

## **Section M1**

# **General Standards and Technical Requirements for Mechanical and Plumbing Works**

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**M1.01      General**

This section of the Specification describes the standard of materials to be used and methods of installation. It shall be read in conjunction with each of the other sections of the specification.

The Principal Contractor shall provide and install everything necessary to complete the installations, and should any portion of the works which would reasonably and obviously be inferred as necessary, not be expressly shown or specified, the Principal Contractor shall provide and execute all such works as an essential part of the contract.

The Principal Contractor may sub-let the engineering work not specified to specialist companies but this shall not negate the responsibility of the Principal Contractor for completion of the works in accordance with this specification. The Mechanical Contractor may not sub let the work.

The whole of each installation must comply in every respect with the regulations and recommendations of the relevant British Standard Water Company, the Gas Company, the Fire Brigade or relevant authority and the current edition of the Building Regulations including all amendments thereto.

Note: Where Principal Contractor is not employed the Mechanical Contractor shall include those items normally carried out by the Principal Contractor with costs included in tender price.

**M1.02      Connections to Existing Services**

Existing services in existing premises shall be maintained at all times, except where specified and all works shall be arranged to minimise inconvenience to the normal running of the premises.

When connecting into or when isolation of any of the existing services is necessary, the prior permission of the Consulting Engineer or his representative shall be obtained before interruption. It should be noted that the services are an integral part of a district heating and distribution system.

**M1.03      Builders Work**

Where the building construction necessitates bracket, supports, etc. being plugged and screwed to backgrounds, such work is to be included in the tender.

All other builders work including construction of bases, supports for storage systems and other equipment, the formation of openings and/or recess, cutting away and making good, formation of trenches and pipe pockets, building in of pipe sleeves, brackets and anchors etc. will be carried out by the Principal Contractor subject to the submission of a fully detailed schedule of builders work required and all marking and setting out and setting out for building in pipe sleeves, brackets etc. and for cutting of holes. The positions of all holes, chases etc. are to be approved by the Structural Engineer before any work is carried out.

Within a week of being notified of the acceptance of the tender, full builders work details shall be submitted to the Consulting Engineer or his representative for comment, including drawings showing details of all bases, openings, flue entry positions, etc. throughout the building. Approval of any builders work drawings shall not exempt responsibility for accuracy of correctness. Any builders work carried out incorrectly due to faulty dimensions, details, setting out etc. shall be re-executed by arrangement without any further cost to the Employer.

The Mechanical Contractor shall be responsible for the marking out of all associated builders work and shall supervise the work of all builders tradesmen detailed to execute it.

**M1.04      Working Drawings**

The Consultant's drawings issued for design intent purposes only and may not show all components required, the Contractor is to allow within the costs for all elements necessary to provide a complete installation.

The Consultant's drawings will require developing by the Service's Contractor and fully co-ordinated detailed working drawings shall be issued to the Consulting Engineer for comment.

Allow 7 working days for comment by the Consulting Engineer. These drawings shall then incorporate comments made and issued in sufficient time within the Contract Period.

**M1.05      Record Drawings**

A complete set of drawings shall be kept on site and as the works proceed, any variations or modifications to the services shall be indicated in colour thereon.

Facilities shall be afforded to the Consulting Engineer or his representative to check these drawings as the works proceed.

Prior to the issue of the Practical Completion Certificate, a set of 'As Installed' drawings shall be issued to the Consulting Engineer or his representative for comment. These drawings shall be to a scale not less than the contract drawings, clearly showing the layout of the plant and pipework etc. and marked 'As Installed'.

Note:-

The Practical Completion Certificate will not be issued until these drawings are approved.

When approved, the above drawings shall be supplied to the Consulting Engineer as follows:-

- a. Two sets of paper prints.
- b. AutoCAD or DXF Digital CAD file on floppy disk.

**M1.06      Operating and Maintenance Manuals**

Prior to handover and before the issue of Practical Completion Certificates a draft set of Operating and Maintenance Instructions shall be issued to the Consulting Engineer or his representative, for comment, comprising fully detailed sections of the following to cover the whole of the existing block and the new extension. A separate tender sum shall be included in the tender summary for these Manuals.

- a. General descriptions of the system and equipment.
- b. Operation of plant and safety precautions.
- c. Schedules of routine maintenance.
- d. Schedules of periodic maintenance.
- e. Schedules of equipment with manufactures names, address and telephone numbers and reference numbers.
- f. Manufacturers instructions, leaflets and literature.

- g. Schedule of fuse charts.
- h. Schedule of valve numbering and operation.
- i. Set of paper prints of 'As Installed' drawings
- j. Wiring diagram of plant and interconnections and control wiring of equipment
- k. Complete set of test and commission certificates

Following comment, two sets of the above documents in stiff backed ring binders shall be given to the Consulting Engineer one week prior to the handover inspections. The binders shall be A4 size, finished in black welded PVC with 'Pull Open' two ring fittings at 80mm centres and of a capacity to suit the intended contents.

Each page of the contents shall be mounted in clear PVC pockets, sealed on three sides, open at the top and punched at 80mm centres. A digital copy of the manuals shall also be provided on a CD/DVD.

The Practical Completion Certificate will not be issued until the approved Operating and Maintenance Manuals are handed over to the Consulting Engineer or his representative.

#### **M1.07 Testing and Commissioning**

The whole of the Mechanical and plumbing soil and waste Services shall be tested and commissioned in accordance with the following:-

Heating, ventilation and air conditioning installations to be commissioned in accordance with CIBSE Commissioning codes with the manufacturer's and Water Supply Company's recommendations and regulations to BS EN 12056, BS EN 806 and (to the entire satisfaction of the Consulting Engineer). Where appropriate, tests shall be carried out in accordance with the relevant British Standard or Code of Practice.

Test Certificates and tables of results for works tests and site tests etc. shall be submitted in duplicate to the Consulting Engineer for comment.

The Principal Contractor shall include the cost of all tests, necessary instruments, plant, supervision and labour. The accuracy of the testing instruments shall be demonstrated where so directed by the Consulting Engineer.

The site tests shall be witnessed over a period of at least six hours duration. Any defects of workmanship, materials, performance, maladjustment or other irregularities which become apparent during the tests shall be rectified by the Principal Contractor at his expense and the tests shall be repeated to the satisfaction of the Consulting Engineer.

The Principal Contractor's representative present on site shall be fully conversant with the operation of the installation and controls, otherwise representatives of the installer shall attend.

Fuel, water and electricity for site tests will be provided free of cost and where appropriate, each meter reading shall be taken and recorded at the start and finish of each test.

All tests shall be carried out as required and approved by the Consulting Engineer before any insulation is applied.

Seven days written notice of his intention to test shall be given to the Consulting Engineer . Should any section of the works be tested without any notice having been given to the Consulting Engineer, such tests shall be carried out again in his presence and if any work has been covered up, it shall be uncovered, all at the Principal Contractor's expense.

- (a) Hydraulic Pressure
- (b) Circulation /Outflow Tests

The Tester shall provide the necessary water pressure pump and also all necessary plugs, blank flanges and temporary filling connection etc., for sealing off open ends in order that the installation may be tested in sections if called for by the Consulting Engineer.

Gas carcassing shall be tested and all gas appliances shall be regulated and commissioned with all pilot and main governors and burners correctly adjusted, all safety devices proven and everything left in correct working order.

All new circuits shall be balanced and it shall be demonstrated that each circuit is operating at the correct flow rates and return water temperature. Such tests shall be of sufficient duration to ensure that regulation has been satisfactorily completed.

All controls shall be calibrated and adjusted and particular attention shall be paid to the following:-

- (a) Satisfactory operation of any automatic or manually operated sequences to be used in the event of fire.
- (b) Safety in the event of failure or sudden resumption of electrical supply.
- (c) Satisfactory operation of safety interlocks designed for the protection of personnel.
- (d) Satisfactory operation of equipment protection devices.
- (e) Satisfactory operation of all sequencing operations and alternative working selections and automatic or manual changeover of duplicate plant.

The following items shall be checked and/or tested and recorded on the site Test Certificate:-

- (a) External air dry bulb temperature and relative humidity.
- (b) Air dry bulb temperature in each space.
- (c) Boiler operating temperature.
- (d) Circulating water flow temperatures.
- (e) Circulating water return temperatures
- (f) Set desired value of all control devices including room thermostats and time clocks.
- (g) Boiler combustion results.
- (h) Thermostatic radiator settings (where appropriate).
- (i) Flow rates for all double regulating valves with pressure tappings, measuring stations or any other flow measuring devices with settings or positions tabulated.
- (j) Balancing of all circuits fitted with regulating or double regulating valves with all necessary settings or positions tabulated.



- (k) Air flow rates and external resistances of all fans.
- (l) Balancing of all ductwork fitted with volume control dampers and tabulated settings or positions.

All commissioning shall be in accordance with the latest relevant CIBSE codes of practice.

Upon completion of Hot and Cold Water Installations the systems shall be set to work to ensure that all draw-off points are adequately served.

Upon completion, the plumbing installation shall be tested in accordance with the requirements of BS EN 12056 and at the following stages during the works:-

- i) Before concealment by suspended ceilings/bulkheads/duct covers/partitions etc.
- ii) On completion of the whole installation including fixing of sanitary ware.

Existing soil, vent and waste pipework which is altered in any way or added to, shall be tested prior to commencement of the works. A copy of the test results shall be forwarded to the Consulting Engineer for comment.

The waste and soil installation shall be air tested to 38mm water gauge and to remain constant for 3 minutes to the satisfaction of the Local Authority.

Discharge tests shall be applied to ranges of fittings to prove the integrity of the system and retention of trap seals.

Upon completion of any air-conditioning system, all fans and controls shall be adjusted for correct air distribution and balance of the whole system checked for mechanical soundness, satisfactory noise levels and correct operation.

Upon satisfactory completion of all testing, the Principal Contractor shall be responsible for draining down all water systems and isolating all electrically operated plant to protect and prevent unauthorised use of any part of the installed systems. The Principal Contractor shall, however, have all systems fully operational again one day prior to the date of Practical Completion.

#### **M1.08 Chlorination**

Upon completion of the hot and cold water installation work and after satisfactory pressure tests, the Contractor shall carry out the disinfection and sterilisation of all of the Hot and Cold water systems in accordance with BS EN 806 FH48 from Health and Safety Executive and Chartered Institute of Building Services document TM13. The works to be carried out by a Specialist Company.

#### **M1.09 Refrigeration Systems**

All refrigeration pipework systems shall conform with the requirements of HVCA standards for good installation guide.

**M1.10 Radiators**

The radiator heating system is to operate at a temperature of 82°C and shall not operate at temperatures exceeding 95°C. Radiators shall be supplied and installed by the Contractor of the types, ratings and dimensions indicated on the drawing. They shall be manufactured and tested in accordance with the requirements of BS EN 442-3:2003. The positions and height above floor of all radiators shall be confirmed with the Consulting Engineer. A minimum clearance of 75mm shall be provided between the floor and the underside of any pipe serving a radiator, the minimum clearance between the floor and the underside of a radiator shall be 150mm. Each radiator shall be provided with self acting thermostatic valves on the inlet connection and a regulating valve on the outlet connection.

