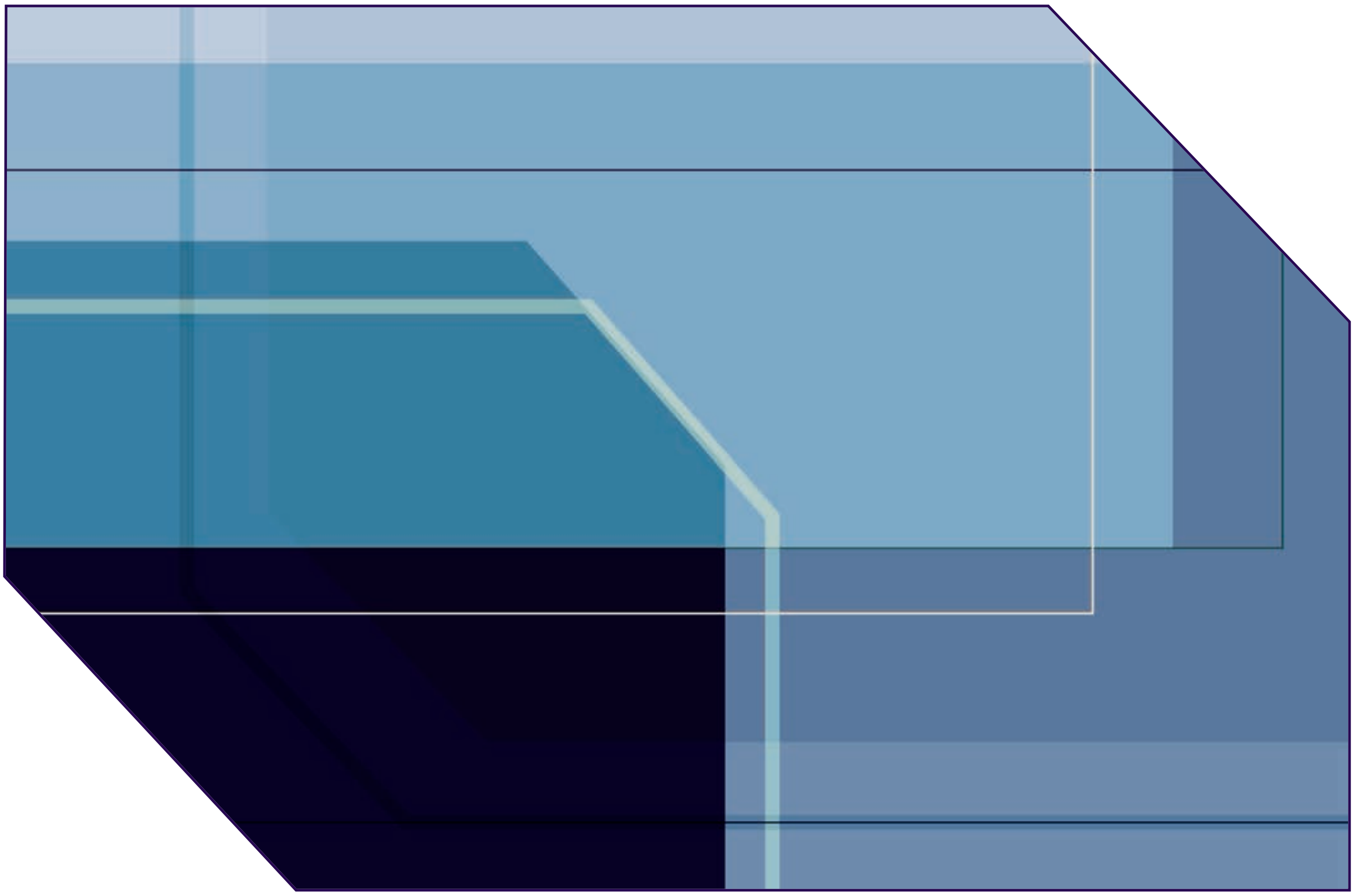
BUILDING & ENGINEERING SERVICES ASSOCIATION

SPECIFICATION FOR

SHEET METAL DUCTWORK



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Second Edition 2013

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THE INDUSTRY STANDARD

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Since its publication in 1998, the Association's Specification for Sheet Metal Ductwork –DW/144 – has gained national and international recognition as the standard against which the quality of ductwork manufacture and installation can be measured.

However, developments in technology and working practices, along with the need to reflect a steady proliferation of European standards, have rendered necessary a far-reaching revision of the original edition.

This second edition is the result of many years of work by members of the Technical Committee of the B&ES Ductwork Group (DWG), who have expanded the content on such subjects as:

- supports and hangers;
- smoke and fire dampers;
- external ductwork;
- internal duct linings;
- thermal insulation;
- air terminal units;
- fire-resisting ductwork;
- ductwork for swimming pools, etc.

Of course, a key element of any such review is to ensure that the specification continues to offer realistic benchmarks to which all individuals and organisations are able to perform.

DW/144 now incorporates B&ES publication, Acceptance Scheme for New Products: Rectangular Cross Joint Classification (DW/TM1), which establishes performance ratings for both air leakage and deflection for cross-joints.

In order to validate the parameters set out in DW/144, B&ES has undertaken extensive testing against recently-introduced CEN requirements to measure panel/flange deflection and air leakage testing. Testing has also been undertaken to determine the lifespan of untreated spot welds over a 30-year period.

The results have allowed the DWG Technical Committee to make a number of recommendations in relation to the construction of ductwork which offer a significant commercial advantage. These include:

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- lighter gauges of steel;
- a reduction in the number of gauge, flange/stiffener manufactured assemblies;
- dispensing with the need to treat spot welds;
- a reduction in coatings thickness/protective finishes;
- further clarification of standard duct sizes used.

During the drafting process, the DWG Technical Committee has consulted widely with individuals and organisations throughout the building engineering services and construction industry to ensure that the new specification fully reflects the current "state-of-the-art" in terms of both technical expertise and industry best practice. We firmly believe that this process has resulted in a publication that clearly demonstrates the high level of professionalism which exists within the ductwork community – and we take this opportunity of thanking all those who have contributed to its production.

In particular, we have worked closely with members of the drafting panel for the Ventilation Hygiene Branch's Guide to Good Practice: Cleanliness of Ventilation Systems (TR/19), as well as representatives of the following organisations:

- Aluminium Federation Ltd (ALFED);
- British Stainless Steel Association (BSSA);
- Building Services Research and Information Association (Testing) (BSRIA);
- Galvanizers Association;
- Heating, Ventilating and Air Conditioning Manufacturers Association (HEVAC);
- Sheet Metal and Air Conditioning National Contractors' Association (SMACNA);
- TATA Steel;
- Thermal Installation Contractors' Association (TICA);
- Thermal Insulation Manufacturers and Suppliers Association (TIMSA);

In addition, the past 15 years have witnessed a number of significant legislative and regulatory innovations – including the Construction Products Regulation, CE Marking and the Construction (Design and Management) Regulations, along with other measures designed to enhance environmental management and health and safety. The latter comprise significant developments within the Building Regulations in England and Wales, with the result that the classes of ductwork to be tested under the regulations have been clarified within DW/144, along with the re-introduction of high-pressure Class D to conform to European practice.

To ensure that companies are fully informed and understand the wealth of information that surrounds our industry we have compiled a new reference document 'Commentary and Guidance to DW/144'. The information contained in this new document is additional supplementary material to support DW/144 and is explanatory in nature. However, we should emphasise that the It does not form any part of the specification and should be used as reference only.

Finally, we would like to offer our profound thanks to the members of the Ductwork Group Technical Sub-Committee, all of whom have devoted a great deal of time and effort in the redrafting process.

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ACKNOWLEDGEMENTS

B&ES wishes to record its sincere thanks to the following Members of the Technical Committee of the Ductwork Group, who contributed their time, knowledge and experience to the production of this document.

Peter Rogers (Chairman)
Mark Cain
Lee Hussey
Brian James
Bob Lane
Jim Murray
Cameron Robertson
Mark Simpson

Ductwork Group Secretary:
Mark Oakes

B&ES wishes to record its sincere thanks to particular organisations that have provided technical support to verify both existing and new information and these acknowledgements can be found both in the Chairman's Introduction and, where appropriate, at the foot of each relevant section.

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OTHER DUCTWORK-RELATED PUBLICATIONS

DW/143	A Practical Guide to Ductwork Leakage Testing
DW/145	Guide to Good Practice for the Installation of Fire and Smoke Dampers
DW/154	Specification for Plastic Ductwork
DW/172	Specification for Kitchen Ventilation Systems
DW/191	Guide to Good Practice: Glass Fibre Ductwork
TR/19	Guide to Good Practice: Internal Cleanliness of Ventilation Systems (incorporating DW/TM2 and TR/17)
B&ES	Working Together – Promoting understanding between mechanical services and ductwork contractors.

Copies of the above publications are available from:

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Previous Sheet Metal Ductwork Related Specifications

-	Ductwork Specification for High-Velocity Air Systems (Circular)	1963
-	Standard Range of Rectangular Ducting	1967
DW/131	Sheet Metal Ductwork Specification for High-Velocity Air Systems (Rectangular)	1968
DW/121	Specification for Sheet Metal Ductwork (Low-Velocity Low-Pressure Air Systems) (Rectangular and Circular) — Metric	1969
DW/122B	Specification for Sheet Metal Ductwork (Low-Velocity Low-Pressure Air Systems (Rectangular and Circular) — British	1969
DW/112	Standard Range of Rectangular Ducts and Fittings — Metric and British Units	1970
DW/132	Specification for Sheet Metal Ductwork (High-Velocity High-Pressure Air Systems) (Rectangular, Circular and Flat Oval) — Metric	1970
DW/141	Specification for Sheet Metal Ductwork (Low and High-Velocity/ Pressure Air Systems (Rect, Circular and Flat Oval) - Metric	1977
DW/142	Specification for Sheet Metal Ductwork (Low, Medium and High Pressure/Velocity Air Systems)	1982
DW/142	Specification for Sheet Metal Ductwork Addendum A (Low, Medium and High Pressure/Velocity Air Systems)	1988
DW/144	Specification for Sheet Metal Ductwork (First Edition)	1998
DW/151	Specification for Plastic Ductwork	1974
DW/171	Standard for Kitchen Ventilation Systems	1999
DW/TM1	Acceptance Scheme for New Products: Rectangular Cross Joint Classification	1987
DW/TM2	Guide to Good Practice: Internal Cleanliness of New Ductwork Installations	1991
TR/17	Guide to Good Practice: Cleanliness of Ventilation Systems	2002

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Tables

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GENERAL NOTES RELATING TO DW/144

(1) Where a project specification calls for the system to be wholly in accordance with DW/144, it will still be necessary for the system designer, in addition to providing drawings showing details and dimensions of the ductwork, to identify specific requirements, particular to the design. This information should be highlighted on the drawings and include the identification of pressure 'break points' between low, medium and high pressure classification elements of the system, non-galvanized constructions and the location and types of all dampers.

The technical information to be provided by the system designer is therefore set out in detail in Part Two.

(2) All dimensions quoted in this specification refer to the nominal sizes, which are subject to the normal relevant commercial and published tolerances.

(3) Manufacturing techniques are continually subject to change and improvements and in respect of proprietary methods and devices this specification does not preclude their use if they can be demonstrated to the system designer to be equally satisfactory. Where there is divergence between the requirements of DW/144 and the manufacturer's recommendations for proprietary methods and devices, the latter shall take precedence.

(4) The expressions 'low-pressure,' 'medium-pressure' and 'high- pressure' relate to the pressure/velocity classes set out in Table 1.

(5) 'Mean air velocity' means the design volume flow rate related to the cross-sectional area.

(6) Reference to the air distribution system pressure relate to the static pressure of the relevant part of the ductwork system and not to the fan static pressure.

(7) Despite reference to 'minimum' requirements, it should be recognised that in several instances, in order to comply with established UK practices, DW/144 exceeds the minimum requirements set out in European Standards.

(8) All references to BS, BS EN, ISO and other standards and regulations purposely omit the year. It is incumbent upon the user to ensure that reference is made to the latest available publication.

(9) Ductwork constructed to DW/144 standard has no fire resistance. General purpose ventilation/air conditioning ductwork and its ancillary items do not have a fire classification and cannot be either utilised as or converted into fire rated ductwork unless the construction materials of the whole system including supports and penetration seals are proven by test and assessment in accordance with the appropriate test standard. In the case where galvanized sheet steel ductwork is clad with the application of protective material, the ductwork construction must be as type tested and comply with the protective material manufacturers recommendation, e.g. sheet thickness of ductwork, frequency of stiffening and non-use of low melting point fasteners and rivets. Particular emphasis should be given to how the ductwork is installed into the supporting construction (walls and floors of different types) and what additional stiffening should be employed within the wall as was tested. Sealants, gaskets and flexible joints should be tested and certificated in accordance with the appropriate test standard and comply with all manufacturers recommendations. Careful consideration must be given to the maximum certified size as tested and the manufacturer's recommendation should always be followed.

PART ONE – SCOPE

SECTION 1 APPLICATION

1.1 COMMERCIAL AND INDUSTRIAL AIR DISTRIBUTION SYSTEMS

This specification sets out minimum requirements for the manufacture and installation of ductwork for commercial and industrial air distribution systems, made from any of the materials listed in Section 2 and being within the limits of size and/or metal thicknesses specified in the relevant tables. Normal operating temperatures up to 70°C are assumed within the pressure/velocity limits and the limits of air leakage for the various pressure classes prescribed in Table 1.

Table 1 Ductwork Classification and Air Leakage Limits

Duct pressure class	Static pressure limit		Maximum air velocity	Air leakage limits litres per second per square metre of duct surface area
	Positive	Negative		
1	*2*	*3*	*4*	*5*
	Pa	Pa	m/s	
Low pressure – Class A	500	500	10	$0.027 \times p^{0.65}$
Medium pressure – Class B	1000	750	20	$0.009 \times p^{0.65}$
High pressure - Class C	2000	750	40	$0.003 \times p^{0.65}$
High pressure - Class D	2000	750	40	$0.001 \times p^{0.65}$

Where *p* is the differential, pressure in pascals.

1.2 UNSUITABLE FOR CONTAMINATED AIR DISTRIBUTION SYSTEMS

This specification is not suitable for operating in extremely hostile conditions, examples of which are: saturated air, explosive contaminants, off-shore, etc. The design, construction, installation, supports and finishes in such cases should be given special consideration by the system designer in relation to the circumstances of each case.

1.3 EXPOSURE TO EXTERNAL ATMOSPHERE

System designers will need to give specific details of any special finishes/construction for ductwork exposed to external atmosphere. See Sections 26 and 32.

1.4 CONFORMITY TO EN STANDARDS

Legislation has been introduced whereby all UK Standards should comply with current EN Standards and a list of these along with many other associated standards can be found in Appendix N.

SECTION 2 MATERIALS

2.1 APPLICATION

This specification applies to ductwork constructed from materials as defined below, or equal. Minimum steel thickness is to be taken as a nominal thickness within the tolerances to BS.EN 10346. (Appendix B).

2.2 ZINC-COATED STEEL

Where DW/144 ductwork is installed in an area of low category corrosion it can be constructed from hot-dip galvanized steel to BS EN 10346, Grade DX51D+Z140, with other coating finishes being considered by the system designer in accordance with the corrosive categories listed in Table 24 of Appendix B.

2.3 MILD STEEL

Where mild steel is specified, it shall be cold- reduced steel to BS.EN10130, Grade FEP 01A.

2.4 STAINLESS STEEL

Where stainless steel is specified, it will be the responsibility of the system designer to indicate the type most suitable for the conditions to which the ductwork will be exposed. In doing so, it is recommended that the factors set out in Appendix D should be taken into account. In this connection, reference must be made to BS EN 10088: Part 2.

2.5 PRE-FINISHED STEEL

Pre-coated steel may be specified for aesthetic or other reasons. The system designer must then consider the availability of suitable materials and the restriction on fabrication methods. Guidance notes are available in Appendix F.

2.6 ALUMINIUM

Where aluminium is specified, it will be the responsibility of the system designer to define the type most suitable for the conditions to which the ductwork will be exposed. Reference must be made to BSEN 485, BSEN 515 and BSEN 573 for aluminium sheet and BSEN 755 Parts 3-6 for aluminium section. Constructional requirements for ductwork made from aluminium sheet and general notes on the material are set out in Appendix E.

SECTION 3 DUCTWORK CLASSIFICATION AND AIR LEAKAGE

3.1 CLASSIFICATION AND AIR LEAKAGE LIMITS

Ductwork classification and air leakage limits are set out in Table 1. (Clause 1.1)

3.2 COMPATIBILITY WITH CEN

The leakage factors used in Table I for Classes A, B, C and D are the same as those for the classes similarly designated in the CEN Document BS EN 12237 / BS EN 1507.

3.3 LEAKAGE AT VARIOUS PRESSURES; AND OTHER RELATIONSHIPS

Applying the limits specified in Table 1, Appendix A (Table 22) sets out the permitted leakage at each of a series of pressures up to a maximum for each class. Included in that appendix is a graphical presentation of the pressure/leakage relationship (see Fig 207). DW/143, 'A Practical Guide to Ductwork Leakage Testing', also gives details of the basis for the leakage limits specified in Table 1.

3.4 AIR LEAKAGE TESTING

Air leakage testing of low and medium pressure ductwork is not mandatory under this specification.

Air leakage testing of high pressure ductwork is mandatory under the specification. See Appendix A for information on air leakage from ductwork. For details of testing procedure refer to DW/143, 'A Practical Guide to Ductwork Leakage Testing'.

3.5 IN–LINE PLANT CASINGS

The casings of all in-line plant and equipment that connect to the ductwork system should be manufactured and sealed to match the ductwork classification and air leakage limits of the systems they serve. Suppliers to confirm their suitability for the pressure classification in which such casings are to be incorporated.

PART TWO – TECHNICAL INFORMATION TO BE PROVIDED BY THE SYSTEM DESIGNER TO THE DUCTWORK CONTRACTOR

SECTION 4 INTRODUCTION

The selection of constructional methods is the decision of the manufacturer to conform with the performance requirements of the specified ductwork classification. Sections 5-7 below define the information that is to be provided by the system designer.

SECTION 5 STANDARDS

5.1 *PRESSURE CLASSIFICATION* *(Table 1)*

5.2 *LEAKAGE CLASSIFICATION* *(Table 1)*

5.3 *POSITIVE AND NEGATIVE PRESSURES* *(Table 1)*

5.4 *MATERIALS* *(Section 2)*

5.5 *PDI LEVELS OF CARE, PROTECTION AND CLEANLINESS*

(Appendix H and B&ES Guide TR/19)

5.6 *ANY SPECIAL SYSTEM REQUIREMENTS*

SECTION 6 COMPONENTS

6.1 *FIRE DAMPERS* *(Section 22)*

Specification and location, on the drawings, of all fire dampers to meet the requirements of the Building / Fire regulations.

6.2 COMBINATION SMOKE AND FIRE DAMPERS *(Section 23)*/ SMOKE DAMPERS *(Section 24)*/ SMOKE CONTROL DAMPERS *(Section 25)*

Specification and location, on the drawings, of all types of smoke dampers to meet the requirements of the Building / Fire regulations.

6.3 REGULATING DAMPERS *(Section 21)*

Specification, location, on the drawings, and mode of operation of all regulating dampers.

6.4 INSPECTION/SERVICING ACCESS OPENINGS *(Section 20 and Appendix H)*

Number and location, on the drawings, of all panels and covers for inspection and/or servicing access other than those covered in Section 20. Number and location of test holes, instrument connections and hinged doors as defined in Section 20.

6.5 CLEANING ACCESS *(Section 20.7 and Appendix H)*

System designers shall stipulate their requirements for periodic internal cleaning of ductwork and for the consequent need for adequate personnel access and for specialist cleaning equipment. As DW/144 ductwork or supports do not take into account either man-loading or the support of other building services, system designers must take this into account in accordance with BS EN 12236, 'Ventilation for buildings – Ductwork hangers and supports – Requirements for strength'. This consideration should also include recognition of all appropriate risk assessments.

6.6 FLEXIBLE DUCTS *(Section 30)*

Specification and location, on the drawings, of any flexible ductwork.

6.7 FLEXIBLE JOINT CONNECTIONS *(Section 31)*

Specification and location, on the drawings, of any flexible connections e.g. plant or building expansion joints.

SECTION 7 PARTICULAR REQUIREMENTS

7.1 AIR LEAKAGE TESTING *(Section 3 of Part One and Appendix A)*

The extent of any air leakage testing shall be specified. Testing of low or medium pressure ductwork is not mandatory - see A.1.3, A.1.4 and A.5 in Appendix A. It shall be mandatory for high-pressure ductwork (as defined in this specification) to be tested for air leakage in accordance with the procedure set out in DW/143, 'A Practical Guide to Ductwork Leakage Testing'.

7.2 PROTECTIVE FINISHES *(Part Seven, Section 32)*

Details and specification of any protective finishes.

7.3 FIRE RESISTING DUCTWORK FOR FIRE AND SMOKE CONTAINMENT

(Commentary and Guidance – Note 4)

Ductwork constructed to DW/144 standard has no fire resistance. However, if the system designer requires any ductwork to be fire resistant, the fire performance criteria for any fire resistant ductwork should be specified with the extent being identified on the specification and drawings.

7.4 INTERNAL ACOUSTIC LINING *(Part Seven, Section 33)*

The extent of any ductwork requiring internal acoustic lining is to be clearly identified on the drawings. A detailed specification of materials and method of application is required. The practical aspects of cleaning or maintenance must be addressed by the system designer before deciding to internally line ductwork.

7.5 EXTERNAL THERMAL INSULATION *(Part Seven, Section 34)*

The specification of follow-on insulation to be provided by others shall be stated with the extent being identified on the drawings. The extent of vapour sealing, if required, and associated support methods shall also be identified on the design drawings. (Section 18.6)

7.6 SPECIAL SUPPORTS *(Part Six)*

Details of any spanning steel or special support requirements not covered by Section 18.

7.7 ATTACHMENT TO BUILDING STRUCTURE *(Appendix K)*

Specific requirements for the junction of ductwork and associated components to openings should be detailed and specified. The provision of penetrations and associated framings are outside the scope of this specification.

7.8 AIR TERMINAL UNITS *(Part Seven, Section 35)*

Detail and specifications of all Air Terminal Units shall be specified. It is expected that all Air Terminal Units and their Plenums will be supported independently of the ceiling grids unless the system designer indicates anything to the contrary. (Figures 201 to 206)

7.9 DUCTWORK LAYOUT DRAWINGS

Details of any special requirements relating to the latest issue of any CAD, scales, etc. It is common practice and cost effective for ductwork manufacturers to utilise their approved ductwork layout drawings as a basis of their manufacturing/installation information by adding the necessary details to the same drawing. Scales of 1:50 or smaller may preclude this practice, therefore, larger scales might be more appropriate. The final choice of manufacturing/installation scales and drawing sizes shall be left to the ductwork contractor.

7.10 ELECTRONIC-BASED DUCTWORK CONTRACT ENQUIRIES

Drawings and specifications relevant to the ductwork systems being quoted should be highlighted and indexed in the enquiry.

7.11 OTHER REQUIREMENTS

Details of any requirements for ductwork not in accordance with the provisions of this specification, any non-DW/144 galvanized ductwork, any modified construction required to conform to any requirements concerning external ductwork (See Part Seven, Section 26) and any requirements to meet the regulations of a Local Authority or other controlling body.

7.12 REFERENCE TO THE SYSTEM DESIGN/DESIGNER

In consideration of the foregoing, reference is also made to the system design/designer in the following sections:-

Section/s	Subject
1.2	Contaminated air
1.3, 26, 32	Exposure to external atmosphere
2.2, Table 24	Zinc coating finishes
2.4, 2.5, 2.6	Stainless and pre-coated steel and aluminium
9.4, 12.2.1, 15.3.1	Proprietary cross joints for rectangular, circular and flat oval
10.5.2	Internal stiffeners
12, 13, 17	Design terminology standard practice for rectangular, circular and flat oval
18.1	Proprietary support systems
18.4	Support spacing for vertical ducts
18.5	Additional loadings on ductwork supports
18.6	Vapour sealing
18.6.2	Heat transfer
20.1	Access considerations
20.5	Test holes
20.6	Instrument connections
20.2, 20.3, 20.8	Access openings
21.1	Damper locations
21.3	Regulating damper materials and construction
21.3.4	Proprietary regulating dampers
22.3	Fire dampers materials
22.5	Fire damper installation
23.3, 24.3, 25.3	Smoke / fire damper materials and construction
23.5, 24.5, 25.5	Smoke / fire damper installation
26.1	External ductwork – waterproofing
26.2	External ductwork – non-insulated
26.6	External ductwork – roof penetrations
26.8	External ductwork – supports
29.2	Bill of quantity descriptions
30.1	Flexible duct - material
30.3	Flexible duct - off-sets and support
31.1	Flexible connections - material
31.1	Flexible connections - locations
32.3.4	Protective finishes
33.1, 33.8	Internal duct linings
34.2, 34.4, 34.6	Thermal insulation
35	Air terminal units
	Additional information is also provided in the reference document Commentary & Guidance – DW/144

PART THREE – RECTANGULAR DUCTS

SECTION 8 RECTANGULAR DUCT SIZES

This specification covers duct sizes up to a maximum longer side of 3,000 mm. Duct sizes with an aspect ratio greater than 4:1 are not recommended. Although they offer no problems of construction, they increase frictional resistance and the possibility of noise.

SECTION 9 CONSTRUCTION

9.1 *GENERAL*

The constructional requirements for rectangular ductwork depend upon the pressure classification as set out in Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2.

The dimensional lengths of straight sections of ductwork are determined by the manufacturer to suit their preferred method of construction. Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2 (in columns 3 to 11) set out the maximum spacing between joints and stiffeners and Clause 9.10 preceding those tables illustrates examples of how these spacings can be interpreted by the individual manufacturer.

9.2 *STEEL THICKNESSES*

Minimum steel thicknesses related to duct longer side to pressure classification are given in Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2

9.3 *LONGITUDINAL SEAMS*

Longitudinal seams are illustrated in Figs. 4 to 11. The limits of use, if any, are given with the individual illustrations.

9.3.1 *SEALING OF LONGITUDINAL SEAMS*

Sealant shall be applied either internally or externally to the seam edge or internal to the joint seam itself. The most appropriate method will be determined by the manufacturer relative to their product and will be associated with traditional fabrication/assembly methods, factory or site based, and/or proprietary methods.

Joint sealing materials are set out in Part Seven, Section 19.

9.4 CROSS JOINTS

9.4.1 CROSS JOINT RATINGS

For cross-joints, a system of rating has been used to define the limits of use. The limits applying to that rating, in terms of duct size longer side and maximum spacing, are given in Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2.

Note: Proprietary products used in the construction of cross-joints should be approved by an accredited test house following tests defined in and proven to be within the new European standards defined in BS EN 1507. Figures No's 13 and 20 to 24 illustrate non-proprietary joints that have an established rating.

9.4.2 SEALING CROSS JOINTS

With socket and spigot joints made on site, sealant shall be applied during or after assembly of the joint. It is permissible to use chemical - reaction tape or heat-shrink strip as alternative methods of sealing, provided that close contact is maintained over the whole perimeter of the joint until the joint is completed.

With all flanged joints, the sealant of sheet and section should preferably be incorporated during construction at works, but site applied sealant is acceptable. The joint between sections of ductwork is then made, using approved type of sealant or gasket. With proprietary flanging systems particular attention should be paid to the sealing of corner pieces and flanges, reference should be made to the manufacturer's assembly and sealing instructions.

9.4.3 ADJUSTABLE/SLIP JOINTS

In order to accommodate manufacturing / building tolerances, site modifications etc, it is accepted practice to use an adjustable joint but with an adjacent stiffener if over 400mm wide.

9.5 STIFFENERS

9.5.1 EXTERNAL STIFFENERS

The sections (including proprietary flanges) suitable for use as single stiffeners have been given a rating from S1 to S6 in terms of duct size longer side and maximum spacing. The ratings are specified with the illustrations of the stiffeners, Figs. 25 to 30, and the limits of use are given in Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2. The stiffeners for socket and spigot joints covered in Figs. 22 to 24 are also applicable to intermediate stiffeners in general. (Fig. 31)

9.5.2 INTERNAL STIFFENERS

Tie bars connecting the flanges of cross-joints illustrated in Figs. 14 to 19, are the only form of internal stiffening for rectangular ductwork recognised by this specification.

Alternative methods for the attachment of tie bars are shown in Figs. 32 to 35.

The use of tie bars or other forms of internal stiffening or bracing shall be acceptable if proved to the system designer to be equally satisfactory. SMACNA (Sheet Metal and Air Conditioning Contractors' National Association), which is the American equivalent to B&ES Ductwork Group, have included a section on internal stiffening and bracing using tie bars in their publication, 'SMACNA/ANSI HVAC Duct Construction Standard Metal & Flexible, 3rd edition 2005' and this contains extensive technical information and data on the subject of mid panel tie rods. SMACNA have given their kind permission for this specification to make reference to this fact. System designers and manufacturers who wish to incorporate this form of internal stiffening into a ductwork system should contact SMACNA direct to obtain copies of their publications (Appendix N).

9.6 DUCTWORK GALVANIZED AFTER MANUFACTURE

Appendix C sets out the recommended sheet thicknesses and stiffening for ductwork galvanized after manufacture.

9.7 FASTENINGS

9.7.1 PERMITTED TYPES AND MAXIMUM CENTRES

Tables 2.3, 3.3, 4.3 and 5.3 and their associated notes set out the permitted fastenings and the maximum spacing for all ductwork classifications. Fastenings resulting in an unsealed aperture shall not be used.

9.7.2 RIVETS

Manufacturers' recommendations as to use, rivet size and drill size are to be followed.

9.7.3 SET SCREWS, NUTS AND LOCK BOLTS

Materials shall be of mild steel, protected by electro-galvanizing, sherardizing, zinc plating, or other equal corrosion resistant finish.

9.7.4 SELF-TAPPING AND PIERCING SCREWS

Providing an adequate seal can be achieved, then self-tapping or piercing screws may be used. Acknowledging the presence of such fastenings / fixings, avoid putting operatives at risk of injury with regard to internal activities such as access maintenance or ductwork cleaning. Such fixings must not be used within 1 metre of an access opening – as BS EN 12097 Clause 4.5.

9.7.5 SELF-PIERCING RIVETS

Providing an adequate seal can be achieved, then self-piercing rivets may be used - see Fig. 3.

9.8 WELDING SHEET JOINTS

The suitability of continuous welding for sheet-to-sheet joints will be governed by the sheet thickness, the size and shape of the duct or fitting and the need to ensure airtightness. Lapped sheet joints with a combination of spot welding and duct sealant is also acceptable. Distortion shall be kept to a minimum.

Areas where the galvanizing has been damaged or destroyed by welding or brazing shall have a suitable protective coating applied as defined in Section 32. Spot welds need not be treated as accelerated salt spray tests undertaken by Leeds University Research Laboratory on behalf of B&ES have indicated that corrosion rates would be well within the life expectancy of the various parent metal zinc coatings as indicated in the data listed in Table 24 of Appendix B.

9.9 BREAK-AWAY DUCT JOINT

A joint connecting a fire damper spigot or sleeve to the attached ductwork which will allow collapse of the ductwork during a fire without disturbing the integrity of the fire damper. 'Break-away' and flexible joints incorporate materials, fixings, clamps, etc, that are manufactured from a non - fire resistant material with a low melting point such as aluminium, plastic, etc. See DW/145, 'Guide to Good Practice for the Installation of Fire and Smoke Dampers'.

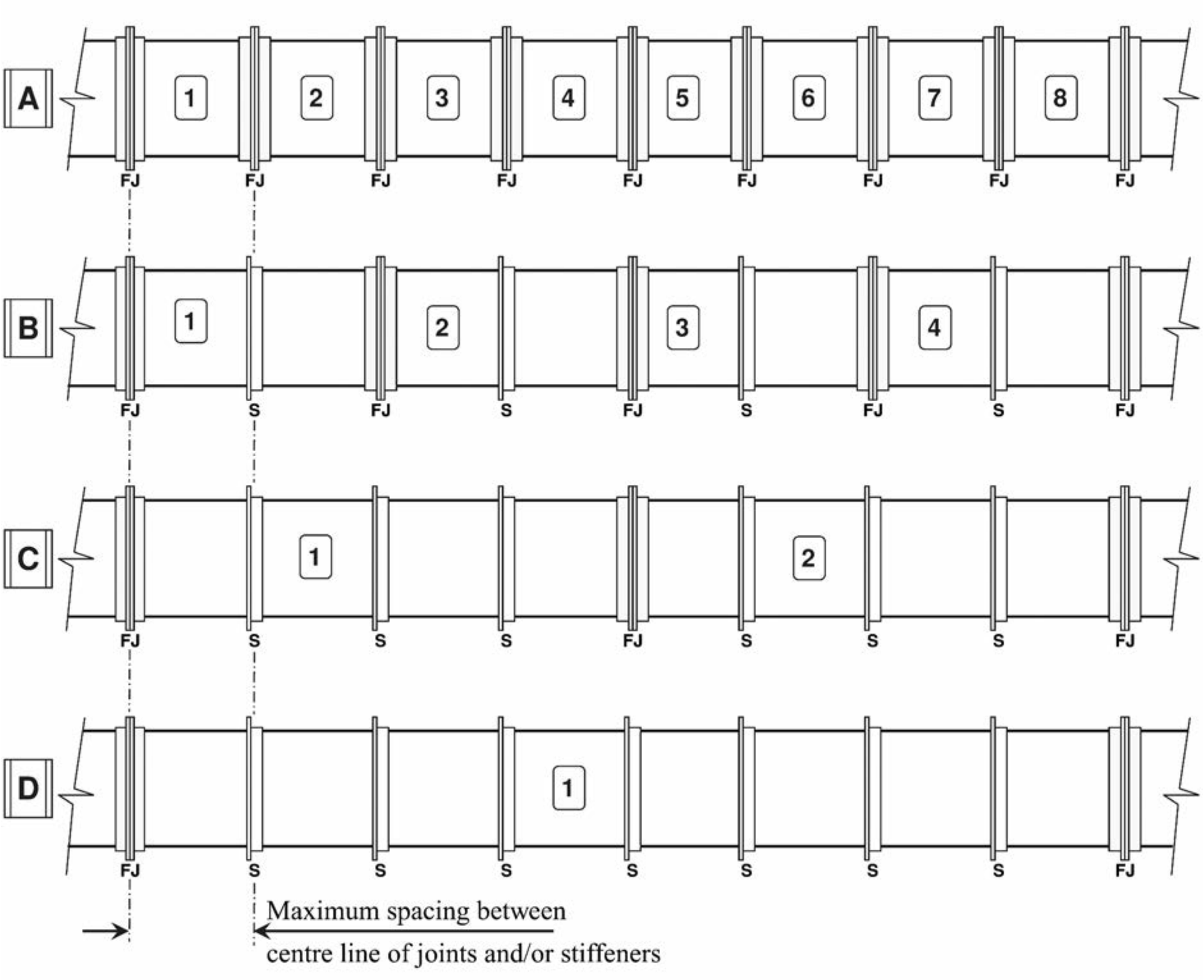
9.10 COST EFFICIENT MANUFACTURING CONSIDERATIONS

The four ranges of ductwork illustrated in Fig. 1 opposite are identical in terms of cross-sectional duct size. Range 'A' consists of eight items of ductwork whereas Range 'D' is made up of just one item.

These four illustrations highlight that the main constructional criteria for 'stiffening' any range of ductwork is that the 'maximum spacing between joints and/or stiffeners' is to be identical for all four ranges – all as per the 'spacing' dimensions listed in columns 3 to 11 of Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2.

Each range however has advantages and disadvantages with regard to both manufacture and installation costs. e.g. Range 'A', made up of eight separate items, has the advantage of suiting mass-production manufacturing techniques but has the disadvantage of increased factory, transportation and site handling costs and increased installation costs along with a greater risk of joint leakage because of the number of site joints involved. The converse applies to Range 'D' which is made up of just one item!

Fig. 1 – Constructional criteria



Each manufacturer has the flexibility to choose, on a project by project basis, what they consider to be the most cost efficient configuration that suits their overall manufacture and installation costs.

LOW PRESSURE CLASS "A"
(limited to 500 Pa positive and 500 Pa negative)

TABLE 2.1 SOCKET AND SPIGOT CONNECTIONS

Dimensions in mm

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
MINIMUM SHEET THICKNESS		**0.6**		**0.8**			**1.0**			**1.2**
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3000**
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN STIFFENERS**								
A1	**PS**	*3000*								
	SS	*3000*								
A2	**PS**	*3000*	*2000*	*1600*	*1250*					
	SS	*3000*	*3000*	*1600*	*1250*					
A3	**PS**	*3000*	*2000*	*1600*	*1250*	*1000*	*800*			
	SS	*3000*	*3000*	*2000*	*1600*	*1250*	*800*			

TABLE 2.2 FLANGED JOINTS

Dimensions in mm

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
MINIMUM SHEET THICKNESS		**0.6**		**0.8**			**1.0**			**1.2**
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3000**
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN FLANGES AND/OR STIFFENERS**								
J1/S1	**PS**	*3000*	*1600*	*1250*	*625*					
	SS	*3000*	*3000*	*1250*	*625*					
J2/S2	**PS**	*3000*	*2000*	*1600*	*1250*	*625*				
	SS	*3000*	*3000*	*1600*	*1250*	*625*				
J3/S3	**PS**	*3000*	*2000*	*1600*	*1250*	*1000*	*800*			
	SS	*3000*	*3000*	*2000*	*1600*	*1250*	*800*			
J4/S4	**PS**	*3000*	*2000*	*1600*	*1250*	*1000*	*800*	*800*		
	SS	*3000*	*3000*	*2000*	*1600*	*1250*	*1000*	*800*		
J5/S5	**PS**	*3000*	*2000*	*1600*	*1250*	*1000*	*800*	*800*	*800*	*625*
	SS	*3000*	*3000*	*2000*	*1600*	*1250*	*1000*	*800*	*800*	*800*
J6/S6	**PS**	*3000*	*2000*	*1600*	*1250*	*1000*	*800*	*800*	*800*	*800*
	SS	*3000*	*3000*	*2000*	*1600*	*1250*	*1000*	*800*	*800*	*800*

TABLE 2.3 FASTENING CENTRES

Dimensions in mm

1	*2*	*3*	*4*	*5*	*6*	*7*
TYPE OF FASTENING	**SHEET TO SHEET**			**SHEET TO SECTION (10)**		
	LONGITUDINAL SEAMS		**CROSS JOINTS**	**CROSS JOINTS**		**STIFFENERS**
	LAP	**STANDING/ CAPPED STANDING**	**SOCKET AND SPIGOT**	**RSA**	**SLIDE ON FLANGES (13)**	
MECHANICALLY CLOSED RIVETS	*75*	*300*	*75*	*150*	*300*	*150*
SELF PIERCING SCREWS	*75*	-	*75*	-	*300*	*150*
LOCK BOLTS/SELF-PIERCING RIVETS	*75*	*300*	-	*150*	*300*	*300*
SET SCREWS AND NUTS	-	*300*	-	*150*	*300*	*300*
SPOT WELDS	*75*	*300*	-	*150*	*300*	*150*
DIMPLING	-	*150* (11)	-	-	*150* (12)	-

Note: *Refer to right hand page opposite for additional information relating to Notes 10 to 13 in Table 2.3*

ADDITIONAL INFORMATION RELATING TO TABLES 2.1, 2.2 & 2.3

Low Pressure Class "A" Ductwork - Tables 2.1 & 2.2

1) The joints and stiffeners have been rated in terms of duct longest side and maximum spacing. Manufacturers may choose to position stiffeners at un-equal distances but must ensure the maximum spacing, as listed in columns 3 to 11 and illustrated in Fig 1, is not exceeded. Refer to clause 9.4 for joints and 9.5 for stiffeners.

2) In column 1, 'A' = Socket and spigot joints, 'J' = Flanged cross joint and 'S' = Single stiffeners.

3) In column 2, 'PS' = Plain sheet and 'SS' = Stiffened sheet (Fig 12 for examples) by means of any of the following methods:-
   (a) Beading at 400mm maximum centres;
   (b) Cross-Breaking within the frame formed joints and/or stiffeners;
   (c) Pleating at 150mm maximum centres.

4) Stiffened panels may limit the choice of insulation materials.

5) Galvanized ductwork after manufacture (Refer to clause 9.6 and Appendix C).

6) Aluminium ductwork (Appendix E).

7) Stainless Steel ductwork (Appendix D).

8) Although not described in this specification, due to their relatively infrequent use, cleated cross joints are an accepted constructional practice. B&ES Ductwork Group should be contacted if details of their ratings and limitations are required.

9) Intermediate stiffeners using roll formed profiles, illustrated in Figs. 26 to 30 of the appropriate rating may also be utilised ensuring that rigid corners are achieved.

Low Pressure Class "A" Ductwork – Table 2.3

10) Fixings of cross joints and stiffeners to sheets to have a minimum of two fastenings per side, with a maximum distance from the corner of 50mm.

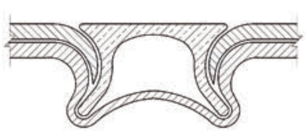
11) If 'un-fixed' dimpling (Fig 2 below) is used on sheet to sheet joints then one other type of fastening must be used at each end. This does not apply to self-piercing rivets as in Fig 3 below.

12) If 'un-fixed' dimpling (Fig 2 below) is used to secure slide-on flanges then one other type of fastening must be used at 450mm centres with a minimum of one per side.

13) Where manufacturers of proprietary flanges and stiffeners have specific recommendations for both fixings and centres, these shall take preference over the information in Table 2.3

Fig 2 – Typical 'un-fixed' dimple

Fig 3 – Typical self-piercing rivet



MEDIUM PRESSURE CLASS "B"
(limited to 1000 Pa positive and 750 Pa negative)

TABLE 3.1 SOCKET AND SPIGOT JOINTS

Dimensions in mm

1	2	3	4	5	6	7	8	9	10	11
MINIMUM SHEET THICKNESS		**0.6**		**0.8**			**1.0**			**1.2**
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3000**
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN STIFFENERS**								
A1	**PS**	*3000*								
	SS	*3000*								
A2	**PS**	*3000*								
	SS	*3000*								
A3	**PS**	*3000*	*1600*	*1250*	*1000*	*800*				
	SS	*3000*	*3000*	*1600*	*1250*	*800*				

TABLE 3.2 FLANGED JOINTS AND STIFFENERS

Dimensions in mm

1	2	3	4	5	6	7	8	9	10	11
MINIMUM SHEET THICKNESS		**0.6**		**0.8**			**1.0**			**1.2**
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3000**
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN FLANGES AND/OR STIFFENERS**								
J1/S1	**PS**	*3000*	*1250*	*625*						
	SS	*3000*	*1250*	*625*						
J2/S2	**PS**	*3000*	*1250*	*1250*	*625*					
	SS	*3000*	*1600*	*1250*	*625*					
J3/S3	**PS**	*3000*	*1600*	*1250*	*1000*	*800*				
	SS	*3000*	*3000*	*1600*	*1250*	*800*				
J4/S4	**PS**	*3000*	*1600*	*1250*	*1000*	*800*	*800*			
	SS	*3000*	*3000*	*1600*	*1250*	*1000*	*800*			
J5/S5	**PS**	*3000*	*1600*	*1250*	*1000*	*800*	*800*	*800*	*625*	
	SS	*3000*	*3000*	*1600*	*1250*	*1000*	*800*	*800*	*800*	
J6/S6	**PS**	*3000*	*1600*	*1250*	*1000*	*800*	*800*	*800*	*800*	*625*
	SS	*3000*	*3000*	*1600*	*1250*	*1000*	*800*	*800*	*800*	*625*

TABLE 3.3 FASTENING CENTRES

Dimensions in mm

1	2	3	4	5	6	7
TYPE OF FASTENING	**SHEET TO SHEET**			**SHEET TO SECTION** [10]		
	LONGITUDINAL SEAMS		**CROSS JOINTS**	**CROSS JOINTS**		**STIFFENERS**
	LAP	**STANDING/ CAPPED STANDING**	**SOCKET AND SPIGOT**	**RSA**	**SLIDE ON FLANGES** [13]	
MECHANICALLY CLOSED RIVETS	*75*	*300*	*75*	*150*	*300*	*150*
SELF PIERCING SCREWS	*75*	-	*75*	-	*300*	*150*
LOCK BOLTS/SELF PIERCING RIVETS	*75*	*300*	-	*150*	*300*	*300*
SET SCREWS AND NUTS	-	*300*	-	*150*	*300*	*300*
SPOT WELDS	*75*	*300*	-	*150*	*300*	*150*
DIMPLING	-	*150* [11]	-	-	*150* [12]	-

Note: *Refer to right hand page opposite for additional information relating to Notes 10 to 13 in Table 3.3*

ADDITIONAL INFORMATION RELATING TO TABLES 3.1, 3.2 & 3.3

Medium Pressure Class "B" Ductwork - Tables 3.1 & 3.2

1) The joints and stiffeners have been rated in terms of duct longest side and maximum spacing. Manufacturers may choose to position stiffeners at un-equal distances but must ensure the maximum spacing, as listed in columns 3 to 11 and illustrated in Fig 1, is not exceeded. Refer to clause 9.4 for joints and 9.5 for stiffeners.

2) In column 1, 'A' = Socket and spigot joints, 'J' = Flanged cross joint and 'S' = Single stiffeners.

3) In column 2, 'PS' = Plain sheet and 'SS' = Stiffened sheet (Fig 12 for examples) by means of any of the following methods:-
   (a) Beading at 400mm maximum centres;
   (b) Cross-Breaking within the frame formed joints and/or stiffeners;
   (c) Pleating at 150mm maximum centres.

4) Stiffened panels may limit the choice of insulation materials.

5) Galvanized ductwork after manufacture (Refer to clause 9.6 and Appendix C).

6) Aluminum ductwork (Appendix E).

7) Stainless Steel ductwork (Appendix D).

8) Although not described in this specification, due to their relatively infrequent use, cleated cross joints are an accepted constructional practice. B&ES Ductwork Group should be contacted if details of their ratings and limitations are required.

9) Intermediate stiffeners using roll formed profiles, illustrated in Figs. 26 to 30 of the appropriate rating may also be utilised ensuring that rigid corners are achieved.

Medium Pressure Class "B" Ductwork – Table 3.3

10) Fixings of cross joints and stiffeners to sheets to have a minimum of two fastenings per side, with a maximum distance from the corner of 50mm.

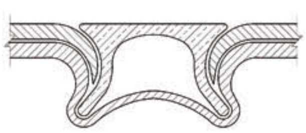
11) If 'un-fixed' dimpling (Fig 2 below) is used on sheet to sheet joints then one other type of fastening must be used at each end. This does not apply to self-piercing rivets as in Fig 3 below.

12) If 'un-fixed' dimpling (Fig 2 below) is used to secure slide-on flanges then one other type of fastening must be used at 450mm centres with a minimum of one per side.

13) Where manufacturers of proprietary flanges and stiffeners have specific recommendations for both fixings and centres, these shall take preference over the information in Table 3.3.

Fig 2 – Typical 'un-fixed' dimple

Fig 3 – Typical self-piercing rivet



HIGH PRESSURE CLASS "C"
(limited to 2000 Pa positive and 750 Pa negative)

TABLE 4.1 SOCKET AND SPIGOT JOINTS

Dimensions in mm

1	2	3	4	5	6	7	8	9	10	
MINIMUM SHEET THICKNESS		**0.8**				**1.0**		**1.2**		
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN STIFFENERS**								
A1	**PS**	*3000*								
	SS	*3000*								
A2	**PS**	*3000*								
	SS	*3000*								
A3	**PS**	*3000*								
	SS	*3000*								

TABLE 4.2 FLANGED JOINTS AND STIFFENERS

Dimensions in mm

1	2	3	4	5	6	7	8	9	10	
MINIMUM SHEET THICKNESS		**0.8**				**1.0**		**1.2**		
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN FLANGES AND/OR STIFFENERS**								
J1/S1	**PS**	*3000*	*625*							
	SS	*3000*	*625*							
J2/S2	**PS**	*3000*	*1250*	*800*						
	SS	*3000*	*1250*	*800*						
J3/S3	**PS**	*3000*	*1250*	*1250*	*800*					
	SS	*3000*	*1250*	*1250*	*800*					
J4/S4	**PS**	*3000*	*1250*	*1250*	*1000*	*800*				
	SS	*3000*	*1250*	*1250*	*1000*	*800*				
J5/S5	**PS**	*3000*	*1250*	*1250*	*1000*	*800*	*800*	*625*		
	SS	*3000*	*1250*	*1250*	*1000*	*800*	*800*	*625*		
J6/S6	**PS**	*3000*	*1250*	*1250*	*1000*	*800*	*800*	*800*	*625*	
	SS	*3000*	*1250*	*1250*	*1000*	*800*	*800*	*800*	*625*	

TABLE 4.3 FASTENING CENTRES

Dimensions in mm

1	2	3	4	5	6	7
TYPE OF FASTENING	**SHEET TO SHEET**			**SHEET TO SECTION (10)**		
	LONGITUDINAL SEAMS		**CROSS JOINTS**	**CROSS JOINTS**		**STIFFENERS**
	LAP	**STANDING/ CAPPED STANDING**	**SOCKET AND SPIGOT**	**RSA**	**SLIDE ON FLANGES (13)**	
MECHANICALLY CLOSED RIVETS	*75*	*300*	*75*	*150*	*300*	*150*
SELF PIERCING SCREWS	*75*	-	*75*	-	*300*	*150*
LOCK BOLTS/SELF PIERCING RIVETS	*75*	*300*	-	*150*	*300*	*300*
SET SCREWS AND NUTS	-	*300*	-	*150*	*300*	*300*
SPOT WELDS	*75*	*300*	-	*150*	*300*	*150*
DIMPLING	-	*150 (11)*	-	-	*150 (12)*	-

***Note:** Refer to right hand page opposite for additional information relating to Notes 10 to 13 in Table 4.3*

ADDITIONAL INFORMATION RELATING TO TABLES 4.1, 4.2 & 4.3

High Pressure Class "C" Ductwork - Tables 4.1 & 4.2

10) The joints and stiffeners have been rated in terms of duct longest side and maximum spacing. Manufacturers may choose to position stiffeners at un-equal distances but must ensure the maximum spacing, as listed in columns 3 to 11 and illustrated in Fig 1, is not exceeded. Refer to clause 9.4 for joints and 9.5 for stiffeners.

