SPECIFICATION

for

MECHANICAL SERVICES

associated with the

REFURBISHMENT OF

2 HAREWOOD PLACE

LONDON

W1S 1BX

Client:

Amsprop Oxford Ltd
10th Floor, Brentwood House
169 Kings Road
Brentwood
Essex
CM14 4EF

Consulting Engineers:

Status Design Associates LLP
Chartered Building Services Engineers
1 Holgate Court
Western Road
Romford
RM1 3JS

Tel: 01708 745666
Fax: 01708 730584

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PART 1 GENERAL CONDITIONS

1.1 CONDITIONS OF CONTRACT

This specification relates to the Mechanical Services works in connection with the refurbishment of **2 Harewood Place, London, W1S 1BX.**

This specification is to be read in conjunction with the Main Contract Preliminaries and specification of Building Work (Bill of Quantities) of which this document forms part. In the context of this contract, the Mechanical Contractor shall be deemed to mean the Contractor (Main Contractor) or his authorised Domestic Sub-Contractor.

The works shall be carried out with the Contractor appointed as a domestic sub-contractor in accordance with the JCT Contract, specified in the Prelims.

All relevant modifications to the contract, including Employers specific requirements, shall be as detailed in the Preliminaries. The said conditions shall apply to the mechanical works, in conjunction with the requirements of this document.

Any ambiguity between the requirements of this document and the Conditions of Contract shall be referred to the Contract Administrator for verification.

The Contractor shall allow for all works as detailed in this specification and as generally shown on the contract drawings.

The Contractor shall complete and return the Form and Make-up of Tender document.

1.2 DEFINITIONS

With this document, the following expressions shall be deemed to be deleted and replaced with that indicated:-

“Engineer” shall be replaced by “Contract Administrator”.

“Architect” shall be replaced by “Contract Administrator”.

“Main Contractor” shall be replaced by “Contractor”.

“Mechanical Contractor” shall be replaced by “Contractor”.

The Contract Administrator shall mean:-

CNP Building & Project Design Consultancy
11 Albamarle Street
London
W11 4HH

Or Authorised Representative.

1.3. SCOPE OF WORKS

The works as detailed in this Specification shall be deemed to include the following:-

(a) Provision, erection, maintenance and removal of tackle, plant or scaffolding, etc., as and when required for the execution of the works.

(b) Delivery, off loading, storage, setting into position, fixing, testing and commissioning, etc. all materials, plant and accessories, etc. as specified and scheduled necessary for the completion of the works, notwithstanding that such materials may or may not be specified in detail.

1.4. INSURANCE AGAINST INJURY TO PERSONS AND PROPERTY

In connection with provisions made in the "Conditions of Contract", the Mechanical Contractor shall maintain and shall cause his Sub-Contractors to maintain:-

(a) Such insurances as are necessary to cover the liability of the Mechanical Contractor and any such Sub-Contractor in respect of personal injury to or the death of any person whosoever, arising out of the Works.

(b) Such insurances as are necessary to cover the liability of the Mechanical Contractor and any such Sub-Contractor, in respect of damage to property, real or personal, arising out of the course of the Works or caused by negligence, omission or default.

The limit for indemnity shall be as detailed in the conditions of Contract, in respect of any one claim, or series of claims, arising out of any one event.

Insurances are to cover the period of the Contract up to the end of the Defects Liability period for all sections.

1.5. REGISTERED OFFICE

The Mechanical Contractor and any authorised installer employed by the Mechanical Contractor or supplier connected with the carrying out of the Works under this Contract must have a properly registered office.

1.6. PROFESSIONAL REGISTRATION

The Mechanical Contractor must at the time of tendering for the works and throughout the duration of the contract, including the defects liability period, be registered with The Confederation for the Registration of Gas Installers (C.O.R.G.I.).

Individual tradesmen employed directly or as sub-contractors shall be registered and/or hold certification in respect of the works they are completing, e.g.

(i) Members of the Institute of Plumbing.
(ii) Courses on Approved Codes of Practice.
(iii) Welding certification.
(iv) City and Guilds, etc.

1.7. PROVISIONAL SUM(S)

It will be deemed that the Mechanical Contractor has included within his total Tender for the Provisional Sum(s) as detailed in the 'Form and Make Up of Tender' document.

The Provisional Sum(s) shall be at the disposal of the Engineer and no proportion thereof is to be expended without his written authority.

Any Provisional Sum not expended shall be deducted from the Contract Sum.

1.8. DRAWINGS AND SPECIFICATION

This Specification and any drawings or other documents attached thereto shall be interpreted in good faith and shall be deemed to include, whether or not specifically mentioned or shown, any materials, apparatus or work as may be necessary for the satisfactory completion of the works in accordance with accepted modern practice or procedure and it will be deemed that the Mechanical Contractor made due allowance in his Tender for such unspecified materials or work. No additional payments will therefore be allowed in this respect.

