



Mechanical Services Standard Specification
7.0 - Ductwork Systems

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For
ROYAL HOLLOWAY
UNIVERSITY OF LONDON

Prepared For The Estates Division By:



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7.1 INTRODUCTION

This specification covers the requirements for ductwork systems providing air conditioning, supply air, warm air heating, mechanical extract and process extract using plastic ductwork.

The specifications relevant to this work should be referred to which have been compiled by the HVCA as follows;

DW/154	Plastics Ductwork
DW/144	Sheet Metal Ductwork
DW/172	Kitchen Ventilation Systems
DW/143	Ductwork Leakage Tests
DW/TR19	Ductwork Cleanliness

The Installer shall be suitably skilled and qualified to undertake this type of work.

**ALL WORKS ARE TO BE INSPECTED BY
THE TENDERING CONTRACTOR PRIOR TO PRICING**

HEALTH AND SAFETY STATEMENT

Health and Safety precautions are required to be taken during the process of undertaking works within buildings cannot be underestimated.

Reference shall be made to Royal Holloway University of London Health and Safety Policy and Contractors Guidance documents available from Royal Holloway University of London Estates Office.

The Health and Safety Executive (HSE) publish a series of guidance documents regarding all many different methods of protecting the workforce and people in general when working with hazardous chemicals (COSH) and undertaking potential dangerous work activities.

Installers engaged in any work shall be registered with the Construction Skills Certificate Scheme (CSCS) and be in possession of a valid skills card.

7.2 DUCTWORK

All ventilation ductwork shall be fabricated to comply with the recommendations in BS5720:1979 and the Heating and Ventilation Contractor Association Specification DW/144 for low, medium and high pressure ductwork, as appropriate and as described herein.

The whole of the supply and installation of ductwork systems shall be carried out by agreed manufacturer's and installers specialising in this particular trade.

The fabrication shall be carried out in a neat and workmanlike manner, true to size, adequately stiffened and braced to prevent drumming or vibration. All internal and external surfaces shall be free from projections or sharp edges.

7.2.1 Finishes

All materials used for the fabrication of the ducts shall be from hot-dip galvanised sheet to BS2989, Grade 22 coating type.

Galvanising after manufacture shall be to BS729, Part 1: 1961. To restrict the distortion encountered in galvanising, such ductwork shall be manufactured from thicker sheet steel as defined in DW/144.

7.2.3 Classification

Low, medium and high pressure ductwork classifications shall be as given in DW/144.

7.2.4 Construction

Ductwork shall be fabricated in accordance with the H.V.C.A. Specification DW/144 for Sheet Metal Ductwork to the following:-

- Table 6, 7 & 8: Rectangular Ducts Constructional Requirements
- Table 14 & 15: Spirally Wound Ducts Constructional Requirements

In all cases in this Specification where fittings Figure Numbers are referred to, these Figure Numbers are the standard references to fittings in H.V.C.A. DW/144.

7.2.5 Fastenings

Tables 10 and 16 give maximum centres for fastening rectangular and circular ductwork. Only fastenings shown in Tables may be used for the application shown.

Solid and mechanically closed rivets shall be used. Perforated rivets shall not be used.

When galvanised material is welded, the areas where the galvanising has been destroyed shall be suitably prepared and painted internally and externally with Zinc-iron paint plus a suitable finishing coat.

Roofing bolts and nuts may be used in some cases, e.g. connection to plant on site. Self-tapping screws shall be restricted to site joints in awkward positions, provided the prior agreement in writing has been obtained from the Services Engineer.

7.2.6 Hangers and Supports

Where there is a possibility of the transmission of noise or vibration, care shall be taken to isolate the duct from the building structure.

Hangers specified in Tables 24, 25 and 26 of DW144 are required for the support at the ductwork and its associated insulation. Where heavy equipment, mechanical services, ceilings or any other additional loads are to be applied, further support may be required. For large ducts, supports should be designed to suite the loading.

Design of supports for vertical ducts is dictated by Site conditions and spacing may be greater than for horizontal ducts.

7.2.7 Leakage Tests

The air leakage tests shall be carried out for medium and high pressure ductwork in accordance with DW/144 and DW/143.

All of the ductwork systems shall be tested by the Installer as the installation proceeds, to the satisfaction of the Services Engineer.

The testing shall start before the ductwork is enclosed and before any terminal units are installed.

The air leakage tests for the ductwork shall be based on measurement of the air leakage rate at a constant static pressure and on audible leaks.

