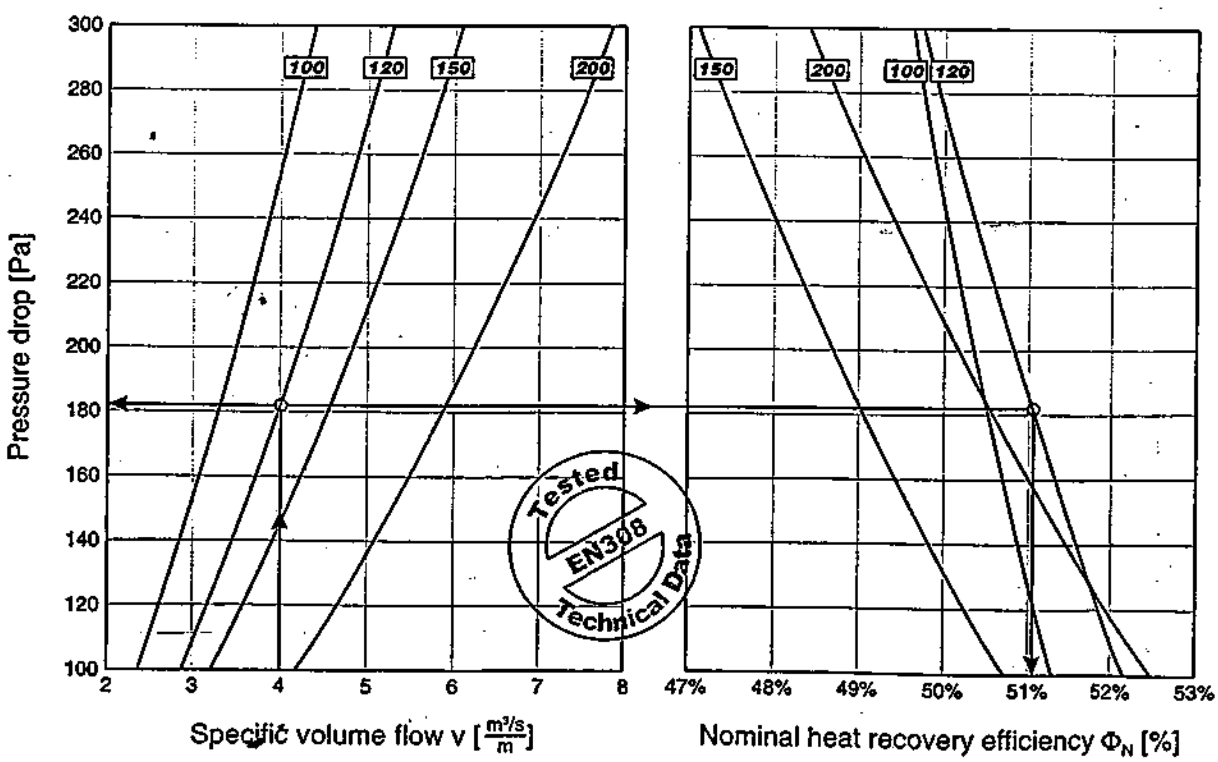


Performance graphs Design F

Design F **Plate spacing X**



Design F **Plate spacing L**



Transport and installation
Commissioning and maintenance
Design guidelines

9. Transport and installation

Hoval plate heat exchangers have no moving parts. Therefore they are easy to install and totally reliable in operation. The following should be checked before installation:

- Has the plate heat exchanger been damaged during transport (visual check of casing and plate package)?
- Has the correct type been delivered (design, series, size, plate spacing, accessories, options)?
- How is the plate heat exchanger to be positioned (⇨ define the installation position)?

Also note the following:

9.1 Transport

The plates must always be vertical during transport.

9.2 Mechanical installation

The Hoval construction offers particular advantageous for installation into air handling units or connection to ducts or other ventilation equipment:

- The corner sections of aluminium are hollow. They can be bolted or riveted without damaging the exchanger.
- Also the flange of the side walls can be used for bolting and riveting.
- The returned edge of the side wall allows easy installation of a sealing all round. It can also be used for side fastening (bolting, riveting).

The examples below show some possibilities for the installation of Hoval plate heat exchangers into air handling units:

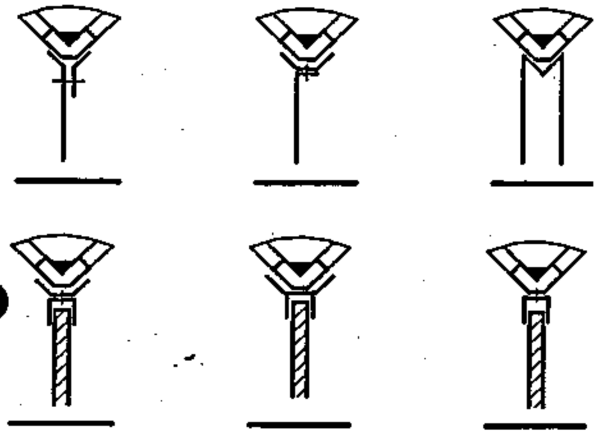


Fig. 40: Installation possibilities

9.3 Hydraulic connection

If condensation is expected make sure that this can drain away freely. We recommend condensate drip trays on both sides, i.e. for both air streams. The expected amount of condensate is calculated with the Hoval computer program. Correspondingly sized condensate drains should be installed.

9.4 Damper drive

When a bypass and dampers are fitted, remember to install the damper drive (check correct position of dampers).

9.5 Fitting of sensors and other detectors

If e.g. temperature sensors are required in the plate heat exchanger make sure that the exchanger package is not damaged by their installation.

9.6 Assembly on site

Depending on local conditions (particularly for retro-fitting) it may be necessary to deliver the plate heat exchanger in several parts. These must then be assembled on site by bolting and riveting. There are various possibilities for breakdown of the exchanger:

- In the width, sections can be manufactured as desired.
- In the height and length, only compound exchangers can be divided. In this case the individual exchanger blocks can be supplied.
- Also bypass and recirculation dampers can be delivered separately.

10. Commissioning and maintenance

10.1 Commissioning

Before commissioning, ensure that the air streams can flow freely through the plate heat exchanger. If dampers are fitted, check their movement and correct adjustment.

Furthermore, check if installation has been carried out correctly and make sure that the application limits (temperature, pressure difference, material, etc.) cannot be exceeded.

10.2 Maintenance

Only periodic visual checks are necessary. If dampers are fitted, test their movement. After initial 3-monthly inspection intervals, checks can be carried out every 12 months.

Based on long experience, dirt build-up inside the plate heat exchangers installed in air handling equipment is not expected. Yet should dirt enter the plate heat exchanger when used for special applications, e.g. welding shops, paint shops, kitchen extracts, etc., the exchanger package can be cleaned as follows:

- Remove dust and fibres with a soft brush or with a vacuum cleaner. Take care when cleaning with pressure air that the exchanger package is not damaged. Keep at a distance!

- Oils, solutions, etc. can be removed with hot water or grease solvents, by washing or immersing. Cleaning with high-pressure devices is possible if:
  – a flat nozzle 40° is used (type WEG40/04),
  – the max. water pressure is 100 bar.

When cleaning take care that the exchanger is not damaged, neither mechanically nor chemically:

– Choose harmless cleansing agents,
– Clean carefully. The material thickness is only 0.125 mm or 0.15 mm!

11. Design guidelines

11.1 Data collection

The data given in chapter 8 is necessary when designing and planning. For exact design the following errors should be avoided when collecting the data:

- Volume flow is not equal to mass flow. For an accurate design the mass flows of fresh and extract air should be known.

- For winter operation the moisture in the air is often estimated too high. (Where does the moisture come from?)

- Are the temperatures (fresh air, extract air) really as stated in practice (or are they wishful thinking)?

11.2 Rules and guidelines

Ascertain before designing which rules and guidelines apply. For instance, for some applications (e.g. hospitals) some heat recovery systems are not suitable or can only be allowed after appropriate proving.

11.3 Positioning of unit and system layout

- Where should the heat recovery unit be positioned?
- Which is the optimum air path?
- Which dimensions are allowed?

These questions are important when selecting a plate heat exchanger and should be thoroughly examined in advance.

Little general recommendation can be given for positioning and air path. Only take care that condensate, if present, can drain freely and does not remain inside the exchanger, thus causing a higher pressure drop. This is always guaranteed with a downward extract air flow. Yet, in practice all possible airflows and positions are used without any problems. Chapter 5.4 gives special tips for horizontal installation.

11.4 Cost-effective design

If the calculation is not carried out with the Hoval computer program CAPS, select the most economical type, regarding efficiency and/or plate spacing. The following rules apply:

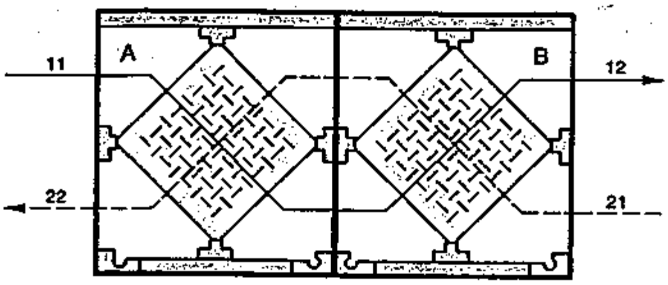
- long periods of operation (e.g. 3 operating shifts)
  ➪ high efficiency

- long life span of unit
  ➪ high efficiency

- high extract air humidity and thus improved efficiency through condensation
  ➪ medium, large or very large plate spacing

- high dirt hazard
  ➪ large or very large plate spacing

Design guidelines



41: ***By connecting two plate heat exchangers in series one achieves not only interesting connection possibilities but also highest heat recovery figures.***

When using plate heat exchangers in process technology, ascertain whether the heat recovery figure is limited due to supply air temperature.

On the other hand cases do exist where a particularly high efficiency is necessary. If – for whatever reasons – a large plate spacing is desired, it is possible to connect two plate heat exchangers in series. Often this can be advantageous to the airflow. The total efficiency for counterflow is calculated as follows:

$$\Phi_{2Ges} = \frac{\Phi_{2A} + \Phi_{2B} - (1 + \mu) \cdot \Phi_{2A} \cdot \Phi_{2B}}{1 - \mu \cdot \Phi_{2A} \cdot \Phi_{2B}}$$

optimum plate heat exchanger selection can only be based on an economic calculation.

11.5 Performance control

Check which internal heat sources are available in the hall. If the extract air temperature is expected to be clearly higher than the desired temperature, a performance control of the plate heat exchanger should be considered (see chapter 2).

11.6 Recirculation bypass

If the air handling installation allows for recirculation operation as well (e.g. during the night) this can also be achieved with a recirculation bypass in the plate heat exchanger. If recirculation is also possible during fresh air operation, reasonable regulation priorities (recirculation/heat recovery) must be defined.

Sound attenuation

Plate heat exchangers have a sound-dampening effect. The performance depends on the plate size and spacing. More details based on various tests and theoretical considerations are available upon request.

11.8 Corrosion

Series V of Hoval plate heat exchangers has proved satisfactory for installation into air handling equipment. If corrosion is expected – e.g. in swimming pools, kitchens, coastal locations and certain industrial applications – series G (corrosion-protected) is used. The Hoval technical department will advise which series is suitable for specific applications.

11.9 Application limits

Prior to selecting a plate heat exchanger, check if any application limits have been exceeded (temperature, pressure difference). See also chapter 6.

11.10 Dirt build-up

In "normal" air handling equipment the air streams are cleaned mostly by coarse dust filters. Therefore there is no dirt hazard for the plate heat exchanger, but if this is expected, in specific applications, consider the following:

- Position the exchanger in such a way that it can be cleaned easily or
- install in such a way that it can easily be removed for cleaning (removable plate heat exchangers on request).
- Fit inspection ports before and after the plate heat exchanger.
- If possible, filter the air streams so that dirt built-up is minimised or cleaning intervals are longer.

It was found in practice that dirt built-up is far less than expected. The Hoval technical department will advise.

11.11 Condensation in the warm air stream

Plate heat exchangers are **not 100 % leakproof unless special measures are taken** (see chapter 1.2 and 1.4). Therefore, if condensation is expected:

- Install condensate drip trays on the supply and extract air side.
- Position the fans in such a way that the pressure gradient and thus leakage is from the supply to the extract air.
- The option "Leakage test" is recommended (see chapter 5.5).

When large amounts of condensate are present in the extract air and the air velocity is higher than 2.5 m/s, condensate drops can be carried along with the airflow and enter ducts or other ventilation components downstream of the heat exchanger. To avoid this and thus uncontrolled condensate escape, we recommend that a drop eliminator is installed in the plate heat exchanger (on site).

In addition, check the following and arrange for appropriate measures:

- How is the condensate drained away?
- Is icing-up hazard expected (see chapter 1.6)?

11.12 Operation and function reliability

Hoval plate heat exchangers do not require power drive, have no moving parts and thus are **100 % reliable in operation.**

Therefore it is possible, at the planning stage, to take recovered heat into consideration. The **heat generation and distribution** required (boilers, heaters, flues) can therefore be **dimensioned and selected on a smaller scale.** Thus cost savings are already in evidence at the installation stage.

11.13 Selection

With the known data and conditions the plate heat exchanger can be selected. This can be done with the **PC program Hoval CAPS.** It calculates the suitable selections, complete with technical data, prices and profitability.

If the performance graphs are used for selection, roughly choose the most suitable types (efficiency, pressure drop) before calculating in detail. Together with the prices, selection is finally reduced to only one or two variants which are calculated according to the design form shown in chapter 8.

11.14 Technical data

Type		________
Weight		________ kg
Height x width x length		________ mm
Warm air:		
Air flowrate at exchanger entry	V_{11}	________ m³/s
Temperature at exchanger entry	t_{11}	________ °C
Rel. humidity at exchanger entry	RH_{11}	________ %
Pressure drop (with condensation)	Δp_1	________ Pa
Cold air:		
Air flowrate at exchanger entry	V_{21}	________ m³/s
Temperature at exchanger entry	t_{21}	________ °C
Rel. humidity at exchanger entry	RH_{21}	________ %
Temperature at exchanger exit	t_{22}	________ °C
Pressure drop	Δp_2	________ Pa
Mass flow ratio	m_2/m_1	________

12. Specification texts

12.1 Design N

Cross-flow plate heat exchanger in design N, for heat recovery, consisting of exchanger package and casing:

The exchanger package consists of aluminium plates Al99, thickness 0.125 mm, with positive and negative stamping for spacing. There are therefore no channels inside the exchanger; airflow and condensate drainage are possible in every direction. The plates are connected by a double fold. This gives a sixfold material thickness at air entry and exit. In addition, the double fold is sealed with epoxy resin.

The corners of the exchanger package are cast and sealed into especially rigid aluminium extrusions in the casing with permanent elastic epoxy resin using a patented method. The side walls of Aluzinc sheet steel are bolted tightly to these extrusions.

Series

- Series V (standard): aluminium plates, extruded aluminium sections and Aluzinc sheet steel; silicone-free.
- Series G (corrosion-protected): aluminium plates, extruded aluminium sections and Aluzinc sheet steel coated; silicone-free.
- Series T (high temperature): aluminium plates, extruded aluminium sections and Aluzinc sheet steel; special sealing agent, resistant to temperatures up to 200 °C.

Options

- A side or middle bypass suited to the exchanger package is built into the casing.
- A side or middle recirculation bypass suited to the exchanger package is built into the casing.
- Control dampers are positioned on the casing before the exchanger and the bypass. These consist of aluminium sections; the geared drives are plastic.
- Horizontal installation position must be considered in fabrication.
- Hoval leakage test.

12.2 Design F

Cross-flow plate heat exchanger in design F, for heat recovery, consisting of exchanger package and casing.

The exchanger package consists of aluminium plates Al99, thickness 0.15 mm, with spacing ribs extending throughout the exchanger where condensate can drain off in every direction. The plates are glued with PU sealing compound and, in addition, sealed with epoxy resin.

The corners of the exchanger package are cast and sealed into especially rigid aluminium extrusions in the casing with permanent elastic epoxy resin using a patented method. The side walls of Aluzinc sheet steel are bolted tightly to these extrusions.

Series

- Series V (standard): aluminium plates, extruded aluminium sections and Aluzinc sheet steel; silicone-free.
- Series G (corrosion-protected): aluminium plates, extruded aluminium sections and Aluzinc sheet steel coated; silicone-free.

Options

- A side or middle bypass suited to the exchanger package is built into the casing.
- A side or middle recirculation bypass suited to the exchanger package is built into the casing.
- Control dampers are positioned on the casing before the exchanger and the bypass. These consist of aluminium sections; the geared drives are plastic.
- Horizontal installation position must be considered in fabrication.
- Hoval leakage test.
- Aluminium protection strips cover the leading and/or trailing edges of the plate heat exchanger.

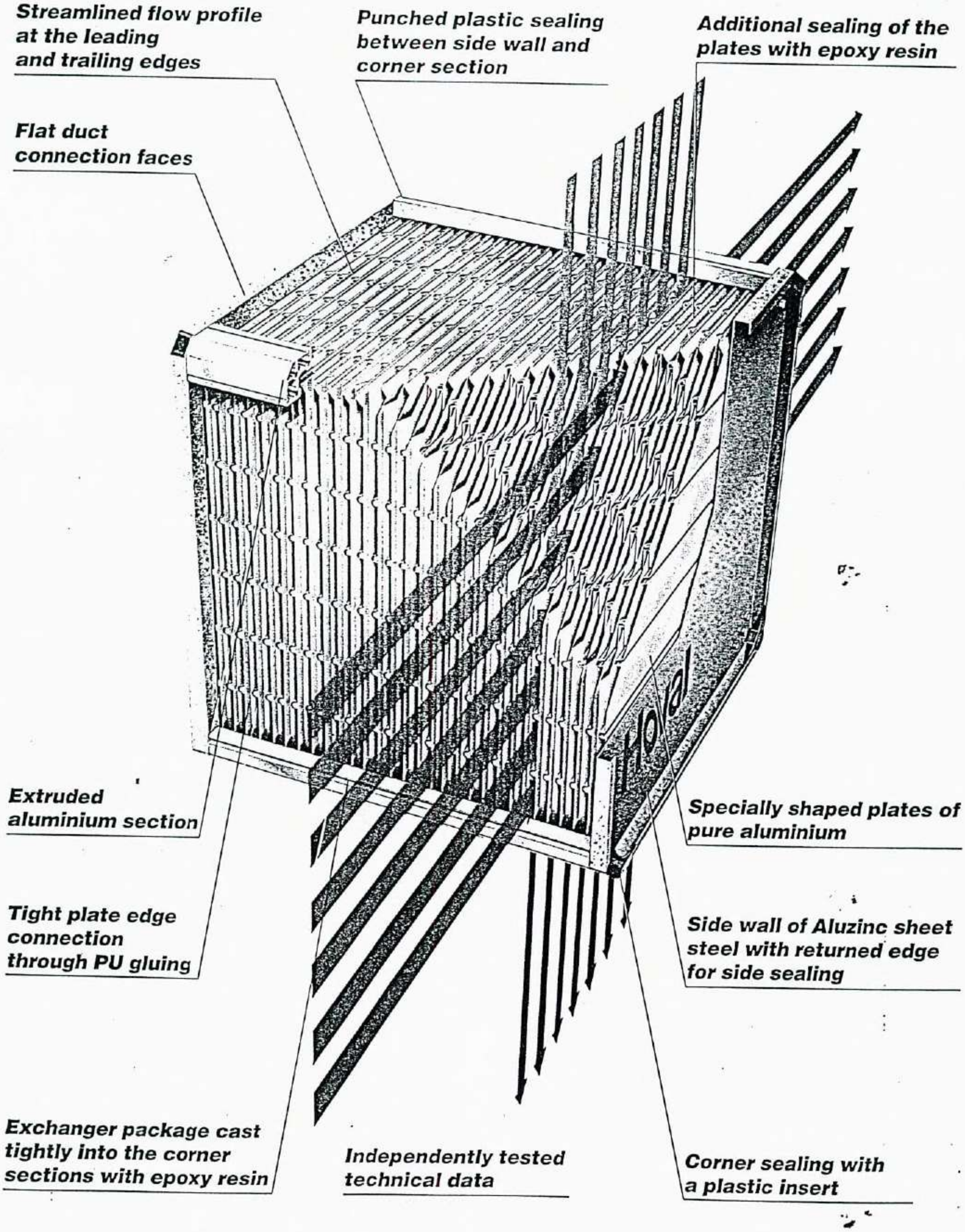
Explanation of symbols

Hoval

Symbol	Unit	Term
A	m^2	Exchanger surface area
b	mm *or* m	Width of the exchanger package
c	kWh/kgK	Specific heat of air ($2.79 \cdot 10^{-4}$)
d	mm	Plate thickness
f_1	–	Factor for increase of the pressure drop with condensation
h	kJ/kg	Enthalpy
k	W/m^2K	Heat transmission
m	kg/h	Mass flow = $V \cdot \rho$
Δp	Pa	Pressure drop
Q	kW	Heat performance
t	K *or* °C	Temperature
V	m^3/h	Volume flow
x	g/kg	Absolute humidity
α	W/m^2K	Heat transfer rate
Φ	%	Heat recovery efficiency $\Phi_1 = \frac{t_{11} - t_{12}}{t_{11} - t_{21}} \cdot 100$ $\Phi_2 = \frac{t_{22} - t_{21}}{t_{11} - t_{21}} \cdot 100$
Φ_N	%	Nominal heat recovery efficiency
$\Delta\Phi_t$	%	Variation of the nominal heat recovery efficiency due to the mass flow ratio
$\Delta\Phi_2$	%	Heat recovery increase with condensation
RH	%	Relative humidity
κ	K	Cooling figure
ρ	kg/m^3	Specific density
μ	–	Mass flow ratio $\mu = \frac{m_2}{m_1}$
λ	W/mK	Heat conductivity

First index:	1	Heat releasing medium, warm air (extract air in winter, fresh air in summer)
	2	Heat absorbing medium, cold air (fresh air in winter, extract air in summer)
Second index:	1	Plate heat exchanger entry
	2	Plate heat exchanger exit
	t	dry (without condensation)

Cut-away view of design F



Hoval® PWT
Experience over many years guarantees sound advice

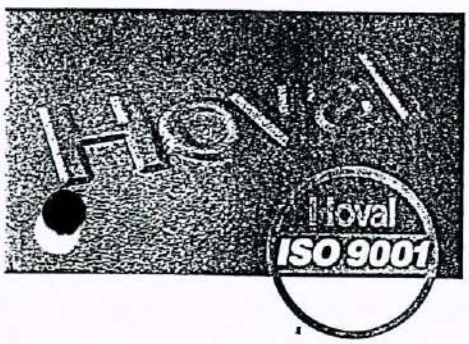
·Ioval - Europe's leading manufacturer ɔf plate heat exchangers

·Ioval, a group with several production ›lants and sales offices in Europe, is a ›ioneer of heating technology. Today the ›roduct range includes not only boilers but ılso air heaters, radiators, waste incinera- on plants and steam boilers.

ˈince 1976 Hoval has manufactured plate eat exchangers in the Schaan factory. The esultant experience forms the basis for Ioval application and technical advisory ervice. All technical data for the ex- han●, e.g. heat recovery and pressure Irop. ive been tested and agreed by ıdependent test institutes – to safeguard onsultants, installers and operators.

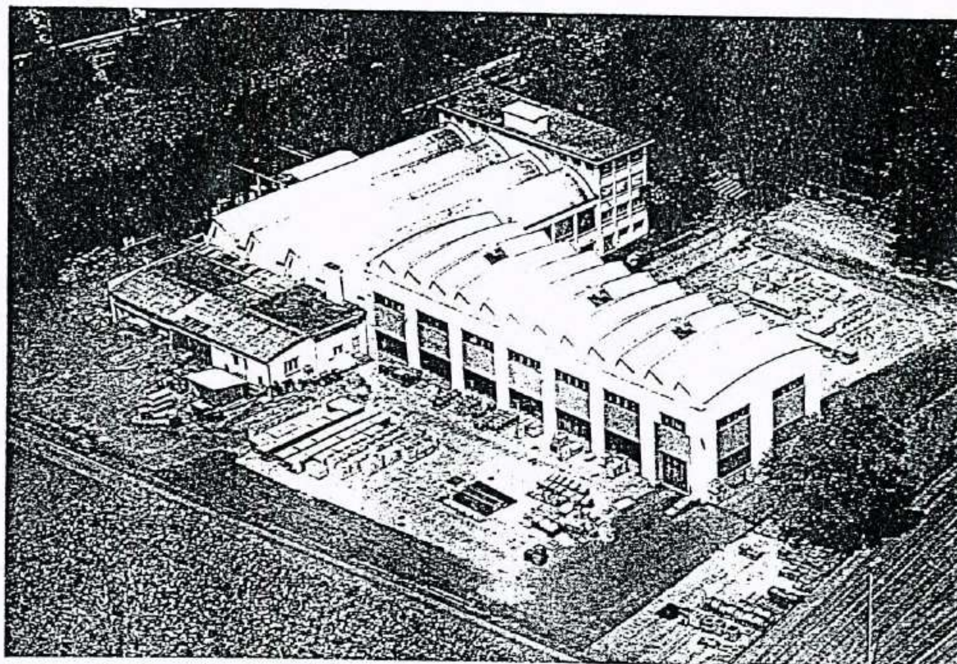
·ertified quality

'he Hoval quality system is tested and ertified under ISO 9001. This means that ptimised procedures are adhered to in evelopment, fabrication and distribution to guarantee the Hoval quality.

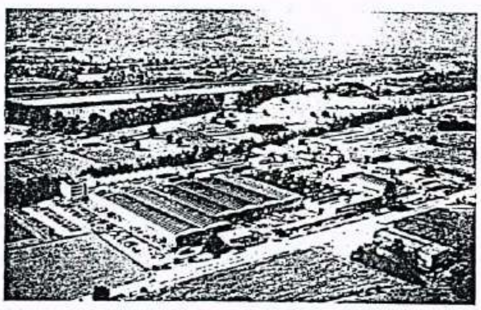


\utomatic production o customer specification

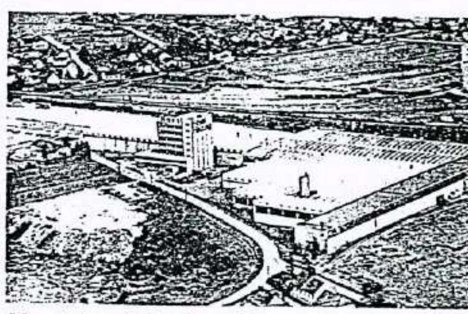
Ioval plate heat exchangers are manufac- ıred to customer specification. Constant igh quality is ensured thanks to production f the exchanger packages on automatic ıachinery.



Schaan factory (Liechtenstein)

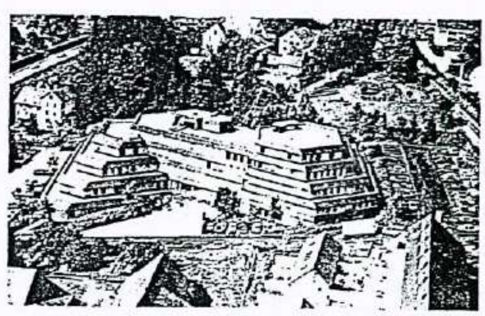


Vaduz factory (Liechtenstein)



Marchtrenk factory (Austria)

Newark factory (Great Britain)



Hoval Feldmeilen (Switzerland)

Hoval

Conservation of Energy – Protection of the Environment

ireat Britain / Northern Ireland:
Ioval Ltd.
Iorthgate
Iewark, Notts. NG 24 1 JN
el. 01636/72711, Fax 01636/73532

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Hovalwerk AG
Zollstrasse 91
FL-9494 Schaan, Liechtenstein
Tel. +41/75/2370101, Fax +41/75/2370181

Republic of Ireland:
Masterair Sales Ltd.
J.F.Kennedy Park, Killeen Road
Dublin 12
Tel. 01/4602188, Fax 01/4602193

T-1e 09/97

SECTION 15

RECOMMENDED SPARES

Recommended Spares
Anti Vibration Mountings

Model	Price (£/ea)	Model	Price (£/ea)
M25 Green	11.60	MS1	21.63
M50 White	11.60	MS2	35.56
M75 Blue	11.60	MS4	65.63
M100 Red	11.60	MS1-HD	23.80
M150Black	14.99	MS2-HD	39.93
M250Plain	14.99	MS4-HD	74.29
		NSM1-HD	19.28
MSLCH1	34.74	NSM2-HD	32.92
MSLCH2	55.45	NSM4-HD	62.69
MSLCH4	92.32	MSO	3.99
M1	15.29	MSO-B	4.67
MB1	17.25	MSF	5.20
M2	27.70		
MB2	30.81		
MP0	4.75		
MP1	7.30		
CM1	12.59		
CM2	19.51		
OSM1	70.21		

All AVM's supplied c/w levelling studs.
All prices quoted are nett & inclusive of delivery
(07/07/98)

Recommended Spares
Fan Bearings

Fan Ref	Bearing Ref	Bearing Code	Price(£)
ADN/RDN 160R	20mm Bearing		10.28
ADN/RDN 180R	20mm Bearing	982000	10.28
ADN/RDN 200R	20mm Bearing		10.28
ADN/RDN 200K	20mm Pillar Block	982200	20.54
ADN/RDN 225R	20mm Bearing		10.28
ADN/RDN 225K	20mm Pillar Block		20.54
ADN/RDN 250R	20mm Bearing		10.28
ADN/RDN 250K	25mm Pillar Block	982201	25.69
ADN/RDN 280R	25mm Bearing		11.30
ADN/RDN 280K	30mm Pillar Block		30.82
ADN/RDN 315R	25mm Bearing		11.30
ADN/RDN 315K	30mm Pillar Block	982202	30.82
ADN/RDN 355R	30mm Bearing		13.36
ADN/RDN 355K	35mm Pillar Block	982203	35.95
ADN/RDN 400R	30mm Bearing		13.36
ADN/RDN 400K	35mm Pillar Block		35.95
ADN/RDN 450R	35mm Bearing		18.50
ADN/RDN 450K	40mm Pillar Block	982204	41.09
ADN/RDN 500R	35mm Bearing		18.50
ADN/RDN 500K	40mm Pillar Block	982204	41.09
ADN/RDN 560R	40mm Bearing		22.60
ADN/RDN 560K	50mm Pillar Block		51.37
ADN/RDN 630R	40mm Bearing		22.60
ADN/RDN 630K	50mm Pillar Block	982206	51.37
ADN/RDN 630K2	50mm Pop Release	982433/982434	178.77
ADN/RDN 710R	50mm Bearing		47.26
ADN/RDN 710K	50mm Pillar Block		51.37
ADN/RDN 710K2	60mm Pop Release	982431/982432	190.07
ADN/RDN 800K	50mm Pillar Block	982206	51.37
ADN/RDN 800K2	60mm Pop Release	982431/982432	190.07
ADN/RDN 900K	60mm Pillar Block		71.92
ADN/RDN 900K2			
ADN/RDN 1000K	60mm Pillar Block	982207	71.92
ADN/RDN1000K 2			

All prices quoted are nett & inclusive of delivery (07/07/98)

Recommended Spares
Transmissions-Belts

SPZ	Price (£)EA	SPA	Price (£)EA	SPB	Price (£)EA	SPC	Price (£)EA
630	6.55	800	13.64	1250	20.85	2000	52.83
670	6.94	825	13.76	1260	20.98	2120	58.06
710	7.21	850	14.15	1320	22.02	2240	61.35
750	7.60	875	14.15	1340	22.41	2360	64.88
760	7.60	900	14.80	1400	23.46	2500	68.69
800	7.87	925	15.19	1410	23.71	2650	73.03
850	8.40	950	15.60	1500	25.03	2800	77.09
900	8.80	975	15.84	1600	26.87	3000	82.70
940	9.17	1000	16.27	1700	28.45	3150	82.90
950	9.17	1030	16.64	1800	30.27	3350	88.10
1000	9.70	1060	17.04	1900	31.99	3550	93.46
1010	9.70	1090	17.31	2000	33.69	3750	98.70
1060	10.09	1120	17.70	2020	34.08	4000	105.51
1080	10.36	1150	18.22	2120	35.66	4250	112.19
1120	10.62	1180	18.61	2150	36.31	4500	118.76
1140	11.02	1220	19.26	2240	37.75	4750	125.44
1180	11.13	1250	19.41	2280	38.67	5000	132.12
1200	11.27	1280	19.79	2360	39.72	5300	140.13
1250	11.78	1320	20.31	2410	40.91	5600	148.11
1270	11.78	1360	20.98	2500	42.21	6000	158.88
1320	12.33	1400	21.37	2530	42.99	6300	166.86
1340	12.33	1450	22.02	2650	44.83	6700	177.35
1400	12.85	1500	22.56	2680	45.62		
1420	12.85	1550	23.46	2800	47.46		
1470	13.50	1600	23.99	2840	48.23		
1500	14.42	1650	24.64	3000	51.00		
1520	14.42	1700	25.29	3150	50.85		
1560	14.80	1750	28.82	3170	51.51		
1600	15.35	1800	26.60	3350	54.27		
1650	15.73	1850	27.13	3550	57.56		
1700	16.27	1900	27.92	3750	60.82		
1800	17.04	2000	29.23	3800	61.86		
1850	17.43	2060	30.02	4000	64.88		
1900	17.96	2120	30.81	4060	66.07		
2000	19.14	2180	31.82	4250	68.94		
2030	19.14	2240	32.38	4310	70.13		
2120	19.79	2300	33.04	4500	71.47		
2240	20.98	2360	33.80	4560	73.14		
2280	21.37	2430	34.88	4750	77.21		
2360	22.02	2500	35.78	4820	78.65		
2410	22.16	2580	36.44	5000	81.27		
2500	23.06	2650	37.75	5070	82.7		
2540	24.38	2720	38.26	5300	86.25		
2650	24.38	2800	39.59	5380	87.69		
2690	24.64	2900	41.37	5600	91.24		
2800	25.69	3000	42.21	5680	92.41		
2840	25.95	3150	44.18	6000	97.78		
3000	27.52	3350	46.80	6300	102.63		
3150	28.71	3550	49.43				
3170	28.71	3750	49.54				
3350	30.54	4000	52.56				
3550	32.38	4250	55.71				
		4500	58.78				

All prices quoted are nett & inclusive of delivery (07/07/98)

Recommended Spares

Filters

Filter Description	Size	Part Number	Price(£)
PRE-FILTERS			
Amerglas Standard	610 x 610	35-315-05M	
Amerglas Standard	508 x 610	35-315-07	
Amerglas Standard	508 x 508	35-315-03	
FILTERS			
DriPak	610 x 610	81-08-825	
DriPak	508 x 508	X5-05-XXX	
DriPak	610 x 508	34-06-825	
DriPak	610 x 508	34-06-512	

All prices quoted are nett & inclusive of delivery

Recommended Spares
Flexible Connection Material (NCA/6)

Size	Price (£/metre)
220 mm wide	8.30
190 mm wide	6.89
310 mm wide	9.39
395 mm wide	10.25

All prices quoted are nett & inclusive of delivery (07/07/98)

Recommended Spares

Misc Parts

All prices quoted are nett & inclusive of delivery

Recommended Spares
Transmissions-Pulleys (SPA)

SPA	Price (£)EA	SPA	Price (£)EA	SPA	Price (£)EA	SPA	Price (£)EA
63x1		140x3	41.68	236x5			
63x2		140x4	49.50	250x1	51.48		
67x1		140x5	60.35	250x2	61.81		
67x2		140x6		250x3	72.77		
71x1		150x1	29.72	250x4	90.65		
71x2		150x2	35.73	250x5	107.19		
71x3		150x3	43.67	280x1	61.66		
80x1	17.59	150x4	52.53	280x2	72.78		
80x2	21.23	150x5	63.53	280x3	85.36		
80x3	25.74	150x6		280x4	105.87		
85x1	18.47	160x1	31.83	280x5	127.71		
85x2	22.17	160x2	39.04	315x1	66.18		
85x3	26.6	160x3	47.91	315x2	890.73		
90x1	19.39	160x4	57.82	315x3	93.96		
90x2	23.22	160x5	69.47	315x4	114.47		
90x3	27.79	160x6		315x5	134.98		
90x4	34.01	170x1		355x1			
95x1	19.79	170x2		355x2			
95x2	24.15	170x3		355x3			
95x3	28.72	170x4		355x4			
95x4	35.99	170x5		355x5			
100x1	20.71	170x6		400x1	86.03		
100x2	24.75	180x1	34.29	400x2	103.23		
100x3	30.50	180x2	41.68	400x3	119.11		
100x4	37.18	180x3	50.16	400x4	146.89		
100x5	44.32	180x4	61.81	400x5	176.01		
106x1	22.04	180x5	74.11	450x1			
106x2	26.27	180x6		450x2			
106x3	32.03	190x1		450x3			
106x4	39.43	190x2		450x4			
106x5	47.10	190x3		450x5			
112x1	23.04	190x4					
112x2	27.73	190x5					
112x3	33.35	180x6					
112x4	41.56	200x1	37.72				
112x5	49.36	200x2	49.50				
118x1	24.02	200x3	58.35				
118x2	29.11	200x4	71.47				
118x3	35.20	200x5	85.36				
118x4	43.41	212x1					
118x5	51.62	212x2					
125x1	25.21	212x3					
125x2	30.50	212x4					
125x3	36.52	212x5					
125x4	45.92	224x1	48.04				
125x5	53.87	224x2	56.64				
132x1	26.47	224x3	67.49				
132x2	31.16	224x4	84.04				
132x3	38.77	224x5	99.25				
132x4	47.51	236x1					
132x5	57.03	236x2					
140x1	27.85	236x3					
140x2	33.49	236x4					

All prices quoted are nett & inclusive of delivery (07/07/98)

Recommended Spares
Transmissions-Pulleys (SPZ)

SPZ	Price (£)EA	SPZ	Price (£)EA	SPZ	Price (£)EA	SPZ	Price (£)EA
56x1	12.65	125x1	21.70	200x6	85.36		
56x2	14.49	125x2	25.61	224x1			
60x1	12.77	125x3	30.84	224x2			
60x2	14.82	125x4	38.38	224x3			
63x1	13.11	125x5	45.26	224x4			
63x2	15.21	125x6	52.40	224x5			
63x3	18.26	132x1		224x6			
67x1	13.44	132x2		250x1	44.06		
67x2	16.34	132x3		250x2	51.74		
67x3	19.32	132x4		250x3	61.01		
71x1	14.35	132x5		250x4	74.77		
71x2	16.81	132x6		250x5	90.65		
71x3	20.31	140x1	24.02	250x6	105.20		
75x1	14.82	140x2	28.31	280x1			
75x2	17.21	140x3	33.49	280x2			
75x3	20.64	140x4	42.48	280x3			
80x1	15.09	140x5	49.64	280x4			
80x2	17.75	140x6	57.57	280x5			
80x3	21.63	150x1		280x6			
80x4	27.46	150x2		315x1	55.71		
85x1	16.81	150x3		315x2	65.50		
85x2	19.32	150x4		315x3	76.77		
85x3	23.29	150x5		315x4	95.29		
85x4	29.06	150x6		315x5	112.49		
85x5	34.13	160x1	27.20	315x6	133.66		
90x1	17.21	160x2	31.45	355x1			
90x2	20.31	160x3	38.65	355x2			
90x3	24.22	160x4	48.04	355x3			
90x4	30.64	160x5	55.47	355x4			
90x5	35.99	160x6	65.50	355x5			
95x1	17.86	170x1		355x6			
95x2	21.18	170x2					
95x3	25.08	170x3					
95x4	31.77	170x4					
95x5	36.93	170x5					
100x1	18.47	170x6					
100x2	21.78	180x1	30.77				
100x3	26.01	180x2	37.18				
100x4	33.49	180x3	44.72				
100x5	38.50	180x4	55.47				
100x6	42.48	180x5	65.38				
112x1	19.73	180x6	75.43				
112x2	23.22	190x1					
112x3	28.13	190x2					
112x4	34.94	190x3					
112x5	41.28	190x4					
112x6	45.92	190x5					
118x1		180x6					
118x2		200x1	35.07				
118x3		200x2	41.28				
118x4		200x3	49.09				
118x5		200x4	60.48				
118x6		200x5	72.12				

All prices quoted are nett & inclusive of delivery (07/07/98)

Recommended Spares
Standard Parts

Door Handles/hinges :(AAF-McQuay)

Handle(Locking)	*Code:* GB-HAN-9414	As req'd	£10.00ea
Handle(Non Locking)	*Code:* GB-HAN-9415	As req'd	£10.00ea
Door Cams	*Code:* GB-CAM-0408	As req'd	£0.50ea
Viewports		As reqd	£46.78ea
Intercostal Gasket			£6.00/roll
Door Gasket			£15.00/roll
Magnahelic Gauge	Series 2000	As req'd	£48.71ea
Minihelic Gauge	Series 2-5000	As req'd	£54.25ea
Pressure Switch	Series 1900	As req'd	£34.25ea

For any information regarding Spare Parts for the above Equipment,our Spares Dept.will be happy to assist.
*Tel No:*0191 2010412/*Fax* 0191 2010411
(Prices at 07/07/98)

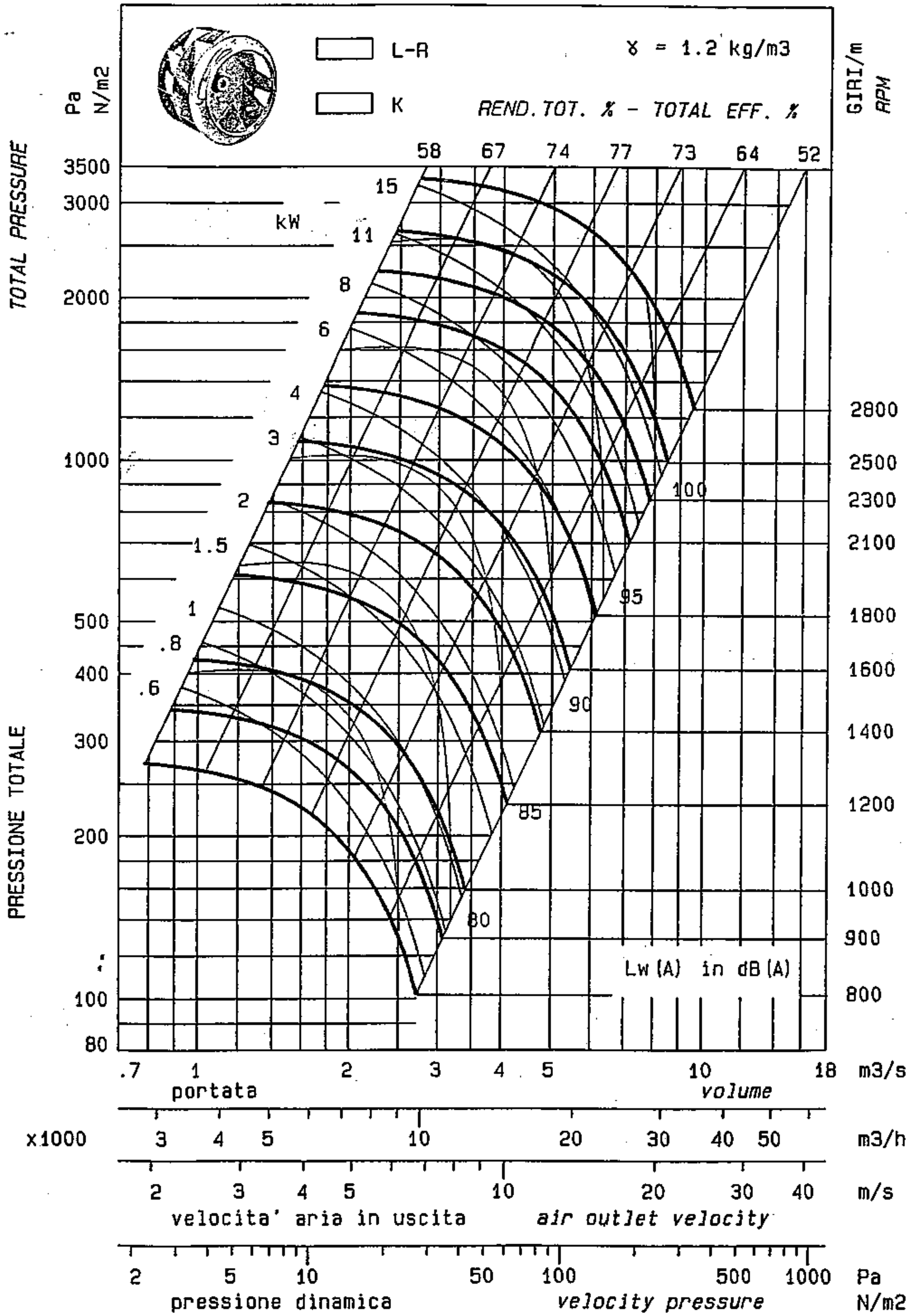
SECTION 16

TEST RESULTS / CERTIFICATES

NICOTRA

RDN 500

DIAMETRO GIRANTE 500 mm *WHEEL DIAMETER*



- Tipo d'installazione : mandata canalizzata
- L'effetto di ostruzioni nel flusso d'aria non e' compreso
- La potenza dissipata nella trasmissione non e' compresa

Installation type : free inlet , ducted outlet
Effects of appurtenances in airstream not included
Power rating kW does not include drive losses

ISO 9001

Certificate No. FS 00623

BROOK Hansen

St.Thomas' Road, Huddersfield HD1 3LJ.
Telephone: (01484) 422150 Telex: 51388
Telefax: (01484) 510848

TYPE TEST CERTIFICATE

SUPPLIED TO

A.A.F. INTERNATIONAL(A.A.F.LTD T/A)
BASSINGTON IND. EST.,

CRAMLINGTON,
NE23 8AF

PURCHASE ORDER REF 6707393/UNIT 02
P020201/1

UNIT No. 3198

FRAME REF.	W-DA160MJ		
OUTPUT 11.00 KW		VOLTS STAR DELTA 400	
HERTZ 50	IC IC411	AMPS 20.90	
REV/MIN 1470			POLES 4
RATING/DUTY S1		SEC.VOLTS	SEC.AMPS
PHASES 3	INSULATION	COS Ø .83	IP 55

LOCKED - ROTOR

CONN	VOLTS	AMPS	Nm	%FLT	%FLC
STAR	400	48.3	46.5	65	230
DOL	400	162	179	250	770

CALCULATION OF THE EFFICIENCY FROM THE SUMMATION OF LOSSES

DESIGN REF. WD160M 4D

PERFORMANCE FIGURES

OUTPUT kW	VOLTS	AMPS	INPUT kW	Hz	REV/MIN	Nm	EFFY %	P.F.	SLIP %
NO LOAD	400	8.96	0.359	50	1500				
2.8	400	10.4	3.2	50	1496	18.0	87.3	.450	0.25
5.6	400	13.1	6.1	50	1489	35.6	90.5	.670	0.74
8.3	400	16.7	9.0	50	1480	53.5	91.5	.780	1.33
[illegible].0	400	20.9	12.0	50	1470	71.5	91.5	.830	2.00
[illegible].7	400	25.5	15.2	50	1458	90.0	90.5	.860	2.80

COLD RESISTANCE			RESISTANCE @ 75 °C		TEMPERATURE RISES (°C) AFTER 5 HRS FULL LOAD				
AMBIENT TEMP.°C	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	AMBIENT TEMP.°C	STATOR FRAME	STATOR WINDING	ROTOR WINDING	ROTOR RINGS
20.0	0.58 Ω	Ω	0.7 Ω	Ω	20.0	30.0	52.0		

OPEN CIRCUIT SEC.VOLTS	INSULATION RESISTANCE STATOR	INSULATION RESISTANCE ROTOR	HIGH-VOLTAGE (ONE MINUTE) STATOR	HIGH-VOLTAGE (ONE MINUTE) ROTOR	DATE OF ISSUE	ISSUED BY
V	50 MΩ	MΩ	2000 V	V	27/11/98	CDO

REMARKS C.O. THERMISTORS

WE CERTIFY THAT MOTOR No.(s)
G158158

IS/ARE REPRESENTATIVE OF THE SAME RATING AS THAT SHOWN ABOVE &
IS/ARE ROUTINELY TESTED IN ACCORDANCE WITH INTERNATIONAL STANDARDS BEFORE
DESPATCH FROM OUR WORKS. (PERFORMANCE FIGURES SUBJECT TO TOLERANCES)

Cert Ref. S304394
Int Ref. 10415610 18

ISO 9001

BSI REGISTERED FIRM

NATIONAL ACCREDITATION OF CERTIFICATION BODIES

Certificate No. FS 00623

BROOK Hansen

St.Thomas' Road, Huddersfield HD1 3LJ.
Telephone: (01484) 422150 Telex: 51388
Telefax: (01484) 510848

TYPE TEST CERTIFICATE

SUPPLIED TO

A.A.F. INTERNATIONAL(A.A.F.LTD T/A)
BASSINGTON IND. EST.,

CRAMLINGTON,
NE23 8AF

PURCHASE ORDER REF 6707393/UNIT 02
P020201/2

[illegible]NT No. 3198

FRAME REF.	W-DA160LR		
OUTPUT 15.00 KW		VOLTS STAR DELTA 400	
HERTZ 50	IC IC411	AMPS 28.00	
REV/MIN 1470			POLES 4
RATING/DUTY S1		SEC.VOLTS	SEC.AMPS
PHASES 3	INSULATION	COS Ø .84	IP 55

LOCKED - ROTOR

CONN	VOLTS	AMPS	Nm	%FLT	%FLC
STAR	400	64.4	63.3	65	230
DOL	400	216	244	250	770

CALCULATION OF THE EFFICIENCY
FROM THE SUMMATION OF LOSSES

DESIGN REF. WD160L 4D

PERFORMANCE FIGURES

OUTPUT kW	VOLTS	AMPS	INPUT kW	Hz	REV/MIN	Nm	EFFY %	P.F.	SLIP %
NO LOAD	400	11.00	0.406	50	1500				
3.8	400	13.5	4.3	50	1496	24	88.8	.460	0.25
7.6	400	17.4	8.2	50	1489	49	91.5	.680	0.74
11.3	400	22.2	12.2	50	1480	73	92.5	.790	1.33
[illegible]0	400	28.0	16.3	50	1470	97	92.0	.840	2.00
[illegible].7	400	34.2	20.6	50	1458	123	91.0	.870	2.80

COLD RESISTANCE			RESISTANCE @ 75 °C		TEMPERATURE RISES (°C) AFTER 5 HRS FULL LOAD				
AMBIENT TEMP. °C	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	AMBIENT TEMP. °C	STATOR FRAME	STATOR WINDING	ROTOR WINDING	ROTOR RINGS
20.0	0.42 Ω	Ω	0.5 Ω	Ω	20.0	47.0	72.0		

OPEN CIRCUIT SEC.VOLTS	INSULATION RESISTANCE STATOR	INSULATION RESISTANCE ROTOR	HIGH-VOLTAGE (ONE MINUTE) STATOR	HIGH-VOLTAGE (ONE MINUTE) ROTOR	DATE OF ISSUE	ISSUED BY
V	50 MΩ	MΩ	2000 V	V	27/11/98	CDO

REMARKS C.O. THERMISTORS

W[illegible]RTIFY THAT MOTOR No.(s)
G158160

IS/ARE REPRESENTATIVE OF THE SAME RATING AS THAT SHOWN ABOVE &
IS/ARE ROUTINELY TESTED IN ACCORDANCE WITH INTERNATIONAL STANDARDS BEFORE
DESPATCH FROM OUR WORKS. (PERFORMANCE FIGURES SUBJECT TO TOLERANCES)

Cert Ref. S304436
Int Ref. 10415823 21

ISO 9001

Certificate No. FS 00623

BROOK Hansen

St.Thomas' Road, Huddersfield HD1 3LJ.
Telephone: (01484) 422150 Telex: 51388
Telefax: (01484) 510848

TYPE TEST CERTIFICATE

SUPPLIED TO

A.A.F. INTERNATIONAL(A.A.F.LTD T/A)
BASSINGTON IND. EST.,

CRAMLINGTON,
NE23 8AF

PURCHASE ORDER REF 6707393/UNIT 01
P020213/1

UNIT No. 3198

FRAME REF.	W-DA160MJ		
OUTPUT 11.00 KW	VOLTS STAR DELTA 400		
HERTZ 50	IC IC411	AMPS 20.90	
REV/MIN 1470		POLES 4	
RATING/DUTY S1	SEC.VOLTS	SEC.AMPS	
PHASES 3	INSULATION	COS Ø .83	IP 55

LOCKED - ROTOR

CONN	VOLTS	AMPS	Nm	%FLT	%FLC
STAR	400	48.3	46.5	65	230
DOL	400	162	179	250	770

CALCULATION OF THE EFFICIENCY FROM THE SUMMATION OF LOSSES

DESIGN REF. WD160M 4D

PERFORMANCE FIGURES

OUTPUT kW	VOLTS	AMPS	INPUT kW	Hz	REV/MIN	Nm	EFFY %	P.F.	SLIP %
NO LOAD	400	8.96	0.359	50	1500				
2.8	400	10.4	3.2	50	1496	18.0	87.3	.450	0.25
5.6	400	13.1	6.1	50	1489	35.6	90.5	.670	0.74
8.3	400	16.7	9.0	50	1480	53.5	91.5	.780	1.33
11.0	400	20.9	12.0	50	1470	71.5	91.5	.830	2.00
[illegible].7	400	25.5	15.2	50	1458	90.0	90.5	.860	2.80

COLD RESISTANCE			RESISTANCE @ 75 °C		TEMPERATURE RISES (°C) AFTER 5 HRS FULL LOAD				
AMBIENT TEMP. °C	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	AMBIENT TEMP. °C	STATOR FRAME	STATOR WINDING	ROTOR WINDING	ROTOR RINGS
20.0	0.58 Ω	Ω	0.7 Ω	Ω	20.0	30.0	52.0		

OPEN CIRCUIT SEC.VOLTS	INSULATION RESISTANCE STATOR	INSULATION RESISTANCE ROTOR	HIGH-VOLTAGE (ONE MINUTE) STATOR	HIGH-VOLTAGE (ONE MINUTE) ROTOR	DATE OF ISSUE	ISSUED BY
V	50 MΩ	MΩ	2000 V	V	27/11/98	CDO

REMARKS C.O. THERMISTORS

I CERTIFY THAT MOTOR No.(s)
G158164

IS/ARE REPRESENTATIVE OF THE SAME RATING AS THAT SHOWN ABOVE & IS/ARE ROUTINELY TESTED IN ACCORDANCE WITH INTERNATIONAL STANDARDS BEFORE DESPATCH FROM OUR WORKS. (PERFORMANCE FIGURES SUBJECT TO TOLERANCES)

Cert Ref. S304394
Int Ref. 10415610 18

ISO 9001

Certificate No. FS 00623

BROOK Hansen

St.Thomas' Road, Huddersfield HD1 3LJ.
Telephone: (01484) 422150 Telex: 51388
Telefax: (01484) 510848

TYPE TEST CERTIFICATE

SUPPLIED TO

AAF LTD DOOR NO 2
BASSINGTON LANE

CRAMLINGTON
NORTHUMBERLAND

PURCHASE ORDER REF. 6707393/UNIT 1 TEAM
P020213/2

[illegible]UNT No. 3198

FRAME REF.	W-DA160LR		
OUTPUT 15.00 KW		VOLTS DELTA STAR 380-415/660-720	
HERTZ 50	IC IC411	AMPS 29.40- 28.00/ 17.00 - 16.20	
REV/MIN 1470			POLES 4
RATING/DUTY S1		SEC.VOLTS	SEC.AMPS
PHASES 3	INSULATION	COS Ø .84	IP 55

LOCKED - ROTOR

CONN	VOLTS	AMPS	Nm	%FLT	%FLC
STAR	400	64.4	63.3	65	230
DOL	400	216	244	250	770

CALCULATION OF THE EFFICIENCY FROM THE SUMMATION OF LOSSES

DESIGN REF. WD160L 4D

PERFORMANCE FIGURES

OUTPUT kW	VOLTS	AMPS	INPUT kW	Hz	REV/MIN	Nm	EFFY %	P.F.	SLIP %
NO LOAD	400	11.00	0.406	50	1500				
3.8	400	13.5	4.3	50	1496	24	88.8	.460	0.25
7.6	400	17.4	8.2	50	1489	49	91.5	.680	0.74
1[illegible].3	400	22.2	12.2	50	1480	73	92.5	.790	1.33
1[illegible].0	400	28.0	16.3	50	1470	97	92.0	.840	2.00
[illegible].7	400	34.2	20.6	50	1458	123	91.0	.870	2.80

COLD RESISTANCE			RESISTANCE @ 75 °C		TEMPERATURE RISES (°C) AFTER 5 HRS FULL LOAD				
AMBIENT TEMP. °C	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	STATOR BETWEEN LINES	ROTOR BETWEEN RINGS	AMBIENT TEMP. °C	STATOR FRAME	STATOR WINDING	ROTOR WINDING	ROTOR RINGS
20.0	0.42 Ω	Ω	0.5 Ω	Ω	20.0	47.0	72.0		

OPEN CIRCUIT SEC.VOLTS	INSULATION RESISTANCE STATOR	INSULATION RESISTANCE ROTOR	HIGH-VOLTAGE (ONE MINUTE) STATOR	HIGH-VOLTAGE (ONE MINUTE) ROTOR	DATE OF ISSUE	ISSUED BY
V	50 MΩ	MΩ	2000 V	V	27/11/98	CDO

REMARKS C.O. THERMISTORS

W[illegible] CERTIFY THAT MOTOR No.(s)

G158166

IS/ARE REPRESENTATIVE OF THE SAME RATING AS THAT SHOWN ABOVE &
IS/ARE ROUTINELY TESTED IN ACCORDANCE WITH INTERNATIONAL STANDARDS BEFORE
DESPATCH FROM OUR WORKS. (PERFORMANCE FIGURES SUBJECT TO TOLERANCES)

Cert Ref. S304436
Int Ref. 10415823 01

S & P Coil Products Ltd
S P C. House
Evington Valley Road
LEICESTER. LE5 5LU
Tel. 0116 2490044 - Fax: 0116 2490033

A.A.F. Ltd
Bassington Lane
Cramlington
Northumberland
NE23 8AF

For the attention of E.Sedgwick

TEST CERTIFICATE.

Product: Coils

YOUR ORDER NO. PO23468
S.P.C. ORDER NO. S33148

COIL REFS.	Tag Unit 3. 6707393	COIL CODE	A/12WH4.1-24t x 1082
	Tag Unit 3. 6707393		A/12WH5.1 24t x 1082

This is to certify that the above item(s) has/have been tested prior to despatch and found to be satisfactory.

TEST.

1. PRESSURE TEST TO COIL. AIR UNDER WATER. TO 22 BAR (2.2 MPA/320 PSIG).

Signed...
R.J.Moss - Technical Director

Date: ......15th January 1999

Document ref TC1 Issue 1

SECTION 17

MANUFACTURERS LITERATURE

SECTION 18

WIRING DIAGRAMS

AAF INTERNATIONAL

Electrical Keysheet

(Order to shop)

EKS-6707393-1 | Rev:

Issued by:
John Wright

Date:
2nd September 1998

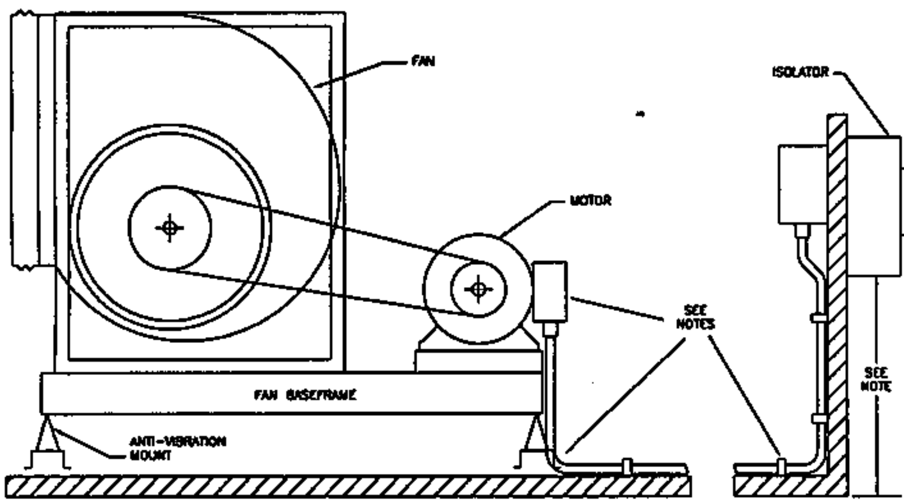
Issue To:	Client (code 1)	(G) Works MFAS Parts	(1) Works Easdale Parts	(3) Works MFAS Weld	(2) Works Easdale Weld	(5) Works MFAS Fit	(N) Works Easdale Fit	(4) Works MFAS Paint	(6) Works Easdale Paint	(A) Kit	(7) Packing	archive	HEMS PCD	HVAC Inspect	Project Engineer (see below)	Total Number of Copies
Prints	3			-			1									4
Plastics																

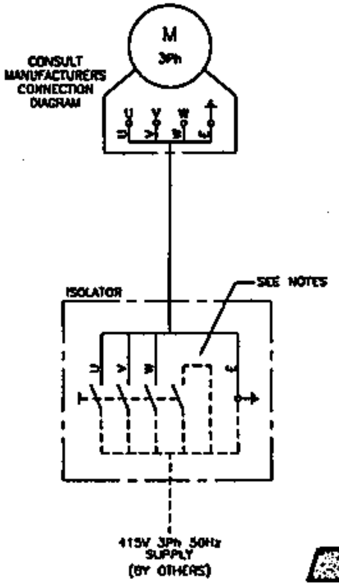
Other:

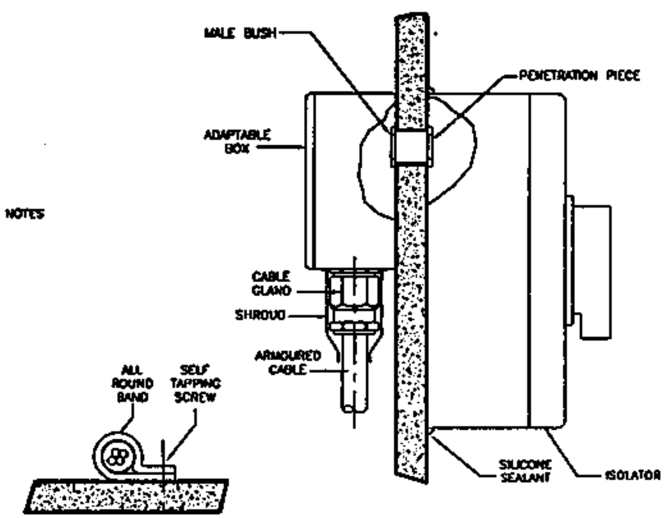
Project Eng: M.CHRISTIE

Revisions	

AAF Unit No.	Clients Reference	Quantities Unit	Quantities Total	Drawing Description	Drawing No.	Cost Allocation Code	Shop Order No.	Schedule Dates (Week No.) Parts	Weld	Paint	Kit	Fitting
1	AHU 1	1	1	15KW (DOL) MOTOR ISOLATOR INSTALLATION XLPE CABLE	A3-921269						39	40
				C/W THERMISTORS	A3-921358							
		1	1	11KW (DOL) MOTOR ISOLATOR INSTALLATION XLPE CABLE	A3-921268						39	40
				C/W THERMISTORS	A3-921358							
		4	4	SINGLE BULKHEAD LIGHT INSTALLATION (PVC)	A3-921345						39	40







No.OFF:1

WOR... RDER NUMBER

SHT 1 OF 1

ITEM.	QTY.	DESCRIPTION	MANUF.PART No. OR CAT No.	AAF PART NO.
1	1	Isolator 63A (3 Pole+Aux)	M02.G63.31	GB-ISO-63A3P
2	1	Adaptable Box (100x100x50)	AB557PB	GB-BOX-100
3	1	Penetration Piece 20mm (PVC)		GB-COU-120
4	1	Male Bush 20mm (PVC)	CMB 20	GB-BUS-120
5	4.50M	Cable 4 Core 4mm XLPE/LSF/SWA/LSF		GB-CAB-4C4
6	2	Cable Gland Hawke 153/RAC/A/20mm	153/RAC/A/20mm	GB-GLA-153A
7	0.25L	Heat Shrink Sleeving G/Y (6.4/3.2)	398-076	GB-SLE-6.4
8	2	Markers Cable Partex PA1/3 U		GB-MAR-013-U
9	2	Markers Cable Partex PA1/3 V		GB-MAR-013-V
10	2	Markers Cable Partex PA1/3 W		GB-MAR-013-W
11	0.50M	Band.Cable.Perf.Black PVC.17mm		GB-BAN-017B
12	3	Flat Blade Crimp Connector 10mmLx6mm	IBL6-10	GB-CON-6-F
13	5	Crimp Terminal Eyelet 0BA/M6	534-430	GB-CON-134
14	1	Reducer 32-20mm (Galv)		GB-RED-032A

Notes:-

1. For actual orientation & position of equipment consult General Arrangement drawing of Air Handling Unit.
2. Surplus length to be left to allow flexing of cable across Anti-Vibration Mount.
3. All round band to be positioned at regular intervals.
4. Mounting height for isolator /terminal box must be adequate to allow for customers incoming cable.
5. Cable/Conduit to be routed away from walkway access (where ever practicable).
6. Cable core which is used for Earthing is to be oversleeved green & yellow (armour cable only).
7. Isolator auxiliary contact is to be wired back to motor starter control circuit (by others).
8. Installed items are described in parts list above.
9. All penetrations through the Air Handling Unit panels are to be adequately sealed.

ROUTE:HELECT	JOB NO. 6707393	UNIT NO. 1	SECT. NO. -	BUBBLE -

AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF

Tel: 01670 713477
Fax: 01670 714370
Telex: 53491

DRAWN BY	DATE
J.M.CAY	13/5/97
CHECKED BY	DATE
J.M.CAY	13/5/97
APPROVED BY	DATE
G.WALKER	13/5/97

TITLE:
ELEC INST. ISOLATOR
(DOL)11kW MOTOR
(XLPE ARMOUR)
DRAKE & SCULL ENGINEERING

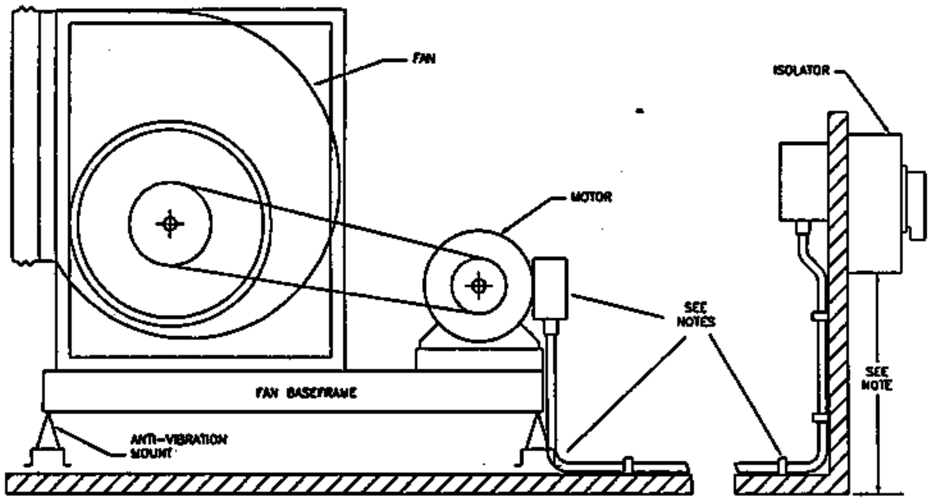
DRAWING No: A3-921268 REV:

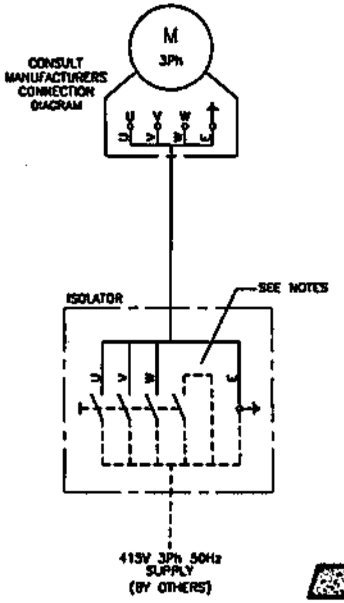
No.OFF:1

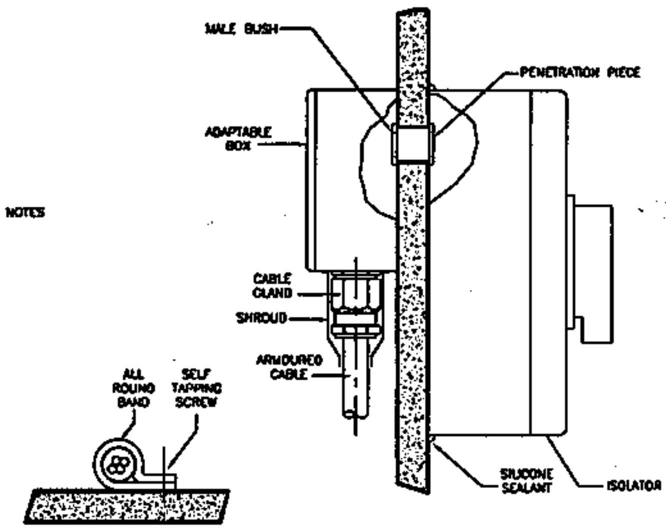
WOR[illegible]RDER NUMBER

[illegible] 1 OF 1

ITEM.	QTY.	DESCRIPTION	MANUF.PART No. OR CAT No.	AAF PART NO.
1	1	Isolator 63A (3 Pole+AUX)	36LB-ENC-AUX	GB-ISO-63A3P
2	1	Adaptable Box (100x100x50)	AB557PB	GB-BOX-100
3	1	Penetration Piece 25mm (PVC)		GB-COU-125
4	1	Male Bush 25mm (PVC)	CMB25	GB-BUS-125
5	4.5M	Cable 4 Core 6mm Xlpe/LSF/SWA/LSF		GB-CAB-4C6
6	2	Cable Gland Hawke 153/RAC/A/20mm	153/RAC/A/20mm	GB-GLA-153A
7	2	Markers Cable Partex PA1/3 U		GB-MAR-013-U
8	2	Markers Cable Partex PA1/3 V		GB-MAR-013-V
9	2	Markers Cable Partex PA1/3 W		GB-MAR-013-W
10	0.50M	Band Cable Perf Block PVC.17mm		GB-BAN-017B
11	5	Crimp Terminal Eyelet 0BA/M6	534-430	GB-CON-134
12	1	Reducer 32-25mm (Galv)		GB-RED-032







Notes:-

1. For actual orientation & position of equipment consult General Arrangement drawing of Air Handling Unit.
2. Surplus length to be left to allow flexing of cable across Anti-Vibration Mount.
3. All round band to be positioned at regular intervals.
4. Mounting height for isolator /terminal box must be adequate to allow for customers incoming cable.
5. Cable/Conduit to be routed away from walkway access (where ever practicable).
6. Cable core which is used for Earthing is to be oversleeved green & yellow (armour cable only).
7. Isolator auxiliary contact is to be wired back to motor starter control circuit (by others).
8. Installed items are described in parts list above.
9. All penetrations through the Air Handling Unit panels are to be adequately sealed.

ROUTE:HELECT | JOB NO. 6707393 | UNIT NO. 1 | SECT. NO. - | BUBBLE -

AAF INTERNATIONAL

AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF
Tel.: 01670 713477
Fax.: 01670 714370
Telex: 53491

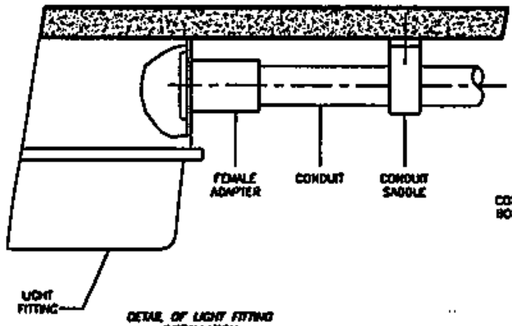
DRAWN BY	J.M.CAY	DATE 13/5/97
CHECKED BY	J.M.CAY	DATE 13/5/97
APPROVED BY	G.WALKER	DATE 13/5/97

TITLE: ELEC INST. ISOLATOR (DOL)15kW MOTOR (XLPE ARMOUR)

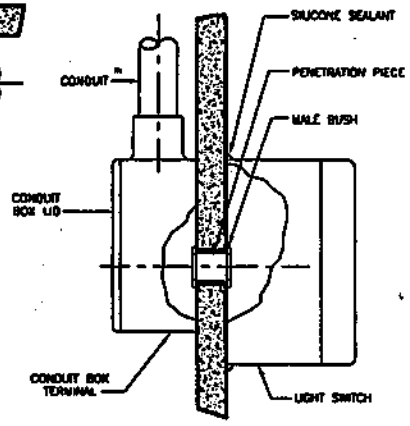
DRAKE & SCULL ENGINEERING

DRAWING No: A3-921269 REV:

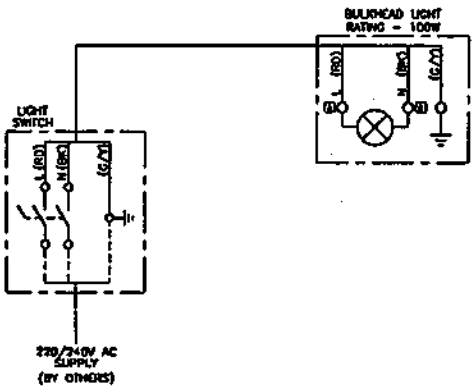
NOTICE: This draw[illegible] the property of AAF-Ltd and is loaned subject to the condition that is shall not be reproduced, copied, loaned or submitted to outside parties for examination without written consent.



DETAIL OF LIGHT FITTING INSTALLATION



DETAIL OF LIGHT SWITCH AND PANEL PENETRATION



No.OFF:4

WORK ORDER [illegible]BER

SHT 1 OF 1

ITEM.	QTY.	DESCRIPTION	MANUF.PART No. OR CAT No.	AAF PART NO.
1	1	Bulkhead light	TL1005SS	GB-LIG-005
2	1	Tungsten lamp 240v 100w ES		GB-LAM-250
3	1	Light switch	GW26212	GB-SWI-677
4	1Length	Conduit heavy gauge 20mm (PVC)	HG20	GB-CON-008
5	1	Conduit ADAPTER 20mm (PVC)		GB-ADA-020
6	4	Conduit saddle spacer bar 20mm (Steel)	SB20	GB-SAD-021
7	1	Conduit male bush 20mm (PVC)	CMB20	GB-BUS-120
8	1	Conduit box terminal 20mm (PVC)	20CRB2	GB-BOX-021
9	1	Conduit box circular lid (PVC)	CCL1	GB-BOX-022
10	2	Conduit box screw(M4x10mmL)		GB-SCR-0410PHZP
11	1	Penetration piece 20mm (PVC)		GB-COU-120
12	4M	Cable 1 core 1.5mm PVC Ins (Red)	6491X	GB-CAB-019R
13	4M	Cable 1 core 1.5mm PVC Ins (Black)	6491X	GB-CAB-019
14	4M	Cable 1 core 1.5mm PVC Ins (Grn/Yel)	6491X	GB-CAB-019-GY
15	2	Flat.blade.crimp.connect.18mmLx1.5-2.5	IBL2.5-18	GB-CON-951

Notes:-

1. For actual orientation & position of equipment consult General Arrangement drawing of Air Handling Unit.
2. With eddison screw lamp holders the neutral connection must be connected to the cap.i.e.terminal.N
3. Conduit must be supported every 750mm (max) and at bend.
4. Cables within the light fitting are to be over sleeved with heat resistant sleeving supplied.
5. All Pvc conduit joints are to be bonded with adhesive.
6. All GALV conduit exposed edges & threads must be coated with Galvacoat.
7. Installed items are described in parts list above.
8. All penetrations through the Air Handling Unit panels are to be adequately sealed.

ROUTE:HELECT	JOB NO. 6707393	UNIT NO. 1	SECT. NO. -	BUBBLE -

AAF INTERNATIONAL

AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF

Tel.: 01670 713477
Fax.: 01670 714370
Telex: 53481

DRAWN BY	J.M.CAY	DATE 12/8/97
CHECKED BY	J.M.CAY	DATE 12/8/97
APPROVED BY	G.WALKER	DATE 12/8/97

TITLE:
ELEC INST/WIRING DIAGRAM
SINGLE BULKHEAD LIGHT FITTING
(PVC CONDUIT)

DRAKE & SCULL ENGINEERING

DRAWING No: A3-921345

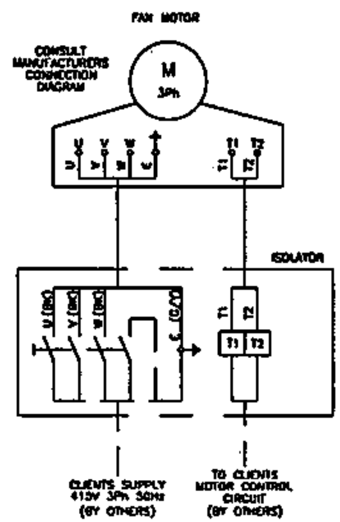
REV:

No.OFF:2

WORK ORDER NUMBER

SHT 1 OF 1

ITEM.	QTY.	DESCRIPTION	MANUF.PART No. OR CAT No.	AAF PART NO.
1	8M	Cable 2 core 1.5mm XLPE/LSF/SWA/LSF		GB-CAB-2C1.5
2	2	Cable gland hawke 153/RAC/O/20mm		GB-GLA-1530
3	1	Terminal block-2 way (Melamine)	425-853	GB-BLO-010
4	4	Flat.blade.crimp.connect.18mmLx1.5-2.5	IBL2.5-18	GB-CON-951
5	4	Markers.cable.partex.PA1/3 T		GB-MAR-013-T
6	2	Markers.cable.No1		GB-MAR-013-1
7	2	Markers.cable.No.2		GB-MAR-013-2
8	0.50M	Band.cable.perf.Black PVC.17mm		GB-BAN-017B



Notes:-

1. For actual orientation & position of equipment consult General Arrangement drawing of Air Handling Unit.
2. Surplus length to be left to allow flexing of cable across Anti-Vibration Mount.
3. All round band to be positioned at regular intervals.
4. Mounting height for isolator /terminal box must be adequate to allow for customers incoming cable.
5. Cable/Conduit to be routed away from walkway access (where ever practicable).
6. Cable core which is used for Earthing is to be oversleeved green & yellow (armour cable only).
7. Isolator auxiliary contact is to be wired back to motor starter control circuit (by others).
8. Installed items are described in parts list above.
9. All penetrations through the Air Handling Unit panels are to be adequately sealed.

ROUTE:HELECT	JOB NO. 6707393	UNIT NO. 1	SECT. NO. –	BUBBLE –

AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF

Tel.: 01670 713477
Fax.: 01670 714370
Telex: 53401

DRAWN BY	DATE
J.M.CAY	7/4/97
CHECKED BY	DATE
J.M.CAY	7/4/97
APPROVED BY	DATE
G.WALKER	7/4/97

TITLE:
THERMISTOR
ARRANGEMENT
(XLPE ARMOUR CABLE)

DRAKE & SCULL ENGINEERING

DRAWING No: A3-921358

REV:

AAF INTERNATIONAL

Electrical Keysheet

(Order to shop)

EKS-6707393-2 | Rev:

Issued by: John Wright

Date: 2nd September 1998

	(G)	(1)	(3)	(2)	(5)	(N)	(4)	(6)	(A)	(7)					
Issue To:	Client (code 1)	Works MFAS Parts	Works Easdale Parts	Works MFAS Weld	Works Easdale Weld	Works MFAS Fit	Works Easdale Fit	Works MFAS Paint	Works Easdale Paint	Kit	Packing	archive	HEMS PCD	HVAC Inspect	Project Engineer (see below)	Total Number of Copies

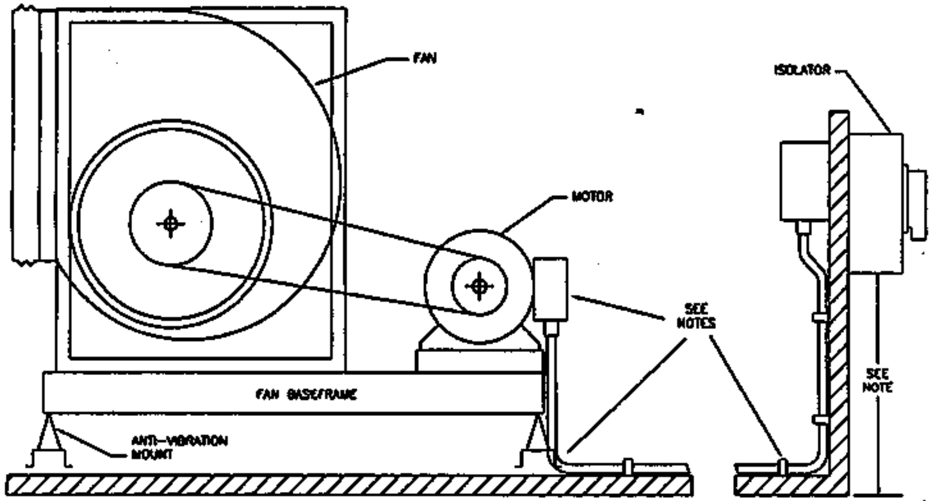
Issue To:	Client (code 1)	Works MFAS Parts	Works Easdale Parts	Works MFAS Weld	Works Easdale Weld	Works MFAS Fit	Works Easdale Fit	Works MFAS Paint	Works Easdale Paint	Kit	Packing	archive	HEMS PCD	HVAC Inspect	Project Engineer (see below)	Total Number of Copies
Prints	3			-			1									4
Plastics																

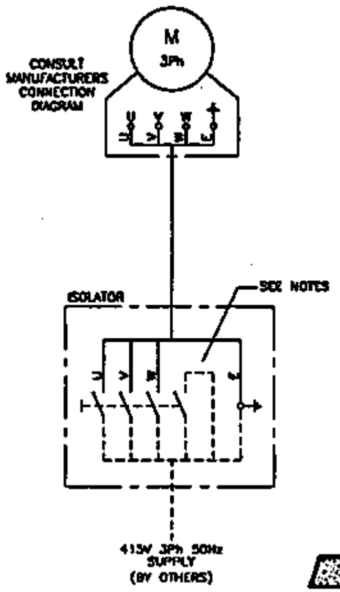
Other:

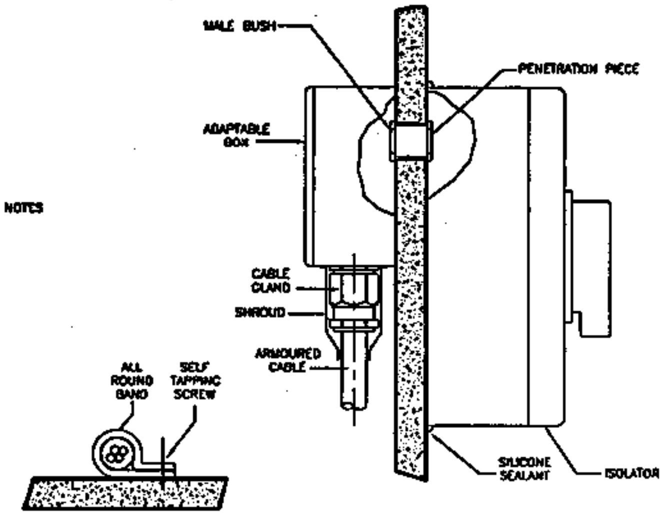
Project Eng: M.CHRISTIE

Revisions	

AAF Unit No.	Clients Reference	Quantities Unit	Quantities Total	Drawing Description	Drawing No.	Cost Allocation Code	Shop Order No.	Schedule Dates (Week No.) Parts	Weld	Paint	Kit	Fitting
2	AHU 2	1	1	15KW (DOL) MOTOR ISOLATOR INSTALLATION XLPE CABLE	A3-921269						39	40
				C/W THERMISTORS	A3-921358							
		1	1	11KW (DOL) MOTOR ISOLATOR INSTALLATION XLPE CABLE	A3-921268						39	40
				C/W THERMISTORS	A3-921358							
		4	4	SINGLE BULKHEAD LIGHT INSTALLATION (PVC)	A3-921345						39	40







No.OFF:1

WOR' RDER NUMBER

SH 1 OF 1

ITEM.	QTY.	DESCRIPTION	MANUF.PART No. OR CAT No.	AAF PART NO.
1	1	Isolator 63A (3 Pole+AUX)	36LB-ENC-AUX	GB-ISO-63A3P
2	1	Adaptable Box (100x100x50)	AB557PB	GB-BOX-100
3	1	Penetration Piece 25mm (PVC)		GB-COU-125
4	1	Male Bush 25mm (PVC)	CMB25	GB-BUS-125
5	4.5M	Cable 4 Core 6mm Xlpe/LSF/SWA/LSF		GB-CAB-4C6
6	2	Cable Gland Hawke 153/RAC/A/20mm	153/RAC/A/20mm	GB-GLA-153A
7	2	Markers Cable Partex PA1/3 U		GB-MAR-013-U
8	2	Markers Cable Partex PA1/3 V		GB-MAR-013-V
9	2	Markers Cable Partex PA1/3 W		GB-MAR-013-W
10	0.50M	Band Cable Perf Black PVC.17mm		GB-BAN-017B
11	5	Crimp Terminal Eyelet 0BA/M6	534-430	GB-CON-134
12	1	Reducer 32-25mm (Galv)		GB-RED-032

Notes:-

1. For actual orientation & position of equipment consult General Arrangement drawing of Air Handling Unit.
2. Surplus length to be left to allow flexing of cable across Anti-Vibration Mount.
3. All round band to be positioned at regular intervals.
4. Mounting height for isolator /terminal box must be adequate to allow for customers incoming cable.
5. Cable/Conduit to be routed away from walkway access (where ever practicable).
6. Cable core which is used for Earthing is to be oversleeved green & yellow (armour cable only).
7. Isolator auxiliary contact is to be wired back to motor starter control circuit (by others).
8. Installed items are described in parts list above.
9. All penetrations through the Air Handling Unit panels are to be adequately sealed.