It will also be deemed that where a discrepancy exists between the Specification and drawings or where the interpretation of this is in doubt, the Mechanical Contractor obtained clarification on such doubtful matters before submitting his Tender and included accordingly. Any correspondence or documents from the Engineer to the main Contractor dated prior to the submission of the Tender and relating to any such doubtful point, shall form part of the Contract documents.

The drawings accompanying this Specification are intended to indicate mechanical requirements only, and will not be deemed to be binding upon the Engineer with respect to any building details given thereon.

The Mechanical Contractor shall be responsible for ascertaining the exact building details and dimensions prior to carrying out any work, and the Engineer will be entitled, if he so wishes, to instruct work which is not installed with regard to current building drawings to be altered at no extra cost.

Where the Mechanical Contractor failed to obtain clarification on any doubtful matter, the Engineer will be at liberty to place such interpretation thereon as he may wish without additional costs being charged to the Employer.

1.9. VARIATIONS

No alteration, modification, variation, addition or omission in the works shall be made by the Mechanical Contractor without the prior consent of the Engineer. The Mechanical Contractor will bear the cost of any additional/alternative works completed without prior consent from the Engineer, including any remedial work to put right work deemed unacceptable by the Engineer.

In cases where the Engineer orders additional work to be performed, the Mechanical Contractor is at liberty to submit in writing, notice that additional time over and above that allotted in the programme will be required. Failure to do so will result in responsibility to satisfy all claims in respect of liquidated damages.

Variations may be made to the Contract in accordance with the Conditions of Contract.

The adjustment to be made to the Contract Sum will be calculated in one of the following ways, as required by the Engineer:-

(i) By submission and acceptance of an itemised quotation covering the amendments to the Works.

(Ii) By measurement of the amendments to the Works, the materials to be priced against a schedule of basic rates in which will be included labour, profit and overheads.

1.10. SCHEDULE OF RATES

The Mechanical Contractor shall, upon the Engineers request, provide a full schedule of rates, prior to the acceptance of the Contract.

The schedule of rates must include all main materials used on the works and the rate indicated for each item shall be deemed to include the cost of labour for fixing or installing the item, together with allowance for overheads, sundry minor items not scheduled and profit. The Engineer shall be entitled to request the Mechanical Contractor to show that the scheduled rates thus arrived at are reasonable and are not excessive on those items most likely to be used in any variations to the Works. The Engineer will also be at liberty to request the Mechanical Contractor to show that the scheduled rates when applied to the abstracted quantities of materials on which the Tender was based will summate to the Tender price.

1.11. QUALITY ASSURANCE

All works under this Specification shall be carried out in a first class manner with materials of the best quality, by qualified and competent tradesmen of the type most suitable for the purpose and to the complete satisfaction of the Engineer.

The materials to be incorporated in the works shall be of the make and description specified herein. In no circumstances, shall materials of any other make or description be substituted without permission, in writing, of the Engineer who may require samples of the proposed materials and workmanship to be submitted prior to installation.

In cases where it would be impracticable for samples of any particular equipment to be submitted, the Mechanical Contractor shall submit to the Engineer for approval working drawings of all such equipment.

Any amendments that the Engineer considers are necessary due to low standards of workmanship shall be rectified at the Mechanical Contractors expense.

The Mechanical Contractor shall not under any circumstances re-use existing materials rendered redundant by this Specification, unless specifically referred to in this Specification or instructed to do so by the Engineer. All items deemed to be re-usable by the Engineer shall be removed carefully such that its condition does not deteriorate and shall remain the
property of the Employer.

1.12. PROGRAMME OF WORKS AND CO-ORDINATION WITH OTHER TRADES

Full account shall be taken of the Technical Specification (Parts 2 and 3) requirements when preparing the programme of works, to ensure it complies with the dates and sections specified in the Contract Preliminaries.

The Mechanical Contractor shall acquaint himself with the work of other trades on site and in particular the work of other Engineering Contractors to ascertain if these concurrent works in any way hinder or obstruct his own works.

The Mechanical Contractor shall be responsible for verifying the Programme of Works prior to commencement of the works, and if for whatever reasons it would appear that the programme cannot be met, the Engineer shall be informed immediately.

The Mechanical Contractor will be required to provide any information as may be necessary (including preparation of drawings) and to co-operate as necessary with the other Contractors that may be working on or connected with the works.

1.13. SITE SUPERVISION, MEETINGS AND ORGANISATION

The Mechanical Contractor shall at all reasonable times keep on site a competent person in charge, who can receive written instruction from the Engineer. Any such person appointed by the Mechanical Contractor shall also monitor the progress of the works and ensure that adequate labour, materials and plant are available to maintain his work progress in accordance with the programme and to prevent a hindrance to other trades.

The Mechanical Contractor shall be represented by senior and competent representatives at all meetings where requested to attend. The Engineer will be at liberty to request from the Mechanical Contractor a typed progress report indicating percentage completion of various elements, etc., for presentation at any such meetings.