11) In column 1, 'A' = Socket and spigot joints, 'J' = Flanged cross joint and 'S' = Single stiffeners.

12) In column 2, 'PS' = Plain sheet and 'SS' = Stiffened sheet (Fig 12 for examples) by means of any of the following methods:-
    (a) Beading at 400mm maximum centres;
    (b) Cross-Breaking within the frame formed joints and/or stiffeners;
    (c) Pleating at 150mm maximum centres.

13) Stiffened panels may limit the choice of insulation materials.

14) Galvanized ductwork after manufacture (Refer to clause 9.6 and Appendix C).

15) Aluminum ductwork (Appendix E).

16) Stainless Steel ductwork (Appendix D).

17) Although not described in this specification, due to their relatively infrequent use, cleated cross joints are an accepted constructional practice. B&ES Ductwork Group should be contacted if details of their ratings and limitations are required.

18) Intermediate stiffeners using roll formed profiles, illustrated in Figs. 26 to 30 of the appropriate rating may also be utilised ensuring that rigid corners are achieved.

High Pressure Class "C" Ductwork – Table 4.3

10) Fixings of cross joints and stiffeners to sheets to have a minimum of two fastenings per side, with a maximum distance from the corner of 50mm.

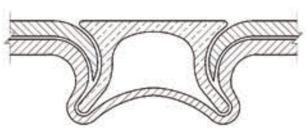
11) If 'un-fixed' dimpling (Fig 2 below) is used on sheet to sheet joints then one other type of fastening must be used at each end. This does not apply to self-piercing rivets as in Fig 3 below.

12) If 'un-fixed' dimpling (Fig 2 below) is used to secure slide-on flanges then one other type of fastening must be used at 450mm centres with a minimum of one per side.

13) Where manufacturers of proprietary flanges and stiffeners have specific recommendations for both fixings and centres, these shall take preference over the information in Table 4.3.

Fig 2 – Typical 'un-fixed' dimple

Fig 3 – Typical self-piercing rivet



HIGH PRESSURE CLASS "D"
(limited to 2000 Pa positive and 750 Pa negative)

TABLE 5.1 SOCKET AND SPIGOT JOINTS

Dimensions in mm

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
MINIMUM SHEET THICKNESS		**0.8**				**1.0**		**1.2**		
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN STIFFENERS**								
A1	**PS**	*3000*								
	SS	*3000*								
A2	**PS**	*3000*								
	SS	*3000*								
A3	**PS**	*3000*								
	SS	*3000*								

TABLE 5.2 FLANGED JOINTS AND STIFFENERS

Dimensions in mm

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
MINIMUM SHEET THICKNESS		**0.8**				**1.0**		**1.2**		
DUCT LONGEST SIDE		**400**	**600**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	
RATING	**SHEET**	**MAXIMUM SPACINGS BETWEEN FLANGES AND/OR STIFFENERS**								
J1/S1	**PS**	*3000*	*625*							
	SS	*3000*	*625*							
J2/S2	**PS**	*3000*	*1250*	*625*						
	SS	*3000*	*1250*	*625*						
J3/S3	**PS**	*3000*	*1250*	*1000*	*625*					
	SS	*3000*	*1250*	*1000*	*625*					
J4/S4	**PS**	*3000*	*1250*	*1000*	*800*	*625*				
	SS	*3000*	*1250*	*1000*	*800*	*625*				
J5/S5	**PS**	*3000*	*1250*	*1000*	*800*	*625*	*625*			
	SS	*3000*	*1250*	*1000*	*800*	*625*	*625*			
J6/S6	**PS**	*3000*	*1250*	*1000*	*800*	*625*	*625*	*625*	*500*	
	SS	*3000*	*1250*	*1000*	*800*	*625*	*625*	*625*	*500*	

TABLE 5.3 FASTENING CENTRES

Dimensions in mm

1	*2*	*3*	*4*	*5*	*6*	*7*
TYPE OF FASTENING	**SHEET TO SHEET**			**SHEET TO SECTION** (10)		
	LONGITUDINAL SEAMS		**CROSS JOINTS**	**CROSS JOINTS**		**STIFFENERS**
	LAP	**STANDING/ CAPPED STANDING**	**SOCKET AND SPIGOT**	**RSA**	**SLIDE ON FLANGES** (13)	
MECHANICALLY CLOSED RIVETS	*75*	*300*	*75*	*150*	*300*	*150*
SELF PIERCING SCREWS	*75*	-	*75*	-	*300*	*150*
LOCK BOLTS/SELF PIERCING RIVETS	*75*	*300*	-	*150*	*300*	*300*
SET SCREWS AND NUTS	-	*300*	-	*150*	*300*	*300*
SPOT WELDS	*75*	*300*	-	*150*	*300*	*150*
DIMPLING	-	*150* (11)	-	-	*150* (12)	-

Note: *Refer to right hand page opposite for additional information relating to Notes 10 to 13 in Table 4.3*

ADDITIONAL INFORMATION RELATING TO TABLES 5.1, 5.2 & 5.3

High Pressure Class "D" Ductwork - Tables 5.1 & 5.2

1) The joints and stiffeners have been rated in terms of duct longest side and maximum spacing. Manufacturers may choose to position stiffeners at un-equal distances but must ensure the maximum spacing, as listed in columns 3 to 11 and illustrated in Fig 1, is not exceeded. Refer to clause 9.4 for joints and 9.5 for stiffeners.

2) In column 1, 'A' = Socket and spigot joints, 'J' = Flanged cross joint and 'S' = Single stiffeners.

3) In column 2, 'PS' = Plain sheet and 'SS' = Stiffened sheet (Fig 12 for examples) by means of any of the following methods:-
   (a) Beading at 400mm maximum centres;
   (b) Cross-Breaking within the frame formed joints and/or stiffeners;
   (c) Pleating at 150mm maximum centres.

4) Stiffened panels may limit the choice of insulation materials.

5) Galvanized ductwork after manufacture (Refer to clause 9.6 and Appendix C).

6) Aluminum ductwork (Appendix E).

7) Stainless Steel ductwork (Appendix D).

8) Although not described in this specification, due to their relatively infrequent use, cleated cross joints are an accepted constructional practice. B&ES Ductwork Group should be contacted if details of their ratings and limitations are required.

9) Intermediate stiffeners using roll formed profiles, illustrated in Figs. 26 to 30 of the appropriate rating may also be utilised ensuring that rigid corners are achieved.

High Pressure Class "D" Ductwork – Table 5.3

10) Fixings of cross joints and stiffeners to sheets to have a minimum of two fastenings per side, with a maximum distance from the corner of 50mm.

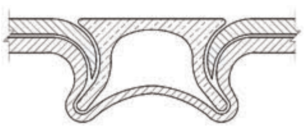
11) If 'un-fixed' dimpling (Fig 2 below) is used on sheet to sheet joints then one other type of fastening must be used at each end. This does not apply to self-piercing rivets as in Fig 3 below.

12) If 'un-fixed' dimpling (Fig 2 below) is used to secure slide-on flanges then one other type of fastening must be used at 450mm centres with a minimum of one per side.

13) Where manufacturers of proprietary flanges and stiffeners have specific recommendations for both fixings and centres, these shall take preference over the information in Table 5.3.

Fig 2 – Typical 'un-fixed' dimple

Fig 3 – Typical self-piercing rivet



Longitudinal seams

For permitted fastenings (type and spacing), see Table 2.3, 3.3, 4.3 and 5.3

Fig. 4 Grooved seam

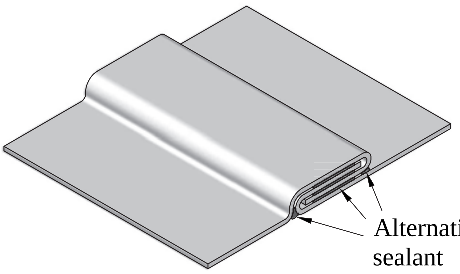


Fig. 5 Grooved corner seam

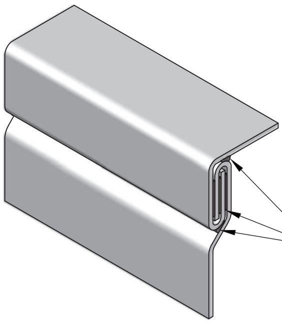


Fig. 6 Pittsburgh lock seam

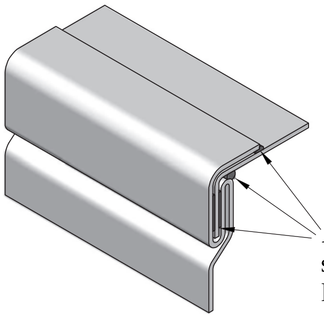


Fig. 7 Button punch snap lock

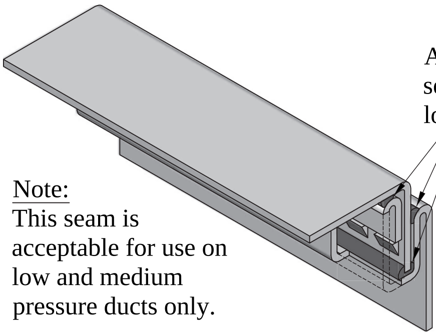


Fig. 8 Returned standing seam (internal or external)

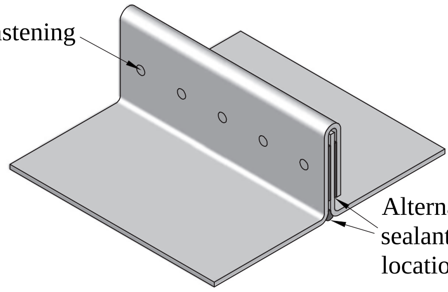


Fig. 9 Capped standing seam (internal or external)

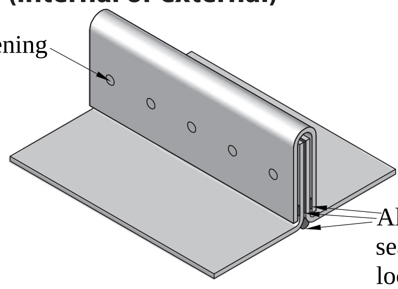


Fig. 10 Tray standing seam (internal or external)

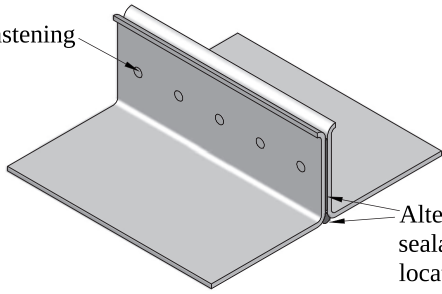
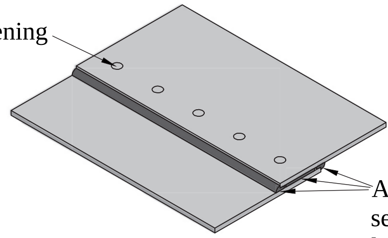


Fig. 11 Lap seam

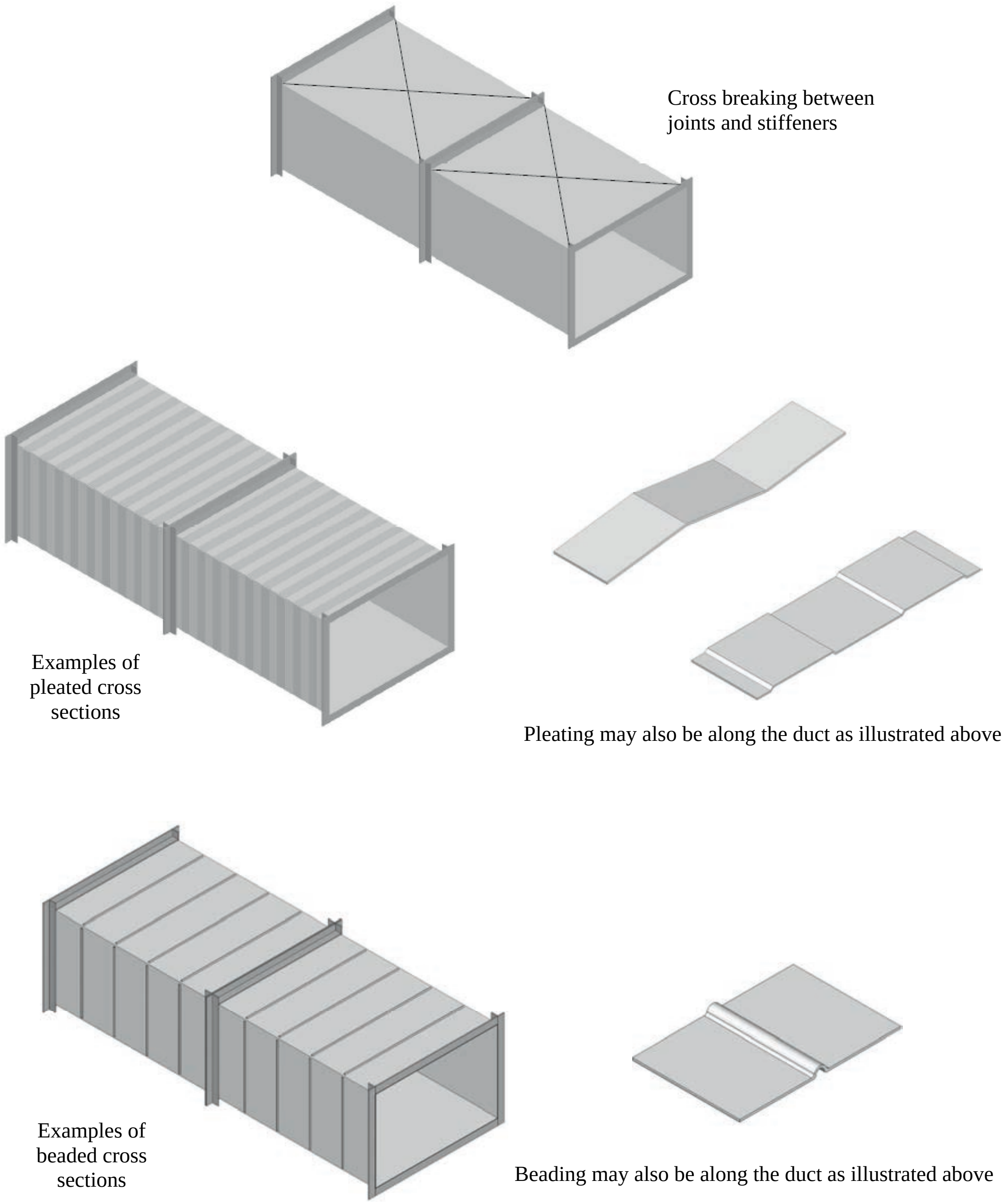


Sealant shall be applied either internally or externally to the seam edge or internal to the joint seam itself. The most appropriate method will be determined by the manufacturer relative to their product and will be associated with traditional fabrication/assembly methods, factory or site based, and/or proprietary methods.

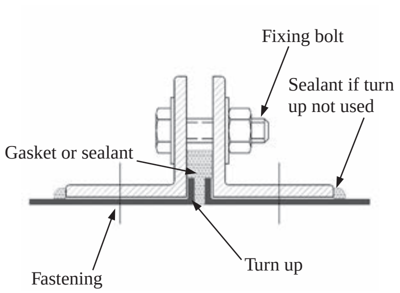
Note: Figures 4 to 11 apply, where appropriate, to cross joints and sheet joints in general

Stiffened Sheet Panels

Fig. 12 Typical Illustrations of panel stiffening



Flanged cross joints

Type	Minimum dimensions	Rating	Pressure classes	Notes / corner treatments
1	2	3	4	5
Fig. 13 Roll steel angle-flanged joint, with welded corners	mm			Duct ends turned up 8 mm minimum.
	25 x 25 x 3 30 x 30 x 4 40 x 40 x 4 50 x 50 x 5	J3 J4 J5 J6	Low Medium High	A turn up as illustrated is NOT mandatory. If not used, the toe of the angle is to be sealed.
	Fixing bolts			Fixing bolts required at each corner and at 300 mm centres.
	25 x 25 x 3 30 x 30 x 4 40 x 40 x 4 50 x 50 x 5	6 mm 8 mm 8 mm 10 mm		

Examples of typical proprietary cross joint flanges produced from roll formed sheet metal profiles

Fig 14

Fig 15

Fig 16

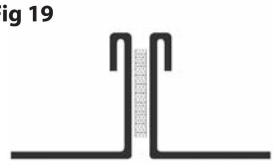
Sealant, clamps / cleats / clips and fixings omitted for clarity

Examples of proprietary cross joint flanges formed from the duct wall, from the duct wall, i.e. 'parent metal' flanges

Fig 17

Fig 18

Fig 19



Clamps / cleats / clips and fixings omitted for clarity

Note: Figures 13 to 19 above are typical examples of cross joint profiles that are in common use for connecting rectangular sheet metal ducts.

There are no set dimensions for the proprietary profiles shown in Figs. 14 to 19 provided they were certified under the B&ES testing scheme DW/TM1 "Acceptance Scheme for new products – Rectangular cross joint classification" which is now obsolete following the advent of BS EN 1507 'Ventilation for buildings – Sheet metal air ducts with rectangular section – Requirement for strength and leakage'.

DW/TM1 was introduced in 1987 in order that proprietary joints for rectangular ductwork (Figs 14 to 19) that were new to the market could be tested for identical strength and leakage characteristics relative to those of rolled steel angle (RSA) flanges, Fig 13, which were predominant at that time.

Proprietary joints since 1987 and up to this latest edition of DW/144 have been tested in accordance with these procedures set out in DW/TM1 but this is now superseded with the advent of BS EN 1507. In order to avoid the re-testing of all current proprietary flanged joints, the maximum leakage and deflection values listed in Table 1 of DW/TM1 have been re-tested on behalf of B&ES by an accredited test house. In addition to the leakage criteria and the deflection of a joint, these latest tests to BS EN 1507 also measure deflection of a duct and the bulging and caving of the duct panel between the joint and the stiffening frame. All test results were proven to be within the new European standards defined in BS EN 1507.

Such are the results of these latest tests undertaken by B&ES, certain sheet thicknesses have been reduced as the performance of these reduced thicknesses are within the new BS EN 1507 standards. These reductions are in Tables 2.1, 2.2, 3.1 and 3.2 and also reflected in the B&ES J-rated flange identification system as listed in Table 6.

All new proprietary flanges from the date of this publication forward shall be tested to the latest BS EN 1507 standards and this includes existing proprietary profiles that wish to take advantage of the reduced sheet thicknesses referred to in the previous paragraph.

B&ES J-rated flange identification system

In order to align to the well-established B&ES J-rated flange identification system, all new proprietary flanges from the date of this publication forward which have been tested for strength and leakage to the latest BS EN 1507 should, when tested, also meet the criteria listed in Table 6 and its associated notes that follow.

Note: A test must be applied to each pressure class up to the maximum rating sought as the joint may perform differently on a larger duct size at a lower pressure. e.g. a new proprietary joint that requires a J3 rating for use on a maximum of Class C – High Pressure 2000Pa ductwork systems must also be tested to meet the Table 6 criteria for Class A – Low Pressure 500Pa and Class B – Medium Pressure 1000Pa.

BS EN 1507

When undertaking BS EN 1507 tests on new proprietary profiles, the manufacturer's technical data should be followed with respect to:

- Connections to duct wall
- Sheet thickness of the proprietary profile
- Corner treatment
- Addition of cleats, clips and clamps
- Application of sealants
- Strength ratings – to be stamped/engraved or indelibly printed on Fig 14-16 roll formed profiles
- Application of tie bars

TABLE 6 – MAXIMUM LEAKAGE AND DEFLECTION VALUES

Information extracted from Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2						Calculations		
Joint Rating	**Class and Max Press (Pa)**	**Duct Size**	**Length per Section (2 off)**	**Sheet Thickness**	**Stiffener Dist from Joint**	**Surface Area (Sq mtrs)**	**Max Test Leakage (Litres/Sec)**	**Max Deflection of Flange or Stiffener**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
J1	Class A - Low 500	1000 x 350	1250	0.8	625	6.75	4.13	4.0
J1	Class B - Med 1000	800 x 300	1250	0.8	625	5.50	1.76	3.20
J1	Class C - High 2000	600 x 200	1250	0.8	625	4.00	0.67	2.40
J1	Class D - High 2000	600 x 200	1250	0.8	625	4.00	0.22	2.40
J2	Class A - Low 500	1250 x 450	1250	0.8	625	8.50	5.20	5.00
J2	Class B - Med 1000	1000 x 350	1250	0.8	625	6.75	2.16	4.00
J2	Class C - High 2000	800 x 300	1500	0.8	800	6.60	1.11	3.20
J2	Class D - High 2000	800 x 300	1250	0.8	625	5.50	0.31	3.20
J3	Class A - Low 500	1600 x 550	1500	1.0	800	12.90	7.89	6.40
J3	Class B - Med 1000	1250 x 450	1500	0.8	800	10.20	3.26	5.00
J3	Class C - High 2000	1000 x 350	1500	0.8	800	8.10	1.36	4.00
J3	Class D - High 2000	1000 x 350	1250	0.8	625	6.75	0.38	4.00
J4	Class A - Low 500	2000 x 700	1500	1.0	800	16.20	9.91	8.00
J4	Class B - Med 1000	1600 x 550	1500	1.0	800	12.90	4.13	6.40
J4	Class C - High 2000	1250 x 450	1500	1.0	800	10.20	1.71	5.00
J4	Class D - High 2000	1250 x 450	1250	1.0	625	8.50	0.48	5.00
J5	Class A - Low 500	3000 x 1000	1250	1.2	625	20.00	12.24	12.00
J5	Class B - Med 1000	2500 x 850	1250	1.0	625	16.75	5.36	10.00
J5	Class C - High 2000	2000 x 700	1250	1.2	625	13.50	2.27	8.00
J5	Class D - High 2000	1600 x 550	1250	1.0	625	10.75	0.60	6.40
J6	Class A - Low 500	3000 x 1000	1500	1.2	800	24.00	14.69	12.00
J6	Class B - Med 1000	3000 x 1000	1250	1.2	625	20.00	6.40	12.00
J6	Class C - High 2000	2500 x 850	1250	1.2	625	16.75	2.81	10.00
J6	Class D - High 2000	2500 x 850	1000	1.2	500	13.40	0.75	10.00

TABLE 6 NOTES

(i) Information is extracted from Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2 inclusive and relates each joint rating (Col.1) to the maximum duct size (Col.3) per pressure class (Col.2);

(ii) The duct depth (Col.3) gives an approximate duct aspect ratio of 3:1;

(iii) Acceptable intermediate stiffening frames profiles are illustrated in Figs 25 to 30 and they must match the rating of the joint i.e. J3/S3. Other proprietary profiles may be used as stiffening frames providing the duct deflection is limited to a maximum of $^{1}/_{250}$ of the duct side under operating pressure;

(iv) The surface area (Col.7) does not include the end caps;

(v) Maximum test leakage (Col.8) is based on 40% of the maximum system leakage contained within Table 22.
i.e. Calculation for line 1 in Table is:

Surface area	x	Max. System Leakage	x 40%	=	Max Test Leakage
6.75sq. m	x	1.53 litres/sec/sq. m	x 40%	=	4.13 litres/sec

The 40% figure is used for the purpose of the cross joint test only to compensate for the laboratory conditions under which the tests are conducted and the losses from other parts of the system which may well arise in a normal working environment.

(vi) Max deflection of Flange or Stiffener (Col.9) is duct width (Col.3) x $^{1}/_{250}$ or where tie rods are used $^{1}/_{250}$ of the span between the central tie rod and the side of the duct;

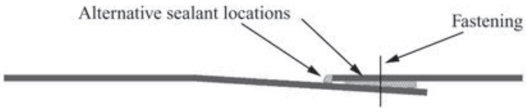
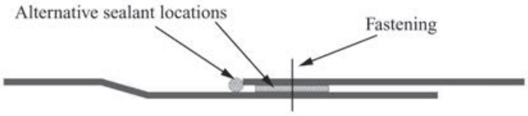
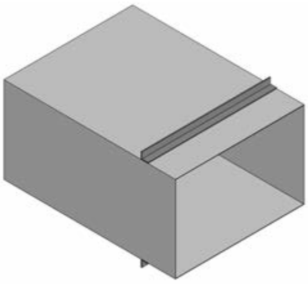
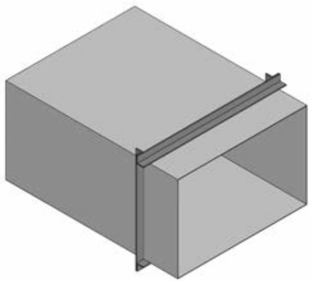
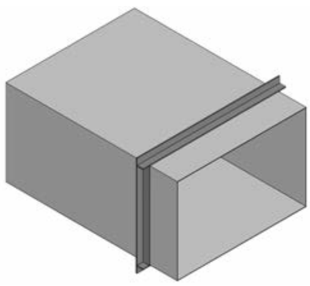
(vii) In ducts where tie rods are fitted 50% of the values in Column 9 shall be used;

(viii) The above information also applies to negative pressure tests apart from the static pressure limits which are 500pa for low pressure and 750pa for medium and high pressure – i.e. as Table 1

(ix) In addition to the deflection of a joint/stiffener, BS EN 1507 tests also measure deflection of a duct ($^{1}/_{250}$ of distance between duct supports or 20mm, whichever is the smaller value) and the bulging and caving of the duct panel between the joint and the stiffening frame (no more than 3% of the panels longest dimension or 30mm, whichever is the smaller value).

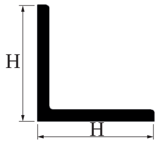
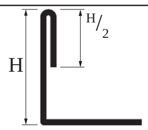
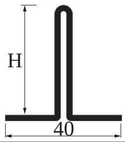
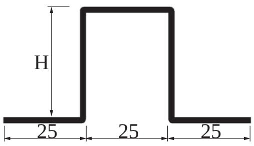
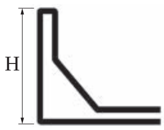
Socket and spigot joints

Note: Particular care must be taken in the sealing of these joints.
For permitted fastenings (types and spacing), see Table 2.3, 3.3, 4.3 and 5.3

Type	Angle size mm	Rating	Pressure classes	Notes
Fig. 20 Plain 	-	A1	Low Medium High	
Fig. 21 Adjustable 	-	A1	Low Medium High	This joint can be used on any duct joints subject to the addition of an adjacent stiffener with a rating appropriate to the duct size
Fig. 22 Angle reinforced (Ducts with shorter side 400mm and less) 	25 x 3	A2	Low	Locate stiffener back from end of spigot joint to allow access for sealing joint
	30 x 4	A3	Low Medium	
Fig. 23 Back to back stiffeners (Ducts with both sides greater than 400mm) 	25 x 3	A2	Low	Locate stiffener back from end of spigot joint to allow access for sealing joint
	30 x 4	A3	Low Medium	Stiffeners shown in Figs 25 to 30 are permissible if provided with rigid corners
Fig. 24 Full girth welded stiffeners (Ducts with both sides greater than 400mm) 	25 x 3	A2	Low	Locate stiffener back from end of spigot joint to allow access for sealing joint
	30 x 4	A3	Low Medium	Stiffeners shown in Figs 25 to 30 are permissible if provided with rigid corners

Single stiffeners
Dimensions and ratings

For permitted fastenings (types and spacing's), see Table 2.3, 3.3, 4.3 and 5.3

Section	H mm	Thickness mm	Rating
Fig. 25 	25 30 40 50 60	3 4 4 5 5	S2 S3 S4 S5 S6
Fig. 26 	25 30 40 50	1.6 1.6 1.6 2.0	S1 S2 S3 S4
Fig. 27 	20 25 35 40	1.6 1.6 1.6 2.0	S1 S2 S3 S4
Fig. 28 	15 20 25 40 50	1.2 1.2 1.6 1.6 2.0	S1 S2 S3 S4 S5
Fig. 29 	20 30 40	0.8 1.0 1.2	S1 S2 S3
Fig. 30 	25	0.8	S1

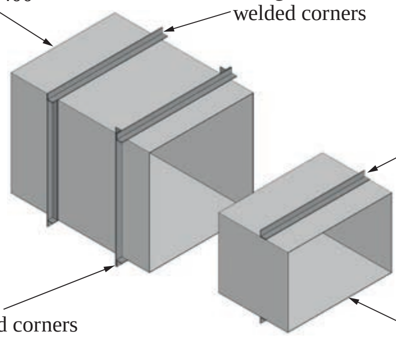
Note: Other profiles may be used providing the duct deflection is limited to a maximum of 1/250 of the duct side under operating pressure.

Intermediate Stiffeners

Fig. 31

For permitted fastenings (types and spacings) see Tables 2.3, 3.3, 4.3 and 5.3

Illustrations show rolled steel angle stiffeners. Stiffeners shown in Figs 26 to 30 are permitted. If used as full girth stiffeners, rigid corners are required



Tie rod assembly – alternative arrangement

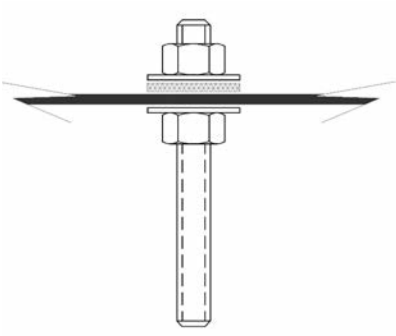


Fig. 32 - With internal and external nuts

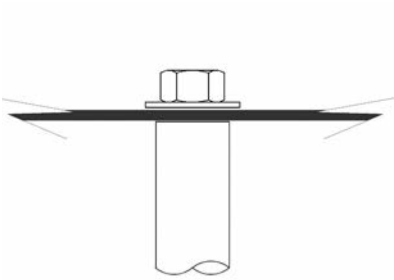


Fig. 33 - With tubing or conduit and threaded inserts

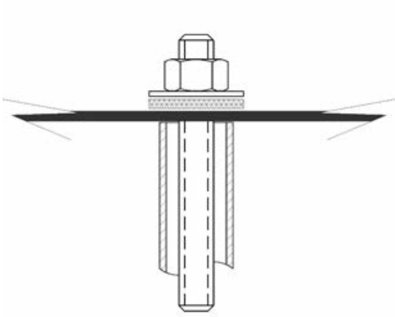


Fig. 34 - With spacers

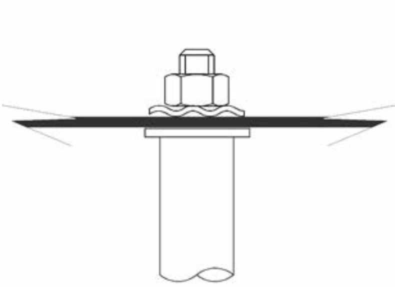


Fig. 35 - With shouldered rod

Turning vanes

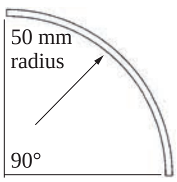


Fig. 36 Single skin vane

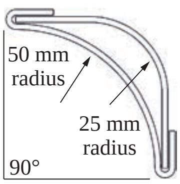
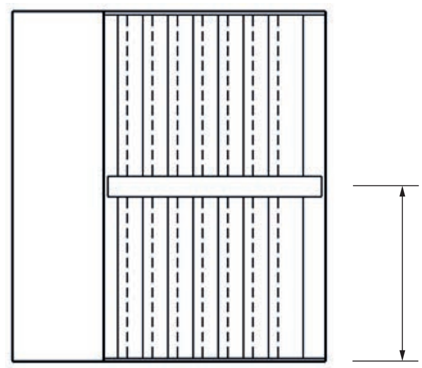


Fig. 37 Typical Double skin vane profile

Fig 36 and 37
Maximum distance between centre of turning vane should not exceed 60 mm pitch

Fig. 38 Bend elevation and plan

When vane length exceeds maximum permitted a central bracing must be utilised
Alternatively, use two banks of vanes fixing the centre rails together at 150 mm centres

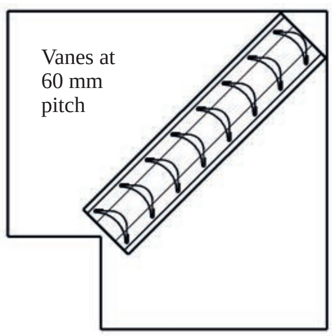


Max vane length

Single skin – 615 mm

Double skin – 1250 mm

ELEVATION



SECTIONAL PLAN

SECTION 10 STANDARDISATION OF RECTANGULAR DUCTWORK COMPONENTS

The terminology and descriptions of rectangular ductwork components as set out in this section are recommended for adoption as standard practice to provide common terms of reference for system designers, quantity surveyors and ductwork contractors, and of those using computers in ductwork design and fabrication.

The illustrations in this section not only highlight, where applicable, geometric limitations for the design and manufacture of ductwork components but also recommend standard drawing representation and terminology.

System designers and surveyors should note that bills of quantities should provide a full description of the items required.

10.1 STIFFENERS

The flat sides of fittings shall be stiffened in accordance with the construction Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2. On the flat sides of bends, stiffeners shall be arranged in a radial pattern, with the spacing measured along the centre of the bend.

10.2 SPLITTERS

If the leading edge of the splitters exceeds 1250mm fit central tie bars at both ends to support the splitters. Leading and trailing edges of splitters must be edge folded and returned and be parallel to the duct axis. Splitters shall be attached to the duct by appropriate fastenings at 100 mm maximum spacing (or by such other fixing as can be shown to be equally satisfactory e.g. proprietary sealed splitter pins).

10.3 TURNING VANES

Where specified or shown on drawings, square throat bends will be fitted with turning vanes as illustrated in Figs. 36 and 37.

Note: If either duct dimension is 200mm or less, air turns will be omitted and a radius pattern bend or a square bend, with or without a radiussed back plate, should be specified.

Turning vanes at 60 mm maximum centres shall be fixed at both ends either to the duct or compatible mounting tracks in accordance with manufacturer's instructions, the whole bank being fixed inside the duct with fastenings at 150mm maximum spacing.

The maximum length of turning vane between duct walls or intermediate support shall be 615 mm for single skin vanes and 1250mm for double skin vanes. Typical examples of fitting turning vanes when the maximum permitted vane lengths are exceeded are shown in Fig. 38.

10.4 BRANCHES

When fitting branch ducts to a main duct, care should be taken to ensure that the rigidity of the duct panel is maintained in terms of the stiffening criteria.

10.5 CHANGE SHAPES

Where a change shape is necessary to accommodate the duct and the cross-sectional area is to be maintained, the slope shall not exceed $22^{1}/_{2}°$ on any side (Figs. 55 to 59). Where a change in shape includes a local reduction in duct cross- sectional area, the slope should not exceed 15° on any side and the reduction in area should not exceed 20 per cent.

10.6 EXPANSIONS AND CONTRACTIONS

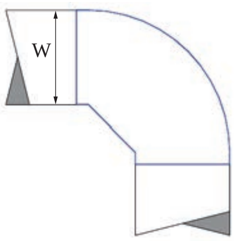
Where these are required, an expansion shall be made upstream of a branch connection and contraction downstream of a branch connection. The slope of either an expansion or a contraction should not exceed $22^{1}/_{2}°$ on any side. Where this angle is not practicable, the slope may be increased, providing that splitters are positioned to bisect the angle between any side and the centre line of the duct (Figs. 55 to 57).

10.7 SEALANT

Sealant shall be used in all longitudinal seams and cross-joints of fittings. Joint sealing materials are set out in Part Seven, Section 19.

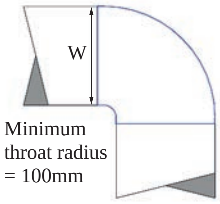
STANDARD COMPONENT DRAWINGS - RECTANGULAR

Fig. 39



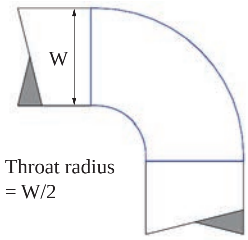
Mitred Throat Bend
For ducts up to 400mm wide

Fig. 40



Short Radius Bend
For ducts up to 400mm wide

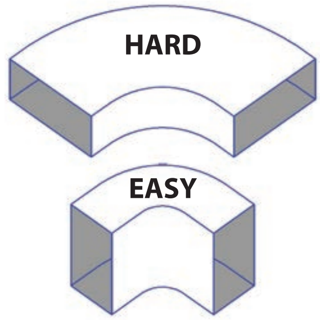
Fig. 41



Medium Radius Bend
(as illustrated)

Long Radius Bend
Similar but radius = W
Applies to any angle

Fig. 42 - examples of 'hard' and 'easy' bends



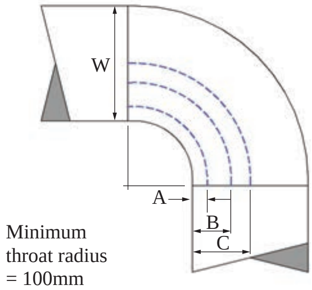
Bends are designated as 'hard' or 'easy', and these terms as used herein have the following meanings:

'Hard' signifies rotation in the plane of the longer side of the cross section – as illustrated in top sketch.

'Easy' signifies rotation in the plane of the shorter side of the cross section – as illustrated in lower sketch.

This configuration also applies to flat oval bends.

Fig. 43

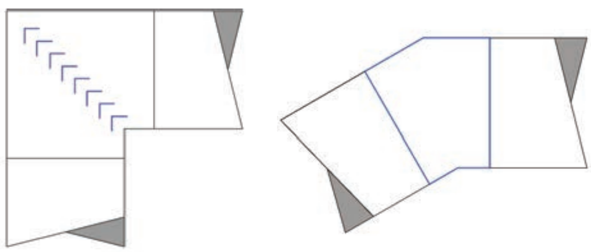


Short Radius Bend with splitters

W mm	Splitters	Splitter position		
		A	B	C
401 - 800	1	W/3	-	-
801 - 1600	2	W/4	W/2	-
1601 - 2000	3	W/8	W/3	W/2

Splitters not required in bends of 45° or less

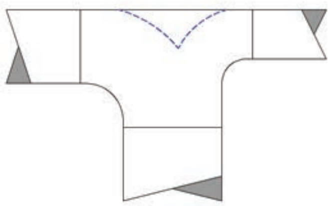
Fig. 44



Square Bend - with turning vanes

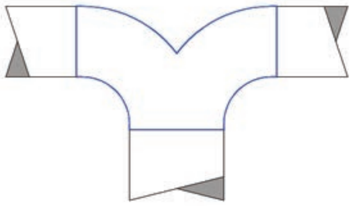
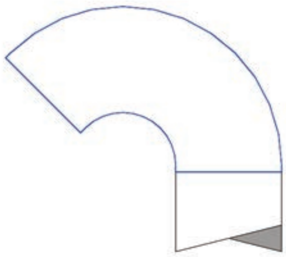
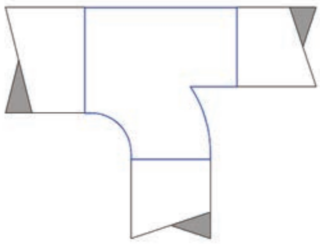
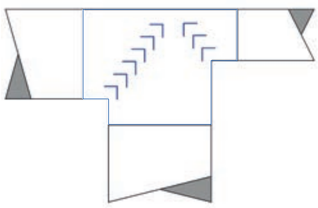
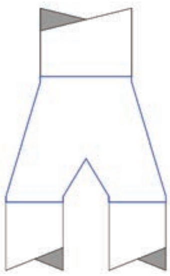
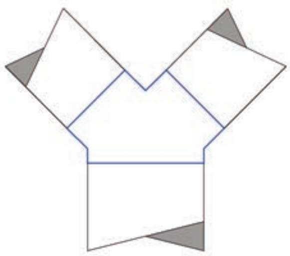
Mitred elbow - 30° max

Fig. 45

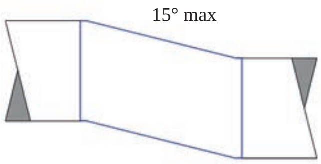
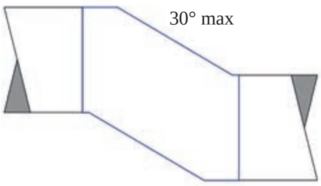
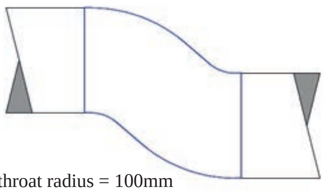
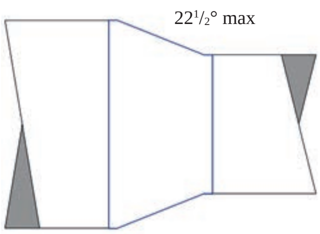
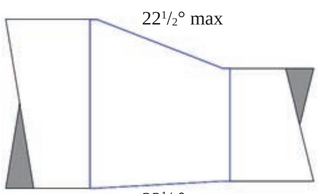
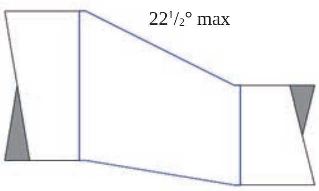


Radius Tee - with 'radiussed back plates' and, if required, splitters as Fig 43

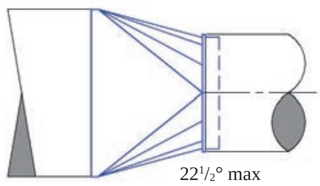
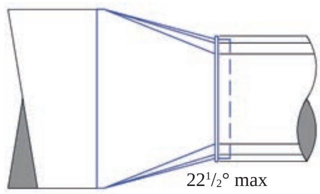
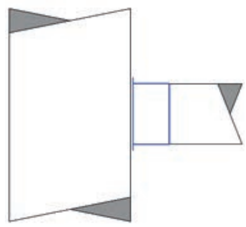
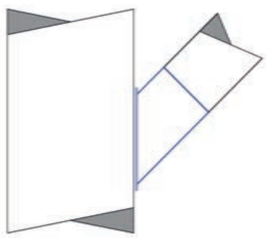
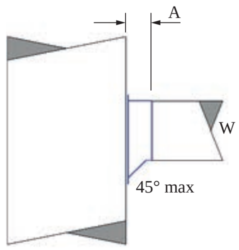
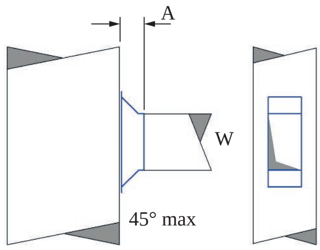
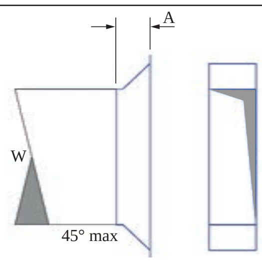
STANDARD COMPONENT DRAWINGS - RECTANGULAR

Fig. 46		**Radiussed Twin Bend**
Fig. 47		**Swan Neck Bend** - typically found on roof exhausts i.e. 135° angle
Fig. 48		**Swept Branch**
Fig. 49		**Square Tee** with turning vanes
Fig. 50		**Breeches Piece**
Fig. 51		**'Y' Piece**

STANDARD COMPONENT DRAWINGS - RECTANGULAR

Fig. 52		**Angled Offset**
Fig. 53		**Mitred Offset**
Fig. 54		**Radiussed Offset**
Fig. 55		**Concentric Taper** 22.5° max in either plane Splitters are required for angles greater than 22.5° and should bisect the angle between any side and the duct centreline.
Fig. 56		**Ecccentric Taper** 22.5° max in either plane Splitters are required for angles greater than 22.5° and should bisect the angle between any side and the duct centreline.
Fig. 57		**Offset Taper** Splitters are required for angles greater than 22.5° and should bisect the angle between any side and the duct centreline.

STANDARD COMPONENT DRAWINGS - RECTANGULAR

<table>
<tr><td>Fig. 58</td><td>
</td><td>Rectangular to Round Transformation</td></tr>
<tr><td>Fig. 59</td><td>
</td><td>Rectangular to Flat Oval Transformation</td></tr>
<tr><td>Fig. 60</td><td></td><td>Square Branch</td></tr>
<tr><td>Fig. 61</td><td></td><td>Angled Branch</td></tr>
<tr><td>Fig. 62</td><td>
</td><td>Shoe Branch
<table>
<tr><th>Branch duct width (W) mm</th><th>Dimension (A) mm</th></tr>
<tr><td>Up to 200</td><td>75</td></tr>
<tr><td>" 300</td><td>100</td></tr>
<tr><td>" 400</td><td>125</td></tr>
<tr><td>" 600</td><td>150</td></tr>
<tr><td>Over 600</td><td>200</td></tr>
</table></td></tr>
<tr><td>Fig. 63</td><td>
</td><td>Bell Mouth Branch
<table>
<tr><th>Branch duct width (W) mm</th><th>Dimension (A) mm</th></tr>
<tr><td>Up to 200</td><td>75</td></tr>
<tr><td>" 300</td><td>100</td></tr>
<tr><td>" 400</td><td>125</td></tr>
<tr><td>" 600</td><td>150</td></tr>
<tr><td>Over 600</td><td>200</td></tr>
</table></td></tr>
<tr><td>Fig. 64</td><td>
</td><td>Bell Mouth
<table>
<tr><th>Branch duct width (W) mm</th><th>Dimension (A) mm</th></tr>
<tr><td>Up to 200</td><td>75</td></tr>
<tr><td>" 300</td><td>100</td></tr>
<tr><td>" 400</td><td>125</td></tr>
<tr><td>" 600</td><td>150</td></tr>
<tr><td>Over 600</td><td>200</td></tr>
</table></td></tr>
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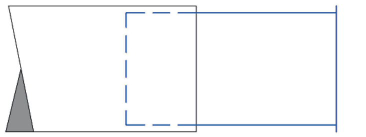
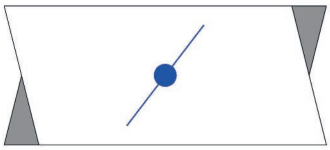
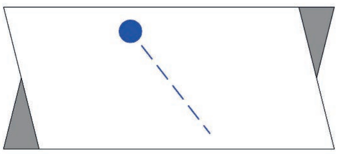
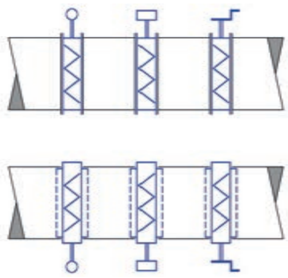
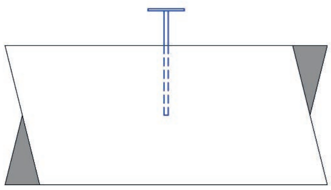
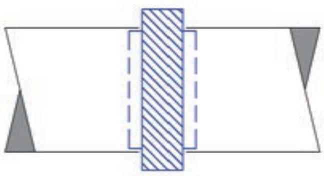
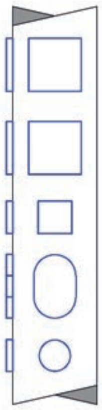
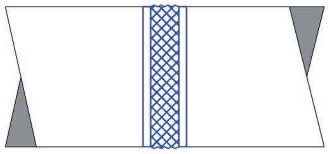
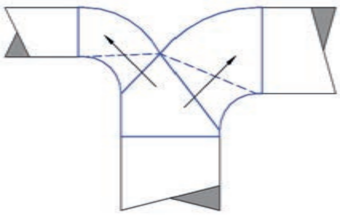
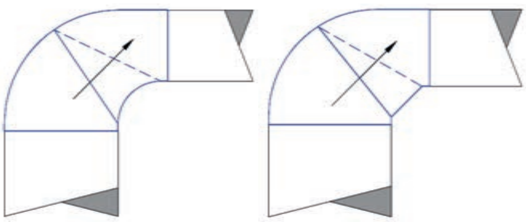
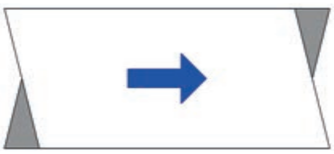
STANDARD COMPONENT DRAWINGS - RECTANGULAR

Fig. 65	 	**Telescopic Joint** Illustrated with SMF – self metal flange.
Fig. 66	 SBD	**Single Blade Damper**
Fig. 67	 NRD	**Non-Return Damper**
Fig. 68	 PD MD HD	**Multi-Leaf Damper** Can be spiggoted or flanged, opposed or parallel blade Alternative controls are: Hand, Motorised, Pneumatic
Fig. 69	 BG	**Blast Gate Damper**
Fig. 70	 FD	**Fire/Smoke Damper** FD - Fire Damper SD - Smoke Damper

STANDARD COMPONENT DRAWINGS - RECTANGULAR

Fig. 71		**Access openings** AP - Access Panel AD - Access Door IC - Inspection Cover
Fig. 72		**Flexible Connection**
Fig. 73		**Drop cheeked reducing radiussed twin bend**
Fig. 74		**Drop cheeked reducing bend radiussed or mitred throat**
Fig. 75		**Air flow symbol**

PART FOUR – CIRCULAR DUCTS

SECTION 11 STANDARD SIZES

The duct sizes in Table 7 have been selected from the EN Standard Ranges.