ROUTE:HELECT | JOB NO. 6707393 | UNIT NO. 2 | SECT. NO. - | BUBBLE -

AAF INTERNATIONAL

AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF
Tel.: 01670 713477
Fax.: 01670 714370
Telex: 53481

DRAWN BY	J.M.CAY	DATE 13/5/97
CHECKED BY	J.M.CAY	DATE 13/5/97
APPROVED BY	G.WALKER	DATE 13/5/97

TITLE: ELEC INST. ISOLATOR (DOL)15kW MOTOR (XLPE ARMOUR)

DRAKE & SCULL ENGINEERING

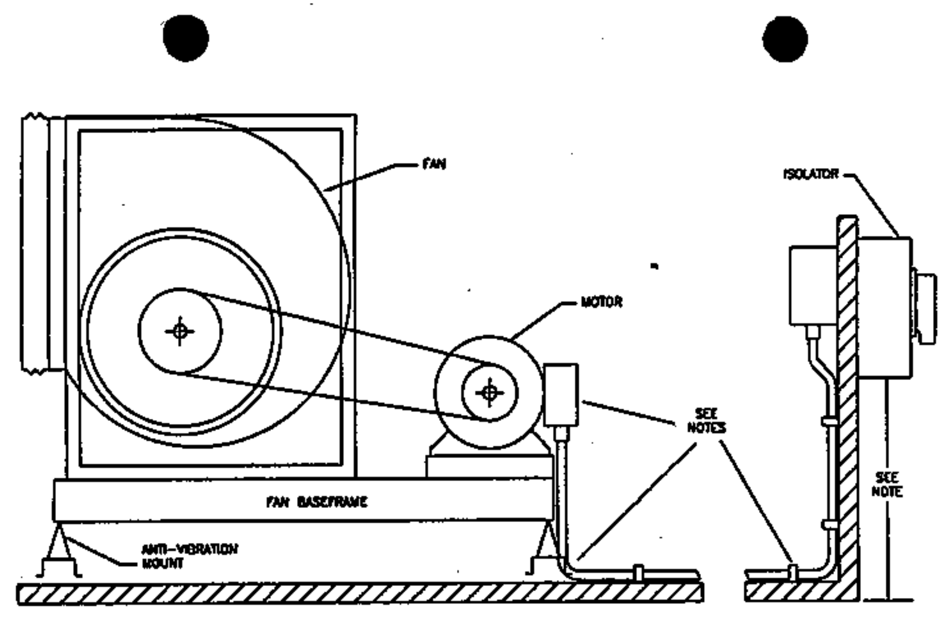
DRAWING No: A3-921269

REV:

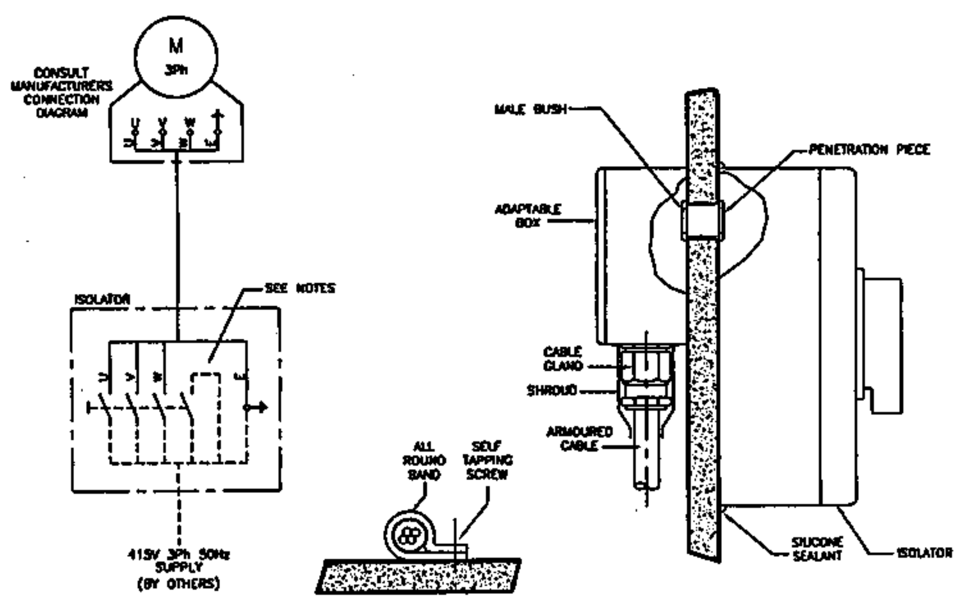
No.OFF:1

WORK ORDER NUMBER

SHT 1 OF 1



ITEM.	QTY.	DESCRIPTION	MANUF.PART No. OR CAT No.	AAF PART NO.
1	1	Isolator 63A (3 Pole+Aux)	M02.G63.31	GB-ISO-63A3P
2	1	Adaptable Box (100x100x50)	AB557PB	GB-BOX-100
3	1	Penetration Piece 20mm (PVC)		GB-COU-120
4	1	Male Bush 20mm (PVC)	CMB 20	GB-BUS-120
5	4.50M	Cable 4 Core 4mm XLPE/LSF/SWA/LSF		GB-CAB-4C4
6	2	Cable Gland Hawke 153/RAC/A/20mm	153/RAC/A/20mm	GB-GLA-153A
7	0.25L	Heat Shrink Sleeving G/Y (6.4/3.2)	398-076	GB-SLE-6.4
8	2	Markers Cable Partex PA1/3 U		GB-MAR-013-U
9	2	Markers Cable Partex PA1/3 V		GB-MAR-013-V
10	2	Markers Cable Partex PA1/3 W		GB-MAR-013-W
11	0.50M	Band.Cable.Perf.Black PVC.17mm		GB-BAN-017B
12	3	Flat Blade Crimp Connector 10mmLx6mm	IBL6-10	GB-CON-6-F
13	5	Crimp Terminal Eyelet 0BA/M6	534-430	GB-CON-134
14	1	Reducer 32-20mm (Galv)		GB-RED-032A



Notes:-

1. For actual orientation & position of equipment consult General Arrangement drawing of Air Handling Unit.
2. Surplus length to be left to allow flexing of cable across Anti-Vibration Mount.
3. All round band to be positioned at regular intervals.
4. Mounting height for isolator /terminal box must be adequate to allow for customers incoming cable.
5. Cable/Conduit to be routed away from walkway access (where ever practicable).
6. Cable core which is used for Earthing is to be oversleeved green & yellow (armour cable only).
7. Isolator auxiliary contact is to be wired back to motor starter control circuit (by others).
8. Installed items are described in parts list above.
9. All penetrations through the Air Handling Unit panels are to be adequately sealed.

ROUTE:HELECT	JOB NO. 6707393	UNIT NO. 2	SECT. NO. -	BUBBLE -

AAF INTERNATIONAL
AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF
Tel.: 01670 713477
Fax: 01670 714370
Telex: 55481

DRAWN BY J.M.CAY	DATE 13/5/97	
CHECKED BY J.M.CAY	DATE 13/5/97	
APPROVED BY G.WALKER	DATE 13/5/97	

TITLE: ELEC INST. ISOLATOR (DOL)11kW MOTOR (XLPE ARMOUR)

DRAKE & SCULL ENGINEERING

DRAWING No: A3-921268

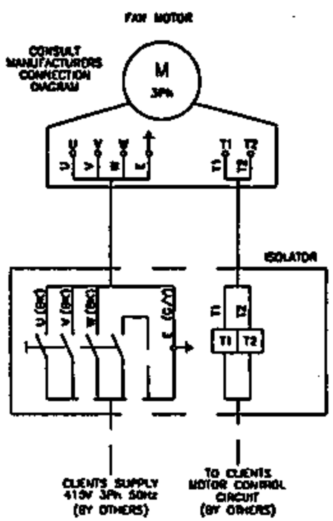
REV:

No.OFF:2

WORK ORDER NUMBER

SHT 1 OF 1

ITEM.	QTY.	DESCRIPTION	MANUF.PART No. OR CAT No.	AAF PART NO.
1	8M	Cable 2 core 1.5mm XLPE/LSF/SWA/LSF		GB-CAB-2C1.5
2	2	Cable gland hawke 153/RAC/0/20mm		GB-GLA-1530
3	1	Terminal block-2 way (Melamine)	425-853	GB-BLO-010
4	4	Flat.blade.crimp.connect.18mmLx1.5-2.5	IBL2.5-18	GB-CON-951
5	4	Markers.cable.partex.PA1/3 T		GB-MAR-013-T
6	2	Markers.cable.No1		GB-MAR-013-1
7	2	Markers.cable.No.2		GB-MAR-013-2
8	0.50M	Band.cable.perf.Black PVC.17mm		GB-BAN-017B



Notes:-

1. For actual orientation & position of equipment consult General Arrangement drawing of Air Handling Unit.
2. Surplus length to be left to allow flexing of cable across Anti-Vibration Mount.
3. All round band to be positioned at regular intervals.
4. Mounting height for isolator /terminal box must be adequate to allow for customers incoming cable.
5. Cable/Conduit to be routed away from walkway access (where ever practicable).
6. Cable core which is used for Earthing is to be oversleeved green & yellow (armour cable only).
7. Isolator auxiliary contact is to be wired back to motor starter control circuit (by others).
8. Installed items are described in parts list above.
9. All penetrations through the Air Handling Unit panels are to be adequately sealed.

ROUTE:HELECT	JOB NO. 6707393	UNIT NO. 2	SECT. NO. -	BUBBLE -

AAF INTERNATIONAL

AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF

Tel.: 01670 713477
Fax.: 01670 714370
Telex: 53481

DRAWN BY J.M.CAY	DATE 7/4/97
CHECKED BY J.M.CAY	DATE 7/4/97
APPROVED BY G.WALKER	DATE 7/4/97

TITLE: THERMISTOR ARRANGEMENT (XLPE ARMOUR CABLE)

DRAKE & SCULL ENGINEERING

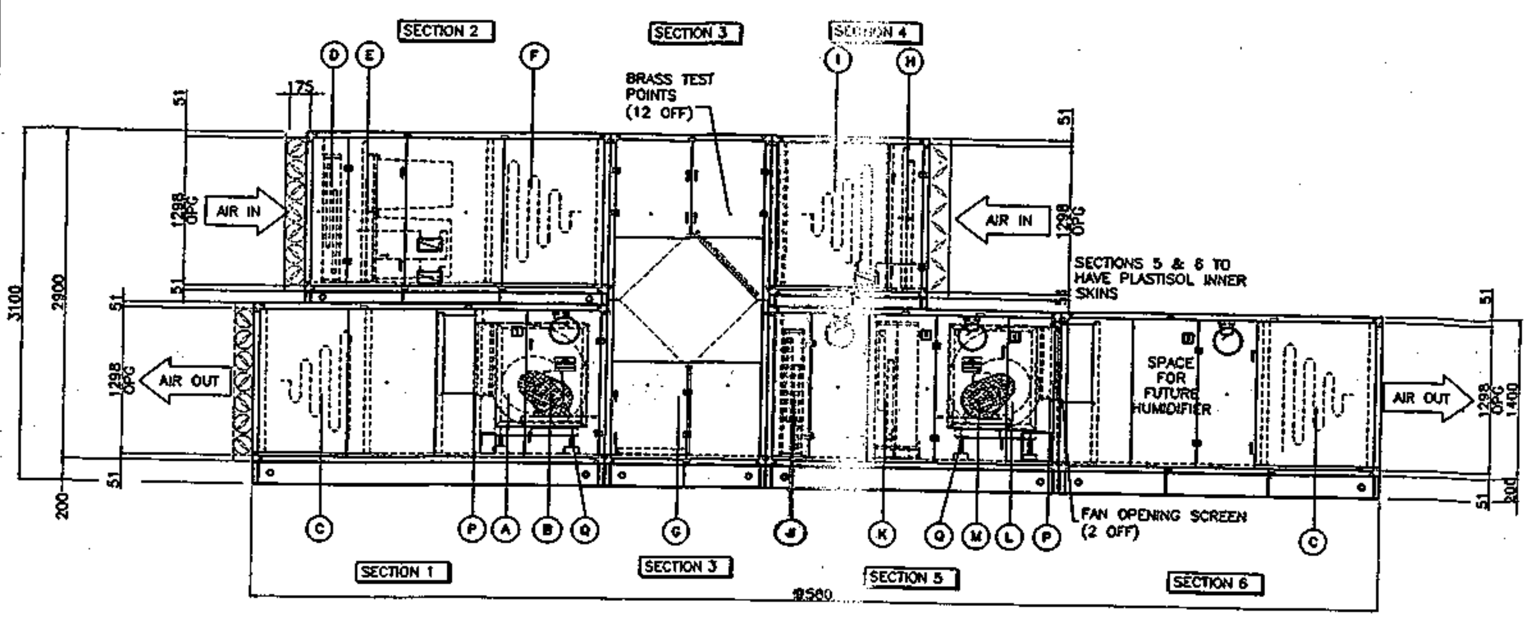
DRAWING No: A3-921358

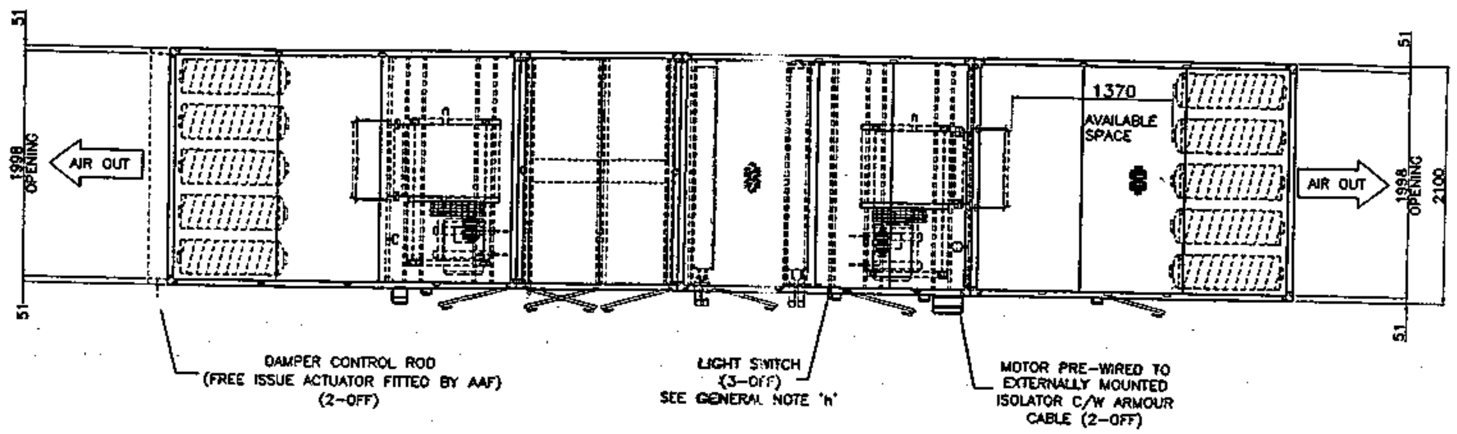
REV:

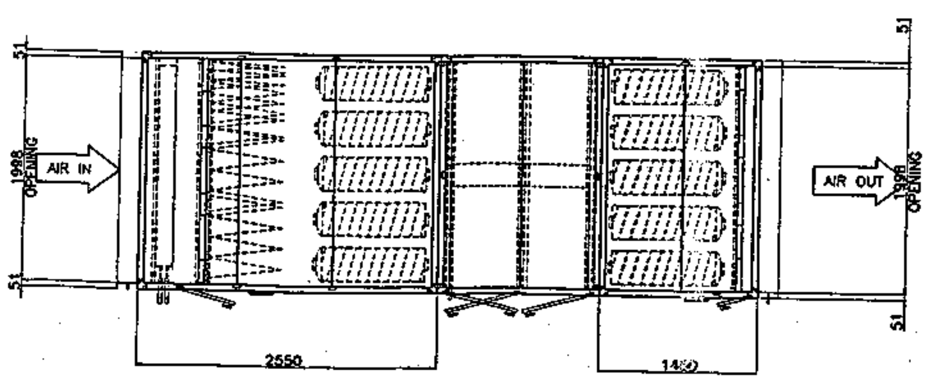
SECTION 19

G.A.DRAWINGS

NOT TO BE SCALED IF IN DOUBT ASK







NOTE:-
1).SECTION'S 5 & 6 TO HAVE PLASTISOL INNER SKINS THIS SECTION ONLY.
2).ALL DOORS TO HAVE HANDLE THAT LOCK.
3).NAMEPLATE TO BE FITTED TO UNIT LISTING T.B.A
4).ALL CONTROL DEVICES INCLUDING DAMPER MOTORS TO BE SUPPLIED BY SYNCHONISED SYSTEMS & FITTED TO CLIENTS SPECIFICATIONS . CONTROL DEVICES TO BE FITTED BY CLIENT AT McQUAY WORKS

TECHNICAL SPECIFICATION

ITEM	DESCRIPTION	DETAILS
A	FAN EXTRACT	FAN MODEL RDN 500 – K IMPELLER TYPE BC AIR FLOW 4.85 m^3/s: 500 Pa ESP: 1037 Pa FSP SPEED 2022 rpm: ABS. POWER 7.93 kW FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K SOUND POWER LEVEL (db) 93 93 93 87 86 83 77 72 VOLUME CONTROL N/A FINISH STANDARD SHAFT GUARDS N/A CASING STANDARD INLET GUARDS FITTED INSPECTION DOOR FITTED DRAIN PLUG FITTED STAINLESS STEEL SHAFT N/A SPARK MINIMISING FEATURES N/A
B	DRIVE MOTOR	RATING 11.0 kW: FRAME SIZE WD160M TYPE TEFV F.L. SPEED 1470 rpm: SUPPLY 400V 3Ph 50Hz FULL LOAD CURRENT 21 amps: WINDING TYPE – STARTING CURRENT 161 amps: STARTING METHOD D.O.L. THERMISTER FITTED YES SPARE DRIVE BELTS 1 SET EPOXY PAINT FINISH N/A ENERGY EFFICIENT N/A
C	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
D	HEATING COIL	MODEL 12WH4.1–28Tx1782 FACE VELOCITY 2.55 m/s 1 ROWS: 4 FIN SPACING: Al FINS: Cu TUBES CONNECTIONS SUPPLY 1 1/4BSP: RETURN 1 1/4BSP WATER 1.17 kg/s: WATER PD 7.40 kPa: TOTAL CAPACITY 52.36 kW ENTERING AIR -4.0 °C: LEAVING AIR 5.0 °C ENTERING WATER 82.0 °C: LEAVING WATER 71.0 °C WATER C/W 0 % OF GLYCOL FLANGES N/A BINDER TAPPING POINTS FITTED CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE–
E	POLYSEAL FILTER	FILTERS PART NO W X H OFF DriPak 34-06-825 610 X 508 3 F7(80–85% Efficiency) 31-06-825 610 X 610 2 33-05-825 508 X 610 1 32-04-825 305 X 610 1 NOTE– PRE–FILTERS PART NO W X H OFF Amerglas AMGC8NS/2024 610 X 508 3 G3(80–85% Arrestance) 35-355-05 610 X 610 2 AMGC8NS/2024 508 X 610 1 AMGC8NS/1224 305 X 610 1 NOTE–
F	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
G	HEAT CUBE	SIZE 085H CODE NV-085/L-199.4 BMK 47.0 SUPPLY FLOWRATE 4.4 m^3/s: EXHAUST FLOWRATE 4.85 m^3/s: SUPPLY AIR ON -4.0 °C SUPPLY AIR OFF 10.8 °C EXHAUST AIR ON 22.0 °C HEAT RECOVERY 86.9 kW EFFICIENCY 57.0 % MATERIALS OF CONSTRUCTION STANDARD BYPASS MIDDLE DRAIN PAN Standard DRAIN CONNECTION 1" NOTE – –
H	FLATBANK FILTER	FILTERS PART NO W X H OFF Amerglas AMGC8NS/2024 610 X 508 3 G3(80–85% Arrestance) 35-355-05 610 X 610 2 AMGC8NS/2024 508 X 610 1 AMGC8NS/1224 305 X 610 1 NOTE–
I	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
J	HEATING COIL	MODEL 12WH5.1–28Tx1782 FACE VELOCITY 2.55 m/s 1 ROWS: 5 FIN SPACING: Al FINS: Cu TUBES CONNECTIONS SUPPLY 1 1/2BSP: RETURN 1 1/2BSP WATER 1.94 kg/s: WATER PD 14.15kPa: TOTAL CAPACITY 87.30 kW ENTERING AIR 5.0 °C: LEAVING AIR 20.0 °C ENTERING WATER 82.0 °C: LEAVING WATER 71.0 °C WATER C/W 0 % OF GLYCOL FLANGES N/A BINDER TAPPING POINTS FITTED CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE–
K	COOLING COIL	MODEL 12WF7.3–28Tx1782 FACE VELOCITY 2.55 m/s 3 ROWS: 7 FIN SPACING Al FINS: Cu TUBES CONNECTIONS SUPPLY 2" BSP: RETURN 2" BSP WATER 3.64 kg/s: WATER PD 23.07 kPa: TOTAL CAPACITY 76.36 kW ENTERING AIR 28.0 °CDB 19.0 °CWB: LEAVING AIR 16.5 °CDB 14.6 °CWB: ENTERING WATER 7.0 °C: LEAVING WATER 12.0 °C: WATER C/W 0 % OF GLYCOL FLANGES: N/A MOISTURE ELIMINATOR FITTED DRAIN PAN SSTL304 DRAIN CONNECTION SIZE 1" BSP BINDER TAPPING POINTS FITTED CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE–
L	FAN SUPPLY	FAN MODEL RDN 500 – K IMPELLER TYPE BC AIR FLOW 4.85 m^3/s: 500 Pa ESP: 1384 Pa FSP SPEED 2204 rpm: ABS. POWER 10.01 kW FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K SOUND POWER LEVEL (db) 95 95 94 88 87 85 78 73 VOLUME CONTROL N/A FINISH STANDARD SHAFT GUARDS N/A CASING STANDARD INLET GUARDS FITTED INSPECTION DOOR FITTED DRAIN PLUG FITTED STAINLESS STEEL SHAFT N/A SPARK MINIMISING FEATURES N/A
M	DRIVE MOTOR	RATING 15.0 kW: FRAME SIZE WD160L TYPE TEFV F.L. SPEED 1470 rpm: SUPPLY 400V 3Ph 50Hz FULL LOAD CURRENT 28 amps: WINDING TYPE – STARTING CURRENT 216 amps: STARTING METHOD D.O.L THERMISTER FITTED YES SPARE DRIVE BELTS 1 SET EPOXY PAINT FINISH N/A ENERGY EFFICIENT N/A
N	HUMIDIFIER	MODEL T.B.A. SPACE FOR FUTURE HUMIDIFIER CONTROL STEAM DUTY Kg/hr DISTRIBUTER PIPES ELECTRICAL SUPPLY 415v 3Ph 50Hz NOTE–
O	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
P	FLEXIBLE CONNECTION	MATERIAL NCA/6 by ISL NEOPRENE COATED FIBREGLASS CONFORMS TO BS.476 Parts 7 and 6
Q	AVM's	MAKE ISL TYPE SPRING No REQUIRED 4
R	FINISH	FRAMES – GREY to BS-4800 10-A-07 PANELS OUTER SKIN :– Goosewing grey BS-4904 10-A-05 PANELS INNER SKIN :– Galvenised mild steel
S	INSULATION	ALL PANELS DOUBLE SKINNED 50 THICK
T	GENERAL NOTES (ONLY IF APPLICABLE)	a) FULL UNIT WIDTH CLEARANCE REQ'D FOR FAN & COIL REMOVAL. b) 650mm CLEARANCE REQUIRED AT ACCESS SIDE OF FILTER SECTION FOR FILTER REMOVAL. c) CARE MUST BE TAKEN WHEN PIPING-UP TO ENSURE THAT NO WEIGHT IS PLACED UPON THE COIL CONNECTIONS. d) NO LOADS FROM CLIENTS DUCTWORK TO BE IMPOSED ON UNIT e) EACH SECTION SHIPPED LOOSE AND JOINED TOGETHER BY CLIENT USING CHANNELS HARDWARE AND SELF ADHESIVE TAPE. (ALL SUPPLIED BY McQuay Int.). f) INLET AND OUTLET FLANGES UNDRILLED . FOR RECOMMENDED DUCTWORK FIXING DETAILS SEE DRAWING No. A2-252070 g) CABLE PENETRATIONS SHOULD BE VIA HOLES CUT IN THE PANELS & MUST BE SEALED WITH A SUITABLE MASTIC / GROMMET AFTER THE CABLE HAS BEEN CLIPPED AND GLANDED. h) A 240V AC SUPPLY IS REQUIRED FOR EACH LIGHT SWITCH (FUSE PROTECTION BY OTHER) j) ESTIMATED SHIPPING WEIGHT = 3995 kg ESTIMATED OPERATING WEIGHT =4043 kg (INCLUDING WATER WEIGHT)

SHIPPED LOOSE ITEMS

FILTER MEDIA
SECTION TO SECTION CHANNELS AND HARDWARE

THE ABOVE FITTED AT SITE BY OTHERS

SECTION NO	LENGTH	WEIGHT
1	2580	964 Kgs
2	2550	658 Kgs
3	1410	552 Kgs
4	1450	399 Kgs
5	2470	828 Kgs
6	2720	591 Kgs

REVISION	DESCRIPTION	DRAWN BY / DATE	CHECKED BY / DATE
E	SECTION 4 LENGHT REVISED LENGHT WAS 1330	J.H 17/09/98	M.L 17/09/98
D	SECTION HEIGHT DIM REVISED ON SECTION 6	J.H 17/09/98	M.L 17/09/98
C	NOTE 1 REVISED. PLASTISOL WAS ONLY SECTION 6 TEST POINTS & FAN OPENING SCREENS ADDED	J.H 10/09/98	M.L 10/09/98
B	INLET DAMPER ADDED TO SECTION 4 NOTE 4 REVISED .ITEM K TEC SPEC REVISED FOR ELIMINATOR INLET GUARDS & SPARE BELTS ADDED	J.H 08/09/98	M.L 08/09/98
A	ELIMINATOR ADDED TO ITEM K .ITEM T NOTE G REVISED NOTES 3 & 4 ADDED .TECHNICAL SPEC REVISED FOR ITEM G DIMENSION ADDED TO PLAN VIEW FOR HUMIDIFIER SPACE	J.H 04/08/98	M.L 04/08/98

MILLIMETRES 0 10 100 150

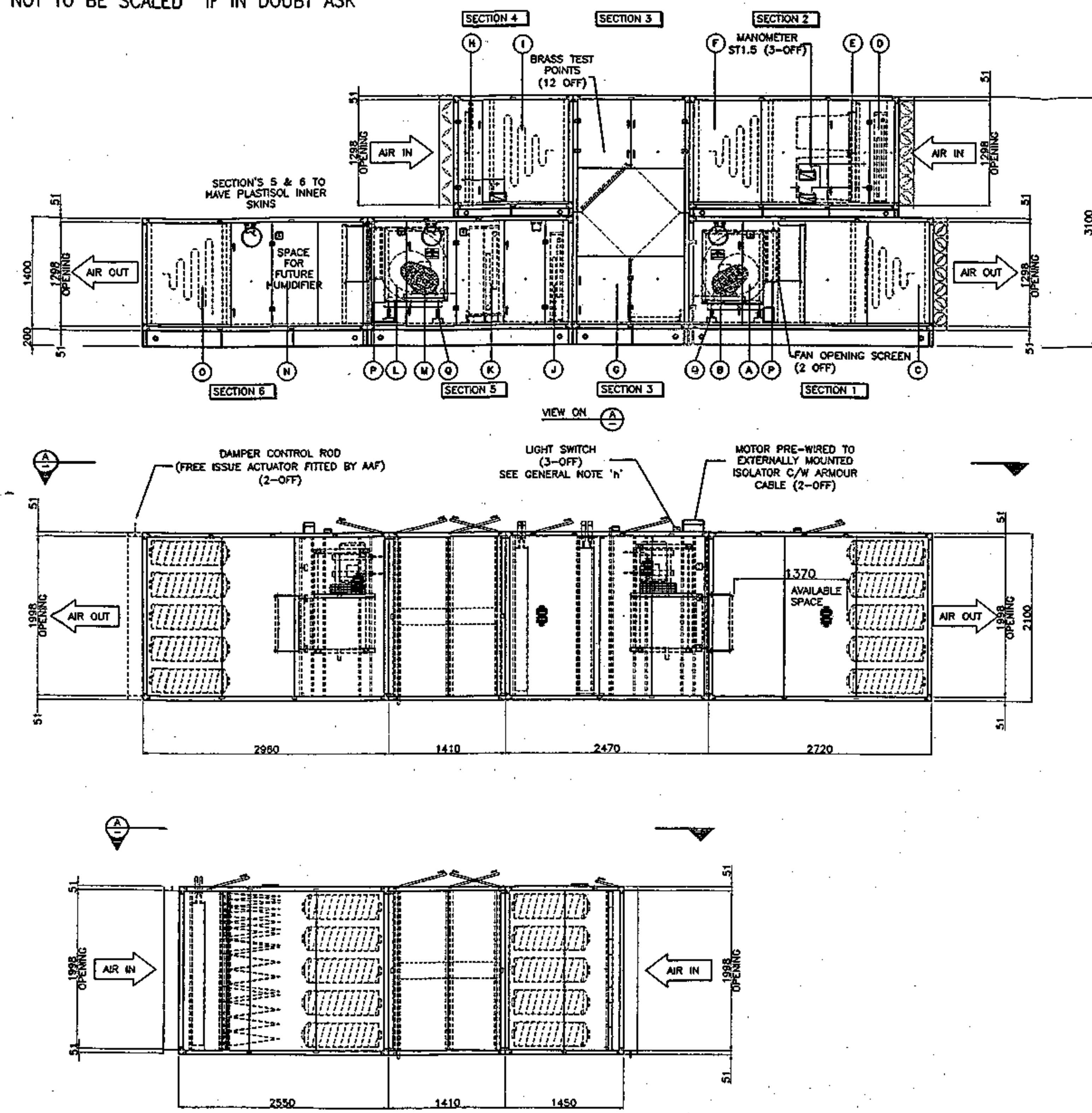
TITLE GENERAL ARRANGEMENT OF AIR HANDLING UNIT

UNIT SIZE – EVA-140*210
CLIENT – DRAKE &SCULL ENGINEERING
CLIENT'S TAGGING – AHU No. 2–West Basement
AAF TAGGING UNIT No. 02
PROJECT:– 5–7 Carlton Gardens.

McQuay International

SCALE 1: 33.3
DRAWN BY M.LYON DATE 22/08/98
CHECKED BY DATE
APPROVED BY DATE
FIRST ORDER NUMBER 6707393
DRAWING NUMBER -A1- 6707393/02/GA REV E

NOT TO BE SCALED IF IN DOUBT ASK



NOTE:-
1).SECTION'S 5 & 6 TO HAVE PLASTISOL INNER SKINS THIS SECTION ONLY.
2).ALL DOORS TO HAVE HANDLE THAT LOCK.
3).NAMEPLATE TO BE FITTED TO UNIT LISTING T.B.A
4).ALL CONTROL DEVICES INCLUDING DAMPER MOTORS TO BE SUPPLIED BY SYNCHONISED SYSTEMS & FITTED TO CLIENTS SPECIFICATIONS , CONTROL DEVICES TO BE FITTED BY CLIENT AT McQUAY WORKS

TECHNICAL SPECIFICATION

ITEM	DESCRIPTION	DETAILS
A	FAN EXTRACT	FAN MODEL RDN 500 – K IMPELLER TYPE BC AIR FLOW 4.85 m^3/s: 500 Pa ESP: 1037Pa FSP SPEED 2022 rpm: ABS. POWER 7.93 kW FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K SOUND POWER LEVEL (db) 93 93 93 87 86 83 77 72 VOLUME CONTROL N/A FINISH STANDARD SHAFT GUARDS N/A CASING STANDARD INLET GUARDS FITTED INSPECTION DOOR FITTED DRAIN PLUG FITTED STAINLESS STEEL SHAFT N/A SPARK MINIMISING FEATURES N/A
B	DRIVE MOTOR	RATING 11.0 kW: FRAME SIZE WD160M TYPE TEFV F.L. SPEED 1470 rpm: SUPPLY 400V 3Ph 50Hz FULL LOAD CURRENT 21 amps: WINDING TYPE – STARTING CURRENT 161 amps: STARTING METHOD D.O.L THERMISTER FITTED YES SPARE DRIVE BELTS 1 SET EPOXY PAINT FINISH N/A ENERGY EFFICIENT N/A
C	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
D	HEATING COIL	MODEL 12WH4.1–28Tx1782 FACE VELOCITY 2.55 m/s 1 ROWS: 4 FIN SPACING: Al FINS: Cu TUBES CONNECTIONS SUPPLY 1 1/4BSP: RETURN 1 1/4BSP WATER 1.17 kg/s: WATER PD 7.40 kPa: TOTAL CAPACITY 52.38 kW ENTERING AIR –4.0 °C: LEAVING AIR 5.0 °C ENTERING WATER 82.0 °C: LEAVING WATER 71.0 °C WATER C/W 0 % OF GLYCOL FLANGES N/A BINDER TAPPING POINTS FITTED CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE–
E	POLYSEAL FILTER	FILTERS / PART NO / W X H / OFF DriPak 34–06–825 610 X 508 3 F7(80–85% Efficiency) 31–08–825 610 X 610 2 33–05–825 508 X 610 1 32–04–825 305 X 610 1 NOTE– PRE–FILTERS / PART NO / W X H / OFF Amerglas AMGC8NS/2024 610 X 508 3 G3(80–85% Arrestance) 35–355–05 610 X 610 2 AMGC8NS/2024 508 X 610 1 AMGC8NS/1224 305 X 610 1 NOTE–
F	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
G	HEAT CUBE	SIZE 085N CODE NV–085/L–199.4 BMK 47.0 SUPPLY FLOWRATE 4.4 m^3/s: EXHAUST FLOWRATE 4.85 m^3/s: SUPPLY AIR ON –4.0 °C SUPPLY AIR OFF 10.8 °C EXHAUST AIR ON 22.0 °C HEAT RECOVERY 86.9 kW EFFICIENCY 57.0 % MATERIALS OF CONSTRUCTION STANDARD BYPASS MIDDLE DRAIN PAN Standard DRAIN CONNECTION 1" NOTE – –
H	FLATBANK FILTER	FILTERS / PART NO / W X H / OFF Amerglas AMGC8NS/2024 610 X 508 3 G3(80–85% Arrestance) 35–355–05 610 X 610 2 AMGC8NS/2024 508 X 610 1 AMGC8NS/1224 305 X 610 1 NOTE–
I	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
J	HEATING COIL	MODEL 12WH5.1–28Tx1782 FACE VELOCITY 2.55 m/s 1 ROWS: 5 FIN SPACING: Al FINS: Cu TUBES CONNECTIONS SUPPLY 1 1/2BSP: RETURN 1 1/2BSP WATER 1.94 kg/s: WATER PD 14.15kPa: TOTAL CAPACITY 67.30 kW ENTERING AIR 5.0 °C: LEAVING AIR 20.0 °C ENTERING WATER 82.0 °C: LEAVING WATER 71.0 °C WATER C/W 0 % OF GLYCOL FLANGES N/A BINDER TAPPING POINTS FITTED CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE–
K	COOLING COIL	MODEL 12WF7.3–28Tx1782 FACE VELOCITY 2.55 m/s 3 ROWS: 7 FIN SPACING Al FINS: Cu TUBES CONNECTIONS SUPPLY 2" BSP: RETURN 2" BSP WATER 3.64 kg/s: WATER PD 23.07 kPa: TOTAL CAPACITY 76.38 kW ENTERING AIR 28.0 °CDB 19.0 °CWB: LEAVING AIR 16.5 °CDB 14.6 °CWB: ENTERING WATER 7.0 °C: LEAVING WATER 12.0 °C: WATER C/W 0 % OF GLYCOL FLANGES: N/A MOISTURE ELIMINATOR FITTED DRAIN PAN SSTL304 DRAIN CONNECTION SIZE 1" BSP BINDER TAPPING POINTS FITTED CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE–
L	FAN SUPPLY	FAN MODEL RDN 500 – K IMPELLER TYPE BC AIR FLOW 4.85 m^3/s: 500 Pa ESP: 1384Pa FSP SPEED 2204 rpm: ABS. POWER 10.01 kW FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K SOUND POWER LEVEL (db) 95 95 94 88 87 85 78 73 VOLUME CONTROL N/A FINISH STANDARD SHAFT GUARDS N/A CASING STANDARD INLET GUARDS FITTED INSPECTION DOOR FITTED DRAIN PLUG FITTED STAINLESS STEEL SHAFT N/A SPARK MINIMISING FEATURES N/A
M	DRIVE MOTOR	RATING 15.0 kW: FRAME SIZE WD160L TYPE TEFV F.L. SPEED 1470 rpm: SUPPLY 400V 3Ph 50Hz FULL LOAD CURRENT 28 amps: WINDING TYPE – STARTING CURRENT 216 amps: STARTING METHOD D.O.L THERMISTER FITTED YES SPARE DRIVE BELTS 1 SET EPOXY PAINT FINISH N/A ENERGY EFFICIENT N/A
N	HUMIDIFIER	MODEL TBA SPACE FOR FUTURE HUMIDIFIER CONTROL STEAM DUTY Kg/hr DISTRIBUTER PIPES ELECTRICAL SUPPLY 415v 3Ph 50Hz NOTE–
O	SILENCER	SILENCER LENGTH 900 mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE– Tissue faced complete with perforated plate
P	FLEXIBLE CONNECTION	MATERIAL NCA/6 by ISL NEOPRENE COATED FIBREGLASS CONFORMS TO BS.476 Parts 7 and 8
Q	AVM's	MAKE ISL TYPE SPRING No REQUIRED 4
R	FINISH	FRAMES – GREY to BS–4800 10–A–07 PANELS OUTER SKIN :– Goosewing grey BS–4904 10–A–05 PANELS INNER SKIN :– Galvanised mild steel
S	INSULATION	ALL PANELS DOUBLE SKINNED 50 THICK
T	GENERAL NOTES (ONLY IF APPLICABLE)	a) FULL UNIT WIDTH CLEARANCE REQ'D FOR FAN & COIL REMOVAL. b) 650mm CLEARANCE REQUIRED AT ACCESS SIDE OF FILTER SECTION FOR FILTER REMOVAL. c) CARE MUST BE TAKEN WHEN PIPING–UP TO ENSURE THAT NO WEIGHT IS PLACED UPON THE COIL CONNECTIONS. d) NO LOADS FROM CLIENTS DUCTWORK TO BE IMPOSED ON UNIT e) EACH SECTION SHIPPED LOOSE AND JOINED TOGETHER BY CLIENT USING CHANNELS HARDWARE AND SELF ADHESIVE TAPE. (ALL SUPPLIED BY McQuay Int.). f) INLET AND OUTLET FLANGES UNDRILLED . FOR RECOMMENDED DUCTWORK FIXING DETAILS SEE DRAWING No. A2–252070 g) CABLE PENETRATIONS SHOULD BE VIA HOLES CUT IN THE PANELS & MUST BE SEALED WITH A SUITABLE MASTIC / GROMMIT AFTER THE CABLE HAS BEEN CLIPPED AND GLANDED. h) A 240V AC SUPPLY IS REQUIRED FOR EACH LIGHT SWITCH (FUSE PROTECTION BY OTHER) j) ESTIMATED SHIPPING WEIGHT = 3995 kg ESTIMATED OPERATING WEIGHT =4043 kg (INCLUDING WATER WEIGHT)

SECTION NO	LENGTH	WEIGHT
1	2960	964 Kgs
2	2550	656 Kgs
3	1410	552 Kgs
4	1450	309 Kgs
5	2470	828 Kgs
6	2720	591 Kgs

SHIPPED LOOSE ITEMS

FILTER MEDIA
SECTION TO SECTION CHANNELS AND HARDWARE
DRIVE BELTS
THE ABOVE FITTED AT SITE BY OTHERS

REVISION	DESCRIPTION	DRAWN BY / DATE	CHECKED BY / DATE
D	SECTION 2 DIM REVISED WAS 2522 LG	J.H 17/09/98	M.L 17/09/98
C	NOTE 1 REVISED. PLASTISOL WAS ONLY SECTION 6 TEST POINTS & FAN OPENING SCREENS ADDED	J.H 10/09/98	M.L 10/09/98
B	INLET DAMPER ADDED TO SECTION 4 NOTE 4 REVISED INLET GUARDS & SPARE BELTS ADDED	J.H 08/09/98	M.L 08/09/98
A	ELIMINATOR ADDED TO ITEM K .ITEM T NOTE G REVISED NOTES 3 & 4 ADDED .TECHNICAL SPEC REVISED FOR ITEM G DIMENSION ADDED TO PLAN VIEW FOR HUMIDIFIER SPACE	J.H 04/08/98	M.L 04/08/98

MILLIMETRES 0 10 100 150

TITLE GENERAL ARRANGEMENT OF AIR HANDLING UNIT

UNIT SIZE – EVA–140*210 AAF TAGGING UNIT No. 01
CLIENT – DRAKE & SCULL ENGINEERING
CLIENT'S TAGGING – AHU No.1 East Basement PROJECT:– 5–7 Carlton Gardens.

McQuay International

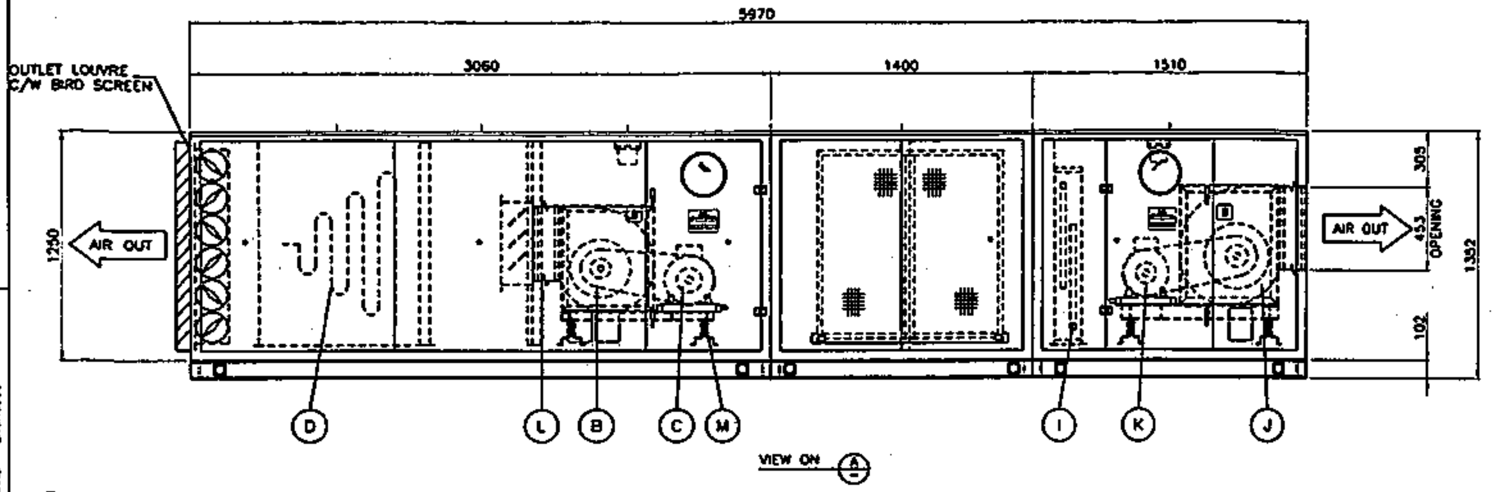
SCALE 1: 33.3
DRAWN BY M.LYON DATE 22/08/98
CHECKED BY P.M DATE 22/08/98
APPROVED BY DATE

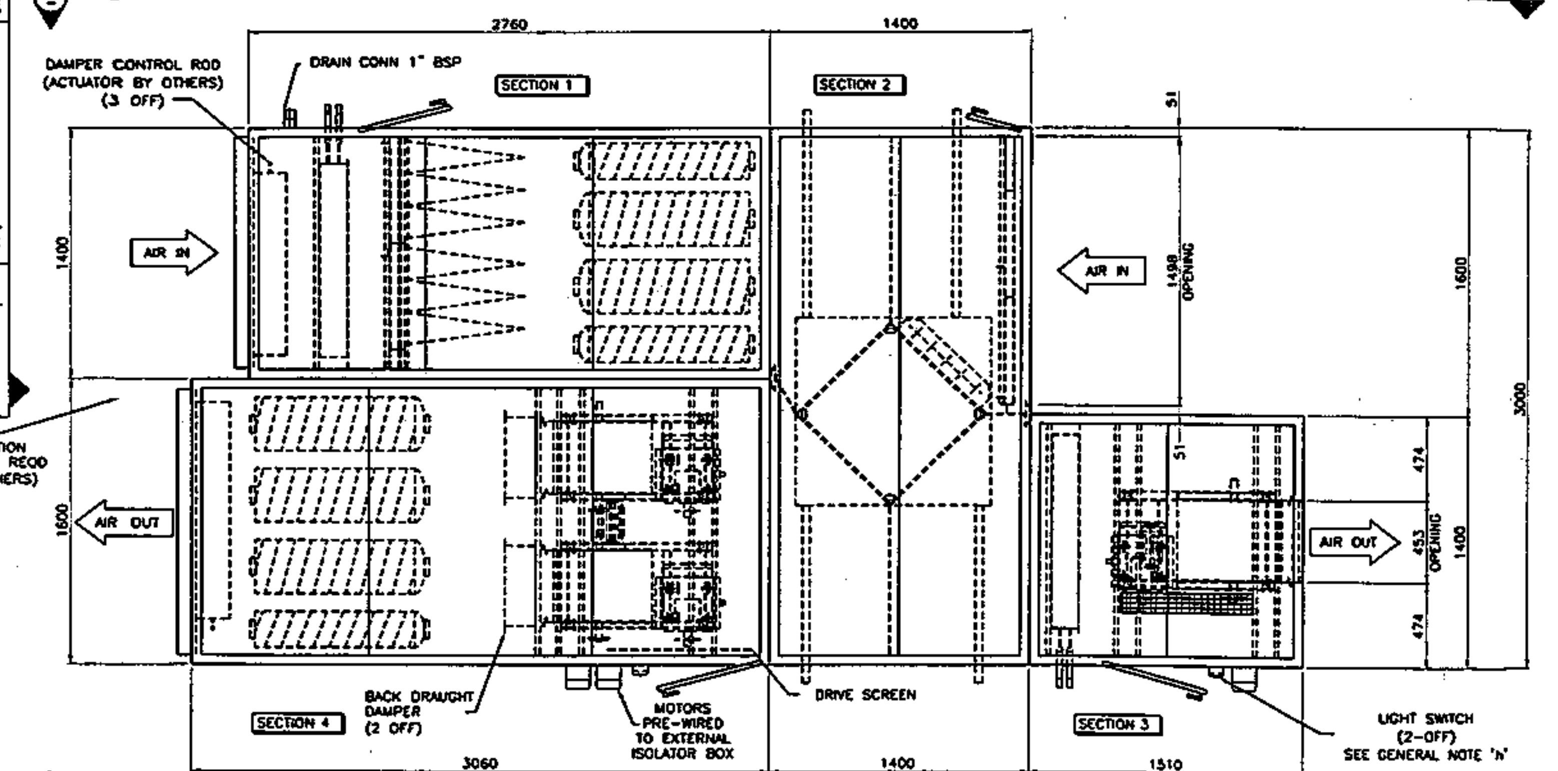
FIRST ORDER NUMBER 6707393
DRAWING NUMBER -A1- 6707393/01/GA REV D

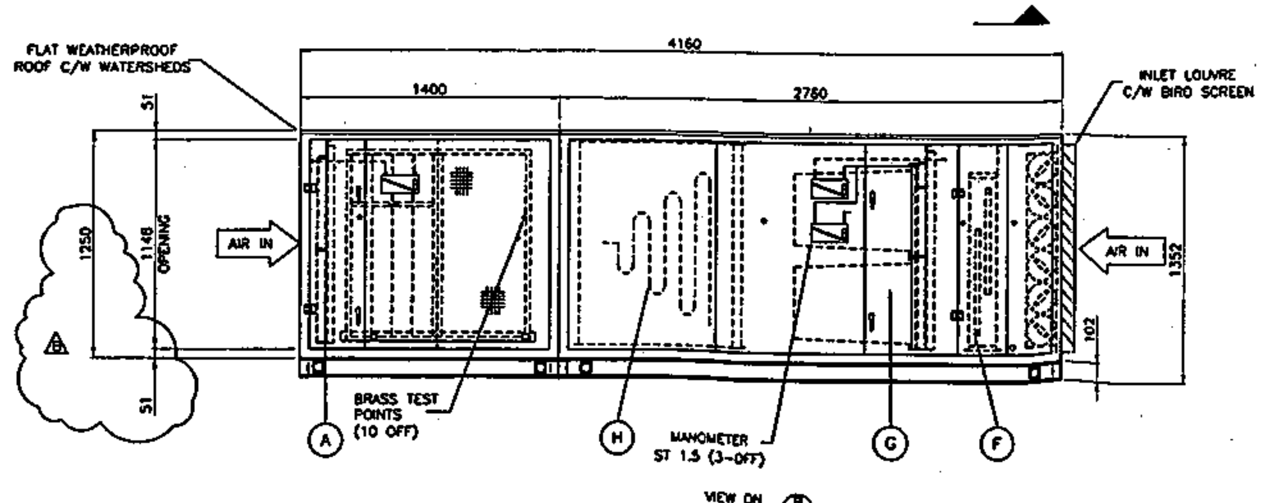
TOLERANCES UNLESS OTHERWISE STATED PART AND FABRICATION TOLERANCES TO BE IN ACCORDANCE WITH AAF–LTD'S STANDARD ENGR0030

FIRST ANGLE PROJECTION

NOT TO BE SCALED IF IN DOUBT ASK







K	DRIVE MOTOR	RATING 5.5 kW: FRAME SIZE WD132SA TYPE TEFV F.L. SPEED 2900 rpm: SUPPLY 415V 3Ph 50Hz FULL LOAD CURRENT 9.8 amps: WINDING TYPE SINGLE STARTING CURRENT 80.5 amps: STARTING METHOD D.O.L. THERMISTER FITTED YES SPARE DRIVE BELTS 1 EPOXY PAINT FINISH N/A ENERGY EFFICIENT N/A
L	FLEXIBLE CONNECTION	MATERIAL NCA/6 by ISL NEOPRENE COATED FIBREGLASS CONFORMS TO BS.476 Parts 7 and 8
M	AVM's	MAKE ISL TYPE SPRING No REQUIRED 4
N	FINISH	FRAMES - GREY to BS-4800 10-A-07 PANELS OUTER SKIN :- Goosewing grey BS-4904 10-A-05 PANELS INNER SKIN :- Galvanised mild steel
O	INSULATION	ALL PANELS DOUBLE SKINNED 50 THICK
P	GENERAL NOTES (ONLY IF APPLICABLE)	a) FULL UNIT WIDTH CLEARANCE REQ'D FOR FAN & COIL REMOVAL. b) 650mm CLEARANCE REQUIRED AT ACCESS SIDE OF FILTER SECTION FOR FILTER REMOVAL. c) CARE MUST BE TAKEN WHEN PIPING-UP TO ENSURE THAT NO WEIGHT IS PLACED UPON THE COIL CONNECTIONS. d) NO LOADS FROM CLIENTS DUCTWORK TO BE IMPOSED ON UNIT e) EACH SECTION SHIPPED LOOSE AND JOINED TOGETHER BY CLIENT USING CHANNELS HARDWARE AND SELF ADHESIVE TAPE. (ALL SUPPLIED BY McQuay Int.). f) INLET AND OUTLET FLANGES UNDRILLED . FOR RECOMMENDED DUCTWORK FIXING DETAILS SEE DRAWING No. A2-252070 g) CABLE PENETRATIONS SHOULD BE VIA HOLES CUT IN THE PANELS & MUST BE SEALED WITH A SUITABLE MASTIC AFTER THE CABLE HAS BEEN CLIPPED AND GLANDED. h) A 240V AC SUPPLY IS REQUIRED FOR EACH LIGHT SWITCH (FUSE PROTECTION BY OTHER) j) ESTIMATED SHIPPING WEIGHT = 2341 kg ESTIMATED OPERATING WEIGHT =2350 kg (INCLUDING WATER WEIGHT)

SHIPPED LOOSE ITEMS

FILTER MEDIA
SECTION TO SECTION CHANNELS AND HARDWARE
CAPPING STRIP & HARDWARE
THE ABOVE FITTED AT SITE BY OTHERS

NOTE:-
1).ALL DOORS TO HAVE HANDLE THAT LOCK. AND RESTRAINT ON ALL DOORS
2).NAMEPLATE TO BE FITTED TO UNIT LISTING T.B.A
3).ALL CONTROL DEVICES INCLUDING DAMPER MOTORS TO BE SUPPLIED BY SYNCHONISED SYSTEMS & FITTED TO CLIENTS SPECIFICATIONS . CONTROL DEVICES TO BE FITTED BY CLIENT AT McQUAY WORKS

SECTION NO	LENGTH	WEIGHT
1	2700	548 Kgs
2	1400	507 Kgs
3	1510	399 Kgs
4	3060	887 Kgs

WEATHERPROOF CONSTRUCTION

TECHNICAL SPECIFICATION

ITEM	DESCRIPTION	DETAILS
A	FLATBANK FILTER	FILTERS PART NO W X H OFF Amerglas AMGCBNS/2024 610 X 508 4 G3(80-85% Arrestance) NOTE- 3 SPARE SETS OF MEDIA SUPPLIED
B	FAN EXTRACT (2 OFF)	FAN MODEL RDN 315 - K IMPELLER TYPE BC AIR FLOW 2.35 m^3/s: 500 Pa ESP: 988 Pa FSP SPEED 3554 rpm: ABS. POWER 4.40 kW FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K SOUND POWER LEVEL (db) 89 89 92 91 87 83 79 73 VOLUME CONTROL N/A FINISH STANDARD SHAFT GUARDS N/A CASING STANDARD INLET GUARDS Yes INSPECTION DOOR FITTED DRAIN PLUG FITTED STAINLESS STEEL SHAFT N/A SPARK MINIMISING FEATURES N/A
C	DRIVE MOTOR	RATING 5.5 kW: FRAME SIZE WD132SA TYPE TEFV F.L. SPEED 2900 rpm: SUPPLY 415V 3Ph 50Hz FULL LOAD CURRENT 9.8 amps: WINDING TYPE SINGLE STARTING CURRENT 80.5 amps: STARTING METHOD D.O.L. THERMISTER FITTED YES SPARE DRIVE BELTS 1 EPOXY PAINT FINISH N/A ENERGY EFFICIENT N/A
D	SILENCER	SILENCER LENGTH 900mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE- Tissue faced complete with perforated plate
E	HEAT CUBE	SIZE 719 x 1050 x 719 CODE FV-075/W105.0 BSK29.0.L SUPPLY FLOWRATE 2.35 m^3/s EXHAUST FLOWRATE 2.35 m^3/s SUPPLY AIR ON -5°C SUPPLY AIR OFF 7.9°C EXHAUST AIR ON 22 °C EFFICIENCY 48 % MATERIALS OF CONSTRUCTION ALUMINIUM / GALVANISED PLATE NOTE -
F	HEATING COIL	MODEL 12WH4.1-24Tx1082 FACE VELOCITY 2.38 m/s 1 ROWS: 4 FIN SPACING: Al FINS: Cu TUBES CONNECTIONS SUPPLY 1" BSP: RETURN 1" BSP WATER 0.62 kg/s: WATER PD 6.80 kPa: TOTAL CAPACITY 25.38 kW ENTERING AIR -4.0 °C: LEAVING AIR 5.0 °C ENTERING WATER 82.0 °C: LEAVING WATER 72.0 °C WATER C/W 0 % OF GLYCOL FLANGES N/A BINDER TAPPING POINTS YES CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE-
G	POLYSEAL FILTER	FILTERS PART NO W X H OFF DriPak 34-06-825 610 X 508 4 F7(80-85% Efficiency) NOTE- 3 SPARE SETS OF MEDIA SUPPLIED PRE-FILTERS PART NO W X H OFF Amerglas AMGCBNS/2024 610 X 508 4 G3(80-85% Arrestance) NOTE- 3 SPARE SETS OF MEDIA SUPPLIED
H	SILENCER	SILENCER LENGTH 900mm Tissue(std) FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K INSERTION LOSS (db) 8 12 21 30 39 38 27 23 NOTE- Tissue faced complete with perforated plate
I	HEATING COIL	MODEL 12WH5.1-24Tx1082 FACE VELOCITY 2.38 m/s 1 ROWS: 5 FIN SPACING: Al FINS: Cu TUBES CONNECTIONS SUPPLY 1 1/4BSP: RETURN 1 1/4BSP WATER 1.04 kg/s: WATER PD 5.75 kPa: TOTAL CAPACITY 42.30 kW ENTERING AIR 5.0 °C: LEAVING AIR 20.0 °C ENTERING WATER 82.0 °C: LEAVING WATER 72.0 °C WATER C/W 0 % OF GLYCOL FLANGES N/A BINDER TAPPING POINTS YES CASEWORK FINISH STANDARD GMS CASEWORK ON COILS NOTE-
J	FAN SUPPLY	FAN MODEL RDN 355 - K IMPELLER TYPE BC AIR FLOW 2.35 m^3/s: 400 Pa ESP: 1041 Pa FSP SPEED 2816 rpm: ABS. POWER 3.73 kW FREQUENCY (Hz) 63 125 250 500 1K 2K 4K 8K SOUND POWER LEVEL (db) 85 85 89 88 83 79 76 69 VOLUME CONTROL N/A FINISH STANDARD SHAFT GUARDS N/A CASING STANDARD INLET GUARDS Yes INSPECTION DOOR FITTED DRAIN PLUG FITTED STAINLESS STEEL SHAFT N/A SPARK MINIMISING FEATURES N/A

REVISION	DESCRIPTION	DRAWN BY / DATE	CHECKED BY / DATE
B	DIMENSION WAS 1260 AND 61 NOW 1250 &51	M.L 21/01/99	J.H 21/01/99
A	ITEM 'C', TECHNICAL SPECIFICATION REVISED .THERMISTERS ADDED SPARE SET OF DRIVE BELTS ADDED	J.H 15/12/98	M.L 15/12/98

MILLIMETRES 0 10 100 150

TITLE GENERAL ARRANGEMENT OF AIR HANDLING UNIT

UNIT TYPE - EVA125*160
CLIENT - DRAKE & SCULL ENG
CLIENT'S TAGGING - AHU 3
AAF TAGGING UNIT No. UNIT 3
PROJECT:- 5-7 Charlton Gardens

McQuay International

SCALE	1:20	
DRAWN BY J.Hogg	DATE 04/11/98	
CHECKED BY M.Lyon	DATE 04/11/98	
APPROVED BY M.C	DATE 04/11/98	

AAF JOB NUMBER 6707393
DRAWING NUMBER REV B
-A1-6707393/03/GA

SECTION 20

COSHH DATA

COSHH INFORMATION MANAGEMENT SYSTEM

Substance Report

Substance: Baxenden RES Resin **Code:** 6B2
Description: RES is the Resin Component of Isofoam RM124 two part polyutherane foam production system.

Packaging Type: 205 litre drums **Physical Form:** Liquid

Manufacturers Address Bexanden Chemicals Ltd.
Paragon Works
Accrington
Lancs.
BB5 2SL

Telephone Number: 01254 872278

Hazard Data Sheet Available:	Y	**Carcinogenic:**	N	**CPL Listed:**	N
Harmful:	N	**Corrosive:**	N	**Irritant:**	N
Harmful to Inhale:	Y	**Ingest:**	Y	**CPL Listing:**	Toxic
Eyes, Nose Throat:	Y	**Skin By Absorption:**	Y	**Skin By Contact:**	Y

Hazard Composition: **Exposure Limit:** None

Resins in liquid form: This resin is not particularly dangerous in isolation. It is mixed 50:50 with an Isocyanate to produce foam. Isocyanates need extreme care. When the resultant foam has cured it is safe to handle.

Storage Instructions: Store in a cool place. Keep container tightly closed. Avoid exposure to fire.

Suppliers Recommendations: Will be used with Isocyanate so use appropriate clothing. Boiler suit, PVC gloves, goggles, as required for Isocyanates. Cured foams present very little health hazard. cutting and sanding can produce dust. Wear appropriate goggles and dust masks to eyes, nose and throat from dust infiltration. Dust presents a greater fire hazard than solid material. An efficient extract system should be used and floors etc. regularly cleaned. Do not use direct flame or excessive heat on foam. Do not smoke.

Potential Health Affects:

Resins and cured foams present very little hazard. The precautions and effects described for the Isocyanates should be studied.
INHALATION: Cutting and sanding can produce dust. This is toxicologically inert but can irritate the eyes and linings of the nose and throat.

Emergency Actions:

INHALATION: Remove to fresh air, keep warm and at rest. If effects persist seek medical advice.
FIRE: Resins: Extinguish with CO_2 or dry powder.
Cured foam: Extinguish with water, CO_2 or dry powder. Large scale fires need drenching from sprinklers or fire hoses. Large quantities of toxic smoke will be produced. Self contained breathing apparatus must be worn.

Hazard Identified By AK Walker
Position: Coshh Systems
Company: McQuay International - AAF Ltd.
Department: Safety Dept

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SEE STAND ALONE

MANUAL

24

MAINTENANCE BULLETIN

Supplier

Noico Limited
London Road
Hook
Hampshire RG27 9EQ

Tel: 01256 766207
Fax: 01256 768413

File Reference: 480327

Product

Noise Control Equipment

Comprising

Anti-vibration equipment.

Client:

Drake & Scull Engineering Ltd
Redcliffe House
10 Whitehouse Street
Bedminster
Bristol BS3 4AU

Tel: 0117 966 4631
Fax: 0117 963 7650

Order number: W079943/1215192

Project

Wool House Garden
5-7 Carlton Gardens
London
SW1Y 5AD

MAINTENANCE

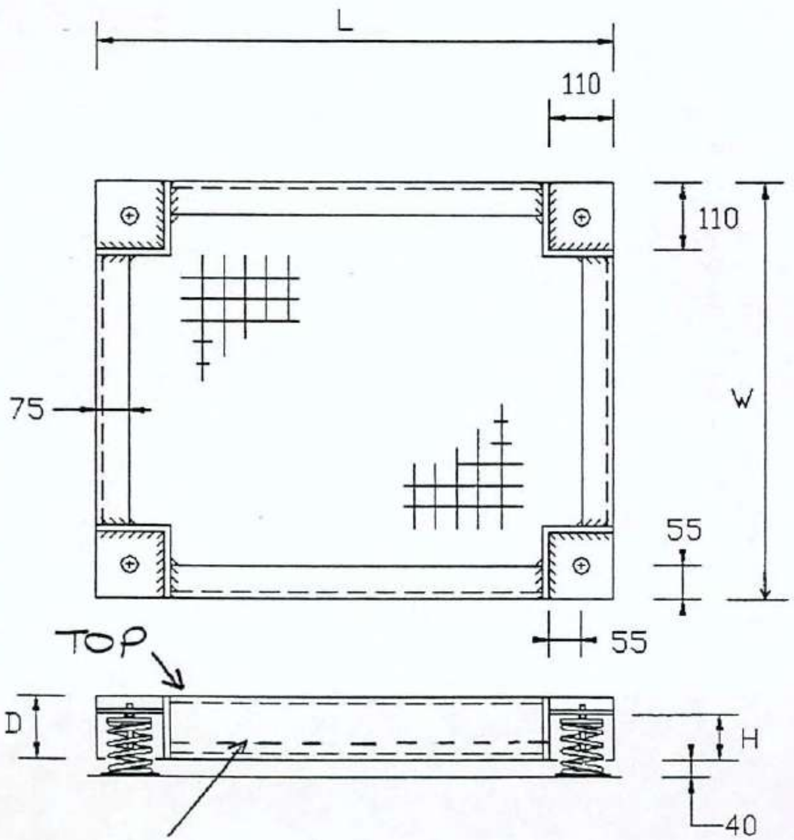
Inertia base frames and anti vibration mountings.

1. As supplied, drawing 680327/IB.1 rev B and 680327/AV.1 rev A.

2. The bases and anti vibration mountings are supplied fully in accordance with the drawings as designated.

3. Once correctly installed the bases and mountings require no maintenance.

NOICO LTD NOISE CONTROL ENGINEERS	INERTIA BASE WITH OPEN SPRING MOUNTS	FILE No. 680327/IB·1
		DATE 08-09-98 REV. B
	CLIENT DRAKE & SCULL ENGINEERING LTD. O/N W079943/1215192	PROJECT 5-7 CARLTON GARDENS



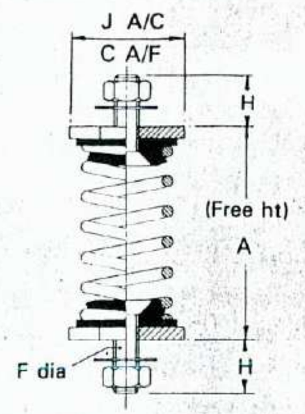
REINFORCING MESH 50mm FROM BOTTOM

ITEM	QTY	W	L	D	H	MOUNTS	REF.
P1	1	1500	1800	200	110	BROWN	P1
P2	1	1200	1500	150	110	ORANGE	P2
P3	1	900	1200	150	110	RED	P3
P4	1	1000	1500	150	110	PURPLE	P4
P5	1	800	1200	150	110	RED	P5
P6	1	800	1200	150	110	RED	P6
P7	1	800	1200	150	110	RED	P7
P8	1	600	1400	150	110	RED	P8
P9	1	700	1600	150	110	RED	P9

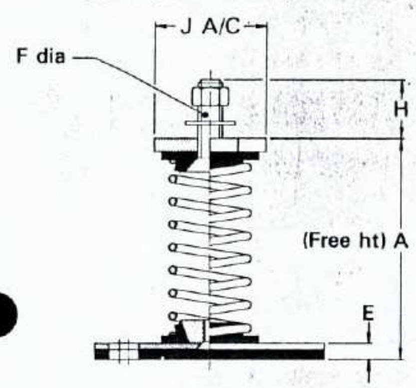
CONCRETE BY OTHERS.

EACH BASE C/W 4 OFF OS25 MOUNTS (COLOUR CODED)

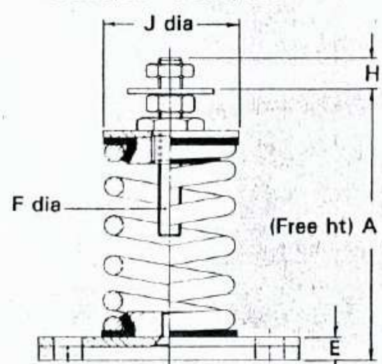
OSB20/10 - OSB15/100

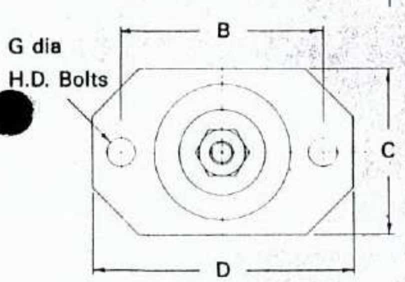


OSS20/10 - OSS15/100

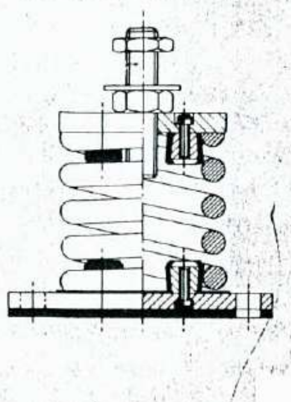


OS25/30 - OS50/500





OS25/650 - OS50/1300



PART No.	COLOUR CODE	RATED LOAD (kg)	DEFLECTION AT RATED LOAD (mm)	DIMENSIONS (mm) A	B	C	D	E	F	G	H	J	WT (kg) Max
OSB20/10	PURPLE	10	20	68	–	32	–	–	M8	–	18	37	0.15
OSB20/15	YELLOW	15	20										
OSB20/20	GREY	20	20										
OSB20/40	GREEN	40	20										
OSB20/70	RED	70	20										
OSB15/100	BLUE	100	15										
OSS20/10	PURPLE	10	20	69	57	38	76	5	M8	M6	18	37	0.2
OSS20/15	YELLOW	15	20										
OSS20/20	GREY	20	20										
OSS20/40	GREEN	40	20										
OSS20/70	RED	70	20										
OSS15/100	BLUE	100	15										
OS25/30	YELLOW	30	25	115	85	70	110	10	M10	M8	20	57	0.9
OS25/60	GREEN	60	30										
OS25/100	BLUE	100	25										
OS25/160	WHITE	160	25										
OS25/250	RED	250	25										
OS25/200	RED	200	25	152	110	90	140	11	M16	M12	27	76	2.6
OS25/300	PURPLE	300	25										
OS25/400	GREY	400	25										
OS25/500	ORANGE	500	25										
OS25/600	BROWN	600	25										
OS25/700	ORANGE/BLACK*	700	25										
OS25/800	BROWN/BLACK*	800	25										
OS50/100	YELLOW	100	50	180	110	90	140	11	M16	M12	27	76	2.4
OS50/200	GREEN	200	50										
OS50/300	BLUE	300	50										
OS50/400	WHITE	400	50										
OS50/500	RED/BLACK	500	50										
OS25/650	YELLOW	650	26	175	165	130	200	18	M20	M16	42	127	7.5
OS25/850	GREEN	850	27										
OS25/1050	BLUE	1050	26										
OS25/1250	WHITE	1250	26										
OS25/1300	RED	1300	27	225	210	150	250	18	M24	M16	51	152	14.0
OS25/1600	PURPLE	1600	25										
OS25/2000	GREY	2000	26										
OS25/2300	BROWN	2300	29										
OS50/510	BLACK/PURPLE	510	51	240	210	150	250	18	M20	M16	42	127	13.0
OS50/760	BLACK/GREY	760	51										
OS50/1000	BLACK/ORANGE	1000	50										
OS50/1300	BLACK/BROWN	1300	53										

*Internal nested spring.

Spring Deflection

- Spring stiffness is linear over its working range therefore the actual deflection for a given load can be calculated as follows:—

$$\text{Actual Deflection (mm)} = \frac{\text{Actual Load (kg)}}{\text{Rated Load (kg)}} \times \text{Rated Deflection (mm)}$$

Isolation Efficiency at Typical Machine Speeds

Machine Speed (rpm)	EFFICIENCY % 15mm DEFL.	25mm DEFL.	50mm DEFL.
300	DO NOT USE	34.0	75.2
500	68.7	83.3	92.3
750	88.1	93.2	96.7
1000	93.7	96.3	98.2
1200	95.5	97.4	98.7
1500	97.3	98.4	99.2
1750	98.0	98.8	99.4
2000	98.5	99.1	99.5

The above figures are theoretical values only based on the vertical natural frequency of the sprung system assuming infinitely stiff structural supports. The effects of high frequency spring coil resonances on low frequency performance are also ignored.

Installation Notes

- Ribbed rubber seating pads should always be used when the mounting is seated on concrete or other rough surfaces.
- When using height adjuster at least 3 full threads should be left protruding below the upper plate.
- All connections to the mounted equipment must include flexible sections offering the maximum practical flexibility to ensure that isolation efficiency is not impaired, also to avoid possible failure of the connections.
- DO NOT use Open Spring Mountings for external applications without independent restraints.
- Surface corrosion is likely without additional protection for external applications.
- For applications where control of transient motion is required, e.g. during start up and run down of large machines, additional mass and viscous dampers may be necessary.

For more detailed information and technical assistance please contact our Applications Engineering Department.

PROJECT:
5-7 CARLTON GARDENS.

REF. 480327/AV.1 revA.

TYPE OS25 MOUNTS.
SEE DRAWING 480327/IB.1

NOICO LTD
NOISE CONTROL ENGINEERS
Tel: 0256 766207
Fax: 0256 768413
LONDON ROAD
HOOK,
BASINGSTOKE RG27 9EQ

25

SEE STAND ALONE

MANUAL

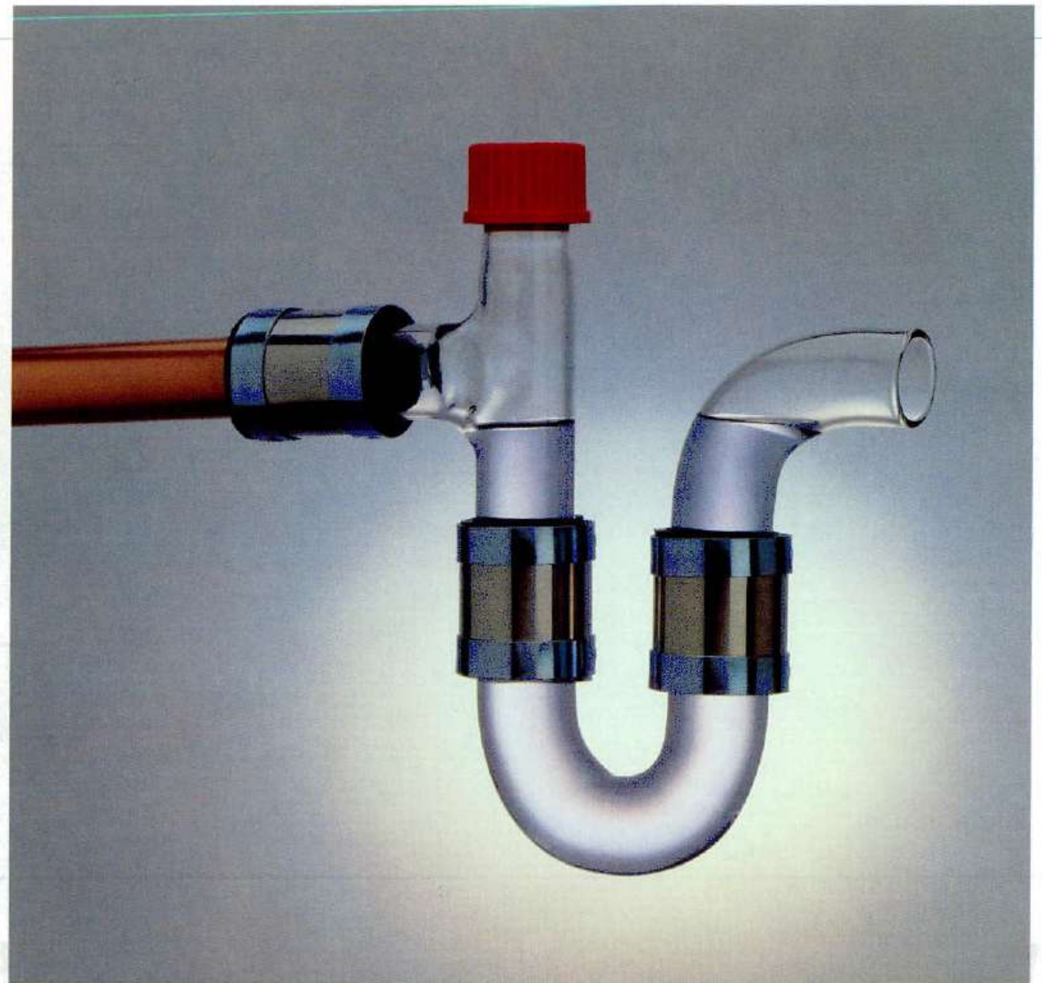
26

SGD

SGD ENGINEERING SERVICES LTD.

Imex Technology Park, Longton Road, Trentham, Stoke-on-Trent ST4 8LJ

Tel: 01782 658877 Fax: 01782 658899



SGD

The SGD Plain End PE™

Borosilicate Glass Trap

& Pipework Systems

AN INTRODUCTION TO PE™ BOROSILICATE GLASS TRAPS & PIPEWORK

DESCRIPTION

Borosilicate Glass Drainage has been utilised in the Air Conditioning Industry, by Hospitals, Office Blocks, Public Buildings and numerous other establishments for many years. It has established its position as the material for the disposal of condensate waste.

The PE™ system incorporates all the traditional features of the existing drainage design with one major facility, transparency, which enables continuous monitoring of the installation and enables a debris-free system to be handed to the client. Maintenance of such an installation being minimal in that blockages which, in themselves are extremely rare, are easily located and cleared.

Itemised below are further characteristics that argue that the PE™ borosilicate glass drainage is second to none.

1. Smooth non-porous surface promote less 'loss of flow velocity' than other materials, inhibiting the build-up of deposits - "K" factor 0.00001.
2. No special fire precautions.
3. Expansion joints are not required due to extremely low coefficient of linear expansion.
4. Resistance of thermal shock is good.
5. No distortion or creep.
6. No material deterioration.
7. No need for special fittings when connecting to other pipework systems.

STANDARDS

The Borosilicate glass drainage conforms to BS 2598 part I and ISO 3585.

APPLICATION

'The System' to convey condensate discharges from air-handling and fan coil units.

COMPOSITION

Borosilicate glass is manufactured from a chemical composition which includes silica, boric oxide, soda and alumina. The system is coupled together by means of a compression coupling, comprising of a stainless steel shell and resilient elastomer.

NOMINAL BORE DIAMETERS

Nominal bore diameters are available in DN20, DN25, DN40 and DN50.

MECHANICAL PROPERTIES

Compressive - 5000 lb/IN² for borosilicate glass

Tensiles - 500 lb/IN² for borosilicate glass

Thermal expansion - Temperature range 0-300°C is 33 x 10^{-7}°C

FIRE RESISTANCE

Borosilicate glass pipes have undergone specific tests carried out by the Fire Research Establishment at Borehamwood, Hertfordshire, the test conditions of BS476 Part 8 being satisfactorily met.

MAINTENANCE

The visual quality of glass enables continuous inspection of the system and instant monitoring of trap seals.

SERVICES

Our Design Department offers a full service on any technical and design queries that may arise. We welcome enquiries for any fitting not shown in our current catalogue. Installation service available. Maintenance service contracts available.

TECHNICAL

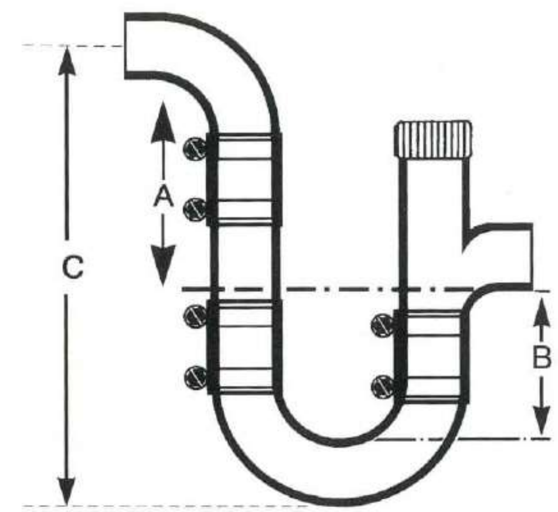
The PE™ plain end form of pipes and fittings, together with the push-fit couplings, provide for speedy installations as well as the ability to make direct connections to other plain end pipework materials.

RECOMMENDATIONS FOR SIZING OF TRAP SEAL DEPTHS

To correctly size condensate traps the following information is required:

- Total static fan pressure (Pascals)
- Position of trap viz, upstream/downstream of fan
- Unit drain size

Detailed below are two examples based upon a total static fan pressure of 2000 and 1500 pascals respectively.



EXAMPLE - NEGATIVE SIDE

Unit total static fan pressure 2000 Pascals
Seal calculated:

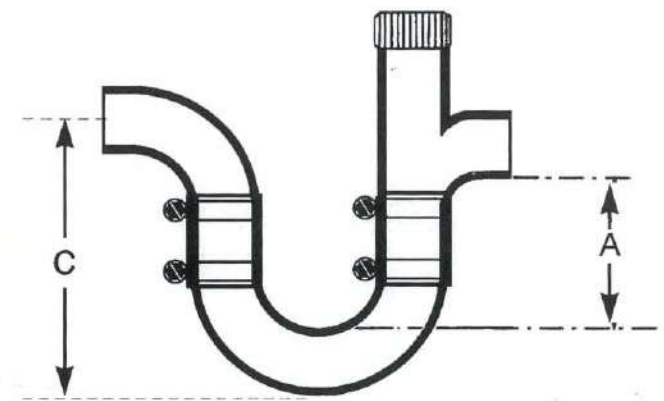
"A" dim = $\frac{2000}{10}$ = **200mm**

"B" dim = Wherever possible should equal "A"
If height restrictions, can accept 50% of "A"

EXAMPLE - POSITIVE SIDE

Unit total static fan pressure 1500 Pascals
Seal calculated:

"A" dim = $\frac{1500}{10}$ x 2 = **300mm**



NB. a) THE ABOVE CALCULATIONS APPLY TO ALL BORE SIZES.
b) IT IS IMPORTANT TO NOTE THAT THERE IS A MINIMUM SEAL DEPTH WE CAN ACHIEVE - SEE CATALOGUE INFORMATION.

EXAMPLE GLASS TRAP SCHEDULE

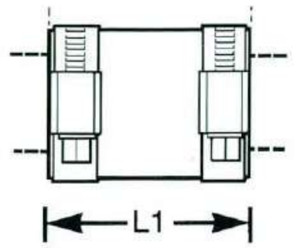
AHU	Fan (PA) Pressure	Seal Depth (Negative)		Seal Depth (Positive)	Depth of Trap	Qty. of Traps	Type Cat. Ref	Drain Size
		A.Dim	B.Dim	A. Dim	C. Dim			
unit 1	2000	200	200		440	1	Pert-25dH	25mm ø
unit 2	1500			300	340	1	Pert-25dH	25mm ø

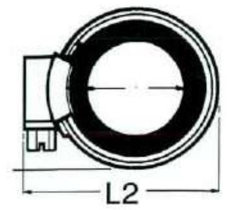
ANCILLARIES

COUPLINGS & PIPE CLIPS

Standard Couplings

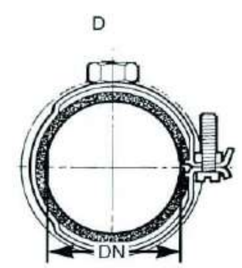
DN	L1	L2	Catalogue code
20	50	46	PEC-20
25	50	58	PEC-25
25	50	58	PEC-25/28
40	54	66	PEC-40
40	54	66	PEC-35/48
40	54	66	PEC-41/48
50	48	85	PEC-50
50	54	80	PEC-50/54





PIPE CLIPS

DN	D	Catalogue code
25	M10	PH-25
40	M10	PH-1
50	M10	PH-2
80	M10	PH-3
100	M10	PH-4



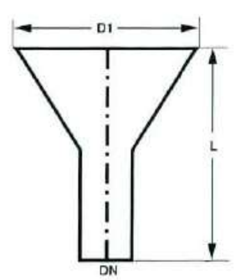
The clip is of single screw design and comes complete with rubber lining.

DN refers to the pipe size for which the clip is used.

TUNDISH

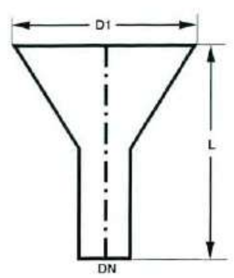
Tundish (Copper)

DN	DI	L	Catalogue code
22	75	150	COT 22-75
28	75	150	COT 28-75
22	100	150	COT 22-100
28	100	150	COT 28-100
40	120	150	COT 40-120
28	150	150	COT 28-150
40	150	150	COT 40-150



Tundish (Glass)

DN	DI	L	Catalogue code
20	75	150	GLT 20-75
25	75	150	GLT 25-75
40	100	150	GLT 40-100
50	100	150	GLT 50-100



Note: SGD Ltd reserve the right to supply products which may differ from those illustrated in this publication.
Dimensions in mm (except where otherwise stated)

LEGIONELLA APPLICATION

BACKGROUND

The transfer of infection, including Legionella Bacteria, and/or unpleasant odours may occur in situations where the contaminated bleeds from an air handling plant discharges to a waste water drain which also receives, without an adequate water seal trap and air break, the discharge from drip trays in the air conditioning plant. The integrity of water seals provided by traps manufactured in Borosilicate Glass is a key factor in the prevention of the dissemination of contaminated air.

PRODUCT EFFICIENCY

The transparency of Glass and its ability to perform safely with temperature and biocidal fluctuation enable the person responsible for maintaining the systems to have visual access into the drains, ensuring that the colonisation of the systems by sediments consisting of sludge, scale, rust and algae are prevented from providing the nutrients known to encourage the proliferation of Legionella.

THE LAW

Employers are required to safeguard the health of their employees at work and to ensure that other people are not endangered by the work activity (Health and Safety at Work HSW Act 1974).

The 'Occupiers' Liability Act 1957 - with respect to persons on the premises and common law as to negligence and nuisance with respect to those in the vicinity.

Health and Safety Commission Consultative Document of November 1989 - 'The Control of Legionellosis Proposals For Statutory Action'.