1.14. COMPLIANCE WITH BRITISH STANDARDS

The Mechanical Contractor is to ensure that all materials used and that all work carried out comply in every respect with the relevant and latest Code of Practice or Specification issued by the British Standards Institute.

In the event of a discrepancy between this Specification and any British Standard Specification or Code of Practice current at the date of Tender, the Mechanical Contractor shall seek instructions from the Engineer.

The Mechanical Contractor will be held entirely responsible for any consequences or expenses resulting from his failure to comply therewith and will be required to correct any such failure at his own cost.

Where materials are specified to conform to a British Standard they shall bear the B.S. Kite Mark.

1.15. COMPLIANCE WITH OTHER REGULATIONS

The Mechanical Contractor shall comply with the following, including all amendments thereto current at the time of the Works.

(i) Bye-Laws and Regulations of the relevant Local Authority.

(ii) Bye-Laws, Requirements and Regulations of the appropriate Gas, Water and Electricity Supply Authority. The Mechanical Contractor shall also be responsible for notification to all Authorities in accordance with their individual requirements.

(iii) I.E.E. Wiring Regulations.

(iv) Recommendations of the Institution of Gas Engineers and Gas Safety Regulations.

(v) Regulations under the Clean Air, Environmental Protection and Electricity Acts.

(vi) H.V.C.A. Standard Ductwork Specifications.

1.16. SAFETY AND WELFARE MEASURES

The Mechanical Contractor shall ensure compliance with the provisions of the Health and Safety at Work, etc., Act 1974 and Regulations made thereunder and shall satisfy the Engineer, that these requirements are being complied with.

The Mechanical Contractor shall ensure that all materials, equipment, tools, manufacturing processes, procedure of construction, finishes, tests, commissioning used by him and his employees on this contract shall comply in all respects with the Act.

The Mechanical Contractor shall further ensure that he and his employees shall comply in all aspects with the Act with regard to themselves and to others during the course of the Contract.

The Mechanical Contractor shall make due allowance in his tender for difficult working conditions due to the presence of hazardous materials or installations, as indicated within the Tender documents, or as notified to him in writing by the Engineer prior to the submission of the Tender.

It is the responsibility of the Mechanical Contractor to ascertain prior to submission of his Tender or quotation what cost allowances and contractual risk he should include in his Tender or quotation for compliance with the Health and Safety Act. Any guidance which may be required can be obtained from the Commissioners Inspectorate, appropriate Trade Associations and Professional Institutions.

The Mechanical Contractors attention is drawn in particular to the following, including all the respective latest amendments current at the time of Works.

(i) The Construction Regulations:- General Provisions, Lifting Operations, Working Places, Health and Welfare, etc.

(ii) Electricity at Work Regulations 1989.

(iii) The Offices, Shops and Railway Premises Act.

(iv) The Code of Welfare Conditions for the Building Industry.

1.17. ASBESTOS HAZARD

Should the Mechanical Contractor during the course of Works come across existing asbestos insulation which may cause a health hazard then the following precautions are to be undertaken:-

(i) Upon discovery of an asbestos hazard the Engineer shall be informed immediately.

(ii) The Mechanical Contractor shall cease work in the area until an authorised person has confirmed the nature of the hazard by analysing samples as required.

(iii) If the analysis proves positive, then arrangements will be made in accordance with either of the following to enable the works to proceed:-

(a) A Specialist Contractor shall be employed by the Employer to safely remove and dispose of the hazard.

(b) The Engineer shall discuss alternative arrangements for the Works should (a) prove impractical.

1.18. FIRE PRECAUTIONS

The Mechanical Contractor shall impress upon all his staff the necessity of due care and attention with regards to potential fire hazards on any site. Adequate measures shall be taken, where work involves the use of naked flames, to protect all building components and furnishings, and the Mechanical Contractor shall be responsible for maintaining suitable fire extinguishers in readiness in all areas where such hazards exist.

The Mechanical Contractor shall ensure that all fire exit routes are not hindered by the Works, and shall comply with any fire regulations peculiar to the site. Care shall be exercised in the storage of any flammable goods and disposal of rubbish. The Mechanical Contractor shall enforce "No Smoking" rules within such areas as roof spaces, service ducts, basement areas or any other area where the slightest difficulty in detecting smouldering or incipient fire is hindered.

Where so desired by the Employer, the Mechanical Contractor shall be responsible for obtaining all necessary "Hot Work Permits" prior to commencement of any Works so requiring a permit.

1.19. ELECTRICAL WORK

Where stipulated in Part 3 of this Specification, that the Mechanical Contractor shall be responsible for all associated electrical works and or control wiring he shall employ a specialist who must be approved by the "National Inspection Council for Electrical Installation Contractors" (NICEIC).