The Contractor shall include taking down radiators once after initial installation for painting and refixing.

**M1.11 Natural Gas Services**

Installation, pipework, joints and fittings shall be in accordance with British Gas Publications 1M/15 and 1M/16 and installed by a Gas Safe registered company and fitters.

A minimum clearance of 150mm shall be maintained between gas pipes and electric cables, conduits, etc. in all installations both inside and outside the building.

**M1.12 Installation of Pipe Services Generally**

Installation of all pipework shall follow the details set out in the accompanying drawings, due allowance being made for the diagrammatic nature of the same and to be in accordance with the best accepted practice.

Details set out in the following Clauses of this section are generally appropriate to all services except where specifically stated.

All pipework shall be adequately supported on hangers or on brackets according to position in order to permit free movement due to expansion and contraction and the amount of such movement shall be proportioned throughout the system by the provision of anchors at suitable points.

All pipework shall be arranged to accommodate without distortion the linear expansion when heated. Pipe supports shall be of the type which will allow full movement of the pipes except at fixed points which shall be provided as necessary between expansion bends. The fixed points shall be secured by anchors or approved design.

Pipes shall be spaced in relation to one another and to the building structure so as not to interfere with any other services and to allow for the required thickness of thermal insulation as specified elsewhere. The combined insulation of two or more pipes in one composition casing will not be permitted.

Clearance between pipework insulation and finished walls, floors, ceilings and other fixtures should be adequate for cleaning purposes, future dismantling etc. and shall not be less than the distance given below:-

Pipework to pipework	- minimum distance 32mm
Pipework to floors	- minimum distance 100mm
Pipework to ceilings	- minimum distance 100mm
Pipework to walls	- minimum distance to conform with standard bracket centres.

All exposed pipe runs shall be arranged to present a neat appearance and where practicable be parallel both with one another and with the building structure taking due regard however to the grading, venting and draining requirements. All vertical pipes shall be plumb.

All exposed pipe runs shall be arranged so that the longest length of tube practicable is used between bends, tees and flanges or unions. Short lengths of tube joined together by sockets shall not be employed.

To facilitate routine maintenance the positions of all valves, drains and supports shall be determined with this aspect in mind. Grouping of valves, drains, unions, flanges etc., shall be preferred to scattered siting. Access panels in ceilings are strictly controlled. Co-ordination of these with the architectural details is required.

No joints shall be formed within the thickness of walls, floors or ceilings. All pipework, valves, fittings and equipment forming that piping installation shall be erected so that it can be dismantled and is accessible for repair and replacement. In this context "accessible" means that the provision for dismantling the flange, union, etc., can be reached and worked upon either in the open or else by removal of a purpose made duct cover, manhole or similar cover, it cannot be manipulated. No pipe shall be installed without a flange or union at a point where it passes through a wall, floor or ceiling and is not readily removable.

Unions or flanges shall be provided generally at a maximum spacing of one per 12 metres, in agreed positions.

Where pipework is not readily accessible it shall be welded (or brazed if copper).

Pipes shall be bent around piers and all other projections and recesses and for all off-sets due to varying thickness of plaster, walls, floors, ceilings and other structural works. Due allowance shall be made in all cases for obtaining full details relating to the skirting heights, sill heights, and door finishes. No pipework off-sets shall be allowed on pipework visible in rooms except by prior agreement.

Bends, springs and off-sets shall be formed by use of an efficient bending machine; fire sets shall not be employed. Copper tube may have its bends and off-sets formed with springs or a bending machine. All changes of direction formed shall be made with a minimum loss of local wall thickness. The diameter shall be maintained. Crinkled and scored work will be rejected.

All cuts from standard lengths of pipe shall have all burrs and swarf removed, the ends shall be trimmed square and shall be thoroughly cleaned before erection. The right is reserved to instruct the cutting open of any 10 (ten) sections of pipework for inspection. If this inspection should prove that all the burrs etc. have been removed the Employer will pay the costs incurred in the removing, testing and replacing the section of pipework.

If, however, the inspection shows that all the burrs etc. have not been removed, the making good of any such faults shall be free of cost to the Employer including the removing, testing and replacing the sections of pipework

If this result suggests that the standard of workmanship on the whole of the rest of the installation is below that required, the right is reserved to instruct the removal of the remainder of the installation in whole or in part, and to have these sections renewed to conform to this Specification. In this case there shall be no claim allowed for the costs involved in removing and renewing these sections of the Works, whether such work is found to be faulty or not.

Where pipes are held in vices, as when screwing or cutting, care shall be taken to ensure that the pipe surface is not damaged. Any pipework so damaged shall not be fitted.

Due allowance shall be made to protect the open ends of all pipework. Suitable caps, plugs or plastic covers only shall be used to cover open ends. Wood, rage or paper plugs shall not be used.

Valves fitted to the open ends of tubes or pipes shall not be used to prevent the entry of dirt.

The right is reserved to order the pipework to be dismantled for as far as considered necessary and the pipework to be cleaned internally should the above requirements not be observed.

This work shall be carried out free of cost to the Employer including the removing, cleaning and replacing of the sections of pipework.

#### **M1.13 Grading of Pipework**

All pipework shall be installed with continuous gradients to allow for drainage and/or release of air, according to the service concerned. Gradients shall be generally as follows for the various services.

Heating and Hot Water (mains)	- 25mm in 12m
Heating and Hot Water (branches)	- 25mm in 6m
Cold Water	- 25mm in 18m
Chilled Water	- 25mm in 18m
Waste	- 25mm in 1.150m

#### **M1.14 Air Venting of Pipework**

Full provision shall be made for air venting of the systems, whether or not shown on the drawings.

All exposed air bottles, automatic vents and drip pipes where required shall be properly insulated and protected against frost.

Air vents shall be provided at all high points on the pipework. They shall be installed at the highest point of the sections which they are intended to vent.

Air bottles on pipework up to and including 80mm bore shall be manufactured from 50mm bore pipe, 100mm bore and over from 100mm bore pipe. All shall be 250mm long with welded end caps and be complete with 8mm copper pipe brought down from the top of the air bottle to within reach of the floor level and fitted with 8mm lockshield needle valve complete with key.

Automatic air vents shall be used where required and shall have gunmetal bodies with not less than 15mm connections, copper or stainless steel floats, guides and non-corrodable needle valves. In all cases the air vent shall be protected by a lockshield pattern stop valve and the discharge from the air vent shall be 12mm copper pipe which shall discharge over an agreed gully, sump or other convenient position.

#### **M1.15 Drainage of System**

Drain points shall be provided on all items of plant and equipment, at all low points of water services installation and also on the branch side of all main isolating valves and cocks whether or not shown on the drawings.

## **M1.16 Pipework Materials**

The materials for the piped services shall be in accordance with the following table and shall not be varied without prior written permission.

Service	Materials
Heating	) Copper EN1057 R250 formally BS 2871 table X
Heating make up or cold feed	) Copper EN1057 R250 formally BS 2871 table X
Heating open vent	) Copper EN1057 R250 formally BS 2871 table X
Mains cold water	) Copper EN1057 R250 formally BS 2871 table X
Cold water services	) Copper EN1057 R250 formally BS 2871 table X
Hot Water Services	) Copper EN1057 R250 formally BS 2871 table X
HWS cold feed	) Copper EN1057 R250 formally BS 2871 table X
HWS open vent	) Copper EN1057 R250 formally BS 2871 table X
Automatic air vent discharges	) EN1057 R250 formally BS2871 table Y
Gas Services	) Black mild steel (medium grade)
Cold water overflows	) Copper EN1057 R250 formally BS 2871 table X
Incoming mains cold water external	) Medium density polyethylene to BS6572 EN1254PT3
Waste Services	) MuPVC to BS4514 Copper EN1057 R250 formally to BS2871 table X
Soil Services	) Cast iron to BS416 PVC-u to BS4514
External Gas Service (if applicable)	) Medium density polyethylene with heat fusion fittings and joints to British Gas Council Codes of Practice.

## **M1.17 Steel Pipework**

The materials and techniques detailed in these Clauses shall be used or employed on the Contract Works as required.

All piping and tubing used in the construction of the works described in this Specification shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects and shall be free from rust and scale.

Standard steel pipes having nominal bores of up to 150mm shall be in accordance with BS 1387:1967 and shall be provided in random lengths of between 4.5m and 7.5m..Gauge of pipe walls shall be in accordance with heavy grades of the Standard.

Where pipes are required for screwed joints, they shall be provided with screwed taper threads to B.S.21.

Steel pipes which are to be used "black" shall be varnished externally throughout their length after manufacture.

**M1.18      Fittings for Mild Steel Pipework**

Screwed tees and bends for use on pipework up to and including 50mm standard steel pipes shall be to B.S.1387 "heavy" grade. Ends shall be provided with either screwed taper threads to B.S.21 or with plain or bevelled ends for welding.

Welding fittings shall be to B.S.1965: Part 1 on pipework over 50mm in standard applications and be manufactured by a forged seamless process from mild steel.

In addition to the range of fittings set out in the standard, branch bends manufactured by the same details may be used.

Ends of fittings, which shall have the same bore and the same wall thickness as that of tube manufactured to the "heavy" grade of B.S.1387 shall be bevelled for butt welding.

Malleable cast iron pipe fittings shall be to B.S.143 and 1256: 1968, manufactured by the Whiteheart process to Grade 1 of B.S.309: 1972, banded or beaded for reinforcement.

Wrought steel pipe fittings shall be manufactured from mild steel by a seamless or welded process to B.S.1740.

The screwed ends of the fittings shall be provided with parallel female and taper male threads to B.S.21, the axis of threads being coincident with the true axis of the fittings. Where specified, threaded fittings shall be provided and shall be in accordance with B.S.143.

Where practicable all fittings shall be of the easy sweep type. Branches shall be made using swept tees or branch bends except where an air lock is liable to form, i.e. tees on rising mains etc., where square tees shall be used.

Elbows shall be used only where the use of bends is impracticable and where written permission has been obtained previously.

Where standard fittings are not available for the duty required, reductions on the run and to the branch shall, in all cases, be made with reducing sockets, not bushes.

Reducing fittings on horizontal pipework shall be of the eccentric pattern fixed so as to give a smooth run to the crown of the pipe. Concentric pattern reducers shall be used on vertical pipework.

All flanges, bolts, nuts and washers shall be manufactured from mild steel to B.S.10, "Table of Pipe Flanges (for land use)", Part 2, to the table appropriate for the pressure specified. Flanges shall incorporate bolt holes drilled not punched.

Flanges for welding shall be machine faced slip-on type with welding necks trimmed at the edges and spot-faced for nuts.

The joint between flanges shall be made up with a full face Klingerite joint ring graphite faced on both sides, and completed using mild steel bolts nuts and washers.

Unions shall, in all instances, be manufactured with double gunmetal seats as the "Navy" pattern.

**M1.19      Mild Steel Pipework Joints**

Welded joints shall be used to fabricate the pipework in the circumstances set out below:-

- .01      Pipework In plant rooms and pump rooms.
- .02      Pipework in ducts, trenches, ceiling voids etc..