RECOMMENDATIONS

1st and 2nd reports of the committee of enquiry chaired by Sir John Badenoch into the outbreak of Legionnaires Disease in Stafford. CH13 PARA 283 and 284. Drains from air conditioning plants should feature glass traps to comply with HH (HAZARD) 85/6 dated 9/7/85 clause 5.

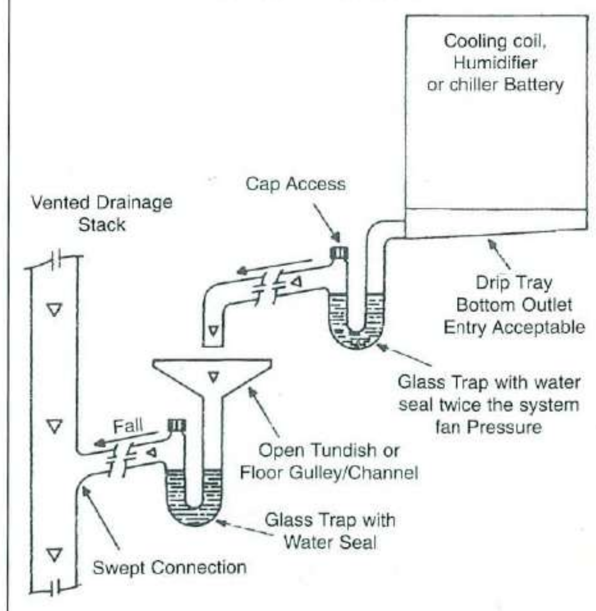
The Chartered Institute of Building Services Engineers have within T.M.13 recommended that the application of the glass trap to A/H plant should be considered in all sensitive buildings.

The Department of Health Code of Practice for the Control of Legionella in Health Care Premises Part 5 issued July 1988.

TYPICAL SPECIFICATION

To achieve maximum isolation and seal integrity borosilicate glass traps with access tees for filling, dosing and cleaning shall be connected directly to the unit drain outlet. The trap seal shall be, wherever possible, calculated to withstand at least twice the static pressure exerted by the system fan. To further isolate the air-handling unit from contamination, it is recommended that the drainage from the unit trap also be installed in borosilicate glass to ensure a sterile condition not available to other opaque pipe materials which are easily colonised by bacteria. The borosilicate glass drain should then discharge via an air break of at least 100mm into a tundish or floor gulley/channel trapped in borosilicate glass with a seal capable of withstanding pressures exerted by the drainage system to which it is connected. Designers, manufacturers and contractors should ensure that adequate clearance has been given to allow the positioning of traps thus enabling the correct gradients of draining to be achieved.

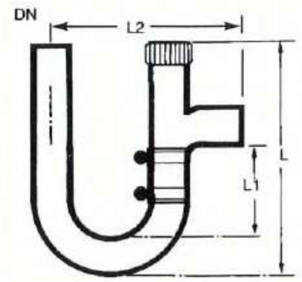
TYPICAL AIR CONDITIONING PLANT DRAIN



TRAP ASSEMBLIES

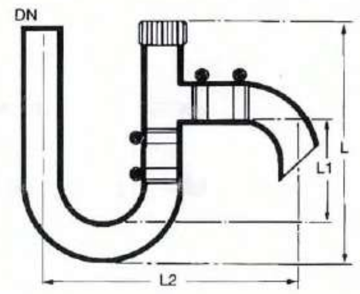
'P' TRAP
with Access Cap Vertical Inlet

DN	L	L1	L2	Catalogue Code
20	240	150	126	PEPT-20V
25	255	150	140	PEPT-25V
40	290	150	170	PEPT-40V
50	325	150	205	PEPT-50V



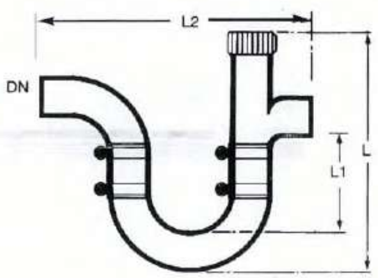
'S' TRAP
with Access Cap Vertical Inlet

DN	L	L1	L2	Catalogue Code
20	240	150	194	PEST-20V
25	255	150	215	PEST-25V
40	290	150	255	PEST-40V
50	325	150	295	PEST-50V



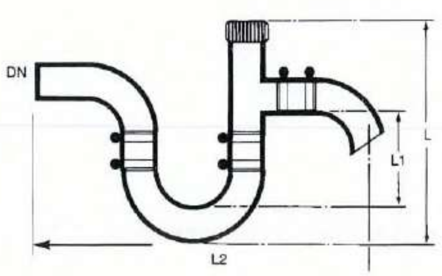
RUNNING TRAP
with Access Cap Horizontal Inlet

DN	L	L1	L2	Catalogue Code
20	240	150	189	PERT-20H
25	255	150	210	PERT-25H
40	290	150	250	PERT-40H
50	325	150	295	PERT-50H



'S' TRAP
with Access Cap Horizontal Inlet

DN	L	L1	L2	Catalogue Code
20	240	150	257	PEST-20H
25	255	150	285	PEST-25H
40	290	150	335	PEST-40H
50	325	150	385	PEST-50H

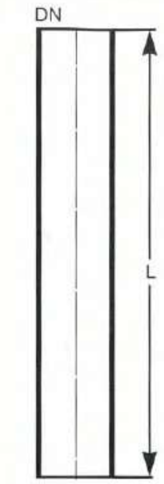


Note. For seal depths in excess of 150mm, 'U' bends can be extended to suit individual needs. Inlet and outlet couplings should be ordered separately specifying type and size of pipe material.

PIPES & FITTINGS

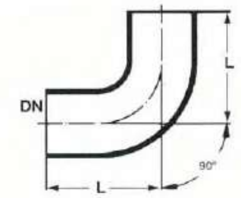
PIPE SECTIONS

DN	L	Catalogue Code	DN	L	Catalogue Code
20	100	PEP-20-0100	40	100	PEP-40-0100
20	250	PEP-20-0250	40	250	PEP-40-0250
20	500	PEP-20-0500	40	500	PEP-40-0500
20	1000	PEP-20-1000	40	1000	PEP-40-1000
20	1500	PEP-20-1500	40	1500	PEP-40-1500
25	100	PEP-25-0100	50	100	PEP-50-0100
25	250	PEP-25-0250	50	250	PEP-50-0250
25	500	PEP-25-0500	50	500	PEP-50-0500
25	1000	PEP-25-1000	50	1000	PEP-50-1000
25	1500	PEP-25-1500	50	1500	PEP-50-1500



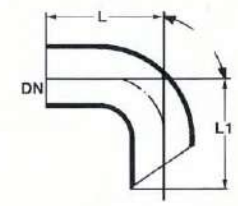
90° BENDS

DN	L	Catalogue Code
20	63	PEB-90-20
25	70	PEB-90-25
40	80	PEB-90-40
50	90	PEB-90-50



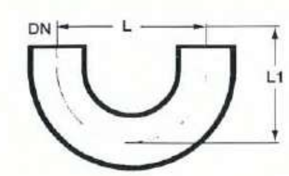
90° DISCHARGE BENDS

DN	L	L1	Catalogue Code
20	63	58	PEBD-90-20
25	70	65	PEBD-90-25
40	80	75	PEBD-90-40
50	90	85	PEBD-90-50



'U' BENDS

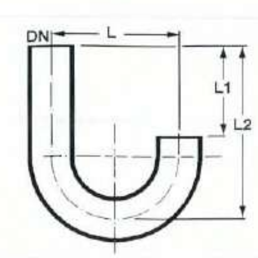
DN	L	L1	Catalogue Code
20	63	100	PEUB-20
25	70	100	PEUB-25
40	80	105	PEUB-40
50	90	115	PEUB-50



'J' BENDS

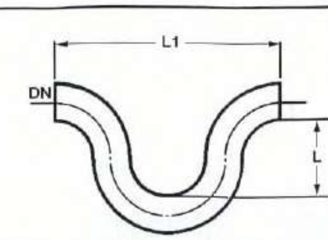
DN	L	L1	L2	Catalogue Code
20	63	126	226	PEJ-20
25	70	140	240	PEJ-25
40	80	160	265	PEJ-40
50	90	180	295	PEJ-50

Note: Leg lengths L1 and L2 can be manufactured varying lengths.



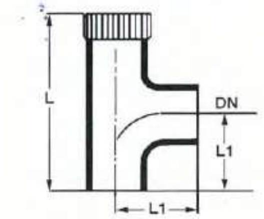
FAN COIL TRAPS

DN	L	Catalogue Code
20	63	FCT-20



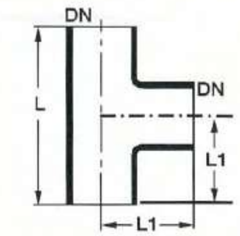
EQUAL 90° TEE PIECES
with access cap

DN	L	L1	Cat. Code
20	63	58	PEAC-90-20
25	70	65	PEAC-90-25
40	80	75	PEAC-90-40
50	90	85	PEAC-90-50



EQUAL 90° TEE PIECES
Interchangeable with 90° bends

DN	L	L1	Cat. Code
20	63	58	PET-90-20
25	70	65	PET-90-25
40	80	75	PET-90-40
50	90	85	PET-90-50



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Stepspeed Limited
Thermal Insulation Engineers

Audley House
Northbridge Road
Berkhamsted, Herts
HP4 1EH

Tel: 01442 876888
Fax: 01442 876860

13-10-98

Attn: Joseph Shabi.

Please find relevant technical + CoSHH data for products being used on Carlton Gardens project.

Contact us if you need further information.

Regards

Scott.

OWENS-CORNING BUILDING PRODUCTS (U.K.) LTD.
PO BOX 10 · STAFFORD ROAD
ST HELENS · MERSEYSIDE · WA10 3NS
TEL 01744 24022 · FAX 01744 612007

Material Safety Data Sheet-MSD 1

Owens Corning Insulation

September 1994

Crown, Ecomax, Icerock, Rocksil, Roofmax, Thermolan and ***Supawrap*** range of products.

1. COMPANY: Owens-Corning Building Products (UK) Ltd., PO Box 10, St. Helens, WA10 3NS Telephone: 01744 693883

2. COMPOSITION: Inert vitreous silicate mineral wool bonded with a thermosetting phenolic resin which has been urea extended. Up to 0.5% of mineral oil.

3. HAZARD IDENTIFICATION:

May cause transient skin irritation. High dust levels may irritate the throat. Classified by IARC as category 2B (possibly carcinogenic to humans).

4. FIRST AID MEASURES: **Eyes:** If irritation occurs wash eyes with water. If symptoms persist seek medical advice.

Skin: If irritation occurs, wash off under running water prior to washing with soap and water.

5. FIRE FIGHTING MEASURES:

The products are generally non-combustible and do not pose a fire hazard. However, some facings and packaging materials may burn.

a) Suitable Extinguishing Media - water, foam, carbon dioxide or dry powder.
b) Unsuitable Extinguishing Media - none.
c) Products of combustion - carbon dioxide, monoxide and some trace gases.
d) Observe normal fire fighting procedures.

6. ACCIDENTAL RELEASE MEASURES:

No special measures required.

7. HANDLING AND STORAGE:

Avoid unnecessary handling of unwrapped product.
Store in original packaging in a dry place.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION:

Maximum Exposure Limit (MEL) 5mg/m^3, 8 hour time weighted average.
Ensure good general ventilation. Local exhaust ventilation may be required if the method of use produces dust levels in excess of the MEL.

Respiratory protection: If the MEL cannot be met, disposable face masks complying with BS/EN149 FFP1 or FFP2 should be used and are suitable for most applications.

Hand protection: Not normally required but industrial gloves can be worn.

Eye protection: When working with product above head height, eye protection is advised.

Skin protection: No special requirement other than loose clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES:

Appearance - vitreous mineral wool supplied in the form of rolls, slabs or in a sectional form.

Melting point - above 600°C.

Solubility - insoluble in water and generally chemically inert.

10. STABILITY AND REACTIVITY:

No special physical conditions need to be avoided.

No restrictions regarding incompatible materials.

Above 230°C, some binder degradation may occur for a short while, leading to evolution of small quantities of carbon dioxide, carbon monoxide and other trace gases.

11. TOXICOLOGICAL EFFECTS:

IARC Classification category 2B (in 1987).

Subsequent human epidemiological studies show no link between exposure to mineral wool fibres and lung disease.

12. ECOLOGICAL INFORMATION:

Stable product with no known adverse environmental effects.

13. DISPOSAL CONSIDERATIONS:

No special precautions.

14. TRANSPORT INFORMATION:

No special precautions.

15. REGULATORY INFORMATION:

No special labelling required.

Mineral wool products are not classified under CHIP as hazardous, but are regulated as man-made mineral fibre (MMMF) under the Control of Substances Hazardous to Health Regulations (COSHH) with MEL of $5mg/m^3$ and/or 2 fibres/ml (respirable), whichever is achieved first.

For mineral wools the appropriate limit is $5mg/m^3$ (gravimetric).

This safety data sheet does not constitute an assessment of workplace risk.

16. OTHER INFORMATION:

Health and Safety Executive Guidance Note EH46 - Man-made Mineral Fibres.

Eurisol Health Statement.

This information reflects typical values and is not a production specification.

No warranty expressed or implied is hereby made.

Introduction

System Thinking™

Whatever you need to insulate Owens Corning has the answer. We have a system of insulation solutions for roofs, walls, floors, building services, fire proofing and industrial applications. As the UK's only manufacturer of glass mineral wool, rock mineral wool and extruded polystyrene products we can provide you with the most appropriate solution to your insulation requirements including fabricated solutions. Our system also includes the best all-round service and support package.

We call it System Thinking™.

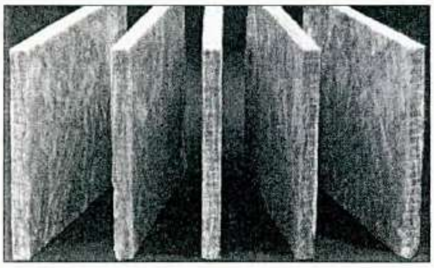
Crown glass mineral wool is the acknowledged leader in H&V and light industrial applications and along with **Rocksil, Ecomax** and **Icerock** for general purpose and heavy industrial use makes up a range of products suitable for applications from cryogenic temperatures through to 950°C. Full details are contained in the appropriate product sheet which is available on request (see back page). To simplify selection of the most suitable Owens Corning product for your application, they are summarised here.

The **Crown**® Range

Crown Pipe Insulation

The leading preformed pipe insulation for heating and ventilating applications and for light industrial use up to maximum operating temperatures of 230°C. Supplied as 1200mm long one piece snap-on tubes, unfaced or faced.

Nominal Density:	80 kg/m^3
Sizes:	To fit all popular BS steel and copper pipe sizes from 15 to 273mm o/d inclusive.
Wall Thicknesses:	20 to 100mm
Coverings:	All popular H&V sizes are supplied with a factory applied Bright Class "O" facing with a self-adhesive overlap. All sizes are available with other coverings via our distribution network.
Product Sheet Ref.:	F200

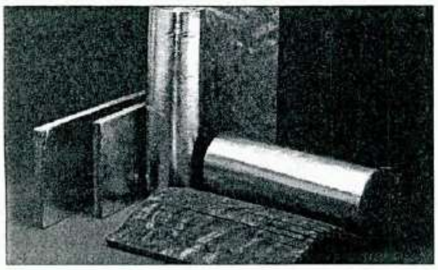


Crown Slabs

A versatile range of slabs for thermal and acoustic insulation in the heating and ventilating, domestic appliance, marine, transport and industrial sectors, or in a range of structural applications, up to maximum operating temperatures of 230°C.

Nominal Densities:	16, 24, 32, 48 and 64 kg/m^3
Sizes:	1200 x 600 and 1200 x 900mm
Thicknesses:	25, 40, 50, 75 and 100mm
Facings:	Normally supplied plain, but also available with Bright Class "O" facing subject to enquiry.
Product Sheet Ref.:	F201

The **Crown**® Range



Crown Universal Ductwrap

A flexible but compression resistant roll used for the thermal and acoustic insulation of all shapes of ductwork in heating, ventilating and air conditioning systems including round, oval, square, rectangular and flat-oval ducts.

Nominal Density:	28 kg/m^3
Size:	1200mm wide (length varies with thickness)
Thicknesses:	25, 40 and 50mm
Facings:	Faced with Bright Class "O" reinforced aluminium foil.
Product Sheet Ref.:	F202

Crown Rigid Duct Insulation

A rigid slab of **Crown** glass mineral wool for use on square or rectangular ductwork and equipment where premium performance is required.

Nominal Density:	48 kg/m^3
Size:	1200 x 600mm
Thicknesses:	25, 40 and 50mm
Facings:	Faced with Bright Class "O" reinforced aluminium foil.
Product Sheet Ref.:	F202

Crown Ductslab

A strong slab of **Crown** glass mineral wool with a factory applied Bright Class "O" facing, used for the general insulation of square or rectangular ductwork and equipment.

Nominal Density:	32 kg/m^3
Size:	1200 x 600mm
Thicknesses:	25, 40, 50 and 75mm
Product Sheet Ref.:	F202

Crown Sonic Liner

A mat of strong, flexible **Crown** glass mineral wool, supplied in roll form and faced on one side with a tough, white, dimensionally stable, woven glass cloth. It is used specifically for acoustic lining in ductwork.

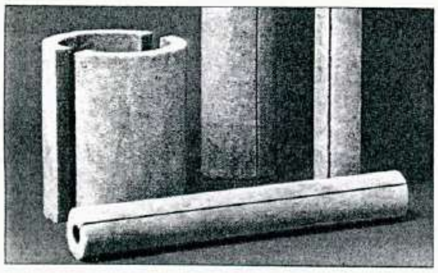
Nominal Density:	16-20 kg/m^3 (depending on thickness)
Size:	1200mm wide (length varies with thickness)
Thicknesses:	25, 50 and 75mm
Product Sheet Ref.:	F202

Crown Lamella

For the thermal and acoustic insulation of large diameter pipework and vessels or other applications when preformed pipe insulation is inappropriate. **Crown Lamella** is also for use on air-conditioning ductwork when additional compression resistance is required.

Nominal Density:	24 kg/m^3 (other densities subject to enquiry)
Size:	1200mm wide (length varies with thickness)
Thicknesses:	25, 30, 40, 50, 60 and 80mm
Facings:	Available with Bright Class "O" reinforced aluminium foil or plain kraft paper.
Product Sheet Ref.:	F202

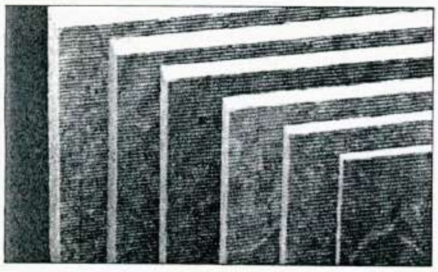
The **Rocksil®** Range



Rocksil Pipe Insulation

The ultimate combination of density, strength, water repellancy and thermal performance, with the versatility to be used in heating, ventilating and similar applications but particularly suited to heavy-duty work e.g. on industrial steam and process pipework, in oil refineries, chemical plants and power stations up to maximum operating temperatures of 750°C. Supplied in 1200mm long snap-on tubes or in 600 or 1200mm long matching halves, depending on bore size.

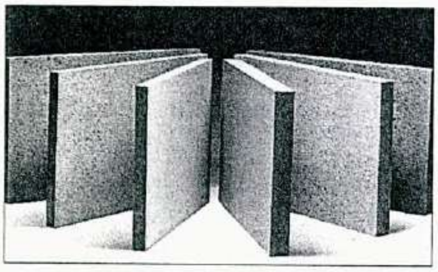
Nominal Density:	150 kg/m^3
Sizes:	To fit all popular BS steel pipe sizes from 17 to 1120mm o/d inclusive.
Wall Thicknesses:	20 to 120mm
Coverings:	Available plain or with a variety of coverings via our distribution network.
Product Sheet Ref.:	R410



Rocksil Slabs

A wide range of slabs for thermal and acoustic insulation from lightweight domestic appliances and structural uses, through to the most demanding heavy industrial applications, up to maximum operating temperatures of 850°C.

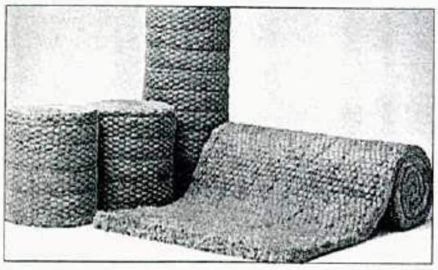
Nominal Densities:	33, 45, 60, 80, 100, 128, 140, 160 and 200 kg/m^3
Size:	1200 x 600mm (900 x 600mm subject to enquiry).
Thicknesses:	25, 30, 40, 50, 60, 75 and 100mm
Facings:	Normally supplied plain, but also available with a Bright Class "O" facing subject to enquiry.
Product Sheet Ref.:	R401



Rocksil HT900 Slabs

These inorganically bonded slabs are suitable for use at continuous operating temperatures of up to 900°C and are used in appropriate applications such as refractory back-up.

Nominal Density:	240 kg/m^3
Size:	900 x 600mm
Thicknesses:	25, 30, 40, 50, 60, 75, 80 and 100mm
Facings:	Supplied plain.
Product Sheet Ref.:	R408

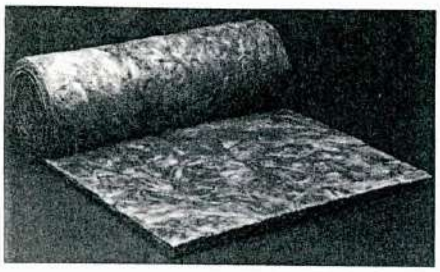


Rocksil Mattress

Unbonded wool faced on one or both sides with galvanised or stainless steel wire mesh. **Rocksil Mattresses** are designed for the thermal insulation of large vessels, boilers and high temperature plant operating up to 750°C or for fire protection purposes.

Nominal Density:	100 and 125 kg/m^3
Sizes:	500mm and 1000mm wide rolls
Thicknesses:	25 to 100mm
Facings:	Galvanised or stainless steel wire mesh on one or both sides.
Product Sheet Ref.:	R402

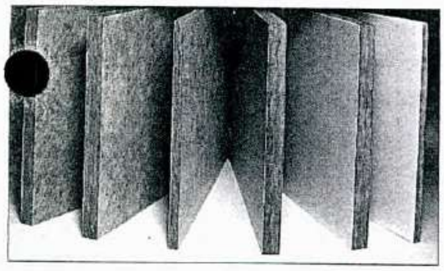
The **Crown**® Range



Crown 100 Rolls

Versatile rolls of strong, flexible glass mineral wool insulation designed for thermal and acoustic insulation in marine, road and rail transport, industrial equipment and domestic appliances.

Nominal Density:	21 kg/m^3 at 25mm and 16 kg/m^3 at 50mm
Size:	1200mm wide (length varies with thickness)
Thicknesses:	25 or 50mm
Facings:	Unfaced.
Product Sheet Ref.:	F204

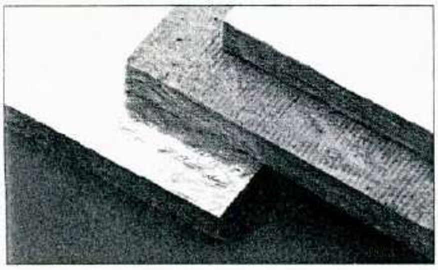


Crown Navy Board

A rigid, purpose-designed glass mineral wool board, faced on one side with tough, puncture resistant, woven glass cloth. For thermal and acoustic insulation in marine applications e.g. the insulation of accommodation areas.

Nominal Densities:	56 kg/m^3
Size:	900 x 600mm
Thicknesses:	25 and 50mm
Facings:	Faced with woven glass cloth with white glass tissue on reverse side.
Product Sheet Ref.:	F205

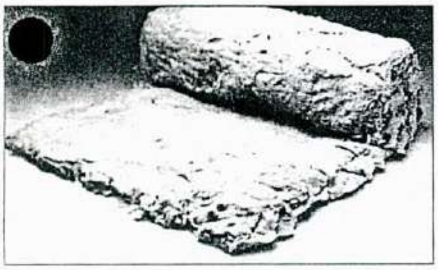
The Rocksil® Range



Rocksil Fire Protection Slab

For the fire protection and thermal insulation of bulkheads, decks and other divisions on ships and off-shore oil/gas installations or other areas where fire protection is required.

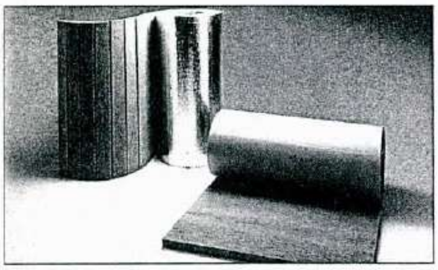
Nominal Density:	110 kg/m^3
Sizes:	1200 x 600mm
Thicknesses:	25, 40, 50 and 75mm
Facings:	Available plain or with an aluminium foil facing if a vapour barrier is required.
Product Sheet Ref.:	R403



Rocksil Loose Wool

Unbonded wool for general insulation purposes up to maximum operating temperatures of 950°C. Typical uses include the thermal and acoustic insulation of industrial ovens and equipment, refrigerated cargo holds, and the acoustic insulation of silencers.

Applied Density:	Varies according to requirements of the application – generally not to be less than 56 kg/m^3
Product Sheet Ref.:	R404



Rocksil Lamella

A highly resilient thermal and acoustic insulation for pipework and vessels where preformed insulation is inappropriate or where additional resistance to compression is required on ductwork etc.

Nominal Density:	33 kg/m^3 (other densities subject to enquiry)
Size:	1200mm wide (length varies with thickness)
Thicknesses:	25, 30, 40, 50, 60 and 80mm
Facings:	Available with Bright Class "O" reinforced aluminium foil or plain kraft paper.
Product Sheet Ref.:	F206

Rocksil Water Repellent Insulation

Is available in slab, mattress and pipe forms. Its typical use is the thermal and acoustic insulation of pipework, flat and curved surfaces in process applications where a particularly high degree of water repellency is required.

Product Sheet Ref.:	R400
N.B.	Product details as for Rocksil Pipe Insulation, Slabs and Mattress.

Salex
Interiors
Limited

A member of the Salex Group
Noise Control Engineers

SALEX
MUFTI-LAG
RANGE

ACOUSTIC INSULATION

for: **Ductwork**

Plenum Chambers

Pipe work and similar applications

Mufti-Lag 'Original' Pat No 8421484
This is the original four part laminate incorporating spacer layer, heavy mass lead core, thermal insulation layer and outer protection vapour barrier.

Mufti-Lag Original is particularly suitable for transform sections where butt-lap joints can be sealed with Bright Class O Mufti-Lag tape, achieving a neat and effective acoustic seal.

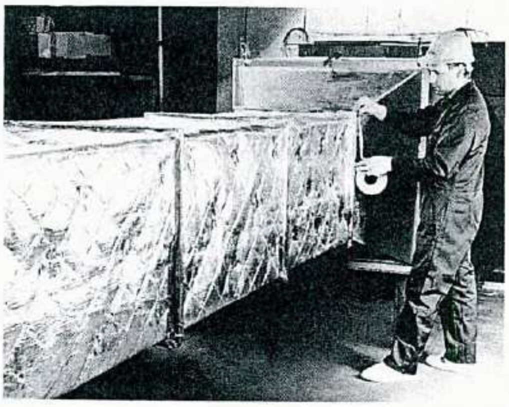
Mufti-Lag 'Prima' Pat No 0125205-6
This is a three part laminate comprising spacer layer, heavy polymeric mass layer and facing of protective vapour barrier. Unique method of manufacture provides cost effective and easy to apply acoustic lagging.

Mufti-Lag 'Hygiena' Pat No 9224319-5
This is a four part laminate that has the same properties as Mufti-Lag 'Prima' but spacer layer is made from melamine foam. Mufti-Lag Hygiena has been specifically designed for sensitive areas such as the food and drink processors, pharmaceutical industry, etc.

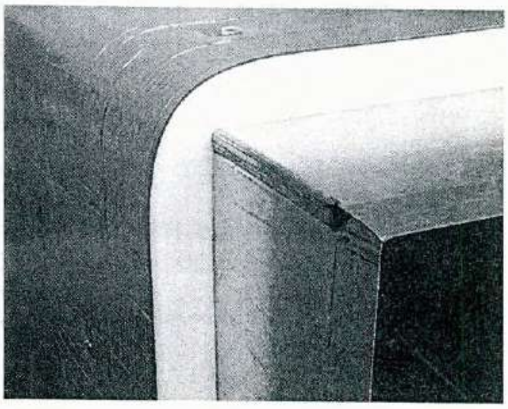
Advantages of Mufti-Lag

- Easy and quick to apply
- Good acoustic performance
- Applied as a dry, one layer treatment
- Excellent fire resistance to Class O
- Simple method of joining
- Attractive appearance

Butt Lap joints with Bright Class O Mufti-Lag tape provides a simple and neat acoustic seal.



Mufti-Lag Prima - the all in one material which is quick and easy to apply.

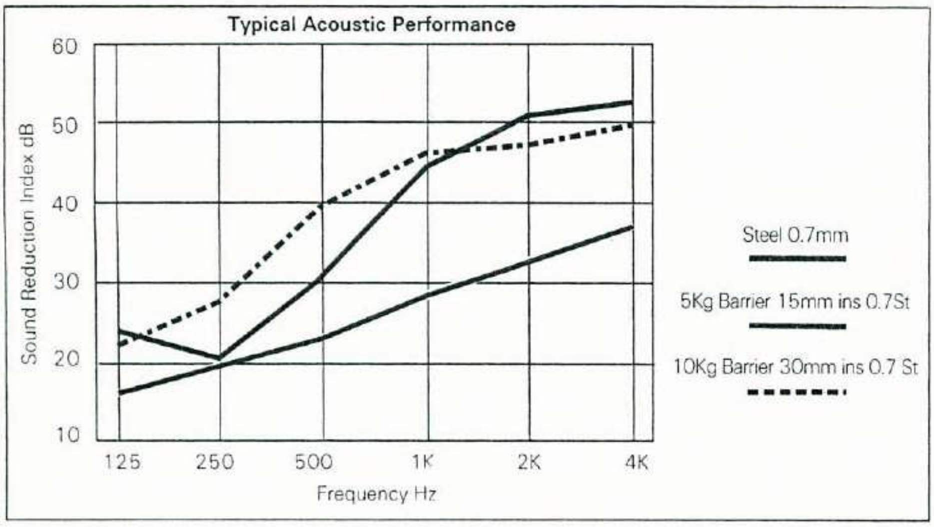


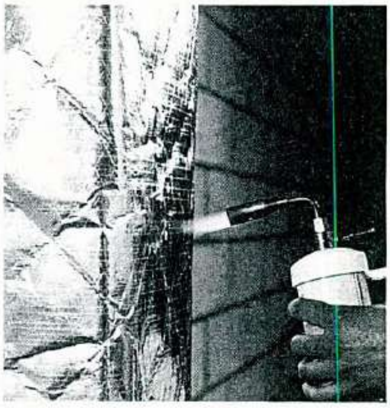
Multi-Lag Hygiena - the clean solution

"offering the complete Acoustic Solution"

TECHNICAL DETAILS

5Kg/m^2 Barrier	Code	Thickness	10Kg/m^2 Barrier	Code	Thickness	15Kg/m^2 Barrier	Code	Thickness
Original	5Kg.	30	**Original**	10Kg.	30	**Original**	15Kg.	30
Prima	0510 0520 0530	15 30 45	**Prima**	1010 1020 1030	15 30 45	**Prima**	1510 1520 1530	15 30 45
Hygiena	0510 0525 0550	12 25 50	**Hygiena**	1012 1025 1050	12 25 50	**Hygiena**	1512 1525 1550	12 25 50





The Salex Mufti-Lag range has an extremely high level of fire resistance achieving BS476 Class O. Mufti-Lag Original is available with either a silver or white surface finish.

The above chart is from actual sound reduction index tests established under laboratory conditions. Performance achieved in situ is dependent on a number of variables, such as size, thickness and shape of ducting, lagging mass and insulation thickness. For typical improvement in noise breakout reduction, contact your Salex Engineer.

Salex
Interiors
Limited

A member of the Salex Group
Noise Control Engineers

Colchester *(Head Office)* **Newcomen Way, Severalls Industrial Park, Colchester Essex. CO4 4YR**
Telephone: 01206 508111 Fax: 01206 852795

Manchester Six Acre House, Town Square, Sale, Cheshire, M33 1XZ
Telephone: 0161 969 7241 Fax: 0161 976 2703

London Saxon House, Downside, Sunbury-on-Thames, Middlesex, TW16 6RX
Telephone: 01932 765844 Fax: 01932 766181

York Bolan House, 19a Front Street, Acomb, York, YO2 3BW
Telephone: 01904 798876 Fax: 01904 797689

Scotland Suite 1, 9th Floor, Plaza Tower, East Kilbride, Scotland, G74 1LW
Telephone: 01355 220055 Fax: 01355 233474

Highly Flammable

INDUSTRIAL ADHESIVES LTD
Moor Road
Chesham
Bucks
HP5 1SB

Telephone: 01494 784444
Fax: 01494 791903

a BURMAH CASTROL company

1 PRODUCT NAME : Indasol MS 2575 - SPRAYTACK Aerosol

PRODUCT CODE : FO 52 06/2575

2 COMPOSITION

Hazardous ingredient	Cas No.	EC No.	Weight%	Symbols	R Phrases
F[illegible]ners, resins, and other a[illegible]ives. Non-hazardous.			10 - 25	---	---
Butane/propane propellant			25 - 50	F+	12
Iso-hexane	64742-49-0	203-777-6	10 - 25	F	11
Acetone	67-64-1	200-662-2	10 - 25	F	11

3 HAZARD IDENTIFICATION

- Highly Flammable (R11)
- Liquefied pressure gas

4 FIRST AID

CONTACT WITH SKIN

- After contact with skin, wash immediately with plenty of soap and water (S28)
- Do not use solvents to clean skin
- Seek medical attention if irritation persists

CONTACT WITH EYES

- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S26)

INGESTION

- Seek immediate medical attention
- Do not induce vomiting because of risk of aspiration into the lungs. If aspiration is suspected obtain immediate medical attention

INHALATION

- Remove patient to fresh air
- Keep warm and at rest
- Seek medical advice

OTHER INFORMATION

5 FIRE-FIGHTING MEASURES

- In case of fire use water, foam, carbon dioxide or dry agent (S43)
- In case of fire, do not breathe fumes
- Inform Fire Brigade of potential danger of exploding and rocketing cylinders

6 ACCIDENTAL RELEASE MEASURES

- Ventilate area
- Absorb spillage in earth or sand
- Wear suitable protective clothing including eye/face protection and gloves (S36/37/39)

7.1 HANDLING

- Do not breathe vapour/fumes (S23)
- Use only in well ventilated areas (S51)
- Avoid contact with skin & eyes
- In use, may form flammable/explosive vapour-air mixture (R18)
- Keep away from heat and sources of ignition

7.2 STORAGE

- Keep out of reach of children (S2)
- Store above 5 deg C
- Do not store above 30 deg C
- Keep container in a well ventilated place (S9)

8.1 PERSONAL PROTECTION

- In case of insufficient ventilation, wear suitable respiratory equipment (S38)

8.2 EXPOSURE LIMITS

9 PHYSICAL AND CHEMICAL PROPERTIES

- Liquid, colourless, solution, miscible with most organic solvents
- Highly flammable (R11)
- Boiling point - not applicable
- Flash point - not known
- Melting point - not applicable
- Auto-ignition point - not known
- pH - not applicable
- Specific gravity - not applicable
- Vapour pressure - not known
- Insoluble in water
- Viscosity - not applicable
- Vapour density - not known

10 STABILITY AND REACTIVITY

- In use, may form flammable/explosive vapour-air mixture (R18)

11 TOXICOLOGICAL INFORMATION

- Vapours or aerosols may cause irritation of eyes, nose and respiratory tract
- Prolonged skin contact will result in defatting of the skin, leading to irritation, and in some cases, dermatitis
- Inhalation of solvent vapours may give rise to nausea, headaches and dizziness

12 ECOLOGICAL INFORMATION

- Not readily biodegradable

13 DISPOSAL

- Disposal should be in accordance with local, state or national legislation
- See Section 16

14.1 TRANSPORT REGULATIONS

UN

UN No.	: 1950	Hazard Class	:
Packing Group	:		

Road/Rail (ADR/RID)

ADR UN No.	: 1950	ADR Hazard Class	: 2
ADR Item no.	: 10°b2	ADR/RID No.	:
Tremcard	: 20G26		

Sea (IMDG)

IMDG UN No.	: 1950	IMDG Hazard Class	: 9
IMDG Page No.	: 9022-	IMDG Pack. Group	: ---
IMDG EmS	: 2-13	IMDG MFAG	: 340

Air (ICAO/IATA)

ICAO UN No.	: 1950	ICAO Hazard Class	: 2.1
ICAO Packing Group	: ---		

14.2 TRANSPORT INFORMATION

15 REGULATORY INFORMATION

- The COSHH Regulations apply in the UK
- The CHIP Regulations apply in the UK
- The Environmental Protection Act applies in the UK

Risk phrase codes : 11
Safety phrase codes : 23(vapour/spray)-38-2-16-36/37

16 OTHER INFORMATION

Do not spray on a naked flame or any incandescent material.
Pressurised container: protect from sunlight and do not expose to temperatures exceeding 50°C.
Do not pierce or burn, even after use.
For intended use and applications see the Technical Data Sheet for the product. Use only for the stated uses and applications.
If you have purchased the product for supply to a third party for use at work, it is your duty to secure that any person handling or using the product is provided with the information in this sheet.
If you are an employer, it is your duty to tell your employees, and others who may be affected, of any hazards described in this sheet and of the precautions which should be taken.

Armaflex®
tubolit®
Insulation Products Division

HEALTH AND SAFETY INFORMATION

CLASS 1 ARMAFLEX **CLASS 'O' ARMAFLEX**

Armaflex is a flexible closed cell CFC free elastomeric material based on nitrile rubber. It also contains proprietary additives to improve fire performance, flexibility, and resistance to ageing.

The materials are suitable for thermal insulation of hot and cold pipework, chilled water and refrigeration systems, air conditioning ductwork and vessels in the temperature range -40°C to +105°C.

Health Hazards

Material when fully cured contains no hazardous components. No flammable or toxic fumes evolved under normal conditions of use. Non-fibrous and dust free. Presents no risk on physical contact.

Fire and Explosion Hazards

Under normal conditions of use material does not present a hazard. Difficult to ignite and does not sustain combustion. In a sustained fire will evole carbon dioxide/carbon monoxide with traces of chlorine, bromine and nitrogen containing gases.

First Aid.

Inhalation. Material does not evolve fumes or gases during normal conditions of us.

Eye Contact Any small solid particles should be carefully removed. Seek medical advice if any irritation should be felt.

Ingestion Small quantities are unlikely to present any hazard.

Disposal. May be discarded with general refuse.

For further information

Contact Techical Dept, Tel: (0895) 202053 or 202050

Issued Jan 1994

Ref: HSARM94

Issued February, 1993 - Sheet 1 of 3

HEALTH & SAFETY INFORMATION

Armaflex Standard Adhesive — Armafinish HN Paint

Armaflex Non-Flam Adhesive — Armaflex Cleaner

ADHESIVE

'Contact' type based on polychloroprene synthetic rubber and other resins dissolved in a blend of solvents.

ARMAFINISH HN PAINT

Solution of chlorosulphonated polyethylene.

ARMAFLEX CLEANER

Volatile liquid.

SOLVENT COMPOSITIONS

Armaflex standard adhesive	- toluene, petroleum distillate, acetone, butan-2-one (MEK).
Armaflex non-flam adhesive	- 1.1.1. Trichloroethane.
Armaflex HN Paint	- Xylene
Armaflex Cleaner	- Xylene, Dichloromethane.

HEAVY METAL

Armafinish HN Paint	- Lead

HEALTH HAZARDS

Area of use should be well ventilated.
Harmful if swallowed.
Keep out of reach of children.
Do not breath fumes.
Avoid contact with eyes and skin.
Danger of cumulative effects (Armafinish HN Paint only).
Keep containers closed when not in use.

cont'd . . .

FLASH POINTS

Armaflex Standard adhesive	-	between -18°C and 0°C
Armaflex non-flam adhesive	-	Not applicable
Armaflex HN Paint	-	25.6°C
Armaflex cleaner	-	23°C

FIRE AND EXPLOSION HAZARDS

Area of use should be well ventilated.
Do not smoke.
Do not use in the presence of naked flames, sparks or hot surfaces.

Suitable extinguishers include dry chemical, carbon dioxide, foam, sand and earth.

Liquids are not miscible with water.

FIRST AID

Inhalation A person suffering from over-exposure should be removed to fresh air, kept warm and at rest. If breathing stops give artificial respiration. SEEK MEDICAL ADVICE.

Eye Contact In case of eye contact flush with plenty of water for at least 15 minutes. SEEK MEDICAL ADVICE.

Skin Contact Immediately wash with soap and water. If irritation persists. SEEK MEDICAL ADVICE.

Ingestion Obtain immediate medical attention. Do NOT induce vomiting as aspiration may occur. Milk or water may be given.

HANDLING

Avoid contact with skin and eyes.
When splashing is possible protective clothing and approved eye protection should be worn.
Gloves or a suitable barrier cream should be used for hand protection.

STORAGE

Keep in a well ventilated fire-resisting store. Small quantities may be kept at the place of work during normal working hours but should be locked in a fire-resisting store when not required.

Armaflex non-flam adhesive does not require special storage facilities.

cont'd . . .

Armaflex®
tubolit®

Insulation Products Division

TREATMENT OF SPILLAGES

Warn others of fire and vapour hazards.
Prevent smoking and use of naked flames. Remove other sources of ignition. Contain using sand or earth, so as to prevent entry into drains and watercourses. Treat spillage with a mineral absorbent or sand and remove to a safe place to allow evaporation.

DISPOSAL

Do not empty into drains. Dried residue may be discarded with general refuse. Tins containing liquid should be disposed of carefully by a specialist disposal company. Empty containers should be discarded with the lids removed.

Extract From Guidance Note EH 40/92

Occupational Exposure Limits 1992

Solvent	Long Term Exposure Limit		Short Term Exposure Limit	
	ppm	mg/m^3	ppm	mg/m^3
Butan-2-one (MEK)	200	590	300	885
Acetone	750	2400	1500	3000
Toluene	50	188	150	560
Ethane-1,2-diol (vapour)	-	60	-	125
Xylene	100	435	150	650
Dichloromethane	100	350	250	870
1.1.1. Trichloroethane	350	1900	450	2450

Rotunda : Polyisobutylene Sheeting

1 IDENTIFICATION:

1.1 Commercial Name: PIB Insulating Sheeting

1.2 Product Nos:

Non-Interleaved: 2581; 2582; 2583:

Interleaved: 2592; 2593:

1.3 Description: Soft Polyisobutylene sheeting used for the waterproofing of thermal insulation on pipework and ducting. These products are not intended as electrical insulating materials. Consult Rotunda Technical Data Sheets for individual products. Other uses should be referred to Rotunda plc for their recommendations in writing.

1.4 Manufacturer:

Manufactured within the Scapa Tapes Group at Lindsay & Williams Ltd.
Ogden Lane Works, Columbine St. Manchester. M11 2LH
TEL: (0044) 0161-320-3636 FAX: (0044) 0161-335--0104

EMERGENCY PHONE No. (0044) 0161-320-3636

2 COMPOSITION / INFORMATION ON INGREDIENTS:

2.1 Tape: Consists mainly of Polyisobutylene Rubber, compounded with carbon, mineral fillers and minor compounding ingredients.

2.2 Interleaving: Tissue (2592 & 2593 only)

2.3 Anti-Tack: The non-interleaved varieties are dusted with mica dust as an anti-tack agent (2581; 2582; & 2583).

3 HAZARDS IDENTIFICATION:

3.1 Toxic Hazard: The product is not considered hazardous. Whilst some of the minor ingredients may themselves present a toxic hazard, once incorporated into the product they do not normally constitute a hazard.

3.2 Mica Dust: Mica dust is not toxic but is a nuisance dust and exposure should be kept to a minimum. Satisfactory conditions should be maintained by vacuum-cleaning of any dust accumulations and by normal industrial hygiene. Avoid inhalation - wear a dust mask if there is any possibility of the occupational exposure limit being approached.

Occupational Exposure Limits: Long-term exposure limit: (8hr TWA)

Total inhalable dust: 10mg/m^3:
Respirable dust: 1mg/m^3:

8 EXPOSURE CONTROLS/ PERSONAL PROTECTION:

8.1 Mica Dust (2581, 2582 & 2583)

Ensure good ventilation and wear a dust mask if there is any possibility of the occupational exposure limit for nuisance dust being approached . (See section 3).

8.2 Personal protection:

Apply normal industrial hygiene.

9 PHYSICAL AND CHEMICAL PROPERTIES:

9.1 Appearance:

Form:	Soft rubbery sheeting, either dusted with anti-tack material or interleaved with a disposable tissue.
Colour:	Black
Odour:	None

9.2 Physical and Safety Data:

pH value:	5.5 - 8.0
Max. Temp:	100°c

10 STABILITY AND REACTIVITY:

Stability:

The products are not resistant to hydrocarbon type solvents, oils, and greases. They should not be used where they come into contact with oil or grease.

Hazardous polymerization:

Will not occur

11 TOXICOLOGICAL INFORMATION:

Not toxic.

Highly Flammable

INDUSTRIAL ADHESIVES LTD
Moor Road
Chesham
Bucks
HP5 1SB

Telephone: 01494 784444
Fax: 01494 791903

a BURMAH CASTROL company

1 PRODUCT NAME : Indasol CT 87 ; PIB Welding Agent

PRODUCT CODE : FO 15 01/0087

2 COMPOSITION

Hazardous Ingredient	Cas No.	EC No.	Weight%	Symbols	R Phrases
Aliphatic Hydrocarbons (C5-	64742-49-0	265-151-9	> 75	F	11
Acetone	67-64-1	200-662-2	< 25	F	11

3 HAZARD IDENTIFICATION

- Highly Flammable (R11)

4 FIRST AID

CONTACT WITH SKIN

- After contact with skin, wash immediately with plenty of soap and water (S28)
- Do not use solvents to clean skin
- Seek medical attention if irritation persists

CONTACT WITH EYES

- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice (S26)

INGESTION

- Seek immediate medical attention
- Do not induce vomiting because of risk of aspiration into the lungs. If aspiration is suspected obtain immediate medical attention

INHALATION

- Remove patient to fresh air
- Keep warm and at rest
- Seek medical advice

OTHER INFORMATION

5 FIRE-FIGHTING MEASURES

- Vapours are heavier than air and may travel considerable distances to a source of ignition and flashback
- May form explosive vapour/air mixtures
- In case of fire use foam, carbon dioxide or dry agent - never use water (S43)
- In case of fire, do not breathe fumes

6 ACCIDENTAL RELEASE MEASURES

- Shut off all ignition sources
- Ventilate area
- Absorb spillage in suitable inert material
- Sweep or shovel-up spillage and remove to a safe place
- Use non-sparking handtools
- Wear protective clothing as per section 8

7.1 HANDLING

- Do not breathe vapour/fumes (S23)
- Use only in well ventilated areas (S51)
- Avoid contact with skin & eyes
- In use, may form flammable/explosive vapour-air mixture (R18)
- Keep away from heat and sources of ignition
- Take precautionary measures against static discharges (S33)

7.2 STORAGE

- Keep container tightly closed (S7)
- Store above 5 deg C
- Do not store above 30 deg C
- Keep in highly flammable materials store

8.1 PERSONAL PROTECTION

- Wear suitable protective clothing, including eye/face protection and gloves (plastic or rubber are recommended)
- In case of insufficient ventilation, wear suitable respiratory equipment (S38)

8.2 EXPOSURE LIMITS

9 PHYSICAL AND CHEMICAL PROPERTIES

- Liquid, colourless, clear, miscible with most organic solvents
- Highly flammable (R11)
- Smells of solvent
- Boiling point 56 deg C to 95 deg C
- Flash point -26 deg C (CC)
- Melting point - not applicable
- Auto-ignition point - not known
- pH - not applicable
- Density 0.7 kg/m3 at 20 deg C
- Vapour pressure - not known
- Viscosity below 1 centipoise
- Vapour density - not known

10 STABILITY AND REACTIVITY

- Stable
- In use, may form flammable/explosive vapour-air mixture (R18)
- Incompatible with organic peroxides
- Partly soluble in water

11 TOXICOLOGICAL INFORMATION

- Vapours or aerosols may cause irritation of eyes, nose and respiratory tract
- Prolonged skin contact will result in defatting of the skin, leading to irritation, and in some cases, dermatitis
- Inhalation of solvent vapours may give rise to nausea, headaches and dizziness

12 ECOLOGICAL INFORMATION

- Biodegradable

13 DISPOSAL

- This material and/or its container must be disposed of as hazardous waste (S60)
- Do not empty into drains (S29)
- Disposal should be in accordance with local, state or national legislation

14.1 TRANSPORT REGULATIONS

UN

UN No.	: 1993	Hazard Class	: 3.1
Packing Group	: II		

Road/Rail (ADR/RID)

ADR UN No.	: 1993	ADR Hazard Class	: 3
ADR Item no.	: 3,b	ADR/RID No.	:
Tremcard	: 30G30		

14.1 TRANSPORT REGULATIONS

Sea (IMDG)

IMDG UN No.	: 1993	IMDG Hazard Class	: 3.1
IMDG Page No.	: 3126-	IMDG Pack. Group	: II
IMDG EmS	: 3-05	IMDG MFAG	: 330

Air (ICAO/IATA)

ICAO UN No.	: 1993	ICAO Hazard Class	: 3
ICAO Packing Group	: II		

14.2 TRANSPORT INFORMATION

15 REGULATORY INFORMATION

- The COSHH Regulations apply in the UK
- The CHIP Regulations apply in the UK
- The Environmental Protection Act applies in the UK
- The storage and use of this product is subject to the Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972
- The Petroleum Storage Regulations apply in the UK
- The Control of Pollution Act applies in the UK

Risk phrase codes : 11

Safety phrase codes : 9-16-23(vapour)-36/37-51

16 OTHER INFORMATION

The data and advice given apply only when the product is used for the stated applications. The product is not sold as suitable for any other application. Use for other applications may give rise to risks not mentioned here, and advice should be sought from us.
For intended use and applications see the Technical Data Sheet for the product.
If you have purchased the product for supply to a third party for use at work, it is your duty to secure that any person handling or using the product is provided with the information in this sheet.
If you are an employer, it is your duty to tell your employees, and others who may be affected, of any hazards described in this sheet and of any precautions which should be taken.

EURAMAX
ALUMINIUM LIMITED

HEALTH AND SAFETY DATA SHEET   EDS. 09 2/10

PRODUCT NAME

Mill Finish Aluminium.

COMPOSITION

Aluminium alloy, in sheet, plate or coil form.

INTENDED USE

Caravan, Building and Engineering Industries.

HEALTH HAZARDS

When handling the product in sheet or coil form there is a risk of laceration of the skin.
Inhalation of aluminium dust may cause shortness of breath and aggravate bronchial conditions.
Occupational Exposure Limits have been established for aluminium dust by the Health and Safety Commission.
This limit is detailed below O.E.L should always be observed.

SUBSTANCE

	OEL 8 HR (a)	OEL 10 MIN (b)	Notes
Aluminium	10 mg M3	20 mg M3	As dust

(a) Long term exposure limit - 8 hour time weighted average.
(b) Short term exposure limit - 10 minute time weighted average.
(s) Occupational Standard Limit.
(m) Maximum Exposure Limit.
(c) Manufacturers Data.
(d) Limits in mg/M3, all other data in parts per million ppm.
(SKIN) There is a risk of absorption through unbroken skin.

Further guidance on OEL and the assessment of occupational exposure to harmful materials including mixed exposures, is given in HSE guidance note EH40.

PRECAUTIONS IN HANDLING AND USE

Protective clothing should be worn to prevent laceration of the skin.
Avoid inhalacion of dust, this should be achieved by the use of local exhaust ventilation and good general ventilation. If this is not sufficient to maintain concentrations of dust particles at a level below the OEL, suitable respiratory protection must be worn.

EURAMAX
ALUMINIUM LIMITED

FIRST AID PROCEDURE

Eye Contact - Irrigate copiously with clean fresh water, holding the eyelids apart.

Skin Contact - Wash skin thoroughly with soap and water or use a proprietary skin cleaner.

FIRE PREVENTION

In plate, sheet or coil form, material does not burn. In powder or chip form, use dry powder or sand. Do no use water or halogen extinguishing agent.

UNUSUAL FIRE HAZARDS

Water, oxidisers and many other chemicals react explosively in contact with molten aluminium fine chips, turnings, and dust in air may explode if ignition source is present.

RELEVENT REFERENCES

A) H.S.E. GUIDANCE NOTES

EH18 : Toxic Substances - a Precautionary Policy.
EH40 : Occupational Exposure Limits 1984.
EH42 : Monitoring Strategies for Toxic Substances.
EH43 : Carbon Monoxide.
EH44 : Dust in the Work Place, General Principals of Protection.

28

Waterloo Air Management

A division of Hunter International plc specialising in air distribution equipment, filters, air handling units and acoustic systems.

Greenwood Air Management

A sister division within Hunter International plc and an established market leader in fans, window ventilators and central ventilation systems for domestic and commercial buildings.

Hunter International

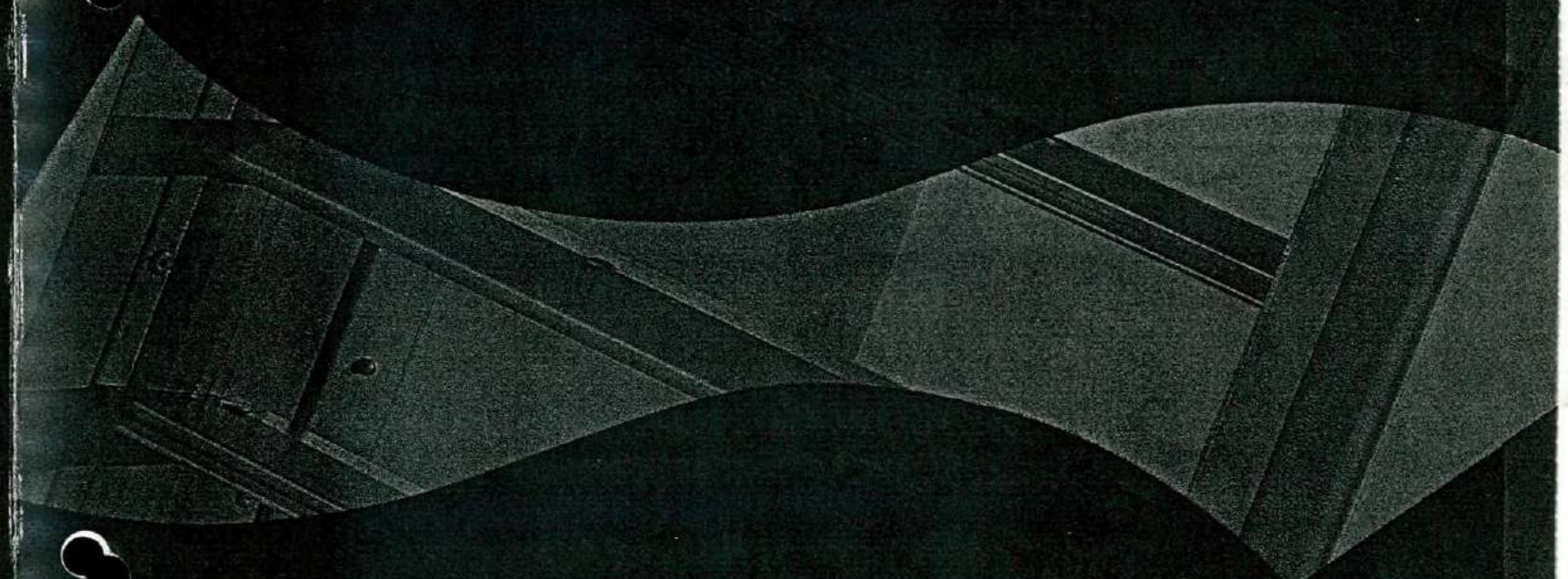
A major international manufacturer and supplier of air management equipment.

Waterloo Air Management Hunter International plc
Quarry Wood Industrial Estate Aylesford Maidstone Kent ME20 7NB
Tel: 01622 717861 Fax: 01622 710648

HUNTER
International
plc

Waterloo aircell

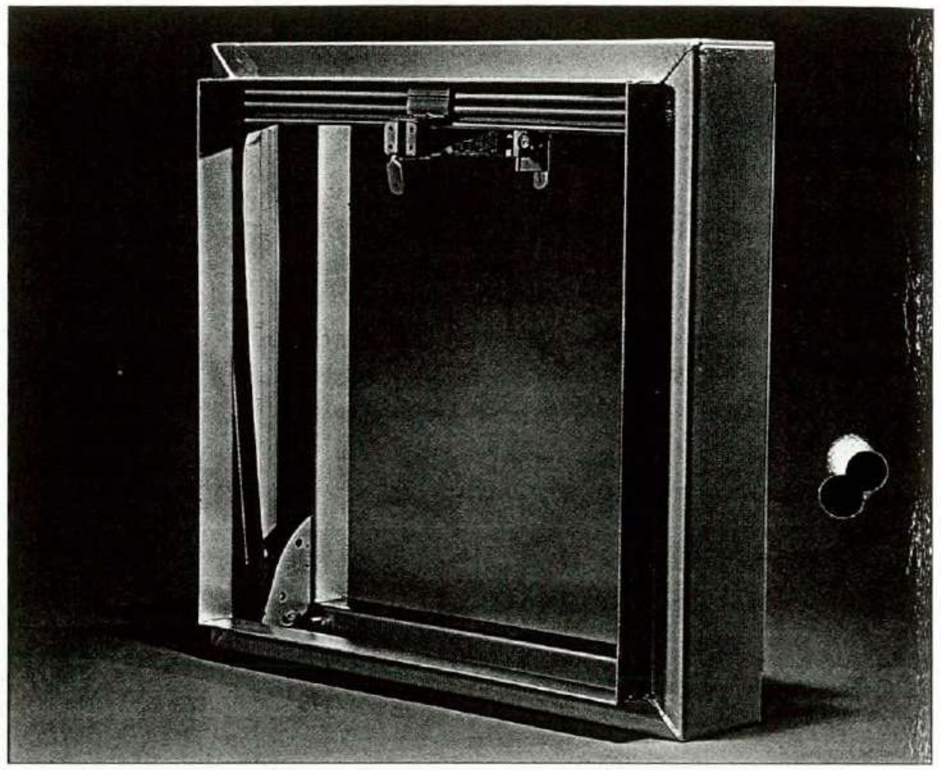
Smoke Seal Dampers and Fire Seal Dampers



WF Fire Seal Dampers

The Waterloo Aircell range of Fire Seal Dampers features galvanised or stainless steel curtain shutters designed to stop the spread of fire through ducts or partitions.

The range incorporates the features typically required by specifiers, contractors and Fire Authorities.



Authority

- Fire tested to BS 476 Part 20:1987, 4 hour rating
- Loss Prevention Council tested: Report No. TE85061
- IMO/Solas Approved for A60 Class damper
- GLC Acceptance to Ozonair Specification No. OZSS002
- Patent No. 1114215, 1189881 & 2028128
- Casing constructed in accordance with requirements of DW142.

Features

- LPC tested
- High quality engineering and material specifications
- Comprehensive control options
- 4 hour fire rating
- Approved HVCA installation frame
- Easily resettable, removable link mechanism (optional)
- Low/High velocity types
- Stainless steel side seals (Optional)
- Blade locking ramp mechanism
- Optional mechanical or microswitch indicators
- Optional stainless steel blades and casing

Specification

Shutter fire dampers shall be Waterloo Aircell Series WF incorporating galvanised or stainless steel blades and frames. Dampers shall be equipped with failsafe fusible links rated at 72°C, which may be tested and replaced from both sides of the damper within the duct system.

Damper sizes shown in the schedule are nominal duct sizes for square, rectangular, circular or flat oval ducts.

WGD Smoke Seal Dampers

This new generation of Aircell Smoke Seal Dampers has been specifically designed to be positioned within the duct system to prevent the free passage of smoke and fire as well as offering the added facility of air balancing control.

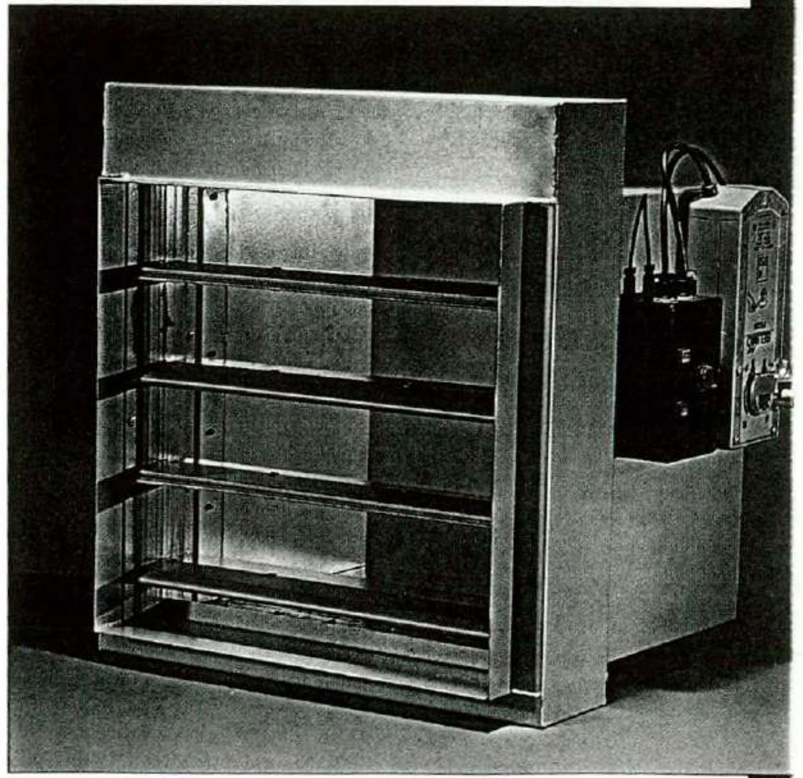
Various types of this combination smoke and fire damper are available ranging from the basic manual resetting version through to the more sophisticated remote setting and closing models, all of which incorporate the features typically required by specifiers, contractors and Fire Authorities.

Features

- Aerofoil interlocking galvanised steel blades with 100mm pitch for minimum leakage
- Many control options available with either manual or automatic reset
- Upgrading facilities available on various control options (subject to specifications)
- Fully welded casing construction with optional HEVAC/HVCA installation frames
- Available to suit all proprietary duct flanges in square, rectangular, circular or flat oval spigot connections
- Air balancing control and modulating facility available on various control options
- Optional stainless steel blades and casing

Authority

- Fire tested to BS 476 Part 20:1987, 4 hour rating
- Loss Prevention Council tested: Report No.TE85061
- GLC Acceptance to Waterloo Specification No. EX1008
- Ductwork Specification DW142, satisfies Classes A, B, C and D



Specification

The Combination Smoke Fire and Control Dampers shall be Waterloo Aircell Series WGD / WSD Smoke Seal having a 4 hour rating in accordance with BS 476 Part 20: 1987.

The double skin aerofoil blades shall be formed from not less than 0.55mm galvanised or stainless steel on a 19mm diameter stainless steel full width drive shaft for structural integrity.

Side gasketing shall be of 0.275mm flexible profiled stainless steel which, together with top and bottom blade stops and the seal formed by the interlocking blades, when closed shall not exceed a leakage of 18 litres per second/metre^2 duct area when subjected to a system differential pressure of 100 Pa.

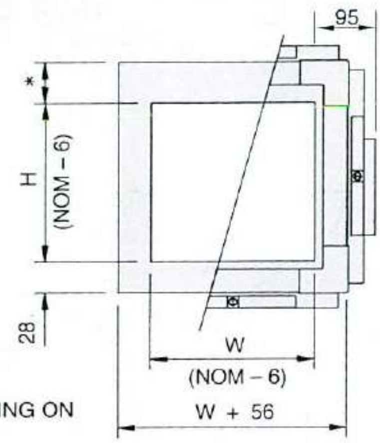
The fully welded damper case shall be formed with spigots from 1.6mm galvanised steel or 1.2mm stainless steel and shall meet the airtightness test requirements of HVCA Ductwork Specification DW142 and Eurovent classes A, B, C and D.

The damper shall be held open by a replaceable fusible link rated at 72°C (or as specified) and this shall override all other control options in the event of an in-duct fire or an abnormal rise in temperature. Dampers shall be supplied with optional controls as detailed in the schedule.

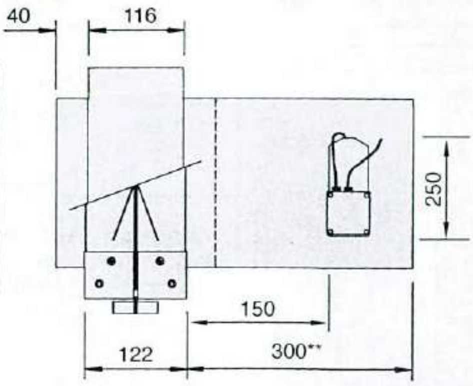
Range & Dimensions

Square and Rectangular Spigots

STANDARD
WGDB GALVANISED BLADES
WSDS STAINLESS STEEL BLADES



HVCA FRAME
WGDB/HF GALVANISED BLADES
WSDS/HF STAINLESS STEEL BLADES

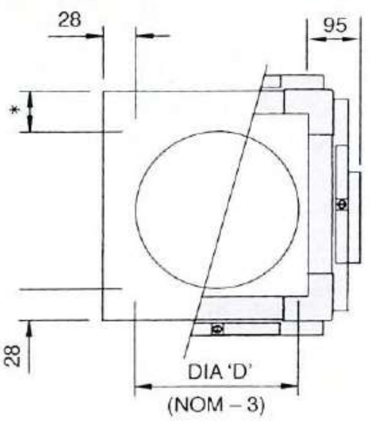


*28–127 DEPENDING ON SPIGOT HEIGHT

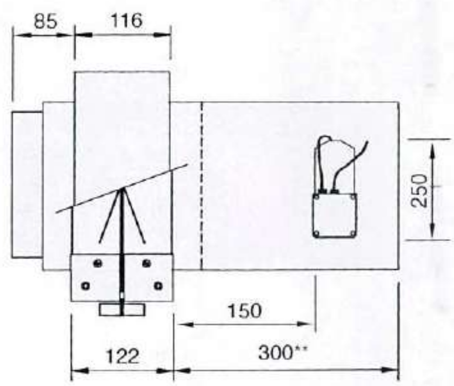
**500 ON MANUAL OPTIONS 1–4

Circular Spigots

STANDARD
WGDC GALVANISED BLADES
WSDT STAINLESS STEEL BLADES



HVCA FRAME
WGDC/HF GALVANISED BLADES
WSDT/HF STAINLESS STEEL BLADES

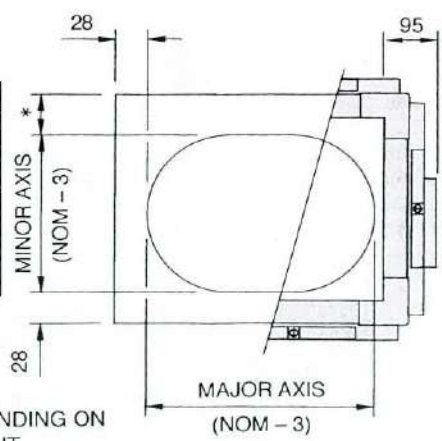


*28–127 DEPENDING ON SPIGOT

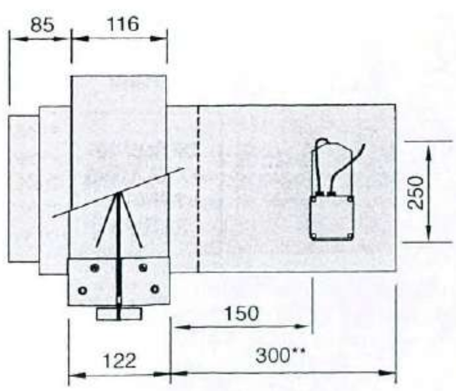
**500 ON MANUAL OPTIONS 1–4

Oval Spigots

STANDARD
WGDD GALVANISED BLADES
WSDO STAINLESS STEEL BLADES



HVCA FRAME
WGDD/HF GALVANISED BLADES
WSDO/HF STAINLESS STEEL BLADES



*28–127 DEPENDING ON SPIGOT HEIGHT

**500 ON MANUAL OPTIONS 1–4

Control Options Summary

CONTROL CONFIGURATION		CONTROL OPTION	APPLICATION NOTES & OPERATION PRINCIPLE	DRIVE MOTOR	SUPPLY/ CONTROL VOLTAGE	MOTOR END SWITCHES	PAGE
MANUAL RESET	FAILSAFE CLOSED	**OPTION 1** FUSIBLE LINK	Manual opening and closure	N/A			3
MANUAL RESET	FAILSAFE CLOSED	**OPTION 2** ELECTRO MAGNET	Manual opening and closure controller with illuminated indicator of damper status	N/A	24Vdc	NO*	4
MANUAL RESET	FAILSAFE CLOSED	**OPTION 3** SOLENOID	Manual opening and closure controller with illuminated indicator of damper status	N/A	240Vac	NO*	4
MANUAL RESET	FAILSAFE CLOSED	**OPTION 4** ELECTRO-THERMAL LINK	Manual opening and closure via 12 or 24Vdc thermo-electric quartzoid fuse	N/A	12 or 24Vdc	NO*	3
MOTORISED REMOTE RESET	FAILSAFE CLOSED	**OPTIONS 5, a, b, c,** OPEN/CLOSED SPRING RETURN	Fully open to fully closed automatic electronic motor drive fitted with a failsafe spring return mechanism operated via a thermal fuse	**5** AF230 **5a** AF230-S **5b** AF24 **5c** AF24-S	240Vac 240Vac 24Vac/dc 24Vac/dc	NO* YES NO* YES	5
MOTORISED REMOTE RESET	FAILSAFE CLOSED	**OPTION 6** MODULATING SPRING RETURN	Modulating automatic electronic motor drive fitted with a failsafe spring return mechanism operated via a thermal fuse	**6** AF24SR	24Vac 0-10Vdc SIGNAL POTENTIOMETER OUTPUT	NO*	6
MOTORISED REMOTE RESET	FAILSAFE OPEN	**OPTIONS 7, a, b, c,** CLOSE/OPEN SPRING RETURN	Fully closed to fully open automatic electronic motor drive fitted with a failsafe spring return mechanism (with or without thermal fuse as required)	**7** AF230 **7a** AF230-S **7b** AF24 **7c** AF24-S	240Vac 240Vac 24Vac/dc 24Vac/dc	NO* YES NO* YES	5
MOTORISED REMOTE RESET	FAILSAFE OPEN	**OPTION 8** MODULATING SPRING RETURN	Modulating automatic electronic motor drive fitted with a failsafe spring return mechanism (with or without thermal fuse as required)	**8** AF24SR	24Vac 0-10Vdc SIGNAL POTENTIOMETER OUTPUT	NO*	6
PNEUMATIC	FAILSAFE CLOSED	**OPTION 9** MODULATING SPRING RETURN	Modulating pneumatic opening and closure fitted with a failsafe spring return mechanism operated via a quartzoid fuse	SPECIFY PRESSURE OPERATING RANGE IN psi or Bar		NO*	7
PNEUMATIC	FAILSAFE OPEN	**OPTION 10** MODULATING SPRING RETURN	Modulating automatic pneumatic closure and opening fitted with a failsafe spring return mechanism (with or without quartzoid fuse as required)	SPECIFY PRESSURE OPERATING RANGE IN psi or Bar		NO*	7

*Optional blade activated open/close micro switch indication is available for drive motors without end switches. (Refer to page 8)

Electronic drive motor references are based on Belimo equipment. Details of other manufacturers products are available on request.

Control option 11 is also available for applications requiring a face mounted damper with a direct drive shaft through the casing. Details of the damper and suitable drive motor options are available on request. Adequate allowance should be made for design and approval of drawings prior to manufacture.

Control Options 1 and 4

Opening
To fully open or set the damper blades in any one of the three other set positions is manually achieved by a clockwise rotation of the actuator shaft with the specially shaped handle provided with every damper.

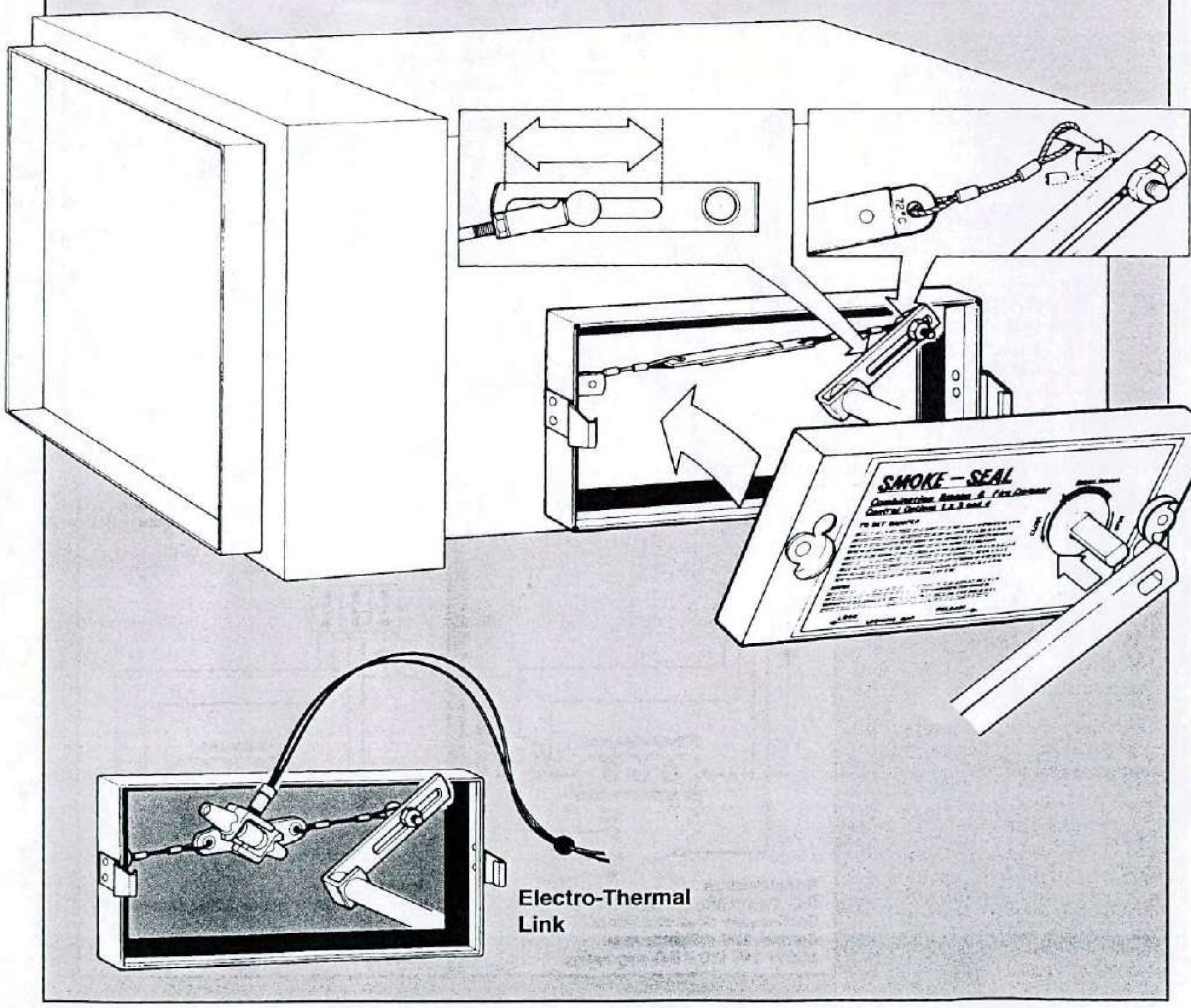
Closure
In the event of an in-duct fire or an abnormal rise in temperature, closure of the damper will be effected by the separation of the fusible link element due to melting. Alternatively, closure may also be accomplished by depressing the manual override lever which allows the damper to be test fired without destroying the fusible link.

Electro-Thermal Link (control option No. 4)
Opening and setting as per control option No. 1, with damper closure instigated by the separation of quartzoid bulb element due to an in-duct fire or an abnormal rise in temperature. Alternatively, closure may also be accomplished by depressing the manual override lever which allows the damper to be test fired without destroying the electro-thermal link. Automatic closure may also be effected by inducing a 12 or 24Vdc. current into the quartzoid bulb and separating the fusible link element and thus providing the added facility of remote closure to one or any number of dampers on the same control network.

Combined Access Panel/Actuator
Convenient entry for in-duct inspection along with the facility for allowing external replacement of the fusible link element is provided by the unique feature of the combined access panel/actuator. A fully adjustable link arm is also included in the assembly to allow a high degree of flexibility during installation and operation.

Visual indicator
Indication of damper blade setting is shown externally to the duct by the indicator located on the combined access panel/actuator.

Note, the indicator is configured to show open status only.



Telephone: 01622 717861 Waterloo Air Management Fax: 01622 710648

Control Options 2 and 3

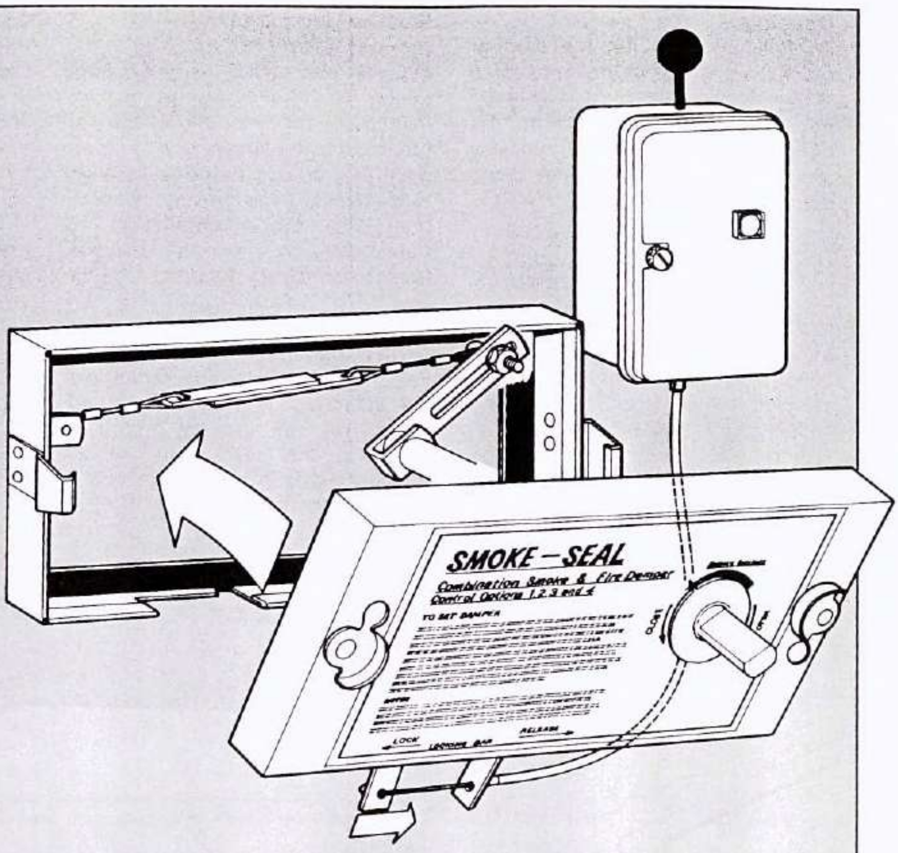
Opening
To fully open or set the damper blades in any one of the three other set positions is manually achieved by a clockwise rotation of the actuator shaft with the specially shaped handle provided with every damper.

Closure
In the event of an in-duct fire or an abnormal rise in temperature, closure of the damper will be affected by the separation of the fusible link element due to melting.
Alternatively, closure may also be accomplished by depressing the manual override lever which allows the damper to be test fired without destroying the fusible link. Automatic actuation of the same lever effected by either de-energising the 24 volt D.C. electro magnet (control option No. 2) or energising the 240 Volt A.C. solenoid (control option No. 3) will provide the added facility of remote closure to one or any number of dampers on the same control network.

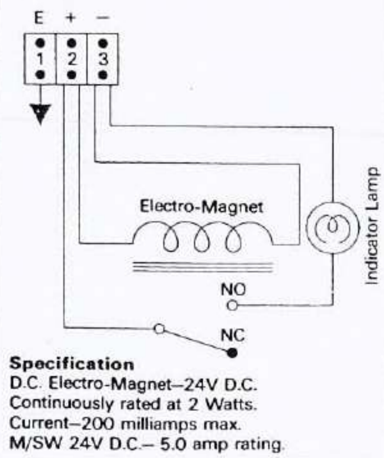
Combined Access Panel/Actuator
Convenient entry for in-duct inspection along with the facility for allowing external replacement of the fusible link element is provided by the unique feature of the combined access panel/actuator. A fully adjustable link arm is also included in the assembly to allow a high degree of flexibility during installation and operation.

Visual Indicator
Indication of damper blade setting is shown externally to the duct by the indicator located on the combined access panel/actuator.

Note, the indicator is configured to show open status only.

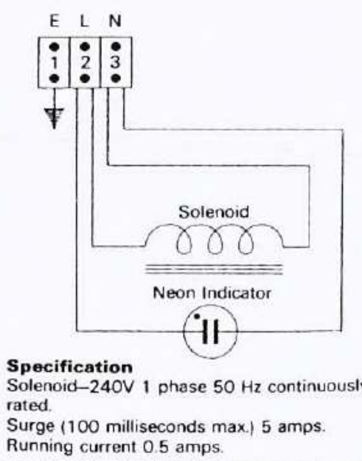


Control Option 2 Wiring Diagram
Green lamp indicates "normally open" circuit awaiting interruption or break to close damper.



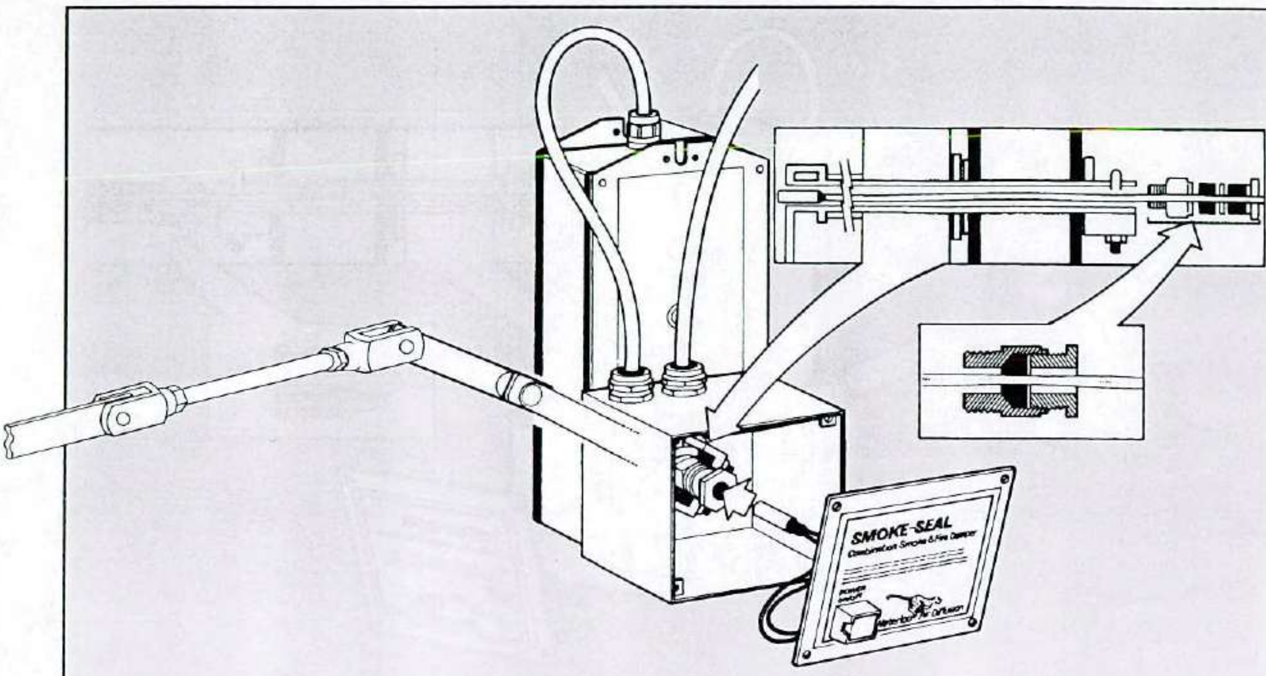
Specification
D.C. Electro-Magnet–24V D.C.
Continuously rated at 2 Watts.
Current–200 milliamps max.
M/SW 24V D.C.– 5.0 amp rating.

Control Option 3 Wiring Diagram
Red neon indicates circuit complete with solenoid energised and damper in the closed position.