1.20. APPROVED SUPPLIERS AND SPECIALISTS

It will be deemed that the approval in this Specification of any supplier or specialist, does not in any way remove or absolve the Mechanical Contractor from full responsibility for the materials, supplies or the work carried out by the approved supplier or specialist.

The Mechanical Contractor will be required to place an order with such firms, organise, supervise and take full responsibility for the payment of any monies due to the suppliers of specialists in respect of these works.

Unless the above work or materials is covered by a provisional sum as later detailed, it will be deemed that the Mechanical Contractor obtained a quotation from the approved supplier or specialist firm prior to submitting his Tender and that due allowance was made in his Tender for the full cost of the supply, delivery and installation of the equipment, together with the costs of his own overheads, etc., and no extras will be allowed in this respect.

1.21. DRAWINGS FOR APPROVAL

The Mechanical Contractor shall produce the following fully dimensioned drawings as required by the Works and submit copies in triplicate to the Engineer for approval. Thereafter the Mechanical Contractor shall provide as many copies as necessary for circulation and records.

(i) Engineering Drawings

(a) All major items of plant and equipment as detailed in this Specification including boilers, calorifiers, storage tanks, vessels, air handling plant, packaged units of any description, control panels, etc.

(b) Shop drawings of all works associated with ventilation installations and flue gas ductwork, etc. These shall be inclusive of layout and construction details for such items as access doors, dampers, access ladders, gantries and any other sheet metal work.

(c) Drawings from approved suppliers and specialists.

(d) Fabricated supports, anchors, guides and brackets, etc. in respect of the works.

(e) Electrical wiring diagrams indicating wiring between items of equipment, instrument control panels and switchgear, etc.

(f) Any site working drawings that the Mechanical Contractor intends to issue.

(ii) Builders Work Drawings

(a) All bases, plinths, piers, framing, etc., for supporting items of plant and equipment, etc.

(b) Templates in respect of marking out specific requirements in connection with machinery or specialist equipment.

(c) Holes, pockets and openings through all aspects of the building structure.

(d) External trenches/service ducts, tank and meter housings and any weatherproofing requirements for external services.

(e) Positions where inserts for supports, etc., are to be built into structures i.e. floor slabs, walls, columns, etc.

(f) Positions required for access panels/doors, in walls, floors and ceilings for maintenance and commissioning requirements.

Whether directly responsible for Builders Work or not, as subsequently defined in Part 3, the Mechanical Contractor shall produce the above mentioned drawings and shall be responsible for ensuring the works are adequately and properly performed. Where it has been deemed that the Mechanical Contractor shall be responsible for builders work he shall employ a competent Specialist.

1.22. MANUFACTURERS RECOMMENDATIONS

In all cases, items of plant, equipment and machinery, etc., shall be installed in full compliance with the manufacturers recommendations including necessary supports, etc. All such leaflets as supplied with any item by the manufacturer shall be kept in a file on site for inspection by the Engineer.

No additional costs shall be given for works resulting from non-compliance with the above.

1.23. INDUCEMENTS

The Employer shall be entitled to determine the employment of the Mechanical Contractor and to recover the value of works to date from the Mechanical Contractor shall he have offered or given or agreed to give any person any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any action in relation to the obtaining or execution of the Contract or for showing or forbearing to show favour or disfavour to any person in relation to the Contract or if the like acts shall have been done by any person employed by him or action on his behalf.

1.24. SITE CONDITIONS AND EXISTING EQUIPMENT

It will be deemed that the Mechanical Contractor visited the site before submitting his Tender and obtained details of site conditions and access, and also details of existing equipment where necessary, and that he made due allowance accordingly in his Tender. No additional costs will be allowed for any extra works or difficulties arising from the Mechanical Contractor's failure to visit the site before tendering.

1.25. SPECIALIST ATTENDANCE FOR COMMISSIONING

The Mechanical Contractor shall arrange and make all payments for specialists to visit site and fully commission all items of plant, machinery, equipment, distribution systems, controls, control panels, etc., as supplied by the Mechanical Contractor, to ensure that the works are properly adjusted and put into working order to the satisfaction of the Engineer.

The commissioning of the works shall be in full accordance with the particular manufacturers requirements and commissioning codes as issued by the Chartered Institute of Building Services Engineers. All equipment used for the purposes of commissioning shall be properly calibrated in accordance with the relevant British Standard and have a current certificate of conformity.

Where the Mechanical Contractor has been responsible for electrical wiring installation, the installation shall be fully tested in accordance with the IEE regulations by competent persons as Clause 1.19.

All commissioning results shall be typed on pro-forma sheets or charts as may be applicable, detailing settings, rates of flow, pressure drops, etc., including referenced schematic sketches of installations, to demonstrate that the section/whole of the works have been fully tested and design criteria met. The mechanical contractor shall recommission all systems/appliances at no additional cost to the works, as many times as proves necessary if, by faulty workmanship, poor installation, or equipment fault, etc., unsatisfactory results are obtained and original commissioning proves abortive in nature.