Table 7 Circular Ducts - Standard Sizes

EN 1506 Duct sizes			
Ø mm	Duct Surface Area m^2/m	Ø mm	Duct Surface Area m^2/m
Recommended sizes			
63	0.198	315	0.990
80	0.251	400	1.257
100	0.314	500	1.571
125	0.393	630	1.979
160	0.502	800	2.512
200	0.628	1000	3.142
250	0.785	1250	3.927
Additional sizes			
150	0.470	560	1.760
300	0.943	710	2.229
355	1.115	900	2.826
450	1.413	1120	3.517

Note: The diameters are subject to normal manufacturing tolerances.
Other sizes may be available from individual manufacturers including larger diameters up to 2400mm.

SECTION 12 CONSTRUCTION

Spirally wound ducts and straight seamed ducts
The constructional requirements set out in Table 8 and 9 are common to the full range of pressures covered in this specification.

The ductwork sealing standards are set out in Part Seven, Section 19.

Minimum steel thicknesses related to duct diameter are given in Tables 8, 9 and 11.

12.1 LONGITUDINAL SEAMS

12.1.1 SPIRALLY-WOUND DUCTS

The seam used in spirally wound circular ducts, provided it is tightly formed to produce a rigid duct, is accepted as airtight to the requirements of all the pressure classifications covered in this specification, without sealant in the seam.

12.1.2 STRAIGHT-SEAMED DUCTS

The longitudinal seam for straight-seamed circular ducts shall be one of the following:-

(a) grooved seam continued to the extreme end of the duct and sealed.

(b) continuous butt lap weld

(c) spot/stitch weld and sealed lap joint (at 75 mm centres) provided this gives a smooth internal finish (Fig. 76).

The most appropriate method will be determined by the manufacturer relative to their product and will be associated with traditional fabrication/assembly methods, factory or site based, and/or proprietary methods.

12.2 CROSS JOINTS

12.2.1 GENERAL

Cross joints for circular ducts, both spirally-wound and straight-seamed, are illustrated in Figs.77 to 90. They include several proprietary types and the limits of use in terms of diameter and pressure classes are noted against each.

12.2.2 WELDED JOINTS

The limitations for welded joints are given in 12.4.

12.3 FASTENINGS

12.3.1 PERMITTED TYPES AND MAXIMUM CENTRES

Table 10 sets out the permitted fastenings and the maximum spacing for all ductwork classifications. Fastenings resulting in an unsealed aperture shall not be used.

12.3.2 RIVETS

Manufacturers' recommendations as to use, size and drill size are to be followed.

12.3.3 SET SCREWS, NUTS AND LOCK BOLTS

Materials shall be of mild steel, protected by electro-galvanizing, sherardizing, zinc plating, or other equal corrosion resistant finish.

12.3.4 SELF TAPPING AND PIERCING SCREWS

Providing an adequate seal can be achieved, then self-tapping or piercing screws may be used. Acknowledging the presence of such fastenings / fixings, avoid putting operatives at risk of injury with regard to internal activities such as access maintenance or ductwork cleaning. Such fixings must not be used within 1 metre of an access opening – as BS EN 12097, Clause 4.5.

12.3.5 SELF-PIERCING RIVETS

Providing an adequate seal can be achieved, then self-piercing rivets may be used. (Fig. 3).

12.4 WELDING SHEET JOINTS

The suitability of continuous welding for sheet-to-sheet joints will be governed by the sheet thickness, the size and shape of the duct or fitting and the need to ensure airtightness. Lapped sheet joints with a combination of spot welding and duct sealant is also acceptable. Distortion shall be kept to a minimum.

Areas where the galvanizing has been damaged or destroyed by welding or brazing shall have a suitable protective coating applied as defined in Section 32. Spot welds need not be treated as accelerated salt spray tests undertaken by Leeds University Research Laboratory on behalf of B&ES have indicated that corrosion rates would be well within the life expectancy of the various parent metal zinc coatings as indicated in the data listed in Table 24 of Appendix B.

12.5 BREAK-AWAY DUCT JOINT

A joint connecting a fire damper spigot or sleeve to the attached ductwork which will allow collapse of the ductwork during a fire without disturbing the integrity of the fire damper. 'Break-away' and flexible joints incorporate materials, fixings, clamps, etc, that are manufactured from a non - fire resistant material with a low melting point such as aluminium, plastic, etc. (DW/145, 'Guide to Good Practice for the Installation of Fire and Smoke Dampers').

Table 8 Spirally Wound Ducts (all pressure classifications)

Maximum (nominal) diameter	Minimum sheet thickness	Minimum stiffening requirements
1	*2*	*3*
mm up to 80	mm 0.4	None
81 - 160	0.5	None
161 - 315	0.6	None
316 - 800	0.8	None
801 - 1000	1.0	None if helically beaded. If not helically beaded use Fig.80 (angle reinforced) or Fig. 81, 82 or 83 (angled flanged – all at 3000 mm maximum spacing.
1001 - 1500	1.0	Figs. 81, 82 or 83 at 3000 mm maximum spacing.

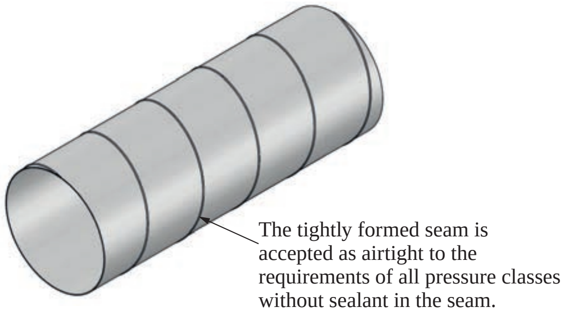
Table 9 Straight-seamed Ducts (all pressure classifications)

Maximum (nominal) diameter	Minimum sheet thickness	Minimum stiffening requirements
1	*2*	*3*
mm up to 200	mm 0.6	None
201 - 500	0.8	Swaged at spigot end as Figs 84 and 85
501 - 800	0.8	Swaged at socket and spigot end as Figs 84 and 85
801 - 1000	1.0	Figs. 87 to 90 at 1500 mm maximum spacing

Notes to Tables 8 and 9

(a) The diameters are subject to normal manufacturers tolerances.
(b) Other sizes may be available from individual manufacturers including larger diameters up to 2400mm
(c) For ductwork above 1500 diameter, advice must be sought from manufacturers which may include the possible use of recognised standards such as SMACNA

Fig. 76
Spirally wound duct



Straight-seamed duct

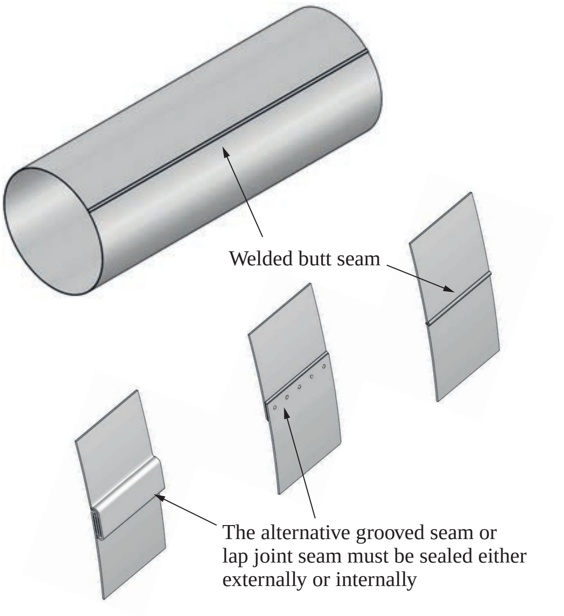


Table 10 Permitted fastenings and maximum spacing – circular ducts

Type of fastening	Sheet to sheet		Sheet to section (joining flanges and intermediate stiffeners)	
	Lap joints	Cross joints	Spirally wound	Straight seamed
1	*2*[1]	*3*[2]	*4*[2]	*5*[2]
Mechanically closed rivets	mm 75	mm 150	mm 150	mm 150
Self piercing screws	75[3]	150[3]	150[3]	150[3]
Set screws and nuts	-	-	300	300
Lock bolts	75	-	300	300
Spot welds	75	75	150	150

Notes to Table 10

1 Minimumof two fixings
2 Minimum of three fixings
3 Not suitable within 1 metre of an access opening.

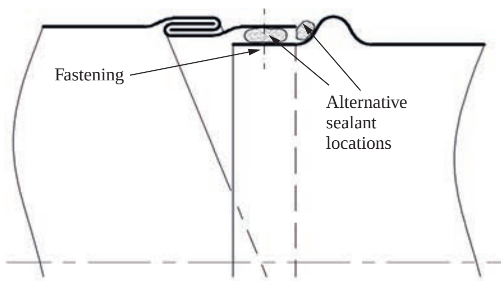
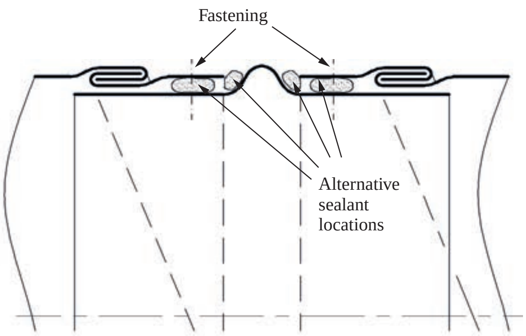
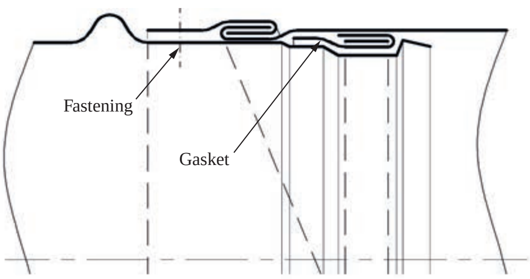
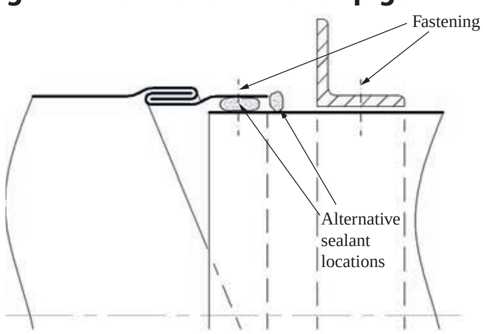
Where manufacturers have specific recommendations, these shall take preference over the centres indicated in this table

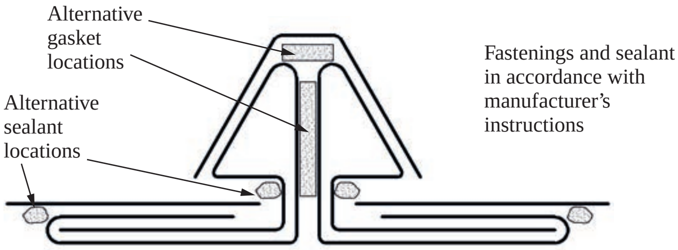
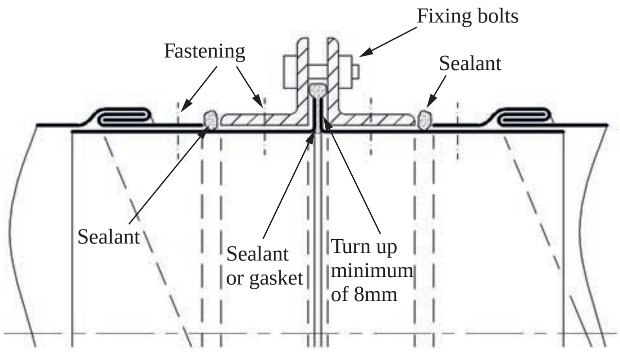
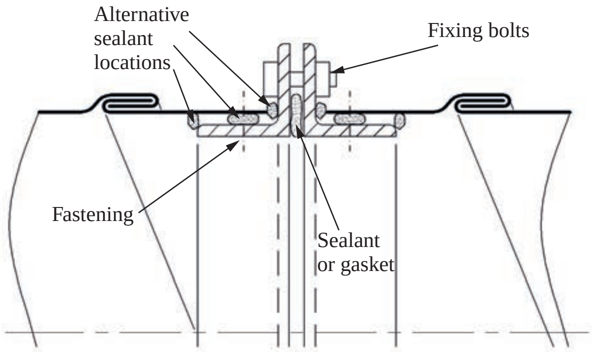
Table 11 Circular duct fittings – Sheet thicknesses

Maximum nominal diameter	Minimum sheet thickness
1	*2*
mm up to 250	mm 0.6
251 - 500	0.7
501 - 630	0.8
631 - 1500	1.0

Circular duct cross joints

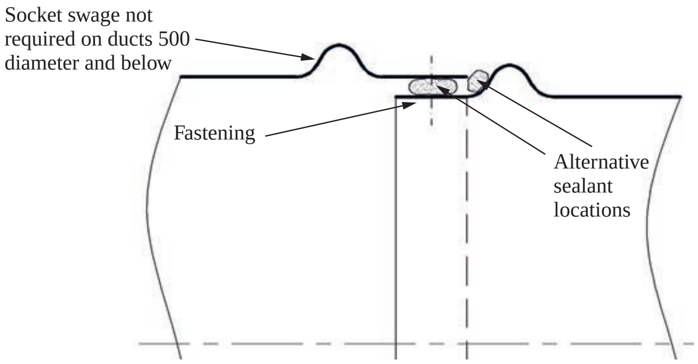
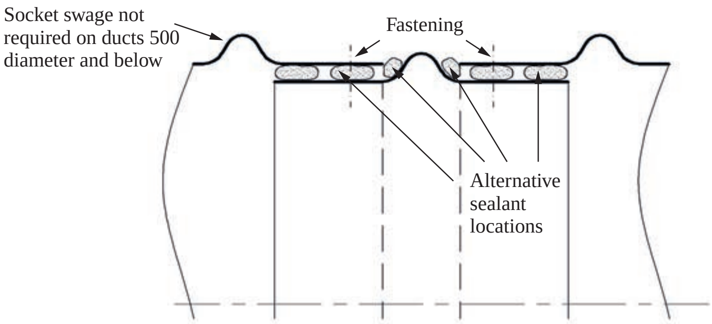
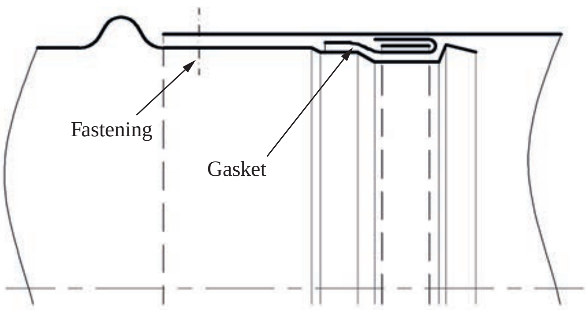
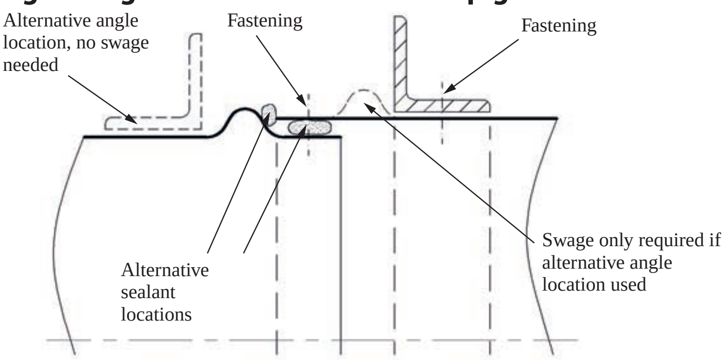
Note – All duct penetrations shall be sealed

Spirally-wound circular ducts	Limits of use		
	Angle size mm	Maximum diameter mm	Pressure classes
Fig 77 Plain socket and spigot (duct to fitting) 	-	1000	Low Medium High
Fig 78 Socket and spigot (duct to duct) with connector. 	-	1000	Low Medium High
Fig 79 Socket and spigot with synthetic rubber gasket 	To be used strictly in accordance with manufacturer's instructions and size limitations. May be suitable for helically beaded spiral tube if guaranteed by manufacturer.		
Fig 80 Angle reinforced socket and spigot 	*25 x 25 x 3 *30 x 30 x 4 40 x 40 x 4 *Where angle rings specified	800 1000 1500	Low Medium High

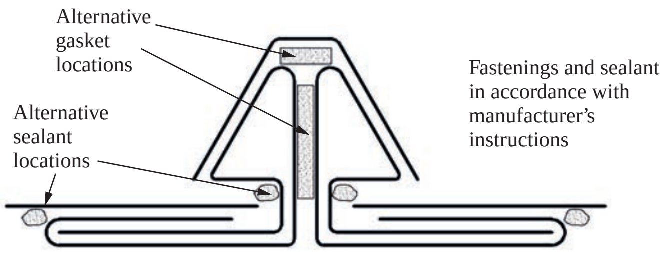
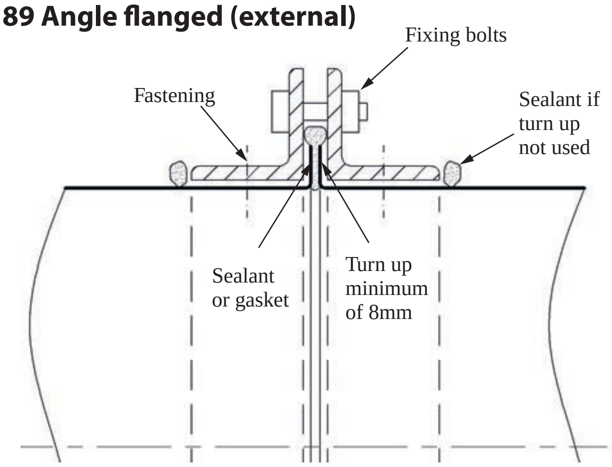
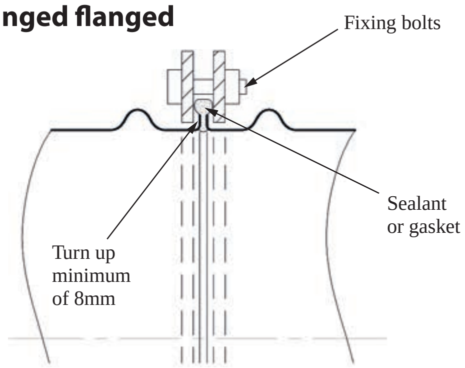
<table>
<tr><th rowspan="2">Spirally-wound circular ducts</th><th colspan="3">Limits of use</th></tr>
<tr><th>Angle size mm</th><th>Maximum diameter mm</th><th>Pressure classes</th></tr>
<tr><td>Fig 81 Example of typical roll formed sheet metal profile

</td>
<td colspan="3">To be used strictly in accordance with manufacturer’s instructions and size limitations.</td></tr>
<tr><td>Fig 82 Angle flanged (external)

</td>
<td>*25 x 25 x 3
*30 x 30 x 4
40 x 40 x 4</td><td>800
1000
1500</td><td>Low
Medium
High</td></tr>
<tr><td></td><td colspan="3">*Where flange joints are specified.
Note: A turn up as illustrated is not mandatory.</td></tr>
<tr><td>Fig 83 Angle flanged (internal)

</td>
<td>*25 x 25 x 3
*30 x 30 x 4
40 x 40 x 4</td><td>800
1000
1500</td><td>Low
Medium
High</td></tr>
<tr><td></td><td colspan="3">*Where flange joints are specified.</td></tr>
</table>

Note: Fixings for angle flanged joints Figs 82 and 83

Section size	Bolt size	
25 x 25 x 3 30 x 30 x 4 40 x 40 x 4	6mm 8mm 8mm	} @ 300 mm maximum centres Minimum of four per joint

<table>
<tr><th rowspan="2">Straight-seamed circular ducts</th><th colspan="3">Limits of use</th></tr>
<tr><th>Angle size mm</th><th>Maximum diameter mm</th><th>Pressure classes</th></tr>
<tr><td>Fig 84 Plain socket and spigot (duct to fitting)

</td><td>-</td><td>800</td><td>Low
Medium
High</td></tr>
<tr><td>Fig 85 Socket and spigot (duct to duct) with connector.

</td><td>-</td><td>800</td><td>Low
Medium
High</td></tr>
<tr><td>Fig 86 Socket and spigot with synthetic rubber gasket

</td><td colspan="3">To be used strictly in accordance with manufacturer's instructions and size limitations</td></tr>
<tr><td>Fig 87 Angle reinforced socket and spigot

</td><td>*25 x 25 x 3
*30 x 30 x 4
40 x 40 x 4

*Where angle rings specified</td><td>800
1000
1500</td><td>Low
Medium
High</td></tr>
</table>

<table>
<tr><th rowspan="2">Straight-seamed circular ducts</th><th colspan="3">Limits of use</th></tr>
<tr><th>Angle size mm</th><th>Maximum diameter mm</th><th>Pressure classes</th></tr>
<tr><td>Fig 88 Example of typical roll formed sheet metal profile

</td><td colspan="3">To be used strictly in accordance with manufacturer’s instructions and size limitations.</td></tr>
<tr><td rowspan="2">Fig 89 Angle flanged (external)

</td><td>*25 x 25 x 3
30 x 30 x 4
40 x 40 x 4</td><td>800
1000
1500</td><td>Low
Medium
High</td></tr>
<tr><td colspan="3">*Where flange joints are specified.
Note: A turn up as illustrated is not mandatory.
If not used, the toe of the angle is to be sealed.
Also acceptable with flange set internally similar to Fig 83</td></tr>
<tr><td>Fig 90 Flat ringed flanged

</td><td>*25 x 3
*30 x 4
40 x 4</td><td>800
1000
1500</td><td>Low
Medium
High</td></tr>
</table>

Note: Fixings for angle and flat ring flanged joints Figs 89 and 90

<table>
<tr><th colspan="2">Section size</th><th rowspan="2">Bolt size</th><th rowspan="2"></th></tr>
<tr><th>Angle</th><th>Bar</th></tr>
<tr><td>25 x 25 x 3
30 x 30 x 4
40 x 40 x 4</td><td>25 x 3
30 x 4
40 x 4</td><td>6mm
8mm
8mm</td><td>} @ 300 mm maximum centres
Minimum of four per joint</td></tr>
</table>

SECTION 13 STANDARDISATION OF CIRCULAR DUCTWORK COMPONENTS

13.1 STANDARDISATION

The terminology and descriptions of circular ductwork components as set out in this section are recommended for adoption as standard practice, to provide common terms of reference for system designers, quantity surveyors and ductwork contractors, and those using computers in ductwork design and fabrication.

The illustrations in this section not only highlight, where applicable, geometric limitations for the design and manufacture of ductwork components but also recommend standard drawing representation and terminology.

Designers and surveyors should note that bills of quantities should provide a full description of the items required.

The requirements for circular duct fittings apply throughout the pressure ranges covered in this specification.

13.2 NOMINAL DIAMETERS

The nominal diameter (Table 7) is the size used for design and ordering. With socket and spigot joints, care should be taken to ensure that the dimensions of the ducts and fittings are correctly related, so that the joint can be effectively sealed.

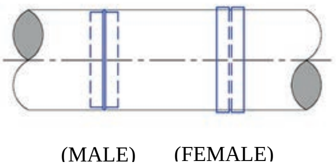
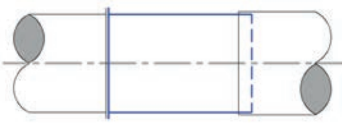
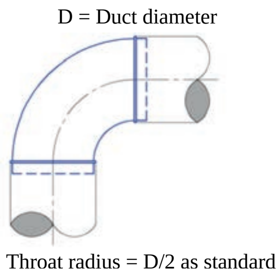
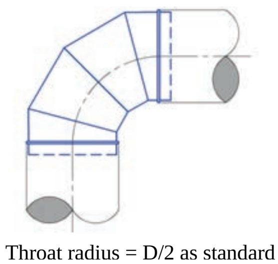
13.3 SHEET THICKNESS

Sheet thickness for circular duct fittings (determined by the largest diameter) shall be not less than those quoted in Table 11.

13.4 SEALING OF JOINTS

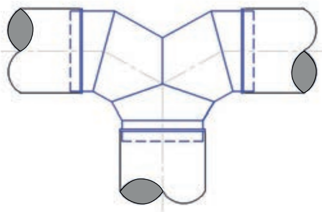
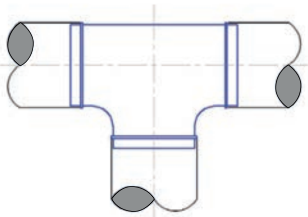
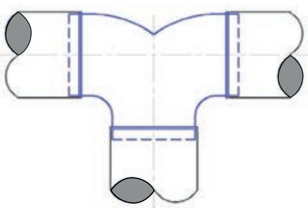
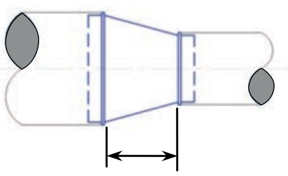
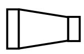
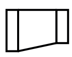
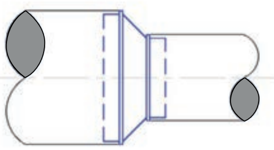
Sealant shall be used in all cross-joints and fittings. Such sealant shall be in accordance with the requirements of Part Seven, Section 19.

STANDARD COMPONENT DRAWINGS - CIRCULAR

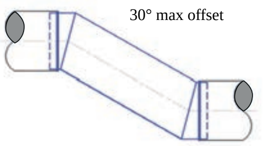
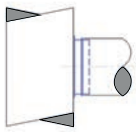
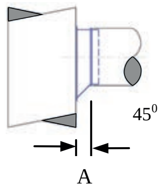
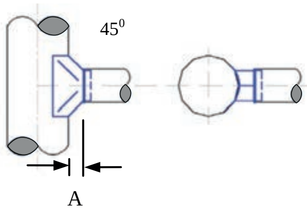
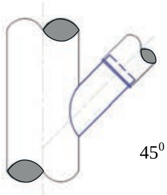
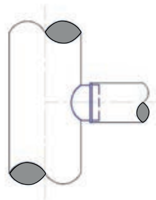
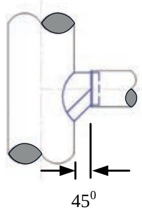
<table>
<tr><td>Fig. 91</td><td>
</td><td>Straight Duct
With male and female connectors</td></tr>
<tr><td>Fig. 92</td><td></td><td>Straight Duct
With flanged joint and slip joint</td></tr>
<tr><td>Fig. 93</td><td>
</td><td>Pressed Bend
15°, 30°, 45°, 60°, 90°
Medium radiussed bend as illustrated
Long radius similar but throat radius = D</td></tr>
<tr><td>Fig. 94</td><td>
</td><td>Segmented Bend
90° four section minimum as illustrated
i.e. middle two sections are full segments and two end sections are half segments

Other angles
60° = 3 sections (one full segment and two half segments)
45° = 3 sections (one full segment and two half segments)
30° = 2 sections (two half segments)</td></tr>
</table>

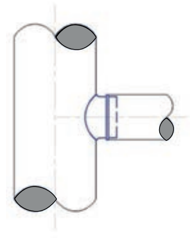
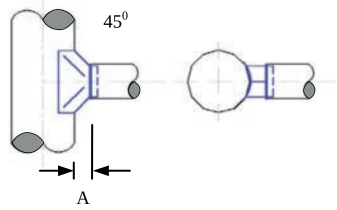
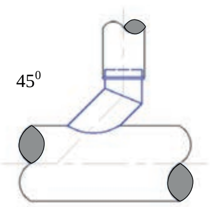
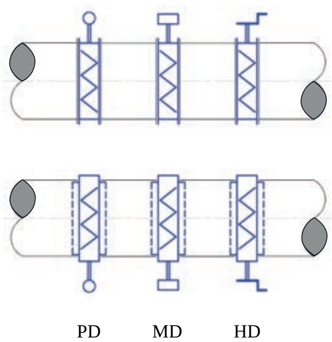
STANDARD COMPONENT DRAWINGS - CIRCULAR

Fig. 95	 Throat radius = D/2 maximum D = Duct diameter	**Segmented Twin Bend** Radius = D/2 maximum May also be fabricated from pressed bends
Fig. 96		**Pressed Equal Tee**
Fig. 97		**Pressed Twin Bend**
Fig. 98	Inclusive angle, 15° < α< 60°  Body length = l	**Taper** Concentric,  (as illustrated) Length $l = (d_1 - d_2)/[2 \tan(\alpha/2)]$ Eccentric,  Length $l = (d_1 - d_2)/\tan \alpha$
Fig. 99	Inclusive angle, α = 90° max 	**Pressed Taper** 315 Dia max on greatest dimension

STANDARD COMPONENT DRAWINGS - CIRCULAR

<table>
<tr><td>Fig. 100</td><td>
</td><td>Offset</td></tr>
<tr><td>Fig. 101</td><td></td><td>Square Branch
Off rectangular</td></tr>
<tr><td>Fig. 102</td><td>
</td><td>Shoe Branch
Off rectangular
<table>
<tr><th>Branch duct dia (D) mm</th><th>Dimension (A) mm</th></tr>
<tr><td>Up to 200</td><td>75</td></tr>
<tr><td>" 300</td><td>100</td></tr>
<tr><td>" 400</td><td>125</td></tr>
<tr><td>" 600</td><td>150</td></tr>
<tr><td>Over 600</td><td>200</td></tr>
</table></td></tr>
<tr><td>Fig. 103</td><td>
</td><td>Conical Branch
Also acceptable with full conical surface
<table>
<tr><th>Branch duct dia (D) mm</th><th>Dimension (A) mm</th></tr>
<tr><td>Up to 200</td><td>75</td></tr>
<tr><td>" 300</td><td>100</td></tr>
<tr><td>" 400</td><td>125</td></tr>
<tr><td>" 600</td><td>150</td></tr>
<tr><td>Over 600</td><td>200</td></tr>
</table></td></tr>
<tr><td>Fig. 104</td><td>
</td><td>Angle Branch</td></tr>
<tr><td>Fig. 105</td><td></td><td>Square Branch</td></tr>
<tr><td>Fig. 106</td><td>
</td><td>Shoe Branch</td></tr>
</table>

STANDARD COMPONENT DRAWINGS - CIRCULAR

<table>
<tr><td>Fig. 107</td><td></td><td>Pressed Branch</td></tr>
<tr><td>Fig. 108</td><td>
</td><td>Bell Mouth Branch
<table>
<tr><th>Branch duct dia (D) mm</th><th>Dimension (A) mm</th></tr>
<tr><td>Up to 200</td><td>75</td></tr>
<tr><td>" 300</td><td>100</td></tr>
<tr><td>" 400</td><td>125</td></tr>
<tr><td>" 600</td><td>150</td></tr>
<tr><td>Over 600</td><td>200</td></tr>
</table></td></tr>
<tr><td>Fig. 109</td><td>
</td><td>Mitred Branch</td></tr>
<tr><td>Fig. 110</td><td></td><td>Blank End</td></tr>
<tr><td>Fig. 111</td><td>
</td><td>Multi-Leaf Damper
Can be flanged or spigotted, opposed or parallel blade

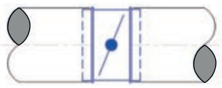
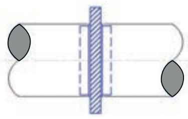
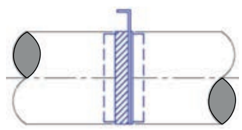
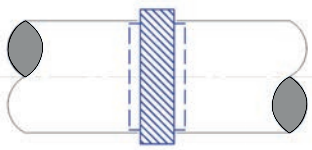
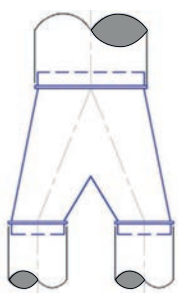
Alternative controls are:-

Hand (HD)

Motorised (MD)

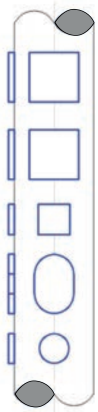
Pneumatic (PD)</td></tr>
</table>

STANDARD COMPONENT DRAWINGS - CIRCULAR

Fig. 112	 SBD	**Single Bladed Damper**
Fig. 113	 NRD	**Non-Return Damper** Vertical application only
Fig. 114	 ID	**Iris Damper**
Fig. 115	 BG	**Blast Gate Damper**
Fig. 116	 FD	**Fire/Smoke Damper** FD - Fire Damper SD - Smoke Damper
Fig. 117		**Breeches Piece**

STANDARD COMPONENT DRAWINGS - CIRCULAR

Fig. 118



Access Openings

AP - Access Panel

AD - Access Door

IC - Inspection Cover

Also applies to curved surface of flat oval duct.

Fig. 119

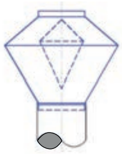


Fig 119a
Solid top cone

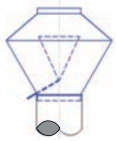


Fig 119b
Open top cone and drain

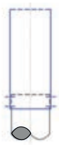


Fig 119c
Sleeve type

Fig 119d
Induction type

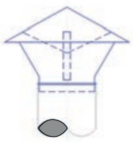


Fig 119e
'Chinaman's Hat'

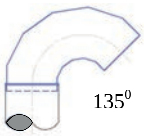
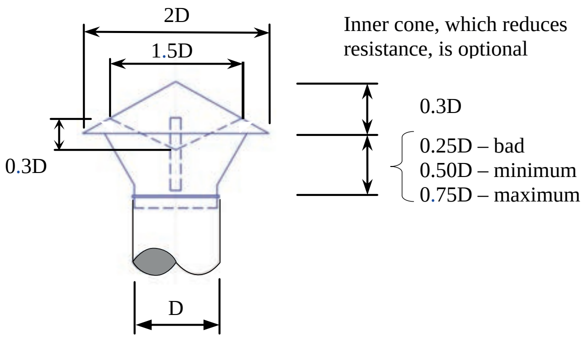


Fig 119f
Swan neck

Discharge cowls

Top four illustrations, Figs 119 (a) to (d), are extracted from DW/172, 'Specification for Kitchen Extract Systems', and that publication contains all necessary dimensional information and design considerations associated with such discharge cowls.

Fig 119 (e), 'Chinaman's Hat', includes below, CIBSE's dimensional guidelines. Note: DW/172 states this "type of cowl should not be used in KE systems due to the potential downdraught caused and the risk of re-entry of the extract air back into the building".



Notes:

(1) Many types of proprietary discharge cowls are also available

(2) DW/172 states "the discharge terminal should be open without mesh", but consideration should be made for all other cowls to avoid the ingress of foreign bodies

PART FIVE – FLAT OVAL DUCTS

SECTION 14 STANDARD SIZES AND SHEET THICKNESSES

Table 12 sets out the standard sizes of spirally - wound oval ducts offered by the manufacturers of ducts of this section.

SECTION 15 CONSTRUCTION (SPIRALLY WOUND DUCTS)

15.1 GENERAL

'Flat oval' is the term used to describe a duct of cross-section with flat opposed sides and semi-circular ends. The duct is formed from a spirally- wound circular duct, using a special former.

Apart from stiffening (see Tables 13 and 14), flat oval ducts have the same constructional requirements throughout the pressure ranges covered in this specification.
The ductwork construction and joint sealing standards are set out in Part Seven, Section 19.

Minimum steel thicknesses related to duct dimensions are given in Table 12.

15.2 LONGITUDINAL SEAMS

Spirally wound flat oval duct is accepted as airtight to the requirements of this specification without sealant in the seams, provided the grooved seam is tightly formed to produce a rigid duct.

15.3 CROSS JOINTS

15.3.1 GENERAL

Cross-joints shall be as Figs. 127 to 132 inclusive or such other proprietary joint as can be demonstrated to the system designer to be equally satisfactory.

15.3.2 SEALANT

All flat oval cross-joints shall be sealed. (See Part Seven, Section 19).

15.3.3 WELDED JOINTS

The limitations for welded joints are given in 15.4.6.

15.4 FASTENINGS

15.4.1 PERMITTED TYPES AND MAXIMUM CENTRES

Table 15 sets out the permitted fastenings and the maximum spacing for all ductwork classifications. Fasteners resulting in an unsealed aperture shall not be used.

15.4.2 RIVETS

Manufacturers' recommendations as to use, size and drill size are to be followed.

15.4.3 SET SCREWS, NUTS AND LOCK BOLTS

Materials shall be of mild steel, protected by electro-galvanizing, sherardizing, zinc plating, or other equal corrosion resistant finish.

15.4.4 SELF-TAPPING AND PIERCING SCREWS

Providing an adequate seal can be achieved, then self-tapping or piercing screws may be used. Acknowledging the presence of such fastenings / fixings, avoid putting operatives at risk of injury with regard to internal activities such as access maintenance or ductwork cleaning. Such fixings must not be used within 1 metre of an access opening - BS EN 12097, Clause 4.5.

15.4.5 SELF-PIERCING RIVETS

Providing an adequate seal can be achieved, then self-piercing rivets may be used. (Fig. 3).

15.4.6 WELDING SHEET JOINTS

The suitability of continuous welding for sheet-to-sheet joints will be governed by the sheet thickness, the size and shape of the duct or fitting and the need to ensure airtightness. Lapped sheet joints with a combination of spot welding and duct sealant is also acceptable. Distortion shall be kept to a minimum.

Areas where the galvanizing has been damaged or destroyed by welding or brazing shall have a suitable protective coating applied as defined in Section 32. Spot welds need not be treated as accelerated salt spray tests undertaken by Leeds University Research Laboratory on behalf of B&ES have indicated that corrosion rates would be well within the life expectancy of the various parent metal zinc coatings as indicated in the data listed in Table 24 of Appendix B.

15.4.7 BREAK-AWAY DUCT JOINT

A joint connecting a fire damper spigot or sleeve to the attached ductwork which will allow collapse of the ductwork during a fire without disturbing the integrity of the fire damper. 'Break-away' and flexible joints incorporate materials, fixings, clamps, etc, that are manufactured from a non - fire resistant material with a low melting point such as aluminium, plastic, etc. See DW/145, 'Guide to Good Practice for the Installation of Fire and Smoke Dampers'.

15.5 STIFFENING

The larger sizes of flat oval duct are stiffened by swages, as indicated in Table 12. Additionally, tie rods (Figs. 32 to 35) are required, positioned as indicated in the respective tables and illustrations.

In special situations as an alternative to tie rods, stiffening in the form of external full frame angles may be used to meet the requirements of the corresponding rectangular duct sizes.

SECTION 16 CONSTRUCTION (STRAIGHT-SEAMED)

Flat oval ducts with opposed sides and semi-circular ends may also be formed using plain sheet and straight seams. Ducts so formed should follow the metal thicknesses of Table 12 and stiffening requirements specified for the corresponding sizes of rectangular ducts, in the form of external full frame angles. Seams and cross-joints (Figs 133 to 137) shall be sealed to ensure the necessary degree of airtightness throughout the pressure ranges covered in this specification.

Table 12 Flat oval spirally wound ducts – Standard sizes and sheet thicknesses

Nominal sheet thickness	Surface area per metre length	(Width of duct (major axis – 'W')-nominal-mm)	Depth of duct (minor axis – 'D') – nominal 75	100	125	150	200	250	300	350	400	450	500
1	*2*	*3*											
mm	Sq.metres		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
	0.178		320										
	0.798		360	350	330	320							
	0.878		400	390	370	360							
0.8	0.958		440	430	410	400							
	1.037		480	470	450	440							
	1.117		520	505	490	480							
	1.197			545	530	520							
	1.277					555	525						
	1.436					635	605	580					
	1.596					715	690	660	630				
	1.756					800	770	740	710	685	655		
	1.915					880	845	825	790	765	735	705	680
	2.075					960	930	900	875	845	815	785	755
	2.238	Swaged				1040	1010	985	955	925	895	865	835
	2.394					1120	1090	1065	1035	1005	975	945	915
	2.553					1200	1170	1145	1115	1085	1055	1025	1000
1.0	2.873						1335	1305	1275	1245	1215	1190	1160
	3.192							1465	1435	1405	1375	1350	1320
	3.511							1625	1595	1570	1540	1510	1480
	3.830							1785	1760	1730	1700	1670	1640

Table 13 – Flat oval ducts – low- and medium-pressure – stiffening requirements

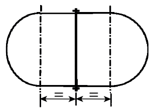
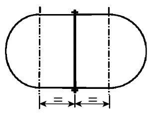
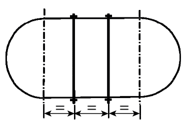
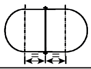
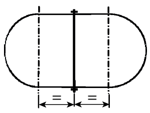
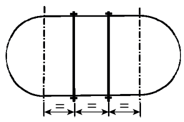
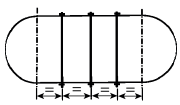
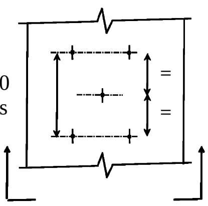
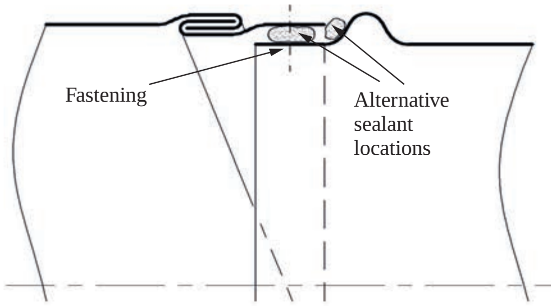
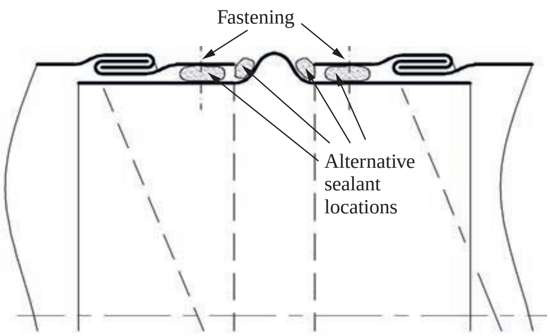
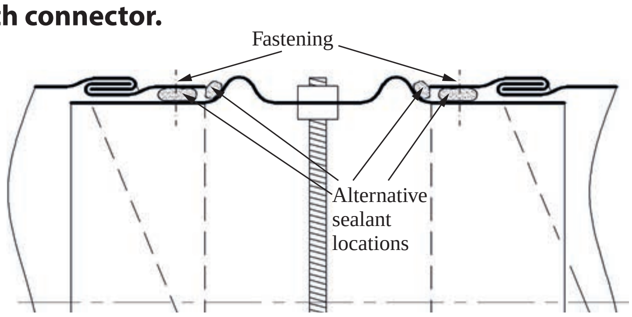
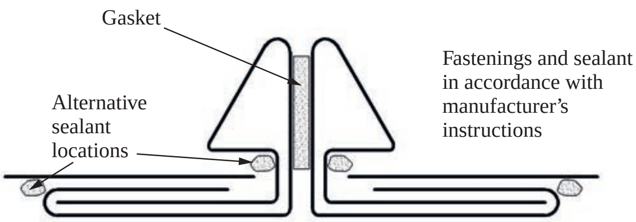
Tie rods	Depth of duct (minor axis – 'D') – nominal										
	75	100	125	150	200	250	300	350	400	450	500
1	*2*										
	Width of duct (major axis – 'W') – nominal - mm										
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
Not required	320										
	360	350	330	320							
	400	390	370	360							
	440	430	410	400							
	480	470	450	440							
	520	505	490	480							
		545	530	520							
				555	525						
				635	605	580					
Fig 120 **1000 mm centres** 				715	690	660	630				
				800	770	740	710	685	655		
				880	845	825	790	765	735	705	680
Fig 121 **750 mm centres** 				960	930	900	875	845	815	785	755
				1040	1010	985	955	925	895	865	835
				1120	1090	1065	1035	1005	975	945	915
Fig 122 **500 mm centres** 				1200	1170	1145	1115	1085	1055	1025	1000
					1335	1305	1275	1245	1215	1190	1160
						1465	1435	1405	1375	1350	1320
						1625	1595	1570	1540	1510	1480
						1785	1760	1730	1700	1670	1640

Table 14 – Flat oval ducts – high-pressure – stiffening requirements

Tie rods	Depth of duct (minor axis – 'D') – nominal 75	100	125	150	200	250	300	350	400	450	500
1	*2*										
Width of duct (major axis – 'W') – nominal - mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
Not required	320										
	360	350	330	320							
	400	390	370	360							
	440	430	410	400							
	480	470	450	440							
	520	505	490	480							
		545	530	520							
Fig 123 1000 mm centres 				555	525						
				635	605	580					
Fig 124 750 mm centres 				715	690	660	630				
				800	770	740	710	685	655		
				880	845	825	790	765	735	705	680
Fig 125 500 mm centres 				960	930	900	875	845	815	785	755
				1040	1010	985	955	925	895	865	835
				1120	1090	1065	1035	1005	975	945	915
				1200	1170	1145	1115	1085	1055	1025	1000
Fig 126  Section  Plan with section above					1335	1305	1275	1245	1215	1190	1160
						1465	1435	1405	1375	1350	1320
						1625	1595	1570	1540	1510	1480
						1785	1760	1730	1700	1670	1640

Flat oval duct cross joints

Note – All duct penetrations shall be sealed

<table>
<tr><th rowspan="2">Spirally-wound flat oval ducts</th><th colspan="3">Limits of use</th></tr>
<tr><th>Angle size mm</th><th>Maximum width mm</th><th>Pressure classes</th></tr>
<tr><td>Fig 127 Plain socket and spigot (duct to fitting)

</td><td>-</td><td>1785</td><td>Low
Medium
High</td></tr>
<tr><td>Fig 128 Socket and spigot (duct to duct) with connector.

</td><td>-</td><td>1785</td><td>Low
Medium
High</td></tr>
<tr><td>Fig 129 Alternative socket and spigot (duct to duct) with connector.

</td><td>-</td><td>1785</td><td>Low
Medium
High</td></tr>
<tr><td>Fig 130 Example of typical roll formed sheet metal profile

</td><td colspan="3">To be used strictly in accordance with manufacturer's recommendations</td></tr>
</table>

Spirally-wound flat oval ducts	Limits of use		
	Angle size mm	Maximum width mm	Pressure classes
Fig 131 Angle flanged (external)	*25 x 25 x 3 *30 x 30 x 4 40 x 40 x 4	800 1040 1785	Low Medium High
	*Where flange joints are specified. Note: A turn up as illustrated is not mandatory.		
Fig 132 Angle flanged (internal)	*25 x 25 x 3 *30 x 30 x 4 40 x 40 x 4	800 1000 1500	Low Medium High
	*Where flange joints are specified.		