The Installer shall provide the following test equipment:-

- Small high pressure fan mounted on a mobile frame with inlet damper and air filter.
- Air bleed-off valve on the fan delivery outlet.
- Calibrated orifice plate to BS1042, complete with tubing, pressure connections, taps and manometer capable of measuring the airflow within an accuracy of +5% at the permissible leakage rate.
- "U" tube for measuring the test pressure on the ductwork.
- Flexible pipework connections for the system.

The following test sequence shall be carried out:-

- Close the inlet damper and orifice pressure connection taps.
- Start the fan, slowly open the inlet damper and by either adjusting the fan speed or by bleeding off air, vary the pressure on the "U" tube to the desired test condition.
- Open the orifice pressure connection taps
- Read and record the airflow shown on the manometer and the test pressure.

The ductwork test sections to be witnessed shall be selected by Royal Holloway University of London during the course of the installation. Flanges shall be provided at the test points, together with blank plates for sealing off the ducting section by section.

Blank caps or cover plates shall be provided for all branch outlets and sealed with 50mm tape. After testing, these caps may be removed to allow for progressive testing or left to prevent the ingress of builder's rubbish.

The test shall be sustained for 15 minutes at the designed static pressure plus 50% during which time leakage, if any, shall not increase. The air shall then be released to zero and the section immediately re-tested at the design static pressure without any increase in leakage.

The aggregate of the air leakage for each test section of the complete ductwork system shall not exceed 1% of the total design volume.

Each test section shall have no audible leaks. The test for audible leaks shall be carried out on each section by pressurising the section, cutting off the air supply fan and any other adjacent noises and inspecting the ductwork for audible leaks.

Finally, all blanks at the flanged joints shall be removed and the flanges carefully re-sealed. The main fan shall be operated at the design volume and pressure. Under this condition, each re-made flanged joint shall be inspected and tested for leakage.

7.2.8 Protection

The open ends of all ductwork stored on site shall be covered by polyethylene sheet taped in position.

7.2.9 Identification

When the installation has been completed, every item of plant shall be clearly and permanently marked with its name and duty. The manufacturer's name, technical particulars (ratings, etc.) and their serial number shall be clearly marked on each unit.

7.2.10 Duct Mounted Sensors

The Installer shall allow for taking delivery of and installing duct mounted control sensors and smoke detectors, to be supplied by the appointed controls specialist.

7.2.11 Flexible Ductwork

The use of flexible ductwork shall not be permitted except where indicated on the drawings or where previously agreed with Royal Holloway University of London.

Where the use of flexible ductwork is permitted for the final connections to grille and diffuser plenum boxes, the flexible ductwork shall not exceed 500mm in length, and shall deviate by not greater than 100mm in any direction from the axis of the ductwork. (i.e. all flexible ductwork shall be run 'straight'). The duct shall comply with BSCP413:1973.

Flexible ductwork shall have a liner and cover of tough tear-resistant fabric equal in durability and flexibility to glass fibre. Fabric shall be impregnated and coated with plastics and shall be reinforced with bonded, galvanised spring steel.

An outer helix of glass fibre cord or equal shall be bonded to the cover to ensure regular convolutions.

Supply air flexible ductwork shall be of the pre-insulated type using at least 25mm high density fibreglass blanket and covered with reinforced aluminium fabric.

Flexible ductwork shall be secured with a band clip. The frictional resistance to air flow shall not exceed 150% of the frictional resistance per unit length of the galvanised mild steel ductwork of equivalent diameter, and shall have a Class O fire rating.

Flexible ducting shall be supported to ensure a "full area" is maintained along its complete length.

7.2.12 Volume Control Dampers

Air volume control dampers shall be provided as described herein.

All volume control dampers shall be installed in accessible locations; hand operated dampers shall be installed with the handle on the most accessible side of the duct.

Volume control dampers shall be provided as an integral part of the ductwork system, and shall be positioned to operate with maximum effect. They shall be installed in the following locations;

- At all fan discharges
- In every branch duct serving two or more air terminal outlets or inlets
- At all diffusers/grilles.

Volume control dampers shall be of the opposed blade type.