All commissioning results must be checked and approved by the Engineer prior to practical completion of sections/the whole of the works. The Engineer is at liberty to witness any such commissioning and where results are ambiguous or unclear, request for further demonstration(s) to clarify the results.

1.26. PROTECTION OF EQUIPMENT AND STORAGE

The Mechanical Contractor is to ensure that all equipment to be used on the works is fully protected against damage and corrosion during delivery to and subsequent storage on site, the protection to be of the kind most suitable for the particular equipment, i.e. boxing, cartons, paint, varnish, etc.

The Engineer may, if in his opinion it is necessary, instruct the Mechanical Contractor to renew, alter or improve any such protection.

Subsequent to the installation of the equipment, the Mechanical Contractor shall still be required to ensure the protection of the equipment until the works are handed over, or receive its final decorative paintwork or is enclosed by a permanent protective device, whichever is applicable.

The Mechanical Contractor shall be responsible for the reinstatement or repair of any items damaged as a result of improper protection due to the actions of any person employed by him or inclement weather.

The Mechanical Contractor shall allow for adequate provision of lock up facilities as required for storage of equipment on site. Positions for lock ups and any additional storage areas allocated on site shall be agreed with the Engineer. Where pipework is to be stored externally, it shall be fitted with end caps to prevent ingress of dirt, etc., and shall be stacked in a purpose made rack clear of ground level.

1.27. REMOVAL OF RUBBISH

At no time shall the Mechanical Contractor allow waste materials and scrap metal to accumulate on site. All such rubbish shall be immediately set aside in a 'safe' area so as not to cause a hazard to any persons on the site. At regular intervals or as deemed by the Engineer, all rubbish shall be cleared from the site and lawfully disposed.

1.28. MANUFACTURERS NAMEPLATES AND LABELLING

The Mechanical Contractor is to leave in position on all equipment of which he is not the actual manufacturer, the manufacturer's nameplate or marking normally attached thereto and no equipment shall be installed without ready means of identifying the manufacturer and pattern or type number of the equipment.

The Mechanical Contractor is to supply and fix approved labels to all items of equipment, valves, dampers, switches, fuses, (both in plant rooms and on general distribution) etc., as may have formed part of his works and these labels shall bear such information as is considered necessary by the Engineer to enable full cross reference to the As Installed drawings, Valve Charts and Operation and Maintenance manuals.

Further details on labelling of services are detailed in Part 2 and, where relevant, any specific requirements are highlighted in Part 3.

1.29. FROST PROTECTION

The complete and partially completed works must be installed and maintained with due regard to the damaging effects of frost. The Mechanical Contractor shall be responsible for any such damage caused by frost either directly to the mechanical installation or indirectly to the building fabric or other installation, until such time he has received a Certificate of Practical Completion. In such events he shall be responsible for making good all damage at his own cost and settle any claims promptly and without detriment to the overall progress of the project.

1.30. ELECTRICAL INTERFERENCE

All electrical equipment supplied under the Contract or used by the Mechanical Contractor during the execution of the works shall be fully suppressed to prevent radio, telephone and television interference.

1.31. NOISE NUISANCE

The Mechanical Contractor shall take all reasonable measures during the course of the works to prevent or minimise nuisance or inconvenience caused by noise to persons on site, occupiers or surrounding properties and the general public. Generators, compressors and other such noisy equipment shall be muffled at all times by means of silencers or screens, etc. Due regard shall also be given to working hours in this respect.

1.32. NOTICES

The Mechanical Contractor shall supply and fix all proper operation of plant, machinery or services. Provision shall also be made for notices, permanent or temporary, warning of potential hazards either due to working procedures or installed equipment.

1.33. SITE MEASUREMENTS

The Mechanical Contractor shall be responsible for taking his own particulars and measurements from site and provide at his own expense all necessary working drawings, copies of which shall be submitted to the Engineer for approval prior to executing the works.

All measurements shall be taken from the actual buildings and plant and not from the Contract drawings, in particular where an item of plant is to be installed close to or within any structure.

The Contractor is to ensure that all major items of plant are installed with due regard to minimum clearances stated by respective manufacturers to enable maintenance. Similarly any apparatus that may need regular access or removal for maintenance should be sited to avoid any difficulties due to adjacent installations.

1.34. MEASUREMENTS OF WORKS

The Mechanical Contractor shall with regards to measuring Works on site comply with the following:-

(a) Give all necessary assistance to enable the Engineer to examine or measure any of the Works.

(b) Ensure that none of the Works are covered or concealed or insulation applied thereto without the prior approval of the Engineer and subject to any testing requirements detailed under Part 2 of this Specification. Due notice shall be given to the Engineer that such works are ready for examination.

(c) Give every facility to the Engineer to measure any variations for which payment is based on a 'Schedule of Rates' or 'Bills of Quantities'.