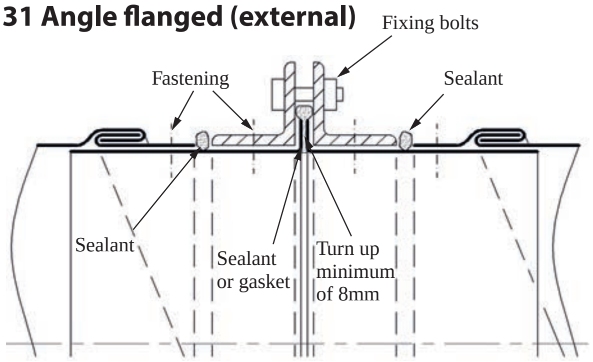


Fig 131 Angle flanged (external)

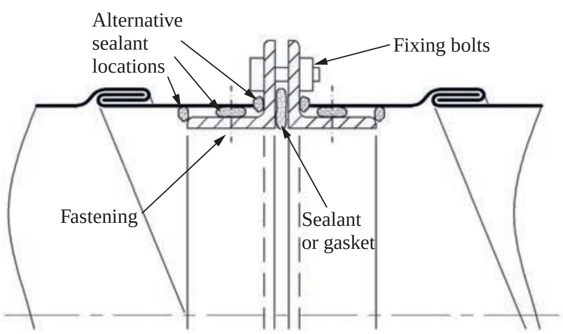


Fig 132 Angle flanged (internal)

Note: Fixings for angle flanged joints Figs 131 and 132

Section size	Bolt size	
25 x 25 x 3	6mm	} @ 300 mm maximum centres
30 x 30 x 4	8mm	Minimum of four per joint
40 x 40 x 4	8mm	

Table 15 – Permitted fastenings and maximum spacings – Flat oval ducts

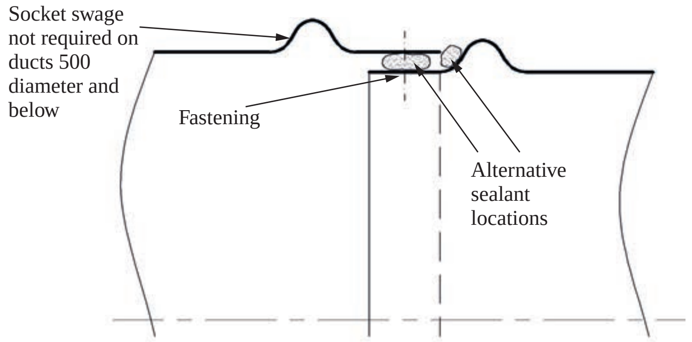
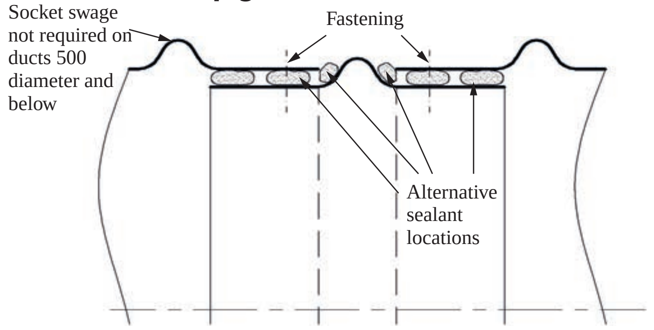
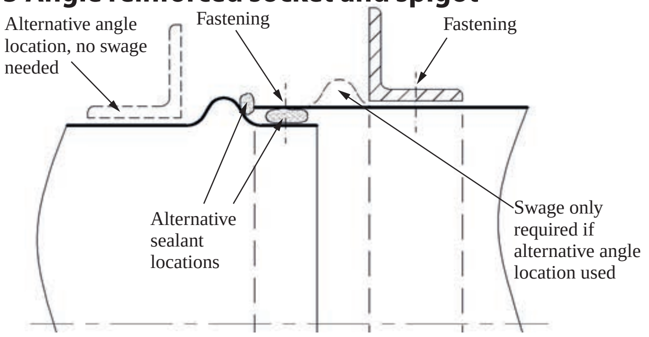
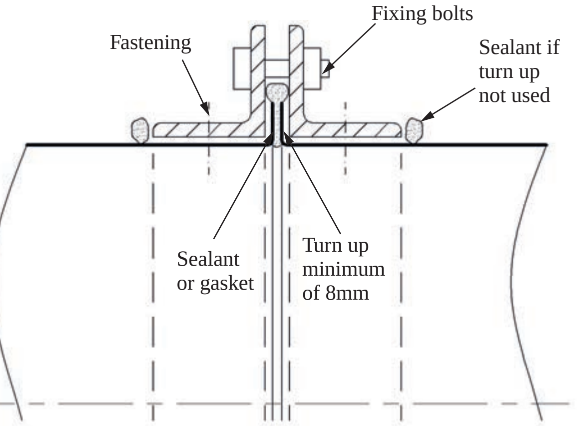
Type of fastening	Sheet to sheet			Sheet to section (jointing flanges and intermediate stiffeners)	
	Lap joints	Cross joints			
		Flat sides	Semi-circular sides	Flat sides	Semi-circular sides
1	*2*[1]	*3*[2]	*4*[2]	*5*[2]	*6*[2]
Mechanically closed rivets	75	75	150	150	150
Self-piercing screws	75[3]	75[3]	150[3]	150[3]	150[3]
Set screws and nuts	-	-	-	150	150
Lock bolts	75	-	-	150	300
Spot welds	75	75	75	150	150

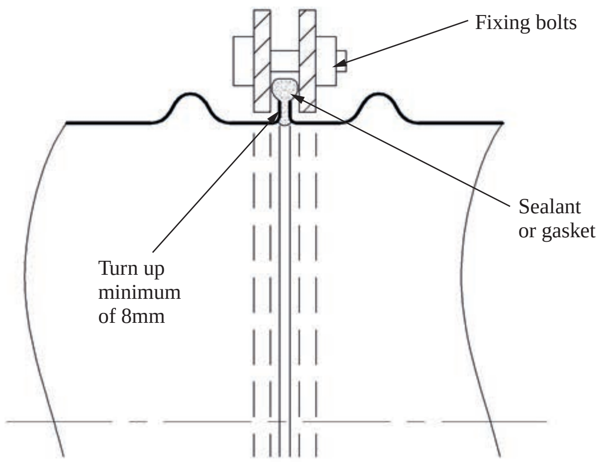
Notes to Table 15

[1] Minimum of two fixings, [2] Minimum of three fixings, [3] Not suitable within 1 metre of an access opening

Where manufacturers have specific recommendations, these shall take preference over the centres indicated in this table

Roll formed flanges shall be fitted strictly in accordance with manufacturer's instructions.

Straight-seamed flat oval ducts	Limits of use: Angle size mm	Limits of use: Maximum width mm	Limits of use: Pressure classes
Fig 133 Plain socket and spigot (duct to fitting)  	-	800	Low Medium High
Fig 134 Socket and spigot (duct to duct) with connector.  	-	800	Low Medium High
Fig 135 Angle reinforced socket and spigot  	*25 x 25 x 3 *30 x 30 x 4 40 x 40 x 4 *Where angle rings specified	800 1040 1785	Low Medium High
Fig 136 Angle flanged (external)  	*25 x 25 x 3 30 x 30 x 4 40 x 40 x 4	800 1040 1785	Low Medium High
	*Where flange joints are specified. Note: A turn up as illustrated is not mandatory. If not used, the toe of the angle is to be sealed. Also acceptable with flange set internally similar to Fig 132		

Straight-seamed flat oval ducts	Limits of use		
	Angle size mm	Maximum width mm	Pressure classes
Fig 137 Flat ringed flanged 	*25 x 3 *30 x 4 40 x 4	800 1000 1500	Low Medium

Note: Fixings for angle and flat ring flanged joints Figs 136 and 137

Section size: Angle	Section size: Bar	Bolt size	
25 x 25 x 3 30 x 30 x 4 40 x 40 x 4	25 x 3 30 x 4 40 x 4	6mm 8mm 8mm	@ 300 mm maximum centres Minimum of four per joint

SECTION 17 STANDARDISATION OF FLAT OVAL DUCTWORK COMPONENTS

The terminology and descriptions of flat oval ductwork components as set out in this section are recommended for adoption as standard practice to provide common terms of reference for system designers, quantity surveyors and ductwork contractors, and of those using computers in ductwork design and fabrication.

The illustrations in this section not only highlight, where applicable, geometric limitations for the design and manufacture of ductwork components but also recommend standard drawing representation and terminology.

System designers and surveyors should note that bills of quantities should provide a full description of the items required.

The requirements for flat oval duct fittings apply throughout the pressure ranges covered in this specification.

17.1 GENERAL CONSTRUCTIONAL REQUIREMENTS

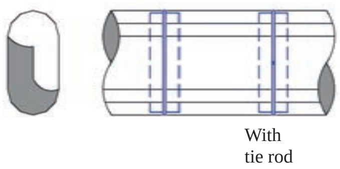
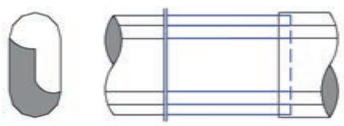
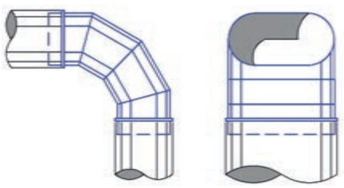
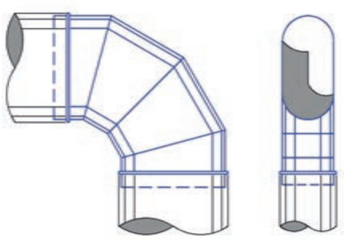
Sheet thicknesses for flat oval fittings (determined by the periphery of the larger end) shall be not less than those given in Table 12 for the ducts themselves.

With socket and spigot joints, care should be taken to ensure that the dimensions of ducts and fittings are correctly related.

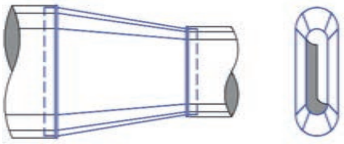
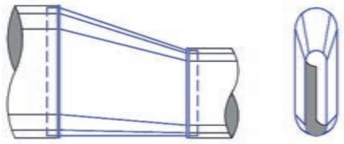
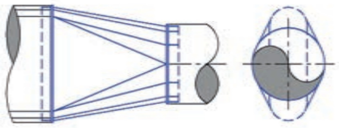
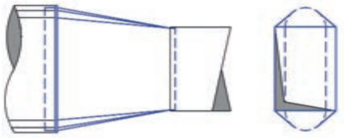
All the seams and joints integral to a fitting shall be sealed to the same standard as the duct. (See Part Seven, Section 19). The most appropriate method will be determined by the manufacturer relative to their product and will be associated with either traditional fabrication/assembly methods, factory or site based, and/or proprietary methods.

STANDARD COMPONENT DRAWINGS – FLAT OVAL

General Note:
In describing flat oval ductwork, the major axis is referred to as the width (W) and the minor axis is referred to as the depth (D)
For tie rod requirements see Tables 13 and 14.

Fig. 138		**Straight Duct** with connectors
Fig. 139		**Straight Duct** with flange joint and slip joint
Fig. 140	 Throat radius = D/2 as standard	**Segmented bend (easy)** 90° four section minimum as illustrated i.e. middle two sections are full segments and two end sections are half segments See Fig 42 in rectangular section for an explanation of 'easy' and 'hard'. **Other angles** 60° = 3 sections (one full segment and two half segments) 45° = 3 sections (one full segment and two half segments) 30° = 2 sections (two half segments)
Fig. 141	 Throat radius = W/2 as standard	**Segmented bend (hard)** 90° four section minimum as illustrated i.e. middle two sections are full segments and two end sections are half segments See Fig 42 in rectangular section for an explanation of 'hard' and 'easy'. **Other angles** 60° = 3 sections (one full segment and two half segments) 45° = 3 sections (one full segment and two half segments) 30° = 2 sections (two half segments)

STANDARD COMPONENT DRAWINGS – FLAT OVAL

Fig. 142	 22.5° max offset on side	**Taper – Concentric**
Fig. 143	22.5° max offset on side 	**Taper - Eccentric**
Fig. 144	 22.5° max offset on other side	**Flat Oval to Circular** Transformation piece Can be concentric, eccentric or offset
Fig. 145	 22.5° max offset on either side	**Flat Oval to Rectangular** Transformation piece Can be concentric, eccentric or offset

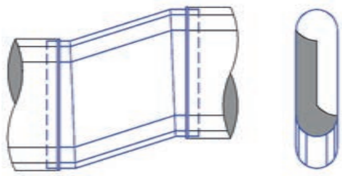
STANDARD COMPONENT DRAWINGS – FLAT OVAL

Fig. 146

30° max offset

Offset - easy

Fig. 147



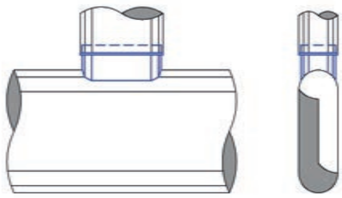
30° max offset

Offset - hard

Fig. 148

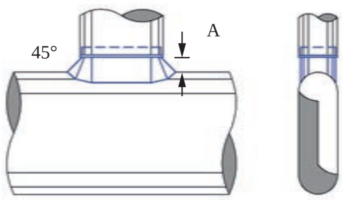
Branches:
Note: for rectangular or circular branches off the flat or circular surface of the flat oval, see the figures in the appropriate standard component drawings of the rectangular or circular sections.

Fig. 149



Square Branch as illustrated
Note: Shoe branch similar to Fig 136 also acceptable

Fig. 150



Conical Branch

Branch duct width mm	Dimension (A) mm
Up to 200	75
" 300	100
" 400	125
" 600	150
Over 600	200

PART SIX – HANGERS AND SUPPORTS

SECTION 18 GENERAL

18.1 *PRINCIPLES ADOPTED*

Supports are an essential part of the ductwork system, and their supply and installation are normally the responsibility of the ductwork contractor. It should be noted however that any secondary steelwork required to achieve maximum support spacings, for example: roll formed channel sections spanned between roof purlins/steels, then this should be the responsibility of the structural contractor. The choice between the available methods of fixing will depend on the type of building structure and on any limitations imposed by the structural design. **Further, unless the system designer has specified his requirements in detail, the load to be carried shall be understood to be limited to the ductwork and its associated thermal insulation.** Supports for acoustic insulation and inline ancillary items are to be designed separately due to probable weight considerations relative to the attached ductwork items. It is recommended that a safety factor of 5 to 1 be added to calculations for attachments to the structure (BS EN 12236).

Note!
(a) Ductwork and duct supports are not designed for man access either inside or on top of the duct.
(b) Ductwork supports are not designed to accommodate additional loadings from other services.

As DW/144 ductwork or supports do not take into account either man-loading or the support of other building services, system designers must take this into account in accordance with BS EN 12236, 'Ventilation for buildings – Ductwork hangers and supports – Requirements for strength'. This consideration should also include recognition of all appropriate risk assessments.

It is not practicable to deal here with the full range of supports available, which increasingly includes proprietary types such as wire rope suspension systems, so in this section various methods of support are dealt with in principle under the three elements of:

(1) Attachment to the structure;
(2) Hanger
(3) Duct bearing member

Illustrations of those most commonly used are shown in Figs. 151 to 172.

Supports for ductwork external to the building have been excluded, as these are individually designed to suit the circumstances, and also may be required to meet local authority standards. For the same reasons, floor supports have not been dealt with. Additional information on this subject can be found in Clause 26.8 (External ductwork supports).

With a proprietary device, it will, unless the system designer has specified his requirements in detail, be the responsibility of the ductwork installer to ensure that it meets requirements, with a recommended safety factor of 5 to 1; and that it is installed in accordance with the manufacturer's recommendations.

The absence of any method or device from this specification does not preclude its use if it can be demonstrated that it is suitable for the duty assigned to it, with a recommended safety factor of 5 to 1 and this will be the responsibility of the ductwork installer, unless the designer has specified his requirements in detail.

18.2 ATTACHMENT TO BUILDING STRUCTURE

The fixing to the building structure should be of a strength and durability compatible with those of the ductwork support attached to it. A fixing must be made in such a way that it cannot become loose or pull out through normal stressing or through normal changes in the building structure. Typical examples of the various methods of fixing to a structure are shown in Figs. 183 to 186. It is not practical to cover the full range of fixing available, therefore any propriety fixing can be considered if substantiated with manufacturers test data.

Note: It is becoming common practice for the types of structural fixings to be specified by the main contractor on a project by project basis.

18.3 HORIZONTAL DUCTWORK

18.3.1 THE HANGER

18.3.1.1 SCREWED ROD / FLAT STRAP

Screwed rod and flat straps must be pre-treated by, for example, hot-dip galvanizing, sherardizing, electro-deposited zinc plating or by other accepted anti-corrosion treatment. Illustrations of those most commonly used are shown in Figs. 151 to 172 with material sizes listed in Tables 16 to 18.

Projection of a screwed rod hanger through the bottom bearer should be approximately twice the thickness of the securing nut. Provided the integrity of the ductwork is maintained, hangers may be attached to the corners of flanges or stiffeners as an alternative to the use of a bottom bearer.

Note: Roll formed flange manufacturer to confirm that their proprietary system is suitable for having hangers attached to the top corner of the flange configuration.

18.3.1.2 WIRE ROPE

Proprietary wire rope suspensions systems are increasingly used to support ductwork within buildings

It is essential to ensure that all the components of the wire rope suspension system including the wire itself are from the same supplier. To satisfy this requirement it is now possible to purchase kits with a recognised third party (UKAS) certificated safe working load incorporating recommended minimum safety factor of 5 to 1 covering the complete suspension from the building structure to the ductwork. Additional design allowance to be made for wire supports set at an angle to the vertical.

Wire rope support centres should be as Tables 16 to 18. Typical examples of wire rope arrangements are shown Figs 167 to 172. It is not practical to cover the full range of applications available therefore manufacturer's guidelines should be consulted. Suspension from roll formed sheet metal flanges is possible subject to confirmation from the ductwork flange manufacturer that there is sufficient integral strength at that point. It should be noted that a support is only as strong as the safe working load of its weakest component.

Note: With any proprietary devices: manufacturers' recommendations for use should always be followed.

18.3.2 THE DUCT-BEARING MEMBER

The choice of the lower support will be dictated by the actual duct section – (Tables 16 to 18).

18.3.2.1 RECTANGULAR DUCTS

Table 16 gives minimum dimensions for hangers and for angle, channel and profile sections bearers. Rolled steel angle bearers are shown in Fig. 173 (rolled steel channel being similar) and profile channel sections in Figs. 174 to 178.

Arrangements of bottom bearer supports for plain and insulated ducts are shown in Figs. 155, 156, 163 and 164.

18.3.2.2 CIRCULAR DUCTS

Table 17 gives minimum dimensions for hangers and bearers. Arrangements of circular supports for plain and insulated ducts are shown in Figs. 151 to 154 and 159 to 162.

18.3.2.3 FLAT OVAL DUCTS

Table 18 gives minimum dimensions for hangers and for the bearer, depending on whether the flat side of the duct is horizontal or vertical. Arrangements for flat oval duct supports are shown in Figs. 155, 157, 158, 163, 165, and 166.

18.4 VERTICAL DUCTS

The design of supports for vertical ducts is dictated by site conditions, and they are often located to coincide with the individual floor slabs, but if the spacing exceeds 4 metres the system designer must specify their requirements. Vertical ducts should be supported from the stiffening angle or the angle frame, or by separate supporting angles fixed to the duct.

Typical methods of supporting vertical rectangular and circular ducts are shown in Figs 179 to 182. The same methods are applicable to vertical flat oval ducts.

18.5 ADDITIONAL LOADINGS ON DUCTWORK SUPPORTS

For ducts larger than those covered by Tables 16 to 18, or where heavy equipment, mechanical services, ceilings or other additional loads are to be applied to the ductwork, supports shall be designed by the system designer to suit the applications.

18.6 INSULATED DUCTS

Where ductwork is required to be insulated, this must be clearly specified by the system designer, so that hangers, where necessary, are spaced to provide clearance for the insulation. Otherwise, supports may be as for un-insulated ductwork, i.e. direct contact between duct skin straps and bearers as illustrated in Figs. 151 to 158.

18.6.1 HEAT TRANSFER

It is not normally necessary to make special arrangements for the limitation of heat transfer via the duct supports. However, there may be special cases where the temperature difference justifies a heat barrier to conserve heat or to prevent condensation and such requirements must be specified by the system designer **in the ductwork specification.**

18.6.2 INSULATED DUCTS WITH VAPOUR SEALING

Where the temperature of the air within the duct is at any time low enough to promote condensation on the exterior surface of the duct and cause moisture penetration through the thermal insulation, vapour sealing may be called for, and in this case the most important requirement is to limit penetration of the seal.

The extent of any vapour sealing of ductwork thermal insulation and the method to be used, must be clearly specified in advance by the system designer.

Method 1
Where the risk of damage due to condensation is slight, the vapour seal can be applied to the insulated duct and made good around the supports to achieve an acceptable level of proofing as shown in Figs. 151 to 158, i.e. direct contact between duct skin and straps and bearers as illustrated in the sketches.

Note: If wire rope is utilized, since the area of contact between the wire rope and the ductwork is minimal this normally negates the need for vapour sealing of the wire apart from where it penetrates the vapour seal and this should be undertaken by the insulation contractor.

Method 2
Where it is essential to keep penetration of the vapour seal to a minimum, supports should be external to the insulation as shown in Figs. 159 to 166.

The insulation and vapour barrier should be abutted to the insulator incorporated into the duct support. This insulator should be non-hygroscopic and shall be capable of carrying the imposed loads without significant compression. Typical materials are hardwood or treated softwood (in separate block form for circular ducts – see note below): GRP (glass reinforced plastics): phenolic block: and hard rubber compounds. Some proprietary systems of support for vapour sealed ducts are available.

Note: Insulators in the form of segmented strips incorporating load bearing insulation segments bonded to a flexible membrane – usually reinforced foil - are sometimes referred to as 'crocodile-strip'.

18.7 FIRE RATED DUCTWORK

DW/144 supports **cannot** be used on fire rated ductwork systems. (Commentary and Guidance – Note 4).

18.8 VIBRATION & ACOUSTIC ISOLATION

The extent of any vibration & acoustic isolation required and the method to be used must be clearly specified in advance by the system designer in the ductwork specification. Equipment, such as fans & air handling units should be provided by the equipment supplier with appropriate ancillaries for vibration isolation.

Table 16	Supports for rectangular horizontal ductwork				
Longest Side	HANGERS		BEARERS		Maximum Spacing's
	Screwed Rod	Flat Straps Fig 156/164	Stirrups	"Z" cm^3 x – x (see Table 19) Fig 155/163	
Up to 400	6	25 x 0.8 Plain or Perforated	N/A	0.40	3000
401 - 600	8	30 x 3 flat	N/A	0.70	3000
601 - 1000	8	N/A	N/A	1.50	3000
1001 - 1500	10	N/A	N/A	2.10	2500
1501 - 2000	10	N/A	N/A	3.05	2500
2001 - 3000	12	N/A	N/A	4.45	2500

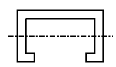
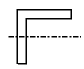
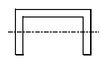
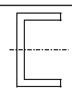
Table 17	Supports for circular horizontal ductwork					
Diameter	HANGERS			BEARERS		Maximum Spacing's
	Screwed Rod	Flat Straps		Stirrups	"Z" cm^3 x – x	
		Figs 151/152/159/160	Fig 154/162	Fig 153/161		
Up to 315	6	25 x 0.8 Plain or Perforated		25 x 3 flat	n/a	3000
316 - 500	8	N/A	25 x 3 flat	30 x 3 flat	n/a	3000
501 - 800	8	N/A	30 x 3 flat	30 x 3 flat	n/a	3000
801 - 1120	10	N/A	40 x 5 flat	40 x 5 flat	n/a	3000
1121 - 1500	10	N/A	40 x 5 flat	40 x 5 flat	n/a	3000
1501 - 2400	12	N/A	50 x 6 flat	50 x 6 flat	n/a	3000

Table 18	Supports for flat oval horizontal ductwork				
Major Axis	HANGERS		BEARERS		Maximum Spacing's
	Screwed Rod	Flat Straps Fig 158/166	Stirrups Fig. 157/165	"Z" cm^3 x – x (see Table 19) Fig 155/163	
Up to 400	6	25 x 0.8 Plain or Perforated	25 x 3 flat	0.40	3000
401 - 605	8	25 x 3 flat	30 x 3 flat	0.70	3000
606 - 1040	8	30 x 3 flat	30 x 3 flat	1.50	3000
1041 - 1510	10	N/A	N/A	2.10	3000
1511 - 1785	10	N/A	N/A	3.05	3000

Notes to Tables 16 to 18

1. The maximum spacings set out in Tables 16 to 18 are related solely to duct weight considerations. Closer spacing may be required by reason of the limitations of the building structure or to achieve the necessary duct rigidity.
2. As an alternative to screwed rod, wire rope may be utilised to suit individual manufacturer's fixing methods and loading-limitations. See Figs 167 to 172.
3. Table 19 opposite indicates typical elastic section moduli for commonly used bearer section for rectangular and flat oval ductwork.

Table 19 - **Typical elastic section moduli for commonly used bearer section**

CHANNEL/ANGLES SIZE mm	ELASTIC SECTION MODULUS (Z) cm^3		AXIS X – X
	Slotted section	Solid section	
40 x 20 x 1.5 RFC	0.71	0.74	
40 x 20 x 2.5 RFC	0.92	0.98	
40 x 40 x 1.5 RFC	2.04	2.13	
40 x 40 x 2.5 RFC	2.87	3.60	
40 x 60 x 2.5 RFC	5.59	6.00	
40 x 80 x 2.5 RFC	9.01	9.93	
25 x 25 x 3 RSA	n/a	0.45	
40 x 40 x 4 RSA	n/a	1.55	
50 x 50 x 5 RSA	n/a	3.05	
76 x 38 x 5 RSC	n/a	4.07	
102 x 50 x 6 RSC	n/a	8.16	
76 x 38 x 5 RSC	n/a	19.46	
102 x 50 x 6 RSC	n/a	40.89	

ARRANGEMENTS OF BEARERS AND HANGERS – utilizing flat, angle or channel bearers.

Either un-insulated ducts or insulated ducts requiring a Method 1 vapour seal

(To be read in conjunction with Table 16, 17 and 18 which list material size relative to duct size)

Key

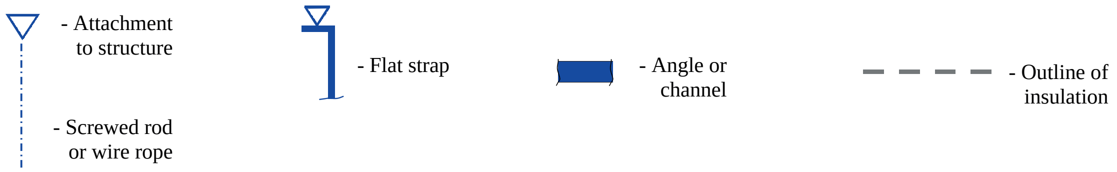


Fig 151 – Circular wrap round hanger

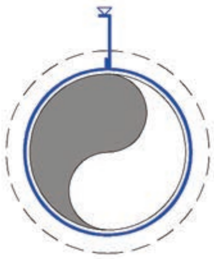


Fig 152 – Circular split clip

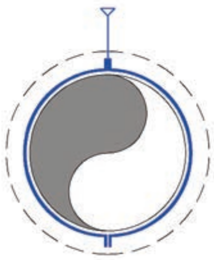


Fig 153 – Circular stirrup

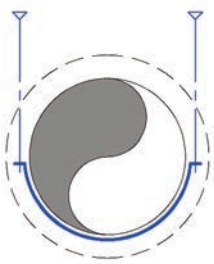


Fig 154 – Circular flat strap hanger

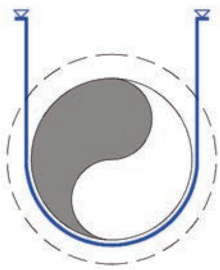


Fig 155 – Rect/Flat oval rolled or profile bearer

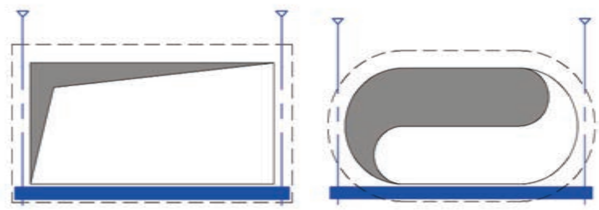


Fig 156 – Rectangular flat strap hanger

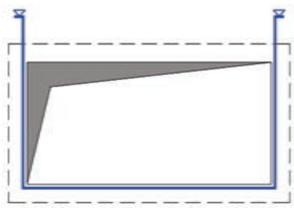


Fig 157 – Flat oval stirrup

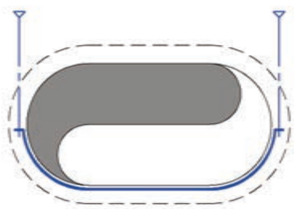
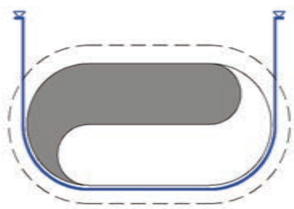


Fig 158 – Flat oval flat strap



ARRANGEMENTS OF BEARERS AND HANGERS – utilizing flat, angle or channel bearers.

Insulated ducts requiring a Method 2 vapour seal

(To be read in conjunction with Table 16, 17 and 18 which list material size relative to duct size)

Key

- Attachment to structure
- Screwed rod or wire rope
- Flat strap
- Angle or channel
- Outline of insulation
- insulator entrapped between support bearer and duct skin

Fig 159 – Circular wrap round hanger

Fig 163 – Rect/Flat oval rolled or profile bearer

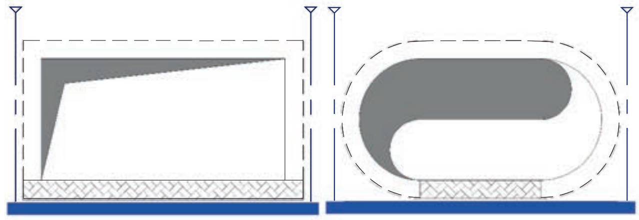


Fig 160 – Circular split clip

Fig 164 – Rectangular flat strap hanger

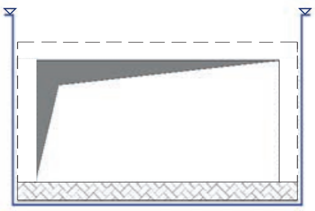


Fig 161 – Circular stirrup

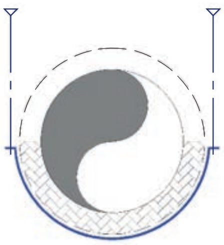


Fig 165 – Flat oval stirrup

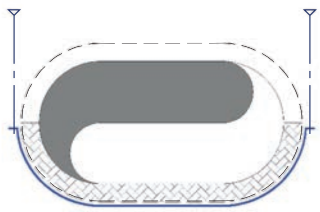


Fig 162 – Circular flat strap hanger

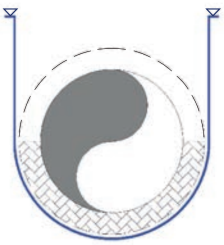
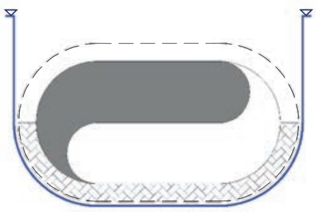


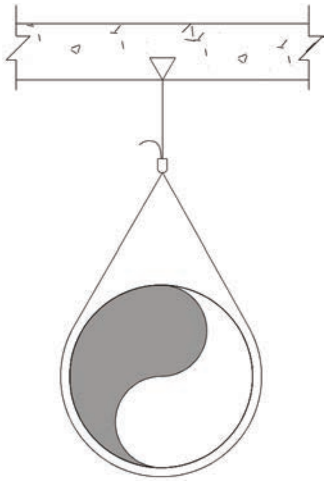
Fig 166– Flat oval flat strap



ARRANGEMENTS OF BEARERS AND HANGERS

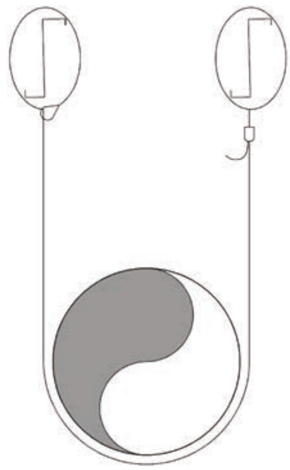
Typical examples of wire rope arrangements.

Fig 167



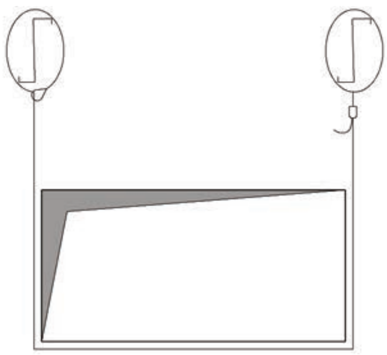
Circular ductwork with single attachment

Fig 168



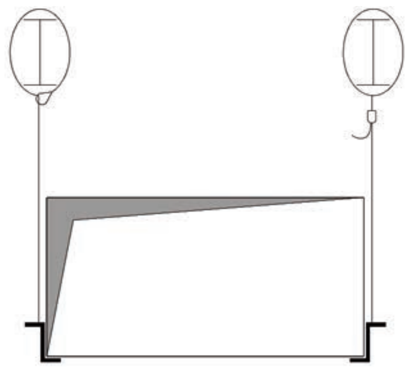
Circular ductwork with looped attachment

Fig 169



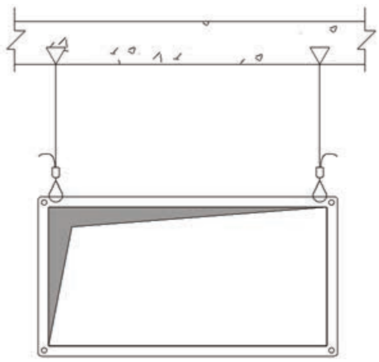
Rectangular ductwork

Fig 170



Rectangular ductwork with corner cleats

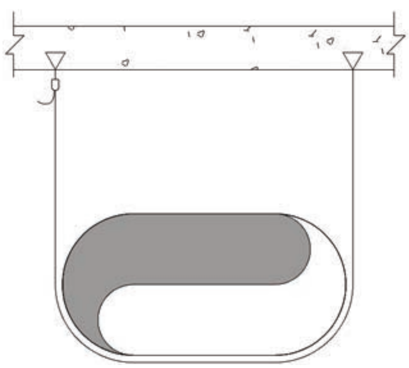
Fig 171



Rectangular ductwork supported on flange

(Roll formed flange manufacturer to confirm that their proprietary system is suitable for having hangers attached to the top corner of the flange configuration)

Fig 172



Flat oval ductwork

SUPPORT BEARERS

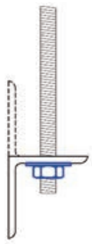


Fig 173

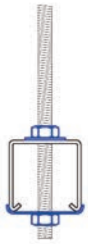


Fig 174


Fig 175


Fig 176

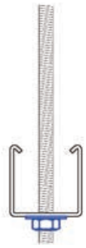


Fig 177


Fig 178

Rolled steel angle (or channel)

Profile channel (alternatives)

Inverted profile channel (alternatives)

VERTICAL DUCTS – Typical arrangements

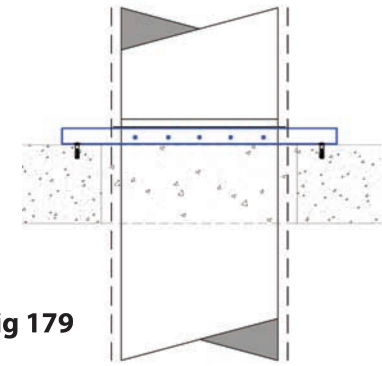


Fig 179

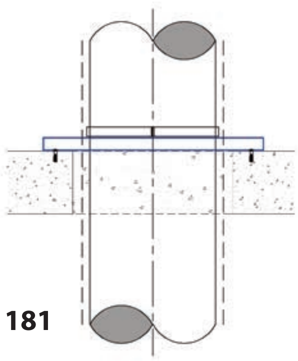


Fig 181

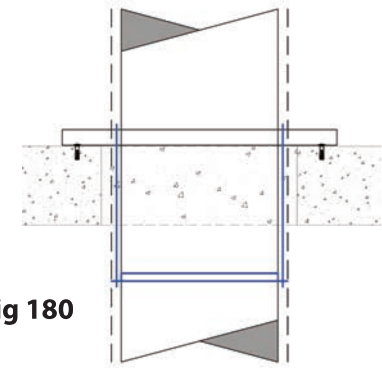


Fig 180

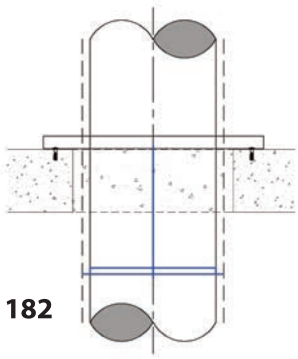


Fig 182

The support bearer, which, depending on duct/structural opening size, could be either channel or angle section, may be utilised in any of the following arrangements:-

a) Fixed directly to duct skin with sealed fixings (flat face only of either rectangular or flat oval)
b) To support the underside of a flat bar clip in halves (circular or flat oval)
c) To support the underside of either the stiffening frame of the flanged joint of any duct section
d) To support either a stiffening frame or a flanged joint below using drop rods/studding

TYPICAL EXAMPLES OF STRUCTURAL FIXINGS

Note: Manufacturers' details to be used for safe working loads

Fig. 183
Structural fixings for use in solid concrete

Stud anchor	
Knock-in anchor	
Sleeve anchor	
Wedge anchor	
Nail anchor	
Screw anchor	
Powder or gas actuated fixing	
Cast-in channel with T-bolt	

Fig. 184
Structural fixings for use in hollow-core concrete

Flared end expansion anchor	
Hollow deck anchor	
Glass reinforced nylon anchor with brass core	
Screw anchor	
Toggle fixing	
Adhesive anchor	

Fig. 185
Structural fixings for use with steelwork

Beam clamp	
Purlin clamp	
Purlin web fixing	
Wrap-around purlin hanger	
Powder actuated fixing	
Loop-end wire rope	

Fig. 186
Structural fixings for use in composite decking

Wedge fixings	

PART SEVEN – DUCTWORK RELATED INFORMATION

SECTION 19 DUCTWORK SEALING

Note: Risk of explosions
Where ductwork is blanked off prior to leakage testing or to prevent the ingress of contamination, the risk of explosion should be considered when the possibility of sealing or paint vapours may not have fully dispersed from within an enclosed section of ductwork.

B&ES members have supplied historical evidence where explosions have occurred when, for example, inspection lamp bulbs have shattered within the confines of a duct and where sparks have occurred resulting from duct skin cutting/drilling.

19.1 GENERAL

The integrity of the ductwork depends on the successful application of the correct sealant, gaskets or tape and be suitable for operating temperatures up to 70°C. The materials used should be suitable for the purpose intended and satisfy the specified pressure classification.
Illustrations indicating sealant locations will be found in the sections dealing with the construction of rectangular, circular and flat oval duct sections.

IN ALL CASES, SEALANT MATERIALS MUST BE APPLIED STRICTLY IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND COSHH ASSESSMENT.

19.2 LIQUID AND MASTIC SEALANTS

These are typically applied to a longitudinal seam formed between two sheets of metal, a socket and spigot, cleated or flanged cross joints. Particular care is needed when sealing "corner pieces" on the proprietary 'slide-on' type flange and reference should be made to the manufacturer's assembly and sealing instructions.

19.3 GASKETS

These can be of various materials in the form of a preformed roll, sheet or strip, applied between opposing faces of flanged cross joints. In the case of proprietary 'slide-on' type flanges, it is advisable to use the gasket strip recommended by the manufacturer.

Factory-fitted proprietary synthetic rubber gaskets of the o-ring or lip-seal type are also acceptable for socket and spigot joints on circular duct systems

19.4 TAPES

Best suited, but not limited, to cross joints on circular or flat oval ductwork. Should tape be used on flat oval ductwork care should be taken to maintain close contact between the material and the flat sides of the duct until the joint is completed.

Manufacturers of proprietary self-adhesive tapes emphasise the need to provide a dry, dust and grease free surface and this is critical if such joints are to meet the air leakage requirements of DW/144.

SECTION 20 ACCESS/INSPECTION OPENINGS

20.1 GENERAL

This section covers inspection/servicing access to inline equipment / components only. Appendix H sets out guidance notes, in summary form, of the access considerations that should be made by the system designer in terms of cleaning inspection and cleaning access. Appendix H recognizes two main aspects of cleaning access:

- Openings used for the inspection / servicing of inline equipment / components, as defined in this Section, will also be utilized for cleaning inspection and access.
- Specialist cleaning contractors, in addition to taking advantage of openings fitted by ductwork manufacturers in accordance with this Section, must fit any additional cleaning openings not only in order to suit their specific methods of cleaning but also to suit the practical site conditions relative to the fabric of the building and other services.

All openings shall be made safe and have sealed panels/covers designed so that they can be speedily removed and re-fixed i.e. multiple set screws and self- tapping screws are not acceptable as a method of fixing panels/covers to an access opening/frame.

The services coordinator should ensure that there is an area free of services and other obstructions to enable a panel/cover to be removed.

It shall be standard practice to connect safety restraints to access panels located in riser ducts.

Subject to the restrictions imposed by duct dimensions, openings for access shall satisfy the maintenance needs of the designated equipment with consideration being given, if more practicable, to the use of removable duct sections or flexible ducts/connections.

Note:
(a) Ductwork and duct supports are not designed for man access either inside or on top of the duct.

(b) Ductwork supports are not designed to accommodate additional loadings from other services.

As DW/144 ductwork or supports do not take into account either man-loading or the support of other building services, system designers must take this into account in accordance with BS EN 12236, 'Ventilation for buildings – Ductwork hangers and supports – Requirements for strength'. This consideration should also include recognition of all appropriate risk assessments.

20.2 ACCESS PANELS

An access panel is to be provided adjacent to items of in-line equipment that require either regular servicing or intermittent access. The opening will be sized to provide hand and/or arm access only and the system designer shall specify the size and location of panels where larger openings are required.

It shall be standard practice to provide access panels for the inspection and servicing of plant and equipment as listed below. Table 20 that follows, summarises these requirements under the heading of those panels to be fitted by the ductwork contractor.

20.2.1 FIRE/SMOKE DAMPERS

Wherever such dampers are installed, adequate means of access should be provided in a convenient position adjacent to the damper. The access panel should be large enough to allow testing and maintenance of both the damper and its actuating mechanism (BS 9999). Panels shall also allow access to the blades and fusible links. On multiple assembly units it may be necessary to provide more than one panel and this may be determined by both external access conditions and the internal reach to the blades and the fusible links.

20.2.2 FILTERS

In addition to access requirements specified by the manufacturer of the filter housing, a duct mounted access panel is to be located on the air entry side i.e. upstream.

20.2.3 HEATING/COOLING/RE-CLAIM COILS

Panel to be located on both sides.

20.2.4 IN-DUCT FANS/DEVICES

Panel to be located on the air entry side, i.e. upstream.

20.2.5 CONTROL DAMPERS

Panel to be located on the air entry side, i.e. upstream, on rectangular ducts 100mm or greater longest side and circular ducts 100mm dia or greater. Ducts smaller than these dimensions are, for access purposes, to be fitted with either flexible ductwork connections or removable duct sections.

20.2.6 ATTENUATORS

Apart from attenuators that are bolted directly to other items of in-line equipment, a panel is to be located on the air entry side, i.e. upstream.

20.2.7 AIR TURNING VANES/SPLITTERS

Panel to be located on the air entry side, i.e. upstream.

20.2.8 INLET / EXHAUST LOUVRES

Panel to be located in the connecting ductwork. It is particularly important that such a panel is accommodated for the inspection of bird mesh screens fitted behind louvres.

20.2.9 OTHER IN-LINE EQUIPMENT

For items such as humidifiers, control components, sensors, etc, panel to be located on the air entry side, i.e. upstream.

20.3 CLEANING INSPECTION AND CLEANING ACCESS.

System designers shall take specialist advice and then stipulate their requirements for the periodic internal cleaning/maintenance of ductwork and of the consequent need for adequate access for specialist cleaning equipment including the size, type and location/frequency of the actual site-fitted access openings specified by the specialist cleaning contractor.

Appendix H sets out guidance notes for the consideration of cleaning access and also makes reference to the B&ES publication TR/19 'Guide to Good Practice, Internal Cleanliness of Ventilation Systems' which covers the subject in greater detail.

Whilst it shall be standard practice to provide access panels for the inspection and servicing of plant and equipment as detailed in 20.2 above, additional panels may be required for cleaning inspection and cleaning access and these will be site-fitted where necessary by a specialist cleaning contractor. Table 20 below is a summary of the parties responsible for fitting access panels either for inspection/servicing access to inline equipment / components or cleaning inspection and cleaning access. This table is reproduced in full in B&ES publication TR/19 'Guide to Good Practice, Internal Cleanliness of Ventilation Systems' which covers the subject of cleaning inspection and cleaning access in greater detail.

Table 20 Location of Access Panels for Inspection/Servicing and/or Internal Cleanliness*

In-line equipment	Location	Party responsible for provision of suitable access panel	
		Ductwork Contractor	Specialist Cleaning Contractor
Control Dampers	Both sides	Up-stream panel	Down-stream panel
Fire Dampers	Both sides	To suit damper maintenance	Opposite side
Heating/Cooling/Re-claim Coils	Both sides	Panel on both sides	-
Attenuators (rectangular)	Both sides	Up-stream panel	Down-stream panel
Attenuators (circular)	Both sides	Up-stream panel	Down-stream panel
Filter sections	Both sides	Up-stream panel	Down-stream panel
Air turning vanes	Both sides	Up-stream panel	Down-stream panel
Changes of direction	One side	-	One panel to suit
In-duct Fans/Devices	Both sides	Up-stream panel	Down-stream panel
Inlet/Exhaust Louvre	One side	One panel to suit	-
Intermediate cleaning panels		-	To suit frequency specified in TR/19 and DW/172

*See following page for important notes relating to Table 20

Important notes relating to Table 20

System designers must ensure that consideration is given to the following aspects:

1 Providing sufficient clearance for cleaning access between in-line items of equipment, e.g. between attenuators and fans.

2 In order to fit access panels, providing sufficient space on the surfaces of large fittings such as, for example, segmented bends in spirally wound systems.

3 The importance of there being sufficient clearance for cleaning access between an Inlet/Exhaust Louvre and an item of inline plant equipment such as an attenuator or fan.

4 Recognising that fire resisting kitchen extract systems need a greater frequency of access panels as detailed in the B&ES publication DW/172, 'Specification for Kitchen Ventilation Systems' and that such panels must be incorporated into the manufacture of the kitchen extract ductwork. In the case of fire-resisting duct systems particular care must be taken to ensure that any retro-fitted access panels are suitably fitted, under licence to the fire-resisting systems manufacturer.

20.4 HAND HOLES

Hand holes to permit proper jointing of duct sections shall be provided at the manufacturer's discretion, but should be kept to a minimum and made as small as practicable. The hand hole cover shall be sealed and securely fastened.

20.5 OPENINGS IN INSULATED DUCTS

It will be the responsibility of the insulation contractor to 'dress' their insulation to the edge of the access opening without impeding the functionality of the panel, cover or door.

20.6 TEST HOLES FOR PLANT SYSTEM COMMISSIONING

It shall be standard practice to provide test holes, normally 13 mm diameter and fitted with an effective removable seal, at the following locations: at fans (in the straightest section of duct near to the fan outlet); at cooling coils and heating coils (both before and after the coil). The actual location of the test holes shall be confirmed by the system designer and/or commissioning engineer either at the drawing approval stage (to be works drilled) or during the commissioning activity to be site drilled by the commissioning engineer. For practical access reasons the latter method is usually preferred.

20.7 INSTRUMENT CONNECTIONS

Instrument connections shall be provided where shown on the contract drawings, suitably drilled or bossed and screwed as sizes specified.

20.8 OPENINGS REQUIRED FOR OTHER PURPOSES

It shall be the system designer's responsibility to specify the location and size of any openings required other than those covered in this section. In the case of hinged access doors it shall be the system designer's responsibility to indicate on the drawings the location and size of any hinged access doors required, ensuring that there is an area free of services and other obstructions to enable the door to be satisfactorily opened.

SECTION 21 REGULATING DAMPERS

21.1 GENERAL

Balancing dampers and control dampers are elements inserted into an air distribution system, or elements of an air distribution system. Balancing dampers permit modification of the air resistance of the system and consequently changing of the airflow rate. Control dampers control the airflow rate and in addition provide low leakage closure of the airflow.

The system designer shall specify damper locations and select the damper type as defined in 21.2 appropriate to the airflow, pressure and acoustic characteristics.

21.1.1 BALANCING DAMPER

Required to achieve a balanced distribution of air in the ductwork system at inlets and/or outlets. For this purpose, the damper blades are set and locked manually in any required position between fully open and fully closed.

Note: There are also proprietary self-powered constant flow rate control dampers that can be manually set to provide a selected constant flow rate balance function independent of upstream pressure.