- .03      Pipework in positions not readily accessible.
- .04      Pipework in room housing electrical switchgear, telecommunications equipment, control gear etc..
- .05      All pipework 65mm diameter and above.  
  
            Screwed B.S.P.T. joints shall be used to fabricate the pipework in the circumstances set out below:-
- .06      Pipework other than described in items .01 to .05 inclusive.
- .07      Where the act of welding would constitute a fire hazard over and above the normal accepted level.

## **M1.20      Welded Joints**

Steel pipe having welded joints on the run shall be prepared for jointing in a manner suitable for the technique employed. Welds shall be carried out in accordance with BS 2633: 1973 for metal arc-welding joints using covered electrodes and : 1957 and BS 2640: for oxy-acetylene welded joints.

Pipes shall be prepared for welding with ends sawn or cut off by hand, flame cut by machine or flame cut by hand with subsequent truing up by filling or by grinding to a level of 37.5 as may be required. Welding rods shall in all cases be of good quality copper coated low carbon steel and the manufacturers shall provide test certificates representative of the rods used in accordance with B.S.1453:1972.

All welded joints, produced by the oxy-acetylene flame process, shall be of first quality, the butts slightly convex with regular ripples and no undercutting, washing away or surface cavities being present. Notches at the root indicating incomplete penetration and excessive weld protruding into the pipe bore in excess of 1.5mm shall not occur and the external reinforcement shall run out smoothly to the pipe surface on either side

Welding shall in all cases be carried out by skilled craftsmen who are in possession of a current certificate of competency issued by an approved authority (which shall be produced upon request) and have had a suitable period of experience for the class of work in which they are engaged.

Highly skilled non-certificated welders may only be used following written approval and test welds, in accordance with B.S.4872: Part 1: 1972, shall be submitted before this approval is given. For this purpose a suitable independent testing authority shall be determined and these tests shall be carried out free of cost to the Employer.

During the progress of the works, inspection will be made to ensure the quality of welding. The right is reserved to instruct the cutting open of any 10 (ten) sections of pipework which include welded joints and to have these parts laboratory tested.

If the tests and inspection should prove that the welds are to the required standard, the Employer will pay the costs incurred in removing, testing and replacing the sections of pipework. If, however, the inspection and tests show that the welds are below the class of workmanship for this class of work, or if they are found to be faulty in any respect, no costs or fees incurred by the tests shall be borne by the Employer.

If this result suggests that the standard of workmanship on the whole of the rest of the welded work is below that required the right is reserved to instruct the removal of the remainder of the welded sections renewed to conform with this Specification. In this cases no claim for the costs involved in removing and renewing these sections of the Works shall be allowed, whether such welds are found to be faulty or not.

All changes in direction shall be proportioned so that the ratio between the centre line radius of the bend and the inside diameter of the pipe is not less than 1.5 to 1.

All bends where practicable shall be formed in the pipe run (i.e. made bends). Where standard welded fittings are used they shall be of the same quality as the pipe and shall conform to BS 1965: Part 1-1963. Bends shall be 90 degree long radius type unless space for pipework is restricted and in which case the short radius welding elbow may be used subject to the prior written approval. Cutting and shutting will not be permitted.

Branch welding fittings shall only be used where the branch is at least two sizes smaller than the main pipework up to and including 50mm bore.

On mains larger than 50mm bore the branch size must be at least three sizes smaller than the main. Sweep welding tees shall be used where the branch size is the same bore as the main or does not comply with the aforementioned conditions.

After cutting or welding, all flashing shall be removed from all pipework before erection.

All welded joints shall be painted two coats of red lead oxide on completion of the joint.

#### **M1.21      Screwed Joints**

Steel pipe having screwed joints shall be carefully reamed out before the plain end is screwed.

P.T.F.E. tape or an approved jointing compound with hemp shall be used when making a joint or screw thread, on pipework carrying water. Joints or screw threads on gas pipework shall be made using a suitable sealant approved by the Gas Board.

The joint shall be arranged so that on completion two or three threads are left showing. Loose hemp left after the joint is made shall be removed to leave a clean appearance.

Should a screwed joint prove defective under subsequent test, the section of pipework in question shall be removed and made good. Caulking will not be permitted.

#### **M1.22      Flanged Joints**

Steel pipes having flanged joints to B.S.10 shall be prepared to suit the method of attachment required.

Pipes not galvanised shall be provided with flanges screwed or welded on for nominal bores of 50mm and below and with flanges welded on for larger sizes. Galvanised pipes shall be provided with galvanised flanges screwed on for nominal bores of 100mm and below and with flanges welded on prior to galvanising the pipe, for larger sizes.

Where flanges are secured by screwing, the threads on the tube shall be arranged to end at a point just inside the bore of the flange, so as not to interfere with the joint.

After the flange has been screwed on, the tube shall be expanded into the flange by a roller expander.

Welding flanges shall be of the slip-on pattern with neck, secured by welding both the neck and bore of the flange to the pipe, with the tube finishing 3mm inside the bore. Care shall be taken not to distort the machine face.



**M1.23      Copper Pipework**

The materials and techniques detailed in this Section shall be used or employed on the works as required.

The following light gauge copper tube shall be used where specified, the use of different grades may be required and these shall be detailed in the relevant Sections of this Specification.

All tubes shall be solid-drawn from phosphorous de-oxidised non-arsenical copper to BS EN 1172, free from any deleterious film.

Half Temper                      -                      Light gauge in accordance with  
EN1057

All piping and tubing used in the construction of the various plants described in this Specification shall be straight, cleanly finished round in cross section, free from cracks, surface flaws, laminations and other defects.

**M1.24      Fittings for Copper Pipework**

Capillary fittings shall be to EN1254 Pt1, i.e. 1.B.P. Conex - Triflow S/R. All fittings shall be manufactured from materials being non-dezincifiable. Any fittings not in keeping with this requirement shall be replaced at no cost to the Employer.

All fittings shall be suitable for the working conditions of the system, and the purpose made fittings shall be used throughout. All branch connections shall be made by purpose made tees either square or sweep to suit the application.

Where practical, fittings shall be of the long sweep pattern. Where standard fittings are not available for the duty and size required, reductions shall be made with purpose made fittings.

Short lengths of tube joined together by sockets shall not be employed.

Where light gauge copper tubes are pulled on site to form bends and off-sets, the material used shall be as for adjacent straight lengths. Tubes having nominal bores up to 28mm may be bent cold but larger sizes shall be annealed before manipulation.

In all cases, tubes shall be loaded prior to bending with springs, low melting point alloys or an inset sand, care being taken that contamination of the tube material is avoided. Where bending machines are used these shall have smooth clean guides and formers, any scored or damaged tools being rejected. Pulled bends with any deformity whatsoever resulting in the forming of the bend will not be accepted.

Unions shall be manufactured from gunmetal and shall be in accordance with EN1254.

**M1.25      Copper Pipework Joints**

All jointing of copper tubes shall be strictly in accordance with the fitting manufacturer's recommendations.

Where capillary fittings are used, care shall be taken to ensure that the solder used is suitable for the temperature conditions of the system.

All solder dropping and the surplus flux shall be removed on completion of the joint.

**M1.26      Supports and Fixings**

All pipework shall be properly supported and bracketed and must permit, where required, adequate free and/or guided movement due to the operating conditions applicable.

Structural steelwork shall not be drilled either for the passage of pipes or the attachment of brackets, nor shall steelwork be welded to, without written permission.

Particular importance must be made to the design and method of supports and brackets for pipework and associated equipment. The materials, construction, method of fixing, practicability and appearance of the brackets must be carefully considered.

Drawings of all brackets and supports shall be forwarded for comment before installation is commenced.

In all positions throughout the building, all necessary supports and brackets complete with all bolts, screws and insert or plug fastenings shall be provided.

All fastenings and fixings to the constructional and fabric elements of the building shall be included. All methods of fixing and fastening shall be purpose designed and approved. Direct fixing, self-drilling and normal drilling methods of fixing to concrete slabs will be considered for approval.

Softwood plugs will not be permitted.

Full and proper care shall be exercised in the positioning and marking out of all brackets and supports.

Pipework subject to expansion that will cause distortion of hanger type brackets shall be supported using chair and roller brackets. Multi-service pipework distribution where supported off horizontal channel or angle iron brackets shall incorporate roller and chair type brackets. Built on type brackets shall only be used where a satisfactory fastening cannot be attained using surface fastening techniques. It shall be insured that the building in of brackets is carried out correctly.

Vertical pipework shall be suitably supported at the base of the riser and at all intermediate levels. Branch circuit pipes shall not be used as a means of support for the riser main.

Brackets and supports shall be set out so that they do not obstruct the access to valves, flanges or fittings requiring maintenance or removal.

Pipes shall not be supported from any item of equipment.

All pipes exposed to view and generally around rooms at floor level shall be supported on schoolboard pattern long shank build-in or screw-on brackets.

Full information shall be obtained concerning the distribution of other services and plant within the building. No extra costs will be allowed for altered pipework which may be necessitated by non-observance of this clause.

Brackets on insulated pipework incorporating a vapour seal shall be fitted with spacers and sleeves of an approved material between the bracket and pipe surface to achieve satisfactory vapour sealing. Materials for supporting and fixing the various items of piping, tubing etc., are detailed subsequently in this Section. It shall, however, be a firm principle of all fixing that the contact of dissimilar metals must be avoided and to this end steel piping shall have steel supporting members actually in contact with the pipe, galvanised piping shall have galvanised contacts and copper tubing shall be carried exclusively from contact members constructed from copper or copper alloy, or where mild steel clamp saddles are used, a lining interposed. All spring washers, shakeproof items, lock nuts etc., shall be included.

The spacing of the supports shall conform to those given in the table below and the distance shall not be exceeded.

In addition to the centres given below, supports shall be provided adjacent to all valves, flanged joints and other special components to prevent undue strain on the adjoining pipework and so that the components or sections of pipework may be removed, leaving the adjoining pipework adequately supported at the ends.

Main walls and partition walls etc., where pipes pass through sleeves, shall not be considered as pipe supports.

Nominal Bore (mm)	Steel		Copper		Cast Iron		
	Horiz. (m)	Vert. (m)	Horiz. (m)	Vert. (m)		Horiz. (m)	Vert. (m)
15	2.0	2.4	1.4	1.8	-	-	
20	2.4	2.7	1.4	1.8	-	-	
25	2.7	3.0	1.7	2.1	-	-	
32	2.7	3.0	1.7	2.1	-	-	
40	3.0	3.6	2.0	2.4	-	-	
50	3.4	3.6	2.0	2.4	-	-	
65	3.7	4.2	-	-	-	-	
75	-	-	-	-	-	1.8	2.0
80	3.7	4.2	-	-	-	-	
100	-	-	-	-	-	1.8	2.0

#### **M1.27 Cast Iron Pipework**

The materials and techniques detailed in these Clauses shall be used or employed on the Contract Works as required.

All piping and tubing used in the construction of the works as described in this Specification shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects and shall be free from rust and scale.

Standard steel pipes having nominal bores of up to 100mm shall be in accordance with BS416 and shall be provided in lengths of 2 metres.

All pipes shall be plain ended.

Cast iron pipes shall be Timesaver as manufactured by Glynwed Foundries.