1.35. PROGRESS, AS INSTALLED DRAWINGS AND CHARTS

Throughout the duration of the Works, the Mechanical Contractor shall maintain on site fully detailed record drawings (marked prints) of all changes from the Tender Drawings to facilitate the Mechanical Contractor's easy and accurate preparation of the 'As Installed Drawings' and to ensure that the drawings are in all respects a true representation of the installation. Such drawings shall also be marked to indicate progress of the Works.

Where the Works include modifications to existing services, the Mechanical Contractor shall include on the 'As Installed Drawings' all available information regarding the existing services. Where practical, the Mechanical Contractor shall check the accuracy of the existing information and supplement it where necessary from surveys of the complete installations.

The Mechanical Contractor shall also upon completion of the Works produce the following drawings which are to be of presentation quality, non fading and mounted within a hardwood timber or aluminium frame and perspex covered. Such charts shall be fixed in positions to be agreed with the Engineer.

(a) Plant room schematic(s), A1 size, indicating all items of plant, interconnecting pipework and ductwork, numbered reference to all valves and dampers, etc., and other in-line equipment. The chart must tabulate the normal operating modes of all items, list the equipment installed with duties, incorporate commissioning flow rates and highlight any emergency and seasonal procedures.

(b) A schematic control wiring diagram, A1 size, detailing all wiring external to the control panel or controller(s) advising number of cores and tabulating specific manufacturers details of control items and their operation in normal use.

Two copies of draft proposals of all drawings and charts are to be submitted to the Engineer for his approval at least two weeks before Practical Completion of the whole of the works. All equipment is to be labelled (Clause 1.28.) so that it can easily be identified and cross referenced with the information given in the operating instructions and on the wiring diagrams and valve charts.

'As Installed Drawings' and charts shall be produced on tracing paper, film, or other similar reproducible material of minimum A1 size, and at scales not less than the original Tender Drawings. All drawings and charts shall be drafted to standards not less than the original Tender Drawings, with all notes thereon to be stencilled. Such drawings shall be given to the Employer in 'approved' form at the Handover.

Further specific requirements on charts, etc. may be requested in Part 3.

1.36. OPERATING AND MAINTENANCE INSTRUCTIONS

The Manual(s) to be A4 size, in plastic covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover titled. All information and drawings in binders shall be contained in plastic wallets with strengthened seams. Drawings larger than A4 to be folded and accommodated in the wallets.

Prepare two draft 'Manuals' with provisional 'As Installed Drawings' and preliminary performance data available at commencement of commissioning to enable the Engineer to make comments. These should be of the same format as the final Manuals with temporary insertions for items which cannot be finalised until the installations are commissioned and performance tested. Provide the Engineer with 3 copies of the final Manual not more than two weeks before Practical Completion of the whole of the works.

Operating and Maintenance Manuals must include:-

(a) A full description of each of the systems installed, written to ensure that the Employer's Maintenance Engineers fully understand the scope and facilities provided.

(b) A description of the mode of operation of all systems.

(c) Diagrammatic drawings of each system indicating principal items of plant, equipment, valves, etc.

(d) Legend for all colour-coded services.

(e) Schedules (system by system) of plant, equipment, valves, etc., stating their locations, duties and performance figures. Each item must have a unique code number cross-referenced to the 'As Installed Drawings', charts and schedules.

(f) The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list numbers.

(g) Manufacturers' technical literature for all items of plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions.

(h) A copy of all Test Certificates (including but not limited to electrical circuit tests, corrosion tests, type tests, works tests, start and commissioning tests) for the installations and plant, equipment, valves, etc., used in the installations.

(i) A copy of all manufacturers' guarantees or warranties.

(j) Starting up, operating and shutting down instructions for all equipment and systems installed.

(k) Control sequences for all systems installed.

(l) Schedules of all fixed and variable equipment settings established during commissioning.

(m) Procedures for seasonal changeovers.

(n) Recommendations as to the preventative maintenance frequency and procedures to be adopted to ensure the most efficient operation of the systems.

(o) Lubrication schedules for all lubricated items.

(p) A list of normal consumable items.

(q) A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and which may involve the Employer in extended deliveries when replacements are required at some future date.

(r) Procedures for fault finding.

(s) Emergency procedures, including telephone numbers for emergency services.

(t) Copies of the 'As Installed Drawings' and Charts.

Where the Works include modifications to existing installations, the Mechanical Contractor shall include in the Operating and Maintenance Instructions all the above information for the existing installations, whether included in the Works or not.

1.37. DEFECTS LIABILITY PERIOD(S)

All items of equipment, whether put into operation before the completion of the Contract or not, shall be maintained in perfect order by the Mechanical Contractor until the completed installation or agreed sections of the installation are handed over.