7.2.13 Motorised Combined Air Control and Shut-Off Dampers

- a) Where air volume control combined with shut-off or open and shut-off dampers are required ducts shall be provided with opposed blade multi-leaf motorised dampers suitable for mounting in the vertical and horizontal plane.
- b) All dampers shall have a galvanised steel casing of all welded corner construction and having peripheral flanges pre-punched with elongated corner hole fixing to suit proprietary duct flanges. The assemblies when installed in the ductwork distribution systems shall satisfy the air leakage requirements of class A and B of Eurovent document 2/2 and test procedures of classes A, B and C of HVCA ductwork specification DW/144.
- c) The motorised dampers shall comprise multi-leaf low profile aspect ratio stainless steel blades of double skin construction which encapsulate a special contoured steel longitudinal reinforcing membrane which interlock hollow extruded highly resistant silicone treated synthetic leading and trailing edge seals to form the absolute lowest possible air leakage in the fully shut-off position with airflow in either direction.
- d) Synthetic blade end seals shall comprise closed cell expanded sponge enclosed within a glass sealer having a P.T.F.E., coating to minimise operational torque and to reduce air leakage at the ends when the blades are in the fully shut position.

- e) All synthetic seals shall be flame retardant with good moisture, ozone resistance and ageing characteristics and suitable for a temperature range of -20°C to +70°C.
- f) The blades of each motorised damper are to be driven through 90°C with the stainless steel gear box drive mechanism totally enclosed and out of the air stream. A stainless steel extended shaft, marked at its outer end to provide visual indication of blade position to ensure precise engagement with the damper gearbox, shall be provided to give sufficient shaft extension for ease of attachment of couplings/linkages and motorisation by the systems control manufacturer. The shafts shall pass through a galvanised support bracket for increased stability.
- g) The electric motors for the control/shut-off damper shall be provided by the Systems Control manufacturer and shall be suitable for the requirements of the overall control system.

7.2.14 Fire Dampers

Fire dampers shall be provided where any fire barrier or compartmentation is penetrated which forms a fire barrier of greater than 30 minute fire resistance. This shall be confirmed by the appointed Fire Officer and Royal Holloway University of London.

The installation of fire dampers shall be in accordance with the guidance set out in DW145.

Fire Dampers shall be located within the thickness of the fire barriers. Where this is not possible the section of the ductwork between the damper and the fire barrier shall have a fire resistance not inferior to that of the damper itself, and be provided with additional protection against impact or other mechanical damage.

Fire Dampers shall be of the Fusible Link type rated at 72°C.

Damper blades shall be of stainless steel spot welded double skin construction interlocking with twin trailing edges to provide a double metal seal. The damper blades shall be approximately 50mm wide and shall have rolled edges interlocking to form full length hinges upon which blades pivot when released.

The steel blades shall fold completely upon themselves and be stacked out of the air stream to provide an unobstructed opening.

The damper frame shall be a continuous channel enclosing the blades and shaped to form continuous stops on both sides of the damper. The damper case shall be of welded construction airtight to test methods of DW144 and formed from galvanised steel with spigot connections for ease of duct attachment. The overall depth of the casing shall be no greater than 100mm and shall normally contain all blades outside air stream. Dampers shall comply with tests in British Standard 476, Part 1.

Fire damper shall be located within the thickness of the fire barrier by means of a purpose made installation frame to suit the building fabric.

Suitable restraining of the ductwork shall be incorporated to prevent distortion during fire conditions.

7.2.15 Smoke and Fire Dampers

Automatic smoke and fire dampers shall be of double skin spigot case having continuously welded corners and spigot connections. Stainless steel aerofoil blades of double skin construction, interlocking within twin trailing edges, the interlocking providing a double metal seal.

The installation of fire and smoke dampers shall be in accordance with the guidance set out in DW145

Incorporated within the blade profile is a synthetic seal to ensure low closed blade smoke leakage at ambient temperature. Accurate bearing, alignment, positive cap and bar drive, and blade retention combine to provide a slimline double skin casing of high rigidity, complying with DW 144 classes A, B and C.

Automatic smoke and fire dampers shall be tested to and comply with BS ISO 10294/1 classification ES, and European Standard EN1366-2. Automatic smoke and fire dampers to be complete with factory fitted installation frames (where specified) to the HVC 06/05/83 specification. Automatic smoke and fire dampers shall be fitted with a snaplock interface and the relevant control mode specified on the drawings.

The snaplock interface and control mode to provide closure with proportional torque control and give visual indication of damper status. Dampers will be fail-safe by means of electrical thermal release which operates at 72°C or by loss of power, complying with BS5588 part 9.

Automatic smoke and fire dampers to be type Smoke/Shield PTC as manufactured by Actionair, telephone 01227 276100 or equal and agreed.

7.2.16 Non Return Dampers

Non return (backdraught or self closing) dampers shall be provided to eliminate backdraught when ventilation systems are not in operation.