#### **M1.28 Fittings for Cast Iron Pipework**

Plain ended branches, bends and traps for use on 75 dia and 100 dia pipework shall be Timesaver as manufactured by Glynwed Foundries.

The fittings shall be in accordance with BS416.

#### **M1.29 Couplings for Cast Iron Pipework**

Cast iron couplings complete with 4 number stainless steel bolts and a synthetic rubber gasket shall be to BS6087 and BS970 Part 2 and BS2494 respectively all as manufactured by Glynwed Foundries.

All couplings are to be complete with electrical continuity strips.

**M1.30 PVC-U Pipework**

The materials and techniques detailed in these Clauses shall be used or employed on the Contract Works as required.

All pipes shall comply in all respects with the requirements of British Standard 4514, and shall where appropriate bear the British Standard Kitemark.

The pipe and fittings shall be colour grey, to British Standard 5252:10.A.07.

All pipes and fittings to comply in all respects with the requirements of British Standard 5255 and shall, where appropriate, bear the British Standard Kitemark.

The pipe and fittings shall be colour grey, to British Standard 5252:10.A.07.

All piping and tubing used in the construction of the works as described in this Specification shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects.

Pipes shall be supplied in plain ended lengths.

The minimum acceptable wall thickness of pipe and fittings shall be:-

Nominal Size mm	Pipe mm	Fittings mm
82	3.20	3.2
110	3.20	3.2
160	3.30	3.5

**M1.31 Fittings for PVC-U Pipework**

All fittings to comply in all respects with British Standard 4514 and shall, where appropriate, bear the British Standard Kitemark.

All soil fittings to be PVC-U with solvent welded joints except where seal ring joints are required for thermal movement.

The minimum acceptable wall thickness of pipe and fittings shall be:-

Nominal Size mm	Pipe and Fittings Wall Thickness mm
32	1.8
38	1.9
50	2.0

**M1.32 Jointing of PVC-U Pipework**

The method of jointing to be employed shall be that of solvent welding using the manufacturer's approved cement. Seal ring fittings shall be used where necessary to accommodate thermal movement, or the sockets of standard fittings shall be converted to seal ring joints by the addition of a seal ring adapter.

The rubber seals for seal ring joints shall be of a section that gives more than one point of contact with the pipe and shall be to the material requirements of British Standard 2494. Water closet connections shall be to the same British Standard.

**M1.33 MuPVC Pipework**

The materials and techniques detailed in these Clauses shall be used or employed on the Contract Works as required.

All piping and tubing used in the construction of the works as described in this Specification shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects.

Standard MuPVC pipes having nominal bores of up to 50mm shall be in accordance with BS4514 and shall be provided in lengths of 4 metres.

All pipes shall be plain ended. MuPVC pipes shall be as manufactured by Terrain.

**M1.34 Fittings for MuPVC Pipework**

Socketed ended branches, bends and connectors for use on 32, 40 and 50 diameter pipework shall be as manufactured by Terrain.

**M1.35 Jointing of MuPVC Pipework**

MuPVC pipework shall be jointed using the solvent welded method. Expansion joints shall be provided to accommodate thermal movement between fixed points as follows:-

- i) between fixed points if the distance exceeds 1 metre
- ii) on branch waste pipes if the length exceeds 1.8 metres

**M1.36 Pipe Sleeves**

In all cases where pipes pass through walls, floors ceilings and footings, sleeves shall be provided and it shall be ensured that the sleeves are correctly built in. Sleeves shall in no case be used as pipe supports.

Sleeves in load-bearing walls or footings shall be cast iron pipe. Sleeves in non load bearing walls, floors, ceilings and partitions shall be in copper or mild steel to suit the particular pipe material.

Inside diameter of sleeves shall not be less than 12mm larger than the outside diameter of the pipe, except where pipes pass through load bearing walls or footings where sleeves shall be 100mm larger than the outside diameter of the pipe.

In fire rated walls the space between the pipe and sleeve is to be fire stopped.

With chilled water pipes the thermal insulated and vapour seal is to be carried right through the sleeve.

**M1.37 Fire Sleeves for PVC-U and MuPVC Pipework**

Intumescent Fire Sleeves. The fire sleeves are to be tested to BS 476 Part 20 and have a fire rating ability of at least four hours, when built into the protected wall/floor.

The sleeve construction is to be a zinc plated mild steel cylindrical casing, lined with a graphite based intumescent laminate. The two halves of the shell are to be hinged together with a removable centre pin hinge, and have at least three toggle clamps diametrically opposite. One end of the body is to have a rectangular pre-drilled fixing flange.

The whole unit is to be finished with a red dry power coated paint.

Fixing instructions are to be as per manufacturer's recommendations.

All vertical PVC-U pipework of 40mm I.D. to 160mm diameter passing through a fire barrier is to have a Firebreak Sleeve positioned within the slab thickness, and following installation all openings around the sleeve to be made good using material that will provide the necessary fire rating, i.e. concrete.

All vertical PVC-U pipework of 40mm I.D. to 160mm diameter passing through a fire barrier is to have a 'Firebreak' Sleeve fitted around the pipework and to be securely fixed flush, with the soffit of the floor slab. Any imperfection between Firebreak flange and mating surface to be filled with intumescent mastic.

All vertical PVC-U pipework of 40mm I.D. to 160mm diameter passing through a fire barrier is to have a Firebreak Sleeve fitted around the pipework within the wall thickness with one face of the sleeve exposed. If wall is of sufficient thickness to accommodate two sleeves, each sleeve to have a face exposed.

All horizontal PVC-U pipework of 40mm I.D. to 160mm diameter passing through a fire barrier is to have a Firebreak Sleeve fitted around the pipework on both sides of the barrier. Both sleeves to be securely fixed to the barrier and any imperfection in the joint between the Firebreak flange and the barrier surface to be filled with an intumescent mastic.

All vertical PVC-U pipework of 40mm I.D. to 160mm diameter passing through timber floors with a fire rated ceiling to have Firebreak Sleeves fitted around the pipework, surface mounted at ceiling level. The flange of the Firebreak to be securely fixed to timber noggins within the floor space and the fire rated ceiling finish to be placed over the flange and neatly finished around the body of the Firebreak, leaving no holes or gaps.

#### **M1.38 Access to Soil Waste Pipework**

Access shall be provided where necessary either by means of an integrally moulded door in an access fitting with an externally fitted rubber seal and secured with two galvanised bolts and nuts, or alternatively by a two-piece clamp type door fitted into the pipe run.

#### **M1.39 Floor Plates**

Where exposed to view, new uninsulated pipes and tubes passing through walls, floors, ceilings, partitions and false ceilings of occupied rooms shall be fitted with a heavy chromium plated die cast zinc alloy masking plate. Such plates shall be split on the diameter, being a snug fit to the pipe concerned and provided with countersunk holes for set screws.

#### **M1.40 Painting**

All ferrous materials including sundry iron and steel brackets shall be primed before dispatch to site, or after fabrication on site. Protective coating removed or damaged shall be thoroughly wire brushed and cleaned before re-painting with red oxide or suitable stop-rust primer prior to erection.

#### **M1.41 Stopcocks and Valves**

Stopcocks and valves shall be in accordance with the following details, unless indicated otherwise on the drawings or supplementary specification.

They shall be as IBP Conex or similar.

Valves and cocks shall be provided as follows:-

- (a) Isolate individual items of equipment.
- (b) Separately isolate duplicate items of equipment.
- (c) Isolate wings or sections of the installation.
- (d) Isolate hot and cold water draw-offs, either separately or in small ranges or groups of similar fittings (each WC to be valved individually).
- (e) Isolate mains cold water services at entry to this building.
- (f) Isolate supplies to and services from tanks and cisterns.
- (g) Regulate branch circulations on heating and HWS installations, including circulation to individual radiators, convectors, coils etc.

### ***Hot and Cold Water Services***

General Isolation	15 - 50mm	Hattersley fig 30
	65 - 100mm	Hattersley 35
Regulating	15mm	Hattersley fig 1473 (low flow)
	15 - 50mm	Hattersley fig 1432
	65 - 100mm	Hattersley fig M733DR
Stopcocks	15 - 50mm	Non dezincifiable copper alloy Stopcocks to BS 1010
Blending	15mm	Horne H15 - 21 C
	22mm	Horne H20 - 11B

### ***Heating***

General isolation	15 - 50mm	Hattersley fig 30
	65 - 100mm	Hattersley fig M549 PN6 gate valves.
Regulating	15 - 50mm	Hattersley fig 1432
	65 - 100mm	Hattersley fig M733DR gatevalves
Commissioning	15 - 50mm	Hattersley fig 2473L (low flow)
	15 - 50mm	Hattersley fig 2473M (medium flow)
	65 - 100mm	Hattersley fig M2733

### ***Chilled Water***

General Isolation	15 - 50mm	Hattersley fig 30
	65 - 100mm	Hattersley fig M549PNE
Regulating	15 - 50mm	Hattersley fig 1432
	65 - 100mm	Hattersley fig M733DR gatevalves
Commissioning	15 - 50mm	Hattersley fig 2473L (low flow)
	15 - 50mm	Hattersley fig 2473M (medium flow)
	65 - 100mm	Hattersley fig M2733

### ***Gas***

15 - 50mm	Hattersley fig 100YL DZR
65 - 100mm	Hattersley fig 201M

All valves must be installed with the correct direction of flow.

Spares to be provided : 3 sets of appropriate keys for each type of valve.

**M1.42      3-Way Plug Cocks**

These shall be as supplied by the boiler manufacturer .

**M1.43      Check Valves**

Valves with screwed connections up to and including 54mm shall be manufactured by Hattersley Newman Hender Ltd., figure No.47

Where flanged valves are required up to and including 54mm, they shall be figure No. 57B.

Check valves 65mm and above shall be figure No.4B with flanged connections.

Check valves fitted to hot and cold water services must comply with Water Company requirements.

**M1.44      Drain and Draw-Off Cocks**

These shall be of Hattersley Newman Hender Ltd. manufacture figure No. 371, on heating, chilled water, domestic services pipework and radiators.

Drain cocks fitted to plant items, i.e. boilers, calorifiers, tanks shall be IBP Conex 5742 or Hattersley Newman Hender Ltd figure No 81HUCC.

**M1.45      Automatic Air Eliminators**

These shall be as Charles Winn type 'B' with a 15mm b.s.p. female inlet and 10mm b.s.p. male outlet with a copper discharge pipe to drain on the outside of the building or to suitable tundish or gully.

**M1.46      Drains and Overflows on Equipment**

Any equipment supplied within the terms of the Contract which are fitted with condensate trays, drains, overflows or discharge collection points, shall be provided with drain pipes extended to discharge through external walls (complete with a water seal and tundish, when required,) by an approved route unless otherwise indicated.

**M1.47      Traps Serving Sanitary Appliances**

Traps shall conform to BS EN 12056 and relevant British Standards. They shall generally be 'P' traps incorporating 75mm deep seal, of the 2 piece tubular pattern, in accordance with BS3983 and of the following sizes:-

Washbasins	-	32mm Diameter
Sinks	-	40mm Diameter
Urinal Bowls	-	40mm Diameter
Shower	-	40mm Diameter

**M1.48      Altitude Gauges**

Altitude gauges shall be provided where indicated on the drawings or where specified elsewhere and shall be 100mm diameter with chromium plated cases.