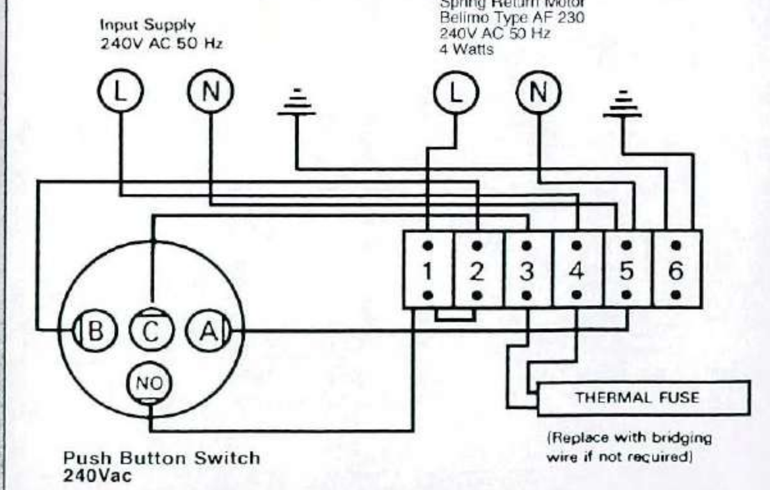
Specification
Solenoid–240V 1 phase 50 Hz continuously rated.
Surge (100 milliseconds max.) 5 amps.
Running current 0.5 amps.

Control Options 5 and 7



Opening
Opening the damper is achieved by providing power to the Belimo AF230 motor actuator either singularly or by using a ring main circuit to any number of dampers for zonal control.
Alternatively, the damper may also be opened by depressing the indicator switch situated on the motor mounting package — indicator light, power on = damper open.

Closure
In the event of an in-duct fire or abnormal rise in temperature, closure of the damper will be effected by the live side of the actuator circuit being broken in the thermal fusible link, causing the motor to close under spring return.
Automatic closure, without destruction to the thermal link, may be achieved by depressing the lighted indicator — indicator unlit, power off = damper closed. Alternatively, automatic closure may also be effected by interruption or failure of mains supply.

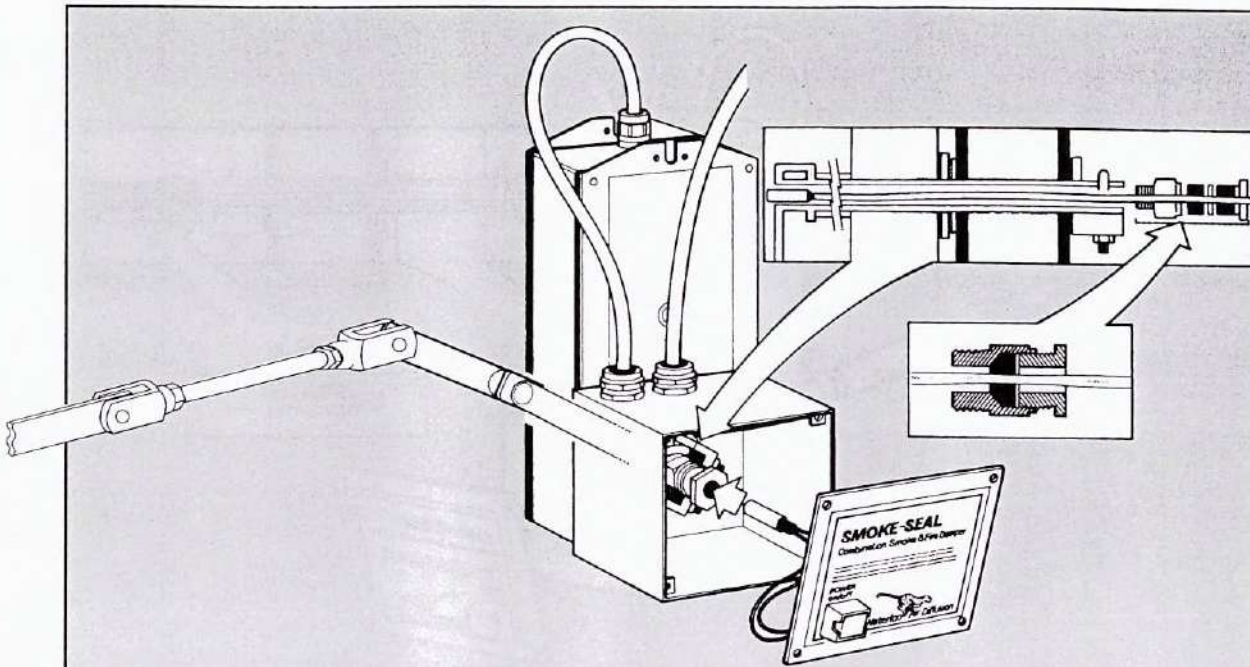


Optional Access panel
Convenient entry for duct inspection to the damper link arm assembly is provided by an optional access panel. (Panels should be ordered as separate items).
External replacement of the electro-thermal link may be accomplished by removing the lid of the cable box assembly, thus exposing the extension shaft and cable gland through which the link may be introduced into the duct.

Control option 7
(reverse operation)
For applications where the damper is required to work in the reverse direction (i.e. smoke vent), thus permitting smoke evacuation of internal building ventilation shafts — the Smoke-Seal damper can be supplied with or without the electro-thermal link in this application.

Motor options 5 & 7 a, b & c
For applications requiring a different voltage, please refer to manufacturer.

Control Options 6 and 8

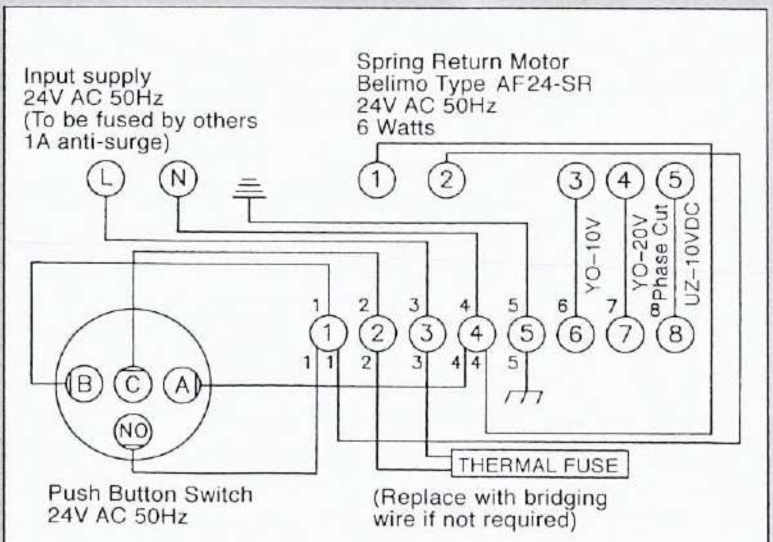


Opening
Opening the damper is achieved by providing 24Vac power to the Belimo AF24-SR motor actuator either singularly or by using a ring main circuit to any number of dampers for zonal control. By applying either a 0-10 volt DC or 0-20 volt phase cut signal the amount of blade opening may be varied from 0-100%, thus giving the damper the added facility of modulation. Alternatively, the damper may also be opened by depressing the indicator switch situated on the motor mounting package — indicator light, power on.

Closure
In the event of an in-duct fire or abnormal rise in temperature, closure of the damper will be effected by the live side of the actuator circuit being broken in the thermal fusible link, causing the motor to close under spring return. Automatic closure, without destruction to the thermal link, may be achieved by depressing the lighted indicator — indicator unlit, power off = damper closed. Alternatively, automatic closure may also be effected by interruption or failure of mains supply.

Optional Access panel
Convenient entry for duct inspection to the damper link arm assembly is provided by an optional access panel. (Panels should be ordered as separate items).
External replacement of the electro-thermal link may be accomplished by removing the lid of the cable box assembly, thus exposing the extension shaft and cable gland through which the link may be introduced into the duct.

Control option 8
(reverse operation)
For applications where the damper is required to work in the reverse direction (i.e. smoke vent), thus permitting smoke evacuation of internal building ventilation shafts — the Smoke-Seal damper can be supplied with or without the electro-thermal link in this application.

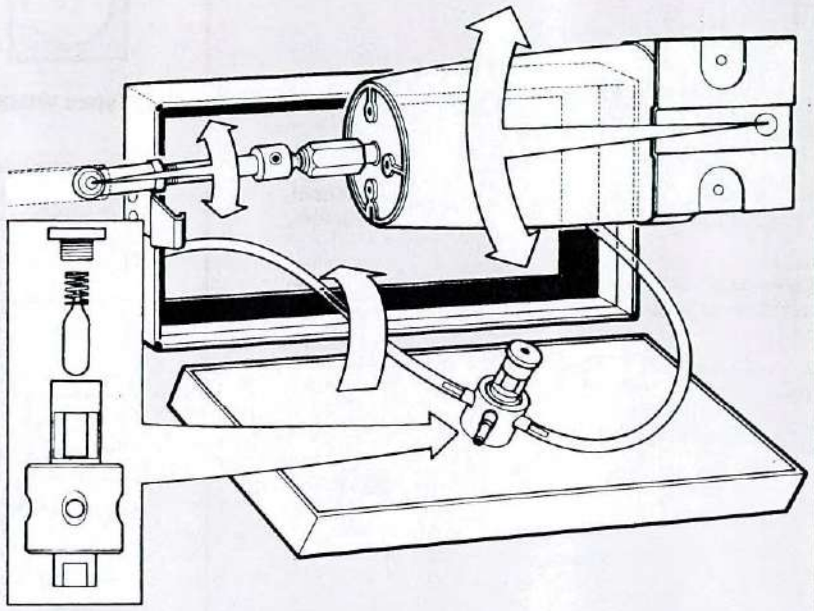


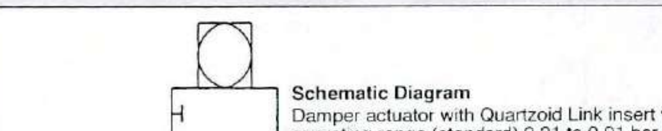
Control Options 9 and 10

Opening
Opening the damper is achieved by applying a pneumatic signal to the Honeywell HP9I3C actuator, either singularly or to any number of dampers to provide zonal control. By varying the pressure signal from 0.21 to 0.91 bar (3-13psi) the amount of blade opening may be varied from 0-100% thus giving the damper the added facility of modulation.

Closure
In the event of an in-duct fire or abnormal rise in temperature, closure of the damper will be effected by the separation of the quartzoid bulb element, thus causing the pneumatic system to go into exhaust mode and allowing the actuator to close under spring return.

Combined Access Panel/Actuator
Convenient entry for both duct inspection and adjustment to the damper link arm assembly is provided by the unique feature of the combined access panel actuator.
External replacement of the quartzoid bulb element may be accomplished by removing the access panel to which the bulb assembly is attached.





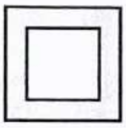
Schematic Diagram
Damper actuator with Quartzoid Link insert valve-operating range (standard) 0.21 to 0.91 bar (3-13psi)

Note: shown with air supply at zero

Control option 10 (reverse operation)
For applications where the damper is required to work in the reverse direction (i.e. smoke vent), thus permitting smoke evacuation of internal building ventilation shafts — the Smoke Seal damper can be supplied with or without the quartzoid bulb element in this application.

Size Ranges • Weights • Optional Extras

Size Ranges

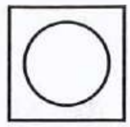


Types WGDB & WSDS – Square and Rectangular spigots.

Nominal duct width – Any size from 200-1000mm.
Nominal duct height – Any size from 200-1000mm.

Sizes over 1000 x 1000mm are available as multiple assemblies. (See below)

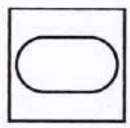
Approximate damper weight - 45kg/m² duct area.
Manual setting mechanism - 4kg.
Belimo motor - 3kg.
Honeywell pneumatic actuator - 2.5kg.



Types WGDC & WSDT – Circular spigots.

Any nominal duct diameter from 200-1000mm. Larger diameters are available as multiple assemblies. (See below)

Approximate damper weight – 66kg/m² duct area.



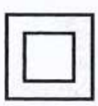
Types WGDD & WSDO – Oval Spigots

Nominal duct width – Any size from 200-1000mm.
Nominal duct height – Any size from 200-1000mm.
Larger sizes are available as multiple assemblies. (See below)

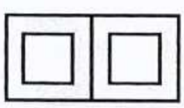
Approximate damper weight – 66kg/m² duct area.

Multiple Assemblies

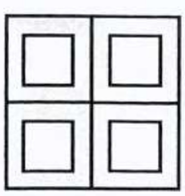
Up to 1000 x 1000
Single damper and installation frame



Up to 1524 x 1000
Double damper in single installation frame

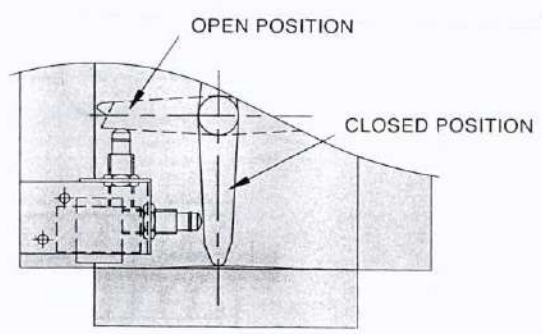


Over 1524 x 1016
Multiple assemblies are not normally available or approved with the HVCA/HEVAC installation frame. However, if approved by the local Building Regulations Department, these can be supplied.



Optional Extras

Microswitch – MSS
Blade activated microswitches are available for motor options without end switch facilities or where positive indication of damper blade operation is required.
The microswitch assembly is fitted inside the damper case and can be configured to indicate open or closed blade status.
Dual microswitches can be supplied to indicate both open and closed blade status where required.



Performance Data

Basis of Data

Full acoustic and aerodynamic performance is presented below and is based on tests carried out in the Waterloo Test Laboratory in accordance with BS 4196 Part 3 (ISO 3743).

Total Pressure Loss
(Pt) is the difference in pressure, for each blade position, measured within a ducted system connecting the inlet and outlet spigots of the damper.

LwNR Level
is the peak level on an NR curve based on sound power level ref. 10^{-12} Watts.

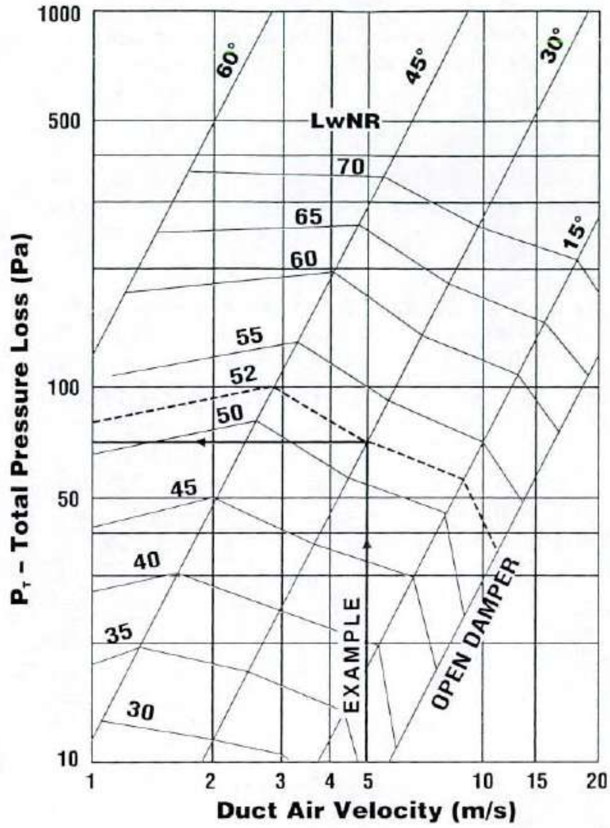
Data
is-based on a damper size 300 x 300.
Corrections for other sizes should be made using the table below.

Duct Area (m²)	Correction (dB)
0.01	- 10
0.05	- 3
0.10	0
0.15	+ 2
0.20	+ 4
0.50	+ 7
1.00	+ 10

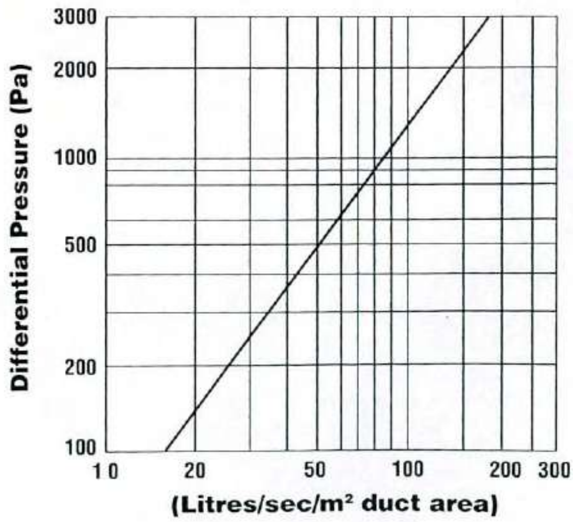
Use and Example
To determine the total pressure loss and noise level characteristic for a given duct air velocity read off from the chart the intersect point at which the line crosses the desired blade position (i.e. from fully open to 60° closed). e.g. From the chart, at a duct air velocity of 5 m/s with the damper blades set at 30°, the resulting noise level will be LwNR 52 at a Pt of 70 Pa.

Special Note
The Waterloo series WGD/WSD fire rated damper is particularly suited to use in vertical ducts and will operate under all normal dynamic conditions with air velocities of up to 20 m/s. For these applications the Smoke-Seal damper is preferred to any conventional curtain fire rated damper.

Pressure Loss and Noise Generation Characteristics



Leakage Performance



Blade Leakage is the air flow leakage under positive duct pressure through the blade system when fully closed.
Meets class II of UL555S

Installation • General Information

Installation

HEVAC/HVCA Installation Frames

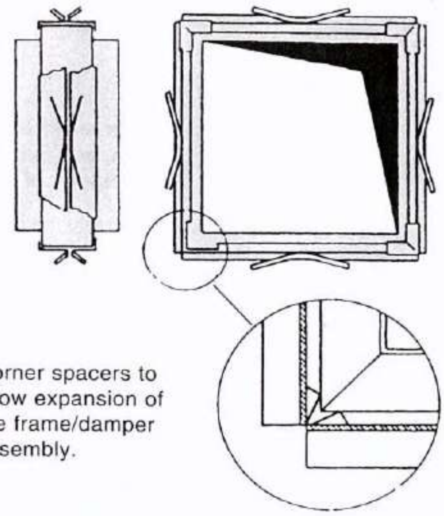
(a) HEVAC/HVAC frames shall be installed centrally in the thickness of the surrounding wall or floor, or in the case of thick walls or floors, so that the centre line of the frame is at least 50mm away from the nearest face of the wall or floor in which the assembly is mounted.

(b) On installation, all fixing tabs except those which are completely inaccessible, shall be bent out into the surrounding wall or floor, and the joints filled with cement mortar.
In the case of reinforced concrete walls and floors, the tabs shall be bent out and tied with wire to the exposed steelwork before being backfilled on both sides of the flange with cement mortar.

(c) Where more than one duct penetrates a fire wall or floor, adjacent smoke/fire dampers must be separated by builders work with a minimum thickness of 225mm.

(d) In the Inner London Area – Paragraph b – must be to the satisfaction of the District Surveyor.

HEVAC/HVCA frames conform to specification HVC 5-83 and DW142.



Corner spacers to allow expansion of the frame/damper assembly.

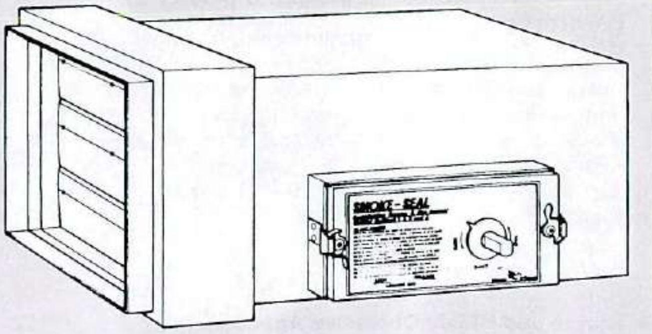
General Information

- Dampers can be installed to suit the structural opening and can be used in both horizontal and vertical applications.
- The combined control operator and access panel for options 1-4 is fitted onto a 500mm length of stub duct as standard; drive motors for options 5-10.are fitted with a 300mm length.
- Where special applications require an all stainless steel casing, these are available.
- For on-site convenience a special resetting tool is supplied attached to each manual reset unit.
- Where sizes larger than 1000 x 1000 are required, multiple assemblies can be made but these are subject to installation approval by the relevant Local Authority (where the size exceeds 1524 x 1016)
- All control operators are replaceable on site without the need to dismantle the damper or ducting.
- Where circular or flat oval dampers are ordered they are supplied on one side with a square or rectangular spigot, in order to achieve a flat surface for mounting the operator.
- It is advised to keep blades of dampers in the closed position at all times until commissioning stage to avoid site damage.
- Dampers must be thoroughly cleaned of dust and rubble prior to test firing on site to avoid damage to the unit.
- Full installation/operating instructions are provided and should be adhered to at all times.
- Smoke-Seal dampers can be used in conjunction with other Waterloo products which include Curtain Shutter Fire Dampers, Volume Control Dampers, Access Panels, Louvres, Grilles, Diffusers, VAV Boxes and acoustic products.
- The Waterloo technical sales engineers are available throughout the country to discuss your requirements in detail.

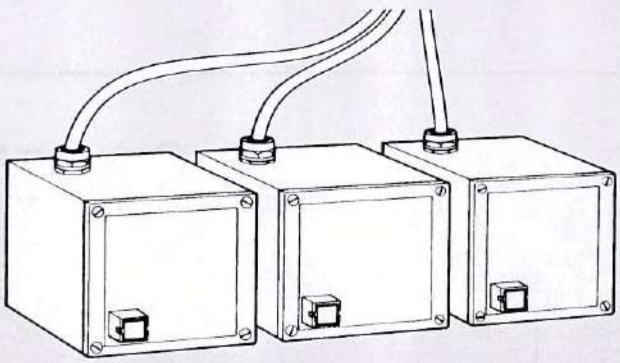
Accessory Packages

Damper and access Panel Assembly
Where required, dampers can be supplied on an extended stub duct complete with access panel and all component parts pre-assembled and tested ready for use.

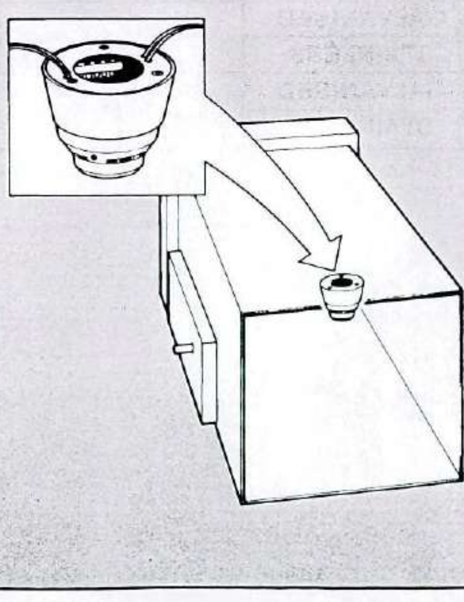
Note, Access panels are supplied as standard on control options 1-4.



Local Damper Test and Status Indication and Control Panels
For control options 5-10, the Smoke seal damper can be supplied with various types of local test switch or blade / motor status indication for either single dampers or zone control.
Multi zone fire control panels can be manufactured to specific requirements to provide complete control and damper status indication or interface facilities to suit other fire control equipment.
Adequate allowance should be made for design and approval of system drawings prior to manufacture.



Optical Smoke Detector
In-duct smoke detectors capable of tripping one or more dampers on the same circuit (only available on control options 2 to 8) are available on request.
Adequate allowance should be made for design and approval of system drawings prior to manufacture.



Operation Notes • Ordering Details

Operational Notes

- **Maintenance**
  Every effort is made during the design and manufacturing process to produce a product as maintenance-free as possible. However, it is strongly advised that periodic preventative maintenance and inspection take place at regular intervals after commissioning. All the Smoke-Seal components are manufactured to the highest quality, but in the unlikely event of a malfunction occurring the faulty component may be returned to Waterloo for immediate replacement.

- **Marine and Highly Corrosive Applications**
  For those special marine applications and where the damper is likely to come into contact with an above average corrosive environment, the Smoke-Seal damper can be manufactured with its major constituent parts produced in 316 grade stainless steel. Details available on request.

- **Handling and Installation**
  As a Life Safety product Waterloo Smoke-Seal dampers should be handled with great care on both site and installation. Extra care should be exercised during installation of the damper package as incorrect alignment of the various components will adversely affect the overall performance of the damper.

- **Reverse Operation (control options 5 to 10)**
  Where application and space dictates, it is possible to reposition the Smoke-Seal access panel actuator on the reverse side of the duct to that shown on the drawing, giving flexibility on left and right hand installations. Details available on request.

- **Uprating Feature**
  As a result of the modular design of the Smoke-Seal range, it is possible to interchange control options 1-4 or 5-10 after installation.

Ordering Details

TYPE	FRAME	NOMINAL WIDTH	NOMINAL HEIGHT	CONTROL OPTION	OPTIONAL EXTRAS
WGDB	HF	1000	800	5a	MSS

TYPE	BLADES	SPIGOT
WGDB	GALVANISED	SQUARE OR RECTANGULAR
WSDS	STAINLESS	SQUARE OR RECTANGULAR
WGDC	GALVANISED	CIRCULAR
WSDT	STAINLESS	CIRCULAR
WGDD	GALVANISED	OVAL
WSDO	STAINLESS	OVAL

OPTION No's 1-11
REFER TO PAGES 3-7

MSS	SINGLE MICROSWITCH

Rectangular Attenuators

Technical Support

Sargents offers customers and specifiers of acoustical equipment a comprehensive technical support service. Experienced engineering teams can undertake project management, negotiations with Planning Authorities and Environmental Health Departments and provide measurement and analysis at all stages.

The Company's support services include measurement of the finished installation and provide "before" and "after" comparisons.

Bend Attenuators

For applications where space limitations preclude the installation of a straight attenuator, angled units are available both in standard sizes and as "specials" to suit the physical limitations of the installation.

PRESSURE DROP N/M²

DIMENSIONS IN MM — AIRFLOW IN M³/SEC.

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
300	300	0.16	0.22	0.27	0.31	0.35	0.39	0.42	0.44	0.47	0.49
600	300	0.32	0.44	0.55	0.63	0.70	0.77	0.84	0.89	0.94	0.98
900	300	0.48	0.66	0.82	0.95	1.06	1.16	1.26	1.33	1.41	1.47
1200	300	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
1500	300	0.79	1.11	1.37	1.58	1.76	1.93	2.09	2.22	2.34	2.45
1800	300	0.95	1.33	1.64	1.89	2.11	2.32	2.51	2.67	2.81	2.94
300	400	0.21	0.30	0.36	0.42	0.47	0.52	0.56	0.59	0.63	0.65
600	400	0.42	0.59	0.73	0.84	0.94	1.03	1.12	1.19	1.25	1.31
900	400	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
1200	400	0.84	1.18	1.46	1.68	1.88	2.06	2.23	2.37	2.50	2.62
1500	400	1.06	1.48	1.82	2.10	2.35	2.58	2.79	2.96	3.13	3.27
1800	400	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
300	500	0.26	0.37	0.46	0.53	0.59	0.65	0.70	0.74	0.78	0.82
600	500	0.53	0.74	0.91	1.05	1.17	1.29	1.40	1.48	1.56	1.64
900	500	0.79	1.11	1.37	1.58	1.76	1.93	2.09	2.22	2.34	2.45
1200	500	1.06	1.48	1.82	2.10	2.35	2.58	2.79	2.96	3.13	3.27
1500	500	1.32	1.85	2.28	2.63	2.93	3.23	3.49	3.71	3.91	4.09
1800	500	1.58	2.21	2.74	3.15	3.52	3.87	4.18	4.45	4.69	4.90
300	600	0.32	0.44	0.55	0.63	0.70	0.77	0.84	0.89	0.94	0.98
600	600	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
900	600	0.95	1.33	1.64	1.89	2.11	2.32	2.51	2.67	2.81	2.94
1200	600	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
1500	600	1.58	2.21	2.74	3.15	3.52	3.87	4.18	4.45	4.69	4.90
1800	600	1.90	2.66	3.28	3.78	4.22	4.64	5.02	5.34	5.63	5.89
300	700	0.37	0.52	0.64	0.74	0.82	0.90	0.98	1.04	1.09	1.14
600	700	0.74	1.03	1.28	1.47	1.64	1.81	1.95	2.07	2.19	2.29
900	700	1.11	1.55	1.92	2.21	2.46	2.71	2.93	3.11	3.28	3.43
1200	700	1.48	2.07	2.55	2.94	3.28	3.61	3.91	4.15	4.38	4.58
1500	700	1.85	2.58	3.19	3.68	4.11	4.51	4.88	5.19	5.47	5.72
1800	700	2.22	3.10	3.83	4.41	4.93	5.42	5.86	6.22	6.56	6.87

PRESSURE DROP N/M²

DIMENSIONS IN MM — AIRFLOW IN M³/SEC.

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
300	800	0.42	0.59	0.73	0.84	0.94	1.03	1.12	1.19	1.25	1.31
600	800	0.84	1.18	1.46	1.68	1.88	2.06	2.23	2.37	2.50	2.62
900	800	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
1200	800	1.69	2.36	2.92	3.36	3.75	4.13	4.46	4.74	5.00	5.23
1500	800	2.11	2.95	3.65	4.20	4.69	5.16	5.58	5.93	6.25	6.54
1800	800	2.53	3.54	4.38	5.04	5.63	6.19	6.70	7.11	7.50	7.85
300	900	0.48	0.66	0.82	0.95	1.06	1.16	1.26	1.33	1.41	1.47
600	900	0.95	1.33	1.64	1.89	2.11	2.32	2.51	2.67	2.81	2.94
900	900	1.43	1.99	2.46	2.84	3.17	3.48	3.77	4.00	4.22	4.41
1200	900	1.90	2.66	3.28	3.78	4.22	4.64	5.02	5.34	5.63	5.89
1500	900	2.38	3.32	4.10	4.73	5.28	5.81	6.28	6.67	7.03	7.36
1800	900	2.85	3.99	4.92	5.67	6.33	6.97	7.53	8.00	8.44	8.83
300	1000	0.53	0.74	0.91	1.05	1.17	1.29	1.40	1.48	1.56	1.64
600	1000	1.06	1.48	1.82	2.10	2.35	2.58	2.79	2.96	3.13	3.27
900	1000	1.58	2.21	2.74	3.15	3.52	3.87	4.18	4.45	4.69	4.90
1200	1000	2.11	2.95	3.65	4.20	4.69	5.16	5.58	5.93	6.25	6.54
1500	1000	2.64	3.69	4.56	5.25	5.86	6.45	6.98	7.41	7.82	8.18
1800	1000	3.17	4.43	5.47	6.30	7.04	7.74	8.37	8.89	9.38	9.81
300	1100	0.58	0.81	1.00	1.15	1.29	1.42	1.53	1.63	1.72	1.80
600	1100	1.16	1.62	2.01	2.31	2.58	2.84	3.07	3.26	3.44	3.60
900	1100	1.74	2.44	3.01	3.47	3.87	4.26	4.60	4.89	5.16	5.40
1200	1100	2.32	3.25	4.01	4.62	5.16	5.68	6.14	6.52	6.88	7.19
1500	1100	2.90	4.06	5.02	5.78	6.45	7.10	7.67	8.15	8.60	8.99
1800	1100	3.48	4.87	6.02	6.93	7.74	8.51	9.21	9.78	10.32	10.79
300	1200	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
600	1200	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
900	1200	1.90	2.66	3.28	3.78	4.22	4.64	5.02	5.34	5.63	5.89
1200	1200	2.53	3.54	4.38	5.04	5.63	6.19	6.70	7.11	7.50	7.85
1500	1200	3.17	4.43	5.47	6.30	7.04	7.74	8.37	8.89	9.38	9.81
1800	1200	3.80	5.31	6.57	7.56	8.45	9.29	10.04	10.67	11.25	11.77

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
SILDUCT REF	LENGTH	ATTENUATOR STATIC INSERTION LOSS – db							
33/6	600	5	8	14	20	27	29	23	18
33/9	900	6	10	17	27	34	35	27	22
33/12	1200	7	13	21	36	42	44	34	29
33/15	1500	9	16	26	42	47	49	39	33
33/18	1800	10	18	30	47	50	50	45	40
33/21	2100	11	21	34	50	50	50	49	45
33/24	2400	13	25	38	50	50	50	50	50

Melinex Lined Attenuators

The following static insertion losses are applicable where attenuator splitters are melinex faced.

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
UNIT REF	LENGTH	STATIC INSERTION LOSS (db)							
33/6 MP	600	7	10	14	20	14	19	19	22
33/9 MP	900	9	13	17	27	18	23	22	27
33/12 MP	1200	11	17	21	36	22	29	28	36
33/15 MP	1500	13	20	26	42	24	32	32	41
33/18 MP	1800	15	22	30	47	27	36	36	50
33/21 MP	2100	17	26	34	50	30	40	40	50
33/24 MP	2400	19	29	38	50	33	44	44	50

Dynamic Insertion Loss

The Dynamic Insertion Loss (D.I.L.) of an Attenuator is the resultant noise reduction achieved under specific conditions of airflow.

The D.I.L., is obtained by adding the sound energy generated by the Attenuator to the theoretical sound level leaving the unit.

In practice this can be calculated by arithmetic subtraction of the Static Insertion Loss (S.I.L.) from the entering system Sound Power Level and adding the result logarithmically to the Attenuator Generated Sound Power Level.

GENERATED POWER LEVEL

FACE VEL. M/SEC.	OCTAVE BAND CENTRES HZ							
	63	125	250	500	1K	2K	4K	8K
	GENERATED SWL – db re 10^{-12} WATTS							
-15	64	60	61	62	59	62	65	61
-13	62	58	59	58	57	60	61	56
-11	58	55	56	55	55	58	57	50
-9	54	52	53	50	54	56	53	43
-7	49	47	49	45	51	53	47	34
-5	41	39	43	38	49	49	41	22
+5	39	29	32	31	27	30	28	19
+7	49	40	40	38	35	36	35	30
+9	56	47	46	45	42	42	42	38
+11	62	53	51	50	46	47	47	44
+13	66	58	55	53	50	51	52	49
+15	70	62	58	57	53	54	56	54

FACE AREA ADJUSTMENT

Face Area (M^2)	0.13	0.25	0.5	1.0	2.0	4.0	8.0
Adjustment	-6	-3	0	+3	+6	+9	+12

DESIGN SERVICE

Sargents offer a design service to ensure that equipment of the most suitable type and construction is selected to meet customers' specific requirements.

Rectangular Attenuators

Sargents Acoustics have been designing and manufacturing duct mounted Attenuator units since 1945. This Data Sheet gives full performance data on the latest developments in the SIlduct range.

Application

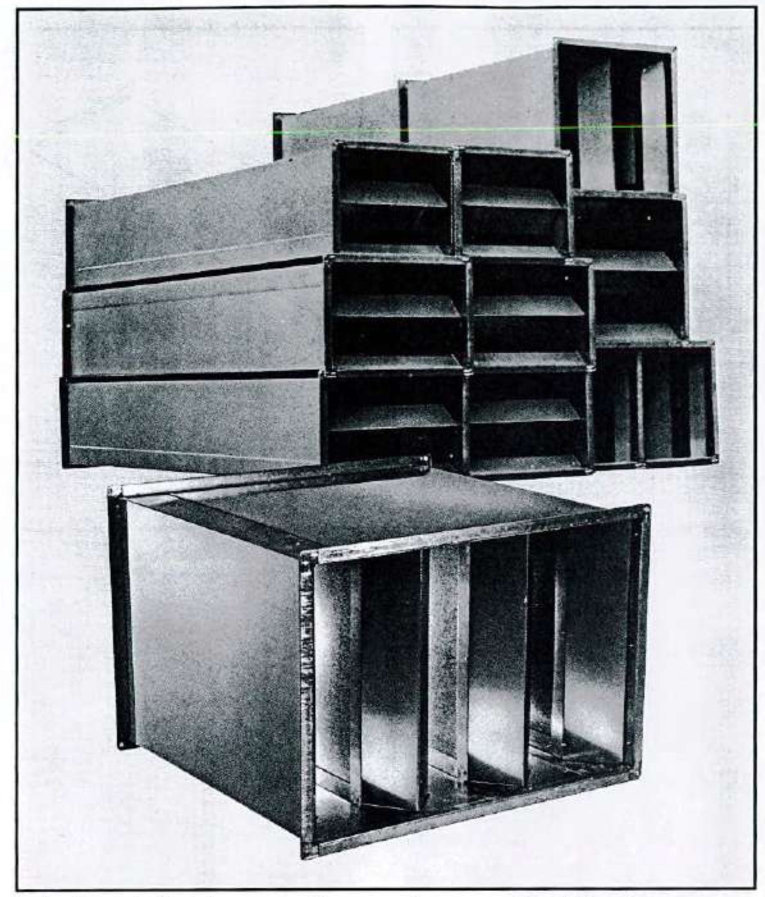
The SIlduct range of Attenuators is designed for inclusion in ductwork systems or for direct connection to fan or A.H.U., inlet and discharge.

The SIlduct range offers infinite flexibility of size and performance and all models can be supplied in any of the nine different material specifications including PVC, glass fibre, aluminium and stainless steel, in addition to the standard pre-galvanised steel construction.

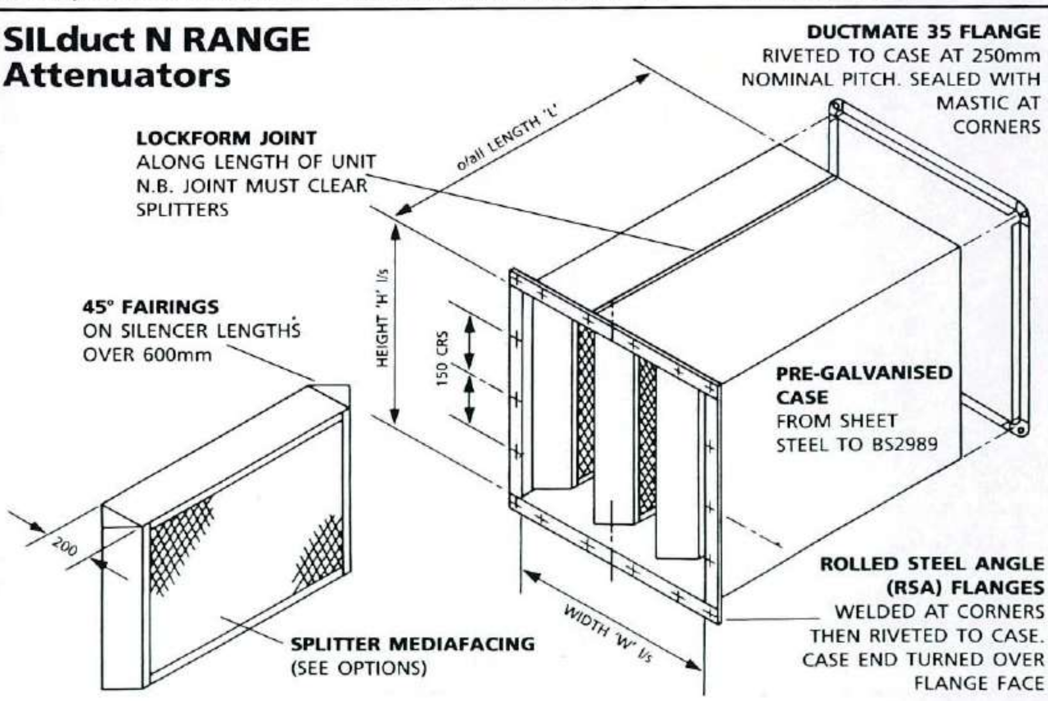
SIlduct Silencer Units may be used in high or low velocity systems; process air handling; dust extraction; wet or dry fume extraction; offshore installations and gas turbine intake systems.

In addition there is a special SIlduct range available for hospital installations.

Full easy to use selection data including airflow/pressure drops and static insertion losses are shown on the following pages of the brochure.



SIlduct N RANGE Attenuators



SARGENTS IS A BS 5750 PART 1 REGISTERED COMPANY

REGISTERED FIRM

SARGEN[...]
ACOUS[...]
A DIVISION OF HUNTER IN[...]

SARGENTS

PLEASE NOTE CHANGE OF ADDRES[...]
Waterloo Air Management
Hunter International plc
Quarry Wood Industrial Estate
Maidstone, Kent ME20 7NB
Tel: 01622 717861 Fax: 01622 710648

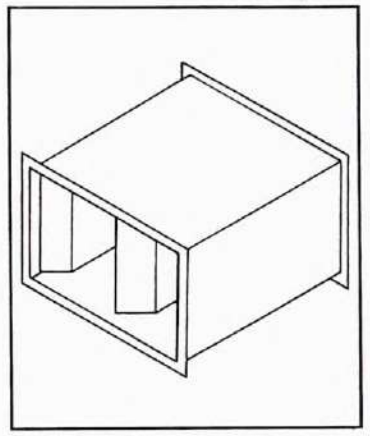
SILDUCT
N RANGE (A selection of Configurations available)

Rectangular Attenuators

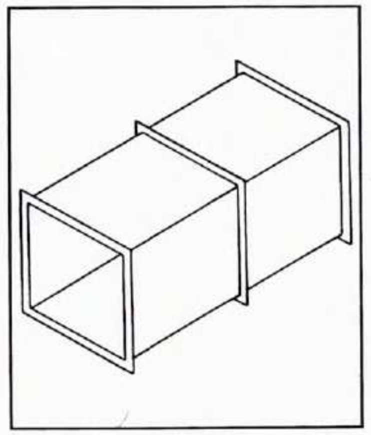
The Company

Sargents Acoustics, a member of the Hunter International Group, has been operating in the specialist field of noise and vibration control since 1945.

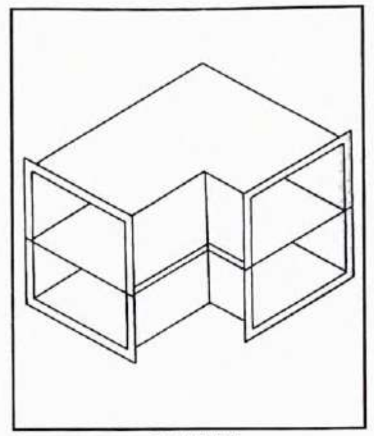
The Company specialises only in these areas and offers equipment that is original in both concept and design. It does not manufacture under license to foreign designs.



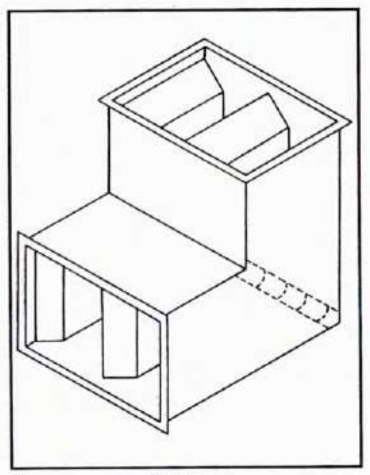
Standard Arrangement



Arrangement TL



Arrangement BH TH



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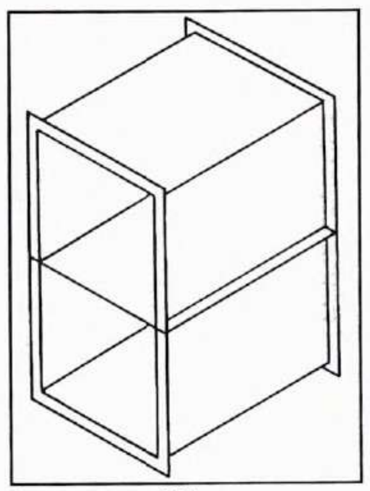

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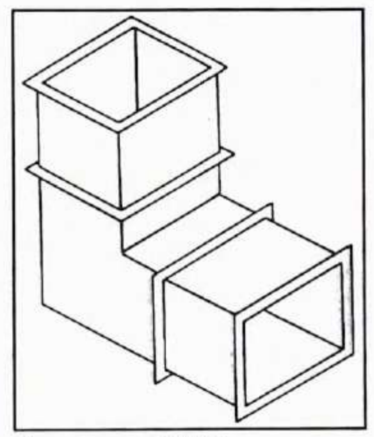

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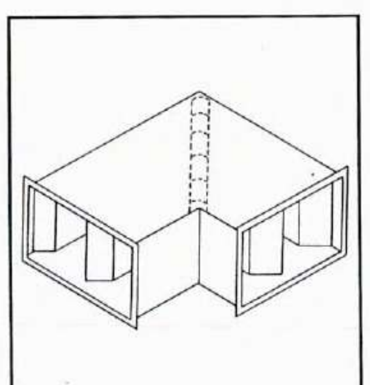

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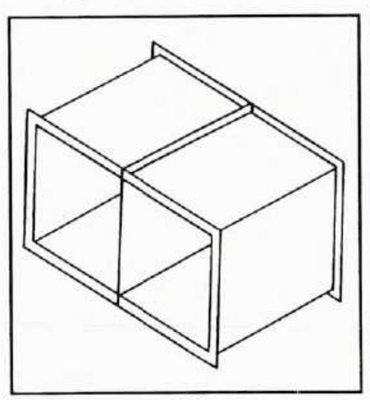
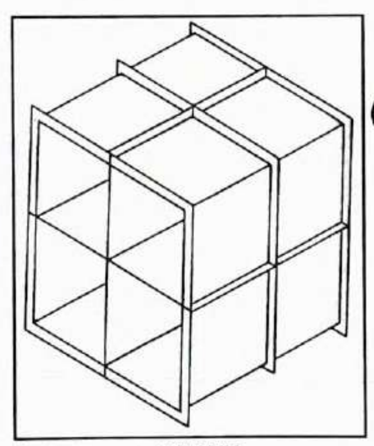


Arrangement TW



Arrangement TL WH

Attenuator requirements can be identified in the following way:-

Width x height x reference/option/ arrangement
e.g. 2200 x 1200 x 22/12/RS/TW
This would designate all attenuator unit 2200mm wide x 1200mm high x 1200mm long Type 22 with rolled steel angle flanges split into two units on the width.

TESTING

All performance data has been derived from tests carried out in accordance with BS 4718, 1971.
Insertion loss, Generated Noise and Pressure loss were measured within a system where the Attenuator forms part of a ducted system discharging into a reverberant chamber having characteristics as required by ISO 3743.

SARGENTS IS A BS 5750 PART 1 REGISTERED COMPANY

REGISTERED FIRM

SILDUCT TYPE 22
N RANGE

Rectangular Attenuators

Construction & Specification

Standard SILduct attenuators have cases from pre-galvanised mild steel sheet having a minimum thickness of 0.9mm constructed in accordance with HVCA specification DW/142.

Attenuating splitters are constructed from a formed framework of pre-galvanised mild steel sheet and incorporate a highly absorbent, inert mineral wool infill with a density of 60-70Kg/m² have a glass cloth and/or pre-galvanised perforated/ expanded metal mild steel sheet facing to the airway surfaces.

Units over 600mm long incorporate faired entry and exit noses to minimise pressure drop.

CASE MATERIAL
20g Minimum Thickness Galvanised Sheet Steel to BS 2989

SILENCERS TO HAVE WHITE TISSUE FACED SPLITTERS & DUCTMATE 35 FLANGES UNLESS OTHERWISE STATED BY SUFFIX

OPTION SUFFIXES
- **MP** Melinex and Flattened Galv. XPM Splitter Facing
- **GC** Glass Cloth Splitter Facing
- **RS** Rolled Steel Angle Flanges
- **P** Flattened Galv. XPM Splitter Facing
- **MZ** Mez Flanges
- **IF** Internal Rolled Steel Angle Flanges
- **HS** Horizontal Splitters
- **PL** Plenum Section One End
- **BN** Bull Nosed Splitters
- **S** Spigot Ended Silencers
- **T** Modular Construction (See Page 2)
- **BV** Vertical Bend (See Page 2)
- **BH** Horizontal Bend (See Page 2)

OVERALL TOLERANCES
UNIT SIZE ±3mm
FLANGE DRILLINGS ±1mm
AIRWAYS ±5mm
SPLITTERS ±2.5mm

PRESSURE DROP N/M²

DIMENSIONS IN MM — AIRFLOW IN M³/SEC.

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
275	300	0.12	0.16	0.19	0.23	0.25	0.28	0.30	0.33	0.35	0.37
550	300	0.24	0.32	0.39	0.45	0.50	0.56	0.61	0.66	0.70	0.74
825	300	0.35	0.48	0.58	0.68	0.76	0.84	0.91	0.98	1.05	1.11
1100	300	0.47	0.64	0.78	0.91	1.01	1.12	1.21	1.31	1.40	1.48
1375	300	0.59	0.80	0.97	1.13	1.26	1.40	1.52	1.64	1.75	1.85
1650	300	0.71	0.96	1.17	1.36	1.51	1.68	1.82	1.97	2.10	2.22
275	400	0.16	0.21	0.26	0.30	0.34	0.37	0.40	0.44	0.47	0.49
550	400	0.31	0.43	0.52	0.60	0.67	0.75	0.81	0.87	0.93	0.99
825	400	0.47	0.64	0.78	0.91	1.01	1.12	1.21	1.31	1.40	1.48
1100	400	0.63	0.86	1.04	1.21	1.34	1.50	1.62	1.75	1.86	1.97
1375	400	0.78	1.07	1.30	1.51	1.68	1.87	2.02	2.18	2.33	2.46
1650	400	0.94	1.28	1.56	1.81	2.02	2.24	2.43	2.62	2.80	2.96
275	500	0.20	0.27	0.32	0.38	0.42	0.47	0.51	0.55	0.58	0.62
550	500	0.39	0.53	0.65	0.76	0.84	0.94	1.01	1.09	1.16	1.23
825	500	0.59	0.80	0.97	1.13	1.26	1.40	1.52	1.64	1.75	1.85
1100	500	0.78	1.07	1.30	1.51	1.68	1.87	2.02	2.18	2.33	2.46
1375	500	0.98	1.34	1.62	1.89	2.10	2.34	2.53	2.73	2.91	3.08
1650	500	1.18	1.60	1.95	2.27	2.52	2.81	3.03	3.28	3.49	3.70
275	600	0.24	0.32	0.39	0.45	0.50	0.56	0.61	0.66	0.70	0.74
550	600	0.47	0.64	0.78	0.91	1.01	1.12	1.21	1.31	1.40	1.48
825	600	0.71	0.96	1.17	1.36	1.51	1.68	1.82	1.97	2.10	2.22
1100	600	0.94	1.28	1.56	1.81	2.02	2.24	2.43	2.62	2.80	2.96
1375	600	1.18	1.60	1.95	2.27	2.52	2.81	3.03	3.28	3.49	3.70
1650	600	1.41	1.93	2.34	2.72	3.02	3.37	3.64	3.93	4.19	4.44
275	700	0.27	0.37	0.45	0.53	0.59	0.65	0.71	0.76	0.82	0.86
550	700	0.55	0.75	0.91	1.06	1.18	1.31	1.42	1.53	1.63	1.72
825	700	0.82	1.12	1.36	1.59	1.76	1.96	2.12	2.29	2.45	2.59
1100	700	1.10	1.50	1.82	2.12	2.35	2.62	2.83	3.06	3.26	3.45
1375	700	1.37	1.87	2.27	2.65	2.94	3.27	3.54	3.82	4.08	4.31
1650	700	1.65	2.25	2.73	3.18	3.53	3.93	4.25	4.59	4.89	5.17

PRESSURE DROP N/M²

DIMENSIONS IN MM — AIRFLOW IN M³/SEC.

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
275	800	0.31	0.43	0.52	0.60	0.67	0.75	0.81	0.87	0.93	0.99
550	800	0.63	0.86	1.04	1.21	1.34	1.50	1.62	1.75	1.86	1.97
825	800	0.94	1.28	1.56	1.81	2.02	2.24	2.43	2.62	2.80	2.96
1100	800	1.25	1.71	2.08	2.42	2.69	2.99	3.23	3.49	3.73	3.94
1375	800	1.57	2.14	2.60	3.02	3.36	3.74	4.04	4.37	4.66	4.93
1650	800	1.88	2.57	3.12	3.63	4.03	4.49	4.85	5.24	5.59	5.91
275	900	0.35	0.48	0.58	0.68	0.76	0.84	0.91	0.98	1.05	1.11
550	900	0.71	0.96	1.17	1.36	1.51	1.68	1.82	1.97	2.10	2.22
825	900	1.06	1.44	1.75	2.04	2.27	2.53	2.73	2.95	3.14	3.33
1100	900	1.41	1.93	2.34	2.72	3.02	3.37	3.64	3.93	4.19	4.44
1375	900	1.76	2.41	2.92	3.40	3.78	4.21	4.55	4.91	5.24	5.54
1650	900	2.12	2.89	3.51	4.08	4.54	5.05	5.46	5.90	6.29	6.65
275	1000	0.39	0.53	0.65	0.76	0.84	0.94	1.01	1.09	1.16	1.23
550	1000	0.78	1.07	1.30	1.51	1.68	1.87	2.02	2.18	2.33	2.46
825	1000	1.18	1.60	1.95	2.27	2.52	2.81	3.03	3.28	3.49	3.70
1100	1000	1.57	2.14	2.60	3.02	3.36	3.74	4.04	4.37	4.66	4.93
1375	1000	1.96	2.67	3.25	3.78	4.20	4.68	5.05	5.46	5.82	6.16
1650	1000	2.35	3.21	3.90	4.54	5.04	5.61	6.06	6.55	6.99	7.39
275	1100	0.43	0.59	0.71	0.83	0.92	1.03	1.11	1.20	1.28	1.36
550	1100	0.86	1.18	1.43	1.66	1.85	2.06	2.22	2.40	2.56	2.71
825	1100	1.29	1.76	2.14	2.49	2.77	3.09	3.34	3.60	3.84	4.07
1100	1100	1.72	2.35	2.86	3.33	3.70	4.11	4.45	4.80	5.13	5.42
1375	1100	2.16	2.94	3.57	4.16	4.62	5.14	5.56	6.01	6.41	6.78
1650	1100	2.59	3.53	4.29	4.99	5.54	6.17	6.67	7.21	7.69	8.13
275	1200	0.47	0.64	0.78	0.91	1.01	1.12	1.21	1.31	1.40	1.48
550	1200	0.94	1.28	1.56	1.81	2.02	2.24	2.43	2.62	2.80	2.96
825	1200	1.41	1.93	2.34	2.72	3.02	3.37	3.64	3.93	4.19	4.44
1100	1200	1.88	2.57	3.12	3.63	4.03	4.49	4.85	5.24	5.59	5.91
1375	1200	2.35	3.21	3.90	4.54	5.04	5.61	6.06	6.55	6.99	7.39
1650	1200	2.82	3.85	4.68	5.44	6.05	6.73	7.28	7.86	8.39	8.87

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
SILDUCT REF	LENGTH	ATTENUATOR STATIC INSERTION LOSS – db							
22/6	600	5	9	15	24	28	30	28	24
22/9	900	7	12	21	35	41	43	39	35
22/12	1200	8	15	25	46	49	50	47	43
22/15	1500	10	18	29	50	50	50	50	47
22/18	1800	12	22	36	50	50	50	50	50
22/21	2100	14	26	41	50	50	50	50	50
22/24	2400	17	30	46	50	50	50	50	50

Melinex Lined Attenuators

The following static insertion losses are applicable where attenuator splitters are melinex faced.

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
UNIT REF	LENGTH	STATIC INSERTION LOSS (db)							
22/6 MP	600	7	11	15	24	15	20	23	30
22/9 MP	900	10	15	21	35	22	28	32	44
22/12 MP	1200	12	19	25	46	25	33	38	50
22/15 MP	1500	15	23	29	50	28	36	44	50
22/18 MP	1800	18	27	36	50	31	40	48	50
22/21 MP	2100	21	32	41	50	35	44	50	50
22/24 MP	2400	25	37	46	50	40	49	50	50

Dynamic Insertion Loss

The Dynamic Insertion Loss (D.I.L.) of an Attenuator is the resultant noise reduction achieved under specific conditions of airflow.

The D.I.L., is obtained by adding the sound energy generated by the Attenuator to the theoretical sound level leaving the unit.

In practice this can be calculated by arithmetic subtraction of the Static Insertion Loss (S.I.L.) from the entering system Sound Power Level and adding the result logarithmically to the Attenuator Generated Sound Power Level.

GENERATED POWER LEVEL

FACE VEL. M/SEC.	OCTAVE BAND CENTRES HZ							
	63	125	250	500	1K	2K	4K	8K
	GENERATED SWL – db re 10^{-12} WATTS							
-15	66	62	62	63	60	63	66	63
-13	63	60	60	60	59	62	63	58
-11	59	57	57	56	57	59	59	52
-9	55	53	54	51	55	57	54	44
-7	50	48	50	46	52	54	49	35
-5	42	40	44	39	48	50	42	22
+5	41	31	33	32	29	31	29	20
+7	50	41	41	40	35	38	37	31
+9	58	49	47	46	43	44	43	39
+11	63	55	52	51	48	49	49	45
+13	68	59	55	55	52	53	54	51
+15	71	63	60	58	55	56	58	55

FACE AREA ADJUSTMENT

Face Area (M²)	0.13	0.25	0.5	1.0	2.0	4.0	8.0
Adjustment	-6	-3	0	+3	+6	+9	+12

SPECIAL FEATURES

SILduct Attenuators are also available with special internal and external finishes and can be manufactured to individual material specifications including PVC, GRP, stainless steel and aluminium.

SILDUCT TYPE 33
N RANGE

Rectangular Attenuators

Technical Support

Sargents offers customers and specifiers of acoustical equipment a comprehensive technical support service. Experienced engineering teams can undertake project management, negotiations with Planning Authorities and Environmental Health Departments and provide measurement and analysis at all stages.

The Company's support services include measurement of the finished installation and provide "before" and "after" comparisons.

Bend Attenuators

For applications where space limitations preclude the installation of a straight attenuator, angled units are available both in standard sizes and as "specials" to suit the physical limitations of the installation.

PRESSURE DROP N/M²

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
300	300	0.16	0.22	0.27	0.31	0.35	0.39	0.42	0.44	0.47	0.49
600	300	0.32	0.44	0.55	0.63	0.70	0.77	0.84	0.89	0.94	0.98
900	300	0.48	0.66	0.82	0.95	1.06	1.16	1.26	1.33	1.41	1.47
1200	300	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
1500	300	0.79	1.11	1.37	1.58	1.76	1.93	2.09	2.22	2.34	2.45
1800	300	0.95	1.33	1.64	1.89	2.11	2.32	2.51	2.67	2.81	2.94
300	400	0.21	0.30	0.36	0.42	0.47	0.52	0.56	0.59	0.63	0.65
600	400	0.42	0.59	0.73	0.84	0.94	1.03	1.12	1.19	1.25	1.31
900	400	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
1200	400	0.84	1.18	1.46	1.68	1.88	2.06	2.23	2.37	2.50	2.62
1500	400	1.06	1.48	1.82	2.10	2.35	2.58	2.79	2.96	3.13	3.27
1800	400	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
300	500	0.26	0.37	0.46	0.53	0.59	0.65	0.70	0.74	0.78	0.82
600	500	0.53	0.74	0.91	1.05	1.17	1.29	1.40	1.48	1.56	1.64
900	500	0.79	1.11	1.37	1.58	1.76	1.93	2.09	2.22	2.34	2.45
1200	500	1.06	1.48	1.82	2.10	2.35	2.58	2.79	2.96	3.13	3.27
1500	500	1.32	1.85	2.28	2.63	2.93	3.23	3.49	3.71	3.91	4.09
1800	500	1.58	2.21	2.74	3.15	3.52	3.87	4.18	4.45	4.69	4.90
300	600	0.32	0.44	0.55	0.63	0.70	0.77	0.84	0.89	0.94	0.98
600	600	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
900	600	0.95	1.33	1.64	1.89	2.11	2.32	2.51	2.67	2.81	2.94
1200	600	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
1500	600	1.58	2.21	2.74	3.15	3.52	3.87	4.18	4.45	4.69	4.90
1800	600	1.90	2.66	3.28	3.78	4.22	4.64	5.02	5.34	5.63	5.89
300	700	0.37	0.52	0.64	0.74	0.82	0.90	0.98	1.04	1.09	1.14
600	700	0.74	1.03	1.28	1.47	1.64	1.81	1.95	2.07	2.19	2.29
900	700	1.11	1.55	1.92	2.21	2.46	2.71	2.93	3.11	3.28	3.43
1200	700	1.48	2.07	2.55	2.94	3.28	3.61	3.91	4.15	4.38	4.58
1500	700	1.85	2.58	3.19	3.68	4.11	4.51	4.88	5.19	5.47	5.72
1800	700	2.22	3.10	3.83	4.41	4.93	5.42	5.86	6.22	6.56	6.87

DIMENSIONS IN MM

AIRFLOW IN M³/SEC.

PRESSURE DROP N/M²

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
300	800	0.42	0.59	0.73	0.84	0.94	1.03	1.12	1.19	1.25	1.31
600	800	0.84	1.18	1.46	1.68	1.88	2.06	2.23	2.37	2.50	2.62
900	800	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
1200	800	1.69	2.36	2.92	3.36	3.75	4.13	4.46	4.74	5.00	5.23
1500	800	2.11	2.95	3.65	4.20	4.69	5.16	5.58	5.93	6.25	6.54
1800	800	2.53	3.54	4.38	5.04	5.63	6.19	6.70	7.11	7.50	7.85
300	900	0.48	0.66	0.82	0.95	1.06	1.16	1.26	1.33	1.41	1.47
600	900	0.95	1.33	1.64	1.89	2.11	2.32	2.51	2.67	2.81	2.94
900	900	1.43	1.99	2.46	2.84	3.17	3.48	3.77	4.00	4.22	4.41
1200	900	1.90	2.66	3.28	3.78	4.22	4.64	5.02	5.34	5.63	5.89
1500	900	2.38	3.32	4.10	4.73	5.28	5.81	6.28	6.67	7.03	7.36
1800	900	2.85	3.99	4.92	5.67	6.33	6.97	7.53	8.00	8.44	8.83
300	1000	0.53	0.74	0.91	1.05	1.17	1.29	1.40	1.48	1.56	1.64
600	1000	1.06	1.48	1.82	2.10	2.35	2.58	2.79	2.96	3.13	3.27
900	1000	1.58	2.21	2.74	3.15	3.52	3.87	4.18	4.45	4.69	4.90
1200	1000	2.11	2.95	3.65	4.20	4.69	5.16	5.58	5.93	6.25	6.54
1500	1000	2.64	3.69	4.56	5.25	5.86	6.45	6.98	7.41	7.82	8.18
1800	1000	3.17	4.43	5.47	6.30	7.04	7.74	8.37	8.89	9.38	9.81
300	1100	0.58	0.81	1.00	1.15	1.29	1.42	1.53	1.63	1.72	1.80
600	1100	1.16	1.62	2.01	2.31	2.58	2.84	3.07	3.26	3.44	3.60
900	1100	1.74	2.44	3.01	3.47	3.87	4.26	4.60	4.89	5.16	5.40
1200	1100	2.32	3.25	4.01	4.62	5.16	5.68	6.14	6.52	6.88	7.19
1500	1100	2.90	4.06	5.02	5.78	6.45	7.10	7.67	·8.15	8.60	8.99
1800	1100	3.48	4.87	6.02	6.93	7.74	8.51	9.21	9.78	10.32	10.79
300	1200	0.63	0.89	1.09	1.26	1.41	1.55	1.67	1.78	1.88	1.96
600	1200	1.27	1.77	2.19	2.52	2.82	3.10	3.35	3.56	3.75	3.92
900	1200	1.90	2.66	3.28	3.78	4.22	4.64	5.02	5.34	5.63	5.89
1200	1200	2.53	3.54	4.38	5.04	5.63	6.19	6.70	7.11	7.50	7.85
1500	1200	3.17	4.43	5.47	6.30	7.04	7.74	8.37	8.89	9.38	9.81
1800	1200	3.80	5.31	6.57	7.56	8.45	9.29	10.04	10.67	11.25	11.77

DIMENSIONS IN MM

AIRFLOW IN M³/SEC.

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
SILDUCT REF	LENGTH	ATTENUATOR STATIC INSERTION LOSS – db							
33/6	600	5	8	14	20	27	29	23	18
33/9	900	6	10	17	27	34	35	27	22
33/12	1200	7	13	21	36	42	44	34	29
33/15	1500	9	16	26	42	47	49	39	33
33/18	1800	10	18	30	47	50	50	45	40
33/21	2100	11	21	34	50	50	50	49	45
33/24	2400	13	25	38	50	50	50	50	50

Melinex Lined Attenuators

The following static insertion losses are applicable where attenuator splitters are melinex faced.

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
UNIT REF	LENGTH	STATIC INSERTION LOSS (db)							
33/6 MP	600	7	10	14	20	14	19	19	22
33/9 MP	900	9	13	17	27	18	23	22	27
33/12 MP	1200	11	17	21	36	22	29	28	36
33/15 MP	1500	13	20	26	42	24	32	32	41
33/18 MP	1800	15	22	30	47	27	36	36	50
33/21 MP	2100	17	26	34	50	30	40	40	50
33/24 MP	2400	19	29	38	50	33	44	44	50

Dynamic Insertion Loss

The Dynamic Insertion Loss (D.I.L.) of an Attenuator is the resultant noise reduction achieved under specific conditions of airflow.

The D.I.L., is obtained by adding the sound energy generated by the Attenuator to the theoretical sound level leaving the unit.

In practice this can be calculated by arithmetic subtraction of the Static Insertion Loss (S.I.L.) from the entering system Sound Power Level and adding the result logarithmically to the Attenuator Generated Sound Power Level.

GENERATED POWER LEVEL

FACE VEL. M/SEC.	OCTAVE BAND CENTRES HZ							
	63	125	250	500	1K	2K	4K	8K
	GENERATED SWL – db re 10^{-12} WATTS							
-15	64	60	61	62	59	62	65	61
-13	62	58	59	58	57	60	61	56
-11	58	55	56	55	55	58	57	50
-9	54	52	53	50	54	56	53	43
-7	49	47	49	45	51	53	47	34
-5	41	39	43	38	49	49	41	22
+5	39	29	32	31	27	30	28	19
+7	49	40	40	38	35	36	35	30
+9	56	47	46	45	42	42	42	38
+11	62	53	51	50	46	47	47	44
+13	66	58	55	53	50	51	52	49
+15	70	62	58	57	53	54	56	54

AIRFLOW IN M³/SEC.

FACE AREA ADJUSTMENT

Face Area (M^2)	0.13	0.25	0.5	1.0	2.0	4.0	8.0
Adjustment	-6	-3	0	+3	+6	+9	+12

DESIGN SERVICE

Sargents offer a design service to ensure that equipment of the most suitable type and construction is selected to meet customers' specific requirements.

SILDUCT TYPE 44
N RANGE

Rectangular Attenuators

Attenuation Application & Principles

Attenuators basically consist of an arrangement of duct mounted absorbent splitters arranged with air-flow passages between them.

Attenuation is achieved by reflection, impedance and absorption.

These are dependant upon:

☐ The airway width in relation to splitter width

☐ The splitter absorption coefficient

☐ The overall attenuator length.

At the entry to and the exit from an attenuator a resistance to airflow is created. The entry loss and the internal frictional losses are normally considerably less than the discharge loss.

Sargents range of SILduct and SILcular silencers minimise the resistance to airflow by incorporating faired airway entry and discharge sections.

PRESSURE DROP N/M²

DIMENSIONS IN MM / AIRFLOW IN M³/SEC.

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
325	300	0.22	0.31	0.37	0.43	0.49	0.54	0.58	0.63	0.68	0.72
650	300	0.45	0.61	0.74	0.86	0.97	1.07	1.17	1.27	1.36	1.44
975	300	0.67	0.92	1.12	1.29	1.46	1.61	1.75	1.90	2.03	2.17
1300	300	0.89	1.22	1.49	1.71	1.94	2.14	2.34	2.53	2.71	2.89
1625	300	1.11	1.53	1.86	2.14	2.43	2.68	2.92	3.17	3.39	3.61
1950	300	1.34	1.84	2.23	2.57	2.91	3.21	3.50	3.80	4.07	4.33
325	400	0.30	0.41	0.50	0.57	0.65	0.71	0.78	0.84	0.90	0.96
650	400	0.59	0.82	0.99	1.14	1.29	1.43	1.56	1.69	1.81	1.92
975	400	0.89	1.22	1.49	1.71	1.94	2.14	2.34	2.53	2.71	2.89
1300	400	1.19	1.63	1.99	2.29	2.59	2.86	3.12	3.38	3.62	3.85
1625	400	1.49	2.04	2.48	2.86	3.23	3.57	3.89	4.22	4.52	4.81
1950	400	1.78	2.45	2.98	3.43	3.88	4.28	4.67	5.07	5.43	5.77
325	500	0.37	0.51	0.62	0.71	0.81	0.89	0.97	1.06	1.13	1.20
650	500	0.74	1.02	1.24	1.43	1.62	1.79	1.95	2.11	2.26	2.41
975	500	1.11	1.53	1.86	2.14	2.43	2.68	2.92	3.17	3.39	3.61
1300	500	1.49	2.04	2.48	2.86	3.23	3.57	3.89	4.22	4.52	4.81
1625	500	1.86	2.55	3.10	3.57	4.04	4.46	4.87	5.28	5.65	6.01
1950	500	2.23	3.06	3.72	4.29	4.85	5.36	5.84	6.34	6.78	7.22
325	600	0.45	0.61	0.74	0.86	0.97	1.07	1.17	1.27	1.36	1.44
650	600	0.89	1.22	1.49	1.71	1.94	2.14	2.34	2.53	2.71	2.89
975	600	1.34	1.84	2.23	2.57	2.91	3.21	3.50	3.80	4.07	4.33
1300	600	1.78	2.45	2.98	3.43	3.88	4.28	4.67	5.07	5.43	5.77
1625	600	2.23	3.06	3.72	4.29	4.85	5.36	5.84	6.34	6.78	7.22
1950	600	2.67	3.67	4.47	5.14	5.82	6.43	7.01	7.60	8.14	8.66
325	700	0.52	0.71	0.87	1.00	1.13	1.25	1.36	1.48	1.58	1.68
650	700	1.04	1.43	1.74	2.00	2.26	2.50	2.73	2.96	3.16	3.37
975	700	1.56	2.14	2.61	3.00	3.40	3.75	4.09	4.44	4.75	5.05
1300	700	2.08	2.86	3.47	4.00	4.53	5.00	5.45	5.91	6.33	6.74
1625	700	2.60	3.57	4.34	5.00	5.66	6.25	6.81	7.39	7.91	8.42
1950	700	3.12	4.28	5.21	6.00	6.79	7.50	8.18	8.87	9.49	10.10

PRESSURE DROP N/M²

DIMENSIONS IN MM / AIRFLOW IN M³/SEC.

WIDTH	HEIGHT	10	20	30	40	50	60	70	80	90	100
325	800	0.59	0.82	0.99	1.14	1.29	1.43	1.56	1.69	1.81	1.92
650	800	1.19	1.63	1.99	2.29	2.59	2.86	3.12	3.38	3.62	3.85
975	800	1.78	2.45	2.98	3.43	3.88	4.28	4.67	5.07	5.43	5.77
1300	800	2.38	3.26	3.97	4.57	5.17	5.71	6.23	6.76	7.23	7.70
1625	800	2.97	4.08	4.96	5.72	6.47	7.14	7.79	8.45	9.04	9.62
1950	800	3.56	4.89	5.96	6.86	7.76	8.57	9.35	10.14	10.85	11.55
325	900	0.67	0.92	1.12	1.29	1.46	1.61	1.75	1.90	2.03	2.17
650	900	1.34	1.84	2.23	2.57	2.91	3.21	3.50	3.80	4.07	4.33
975	900	2.00	2.75	3.35	3.86	4.37	4.82	5.26	5.70	6.1	6.50
1300	900	2.67	3.67	4.47	5.14	5.82	6.43	7.01	7.60	8.14	8.66
1625	900	3.34	4.59	5.58	6.43	7.28	8.03	8.76	9.50	10.17	10.83
1950	900	4.01	5.51	6.70	7.72	8.73	9.64	10.51	11.40	12.21	12.99
325	1000	0.74	1.02	1.24	1.43	1.62	1.79	1.95	2.11	2.26	2.41
650	1000	1.49	2.04	2.48	2.86	3.23	3.57	3.89	4.22	4.52	4.81
975	1000	2.23	3.06	3.72	4.29	4.85	5.36	5.84	6.34	6.78	7.22
1300	1000	2.97	4.03	4.96	5.72	6.47	7.14	7.79	8.45	9.04	9.62
1625	1000	3.71	5.10	6.20	7.14	8.09	8.93	9.74	10.56	11.30	12.03
1950	1000	4.46	6.12	7.44	8.57	9.70	10.71	11.68	12.67	13.56	14.43
325	1100	0.82	1.12	1.36	1.57	1.78	1.96	2.14	2.32	2.49	2.65
650	1100	1.63	2.24	2.73	3.14	3.56	3.93	4.28	4.65	4.97	5.29
975	1100	2.45	3.37	4.09	4.72	5.34	5.89	6.43	6.97	7.46	7.94
1300	1100	3.27	4.49	5.46	6.29	7.11	7.86	8.57	9.29	9.95	10.59
1625	1100	4.08	5.61	6.82	7.86	8.89	9.82	10.71	11.62	12.43	13.23
1950	1100	4.90	6.73	8.19	9.43	10.67	11.78	12.85	13.94	14.92	15.88
325	1200	0.89	1.22	1.49	1.71	1.94	2.14	2.34	2.53	2.71	2.89
650	1200	1.78	2.45	2.98	3.43	3.88	4.28	4.67	5.07	5.43	5.77
975	1200	2.67	3.67	4.47	5.14	5.82	6.43	7.01	7.60	8.14	8.66
1300	1200	3.56	4.89	5.96	6.86	7.76	8.57	9.35	10.14	10.85	11.55
1625	1200	4.46	6.12	7.44	8.57	9.70	10.71	11.68	12.67	13.56	14.43
1950	1200	5.35	7.34	8.93	10.29	11.64	12.85	14.02	15.21	16.28	17.32

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
SILDUCT REF	LENGTH	ATTENUATOR STATIC INSERTION LOSS – db							
44/6	600	4	6	12	18	22	24	16	10
44/9	900	5	9	16	26	32	33	21	11
44/12	1200	7	12	19	32	38	39	25	15
44/15	1500	8	14	23	38	44	46	28	17
44/18	1800	9	16	26	42	48	50	32	19
44/21	2100	10	18	29	45	50	50	35	22
44/24	2400	11	21	32	48	50	50	38	26

Melinex Lined Attenuators

The following static insertion losses are applicable where attenuator splitters are melinex faced.

OCTAVE BAND CRS – HZ		63	125	250	500	1K	2K	4K	8K
UNIT REF	LENGTH	STATIC INSERTION LOSS (db)							
44/6 MP	600	6	8	12	18	12	9	13	12
44/9 MP	900	8	11	16	26	17	12	17	14
44/12 MP	1200	10	15	19	32	20	14	21	19
44/15 MP	1500	12	18	23	38	23	16	23	21
44/18 MP	1800	13	20	26	42	25	19	26	24
44/21 MP	2100	15	22	29	45	27	22	28	27
44/24 MP	2400	16	25	32	48	30	25	31	32

Dynamic Insertion Loss

The Dynamic Insertion Loss (D.I.L.) of an Attenuator is the resultant noise reduction achieved under specific conditions of airflow.

The D.I.L., is obtained by adding the sound energy generated by the Attenuator to the theoretical sound level leaving the unit.

In practice this can be calculated by arithmetic subtraction of the Static Insertion Loss (S.I.L.) from the entering system Sound Power Level and adding the result logarithmically to the Attenuator Generated Sound Power Level.

GENERATED POWER LEVEL

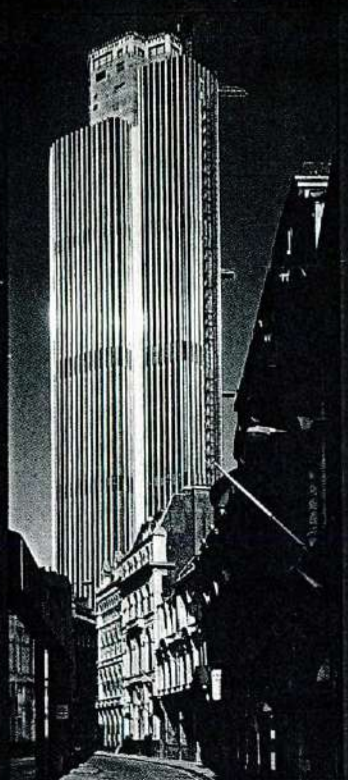
FACE VEL. M/SEC.	OCTAVE BAND CENTRES HZ							
	63	125	250	500	1K	2K	4K	8K
	GENERATED SWL – db re 10^{-12} WATTS							
-15	63	59	59	61	58	61	63	59
-13	60	57	57	57	56	59	60	54
-11	57	54	55	54	55	57	56	48
-9	53	50	52	49	53	55	52	42
-7	48	45	47	44	50	52	46	33
-5	40	38	41	37	47	49	40	22
+5	38	28	31	30	26	29	27	18
+7	48	38	38	37	34	35	34	29
+9	55	45	44	43	40	41	41	36
+11	60	51	49	48	45	45	46	42
+13	64	56	53	52	49	49	51	47
+15	68	60	57	55	52	53	55	52

FACE AREA ADJUSTMENT

Face Area (M^2)	0.13	0.25	0.5	1.0	2.0	4.0	8.0
Adjustment	-6	-3	0	+3	+6	+9	+12

NON-STANDARD ITEMS

Our manufacturing procedures allow for the construction of unusual shapes and materials to suit most requirements.



SARGENTS' EXPERTISE IN THE FIELD OF NOISE CONTROL HAS HELPED

Property Services Agency
National Westminster Bank
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Waterloo B.V., Industriestraat 3, Postbus 28, NL-7450 AA Holten, Netherlands. Tel: 01031 548364065. Fax: 01031 548364165

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SARGENTS
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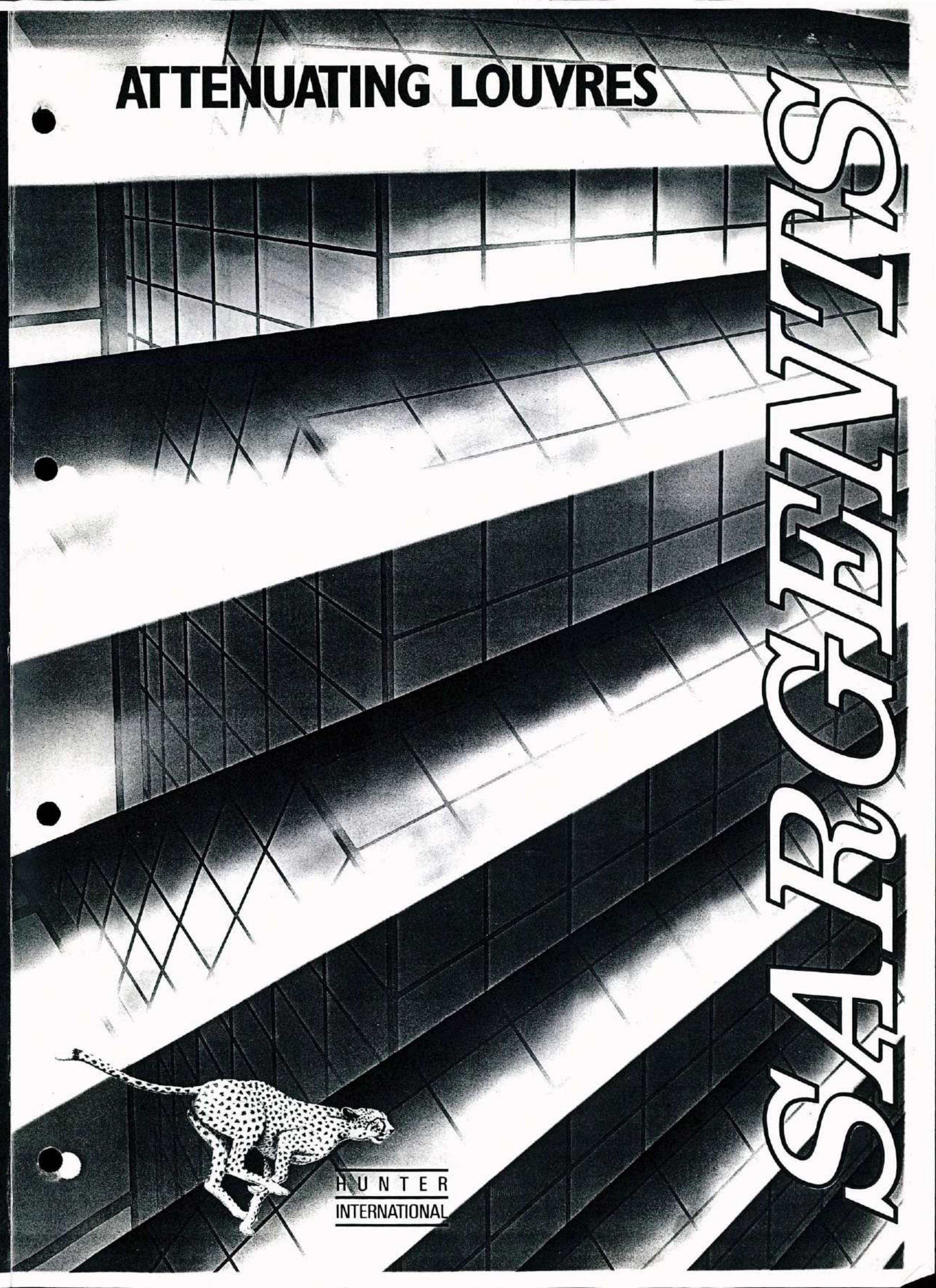
PLEASE NOTE CHANGE OF ADDRESS
Waterloo Air Management
Hunter International plc
Quarry Wood Industrial Estate, Aylesford
Maidstone, Kent ME20 7NB
Tel: 01622 717861 Fax: 01622 710648

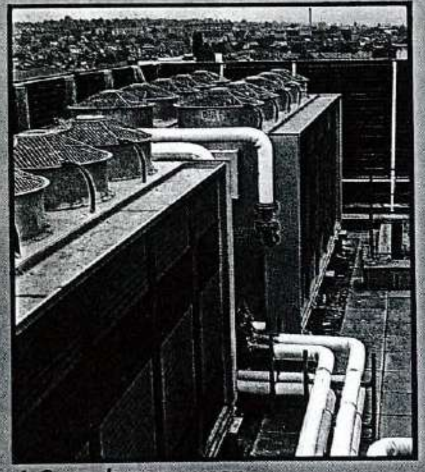


INTRODUCTION

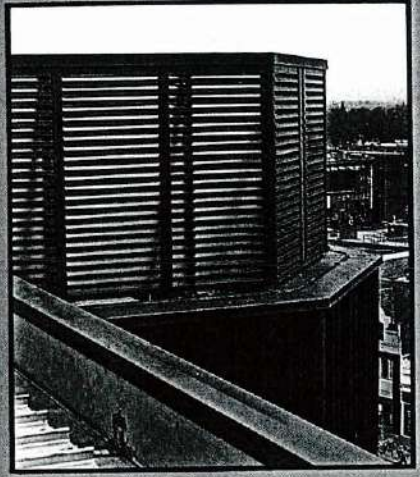
Noise emitted from plant through essential ventilation apertures can be effectively reduced by fitting attenuating louvres. Centrifugal fans handling large quantities of air in industrial applications and refrigeration equipment can be particularly noisy. One effective way of minimising the environmental impact of such machinery is to screen off the plant by means of silencer composed of horizontal acoustic spliters which will attenuate the noise, allow ingress of cooling air and have an aesthetically pleasing louvred appearance.

APPLICATION

Sargents' louvred screens are designed to provide maximum attenuation of plant noise whilst at the same time being robust and aesthetically pleasing. They are ideal for use in screening plant rooms, generator buildings and roof-mounted air conditioning plant. Test certificates can be provided to warrant conformity to specified criteria.