21.1.2 CONTROL DAMPER

Required to secure dynamic control of the air flow in the ductwork system. In this function, the damper will always be power – actuated and may require to be modulated between fully open and fully closed, and to be capable of taking up any position between these extremes. In the fully open position, the damper should have a minimum pressure drop. In the fully closed position, it will not necessarily achieve a complete shut off.

21.2 TYPES OF AIRFLOW CONTROL DAMPER

Air flow dampers of various types are available for specific purposes as follows.

21.2.1 SINGLE-BLADE DAMPERS (SINGLE OR DOUBLE SKIN)

Single-blade dampers shall consist of a single pivoted blade contained within a casing or section of ductwork. The blade shall be adjustable through a nominal 90° angle by means of a quadrant or similar operating mechanism. Where automatic control of the damper is required the spindle shall be extended to enable a powered actuator to be mounted. Single-blade dampers (single-skin section) shall have a maximum duct width of 300 mm and a maximum duct height of 300 mm for rectangular ducts; and for circular ducts a maximum diameter of 315 mm.

Single-blade dampers (double-skin section) are suitable for use in rectangular ducts, and shall have a maximum duct width of 1250 mm and a maximum height of 300 mm.

Note: Dampers, from a recognised manufacturer, with proven performance may be used to any size.

21.2.2 *MULTI-BLADE DAMPERS (SINGLE OR DOUBLE SKIN) PARALLEL OR OPPOSED BLADE*

Multi-blade dampers shall consist of a number of pivoted blades contained within a casing. The blades shall be adjustable through a nominal 90° angle simultaneously by interconnected linkage or gears, connected to a quadrant or similar operating mechanism. Where automatic control of the damper is required a spindle shall be extended to enable a powered actuator to be mounted.

There is no restriction on the size of duct in which multi-blade dampers or damper assemblies may be used. Where dampers are required for blade lengths in excess of 1250 mm, the blades should be suitably re-inforced or supported. No individual damper blade should exceed 200 mm in width.

Note: Dampers, from a recognised manufacturer, with proven performance may be used to any size.

21.2.3 *IRIS DAMPERS*

Iris dampers shall consist of a number of radially inter-connected blades which open or close within a casing with duct connection spigots. The blades shall be simultaneously adjusted by a quadrant or similar operating mechanism.

Iris dampers should be installed as specified by the manufacturer's operating and installation instructions, where the product is unidirectional with regard to airflow.

Iris dampers are available for circular ducts only, in diameters up to 800 mm (It should be noted that the damper casing may be up to twice the diameter of the duct).

21.2.4 *BACKDRAFT DAMPERS*

Air pressure operated uni-directional rectangular (single or multi-blade) with adaptors if fitted to circular or oval ducts.

21.2.5 *HIT AND MISS DAMPERS*

Two parallel adjacent plates each with multiple openings sliding against each other. The openings are designed to provide 50% maximum free area for flow rate when they fully coincide. Used for simple operations and designed up to 400 mm on the longest side.

Note: Dampers, from a recognised manufacturer, with proven performance may be used to any size.

21.2.6 SLIDE AND BLAST GATE DAMPERS

A damper used as a shut off facility, normally for use in circular ductwork with an external slide housing allowing a blade to be fully inserted to fully extended for maximum air flow. Generally available in cast/pressed formats up to 355 mm diameter and normally used in industrial exhaust applications.

Note: Dampers, from a recognised manufacturer, with proven performance may be used to any size.

21.3 CONSTRUCTION

21.3.1 MATERIALS

Dampers shall be constructed from steel, stainless steel, aluminium or synthetic materials. All products shall be protected against corrosion as necessary and supplied in a fully finished condition as specified by the system designer.

21.3.2 DAMPERS USED IN LOW AND MEDIUM PRESSURE SYSTEMS

The following recommendations apply to dampers forming an integral part of ductwork with pressure classification A and B air leakage limits. The dampers shall be constructed to prevent distortion and jamming in operation. The blades shall be sufficiently rigid to minimise movement when in the locked position. The blades shall be securely fixed to the operating mechanism. Spindles shall be carried in either non-ferrous, synthetic or roller bearings. All balancing dampers shall have a locking device located on the outside of the case and shall give clear indication of the actual blade position. All penetrations of the duct shall be fitted with suitable seals where necessary.

21.3.3 DAMPERS USED IN HIGH PRESSURE SYSTEMS

Regulating dampers used in ductwork systems to pressure classifications C and D shall meet the construction requirements specified in 21.3.1 and 21.3.2 with operating mechanisms out of the airstream.

21.3.4 PROPRIETARY TYPES OF DAMPER

The use of any specific type of proprietary damper shall be confirmed by the system designer. In all cases, proprietary dampers shall meet the relevant requirements of this specification.

21.3.5 DAMPER AERODYNAMIC PERFORMANCE

Performance and rating test methods for dampers and valves are specified in BS EN 1751 and ISO 5129 and are referenced opposite:

21.3.5.1 DAMPER BLADE LEAKAGE

Leakage past a closed damper or valve may be classified using the data published in BS EN 1751. Balancing dampers would have no classification as they will not be expected to close and isolate. Classes then increase 1 to 4 with Class 4 being the most leak-tight.

Note: For standard HVAC type applications Class 4 is generally unnecessary and expensive to achieve.

21.3.5.2 DAMPER CASING LEAKAGE

Duct damper casings shall be constructed to meet the minimum leakage limits specified for the ductwork system to which they are installed. Dampers shall have casing leakage classes to meet BS EN 1751. Ductwork leakage classifications C and D will be met by dampers having casing leakage classification C from BS EN 1751 (Note: there is no class D classification for damper casings in BS EN 1751, but due to the small surface area of a damper as part of the whole ductwork system Class C is adequate).

In order to apply the square metre leakage calculation as detailed in DW/143 'A Practical Guide to Ductwork Leakage Testing', the reference casing area shall be taken as the perimeter size of the damper multiplied by the equivalent length of one metre e.g. an 800 mm x 400 mm duct damper shall have a surface area for casing leakage performance calculated as follows; [(2 x 0.8) + (2 x 0.4)] x 1 = 2.4m^2 casing area.

21.3.5.3 DAMPER FLOW RATE/PRESSURE RESISTANCE CHARACTERISTICS

These shall be measured according to the method prescribed, and presented in the manner described, in BS EN 1751.

21.3.5.4 OPERATIONAL TORQUE TESTING

These shall be measured according to the method prescribed, and presented in the manner described, in BS EN 1751.

21.3.5.5 THERMAL TRANSMITTANCE TESTING

Where required these shall be measured according to the method prescribed, and presented in the manner described, in BS EN 1751.

21.3.5.6 REGENERATED SOUND POWER LEVELS

These shall be measured according to the method prescribed, and presented in the manner described, in ISO 5129

21.4 INSTALLATION

Dampers shall be installed in accordance with the relevant ISO, EN or British Standard, local building regulations and national codes of practice as well as the manufacturer's recommendations.

SECTION 22 FIRE DAMPERS

Important note!
Legislation and accountability for Fire Safety Products is a critical aspect in the manufacture of fire dampers and this section must be read in conjunction with Appendices L and M and Commentary and Guidance – Note 5.

22.1 GENERAL

Fire dampers are required in air distribution systems for fire containment (please refer to the current version of Approved Document B: Fire safety – official interpretation of the building regulations). Generally they are called for where ducts penetrate walls or floors which form fire compartmentation. For CE marking fire dampers are required to meet the requirements of BS EN 15650. Fire dampers shall be fire tested to BS EN 1366-2 and classified to BS EN 13501-3.

The damper assembly shall have a fire integrity classification (E) equal to that of the fire barrier it penetrates. A further leakage classification (S) is also available and is required for areas such as the protection of escape routes and where there is sleeping risk.

Note 1: dampers of the same model may have a different E or ES classification depending upon how, and in which type of construction, they are installed.

Note 2: dampers protecting escape routes or areas with sleeping risk may need to be remotely operated in response to smoke alarms.

Note 3: dampers that have been tested to BS476-20/22 may only be used where any fans are to be immediately turned off in a fire situation (although allowed by ADB these may not be CE marked and therefore may not be available).

Note 4: fire dampers only tested to BS476-20/22 cannot be CE marked or classified E or ES to BS EN 13501-3.

22.2 TYPES OF FIRE DAMPERS

Fire dampers of various types are available for specific purposes, as follows:

22.2.1 FOLDING CURTAIN FIRE DAMPER

Folding curtain fire dampers shall be constructed of a series of interlocking blades which fold to the top of the assembly permitting the maximum free area in the airway. The blades shall be held in the open position by means of a thermal release mechanism rated at 72°C ± 4°C. The fire damper must be able to close against static air conditions when mounted in either the vertical or horizontal planes. A local excess temperature in the area of the fire damper shall, independent of any remote sensors, automatically release the blades and close the airway by means of the thermal release mechanism,. If required, in the event of a signal from a remote sensor the fire damper blades shall be released and close the airway. This would normally be achieved by an electric solenoid or electromagnet. Curtain fire dampers generally provide an E classification to BS EN 13501-3, as they do not have the cold leakage characteristics to achieve the ES classification.

22.2.2 SINGLE BLADE FIRE DAMPER

Single blade fire dampers shall consist of a single pivoted blade within a fire resistant case. The blade shall be released from its open position by means of a thermal release mechanism rated at 72°C ± 4°C. If required, in the event of a signal from a remote sensor this would be achieved by an actuator, electric solenoid, electromagnet or other device. The blade shall close the airway by means of any one, or combination of, an eccentric pivot, balance weight(s) and/or spring(s), the spring element being incorporated within the damper or actuator mechanism. The fire damper shall be able to operate in either or both the vertical and horizontal planes. Single blade fire dampers may provide an E or ES classification to BS EN 13501-3, depending on their individual design, their proposed method of installation and the construction they are to be mounted in to. Care should be taken before selection any such units, with particular regard to an ES requirement, to ensure that all three restraints will be fulfilled.

22.2.3 MULTI-BLADE FIRE DAMPER

Multi-blade fire dampers shall consist of a number of linked blades contained within a fire resistant case. The blades shall be released from their open position by means of either a thermal release mechanism rated at 72°C ± 4°C. If required, in the event of a signal from a remote sensor this would be achieved by an actuator, electrical solenoid, electromagnet, or other device.

The blades shall close the airway by means of a spring(s), the spring element being incorporated within the damper or actuator mechanism. The fire damper shall be able to operate in either or both the vertical and horizontal planes. Multi blade fire dampers may provide an E or ES classification to BS EN 13501-3, depending on their individual design, their proposed method of installation and the construction they are to be mounted in to. Care should be taken before selection any such units, with particular regard to an ES requirement, to ensure that all three restraints will be fulfilled.

22.2.4 INTUMESCENT FIRE DAMPER

Intumescent fire dampers incorporate components, which swell by intumescent activity under the action of heat, to close the airway to prevent the passage of fire. They are required to be tested to BS EN1366-2 and/or BS ISO 10294-4. The intumescent materials form the main component for fire integrity. Activation temperatures will be influenced by the type of intumescent material selected and these temperatures typically range from 120°C to 270°C. In some instances this may be supported with a mechanical device to prevent cold smoke leakage. If required, in the event of a signal from a remote sensor activation of this device would be achieved by an actuator, electrical solenoid, electromagnet, or other device.

Note: these devices are generally used in door/partition low velocity applications. Intumescent dampers without a cold smoke leakage prevention device will only achieve an E classification to BS EN 13501-3, as they have no cold smoke leakage performance to achieve ES. Intumescent dampers with a cold smoke leakage device may provide an E or ES classification to BS EN 13501-3, depending on their individual design, their proposed method of installation and the construction they are to be mounted in to. Care should be taken before selection any such units, with particular regard to an ES requirement, to ensure that all three restraints will be fulfilled.

22.3 FIRE DAMPER MATERIALS AND CONSTRUCTION

The damper shall be constructed from steel or stainless steel or other approved material. Steel products shall be protected against corrosion and supplied in a fully assembled condition as specified by the system designer.

22.4 FIRE DAMPER AERODYNAMIC PERFORMANCE

Performance and rating test methods for dampers and valves are specified in BS EN 1751 and ISO 5135 (section 21.3.5).

22.5 FIRE DAMPER INSTALLATION

Damper installation shall be in accordance with the manufacturer's recommendations and to the satisfaction of the local building control department. The former is mandatory to match the performance given for a CE marked product.

Further reference should be made to the B&ES Publication DW/145 – 'Guide to Good Practice, for the installation of Fire and Smoke Dampers', noting that fire dampers may provide an E or ES classification to BS EN 13501-3, depending on their individual design, their proposed method of installation and the construction they are to be mounted in. Care should be taken before selecting any such units, with particular regard to an ES requirement, to ensure that all three restraints will be fulfilled.

For the same reason, changes to any dampers specified in a design should only be undertaken with very careful consideration. They may have been selected with special installation methods/requirements to allow E or ES classifications that a different manufacturer may not be able to supply test evidence for.

Any conflict between the manufacturer's recommendation and DW/145 should be resolved and authorised by the system designer responsible for the fire damper selection. Simply using a method shown in DW/145 does not mean that an installation is compliant; it must be checked against the manufacturer's installation information.

The information in this up-dated section is based on information kindly supplied by the Heating, Ventilation and Air Conditioning Association (HEVAC) and further information on this subject can be obtained from their web site at www.feta.co.uk

SECTION 23 COMBINATION SMOKE AND FIRE DAMPERS

Important note!
Legislation and accountability for Fire Safety Products is a critical aspect in the manufacture of fire dampers and this section must be read in conjunction with Appendices L and M and Commentary and Guidance – Note 5.

23.1 *GENERAL*

These units are fire dampers as generally described above, but would be expected to be actuated in some way to respond to a remote signal in the case of a smoke alarm to prevent the passage of cold smoke. They would normally be expected to achieve an ES classification to BS EN 13501-4. If selected for the protection of escape routes or sleeping risk areas they must have an ES classification.

23.2 *TYPES OF COMBINATION FIRE AND SMOKE DAMPER*

As single, multi-blade and intumescent (with mechanical device to prevent cold leakage) fire dampers with ES classification.

23.3 *COMBINATION FIRE AND SMOKE DAMPER MATERIALS AND CONSTRUCTION*

The damper shall be constructed from steel or stainless steel or other approved material. Steel products shall be protected against corrosion and supplied in a fully assembled condition as specified by the system designer.

23.4 *COMBINATION FIRE AND SMOKE DAMPER AERODYNAMIC PERFORMANCE*

Performance and rating test methods for dampers and valves are specified in BS EN 1751 and ISO 5135 (section 21.3.5).

23.5 *COMBINATION FIRE AND SMOKE DAMPER INSTALLATION*

Combination fire and smoke damper installation shall be in accordance with the manufacturer's recommendations and to the satisfaction of the local building control department.
Further reference should be made to the B&ES Publication DW/145 – 'Guide to Good Practice for the installation of Fire and Smoke Dampers,' noting that fire dampers may provide an E or ES

classification to BS EN 13501-3, depending on their individual design, their proposed method of installation and the construction they are to be mounted in to. Care should be taken before selection any such units, with particular regard to an ES requirement, to ensure that all three restraints will be fulfilled.

For the same reason, changes to any dampers specified in a design should only be undertaken with very careful consideration. They may have been selected with special installation methods/requirements to allow E or ES classifications that a different manufacturer may not be able to supply test evidence for.

Any conflict between the manufacturer's recommendation and DW/145 should be resolved and authorised by the system designer responsible for the fire damper selection.

The information in this up-dated section is based on information kindly supplied by the Heating, Ventilation and Air Conditioning Association (HEVAC) and further information on this subject can be obtained from their web site at www.feta.co.uk

SECTION 24 SMOKE DAMPERS

Important note!
Legislation and accountability for Fire Safety Products is a critical aspect in the manufacture of fire dampers and this section must be read in conjunction with Appendices L and M and Commentary and Guidance – Note 5.

24.1 GENERAL

When smoke and heat exhaust ventilation is being considered, it becomes apparent that a clear path must be made between the area where heat and smoke is being generated (the fire) and the outside of the building.

To create this path there must be ducts and the smoke extract path must remain uninterrupted. This means that dampers at the fire have to be open and remain open. Dampers along the path have to be open and remain open. Dampers at branches, or on the surface of the duct, along the path must be closed and remain closed. In fact, if the duct crosses a compartment boundary it becomes part of the fire compartment in which the fire started.

To achieve this, modified fire dampers may be applied, but the units should be fitted with on/off actuators, have no thermal operating elements and be under the control of a smoke management system. Dampers that are designed to fail open using a thermal operating element at the outside of the building or in a collection area may be used, noting that once this device has operated, the unit ceases to be under the control of the system as its action may not be reversed by the system.

Smoke dampers that have the demonstrated ability to function at raised temperature (e.g. 300°C) for 1 or 2 hours may also be specified. Therefore it is suggested that dampers achieving an ES classification would be most suitable as they have proven hot and cold leakage.

24.2 TYPES OF SMOKE DAMPER

As single and multi-blade fire dampers with ES classification.

24.3 SMOKE DAMPER MATERIALS AND CONSTRUCTION

The damper shall be constructed from steel or stainless steel or other approved material. Steel products shall be protected against corrosion and supplied in a fully assembled condition as specified by the system designer.

24.4 SMOKE DAMPER AERODYNAMIC PERFORMANCE

Performance and rating test methods for dampers and valves are specified in BS EN 1751 and ISO 5129 (see section 21.3.5).

24.5 SMOKE DAMPER INSTALLATION

Smoke damper installation shall be in accordance with the manufacturer's recommendations and to the satisfaction of the local building control department.

Further reference should be made to B&ES Publication DW/145– 'Guide to Good Practice for the installation of Fire and Smoke Dampers', noting that fire dampers may provide an E or ES classification to BS EN 13501-3, depending on their individual design, their proposed method of installation and the construction they are to be mounted in to. Care should be taken before selecting any such units, with particular regard to an ES requirement, to ensure that all three restraints will be fulfilled.

For the same reason, changes to any dampers specified in a design should only be undertaken with very careful consideration. They may have been selected with special installation methods/requirements to allow E or ES classifications that a different manufacturer may not be able to supply test evidence for.

Any conflict between the manufacturer's recommendation and DW/145 should be resolved and authorised by the system designer responsible for the fire damper selection.

The information in this up-dated section is based on information kindly supplied by the Heating, Ventilation and Air Conditioning Association (HEVAC) and further information on this subject can be obtained from their web site at www.feta.co.uk

SECTION 25 SMOKE CONTROL DAMPERS

Important note!
Legislation and accountability for Fire Safety Products is a critical aspect in the manufacture of fire dampers and this section must be read in conjunction with Appendices L and M and Commentary and Guidance – Note 5.

25.1 GENERAL

A further smoke control damper product is now defined within standards that is applicable to smoke control ductwork tested to BS EN 1366-8, BS EN 1366-9, product standard BS EN 12101-7 and classification standard BS EN 13501-4. These smoke control dampers have a product standard BS EN 12101-8, should be tested to BS EN 1366-10 and may be classified to BS EN 13501-4.

These standards for smoke control ductwork and dampers may become applicable within the life of this standard and then similar procedures should be followed as that which are followed for fire dampers above, but using the published standards for smoke control products.

25.2 TYPES OF SMOKE CONTROL DAMPER

As single and multi-blade fire dampers with ES classification.

25.3 SMOKE CONTROL DAMPER MATERIALS AND CONSTRUCTION

The damper shall be constructed from steel or stainless steel or other approved material. Steel products shall be protected against corrosion and supplied in a fully assembled condition as specified by the system designer.

25.4 SMOKE CONTROL DAMPER AERODYNAMIC PERFORMANCE

Performance and rating test methods for dampers and valves are specified in BS EN 1751 and ISO 5135 (see section 21.3.5).

25.5 SMOKE CONTROL DAMPER INSTALLATION

Smoke control damper installation shall be in accordance with the manufacturer's recommendations and to the satisfaction of the local building control department.

Further reference should be made to B&ES Publication DW/145 – 'Guide to Good Practice for the installation of Fire and Smoke Dampers,' noting that fire dampers may provide an E or ES classification to BS EN 13501-4, depending on their individual design, their proposed method of installation and the construction they are to be mounted in to. Care should be taken before selecting any such units, with particular regard to an ES requirement, to ensure that all three restraints will be fulfilled.

For the same reason, changes to any dampers specified in a design should only be undertaken with very careful consideration. They may have been selected with special installation methods/requirements to allow E or ES classifications that a different manufacturer may not be able to supply test evidence for.

Any conflict between the manufacturer's recommendation and DW/145 should be resolved and authorised by the system designer responsible for the fire damper selection.

The information in this up-dated section is based on information kindly supplied by the Heating, Ventilation and Air Conditioning Association (HEVAC) and further information on this subject can be obtained from their web site at www.feta.co.uk

SECTION 26 EXTERNAL DUCTWORK

26.1 *DW/144 DUCTWORK*

Ductwork constructed to B&ES DW/144 standard requirements is neither weatherproof nor watertight. However it is acceptable and economical to use Z140 coating galvanized ductwork constructed to B&ES DW/144 construction in locations external to the building providing that the ductwork is not only manufactured in accordance with the guidelines set out in this section but that it is also protected from the elements by a watertight membrane - provided by others. The application of a follow-on waterproof membrane must be programmed to be installed immediately after the DW/144 ductwork has been installed. Also see Clause 34.5, External ductwork, in the section 'THERMAL INSULATION'. If airtight, waterproof flexible insulation jackets are applied on positive pressure ducts, the insulation should accommodate some duct leakage: ducts are not completely airtight.

System designers should give consideration to the following;

- Waterproofing details
- Expected inclement weather conditions
- Expected service life relative to its exposure particularly with regard to the corrosive effect of coastal areas
- Orientation of air intakes and discharges to minimize water ingress
- On-going maintenance of exposed surfaces

26.2 *CONSTRUCTION OF NON-INSULATED DW/144 DUCTWORK*

If ductwork is NOT to be protected by a watertight membrane as in 26.1 above then a construction should be specified by the system designer that takes into account the following aspects:-

26.2.1

The ductwork should be constructed from galvanized sheet with a minimum coating thickness of Z275

26.2.2

Careful consideration must be given to the construction of the ductwork to ensure, where possible, that the longitudinal seams are at the bottom of horizontal ductwork.

26.2.3

All mild steel components such as RSA/RSC should be protected in accordance with SECTION 32.

26.2.4

Areas where galvanizing has been damaged or destroyed during the manufacturing process shall be suitably prepared and painted with zinc rich or a suitable protective coat - in accordance with SECTION 32.

26.2.5

Access panels should be positioned on the duct sides and it is recommended that the top opening joint is protected from water ingress by a suitably sized / located protective 'apron'.

26.3 DUCTWORK GASKETS AND SEALANTS

26.3.1 GASKETS

Gasket material must maintain a seal, be waterproof and not harden or lose flexibility, adhesion, or elongation after prolonged exposure to high or low temperatures and ultraviolet light. i.e. butyl rubber or similar. Open cell rubber gasket tape is not recommended.

26.3.2 SEALANTS

Sealant should be applied to all exposed joints where water may enter the ductwork. Sealants should be fit for purpose; the following consideration should be given when selecting sealants for external ductwork

- Specific for bonding to metal
- Remain flexible when cured
- Specifically designed for external weather
- Ability to remain impervious to ultra violet
- Temperature variations

Polysulphide sealant or similar meets these requirements and is a one component, gun applied, synthetic rubber based sealant. In all cases manufacturer's recommendations should be followed. Water based sealants should not be used on external ductwork.

26.4 PROTECTIVE PAINTING

Refer to Clause 32, Protective finishes.

26.5 HOT DIPPED GALVANIZED AFTER MANUFACTURE DUCTWORK

An alternative solution is for the ductwork to be fabricated using all welded construction techniques using black mild steel sheet and RSA flanges and stiffener frames and then galvanized after manufacture (Appendix C). The galvanizing process induces a great deal of stresses into the duct panels, which tends to distort the panels. Although this can give a non-uniform and unsightly appearance, this is the most effective way to avoid water ingress. As a secondary precaution, polysulphide waterproof synthetic rubber sealant should be site applied to joint gaskets.

26.6 ROOF PENETRATIONS

System designers should ensure that all roof openings have a roof kerb built as part of the building structure in order to avoid water ingress or snow. Each roof opening should only have one duct passing through - not multi-service. The ductwork should have a weathering cravat to fit over the kerb. The ductwork manufacturer will provide a roof skirt (cravat) to cover the roof kerb and this should be of either a fully welded construction or have seams sealed with a polysulphide sealant or similar.

Typical arrangements of roof penetrations are shown in Figs. 187 to 189.

26.7 ROOF UNITS

It is recommended that all such units are of a proprietary type due to their increased commercial availability. If necessary, basic roof discharge cowls for circular systems should be sized to suit Fig. 119 and suitably sealed. All air inlet openings and discharge cowls should be fitted with devices to prevent the entry of 'foreign bodies'.

26.8 DUCTWORK SUPPORTS

When considering ductwork roof supports, the system designer must not only consider the effect of high wind but also the method of retaining the ductwork in position.

To ensure a watertight, structural solution, system designers may need to consider the following

- The integrity of the roof structure and its ability to support the weight of the ductwork
- The ability of the roof membrane to accommodate the duct weight and its support feet
- The potential wind loading on the external ductwork
- The need to secure the ductwork to the supporting structure including the use of guy wires

There are a number of proprietary support feet available to assist in spreading the weight load on a roof membrane however consideration must be given to ensure that provision has been made for the ductwork to be secured to the roof.

26.9 TYPICAL ARRANGEMENTS OF ROOF PENETRATIONS

Fig 187

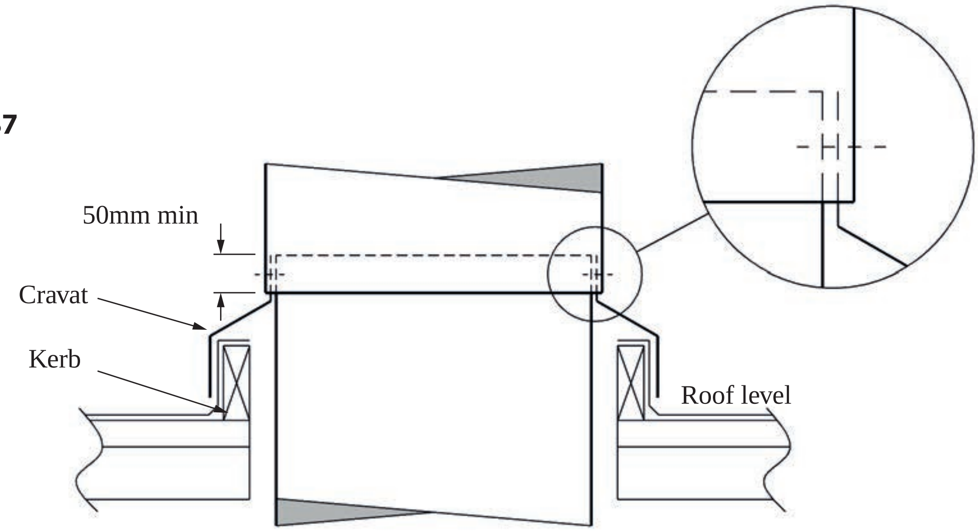


Fig 188

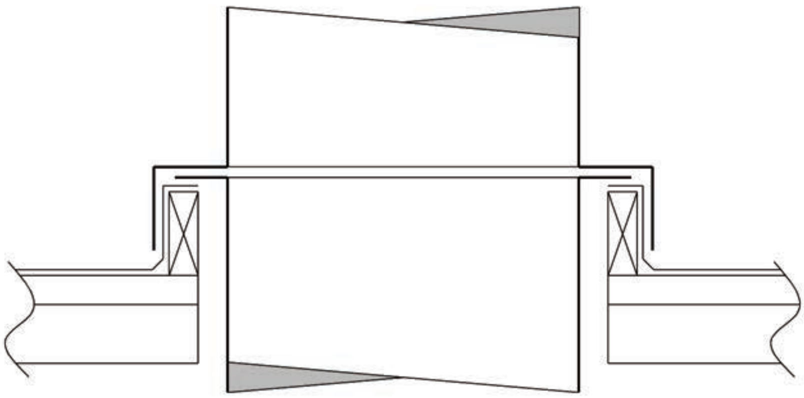
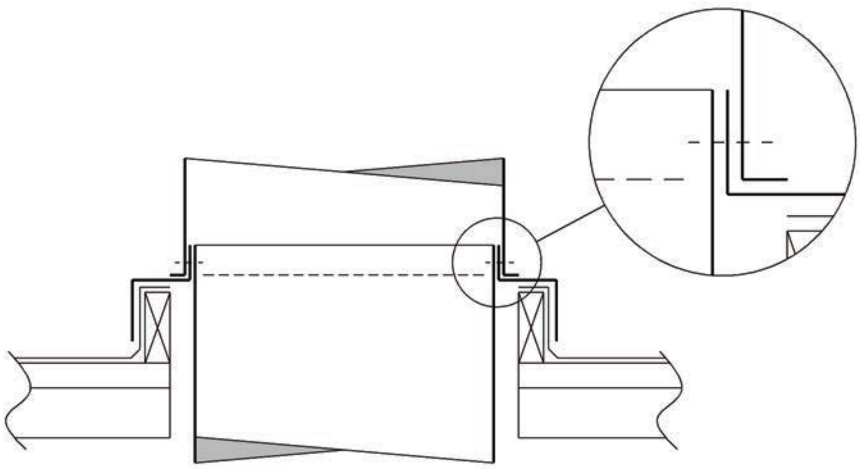


Fig 189



SECTION 27 KITCHEN VENTILATION

For detailed information reference should be made to B&ES Publication, DW/172 'Specification for Kitchen Ventilation Systems:'

SECTION 28 FIRE RESISTING AND SMOKE CONTAINMENT DUCTWORK

For information see Commentary and Guidance – Note 4.

Ductwork constructed to DW/144 standard has no fire resistance. General purpose ventilation/air conditioning ductwork and its ancillary items do not have a fire classification and cannot be either utilised as or converted into fire rated ductwork unless the construction materials of the whole system including supports and penetration seals are proven by test and assessment in accordance with the appropriate test standard. In the case where galvanized sheet steel ductwork is clad with the application of protective material, the ductwork construction must be as type tested and comply with the protective material manufacturers recommendation, e.g. sheet thickness of ductwork, frequency of stiffening and non-use of low melting point fasteners and rivets. Particular emphasis should be given to how the ductwork is installed into the supporting construction (walls and floors of different types) and what additional stiffening should be employed within the wall as was tested. Sealants, gaskets and flexible joints should be tested and certificated in accordance with the appropriate test standard and comply with all manufacturers recommendations. Careful consideration must be given to the maximum certified size as tested and the manufacturer's recommendation should always be followed.

In BS9999, the definition of fire resistance is the 'Ability of a component or construction of a building to meet for a stated period of time some or all of the appropriate criteria specified in the relevant part of BS 476 or the relevant BS EN 1366 test standard'. So, a duct simply tested or assessed to 300/400^{0}C is **NOT** fire resistant in a fully developed fire.

SECTION 29 STANDARD COMPONENT DRAWINGS FOR PLANT/EQUIPMENT/MISCELLANEOUS AND ABBREVIATIONS

Figs. 190 to 198 that follow in this section recommend standard drawing representation and terminology for plant/equipment/miscellaneous components. System designers and surveyors should note that bills of quantities should provide a full description of the items required.

The abbreviations listed in Table 21 are commonly used throughout the industry. It is expected that any other abbreviations used are separately defined when used in specifications, drawings, etc.

STANDARD COMPONENT DRAWINGS – PLANT / EQUIP / MISC

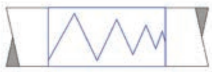
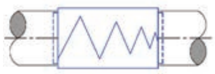
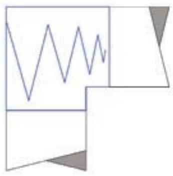
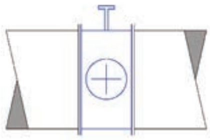
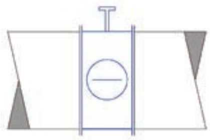
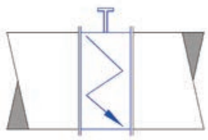
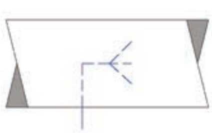
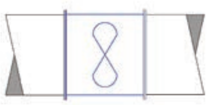
Fig. 190		**Rectangular Attenuator**
Fig. 191		**Circular Attenuator**
Fig. 192		**Bend Attenuator**
Fig. 193		**Heating Coil**
Fig. 194		**Cooling Coil**
Fig. 195		**Electric Heating Coil**
Fig. 196		**Humidifier**
Fig. 197		**Axial Fan**
Fig. 198		**Non-standard Ductwork** Cross hatching (of any separate type) indicates by reference to a key, any non DW/144 ductwork system. e.g. internally lined, fire rated, stainless steel, aluminium, pre-finished or other.

Table 21 - STANDARD ABBREVIATIONS

ABBREVIATION	FULL
AD	Access Door
AFF	Axial Flow Fan
AHU	Air Handling Unit
ALI	Aluminium
AP	Access Panel
ATT	Attenuator
ATU	Air Terminal Unit
BE	Blank End
BG	Blast Gate Damper
BOD	Bottom of Duct
CC	Cooling Coil
CF	Centrifugal Fan
CTA	Cross Talk Attenuator
CVU	Constant Volume Unit
DP	Drain Point
EHC	Electric Heating Coil
EXH	Exhaust Outlet
F	Filter
FAI	Fresh Air Inlet
FA	From Above
FB	From Below
Flex/C	Flexible Connection
Flex/D	Flexible Duct
FC	False Ceiling
FCU	Fan Coil Unit
FD	Fire Damper
FFL	Finished Floor Level
FJ	Flanged Joint
FOB	Flat on Bottom
FOT	Flat on Top
FRD	Fire Rated Ductwork
FRP	Fibre Reinforced Plastic
GAM	Galvanized after Manufacture
GRP	Glass Reinforced Plastic
GSS	Galvanized Sheet Steel
HC	Heating Coil
HD	Hand Controlled Damper
HH	Hand Hole
HL	High Level
HP	Hepa Filter
IC	Inspection Cover
ID	Iris Damper

Table 21 - STANDARD ABBREVIATIONS (continued)

ABBREVIATION	FULL
IU	Induction Unit
LL	Low Level
MD	Motor Controlled Damper
MS	Mild Steel
NRD	Non Return Damper
NTS	Not to Scale
OBD	Opposed Blade Damper
OE	Open End
PBD	Parallel Blade Damper
PE	Polyethylene
PD	Pneumatic Controlled Damper
PP	Polypropylene
PPs	Fire Retardant Polypropylene
PRD	Pressure Relief Damper
PVC-u	Polyvinyl Chloride
RC	Reclaim Coil
RFC	Rolled Form Channel
RSC	Rolled Steel Channel
RU	Roof Unit
SBD	Single Blade Damper
SBFD	Single Blade Fire Damper
SD	Smoke Damper
SJ	Slip Joint
ST/ST	Stainless Steel
SSL	Structural Slab Level
TA	To Above
TB	To Below
TD	Top Down (In Direction of flow)
TJ	Telescopic Joint
TOD	Top of duct
TP	Test Point
TV	Turning Vane
TU	Top Up (In Direction of flow)
UOS	Unless Otherwise Stated
UPVC	Unplasticised Polyvinyl Chloride
US	Underside
VAV	Variable Air Volume
40 SMF	Self Metal Flange (With size)
50 RSA	Rolled Steel Angle (With size)

SECTION 30 FLEXIBLE DUCTS

30.1 *GENERAL*

Flexible ducts are available in a range of materials including metal, plastics and coated fabrics, and are commonly used for connections to the following equipment:-

- Terminal units
- Fan coil units
- Volume control devices
- Grilles and Diffusers
- Plenum boxes

Flexible ducts are also available in a pre-insulated format that can provide thermal or acoustic insulation properties.

The system designer shall consider the following when selecting a particular type of flexible duct including:

- Temperature range
- Flammability
- Resistance to air flow
- Airtightness
- Length restrictions if applicable
- Support requirements
- Flexibility
- Insulation values
- System pressure
- Resistance to damage and decay
- Cleanability
- Acoustic properties

All flexible ducts shall comply with current Building Regulations regarding the spread of fire and smoke.

30.2 MATERIALS

30.2.1 METAL

Flexible ducts made of coated steel, stainless steel or aluminium are normally helically wound with a lock seam to form a corrugated duct capable of being bent without deforming the circular section. Bending is done by closing the corrugations in the throat and slightly opening the corrugations at the back of the bend. Some re-adjustment is possible but small radius bends cannot be straightened without leaving some distortion of the corrugations. Repeated bending is not recommended.

The ducts shall be securely fastened at each end and particular care shall be taken to ensure that the required airtightness of the system is maintained. Fastenings shall be as for rigid circular ducts Section 12.3 and Table 10. Sealing shall be as Part Seven, Section 19.

30.2.2 OTHER MATERIALS

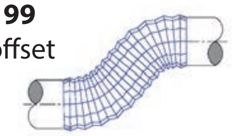
Flexible ducts made from materials including P.V.C/Polyester laminate, Aluminium/Polyester laminate encapsulating a high tensile steel wire or fibreglass helix is a form of construction that provides great flexibility in use. The length of such flexible ducts should be kept to a minimum consistent with the particular application.

Flexible ducts shall be securely fastened at each end using a proprietary band such as a plastic tie-wrap. Care should be taken not to damage the flexible duct and to ensure that the required airtightness of the system is maintained.

30.3 OFF-SETS AND SUPPORTS

Flexible ductwork is traditionally installed as a final connection between first fix ductwork and air terminal units / boxes in order to overcome building tolerances. As flexible ducts have a higher resistance factor than conventional ductwork of the same diameter, it is generally recommended that in any application the length does not exceed 6 x diameter but this can be varied if due allowance is made in the system design for the pressure drop. It is important that the flexible ductwork is fully extended and not compressed along its length. Excessive sag and deviation of the duct should be avoided and it may therefore be necessary to provide supports for the flexible ducts at approximately 1.5 metre centres.

Fig 199
45° offset



A 45° offset, as illustrated, is acceptable providing the flex is elongated and not compressed. Manufacturers of flexible ductwork will normally provide pressure drop data to a system designer to suit the anticipated ductwork configuration.

30.4 TEST HOLES

It is not practicable to make test holes or take test readings in metal or fabric flexible ducts. Where readings are required, the test holes should be made in rigid ductwork.

SECTION 31 FLEXIBLE JOINT CONNECTIONS

31.1 GENERAL PROPERTIES

The system designer/contractor shall consider the following when selecting the materials and construction of a flexible joint connection including:

- Temperature range
- System pressure
- Fire rating
- Vibration isolation
- Resistance to damage and decay
- Cleanability
- Acoustic properties
- Connection size and length
- Flexibility
- Resistance to damage and decay

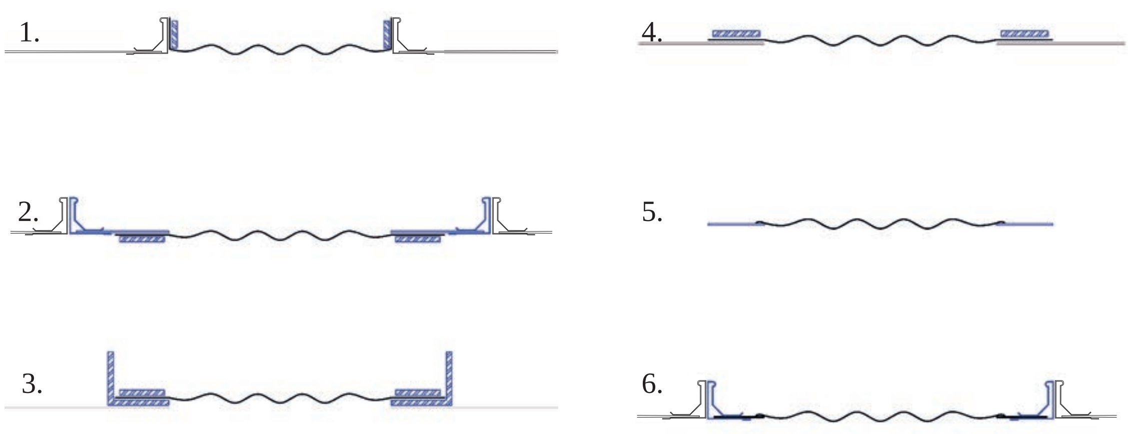
All flexible joint connections shall comply with current Building Regulations regarding the spread of fire and smoke.

Flexible joint connections are manufactured by specialists from the specified material as plain sleeves or sleeves with flanges at one or both ends. Plain sleeves are also available as a proprietary item, with a limited range of flexible material fixed between two strips of sheet metal.

Typical flexible joint connections are shown in Fig. 200

Fig 200 Typical rectangular, circular, flat oval alternative flanged, roll formed flange and spigot connections

Effective length of the unsupported material shall be 50mm minimum – 250mm maximum



31.2 LOCATION

The system designer shall show the required location of all flexible joints on the contract drawings and make clear if it is the responsibility of the ductwork contractor to supply them. Flexible joints are typically used at building expansion joints, fan and air handling unit inlet/outlets and for break-away joints.

Flexible joint connections shall be installed under a reasonable amount of compression taking care to minimise misalignment.

31.3 LENGTH

The minimum practical effective length of a flexible joint is 50 mm. The maximum effective length shall not exceed 250 mm.

SECTION 32 PROTECTIVE FINISHES

Unless stated otherwise all ductwork will be manufactured in pre-galvanized, aluminium or stainless steel as specified, with primer coating where applicable (see 32.3.5). Any additions to this would normally be the responsibility of others. Any special coating/paint finishes being provided by the ductwork contractor must be advised by the system designer.

32.1 GALVANIZING AFTER MANUFACTURE

Galvanizing after manufacture is not recommended for general DW/144 ductwork, as distortion of the ductwork during the galvanizing process often occurs, thus making it difficult to achieve an airtight joint. Galvanizing after manufacture is, however, an acceptable protective finish for external ductwork exposed to atmosphere.

Where hot dip galvanizing after manufacture is specified, it shall in accordance with BS EN ISO 1461, see Appendix C. No paint protection is required.

32.2 METAL SPRAYING

Zinc or aluminium spraying shall be to BS EN ISO 2063.

32.3 PAINTS

A wide range of paints are available which are suitable for use as protective coating and for both un-coated materials and minor damage caused by welding. In all cases the paint manufacturer should be consulted regarding suitability for the intended application.

32.3.1 SURFACE PREPARATION AND PAINT APPLICATION

Surface preparation and paint application shall be in accordance with the paint manufacturer's recommendations.

32.3.2 MAKING GOOD WELDING DAMAGE

Galvanizing or other metallic zinc finish damaged by welding shall be suitably cleaned and painted with one coat of zinc-rich or aluminium paint. Spot welds need not be treated as accelerated salt spray tests undertaken by Leeds University Research Laboratory on behalf of B&ES have indicated that corrosion rates would be well within the life expectancy of the various parent metal zinc coatings as indicated in the data listed in Table 24 of Appendix B.

32.3.3 DUCTWORK MADE FROM PRE-GALVANIZED SHEET OR COIL

Ductwork and profile sections made from pre-galvanized sheet or coil do not require painting or further protection where located inside a building. This also applies to exposed cut edges in accordance with criteria laid down by TATA Steel PLC. (Appendix N).

32.3.4 DUCTWORK MADE FROM MILD STEEL SHEET

Where circumstances require ductwork to be made from mild steel sheet or coil other than the foregoing, protective requirements shall be specified by the system designer.

32.3.5 UNTREATED STEELWORK PROFILES AND SHEET

Any plain mill finish unprotected mild steel such as rolled steel sections and/or sheet used for flanging, stiffeners, supports and duct walls must be treated. Treatment would be an appropriate primer such as zinc rich, zinc chromate, red oxide or aluminium paint. Alternatively hot dip galvanizing could also be specified.

32.4 DUCTWORK AESTHETICS

It is recognised that ductwork aesthetics is an important aspect of a newly installed ductwork system. Using suitable precautions when handling, transporting and installing the ductwork will help to minimise un-necessary damage.

The light gauge construction of the ductwork described in this specification is susceptible during handling to minor scuffs, scratches and dents which have no detrimental effect on the performance of the ductwork. Protective treatment on such marks are only required if such occurrences breaks fully through the zinc coating to expose the bare steel substrate. In instances where the substrate is visible, although sacrificial protection will be afforded by the zinc coating, longer term there could be a chance of red rust occurring, depending upon the severity of the surrounding environment and in such cases treatment would be an appropriate primer such as zinc rich, zinc chromate or aluminium paint.

For information on ‘white rust’, see Appendix B, Clause B.5.7.

SECTION 33 INTERNAL DUCT LININGS

33.1 GENERAL

Where an acoustic lining to ductwork is specified it should preferably be fitted at works. Before duct manufacture it should be clarified that specified external duct dimensions allow for the lining thickness. Any form of lining must have a minimum reaction to fire classification to current BS EN Standards and satisfy the Building Regulations Approved Document B and Approved Document 7. The system designer must specify material type, thickness, and application method.

33.2 LINING APPLICATION CONSIDERATIONS

Prior to the application of any lining the internal duct surface must be thoroughly cleaned to provide a dust free dry surface which may additionally require degreasing.

Securing the lining to the internal duct surface can be achieved in several ways including applied adhesive, self-adhesive and physical methods such as fasteners in conjunction with surface washers at a specified square pitch.

33.3 SURFACE STABILITY

Fibrous materials such as mineral wool and glass fibre (especially the commonly used long fibre type) must have a stable surface coating. This can be sprayed on (this will affect the performance) or a scrim bonded to the surface (usually a non-woven glass cloth). Adjacent sections of lining should abut with minimal gap and integral or separate surface finish lap to such joints and or gap filling proprietary products being applied. These procedures are to obviate any particle migration.

The need for the surface protection can be eliminated by using foam such as those which are melamine based but they must have a minimum reaction to fire classification to current BS EN Standards and satisfy the Building Regulations Approved Document B and Approved Document 7. They can be self-adhesive or bonded using a separate agent but the surface preparation required to ensure a lasting bond requires vigorous adherence to the surface preparation. Foams should not be used where there is a likelihood of airborne contaminants which can reduce the ability of the foam to resist the spread of flame, such as grease from kitchen extract systems.

During application and any curing, consideration should be given to ambient temperature and humidity requirements.

In all circumstances linings should be fitted to material manufacturer's recommended methods.

33.4 PERFORATED / EXPANDED METAL RETAINER

For complete protection, a perforated /expanded metal retainer can be used in conjunction with a scrim to ensure the integrity of the lining. If contaminates such as grease and especially moisture are present then a thin BoPET (bi-axially oriented polyethylene terephthalate) polyester film should be used to protect the fibrous lining and retained with perforated /expanded metal. The use of film facing will reduce the absorption of sound particularly at the mid to higher frequencies.

33.5 PROPRIETARY ATTENUATORS

Technically, the use of absorptive linings can be effective where the amount of noise reduction is small and in the mid frequencies. If it requires long lengths of lined duct to achieve the reduction in sound level then the proprietary attenuator becomes an economic alternative.

33.6 LINING THICKNESS

There is a relationship between duct depth and lining thickness (which should be based on a minimum thickness T= D/10) and as an example:

Based on the 1000Hz octave band, laboratory tests show that a 25mm thick lining provides 12dB/metre loss in a 250mm deep duct compared with 9dB/metre loss in a 500mm deep duct and 6dB/metre loss when the duct is 1000mm deep.

33.7 CIRCULAR DUCTS

Lining circular ducts is impractical and is not recommended.

33.8 CLEANING AND MAINTENANCE

Designers should be aware of the possible porous / fibrous surface nature of linings as they may present practical/hazardous problems in cleaning and maintenance. Reference in this respect should be made to the B&ES Publication, TR/19 'Guide to Good Practice, Cleanliness of Ventilation Systems'.

SECTION 34 THERMAL INSULATION

34.1 PROVISION AND APPLICATION

The provision and application of thermal insulation to ductwork is not normally the responsibility of the ductwork contractor. The information in this section is provided for general guidance only and more detailed information on thermal insulation can be obtained from TIMSA (Thermal Insulation Manufacturers and Suppliers Association) and TICA (Thermal Insulation Contractors Association) both of whom have jointly provided the information in this section.

Note: TIMSA and TICA also need to be contacted in order to verify the latest release of any BS documents referred to in this section.

Fastening techniques for thermal insulation materials to ductwork must be fit for the purpose intended and strictly in accordance with fastening ancillary and insulation manufacturers' recommendations.

34.2 INSULATION CATEGORIES

Ductwork systems distribute chilled, warm or dual-purpose chilled or warm air. Where ductwork is required to be insulated before installation, the insulation specification should be agreed with the system designer and comply with BS 5422. In England and Wales also refer to TIMSA 'Guidance for Achieving Compliance with Part L of the Building Regulations' and in Scotland also refer to Technical Handbooks; Domestic Handbook 2010 and non-Domestic Handbook 2010 Sections 6 – Energy.