Altitude gauges shall be fitted with level handle cocks and where appropriate, syphon pipes and shall be calibrated in kPa.

Scale ranges shall not exceed twice the maximum design working pressure.

These shall be provided to all heating and HWS pump sets. The pressure gauges shall be connected by light gauge copper tubing, syphons and cocks, one to the suction side and one to the delivery side of the pumping set.

Where gauges are provided in association with pumps the static head of the system with the pumps at rest shall be marked by an adjustable red pointer.

**M1.49      Thermometers**

Thermometers shall be provided where indicated on the drawings or where specified elsewhere and shall be 100mm diameter with chromium plated cases. Thermometers shall be graduated in deg C, be complete with brass pocket and shall be selected angle or straight to suit the application and ensure ease of reading.

The calibration range shall be 0 - 100 °C.

**M1.50      Strainers**

Strainers shall be provided where indicated on the drawings or where specified elsewhere shall be Hattersley fig 807 with standard mesh screen.

**M1.51      Test Points**

Where indicated on the drawings and generally at each LPHW connection to heater batteries and calorifiers, self sealing pressure and temperature test points shall be provided.

**M1.52      Test Point Gauges**

One set of duplicate temperature and pressure gauges shall be provided for use with the self-sealing test points. Calibration of these gauges shall be 0 - 100°C and 0 - 300 kPa.

**M1.53      Isolation Bellows**

All heating and HWS pump sets shall be fitted with isolation bellows of Engineering Appliances Ltd. Manufacture, figure No. S-Flex type AS complete with rubber grommets in the bolt holes.

**M1.54      Safety Valves**

These shall be Hattersley fig 320 Bronze Pop safety valve, springs shall be selected to suit the discharge head of the installation, and installed with a discharge pipe carried to a suitable safe position.

**M1.55      Float Operated Ball Valves**

These shall be provided to the cold water storage tank and shall comply with B.S.1212/1953 and the Local Water Authority.

**M1.56      Expansion Bellows**

Expansion bellows should be fitted where denoted on the drawings or where long runs of pipework could cause expansion problems.

**M1.57      Thermal Insulation**

***General***

The Tender shall include all thermal insulation work, which shall be carried out by an approved specialist Thermal Insulation Company. Only skilled operators shall be employed.

The thermal insulation shall comply in every respect with the 1976 Building Regulations No. 1676 and in particular Part 'R' relating to thermal insulation of pipes carrying heated fluids. In this respect, the thermal insulation thickness shall comply with BS 5422:1977.

The Thermal Insulation Specialist shall be acquainted with all the conditions of the works, including specification, programming, hours of working etc., and he shall complete the work within such programme.

The Thermal Insulation work shall not be commenced, unless otherwise approved in writing, until the whole of the installation has been completed and tested as set out in the relevant pipework, plant and air distribution sections of the specification.

Alternative materials or methods may only be used with express permission of the Engineer in writing, and full details, test certificates, etc., must be submitted in respect of any proposed alternative.

Test certificates shall be submitted to the Engineer in respect of all materials classified under BS 476 part 7:1971.

Under no circumstances shall pipes be married together with insulating material.

**M1.58      Thermal Insulation of Pipework**

The thickness of the pre-formed rockwool sections shall be as follows:-

Pipe Size	Insulation Thickness mm			
Nominal	Heating	Ch.W	HWS	CWS
15	20	25mm	20	25
22	20	25mm	20	25
28	20	30mm	30	30
35	25	30mm	30	30
42	25	30mm	30	30
54	30	30mm	40	30
67	30	30mm	40	30
76	30	30mm	40	30

The minimum thermal conductivity shall be 0.04W/M°C.

Where Armaflex insulation is specified it is to be class 'O', cut with square edges and straight seams:-

Armstrong Insulation products  
Mars Street  
Oldham  
Lancashire  
OL9 6LY

Phone No: 0161 287 7100  
Fax No: 0161 633 2685

It is to be installed in accordance with methods detailed in the Armstrong Armaflex Insulation Manual which is available free on request.

Thickness of Armaflex insulation is as follows:-

Pipe Size	Service Heating	Hot Water	Cold Water	Mains Water
15	13	13	22	22
22	19	19	22	22
28	25	25	13	13

Sizes above these to specified in Particular Specification on our drawings.

#### **M1.59 Thermal Insulation of Ductwork**

Insulation shall be applied to all ductwork where specified.

The thermal insulation around ducts shall be 25mm thickness Rockwool ductslab on rectangular and square ducts, all with reinforced aluminium foil protective covering.

The protective covering shall be factory made laminate two layers of aluminium foil thickness 0.030mm minimum, reinforced in between with glass fibre to achieve a class 'O' fire rating. All joints to have a minimum overlap of 38mm longitudinal and 50mm at ends secured with 75mm wide plain soft aluminium self adhesive tape (Idenden type T303 or similar and approved). The whole to be further supported by means of 19-22 swg x 50mm mesh galvanised wire netting.

#### **M1.60 Thermal Insulation**

##### ***M1.60.01 General Requirements***

This section of the specification sets out the standards, methods and process to be adopted for the supply and installation of thermal insulation.

Attention of drawn to health hazards to personnel handling insulation materials, including some plastic materials, cleaners, solvents, etc..

Adequate precautions shall be taken against any hazard involved in the use of any solvent, cleaner or material in connection with insulation and the manufacturer of any such materials shall be consulted for guidance in this matter.

##### ***M1.60.02 British Standards***

Unless otherwise specifies, thermal insulation work, materials, methods and processes shall be in accordance with the following standards:

- BS 5422    Method of specifying thermal insulating materials on pipes, ductwork and equipment.
- BS 5970    Code of Practice for Thermal Insulation of Pipework and Equipment.
- BS 3958    Thermal Insulating Materials, Parts 1-6
- BS 476     Fire Tests on Building Materials and Structures.

#### ***M1.60.03    Workmanship***

Thermal insulation shall not be commenced until the pressure tests for all sections of the various systems have been witnessed and approved by the Consulting Engineers.

All insulation work shall be carried out by an approved specialist firm of repute, as a Specialist Sub-Contractor to the Contractor, the latter remaining responsible for the quality of material and workmanship.

Neither poor quality nor badly finished work will be accepted, as will irregularities in the thickness of the insulating material or in any covering. All work is to be left smooth, clean and properly finished. The materials shall be of reputable manufacture and in accordance with the relevant British Standards Specification.

Samples of insulating materials and finishes together with their Manufacturer's Technical Data, suitable highlighted shall be submitted for approval. Samples submitted shall be sent to the National Physical Laboratory for a report and, if so rejected, shall be removed and replaced at no additional expense.

If requested a test of thermal conductivity of a sample of one or more materials removed from the Works shall be carried out at the Manufacturer's works or at the National Physical Laboratory. This shall be carried out at the Contractor's expense.

Should the tests show that the thermal conductivity is not appropriate to the thickness required, the CE may call for extra thickness to be applied to the Works, based on the test value and at the Contractor's expense.

A test for thickness of applied insulating material by means of a probe may be carried out. If the test shows that insufficient insulating material has been applied, then additional material shall be applied to bring up the thickness to that required, at the Contractor's expense.

#### ***M1.60.04    Insulating Materials***

All insulating materials shall be glass or mineral fibre. Under no circumstances shall any insulation material requiring the use of CFC's in its manufacture or containing asbestos be used.

Thermal conductivity values shall be in accordance with the requirements of BS 874 and BS 2972.

Preformed mineral fibre shall be manufactured from mineral wool based on rock or slag bonded into a rigid form with heat resistant resin to BS 3958: Part 4 with a density of 80 Kg/cubic metre. Conductivity shall not be greater than 0.045 W/mK at a temperature of 100°C.

Adhesive used shall be non-flammable and shall be compatible with the insulation. In no circumstances shall an adhesive or solvent which attacks or dissolves the pipework, ductwork or the insulation be used.

All thermal insulating materials shall be classified as non-combustible in accordance with BS476:

Part 4, the surface spread of flame rating shall be Class 1 when tested in accordance with BS 476:  
Part 7 and the fire propagation rating shall meet Class 'O' when tested in accordance with BS 476:  
Part 6.

#### ***M1.60.05 Insulating Application***

Before application of insulation, all surfaces are to be thoroughly cleaned. Ferrous surfaces, where not galvanised shall be treated with a corrosion inhibiting paint.

The insulation material shall be applied in the sequence and thicknesses specified with adequate time for drying out where appropriate. Joints shall be close butted or overlapped and shall be staggered and sealed.

All necessary supporting and reinforcing of the insulation and finishes shall be incorporated to ensure that there is no sag and that the insulation is securely attached in close contact with the surface. Cut ends of all insulation shall be capped with aluminium of a substantial gauge, correctly fitted to provide an end seal.

All finishing coats shall be properly finished smooth, neat and straight and, unless inherently impermeable, shall be sealed before painting.

Painting of insulation where required shall be carried out by the Contractor.

Ductwork and pipework shall be erected such that supports and hangers are clear of insulation.

Vapour sealed insulation must have the vapour seal restored to provide an unbroken seal.

#### ***M1.60.06 Insulation of Pipework***

All low pressure hot water and hot water services shall be insulated to minimise heat transfer with the surroundings.

All cold water services, pipework inside the building shall be insulated to prevent condensation formation.

Where necessary all services shall be insulated after trace heating has been applied.

Where valves, strainers and the like are installed in the pipework system including control valves, regulating valves and isolating valves, these shall also be insulated and vapour sealed to the same integrity as the pipework system, except for diameters of 25mm or less on heating and HWS systems which may be left uninsulated.

The insulation shall be tapered and stopped off at all flanges, unions, valves and the like, which shall then be fitted with shaped and formed boxes as required by the schedule. The boxes shall be fitted with quick release toggle clips for easy removal and shall be lined with the same material and to the same thickness as the adjacent pipework. The insulation shall terminate short of the fitting to allow for bolt withdrawal and the boxes shall extend over the pipework insulation and finish. Samples of boxes shall be submitted for comment prior to manufacture.

Thermal insulation on pipework shall be of mineral wool sections securely fixed to the pipework. Thermal insulation applied to pipework shall be fixed in close contact with the pipe. Pipes shall not be insulated together.

#### ***M1.60.07 Insulation of Ductwork***

Thermal insulation shall be applied to the ductwork carrying heated or conditioned air and to ductwork carrying untreated air within the building. The extract systems shall not be insulated except external to the building and in plant rooms.

Rectangular ductwork shall be insulated with rigid mineral slabs with a minimum density of 80kg/m<sup>3</sup> securely bonded to the duct with a suitable adhesive. Conductivity shall not be greater than 0.04W/mK at a temperature of 50°C.

Circular ductwork shall be insulated with Lamella fibreglass/mineral wool mattress with a minimum density of 32kg/m<sup>3</sup> securely bonded to the duct with a suitable adhesive. Conductivity shall not be greater than 0.05W/mK at a temperature of 50°C.