For a period of 12 calendar months, unless otherwise indicated after the Practical Completion of the Contract or part thereof, the Mechanical Contractor shall be responsible for any defects which may develop under normal conditions as a consequence of faulty materials, design or workmanship in the Works but not otherwise. The Mechanical Contractor shall forthwith remedy such defects when called upon to do so by the Engineer who shall state in writing in what respect any portion of the installation is faulty.

The Mechanical Contractor shall allow for obtaining extended warranties and guarantees from manufacturers and suppliers, where such normal warranties and guarantees would not cover the Defects Liability Period for the works from the date of Practical Completion of the Contract or part thereof.

The Mechanical Contractor will also be held liable for any costs of dismantling or re-erection and making good of any of the works (whether forming part of his Contract or not) which may have to be undertaken in order to replace defective parts.

After the installations are completed, tested, set to work and handed over to the Employer, the Mechanical Contractor shall supervise and be completely responsible for the running of all installations for a period of four weeks. During this period, the Mechanical Contractor shall instruct the Employer's Maintenance Engineers in the running, operating and maintenance of the installations.

1.38. HANDOVER

Handover of the Works shall generally include:-

(a) Supply of original "As Installed Drawings", fixing of charts, and supply of "Operating and Maintenance Instructions".

(b) Supply of spares as specified in Part 3.

(c) Completion of all painting, application of identification requirements, supply and fixing of all labels and notices.

(d) Cleaning of all items of plant such that they are in clean appearance and to ensure manufacturer's nameplates are clearly visible.

(e) General finishing and tidying of the installation.

(f) Agreeing with the Engineer a list of any outstanding items or defects, which shall then be rectified within 4 weeks from the handover date.

(g) Familiarising the Employer's Maintenance Engineers with the installation.

PART 2 GENERAL TECHNICAL REQUIREMENTS

2.1. INTRODUCTION

This Part 2 of the Specification covers the standards of materials and workmanship which are to apply to all Mechanical Engineering Services. It is intended to cover a wide range of mechanical work, although some projects may not contain all of the work covered in this Part.

Part 3 of this Specification will describe generally this particular Contract and will specify any work not covered in the Standard Part 2.

Notwithstanding any reference contained in Part 3, the whole of the works must comply with Part 2 of this Specification unless the Part 3 reference particularly states that the standard in connection with that particular job is to be disregarded or modified.

Materials shall be as specified unless 'or equal' appears, when the Mechanical Contractor may offer an alternative item of equivalent quality, workmanship and appearance and resulting in a nett cost benefit to the contract.

Any such alternatives must be identified by the Mechanical Contractor at the time of submitting the tender, and priced in a separate schedule from that of the specified works. The Engineer may request for detailed information, calculations, samples, etc., as may be necessary to consider the alternative to ascertain its 'equivalence' to the specified materials.

Rejection of any alternative submitted shall not reduce the Mechanical Contractor's responsibility to complete the works (using approved materials) within the contract period.

When ordering materials, the Mechanical Contractor shall state the description, as specified, as well as the manufacturer and catalogue number. The specified description may have certain differences from the standard catalogued item.

When obtaining quotation(s) for the preparation of the Tender, the Tenderer shall, where applicable, state full description and quantities in his enquiry. Any details and/or quantities the manufacturer may have obtained previously from the Engineer or from any other source may be superseded and therefore not applicable. It shall be the Mechanical Contractor's full responsibility that all equipment conforms with the relevant details of this
Specification.

2.2. PIPEWORK GENERAL

All pipework shall be run generally in accordance with and in the positions indicated, on drawings, room layouts or plans issued as part of the contract. Due allowance shall be made for the diagrammatic nature of such drawings. Pipework shall be neatly set round to avoid ventilation trunking, cable trunking, drainage and other services, structural beams and other obstructions as necessary. The Mechanical Contractor shall make due allowance for the above in his tender.

All pipework shall be run at least 150mm from any electrical conduit or lighting and power cables. Pipes shall be spaced in ducts, ceilings and voids, trenches and below floors in a manner that permits subsequent access to any pipe for maintenance or removal without disturbance to the remaining pipework.

Branches from mains in horizontal ducts shall be kept clear to vertical ducts.

Pipes shall not be solidly built into walls or plaster and wherever possible joints shall not be positioned within the thickness of walls, floors or in any other inaccessible position.

Pipes shall be fixed with a minimum clearance of 25mm and a maximum of 40mm between the surface of pipe or covering and the finished surface of walls, and a minimum clearance of 80mm from finished surface of floor or ceiling at the lowest or highest points, within a building.

Gradients on all pipes shall not be less than 15mm in 6.0m in the case of Heating, Domestic Hot Water Service, Steam and Condensate mains, except where otherwise specified or with the written approval of the Engineer. All mains shall be laid to the gradients to ensure sufficient venting and drainage of the service. Drainage lines from tundishes and appliances, etc. shall have a minimum fall of 25mm in 6.0m.