Non return dampers shall comprise anodised aluminium blades, hinged by means of stainless steel shaft/brass bearing assemblies all mounted within a rigid galvanised steel frame of minimum thickness 1.2mm and flanged to match adjacent plant items. The complete assembly shall be arranged to remain open under the influence of the moving air stream and shall close against efficient neoprene seals under no-flow or backdraught conditions.

7.2.17 Access Doors

Shall be provided in accordance with Appendix M, Table 25 level 3 of DW144.

- a) All access openings shall be rigidly framed, with lift-off airtight covers designed so that they can be speedily removed and re-fixed with zinc plated progressive cam lock operation quick release tension locks. Multiple set screws and self tapping screws are not acceptable as a method of fixing.
- b) Access openings and lift-off airtight covers shall be provided on all ducts of 150mm diameter and above or ducts having a long side of 150mm or more. In extreme cases flanged removable duct sections are to be provided on the smaller duct sizes.
- c) Subject to the restrictions imposed by duct dimensions, openings for access shall not be smaller than 375 x 300mm or larger than 450 x 375mm. Openings for inspection only shall have a minimum size of 150mm diameter or 150 x 150mm.

- d) Access openings and lift-off airtight covers shall be provided in the ductwork for the inspection and servicing of plant and equipment as follows:-
- i) Fire dampers: - access to be so located as to give access both to the dampers and fusible links.
 - ii) Volume control dampers: - access to be so located as to give access to blades and linkages.
 - iii) Ducted mounted filters: - access cover to be mounted upstream. Dimensions of access opening to be sized to allow filter elements of the front withdrawal type to be easily removed and replaced.
 - iv) Controls and probes: - access cover to be so located as to give access to any duct mounted equipment or apparatus concealed within the duct.
 - v) Obstructions: - in addition to the items listed in (i) to (iv) above, inspection covers shall be provided on either side of any other obstruction not scheduled, e.g., turning vanes, bends etc., and elsewhere as indicated on the drawings.
- e) Access openings and lift-off airtight covers to allow internal cleaning of ductwork to be carried out shall be provided as follows:-
- i) For ductwork less than 600mm x 300mm or 450mm diameter, access openings shall be 450mm x 250mm every 9m.
 - ii) For ductwork in excess, of 600mm x 300mm or 450 diameter access openings shall be 500mm x 350mm every 13m.
 - iii) For small ducts, access openings shall be 300 x 150mm every 7m.
- f) On insulated ducts all lift-off access covers shall be thermally and acoustically insulated constructed with a double skin 0.8mm galvanised mild steel casing enclosing a rock wool infill with a rigid angle sub-frame to allow either flush fixing or surface mounting to the ducting. For safety, every access door shall be provided with a retaining wire linking it permanently to the frame.
- g) All access openings and covers shall be provided with an integral peripheral fire resistant sealing gasket positioned on the door or frame to ensure air tightness to the test methods of HVCA Ductwork Specification DW/144 and Eurovent classes A, B and C.
- h) Hinged access doors shall be provided where indicated on the drawings with openings not larger than 1350mm high by 500mm wide, the doors opening against the air pressure.
- i) The hinged access doors shall comprise a double skin steel casing enclosing a insulated infill with a rigid sub-frame to allow flush fixing to the duct. Both the door and sub-frame shall be suitably reinforced to prevent distortion.

- j) Hinged access doors shall be provided with an integral peripheral fire resistant sealing gasket positioned on the frame together with sufficient clamping type latches to ensure an airtight and weather tight seal between the door and the frame. For safety reasons to prevent personnel being trapped inside the duct the latches shall have operating handles both inside and outside the duct.
- k) A fire resistant sealant shall be provided and inserted between all hinged door and access frames and the duct to which they are attached.
- l) The location of all access/inspection openings and hinged doors shall be co-ordinated with the structure, ceiling grid and other services to ensure that access is unobstructed.

7.2.18 Duct Mounted Silencers

Duct mounted silencers shall be provided and be secured and installed fully in compliance with the manufacturers requirements.

7.2.19 Air Intake/Exhaust Louvres

Where specified external louvres shall be provided for the supply and discharge of ventilation systems.

Louvres shall be complete with lip on leading edge of each blade and weather guard inserted laterally between the blades which shall also provide the necessary protection against bird and vermin entering throughout the louver blades and act as an equalising screen to improve aerodynamic performance.

All louvres shall be finished in a PVF 2 coating to a standard RAL colour to be advised by Royal Holloway University of London.

7.2.20 Grilles and Diffusers

Supply air diffusers shall be selected to ensure satisfactory air discharge is achieved and to ensure nuisance draughts are not incurred and that NR levels are not exceeded.