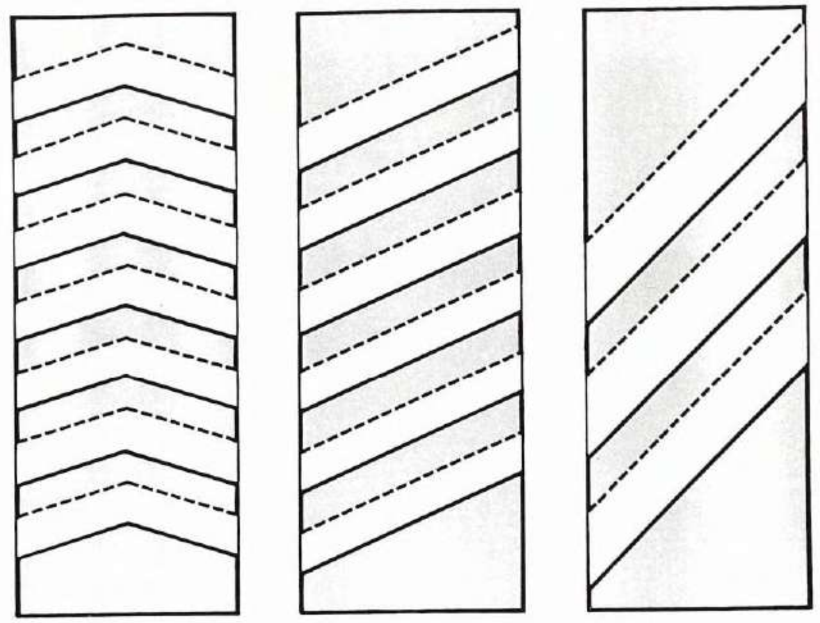


A.C.condenser screen



Roof mounted plant screen

ATTENUATING LOUVRE TYPES



TYPE LV TYPE SV TYPE WL

LOUVRE Type LV

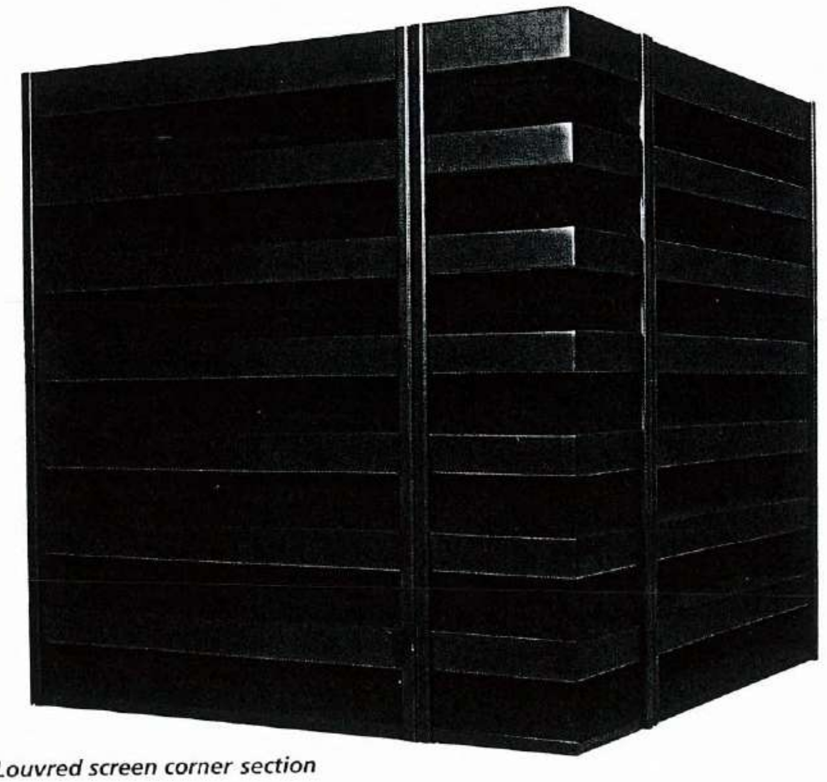
Particularly effective high-level plant rooms and screens where 'line-of-sight' through the louvre is undesirable.

LOUVRE Type SV

For use where weather resistance is important. Its low pressure drop characteristics make it ideal for fresh air inlet and discharge to atmospheric openings.

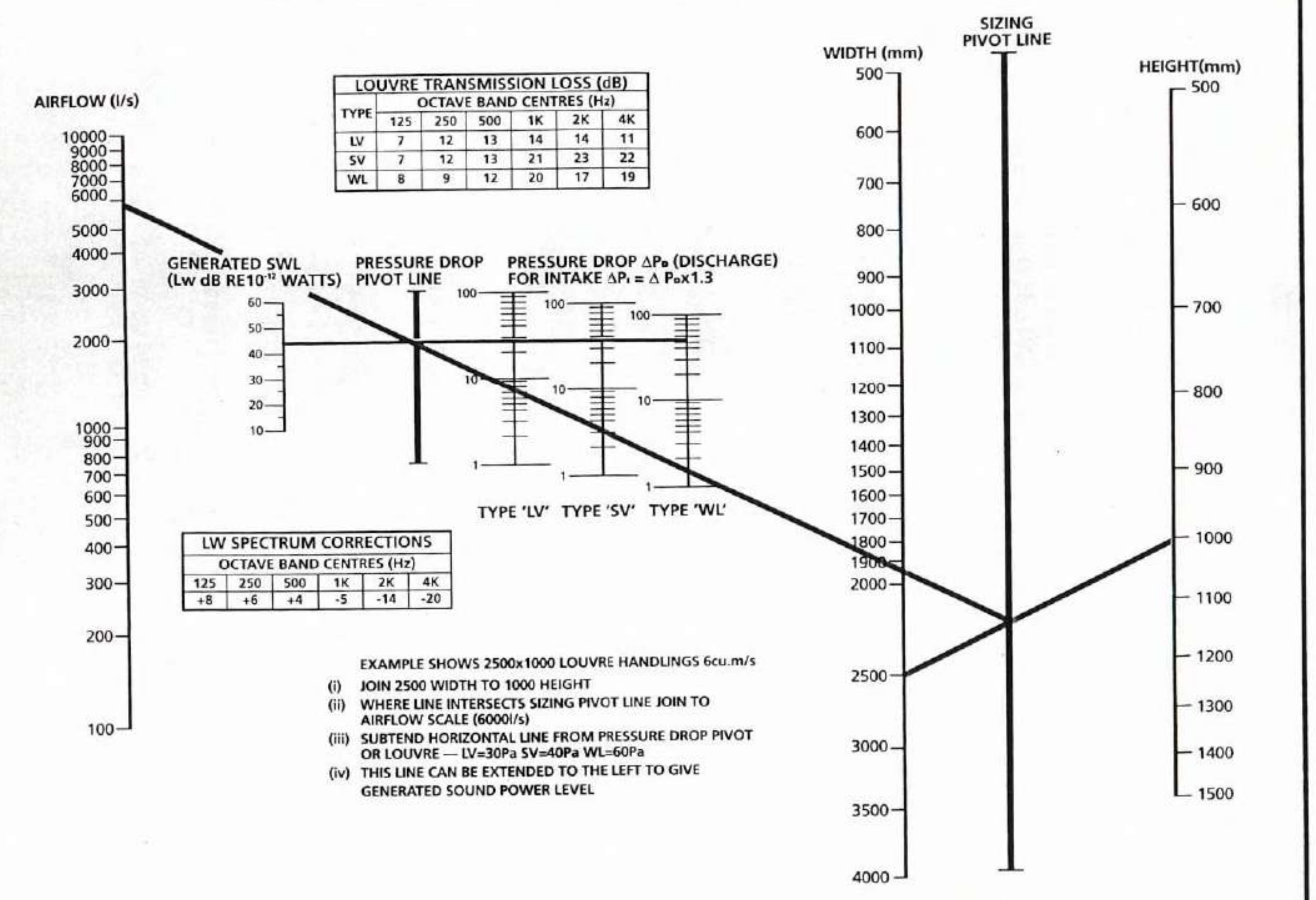
LOUVRE Type WL

A slightly larger blade format and steeper slope gives excellent attenuation characteristics coupled with good weather resistance. Not suitable for louvre heights of less than 600mm.



Louvred screen corner section

LOUVRE SELECTION/PERFORMANCE GUIDE



LOUVRE TRANSMISSION LOSS (dB)						
TYPE	OCTAVE BAND CENTRES (Hz)					
	125	250	500	1K	2K	4K
LV	7	12	13	14	14	11
SV	7	12	13	21	23	22
WL	8	9	12	20	17	19

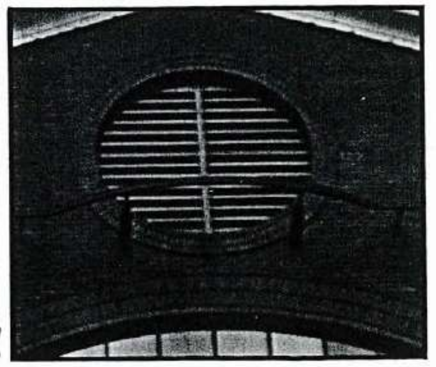
LW SPECTRUM CORRECTIONS					
OCTAVE BAND CENTRES (Hz)					
125	250	500	1K	2K	4K
+8	+6	+4	-5	-14	-20

EXAMPLE SHOWS 2500x1000 LOUVRE HANDLINGS 6cu.m/s

(i) JOIN 2500 WIDTH TO 1000 HEIGHT
(ii) WHERE LINE INTERSECTS SIZING PIVOT LINE JOIN TO AIRFLOW SCALE (6000l/s)
(iii) SUBTEND HORIZONTAL LINE FROM PRESSURE DROP PIVOT OR LOUVRE — LV=30Pa SV=40Pa WL=60Pa
(iv) THIS LINE CAN BE EXTENDED TO THE LEFT TO GIVE GENERATED SOUND POWER LEVEL

TESTING

The above performance data has been prepared from tests carried out in accordance with BS 2750 Part 3-1980 (ISO 140 Part III-1978) in our own laboratories and in an independent NAMAS accredited laboratory.



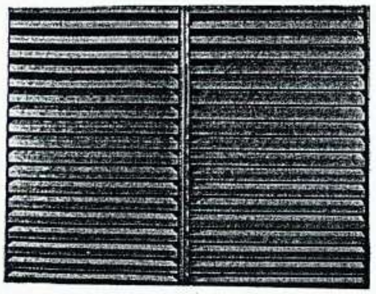
Circular plant room discharge louvre

Triangular make-up section

Non-standard Items

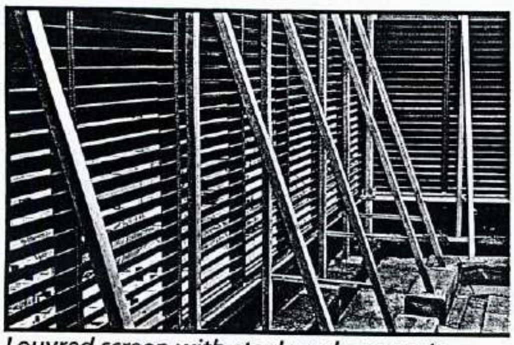
Our manufacturing procedures allow for the construction of unusual shapes and materials to suit most requirements.

CONSTRUCTION



Attenuating louvres are constructed from pre-galvanised mild steel in one of three profiles to suit a range of applications. Each hollow section has a perforated under-face and is filled with highly-absorbent mineral wool to provide maximum acoustic attenuation. The infill which is inert, vermin proof, non-combustible and non-hygroscopic is retained behind the perforations with a glass tissue interface to prevent entrainment of the absorbent medium.

Surface finish can be galvanised or painted to any industrial specification. Where required sections can be constructed from stainless steel sheet or aluminium. The louvres can also be fitted with additional screens to prevent ingress by birds, insects or sand.



Louvred screen with steel work supports

Each of the three louvre profiles is 300mm deep. For additional attenuation, sections can be mounted back-to-back. Panels can be constructed to a maximum width of 2400mm and to any height by adding additional louvres as necessary. Head and cill sections can be engineered to match any required shape. Where access is a problem, units can be delivered in kit form for site assembly.

DESIGN & INSTALLATION

Design Service

Sargents offer a design service to ensure that louvres of the most suitable type and performance are specified for each application to meet the architect's aesthetic and noise reduction criteria. A range of individual datasheets is also available for reference.

Drawing office

Each project is individually designed to the highest engineering standards covering acoustical performance, airflow characteristics, construction, manufacturing and structural aspects. Certificates of Conformity to specified criteria can be provided.

Computer aided design

Installation service

Sargents have their own installation department and can undertake erection of Attenuating Louvres anywhere in the UK or Europe.

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REGISTERED COMPANY

SARGENTS ACOUSTICS LIMITED
THE ALDERS, MEREWORTH,
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Department 'C' Advertising 2/92/SK Printed in England

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Draft for client approval

WOODS GAINS LPCB APPROVAL

Woods of Colchester's JM and JM-H.T Series high temperature Axial Flow and Bifurcated fans for smoke control have been awarded the prestigious Loss Prevention Council Board (LPCB) Certification. The company is the first fan manufacturer to gain this important approval.

The LPCB Certification puts Wood's Fans on a list of approved building products for use in an overall Fire Safety Scheme. They are now included in the LPCB'S select product book sent to Fire Chiefs, Fire Safety Specialists, Building Contractors and Architects, which lists products approved by the insurance-based LPCB.

In many countries, particularly many European countries, the Far East and the Middle East, Building Regulations stipulate that an approved Fire Safety Programme must be implemented. Woods JM-HT Fans now with LPCB'S approval can contribute significantly to such a fire safety programme.

The LPCB certification is recognised world-wide as approving industry-leading products associated with this important fire safety application.

Woods products with LPCB accreditation are:-

315 - 1600mm JM Axial Fans at 200°C for 2 hours
315 - 1600mm JM Axial Fans at 300°C for 1 hour
315 - 1250mm JM Axial Fans at 400°C for 2 hours
630 - 1250mm JF Axial Fans with steel blades at 400°C for 2 hours
400 - 1250mm JM Bifurcated Fans at 200°C for 2 hours
400 - 15#250mm JM Bifurcated Fans at 300°C for 1 hour
400 - 1250mm JM Bifurcated Fans at 400°C for 2 hours
630 - 1250mm JF Bifurcated Fans with steel blades at 400°C for 2 hours
400 - 1250mm JF Bifurcated Fans with steel blades at 600°C for 1.½ hours

The approved products underwent rigorous tests to prove their suitability for emergency ventilation at independent laboratories, including TU in Germany and CITM in France. Tests have been witnessed by the LPCB as well as French, German and other national authorities.

MORE

LPCB Senior Certifying Officer, Andy James said, "Wood's products went through a very strict performance review, beyond just performance testing. All data is reviewed and analysed before we put our stamp of certification on fans for use in fire safety".

"The LPCB has been working with Woods on a project-by-project basis for a few years now and we know that Woods' Production Facilities and Laboratories are high quality and staffed with specialist engineers. We are proud to have Woods as our **first** fan manufacturing company to gain our certification"

Woods of Colchester's Product & Applications Manager, Paul Wenden said - "We helped create the market for using fans as part of a fire safety programme and this certification re-affirms our position as a world leader. We're hoping to grow this market sector further and are committed to research and development in air movement technology for this purpose". "By insisting on, and specifying L.P.C.B approved products, regulators and consultants can now help raise the standards for fan products used to power fire smoke control systems."

For more information on Woods' high temperature fans, contact Paul Wendon on:-

Telephone:	01206-544122
Fax:	01206 574434
"E" Mail Enq.	@ woods-fans.com.

Woods is a foundling member of the UK Smoke Venting Association and participants in the CEN Committee on Smoke Control. A GEC Company, Woods is registered to BS EN ISO 9001: 1994 for quality assurance, an "Investor in People" and a member of AMCA and the HEVAC Association. The company is based at Tufnell Way, Colchester, Essex CO4 5AR. Woods internet address is:- http:\www.woods-fans.com.

ENDS.

FSW/PR/Rel.LPCB/Woods
05 January 1998

For further details and discussion, please contact your local Sales Centre or Head Office in Colchester.

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Zambia
Telefax: 02 612 449

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Singapore
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Distribution and service available in all countries. Contact Woods Head Office.

Woods represented in over 70 countries Worldwide

For any further details of the representatives, please contact us below.

LEADERSHIP IN
AIR MOVEMENT
TECHNOLOGY

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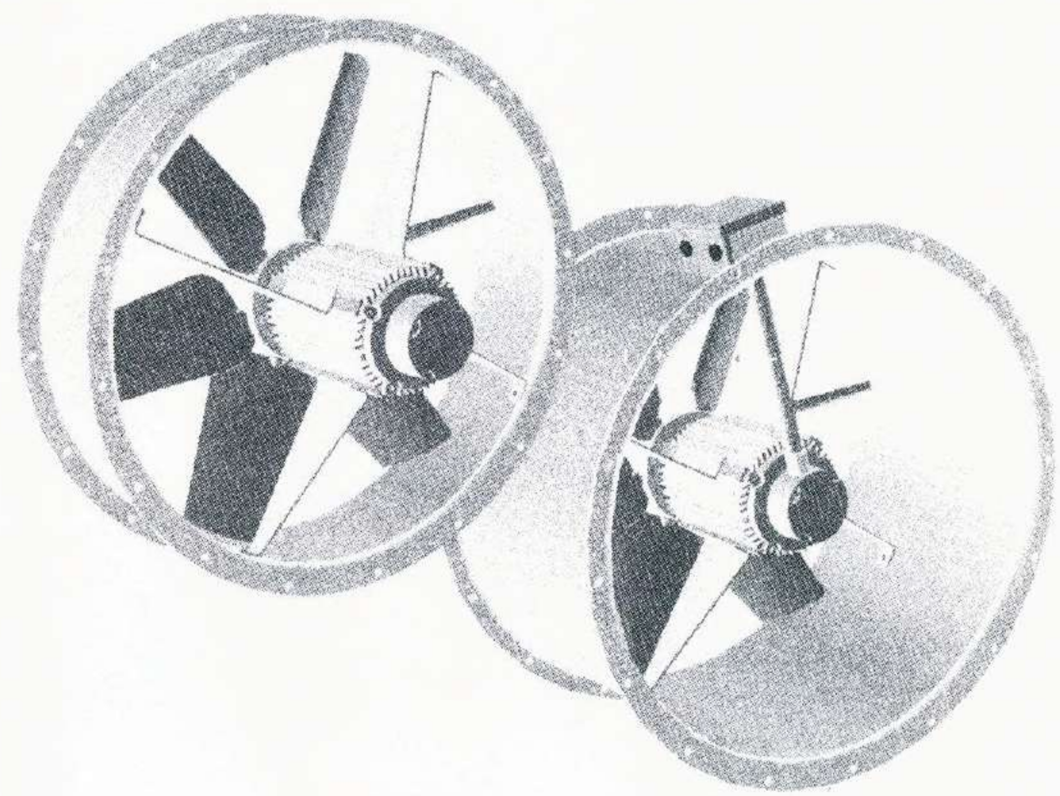
Due to a policy of continuous development and improvement the right is reserved to supply products which may differ from those illustrated and described in this publication. Certified dimensions will be supplied on request on receipt of order.

a GEC company

Part No. 414917
March 1998

Distributor

CASED AEROFOIL AND JETFOIL AXIAL FLOW FANS



Safety, Installation and Maintenance Instructions

BS5750 : Part 1
ISO 9001
EN 29001

Part No. 414917

Installation Operation and Maintenance Instructions for Cased Aerofoil and Jetfoil Axial Flow Fans

Safety
This product contains rotating parts and electrical connections which can be a danger and cause injury.

If the installer is unable to understand the information in this manual or there is any doubt that a safe and reliable installation of the equipment can be assured, the manufacturer or his agent should be contacted

1. Whatever the application, access from either side to the rotating parts must be prevented whilst the fan is operating. Guards are available for this purpose.
2. The fan must be earthed and no installation or maintenance work should be attempted without first switching off and isolating the fan and its controls from the electrical supply and allowing the rotating parts to come to rest.
3. The fan is intended for moving air and is not suitable for use in environments or for the purposes other than those specified in these instructions. If used improperly, or for different purposes without the prior agreement of Woods of Colchester Ltd. or their agents, then such use would be outside the scope of reasonably foreseeable circumstances and may be unsafe.
4. Do not re-use locking devices such as locking washers or wedge-lock screws.
5. If it is necessary to carry out any assembly operations before installing the fan, ensure that all fastenings are tightened correctly and proper use is made of lifting points.
6. The security of fastenings and the integrity of components should be checked regularly as part of the routine maintenance operation. Particular attention should be paid to the impeller fastening screw.
7. It is the responsibility of the users to satisfy themselves that the fan is suitable for the conditions of use, and that installations and regular maintenance is carried out by personnel with the appropriate skills and in accordance with these instructions.

INTRODUCTION

The cased Aerofoil axial flow fans are designed to move air from one end of the casing to the other against a resistance. The Jetfoil Series of axial flow fans are designed to increase the momentum of air in a tunnel or subway. Neither Jetfoil or Aerofoil axial flow fans should be used for any other purpose. The maximum ambient temperature in which an individual fan may operate continuously is given on the nameplate. Standard fans are suitable for air containing free moisture but for air containing corrosive or flammable gases the installation should be treated with caution and if there is any doubt about the suitability of the fan for the application Woods local Sales Agent should be consulted. It is the responsibility of the users to satisfy themselves that the fans suitable for the conditions of use and that regular maintenance is carried out by personnel with the appropriate skills and in accordance with these instructions. Failure to comply with these instructions may invalidate the guarantee. Installers, users and maintainers are reminded of their duties under the UK Health and Safety at Work Act, the European Community Workplace, Machinery and Construction Products Directives and other national legislation on safety.

These instructions apply to standard fans supplied with a ‘continuous’ rating for use at operating temperatures up to the maximum shown on the rating plate. Where fans are supplied with an additional capability under emergency conditions of operation at a higher temperature for a specified period this will be shown on a separate label adjacent to the fan nameplate. For these fans additional precautions and procedures apply and reference should be made to Woods Instruction Leaflet Part No. 412111 for this information.

STORAGE

On receipt of the fans check that it is as ordered in all respects and undamaged. Also confirm that the site electrical supply in terms of voltage, frequency, number of phases and power rating comply with the details of the fan nameplate. In the event of damage or equipment incompatibility, Woods Service Centre should be contacted (see section headed Communications).

NOTE THAT THE FANS SHOULD NOT BE CONTROLLED BY A FREQUENCY INVERTER WITHOUT APPROVAL FROM WOODS OF COLCHESTER LTD.

All fans should be stored in a clean, dry, vibration free location. If the fans are to be stored for a period before installation, regular rotation of the impeller is recommended to prevent grease hardening and possible brinelling of the bearings. The impeller should not be in the same angular positions before and after rotation. If the fan is to be stored for an extended period an inspection by Woods' Service Centre before commissioning is advised.

When fans are retained in storage, access by un-authorised persons must be prevented with the use of guards, barriers or secure premises such that fan impellers which may be rotating do not present a hazard.

Extension of the standard warranty can be arranged. Contact the Service Department for a quotation.

MECHANICAL INSTALLATION

Proper precautions should be taken when handling or lifting fans. Generally flange holes or mounting feet holes can be used for lifting unless special lifting points are provided in which case these should be used. Particular care is necessary when moving short case fans with shaft horizontal, and some belt drive fans, where the motor position can make the fan less stable than other types. To obtain the specified performance, sharp bends in the ductwork systems should be avoided, particularly in the vicinity of the fan. Upstream ductwork connections must always reduce in area approaching fan and may have an equivalent cone angle of up to 60°. Downstream of the fan, any increase in area, due for example to a round - to - square transformation sections must not have an equivalent cone angle exceeding 45°.

Though it is not essential on fans with a motor rating of less than 1.5 kW, it is recommended that rubber-in-shear vibration isolators are fitted in order to minimise the transmissionof fluctuating forces into the support structure. In these circumstances, duct connections should be made via flexible joints and flexible electrical conduiting specified. The fan and ductwork must be closely aligned and the flexible connector sleeve must be nearly taut whilst fully overlapping the spigots on the matching flanges. Typical installations are shown in figures 1, 2 and 3. Note that the vibration isolators must be positions and/or packed to ensure a similar deflection and therefore load on each isolator.

Fans must be installed such that they are correctly positioned in accordance with the airflow and rotation direction arrows and. in the case of multi-stage fans, the sequence of stages identified on the nameplate - stage 1 is the upstream fan.

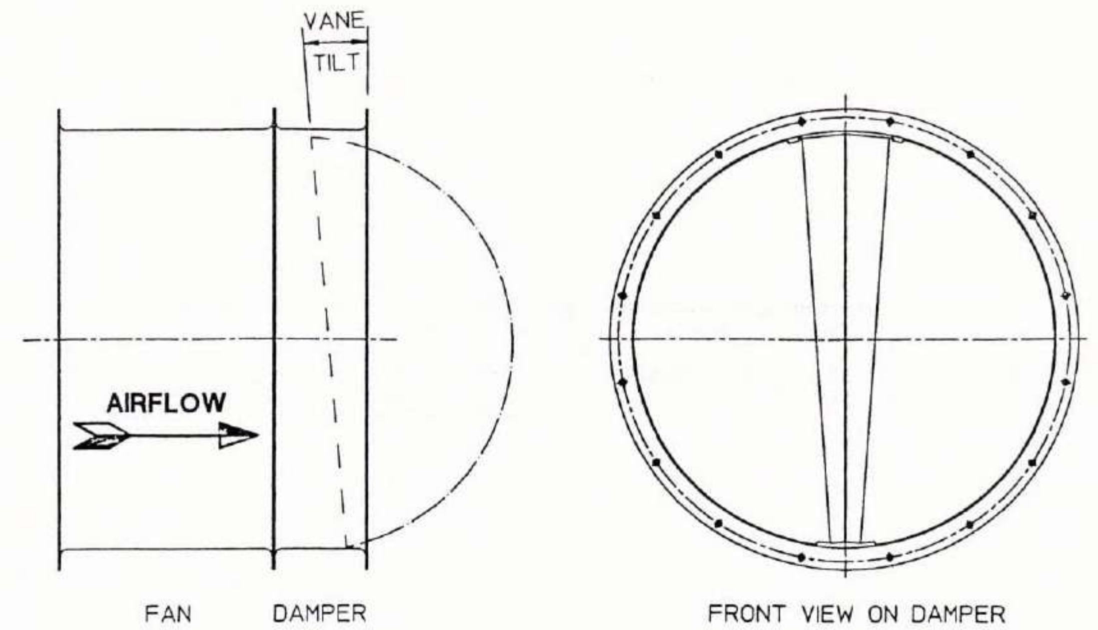
Most fans are supplied with weatherproof motors fitted with drain holes. In wet conditions, the fans should be installed with these at the lowest point. If the drain holes are plugged, the plugs should be removed before commissioning.

Bifurcated Aerofoil fans, when mounted horizontally, should have the motor tunnel opening at between 3 and 9 o'clock.

An essential part of a fan installation is ensuring the safety of the user. To this end safety guards are available. These should be specified and fitted whenever there is a risk of injury. It is the responsibility of the installer to satisfy himself that any such risk has been minimised.

Particular attention should be paid to the security of fastenings provided as part of the installation works, attachment of safety guards, flexible connector assemblies and vibration isolator fixings.

FIGURE 5



COMMUNICATIONS

Any queries regarding operating problems accompanied by the details shown on the motor nameplate should be referred to your local Woods Office or Agent.

Where a failure occurs whilst the product is under guarantee, the Woods of Colchester Ltd. Service Department should be contacted before any repair work is undertaken.

Telephone: (01206) 544122 Int. +44 (1206) 544122

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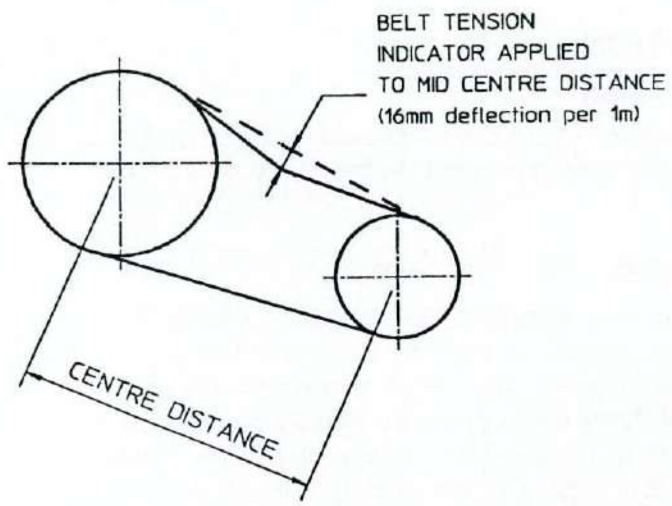
For a deflection of 16mm per metre of span:

Belt Section	Diameter of smaller pulley (mm)	Force for deflection (kg)
SPZ	67 - 95	1.3 to 2.0
	100 - 140	2.0 to 2.5
SPA	100 - 132	2.5 to 3.6
	140 - 200	3.6 to 4.6
SPB	160 - 224	4.6 to 6.6
	236 - 315	6.6 to 8.7

After tensioning the belts the alignment of the pulleys should be checked by holding a straight edge across their faces. These should be parallel and in line. For details of tensioning arrangement see figures 2 and 3.



DAMPER

Vanes and pivots should be assembled in accordance with figure 4 and all fixings tightened to the values shown in the table on page 9. It must be ensured that all end play is taken up in the bearings and the gaitors are packed with grease. Check vanes operate smoothly and fall back to the closed position in horizontal or vertical operation depending on application. Orientation of damper should be as shown in figure 5.

FIGURE 4

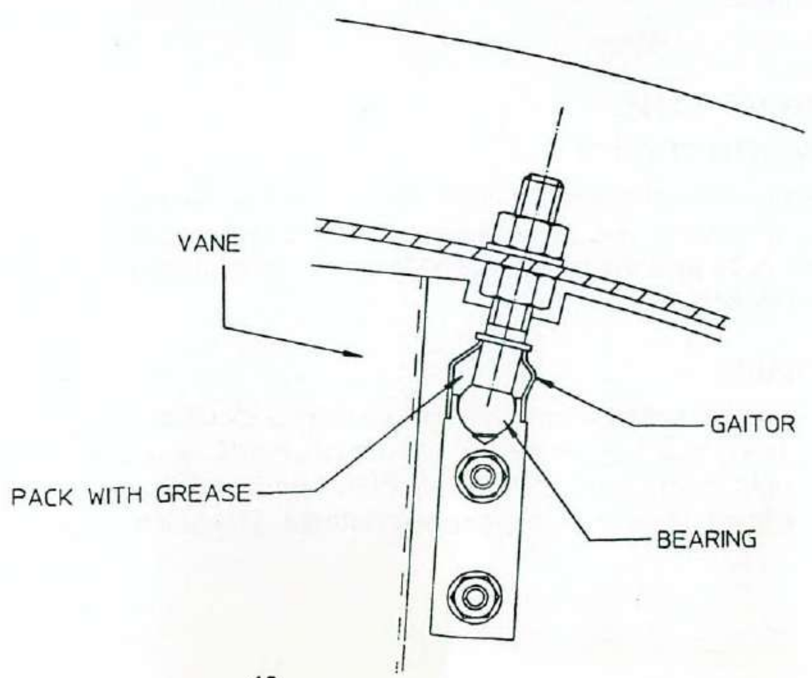


FIGURE 1

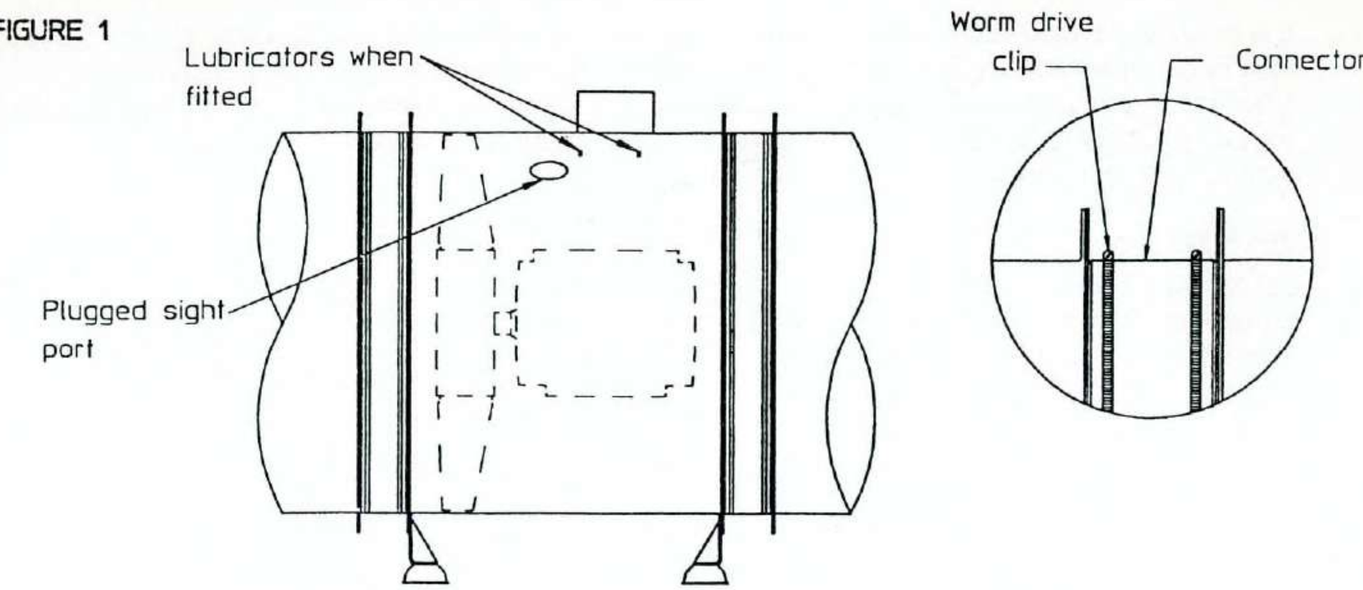


FIGURE 2

Belt driven fan

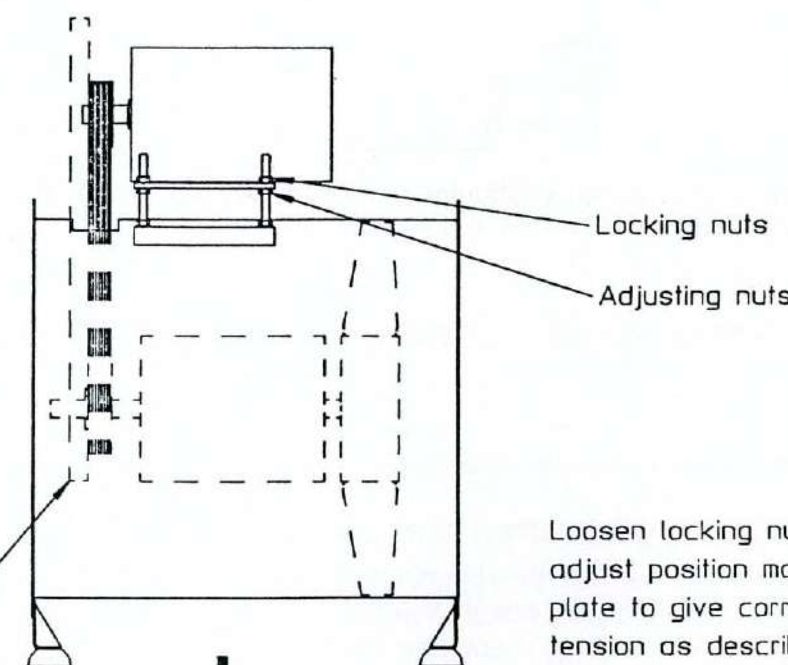
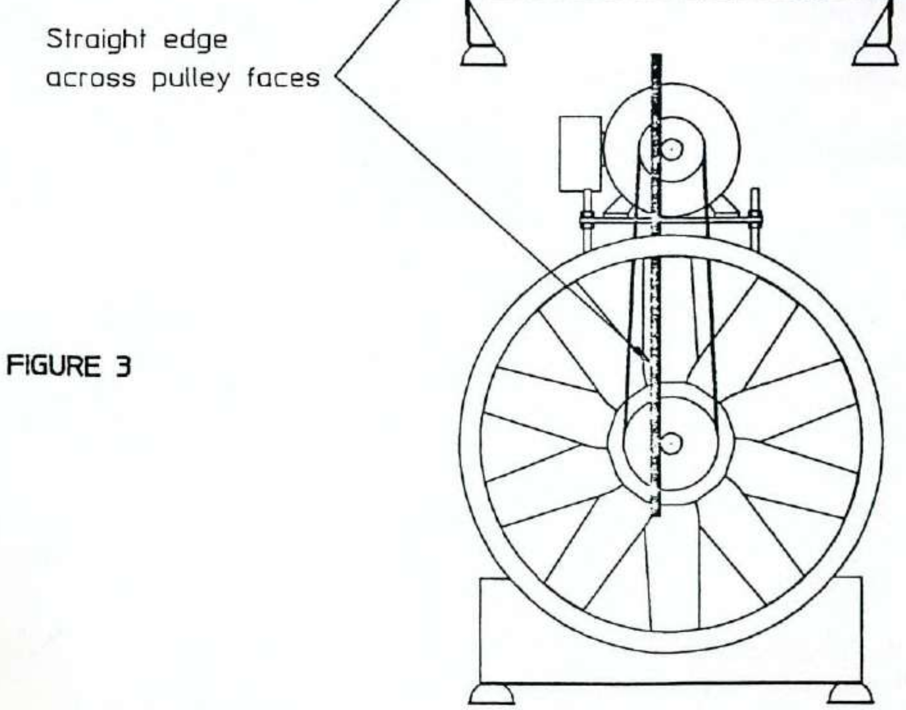


FIGURE 3

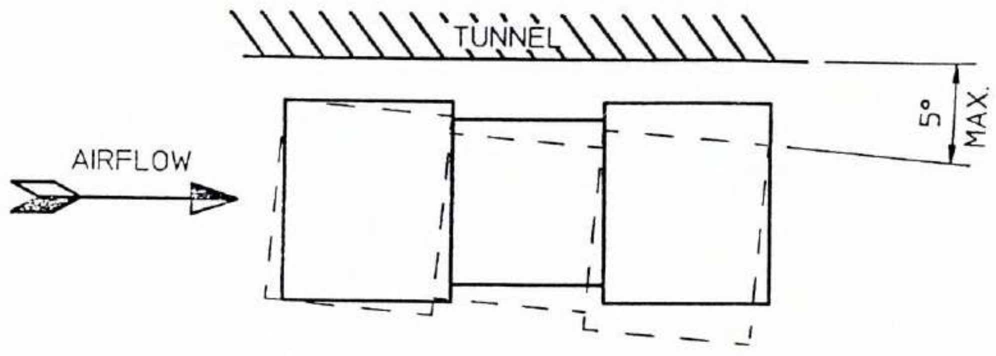


Loosen locking nuts and adjust position motor base plate to give correct belt tension as described in text and tighten adjusting nuts. Check for alignment of pulleys by holding a straight edge across their faces, pulleys should be parallel and in line.

It is strongly advised that adequate accessibility is made available to maintain and service the fan, This can range from simply making access available for normal inspection and maintenance for a small fan, to the provision of lifting rails and adequate space for demounting the fan, thus enabling major components to be changed, on larger fans, It is the responsibility of the building services contractor to ensure that proper accessibility is available to the fan.

JETFOIL

Jet foil fans should normally be installed with their axes parallel with that of the tunnel. Subject to agreement with the client, the discharge end of the Jetfoil may be depressed by up to 5° away from the tunnel wall or roof.



ELECTRICAL INSTALLATION

REGULATIONS

Electrical supply connections to the fan and earthing must be in accordance with the local regulations/supply authority or code of practice.

FANS WITH DUCT MOUNTED TERMINAL BOX

A duct mounted terminal box is provided with entries on opposite sides. Unused entries must be sealed with the rigid plug and locknuts provided. An additional entry is available for lower voltage ancillary supplies such as thermistor overheat protection or anti-condensation heaters on BT, CT, F22 motor frames. For larger motors, one of the four main entries can be used for ancillary supplies.
The fan must be earthed using the earth pillar provided on the side of the terminal box.

FANS WITH MOTOR MOUNTED TERMINAL BOX

Fans with motor mounted terminal box - BT, CT and F22 motor frames:
Remove the cable gland bush and sealing washer, Thread the cable through the gland assembly and wire to the terminal block. Tighten the bush just enough to compress the grommet to hold the cable and prevent ingress of water, Glands are not provided on larger motor frames.
Depending on the requirements of fan operation and control, ie. speed control, 2 speed etc. it may be necessary to select an alternative connection diagram for wiring up to the fan to that supplied in the motor terminal box. Appropriate diagram letter references will be marked on the motor nameplate on BT, CT and F22 motors - these relate to the diagrams on the following pages.

Other circuits if fitted are identified as follows:

HH	Anti-Condensation Heaters
TB1, TB2 or KK	Thermostatic Overheat Protection
T1, T2 or SS	Thermistor Overheat Protection (Operating Resistance 3k Ohms)

ASSEMBLY TORQUE Nm			
Size	Impeller Fixing	Nut & Bolt (GR 8.8)	Nut on Mild Steel Stud
M5	3.5	7	3.5
M6	6.0	12	6.0
M8	15.0	28	15.0
M10	30.0	55	30.0
M12	50.0	100	50.0
M16	120.0	245	120.0
M20	180.0	475	240.0
M24	–	820.5	410.0

BEARING LUBRICATION

BT AND CT MOTOR FRAMES

Bearing are supplied 'sealed for life' and should not normally require attention. Lubrication of bearings by customer is not recommended. In the event of a bearing failure, exchange motors can be supplied.

LARGER MOTOR FRAMES

Where lubrication facilities are supplied, re-lubrication should take place in accordance with the instructions on the fan or motor nameplate. A compatible greases type must be used and it is essential that every trace of water and dirt is removed from around the grease nipple and that a clean grease gun is used. Only a low pressure should be needed to inject the specified quantity of grease. If a high pressure is required the cause should be investigated. Grease nipples on long case fans are located in the region of the duct terminal box. On short case fans, the nipples are normally positioned on the motor end covers - one at each end of the motor.

IMPELLER SHAFT BEARINGS AND MOTORS WITH LUBRICATORS

Details of the relubrication period, and the quantity of the lubricant, is given on the motor nameplate. When carrying out relubrication it is essential that every trace of water and dirt is removed from around the grease nipple and that a clean grease gun is used. Only a low pressure should be needed to inject the specified quantity. If a high pressure is required the cause should be investigated.

BELT DRIVE FANS

GUARD VENTILATION

When the fan is used to handle clean air, no internal belt guard is fitted and the external belt guard is sealed. If there is dirt, excessive water or pollutants in the air, an internal guard is fitted to protect the belts and the external belt guard is ventilated. This ventilation must not be obstructed otherwise the belt may overheat.

BELT TENSION

After three months, and thereafter as experience dictates, the fan should be inspected to ensure that there is no build up of dirt or other matter that would obstruct the impeller track. The belt tension should be checked after the first few hours running (see diagram below) and thereafter as three monthly intervals or as experience dictates. The belt tension should be set as follows:

ELECTRICAL PROTECTION

Any fuses in the circuit should be regarded as protecting the wiring against the effects of short circuits or earth faults only. They are not suitable for overload protection. Fuse ratings must be sufficient to carry the starting current, which, if not specific information is available, may be taken as six times the nameplate current, for three second (three phase) or four times the nameplate current for twenty seconds (single phase).
To provide protection against a blown fuse or a bad contact, a starter with single phase protection must be used.
The overload current setting should be up to 1.15 times the nameplate current.
Motors fitted with thermistor or thermostatic overheat protection should be wired in accordance with the instructions supplied with the motor.

SPEED CONTROL BY VOLTAGE REGULATION

A wide range of Woods electronic and transformer speed controllers for both single and three phase supply are available. The use of an unsuitable speed controller can cause problems and invalidate the warranty.

STARTING

Before starting, the resistance to earth must be measured. If this is less than 10 megohm the motor should be dried out before applying the main voltage.
Ensure there are no loose objects in the duct system either side of the fan.
Starting of the fan may be carried out manually or automatically. The number of starts in a given time should be limited as follows:

4 direct on-line starts/hour.
2 starts in quick succession followed by 30 minutes cooling which may be achieved by either running or switching off.
Note: Motors up to 1kW are suitable for up to 8 starts/hour.

Motors may be supplied with protection to IP55 for outdoor operation. These motors must have the drain plug(s) at the lowest point of the motor, removed to convert to 'weatherproof' protection. To ensure the properlevel ofprotection, motor and duct terminal box lids must be correctly replaced after making electrical connections.
The motor running current should be checked to ensure that it is within the rated figure shown on the fan or motor nameplate.

MAINTENANCE

SAFETY

No maintenance work should be carried out without isolating the fan and its controls from the electrical supply, and allowing the impeller to come to rest.

DIRECT DRIVE AND BELT DRIVE FANS

The following should be checked regularly:

Motor fins Clean as necessary
Impeller Clean as necessary
Assembly running clearance and mounting fixings Tightness and even blade tip clearance should be confirmed and any fixings that are removed must be replaced by fixings having the same locking features and tightened to the torque figure in table below.
Tightness of ancillary fixings
Correct attachment of safety guards
On Bifurcated fans - unrestricted flow of cooling air through motor support tunnel

SINGLE PHASE

Though most fans have the capacitor fixed to the motor, for a few duties requiring two or more capacitors a boxed assembly will be provided, to be mounted separate from the fan.
Motors are wired for standard rotation. If the non-standard form of running is required then the winding leads U1 and U2 have to be interchanged at the fan terminal block.
Overheat protections is included providing automatic cut out in most cases, internally connected as supplied. These fans are liable to automatically re-start, therefore the fan must be isolated before attempting any maintenance work. If required the protector leads can be brought out, eg. to an external contactor for remote control. In this case remove the link between 'K' and 'UZ' and connect supply to 'UZ' and 'U'. when a speed controller is to be used, it is essential that the link between 'U' and 'P' is removed, as indicated on diagrams 'G' and 'H' page
The connection diagram letters will indicate all acceptable circuits.

First letter indicates constant speed
Second letter indicates variable speed

eg. AG CONNECTION

A = 1 Phase. Integral Capacitor with O/Heat Protector
G = 1 Phase. Integral Capacitor with O/Heat Protector used with Auto-Transformer or Electronic Controllers

Some single phase fans can be speed controlled by the 2 wire method, although Woods recommendation is to use the 3 wire method with its distinct advantages. The appropriate connection diagram letters are shown on the motor nameplate located on the periphery of the terminal box housing, which will indicate up to three possibilities.

WARNING With the preferred 3 wire circuit for speed regulation it is essential that the link between 'U' and 'P' is removed as indicate din diagrams G, H, J & K.

THREE PHASE

A trial connection should be made to check that the fan rotation is correct. If incorrect, interchange any two phases of the three phase supply. Overheat protection is not provided as standard.
Where a fan is suitable for speed control, this is indicated in the catalogue. The connection diagram letters will indicate up to three possibilities

First letter indicates constant speed
Second letter indicates variable speed by auto-transformer controller
Third letter indicates variable speed by electronic controller

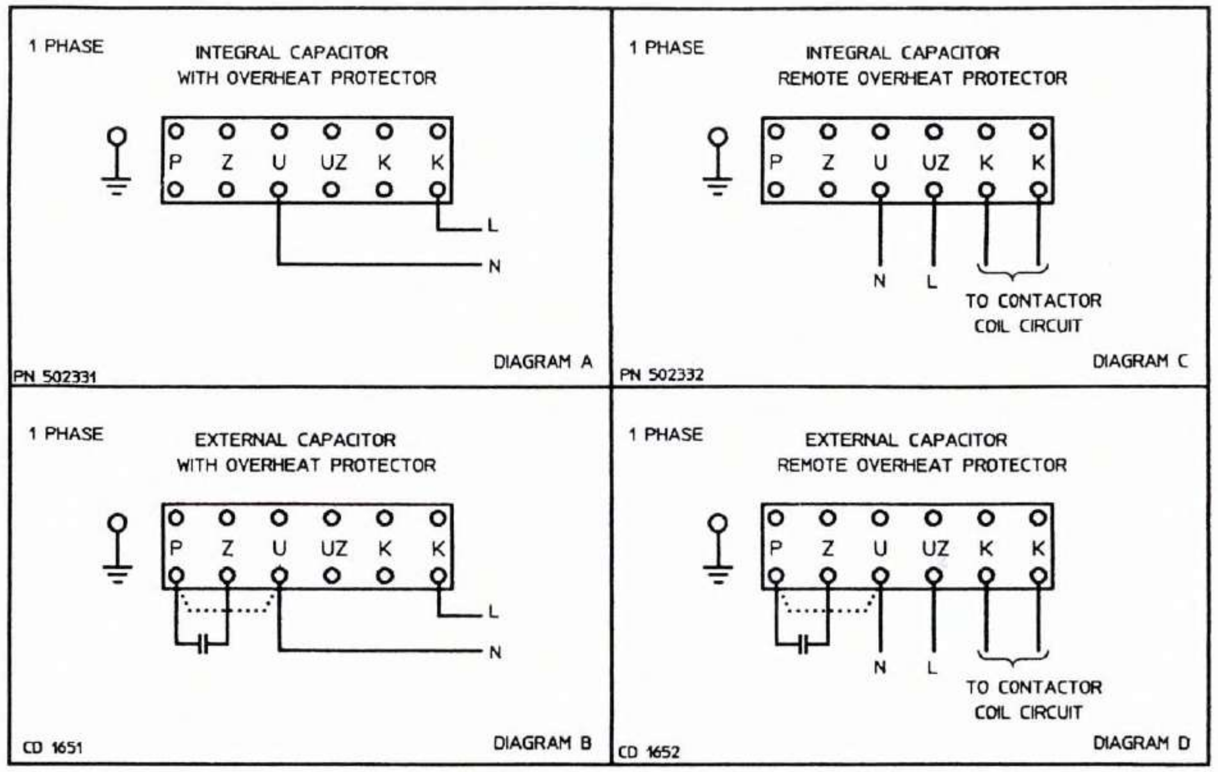
eg. ESP CONNECTION

E = 3 Phase Constant Speed (Dual Voltage Single Speed
S = 3 Phase with Auto Transformer Controller
P = 3 Phase with Electronic Controller

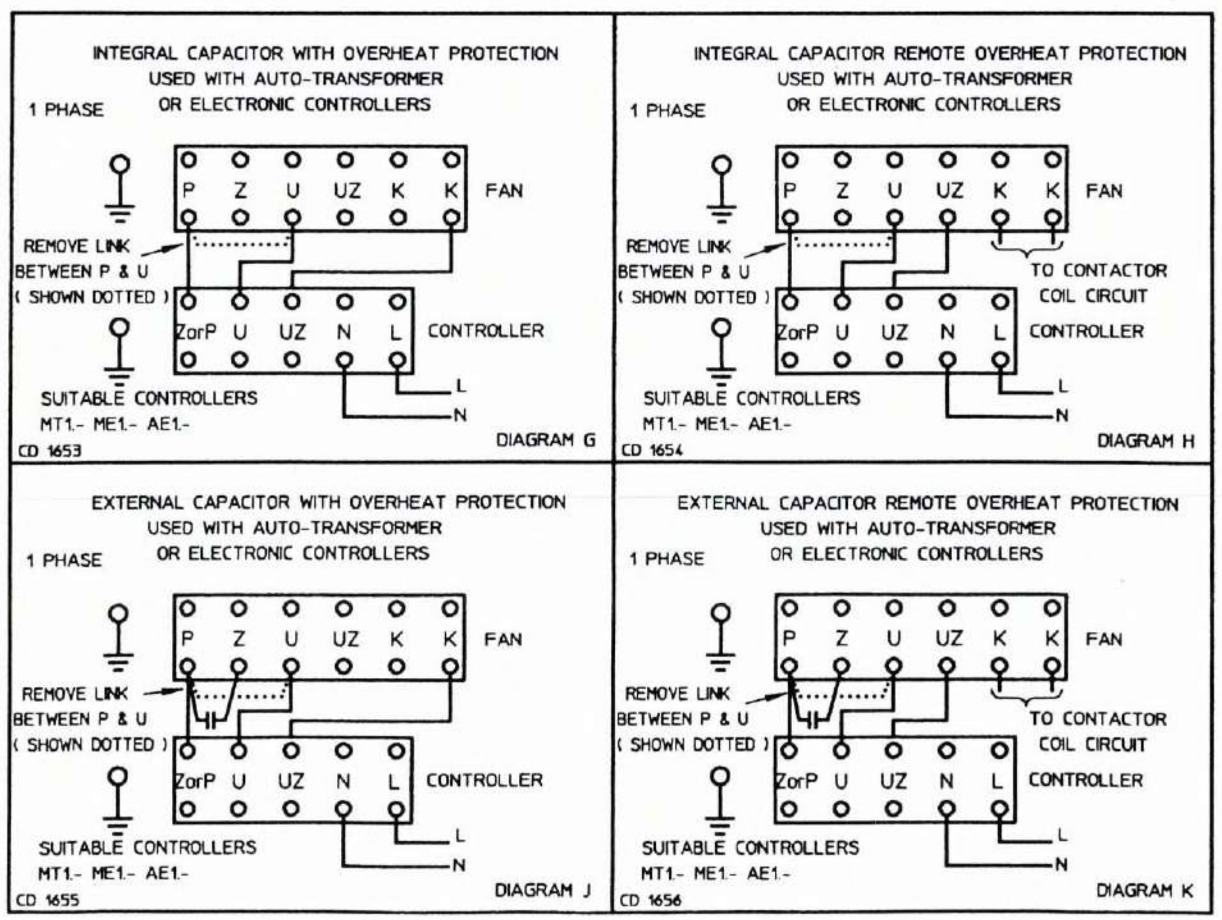
Certain selected sizes are supplied suitable for two speed as standard by the Delta/Star re-connection method, the lower speed being approximately 80% of full speed. This can be done by changing links on a permanent basis as diagram 'F' or using a special 6 pole changeover switch as shown in diagram 'X'. The switch selected should have an inductive current rating not less than the rated full load current for the fan.

SINGLE PHASE FANS
BT & CT MOTOR FRAMES IN S-TYPE FANS
for F22 motor frames and all L-type fans see diagram in terminal box

SINGLE SPEED FANS

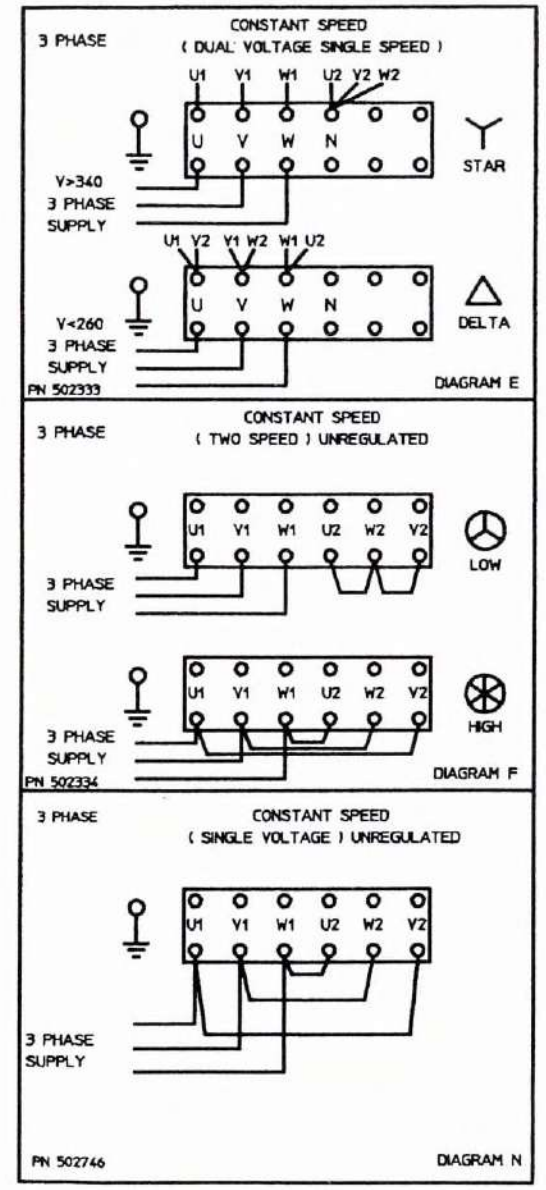


SPEED CONTROLLED FANS



THREE PHASE SINGLE SPEED FANS
BT & CT MOTOR FRAMES
for F22, D132 and D160 motor frames see diagram in terminal box

SINGLE SPEED FANS



SPEED CONTROLLED FANS

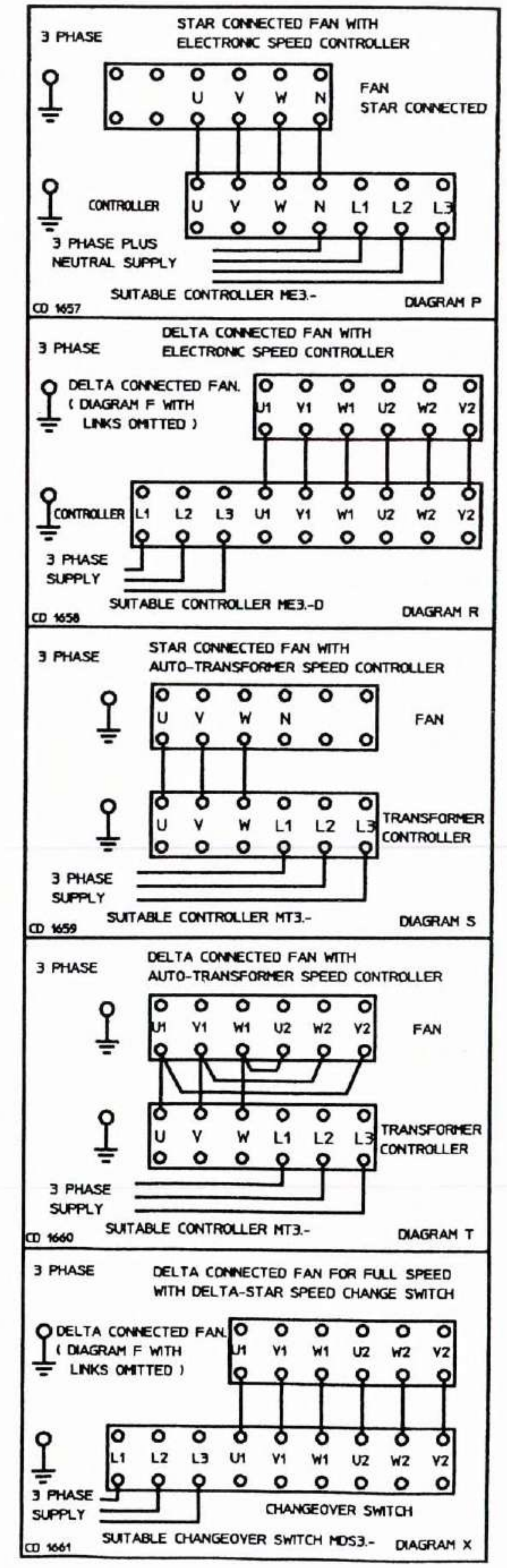


Figure 5 — Relubrication — Direct Drive Aerofoil Fans

Motor	Bearing DE ML	Bearing DE In^3	Bearing TE ML	Bearing TE In^3	Relubrication Period Hours, Nominal Speed Rev/min: Up to 3600	Up to 3000	Up to 1800	Up to 1500
AF5	0.6	0.04	0.6	0.04	16000	16000	32000	32000
AF7	0.75	0.05	0.75	0.05	16000	16000	32000	32000
AFP2061, 62, 22	4.0	0.25	3.5	0.20	8000	8000	16000	16000
AFP2024, 26, 65	5.0	0.30	4.0	0.25	8000	8000	16000	16000
AF20 Bif. (1)	5.0	0.30	4.0	0.25	8000	8000	16000	16000
AFP40	12.5	0.75	5.5	0.30	4000	4000	8000	16000
AFP50	17.5	1.1	8.5	0.50	4000	4000	8000	16000
F8	0.75	0.05	0.75	0.05	16000	16000	32000	32000
D63/71	2.0	0.10	2.0	0.10	8000	8000	16000	16000
F16	2.5	0.15	2.5	0.15	8000	8000	16000	16000
F16 (D80) F16A	3.5	0.20	3.5	0.20	8000	8000	16000	16000
F22	4.0	0.25	4.0	0.25	8000	8000	16000	16000
F22A	5.0	0.30	4.0	0.25	8000	8000	16000	16000
F32	10.5	0.65	4.0	0.25	4000	4000	8000	16000
D132	8.0	0.50	7.0	0.45	4000	4000	8000	16000
D160	12.5	0.75	8.0	0.50	4000	4000	8000	16000
D160/S	15.0	0.90	8.0	0.50	4000	4000	8000	16000
D180	15.0	0.90	9.0	0.55	4000	4000	8000	16000
D180/S	17.5	1.1	9.0	0.55	4000	4000	8000	16000
D200	20.0	1.2	12.0	0.75	2000	4000	8000	8000
D200/S	23.0	1.4	12.0	0.75	2000	4000	8000	8000
D200/A	23.0	1.4	23.0	1.4	2000	4000	8000	8000
D225	23.0	1.4	17.5	1.1	2000	4000	8000	8000
D225/A	23.0	1.4	17.5	1.1	2000	4000	8000	8000

Note: The periods apply to a temperature of 50°C. For each increase of 15°C the lubrication period should be halved.

(1) For high temperature bifurcated fans the lubrication period should be halved.

Figure 6 — Relubrication — Belt Driven Aerofoil Fans

Fan Code	Bearing Housing ML	Bearing Housing In^3	Relubrication Period — Hours, Nominal Speed — Rev/min: Up to 3600	Up to 3000	Up to 1800	Up to 1500
15BJG	4	.24	8000	8000	16000	16000
19BJG	6	.37	8000	8000	16000	16000
24BJG	8	.49	4000	8000	16000	16000
30BJG	9	.55	4000	4000	8000	8000
38BJG	13	.79	4000	4000	8000	8000

Periods refer to an air handling temperature of up to 65°C, for temperatures up to 80°C period should be halved. For motor relubrication refer to motor nameplate and instruction leaflet.

WOODS OF COLCHESTER LTD., Colchester, CO4 5AR, England

Telephone: 0206 44122 Telex: 98422 Woods G

PN. 400045 a GEC company 4/83

WOODS AIR MOVEMENT

AEROFOIL FANS

Installation, Operation and Maintenance Instructions

Site Storage

The fan must be stored in clean, dry conditions in a vibration-free area. Before installation the resistance to earth should be measured. If this is less than 1 megohm the motor should be dried out before applying main voltage. The impeller should be rotated occasionally to prevent hardening of the grease and corrosion of the bearings.

Supply

The details of the site supply must be checked to ensure that the voltage, frequency, power rating and number of phases comply with the details given on the fan name-plate.

Installation

The Aerofoil fan is supplied completely assembled and is tested at the factory. In dry conditions and unless otherwise stated, the fan may be mounted in any position; horizontally, vertically or inclined up to the sizes listed below:

48" – 1500 rev/min)
60" – 1000 rev/min) provided fans are not fitted
75" – 750 rev/min) with a motor frame D250 or larger
95" – 500 rev/min)

Weatherproof motors are provided with drain holes and in wet conditions must be mounted with the drain holes at the lowest point. If the drain holes are plugged the plugs must be removed before commissioning.

When installing the fan, sharp bends in the ductwork should be avoided in the vicinity of the fan. For optimum performance the connection to the ductwork should be by means of a smooth transformation duct with a 60° maximum effective included angle when the diameter decreases in the direction of airflow, or a 15° maximum effective included angle when it increases in the direction of airflow. The height of the fan supports should be adjusted so that no undue distortion of the fan casing or mounting occurs.

When anti-vibration mounts are used, flexible connectors and electrical conduit should also be used. The flexible connectors should be fitted so that they are almost taut and completely overlap the spigot on the matching flange. The fan should be aligned closely with the inlet and outlet ductwork and must be fitted in accordance with the airflow direction and rotation arrows shown on the nameplate. Typical installations are shown on figures 1 and 2.

When installing multi-stage fans refer to duct nameplate for stage number, stage 1 is installed in the upstream position, comply with airflow direction and rotation arrows. Aerofoil bifurcated fans when mounted horizontally should have the motor inlet/outlet tunnel positioned at 3 o'clock, 9 o'clock or vertically downwards (not upwards).

Connection

The wiring must be connected in accordance with the wiring diagram in the terminal box.

The direction of rotation is marked on the casing to comply with the form of running required. Single phase motors are despatched correctly connected. Three phase motors require a trial connection to the supply; if the rotation is incorrect, interchange any two phases of the 3 phase supply.

Not to be controlled by frequency inverter without approval from Woods of Colchester Ltd.

Earthing (Grounding)
The fan must be earthed in accordance with the requirements of the local supply authority or code of practice. A separate earth continuity conductor should be connected to the earthing screw in the terminal box.

Conduit
Wiring should be in accordance with the local regulations or code of practice. For flameproof motors see separate section.

Starting
Starting of the fan may be carried out manually or automatically. The number of starts in a given time should be limited as follows:

4 direct on line starts/hour.
2 reversals per hour with a run-down time of 5 seconds before reversal.
2 starts in quick succession followed by 30 minutes cooling, which may be achieved either by running or switching off.

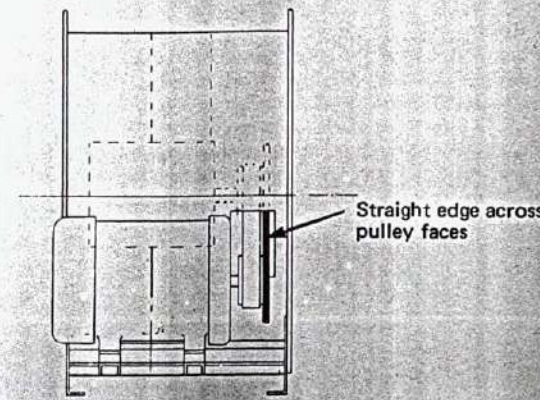
Note: Motors up to 1kW are suitable for up to 8 starts/hour.

Protection
Any fuses in the circuit should be regarded as protecting the wiring against the effects of short circuits or earth faults only. They are not suitable for overload protection. Fuse ratings must be sufficient to carry the starting current, which, if no specific information is available, may be taken as six times the nameplate current, for three seconds (three phase) or four times the nameplate current for 20 seconds (single phase).
To provide protection against a blown fuse or a bad contact, a starter with single phasing protection must be used.
The overload current setting should be up to 1.15 times the nameplate current.
Motors fitted with thermistor or thermostatic overheat protection should be wired in accordance with the instructions given.

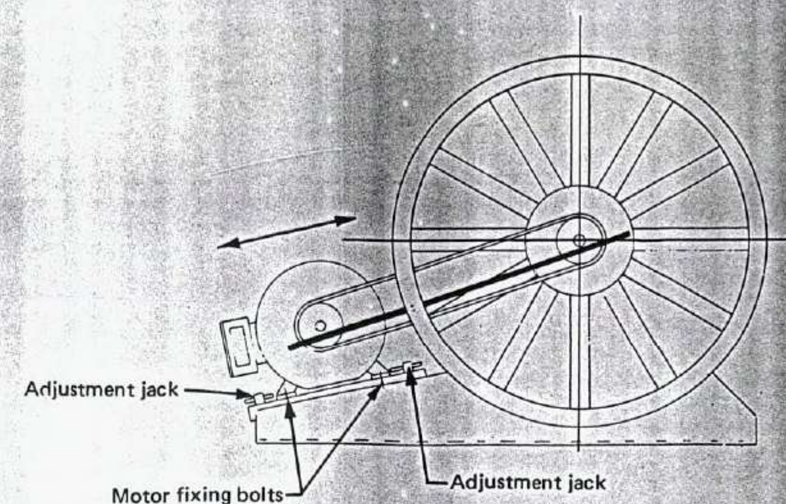
Operating Conditions
Standard fans are suitable for use in an ambient temperature of $-40^{\circ}C$ to $+40^{\circ}C$, except for belt driven fans which may be used up from 0° to $80^{\circ}C$, provided the motor is in an ambient from -20° to $40^{\circ}C$. The maximum ambient temperature in which an individual fan may be used is given on the nameplate. When fans are operating in ambient temperatures below $0^{\circ}C$ icing up must be avoided.
Standard fans are not suitable for handling air containing free moisture or corrosive fumes.

Routine Maintenance
After three months, and thereafter as experience dictates, the fan should be inspected to ensure that there is no build-up of dirt or other matter that would cause overheating of the motor or obstruct the impeller track.
The belt tension of Belt Driven Aerofoils should be checked after the first few hours running and thereafter at 3 monthly intervals or as experience dictates. The belt tension should be set as follows:

FIGURE 4



Loosen motor fixing bolts, and using adjustment jacks position motor on slides to give correct tension as described in text and tighten motor fixing bolts.
Check for alignment of pulleys by holding a straight edge across faces. Pulleys should be parallel and in line.



Conduit
Joints should be made through special flameproof junction boxes or unions throughout the hazardous area.
At a point outside the hazardous area, the flameproof conduit system must be sealed off by a special junction box having a flameproof barrier. Beyond this point any standard method of wiring with non-flameproof control gear may be used. Glands and flexible cable should be used to connect to the fan when it is supported on resilient mountings.

Note 1
Access must be provided to the non-drive end of fans which are not fitted with casing terminal boxes for supply connection. Alternatively connection should be made before the fan is installed in the duct system.

Stopper Boxes
A stopper box, where fitted, must be filled with barrier compound when the connections have been completed.

Operating Conditions
Provided the motor is not allowed to become coated with dirt, dust, or other solid matter that would restrict surface cooling, the carcase temperature will never exceed 80°C when operating in the maximum ambient temperature of 40°C.
It is incumbent on users to satisfy themselves that this carcase temperature is safe under the conditions of use and with respect to the particular flammable media in the vicinity.

Note 2
Failure to comply with these instructions may invalidate the guarantee.

Safety
When installing or using products the following precautions should be taken.
1. No work should be carried out without switching off and otherwise isolating the machine from the electrical supply.
2. If it is necessary to carry out any assembly operations before installing the fan, ensure that all fastenings are tightened securely and that any lifting points provided are made use of.
3. The security of fastenings and the integrity of components should be checked regularly as part of the routine maintenance operation. Particular attention should be paid to impeller fastening screw.
4. Do not re-use locking devices such as locking washers or wedge-lock screws.
5. If the unit is installed where there is a reasonable possibility of persons or objects coming into contact with the impeller a guard should be fitted. It is the responsibility of the installer and the user to ensure that the installation complies with the local regulation and code of practice. NB: In U.K. – Health and Safety at Work Act 1974 Sections 2-1 and 6-3.
6. Where a unit is installed so that a failure of components could result in injury to personnel, precautions should be taken to prevent such an injury.

FIGURE 1

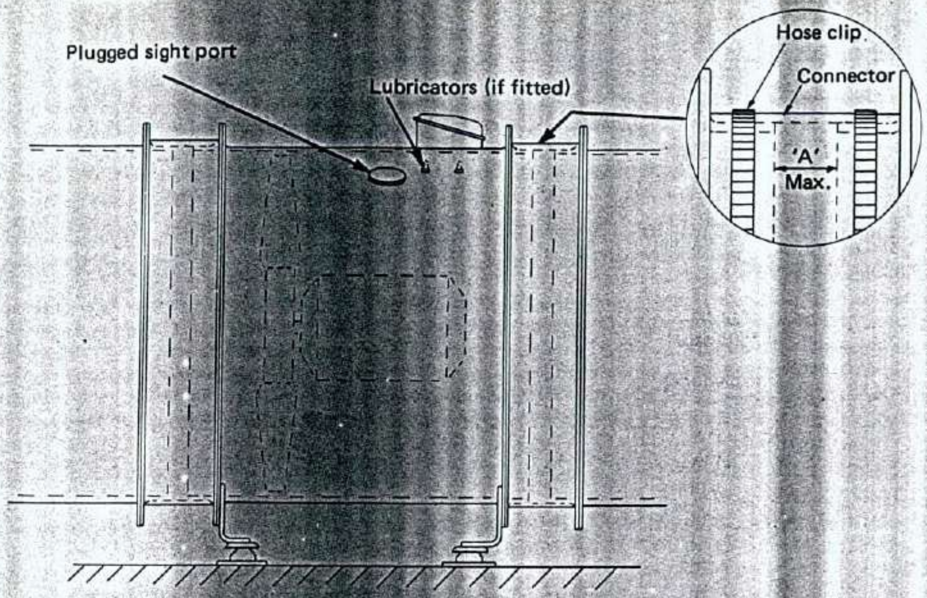


FIGURE 2

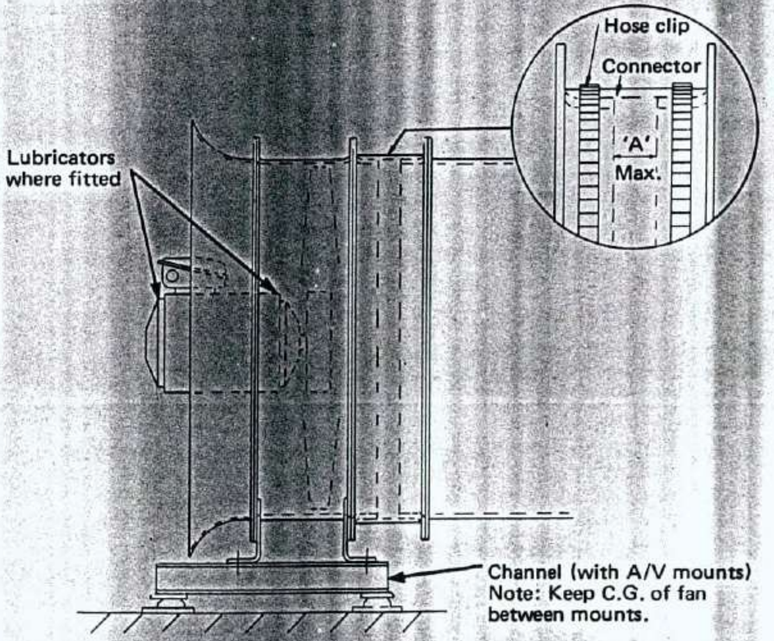
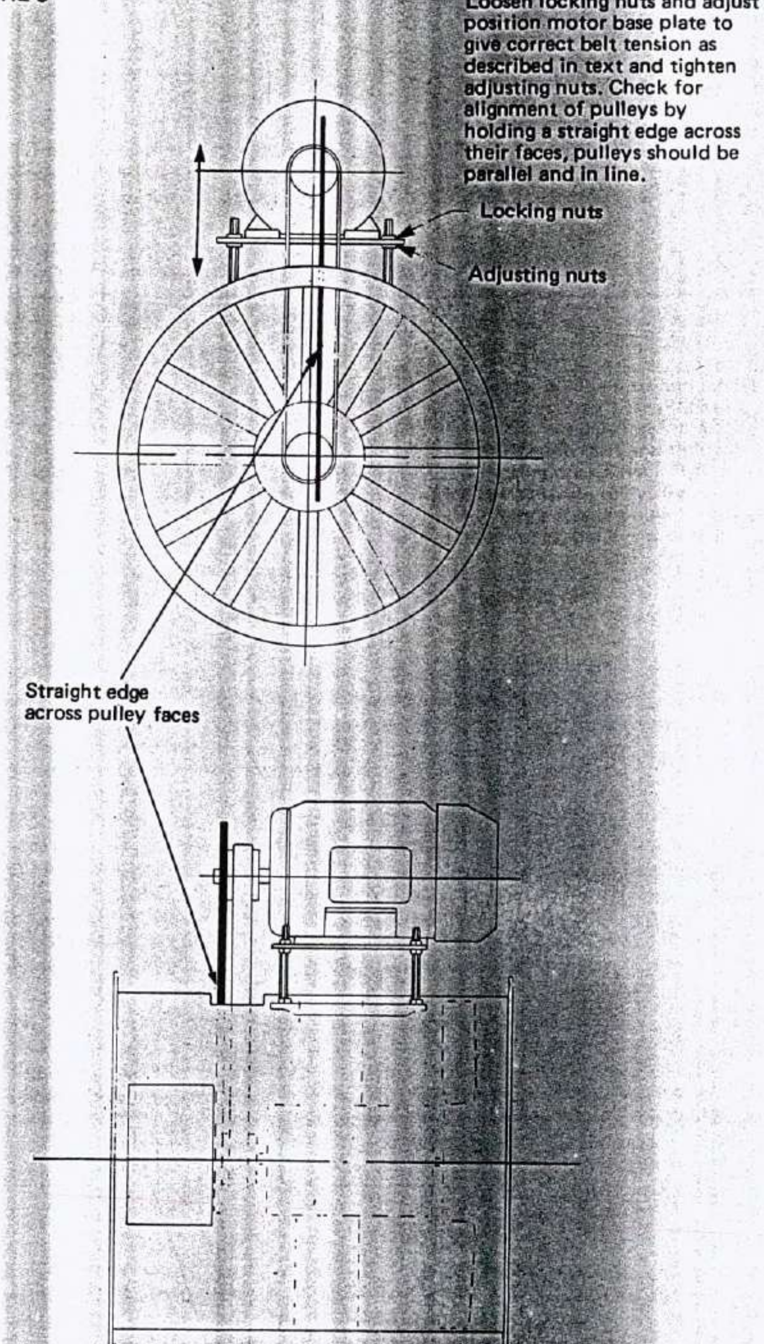


FIGURE 3



For a deflection of 16 mm per metre of span –

Belt Section	Diameter of Smaller Pulley (mm)	Force for Deflection (kg) Min	Max
SPZ	67 – 95	1.0	1.5
	100 – 140	1.5	2.0
SPA	100 – 132	2.0	2.7
	140 – 200	2.8	3.5
SPB	160 – 224	3.5	5.1
	236 – 315	5.1	6.6

After tensioning the belts the alignment of the pulley should be checked by holding a straight edge across their faces. These should be parallel and in line. For details of tensioning arrangement see Figures 3 and 4.

Lubrication

The fan is supplied lubricated with Shell Alvania RA Grease and does not require further lubrication until after the period specified.

Motors without Lubricators

If the fan is not fitted with lubricators it should be relubricated after twice the period shown in Figure 5. The relubrication period should be halved for each increase of 15°C above 50°C. Regardless of the period calculated, the relubrication period should not exceed 5 years.

To relubricate, the motor should be dismantled and the rotor removed complete with bearings. The old grease should be washed out with a good quality solvent. The bearings should then be refilled with grease, leaving the housing empty. If a bearing is removed from the rotor it should be discarded.

Motors with Lubricators and Bearing Housings

Details of the relubrication period and the quantity of lubricant are given on Figures 5 and 6. When carrying out relubrication it is essential that every trace of dirt and water is removed from around the grease nipple and that a clean grease gun is used. Only a low pressure should be required to inject the specified quantity. If a high pressure is required the cause should be investigated.

Additional Instructions for Flameproof Motors

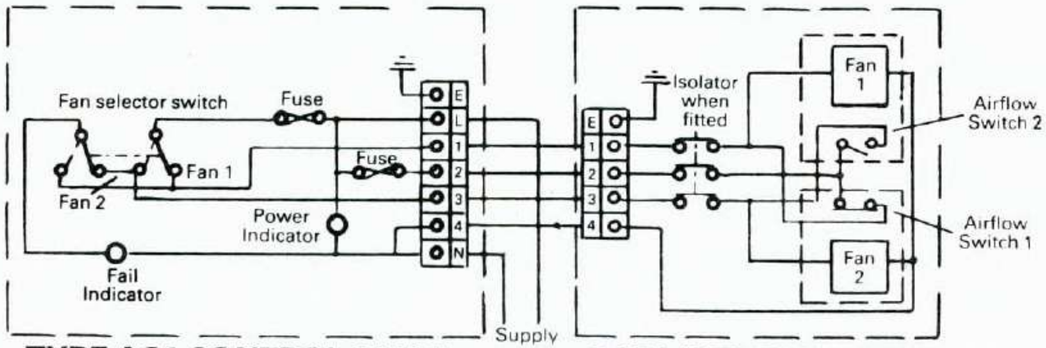
Flameproof Certificate

The fan motor has been granted a Certificate of compliance with either BS 229 for Groups II and III gases or BS 4683 Groups IIA and IIB gases.

Casing terminal boxes, when supplied as part of the fan, are covered by the same Flameproof Certificate.

Subject to the local regulations and the recommendations given under "Operating Conditions" in these instructions, the fan is suitable for use in flammable atmospheres such as are associated with petroleum products, cellulose solvents, etc. Capacitors, control gear, etc., supplied with these fans are not normally flameproof and should be installed outside the hazardous area.

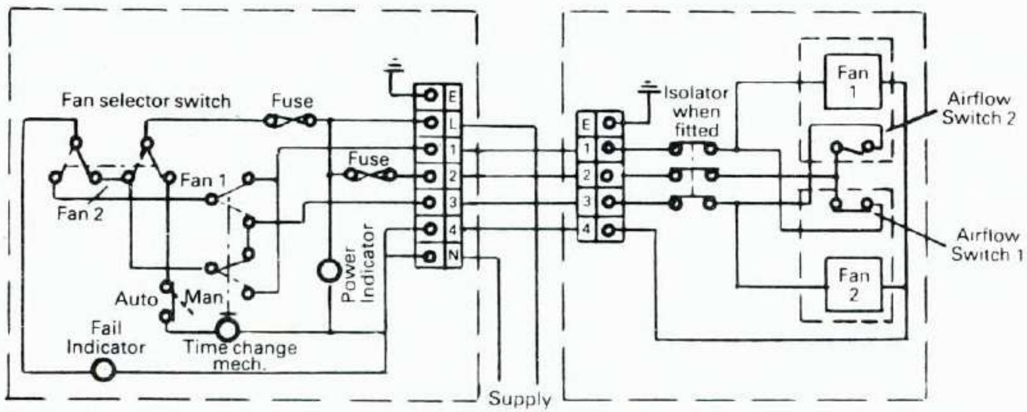
1 PHASE



TYPE AC1 CONTROL PANEL.
MANUAL SELECTION.

PARALLEL FAN UNITS
TYPE TF & DTF.
ALSO BTF AND BTFD.

①



TYPE ACDS 1 CONTROL PANEL.
AUTOMATIC DUTY.

PARALLEL FAN UNITS
TYPE TF & DTF.
ALSO BTF & BTFD.

②

When fan units are used without control panel, supply should be connected to terminals 1 & 4 for Fan 1 and terminals 3 & 4 for Fan 2.

Part No. 410591 10/88

WOODS AIR MOVEMENT

Parallel Fan Units Models TF & DTF

Installation and Maintenance Instructions

Site Storage
Units must be stored in a clean and dry atmosphere.

Supply
Check that the site supply voltage and other electrical details agree with that marked on the equipment.

Installation
Roof mounting units must be securely screwed to roof curb using the four screw holes to be found in the unit skirt.

Roof mounting units type TF should be fitted only on flat roofs, unless a suitable adaptor section is provided between unit and sloping roof.

Certified drawings are available on request, showing suggested method for roof preparation.

Duct mounting units type DTF may be mounted horizontally with top or bottom access, or vertically with air discharge upward.

Connection
The wiring must be connected in accordance with the wiring diagram printed overleaf, showing controls type AC1 or ACDS1. Parallel Fan Units may be connected to other control systems, provided such offer the appropriate method of control with suitable wiring circuitry.

Earthing
Units must be earthed in accordance with the wiring diagram and local supply authority requirements.

Protection against Electrical Faults
All fuses in the control circuit should be regarded as protecting the wiring against the effects of short circuits or earth faults only. They are not suitable for overload protections.

Maintenance 6 monthly intervals.

Wiring Check all electrical wiring for condition and take necessary action to correct any sign of deterioration.

Fan Motors are fitted with life lubricated bearings, and require no further attention if equipment is not continuously running, e.g. 12 hours on 12 off. If, however, equipment is required to run continuously, it is advisable to apply a light application of oil to motor bearings via the shaft.

Check the following:–

1. Check motors for overheating.
2. Check motors bearings for wear.
3. Check general condition of motors including connections.
4. Check security of fan impellers on fan shafts.

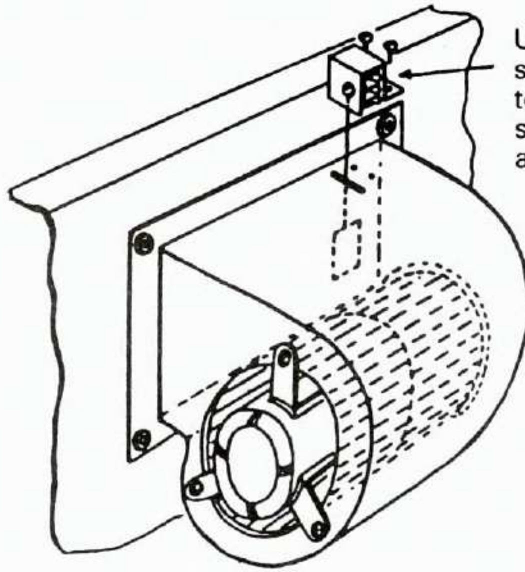
Cleaning Fan Impellers Remove damper blades, using flat face of screw-driver or similar tool, to push damper spindle. (See instruction for damper removal.)

Important To avoid damage to airflow switch when cleaning fan impellers, the airflow switch should be removed. (See instruction.)

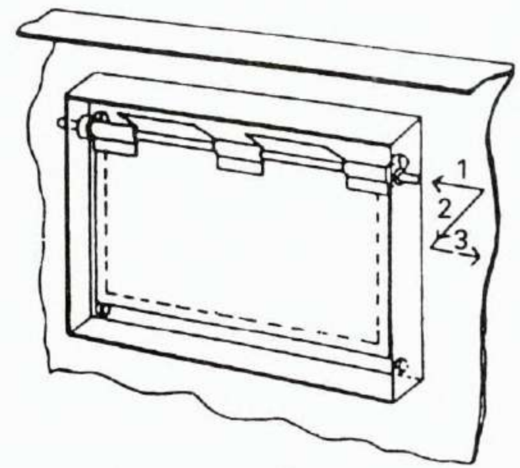
To clean impellers, use a suitable size paint brush.

Dampers Check dampers for freedom of operation. Check damper seals for condition, and renew if necessary.

Airflow Switches Check for freedom of operation. Correct electrical and mechanical functioning of airflow switches will be observed by noting momentary illumination of fault warning light on automatic changeover panel, when manually switching from one fan to the other.