For ductwork carrying chilled or outside air, the insulation shall cover the flanges either by means of flange boxes or by increasing the general thickness of insulation to give at least 6mm cover at the flanges. Where the insulation is 50mm thick or more (except for insulation which is sprayed or moulded in situ), the insulation shall be fixed in two layers with the joints staggered. For air heaters using media at high temperatures, the thermal insulation material shall be suitable for use at those temperatures.

On rectangular ductwork, the underside insulation must be additionally supported at 300mm centres to prevent sagging. All corners must be reinforced by light gauge angle or similar.

Insulation shall be cut around test holes, access doors, damper quadrants, etc. and where vapour sealed, the cut edges sealed and exposed metal treated with an anti-condensation paint. Access panels shall be provided with separate insulating pads fixed with velcro fasteners.

#### ***M1.60.08 Insulation Thicknesses***

##### ***01 General***

The minimum thickness of rigid sectional insulation to be applied shall be determined as listed in the succeeding parts of this Clause. Packaged and other equipment supplied as pre-insulated units shall, as a minimum, be provided with the thicknesses of insulation listed in the appropriate Table of BS 5422.

##### ***02 Cold Water Service Pipework***

Cold Water services pipework shall have the following minimum thicknesses:

Nom Dia	Thickness
Up to 15mm	50mm
20 to 50mm	50mm
65 to 200mm	40mm
Larger sizes & Flat Surfaces	50mm

### **03 Heating, Steam and Condensate Pipework**

Heating, steam and condensate pipework shall be insulated to the following minimum thicknesses:

Nom Dia	Thickness
Up to 25mm	40mm
30 to 150mm	50mm
Larger Sizes & Flat Surfaces	65mm

### **04 Domestic Hot Water Services Pipework**

Domestic hot water services pipework shall be insulated to the following minimum thicknesses:

Nom Dia	Thickness
Up to 22mm	40mm
25 to 65mm	50mm
Larger Sizes & Flat Surfaces	65mm

### **05 Ductwork**

Insulation shall be applied to a minimum thickness of 65mm to all external ductwork. Ductwork in plant rooms, rising ducts and unheated or unconditioned areas shall be insulated to a minimum thickness of 50mm. Ductwork in suspended ceiling areas over-heated or conditioned areas shall be insulated to a minimum thickness of 40mm.

#### **M1.60.09 Vapour Seals**

Vapour seals forming complete and effective vapour barriers shall be applied to all pipework carrying chilled water or cold water services. They shall also be applied to all ductwork carrying chilled air or air at external temperatures. All cold water storage tanks and any vessel, pipe, duct, or other surface liable to condensation shall be similarly provided with a vapour seal.

Vapour barriers incorporating glass cloth shall be wet applied of the cut back bitumen type, bitumen emulsion with or without elastomer latex, and solvent based polymers. They shall conform to the recommendations as set out in Table 1 of BS 5422.

Glass cloth shall be of the open weave type numbers 10 to 20 and shall have a minimum weight of 70 gm/m.

Class 'O' finish, integral with sectional, slab or mattress insulation shall comprise a bright glass reinforced aluminium foil, with easy clean surface.

All lap joints shall be sealed with a suitable adhesive and all butt joints sealed with 100mm wide matching tape. Bends shall be mitred and sealed with adhesive and matching tape. Exposed ends of insulation shall be sealed to preserve the integrity of the vapour barrier. Bends and elbows shall be coated with two coats of vapour seal.

Vapour barriers shall also be provided between sections of insulation at intervals of not greater than 4m to prevent moisture migrating along the insulation in the event of perforation of the vapour barrier.

Pipe and duct support blocks shall extend a minimum of 25mm either side of the pipe bracket and insulation shall butt neatly against the bracket. The joint shall be neatly taped to provide a vapour seal.

For ductwork carrying chilled or outside air, the outer surface of the thermal insulation shall be protected by a continuous water vapour barrier having a permeance not exceeding 57.2 kg/Ns. The vapour barrier and the insulation shall not be pierced or damaged by supports. Load distributing sleeves shall be provided where necessary. At discontinuities and the ends of sections, the vapour barrier shall be returned to the ductwork to prevent moisture from entering the insulation at the edges.

#### ***M1.60.10 Finishes***

##### ***M1.60.10.01 Hammerclad Aluminium - Applied in Plantrooms.***

The fibreglass or mineral wool sections shall be securely attached. The insulation shall then be clad with Hammerclad aluminium sheets having a minimum thickness of 0.8mm secured by rivets, PK screwed or bands.

On vapour sealed pipework PK screws shall not be used. On straight pipework the finish shall be secured by bands at 300mm centres. The finish on bends, elbows and the like shall be secured by self sealing pop rivets protected internally to prevent damage to the vapour seal.

Valves, flanges, etc. on vapour sealed systems shall be packed around with Densofil before being fitted with boxes.

##### ***M1.60.10.02 Class 'O' Finish***

Mineral wool insulation sections shall be provided with a Class 'O' facing.

All lap joints shall be sealed with a suitable adhesive and butt joints sealed with 100mm wide matching tape. Bends, fittings, flanges and pipework clips shall be neatly cut on site and finished to match adjacent pipework. The insulation shall be additionally supported by three aluminium bands per section.

On ductwork and equipment the finish shall then be securely retained by wrapping with 40mm mesh galvanised wire netting, carefully applied so as not to puncture the Class 'O' facing during installation.

##### ***M1.60.10.03 Waterproof***

Mineral wool fibre insulation shall be applied as rigid sections and shall be securely attached as previously described. Insulation of tops of rectangular ducts shall be arranged to maintain a minimum of 10° pitch.

The insulation shall then be covered with two layers of polyisobutylene sheet not less than 0.8mm thick and a minimum tensile strength of 3e.4 MN/m. All laps shall be secured with the manufacturer's recommended solvent adhesive. Any opening in the sheet shall be sealed around with the recommended sealant. Laps shall be of adequate size and arranged to assist water shedding. The second layer shall be bonded to the inner layer.

For ductwork over 300mm wide measured across the insulation the outer layer shall be complete with reinforcement mesh.

Valves and flanges shall be insulated by using oversized sections and finally wrapping with polyisobutylene sheet. Removable Hammerclad aluminium valve boxes shall then be fitted.

Where the weatherproof insulation is exposed to damage a 1.0mm thickness galvanised metal cover shall be fitted and secured with pop rivets, such pop riveting carried out so as not to cause any damage to the weatherproof membrane.



Where any of the other finishes, as described earlier, is to be applied over the waterproof covering, particular care shall be taken to ensure that the fixings do not penetrate the waterproofing.

**M1.60.10.04      *Heating and HWS Pipework.***

Heating and HWS pipework shall be individually insulated with plain pre-formed glass fibre sections, free from shot and coarse fibres.

The sections shall be applied in 915mm lengths, cut longitudinally into two halves securely taped on with 25mm wide self-adhesive PVC tape and then enclosed with 24 gauge aluminium sheeting, secured with aluminium or cadmium plated self-tapping screws.

Where bends and sets occur in the pipework, pre-formed or lobster back bends shall be used, filled with mineral wool to the necessary thickness to match the adjoining section of insulation.

**M1.60.10.05      *Cold Water Main and CWDS Pipework***

Cold Water Main and Cold Water Down Service pipework shall be individually insulated in an identical manner to that described in clause .01 above for Heating and HWS Pipework..

**M1.60.10.06      *Thermal Insulation of Pipework in Calorifier Rooms***

Heating, hot water, cold feed, cold water main, cold water down service and open vent pipework shall be individually insulated with preformed glass fibre sections, free from shot and coarse fibre

Insulation shall be finished with 'Bright' Class O reinforced foil covering or equal.

**M1.60.10.07      *Thermal Insulation of Plant and Equipment***

Internal water storage tanks shall be insulated with 50mm non fibrous fire resistant aluminium foil faced slabs, secured with an approved adhesive and galvanised lacing wire. The tanks shall be insulated on all sides and top.

**M1.60.10.08      *Thermal Insulation of Pipework in Roof Space and Service Voids***

Heating, hot water, cold feed, cold water main, cold water down service and open vent pipework shall be individually insulated with preformed glass fibre sections, free from shot and coarse fibre.

**M1.61      Thermal Insulation Protection**

Any pipework or ductwork which is insulated, but which is likely to be accidentally damaged during maintenance, or in gaining access to an area or void, or at low level in plant rooms etc., shall be additionally protected with a non-corrosive casing of sufficient thickness height and width to withstand the damage. Any damage within the contract period which may occur as a result of non-compliance with the requirement shall be made good at no cost to the Employer.

**M1.62      Painting of Thermal Insulation and Equipment in Plant Rooms**

All exposed steelwork, flange joints, cast iron or steel valves, fittings, brackets etc. shall be thoroughly wire brushed and painted one coat of Red oxide/linseed oil based metal primer to BS 2524, followed by one coat of heat resistant black gloss paint to B.S.4800.

All exposed uninsulated pipework shall be thoroughly wire brushed and painted three coats of heat resistant paint as follows:-

First Coat - lead based primer to B.S.2521/2523

Second Coat - flat undercoat to the basic identification colour, as specified under Thermal Insulation Identification clause.

Third Coat - gloss coat to the basic identification colour, with colour code indication bands as specified under Thermal Insulation Identification clause.

## **M1.63 Thermal Insulation Identification**

### ***False Ceilings and Risers***

All insulation shall be identified by colour code/safety indication and basic colour identification bands, as B.S.1710.

The safety colour and colour code indication bands shall be 100mm wide, between two basic colour identification bands each of a length of 150mm. The Identification shall be at centres of not more than 3 metres, and adjacent to all valves, items of plant, changes in direction and points where the pipework passes through walls, floors etc.

Pipe sizes, flow and return (F of R) designation and directions of flow arrows in black, shall be applied on the basic colour identification band as detailed in Appendix 'E' of B.S.1710.

Colours for colour code/safety indication and basic colour identification shall be as detailed in the Appendix 'D' of BS 1710, the main services being shown in the following table.

	Basic Colour 150mm	Colour Code Identification 100mm	Basic Colour 150mm
Service	Name BS Code Ref	Name BS Code Ref	Name BS Code Ref
Drinking Water	Green 12 D 45	Blue 18 B 53	Green 12 D 45
Boiler Feed	Green 12 D 45	Crimson/White/Crimson 04 D 45/White/04 D 45	Green 12 D 45
Heating L.T.H.W.	Green 12 D 45	Blue/Crimson/Blue 18 B 53/04 D 45/18 B 53	Green 12 D 45
Hot Water Supply	Green 12 D 45	White/Crimson/White White/04 D 45/White	Green 12 D 45
Natural Gas		Yellow Ochre 08 C 35	
Drainage		Black	
Electrical Conduits		Orange 06 E 51	
Chilled Water	Green 12 D 45	White/Emerald Green/White 00 E 55 14 E 53 00 E 55	Green 12 D 45

All ductwork shall be identified to show direction of Airflow and whether it is supply or extract air.

**M1.64      Cleaning**

Due allowance shall be made for the full and proper protection of all items of plant and equipment during the insulation installation period.

The necessary completion certificate will not be issued until the work has been properly carried out and the cleaning down on completion has been approved.