The Installer shall supply, install, set to work and commission all air terminal devices.

All grilles and diffusers shall have 'secret' fixings, no exposed or visible fixing methods will be allowed.

Allowance shall be made for visiting each grille and diffuser once fixed to ensure the discharge arrangement is as recommended by the manufacturer.

All plenum boxes on supply grilles and diffusers shall be thermally and acoustically insulated.

Sample of grilles and diffuser shall be provided for agreement prior to placing of the order for the equipment.

Grilles and diffusers shall be selected to match the base build colours, unless advised otherwise by Royal Holloway University of London to be white RAL 9010 20% gloss.

All grilles and diffusers shall be provided complete with removable core and those in plasterboard ceilings with opposed blade volume regulating dampers. The core shall be manufactured to give not less than 80% free area, and the regulating damper shall be such as to allow easy adjustment from the grille face. The grille core shall be easily removable from the grille face without removing the grille frame.

A neoprene sealing gasket shall be provided in the flange perimeter.

All grilles and diffusers shall be manufactured from high quality aluminium extrusions, with frames and where fitted with inner cores these shall have mitred corners.

7.2.21 Transfer Grilles

Door transfer grilles shall be manufactured from satinised finished aluminium and shall be complete with external flanges on both sides. The grilles shall be telescopic and shall be manufactured in such a fashion as to fit differing thickness of door by on site adjustment and fire resistance as the door they are fitted into.

7.2.22 Fixings

No fixings shall be visible on the face of the diffusers and grilles. All plenum boxes shall be independently supported from the structure by drop rods providing both lateral and vertical adjustment to suit the ceiling by the Contractor.

Holes in ceiling tiles/solid ceilings will be provided by others under the supervision of Royal Holloway University of London including final fixing/supporting of diffusers and grilles.

7.2.23 Grille Plenum Boxes

All supply and extract grilles and diffusers shall be provided with a plenum box for connection to the ductwork system. Each plenum box shall be of plan dimensions to suit the grille, with a height to width rating suitable for the ceiling void it is fitted within. Supply plenums delivering cold air shall be of the insulated type. Where practicable, ductwork shall be arranged for connection into the side of the plenum box.

7.2.24 Bonding

The following shall be provided with a spade connection suitable for electrical bonding with a 6mm² cable by the Electrical Installer.

- All grilles, diffusers and plenum boxes to the ceiling grid (in turn earthed by the Electrical Contractor).
- All grille and diffusers plenum boxes
- At each side of all flexible ducts and flexible connections.

7.2.25 Flexible Connections (Fans, etc.)

All fans, inline and AHU's etc. to have flexible connections between the fan and associated ductwork, to stop transmission of vibration or noise.

Flexible material to be fire resistant to BS476 Part 7 Class 1.

7.2.26 Plastic Ductwork

Plastic ductwork shall be manufactured and installed in accordance with the HVCA specification DW/154:2000 and is specifically designed for use with commercial and industrial fume extraction systems including fume cupboard extract systems.

Specialist manufacturers and installers shall carry out this work particularly in conjunction with any specialist process or fume cupboard installations as applicable.

All pressure and leakage testing shall also be carried out as detailed within HVCA DW/154.

Fire Rated Ductwork

Fire duct systems shall be manufactured to Method 3 of BS.5588 Part9, shall provide Class O Surface Spread of Flame and BS.476 Part 7, Class 1.

Materials shall have been tested to comply with BS.476 Part 24 and ISO 6944 with regard to stability, integrity and insulation.

Internal and external surfaces shall be smooth and cleanable.

Fitting internal dimensions, shapes and pressure ratings shall be as HVCA DW144 and DW143 specifications for normal galvanised mild steel ducting.

7.2.27 Kitchen Ventilation Systems

Kitchen ventilation systems shall be manufactured and installed following the requirements of HVCA DW/172.

Specialist kitchen systems shall follow the requirements as given by the appointed kitchen installers and Royal Holloway University of London directive.

7.2.28 Ductwork Cleanliness

It is vital that a high standard of cleanliness is maintained from initial manufacture, delivery to site, installation and final commissioning.

Failure to maintain the highest possible standards may result in Royal Holloway University of London instructing independent tests to be carried out. Failure to meet the required standards shall result in all costs for the test and resultant ductwork cleaning by a specialist to be borne by the Installer.

Clear guidance as to the level of cleanliness required shall be provided by Royal Holloway University of London and all reference should be made to TR/19.