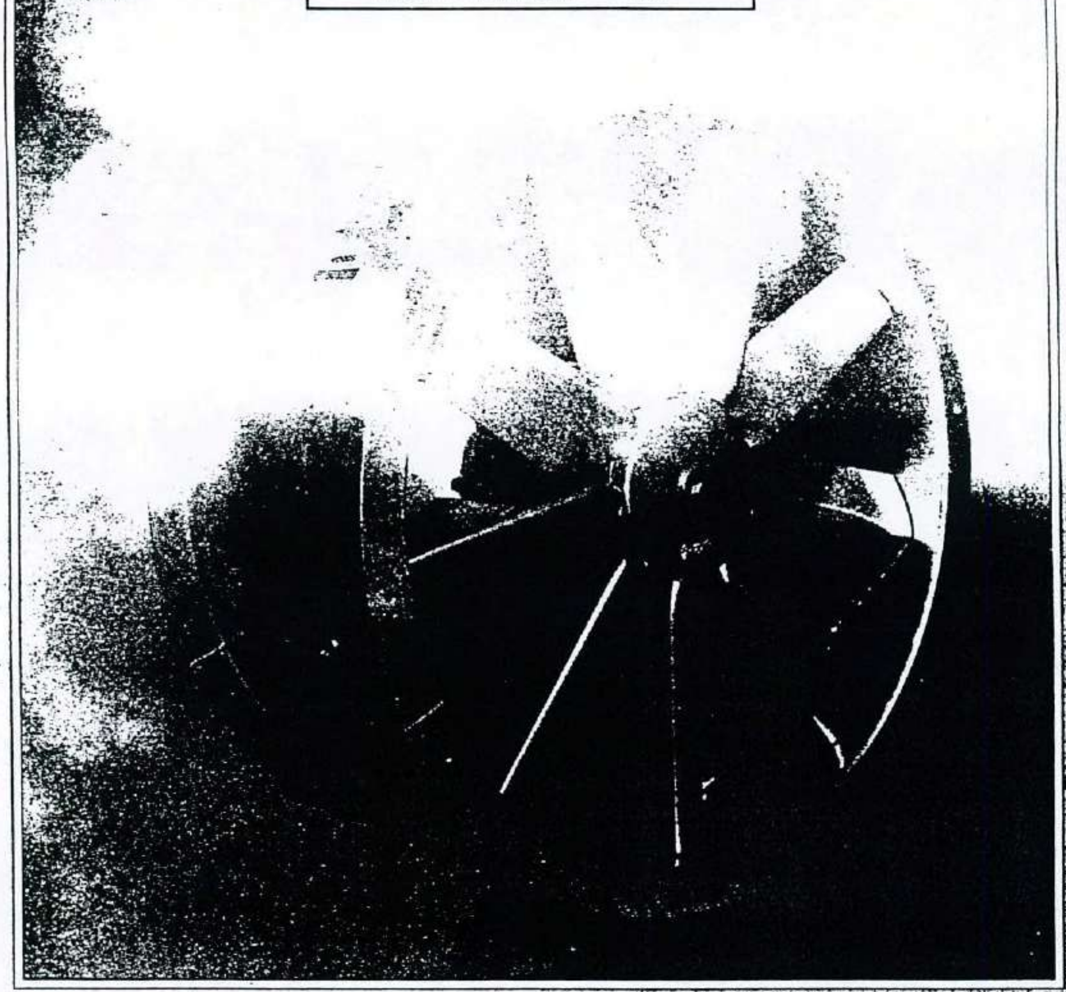
Removing Airflow Switch



Removing Damper Blades

1. Push spindle in, to disengage from spindle bearing.
2. Draw spindle forward to clear damper housing.
3. Withdraw damper and spindle from opposite bearing.

Take care not to lose damper spacers when removing.



SMOKE VENTING EQUIPMENT

JM AEROFOIL
H.T. SERIES FANS
50 Hz

a GEC company

CONTENTS

WOODS AIR MOVEMENT

INTRODUCTION

Woods of Colchester Limited, has made Aerofoil axial flow fans suitable for continuous operation in high temperature air streams for over 25 years. These fans are currently fitted into Drying Machines, Stenters, and Smoke Venting systems, all over the world.

This long experience coupled with the introduction of the new improved performance JM Aerofoil fan range forms the basis for the new H.T. SERIES fans and roof extract units designed specifically for Fire Smoke Ventilation.

Woods manufactures fan motors, and is therefore able to look critically at the requirements of motor insulation, bearings and lubricants which are vital elements in achieving high temperature performance. Extensive stress tests on the new JM Aerofoil fan impellers operating at high temperatures has enabled Woods to make the best use of both designs and materials.

A full high temperature test programme has been successfully completed. Some of this programme was carried out at independent laboratories, eg T.Ü. in Germany and C.T.I.C.M. in France

These tests combined with Woods' renowned high standard of engineering and quality assurance serve to support the H.T. SERIES specification.

Extensive market research has resulted in the H.T. SERIES being offered in six temperature/time categories to meet all of the internationally recognised requirements.

The equipment detailed in this publication is not the full range of items available. If your requirement is not included please enquire to your nearest sales office.

CATEGORY TEMPERATURE (°C)	CATEGORY TIME (Hours)	CATEGORY CODE	FAN TYPES* AVAILABLE	ROOF EXTRACT** UNITS AVAILABLE
200	2.0	H.T.200/2	AEROFOIL	DVA & UDA
250 300	2.0 0.5	H.T.300/0.5	AEROFOIL	DVA & UDA
300	1.0	H.T.300/1.0	AEROFOIL	DVA & UDA
400	2.0	H.T.400/2	AEROFOIL	UDA
600**	1.5	H.T.600/1.5B**	BIFURCATED	UDA

* Other fan types are available, e.g. Bifurcated and Varofoil - Please refer to separate publication C10.

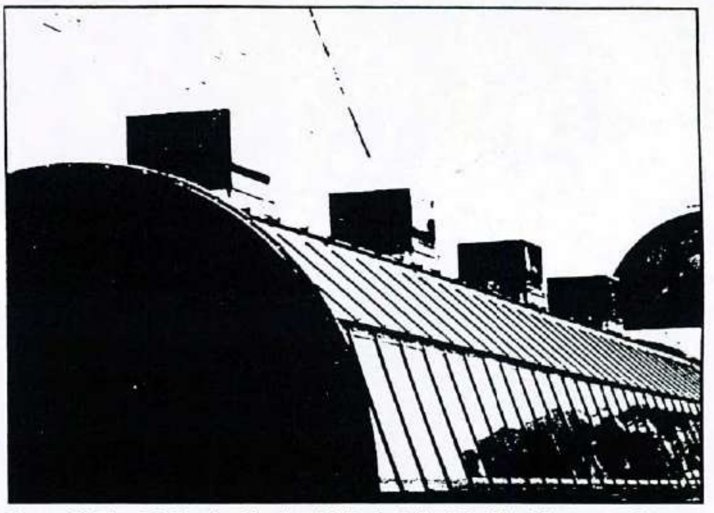
** Refer to separate publication C10 for details of this specialist range of fans/units.

WOODS AIR MOVEMENT

APPLICATIONS & PERFORMANCE TESTING

In any building, fire smoke can be the major killer. In the event of fire in densely populated buildings, such as DEPARTMENT STORES, SHOPPING MALLS, SPORTS CENTRES and HOTELS, efficient clearance of smoke is vital to:

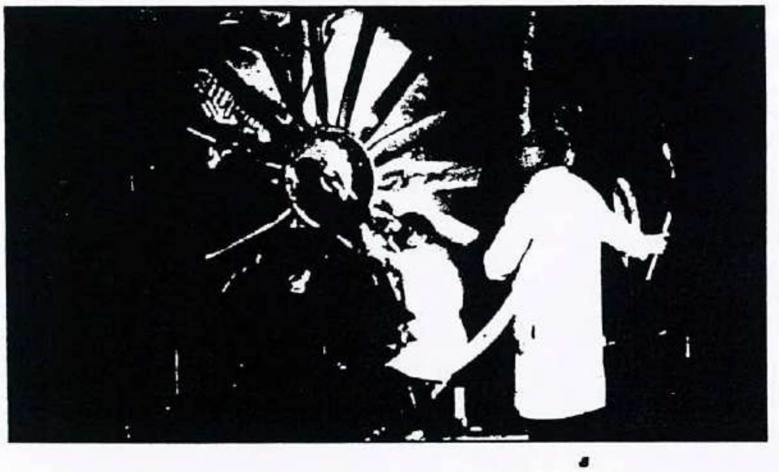
- Keep escape routes clear at all times.
- Assist fire brigades in fighting fire.
- Minimise damage to buildings and contents.



Some Of The 26 Smoke Venting Units Installed On The Kingsgate Centre, Dunfermline Scotland

Woods H.T. SERIES smoke venting fans and roof extract units achieve this using simple designs and tested and certified components.

All H.T. SERIES fans and roof extract units, are suitable for continuous operation at temperatures up to 50°C max, and therefore can be used to provide the normal ventilation requirements of the building.



High Temperature Aerofoil Test Rig.

Quality is assured at Woods. The H.T. SERIES is no exception, with compliance of Woods to BS EN ISO9001:1994, the international standard for Quality Assurance.

H.T. SERIES JM Aerofoil fans (and roof extract units) have successfully completed an extensive programme of high temperature tests from 200°C to 400°C for periods varying from half an hour to two hours, and would operate when tested in accordance with BS7346: Part 2: 1990.

Some of these tests have been witnessed by independent authorities such as the Loss Prevention Council (F.I.R.T.O.) in the U.K., or undertaken in independent laboratories at C.T.I.C.M. in France and Technische Universität (T.Ü.) Munchen in Germany.

The H.T. SERIES fans are certified and approved for use in fire smoke venting systems. All performances shown are based on tests to ISO5801.

JM AEROFOIL - H.T. SERIES

WOODS
AIR MOVEMENT

SPECIFICATIONS - FANS

JM Aerofoil Fans

Full technical data of the highly efficient Woods JM Aerofoil Fan range can be found in publications C22a and C23a.

Aerofoil fan motors are rated to handle the peak powers of the fans at both ambient and high temperature. JM Aerofoil fans have a safe non-overloading characteristic.

Casings

The cylindrical casing, housing the fan, is made of steel, hot dipped galvanised after manufacture. It is flanged and drilled at each end for ease of installation.

S-TYPE - The casing surrounds the impeller only and supports the motor mounting. The electrical terminal box is mounted on the motor. Suitable for temperatures up to 400°C.

L-TYPE - The casing completely surrounds both the impeller and motor. The terminal box is mounted on the casing and pre-wired to the motor. Suitable for temperatures up to 400°C.

Impellers

Fan categories H.T.250/2: H.T.300/0.5: H.T.300/1 and H.T.400/2 use a Woods JM Aerofoil impeller, die cast in aluminium alloy and X-ray inspected against exacting standards to ensure stable castings.

Impellers have a range of blade angles and impeller solidity (number of blades) for flexibility of air duty. Impeller blade angles are set and fixed at works, but are adjustable on site within motor power limits.

Motors

Woods H.T. SERIES fans utilise a totally enclosed induction motor. The motor carcase is constructed of either aluminium alloy or cast iron dependent on the temperature of operation.

The grades of motor insulation have been selected to meet the specific requirements of each H.T. Category, as the essential property of withstanding thermal shock is not common to all high temperature materials. At temperatures above 400°C, bifurcated fans with motor out of the air stream are the only reliable solution. (See our publication C10).

Two speed motors available.

Pole Change (PC) or Dahlander

Two speeds can be obtained by reconnecting a single winding via six winding terminals to give two separate polarities. The term "Pole change" or "Dahlander" refers to polarity/speed ratios of 2 : 1.

Pole Amplitude Modulation (PAM)

This allows speed ratios other than 2 : 1 to be achieved. The motor winding is reconnected in the same way as for a pole change winding.

Dual Wound

This type of motor has two separate individual windings of the requisite polarity to give the speeds required.

Details of dual wound motors are available on request.

Lubrication

Woods H.T. SERIES fan motor bearings for time/temperature categories above H.T.200/2 must be lubricated strictly in accordance with the instructions on the motor nameplate.

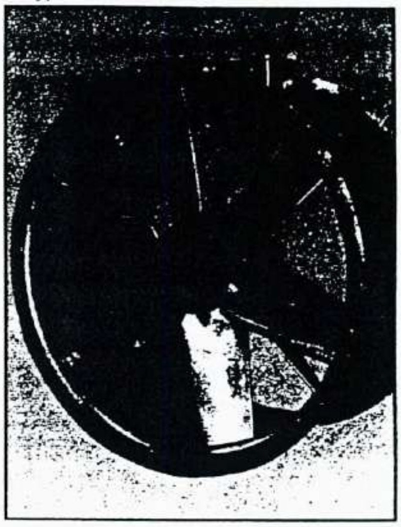
The motor bearings and greases used in the H.T. SERIES have been selected to provide long life at normal ambient temperature and still survive the emergency condition during this life-time.

The special greases required for fan motors operating above 300°C are unsuitable for conventional relubricating methods - extended lubricators, grease guns etc. Here the motor will need to be dismantled and regreased at specified intervals.

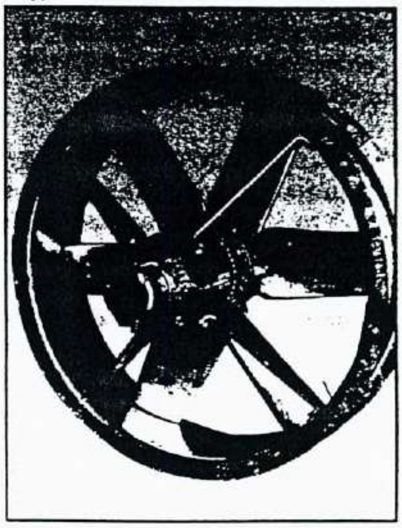
Electrical Supplies

H.T. SERIES fans are available for connections to 380 - 420 V / 50 Hz / 3ϕ electrical supplies. For other voltages and frequencies - please enquire.

L-Type JM Aerofoil Fan



S-type JM Aerofoil Fan



WOODS AIR MOVEMENT

GUIDE TO FAN SELECTION

Publication C10 details a selection of popular fans to be used for fire smoke venting. This is not the complete range. For details outside this range please enquire.

The detailed performance data is contained within publications C22a and C23a. These publications can be used to obtain fan selections with the associated impeller blade pitch angle data. For motor and electrical data, dedicated motor frame size schedules have been included for categories H.T.250/2 and 300/0.5 H.T.300/1 and H.T. 400/2 (see pages 9 to 30).

Once a fan has been selected from publication C22a or C23a, use the relevant motor frame size schedule to select the required motor.

NOTES:

1) No performance corrections are necessary for any H.T. categories up to and including H.T. 300/1 or when any H.T. fan is to be used for emergency ventilation only. If fans for H.T. category 400/2 are to be used for both normal and emergency duty applications, increase the required static pressure by 20% prior to selection.

2) For exhaust volumes greater than those provided by 100 JM use Woods H.T. Series - J Range publication.

Examples:

For a required duty of 8m³/sec @ 200 Pa fan static pressure:

H.T. Category H.T. 200/2

Aerodynamic Selection - use publications C22a or C23a: 80JM/25/4/6/28°

Motor Data - Use publications C22a or C23a (i.e. standard motor data applies - single phase motors are **not** suitable)

F2249

Motor Rating (kW)	=	4.4
Full load current (A)	=	9.3
Starting Current (A)	=	52

H.T. Category H.T. 250/2 & H.T. 300/0.5

Aerodynamic selection - Use publications C22a or C23a: 80JM/25/4/6/28°

Motor data - Use dedicated motor frame size schedule (Pages 9 to 12 enclosed).

D132/MS

Motor Rating (kW)	=	6.3
Full load current (A)	=	13.1
Starting Current (A)	=	85

H.T. Category H.T. 300/1

Aerodynamic selection - Use publications C22a or C23a: 80JM/25/4/6/28°

Motor data - Use dedicated motor frame size schedule (Pages 13 to 23 enclosed).

D112M

Motor Rating (kW)	=	4.6
Full load current (A)	=	9.8
Starting Current (A)	=	58.8

H.T. Category H.T. 400/2

Only if the fan is to be used for both normal and emergency duty applications, increase required static pressure by 20% = 200 x 1.2 = 240 Pa
New duty for selection purposes = 8m³/sec @ 240 Pa fan static pressure.

Aerodynamic Selection - Use publications C22a or C23a: 80JM/25/4/6/30°

Motor data - Use dedicated motor frame size schedule (Pages 24 to 30 enclosed)

DF132MS

Motor Rating (kW)	=	5.5
Full load current (A)	=	11.1
Starting current (A)	=	76

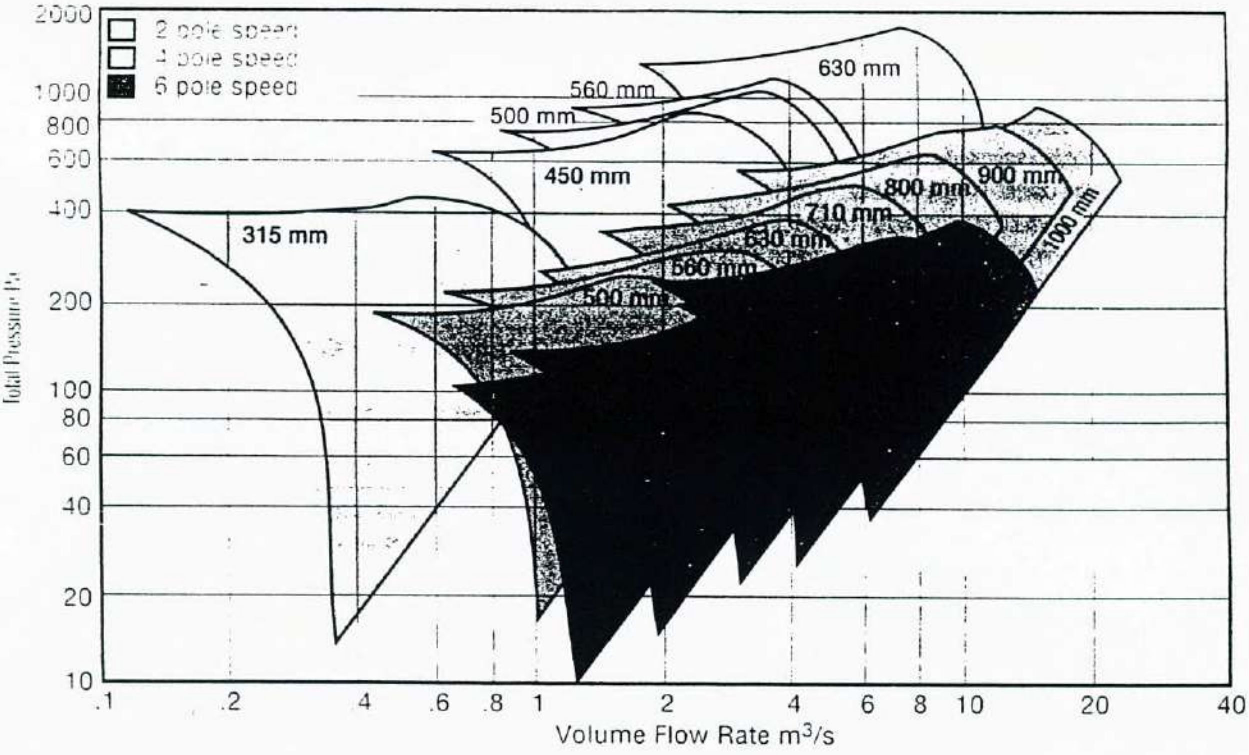
Please enquire if alternative temperature time categories are required.

H.T. Category H.T. 600/1.5

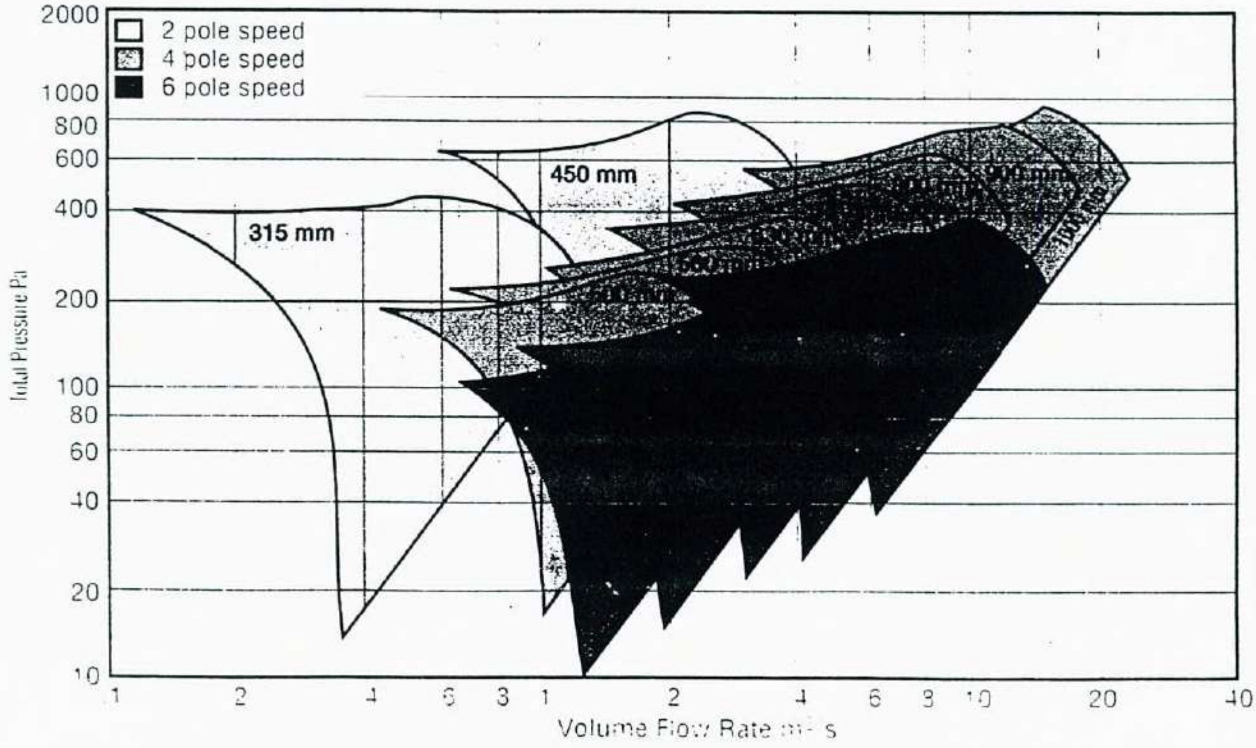
For this particular H.T. Category please enquire or refer to publication C10.

PERFORMANCE

Time Category H.T. 250/2 : H.T. 300/0.5 & H.T. 300/1



Time Category H.T. 400/2



JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules: H.T. 250/2 & H.T. 300/0.5

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
31JM/16/2/5/...	2840	20	BT5	0.33	0.9	3.6	65	0.88
		32	BT9	0.55	1.4	6	71	0.82
		40	CT5	1	2.4	9.5	71	0.84
45JM/20/2/6/...	2910	10	CT5	1	2.4	9.5	71	0.84
		18	CT9	1.7	3.7	19	78	0.9
		32	F2225B	3.3	7	44	79	0.87
		40	F2229B	5.7	11.5	90	85	0.86
50JM/16/4/5/...	1420	12	BT5	0.22	0.6	2.4	65	0.83
		22	BT9	0.37	1.1	4.6	66	0.75
		34	CT5	0.7	2	6.5	67	0.76
		40	CT9	1.3	3.3	12	72	0.79
50JM/20/2/3/...	2910	12	CT5	1	2.4	9.5	71	0.84
		18	CT9	1.7	3.7	19	78	0.9
		32	F2225B	3.3	7	44	79	0.87
		36	F2229B	5.7	11.5	90	85	0.86
50JM/20/4/6/...	1420	10	BT5	0.22	0.6	2.4	65	0.83
		20	BT9	0.37	1.1	4.6	66	0.75
		32	CT5	0.7	2	6.5	67	0.76
		40	CT9	1.3	3.3	12	72	0.79
50JM/20/2/6/...	2910	12	CT9	1.7	3.7	19	78	0.9
		22	F2225B	3.3	7	44	79	0.87
		32	F2229B	5.7	11.5	90	85	0.86
56JM/16/4/5/...	1420	12	BT9	0.37	1.1	4.6	66	0.75
		24	CT5	0.7	2	6.5	67	0.76
		40	CT9	1.3	3.3	12	72	0.79
56JM/20/4/3/...	1420	12	BT5	0.22	0.6	2.4	65	0.83
		20	BT9	0.37	1.1	4.6	66	0.75
		32	CT5	0.7	2	6.5	67	0.76
		36	CT9	1.3	3.3	12	72	0.79
56JM/20/2/3/...	2910	12	CT9	1.7	3.7	19	78	0.9
		22	F2225B	3.3	7	44	79	0.87
		32	F2229B	5.7	11.5	90	85	0.86
56JM/20/4/6/...	1420	10	BT9	0.37	1.1	4.6	66	0.75
		22	CT5	0.7	2	6.5	67	0.76
		36	CT9	1.3	3.3	12	72	0.79
		40	F2245B	2.5	5.7	30	83	0.8
56JM/20/2/6/...	2910	12	F2225B	3.3	7	44	79	0.87
		22	F2229B	5.7	11.5	90	85	0.86
63JM/20/6/3/...	900	36	CT9	0.75	2.5	7.5	63	0.7
63JM/20/4/3/...	1420	8	BT9	0.37	1.1	4.6	66	0.75
		18	CT5	0.7	2	6.5	67	0.76
		30	CT9	1.3	3.3	12	72	0.79
		36	F2245B	2.5	5.7	30	83	0.8
63JM/20/6/6/...	900	36	CT9	0.75	2.5	7.5	63	0.7
63JM/20/4/6/...	1420	10	CT5	0.7	2	6.5	67	0.76
		22	CT9	1.3	3.3	12	72	0.79
		36	F2245B	2.5	5.7	30	83	0.8
63JM/25/6/3/...	935	32	F2265B	1.4	4	15	73	0.7

JM AEROFOIL - H.T. SERIES

Motor Frame Size Schedules:
H.T. 250/2 & H.T. 300/0.5

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
63JM/25/4/3/...	1440	32	F2245B	2.5	5.7	30	83	0.8
63JM/25/2/3/...	2910	14	F2225B	3.3	7	44	79	0.87
		20	F2229B	5.7	11.5	90	85	0.86
		22	DF132/MSA	6.3	12	84	86	0.88
		28	DF132/MSB	8.6	16.3	114	86	0.88
		32	DF132/M	12	22	165	88	0.9
63JM/25/6/6/...	935	36	F2265B	1.4	4	15	73	0.7
63JM/25/4/6/...	1440	36	F2245B	2.5	5.7	30	83	0.8
63JM/25/2/6/...	2910	8	F2225B	3.3	7	44	79	0.87
		14	F2229B	5.7	11.5	90	85	0.86
		16	DF132/MSA	6.3	12	84	86	0.88
		20	DF132/MSB	8.6	16.3	114	86	0.88
		26	DF132/M	12	22	165	88	0.9
		26	DF160/LMA	12.6	24	180	87	0.87
		34	DF160/LMB	17.3	32	240	88	0.89
		36	DF160/L	22	38	285	90	0.91
63JM/25/6/9/...	935	40	F2265B	1.4	4	15	73	0.7
63JM/25/4/9/...	1440	32	F2245B	2.5	5.7	30	83	0.8
		40	F2249B	4.2	9	52	82	0.84
63JM/25/2/9/...	2910	10	F2229B	5.7	11.5	90	85	0.86
		12	DF132/MSA	6.3	12	84	86	0.88
		16	DF132/MSB	8.6	16.3	114	86	0.88
		22	DF132/M	12	22	165	88	0.9
		22	DF160/LMA	12.6	24	180	87	0.87
		28	DF160/LMB	17.3	32	240	88	0.89
		34	DF160/L	22	38	285	90	0.91
		40	DF160/LKE	30	53	398	90	0.91
71JM/20/6/3/...	900	34	CT9	0.75	2.5	7.5	63	0.7
		36	F2265B	1.4	4	15	73	0.7
71JM/20/4/3/...	1440	8	CT5	0.7	2	6.5	67	0.76
		20	CT9	1.3	3.3	12	72	0.79
		32	F2245B	2.5	5.7	30	83	0.8
		36	F2249B	4.2	9	52	82	0.84
71JM/20/6/6/...	900	24	CT9	0.75	2.5	7.5	63	0.7
		36	F2265B	1.4	4	15	73	0.7
71JM/20/4/6/...	1440	10	CT9	1.3	3.3	12	72	0.79
		22	F2245B	2.5	5.7	30	83	0.8
		34	F2249B	4.2	9	52	82	0.84
71JM/25/6/3/...	935	32	F2265B	1.4	4	15	73	0.7
71JM/25/4/3/...	1440	32	F2245B	2.5	5.7	30	83	0.8
71JM/25/6/6/...	935	36	F2265B	1.4	4	15	73	0.7
71JM/25/4/6/...	1440	26	F2245B	2.5	5.7	30	83	0.8
		36	F2249B	4.2	9	52	82	0.84
71JM/25/6/9/...	935	36	F2265B	1.4	4	15	73	0.7
71JM/25/4/9/...	1440	20	F2245B	2.5	5.7	30	83	0.8
		32	F2249B	4.2	9	52	82	0.84
		36	DF132/MS	6.3	13.1	85	85	0.81

Motor Frame Size Schedules:
H.T. 250/2 & H.T. 300/0.5

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
80JM/20/6/3/...	935	24	CT9	0.75	2.5	7.5	63	0.7
		36	F2265B	1.4	4	15	73	0.7
80JM/20/4/3/...	1440	12	CT9	1.3	3.3	12	72	0.79
		22	F2245B	2.5	5.7	30	83	0.8
		34	F2249B	4.2	9	52	82	0.84
80JM/20/6/6/...	935	14	CT9	0.75	2.5	7.5	63	0.7
		26	F2265B	1.4	4	15	73	0.7
		36	F2269B	2.4	6.4	26	75	0.73
80JM/20/4/6/...	1440	12	F2245B	2.5	5.7	30	83	0.8
		22	F2249B	4.2	9	52	82	0.84
80JM/25/6/3/...	935	32	F2265B	1.4	4	15	73	0.7
80JM/25/4/3/...	1440	26	F2245B	2.5	5.7	30	83	0.8
		32	F2249B	4.2	9	52	82	0.84
80JM/25/6/6/...	935	30	F2265B	1.4	4	15	73	0.7
		36	F2269B	2.4	6.4	26	75	0.73
80JM/25/4/6/...	1440	16	F2245B	2.5	5.7	30	83	0.8
		26	F2249B	4.2	9	52	82	0.84
		36	DF132/MS	6.3	13.1	85	85	0.81
80JM/25/6/9/...	935	24	F2265B	1.4	4	15	73	0.7
		36	F2269B	2.4	6.4	26	75	0.73
80JM/25/4/9/...	1440	10	F2245B	2.5	5.7	30	83	0.8
		20	F2249B	4.2	9	52	82	0.84
		28	DF132/MS	6.3	13.1	85	85	0.81
		36	DF132/M	10	20	140	87	0.83
90JM/25/6/3/...	935	30	F2265B	1.4	4	15	73	0.7
		32	F2269B	2.4	6.4	26	75	0.73
90JM/25/4/3/...	1440	18	F2245B	2.5	5.7	30	83	0.8
		26	F2249B	4.2	9	52	82	0.84
		32	DF132/MS	6.3	13.1	85	85	0.81
90JM/25/6/6/...	935	20	F2265B	1.4	4	15	73	0.7
		30	F2269B	2.4	6.4	26	75	0.73
		32	DF132/MS	3.5	8	44	83	0.76
90JM/25/4/6/...	1440	8	F2245B	2.5	5.7	30	83	0.8
		16	F2249B	4.2	9	52	82	0.84
		24	DF132/MS	6.3	13.1	85	85	0.81
		32	DF132/M	10	20	140	87	0.83
90JM/25/6/9/...	935	12	F2265B	1.4	4	15	73	0.7
		22	F2269B	2.4	6.4	26	75	0.73
		30	DF132/MS	3.5	8	44	83	0.76
		36	DF132/MA	4.6	10.5	58	83	0.76
90JM/25/4/9/...	1440	10	F2249B	4.2	9	52	82	0.84
		16	DF132/MS	6.3	13.1	85	85	0.81
		26	DF132/M	10	20	140	87	0.83
		30	DF160/LM	12.6	24	180	87	0.87
		36	DF160/L	17.3	32	240	89	0.88
100JM/25/6/3/...	935	22	F2265B	1.4	4	15	73	0.7
		32	F2269B	2.4	6.4	26	75	0.73

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 250/2 & H.T. 300/0.5

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
100JM/25/4/3/...	1440	10	F2245B	2.5	5.7	30	83	0.8
		18	F2249B	4.2	9	52	82	0.84
		26	DF132/MS	6.3	13.1	85	85	0.81
		32	DF132/M	10	20	140	87	0.83
100JM/25/6/6/...	950	12	F2265B	1.4	4	15	73	0.7
		22	F2269B	2.4	6.4	26	75	0.73
		28	DF132/MS	3.5	8	44	83	0.76
		32	DF132/MA	4.6	10.5	58	83	0.76
100JM/25/4/6/...	1450	10	F2249B	4.2	9	52	82	0.84
		16	DF132/MS	6.3	13.1	85	85	0.81
		24	DF132/M	10	20	140	87	0.83
		28	DF160/LM	12.6	24	180	87	0.87
		32	DF160/L	17.3	32	240	89	0.88
100JM/25/6/9/...	960	14	F2269B	2.4	6.4	26	75	0.73
		20	DF132/MS	3.5	8	44	83	0.76
		26	DF132/MA	4.6	10.5	58	83	0.76
		36	DF132/MB	7	15.5	82.5	85	0.76
100JM/25/4/9/...	1470	8	DF132/MS	6.3	13.1	85	85	0.81
		16	DF132/M	10	20	140	87	0.83
		20	DF160/LM	12.6	24	180	87	0.87
		28	DF160/L	17.3	32	240	89	0.88
		32	DF160/LAK	22	40	300	89	0.88
		36	DF160/LBK	25	44	330	90	0.91
100JM/31/4/9/...	1470	8	DF132/MS	6.3	13.1	85	85	0.81
		16	DF132/M	10	20	140	87	0.83
		20	DF160/LM	12.6	24	180	87	0.87
		26	DF160/L	17.3	32	240	89	0.88
		32	DF160/LAK	22	40	300	89	0.88
		36	DF160/LBK	25	44	330	90	0.91

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules: H.T. 300/1

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
31JM/16/2/5/...	2840	40	D80/A	0.9	2.2	12.1	78	0.75
45JM/20/2/6/...	2910	10	D80/A	0.9	2.2	12.1	78	0.75
		14	D90/B	1.3	3	18.8	79	0.78
		18	D90/LNS	1.75	3.8	24.7	78	0.85
		26	D90/LN	2.5	5.2	33.8	80	0.86
		32	D100/L	3.5	6.9	26.3	83	0.88
		40	D112/M	4.6	8.8	66	86	0.87
50JM/16/4/5/...	1420	34	D80/A	0.65	1.9	7.4	73	0.69
50JM/20/2/3/...	2910	10	D80/A	0.9	2.2	12.1	78	0.75
		14	D90/B	1.3	3	18.8	79	0.78
		20	D90/LNS	1.75	3.8	24.7	78	0.85
		26	D90/LN	2.5	5.2	33.8	80	0.86
		32	D100/L	3.5	6.9	26.3	83	0.88
		36	D112/M	4.6	8.8	66	86	0.87
50JM/20/4/6/...	1420	32	D80/A	0.65	1.9	7.4	73	0.69
		40	D90/B	0.9	2.5	11.3	76	0.69
50JM/20/2/6/...	2910	8	D90/B	1.3	3	18.8	79	0.78
		12	D90/LNS	1.75	3.8	24.7	78	0.85
		16	D90/LN	2.5	5.2	33.8	80	0.86
		22	D100/L	3.5	6.9	26.3	83	0.88
		28	D112/M	4.6	8.8	66	86	0.87
56JM/16/4/5/...	1420	22	D80/A	0.65	1.9	7.4	73	0.69
56JM/20/4/3/...	1420	32	D80/A	0.65	1.9	7.4	73	0.69
		36	D90/B	0.9	2.5	11.3	76	0.69
56JM/20/2/3/...	2910	10	D90/B	1.3	3	18.8	79	0.78
		12	D90/LNS	1.75	3.8	24.7	78	0.85
		18	D90/LN	2.5	5.2	33.8	80	0.86
		24	D100/L	3.5	6.9	26.3	83	0.88
		28	D112/M	4.6	8.8	66	86	0.87
56JM/20/4/6/...	1420	22	D80/A	0.65	1.9	7.4	73	0.69
		28	D90/B	0.9	2.5	11.3	76	0.69
		38	D90/LNS	1.35	3.2	16	77	0.73
		40	D90/LN	1.75	4.4	22	78	0.73
56JM/20/2/6/...	2910	10	D90/LN	2.5	5.2	33.8	80	0.86
		14	D100/L	3.5	6.9	26.3	83	0.88
		18	D112/M	4.6	8.8	66	86	0.87
63JM/20/6/3/...	900	34	D80/A	0.42	1.7	5	64	0.57
		36	D80/B	0.65	2.2	8.3	68	0.63
63JM/20/4/3/...	1420	18	D80/A	0.65	1.9	7.4	73	0.69
		24	D90/B	0.9	2.5	11.3	76	0.69
		32	D90/LNS	1.35	3.2	16	77	0.73
		36	D90/LN	1.75	4.4	22	78	0.73
63JM/20/6/6/...	900	24	D80/A	0.42	1.7	5	64	0.57
		34	D80/B	0.65	2.2	8.3	68	0.63
		36	D90/LNS	0.85	2.9	10.2	65	0.67
63JM/20/4/6/...	1420	10	D80/A	0.65	1.9	7.4	73	0.69
		14	D90/B	0.9	2.5	11.3	76	0.69
		22	D90/LNS	1.35	3.2	16	77	0.73
		28	D90/LN	1.75	4.4	22	78	0.73
		36	D100/L	2.5	5.9	34.2	79	0.78

JM AEROFOIL - H.T. SERIES

Motor Frame Size Schedules:
H.T. 300/1

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
63JM/25/6/3/...	935	32	D112/M	2.5	6.9	31.1	77	0.68
63JM/25/4/3/...	1440	32	D112/M	4.6	9.8	58.8	84	0.81
63JM/25/2/3/...	2910	18	D112/M	4.6	8.8	66	86	0.87
		22	DF132/MSA	6.3	12	84	86	0.88
		28	DF132/MSB	8.6	16.3	114	86	0.88
		32	DF132/M	12	22	165	88	0.9
63JM/25/6/6/...	935	36	D112/M	2.5	6.9	31.1	77	0.68
63JM/25/4/6/...	1440	36	D112/M	4.6	9.8	58.8	84	0.81
63JM/25/2/6/...	2910	12	D112/M	4.6	8.8	66	86	0.87
		16	DF132/MSA	6.3	12	84	86	0.88
		20	DF132/MSB	8.6	16.3	114	86	0.88
		26	DF132/M	12	22	165	88	0.9
		26	DF160/LMA	12.6	24	180	87	0.87
		34	DF160/LMB	17.3	32	240	88	0.89
		36	DF160/L	22	38	285	90	0.91
63JM/25/6/9/...	935	40	D112/M	2.5	6.9	31.1	77	0.68
63JM/25/4/9/...	1440	40	D112/M	4.6	9.8	58.8	84	0.81
63JM/25/2/9/...	2910	8	D112/M	4.6	8.8	66	86	0.87
		12	DF132/MSA	6.3	12	84	86	0.88
		16	DF132/MSB	8.6	16.3	114	86	0.88
		22	DF132/M	12	22	165	88	0.9
		22	DF160/LMA	12.6	24	180	87	0.87
		28	DF160/LMB	17.3	32	240	88	0.89
		34	DF160/L	22	38	285	90	0.91
		40	DF160/LKE	30	53	398	90	0.91
71JM/20/6/3/...	900	24	D80/A	0.42	1.7	5	64	0.57
		32	D80/B	0.65	2.2	8.3	68	0.63
		36	D90/LNS	0.85	2.9	10.2	65	0.67
71JM/20/4/3/...	1440	12	D90/B	0.9	2.5	11.3	76	0.69
		20	D90/LNS	1.35	3.2	16	77	0.73
		26	D90/LN	1.75	4.4	22	78	0.73
		32	D100/L	2.5	5.9	34.2	79	0.78
		36	D100/LB	3.5	8.1	48.6	82	0.76
71JM/20/6/6/...	900	14	D80/A	0.42	1.7	5	64	0.57
		22	D80/B	0.65	2.2	8.3	68	0.63
		28	D90/LNS	0.85	2.9	10.2	65	0.67
		36	D90/LN	1.25	3.8	13.3	70	0.68
71JM/20/4/6/...	1440	10	D90/LNS	1.35	3.2	16	77	0.73
		16	D90/LN	1.75	4.4	22	78	0.73
		22	D100/L	2.5	5.9	34.2	79	0.78
		30	D100/LB	3.5	8.1	48.6	82	0.76
		36	D112/M	4.6	9.8	58.8	84	0.81
71JM/25/6/3/...	935	32	D112/M	2.5	6.9	31.1	77	0.68
71JM/25/4/3/...	1440	32	D112/M	4.6	9.8	58.8	84	0.81
71JM/25/6/6/...	935	36	D112/M	2.5	6.9	31.1	77	0.68
71JM/25/4/6/...	1440	36	D112/M	4.6	9.8	58.8	84	0.81

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 300/1

400 V / 50 Hz / 3 φ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
71JM/25/6/9/...	935	36	D112/M	2.5	6.9	31.1	77	0.68
71JM/25/4/9/...	1440	34	D112/M	4.6	9.8	58.8	84	0.81
		36	DF132/MS	6.3	13.1	85	85	0.81
80JM/20/6/3/...	935	14	D80/A	0.42	1.7	5	64	0.57
		22	D80/B	0.65	2.2	8.3	68	0.63
		26	D90/LNS	0.85	2.9	10.2	65	0.67
		36	D90/LN	1.25	3.8	13.3	70	0.68
80JM/20/4/3/...	1440	12	D90/LNS	1.35	3.2	16	77	0.73
		16	D90/LN	1.75	4.4	22	78	0.73
		22	D100/L	2.5	5.9	34.2	79	0.78
		28	D100/LB	3.5	8.1	48.6	82	0.76
		36	D112/M	4.6	9.8	58.8	84	0.81
80JM/20/6/6/...	935	12	D80/B	0.65	2.2	8.3	68	0.63
		16	D90/LNS	0.85	2.9	10.2	65	0.67
		24	D90/LN	1.25	3.8	13.3	70	0.68
		30	D100/L	1.7	5.4	21.6	74	0.62
		36	D112/M	2.5	6.9	31.1	77	0.68
80JM/20/4/6/...	1440	8	D90/LN	1.75	4.4	22	78	0.73
		12	D100/L	2.5	5.9	34.2	79	0.78
		18	D100/LB	3.5	8.1	48.6	82	0.76
		24	D112/M	4.6	9.8	58.8	84	0.81
80JM/25/6/3/...	935	32	D112/M	2.5	6.9	31.1	77	0.68
80JM/25/4/3/...	1440	32	D112/M	4.6	9.8	58.8	84	0.81
80JM/25/6/6/...	935	36	D112/M	2.5	6.9	31.1	77	0.68
80JM/25/4/6/...	1440	28	D112/M	4.6	9.8	58.8	84	0.81
		36	DF132/MS	6.3	13.1	85	85	0.81
80JM/25/6/9/...	935	36	D112/M	2.5	6.9	31.1	77	0.68
80JM/25/4/9/...	1440	22	D112/M	4.6	9.8	58.8	84	0.81
		28	DF132/MS	6.3	13.1	85	85	0.81
		36	DF132/M	10	20	140	87	0.83
90JM/25/6/3/...	935	32	D112/M	2.5	6.9	31.1	77	0.68
90JM/25/4/3/...	1440	28	D112/M	4.6	9.8	58.8	84	0.81
		32	DF132/MS	6.3	13.1	85	85	0.81
90JM/25/6/6/...	935	32	D112/M	2.5	6.9	31.1	77	0.68
90JM/25/4/6/...	1440	18	D112/M	4.6	9.8	58.8	84	0.81
		24	DF132/MS	6.3	13.1	85	85	0.81
		32	DF132/M	10	20	140	87	0.83
90JM/25/6/9/...	935	24	D112/M	2.5	6.9	31.1	77	0.68
		30	DF132/MS	3.5	8	44	83	0.76
		36	DF132/MA	4.6	10.5	58	83	0.76
90JM/25/4/9/...	1440	12	D112/M	4.6	9.8	58.8	84	0.81
		16	DF132/MS	6.3	13.1	85	85	0.81
		26	DF132/M	10	20	140	87	0.83
		30	DF160/LM	12.6	24	180	87	0.87
		36	DF160/L	17.3	32	240	89	0.88

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 300/1

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
100JM/25/6/3/...	935	32	D112/M	2.5	6.9	31.1	77	0.68
100JM/25/4/3/...	1440	20	D112/M	4.6	9.8	58.8	84	0.81
		26	DF132/MS	6.3	13.1	85	85	0.81
		32	DF132/M	10	20	140	87	0.83
100JM/25/6/6/...	950	22	D112/M	2.5	6.9	31.1	77	0.68
		28	DF132/MS	3.5	8	44	83	0.76
		32	DF132/MA	4.6	10.5	58	83	0.76
100JM/25/4/6/...	1450	10	D112/M	4.6	9.8	58.8	84	0.81
		16	DF132/MS	6.3	13.1	85	85	0.81
		24	DF132/M	10	20	140	87	0.83
		28	DF160/LM	12.6	24	180	87	0.87
		32	DF160/L	17.3	32	240	89	0.88
100JM/25/6/9/...	960	14	D112/M	2.5	6.9	31.1	77	0.68
		20	DF132/MS	3.5	8	44	83	0.76
		26	DF132/MA	4.6	10.5	58	83	0.76
		36	DF132/MB	7	15.5	82.5	85	0.76
100JM/25/4/9/...	1470	8	DF132/MS	6.3	13.1	85	85	0.81
		16	DF132/M	10	20	140	87	0.83
		20	DF160/LM	12.6	24	180	87	0.87
		28	DF160/L	17.3	32	240	89	0.88
		32	DF160/LAK	22	40	300	89	0.88
		36	DF160/LBK	25	44	330	90	0.91
100JM/31/4/9/...	1470	8	DF132/MS	6.3	13.1	85	85	0.81
		16	DF132/M	10	20	140	87	0.83
		20	DF160/LM	12.6	24	180	87	0.87
		26	DF160/L	17.3	32	240	89	0.88
		32	DF160/LAK	22	40	300	89	0.88
		36	DF160/LBK	25	44	330	90	0.91

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 300/1: Two Speed (Full & Half Pole Change)

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Low Speed rev/min	Low Speed (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
31JM/16/2-4/5/...	2840	32	D80/A	0.55	1420	0.07	1.45/.25	5.8/1.2	67/67	.82/.62
		40	D80/B	0.75	1420	0.09	2/.31	8/1.6	70/70	.76/.6
45JM/20/2-4/3/...	2910	10	D80/A	0.55	1420	0.07	1.45/.25	5.8/1.2	67/67	.82/.62
		14	D80/B	0.75	1420	0.09	2/.31	8/1.6	70/70	.76/.6
		20	D90/SN	1.1	1420	0.14	2.8/.66	16.5/4.6	67/57	.86/.54
		22	D90/LN	1.3	1420	0.16	3/.68	19/5.1	73/61	.88/.56
		36	D100/LA	2.6	1420	0.33	5.5/1.3	27.5/7.8	75/60	.9/.62
45JM/20/2-4/6/...	2910	8	D80/B	0.75	1420	0.09	2/.31	8/1.6	70/70	.76/.6
		12	D90/SN	1.1	1420	0.14	2.8/.66	16.5/4.6	67/57	.86/.54
		14	D90/LN	1.3	1420	0.16	3/.68	19/5.1	73/61	.88/.56
		26	D100/LA	2.6	1420	0.33	5.5/1.3	27.5/7.8	75/60	.9/.62
		34	D100/LB	3.6	1440	0.45	7.5/1.8	37.5/10.8	79/66	.9/.62
		40	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6
50JM/16/4-8/5/...	1420	24	D80/A	0.4	700	0.05	1.2/.3	4.6/.6	71/53	.71/.45
		28	D80/B	0.52	700	0.07	1.4/.4	5.6/.8	73/55	.71/.45
50JM/20/4-8/3/...	1420	32	D80/A	0.4	700	0.05	1.2/.3	4.6/.6	71/53	.71/.45
		36	D80/B	0.52	700	0.07	1.4/.4	5.6/.8	73/55	.71/.45
50JM/20/2-4/3/...	2910	8	D80/B	0.75	1420	0.09	2/.31	8/1.6	70/70	.76/.6
		12	D90/SN	1.1	1420	0.14	2.8/.66	16.5/4.6	67/57	.86/.54
		14	D90/LN	1.3	1420	0.16	3/.68	19/5.1	73/61	.88/.56
		26	D100/LA	2.6	1420	0.33	5.5/1.3	27.5/7.8	75/60	.9/.62
		32	D100/LB	3.6	1440	0.45	7.5/1.8	37.5/10.8	79/66	.9/.62
		36	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6
50JM/20/4-8/6/...	1420	22	D80/A	0.4	700	0.05	1.2/.3	4.6/.6	71/53	.71/.45
		26	D80/B	0.52	700	0.07	1.4/.4	5.6/.8	73/55	.71/.45
		32	D90/SN	0.67	720	0.08	1.7/.42	7.6/1.1	77/62	.72/.45
		40	D90/LN	1	720	0.12	2.6/.62	11.7/1.6	77/62	.72/.45
50JM/20/2-4/6/...	2910	8	D90/LN	1.3	1420	0.16	3/.68	19/5.1	73/61	.88/.56
		18	D100/LA	2.6	1420	0.33	5.5/1.3	27.5/7.8	75/60	.9/.62
		22	D100/LB	3.6	1440	0.45	7.5/1.8	37.5/10.8	79/66	.9/.62
		28	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6
56JM/16/4-8/5/...	1420	14	D80/A	0.4	700	0.05	1.2/.3	4.6/.6	71/53	.71/.45
		18	D80/B	0.52	700	0.07	1.4/.4	5.6/.8	73/55	.71/.45
56JM/20/4-8/3/...	1420	22	D80/A	0.4	700	0.05	1.2/.3	4.6/.6	71/53	.71/.45
		28	D80/B	0.52	700	0.07	1.4/.4	5.6/.8	73/55	.71/.45
		32	D90/SN	0.67	720	0.08	1.7/.42	7.6/1.1	77/62	.72/.45
		36	D90/LN	1	720	0.12	2.6/.62	11.7/1.6	77/62	.72/.45
56JM/20/2-4/3/...	2910	8	D90/SN	1.1	1420	0.14	2.8/.66	16.5/4.6	67/57	.86/.54
		10	D90/LN	1.3	1420	0.16	3/.68	19/5.1	73/61	.88/.56
		18	D100/LA	2.6	1420	0.33	5.5/1.3	27.5/7.8	75/60	.9/.62
		24	D100/LB	3.6	1440	0.45	7.5/1.8	37.5/10.8	79/66	.9/.62
		28	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6
56JM/20/4-8/6/...	1420	12	D80/A	0.4	700	0.05	1.2/.3	4.6/.6	71/53	.71/.45
		18	D80/B	0.52	700	0.07	1.4/.4	5.6/.8	73/55	.71/.45
		22	D90/SN	0.67	720	0.08	1.7/.42	7.6/1.1	77/62	.72/.45
		30	D90/LN	1	720	0.12	2.6/.62	11.7/1.6	77/62	.72/.45
		40	D100/LA	2.2	720	0.28	5.4/2.3	32/6.9	75/42	.78/.42
56JM/20/2-4/6/...	2910	10	D100/LA	2.6	1420	0.33	5.5/1.3	27.5/7.8	75/60	.9/.62
		14	D100/LB	3.6	1440	0.45	7.5/1.8	37.5/10.8	79/66	.9/.62
		18	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6

JM AEROFOIL - H.T. SERIES

Motor Frame Size Schedules:
H.T. 300/1: Two Speed (Full & Half Pole Change)

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Low Speed rev/min	Low Speed (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
63JM/20/4-8/3/...	1420	10	D80/A	0.4	700	0.05	1.2/.3	4.6/.6	71/53	.71/.45
		14	D80/B	0.52	700	0.07	1.4/.4	5.6/.8	73/55	.71/.45
		18	D90/SN	0.67	720	0.08	1.7/.42	7.6/1.1	77/62	.72/.45
		24	D90/LN	1	720	0.12	2.6/.62	11.7/1.6	77/62	.72/.45
		36	D100/LA	2.2	720	0.28	5.4/2.3	32/6.9	75/42	.78/.42
63JM/20/4-8/6/...	1420	10	D90/SN	0.67	720	0.08	1.7/.42	7.6/1.1	77/62	.72/.45
		16	D90/LN	1	720	0.12	2.6/.62	11.7/1.6	77/62	.72/.45
		32	D100/LA	2.2	720	0.28	5.4/2.3	32/6.9	75/42	.78/.42
		36	D100/LB	2.9	720	0.36	6.7/2.7	40/8.1	80/50	.78/.38
63JM/25/4-8/3/...	1440	32	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
63JM/25/2-4/3/...	2910	18	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6
		24	D132/MS	7.2	1460	0.9	15.5/2.8	116/25.2	82/78	.82/.6
		30	D132/M	9	1460	1.2	17.2/3.4	129/31	87/80	.87/.63
		32	D160/LM	16	1460	2	29/5	203/45	87/81	.92/.71
63JM/25/4-8/6/...	1440	36	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
63JM/25/2-4/6/...	2910	12	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6
		16	D132/MS	7.2	1460	0.9	15.5/2.8	116/25.2	82/78	.82/.6
		20	D132/M	9	1460	1.2	17.2/3.4	129/31	87/80	.87/.63
		32	D160/LM	16	1460	2	29/5	203/45	87/81	.92/.71
		36	D160/L	21	1460	2.6	38/6.5	266/59	88/81	.92/.71
63JM/25/4-8/9/...	1440	40	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
63JM/25/2-4/9/...	2910	8	D112/M	4.8	1440	0.6	10.5/1.9	63/14.3	80/75	.82/.6
		12	D132/MS	7.2	1460	0.9	15.5/2.8	116/25.2	82/78	.82/.6
		16	D132/M	9	1460	1.2	17.2/3.4	129/31	87/80	.87/.63
		26	D160/LM	16	1460	2	29/5	203/45	87/81	.92/.71
		32	D160/L	21	1460	2.6	38/6.5	266/59	88/81	.92/.71
		36	D160/LBK	23	1460	2.9	41/7.3	287/66	88/81	.92/.71
71JM/20/6-12/3/...	900	20	D90/SN	0.35	460	0.04	.93/.29	3.3/.6	68/42	.8/.48
		26	D90/LN	0.5	460	0.06	1.3/.47	4.6/.9	70/40	.78/.46
		36	D100/L	1.4	460	0.18	4.1/1.55	14.4/3.9	67/37	.73/.45
71JM/20/4-8/3/...	1440	8	D90/SN	0.67	720	0.08	1.7/.42	7.6/1.1	77/62	.72/.45
		14	D90/LN	1	720	0.12	2.6/.62	11.7/1.6	77/62	.72/.45
		30	D100/LA	2.2	720	0.28	5.4/2.3	32/6.9	75/42	.78/.42
		36	D100/LB	2.9	720	0.36	6.7/2.7	40/8.1	80/50	.78/.38
71JM/20/6-12/6/...	900	10	D90/SN	0.35	460	0.04	.93/.29	3.3/.6	68/42	.8/.48
		16	D90/LN	0.5	460	0.06	1.3/.47	4.6/.9	70/40	.78/.46
		36	D100/L	1.4	460	0.18	4.1/1.55	14.4/3.9	67/37	.73/.45
71JM/20/4-8/6/...	1440	20	D100/LA	2.2	720	0.28	5.4/2.3	32/6.9	75/42	.78/.42
		24	D100/LB	2.9	720	0.36	6.7/2.7	40/8.1	80/50	.78/.38
		34	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
71JM/25/6-12/3/...	935	32	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
71JM/25/4-8/3/...	1440	32	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
71JM/25/6-12/6/...	935	36	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
71JM/25/4-8/6/...	1440	36	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
71JM/25/6-12/9/...	935	36	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
71JM/25/4-8/9/...	1440	32	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		36	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 300/1: Two Speed (Full & Half Pole Change)

400 V / 50 Hz / 3 φ

Code	Speed	Max. Pitch	Motor	Motor Rating	Low Speed		Full Load Current	Starting Current	Efficiency	Power Factor
	rev/min	Angle (°)		(kW)	rev/min	(kW)	(A)	d.o.l (A)	%	cos Ø
80JM/20/6-12/3/...	935	12	D90/SN	0.35	460	0.04	.93/.29	3.3/.6	68/42	.8/.48
		18	D90/LN	0.5	460	0.06	1.3/.47	4.6/.9	70/40	.78/.46
		36	D100/L	1.4	460	0.18	4.1/1.55	14.4/3.9	67/37	.73/.45
80JM/20/4-8/3/...	1440	8	D90/LN	1	720	0.12	2.6/.62	11.7/1.6	77/62	.72/.45
		20	D100/LA	2.2	720	0.28	5.4/2.3	32/6.9	75/42	.78/.42
		26	D100/LB	2.9	720	0.36	6.7/2.7	40/8.1	80/50	.78/.38
		34	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
80JM/20/6-12/6/...	935	8	D90/LN	0.5	460	0.06	1.3/.47	4.6/.9	70/40	.78/.46
		26	D100/L	1.4	460	0.18	4.1/1.55	14.4/3.9	67/37	.73/.45
		34	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
80JM/20/4-8/6/...	1440	10	D100/LA	2.2	720	0.28	5.4/2.3	32/6.9	75/42	.78/.42
		16	D100/LB	2.9	720	0.36	6.7/2.7	40/8.1	80/50	.78/.38
		22	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
80JM/25/6-12/3/...	935	32	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
80JM/25/4-8/3/...	1440	32	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
80JM/25/6-12/6/...	935	36	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
80JM/25/4-8/6/...	1440	26	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		34	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		36	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
80JM/25/6-12/9/...	935	32	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
		36	D132/MS	2.9	470	0.36	7.3/2.3	36.5/6.9	76/57	.75/.4
80JM/25/4-8/9/...	1440	20	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		26	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		34	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
		36	D160/LM	12	740	1.5	23/7.2	173/36	87/72	.87/.42
90JM/25/6-12/3/...	935	32	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
90JM/25/4-8/3/...	1440	28	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		32	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
90JM/25/6-12/6/...	935	28	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
		32	D132/MS	2.9	470	0.36	7.3/2.3	36.5/6.9	76/57	.75/.4
90JM/25/4-8/6/...	1440	18	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		22	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		30	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
		32	D160/LM	12	740	1.5	23/7.2	173/36	87/72	.87/.42
90JM/25/6-12/9/...	935	20	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
		26	D132/MS	2.9	470	0.36	7.3/2.3	36.5/6.9	76/57	.75/.4
		30	D132/MA	3.4	470	0.43	8.4/2.6	42/7.8	77/58	.76/.41
		36	D132/MB	4.5	470	0.56	10.7/3.2	53.5/9.6	78/60	.78/.42
90JM/25/4-8/9/...	1440	10	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		16	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		22	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
		30	D160/LM	12	740	1.5	23/7.2	173/36	87/72	.87/.42
		36	D160/L	15.7	740	2	30/9.2	225/46	88/73	.87/.43
100JM/25/6-12/3/...	935	30	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
		32	D132/MS	2.9	470	0.36	7.3/2.3	36.5/6.9	76/57	.75/.4

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules.

H.T. 300/1: Two Speed (Full & Half Pole Change)

400 V / 50 Hz / 3 ϕ

Code	Speed	Max. Pitch	Motor	Motor Rating	Low Speed		Full Load Current	Starting Current	Efficiency	Power Factor
	rev/min	Angle (°)		(kW)	rev/min	(kW)	(A)	d.o.l (A)	%	cos Ø
100JM/25/4-8/3/...	1440	20	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		24	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		30	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
		32	D160/LM	12	740	1.5	23/7.2	173/36	87/72	.87/.42
100JM/25/6-12/6/...	950	18	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
		24	D132/MS	2.9	470	0.36	7.3/2.3	36.5/6.9	76/57	.75/.4
		28	D132/MA	3.4	470	0.43	8.4/2.6	42/7.8	77/58	.76/.41
		32	D132/MB	4.5	470	0.56	10.7/3.2	53.5/9.6	78/60	.78/.42
100JM/25/4-8/6/...	1450	10	D112/M	4.3	730	0.54	10/3.25	60/13	80/60	.78/.4
		14	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		20	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
		28	D160/LM	12	740	1.5	23/7.2	173/36	87/72	.87/.42
		32	D160/L	15.7	740	2	30/9.2	225/46	88/73	.87/.43
100JM/25/6-12/9/...	960	12	D112/M	2.1	460	0.26	6.8/2.4	24/4.8	68/39	.66/.4
		18	D132/MS	2.9	470	0.36	7.3/2.3	36.5/6.9	76/57	.75/.4
		20	D132/MA	3.4	470	0.43	8.4/2.6	42/7.8	77/58	.76/.41
		26	D132/MB	4.5	470	0.56	10.7/3.2	53.5/9.6	78/60	.78/.42
		28	D132/MK	5.1	470	0.64	11.6/3.5	58/10.5	79/62	.8/.43
		36	D160/LM	7.5	480	0.93	15.7/4.1	79/12.3	84/71	.81/.46
100JM/25/4-8/9/...	1470	8	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		12	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
		20	D160/LM	12	740	1.5	23/7.2	173/36	87/72	.87/.42
		24	D160/L	15.7	740	2	30/9.2	225/46	88/73	.87/.43
		26	D160/LBK	17	740	2.1	32/9.5	240/48	88/74	.86/.43
100JM/31/4-8/9/...	1470	8	D132/MS	5.8	730	0.72	13.1/4	98/16	84/64	.76/.4
		12	D132/M	8	730	1	17.1/5.3	128/21.2	85/68	.8/.4
		20	D160/LM	12	740	1.5	23/7.2	173/36	87/72	.87/.42
		24	D160/L	15.7	740	2	30/9.2	225/46	88/73	.87/.43
		26	D160/LBK	17	740	2.1	32/9.5	240/48	88/74	.86/.43
		30	D180/LM	19.5	740	2.5	37/11	278/55	89/78	.86/.42
		34	D180/L	24	740	3	45/13	338/65	89/78	.86/.42

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 300/1: Two Speed (Full & Other P.A.M. Wound)

400 V / 50 Hz / 3 ϕ

Code	Speed	Max. Pitch	Motor	Motor Rating	Low Speed		Full Load Current	Starting Current	Efficiency	Power Factor
	rev/min	Angle (°)		(kW)	rev/min	(kW)	(A)	d.o.l (A)	%	cos Ø
50JM/20/4-6/3/...	1420	30	D80/A	0.37	920	0.11	1.4/.55	4.9/1.4	70/52	.55/.55
		36	D80/B	0.5	920	0.15	1.2/.64	5.3/1.6	80/55	.77/.62
50JM/20/4-6/6/...	1420	20	D80/A	0.37	920	0.11	1.4/.55	4.9/1.4	70/52	.55/.55
		26	D80/B	0.5	920	0.15	1.2/.64	5.3/1.6	80/55	.77/.62
		32	D90/SN	0.67	910	0.2	1.5/.73	7.6/2.2	80/60	.79/.66
		40	D90/LN	0.9	910	0.27	2.1/1.1	10.3/3.2	82/62	.77/.59
56JM/16/4-6/5/...	1420	12	D80/A	0.37	920	0.11	1.4/.55	4.9/1.4	70/52	.55/.55
		18	D80/B	0.5	920	0.15	1.2/.64	5.3/1.6	80/55	.77/.62
56JM/20/4-6/3/...	1420	22	D80/A	0.37	920	0.11	1.4/.55	4.9/1.4	70/52	.55/.55
		26	D80/B	0.5	920	0.15	1.2/.64	5.3/1.6	80/55	.77/.62
		32	D90/SN	0.67	910	0.2	1.5/.73	7.6/2.2	80/60	.79/.66
		36	D90/LN	0.9	910	0.27	2.1/1.1	10.3/3.2	82/62	.77/.59
56JM/20/4-6/6/...	1420	12	D80/A	0.37	920	0.11	1.4/.55	4.9/1.4	70/52	.55/.55
		16	D80/B	0.5	920	0.15	1.2/.64	5.3/1.6	80/55	.77/.62
		22	D90/SN	0.67	910	0.2	1.5/.73	7.6/2.2	80/60	.79/.66
		28	D90/LN	0.9	910	0.27	2.1/1.1	10.3/3.2	82/62	.77/.59
		40	D100/LA	1.5	940	0.44	3.7/1.9	22.2/6.5	78/56	.75/.61
63JM/20/4-6/3/...	1420	8	D80/A	0.37	920	0.11	1.4/.55	4.9/1.4	70/52	.55/.55
		12	D80/B	0.5	920	0.15	1.2/.64	5.3/1.6	80/55	.77/.62
		18	D90/SN	0.67	910	0.2	1.5/.73	7.6/2.2	80/60	.79/.66
		24	D90/LN	0.9	910	0.27	2.1/1.1	10.3/3.2	82/62	.77/.59
		34	D100/LA	1.5	940	0.44	3.7/1.9	22.2/6.5	78/56	.75/.61
		36	D100/LA	2.4	940	0.8	5.9/3.3	36/11.5	78/56	.75/.61
63JM/20/4-6/6/...	1420	10	D90/SN	0.67	910	0.2	1.5/.73	7.6/2.2	80/60	.79/.66
		14	D90/LN	0.9	910	0.27	2.1/1.1	10.3/3.2	82/62	.77/.59
		24	D100/LA	1.5	940	0.44	3.7/1.9	22.2/6.5	78/56	.75/.61
		34	D100/LA	2.4	940	0.8	5.9/3.3	36/11.5	78/56	.75/.61
		36	D100/LB	3.3	940	1	8.1/4.6	49/16.1	78/56	.75/.61
63JM/25/4-6/3/...	1440	32	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
63JM/25/4-6/6/...	1440	36	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
63JM/25/4-6/9/...	1440	40	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
71JM/20/6-8/3/...	900	22	D90/SN	0.4	680	0.05	1.8/.86	7.1/2.2	65/52	.5/.55
		30	D90/LN	0.6	680	0.08	2.5/1.2	10.2/3	68/54	.5/.55
		36	D100/LA	1	690	0.42	3.5/1.6	13.9/3.3	65/54	.64/.69
71JM/20/4-6/3/...	1440	8	D90/SN	0.67	910	0.2	1.5/.73	7.6/2.2	80/60	.79/.66
		12	D90/LN	0.9	910	0.27	2.1/1.1	10.3/3.2	82/62	.77/.59
		22	D100/LA	1.5	940	0.44	3.7/1.9	22.2/6.5	78/56	.75/.61
		32	D100/LA	2.4	940	0.8	5.9/3.3	36/11.5	78/56	.75/.61
		36	D100/LB	3.3	940	1	8.1/4.6	49/16.1	78/56	.75/.61
71JM/20/6-8/6/...	900	12	D90/SN	0.4	680	0.05	1.8/.86	7.1/2.2	65/52	.5/.55
		18	D90/LN	0.6	680	0.08	2.5/1.2	10.2/3	68/54	.5/.55
		30	D100/LA	1	690	0.42	3.5/1.6	13.9/3.3	65/54	.64/.69
		36	D100/LA	1.4	690	0.65	4.9/2.5	19.6/5	65/54	.64/.69
71JM/20/4-6/6/...	1440	12	D100/LA	1.5	940	0.44	3.7/1.9	22.2/6.5	78/56	.75/.61
		20	D100/LA	2.4	940	0.8	5.9/3.3	36/11.5	78/56	.75/.61
		28	D100/LB	3.3	940	1	8.1/4.6	49/16.1	78/56	.75/.61
		36	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
71JM/25/6-8/3/...	935	32	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
71JM/25/4-6/3/...	1440	32	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules:

H.T. 300/1: Two Speed (Full & Other P.A.M. Wound)

400 V / 50 Hz / 3 ϕ

Code	Speed	Max. Pitch	Motor	Motor Rating	Low Speed		Full Load Current	Starting Current	Efficiency	Power Factor
	rev/min	Angle (°)		(kW)	rev/min	(kW)	(A)	d.o.l (A)	%	cos Ø
71JM/25/6-8/6/...	935	36	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
71JM/25/4-6/6/...	1440	36	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
71JM/25/6-8/9/...	935	36	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
71JM/25/4-6/9/...	1440	32	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		36	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
80JM/20/6-8/3/...	935	14	D90/SN	0.4	680	0.05	1.8/.86	7.1/2.2	65/52	.5/.55
		20	D90/LN	0.6	680	0.08	2.5/1.2	10.2/3	68/54	.5/.55
		28	D100/LA	1	690	0.42	3.5/1.6	13.9/3.3	65/54	.64/.69
		36	D100/LA	1.4	690	0.65	4.9/2.5	19.6/5	65/54	.64/.69
80JM/20/4-6/3/...	1440	14	D100/LA	1.5	940	0.44	3.7/1.9	22.2/6.5	78/56	.75/.61
		22	D100/LA	2.4	940	0.8	5.9/3.3	36/11.5	78/56	.75/.61
		28	D100/LB	3.3	940	1	8.1/4.6	49/16.1	78/56	.75/.61
		36	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
80JM/20/6-8/6/...	935	10	D90/LN	0.6	680	0.08	2.5/1.2	10.2/3	68/54	.5/.55
		18	D100/LA	1	690	0.42	3.5/1.6	13.9/3.3	65/54	.64/.69
		26	D100/LA	1.4	690	0.65	4.9/2.5	19.6/5	65/54	.64/.69
		30	D100/LB	1.8	690	0.8	6.2/3	24.8/6	66/55	.64/.69
		36	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
80JM/20/4-6/6/...	1440	12	D100/LA	2.4	940	0.8	5.9/3.3	36/11.5	78/56	.75/.61
		18	D100/LB	3.3	940	1	8.1/4.6	49/16.1	78/56	.75/.61
		24	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
80JM/25/6-8/3/...	935	32	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
80JM/25/4-6/3/...	1440	32	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
80JM/25/6-8/6/...	935	36	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
80JM/25/4-6/6/...	1440	28	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		34	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		36	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
80JM/25/6-8/9/...	935	32	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
		36	D132/MS	3	710	1.3	7.9/4.1	47/12.3	79/70	.7/.65
80JM/25/4-6/9/...	1440	22	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		26	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		34	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
		36	D160/LM	12	970	4	23/10.2	161/51	87/80	.86/.7
90JM/25/6-8/3/...	935	32	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
90JM/25/4-6/3/...	1440	28	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		32	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
90JM/25/6-8/6/...	935	28	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
		32	D132/MS	3	710	1.3	7.9/4.1	47/12.3	79/70	.7/.65
90JM/25/4-6/6/...	1440	18	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		24	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		30	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
		32	D160/LM	12	970	4	23/10.2	161/51	87/80	.86/.7
90JM/25/6-8/9/...	935	20	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
		26	D132/MS	3	710	1.3	7.9/4.1	47/12.3	79/70	.7/.65
		30	D132/MA	3.5	710	1.5	8.8/4.6	53/13.8	80/71	.72/.66
		36	D132/MB	4.5	710	1.95	10.8/5.8	65/17.4	82/71	.73/.68

Motor Frame Size Schedules:
H.T. 300/1: Two Speed (Full & Other P.A.M. Wound)

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Low Speed rev/min	Low Speed (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
90JM/25/4-6/9/...	1440	10	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		16	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		22	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
		30	D160/LM	12	970	4	23/10.2	161/51	87/80	.86/.7
		36	D160/L	16	970	5.3	30/13	210/78	89/83	.86/.7
100JM/25/6-8/3/...	935	30	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
		32	D132/MS	3	710	1.3	7.9/4.1	47/12.3	79/70	.7/.65
100JM/25/4-6/3/...	1440	20	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		24	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		30	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
		32	D160/LM	12	970	4	23/10.2	161/51	87/80	.86/.7
100JM/25/6-8/6/...	950	20	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
		24	D132/MS	3	710	1.3	7.9/4.1	47/12.3	79/70	.7/.65
		28	D132/MA	3.5	710	1.5	8.8/4.6	53/13.8	80/71	.72/.66
		32	D132/MB	4.5	710	1.95	10.8/5.8	65/17.4	82/71	.73/.68
100JM/25/4-6/6/...	1450	10	D112/M	4.5	960	1.5	10.5/5.6	63/19.6	82/65	.75/.61
		14	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		20	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
		28	D160/LM	12	970	4	23/10.2	161/51	87/80	.86/.7
		32	D160/L	16	970	5.3	30/13	210/78	89/83	.86/.7
100JM/25/6-8/9/...	960	12	D112/M	2.2	690	1	6.9/3.6	27.6/7.2	72/58	.64/.69
		18	D132/MS	3	710	1.3	7.9/4.1	47/12.3	79/70	.7/.65
		20	D132/MA	3.5	710	1.5	8.8/4.6	53/13.8	80/71	.72/.66
		26	D132/MB	4.5	710	1.95	10.8/5.8	65/17.4	82/71	.73/.68
		28	D132/MK	5.1	710	2.2	12.3/6.6	74/19.8	82/71	.73/.68
		36	D160/LM	7.5	720	3.2	16.2/8.2	105/33	85/78	.78/.72
100JM/25/4-6/9/...	1470	8	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		12	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
		20	D160/LM	12	970	4	23/10.2	161/51	87/80	.86/.7
		26	D160/L	16	970	5.3	30/13	210/78	89/83	.86/.7
		28	D160/LBK	18	970	6	34/15	238/90	89/83	.86/.7
100JM/31/4-6/9/...	1470	8	D132/MS	6	950	1.8	12.4/4.3	87/28	84/68	.83/.61
		12	D132/M	8.1	950	2.7	16.5/8.9	116/36	85/70	.83/.64
		20	D160/LM	12	970	4	23/10.2	161/51	87/80	.86/.7
		26	D160/L	16	970	5.3	30/13	210/78	89/83	.86/.7
		28	D160/LBK	18	970	6	34/15	238/90	89/83	.86/.7
		30	D180/LM	19.5	980	6.5	39/14.5	293/94	87/85	.83/.76
		34	D180/L	23	980	7.7	45/16.8	338/110	88/86	.84/.77

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules: H.T. 400/2

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
31JM/16/2/5/...	2840	40	D80/A	0.75	1.8	9.9	78	0.77
45JM/20/2/6/...	2910	8	D80/A	0.75	1.8	9.9	78	0.77
		12	D80/B	1.1	2.6	16.3	79	0.8
		16	D90/LNS	1.5	3.3	22.3	76	0.86
		22	D90/L	2.2	4.6	34.5	81	0.86
		28	D100/L	3	5.8	43.5	84	0.9
		36	DF112/M	4	7.5	56.3	86	0.9
50JM/16/4/5/...	1420	30	D80/A	0.55	1.6	6.4	73	0.7
		38	D80/B	0.75	1.9	8.6	77	0.7
50JM/20/4/6/...	1420	28	D80/A	0.55	1.6	6.4	73	0.7
		36	D80/B	0.75	1.9	8.6	77	0.7
56JM/16/4/5/...	1420	20	D80/A	0.55	1.6	6.4	73	0.7
		26	D80/B	0.75	1.9	8.6	77	0.7
56JM/20/4/3/...	1420	28	D80/A	0.55	1.6	6.4	73	0.7
		34	D80/B	0.75	1.9	8.6	77	0.7
		36	D90/LNS	1.1	3.1	14	79	0.65
56JM/20/4/6/...	1420	18	D80/A	0.55	1.6	6.4	73	0.7
		24	D80/B	0.75	1.9	8.6	77	0.7
		32	D90/LNS	1.1	3.1	14	79	0.65
		40	D90/LN	1.5	3.7	19.4	82	0.71
63JM/20/6/3/...	900	32	D80/A	0.37	1.4	4.2	65	0.58
		36	D80/B	0.55	1.7	6.4	70	0.64
63JM/20/4/3/...	1420	14	D80/A	0.55	1.6	6.4	73	0.7
		20	D80/B	0.75	1.9	8.6	77	0.7
		26	D90/LNS	1.1	3.1	14	79	0.65
		34	D90/LN	1.5	3.7	19.4	82	0.71
		36	D100/LA	2.2	5.2	30.2	79	0.78
63JM/20/6/6/...	900	22	D80/A	0.37	1.4	4.2	65	0.58
		30	D80/B	0.55	1.7	6.4	70	0.64
		36	D90/SN	0.75	2.4	9	71	0.62
63JM/20/4/6/...	1420	8	D80/A	0.55	1.6	6.4	73	0.7
		12	D80/B	0.75	1.9	8.6	77	0.7
		18	D90/LNS	1.1	3.1	14	79	0.65
		24	D90/LN	1.5	3.7	19.4	82	0.71
		32	D100/LA	2.2	5.2	30.2	79	0.78
		36	D100/LB	3	7.1	44.7	82	0.75
63JM/25/6/3/...	935	32	DF112/M	2.2	6.1	24.5	77	0.68
63JM/25/4/3/...	1440	32	DF112/M	4	8.7	50	83	0.8
63JM/25/4/3/...	1440	32	DF112/M	4	8.7	50	83	0.8
63JM/25/6/6/...	935	36	DF112/M	2.2	6.1	24.5	77	0.68
63JM/25/4/6/...	1440	36	DF112/M	4	8.7	50	83	0.8
63JM/25/6/9/...	935	40	DF112/M	2.2	6.1	24.5	77	0.68
63JM/25/4/9/...	1440	40	DF112/M	4	8.7	50	83	0.8
71JM/20/6/3/...	900	22	D80/A	0.37	1.4	4.2	65	0.58
		28	D80/B	0.55	1.7	6.4	70	0.64
		36	D90/SN	0.75	2.4	9	71	0.62

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 400/2

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
71JM/20/4/3/...	1440	10	D80/B	0.75	1.9	8.6	77	0.7
		16	D90/LNS	1.1	3.1	14	79	0.65
		22	D90/LN	1.5	3.7	19.4	82	0.71
		30	D100/LA	2.2	5.2	30.2	79	0.78
		36	D100/LB	3	7.1	44.7	82	0.75
71JM/20/6/6/...	900	12	D80/A	0.37	1.4	4.2	65	0.58
		18	D80/B	0.55	1.7	6.4	70	0.64
		24	D90/SN	0.75	2.4	9	71	0.62
		34	D90/LN	1.1	3.2	12	75	0.66
		36	D100/L	1.5	4.5	20.3	75	0.65
71JM/20/4/6/...	1440	8	D90/LNS	1.1	3.1	14	79	0.65
		12	D90/LN	1.5	3.7	19.4	82	0.71
		20	D100/LA	2.2	5.2	30.2	79	0.78
		26	D100/LB	3	7.1	44.7	82	0.75
		32	DF112/M	4	8.7	50	83	0.8
71JM/25/6/3/...	935	32	DF112/M	2.2	6.1	24.5	77	0.68
71JM/25/4/3/...	1440	32	DF112/M	4	8.7	50	83	0.8
71JM/25/6/6/...	935	36	DF112/M	2.2	6.1	24.5	77	0.68
71JM/25/4/6/...	1440	36	DF112/M	4	8.7	50	83	0.8
71JM/25/6/9/...	935	36	DF112/M	2.2	6.1	24.5	77	0.68
71JM/25/4/9/...	1440	30	DF112/M	4	8.7	50	83	0.8
		36	DF132/MS	5.5	11.1	75.5	86	0.83
80JM/20/6/3/...	935	12	D80/A	0.37	1.4	4.2	65	0.58
		18	D80/B	0.55	1.7	6.4	70	0.64
		24	D90/SN	0.75	2.4	9	71	0.62
		32	D90/LN	1.1	3.2	12	75	0.66
		36	D100/L	1.5	4.5	20.3	75	0.65
80JM/20/6/6/...	935	10	D80/B	0.55	1.7	6.4	70	0.64
		14	D90/SN	0.75	2.4	9	71	0.62
		22	D90/LN	1.1	3.2	12	75	0.66
		28	D100/L	1.5	4.5	20.3	75	0.65
		36	DF112/M	2.2	6.1	24.5	77	0.68
80JM/25/6/3/...	935	32	DF112/M	2.2	6.1	24.5	77	0.68
80JM/25/4/3/...	1440	32	DF112/M	4	8.7	50	83	0.8
80JM/25/6/6/...	935	36	DF112/M	2.2	6.1	24.5	77	0.68
80JM/25/4/6/...	1440	26	DF112/M	4	8.7	50	83	0.8
		32	DF132/MS	5.5	11.1	75.5	86	0.83
		36	DF132/M	7.5	15	113	87	0.83
80JM/25/6/9/...	935	32	DF112/M	2.2	6.1	24.5	77	0.68
		36	DF132/MS	3	6.8	41	82	0.77
80JM/25/4/9/...	1440	20	DF112/M	4	8.7	50	83	0.8
		26	DF132/MS	5.5	11.1	75.5	86	0.83
		32	DF132/M	7.5	15	113	87	0.83
		36	DF160/LM	11	20.8	135	88	0.86
90JM/25/6/3/...	935	32	DF112/M	2.2	6.1	24.5	77	0.68

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 400/2

400 V / 50 Hz / 3 ϕ

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
90JM/25/4/3/...	1440	26	DF112/M	4	8.7	50	83	0.8
		32	DF132/MS	5.5	11.1	75.5	86	0.83
90JM/25/6/6/...	935	28	DF112/M	2.2	6.1	24.5	77	0.68
		32	DF132/MS	3	6.8	41	82	0.77
90JM/25/4/6/...	1440	16	DF112/M	4	8.7	50	83	0.8
		22	DF132/MS	5.5	11.1	75.5	86	0.83
		28	DF132/M	7.5	15	113	87	0.83
		32	DF160/LM	11	20.8	135	88	0.86
90JM/25/6/9/...	935	20	DF112/M	2.2	6.1	24.5	77	0.68
		26	DF132/MS	3	6.8	41	82	0.77
		34	DF132/MA	4	9.3	51.2	83	0.74
		36	DF132/MB	5.5	12.8	70.4	85	0.73
90JM/25/4/9/...	1440	8	DF112/M	4	8.7	50	83	0.8
		14	DF132/MS	5.5	11.1	75.5	86	0.83
		20	DF132/M	7.5	15	113	87	0.83
		28	DF160/LM	11	20.8	135	88	0.86
		34	DF160/L	15	28	202	90	0.87
		36	DF160/LAK	18.5	34	255	89	0.88
100JM/25/6/3/...	935	30	DF112/M	2.2	6.1	24.5	77	0.68
		32	DF132/MS	3	6.8	41	82	0.77
100JM/25/4/3/...	1440	18	DF112/M	4	8.7	50	83	0.8
		24	DF132/MS	5.5	11.1	75.5	86	0.83
		28	DF132/M	7.5	15	113	87	0.83
		32	DF160/LM	11	20.8	135	88	0.86
100JM/25/6/6/...	950	20	DF112/M	2.2	6.1	24.5	77	0.68
		26	DF132/MS	3	6.8	41	82	0.77
		30	DF132/MA	4	9.3	51.2	83	0.74
		32	DF132/MB	5.5	12.8	70.4	85	0.73
100JM/25/4/6/...	1450	8	DF112/M	4	8.7	50	83	0.8
		14	DF132/MS	5.5	11.1	75.5	86	0.83
		18	DF132/M	7.5	15	113	87	0.83
		26	DF160/LM	11	20.8	135	88	0.86
		32	DF160/L	15	28	202	90	0.87
100JM/25/6/9/...	960	12	DF112/M	2.2	6.1	24.5	77	0.68
		18	DF132/MS	3	6.8	41	82	0.77
		24	DF132/MA	4	9.3	51.2	83	0.74
		30	DF132/MB	5.5	12.8	70.4	85	0.73
		36	DF160/LM	7.5	16.6	116	87	0.75
100JM/25/4/9/...	1470	8	DF132/MS	5.5	11.1	75.5	86	0.83
		12	DF132/M	7.5	15	113	87	0.83
		18	DF160/LM	11	20.8	135	88	0.86
		24	DF160/L	15	28	202	90	0.87
		28	DF160/LAK	18.5	34	255	89	0.88
		32	DF160/LBK	21	38	285	89	0.88
100JM/31/4/9/...	1470	8	DF132/MS	5.5	11.1	75.5	86	0.83
		12	DF132/M	7.5	15	113	87	0.83
		18	DF160/LM	11	20.8	135	88	0.86
		24	DF160/L	15	28	202	90	0.87
		28	DF160/LAK	18.5	34	255	89	0.88
		32	DF160/LBK	21	38	285	89	0.88

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 400/2: Two Speed (Full & Half Pole Change)

400 V / 50 Hz / 3 ф

Code	Speed rev/min	Max. Pitch Angle (°)	Motor	Motor Rating (kW)	Low Speed rev/min	Low Speed (kW)	Full Load Current (A)	Starting Current d.o.l (A)	Efficiency %	Power Factor cos Ø
31JM/16/2-4/5/...	2840	32	D80/A	0.55	1440	0.07	Information available on request			
		40	D80/B	0.75	1440	0.09				
45JM/20/2-4/3/...	2910	10	D80/A	0.55	1440	0.07				
		14	D80/B	0.75	1440	0.09				
		20	D90/LS	1.1	1420	0.14				
		36	D100/LA	3	1440	0.6				
45JM/20/2-4/6/...	2910	8	D80/B	0.75	1440	0.09				
		12	D90/LS	1.1	1420	0.14				
		14	D90/L	1.3	1420	0.16				
		28	D100/LA	3	1440	0.6				
		36	DF112/M	4	1440	0.85				
50JM/20/4-8/3/...	1420	32	D80/A	0.4	700	0.05				
		36	D80/B	0.52	700	0.07				
50JM/20/4-8/6/...	1420	22	D80/A	0.4	700	0.05				
		26	D80/B	0.52	700	0.07				
		32	D90/LS	0.67	700	0.08				
		40	D90/L	1	700	0.12				
56JM/20/4-8/3/...	1420	22	D80/A	0.4	700	0.05				
		26	D80/B	0.52	700	0.07				
		32	D90/LS	0.67	700	0.08				
		36	D90/L	1	700	0.12				
56JM/20/4-8/6/...	1420	12	D80/A	0.4	700	0.05				
		16	D80/B	0.52	700	0.07				
		22	D90/LS	0.67	700	0.08				
		30	D90/L	1	700	0.12				
		40	D100/LA	1.85	700	0.48				
63JM/20/4-8/3/...	1420	12	D80/B	0.52	700	0.07				
		18	D90/LS	0.67	700	0.08				
		24	D90/L	1	700	0.12				
		36	D100/LA	1.85	700	0.48				
63JM/20/4-8/6/...	1420	10	D90/LS	0.67	700	0.08				
		16	D90/L	1	700	0.12				
		28	D100/LA	1.85	700	0.48				
		34	D100/LA	2.4	700	0.55				
		36	DF112/M	3.6	700	0.75				
63JM/25/4-8/3/...	1440	32	DF112/M	3.6	700	0.75				
63JM/25/4-8/6/...	1440	36	DF112/M	3.6	700	0.75				
63JM/25/4-8/9/...	1440	40	DF112/M	3.6	700	0.75				
71JM/20/4-8/3/...	1440	14	D90/L	1	700	0.12				
		26	D100/LA	1.85	700	0.48				
		32	D100/LA	2.4	700	0.55				
		36	DF112/M	3.6	700	0.75				
71JM/20/4-8/6/...	1440	16	D100/LA	1.85	700	0.48				
		20	D100/LA	2.4	700	0.55				
		30	DF112/M	3.6	700	0.75				
71JM/25/4-8/3/...	1440	32	DF112/M	3.6	700	0.75				
71JM/25/4-8/6/...	1440	34	DF112/M	3.6	700	0.75				
		36	DF132/MS	4.8	700	1.1				

WOODS AIR MOVEMENT

Motor Frame Size Schedules:
H.T. 400/2: Two Speed (Full & Half Pole Change)

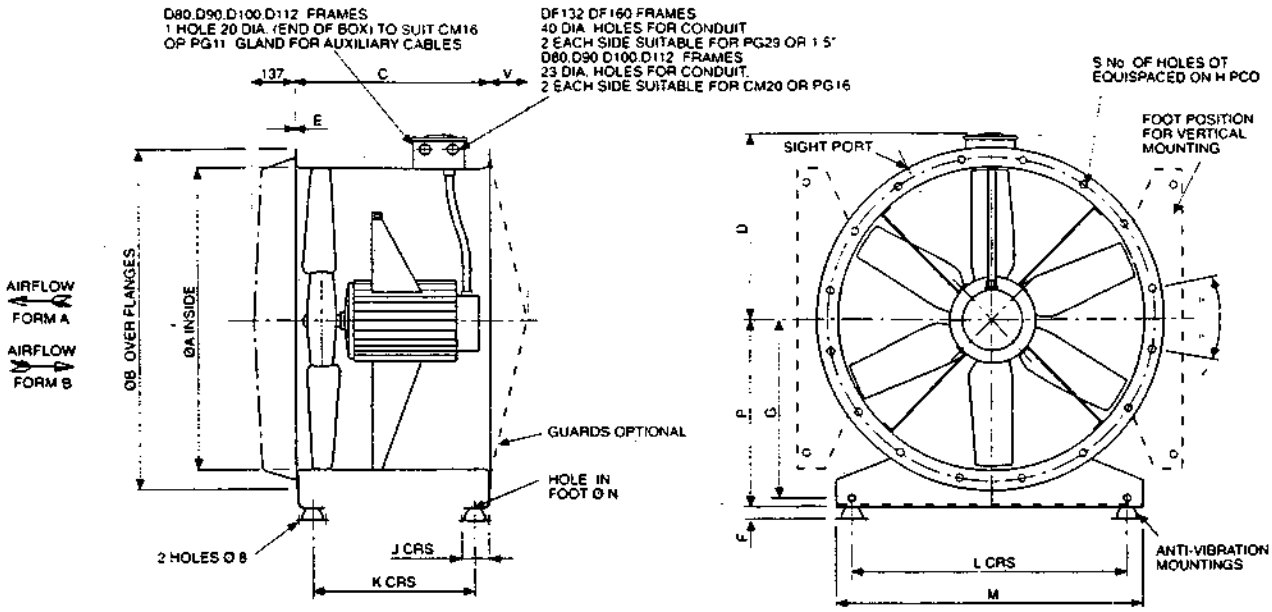
400 V / 50 Hz / 3 ϕ

Code	Speed	Max. Pitch	Motor	Motor Rating	Low Speed		Full Load Current	Starting Current	Efficiency	Power Factor
	rev/min	Angle (°)		(kW)	rev/min	(kW)	(A)	d.o.l (A)	%	cos Ø
71JM/25/4-8/9/...	1440	28	DF112/M	3.6	700	0.75	Information available on request			
		34	DF132/MS	4.8	700	1.1				
		36	DF132/M	6.7	700	1.5				
80JM/25/4-8/3/...	1440	32	DF112/M	3.6	700	0.75				
80JM/25/4-8/6/...	1440	24	DF112/M	3.6	700	0.75				
		28	DF132/MS	4.8	700	1.1				
		36	DF132/M	6.7	700	1.5				
80JM/25/4-8/9/...	1440	18	DF112/M	3.6	700	0.75				
		22	DF132/MS	4.8	700	1.1				
		30	DF132/M	6.7	700	1.5				
		36	DF160/LM	10	720	2.2				
90JM/25/4-8/3/...	1440	24	DF112/M	3.6	700	0.75				
		30	DF132/MS	4.8	700	1.1				
		32	DF132/M	6.7	700	1.5				
90JM/25/4-8/6/...	1440	14	DF112/M	3.6	700	0.75				
		20	DF132/MS	4.8	700	1.1				
		26	DF132/M	6.7	700	1.5				
		32	DF160/LM	10	720	2.2				
90JM/25/4-8/9/...	1440	8	DF112/M	3.6	700	0.75				
		12	DF132/MS	4.8	700	1.1				
		18	DF132/M	6.7	700	1.5				
		24	DF160/LM	10	720	2.2				
		32	DF160/L	13.3	720	3				
100JM/25/4-8/3/...	1440	16	DF112/M	3.6	700	0.75				
		20	DF132/MS	4.8	700	1.1				
		26	DF132/M	6.7	700	1.5				
		32	DF160/LM	10	720	2.2				
100JM/25/4-8/6/...	1450	8	DF112/M	3.6	700	0.75				
		10	DF132/MS	4.8	700	1.1				
		16	DF132/M	6.7	700	1.5				
		24	DF160/LM	10	720	2.2				
		28	DF160/L	13.3	720	3				
100JM/25/4-8/9/...	1470	10	DF132/M	6.7	700	1.5				
		16	DF160/LM	10	720	2.2				
		22	DF160/L	13.3	720	3				
100JM/31/4-8/9/...	1470	10	DF132/M	6.7	700	1.5				
		16	DF160/LM	10	720	2.2				
		22	DF160/L	13.3	720	3				
		26	DF180/LM	16	720	3.7				
		30	DF180/L	20	720	4.5				

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

DIMENSIONS AND WEIGHTS LONG CASED



Code	Motor Frame	A	B	C	D	E	F	G	H	J	K	L	M	N	P	S	T	V	Weight (kg)
		DIMENSION REFERENCE (mm)																	
315	D80	315	395	375	235	2.5	25	175	355	66	289	265	315	10	200	8	10	30	31
450	D80	450	530	375	306	2.5	25	255	500	66	289	400	450	10	280	8	12	30	36
	D90	450	530	520	306	3	25	255	500	66	434	400	450	10	280	8	12	30	49
	D100	450	530	520	306	3	25	255	500	66	434	400	450	10	280	8	12	30	51
	DF112	450	530	520	306	3	25	255	500	66	434	400	450	10	280	8	12	30	63
500	D80	500	594	375	338	2.5	25	290	560	66	289	450	500	10	315	12	12	30	39
	D90	500	594	520	338	3	25	290	560	66	434	450	500	10	315	12	12	30	59
	D100	500	594	520	338	3	25	290	560	66	434	450	500	10	315	12	12	30	61
	DF112	500	594	520	338	3	25	290	560	66	434	450	500	10	315	12	12	30	75
560	D80	560	654	375	368	2.5	25	330	620	66	289	510	560	10	355	12	12	50	43
	D90	560	654	520	368	3	25	330	620	66	434	510	560	10	355	12	12	50	61
	D100	560	654	520	368	3	25	330	620	66	434	510	560	10	355	12	12	50	63
	DF112	560	654	520	368	3	25	330	620	66	434	510	560	10	355	12	12	50	77
630	D80	630	724	375	403	3	25	375	690	66	289	580	630	10	400	12	12	50	57
	D90	630	724	520	403	3	25	375	690	66	434	580	630	10	400	12	12	50	75
	D100	630	724	520	403	3	25	375	690	66	434	580	630	10	400	12	12	50	77
	DF112	630	724	520	403	3	25	375	690	66	434	580	630	10	400	12	12	50	89
	DF132	630	724	520	440	4	25	375	690	66	434	580	630	12	400	12	12	50	158
	DF160	630	724	625	440	4	25	375	690	66	529	580	630	12	400	12	12	50	215
710	D80	710	804	375	443	3	25	415	770	66	259	660	710	10	440	16	12	50	63
	D90	710	804	520	443	3	25	415	770	66	404	660	710	10	440	16	12	50	79
	D100	710	804	520	443	3	25	415	770	66	404	660	710	10	440	16	12	50	81
	DF112	710	804	520	443	3	25	415	770	66	404	660	710	10	440	16	12	50	93
	DF132	710	804	520	480	4	25	415	770	66	404	660	710	12	440	16	12	50	170
800	D80	800	894	375	488	3	25	485	860	66	259	750	800	10	510	16	12	50	68
	D90	800	894	520	488	3	25	485	860	66	404	750	800	10	510	16	12	50	88
	D100	800	894	520	488	3	25	485	860	66	404	750	800	10	510	16	12	50	90
	DF112	800	894	520	488	3	25	485	860	66	404	750	800	10	510	16	12	50	102
	DF132	800	894	520	525	3	45	485	860	124	404	750	800	12	510	16	12	50	194
	DF160	800	894	625	525	5	45	485	860	124	499	750	800	12	510	16	12	50	229
900	DF112	900	1006	520	538	3	25	491	970	66	444	850	900	10	518	16	15	50	107
	DF132	900	1006	520	575	5	45	491	970	124	444	850	900	12	518	16	15	50	214
	DF160	900	1006	625	575	5	45	491	970	124	539	850	900	12	518	16	15	50	261
1000	DF112	1000	1106	520	588	3	25	547	1070	66	444	950	1000	10	574	16	15	50	115
	DF132	1000	1106	520	625	5	45	547	1070	124	444	950	1000	12	574	16	15	50	229
	DF160	1000	1106	625	625	5	45	547	1070	124	539	950	1000	12	574	16	15	50	277

JM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

Motor Frame Size Schedules.