**M1.65      Ductwork**

***Installation of Ductwork Generally***

The installation of ductwork shall follow the detail set out in the accompanying drawings, and be in accordance with the regulations published by the Heating and Ventilating Contractors Association.

The drawings are generally diagrammatic and all ductwork before fixing shall have the manufacturers detailed drawings approved.

All ductwork shall be adequately supported on hangers and/or brackets in order to permit free movement of the ducts due to expansion or contraction.

Ducts shall be positioned and spaced in relation to one another and to the building structure so as to allow for the required thickness of insulation as specified elsewhere.

***Sheet Steel Ductwork***

Ductwork shall be cold reduced, continuously hot dipped galvanised commercially flat steel complying with BS 2989 Group 2 Class 2A, and shall comply with HVCA Specification DW/144.

Connections to equipment shall be made with angle flanged joints. Ductwork which may have to be moved to enable plant to be removed shall incorporate angle flanged joints. In any case in plant room areas and for long runs angle flanged joints shall be included at intervals to facilitate any subsequent alterations.

Bends and off-sets shall have a minimum throat radius equal to the width of the duct. Where short radiused elbows are indicated or are agreed by the Supervising Officer as necessary due to site limitations, the dimensions and internal vane(s) shall be in accordance with HVCA Specification DW/144.

***Circular Ductwork***

Circular ductwork shall be spiral wound.

**M1.66      Turning and Guide Vanes**

Where radiused ductwork bends in accordance with the HVCA Specifications cannot be accommodated owing to space restrictions, the Specialist Contractor shall provide turning vanes of the double skin roll formed type, as manufactured by Henry Hargreaves & Son Ltd. "Airoturn" type, or equal and approved.

**M1.67      Dampers**

Balancing dampers shall be provided where shown on the drawings and where necessary, to regulate and balance the system. Dampers on grilles or diffusers shall be used for fine or secondary control. All dampers shall be sufficiently rigid to prevent fluttering. Unless otherwise indicated the air leakage past dampers in the fully closed position shall not exceed 5% of the maximum design airflow in the duct. All duct dampers except fire dampers and self-closing dampers shall be fitted with locking devices and position indicators. Dampers shall be generally in accordance with the appropriate HVCA Specification(s).

Rectangular dampers shall be multileaf type as manufactured by Actionair Ltd.

**M1.68      Fire Dampers**

Where indicated on the drawings and generally on every ventilation duct passing through fire barriers, fire dampers are to be installed. Each fire damper assembly shall be held in the open position by a fusible link (generally set to release at a temperature of 70 °C) and all blades must be weighted to ensure immediate closure on release of the link. The fire dampers shall be as Messrs Actionair Equipment Ltd., South Street, Whitstable Kent CT5 3DU or equal and approved. All fire damper blades shall be located out the air streams.

Where fire dampers cannot be accommodated within the wall or floor thickness a 5mm thick flanged sleeve shall be fitted through the wall to securely fix the fire damper. Details of all such fittings must be submitted for approval prior to installation.

The fire damper shall be in accordance with the 1976 Building Regulations No. 1676, and in particular Part E9, paragraph 9 (a) (i), and to the requirements of the Building Inspector.

**M1.69      Flexible Joints**

Flexible joints shall be provided on fan inlet and outlet connections and elsewhere on the ductwork where indicated. They shall be of the full cross sectional area of the mating fan inlet or outlet or duct section. The ends of the ducts or the duct and fan connection shall be in line.

Flexible joints shall consist of, or be protected by, material having a fire penetration time of at least 15 minutes when tested in accordance with BS 476:Part 1 Section 2. The material shall be of the glass fibre cloth type; canvas will not be accepted. The width of the joints from metal edge to metal edge shall not be less than 80mm and not more than 250mm.

All flexible joints other than fan inlet connections shall be between flanged ends. The flexible material flange and the flexible joint shall be securely held between the metal flanges. Flat iron bands used with fan inlets shall not be less than 5mm thick.

**M1.70      Flexible Connections**

Where flexible connections are indicated or required between rigid ductwork and particular components of items of equipment the internal diameter of the flexible duct shall be equal to the external diameter of the rigid ductwork and of the spigot served. The use of flexible duct between rigid sections of sheet metal ductwork to change direction or plane will not be permitted except where indicated or expressly authorised by the Engineer.

**M1.71      Vibration Isolators**

All plant items, i.e. fans, pumps, A/H/Us, chillers, etc. shall be mounted on or suspended from supports that are complete with resilient mounting that will prevent the transfer of vibration from the plant item to the building fabric.

**M1.72      Access Opening**

***Ductwork***

Access openings are to be provided adjacent to all equipment that requires either maintenance, frequent replacing, cleaning or inspection (eg. fire dampers, fusible links etc.)

These openings shall be rigidly framed and fitted airtight covers so designed as to be simply and speedily removed and refixed as manufactured by Actionair Ltd.

Access panels shall be carefully positioned such that access to fusible links can be readily achieved and other services (i.e. mechanical or electrical) must not interfere with such access.

***Soil and Waste***

In addition to those indicated on the drawings, access shall be provided to facilitate testing and future rodding of the installation in accordance with BS 5572:1978 and at junctions and changes of direction. These shall be located in fully accessible positions.

**M1.73      Grilles**

All grilles or air diffusers, of the sizes and types as indicated on the drawings, shall be as manufactured by Waterloo-Ozonair or other equal and approved manufacturer.

As part of the commissioning requirements test and balance the air flow from each grille or diffuser in accordance with the air quantities indicated on the drawings.

**M1.74      Sanitary Appliances**

Sanitary appliances shall be fixed in accordance with BS8000 part 13. They shall be of the types detailed in the Sanitaryware Schedule or on the drawings.

**M1.75      Installation of Sanitaryware Generally**

All sanitaryware appliances shall be fixed in accordance with BS 8000 Part 13 and the following:-

Assemble and fix appliances and accessories so that surfaces designed to fall, drain as intended.

Use non-ferrous or stainless steel fastenings unless specified otherwise.

When not specified otherwise, use jointing and bedding compounds recommended by the manufacturers of the appliances, accessories and pipes being jointed or bedded.

Prevent use of appliances for any purpose until Practical Completion.

On completion, check for damage and defects and test for satisfactory operation. Replace damaged or defective components and accessories. Clean thoroughly.

### ***Noggings/Bearers***

Ensure that noggings, bearers, etc. required to support sanitary appliances and fittings are accurately positioned and securely fixed.

### ***Tiled Backgrounds (other than splashbacks)***

Ensure that:-

- i) Tiling is complete before fixing appliances
- ii) Fixings do not overstress tiles

### ***WC Pans***

Ensure that seat and lid are stable when raised.

### ***Cisterns***

Unless specified otherwise obtain cistern operating components from cistern manufacturer. Ensure that ball valve matches pressure of water supply.

Fix at the height recommended by manufacturer unless otherwise specified or shown on drawings.

Ensure that overflow pipe is fixed to falls, and located to give visible warning of discharge. Agree position with CA where not shown on drawings.

Ensure that overflow pipe is fixed to falls, and located to give visible warning of discharge. Agree position with CA where not shown on

### ***Taps***

Fix securely, making a watertight seal with the appliance. Place hot tap to left of cold tap as viewed by user of appliance.

### ***Wastes/Overflows***

Bed in waterproof jointing compound and fix with resilient washer between appliance and backnut.

### ***Sealant Pointing***

Sealant: silicone based to BS 5889, Type B with fungicide.

Manufacturer and reference: Dow Corning

Colour: White

### ***Suitability of Joints***

Before commencing, check that:-

- i) Joint dimensions are within limits specified for the sealant.
- ii) Surfaces are smooth and undamaged.
- iii) Preparatory work which must be done before assembly of the joint has been carried out.

Inform CA if joints are not suitable to receive sealant and submit proposals for rectification.

### ***Preparing Joints***

Clean surfaces to which sealant must adhere using methods and materials recommended by sealant manufacturer.

Remove all temporary coatings, tapes, loosely adhering material, dust, oil, grease and other contaminants which may affect bond.

Keep joints clean and protect from damage until sealant is applied.

Backing strip, bond breaker, primer, types recommended for the purpose by sealant manufacturer.

Insert backing strips and/or bond breaker tape into joint leaving no gaps.

Cover adjacent surfaces with masking tape to prevent staining and protect surfaces which would be difficult to clean if smeared with primer or sealant.

### ***Applying Sealants***

Ensure that operatives observe manufacturer's and statutory requirements for storage and safe usage of sealants.

Use equipment and methods recommended by sealant manufacturer and apply within the recommended application life of primer and sealant, and the recommended air and substrate temperature ranges.

Do not apply to damp surfaces (unless recommended otherwise), to surfaces affected by ice or snow or during inclement weather. Do not heat joints to dry them or raise the temperature.

Fill joints completely, leaving no gaps, excluding all air and ensuring firm adhesion of sealant to required joint surfaces. Tool the sealant to a neat, slightly concave profile unless specified otherwise.

Protect until cured.

## **M1.76 Final Flushing**

The whole heating, chilled, hot and cold water services shall be drained down completely and all low points cleared of any swarf, sludge or scale which may have collected there. The installations shall then be thoroughly flushed through finally to ensure that all pipes are clear.

All strainers are to be removed prior to flushing and replaced afterwards.

The installation shall then be filled, vented and commissioned and left to operate under normal working conditions.

## **M1.77 Sterilisation**

All new cold water mains, drinking water services, hot and cold down service pipelines are to be sterilised in accordance with the British Standard Code of Practice BS EN 806, Health and executive document EH48, Chartered Institute of Building Services Document TM13 and all amendments.

After flushing through the whole of the water installations to remove debris the systems shall be treated with chlorine by a specialist company. After treatment a sample of water from the system shall be analysed by the Public Analyst and only when he has approved its use can the system be brought into service for the occupants.

**M1.78      Electrical Installations**

For installation standards of electrical engineering work for the Mechanical Engineering systems refer to the Electrical Specification.

**M1.79      Drainage (Below Ground)**

All workmanship shall comply with BS8301:1985 and the Building Regulations where appropriate and applicable.

**M1.79.01**    Drainage pipes and fittings are to comply with the requirements of the appropriate BS listed below:-

Vitrified clayware pipes and fittings	B.S. 65 & 540
Vitrified clayware traps and gullies	B.S. 539
Cast iron pipes, fittings and chambers	B.S. 437 & 11
Concrete pipes, fittings and chambers	B.S. 556
Cast iron manhole covers and gullies	B.S. 497
Step irons	B.S. 1247

**M1.79.02    Cement**

Portland cement is to comply with B.S.12.

**M1.79.03    Bricks**

Bricks for drainage works are to be Engineering bricks complying with B.S. 3921 Class B, and obtained from an approved manufacturer.

**M1.79.04    Reinforcement**

Steel reinforcement is to be as described in Concreting Section.

**M1.79.05    Excavations**

Excavations for drainage trenches are to be in straight lines and to be correct depths and gradients for the pipes and beds as specified and shown on the drawings and of sufficient width to allow adequate working space for the drainlayer and joiner. Proper planking and strutting is to be provided and all trenches are to be kept free of water during the progress of the work. Excavations carried out deeper than necessary are to be filled to the correct depth with concrete (1:10). All pipes and cables exposed by the excavations are to be supported.