The stipulated maximum heat loss/gain limits should be calculated in accordance with BS EN ISO 12241 using the standardised assumptions contained within the document.
Insulation should be installed within the guidelines given in BS 5970 Code of practice for thermal insulation of pipework and equipment (in the temperature range –100ºC to +870ºC).

34.3 NON-METALLIC PRE-INSULATED DUCTWORK

Non-metallic pre-insulated ducts should be in accordance with BS EN 13403. Non-metallic ducts pre-insulated must have a minimum reaction to fire classification to current BS EN Standards and satisfy the Building Regulations Approved Document B and Approved Document 7. These standards are for both on-site and off-site fabrication. The thermal insulation element of pre-insulated ductwork should comply with the Building Regulations Approved Document L as per clause 34.2.

34.4 CONDENSATION AND VAPOUR SEALING

Where the temperature of the air within the duct is at any time low enough to promote condensation on the exterior surface of the duct and cause moisture penetration through the thermal insulation, vapour sealing may be requested.

The extent of any vapour sealing of ductwork and the support method to be used must be clearly specified in advance by the system designer. The system designer also needs to confirm that the support allows for continuing the vapour seal by extending any spacer past the support device. See Clause 18.6, 'Insulated ducts', in Part Six 'Hangers and Supports'.

For cooled systems, it is also important to ensure that the risk of condensation is adequately controlled. For guidance on controlling condensation reference should be made to both BS 5422 and the TIMSA HVAC Guide.

Care shall be taken to ensure that the integrity of any vapour seal is maintained and reference in this respect must be made to both BS 5422 and BS 5970.

34.5 EXTERNAL DUCTWORK

The most commonly used systems to protect foil faced mineral wool slab and PIR / phenolic insulation is aluminium cladding although other proprietary weather-proof jacketing systems are becoming more common such as Glass Reinforced Plastics 'GRP' and aluminium foil reinforced jacketing systems.

The following issues can occur in 'unprotected areas' and these must be taken into account when designing and installing the chosen proprietary weather-proof jacketing system, as follows:

- Bird attacks when beaks penetrate both the external weather proof system and foil vapour barrier beneath leading to water ingress, potentially inducing moisture absorption within the insulation, which leads to reduced thermal efficiency and possible Corrosion under Insulation (CUI).
- Exposure to foot traffic to access other parts of roof areas can cause the proprietary weather-proof jacketing system to split – again leading to water ingress and loss of thermal efficiency.
- Leakage of air from the ductwork can cause insulation damage and degradation as the cover becomes 'bloated' and susceptible to breaking up.
- Ductwork corrosion can occur due to exposure to moisture.
- Energy costs and carbon emissions can increase due to inefficient insulation.

Aluminium cladding is a more rigid protective finish than most other proprietary weather-proof jacketing systems, and is less susceptible to bird damage. Even so, typical issues that should be avoided in 'unprotected areas' include:

- Top surfaces should not be exposed to foot traffic as seams can open and allow water ingress. If the top surface is indented in any way, water puddles will form
- Independently supported ladder style walkways and gantries should be utilised

34.6 SYSTEM DESIGN CONSIDERATIONS

TICA members are sometimes faced with problems which could be avoided if the design and project teams addressed some of the following issues before the ductwork is installed:

- Lack of services co-ordination, mainly in builders work risers and plant areas, results in conditions that are difficult to meet the established standards for ductwork insulation.
- Ductwork installed too close to the fabric of the building and in particular roof levels results in conditions that make it impossible to meet the established standards for ductwork insulation, with the exception of pre-insulated ductwork which can be installed directly on any surface level. TICA are able to advise on the recommended clearance dimensions for insulating ductwork.
- In restricted areas, not enough consideration given to insulating ductwork either prior to insulation or progressively during installation.
- Lack of attention to the selection of support members and the subsequent effect on issues such as vapour sealing, support collapse.

TICA should be approached as they and their members can provide guidance in order to eliminate many of the issues listed above.

The information in this section is based largely on information kindly supplied by the following two associations:
TICA (Thermal Insulation Contractors Association) www.tica-acad.co.uk
TIMSA (Thermal Insulation Manufacturers and Suppliers Association) www.timsa.org.uk

SECTION 35 AIR TERMINAL UNITS

It is expected that all Air Terminal Units (ATU's) and their plenums will be supported independently unless the system designer indicates a method of support in which the design can accommodate the weight of such units.

Where independent support is required reference should always be made to the ATU manufacturer's literature and Section 18 of this document. Where independent support is not deemed necessary it shall be standard practice, as Figs. 201, 202 and 203, to provide a wire safety support for all ATU's and/or their plenums in order to prevent the units falling in the event of a ceiling failure.

Further detailed information on air terminal units and their supports along with many other associated subjects can be found in the HEVAC Guide to Air Distribution Technology for the Internal Environment – see the HEVAC web site at www.feta.co.uk

Fig 201 – Angle trim support

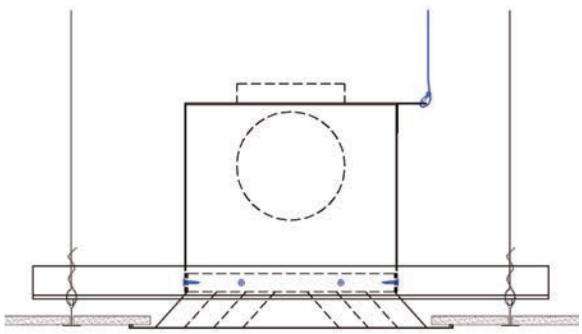


Fig 202 – Tile replacement support

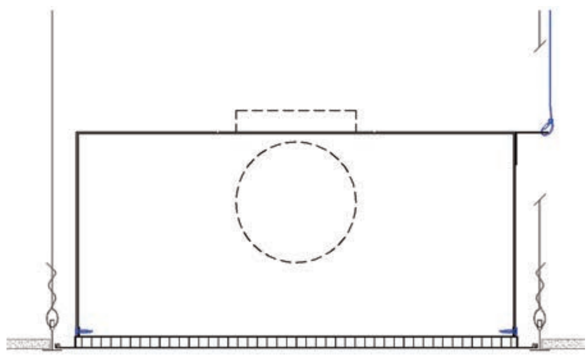


Fig 203 – Pattress support

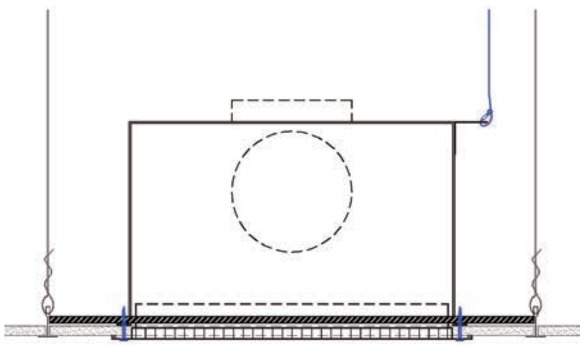


Fig 204 – Plasterboard wall support

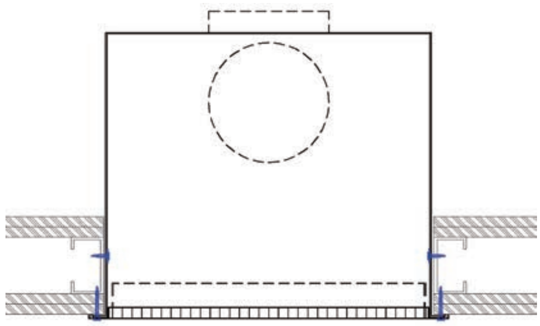


Fig 205 – Independent support

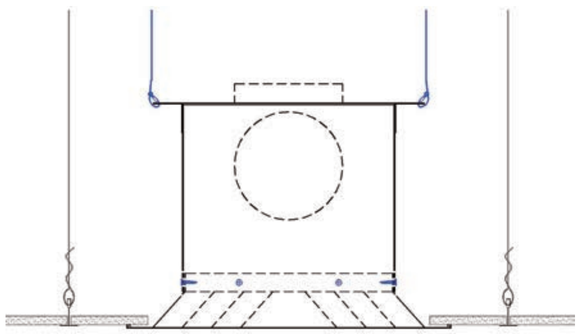
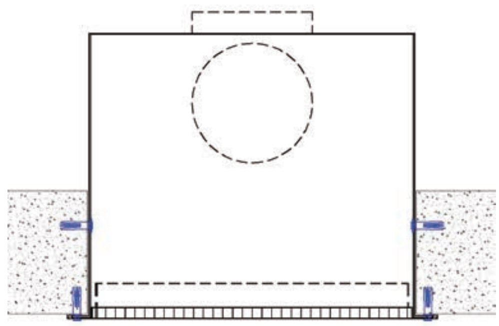


Fig 206 – Concrete wall / soffit support



PART EIGHT – APPENDICES

APPENDIX A DUCTWORK AIR LEAKAGE TESTING

To be read in conjunction with DW/143 'A Practical Guide to Ductwork Air Leakage Testing'.

A.1 INTRODUCTION

Air leakage from ducted distribution systems is an important consideration in the design and operation of ventilation and air conditioning systems. A ductwork system that has limited air leakage, within defined limits, will ensure that the design characteristics of the system can be maintained. It will also ensure that energy and operational costs are maintained at optimum levels.

A.1.1 MANDATORY TESTING

Both Clause 3.4 and 7.1 of DW/144 emphasise that only the testing of high-pressure ductwork is mandatory.

With the availability of four pressure classifications in DW/144 it is hoped that the system designer, having control over performance standards, will find air leakage testing an unnecessary contract expense with regard to low and medium pressure ductwork. The standards imposed by DW/144, the improved quality of sealants, modern fabrication machinery and well defined methods of assembly on site, all make for a higher quality of low leakage ductwork and, in the majority of cases, visual inspection of low and medium pressure ductwork will usually suffice to verify a well-engineered installation. It should be recognised that the testing of duct systems adds a significant cost to the installation and incurs a great deal of extra time which needs to be pre-planned into the contract programme.

A.1.2 BUILDING REGULATIONS

ADL2A (new buildings) and ADL2B (existing buildings) state that "Ductwork leakage testing should be carried out in accordance with the procedures set out in B&ES DW/144".

A.1.3 RANDOM TESTING OF MEDIUM-PRESSURE DUCTWORK

If the system designer considers the testing of medium-pressure class ductwork to be unavoidable then it is recommended that random tests are identified and actioned as set out in the example outlined in Clause A.5.

A.1.4 SPECIFICATIONS AND DUCTWORK ENQUIRIES

Low and medium pressure systems will not be tested unless specific requirements are stated in the ductwork specification.

A.2 DUCT PRESSURE

Ductwork constructed to DW/144 will be manufactured to a structural standard that is compatible with the system operating pressure. There are four classes of duct construction to correspond with the four pressure classifications:

Table 1 (repeated from DW/144 Part One, Section 1.1)

Duct pressure class	Static pressure limit		Maximum air velocity	Air leakage limits litres per second per square metre of duct surface area
	Positive	Negative		
1	*2*	*3*	*4*	*5*
	Pa	Pa	m/s	
Low pressure – Class A	500	500	10	$0.027 \times p^{0.65}$
Medium pressure – Class B	1000	750	20	$0.009 \times p^{0.65}$
High pressure - Class C	2000	750	40	$0.003 \times p^{0.65}$
High pressure - Class D	2000	750	40	$0.001 \times p^{0.65}$

Where *p* is the differential, pressure in pascals.

A.3 LEAKAGE FROM DUCTWORK

Air leakage from sheet metal ductwork occurs at the seams and joints and is therefore proportional to the total surface area of the ductwork in the system. The level of leakage is similarly related to the air pressure in the duct system and whilst there is no precise formula for calculating the level of air loss it is generally accepted that leakage will increase in proportion to pressure to the power of 0.65.

The effect of air leakage from high pressure/velocity ductwork is critical in terms of system performance, energy consumption and the risk of high frequency noise associated with leakage.

These problems are less critical with medium pressure/velocity systems, but should be considered.

Low pressure/velocity ducts present the lowest risk in terms of the effect of leakage on the effective operation of the system.

A.4 SYSTEM LEAKAGE LOSS

As there is no direct relationship between the volume of air conveyed and the surface area of the ductwork system required to match the building configuration it is difficult to express air leakage as a percentage of total air volume.

Similarly, the operating pressure will vary throughout the system and as leakage is related to pressure the calculations are complex. However, it is generally accepted that in typical good quality systems the leakage from each class of duct under operating conditions will be in the region of:

Class A	low pressure	6%
Class B	medium pressure	3%
Class C	high pressure	2%
Class D	high pressure	0.5%

A.5 SPECIFYING AIR LEAKAGE TESTING

Accepting that it is only mandatory to test high-pressure ductwork, the individual project specification and/or ductwork enquiry must highlight any non-mandatory testing. Respecting both the cost and programme implications associated with testing ducts for leakage and with the ductwork system designer having selective control over performance standards, it is suggested that if medium pressure air leakage testing is considered to be a necessity, then qualified random testing is the most cost efficient approach.

The system designer may, for example, indicate that a particular system is tested as follows:

a) High pressure ducts – all tested.

b) Medium pressure ducts — 10% of the ductwork shall be selected at random and tested.

c) Low pressure – untested.

In the case where a random test is selected for medium pressure ducts the following clause is suggested for inclusion by the system designer.

The system designer shall select at random a maximum of 10% of the medium pressure duct system to be tested for air leakage. The duct shall be tested at the pressure recommended in Table 22 of DW/144 for the classification for the section of the ductwork that is to be tested.

The tests shall be carried out as the work proceeds and prior to the application of thermal insulation. In the event of test failure of the randomly selected section, the system designer shall have the right to select two further sections at random for testing. Where successive failures are identified there shall be a right to require the ductwork contractor to apply remedial attention to the complete ductwork system.

The ductwork contractor shall provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and the client, or his agent, shall witness and sign the results of the test.

Note: Leakage testing is always done under positive pressure even when the ductwork is to operate under negative pressure. The reason being that if a duct under a negative pressure fails a leakage test it is impossible to identify the leakage path.

A.6 SPECIAL CASES

There may be situations on a project where circumstances dictate that special consideration be given to containing air losses, e.g. a long run of ductwork may incur a disproportionate level of air loss.

In cases such as this example the system designer can specify an improved standard of airtightness, i.e. 80% of allowable loss for Class 'B' ducts.

The system designer should not specify a Class 'C' test at Class 'C' pressure for a Class 'B' duct as this could have an effect on either rectangular ductwork flange/stiffener or panel deflections and create a non-compliant system relative to BS EN 1507.

A.7 SUGGESTED RANGE OF TESTING

• High pressure ducts	100% test
• Medium pressure ducts	Untested - See Clause A5
• Low pressure ducts	Untested
• Exposed extract systems	Untested
• Ceiling void extract systems	Untested
• Secondary ducts from VAV or fan coil units	Untested
• Flexible ducts	Untested
• Final connections and branches to grilles and diffusers	Untested
• Air terminal boxes	Untested

A.8 TESTING OF PLANT ITEMS

Items of in-line plant (e.g. Figs. 190 to 197) will not normally be included in an air leakage test. The ductwork contractor may include such items in the test if the equipment has a manufacturer's certificate of conformity for the pressure class and air leakage classification for the system under test.

A.9 SYSTEM DESIGNER'S CALCULATIONS

The system designer can calculate with reasonable accuracy the predicted total loss from a system by:

a) Calculating the operating pressure in each section of the system.
b) Calculating the surface area of the ductwork in each corresponding pressure section.
c) Calculating the allowable loss at the operating pressure for each section of the system (see Table 22 for allowable leakage figures).

A.10 VARIABLE PRESSURES IN SYSTEMS

System designers can achieve significant cost savings by matching operating pressures throughout the system to constructional standards and appropriate air leakage testing, e.g. the practice of specifying construction standards for whole duct systems based on fan discharge pressures may incur unnecessary costs on a project.

For example, some large systems could well be classified for leakage limits as follows:

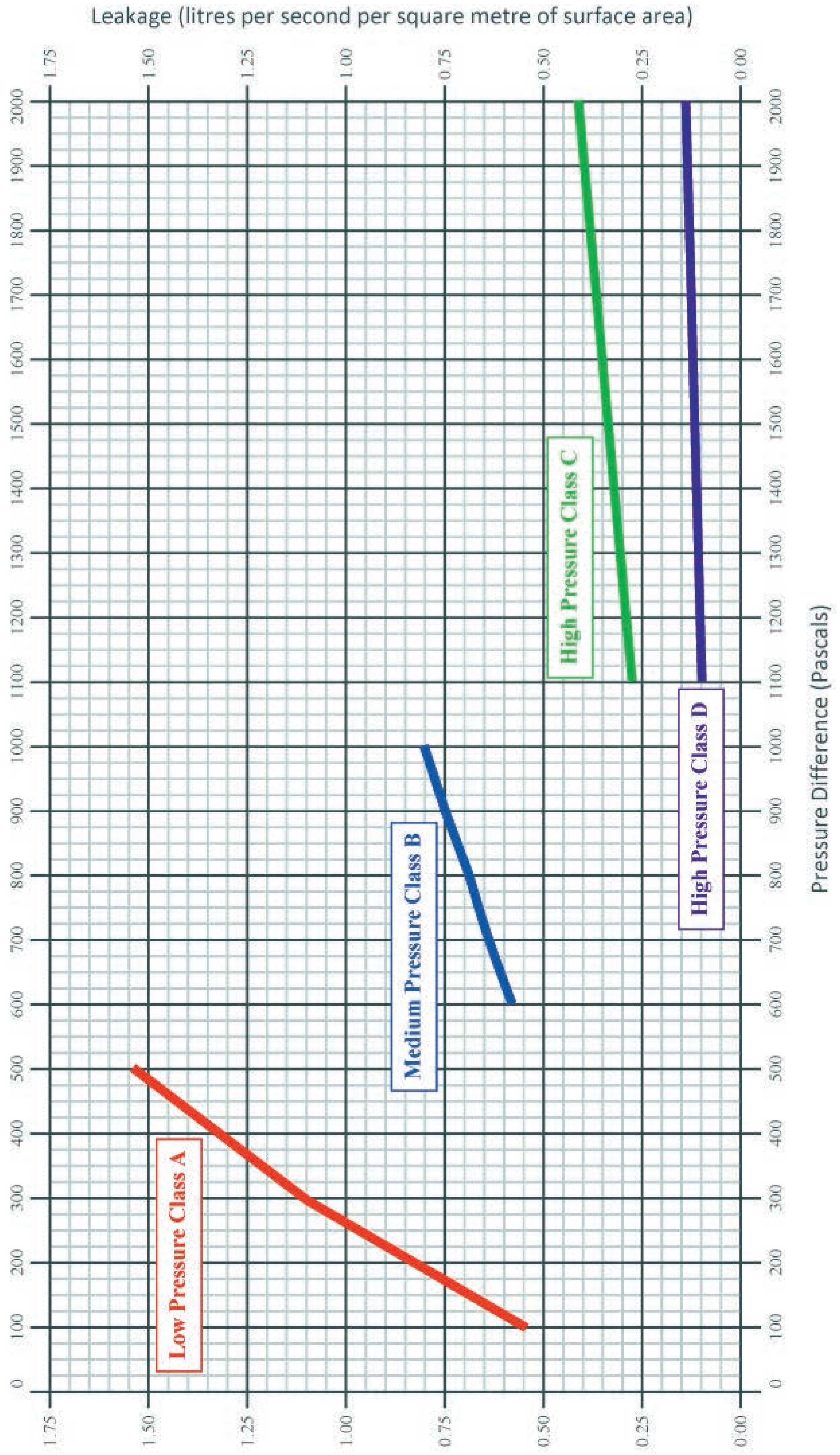
Plant room risers	Class C or D
Main floor distribution	Class B
Low pressure outlets	Class A

Table 22 Air leakage rates

Note: Recommended 'mean' test pressures are highlighted in **bold** type with the actual selection being left to the test operator.

Static pressure differential	Maximum leakage of duckwork			
	Testing not mandatory		Testing mandatory	
	Low pressure Class A	Medium pressure Class B	High pressure Class C	High pressure Class D
1	2	3	4	5
Pa	Litres per second per square metre of surface area			
100	0.54			
200	0.84			
300	1.10			
400	1.32			
500	1.53			
600		0.58		
700		0.64		
800		0.69		
900		0.75		
1000		0.80		
1100			0.29	0.10
1200			0.30	0.10
1300			0.32	0.11
1400			0.33	0.11
1500			0.35	0.12
1600			0.36	0.12
1700			0.38	0.13
1800			0.39	0.13
1900			0.40	0.14
2000			0.42	0.14

Fig 207 Permitted leakage at various pressures



Specimen of air leakage test sheet

See DW/143 for a completed working example of this test sheet

Test Certificate No.	

Date	

Project:	
Material:	
Test Pressure	
Leakage Class	

Building No.			
Location			
Drawing No.			
Sheet No.		of	

Test Equipment Details			
Equipment	Serial No.	Calibration Certificate No.	Expiry Date

Duct Item No(s).								Equipment	
								Type	Ref No.

Surface Area M²			
Length (M)	Duct Size (mm)	Periphery (mm)	Surface Area (M²)
			Total:

Test Particulars

a)	Surface area under test (as above)		M²
b)	Leakage factor (DW143 Table-22)		l/s/M²
c)	Maximum permitted leakage (A x B)		l/s/M²
d)	Duct Static Pressure Reading		Pa
e)	Air Flow Leakage		l/s/M²
f)	Duration of Test (Minimum 15 minutes)		min
g)	Test Result (Pass / Fail)		

Final Acceptance	Signed Print Date

Final Acceptance	Signed Print Date

APPENDIX B – SUMMARY BS EN 10346 CONTINUOUSLY HOT-DIP COATED STEEL FLAT PRODUCTS – TECHNICAL DELIVERY CONDITIONS

Note: The extracts from BS.EN 10346 have been prepared by B&ES and are included here by courtesy of the British Standards Institution.

B.1 GENERAL

B.1.1

British Standard BS.EN 10142 entitled 'Continuously hot-dip zinc coated mild steel strip and sheet for cold forming' was superseded by BS.EN 10327 entitled 'Continuously hot-dip coated strip and sheet of low carbon steel for cold forming – technical delivery conditions' and, more recently, by BS.EN 10346 entitled 'Continuously hot-dip coated steel flat products - Technical delivery conditions'.

B.1.2

British Standards BS.EN 10346 sets out requirements for continuously hot-dip coated products made of low carbon steels for cold forming with zinc (Z) zinc-iron (ZF), zinc-aluminium (ZA), aluminium-zinc alloy (AZ) and aluminium-silicon alloy (AS). Included within DW/144 Part One, Section 2 are both conventional galvanized (zinc) and zinc-iron alloy.

The grade of steel normally used for interior ductwork is DX51D+Z 140 with the coating being dependent on the corrosive category listed in Table 24 at the end of this Appendix.

B.2 STEEL GRADES

BS.EN 10346 lists the grades of steel set out in the columns below, among others:

Grade	Name of Grade	Application
DX51D+Z	Bending and Profiling quality	Forming quality steel suitable for manufacture of the most profiles and more difficult bending operations.
DX52D+Z	Drawing quality	Forming quality steel suitable for simple drawing operations and for more difficult pro-filing operations.
DX53D+Z	Deep drawing quality	Forming quality steel suitable for deep drawing and difficult forming operations.
DX54D+Z	Special deep drawing quality	Forming quality steel suitable for deep drawing and difficult forming operations where a non-ageing steel is required.

B.3 COATING TYPES AND TOLERANCES

B.3.1

The types of zinc coating mass are set out in Table 23. Extract from BSEN 10346 reproduced at the end of this Appendix.

B.3.2

Whilst the coating thickness is not subject to tolerances, the substrate and consequently the sheet thickness does have accepted tolerances and these, including sheet widths/lengths, can be found in BS.EN 10143.

B.4 COATING FINISHES

BS.EN 10346 includes a description of the various types of finish available:

Normal spangle (N). This finish is obtained when the zinc coating is left to solidify normally. Either no spangle or zinc crystals of different sizes and brightness appear depending on the galvanizing conditions. The quality of the coating is not affected by this.

Minimised spangle (M). The surface has minimized spangles obtained by influencing the solidification process in a specific way. The finish may be specified if the normal spangle applicable does not satisfy the surface appearance requirements.

Note: Minimised spangle is generally the most widely available product.

B.5 SURFACE PROTECTION

B.5.1 GENERAL

Hot-dip zinc coated strip and sheet products generally receive surface protection at the producer's plant. The period of protection afforded depends on the atmospheric and storage conditions.

B.5.2 CHEMICAL PASSIVATION (C)

Chemical passivation protects the surface against humidity and reduces the risk of formation of 'white rust' (see B.5.7) during transportation and storage. Local discolouring as a result of this treatment is permissible and does not impair the quality.

B.5.3 OILING (O)

This treatment also reduces the risk of corrosion. It shall be possible to remove the oil layer with a suitable degreasing solvent which does not adversely affect the coating.

B.5.4 CHEMICAL PASSIVATION AND OILING (CO)

Agreement may be reached on this combination of surface treatment if increased protection against the formation of 'white rust' (see B.5.7) is required. Default order option when purchasing galvanized material is generally passivated, and that passivation provides only short term additional 'white rust' protection during storage and transportation. Suitable preparation is required prior to any painting processes.

B.5.5 UNTREATED

Hot-dip zinc coated strip and sheet products complying with the requirements of this standard are only supplied without surface protection if expressly desired by the purchaser on their own responsibility. In this case, there is increased risk of formation of corrosion products on the surface during storage and transportation.

B.5.6 SEALED (S)

Application of a transparent organic film coating by agreement, on one or both sides, of approximately 1g/m^2. This treatment offers additional corrosion protection, depending on its nature. It increases the protection against fingerprints. It may improve the sliding characteristics during forming operations and can be used as a primer coat for subsequent painting.

B.5.7 'WHITE RUST'

Light coatings of 'white rust' on ductwork are caused by moisture trapped between sheets or components during transport or storage – or by condensation. No remedial action is required as the protective properties of zinc are not impaired by the presence of superficial 'white rust'. Existing white rust deposits will slowly convert to a protective basic zinc carbonate.

Heavier deposits of 'white rust' are caused by prolonged, adverse storage or inadequate protection during transport allowing water ingress between stacked sheets and components. This can also occur before a building is weathered where components are subject to a cycle of wetting and drying. Deposits should be removed with a stiff bristled brush (not a wire brush)

In general, deposits of 'white rust' give the impression of corrosion, however, in the vast majority of cases it does not indicate serious degradation of the zinc coating nor does it necessarily imply any reduction in the life expectancy of the ductwork. In time, in the dry internal atmosphere of a building, superficial deposits of 'white rust' can be ignored as they will gradually 'tone-in' and eventually disappear.

In the knowledge that it is easier to prevent white rust than to remove it, components should be stored in a clean, dry area. If uneven temperatures cannot be avoided, components should be stored off the ground on, for example, pallets with an air gap being maintained between the covers and the components in order to maintain air circulation. See Appendix G for more detailed guidance on the storage and protection of components.

B.6 FORMING

BS EN 10346 states that provided that the profiling machine is set to avoid excessive stretching in the product, it is possible to form lock seams successfully with DX51D + Z sheet up to a thickness of 1.5mm and DX52D + Z sheet up to 2 mm; and snap lock seams with DX51D + Z up to 0.9 mm thick sheet and DX52D + Z sheet up to 2mm.

B.7 WELDING

Care should be taken to use correct or suitable methods and procedures. The iron-zinc coating is more suitable for resistance welding than the conventional zinc coating.

Table 23 (Extract from BS.EN 10346) **Coating mass (weight)**

Coating designation	Minimum coating mass including both sides	
	Triple spot test	Single Spot test
Zinc coatings (Z)	g/m^2	g/m^2
Z140	140	120
Z275	275	235
Z600	600	510

Note: The coating mass is not always equally distributed on both product surfaces. However, it may be assumed that a coating mass of at least 40% of the value given in the above table for the single spot test exists on each surface of the product. To convert g/m^2 to microns (µm) divide by 7.14.

Table 24 – Corrosive categories and life-time expectancy (as provided by Tata Steel)

			Galvanized steel designation		Z140	Z275	Z600
			Nominal Zinc Coating Thickness (µm per side)		9.8	19.3	42
Corrosive Category		**Estimated zinc corrosion rate (according to BS EN ISO 12944-1998)**	**External Ductwork Systems**	**Interior Ductwork Systems**	**Lifetime expectancy**		
C1	Very low	Up to 0.1 µm per year	-	Heated buildings/ neutral atmosphere	≥ 100yrs	≥ 200yrs	≥ 400yrs
C2	Low	0.1 mm to 0.7 µm per year	Rural areas, low pollution, dry	Unheated buildings, possible condensation	15 to 100yrs	30 to 200yrs	60 to 400yrs
C3	Medium	0.7 mm to 2.1 µm per year	Urban and industrial atmospheres. Moderate SO2 pollution Moderate coastal Cl	Production rooms with high humidity & some air pollution	5 to 15yrs	9 to 30yrs	20 to 60yrs
C4	High	2.1 mm to 4.2 µm per year	Industrial and coastal	Chemical processing plants, swimming pools	2.5 to 5yrs	5 to 9yrs	10 to 20yrs
C5	Very high	4.2 mm to 8.4 µm per year	Industry with high humidity and aggressive atmosphere Marine coastal, offshore, high salinity	Permanent condensation and high pollution	1 to 2.5yrs	2 to 5yrs	5 to 10yrs

Note: The life expectancy periods tabled above are not intended to act as a guarantee but to provide general guidance as it is the actual 'micro-climate' immediately surrounding the ductwork system that will determine the probable corrosion rate for practical purposes. Further more detailed advice on corrosive rates may be obtained from the Institute of Corrosion (www.icorr.org) and the Galvanizer's Association (www.galvanizing.org.uk)

The information on which this Appendix is based has been kindly provided and reviewed by Tata Steel (www.tatasteel.com)

APPENDIX C HOT DIP GALVANIZING AFTER MANUFACTURE

C.1 GENERAL

C.1.1 PROCESS APPRECIATION

For Hot Dip Galvanizing after manufacture of any component it is necessary to appreciate the nature of the process, including the surface preparation of the component to be treated, and the precautions to be taken in design, manufacture and handling.

C.1.2 PROCESS AND MOLTEN ZINC TEMPERATURE

In the Hot Dip Galvanizing process, components are dipped into a bath containing molten zinc (at a temperature of around 450°C).

C.1.3 COATING THICKNESSES

The coating thicknesses are normally determined by the component thickness and are set out in BS EN ISO 1461.

C.1.4 BATH SIZE

It is recommended that prior to manufacture the component manufacturer checks with the proposed galvanizing plant regarding the galvanizing bath size available to ensure components can be hot dip galvanized.

C.2 DESIGN AND MANUFACTURE

C.2.1 FABRICATION METHOD AND FINISHED APPEARANCE

Ductwork must be fabricated using all welded construction techniques with vented flanges and stiffening frames (see C.2.3) as mechanical fixing and lock-forming techniques are not compatible with the Hot Dip Galvanizing process. In the course of dipping into the molten zinc bath, unsightly panel distortion will occur due to the relief of inherent stress in the steel sheet and any stresses that may have been built into the item during manufacture. Tables 25 and 26 indicates the minimum requirements for the construction of ductwork.

Table 25 Ductwork galvanized after manufacture - Rectangular

Maximum duct size (longer side)	Recommended minimum sheet thickness	Fig 13 Joint rating *	Fig 25 Stiffener rating *	Maximum spacing for joints/stiffeners
1	2	3	4	5
mm	mm	mm	mm	mm
400	1.6	J3	S3	3000
1000	1.6	J4	S4	1250
1600	1.6	J5	S5	800
2000	1.6	J6	S6	800

* This refers to material size only

Table 26 Ductwork galvanized after manufacture - Circular

Maximum duct size (Diameter)	Recommended minimum sheet thickness	Figs 89 and 90 *	Figs 89 and 90 *	Maximum spacing for joints/stiffeners
1	2	3	4	5
mm	mm	mm	mm	mm
250	1.6	Flat Bar 25 x 3	Flat Bar 25 x 3	1500
800	1.6	25 x 25 x 3	25 x 25 x 3	1500
1000	1.6	30 x 30 x 5	30 x 30 x 5	1000
1500	2.0	40 x 40 x 5	40 x 40 x 5	750

* This refers to material size only

C.2.2 COMPONENT RIGIDITY

It is essential to have a free flow of the molten zinc over the component to be galvanized, together with quick and complete drainage of the molten metal. Because of the high temperature involved, the component to be galvanized should be as rigid as possible, either by the use of sufficiently heavy sheet or by stiffening, bracing or both.

C.2.3 HOLLOW CAVITIES AND EXPLOSION RISK

Any sealed hollow section or cavity must be adequately vented in order to obviate any possibility of explosion. Holes of sufficient size (see C.2.4) in vertical members must be provided diagonally opposite each other at the top and bottom of the member.

C.2.4 CAVITY VENT HOLES

Vent holes should be of sizes as follows:

Table 27 - Cavity vent hole sizes

Size of hollow section (diameter or side)	Minimum diameter of vent end drainage holes
mm	mm
Up to 50	10
51 to100	16
101 to 150	20
Over 150	25

C.2.5 STIFFENING FRAME CONSTRUCTION

Rectangular stiffeners should preferably have their corners cropped so as to allow a free flow of zinc across the component. Stiffeners should be rolled steel angle, uncoated.

C.3 SURFACE PREPARATION BEFORE GALVANIZING

The steel surface to be galvanized must be chemically cleaned before dipping to ensure a continuous coating. This is mainly achieved at the galvanizer's works by pickling in an acid bath and fluxing before the article goes into the zinc bath. However, the pickling process does not generally remove grease, oil or oil-based paint, and such substances should be removed by the manufacturer by the use of suitable methods before the component to be treated is delivered to the galvanizing works. Any surface rust that develops on the object between the time of treatment is not important, as this is cleaned off by the acid pickling process.

C.4 HANDLING AND STORAGE AFTER GALVANIZING

C.4.1 DUCTWORK STAINING

While a galvanized surface will not develop rust in the ordinary sense as long as the zinc coating is undamaged, zinc is subject to what is known as the harmless condition of 'wet storage staining' or "white rust" (See B.5.7). Wet storage staining are the white and dark stains which may be seen on the surfaces of newly galvanized components when they are closely stacked and stored or transported under damp conditions.

The damage to the zinc coating is negligible in most cases. When the deposits are heavy, these should be removed by brushing with a stiff bristle brush – not a wire brush!

C.4.2 COMPONENT STACKING

Galvanized components should therefore not be stacked or loaded when wet; they should preferably be transported under cover or shipped in dry, well ventilated conditions, inserting spacers (but not resinous wood) between the galvanized components as necessary.

C.4.3 COMPONENT STORAGE

When stored on site or elsewhere, care should be taken to avoid resting the galvanized components on cinders or clinker, as the acid content of these substances will attack the zinc surface.

C.5 *SUBSEQUENT FINISHING*

Paint finishing subsequent to galvanizing is sometimes required either for additional protection or for decorative reasons. Galvanized surfaces require chemical pre-treatment prior to painting. Examples of such a treatment are T-Wash and Etch Primer types. Advice should be sought from the paint manufacturer.

Appendix C incorporates information given in publications available from the Galvanizers' Association - www.galvanizing.org.uk

APPENDIX D STAINLESS STEEL FOR DUCTWORK

D.1 GENERAL DESIGN CONSIDERATIONS

D.1.1

It is the system designer's responsibility to indicate the type of Stainless Steel most suitable for the conditions to which the ductwork is to be exposed. If users and system designers are in doubt as to which material is appropriate to a particular application, technical advice may be obtained from from the British Stainless Steel Association www.bssa.org.uk. The suitability of Stainless Steel for swimming pool applications is covered in Commentary and Guidance – Note 1, Clause 1.3.

D.1.2

Stainless Steel has a combination of good formability and weldability, and can be supplied in a variety of compositions and surface finishes (see D.2 and D.4.1). Stainless Steel has been developed to cover a wide range of uses where high resistance to corrosion and low maintenance costs are important.

D.1.3

Ductwork applications for which Stainless Steel is suited include those where a high integrity inert material is essential; where a high degree of hygiene is required; where toxic or hazardous materials may be contained; and in nuclear and marine applications. Stainless Steel also finds application in exposed ductwork where the finish can be used for aesthetic reasons.

D.2 GRADES OF STAINLESS STEEL

D.2.1

The grades of Stainless Steel most commonly used for ductwork applications are those covered by BS EN 10088 Part 2. Designations of the most common Stainless Steel grades are given in Tables 28 and 29.

Before a grade is specified, the nature of the interior and exterior environments of the ductwork system should be taken into account. The steels described cover most applications. However, advice on specific corrosion risks should be taken if the ductwork is to be installed in a chemically contaminated atmosphere, or is to be used to transport contaminated air, particularly if there is a risk of internal condensation. More highly alloyed grades of Stainless Steel with enhanced corrosion resistance are available if required.

The more commonly used steels divide into two main families; the lower alloy ferritic 10.5-18% chromium Stainless Steel and the austenitic 18% chromium, 9% nickel Stainless Steel the characteristics of which are described as follows;

D.2.1.1

Ferritic Stainless Steel (11.5% chromium) with a titanium addition, designation 1.4512, X2CrTi12 – equivalent to 409S19.

This, and related grades, are among the leanest alloyed of the stainless steels. Forming characteristics are similar to those of mild steel, so it can be worked using conventional practices. The composition and processing is usually adjusted by the manufacturer to balance forming response, weldability and corrosion resistance. It is readily weldable in thin sheet form and, since it does not form a hardened heat affected zone (HAZ), no post-weld heat treatment is required. It is suitable for a range of ducting and structural applications in mildly corrosive applications.

D.2.1.2

Ferritic Stainless Steel (17% chromium) designation 1.4016, X6Cr17 equivalent to 430S17.

Forming and general characteristics are similar to the 1.4512 (409) grade, but the higher chromium level confers better general corrosion resistance.

D.2.1.3

Austenitic Stainless Steel (18% chromium, 9% nickel).

A widely used grade is designation 1.4301, X5CrNi18-10 equivalent to 304S15. There are compositional variants within this family, designed to give specific formability and welding characteristics. All are weldable and have good general corrosion resistance to normal and mildly corrosive atmospheres. They are ductile and formable, but forming loads are higher than for mild steels and suitable, robust equipment is required.

D.2.1.4

Austenitic Stainless Steel (17% chromium, 11% nickel, 2% molybdenum).

A widely used grade of this type is designation 1.4401, X5CrNiMo17-11-2 equivalent to 316S31. This Stainless Steel has a significantly higher corrosion resistance than the standard 18% chromium, 9% nickel Stainless Steel and is suitable for use in more aggressive environments such as those encountered in process plants. However, more highly alloyed Stainless Steel with better corrosion resistance is also available and the advice concerning aggressive environments given under section D.2.1 should be noted.

D.3 AVAILABILITY

Stainless Steel is supplied in a wide range of thicknesses, from 0.4 mm for cold-rolled sheet and coil, and from 0.075 mm for precision rolled strip. It is supplied in slit widths as specified by the customer, up to a maximum width of 2030 mm, depending on thickness. Material compatibility of sheet, section and fixings is not always assured in practice due to commercial availability.

D.4 SURFACE FINISHES

D.4.1

Stainless Steel is available in a wide selection of finishes, varying from fine matt to mirror polished, as defined in BS EN 10088 Part 2.

Mill Finishes

Type 2D	Cold finished softened and descaled. A uniform matt finish.
Type 2B	Cold rolled, softened, descaled and lightly worked with polished rolls. A smooth finish brighter than 2D.
Type 2R	Bright annealed. A cold finished reflective appearance retained through annealing.

Polished Finishes

Type 4/2J	Dull polished. A lustrous unidirectional finish produced by fine grinding, generally with abrasives of 150 grit size. It has little specular reflectivity. Further dull polishing after fabrication will diminish the effects on appearance of welds or accidental damage by blending them into the surrounding metal.
Type 5/2K	Satin polished. With specific requirements, to achieve a fine, clean cut surface finish with good corrosion resistance. Maximum surface roughness Ra = 0.5 micron.
Type 8/2P	Mirror polished. A bright, non-directional reflective finish with a high degree of image clarity.

D.4.2

Where other finishes are required, such as for aesthetic purposes, a range of patterned or textured (2F, 2M) finishes is available. Colour may be applied in the form of paint or lacquer, or the material may be supplied pre-coloured as by the 'INCO' process or by mill application of polymer coatings.

D.5 SURFACE PROTECTION

D.5.1

No surface protection is required for Stainless Steel ductwork used indoors or outdoors, provided the correct grade is specified. This is due to the naturally occurring chromium-rich oxide film which is present on the surface of the metal, if damaged, reforms immediately by reaction between the metal and the atmospheric or other source of oxygen.

D.5.2

If a mixture of dis-similar metals is used, such as Mild Steel Supports for Stainless Steel ductwork, the surface of the metals must be adequately isolated to protect from galvanic corrosion that might result from the direct contact between the two types of metal.

D.6 CONSTRUCTION

D.6.1

Sheet thicknesses for Stainless Steel ductwork should be the same as for galvanized steel ductwork. Provided the correct grade of Stainless Steel has been selected, there is no requirement for a corrosion allowance with Stainless Steel and the gauge can be selected on structural considerations only.

D.6.2

The forming of rectangular and circular ducts can be carried out by the use of conventional press working and sheet metal forming machines. Some alteration in working practices may be necessary, depending on the type of Stainless Steel being used.

D.6.3

As a general rule, the 400 (ferritic) series of Stainless Steel can be formed using normal Mild Steel settings. The 300 (austenitic) series, however, because of the higher yield point and the greater rate of work hardening, will require higher working pressures.

D.6.4

The forming of longitudinal joints such as pittsburgh lock and button punch snap lock in Stainless Steel ductwork can be difficult. As regards cross joints, socket and spigot joints are recommended, and some slide-on-flanges are available in Stainless Steel. In view of the foregoing, it is recommended that trials be carried out before starting production.

D.7 RECTANGULAR DUCTS

The constructional requirements for rectangular Stainless Steel ducts are the same as for galvanized Mild Steel (see DW/144, Tables 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1 and 5.2).

D.8 CIRCULAR DUCTS

The constructional requirements for circular Stainless Steel ducts are the same as for galvanized Mild Steel.(see DW/144, Tables 8 and 9).

D.9 STIFFENING

The material used for stiffening should be of the same grade of Stainless Steel as used for the construction of the ducts.

D.10 FIXINGS AND FASTENINGS

The types of fastening and the maximum spacing's specified in DW/144, Tables 2.3, 3.3 4.3 and 5.3 (rectangular) and Table 10 (circular) also apply to Stainless Steel ductwork. Fixings and fastenings should be of the appropriate grade of Stainless Steel as used in the construction of the ductwork. The type of Stainless Steel fastening used should conform to the requirements of specification BS EN ISO 3506.

D.11 WELDING

Common welding processes may be used to weld Stainless Steel but carburising operations such as oxy-acetylene and carbon arc welding are not suitable. The Tungsten inert gas (TIG) and resistance welding techniques are most likely to be used for thin sheet materials. Attention is drawn to BS EN 15607 (Specification for qualification of welding procedures for metallic materials – general rules) and BS EN 1011 Part 3 (General recommendations for arc welding of Stainless Steel).

Selection of the correct welding consumable is important, particularly when welding dis-similar metals, such as Stainless Steel to non-stainless structural steels. Reference for guidance should be made to BS EN 12072 for rods and wires for gas shielded welding and BS EN 1600 for electrodes for Manual Metal Arc (MMA) welding.

D.12 AVOIDANCE OF CONTAMINATION

Attention is drawn to the risks of cross-contamination of Stainless Steel surfaces resulting in potential rusting from contamination by non-stainless steel or iron debris.

If particles such as filings or grinding dust of a non-stainless steel or iron are brought into contact with a Stainless Steel, subsequent exposure to moisture will lead to staining of the surface as these particles rust. Whilst this staining often can be removed without harm to the Stainless Steel surface, in aggressive environments corrosion around the contamination can create a risk of pitting of the Stainless Steel. As a general rule, Stainless Steel should be kept free from iron dust and debris contamination. In particular, wire brushes must be made of Stainless Steel and shot, beads and abrasive media used to clean surfaces must be 'iron free'.

Contamination can arise from tools and machinery which has been used previously on non-stainless steels without adequate cleaning and from abrasion on stillage's and racks. It is good practice to dedicate storage and bench areas for Stainless Steel, with soft surfaces, e.g. wooden battens, to minimise scratching of the surface and if practicable designate Stainless Steel only working areas.

D.13 SEALANTS, GASKETS AND TAPES

The sealing materials and methods set out in this specification are also applicable to Stainless Steel ductwork. However, any **chloride-based material**, **such as polyvinyl chloride (PVC), should be avoided**, as breakdown of such material at certain elevated temperatures could lead to corrosion of the Stainless Steel.

Table 28 - Austenitic Grades

Base Material		Welding Consumables Grade
EN-10088 Number	*AISI Grade	
1.4301	304	19.9 or 19.9.L
1.4307	304L	19.9.L
1.4541	321	19.9.Nb
1.4401	316	19.12.2 or 19.12.2.L
1.4404	316L	19.12.3.L
1.4571	316Ti	19.12.3.Nb

Table 29 - Ferritic Grades

Base Material		Welding Consumables Grade
EN-10088 Number	AISI* Grade	
1.4512	409	19.9.L
1.4016	430	17 or 19.9.L

*AISI: American Iron and Steel Institute

The contents of Appendix D have been reviewed by the Stainless Steel Advisory Service which is a service provided by the British Stainless Steel Association (BSSA) - www.bssa.org.uk

APPENDIX E ALUMINIUM DUCTWORK

E.1 SCOPE

This section applies only to rectangular and circular aluminium ductwork operating at low pressure, as defined in Tables 30 and 31.

If consideration is being given to either higher pressures or flat oval ductwork then it would be prudent for the system designer to seek advice from manufacturers who have the experience and capacity to manufacture aluminium ductwork.

Aluminium ductwork is not suitable for kitchen extract.

E.2 SUITABLE GRADES

E.2.1

Ductwork can be constructed from all the commonly used aluminium alloys, the choice depending on the purpose for which the ducts will be used and the service environment.

E.2.2

The alloys 1050, 1200, 3103 and 5251 (as specified in BS.EN485, BS.EN515, BS.EN573) are easy to form and to join, and have excellent resistance to atmospheric corrosion, with 5251 being rather more resistant to marine atmospheres.

E.2.3

These alloys can be supplied in various tempers produced by different degrees of cold rolling, so that a range of strengths is available. In choosing a temper, it is necessary to consider any forming that will be done, as with the harder tempers the forming of tight bends might cause cracking. Where high strength is required, alloy 6082-T6 sheet can be used.

E.2.4

Aluminium coil is available in plain form and pre-painted finish.

E.3 CONSTRUCTION – RECTANGULAR DUCTS

E.3.1

Table 30 sets out the minimum constructional and stiffening requirements for rectangular aluminium ducts and the permitted types of cross joint.

E.3.2

Sealant requirements set out in DW/144 for galvanized steel rectangular ductwork also apply to the longitudinal seams and cross joints in aluminium ductwork.

E.4 CONSTRUCTION - CIRCULAR DUCTS

Table 31 sets out the minimum constructional and stiffening requirements for circular ducts made from aluminium, and the permitted types of cross-joint.

E.5 FASTENINGS

The types of fastening and the maximum spacings specified in DW/144, Tables 2.3, 3.3, 4.3 and 5.3 (rectangular) and Table 10 (circular) apply to aluminium ductwork, except that such fastenings shall be of aluminium, stainless steel or monel metal.

E.6 WELDING

E.6.1

All the aluminium alloys can be welded by MIG (Metal Inert Gas) or TIG (Tungsten Inert Gas) methods, with argon as the shielding gas. Helium or a mixture of helium and argon can be used, but not C02. Alloys in a work-hardened temper are reduced to the annealed condition in the heat-affected zone; 6082-T6 is reduced approximately from the T6 to the T4 temper. Alloys 1200 and 3103 are easy to braze, as is 6082, but the latter needs to be re-heat treated to regain its strength.

E.7 PROTECTIVE FINISHES

E.7.1

No protective finishes are required for aluminium ductwork used indoors or outdoors in normal atmospheric conditions. In moist atmospheres, particularly if they are contaminated by industrial effluent or by salt from the sea, surfaces not exposed to washing by rain will become roughened and covered with a layer of white corrosion product. However, this has the effect of sealing the surface against further attack, and the mechanical properties of any but the thinnest of materials will be only slightly affected.

E.7.2

If surface protection is specified, any of the normal organic finishes can be used, including the laminated PVC films, although paints with heavy metal pigments are not suitable. The use of pre-painted strip in coil form provides a reliable quality finish and often proves more economical than painting after assembly. Anodising provides an excellent finish for aluminium, but this process would have to be carried out after forming and would therefore not usually be practicable for ductwork, except perhaps for ducts formed from extrusions.