H.T. 400/2: Two Speed (Full & Other P.A.M. Wound)

400 V / 50 Hz / 3 ϕ

Code	Speed	Max. Pitch	Motor	Motor Rating	Low Speed		Full Load Current	Starting Current	Efficiency	Power Factor
	rev/min	Angle (°)		(kW)	rev/min	(kW)	(A)	d.o.l (A)	%	cos Ø
90JM/25/4-6/3/...	1440	24	DF112/M	3.7	960	1.25	Information available on request			
		30	DF132/MS	5	950	1.5				
		32	DF132/M	6.7	950	2.1				
90JM/25/4-6/6/...	1440	14	DF112/M	3.7	960	1.25				
		20	DF132/MS	5	950	1.5				
		26	DF132/M	6.7	950	2.1				
		32	DF160/LM	10	970	3				
90JM/25/4-6/9/...	1440	8	DF112/M	3.7	960	1.25				
		12	DF132/MS	5	950	1.5				
		18	DF132/M	6.7	950	2.1				
		26	DF160/LM	10	970	3				
		32	DF160/L	13.2	970	3.7				
100JM/25/4-6/3/...	1440	16	DF112/M	3.7	960	1.25				
		22	DF132/MS	5	950	1.5				
		26	DF132/M	6.7	950	2.1				
		32	DF160/LM	10	970	3				
100JM/25/4-6/6/...	1450	8	DF112/M	3.7	960	1.25				
		12	DF132/MS	5	950	1.5				
		16	DF132/M	6.7	950	2.1				
		24	DF160/LM	10	970	3				
		30	DF160/L	13.2	970	3.7				
100JM/25/4-6/9/...	1470	10	DF132/M	6.7	950	2.1				
		16	DF160/LM	10	970	3				
		22	DF160/L	13.2	970	3.7				
100JM/31/4-6/9/...	1470	10	DF132/M	6.7	950	2.1				
		16	DF160/LM	10	970	3				
		22	DF160/L	13.2	970	3.7				
		26	DF180/LM	16	980	5.3				
		28	DF180/L	18.5	980	6				

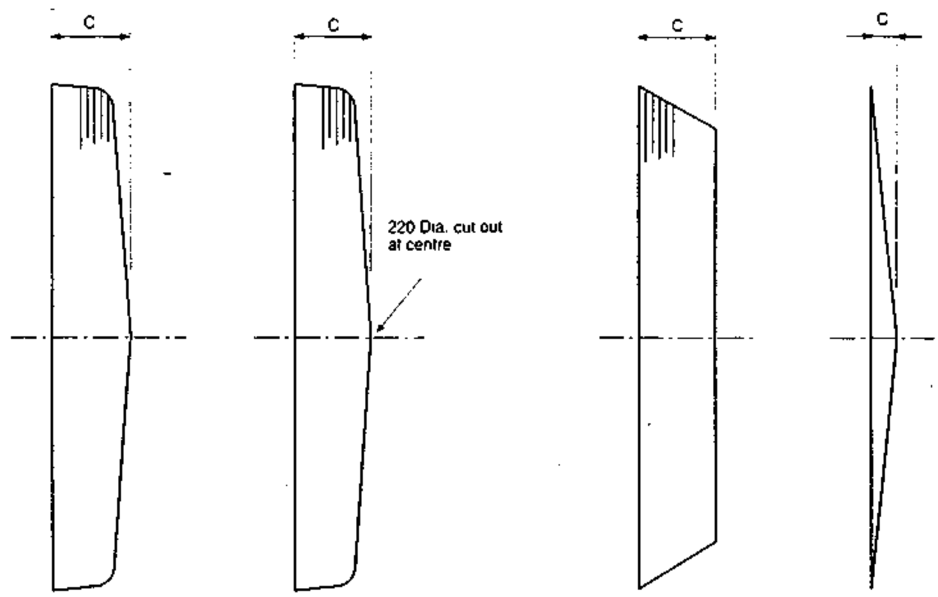
IM AEROFOIL - H.T. SERIES

WOODS AIR MOVEMENT

ANCILLARIES

GUARDS

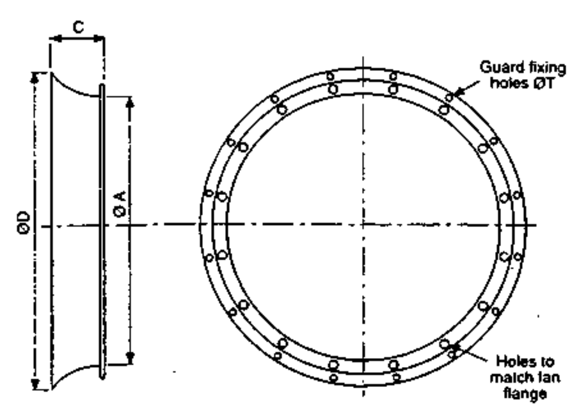
TYPE I Impeller Side (all) & Motor Side (BT & CY)	TYPE II Motor Side (F22)	TYPE III Motor Side (D132 & D160)	TYPE IV Bellmouth & Motor Side 'L' type (all)



Suitable for fan ØA	Type	C	Weight (kg)
315	I	137	1.2
315	IV	30	0.5
450	I	137	1.8
450	II	137	1.6
450	IV	30	0.6
500	I	137	2.0
500	II	137	1.8
500	IV	30	0.7
560	I	137	2.2
560	II	137	2.0
560	IV	50	1.0
630	I	137	2.8
630	II	137	2.6
630	III	350	3.0
630	IV	50	1.2
710	I	137	3.2
710	II	137	3.0
710	III	350	3.4
710	IV	50	1.4
800	I	137	3.5
800	II	137	3.3
800	III	350	3.9
800	IV	50	1.5
900	I	137	4.2
900	II	137	4.2
900	III	310	4.8
900	IV	50	1.7
1000	I	137	5.0
1000	II	137	4.8
1000	III	310	5.6
1000	IV	50	2.0

BELLMOUTH

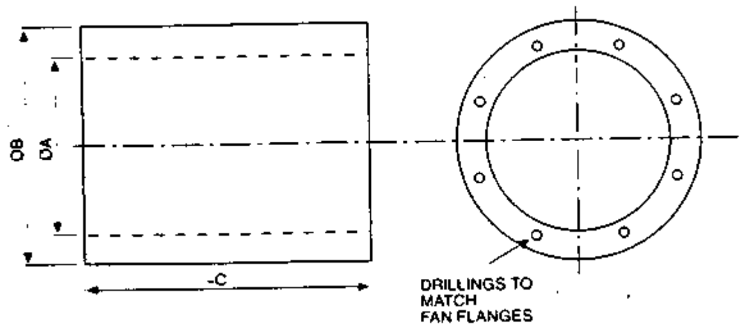
Suitable for fan ØA	C	D	Weight (kg)
315	65	379	1.0
450	95	536	2.0
500	87	600	3.2
560	100	668	4.0
630	108	757	4.8
710	126	857	5.4
800	134	957	6.8
900	150	1077	8.0
1000	167	1199	16.0



All dimensions in mm and Kgs

ANCILLARIES

SILENCER - B TYPE

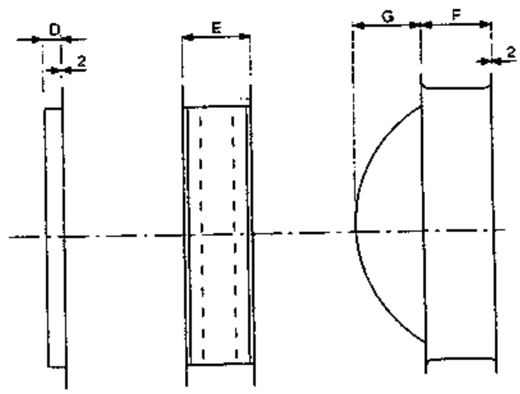


Suitable for fan ØA	B	C	Weight (kg) B type	Weight (kg) C type
315	415	315	10	13
450	600	450	20	24
500	650	500	25	29
560	710	560	30	35
630	780	630	35	42
710	860	710	44	53
800	1000	800	55	66
900	1100	900	70	84
1000	1200	1000	82	100

The above silencers give the approximate dB(A) reductions:-
B Type 1 diameter length - 7 to 10 dB(A)
C Type 1 diameter length - 12 to 15 dB(A)
For full acoustic details see publication AF1.3/c or contact our Woods Acoustic Division.

Suitable for fan ØA	D	E	F	G	Weight (kg) Matching Flange	Weight (kg) Flexible Connection	Weight (kg) Damper
315	32	110	225	-	1.1	2.3	8
450	32	110	225	39	1.7	3.5	12
500	32	110	225	75	2.0	4.2	16
560	32	110	225	125	2.3	4.8	18
630	50	160	225	176	3.0	6.2	20
710	50	160	225	210	3.2	6.7	23
800	50	160	225	270	3.6	7.5	27
900	50	160	225	305	4.1	8.5	31
1000	50	160	225	345	4.6	9.5	36

MATCHING FLANGE | FLEXIBLE CONNECTION | DAMPER



ANTI VIBRATION MOUNTINGS

Various types of anti vibration mountings can be specified against each H.T. temperature/time category on request

All dimensions in mm and Kgs

SFC1 FILE

JM AEROFOIL

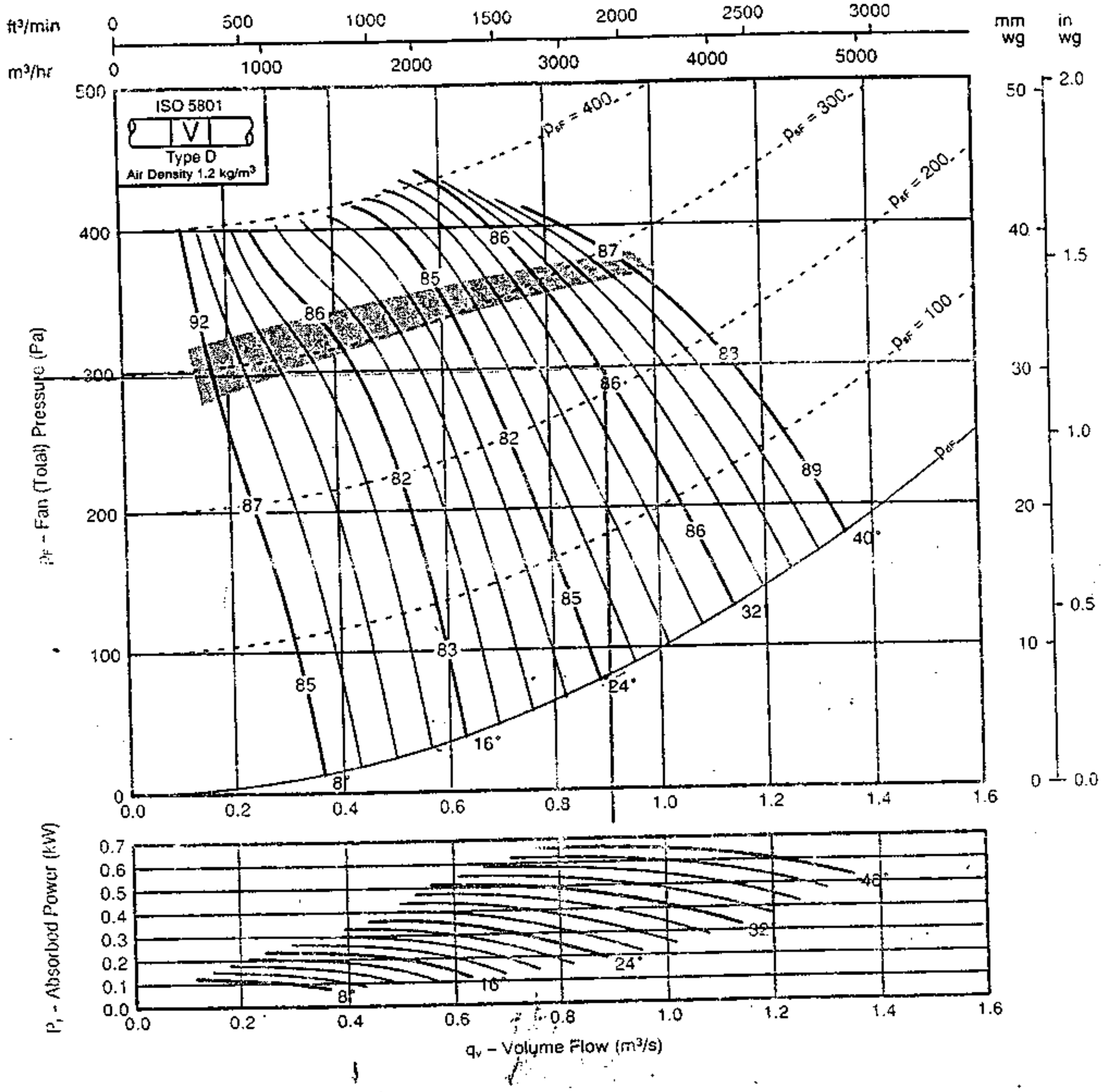
WOODS AIR MOVEMENT

BS 5750 Pt 1
EN 29001
ISO 9001

Fan Code: 31JM/16/2/5/...
315 mm 2840 rev/min 5 Blades 50 Hz

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	–12 –16	–7 –13	–6 –8	–5 –8	–9 –3	–17 –11	–24 –17	–30 –25
16	–14 –15	–11 –10	–4 –5	–9 –7	–5 –7	–14 –11	–20 –15	–27 –21
24 – 40	–9 –9	–4 –7	–6 –5	–10 –10	–12 –10	–17 –14	–20 –18	–25 –23

Outlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	–10 –14	–7 –12	–3 –6	–4 –8	–8 –3	–16 –11	–24 –16	–29 –23
16	–13 –13	–11 –10	–1 –2	–8 –7	–5 –6	–13 –11	–20 –15	–27 –21
24 – 40	–7 –7	–4 –6	–5 –1	–9 –9	–11 –10	–15 –13	–18 –16	–23 –22

02/02/94

SK9755

WOODS OF COLCHESTER LTD.

JM AEROFOIL

Date: 12/08/98
Fan Reference : SF02

Quote Number	: QPEN2594R
Customer	: Drake & Scull
Project Reference	: 5-7 Carlton Gardens

Requested Duty (adj.)	: 0.34 m^3/s at 380 Pa (Static Pressure)
Actual Duty	: 0.34 m^3/s at 385 Pa (Static Pressure)
Obtained Duty	: 101 % of volume flow rate.

Fan Code	: 35JM/16/2/5/10	No. Blades	: 5
Fan Diameter	: 355 mm	Pitch Angle	: 10°
Fan Hub Diameter	: 160 mm	Form of Running	: B
Fan Speed	: 2 Pole/2840 rpm	Fan Casing	: Long Cased

Absorbed Power	: 0.23 kW
Peak Power	: 0.28 kW
Fan Total Efficiency	: 53 %

Ducted Inlet Sound Level (Lw): 91 dB

Sound Spectrum(Hz)	63	125	250	500	1K	2K	4K	8K
Inlet (Lw)	78	81	84	85	85	78	71	65
Outlet (Lw)	81	82	87	87	86	79	71	65

Motor Frame Size	: BT5	Starting Current	: 3.60 A
Rated Motor Power	: 0.35 kW	Electrical Supply	: 380-420v 3 Phase 50Hz
Full Load Current	: .90 A	Start Type	: Direct on Line
		Control	: Fixed Speed

Performance Data :
ISO 5801
Performance shown is specifically for fully ducted installations.

Sound Data :
(BS 848 Pt2 1985)

The single figure is the overall inlet sound power level, derived from measurements taken in Woods laboratory specifically under ducted conditions.

Terms and Conditions
This offer is made subject to the terms and condiions detailed on the accompanying letter.

DESCRIPTION	QTY	PRICE EACH	PRICE
JM Aerofoil Fan: **Fan Code: 35JM/16/2/5/10** **JM Aerofoil Fan Ancillaries (QUANTITIES PER FAN):** Despatch: 2 typical working weeks	x1		
Total price fan and ancillaries (ex. Works) in £'s			

Woods of Colchester Ltd.
Tufnell Way, Colchester, Essex, CO4 5AR, England
Tel: + 44 (0) 1206 544122, Fax: + 44 (0) 1206 574434, Telex 98422

a GEC group company

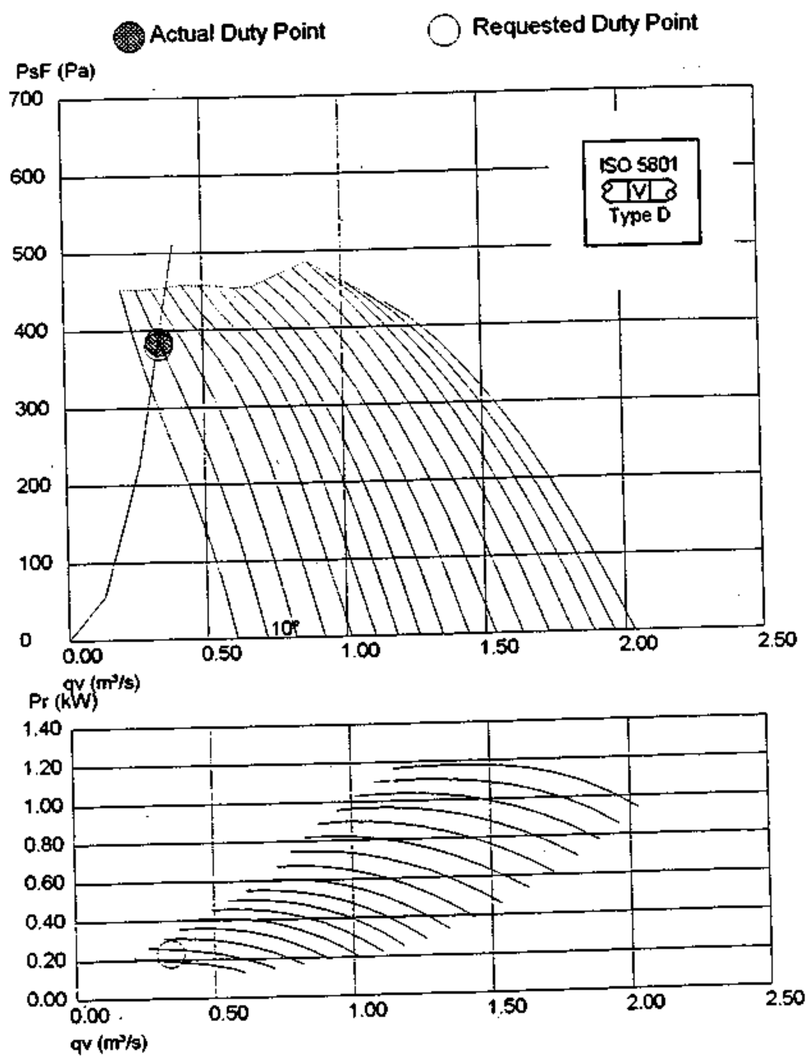
Fan Selector v1.1.05

WOODS OF COLCHESTER LTD.

JM AEROFOIL

Quote Number	: QPEN2594R
Customer	: Drake & Scult
Project Reference	: 5-7 Carlton Gardens
Fan Code	: 35JM/16/2/5/10

Date: 12/08/98
Fan Reference : SF02



Symbols

PsF Fan (Static) Pressure, Pr Absorbed Impeller Power
PF Fan (Total) Pressure, qv Volume Flow Rate

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a GEC group company

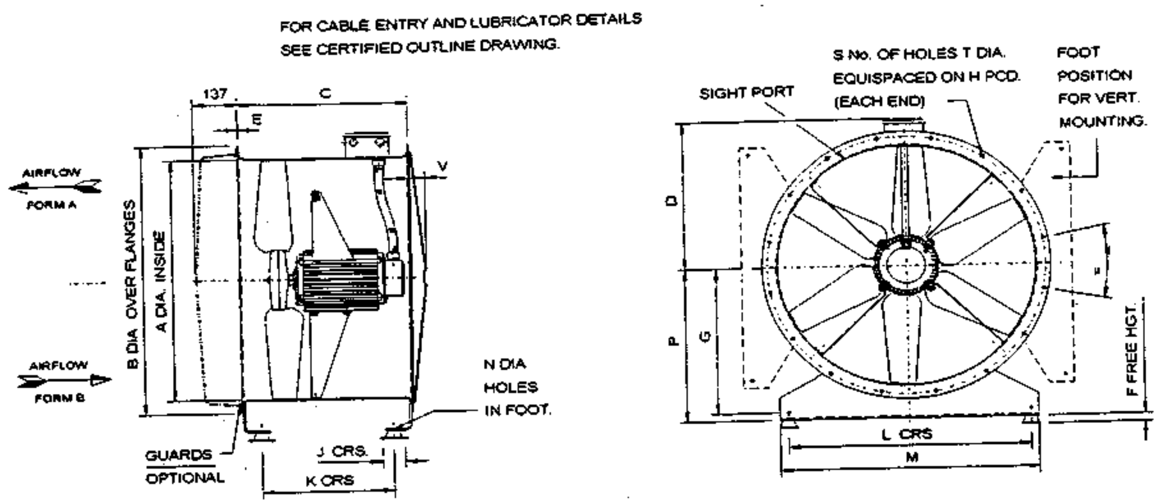
WOODS OF COLCHESTER LTD.

JM AEROFOIL

Quote Number : QPEN2594R
Customer : Drake & Scull
Project Reference : 5-7 Carlton Gardens

Fan Code : 35JM/16/2/5/10

Date: 12/08/98
Fan Reference : SF02



Fan dimensions in mm

A	B	C	D	E	F	G	H	J	K	L	M	N	P	S	T	V	kg
355	435	375	256	2.5	25	200	395	66	289	305	355	10	225	8	10	30	24

Woods of Colchester Ltd.
Tufnell Way, Colchester, Essex, CO4 5AR, England
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a GEC group company

Fan Selector v1.1.05

SF02

JM AEROFOIL

WOODS AIR MOVEMENT

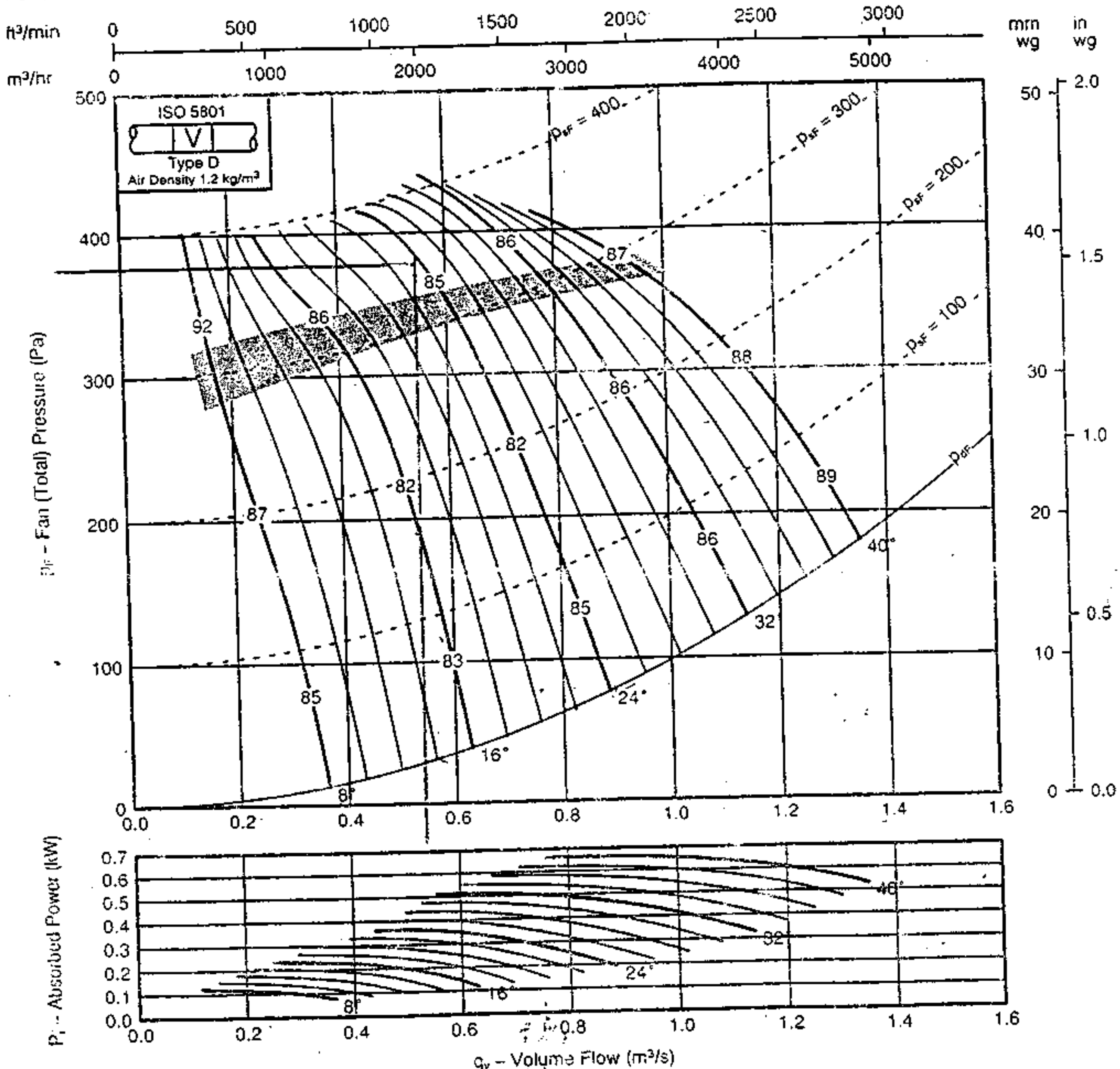
BS 5750 Pt 1
EN 29001
ISO 9001

Fan Code: 31JM/16/2/5/...

315 mm 2840 rev/min 5 Blades 50 Hz

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−12 −16	−7 −13	−6 −6	−5 −8	−9 −3	−17 −11	−24 −17	−30 −25
16	−14 −15	−11 −10	−4 −5	−9 −7	−5 −7	−14 −11	−20 −15	−27 −21
24 – 40	−9 −9	−4 −7	−6 −5	−10 −10	−12 −10	−17 −14	−20 −18	−25 −23

Outlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−10 −14	−7 −12	−3 −6	−4 −8	−8 −3	−16 −11	−24 −16	−29 −23
16	−13 −13	−11 −10	−1 −2	−8 −7	−5 −6	−13 −11	−20 −15	−27 −21
24 – 40	−7 −7	−4 −6	−5 −1	−9 −9	−11 −10	−15 −13	−18 −16	−23 −22

02/02/94

SK9755

WOODS OF COLCHESTER LTD.

JM AEROFOIL

Quote Number	: QPEN2594R	Date: 12/08/98
Customer	: Drake & Scull	Fan Reference : SF03
Project Reference	: 5-7 Carlton Gardens	

Requested Duty (adj.) : 0.12 m³/s at 200 Pa (Static Pressure)
Actual Duty : 0.15 m³/s at 326 Pa (Static Pressure)
Obtained Duty : 128 % of volume flow rate.

Fan Code	: 31JM/16/2/5/8	No. Blades	: 5
Fan Diameter	: 315 mm	Pitch Angle	: 8°
Fan Hub Diameter	: 160 mm	Form of Running	: B
Fan Speed	: 2 Pole/2840 rpm	Fan Casing	: Long Cased

Absorbed Power	: 0.11 kW
Peak Power	: 0.14 kW
Fan Total Efficiency	: 41 %

Ducted Inlet Sound Level (Lw): 91 dB

Sound Spectrum(Hz)	63	125	250	500	1K	2K	4K	8K
Inlet (Lw)	79	84	85	86	82	74	67	61
Outlet (Lw)	81	84	88	87	83	75	67	62

Motor Frame Size	: BT5	Starting Current	: 3.00 A
Rated Motor Power	: 0.23 kW	Electrical Supply	: 380-420v 3 Phase 50Hz
Full Load Current	: .60 A	Start Type	: Direct on Line
		Control	: Fixed Speed

Performance Data :
ISO 5801
Performance shown is specifically for fully ducted installations.

Sound Data :
(BS 848 Pt2 1985)

The single figure is the overall inlet sound power level, derived from measurements taken in Woods laboratory specifically under ducted conditions.

Terms and Conditions
This offer is made subject to the terms and conditions detailed on the accompanying letter.

DESCRIPTION	QTY	PRICE EACH	PRICE
JM Aerofoil Fan: Fan Code: 31JM/16/2/5/8 **JM Aerofoil Fan Ancillaries (QUANTITIES PER FAN):**	x1		
Despatch: 2 typical working weeks			
Total price fan and ancillaries (ex. Works) in £'s			

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Tel: + 44 (0) 1206 544122, Fax: + 44 (0) 1206 574434, Telex 98422

a GEC group company

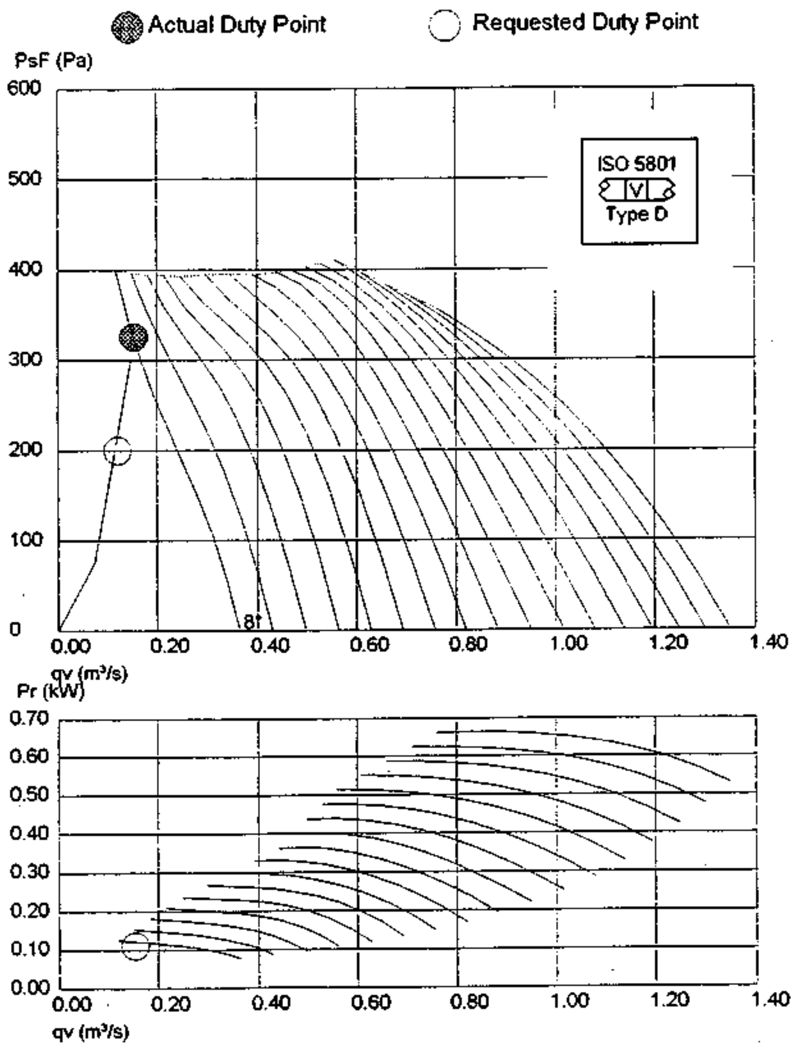
Fan Selector v1.1.05

WOODS OF COLCHESTER LTD.

JM AEROFOIL

Quote Number	: QPEN2594R
Customer	: Drake & Scull
Project Reference	: 5-7 Carlton Gardens
Fan Code	: 31JM/16/2/5/8

Date: 12/08/98
Fan Reference : SF03



Symbols

PsF Fan (Static) Pressure, Pr Absorbed Impeller Power
PF Fan (Total) Pressure, qv Volume Flow Rate

Woods of Colchester Ltd.
Tufnell Way, Colchester, Essex, CO4 5AR, England
Tel: + 44 (0) 1206 544122, Fax: + 44 (0) 1206 574434, Telex: 98422

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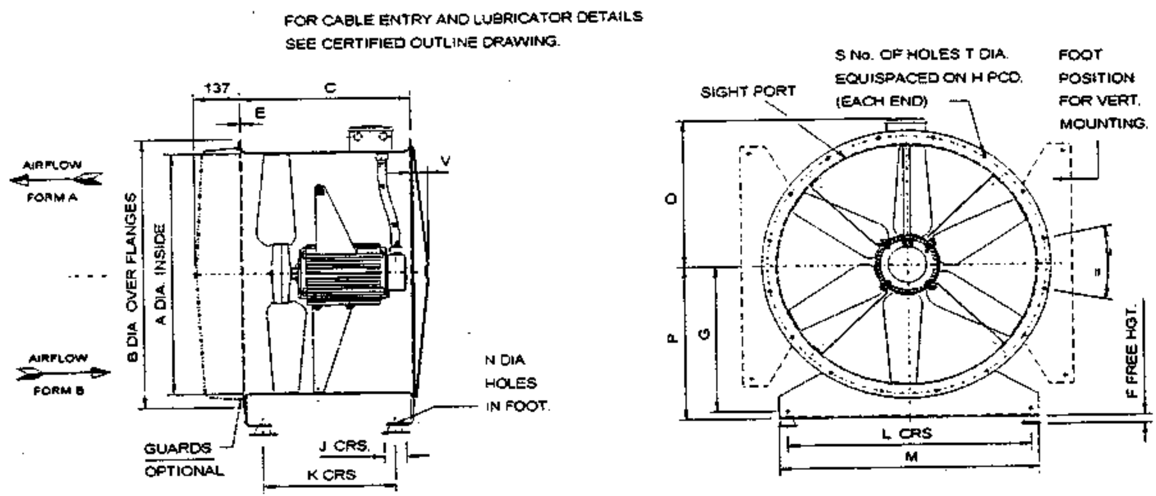
Fan Selector v1.1.05

WOODS OF COLCHESTER LTD.

JM AEROFOIL

Quote Number	: QPEN2594R	Date: 12/08/98	
Customer	: Drake & Scull	Fan Reference : SF03	
Project Reference	: 5-7 Carlton Gardens		
Fan Code	: 31JM/16/2/5/8		



Fan dimensions in mm

A	B	C	D	E	F	G	H	J	K	L	M	N	P	S	T	V	kg
315	395	375	235	2.5	25	175	355	66	289	265	315	10	200	8	10	30	22

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Fan Selector v1.1.05

SFo3

JM AEROFOIL

BS 5750 Pt 1
EN 29001
ISO 9001

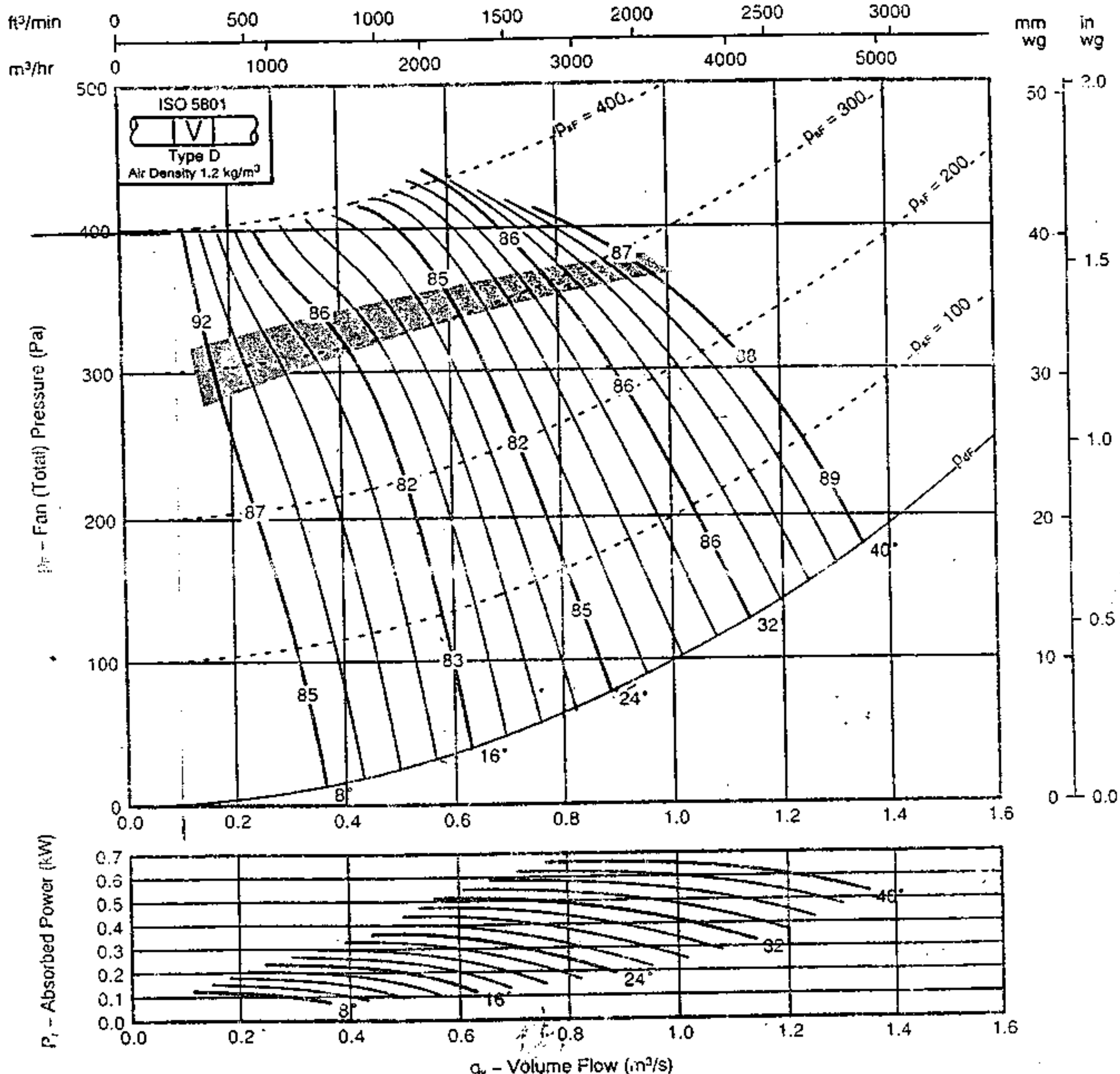
Fan Code: 31JM/16/2/5/...

315 mm 2840 rev/min 5 Blades 50 Hz

WOODS AIR MOVEMENT

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−12 −16	−7 −13	−6 −8	−5 −8	−9 −3	−17 −11	−24 −17	−30 −25
16	−14 −15	−11 −10	−4 −5	−9 −7	−5 −7	−14 −11	−20 −15	−27 −21
24 – 40	−9 −9	−4 −7	−6 −5	−10 −10	−12 −10	−17 −14	−20 −18	−25 −23

Outlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−10 −14	−7 −12	−3 −6	−4 −8	−8 −3	−16 −11	−24 −16	−29 −23
16	−13 −13	−11 −10	−1 −2	−8 −7	−5 −6	−13 −11	−20 −15	−27 −21
24 – 40	−7 −7	−4 −6	−5 −1	−9 −9	−11 −10	−15 −13	−18 −16	−23 −22

WOODS OF COLCHESTER LTD.

WOODS AIR MOVEMENT

JM AEROFOIL

Quote Number	: QPEN2594R	Date: 12/08/98
Customer	: Drake & Scull	Fan Reference : SF04
Project Reference	: 5-7 Carlton Gardens	

Requested Duty (adj.)	: 0.12 m^3/s at 140 Pa (Static Pressure)
Actual Duty	: 0.17 m^3/s at 292 Pa (Static Pressure)
Obtained Duty	: 145 % of volume flow rate.

Fan Code	: 31JM/16/2/5/8	No. Blades	: 5
Fan Diameter	: 315 mm	Pitch Angle	: 8°
Fan Hub Diameter	: 160 mm	Form of Running	: B
Fan Speed	: 2 Pole/2840 rpm	Fan Casing	: Long Cased

Absorbed Power	: 0.11 kW
Peak Power	: 0.14 kW
Fan Total Efficiency	: 43 %

Ducted Inlet Sound Level (Lw): 91 dB

Sound Spectrum(Hz)	63	125	250	500	1K	2K	4K	8K
Inlet (Lw)	76	80	84	84	86	78	72	64
Outlet (Lw)	78	81	86	84	86	78	72	66

Motor Frame Size	: BT5	Starting Current	: 3.00 A
Rated Motor Power	: 0.23 kW	Electrical Supply	: 380-420v 3 Phase 50Hz
Full Load Current	: .60 A	Start Type	: Direct on Line
		Control	: Fixed Speed

Performance Data :
ISO 5801
Performance shown is specifically for fully ducted installations.

Sound Data :
(BS 848 Pt2 1985)

The single figure is the overall inlet sound power level, derived from measurements taken in Woods laboratory specifically under ducted conditions.

Terms and Conditions
This offer is made subject to the terms and conditions detailed on the accompanying letter.

DESCRIPTION	QTY	PRICE EACH	PRICE
JM Aerofoil Fan: **Fan Code: 31JM/16/2/5/8** **JM Aerofoil Fan Ancillaries (QUANTITIES PER FAN):**	x1		
Despatch: 2 typical working weeks			
Total price fan and ancillaries (ex. Works) in £'s			

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WOODS OF COLCHESTER LTD.

JM AEROFOIL

Quote Number	: QPEN2594R	Date: 12/08/98	
Customer	: Drake & Scull	Fan Reference	: SF04
Project Reference	: 5-7 Carlton Gardens		

Requested Duty (adj.) : 0.12 m³/s at 140 Pa (Static Pressure)
Actual Duty : 0.17 m³/s at 292 Pa (Static Pressure)
Obtained Duty : 145 % of volume flow rate.

Fan Code	: 31JM/16/2/5/8	No. Blades	: 5
Fan Diameter	: 315 mm	Pitch Angle	: 8°
Fan Hub Diameter	: 160 mm	Form of Running	: B
Fan Speed	: 2 Pole/2840 rpm	Fan Casing	: Long Cased

Absorbed Power : 0.11 kW
Peak Power : 0.14 kW
Fan Total Efficiency : 43 %

Ducted Inlet Sound Level (Lw): 91 dB

Sound Spectrum(Hz)	63	125	250	500	1K	2K	4K	8K
Inlet (Lw)	76	80	84	84	86	78	72	64
Outlet (Lw)	78	81	86	84	86	78	72	66

Motor Frame Size	: BT5	Starting Current	: 3.00 A
Rated Motor Power	: 0.23 kW	Electrical Supply	: 380-420v 3 Phase 50Hz
Full Load Current	: .60 A	Start Type	: Direct on Line
		Control	: Fixed Speed

Performance Data :
ISO 5801
Performance shown is specifically for fully ducted installations.

Sound Data :
(BS 848 Pt2 1985)

The single figure is the overall inlet sound power level, derived from measurements taken in Woods laboratory specifically under ducted conditions.

Terms and Conditions
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DESCRIPTION	QTY	PRICE EACH	PRICE
JM Aerofoil Fan: **Fan Code: 31JM/16/2/5/8** **JM Aerofoil Fan Ancillaries (QUANTITIES PER FAN):** Despatch: 2 typical working weeks	x1		
Total price fan and ancillaries (ex. Works) in £'s			

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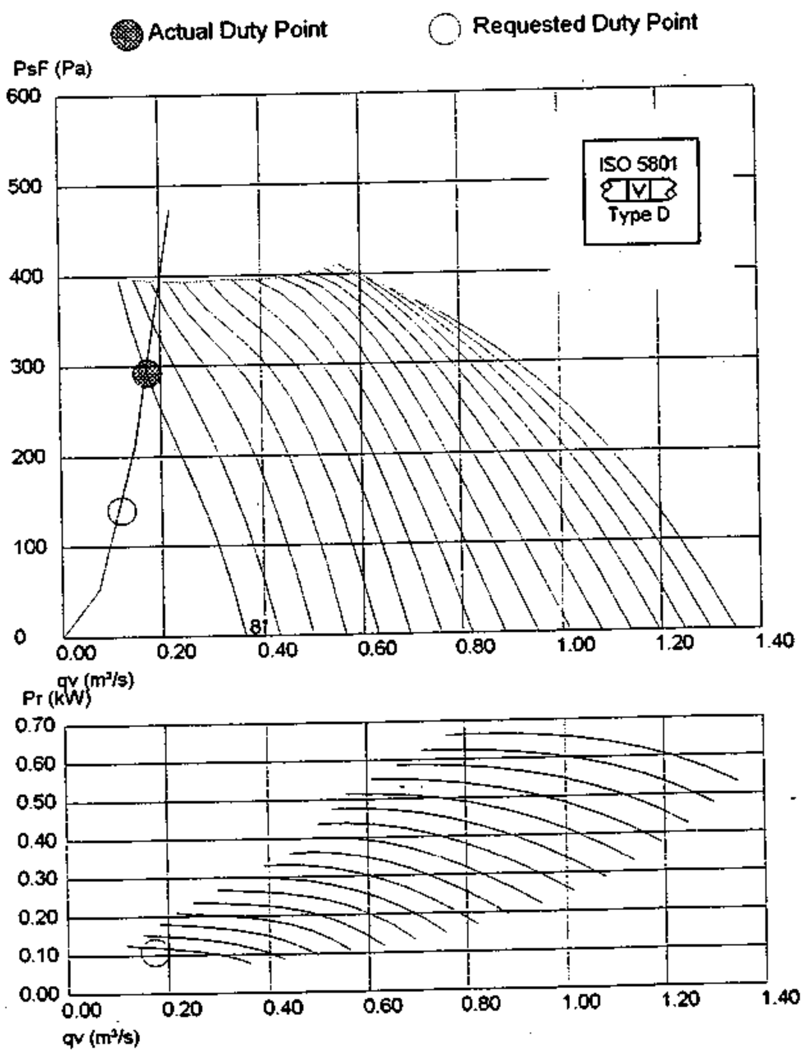
WOODS OF COLCHESTER LTD.

JM AEROFOIL

Quote Number	: QPEN2594R
Customer	: Drake & Scull
Project Reference	: 5-7 Carlton Gardens
Fan Code	: 31JM/16/2/5/8

Date: 12/08/98
Fan Reference : SF04



Symbols

PsF Fan (Static) Pressure, Pr Absorbed Impeller Power
PF Fan (Total) Pressure, qv Volume Flow Rate

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Fan Selector v1.1.05

SF 04

JM AEROFOIL

Fan Code: 31JM/16/2/5/...

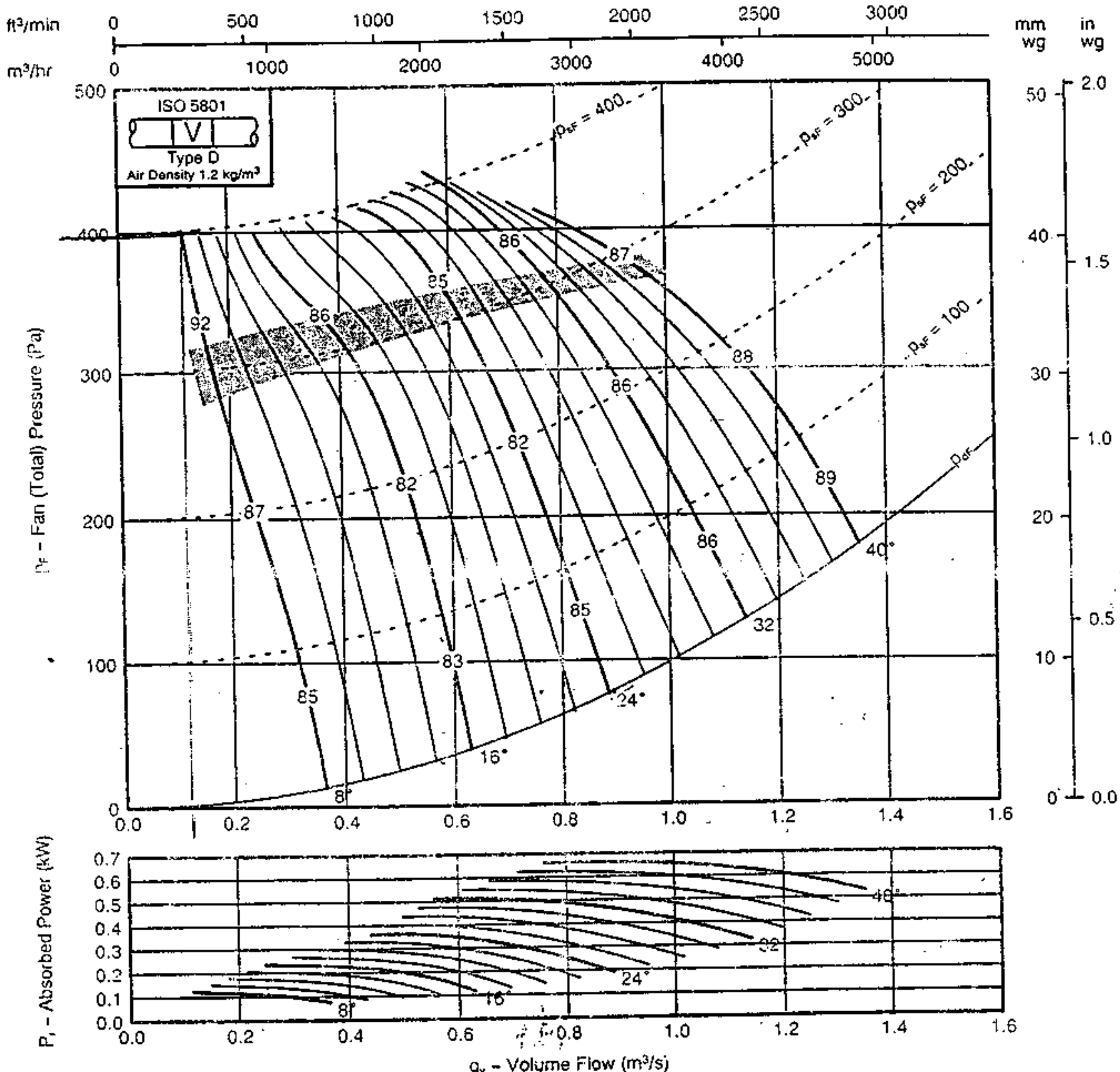
315 mm 2840 rev/min 5 Blades 50 Hz

BS 5750 Pt 1
EN 29001
ISO 9001

WOODS AIR MOVEMENT

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−12 −16	−7 −13	−6 −8	−5 −8	−9 −3	−17 −11	−24 −17	−30 −25
16	−14 −15	−11 −10	−4 −5	−9 −7	−5 −7	−14 −11	−20 −15	−27 −21
24 – 40	−9 −9	−4 −7	−6 −5	−10 −10	−12 −10	−17 −14	−20 −18	−25 −23

Outlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−10 −14	−7 −12	−3 −6	−4 −8	−6 −3	−16 −11	−24 −16	−29 −23
16	−13 −13	−11 −10	−1 −2	−8 −7	−5 −6	−13 −11	−20 −15	−27 −21
24 – 40	−7 −7	−4 −6	−5 −1	−9 −9	−11 −10	−15 −13	−18 −16	−23 −22

WOODS OF COLCHESTER LTD.

JM AEROFOIL - H.T. SERIES (200°C/2)

WOODS AIR MOVEMENT

Quote Number	: QPEN2594R
Customer	: Drake & Scull
Project Reference	: 5-7 Carlton Gardens

Date: 13/08/98
Fan Reference : SP01 ALT

Requested Duty (adj.)	: 14.6 m^3/s at 516 Pa (Static Pressure)
Actual Duty	: 14.7 m^3/s at 524 Pa (Static Pressure)
Obtained Duty	: 101 % of volume flow rate.

Fan Code	: 112JM/40/4/6/18	No. Blades	: 6
Fan Diameter	: 1120 mm	Pitch Angle	: 18°
Fan Hub Diameter	: 400 mm	Form of Running	: B
Fan Speed	: 4 Pole/1470 rpm	Fan Casing	: Long Cased

Absorbed Power	: 12.9 kW
Peak Power	: 14.2 kW
Fan Total Efficiency	: 71 %

Ducted Inlet Sound Level (Lw): 109 dB

Sound Spectrum(Hz)	63	125	250	500	1K	2K	4K	8K
Inlet (Lw)	107	100	100	97	95	93	90	86
Outlet (Lw)	109	102	101	97	96	94	90	87

Motor Frame Size	: D160/26	Starting Current	: 185.00 A
Rated Motor Power	: 17.0 kW	Electrical Supply	: 380-420v 3 Phase 50Hz
Full Load Current	: 33.00 A	Start Type	: Direct on Line
		Control	: Fixed Speed

Performance Data :
ISO 5801
Performance shown is specifically for fully ducted installations.

Sound Data :
(BS 848 Pt2 1985)

The single figure is the overall inlet sound power level, derived from measurements taken in Woods laboratory specifically under ducted conditions.

Terms and Conditions
This offer is made subject to the terms and conditions detailed on the accompanying letter.

DESCRIPTION	QTY	PRICE EACH	PRICE
JM Aerofoil Fan:			
Fan Code: 112JM/40/4/6/18	x2		
JM Aerofoil Fan Ancillaries (QUANTITIES PER FAN):			
Mounting Feet (Set)			
Spring Vibration Isolators (Set)	x1		
Matching Flanges / Companion Flanges	x1		
Flexible Connector	x1		
Air Operated Damper / Airstream Damper	x1		
	x1		
Despatch: 7 typical working weeks			
Total price fan and ancillaries (ex Works) in £'s			

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Fan Selector v1.1.05

FAN SPOT

JM AEROFOIL

WOODS AIR MOVEMENT

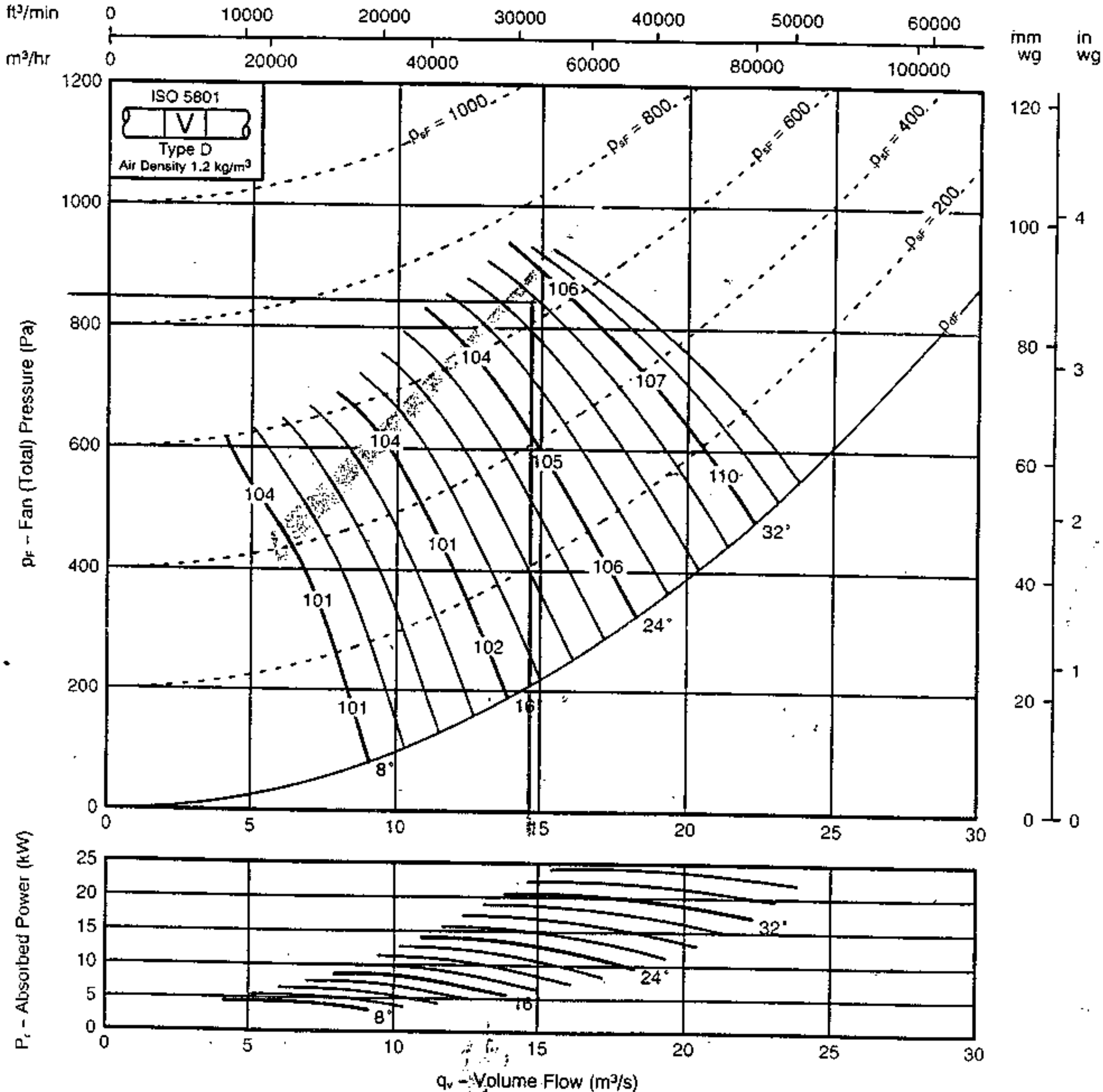
BS 5750 Pt 1
EN 29001
ISO 9001

Fan Code: 100JM/31/4/9/...

1000 mm 1470 rev/min 9 Blades 50 Hz

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	63	125	250	500	1k	2k	4k	8k
	Octave Band Centre Frequency (Hz)							
8	−21 −17	−21 −18	−14 −10	−9 −10	−4 −6	−6 −5	−12 −9	−19 −15
16	−15 −10	−16 −11	−12 −8	−7 −8	−4 −7	−7 −8	−12 −12	−19 −17
24 – 36	−8 −6	−9 −8	−8 −7	−8 −9	−8 −10	−8 −10	−13 −14	−16 −18

Outlet Levels

Pitch Angle	63	125	250	500	1k	2k	4k	8k
	Octave Band Centre Frequency (Hz)							
8	−20 −17	−20 −18	−13 −9	−9 −10	−4 −6	−5 −3	−11 −8	−16 −13
16	−14 −10	−16 −11	−12 −7	−6 −8	−4 −6	−7 −8	−11 −11	−17 −15
24 – 36	−7 −6	−9 −8	−8 −6	−8 −9	−8 −10	−8 −10	−12 −13	−15 −16

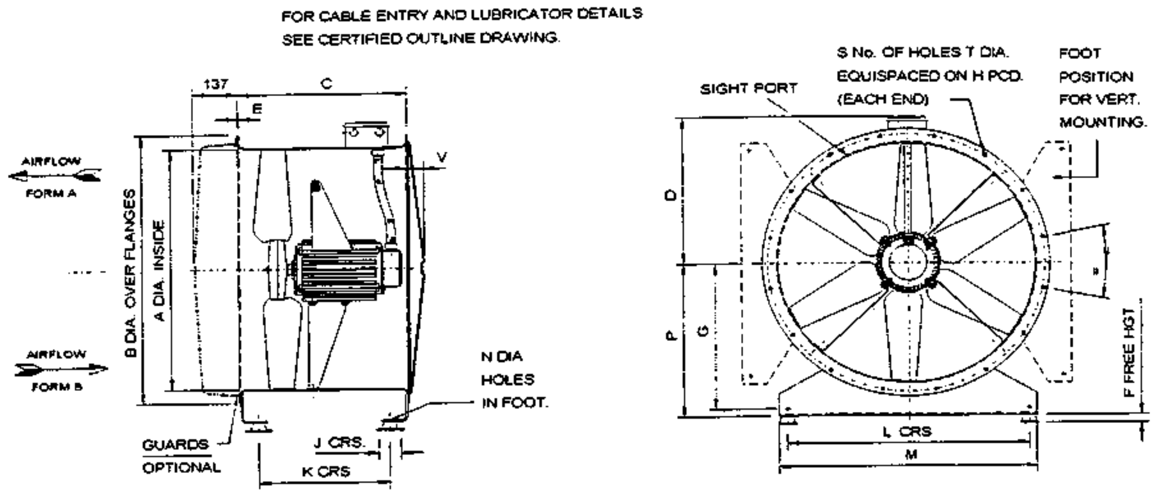
SK10257

10/01/95

WOODS OF COLCHESTER LTD.

JM AEROFOIL 400°C / 2 Hrs

Quote Number	: QPEN2594R	Date: 12/08/98
Customer	: Drake & Scull	Fan Reference : SP02
Project Reference	: 5-7 Carlton Gardens	
Fan Code	: 45JM/20/2/6/30	



Fan dimensions in mm

A	B	C	D	E	F	G	H	J	K	L	M	N	P	S	T	V	kg
450	530	520	306	3	25	255	500	66	434	400	450	10	280	8	12	30	44

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Fan Selector v1.1.05

FAN SP02

JM AEROFOIL

WOODS AIR MOVEMENT

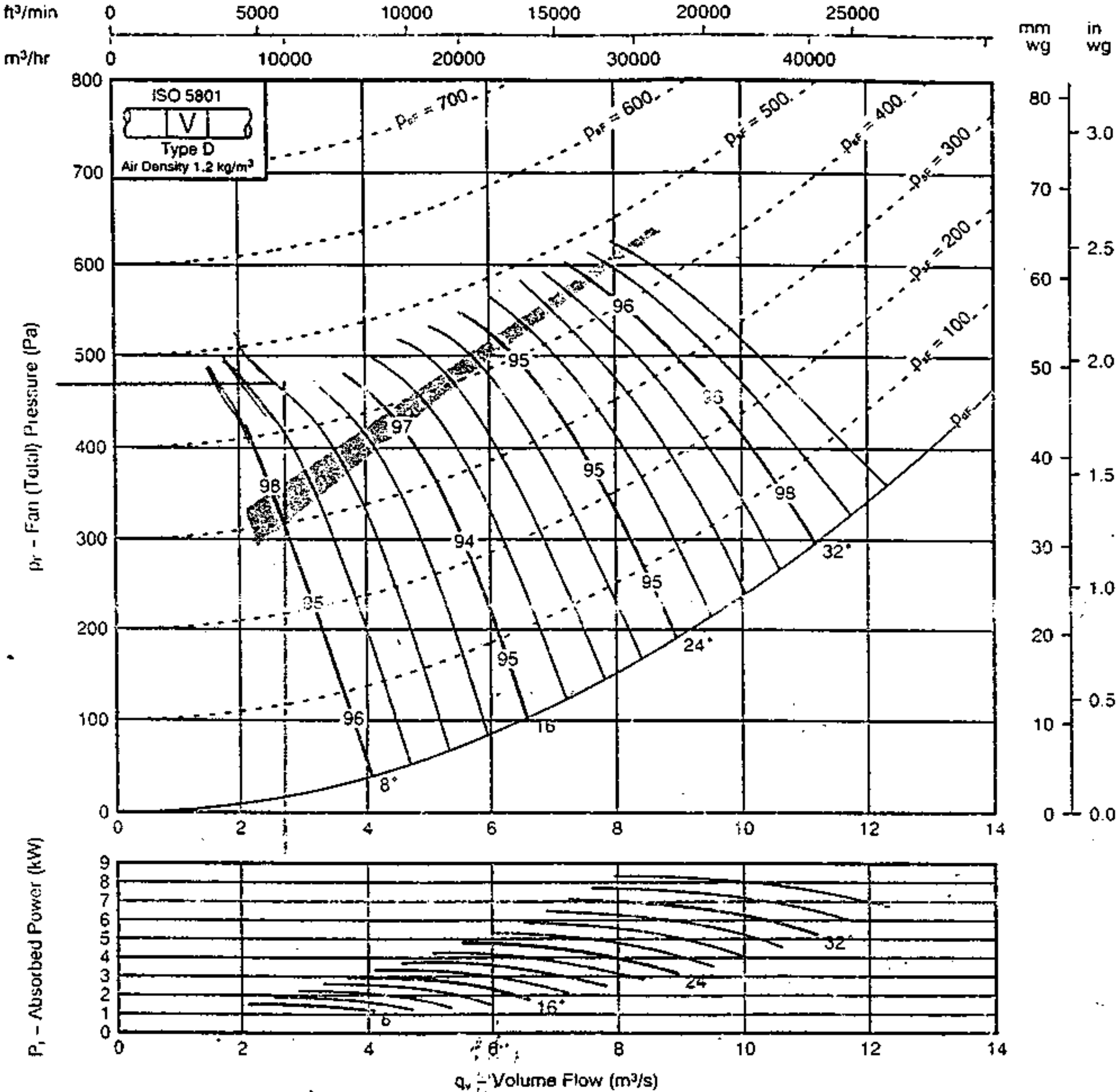
BS 5750 Pt 1
EN 29001
ISO 9001

Fan Code: 80JM/25/4/9/...

800 mm 1440 rev/min 9 Blades 50 Hz

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−10 −10	−11 −11	−10 −9	−6 −7	−5 −7	−11 −8	−18 −11	−27 −21
16	−8 −7	−11 −12	−7 −7	−8 −6	−7 −8	−13 −12	−18 −15	−23 −21
24 – 36	−5 −6	−13 −11	−10 −8	−7 −6	−7 −8	−12 −13	−15 −16	−19 −20

Outlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−9 −10	−11 −11	−8 −8	−7 −8	−5 −7	−10 −7	−17 −10	−24 −19
16	−6 −7	−11 −12	−7 −7	−6 −6	−7 −8	−13 −12	−17 −15	−21 −19
24 – 36	−3 −5	−13 −11	−10 −8	−8 −6	−7 −8	−12 −13	−14 −15	−18 −18

WOODS OF COLCHESTER LTD.

WOODS AIR MOVEMENT

JM AEROFOIL HT 400°C/2hr

Quote Number	: QPEN2594R
Customer	: Drake & Scull
Project Reference	: 5-7 Carlton Gardens

Date: 12/08/98
Fan Reference : SP03

Requested Duty (adj.)	: 2.26 m^3/s at 560 Pa (Static Pressure)
Actual Duty	: 2.27 m^3/s at 564 Pa (Static Pressure)
Obtained Duty	: 100 % of volume flow rate.

Fan Code	: 45JM/20/2/6/26	No. Blades	: 6
Fan Diameter	: 450 mm	Pitch Angle	: 26°
Fan Hub Diameter	: 200 mm	Form of Running	: B
Fan Speed	: 2 Pole/2910 rpm	Fan Casing	: Long Cased

Absorbed Power	: 2.37 kW
Peak Power	: 2.50 kW
Fan Total Efficiency	: 66 %

Ducted Inlet Sound Level (Lw): 93 dB

Sound Spectrum(Hz)	63	125	250	500	1K	2K	4K	8K
Inlet (Lw)	85	85	86	86	83	82	77	74
Outlet (Lw)	86	86	87	87	84	83	79	75

Motor Frame Size	: ~~F2225~~ DF112M	Starting Current	: ~~44.00 A~~ 56.3
Rated Motor Power	: ~~3.80 kW~~ 4.0	Electrical Supply	: 380-420v 3 Phase 50Hz
Full Load Current	: ~~7.10 A~~ 7.5	Start Type	: Direct on Line
		Control	: Fixed Speed

Performance Data :
ISO 5801
Performance shown is specifically for fully ducted installations.

Sound Data :
(BS 848 Pt2 1985)
The single figure is the overall inlet sound power level, derived from measurements taken in Woods laboratory specifically under ducted conditions.

Terms and Conditions
This offer is made subject to the terms and conditions detailed on the accompanying letter.

DESCRIPTION	QTY	PRICE EACH	PRICE
JM Aerofoil Fan: Fan Code: 45JM/20/2/6/26 **JM Aerofoil Fan Ancillaries (QUANTITIES PER FAN):**	x2		
Despatch: 2 typical working weeks			
Total price fan and ancillaries (ex. Works) in £'s			

Woods of Colchester Ltd.
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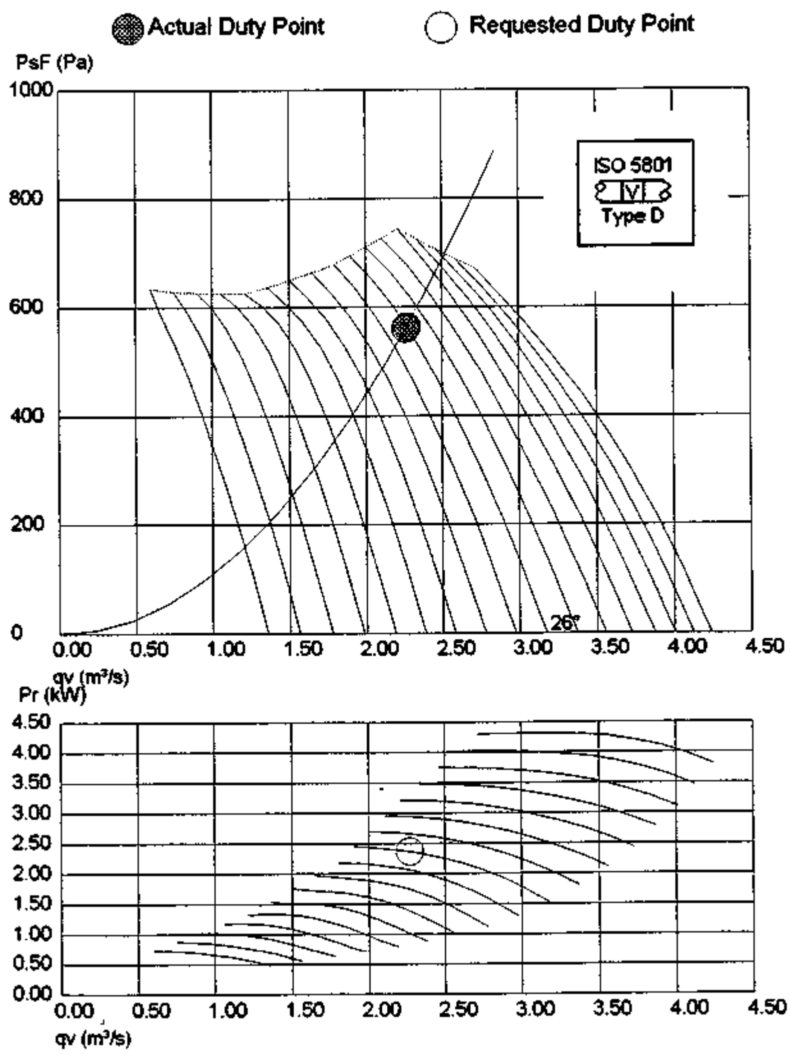
WOODS OF COLCHESTER LTD.

JM AEROFOIL HT 400°C / 2 Hr

Quote Number	: QPEN2594R	Date: 12/08/98	
Customer	: Drake & Scull	Fan Reference	: SP03
Project Reference	: 5-7 Carlton Gardens		
Fan Code	: 45JM/20/2/6/26		



Symbols

PsF Fan (Static) Pressure, Pr Absorbed Impeller Power

PF Fan (Total) Pressure, qv Volume Flow Rate

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WOODS AIR MOVEMENT

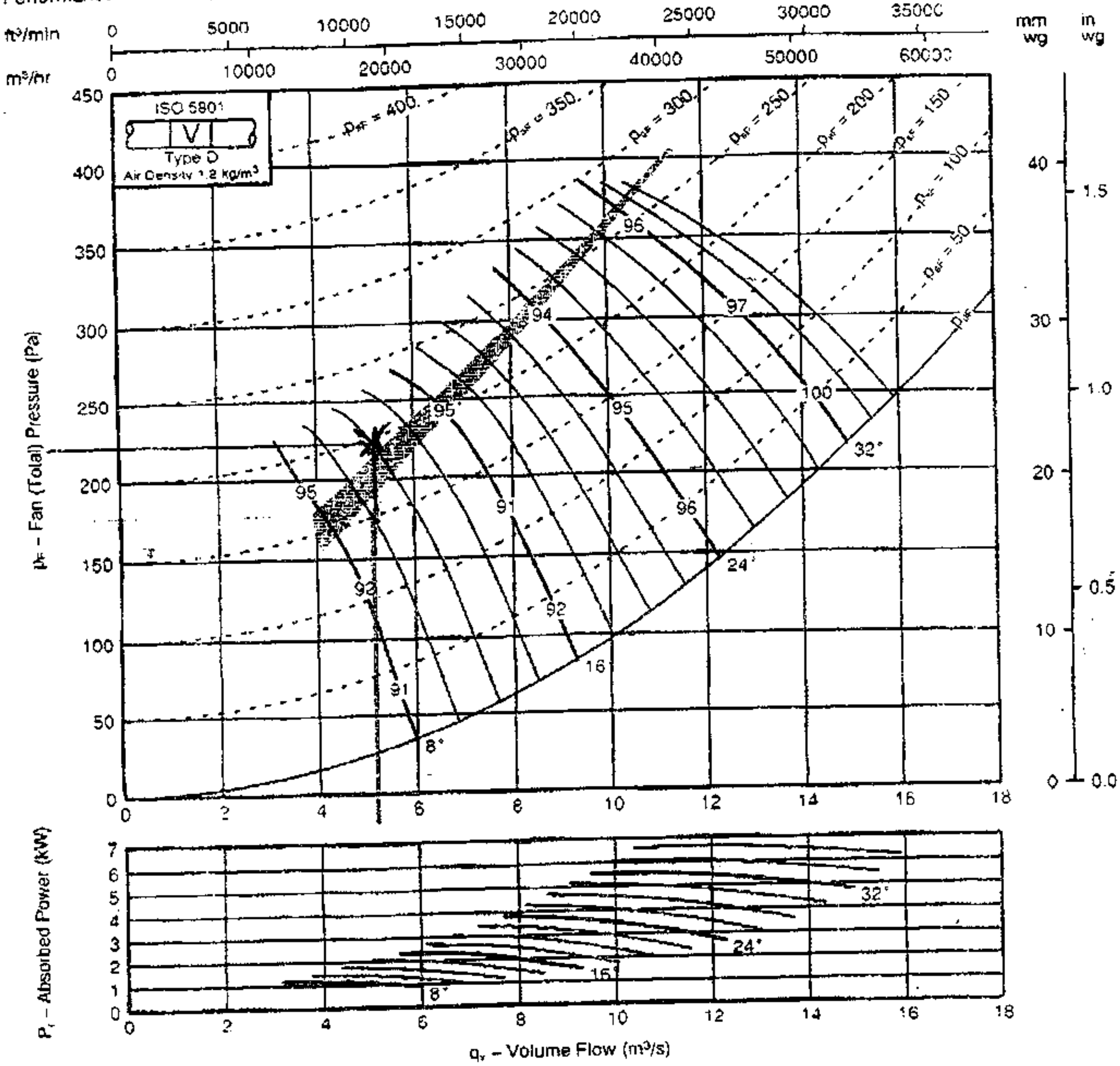
BS 5750 Pt 1
EN 29001
ISO 9001

Fan Code: 100JM/25/6/9/...
1000 mm 960 rev/min 9 Blades 50 Hz

LOW SPEED

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−21 −18	−14 −10	−11 −10	−4 −8	−4 −4	−9 −8	−17 −13	−23 −18
16	−16 −10	−12 −7	−10 −8	−4 −6	−6 −7	−10 −11	−17 −15	−24 −20
24 – 36	−5 −6	−8 −6	−8 −8	−7 −9	−7 −9	−11 −12	−15 −16	−19 −20

Outlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−20 −18	−12 −8	−11 −10	−6 −8	−4 −4	−9 −5	−16 −13	−21 −17
16	−14 −10	−12 −7	−10 −8	−4 −6	−6 −7	−10 −10	−16 −14	−22 −19
24 – 36	−7 −5	−7 −6	−8 −8	−7 −9	−7 −9	−11 −12	−14 −15	−18 −19

SK9848

02/02/94

HIGH SPEED

EXH01

JM AEROFOIL

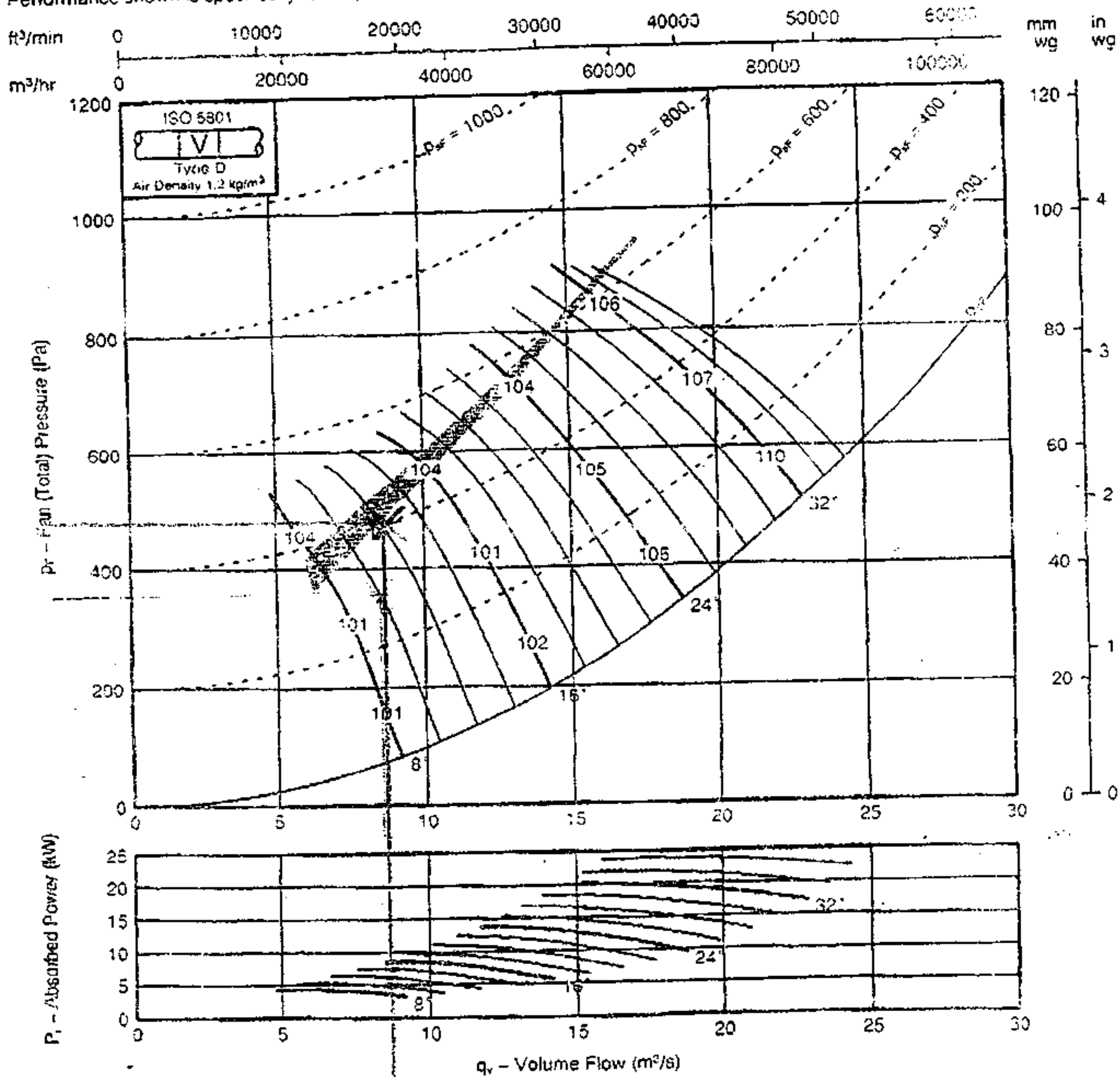
WOODS AIR MOVEMENT

BS 5750 Pt 1
EN 29001
ISO 9001

Fan Code: 100JM/25/4/9/...