Backfilling is to be done in layers of 300 mm, the first layer over pipes to be of selected material to avoid damage to be pipes, and the whole well rammed with mechanical rammers or other effective means of consolidation. Surplus earth is to be carted away from the site or deposited and spread as specified.

**M1.79.06    Laying of Pipes**

All pipes and fittings are to be examined for defects and any cracked or unsound pieces discarded. Pipes are to be laid to regular and even gradients and in straight lines as shown on the drawings. The interior of all drains is to be kept free from earth and jointing material. Socketed pipes are to be laid with the sockets facing up the gradient and are to rest on a solid bed for the full length of the barrel, a hole being cut out for the underside of the socket.



Where specified, pipes are to be laid on a bed of concrete (1:8) 150 mm thick and haunched at the sides or on a granular bed and surrounded 150 mm thick.

**M1.79.07    Joints**

Proprietary joints incorporating a rubber O ring or flexible plastic sleeve connectors for socketed and plain pipes are to be used. Proprietary joints shall be obtained from the supplier of the pipe to be used.

Cast iron pipes are to be jointed by caulking hemp yarn or lead strip followed by the insertion in the socket of lead wool tightly caulked home. Mechanical joints, where specified, are to consist of either a rubber ring secured by a steel pressure ring held in position by bolts or a lead tipped rubber ring compressed and held in position by an internal gland screwed into the socket.

**M1.79.08    Testing**

The whole of the drainage work is to be tested when laid and at the completion of the contract by means of water or air test in accordance with BS 8301:1985.

**M1.79.09    Construction of Chambers**

Manholes and inspection chambers are to be constructed in the positions shown on the drawings. The sizes shall be as shown on the drawings or as listed in the Manhole Schedule. The foundation to consist of a bed on concrete (1:2:4) not less than 150 mm thick the full dimensions of the excavation. The sides are to be built up in engineering bricks in cement mortar (1:3) in English Bond with 150 mm deep reinforced concrete lintel over pipes and rendered in cement mortar (1:3) 12 mm thick externally as the work proceeds. Step irons are to be built in at every fourth course for all chambers of greater depth than 1 m. The brickwork is to be corbelled over to receive the cover and frame or topped with concrete (1:2:4) 150 mm thick reinforced with steel, all as specified and shown on the drawings.

Alternatively, the chambers are to be formed of precast concrete rings, surrounded with concrete (1:8) 150 mm thick.

Cast iron or steel covers and frames as specified are to be bedded in cement mortar (1:3) with a fillet formed across the frame on brick courses to suit the finished levels shown on the drawings.

**M1.79.10    Chamber inverts**

Inverts are to be properly formed with glazed channels and junctions and benched up to the full height of the pipe with concrete (1:8) finished in cement mortar (1:3) minimum thickness 25 mm.

**M1.79.11    Backdrops**

Where indicated on the drawings, backdrops are to be provided with pipes of the same material and size as the main drain, with rodding access at the head of the backdrop, the whole surrounded in concrete 4(1:8) 150 mm thick.

**M1.79.12    Gullies**

All gullies are to be set on and surrounded with concrete (1:8) minimum 150 mm thick.

**M1.80 Concreting**

**M1.80.01 Cement**

Portland cement is to comply with BS 12 delivered in the manufacturer's sealed bags and stored under cover to avoid deterioration.

**M1.80.02 Fine Aggregate**

Fine aggregate is to comply with BS 882 and consist of well graded coarse sand, mainly passing a 4.75mm test sieve.

**M1.80.03 Coarse Aggregate**

Coarse aggregate is to comply with BS 882 and consist of natural gravel, crushed gravel or crushed stone, well graded from the nominal maximum sizes referred to hereafter.

**M1.80.04 All-in Aggregate**

All-in aggregate is to comply with BS 882 and consist of aggregate containing a proportion of material of all sizes as obtained from the pit, well graded from the nominal maximum sizes referred to hereafter to 4.75mm.

**M1.80.05 Water**

Water for concrete is to be clean and fresh and obtained from the Water Authority's main.

**M1.80.06 Proportions of Concrete Mix**

The nominal mixes of concrete in the table below, are to have the quantities of aggregate stated per 50kg of cement and possess the resistances to crushing not less than those stated in the table.

Ref:	Nominal Mix	Fine Agg m <sup>3</sup>	Coarse Agg Agg m <sup>3</sup> Agg	All-in m <sup>3</sup>	Crushing Strength N/mm <sup>2</sup>	
					7 day	28 day
A.	1 : 1 : 2	.035	.07		20	30
B.	1 : 1½ : 3	.05	.10		17	25.5
C.	1 : 2 : 4	.07	.14		14	21
D.	1 : 8			.28		

**M1.80.07 Mixing Concrete**

Materials for concrete are to be measured in approved gauge boxes or by weight. The amount of mixing water is to be sufficient to give a good workable mix but in no case is the slump to exceed 50mm, as measured in accordance with Appendix M of BS 882.

The mixing is to be carried out in an approved mechanical batch mixer. All concrete is to be transported and placed as soon as possible after mixing and in all cases within 30 minutes of mixing.

No mixing or placing of concrete is to be done during frosty weather, i.e. when the temperature is below 2.2C (36F). Where ready-mix concrete is approved for use on the works, it is to comply with BS 1926.

**M1.80.08    *Hard-Core***

Hard-core is to be broken brick, concrete, stone or other similar hard material free from debris and rubbish, of nominal size 100mm.

**M1.80.09    *Reinforcement***

Steel reinforcing bars are to comply with BS 4449 and fabric reinforcement with BS 4483. All steel is to be free from oil, dirt, rust scale. etc. prior to placing in concrete and is to be properly positioned and secured with annealed iron wire as indicated on the drawings or specified hereafter.

**M1.80.10    *Placing of Concrete***

Immediately after mixing, the concrete is to be run to the work and placed in position and tamped so as to exclude any voids. Care must be taken to ensure that any reinforcement used is not displaced from its correct position during concreting.

**M1.80.11    *Protection of Concrete***

All concrete is to be suitably protected against the weather until it has hardened. During frosty weather it is to be covered with Hessian cloth, straw or other insulating material and during the summer months with Hessian cloth on frames kept damp with water.

**M1.80.12    *Formwork***

All formwork must be sufficiently strong to resist the dead weight of concrete, barrows and workmen, during concreting without undue deflection. Struts and forms are not to be removed until the concrete is strong enough to carry the dead loads and such striking may require to be done in stages.

All formwork is to be properly cleaned before re-use. Suitable lining material is to be used where the exposed faces of concrete are required to have a smooth finish.

**M1.80.13    *Construction Joints***

All construction joints are to be properly rebated and grouted with neat cement prior to placing new concrete, all to the approval of the Architect.

**M1.80.14    *Fixings***

Bolts, plugs, inserts and similar fixings and anchorages to be used in the works are to have the prior approval of the Architect.

**M1.81        *Brickwork***

**M1.81.01** Bricks are to be hard, sound, square and clean and comply with BS 3921 Part 2 for clay bricks, BS 187 Part 2 for calcium silicate bricks, BS 1180 for concrete bricks and BS 2028/1364 for precast concrete blocks.

The resistance to crushing in N/mm<sup>2</sup> of gross horizontal area of bricks or blocks for the purposes indicated is not to be less than that given in the following table:-

Purpose	Resistance to Crushing in N/mm <sup>2</sup>
External/internal load bearing	7.00 (1000 lb/sq in)
External, non-load bearing	2.75
Internal, non-load bearing	1.50
Class B Engineering bricks	48.50

**M1.81.02 Common Bricks**

Common bricks are to be flettons from an approved manufacturer and grooved where required for plastering. They are not to be used below the ground level damp proof course.

**M1.81.03 Engineering Bricks**

Engineering bricks are to comply with BS 3921 Class B and obtained from an approved manufacturer.

**M1.81.04 Facing Bricks**

Clay facing bricks are to match or blend with existing work where this applies.

**M1.81.05 Wall Ties**

Metal wall ties for use in cavity walls are to be of the vertical twist type coated with zinc and complying with BS 1243.

**M1.81.06 Cement**

Portland cement is to be as specified in Concreting section.

**M1.81.07 Lime**

Lime is to be quicklime or dry hydrated lime complying with BS 890 Building Limes.

**M1.81.08 Sand**

Sand for mortar is to be natural sand, crushed stone or gravel, thoroughly clean, complying with BS 1200, graded to pass a 4.75mm mesh.

**M1.81.09 Mortar**

Cement mortar is to be composed of ordinary Portland cement mixed with sand in proportions of one volume of cement to three volumes of sand.

Cement-lime mortar is to be composed of one volume of Portland cement to one volume of lime to six volumes of sand.

**M1.81.10    *Mixing***

The ingredients for cement, cement-lime and lime mortar are to be measured in proper gauge boxes on a boarded platform, the ingredients being turned over twice dry and twice whilst water is added. Alternatively, mixing may be by means of an approved mechanical batch mixer. In the case of cement-lime mortar, the sand and lime are to be mixed first and the cement added. Mortars containing cement should be used within two hours of the addition of the cement.

**M1.81.11    *Plasticisers***

Mortar plasticisers are to be an approved make and used in the proportions and manner recommended by the manufacturer.

**M1.81.12    *Damp-proof Courses***

Materials for use in damp-proof courses are to consist of any of the following materials:-

Two courses of sound whole slates not less than 225mm in length complying with the requirements of the absorption test in BS 680, laid breaking joint and bedded in cement mortar.

Bitumen damp-proof courses to BS 743 'Materials for Damp Proof Courses'. Low density polythene sheet conforming to BS 743.

**M1.81.13    *Brickwork and Blockwork Generally***

All brickwork and blockwork is to be laid to level courses and to plumb plane faces and true angles. Care is to be taken to avoid mortar and other stains on the face of work and chipped or damaged bricks are to be built in so that the damaged parts are not visible. All vertical, cross and bed joints, the full thickness of the wall are to be filled solid with mortar, the work taken up uniformly in not greater than 1m steps, and all perpend, quoins and angles are to be kept true and square.

Brickwork generally is to be built in English bond with bats used only where required for bond. New brickwork is to be properly block bonded to existing work. Facing brickwork is to be properly coursed, and is to match existing work where this applies, with joints raked out and pointed in cement mortar (1:1) with neat flush joints as the work proceeds. In cavity wall construction, wall ties are to be built in at horizontal intervals not exceeding 900mm and in courses at vertical intervals not exceeding 450mm, and all cavities kept free of mortar droppings and brick debris.

All brickwork is to be covered up and protected against adverse weather conditions. No brick or blockwork is to be carried out when the air temperature is below 2.2C (36 F), and all work done is to be properly protected against frost. Any damage caused by frost is to be made good by rebuilding as necessary, at the Contractor's expense.

Openings are to be properly formed to the dimensions shown on the drawings and to suit brick sizes. Allow for executing all cutting, oversailings, beam filling and sundry labours, cutting out for and fixing timbers, frames, lintels, cills etc, including galvanised steel cramps, all in accordance with good trade practice. External frames to be pointed in mastic.