E.7.3

Mild Steel section used in supporting aluminium ductwork shall have a protective finish (DW/144, Clause 32.3.5).

Table 30 Rectangular aluminium ducts – low pressure constructional requirements

Maximum duct size (longer side)	Minimum sheet thickness	Suitable cross-joints	Maximum spacing between joints/stiffeners		Minimum aluminium angle section for cross-joints and stiffeners
			Plain sheet	With cross breaking or pleating	
1	2	3	4	5	6
mm	mm	Figs	mm	mm	mm
400	0.8	20, 21	-	-	-
600	0.8	13-19, 22-24	1500	-	25x25x3
800	1.0	13-19, 22-24	1200	1500	30x30x4
1000	1.0	13-19, 22-24	800	1200	40x40x4
1500	1.2	13-19, 22-24	600	800	40x40x4
2250	1.2	13, 14	600	800	50x50x5
3000	1.6	13, 14	600	600	60x60x5

Table 31 Circular aluminium ducts (spirally-wound and straight-seamed) – low pressure constructional requirements.

Spiral-wound duct			Straight-seamed duct			Minimum aluminium angle section for cross joints and stiffeners	
Normal sheet thickness	Cross joints	Minimum stiffening requirements	Normal sheet thickness	Cross joints	Minimum stiffening requirements	Duct diameter	Angle
As for galvanized duct Table 8	Figs 77-83 with LP Limits	As for galvanized duct Table 8	As for galvanized duct Table 9	Figs 84-90 with LP limits	As for galvanized duct Table 9	mm 800 1000 1500	mm 25x25x3 30x30x4 40x40x4

Incorporates information provided by the Aluminium Federation Ltd
More detailed information may be obtained at www.alfed.org.uk

APPENDIX F PRE-FINISHED STEEL

F.1 NATURE OF THE MATERIAL

F.1.1

Pre-finished steel is a steel strip product with a number of paint layers and treatments applied in a highly automated and carefully controlled environment

F.1.2

The base metal to which the coatings are applied are hot-dip galvanized steel or zinc coated to BS EN 10346

F.2 RANGE OF COATINGS AVAILABLE

F.2.1

A number of different types of pre-finished steel, in various thicknesses, are available to the system designer such as a range of plastisol coatings and high build polyurethanes. More information on coatings is available from the two sources listed at the end of this Note. In addition to the term 'pre-finished' such material is also referred to as 'coil-coated', 'pre-coated' and 'pre-painted'.

F.2.2

A wide range of colours and surface finishes are available, but there are minimum quantity requirements for some types of coating, finish and colour. The characteristics of the particular type of coating contemplated for a particular use should be investigated in respect of formability, fastness to light, resistance to high operating temperatures, chemical resistance and other relevant properties.

F.2.3

The material can be supplied with one or both sides treated, with the specified coating. Standard 'backing coat' finishes are usually applied to the reverse side unless otherwise stated.

F.3 SIZES AVAILABLE

Pre-finished steel is available in sheet or coil form. The maximum available width can vary according to the steel thickness required. Availability varies according to type of substrate and coating, so prospective purchasers should confirm the sizes available for the specific type required.

F.4 SOURCES OF SUPPLY

Pre-finished steel is widely available but it should be noted that minimum order quantities may apply.

F.5 DUCTWORK CONSTRUCTION FROM PRE-FINISHED STEEL

F.5.1

The type of pre-finished steel most suitable for ductwork should be carefully considered, mainly from the point of view of the fabrication properties of the coating type. It is probable that a plastisol coating will be found to be most suitable for ductwork, as this type of coating will withstand forming at normal ambient temperatures. It also tolerates rougher handling during forming and erection than the much thinner paint coating types.

F.5.2

Careful consideration should be given to the constructional methods to be used for ductwork to be made from pre-finished steel. The principle to be followed should be to make seams and joints as unobtrusive as possible. Some of the conventional methods of seaming may be used, but a number of others are not suitable. Welding with conventional equipment should not be attempted.

Mechanical fastenings should be chosen with care having regard to appearance as well as efficiency; and sealant should be applied with these factors in mind. Stiffening should be carefully considered in relation to appearance.

F.6 HANDLING, STORAGE, TRANSPORT AND ERECTION

F.6.1

Much more care than usual is required in these respects, as the coatings are all, to a greater or lesser degree, susceptible to mechanical damage. For example, sheet should not be dragged off the top of a pile but removed by 'turning' off the stack.

F.6.2

With steel sheet pre-finished on one side only, it may be found desirable to stack face to face

F.6.3

The flexibility of the types of topcoats used on pre-finished steel depends on temperature. Forming therefore, should be carried out at temperatures above 16°C (60°F) in order to minimise the risk of the film cracking on roll forming, etc. If the material has been stored outside at low temperature, a warm-up period should be allowed before forming of the sheet is undertaken.

Tata Steel are able to provide further detailed information on the subject of coil storage recommendations and practices on their website.

The information on which this Appendix is based has been supplied mainly by Tata Steel (www.colorcoat-online.com). Tata Steel are members of the European Coil Coating Association (ECCA) and their UK web site at www.ecca-uk.co.uk and their European web site at www.prepaintedmetal.eu contains a vast amount of information on the subject of pre-finished steel.

APPENDIX G HANDLING, STORAGE AND PROTECTION OF DUCTWORK

All parties should ensure that a common sense / practical approach is adopted when handling and storing ductwork to reduce the risk of un-necessary damage. To minimise the risk of damage it is recommended that before a contract is finalised, that consideration is given to the following subjects:-

- Transport
- Handling
- Storage (Factory / Site)
- Internal Cleanliness
- Protection
- Site Access

Each subject should be clearly addressed as each can have a strong influence on the overall cost efficiency of the completed ductwork installation.

G.1 TRANSPORT

Large capacity vehicles with high-sided open or closed-top bodies are the most suitable for the transporting of ductwork. However site handling facilities along with vehicular access restrictions may influence the type and size of transport to be utilised.

Loading of ductwork should be carefully planned to avoid crushing. Ductwork with projections, such as branches, bends, flanges, damper quadrants, etc, should be loaded so as to avoid possible damage to adjacent items. In some instances, particularly on contracts calling for repetitive sizes, the use of timber / polystyrene jigs and spacers may be justified.

Where reduced bulk and greater protection are major factors, such as consignments for export, transporting ductwork in 'L' sections may justify the increased site assembly costs.

G.2 HANDLING

The light gauge construction of the ductwork described in this specification is susceptible during handling to minor scuffs, scratches and dents which have no detrimental effect on the performance of the ductwork. Protective treatment on such marks are only required if such occurrences breaks fully through the zinc coating to expose the bare steel substrate. In instances where the substrate is visible, although sacrificial protection will be afforded by the zinc coating, longer term there could be a chance of red rust occurring, depending upon the severity of the surrounding environment and in such cases treatment would be an appropriate primer such as zinc rich, zinc chromate or aluminium paint.

To minimise the risk of damage, each duct section should be clearly identified with deliveries to site being closely linked to the installation programme, to avoid the accumulation of un-installed ductwork and reduce the need for double-handling. It is important to recognise that ductwork panels, joints and corners are particularly susceptible to damage and care should be taken to ensure suitable handling methods are used on site.

The movement of ductwork will inevitably involve manual handling. A large number of injuries at work are caused by accidents during this process through poor handling techniques. It is recommended that individual components should have a clear indication of their weight, allowing the component to be assessed, and a suitable method of handling, either manual or mechanical, being selected.

The responsibility of employers and employees to assess the risk of personal injury during manual handling operations is set out in the H.S.E. publication L23 (Edition 3), 'Guidance on Manual Handling Regulations'.

G.3 STORAGE

The storage of ductwork is an important factor in ensuring the risk of damage is minimised. The conditions for factory and site storage are the same, however it is appreciated duplicating factory conditions on site is not always possible. The basic requirements for storage are:-

G.3.1 FACTORY

With the introduction of modern manufacturing principles factory storage has become less of an issue. If the need arises ductwork stored in the factory should be stored in such a manner to prevent damage and be readily accessible for delivery in accordance with the installation programme.

G.3.2 SITE

Adequate floor space must be provided within the building or other designated site location for storage. The storage areas provided must be covered and dry with the ductwork being stored off the floor if the possibility of standing water exists. This is particularly important if 'white rust' is to be avoided. (Appendix B, Clause B.5.7).

The storage area shall also make due allowance for the storage of ductwork in stacks with sufficient access to allow the removal of items when required without interference to adjoining stacks.

Care should be taken to ensure that stacked ductwork is stored in such a way as to avoid items being crushed and the possibility of ductwork stacks becoming unstable due to poor positioning. When stacking ductwork for storage purposes, each item should be positioned to ensure the stability of the stack and the safety of personnel working in or around the storage area.

The site storage of ductwork also introduces the additional important consideration of maintaining any factory applied protection and the internal cleanliness of the ductwork. It may be necessary to provide additional protective sheeting to stored ductwork to ensure the factory applied protection and cleanliness requirements remain in place.

G.4 INTERNAL CLEANLINESS

Whilst capping off will minimise the ingress of dust, the only certain way to ensure cleanliness on final handover is to employ a specialist cleaning contractor. Reference should be made to B&ES document:-

- B & ES Publication TR/19 'Guide to Good Practice – Internal Cleanliness of Ventilation Systems'.

It is the responsibility of the system designer/specifier to assess the acceptable risk of contamination and to select and clearly specify in accordance with TR/19, Table A, Protection, Delivery and Installation (PDI) Level applicable as part of the contract conditions.

G.5 PROTECTION

Practical experience shows that due to the various activities that typically occur on site, there is a risk that the stored and installed ductwork will not avoid airborne contamination regardless of any measures of protection employed. Any protection applied should be checked on a regular basis to ensure it remains in a suitable condition.

G.6 SITE ACCESS

Careful consideration should be given to the unloading of ductwork on receipt at site as not all sites will benefit from the material handling facilities or vehicular access commonly found in manufacturing workshops such as cranes, fork-lifts or loading bays. Also take into account any material acceptance rules imposed by the main contractor.

APPENDIX H GUIDANCE NOTES FOR CLEANING INSPECTION AND CLEANING ACCESS OPENINGS

H.1 GENERAL

Appendix H highlights, in summary form, the consideration that should be made by the system designer in terms of cleaning inspection and cleaning access. These considerations are clearly set out in the B&ES publication TR/19 'Guide to Good Practice, Internal Cleanliness of Ventilation Systems' – see Clause H.2.4

Note: In the absence of any indication by the system designer for cleaning requirements, only the access panels for inspection and servicing set out in Section 20 of this specification will be incorporated into a new ductwork system.

Having considered the scope and the design of the ductwork system relative to the guidelines outlined in J.2 below, the contract should clearly indicate the internal access requirements, if any, that are to be incorporated into the manufacture of a new ductwork system. TR/19 also makes reference to BS EN 15780, and in particular Clause A.6, which defines acceptable levels of dust accumulation in new ductwork. The contract should clearly indicate:

(a) The requirements for protection, delivery and installation as set out in detail in TR/19.

(b) Which party is responsible for establishing the dust accumulation levels in newly installed ductwork and the fact that this specialist activity is to be undertaken prior to handover .

Note: Ductwork cleaning is a specialist contractor activity and would not be included for or undertaken by a ductwork installation contractor.

This Note recognizes two main aspects of cleaning access:

- Openings used for the inspection / servicing of inline equipment / components, as defined in DW/144 Section 20, will also be utilised for cleaning inspection and cleaning access.
- Specialist cleaning contractors, in addition to taking advantage of openings fitted by ductwork manufacturers in accordance with Section 20, must fit any additional cleaning openings not only in order to suit their specific methods of cleaning but also to suit the practical site conditions relative to the fabric of the building and other services.

Table 20 in DW/144, Clause 20.3 is a summary of the parties responsible for fitting access panels either for inspection/servicing access to inline equipment / components or cleaning inspection and cleaning access.

As DW/144 ductwork or supports do not take into account either man-loading or the support of other building services, system designers must take this into account in accordance with BS EN 12236, 'Ventilation for buildings – Ductwork hangers and supports – Requirements for strength'. This consideration should also include recognition of all appropriate risk assessments.

H.2 DESIGN CONSIDERATIONS

H.2.1 INSPECTION AND SERVICING

Inspection and servicing requirements for in-line equipment / components are set out in Section 20 of DW/144.

H.2.2 SPECIFIC LEVELS OF CLEANLINESS

Care, protection and standards of cleanliness prior to commissioning are set out in the B&ES publication TR/19 'Guide to Good Practice, Internal Cleanliness of Ventilation Systems'. Section 2 of TR/19 states that where specific levels of cleanliness are required, ductwork shall be cleaned after installation by a specialist cleaning contractor. This is particularly relevant in view of the definition of acceptable dust accumulation levels in new ductwork as set out in Clause A.6 of BS EN 15780

H.2.3 SPECIALIST CLEANING CONTRACTOR

It will be in the interests of the contract, both financially and practically, to employ a specialist cleaning contractor at the outset of a contract to internally clean newly installed ductwork prior to hand-over. This approach would realise the following benefits:

i) The actual number of cleaning access panels would be determined, and fitted, by the specialist contractor to suit the method of cleaning to be adopted.

ii) Those panels already incorporated into the system for the inspection / servicing of inline equipment / components as defined in Section 20 of DW/144 could be utilised for cleaning purposes.

iii) Additional panels can be fitted by the specialist contractor to satisfy, if needed, access to both sides of an internal duct obstruction that prevents 'through' cleaning using the existing inspection / servicing panel.

iv) Additional panels can be fitted by the specialist contractor to satisfy practical conditions associated with the need to provide access panels at changes of direction and at a minimum of 15 metre intervals

v) A specialist cleaning operation prior to commissioning enables the cleaning contractor to verify the practical access requirements for the future cleaning operations associated with a regular maintenance programme.

vi) A specialist cleaning operation prior to commissioning allows the system designer to omit from the specification any specific requirements for factory sealing, protection, wipe downs and capping-off.

vii) Unacceptable levels of dust accumulated as a result of adverse site installation conditions would be avoided.

H.2.4 TR/19 "GUIDE TO GOOD PRACTICE, INTERNAL CLEANLINESS OF VENTILATION SYSTEMS".

Cleaning requirements for both new and existing ventilation systems are set out in the B&ES publication TR/19 'Guide to Good Practice, Internal Cleanliness of Ventilation Systems'. TR/19 establishes standards for protection, delivery, installation, testing, cleaning and verification and provides greater detail for the system designer's consideration than the basic information included in this Appendix. The Guide also includes the statement; "The precise location, size and type of access would be dependent on the system design and the type of ductwork cleaning, inspection and testing methods to be adopted".

H.2.5 HEAVILY CONGESTED CEILING AREAS

Special consideration must be given by the system designer to the practical problems associated with gaining personnel access to heavily congested ceiling areas and multi-layered ductwork systems. Such consideration would avoid the possibility of access panels being incorporated into a ductwork system at the manufacturing stages that were later found to be inaccessible for either cleaning inspection or cleaning activities.

H.2.6 KITCHEN EXTRACT

Kitchen extract systems, with panels at 3 metre intervals, and vertical ductwork, with a panel at the bottom and top of each riser, are the only exceptions to panels being at 15 metre intervals.

H.3 ACCESS TO IN-LINE EQUIPMENT

This note only covers inspection/access through the ductwork body adjacent to any item of in-line equipment and not openings in the equipment itself.

APPENDIX J 'DESIGN NOTES FOR DUCTWORK' (CIBSE Technical Memorandum No. 8)

J.1

Technical Memorandum (TM) No 8 brought together information on the design of ductwork systems.

J.2

The contents had been drawn from the relevant sections of the CIBSE Guide and other recognised references, and include additional material on good design practice. The notes make frequent reference to DW/142, and an effort was made to ensure consistency between the two publications. Whilst DW/142 has now been superceded by DW/144 the technical memorandum has not currently been up-dated but still contains relevant information that may be of use to a system designer/manufacturer. Whilst some of the information may now be superseded, TM8 includes chapters on:

- Pressure loss in ducts, including corrections for duct surface type, air pressure, air density, temperature and altitude, and loss factors for fittings.
- Equivalent diameters of rectangular and flat oval ducts.
- Standard dimensions of circular, rectangular and flat oval ducts.
- Duct sizing methods, including velocity, equal- friction and static regain methods, and pressure loss calculations, with an example calculation. Heat loss from and gain to air in the duct; condensation, noise control and fire. Commissioning and testing.
- Overseas work.
- Drawing symbols in current use.

J.3

The flow of heavily contaminated air in ducts is not covered in detail in the notes; nor are the constructional aspects of ductwork, which are dealt with in DW/144.

J.4

The notes were completed by references, a bibliography of over thirty titles and appendices covering properties of air, ductwork support loads, velocity pressure for air flow and conversion to SI units.

TM No. 8 was published by CIBSE (the Chartered Institution of Building Services Engineers), www.cibse.org

Whilst TM8 is no longer available as a publication, it is still available from CIBSE in photo-copy form.

APPENDIX K GUIDANCE FOR CONNECTIONS TO BUILDING OPENINGS

K.1 RESPONSIBILITIES

Forming and finishing building openings are not the responsibility of the ductwork contractor and the notes that follow are for guidance purposes only.

K.1.1 BUILDERS WORK FRAMES

Openings in brick, block or concrete walls shall have inset frames to provide a suitable means of fixing grilles, louvres, masking flanges or the flanged ends of ductwork.

The inset frames shall be constructed to maintain the structural integrity of the wall and where applicable cavities shall be suitably lined.

K.1.2 DRY LINING FRAMES

In order to provide a suitable means of fixing grilles, louvres, masking flanges or the flanged ends of ductwork, openings in dry lining partitions shall have inset frames formed by the dry lining contactor.

K.1.3 STEELWORK BUILDINGS

In order to provide a suitable means of fixing grilles, louvres, masking flanges or the flanged ends of ductwork, openings in cladding walls and roofs of steelwork formed buildings shall have flanged sleeves/frames to provide a suitable means of fixing.

K.1.4 PROTECTION AGAINST THE ELEMENTS

Horizontal and vertical openings that are exposed to outside atmosphere shall have a suitable weathering finish at the external face.

K.1.5 FIRE RISKS

Timber framed openings are not permitted in fire compartment walls.

K.2 FLANGED CONNECTIONS

Ductwork connections to building openings shall have a flange of suitable profile to permit practical fixing to the opening frame. In selecting the profile, consideration shall be given to Table 2.2, 3.2, 4.2 and 5.2 in DW/144 relating to duct size and rating. Gasket strip and/or sealer shall be applied between the flange and building opening frame.

APPENDIX L CDM REGULATIONS

The Construction Design and Management Regulations (commonly known as the CDM Regulations) were revised in April 2007 with the intention to make it easier for those involved in construction projects to comply with their health and safety duties.

They are aimed at improving the management of health, safety and welfare to reduce the large number of serious and fatal accidents which happen every year in the industry.

A CDM Co-ordinator has to be appointed by the client if a project lasts more than 30 days or involves more than 500 person days of work, and he is required to advise and assist the client on how to fulfill their duties. Only the initial design work for the job should have been completed before the position is filled.

The Regulations place duties on *all* those who can contribute to the health and safety of a construction project. Duties are placed upon clients, system designers *and contractors* with more power given to the CDM Co-ordinator who has a more authorative and policing role.

The new regulations combine the Construction (Health, Safety and Welfare) Regulations (1996) and CDM 1994 into one single set of regulations which introduce some important changes to the safety regime. These include:

- A new duty on system designers to eliminate hazards and reduce risks, as far as is reasonably practicable.
- A Client will no longer be able to appoint an agent to take on their legal duties and criminal liabilities, thereby making the CDM Coordinator role more advisory in helping to fulfill their duties to comply with the Regulations
- When Principal Contractors appoint contractors, they will have to tell those contractors how much time they have to prepare for on-site work.
- Contractors will have a duty towards their on-site personnel, as well as being obliged to plan and manage their own work.
- The Client has a duty under Health and Safety at Work Act 1974 and the Management of Health and Safety at Work Regulations 1999 to ensure construction projects are carried out safely.

Under the new CDM Regulations 2007, clients must take reasonable steps to ensure that:

- Construction can be carried out without risk to health and safety.
- Welfare arrangements are in place before work begins.
- Any structure designed for use as a workplace complies with the Workplace Regulations.
- Sufficient time and resources are allocated to achieve these duties.
- To advise contractors and system designers how much time is available for planning and preparation before work starts.

- Duty holders must be sure that anyone they appoint to carry out or manage design or construction is competent.

- Duty holders themselves need to ensure that they are competent.

The CDM Regulations do not apply to the following projects:

- Construction work for a domestic client.

- Construction work carried out inside offices and shops or similar premises without interrupting the normal activities in the premises and without separating the construction activities from the other activities.

If there is any doubt about whether the CDM Regulations apply to a project, contact should be made with the local HSE office.

To ensure that a company meets the CDM regulations, it is recommended that they have a CDM audit carried out by a third party which provides an objective view of a company's strengths and weaknesses in this area. The CDM compliance audit takes part in two separate stages. The initial approach is to gather information, followed by a detailed evaluation which will be presented in a formal report.

APPENDIX M REGULATORY REFORM (FIRE SAFETY) ORDER AND CONSTRUCTION PRODUCTS REGULATIONS (CPR)

This section relates to legislation and accountability for Fire Safety Products, and DW/144, Sections 22 to 25 (Fire & Smoke Dampers) and Commentary and Guidance – Note 4 (Fire Resisting Ductwork) are all to be read in conjunction with this Note.

M.1 GENERAL

Any person designing for the use of, purchasing and/or installing fire safety products, such as fire resisting ducts, penetration seals, fire dampers and smoke control dampers etc must be aware of the following information. This is not limited to the use of only these products but relates to all fire safety products.

It should be noted that all the regulations and orders are the law, not just guidance. It is very clear that fire safety products must be properly manufactured, tested and certificated in accordance with the latest BS-EN requirements and installed in accordance with the manufacturer's instructions.

Information on the regulations is available at government websites as is Approved Document B. They are generally free as is the associated government guidance. British Standards are available from the British Standards Institute (BSI). More information on the implications of the Construction Products Regulation and CE marking is available from the Construction Products Association which has published guidance developed with government agencies.

M.2 THE REGULATORY REFORM (FIRE SAFETY) ORDER (RRFSO)

Much has been said about the Regulatory Reform Order (Fire Safety) Order (2005) (RRFSO) In simple terms it removes the issue of fire certificates and places responsibility for the fire safety of the building, its occupants and those within the immediate vicinity, under the care of the 'Responsible Person'.

In addition to defining the requirements for risk assessment etc it also defines the "Responsible Person" and the duties to which they are held responsible. The catch all paragraph is as follows – *"Any duty imposed by articles 8 to 22 or by regulations made under article 24 on the responsible person in respect of premises shall also be imposed on every person, other than the responsible person referred to in paragraphs (1) and (2), who has, to any extent, control of those premises so far as the requirements relate to matters within his control."*

The term "Responsible Person" places a legal responsibility on the 'person' or organisation itself. The intent of the RRFSO is to ensure that any changes to the original building or its operation, must not adversely affect the safety of the premises. It's a little like passing an MOT test for a car, then immediately changing its wheels or brakes which could affect the vehicle's safety. In this analogy the change to the vehicle would not become apparent until its next MOT or when a collision occurs! The RRFSO makes someone 'corporate' or otherwise, responsible for the building's fire safety in an on-going basis. Systems that are immediately identifiable as fire rated minimise the risk of unauthorised modifications (i.e. a carelessly cut in a duct branch, or an access door installed at a later date by a ductwork cleaning company, on a plain and not immediately identifiable fire rated duct) breaching compartmentation and having serious ramifications for the building's fire safety.

For those persons responsible for specifying the materials and/or appointing the installation contractors, it will also be their responsibility to ensure that they can prove compliance for the fire protection materials used and the works to be carried out. It's no longer simply a duty of care or voluntary – it's a legal obligation.

If you knowingly ignore advice or information that leads to a failure in the fire performance of any element of installed fire protection within a building, then you are likely to be found to be just as culpable as the deficient installer. You share liability for the provision of information required under Building Regulation 16B that tells the user of the building about the fire prevention measures provided in the building. Otherwise, the user cannot make an effective risk assessment under the RRFSO.

In the event of fire, whether or not deaths occur as a result, a court will want to know how every fire protection system was selected; the basis for selection of the installer, whether adequate time was provided for its installation and whether there was adequate liaison between the different parties to ensure it was installed correctly. No ifs, no buts – it's all contained in the Construction, Design and Management Regulations 2007 (CDM). (Appendix L).

The CDM regulations 2007, enforced by Health and Safety Executive, concentrate on managing the risk and the health and safety of all those who build, those that use the building, those who maintain it and those that demolish it – cradle to grave.

So if you design anything, supply anything, install anything, you have effectively become a responsible person within the lifetime of the building. This responsibility is not handed over at any point. A responsible person should ask if they are not sure. This personal responsibility goes down to individuals who are using the building. They should point out any shortcomings too, although this would probably be seen with regard to blocked escape routes etc, not fire safety installations. It is expected by the RRFSO that any new building or change to a building is carried out under the current building regulations to which Approved Document B (ADB) gives guidance. There is room to seek compromise to the RRFSO, but this of course may not be reached. ADB gives guidance on fire safety information if required at building completion or occupation - whichever is earlier. "Fire safety information" means information relating to the design and construction of the building or extension, and the services, fittings and equipment provided in or in connection with the building or extension which will assist the responsible person to operate and maintain the building or extension with reasonable safety.

This is because the new responsible person (owner/occupier) under the RRFSO will need to know how to maintain fire safety equipment and how to get to it. The design and installation details are important as these will form the basis of any records for risk assessment purposes and how to fix any installation damage that might appear in the future. A responsible person should be asking for all the Regulation 38 documentation when a building is handed over. It could be said that effectively under law that everyone is responsible in some way for fire safety.
Full guidance with regard to risk assessment, maintenance etc is given in the RRFSO or its associated guidance.

Fire brigades will seek changes under this legislation if they find discrepancies and will start court proceedings if they find major problems that have not been put right.

M.2.1 BUILDING REGULATION 38 – FIRE SAFETY INFORMATION

All fire safety information must be handed over at completion or date of occupation whichever is earlier. "Fire safety information" means information relating to the design and construction of the building or extension, and the services, fittings and equipment provided in or in connection with the building or extension which will assist the responsible person to operate and maintain the building or extension with reasonable safety.

This is because the new responsible person (owner/occupier) under the RRFSO will need to know how to maintain fire safety equipment and how to get to it. The design and installation details are important as these will form the basis of any records for risk assessment purposes and how to fix any installation damage that might appear in the future. A responsible person should be asking for all the Regulation 38 documentation when a building is handed over and under the above has a legislative right to it

M.2.2 APPROVED DOCUMENT B (FIRE SAFETY) VOLUME 2 – BUILDINGS OTHER THAN DWELLINGHOUSES

ADB gives guidance to meeting the requirements of the building regulations with the basic need to build a safe building and meet various fire safety levels.

The use of third party certificated products and installers is clearly recommended. For fire safety products with relevant harmonised product standards such as fire resisting ductwork, fire dampers, smoke control dampers, etc, it is a requirement of CE marking. No third party certification means no CE mark. Following this advice will make the provision of the Regulation 38 information much easier. Information is given for a range of fire safety equipment as well as design information for means of escape etc. It also refers to the BS5588 series of British Standards. These have now essentially been replaced by the single BS9999 standard.

BS9999 - Code of practice for fire safety in the design, management and use of buildings

This standard gives a large amount of information to support ADB. It also gives guidance on the continuing maintenance for smoke control systems, ventilation ductwork and other equipment with fire safety performance or requirements. This should be a clear reference for responsible persons and risk assessors.

M.2.3 APPROVED DOCUMENT 7 MATERIAL AND WORKMANSHIP (2013 EDITION)

This document gives guidance on how to comply with regulation 7 of the Building Regulations, for both materials and workmanship. It also states interaction with other legislation that the Construction Product Regulation requires for construction products that are covered by a Harmonised Product Standard (hEN) or conform to a European technical assessment, should normally have CE marking.

Persons responsible for compliance with AD7 are people who are responsible for building work (e.g. agent, system designer, builder, manufacturer or installer) who must ensure that the work complies with all the applicable requirements of the building regulations.

This Approved Document (2013 edition) took effect on 1 July 2013 and is for use in England and Wales. The 1999 edition of Approved Document 7 will continue to apply to work started before 1 July 2013 or subject to building notice, full planning application or initial notice submitted before 1 July 2013.

M.3 THE CONSTRUCTION PRODUCTS REGULATION (CPR) – CE MARKING

The Construction Products Regulations (CPR) Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC came into force in April 2011. It has been adopted by the European Commission and the UK Government and replaces the Construction Products Directive (CPD). The CPR becomes a statutory requirement in each European country when it is incorporated in national Building Regulations.

The CPR aims to remove technical barriers to trade for construction products across Europe. The principal mechanism for achieving this is through the replacement of existing national standards and technical approvals with a single set of European-wide technical specifications for construction products (i.e. harmonised European standards or European Technical Approvals). The CPR builds on the success of the CPD, by allowing construction products that have been assessed against harmonised standards to be legally placed on the market anywhere in the European Economic Area.

M.3.1 THE SEVEN BASIC REQUIREMENTS FOR CONSTRUCTION WORKS IN THE CPR

The scope of the CPR is limited to regulated issues under seven basic requirements for construction works, as shown below:

1. Mechanical resistance and stability.
2. Safety in case of fire.
3. Hygiene, health and the environment.
4. Safety and accessibility in use.
5. Protection against noise.
6. Energy economy and heat retention.
7. Sustainable use of natural resources.

M.3.2 SAFETY IN CASE OF FIRE

The CPR states that the construction works must be designed and built in a way that in the event of an outbreak of fire:

1. The load-bearing capacity of the construction can be assumed for a specific period of time.
2. The generation and spread of fire and smoke within the construction works are limited.
3. The spread of fire to neighbouring construction works is limited.
4. Occupants can leave the construction works or be rescued by other means.
5. The safety of rescue teams is taken into consideration.

M.3.3 CE MARKING AND THE CONSTRUCTION PRODUCTS REGULATIONS

CE marking is a declaration by a manufacturer that a product meets all the appropriate provisions of the relevant legislation implementing certain European Directives. The European Union (EU) introduced the CE marking scheme to make trade easier and cheaper between EU countries. A CE mark means that a manufacturer claims that their product conforms to the minimum legal requirements for health and safety as laid down in EU directives.

CE marking is mandatory in the UK for products covered by a harmonised European Standard (hEN). Manufacturers and importers had until July 2013 to ensure that their construction products meet the CE requirements of the new Construction Products Regulations (CPR).

According to the Regulations, the requirement for CE marking will apply to:

> *"any product or kit which is produced and placed on the market for incorporation in a permanent manner in construction works or parts thereof and the performance of which has an effect on the performance of the construction works with respect to the basic requirements for construction works."*
>
> Any products that fall under this definition that are placed on the market from July 2013 and are covered by a harmonised standard, will have to be accompanied by a Declaration of Performance (DoP) and will need to display the CE mark.

For products not covered, or not fully covered, by a harmonised European Standard (hEN), CE marking may be applied through a European Technical Assessment (ETA), issued by an approved body.

From 1 July 2013 it was a requirement that all fire resisting ductwork, fire dampers and smoke control dampers sold (manufactured or from stock) that has a European Product Standard must be CE marked. CE marking requires full testing supported by third party certification. These products are not allowed to have self-certification. Manufacturers and distributors have responsibilities under the CPR and are responsible persons as described above. They should be able to provide competent information, but this should be checked too. It should be noted that the 1 July 2013 was the end of a transition period that started in early 2011.

APPENDIX N BIBLIOGRAPHY

Included in this Bibliography are technical publications which may be of interest to ductwork system designers, manufacturers and installers, and to those in the heating, ventilating, and air conditioning industries generally. Enquiries should be made of the relevant organisation, at the contact details quoted. Since its publication other addresses contained within DW/144 may have changed, and some publications may have been superseded, it is the readers responsibility to ascertain the latest applicable information.

BUILDING & ENGINEERING SERVICES ASSOCIATION (B&ES)

T:	+44 (0) 1768 860405
E:	b-espublications@welplan.co.uk
W:	www.b-espublications.co.uk

PUBLICATIONS

DW/143	*A Practical Guide to Ductwork Leakage Testing*
DW/144	*Specification for Sheet Metal Ductwork.*
	(Low, medium and high pressure velocity Air Systems) Incorporating DW/TM1.
DW/145	*Guide to Good Practice for the Installation of Fire and Smoke Dampers*
DW/154	*Specification for Plastics Ductwork*
DW/172	*Specification for Kitchen Ventilation Systems*
DW/191	*Guide to Good Practice - Glass Fibre Ductwork*

CMSO1	*B&ES COSHH Management Systems*
JS1	*Worksafe – Guide to Site Safety*
JS2	*Tool Box Talks*
JS5	*Worksafe - Welding Safety Guide*
JS19	*Worksafe - Safety Facts Book*
JS23	*Risk Management*
TR5	*Welding of Carbon Steel Pipework*
TR6	*Site Pressure Testing of Pipework*
TR14	*Environmental Polices Document*
TR/19	*Guide to Good Practice - Internal Cleanliness of Ventilation Systems*

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ASSOCIATION FOR SPECIALIST FIRE PROTECTION (ASFP)

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W:	www.asfp.org.uk

PUBLICATIONS

Fire and Smoke Resisting Dampers – The Grey Book
Fire Resisting Ductwork - The Blue Book

TGD18	*Code of practice for the Installation and Inspection of Fire Resisting Duct Systems*

BUILDING SERVICES RESEARCH AND INFORMATION ASSOCIATION (BSRIA)

T:	+44 (0) 1344 465600
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W:	www.bsria.co.uk

APPLICATION GUIDES

AG.1/9	*Commissioning of VAV Systems in Buildings.*
AG 3/89.3	*The Commissioning of Air Systems in Buildings*
TM1/88.1	*Commissioning HVCA Systems*
FMS1/97	*Guidance and Specification for Ventilation Hygiene*
BG30/2007	*Guide to HVAC Building Services Calculations 2nd Ed*
BG10/2010	*Structural Fixings for Ductwork Systems*

BRITISH STAINLESS STEEL ASSOCIATION (BSSA)

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BRITISH STANDARDS INSTITUTION (BSI)

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W:	www.bsigroup.com

STANDARDS

BS 0	*A standard for standards – Principles of standardisation*
BS 381C	*Specification for colours for identification, coding and special purposes.*
BS 476-3	*Fire tests on building materials and structures.*
BS 476-4	*Non-combustibility test for materials.*
BS 476-6	*Fire tests on building materials and structures. Method of test for fire propagation for products.*
BS 476-7	*Method for classification of the surface spread of flame tests for materials.*
BS 476- 20	*Method for determination of the fire resistance of elements of construction (general principles)*
BS 476-21	*Method for determination of fire the resistance of load bearing elements of construction.*
BS 476-22	*Method for determination of the fire resistance of non-load bearing elements of construction.*
BS 476-23	*Method for determination of the contribution of components to the fire resistance of a structure.*
BS 476-24	*Method for determination of the fire resistance of ventilation ducts.*
BS EN 485 parts 1-4	*Aluminium and aluminium alloys. Sheet, strip and plate.*
BS EN 515	*Aluminium and aluminium alloys. Wrought products. Temper designations.*
BS EN 573 parts 1-4	*Aluminium and aluminium alloys. Chemical composition and form of wrought products.*
BS EN 755 parts 2-9	*Aluminium and aluminium alloys. Extruded rod/bar, tube and profiles.*
BS EN 1011-3:	*Welding. Recommendations for welding of metallic materials. Arc welding of stainless steels.*
BS EN 1363-1:	*Fire resistance tests. General requirements.*

BS EN 1366-1	*Fire resistance tests for service installations. Fire resistance tests for service installations. Ducts.*
BS EN 1366-2	*Fire resistance tests for service installations. Fire dampers.*
BS EN 1366-5	*Fire resistance tests for service installations . Service ducts and shafts.*
BS EN 1366-8	*Fire resistance tests for service installations. Smoke extraction ducts.*
BS EN 1366-9	*Fire resistance tests for service installations. Single compartment smoke extraction ducts.*
BS EN 1366-10	*Fire resistance tests for service installations. Smoke control dampers.*
BS EN ISO 1461	*Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.*
BS 1449-1	*Carbon steel plate, sheet and strip.*
BS EN ISO 1479	*Specification for hexagon head tapping screws.*
BS EN 1506	*Ventilation for buildings. Sheet metal air ducts and fittings with circular cross-section.*
BS EN 1507	*Ventilation for buildings. Sheet metal air ducts with rectangular section.*
BS EN 1600	*Welding consumables. Covered electrodes for manual metal arc welding of stainless and heat resisting steels.*
BS 1710	*Specification for identification of pipelines and services.*
BS EN 1751	*Ventilation for buildings. Air terminal devices. Aerodynamic testing of dampers and valves.*
BS EN ISO 2063	*Thermal spraying. Metallic and other inorganic coatings. Zinc, aluminium and their alloys.*
BS 3533	*Glossary of thermal insulation terms.*
BS EN ISO 3506 parts 1-2	*Mechanical properties of corrosion-resistant stainless-steel fasteners. Bolts, screws, studs and nuts.*
BS EN ISO 3834-1	*Quality requirements for fusion welding of metallic materials.*
BS 4800	*Schedule of paint colours for building purposes.*
BS 4872-1:1982	*Specification for approval testing of welders when welding procedure approval is not required. Fusion welding of steel.*
BS 5422	*Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C.*
BS 5970	*Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of -100°C to +870°C.*
ISO 6944-1	*ISO6944-1 : 2008 Fire containment. Elements of building construction. Part 1. Ventilation ducts.*
BS EN ISO 7049	*Cross recessed pan head tapping screws.*
BS EN ISO 9445	*Continuously cold-rolled stainless steel narrow strip, wide strip, plate/sheet and cut lengths. Narrow strip and cut lengths.*
BS 9999	*Code of practice for fire safety in the design, management and use of buildings*
BS EN 10048	*Hot rolled narrow steel strip.*
BS EN 10051	*Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels.*
BS EN 10088-1	*Stainless steels. List of stainless steels.*
BS EN 10088-2	*Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes.*
BS EN 10095	*Heat resisting steels and nickel alloys.*
BS EN 10130	*Cold rolled low carbon steel flat products for cold forming.*
BS EN 10131	*Cold rolled uncoated and zinc or zinc-nickel electrolytically coated low carbon and high yield strength steel flat products for cold forming.*
BS EN 10142	*Continuously hot-dip zinc coated low carbon steels strip and sheet for cold forming.*
BS EN 10143	*Continuously hot-dip coated steel sheet and strip. Tolerances on dimensions and shape.*
BS EN 10149 parts 2-3	*Specification for hot-rolled flat products made of high yield strength steels for cold forming.*

BS EN 10209	*Cold rolled low carbon steel flat products for vitreous enamelling.*
BS EN 10210-2	*Hot finished structural hollow sections of non-alloy and fine grain steels. Tolerances, dimensions and sectional properties.*
BS EN 10346	*Continuously hot-dip coated steel flat products.*
BS EN ISO 11925-2	*Reaction to fire tests. Ignitability of products subjected to direct impingement of flame. Single-flame source test.*
BS EN 12097	*Ventilation for buildings. Requirements for ductwork components to facilitate maintenance of ductwork systems.*
BS EN 12020-2	*Aluminium and aluminium alloys. Extruded precision profiles in alloys EN AW-6060 and EN AW-6063.*
BS EN 12101-7	*Smoke and heat control systems. Smoke duct sections.*
BS EN 12101-8	*Smoke and heat control systems. Smoke control dampers.*
BS EN 12236	*Ventilation for buildings. Ductwork hangers and supports. Requirements for strength.*
BS EN 12237	*Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts.*
BS EN ISO 12241	*Thermal insulation for building equipment and industrial Installations.*
BS EN 13030	*Ventilation for buildings-Terminals-Performance testing louvres subject to simulated rain.*
BS EN 13181	*Ventilation for buildings-Terminals-Performance testing louvres subject to simulated sand.*
BS EN 13236	*Safety requirements for super abrasive products*
BS EN 13264	*Ventilation for buildings-Floor mounted air terminal devices-Tests for structural classification.*
BS EN 13403	*Ventilation for buildings. Non metallic ducts. Ductwork made from insulation duct boards.*
BS EN 13501-1	*Fire classification of construction products and building elements. Classification using test data from reaction to fire tests.*
BS EN 13501-3	*Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers.*
BS EN 13501-4	*Fire classification of construction products and building elements. Classification using data from fire resistance tests on components of smoke control systems.*
BS EN 13823	*Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item.*
BS EN ISO 14001	*Environmental management systems. Requirements with guidance for use.*
BS EN ISO 14343	*Welding consumables. Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels. Classification.*
BS EN ISO 15609-4	*Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Laser beam welding.*
BS EN ISO 15609-5	*Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Resistance welding.*
BS EN 15780:2011	*Ventilation for buildings. Ductwork. Cleanliness of ventilation systems.*
BS EN 15871	*Ventilation for buildings. Fire resisting duct sections. Kitchen extract.*
BS EN 15882-1	*Extended application of results from fire resistance tests for service installations. Ducts.*
BS EN 15882-3	*Extended applications of results from fire resistance tests for service installations. Penetration seals.*
BS EN 15882-4	*Extended application of results from fire resistance tests for service installations. Linear joint seals.*
BS EN 15780	*Ventilation for buildings. Ductwork. Cleanliness of ventilation systems.*
BS EN ISO 18286	*Hot-rolled stainless steel plates. Tolerances on dimensions and shape.*

Note: The numbers of British Standards and other documents are those available at the date of this publication. It should also be noted that in a number of cases hybrid references are used for clarity, most are where standards are in a state of transitional change. Users should ensure that they consult with the latest version. The full titles have not always been used.

CHARTERED INSTITUTION OF BUILDING SERVICES ENGINEERS (CIBSE)

T:	+44 (0)20 8675 5211
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CIBSE Guide

Vol A	*Environmental Design Data*
Vol B3	*Installation and Equipment Data*
Vol C	*Reference Data*

COMMISSIONING CODES

These Codes cover the preliminary checks, setting to work and regulation of various categories of plant. The Commissioning Codes give a guide to design implications.

Code A	*Air Distribution Systems*
Code B	*Boilers*
Code C	*Automatic Controls*
Code R	*Refrigerating Systems*
Code W	*Water Distribution Systems*

TECHNICAL MEMORANDA

TM 04:	*Design Notes for the Middle East*
TM 08:	*Design Notes for Ductwork*
TM 13:	*Minimising the Risk of Legionnaires Disease*

RESEARCH REPORTS

RR01/95:	*Ventilation System Hygiene*
RR02/95:	*Air-to-air heat recovery*
RR03/95:	*Influence of HVAC on smoke detectors*

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BUILDING REGULATIONS

Approved Document L2A
Conservation of Fuel and Power (New buildings other than dwellings)
Approved Document L2B
Conservation of Fuel and Power (Existing buildings other than dwellings)
Approved Document 7
Materials and Workmanship

LEGISLATION

Construction Products Regulations (CPR) (Regulation (EU) No 305/2011)

DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS (DEFRA)

T:	08459 33 55 77
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PUBLICATIONS

M & E No.1 1972	Electrical installations in buildings
M & E No.3 1988	Heating, hot and cold water, steam and gas installations for buildings.
M & E No.100 1971	Mechanical ventilation for buildings

EUROPEAN COMMITTEE FOR STANDARDIZATION (CEN)

Information on the work programmes of the following CEN Technical Committees, including a full list of published and draft ventilation product standards, can be found in the 'Technical Bodies' section of the CEN website.

CEN/TC 156	*Ventilation for buildings*
CEN/TC 127	*Fire safety in buildings*

W:	http://standards.cen.eu

EUROVENT

T:	+ 32 (2) 706 79 62
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HEALTH & SAFETY EXECUTIVE (HSE)

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W:	www.hse.gov.uk

PUBLICATIONS

L23 - Manual Handling Operations Regulations Standards
Health & Safety at Work Act 1974
The Management of Health & Safety at Work regulations 1999
Construction (Design and Management) Regulations 2007 (CDM)
Workplace (Health & Safety Welfare) Regulations 1992

HEATING, VENTILATING AND AIR CONDITIONING MANUFACTURERS ASSOCIATION (HEVAC)

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PUBLICATIONS

Guide to Air Distribution Technology for the Internal Environment
Specification for Floor Grilles – Types, Performance and Method of Test
TM42 - CIBSE/FMA Application Guide
Fan and Ductwork Installation Guide

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION INC. (SMACNA)

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PUBLICATIONS

Accepted Industry Practice for Industrial Duct Construction
Architectural Sheet Metal Manual
Ducted Electric Heat Guide for Air Handling Systems
Fibrous Glass Duct Construction Standards
Fire, Smoke & Radiation Damper Installation Guide for HVAC Systems
HVAC Air Duct Leakage Test Manual
HVAC Duct Construction Standards – Metal and Flexible
HVAC Duct Systems Inspection Guide
HVAC Systems-Duct Design
Rectangular Industrial Duct Construction Standards
Round Industrial Duct Construction Standards
Seismic Restraint Manual
Guidelines for Mechanical Systems
Thermoplastic Duct (PVC) Construction Manual
SMACNA CD-ROM Technical Manual Collection

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PUBLICATIONS

Edge Protection by Zinc

THERMAL INSULATION CONTRACTORS ASSOCIATION (TICA)

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PUBLICATIONS
Guidance for Achieving Compliance with Part L of the Building Regulations
Technical Handbooks: Domestic Handbook 2010
Technical Handbooks: Non-Domestic Handbook 2010 Section 6-Energy

APPENDIX P CONVERSION TABLES

P.1 SHEET THICKNESSES

Galvanized steel *			
Standard thickness		Birmingham Gauge	
inch	mm	BG	inch
.0197	**0.5**	**26**	.0196
.0236	**0.6**	**24**	.0248
.0276	**0.7**		
.0315	**0.8**	**22**	.0312
.0354	**0.9**		
.0394	**1.0**	**20**	.0392
.0472	**1.2**		
		18	.0495
.0630	**1.6**	**16**	.0625
.0787	**2.0**	**14**	.0785
.0984	**2.5**	**12**	.0991

Aluminium			
Standard thickness		Standard Wire Gauge	
inch	mm	swg	inch
		26	.018
.0197	**0.5**		
		24	.022
.0236	**0.6**		
.0276	**0.7**	**22**	.028
.0315	**0.8**		
.0354	**0.9**	**20**	.036
.0394	**1.0**		
.0472	**1.2**	**18**	.048
.0630	**1.6**	**16**	0.64
.0787	**2.0**	**14**	.080
.0984	**2.5**		
		12	.104
.1181	**3.0**		
		10	.128

0.5 mm is a standard thickness for galvanized sheet only
2.5mm is a standard thickness for hot-rolled sheet only

* See DW/144, Appendix B, Section B.3.2, which contains information on sheet thickness and sheet width/length tolerances

P.2 SOME MISCELLANEOUS CONVERSION FACTORS

To convert	*Multiply by*	*To convert*	*Multiply by*
Length			
Inches to millimetres	25.40	Millimetres to inches	0.03937
Feet to metres	0.3048	Metres to feet	3.281
Area			
Square inches to square millimetres	645.2	Square millimetres to square inches	0.00155
Square feet to square metres	0.0929	Square metres to square feet	10.764
Volume			
Cubic feet to cubic metres	0.02832	Cubic metres to cubic feet	35.315
Cubic feet to litres	28.31	Litres to cubic feet	0.0353
Gallons (UK) to litres	4.546	Litres to gallons (UK)	0.22
Mass			
Ounces to grams	28.35	Grams to ounces	0.03527
Pounds to kilograms	0.4536	Kilograms to pounds	2.205
Tons to tonnes	1.016	Tonnes to tons	0.9842

Volume Flow

Cubic feet per minute to cubic metres per second	0.000472	Cubic metres per second to cubic feet per minute	2119
Cubic feet per minute to litres per second	0.4719	Litres per second to cubic feet per minute	2.119

Motion

Feet per minute to metres per second	0.00508	Metres per second to feet per minute	197

Pressure

Inches water gauge to millibars	2.491
Inches water gauge to pascals (Pa)	249.1

1 Pa = 1 Newton per square metre = 10^{-2} millibars

Notes:
(a) The symbol for litres is 'L'. 1000 litres per second is equivalent to 1 cubic metre per second
(b) The Pascal (Pa) is the internationally agreed unit of pressure. The relationship of the Pascal to other units of pressure is: 500 Pascals = 500 Newtons per square metre = 5 millibars = approximately 2 inches water gauge.