1000 mm 1470 rev/min 9 Blades 50 Hz

Performance Data ISO 5801:
Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:
Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−21 −17	−21 −18	−14 −10	−9 −10	−4 −6	−6 −5	−12 −9	−19 −15
16	−15 −10	−18 −11	−12 −8	−7 −8	−4 −7	−7 −8	−12 −12	−19 −17
24 – 36	−8 −6	−9 −8	−8 −7	−8 −9	−8 −10	−8 −10	−13 −14	−16 −18

Outlet Levels

Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−20 −17	−20 −18	−13 −9	−9 −10	−4 −6	−5 −3	−11 −8	−16 −13
16	−14 −10	−16 −11	−12 −7	−6 −6	−4 [illegible]	−7 −8	−11 −11	−17 −15
24 – 36	−7 −8	−9 −8	−3 [illegible]	−8 [illegible]	−6 [illegible]	−8 [illegible]	−12 [illegible]	−13 [illegible]

16-JUL-98 19:20

EXH02803 LOW SPEED

JM AEROFOIL

WOODS AIR MOVEMENT

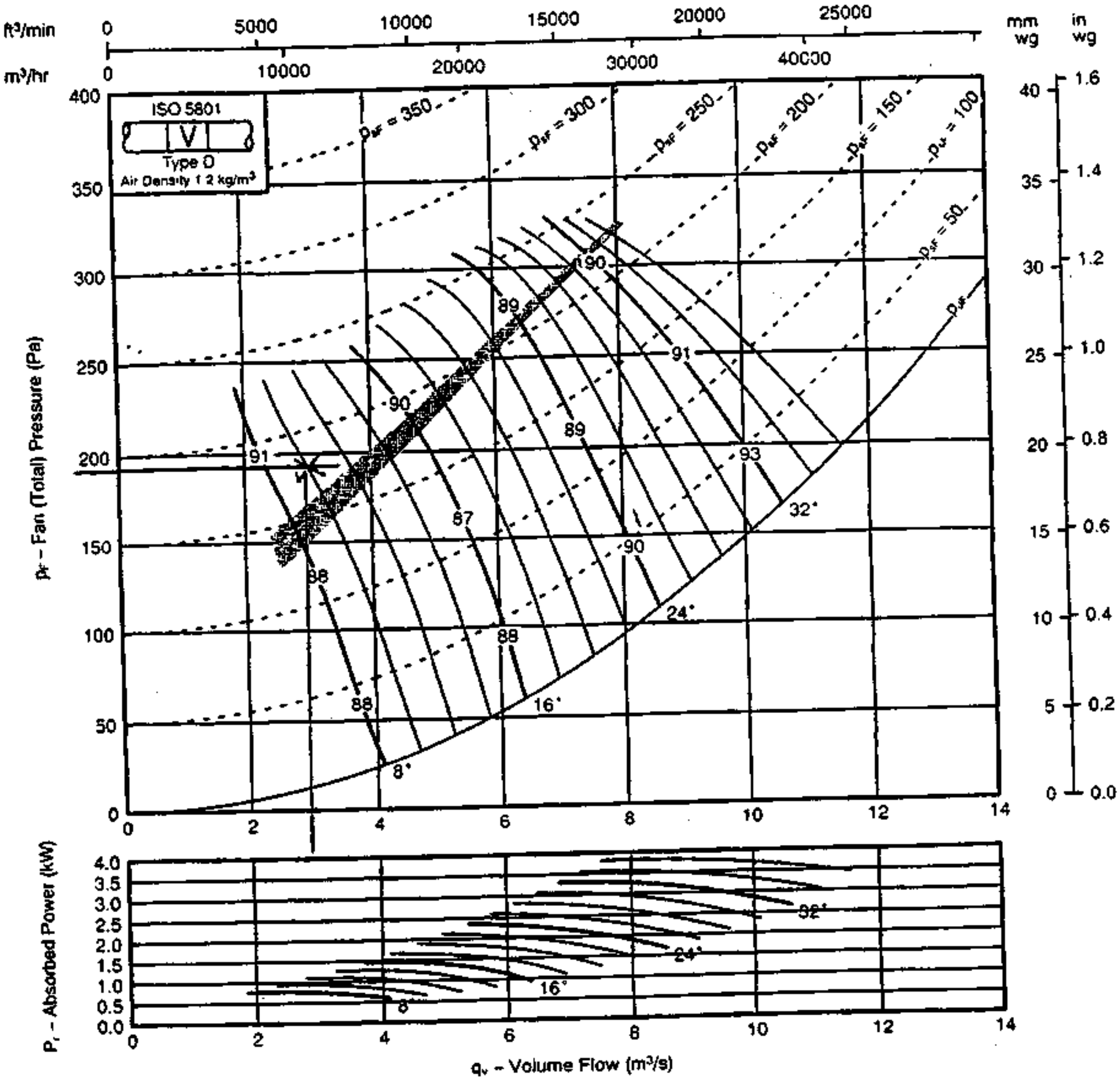
BS 5750 Pt 1
EN 29001
ISO 9001

Fan Code: 90JM/25/6/9/...

900 mm 935 rev/min 9 Blades 50 Hz

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels

Pitch Angle	63	125	250	500	1k	2k	4k	8k
8	−15 −14	−11 −8	−8 −9	−4 −7	−6 −6	−12 −8	−20 −15	−26 −21
16	−12 −10	−9 −6	−7 −7	−4 −7	−7 −8	−12 −12	−18 −16	−25 −22
24 – 36	−9 −7	−8 −6	−7 −7	−6 −8	−8 −10	−11 −13	−15 −16	−19 −21

Outlet Levels

Pitch Angle	63	125	250	500	1k	2k	4k	8k
8	−14 −14	−9 −7	−8 −9	−4 −7	−6 −6	−11 −7	−19 −15	−24 −20
16	−11 −9	−9 −6	−7 −7	−4 −7	−7 −8	−12 −11	−17 −16	−23 −20
24 – 36	−7 −7	−8 −6	−7 −7	−6 −8	−8 −10	−11 −13	−14 −15	−18 −19

Octave Band Centre Frequency (Hz)

SK9839 02/02/94

EXH 02 + EXH 03

JM AEROFOIL HIGH SPEED

WOODS AIR MOVEMENT

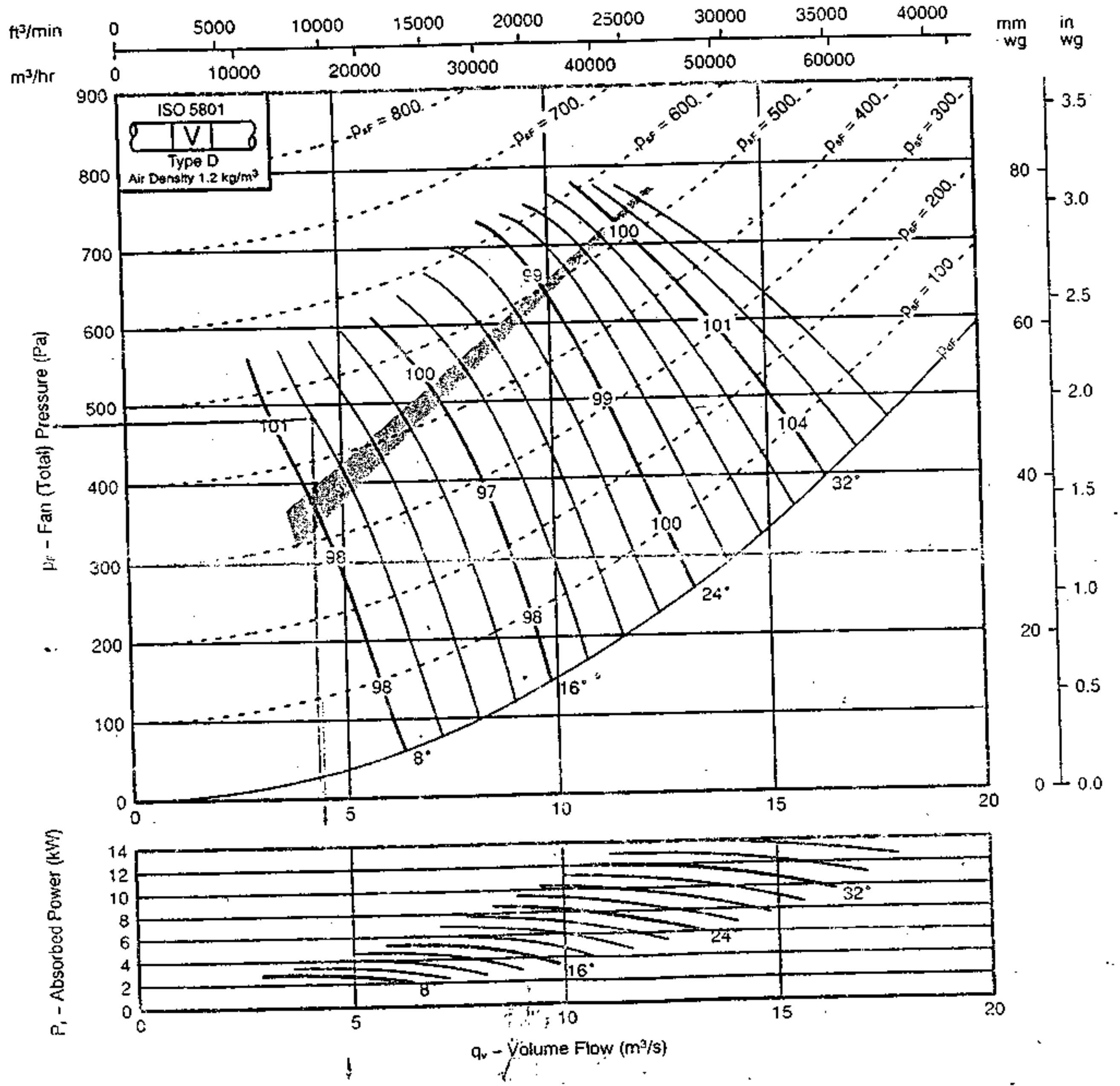
Fan Code: 90JM/25/4/9/...

BS 5750 Pt 1
EN 29001
ISO 9001

900 mm 1440 rev/min 9 Blades 50 Hz

Performance Data ISO 5801:

Performance shown is specifically for fully ducted installations.



Sound Data BS848 Part 2 1985:

Single figures on performance curves are overall inlet sound power levels, derived from measurements taken in Woods laboratory specifically under ducted conditions. For sound power levels in eight octave bands, apply the following corrections to the overall level. Use upper corrections when operating point is above shaded area, or lower corrections when operating point is below shaded area.

Inlet Levels								
Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−16 −14	−16 −15	−11 −8	−8 −9	−4 −7	−8 −7	−15 −10	−23 −18
16	−12 −9	−14 −12	−9 −7	−7 −7	−6 −8	−10 −10	−15 −14	−21 −19
24 – 36	−7 −6	−11 −9	−9 −8	−8 −8	−8 −9	−10 −12	−14 −15	−17 −19

Outlet Levels								
Pitch Angle	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
8	−14 −14	−15 −14	−9 −7	−7 −8	−4 −6	−7 −5	−13 −9	−20 −16
16	−10 −8	−13 −11	−8 −6	−6 −7	−5 −7	−9 −9	−13 −13	−19 −17
24 – 36	−5 −6	−10 −9	−8 −7	−8 −7	−7 −9	−10 −11	−13 −14	−16 −17

02/02/94

SK9842

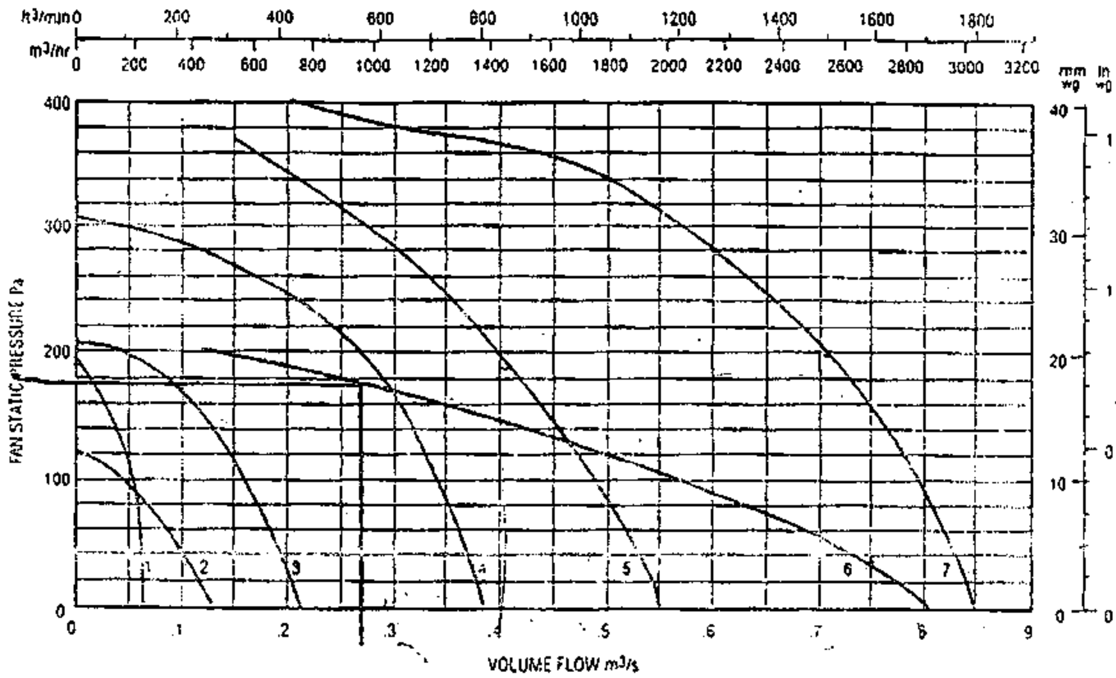
EXH 07

PARALLEL FAN UNITS

WOODS AIR MOVEMENT

DIRECT DRIVE UNITS

Fan Performance



Electrical Data (220-240 V / 50Hz/ 1φ)

Code	Watts input	Starting Current* (A)	Running current (A)	Speed rev/min
TF/DTF1	75	0.78x2	0.52	2000
TF/DTF2	170	1.8x2	1.1	1275
TF/DTF3	225	2.3x2	1.5	1275
TF/DTF4	350	3.1x2	1.6	1350
TF/DTF5	700	6.9x2	3.1	1350
TF/DTF6	640	6.9x2	3.1	940
TF/DTF7	1420	13.6x2	6.2	1400

Enquire for other voltages and frequencies. *Momentarily both fans will start (initial start only).

Sound Power Level Spectra in dB re 1 pW

Code	Octave Band Centre Frequency								Sound* Level dBA @ 3 m	Breakout* Sound Level dBA @ 3 m
	63	125	250	500	1K	2K	4K	8K		
TF/DTF-1A	67	65	62	59	55	53	50	47	44	39
TF/DTF-1AL	67	65	62	58	52	49	46	44	42	37
TF/DTF-2A	67	65	58	51	53	52	50	47	42	37
TF/DTF-2AL	67	65	58	50	50	48	46	44	39	34
TF/DTF-3A	68	66	59	50	54	53	51	49	43	38
TF/DTF-3AL	68	66	59	49	51	49	47	45	40	35
TF/DTF-4A	72	70	63	54	58	57	55	52	47	39
TF/DTF-4AL	72	70	63	53	55	53	51	49	44	36
TF/DTF-5A	74	72	65	56	60	59	57	54	49	41
TF/DTF-5AL	74	72	65	55	57	55	53	51	47	39
TF/DTF-6A	79	75	73	70	71	71	65	63	58	50
TF/DTF-6AL	79	75	73	69	68	67	61	59	54	46
TF/DTF-7A	89	85	75	75	79	80	76	70	68	60
TF/DTF-7AL	89	85	75	74	78	76	72	66	64	56

*See note on Sound Levels, Page 3.
Sound pressure levels are measured in dB(A) @ 20 μ Pa.
The breakout Sound Levels assume the unit is fully ducted.

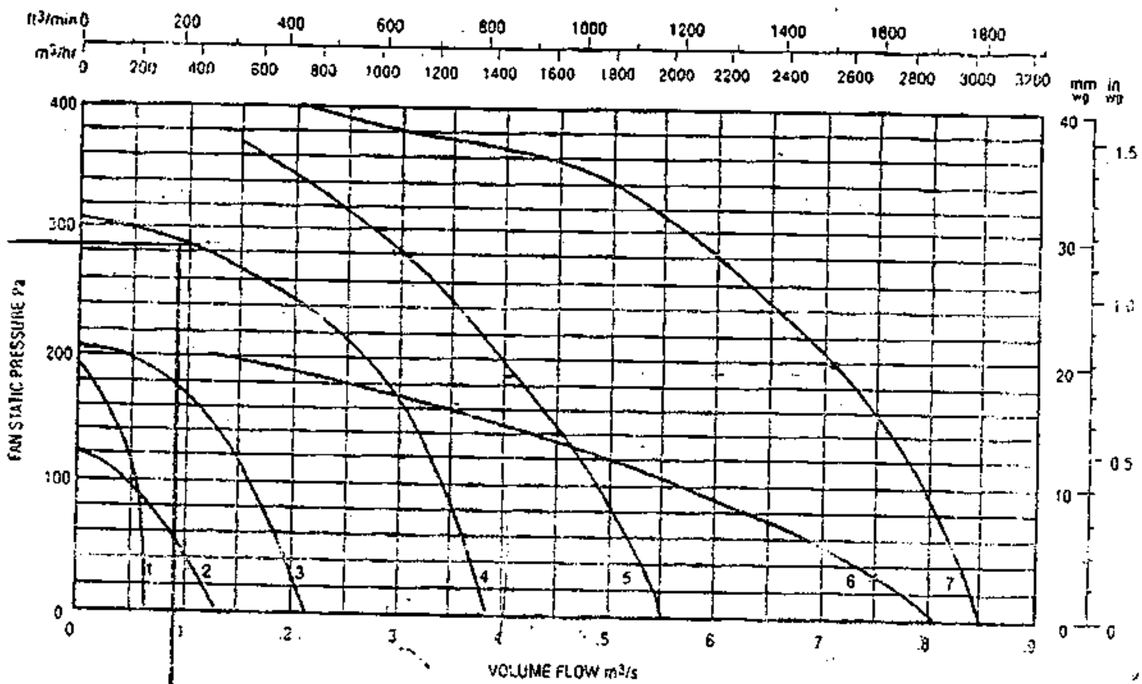
Model ref AL = Acoustically Lined Unit
Model ref A = Unlined Unit

PARALLEL FAN UNITS

DIRECT DRIVE UNITS

WOODS AIR MOVEMENT

Fan Performance



Electrical Data (220-240 V / 50Hz/-1ϕ)

Code	Watts Input	Starting Current* (A)	Running current (A)	Speed rev/min
TF/DTF1	75	0.78x2	0.52	2000
TF/DTF2	170	1.5x2	1.1	1275
TF/DTF3	225	2.3x2	1.5	1275
TF/DTF4	350	3.1x2	1.6	1350
TF/DTF5	700	6.9x2	3.1	1350
TF/DTF6	640	6.9x2	3.1	940
TF/DTF7	1420	13.6x2	6.2	1400

Enquire for other voltages and frequencies. *Momentarily both fans will start (initial start only).

Sound Power Level Spectra in dB re 1 pW

Code	Octave Band Centre Frequency								Sound* Level dBA @ 3 m	Breakout* Sound Level dBA @ 3 m
	63	125	250	500	1K	2K	4K	8K		
TF/DTF-1A	67	65	62	59	55	53	50	47	44	39
TF/DTF-1AL	67	65	62	58	52	49	46	44	42	37
TF/DTF-2A	67	65	58	51	53	52	50	47	42	37
TF/DTF-2AL	67	65	58	50	50	48	46	44	39	34
TF/DTF-3A	68	66	59	50	54	53	51	48	43	38
TF/DTF-3AL	68	66	59	48	51	49	47	45	40	35
TF/DTF-4A	72	70	63	54	58	57	55	52	47	39
TF/DTF-4AL	72	70	63	53	55	53	51	49	44	36
TF/DTF-5A	74	72	65	56	60	59	57	54	49	41
TF/DTF-5AL	74	72	65	55	57	55	53	51	47	39
TF/DTF-6A	79	75	73	70	71	71	65	63	58	50
TF/DTF-6AL	79	75	73	69	68	67	61	59	54	46
TF/DTF-7A	89	85	75	75	79	80	76	70	68	60
TF/DTF-7AL	89	85	75	74	76	76	72	66	64	56

*See note on Sound Levels, Page 3.
Sound pressure levels are measured in dB(A) @ 20 µ Pa.
The breakout Sound Levels assume the unit is fully ducted.

Model ref AL = Acoustically Lined Unit
Model ref A = Unlined Unit

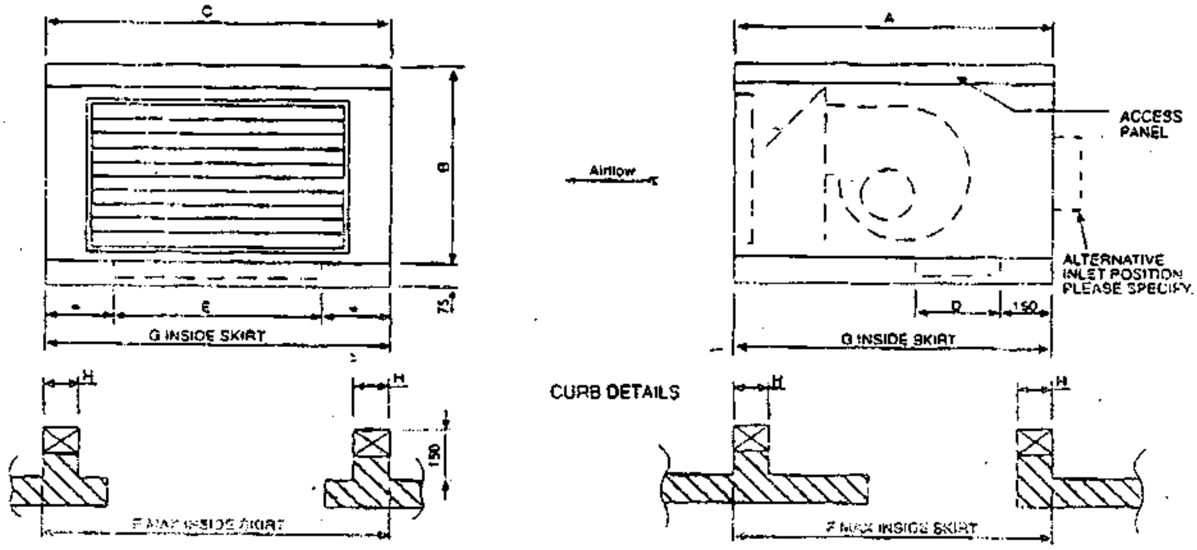
PARALLEL FAN UNITS

DIRECT DRIVE UNITS

Dimensions and Weights

WOODS AIR MOVEMENT

Roof Mounting - Model TF (A) and (AL)

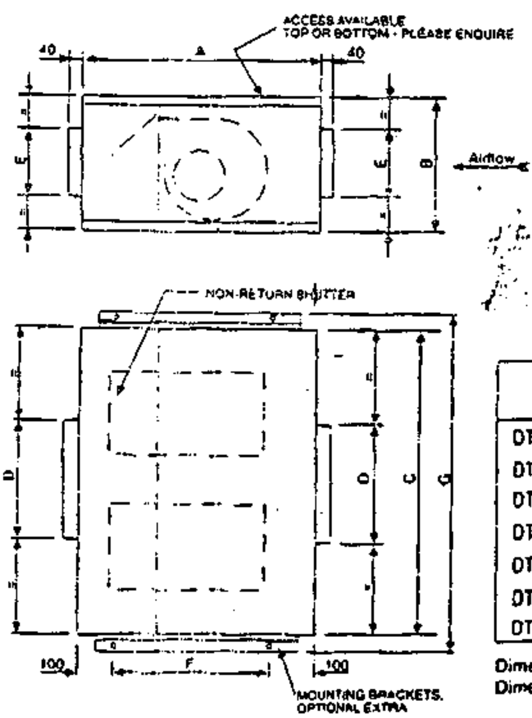


Code	A	B	B_L	C	D	E	F	G	H	Weight (kg)	Weight $_L$ (kg)
TF 1A (L)	500	250	275	670	100	150	490	500	75	14	17
TF 2A (L)	700	340	365	750	150	225	690	700	75	16	22
TF 3A (L)	700	390	415	750	150	250	690	700	75	18	25
TF 4A (L)	800	450	475	850	200	300	790	800	75	33	40
TF 5A (L)	950	550	575	1000	250	500	940	950	100	49	58
TF 6A (L)	1050	550	575	1050	300	600	1040	1050	100	59	70
TF 7A (L)	1050	550	575	1050	300	600	1040	1050	100	59	70

Dimension B_L and Weight $_L$ = Acoustically lined units - Model AL

Dimensions in millimetres

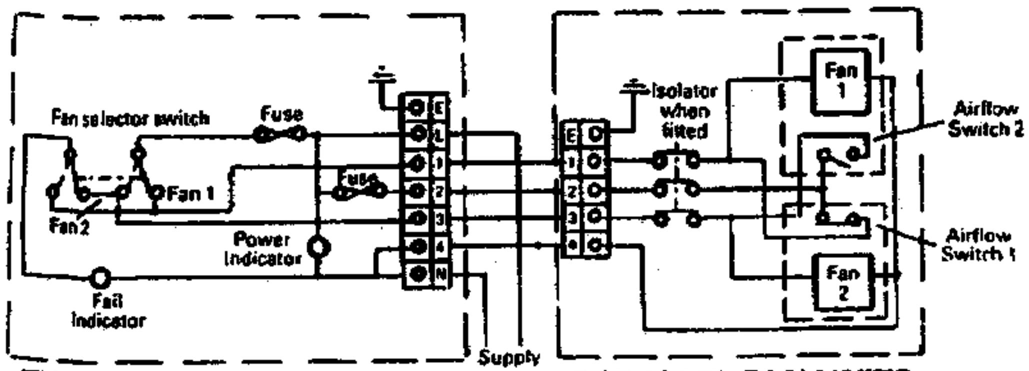
Duct Mounting - Model DTF (A) and (AL)



Code	A	B	B_L	C	D	E	F	G	Weight (kg)	Weight $_L$ (kg)
DTF-1A (L)	452	210	260	530	175	100	225	630	18	20
DTF-2A (L)	525	260	310	740	225	150	325	840	21	25
DTF-3A (L)	600	330	380	740	250	150	400	840	27	37
DTF-4A (L)	700	390	440	900	350	200	500	1000	40	52
DTF-5A (L)	800	440	490	1000	400	325	600	1100	52	61
DTF-6A (L)	800	440	490	1000	450	350	600	1100	64	75
DTF-7A (L)	800	440	490	1000	450	350	600	1100	64	75

Dimension B_L and Weight $_L$ = Acoustically lined units - Model AL
Dimensions in millimetres

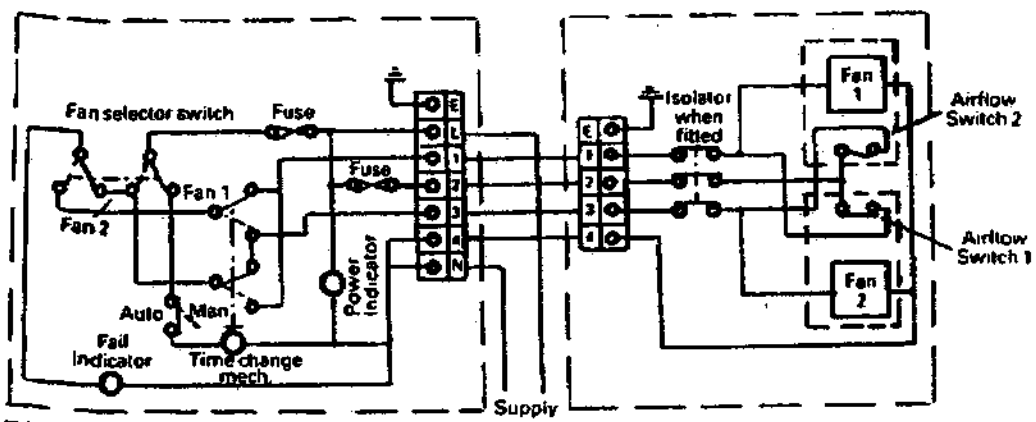
1 PHASE



TYPE AC1 CONTROL PANEL. MANUAL SELECTION.

PARALLEL FAN UNITS TYPE TF & DTF. ALSO BTF AND BTFD.

(1)



TYPE ACDS 1 CONTROL PANEL. AUTOMATIC DUTY.

PARALLEL FAN UNITS TYPE TF & DTF. ALSO BTF & BTFD.

(2)

When fan units are used without control panel, supply should be connected to terminals 1 & 4 for Fan 1 and terminals 3 & 4 for Fan 2.

Part No. 410591 10/88

WOODS AIR MOVEMENT

Parallel Fan Units Models TF & DTF

Installation and Maintenance Instructions

Site Storage
Units must be stored in a clean and dry atmosphere.

Supply
Check that the site supply voltage and other electrical details agree with that marked on the equipment.

Installation
Roof mounting units must be securely screwed to roof curb using the four screw holes to be found in the unit skirt.

Roof mounting units type TF should be fitted only on flat roofs, unless a suitable adaptor section is provided between unit and sloping roof.

Certified drawings are available on request, showing suggested method for roof preparation.

Duct mounting units type DTF may be mounted horizontally with top or bottom access, or vertically with air discharge upward.

Connection
The wiring must be connected in accordance with the wiring diagram printed overleaf, showing controls type AC1 or ACDS1. Parallel Fan Units may be connected to other control systems, provided such offer the appropriate method of control with suitable wiring circuitry.

Earthing
Units must be earthed in accordance with the wiring diagram and local supply authority requirements.

Protection against Electrical Faults
All fuses in the control circuit should be regarded as protecting the wiring against the effects of short circuits or earth faults only. They are not suitable for overload protections.

Maintenance 6 monthly intervals.

Wiring Check all electrical wiring for condition an' 'ake necessary action to correct any sign of deterioration.

Fan Motors are fitted with life lubricated bearings, and require no further attention if equipment is not continuously running, e.g. 12 hours on 12 off. If, however, equipment is required to run continuously, it is advisable to apply a light application of oil to motor bearings via the shaft.

Check the following:–

1. Check motors for overheating.
2. Check motors bearings for wear.
3. Check general condition of motors including connections.
4. Check security of fan impellers on fan shafts.

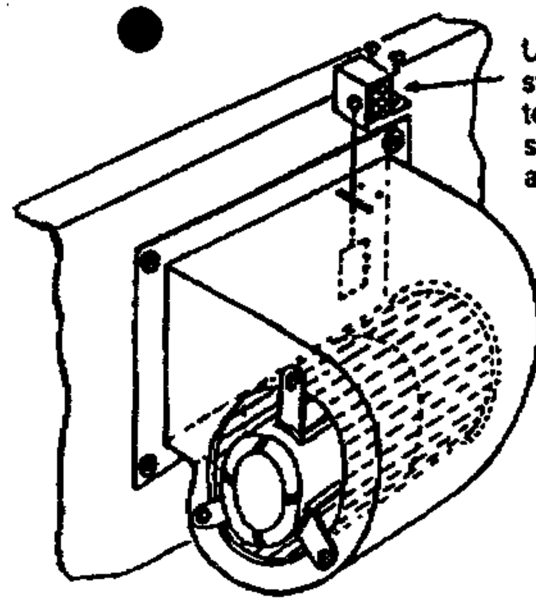
Cleaning Fan Impellers Remove damper blades, using flat face of screw-driver or similar tool, to push damper spindle. (See instruction for damper removal.)

Important To avoid damage to airflow switch when cleaning fan impellers, the airflow switch should be removed. (See instruction.)

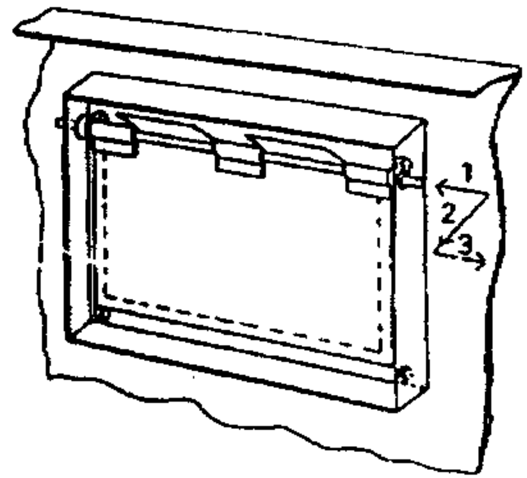
To clean impellers, use a suitable size paint brush.

Dampers Check dampers for freedom of operation. Check damper seals for condition, and renew if necessary.

Airflow Switches Check for freedom of operation. Correct electrical and mechanical functioning of airflow switches will be observed by noting momentary illumination of fault warning light on automatic changeover panel, when manually switching from one fan to the other.



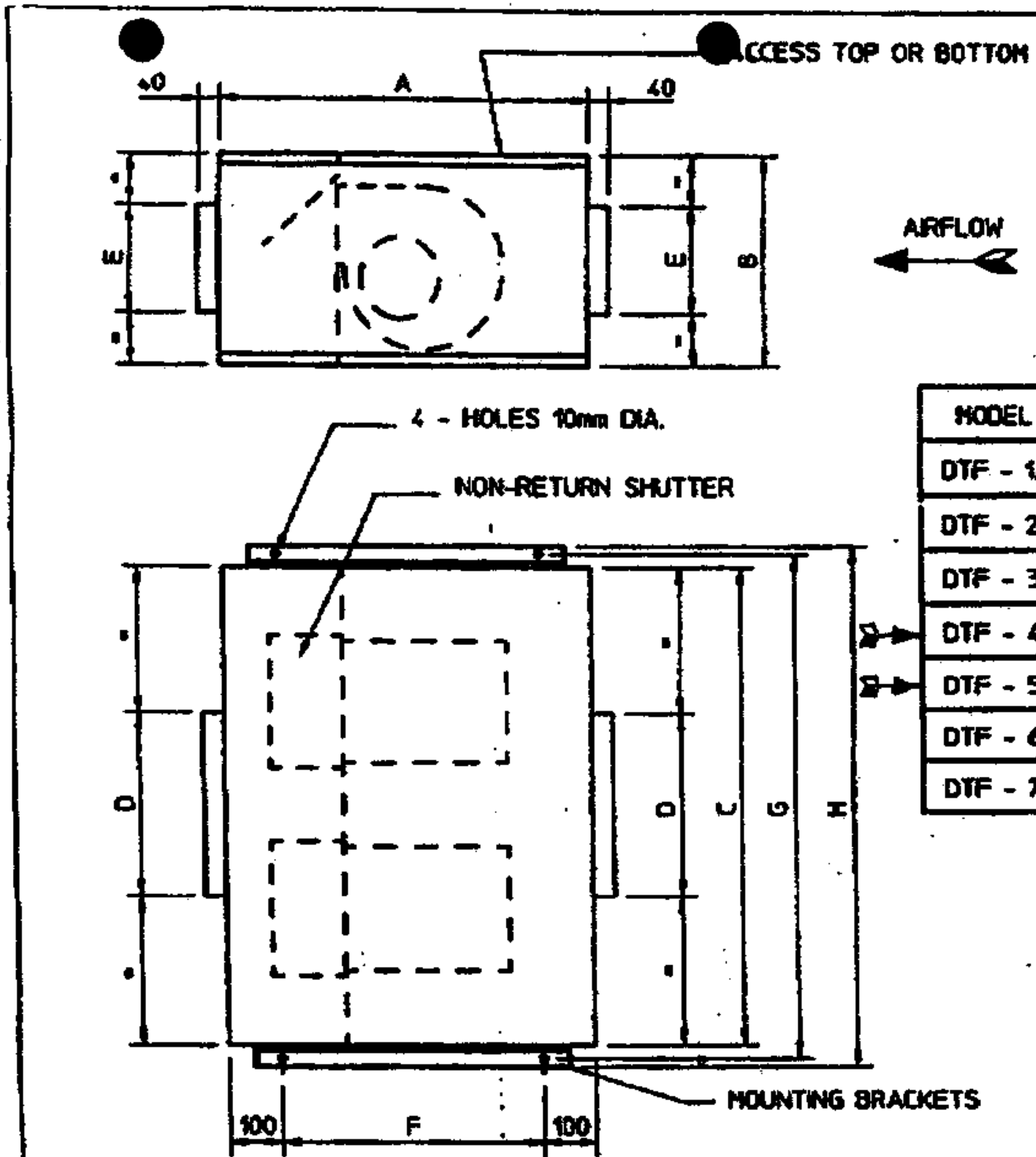
Removing Airflow Switch



Removing Damper Blades

1. Push spindle in, to disengage from spindle bearing.
2. Draw spindle forward to clear damper housing.
3. Withdraw damper and spindle from opposite bearing.

Take care not to lose damper spacers when removing.



SYSTEM	FAN REF	WOC REF
	EXH-07	15Y
	EXH-08	16S

MODEL	A	B	C	D	E	F	G	H	WEIGHT kg.
DTF - 1A	425	210	530	175	100	225	580	630	16
DTF - 2A	525	260	740	225	150	325	790	840	21
DTF - 3A	600	330	740	250	150	400	790	840	27
DTF - 4A	700	390	900	350	200	500	950	1000	40
DTF - 5A	800	440	1000	400	325	600	1050	1100	52
DTF - 6A	800	440	1000	450	350	600	1050	1100	64
DTF - 7A	800	440	1000	450	350	600	1050	1100	64

DRAKE & SCULL ENG. LTD
ORDER No: W078659/1215192
CARLTON GARDENS.
WAM REF: 573923L

GEOMETRICAL TOL. SPEC. AS BS308. | PART No. NONE | MATERIAL: xxxxxxxxx - xxxxxxxxxxxxxxxxxxxxxxxxxxxx | MASS kg | N. OF L kg-m²

© COPYRIGHT AS DATE BELOW | FINISH: xxxxxxxxxxxxxxxxxxxxxxxx | PARTS CLASSIFICATION CODE

	SIG.	DATE		SIG.	DATE
DRAWN	geg	17-05-77	TRACED		
CHECKED	geg	17-05-77	CHECKED		
APPROVED	CTW	18-05-77			

THIRD ANGLE PROJECTION

UPDATED FOR CAD

DLG 6.2.90 MOD C

ISSUE A — DO NOT SCALE

ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE
General Tolerances as Drg. No. 152400 Except Where Stated

IF IN DOUBT ASK

CLIENTS NAME | CLIENTS O/NO. | WOODS O/NO. | NO. OFF

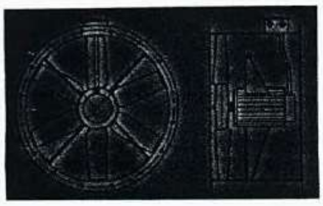
TITLE TWIN FAN UNIT DUCT MOUNTING
DIRECT DRIVEN TYPE DTF 1A-7A

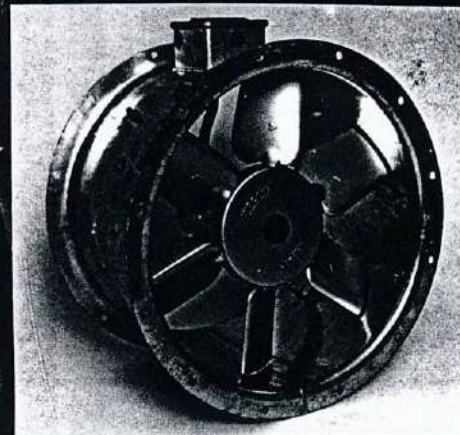
SCALE		DRAWING NO.	MOD	VERSION	STATUS
1:10	A3	D238577	C	1	IS

WOODS AIR MOVEMENT
Woods of Colchester Ltd.
INCORPORATING KEITH BLACKMAN
COLCHESTER, ESSEX CO4 5AR

ADJUSTABLE PITCH AEROFOIL FAN

JM AEROFOIL





- 315 mm - 1000 mm diameter
- Volume flow up to 20 m³/s (42000 ft³/min)
- Static pressures up to 700 Pa (2.8 in. wg)
- High energy efficiency
- Low installed noise levels
- Motor protection IP55
- Overheat protection fitted as standard on 1ϕ motors
- 100% X-ray of cast aluminium impeller components
- Casing hot dipped galvanised
- Full range of ancillary equipment

SIZES:

31JM - 315 mm, 35JM - 355 mm, 40JM - 400 mm, 45JM - 450 mm, 50JM - 500 mm, 56JM - 560 mm, 63JM - 630 mm, 71JM - 710 mm, 80JM - 800 mm, 90JM - 900 mm, 100JM - 1000 mm

FAN PERFORMANCE:

All fans are tested to the latest internationally recognised standard ISO5801 Part 1, installation category D for aerodynamic performance and BS848 Part 2 (1985) for acoustic performance.

Coupled with the above fan diameters, the adjustable pitch Aerofoil impeller gives the exact performance required, with a non overloading fan characteristic.

IMPELLERS:

A unique high efficiency aerofoil section blade with a purposely smoothed hub and clamplate for adjustable pitch angle availability.

The Woods impellers are all high pressure die cast to offer thin aerofoil sections for low generation of noise levels. Every cast aluminium component is X-rayed using Real Time Radiography inspection prior to assembly.

MOTORS:

All motors are totally enclosed air stream rated class F insulation. Constructed from aluminium as standard with special 'T' slot and pad mounted fixings.

Suitable for horizontal through to vertical shaft operation. Supplied IP55, with removable drain plugs. Sealed for life bearings lubricated with wide temperature range grease. Flameproof motors are certified to BS5501 Parts 1 and 5 suitable for use in gas groups 2A and 2B. Temperature class T4.

ELECTRICAL SUPPLY:

220-240 V / 50 Hz / 1 ϕ
380-420 V / 50 Hz / 3 ϕ

TEMPERATURE RANGE:

-40°C to 50°C as standard. Fans can be operated up to 70°C with appropriate deration of motors (please enquire).

CASINGS:

JM Aerofoil fans are available in either a long cased form complete with externally mounted pre-wired electrical terminal box or short cased for duct or plate installation.

Casings are spun from sheet steel with integral pre-drilled and radiused inlet flanges. The galvanised finish gives a high resistance to corrosion and makes it ideal for external use.

ANCILLARY EQUIPMENT:

Silencers, Mounting feet, Vibration isolators, Matching flanges, Flexible connectors, Air operated non return dampers, Guards, Bell mouth inlets.

HOW TO SPECIFY / ORDER:

- Manufacturer: Woods of Colchester
- Fan Type: Adjustable pitch aerofoil fan with x-ray inspected aluminium impeller

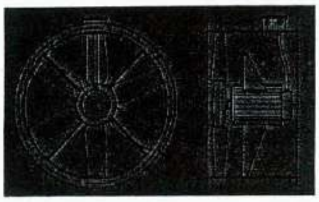
1. Fan code: eg. 63 denotes the fan impeller diameter in cm. JM denotes fan type
2. 20 denotes impeller hub diameter in cm.
3. 6 denotes a nominal 6 pole speed.
4. 6 denotes the number of blades.
5. 20 denotes the pitch angle for the required duty.
6. Electrical Supply: eg. 240 V / 50 Hz / 1 ϕ

- Ancillary items required: eg. Feet, Vibration isolators etc.

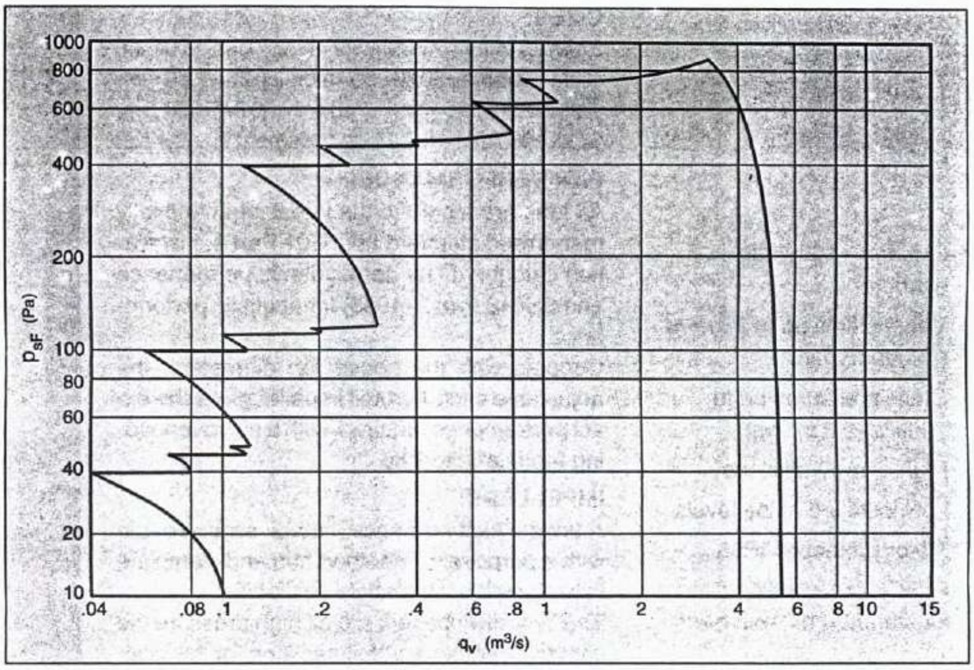
1		2	3	4	5	6		
63	JM	20	6	6	20	240	50	1
							50	

FOR FURTHER INFORMATION, PLEASE CONTACT YOUR LOCAL SALES CENTRE

WOODS AIR MOVEMENT

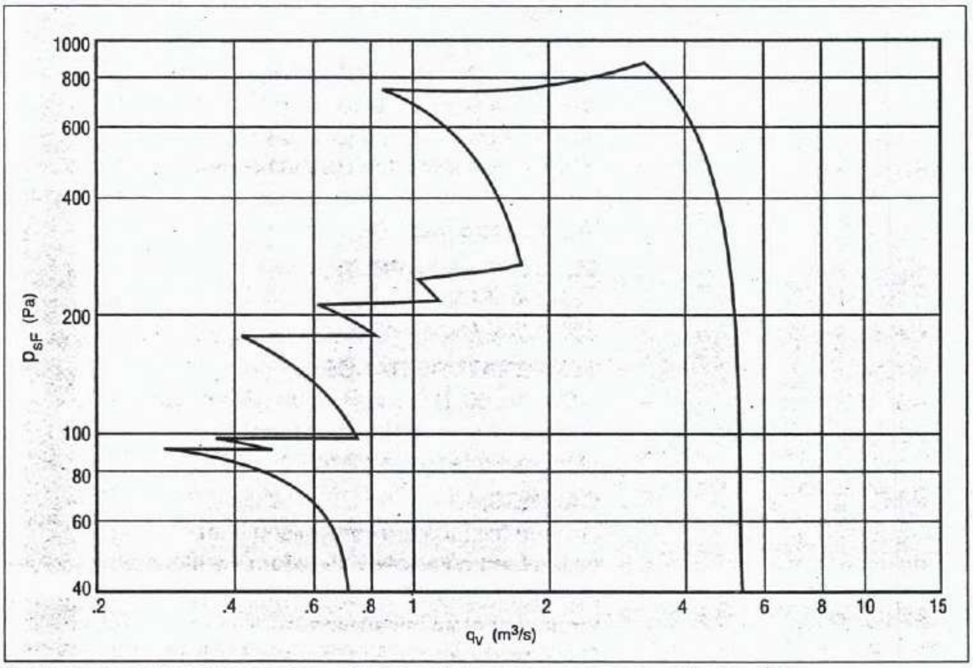


AEROFOIL FAN 31JM - 50JM (See page 16 for details)



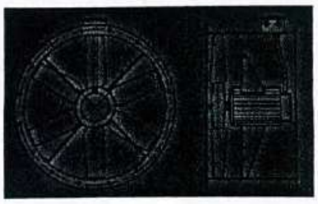
Single stage, preferred range only. For full performance curves see publication C22a.

AEROFOIL FAN 50JM - 63JM (See page 18 for details)



Single stage, preferred range only. For full performance curves see publication C22a.

ADJUSTABLE PITCH AEROFOIL FAN 31JM - 50JM



SELECTION TABLE 31JM - 50JM

m³/s	at Pa (Static) 20	50	100	150	200	400	600
0.25	31JM 1420 14°	31JM 1420 16°	35JM 1420 16°	31JM 2840 8°	31JM 2840 10°	35JM 2840 10°	---
0.37	31JM 1420 22°	31JM 1420 26°	35JM 1420 22°	31JM 2840 12°	31JM 2840 12°	35JM 2840 12°	---
0.50	31JM 1420 32°	35JM 1420 22°	35JM 1420 30°	50JM/16 1420 10°	31JM 2840 16°	35JM 2840 16°	---
0.65	35JM 1420 26°	35JM 1420 30°	40JM 1420 22°	50JM/16 1420 12°	31JM 2840 22°	35JM 2840 20°	---
0.80	35JM 1420 34°	40JM 1420 22°	40JM 1420 30°	31JM 2840 28°	31JM 2840 28°	35JM 2840 24°	---
1.00	40JM 1420 26°	40JM 1420 30°	45JM/16 1420 22°	50JM/16 1420 18°	35JM 2840 22°	35JM 2840 30°	50JM/16 2840 10°
1.25	40JM 1420 38°	45JM/16 1420 24°	45JM/16 1420 28°	50JM/16 1420 24°	35JM 2840 28°	40JM 2840 22°	50JM/20 2910 10°
1.50	45JM/16 1420 26°	45JM/16 1420 30°	50JM/16 1420 22°	50JM/16 1420 28°	40JM 2840 20°	40JM 2840 26°	50JM/20 2910 12°
2.00	50JM/16 1420 26°	50JM/16 1420 28°	50JM/20 1420 30°	40JM 2840 28°	40JM 2840 30°	50JM/20 2910 12°	50JM/20 2910 16°
2.50	50JM/20 2910 12°	50JM/20 2910 12°	50JM/20 2910 14°	50JM/20 2910 14°	50JM/20 2910 14°	50JM/20 2910 16°	50JM/20 2910 20°

ELECTRICAL DATA 31JM - 50JM

Sound pressure levels quoted are calculated in dB(A) at 3 metres distance over a sphere, based on form B running under free field conditions, and are presented for comparative purposes only.

Cylindrical silencers are available as standard. See page 65 for details.

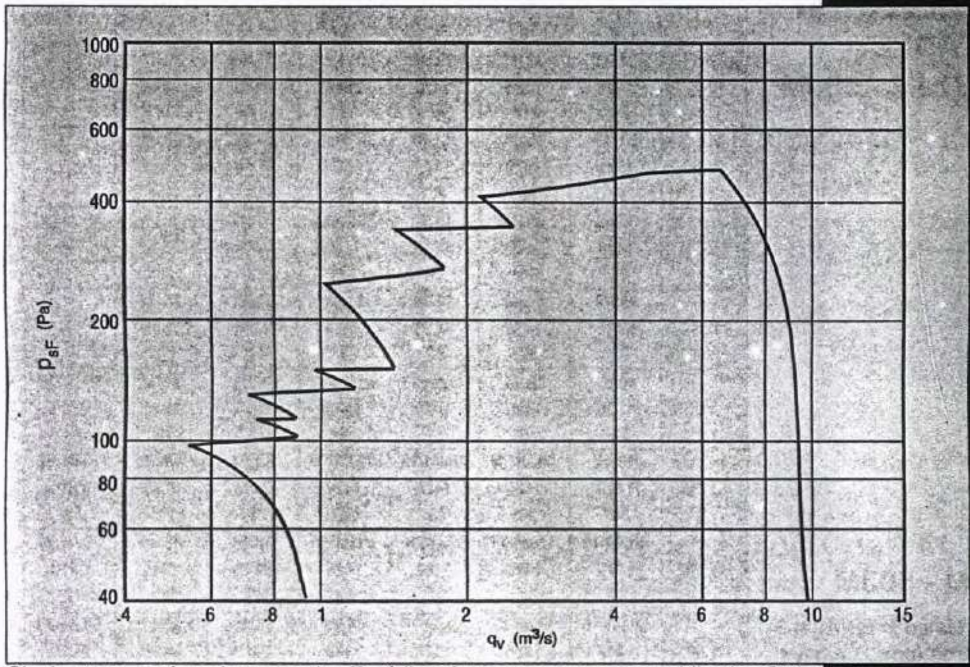
Preferred Range shown in bold type

Code	Speed	Motor	Pitch Angle	220-240 V / 50 Hz / 1ϕ Motor Rating	Full Load Current (at 230 V)	Starting Current (at 230 V)	Speed Controller Electronic	Speed Controller Trans-former	380-420 V / 50 Hz / 3ϕ Pitch Angle	Motor Rating	Full Load Current (at 400 V)	Starting Current (at 400 V)	Speed Controller Electronic	Speed Controller Trans-former	Sound Level dB(A)
	(rev/min)		(°)	(kW)	(A)	(A)			(°)	(kW)	(A)	(A)			
31JM/16/6/5...	900	*BT5/4	22-40	0.04	0.5	0.7	ME1.1	MT1.1	38-40	0.06	0.3	0.8	ME3.2D	MT3.0-5	35
31JM/16/4/5...	1420	*BT5/4	24-38	0.07	0.6	1.8	ME1.1	MT1.1	30-40	0.13	0.5	1.8	ME3.2D	MT3.0-5	44
31JM/16/2/5...	2840	BT9	26-32	0.5	3.3	9.0	N/A	N/A	24-34	0.58	1.4	6.0	N/A	N/A	62
		CT5	36-40	0.75	4.9	8.5	N/A	N/A	36-40	0.95	2.0	9.5	N/A	N/A	64
35JM/16/6/5...	900	*BT5/4	12-40	0.04	0.5	0.7	ME1.1	MT1.1	26-40	0.06	0.3	0.8	ME3.2D	MT3.0-5	38
35JM/16/4/5...	1420	*BT5/4	16-24	0.07	0.6	1.8	ME1.1	MT1.1	20-34	0.13	0.5	1.8	ME3.2D	MT3.0-5	47
		BT4	28-40	0.13	1.0	2.0	ME1.1	MT1.5	36-40	0.20	0.7	2.4	ME3.2D	MT3.1	48
35JM/16/2/5...	2840	CT5	24-28	0.75	4.9	8.5	N/A	N/A	24-32	0.95	2.0	9.5	N/A	N/A	64
		CT9	36-40	1.4	8.3	27.0	N/A	N/A	34-40	1.7	3.5	20.0	N/A	N/A	66
40JM/16/6/5...	900	†BT4/5	28-38	0.06	0.6	1.0	ME1.1	MT1.1	36-40	0.09	0.4	1.2	ME3.2D	MT3.0-5	40
40JM/16/4/5...	1420	BT5	26-28	0.16	1.2	2.7	ME1.3	MT1.5	24-30	0.20	0.7	2.4	ME3.2D	MT3.1	51
		BT9	34-40	0.25	1.7	3.8	ME1.3	MT1.5	32-40	0.30	0.9	4.6	ME3.2D	MT3.1	52
40JM/16/2/5...	2840	CT9	24-28	1.40	8.3	27.0	N/A	N/A	22-32	1.70	3.5	20.0	N/A	N/A	67
45JM/16/6/5...	900	BT5	22-34	0.09	0.8	1.6	ME1.1	MT1.1	24-30	0.09	0.4	1.2	ME3.2D	MT3.0-5	43
		BT9	36-40	0.12	1.1	2.2	ME1.3	MT1.5	32-40	0.14	0.6	1.8	ME3.2D	MT3.1	44
45JM/16/4/5...	1420	BT9	24-30	0.3	2.1	5.3	ME1.3	MT1.5	22-26	0.3	0.9	4.6	ME3.2D	MT3.1	56
		CT5	36-40	0.45	2.9	7.0	ME1.3	MT1.5	36-40	0.58	1.7	6.5	ME3.2D	MT3.2	58
45JM/16/2/5...	2840	CT9	16-18	1.4	8.3	27.0	N/A	N/A	14-20	1.7	3.5	20.0	N/A	N/A	69
45JM/20/2/6...	2910	F2225	N/A						20-34	5.8	7.1	44.0	N/A	N/A	70
50JM/16/6/5...	915	BT9	30-32	0.14	1.2	2.8	ME1.3	MT1.5	22-28	0.14	0.6	1.8	ME3.2D	MT3.1	47
		CT5	36-40	0.19	1.8	3.0	ME1.3	MT1.5	40	0.3	1.1	3.3	ME3.2D	MT3.2	47
50JM/16/4/5...	1420	CT5	26-28	0.45	2.9	7.0	ME1.3	MT1.5	26-30	0.58	1.7	6.5	ME3.2D	MT3.2	60
		CT9	38-40	0.68	4.2	11.0	ME1.6	MT1.8	32-40	0.9	2.3	9.0	ME3.2D	MT3.2	61
50JM/20/4/6...	1420	CT5	30-32	0.55	3.7	5.5	ME1.6	MT1.5	24-30	0.58	1.7	6.5	ME3.2D	MT3.2	61
		CT9	40	0.9	5.8	19.0	ME1.6	MT1.8	32-40	0.9	2.3	9.0	ME3.2D	MT3.2	62
50JM/20/2/6...	2910	F2225	N/A						12-24	3.8	2.1	44.0	N/A	N/A	73
		F2229	N/A						26-34	6.2	11.0	90.0	N/A	N/A	75

* BT5 for 1ϕ and BT4 for 3ϕ

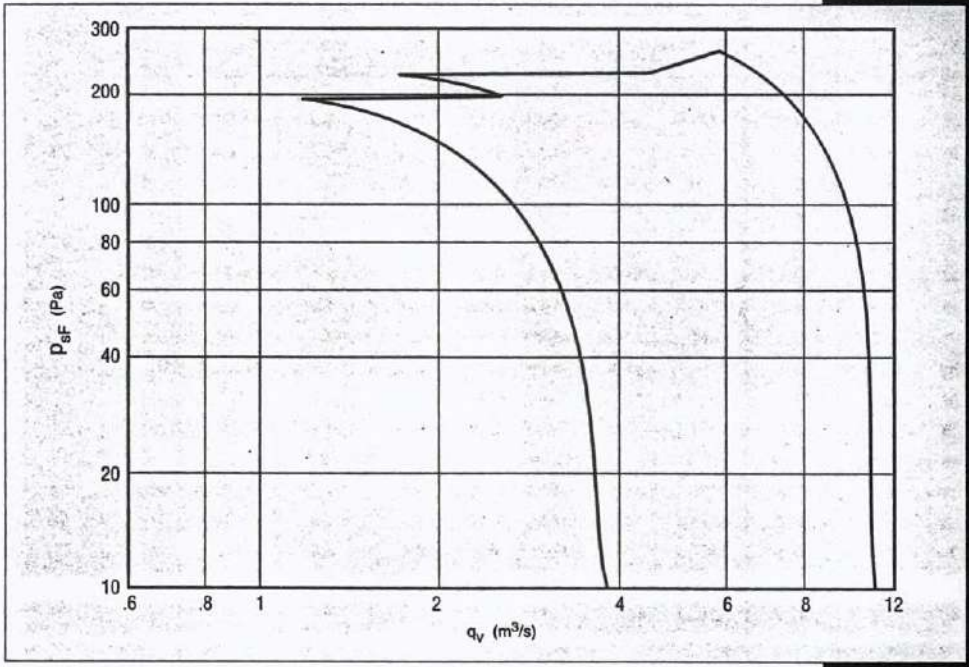
† BT4 for 1ϕ and BT5 for 3ϕ

AEROFOIL FAN 63JM - 80JM (See page 20 for details)

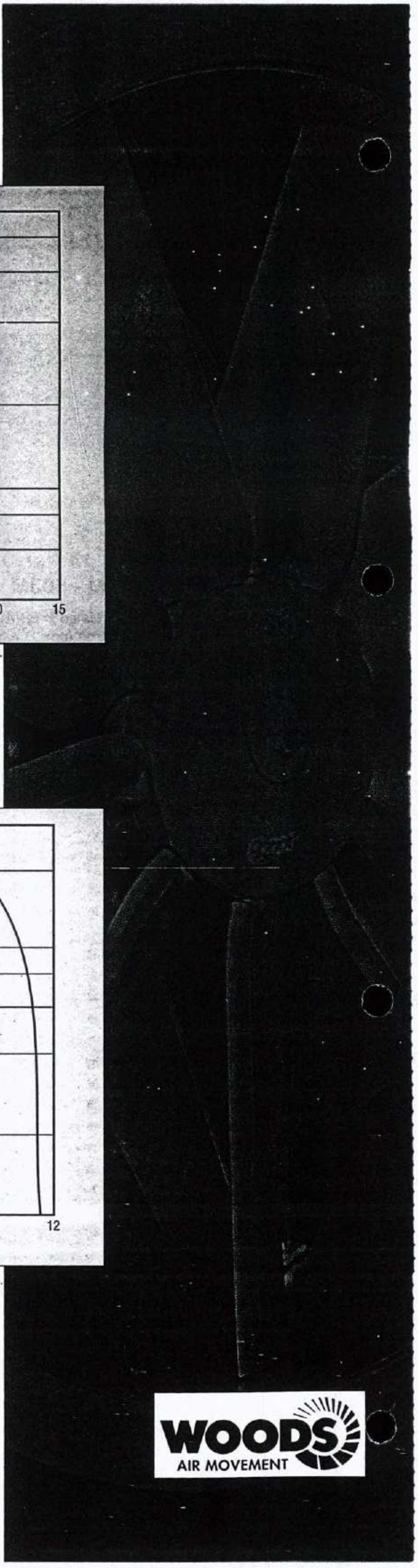


Single stage, preferred range only. For full performance curves see publication C22a.

AEROFOIL FAN 90JM - 100JM (See page 22 for details)



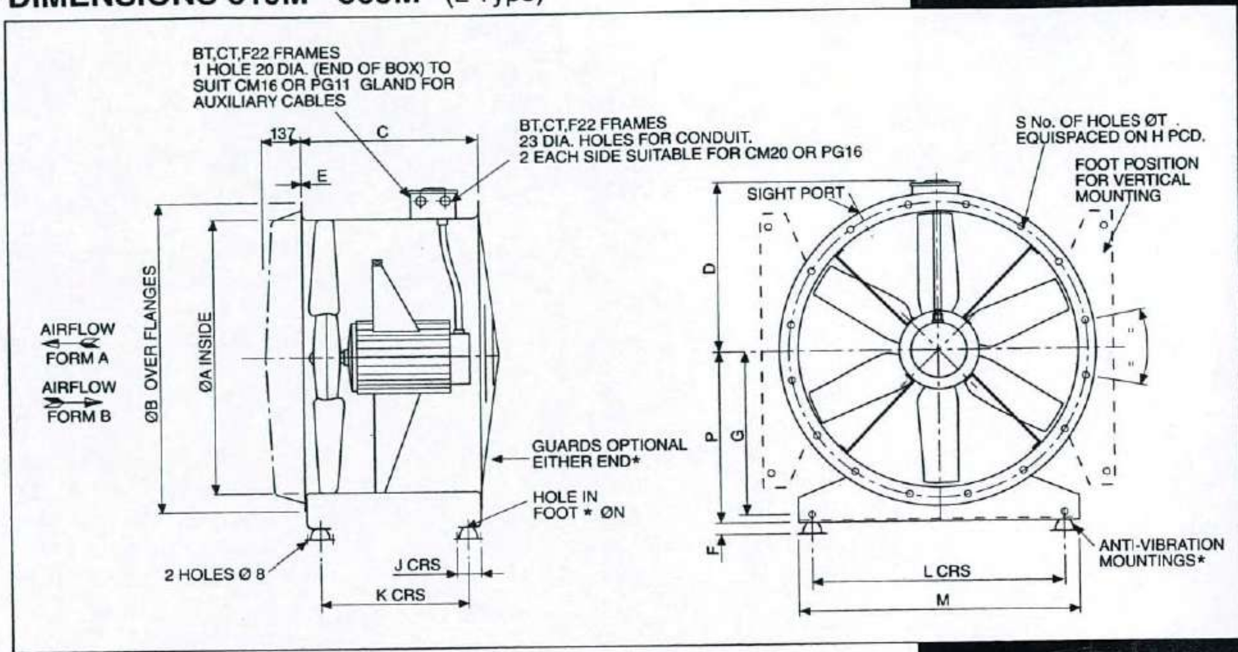
Single stage, preferred range only. For full performance curves see publication C22a.



FLAMEPROOF AEROFOIL FAN 40JM-80JM
(See page 24 for details)

WOODS AIR MOVEMENT

DIMENSIONS 31JM - 50JM (L Type)

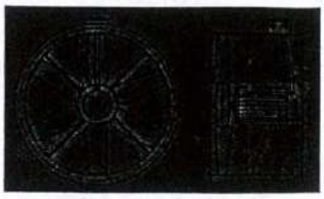


* Ancillaries are optional and supplied separately
(for full details see pages 65-68)

Code	Motor Frame	A	B	C	D	E	F	G	H	J	K	L	M	N	P	S	T	Weight (kg)
		DIMENSION REFERENCE (mm)																
315	BT4/5/9	315	395	375	235	2.5	25	175	355	66	289	265	315	10	200	8	10	22
	CT5	315	395	375	235	2.5	25	175	355	66	289	265	315	10	200	8	10	27
355	BT4/5/9	355	435	375	256	2.5	25	200	395	66	289	305	355	10	225	8	10	24
	CT5/9	355	435	375	256	2.5	25	200	395	66	289	305	355	10	225	8	10	28
400	BT4/5/9	400	480	375	279	2.5	25	225	450	66	289	350	400	10	250	8	12	26
	CT9	400	480	375	279	2.5	25	225	450	66	289	350	400	10	250	8	12	30
450	BT5/9	450	544	375	306	2.5	25	255	500	66	289	400	450	10	280	8	12	28
	CT5/9	450	544	375	306	2.5	25	255	500	66	289	400	450	10	280	8	12	32
	F2225	450	544	520	306	3	25	255	500	66	434	400	450	10	280	8	12	44
500	BT9	500	594	375	338	2.5	25	290	560	66	289	450	500	10	315	12	12	28
	CT5/9	500	594	375	338	2.5	25	290	560	66	289	450	500	10	315	12	12	34
	F2225	500	594	520	338	3	25	290	560	66	434	450	500	10	315	12	12	54
	F2229	500	594	520	338	3	25	290	560	66	434	450	500	10	315	12	12	65

Dimensions in mm

WOODS AIR MOVEMENT



SELECTION TABLE 50JM - 63JM

	at Pa (Static)						
m³/s	20	50	100	150	250	400	600
1.00	**50JM/16 915 20°**	**50JM/16 1420 10°**	**50JM/16 1420 14°**	**50JM/16 1420 18°**	---	---	---
1.50	**50JM/16 14200 16°**	**50JM/16 1420 30°**	**50JM/16 1420 22°**	**50JM/16 1420 28°**	**50JM/20 2910 8°**	**50JM/16 2840 10°**	**50JM/20 2910 12°**
2.00	**50JM/16 1420 26°**	**50JM/16 1420 28°**	**50JM/20 1420 30°**	**56JM/16 1420 24°**	**50JM/20 2910 10°**	**50JM/20 2910 12°**	**50JM20 2910 16°**
2.50	**56JM/16 1420 20°**	**56JM/16 1420 22°**	**56JM/16 1420 26°**	**56JM/16 1420 30°**	**63JM/20 1420 22°**	**50JM/20 2910 16°**	**50JM/20 2910 20°**
3.00	**56JM/16 1420 26°**	**56JM/16 1420 30°**	**56JM/20 1420 32°**	**63JM/20 1420 20°**	**63JM/20 1420 26°**	**50JM20 2910 20°**	**50JM/20 2910 24°**
3.50	**56JM/20 1420 32°**	**63JM/20 1420 22°**	**63JM/20 1420 24°**	**63JM/20 1420 26°**	**50JM/20 2910 22°**	**50JM/20 2910 26°**	**50JM/20 2910 30°**
4.00	**63JM 1420 24°**	**63JM/20 1420 26°**	**63JM/20 1420 28°**	**63JM/20 1420 30°**	**50JM/20 2910 28°**	**50JM/20 2910 30°**	56JM/20 2910 20°
4.50	**63JM/20 1420 28°**	**63JM/20 1420 28°**	**50JM/20 2910 30°**	**50JM/20 2910 30°**	**50JM/20 2910 32°**	56JM/20 2910 20°	56JM/20 2910 24°

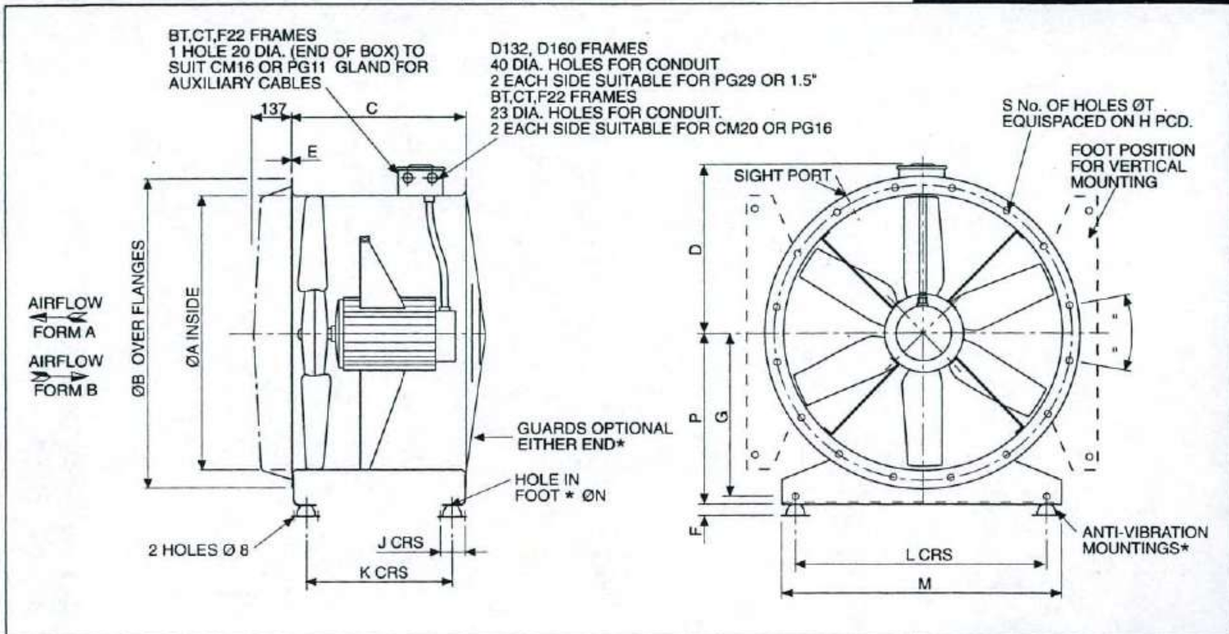
Preffered Range shown in bold type

ELECTRICAL DATA 50JM - 63JM

Code	Speed	Motor	220-240 V / 50 Hz / 1φ						380-420 V / 50 Hz / 3φ						Sound Level dB(A)
			Pitch Angle	Motor Rating	Full Load Current (at 230 V)	Starting Current (at 230 V)	Speed Controller		Pitch Angle	Motor Rating	Full Load Current (at 400 V)	Starting Current (at 400 V)	Speed Controller		
	(rev/min)		(°)	(kW)	(A)	(A)	Electronic	Trans-former	(°)	(kW)	(A)	(A)	Electronic	Trans-former	
50JM/16/6/5...	915	BT9	**30-32**	**0.14**	**1.2**	**2.8**	ME1.3	MT1.5	**22-28**	**0.14**	**0.6**	**1.8**	ME3.2D	MT3.1	47
		CT5	36-40	0.19	1.8	3.0	ME1.3	MT1.5	40	0.3	1.1	3.3	ME3.2D	MT3.2	49
50JM/16/4/5...	1420	CT5	26-28	0.45	2.9	7.0	ME1.3	MT1.5	**26-30**	**0.58**	**1.7**	**6.5**	ME3.2D	MT3.2	60
		CT9	38-40	0.68	4.2	11.0	ME1.6	MT1.8	32-40	0.9	2.3	9.0	ME3.2D	MT3.2	61
50JM/20/4/6...	1420	CT5	**30-32**	**0.55**	**3.7**	**5.5**	ME1.6	MT1.5	**24-30**	**0.58**	**1.7**	**6.5**	ME3.2D	MT3.2	61
		CT9	40	0.9	5.8	19.0	ME1.6	MT1.8	32-40	0.9	2.3	9.0	ME3.2D	MT3.2	62
50JM/20/2/6...	2910	F2225	N/A						12-24	3.8	2.1	44.0	N/A	N/A	73
		F2229	N/A						**26-34**	**6.2**	**11.0**	**90.0**	N/A	N/A	75
56JM/16/6/5...	900	CT5	**38-40**	**0.3**	**2.4**	**4.0**	ME1.3	MT1.5	**30-36**	**0.3**	**1.1**	**3.3**	ME3.2D	MT3.2	
56JM/16/4/5...	1420	CT5	22	0.55	3.7	9.5	ME1.6	MT1.5	16-20	0.58	1.7	6.5	ME3.2D	MT3.2	60
		CT9	**28-32**	**0.9**	**5.8**	**19.0**	ME1.6	MT1.8	**22-30**	**0.9**	**2.3**	**9.0**	ME3.2D	MT3.2	61
56JM/20/4/6...	1420	CT5	20	0.55	3.7	5.5	ME1.6	MT1.5	16-20	0.58	1.7	6.5	ME3.2D	MT3.2	61
		CT9	32-36	1.1	7.2	23.0	ME1.12	MT1.12	**30-32**	**1.15**	**3.0**	**14.0**	ME3.2D	N/A	62
63JM/20/8/6...	680	CT9	N/A						**28-32**	**0.25**	**1.2**	**2.6**	ME3.2D	MT3.2	47
63JM/20/6/6...	900	CT5	**22**	**0.3**	**2.4**	**4.0**	ME1.3	MT1.5	16-20	0.3	1.1	3.3	ME3.2D	MT3.2	50
		CT9	**34**	**052**	**4.0**	**9.2**	ME1.6	MT1.8	**26-30**	**0.52**	**1.7**	**7.5**	ME3.2D	MT3.2	55
63JM/20/4/6...	1420	CT9	16-18	0.9	5.8	19.0	ME1.6	MT1.8	12-14	0.9	2.3	9.0	ME3.2D	MT3.2	63
		CT9	**20-22**	**1.1**	**7.2**	**23.0**	ME1.12	MT1.12	**18-20**	**1.15**	**3.0**	**14.0**	ME3.2D	AT5.0	64
		F2245	N/A						**28-30**	**2.1**	**4.7**	**30.0**	N/A	N/A	67

Sound pressure levels quoted are calculated in dB(A) at 3 metres distance over a sphere, based on form B running under free field conditions, and are presented for comparative purposes only.
Cylindrical silencers are available as standard. See page 65 for details.

DIMENSIONS 90JM - 100JM (L Type)

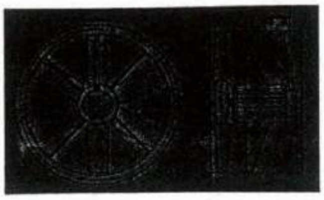


* Ancillaries are optional and supplied separately
(for full details see pages 65-68)

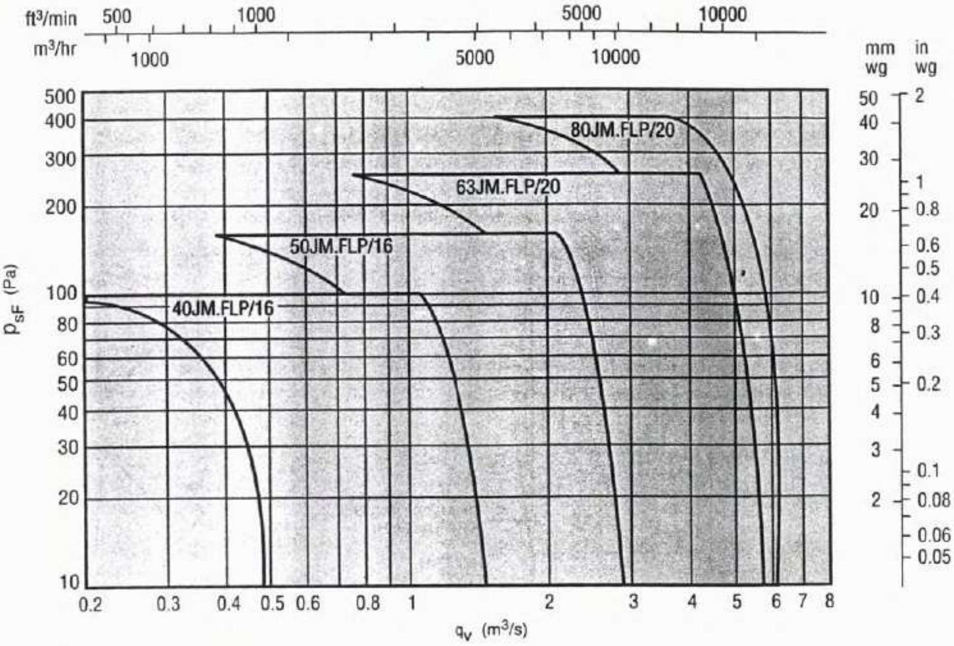
Code	Motor Frame	DIMENSION REFERENCE (mm)																Weight (kg)
		A	B	C	D	E	F	G	H	J	K	L	M	N	P	S	T	
900	F2269	900	1006	520	538	3	25	491	970	66	444	850	900	10	518	16	15	99
	D132	900	1006	520	575	5	45	491	970	124	444	850	900	12	518	16	15	183
	D160	900	1006	625	575	5	45	491	970	124	539	850	900	12	518	16	15	252
1000	F2269	1000	1106	520	588	3	25	547	1070	66	444	950	1000	10	574	16	15	107
	D132	1000	1106	520	625	5	45	547	1070	124	444	950	1000	12	574	16	15	198
	D160	1000	1106	625	625	5	45	547	1070	124	539	950	1000	12	574	16	15	268

Dimensions in mm

WOODS AIR MOVEMENT



FLAMEPROOF JM AEROFOIL FAN 40JM - 80JM



Single stage, full solidity fan performance details only are shown.

SELECTION TABLE Flameproof JM Aerofoil 40JM - 80JM

	at Pa						
m³/s	25	50	100	150	200	300	400
0.5	40JM 1420 10°	40JM 1420 10°	40JM 1420 14°	50JM 1420 10°	63JM 1420 4°	---	---
0.7	40JM 1420 16°	40JM 1420 18°	40JM 1420 24°	50JM 1420 12°	63JM 1420 4°	---	---
1.0	40JM 1420 26°	40JM 1420 28°	40JM 1420 36°	50JM 1420 18°	63JM 1420 6°	---	---
1.5	50JM 1420 16°	50JM 1420 18°	50JM 1420 20°	50JM 1420 26°	63JM 1420 12°	---	---
2.0	50JM 1420 24°	50JM 1420 26°	50JM 1420 30°	63JM 1420 14°	63JM 1420 16°	80JM 1440 8°	80JM 1440 8°
2.5	50JM 1420 32°	50JM 1420 34°	63JM 1420 16°	63JM 1420 18°	63JM 1420 20°	80JM 1440 10°	80JM 1440 16°
3.0	63JM 1420 18°	63JM 1420 18°	63JM 1420 20°	63JM 1420 22°	63JM 1420 26°	80JM 1440 10°	---
3.5	63JM 1420 22°	63JM 1420 22°	63JM 1420 24°	63JM 1420 28°	63JM 1420 30°	80JM 1440 12°	---
4.0	63JM 1420 26°	63JM 1420 26°	63JM 1420 28°	63JM 1420 32°	63JM 1420 36°	80JM 1440 14°	---
5.0	63JM 1420 34°	63JM 1420 36°	80JM 1440 12°	80JM 1440 12°	80JM 1440 14°	80JM 1440 16°	---
5.5	80JM 1440 12°	80JM 1440 12°	80JM 1440 12°	80JM 1440 14°	80JM 1440 14°	80JM 1440 18°	80JM 1440 24°
6.0	80JM 1440 14°	80JM 1440 14°	80JM 1440 14°	80JM 1440 16°	80JM 1440 18°	80JM 1440 20°	80JM 1440 26°

(All Flameproof JM Aerofoils - suffix JM.FLP/

ELECTRICAL DATA Flameproof 40JM - 80JM

Code	Speed	Pitch Angle Range (Single Stage)	Motor	380-420 V / 50 Hz / 3φ			Sound Level (max.)
				Motor Rating	Full Load Current (at 400 V)	Starting Current (at 400 V) d.o.l	
	rev/min	(°)		(kW)	(A)	(A)	dB(A)
40JM.FLP/16	1420	8-40	ENV89MP	0.75	1.70	9.40	52
50JM.FLP/16	1420	8-38	ENV89MP	0.75	1.70	9.40	60
63JM.FLP/20	1420	8-26	ENV89MP	1.70	3.90	21.5	64
	1420	28-36	ENV89LP	2.70	5.70	28.5	67
80JM.FLP/20	1440	8-14	ENV89LP	2.70	5.70	28.5	70

Sound pressure levels quoted are calculated in dB(A) at 3 metres distance over a sphere, based on form B running under free field conditions, and are presented for comparative purposes only.

Cylindrical silencers are available as standard. See page 65 for details.

Flameproof Fans are not suitable for speed regulation.

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