P.3 STANDARD DIMENSIONS OF STEEL AND ALUMINIUM SHEET AND WEIGHT OF GALVANIZED SHEET

Steel (mild and galvanized)	
Metric	Equivalent
mm	ft/in
2000 x 1000	6' 6$^3/_4$" x 3' 3$^3/_8$"
2500 x 1250	8' 2$^7/_{16}$" x 4' 1¼"
3000 x 1350	9' 10$^1/_8$" x 4' 5$^1/_8$"
3000 x 1500	9' 10$^1/_8$" x 4' 11$^1/_{16}$"

Aluminium (commercially pure and alloy)	
Metric	Equivalent
mm	ft/in
2000 x 1000	6' 6$^3/_4$" x 3' 3$^3/_8$"
2500 x 1250	8' 2$^7/_{16}$" x 4' 1¼"
3750 x 1250	12' 3$^5/_8$" x 4' 1$^1/_4$"

Weight of galvanized steel sheet

Thickness	Weight per square metre
km	kg
0.5	3.9213
0.6	4.7056
0.7	5.4898
0.8	6.2741
0.9	7.0584
1.0	7.8426
1.2	9.4111
1.6	12.5481
2.0	15.6852
2.5	19.6064

P.4 NOMINAL DUCTWORK WEIGHTS

This is a guide for use relating to such subjects as manual handling.

Note – The following weights have been calculated using the parameters below: -

a) Constructed to Low Pressure requirements as tables 2.1, 2.2, 8 & 13 in DW/144 (including tie rods on flat oval ductwork).

b) Flanged & stiffened using roll-formed sheet metal joints on rectangular ductwork (weights for circular & flat oval ductwork do not include flange joints)

c) The weights do not include any brackets or insulation.

d) The weights for rectangular ductwork are calculated with flange joints at 1.5m centres.

e) The weights are approximate due to manufacturing tolerances.

f) Ancillaries such as air turns, splitters & damper blades are not included.

P.4.1 GALVANIZED STEEL RECTANGULAR DUCTWORK

Size mm	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
250	7.25	10.75	14.25	19.00								
500		14.25	17.75	22.75	34.00	38.75	47.75	52.75				
750			21.25	26.25	38.75	43.50	52.75	58.00	68.50	74.00	90.75	97.00
1000				30.00	43.50	48.25	58.00	63.00	74.00	79.50	97.00	103.50
1250					48.25	53.00	63.00	68.00	79.50	85.00	103.50	109.75
1500						57.75	68.00	73.25	85.00	90.50	109.75	116.00
1750			Weight Kg/M				73.25	78.25	90.50	96.00	116.00	122.25
2000								83.50	96.00	101.50	122.25	128.50
2250									101.50	107.00	128.50	134.75
2500										112.50	134.75	141.00
2750											141.00	147.50
3000												153.75

P.4.2 GALVANIZED STEEL SPIRALLY-WOUND CIRCULAR DUCTWORK

Diameter mm	Weight Kg/M
63	0.80
80	1.00
100	1.56
125	1.96
150	2.34
160	2.50
200	3.75
250	4.69
300	5.63
315	5.92
355	8.88

Diameter mm	Weight Kg/M
400	10.01
450	11.25
500	12.50
560	14.00
630	15.76
710	17.76
800	25.45
900	28.60
1000	31.80
1120	44.73
1250	48.76

P.4.3 GALVANIZED STEEL SPIRALLY-WOUND FLAT OVAL DUCTWORK

Size mm	Weight
W x D	Kg/M
320 x 76	4.20
361 x 76	4.69
401 x 76	5.26
442 x 76	5.63
480 x 76	8.88
521 x 76	8.88
345 x 102	4.69
386 x 102	5.26
427 x 102	5.63
467 x 102	8.88
508 x 102	8.88
546 x 102	10.01
333 x 127	4.69
371 x 127	5.26
411 x 127	5.63
452 x 127	8.88
493 x 127	8.88
533 x 127	10.01
318 x 152	4.69
358 x 152	5.26
399 x 152	5.63
437 x 152	8.88
478 x 152	8.88
518 x 152	10.01
559 x 152	10.01
638 x 152	11.25
719 x 152	12.55
800 x 152	14.05
879 x 152	15.30
960 x 152	16.57
1039 x 152	17.83
1120 x 152	19.12
1201 x 152	25.65
531 x 203	10.01
610 x 203	11.25
691 x 203	12.50
770 x 203	14.06
851 x 203	15.31
932 x 203	16.56
1011 x 203	17.84
1092 x 203	19.58
1171 x 203	25.53
1334 x 203	27.36

Size mm	Weight
W x D	Kg/M
582 x 254	11.25
663 x 254	12.50
742 x 254	14.00
823 x 254	15.33
902 x 254	16.58
983 x 254	17.84
1064 x 254	19.16
1143 x 254	25.56
1224 x 254	27.15
1303 x 254	28.92
1384 x 254	30.52
1466 x 254	32.12
1626 x 254	45.05
1786 x 254	49.08
632 x 305	12.50
714 x 305	14.00
792 x 305	15.25
874 x 305	16.59
955 x 305	17.85
1034 x 305	19.14
1115 x 305	25.57
1196 x 305	27.16
1275 x 305	28.72
1356 x 305	30.56
1435 x 305	32.16
1598 x 305	45.09
1758 x 305	49.12
686 x 356	14.00
765 x 356	15.25
846 x 356	16.56
925 x 356	17.87
1006 x 356	19.16
1087 x 356	25.56
1166 x 356	27.19
1247 x 356	28.75
1326 x 356	30.35
1407 x 356	32.24
1567 x 356	45.17
1727 x 356	49.20
1890 x 356	53.28
1969 x 356	55.18

Size mm	Weight
W x D	Kg/M
655 x 406	14.00
737 x 406	15.25
818 x 406	16.50
897 x 406	17.76
978 x 406	19.17
1057 x 406	25.57
1138 x 406	27.16
1219 x 406	28.76
1298 x 406	30.36
1379 x 406	31.96
1539 x 406	45.21
1699 x 406	49.24
1859 x 406	53.32
1941 x 406	55.22
709 x 457	15.25
787 x 457	16.50
869 x 457	17.76
950 x 457	19.50
1029 x 457	25.29
1110 x 457	27.18
1189 x 457	28.75
1270 x 457	30.39
1351 x 457	31.99
1511 x 457	45.29
1671 x 457	49.32
1831 x 457	53.40
1913 x 457	55.30
678 x 508	15.25
759 x 508	16.50
841 x 508	17.76
919 x 508	19.05
1001 x 508	25.45
1080 x 508	27.19
1161 x 508	28.75
1242 x 508	30.35
1321 x 508	32.00
1483 x 508	44.93
1643 x 508	49.36
1803 x 508	53.44
1885 x 508	55.34

OTHER **DUCTWORK–RELATED** PUBLICATIONS

DW/143
A Practical Guide to Ductwork Leakage Testing

DW/145
Guide to Good Practice for the Installation of Fire and Smoke Dampers

DW/154
Specification for Plastic Ductwork

DW/172
Specification for Kitchen Ventilation Systems

DW/191
Guide to Good Practice: Glass Fibre Ductwork

TR/19
Guide to Good Practice: Internal Cleanliness of Ventilation Systems(incorporating DW/TM2 and TR/17)

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BUILDING & ENGINEERING SERVICES ASSOCIATION

COMMENTARY & GUIDANCE

DW/144

The information in Commentary and Guidance to DW/144 is additional supplementary material to support the document text and is explanatory in nature. It does not form any part of the DW/144 technical specification and should be used for reference only.

www.b-es.org

COMMENTARY AND GUIDANCE – DW/144

Contents

NOTE 1 SWIMMING POOL SYSTEMS – GUIDANCE NOTES FOR SYSTEM DESIGNERS

In recent years there have been issues relating to the use of various materials not only in the construction of the ductwork but also, and even more importantly, the materials used in the ductwork support systems.

The design of swimming pool ductwork systems and their supports is the responsibility of the system designer and not the ductwork contractor.

The micro-climates in different areas of swimming pool buildings have an important bearing on the choice of ductwork materials and supports and the system designer should take direct advice from those organisations and associations that specialise in particular types of materials.

This section highlights the importance of the selection of appropriate materials that will withstand the warm, humid and corrosive atmospheres associated with such areas.

System design should take into account the need for future inspection regimes and the maintenance access available to the ductwork and its associated supports.

1.1 *GALVANIZED DUCTWORK AND SUPPORTS*

Ductwork and associated support materials, unless stated otherwise by the system designer, should be manufactured from galvanized steel with a recommended coating mass of Z600.

All galvanized ductwork systems and associated supports should be periodically inspected for signs of rust and be treated/replaced accordingly.

Additional protection from the application of suitable paint finishes can also prolong the ductwork systems life and improve the aesthetics of the installation.

1.2 *PLASTIC DUCTWORK AND SUPPORTS*

Thermoplastics and composite materials such as Polyvinyl Chloride (PVCu), Polypropylene (PP), Fire retardant Polypropylene (PPs), Polyethylene (PE) and Fibreglass (GRP), ductwork systems are chemically resistant inside and out and able to withstand corrosive attack to conditions such as hydrogen sulphide, chlorine, salt, fluoride, acids and other hazardous liquids and gases.

With the correct choice of resin, fibreglass reinforcement can be applied to provide the following:-

- further chemical resistance
- structural strength with no sagging of the duct occurring when handling warm gases
- UV resistance
- choice of aesthetic finish to match the surroundings.

Unlike coated steel ducts, scratches to PVCu, PP, PPs and PE ducts and fittings will not result in corrosion or long term damage that may otherwise require the duct section to be replaced.

Resistant Support Systems: A full range of split ring brackets and support system manufactured in chemical resistant materials is available.

A competent installer should deliver a fully sealed system providing a low maintenance, long life solution.

For further information on plastic ductwork refer to B&ES publication, DW/154 'Specification for Plastic Ductwork'.

1.3 STAINLESS STEEL DUCTWORK AND SUPPORTS

Stainless Steel can be suitable for swimming pool applications provided that:

- The possibility of failure by Stress Corrosion Cracking (SCC) is properly assessed for load bearing components
- The grade and surface finish is chosen to give optimum corrosion resistance

There are factors which are very specific to swimming pool buildings which need to be taken into account when designing new swimming pool buildings or refurbishing existing ones using stainless steel. The most important of these factors is the potential for Stress Corrosion Cracking (SCC) in some grades of stainless steel associated with the ductwork supports.

1.3.1 STRESS CORROSION CRACKING (SCC)

SCC requires 4 factors to occur:

- Tensile stress. Either from an externally applied load or as a residual stress from the fabrication process
- Sufficiently high temperature
- Sufficiently corrosive environment
- A susceptible material

Research has showed that SCC could occur at 25° C in conditions of:

- High chloride content plus high acidity
- Very high chloride in neutral conditions

The cause of these conditions in swimming pool buildings is the production of organic chemicals called chloramines. These are formed by the interaction of chlorine-based pool disinfection chemicals and organic compounds from bathers, notably sweat and urine. These chemicals evaporate and condense on surfaces and can be highly concentrated depending on the combination of temperature and humidity in the pool hall. Areas in the roof space are particularly vulnerable as there is no opportunity for natural washing or easy maintenance of such components hence the need to consider this aspect in future inspection / maintenance regimes. Immersed components are not at all susceptible to SCC.

SCC resistant grades of Stainless Steel had already been developed for other applications so it was natural that these grades should be tested to see if it would be suitable in a swimming pool environment.

It has been found that many of these grades give a significantly improved resistance to SCC in this environment.

1.3.2 MATERIAL FINISH

Another important consideration is ensuring that the Stainless Steel material retains its initial finish throughout its life. However, examples of badly stained Stainless Steel are reported from time to time and it is worth examining the factors which can cause this and the remedial action which might be taken. The surface finish is just as critical in determining the corrosion resistance of Stainless Steel as the grade. As with coastal applications, poor quality polished finishes can lead to disappointing performance of Stainless Steel. A full explanation of this phenomenon can be provided by the British Stainless Steel Association (BSSA).

Swimming pool buildings have the additional complication of a large variations in conditions which can exist in a pool environment. The corrosivity is influenced by:

- Ventilation and air recirculation
- Disinfection regime
- Cleaning and maintenance regime
- Temperature control
- Bather loading and behaviour
- Local "mini-climates" within the pool hall

These factors can lead to variations in performance in components in different places within the pool building made from the same grade and surface finish.

1.3.3 SPECIALIST ADVICE

The British Stainless Steel Association – BSSA (www.bssa.org.uk), on whose information these stainless steel notes are based, and the Nickel Institute (www.nickelinstitute.org) have jointly developed a CPD Module for architects and system designers on this very complex subject.

The Health and Safety Executive have also produced technical information papers on the subject of 'Stress Corrosion Cracking of Stainless Steels in Swimming Pool Buildings' and this information can be found on their website at www.hse.gov.uk. This important document suggests that a full "inventory" of Stainless Steel components should be made at each pool and inspection and maintenance programmes be set up.

Individual swimming pool projects using Stainless Steel should be discussed with the BSSA Technical Advisor

For more information on Stainless Steel materials for ductwork in general, see Appendix D.

NOTE 2 ENVIRONMENTAL MANAGEMENT

2.1 *GENERAL*

Increasing awareness of global environmental issues means that to maintain a competitive advantage businesses need to achieve and demonstrate sound environmental performance through their activities, products and services. The implementation of an Environmental Management System (EMS) can assist a business in managing and meeting its increasingly heavy burden of responsibility for the future protection of the global environment.

2.2 *ENVIRONMENTAL MANAGEMENT BENEFITS*

An EMS allows companies to take an active role to both improve environmental performance and enhance business sustainability. The implementation of an EMS is essentially a voluntary initiative which requires you to examine your practices and determine how your impacts should best be managed. Implementation of an EMS such as ISO 14001 allows businesses to:

- Demonstrate a commitment to achieving legal and regulatory compliance to regulators and government
- Demonstrate your environmental commitment to stakeholders
- Demonstrate an innovative and forward thinking approach to customers and prospective employees
- Increase your access to new customers and business partners
- Better manage your environmental risks, now and in the future
- Potentially reduce public liability insurance costs
- Reduce operational costs through reduced energy consumption and use of natural resources
- Reduce fines and clean-up costs
- Enhance your reputation

2.3 *ISO 14001 CERTIFICATION*

ISO 14001 is the internationally recognised standard which specifies requirements for an environmental management system. It is intended to apply to all types and sizes of organisations with the overall aim to support environmental protection and prevent pollution.

Certification is the term commonly used for having a management system certified independently. Those companies wishing to act as certification bodies should ideally be UKAS (United Kingdom Accreditation Service) accredited. UKAS is the only UK accreditation body recognised by Government who can provide this service. Accreditation means the certification body can demonstrate that it has been successful in meeting the requirements of international accreditation standards. Accreditation is not mandatory.

Note: Details regarding accreditation bodies can be found on the UKAS website - www.ukas.com

NOTE 3 HEALTH AND SAFETY

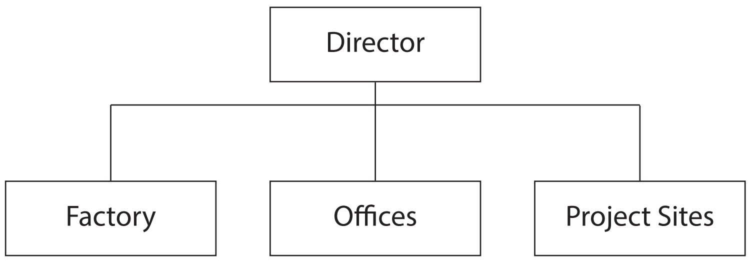
The Health & Safety at Work etc. Act 1974 is the 'primary' legislation that imposes a general duty on employers, employees and the self-employed for health & safety. There are many other regulations that govern specific aspects of health & safety and include regulations such as The Management of Health & Safety at Work Regulations 1999, Construction (Design and Management) Regulations 1997 (Appendix L) and Workplace (Health, Safety and Welfare) Regulations 1992, which are also applicable to installation and/or construction works - the type of work typically carried out by B&ES members.

3.1 *LEGAL REQUIREMENTS AND RESPONSIBILITIES*

It is a legal requirement for companies with 5 or more employees to prepare and bring to the attention of all employees a written statement of the general Health and Safety policy, which is to be signed by the Director or most senior person in the company who is responsible for the overall system and to highlight the intent that the Company and its direct employees and sub-contractors comply with the act.

The individuals responsible for the implementation of safety within the company should be listed and shown in an organizational chart, which should include the named Director who is responsible for the overall scheme along with named individuals who are responsible for all direct employees and sub-contractors in the workplace and each individual project site.

Fig 208 Organizational Chart



Every individual within a company is responsible for the implementation of safety. Certain people may have defined roles; it is these people who should be identified within the organizational chart along with their role.

Certain regulations require particular records to be produced, kept or maintained. The designated Director has the overall responsibility for ensuring that company knowledge is updated on current legislation, guidelines and codes of practice, and the dissemination of this information to employees and sub-contractors. The Company must provide the necessary personnel and resources to comply with this requirement.

The Director is not usually responsible for the physical updating of company knowledge on legislation, more often this is the role of a safety professional. The Health and Safety Executive (HSE) guidance on Director Responsibilities recommends five action points:

- The board needs to accept formally and publicly its collective role in providing health and safety leadership in its organisation.

- Each member of the board needs to accept their individual role in providing health and safety leadership for their organisation.

- The board needs to ensure that all board decisions reflect its health and safety intentions, as articulated in the health and safety policy statement.

- The board needs to recognise its role in engaging the active participation of workers in improving health and safety.

- The board needs to ensure that it is kept informed of, and alert to, relevant health and safety risk management issues. The Health and Safety Commission (HSC) recommends that boards appoint one of their numbers to be the health and safety director.

In certain instances it may be necessary to employ the services of an external Safety Consultant and details of their involvement must be included in the statement. The HSE maintain a national registration scheme of safety consultants.

3.2 REGULATIONS

The CDM Regulations 2007 (Appendix L) specify a need to assess competence. Corporate competency should be assessed by a two-stage process;

Stage 1: An assessment of the company's organisation and arrangements for health and safety.

Stage 2: An assessment of the company's experience and track record.

Companies will be expected to reach the standards set out in the core criteria in CDM 2007 ACoP Appendix 4. This core criteria has been agreed between industry & HSE.

Systems should be in place for the induction of new employees and for the provision of any necessary training.

Procedures for the selection of all employees and sub-contractors need to be set down with requirements for items such as personnel protection equipment, skill cards, method statements, risk-based assessments, insurances and the safety document.

More specific detail is then required on specific items, some of which are as follows:

- Working at height covering scaffolding, ladders, steps, roof-works, excavations etc, and mobile elevating working platforms (MEWPs) such as cherry pickers and scissor lifts.

- Manual handling.

- Electrical supplies and trailing leads.

- Power tools and portable appliance testing (PAT).

- Vibration at work.

- Noise at work.

- Abrasive wheels.

- Asbestos.

- Fire precautions.
- Accident reporting and location of Accident Book.
- First aid and location of first aid equipment.
- Control of substances hazardous to health (COSHH).
- Provisions for personal protective equipment (PPE).

3.3 TOOL BOX TALKS

To help maintain standards of safety in the workplace, tool box talks should be held on a regular basis with employees, and records should be kept of the dates and people to whom the talks have been given.

B&ES publish a series of 'Tool Box' talks.

NOTE 4 FIRE RESISTING DUCTWORK FOR FIRE AND SMOKE CONTAINMENT

Important note!
Legislation and accountability for Fire Safety Products is a critical aspect in the manufacture of fire resisting ductwork and this section must be read in conjunction with Appendices L and M and Commentary and Guidance Note 5.

4.1 *CAUTIONARY NOTE TO ALL DUCTWORK SYSTEM DESIGNERS AND MANUFACTURERS*

Ductwork constructed to DW/144 standard has no fire resistance. General purpose ventilation/air conditioning ductwork and its ancillary items do not have a fire classification and cannot be either utilised as or converted into fire rated ductwork unless the construction materials of the whole system including supports and penetration seals are proven by test and assessment in accordance with the appropriate test standard. In the case where galvanized sheet steel ductwork is clad with the application of protective material, the ductwork construction must be as type tested and comply with the protective material manufacturers recommendation, e.g. sheet thickness of ductwork, frequency of stiffening and non-use of low melting point fasteners and rivets. Particular emphasis should be given to how the ductwork is installed into the supporting construction (walls and floors of different types) and what additional stiffening should be employed within the wall as was tested. Sealants, gaskets and flexible joints should be tested and certificated in accordance with the appropriate test standard and comply with all manufacturers recommendations. Careful consideration must be given to the maximum certified size as tested and the manufacturer's recommendation should always be followed.

In BS9999, the definition of fire resistance is the 'Ability of a component or construction of a building to meet for a stated period of time some or all of the appropriate criteria specified in the relevant part of BS 476 or the relevant BS EN 1366 test standard'. So, a duct simply tested or assessed to 300/400^{0}C is **NOT** fire resistant in a fully developed fire.

4.2 *MAIN AREAS WITHIN BUILDING WHERE DUCTWORK SHOULD BE FIRE PROTECTED.*

The following notes are for guidance only and it should be noted that authority rests with the Building Control Officer and/or the Fire Officer responsible for the building. Reference on the following systems should also be made to the current building regulations.

4.2.1 *SMOKE EXTRACT SYSTEMS*

As described later under BS EN 1366-8/9 depending upon whether the system is for single compartment or multi compartment.

4.2.2 *ESCAPE ROUTES COVERING STAIRWAYS, LOBBIES AND CORRIDORS*

All escape routes must be designed so that the building occupants can evacuate the building safely in the case of fire. Ductwork which passes through a protected escape route must have a fire resistance at least equal to the fire compartment through which the ductwork passes either by the use of fire dampers or fire resisting ductwork. Fire dampers must have an ES classification for the protection of escape routes.

4.2.3 NON-DOMESTIC KITCHEN EXTRACT SYSTEMS

Where there is no immediate discharge to atmosphere, i.e. the ductwork passes to atmosphere via other fire compartments, fire resistant ductwork must be used. Kitchen extract ductwork presents a particular hazard as combustible deposits such as grease are likely to accumulate on internal surfaces, therefore all internal surfaces of the duct must be smooth. A fire in an adjacent compartment through which the ductwork passes, could lead to ignition of the grease deposits, which may continue through the ductwork system, possibly prejudicing the safety of the kitchen occupants. For this reason, consideration must be given to the stability, integrity and insulation performances of the kitchen extract ductwork.

Access doors for cleaning must be provided at intervals not exceeding 3m.

Fire dampers must not be used.

Use of volume control dampers and turning vanes are not recommended.

Further information on kitchen extract systems can be found in B&ES publication DW/172 'Specification for Kitchen Ventilation Systems'.

4.2.4 ENCLOSED CAR PARKS WHICH ARE MECHANICALLY VENTILATED

Car parks must have separate and independent extract systems, because of the polluted nature of the extract air. Due to the fire risk associated with car parks these systems must be treated as smoke extract systems and therefore maintain a minimum cross sectional area under fire conditions in accordance with BS / BS EN Standards.

Fire dampers must not be installed in extract ductwork serving car parks, however smoke control dampers could be used.

4.2.5 BASEMENTS

Ductwork for basements must be fire rated. If the basements are compartmented each separate compartment must have a separate outlet and have access to ventilation without having to gain access, i.e. open a door to another compartment. Basements with natural ventilation should have a permanent opening, not less than 2.5% of the floor area and be arranged to provide a through draft with separate fire ducts for each compartment. Smoke control dampers may be used in association with any fire resisting ductwork as this is covered in their direct field of application.

4.2.6 PRESSURISATION SYSTEMS

Pressurisation is a method of restricting the penetration of smoke into certain critical areas of a building by maintaining the air at higher pressures than those in adjacent areas.

It applies particularly to protect stairways, lobbies, corridors and fire-fighting shafts serving deep basement as smoke penetration to those areas would inhibit escape.

As the air supply creating the pressurisation must be maintained for the duration of the fire, fire dampers cannot be used within the ductwork to prevent the spread of fire as they will close on temperature increase, but use may be made of smoke control dampers, which may open or close depending on their position. Any ductwork penetrating fire resisting barriers must be capable of providing the same period of fire resistance.

4.2.7 HAZARDOUS AREAS

There are other areas within the building where the building control officer or fire officer could state a requirement for fire resisting ductwork, e.g. areas of high risk, boiler houses, plant rooms, transformer rooms, etc.

4.3 BACKGROUND AND EXPLANATIONS TO THE NEED FOR FIRE RATED DUCT SYSTEMS INCLUDING THE TESTING AND STANDARDS THAT SHOULD BE ACHIEVED

4.3.1 DUCTWORK SYSTEMS & FIRE HAZARDS

Fire & smoke compartmentation and hazards are factors which influence the design and installation of ductwork systems.

Information concerning fire protection systems is laid down in BS 9999 Code of Practice for the fire safety in the design, management and use of buildings. Since 1999 European standards have run alongside the British Standard 476 Part 24. The test standard for fire resisting ductwork is BS EN1366-1. The test standard for multi compartment smoke control ductwork is BS EN1366-8. The test standard for single compartment smoke control duct is BS EN1366-9. Industry faces significant changes to test standards over the next few years, particularly with regard to assessments.

With the transition period for compliance with the CPR (Construction Products Regulations), having ended on the 1 July 2013, there is now a requirement for any products having harmonised product standards to be CE marked. In reality BS476-24 is being withdrawn, as a BS EN standard is available to replace it. See clause P.3.2 below.

The British Standards Institution (BSI) state the following:

"The BS 476 series are retained as current standards, predominantly for use outside the European Union in countries in which they are mandated by law or reflect long-standing custom and practice. They cannot be used to support CE marking of construction products, which becomes mandatory from 1 July 2013 where a harmonised (hEN) product standard is in place."

BSI also adds the following warning on newly purchased BS476 standards:

"This standard has been superseded by the current BS EN… but it has been retained based on legitimate need for the standards within non EN markets"

Fire resisting ductwork covered by harmonised product standard prEN15871 which, when published, will require CE marking approximately a year after publication. This requires testing to BS EN1366-1 and obtaining classification using BS EN 13501-3.

However smoke control ductwork is covered by harmonised product standard BS EN12101-7 which is published and so CE marking is required if the smoke control (FPC) ductwork comes within its scope. This requires testing to BS EN1366-9 for single compartment smoke control ducts and testing to both BS EN1366-1 and BS EN1366-8 for multi compartment smoke control ducts and obtaining a classification to BS EN 13501-4

CE marking to harmonised product standards for the majority of fire resisting and smoke control products generally needs initial type testing and a factory production control (FPC) system such as ISO9001 with third party certification

4.3.2 BS O , A STANDARD FOR STANDARDS - PRINCIPLES OF STANDARDIZATION

This British Standard sets out the principles of standardization undertaken by the British Standards Institution (BSI) in its role as the UK National Standards Body (NSB) and states that in clauses 5.4 & 6.1.2.

"Clause 5.4 The purpose of European standardization is primarily to support the single European market. In contrast to international standardization, it can have a quasi-regulatory role in certain cases. In these cases compliance with relevant technical provisions of a standard provides presumption of conformity to the essential requirements of one or more European Directives established under the "New Legislative Framework".

As the UK member of CEN and CENELEC, there is an obligation on BSI to:

a) adopt without change all European standards ratified by those bodies;

b) remove (by withdrawal or amendment) any conflicting provisions in pre-existing national standards; and

c) subject to the specific provisions of the CEN/CENELEC Internal Regulations [N2], refrain from undertaking the development of any national standardization material that would be in conflict with ratified European standards, or those for which development has been approved (the European standardization policy known as "standstill")".

"Clause 6.2.1 Adoption of European standards
The obligations set out in 5.4 regarding European standards are, in effect, legal obligations and therefore non-negotiable."

4.3.3 BS EN PRODUCT STANDARDS

The new BS EN fire resistance EN Product Standards classification Fire Tests use formal rules for direct and extended field of application of test data. As a general rule size assessments or variations to the tested systems, will not be permitted, except in exceptional circumstances where testing is not possible, an assessment would be acceptable, however it will be difficult to obtain given the guidelines or lack of them.

4.3.4 BUILDING REGULATIONS IN THE UK

Require that new buildings be divided into fire compartments in order that the spread of smoke and fire in the buildings is inhibited, and to stop the spread of smoke and fire from one fire compartment to another for given periods of time as specified in the Building Regulations Approved Document B.

4.3.5 THE THREE METHODS OF FIRE PROTECTION RELATED TO FIRE SYSTEMS GIVEN IN BS9999

Method 1 Protection using fire dampers
All fire dampers should be tested to BS EN 1366-2 and consequently under BS EN15650 (harmonised product standard) CE marked.

Method 2 Protection using fire resisting enclosures

Method 3 Protection using fire resisting ductwork

4.4 EUROPEAN PRODUCT TEST STANDARDS

4.4.1 PRODUCT STANDARDS

Product standards define what tests should be undertaken, what production control should be achieved, what installation and maintenance information should be given, how to label products and how to CE mark

Standard	Title	Reference
prEN15871	Fire resistance tests for service installations - Ducts	Ducts for ventilation, pressurisation and kitchen extract
BS EN12101-7	Smoke and heat control systems. Smoke duct sections	Smoke control ductwork

Ensures that the Fire Duct Manufacturer has tested to the BS EN Standards at a Notified Certification body and has ISO 9001 quality systems for manufacture and installation of the duct system, and that the fire duct system has 3rd party certification for the manufacture and installation on site.

The product construction standards require that the duct is tested to at least one of the following test standards.

4.4.2 TEST STANDARDS

Test standards provide a method of test how to report on the test and a direct field of application of the test results

Standard	Title	Reference
BS EN1366-1	Fire resistance tests for service installations - Ducts	Ducts for ventilation, pressurisation and kitchen extract
BS EN1366-5	Fire resistance tests for service installations - Service ducts and shafts	Ducts for cables, pipes and other service
BS EN1366-8	Fire resistance tests for service installations – Smoke extraction ducts	Ducts for multi compartment smoke extraction
BS EN1366-9	Fire resistance tests for service installations. Single compartment smoke extraction ducts extraction	Ducts for single compartment smoke

Ducts larger than 1000 x 1250mm rectangular or 1000mm circular are of a different pressure class etc than defined in the Direct field of Application, will need to be tested to the requirements of the extended field of application test procedures.

4.4.3 EXTENDED FIELDS OF APPLICATION STANDARDS FOR FIRE RESISTING DUCTWORK

Extended field of application standards (EXAPs) define how test results may be extended by a notified body to allow other applications and design changes. They are very limited and cannot simply be applied by a manufacturer.

Standard	Title	Reference
BS EN15882-1	Extended application of results from fire resistance tests for service installations - Ducts	Ducts for ventilation, pressurisation and kitchen extract
prEN15882-5	Extended application of results from fire resistance tests for service installations – Smoke control ducts	Smoke control ducts etc.

BS EN 15882-1&5 Series of tests to achieve ducts 2500mm x 1250 mm Rectangular or 1250mm diamter Circular.

4.4.4 CLASSIFICATION STANDARD FOR DUCTS TESTED TO BS EN1366- 1, 5, 8 or 9 & BS EN 15882 – 1 or 5

Classification standards define how products may be classified following successful testing.

Standard	Title	Reference
BS EN13501-3	Fire classification of construction products and building elements. Fire resisting ducts and fire dampers	Ducts for ventilation, pressurisation and kitchen extract
BS EN13501-4	Fire classification using data from fire resistance tests on components of smoke control systems	Smoke control ducts etc.

BS EN 13501 – 3 or 4 define how to give a fire resistance classification as a result of testing.

4.4.5 BS EN 1366-1 FIRE RESISTANT TEST FOR SERVICE INSTALLATION DUCTS

This is primarily the fire test for Ventilation ducts and Kitchen Extracts, but it is also used as a precursor to the Smoke Extract ducts where fire insulation is required to be demonstrated.

The test is conducted without the involvement of fire dampers. It is applicable to vertical and horizontal ducts taking into account joints, air supply and exhaust openings as well as suspension devices and penetration seals.

The tested duct assembly is judged against four performance criteria. These are;

1) Insulation
2) Integrity
3) Smoke leakage
4) Stability

Direct field of application

The direct field of application only covers circular and four sided rectangular ducting at this time.

Test results achieved for horizontal ducts A and B are applicable to horizontal ducts only. Test results achieved for vertical ducts A and B are applicable to vertical ducts only.

The test result obtained for the standard size of ducts A & B is applicable to all dimensions up to the size tested together with the increase as follows.

Fire Outside (duct A) plus 250mm wide, plus 500mm high (for rectangular ducts) plus 200m diameter (for circular ducts).

Fire Inside (duct B) plus 250mm wide, plus 750mm high (for rectangular ducts) plus 370mm diameter (for circular ducts).

This means under the field of direct application, the largest ducts, for duct A and B will be 1250mm wide x 1000mm high (for rectangular ducting) and 1000mm diameter (for circular ducting).

If an Independent protection system is used on the outside of the duct, the internal dimensions of the duct shall be used to validate the field of application.

The BS EN test configuration does not allow an assessment of the load bearing capacity. The suspension devices for the ductwork shall be made of steel and be sized such that the calculated stresses do not exceed the following;

Tensile stress in all vertical components (Drop Rods etc) for

Fire resisting duct rated at 60 mins (945°C) reduces tensile stress in vertical components from 430 N/mm^2 to 9 N/mm^2.

Fire resisting duct rated at120mins (1049°C) reduces tensile stress in vertical components from 430 N/mm^2 to 6 N/mm^2.

Fire resisting duct rated at 240mins (1153°C) reduces tensile stress in vertical components from 430 N/mm^2 to 3 N/mm^2.

Stress is calculated from supported load only and ignores assembly stresses.

If tested unprotected Steel Suspension devices (Drop Rods) can be used up to 1.5m long.

Note: for unprotected suspension devices of not greater than approximately 1.5m length an elongation of 40mm can be expected for 2 hour fire resistant period. Suspension devices (drop rods) between 1.5m and 4m long shall be insulated to ensure that the drop rods do not expand by a maximum of more than 40mm. The drop rod should be tested inside the furnace and subject to the maximum weight that the drop rod would have to bear in practice.

The centres (largest distance) between suspension devices used in the test construction cannot be exceeded in practice.

4.4.6 *EXTENDED FIELD OF APPLICATION - BS EN 15882-1*

When fire rated ductwork is required larger than that covered under the direct field of application, the system should be tested to BS EN 15882-1, this allows for ductwork to be tested up to a maximum of size of 2500mm x 1250mm for Rectangular and 1250mm diameter for Circular for both ducts A & B.

Additional tests will also be required if the classification covers

a. Higher pressure differentials than +/- 300Pa.

b. Larger cross sections than width/height = 1250mm x 1000mm or 1000mm diameter.

c. Larger distances between floors than 5m.

d. Hanger lengths greater than 1.5m.

e. Inspection openings and their closures.

f. Flexible connections.

4.4.7 *BS EN 1366-8 FIRE RESISTANT TESTS FOR SMOKE EXTRACT DUCTS (MULTI COMPARTMENT)*

This test is applicable to fire resisting ducts that have already passed the appropriate test period to BS EN 1366-1 where the fire outside (duct A) has been tested to a differential pressure of 500 Pa, plus fire inside (duct B) to determine Insulation classification (I).

The smoke duct also needs to be tested as fire inside (duct C). This is applicable only to four-sided rectangular and circular duct. One, two and three sided ductwork is not yet covered by this test standard but this test standard is under development prEN 1366-13. **The tested duct assembly is judged against five performance criteria.**

1) Insulation
2) Integrity
3) Smoke leakage
4) Reduction in cross section
5) Mechanical stability

Direct field of application

1. The requirements for direct field of application of the test results of all duct tested to BS EN 1366-1 apply together with the following;

a. A test result obtained from the standard sizes of duct C is applicable to all dimensions up to the size tested together with the size increase as follows;

Duct C +250mm wide +750mm high (for rectangular ducting) and +440mm (for circular ducting).

b. The test results on the duct are applicable to the following under and over pressures depending on the tested pressure.

1. Tested at - 150 Pa applicable to ducts of - 500 Pa to + 500 Pa
2. Tested at - 300 Pa applicable to ducts of -1000 Pa to + 500 Pa
3. Tested at - 500 Pa applicable to ducts of -1500 Pa to + 500 Pa

Classification classes for multi compartment Smoke Control system ducts

EI 30 60 90 120
The classification is completed by the suffix multi to indicate suitability for multi compartment use. In addition the symbols ve and/or ho indicates suitability for vertical and/or horizontal use. **S** indicates a leakage rate of less than $5m^3$ per m^2 per hour, 500, 1000, or 1500 indicate that when tested at these negative pressures the duct is suitable for use over the range from the tested negative pressure up to a positive pressure of 500 Pa.

4.4.8 EXTENDED FIELD OF APPLICATION FOR BS EN 1366-8/9 SMOKE EXTRACT DUCT – BS EN 15882-5

When fire rated ductwork is required larger than that covered under the direct field of application, the system should be tested to BS EN 15882-5, this allows for ductwork to be tested up to size of 2500mm x 1250mm for both ducts A & B. Additional tests are as described in clause P.4.6

4.4.9 BS EN 1366-9 FIRE RESISTANT TEST FOR SINGLE COMPARTMENT SMOKE EXTRACTS DUCTS

This part of BS EN 1366 specifies a test method for determining the fire resistance of horizontal extract ducting that are used for final or single compartment applications only. In such applications the smoke extract system is only intended to function up to flashover (typically 600°C). Where the smoke extract ducts pass through into other fire compartments, it must be tested to BS EN 1366-8.

The test duct assembly is judged against three performance criteria.
1) Smoke leakage, 2) Mechanical stability, 3) Reduction in Cross Section

Classification
Classes for single compartment smoke extract ducts.
E300 30 60 90 120
E600 30 60 90 120

Extended field of application (EXAP)
This is covered under BS EN 15882-5 which includes BS EN 1366 -8 and BS EN 1366 -9.

4.4.10 BS EN 1366-13 1-2-3 SIDED VENTILATION DUCTS

Standard for fire test being currently drafted at date of this publication.

4.4.11 BS EN 1366-14 KITCHEN EXTRACT DUCTS

Dedicated kitchen extract duct fire test standard being currently drafted, at date of this publication, thermocouples T3 in BS EN 1366-1 (Clause 9-1-2-3) will be used.

4.5 CE MARKING OF FIRE RATED DUCTING

4.5.1

CE Marking of products with harmonised product standards became mandatory on 1 July 2013. Within the requirements of the European directive, any fire protection products that have an EN Product Standard must be CE marked by 1 July 2013.

Consequently smoke control ductwork covered by Product Standard BS EN 12101-7 must be CE marked. Fire resistant ductwork covered by Product Standard prEN 15871 will require mandatory CE marking one year after the publication of the standard is qualified in the Official Journal of the EU. The fire duct manufacturer or his authorised representative established within the European Economic Area (EEA) is responsible for fixing of the CE mark.

Below is a typical example of the CE marking information to appear on all duct sections.

Fig 209
TYPICAL LABEL ATTACHED TO EACH DUCT SECTION

Label		
CE		CE conformity marking, consisting of the "CE" symbol given in Directive 93/68/EEC
01234	a)	Identification number of the notified product certification body
AnyCo Ltd, PO Box 21, B-10-50	b)	Name or identifying mark and registered address of the manufacturer
10	c)	Last two digits of the year in which the marking was affixed
01234-CPD 00234	d)	Number of the EC certificate of conformity
BS EN 12101-7	e)	Number of European Product Standard
Smoke control of duct section	f)	Description of product
Model : DUCT X	g)	Manufacturer's Type/Model number
Classification	h)	Classification to BS EN 13501 – 3 or 4
El 120 (i<>0) multi S	i)	Classification Symbols

4.5.2 CLASSIFICATION

The classification shall indicate if the performance criteria are satisfied by fire from inside or fire from outside or both and whether it applies to vertical or horizontal orientations or both.

For example, a classification EI 30 (veho i<>o) indicates a ventilation duct capable of satisfying 30 minutes integrity and insulation from both inside to outside and vice versa in both vertical and horizontal applications.

The classification S (smoke leakage) shall be added based on pass/failure test for the leakage. For example a classification EI 30 (veho i<>o) S indicates a duct with the same performance as above but additionally satisfying the leakage criteria (10m^3/m^2 /hr).

Failure of the suspension devices does not constitute failure of the test specimen unless it leads to failure of either E or EI.

Classification symbols defining BS EN 1366 Parts 1, 8 or 9 tests that have been carried out and the suitability of the duct used for particular applications.

Plus Extended Field of Application Tests to BS EN 15882 Parts 1 & 5.

E	=	Integrity
I	=	Insulation
S	=	Smoke leakage 500, 1000 or 1500 pa
t	=	class in time i.e. 30, 60, 120, etc
Ve	=	Vertical duct
ho	=	Horizontal duct

500, 1000, or 1500 for smoke duct only indicates negative pressure tested to and allows 500pa position pressure

i	=	fire inside test (Type B or C)
o	=	fire outside test (Type A)
i > o	=	tested for fire inside duct
i < o	=	tested for fire outside duct
i <> o	=	tested for both respectively
Multi	=	multi compartment
Single	=	single compartment
E300	=	300°C smoke temp single compartment only

E600 = 600°C smoke temp single compartment only

EXAP 2500 x 1250 = EXAP size of duct tested to BS EN 15882-1 or 5

Typical classification in accordance to BS EN 13501-3 or 4

E	I	1	2	0	(	i	<->	o	)	ho	Ve	S
Integrity	Insulation	Time in minutes				tested for fire inside duct		tested for fire outside duct		Tested for horizontal duct	tested for vertical duct	tested for smoke leakage

4.6 THIRD PARTY CERTIFICATION

It is important to ensure that fire resistant duct installation companies are third party accredited by a reputable UKAS accredited independent third party certification scheme that ensures that the performance quality, reliability and traceability of the fire duct product is achieved. The certification scheme should be recognised by the regulatory authorities worldwide, being an internationally respected mark for fire safety. The fire rated duct product should also be subjected to site inspections as through the Warrington certification FIRAS scheme, which is a UKAS accredited third party certification scheme, designed for the certification of competent installation companies erecting the fire rated ducting.

The fire rated duct system should be installed by a third party certificated contractor certified by a UKAS accredited certification body. Installer certification uses a combination of approaches to verify quality of installation and typically require:

- assessment of the installer company's management systems
- ongoing evaluation of the competency of the installing staff, in terms of practical skill and underpinning knowledge
- ongoing inspection of a proportion of on-site operations."

4.7 NOTE REGARDING EVOLVING BS EN TEST PROCEDURES

Fire rated ductwork is a life safety product with mandatory requirements to test, manufacture and install to very high standards. UK/European technical committees are constantly evolving and updating fire test standards for fire rated ductwork. Plus after each standard is published, there is a minor review every 5 years and a major review every 10 years. This together with completely new test and classification standards being developed to meet the constantly changing needs of industry. It is therefore essential that the reader checks the up to date test product/classification/standard for the particular duct system required.

4.8 CE MARKING STEPPING STONES

Stepping stones to achieve CE marking, for fire resisting duct or smoke control duct systems covered by Product Standards, BS EN 12101-7 & pr EN 15871, are:

- Manufacturer should approach a notified certification body before any testing is undertaken to determine which products should be included in any test program.

- As almost all fire protective products are AVCP system 1 (highest quality) the certification body is responsible for taking samples for testing from the production line (where possible). Tests carried out prior to involvement of the certification body are not acceptable for CE marking because they have not been sampled independently.

- The notified certification body will carry out a Factory Production Control (FPC) inspection (QA/QC audit) and will set up a system of regular surveillance visits.

- Once the system (sampled by the Notified Certification Body) has been tested to BS EN 1366-1, 8 or 9 and achieved a European Classification to BS EN 13501-3 or 4, the Notified Certification Body will issue an EC Certificate of Conformity (C of C) to the manufacturer

- The manufacturer will then issue a Declaration of Conformity and then CE Mark the product.

- here is a requirement under the CPR that each system has a Declaration of Performance (DOP) from the manufacturer, an example of which is given in the CPR and/or in the product standard if it is updated to the latest CPR requirements.

- he Notified Certification Body will use a mixture of regular e.g. annual surveillance visits, audit tests and selection of products from the market to verify the on-going quality of the product.

This Note incorporates information given in the ASFP (Association for Specialist Fire Protection) publication, the 'Blue Book - Fire Resisting Ductwork' which is available via the ASFP web site www.asfp.org.uk

NOTE 5 GUIDANCE ON BS EN STANDARDS

With the advent of the CPR (Construction Products Regulations) and the introduction of BS EN standards for fire and smoke dampers, fire and smoke ductwork, penetration seals, etc, there inevitably have been issues raised within the industry. In an attempt to answer some of the concerns, there is below a short explanation of the current situation plus a practical way forward as far as the UK is concerned, prior to the completion and implementation of all the new rules, standards and regulations.

5.1

Approved Document 7 of the Building Regulations gives some clarification as far as the UK is concerned, by stating that any projects that have applied for initial planning permission prior to 1 July 2013 can still be constructed to the existing British Standards, or the equivalent BS EN Standards.

5.2

For Projects applying for planning permission after 1 July 2013, it is advised that products that are CE marked (hEN or ETAG – see below) will be acceptable under the building regulations and that this is a good way to confirm suitability and workmanship.

> British Standards advise the following via their 'Knowledge Centre' reference existing BS476 Series test standards.
>
> *"The BS 476 series are retained as current standards, predominantly for use outside the European Union in countries in which they are mandated by law or reflect long-standing custom and practice. They cannot be used to support CE marking of construction products, which became mandatory on 1 July 2013 where a harmonised (hEN) product standard is in place. For this purpose, the appropriate BS EN is to be regarded as the definitive UK national standard."*
>
> British Standards now include the following 'health warning' on all BS476 series standards that have a published BS EN Standard.
>
> *"This standard has been superseded by the current BS EN… but it has been retained based on legitimate need for the standards within non EN markets."*

5.3

However, it is a mandatory requirement that any fire resisting dampers or ducts falling within the scope of a harmonised product standard (hEN), with classification and test standards in place, will need to be classified and tested to BS EN Standards and CE marked under the CPR and be provided with a Declaration of Performance. Alternatively where an ETA. (European Technical Assessment) exists this may allow CE marking of the system on a voluntary basis.

5.4

If the harmonised European Standard (hEN) is in place but the test standard is not in place, then the existing British Standard testing is acceptable; also if the Extended Field of Application (EXAP) standard is not in place, then an Engineering Assessment based on the product tested to the new BS EN Standard by a Notified Body is acceptable until the Extended Field of Application (EXAP) standard is available.

5.5

Where there is not a harmonised European Standard (hEN) in place, it is not a mandatory requirement that fire rated dampers and ducts are manufactured & installed to the test requirements of the published BS EN standards. However BS '0' states that where there is a new BS EN in place, it replaces the existing British Standard and any conflicting BS standard should be withdrawn.

5.6

There is an alternative route via European Technical Approval Guidelines (ETAGs) used as European Assessment Documents (EADs) for issuing European Technical Assessments (ETAs). By testing to the requirements of ETAG 0018-4, for fire protective products not preassembled in a factory, but assembled on site using CE marked components providing the manufacturer of the components has Tested & Classified the assembly to the new BS EN test (to BS EN 1366/series- BS EN 15882/series) & Classification (to BS EN 13501/series) requirements for the fire resisting or smoke extract ductwork that the supplier wishes to install.

SUMMARY

From 1st July 2013 manufacturers of construction products which are covered by harmonised European standards (hENs), were required, when placing a product on the market, to:

- Make a declaration of performance (DoP) for the product.
- Affix the CE mark
- The Building Regulation 2010, Approved Document 7 regulation 7, 2013 edition – for use in England, notes "the 1999 edition will continue to apply to work started before 1st July 2013, or to work subject to a building notice, full plans application or initial notice submitted before 1st July 2013".

NOTE 6 EUROVENT

6.1 GENERAL

Some explanation of the function, composition, objectives and membership of EUROVENT is given below.

6.2 MEMBERSHIP

EUROVENT is the European Committee of Air Handling and Refrigeration Equipment Manufacturers. The committee was formed in 1959, and in 2010 its constituent members were the relevant national associations in Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Slovenia, Spain, Sweden and Turkey.

6.3 OBJECTIVES

The objectives of EUROVENT are 'to improve and develop technical matters in the manufacture and operation of air handling equipment; to improve the professional status of its members and to facilitate commercial exchanges between its member nations in the search for improved quality; and the adoption of rules, directives and codes of practice in the technical and economic spheres in the member countries'.

6.4 AIR LEAKAGE

The basis on which air leakage is calculated in EUROVENT Document 2/2 has been adopted in DW/143 'A Practical Guide to Ductwork Leakage Testing'.

Information about EUROVENT may be obtained from either the HEVAC Association (www.feta.co.uk) or EUROVENT direct (www.eurovent-association.eu)

Details of how to obtain further copies of this and other publications are available from:

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