All screwed joints shall be clean threaded and the bore carefully reamered to ensure the pipe is free from burrs or obstructions. Threads shall be full depth on the pipe. Screwed joints shall be pulled up tight and the jointing material shall be neatly cleaned off close to the socket, flange union or valve. All fittings and materials on domestic water services shall conform with "The Water Fittings and Materials Directory" as authorised by the Water Research Centre. Hemp shall only be used on non-domestic water services and shall where used be fine long dressed Italian Hemp.

Caulking of Joints will not be allowed.

Efficient plugs shall be inserted in all open ends during the progress of the work. Plugs of wood, paper or rag, etc., shall not be used.

The Mechanical Contractor shall be responsible for the location and removal of any stoppage due to foreign matter or air lock which is found to impede the flow of fluid after the systems are put into use, including the cost of making good all pipework, insulation, building decorations or other damage caused in locating and making good these defects.

Long sweep bends shall be used in preference to round elbows. Square elbows shall not be used. All made or set bends shall have as large a radius as possible and shall be free from deformation of the bore and tube or any undue thinning of the wall of the tube.

All bends and sets shall be pulled cold on pipework up to 50mm nominal bore, using a bending machine with the correct formers for the size of pipe used. Distortion of the pipe, thinning on the heel or corrugations on the throat of formed bends will not be accepted.

Fire pulled bends and sets on galvanised pipework will not be allowed.

Tees shall be of the easy or twin elbow pattern except where square equal tees will facilitate venting and drainage.

Bushes shall only be used on radiator connections. Reduction in pipe size other than where taper pieces are indicated, shall be by reducing sockets or tees. These shall be of the eccentric pattern or horizontal lines and concentric on vertical lines to ensure proper drainage and the elimination of air pockets. Pipes shall be erected and provided with flanges or unions as specified hereinunder.

Unions shall be installed on the outlet of all screwed valves (except draw off points) and at strategic points in the pipeline to enable disconnection of appliances, or dismantling of pipe sections. Unions shall be Navy Pattern with Gunmetal to Gunmetal faces. On Copper pipework, compression fittings shall be used to provide similar or disconnection.
Long screws and back-nuts shall not be used.

Where pipework enters buildings from earth trenches, the entry through the external wall shall be by means of puddle flanges to prevent the ingress of water.

All galvanised mild steel tubes shall be assembled by means of screwed and socketed joints and galvanised beaded malleable iron fittings except where specified. All exposed threads or damaged surfaces of galvanised pipes and fittings shall be painted two coats of approved protective paint.

Pipe lines shall be run straight and true with a minimum use of pipe sockets and couplings and with only such offsets as may be required to clear unavoidable obstructions, to provide necessary clearance or headroom, or to provide the necessary flexibility in the piping system. Changes in direction of pipe lines shall be made with approved fittings or pipe bends only. Mitred joints or 'lobster' back bends in welded pipe lines will not be permitted. It will be deemed that the Mechanical Contractor allowed in his tender for setting around all rainwater, soil and vent pipes and other obstructions.

Piping shall be installed so that it follows the lines of the building structure and horizontal piping shall be graded wherever necessary to allow venting and draining of the piping. Vertical pipework shall be plumb.

Particular care shall be taken to ensure that visible pipes shall be in line with structural features and each other.

Provision shall be made to insulate all pipes separately so that the final insulation presents a clean and tidy appearance.

Pipework shall be so installed so as to avoid airlocks and so that all pipework and fittings can be completely emptied of water. Drain cocks shall be fitted at each low point and on each main circuit or branch and from these points the piping shall rise to the venting positions. Where the sub-circuit pipework is to be vented to the mains, the connection to the mains are to be taken from the bottom. Where the mains are to be vented to the sub-circuits, the sub-circuit connections are to be taken from the top.

Where hot or cold water pipes connect to sanitary fittings, they are generally accompanied by waste pipes or drains and it will be necessary for any other pipes passing these at right angles to be double set past the vertical pipes, and it will be seemed that the Mechanical Contractor included for all such sets.

Refrigeration systems pipework shall be installed so that any oil in the compressor discharge refrigerant which passes through the oil separator (if fitted) is carried through the system and returned. Pipework shall also be fitted with due regard to liquid slugging, suction pressure and other problems peculiar to a refrigerant systems.

Sleeves for copper pipework shall be either copper, brass or gunmetal. Ferrous sleeves shall not be used.

All sleeves through building elements shall project 15mm beyond the finished surface unless otherwise instructed.

The weight of the pipes shall not be borne by the sleeves and all sleeves shall be set concentric with the pipes. Clearance all round shall be left to allow for free movement.

The Contractor shall be responsible for ensuring that no pipes are bedded in the sleeves so as to restrict movement, by any making good, or by any cause whatsoever. The Mechanical Contractor shall also be responsible for the accuracy and correct alignment and levels of all holes required to be left or cut for the fitting of sleeves.

All sleeves required to be built into or embedded in structural concrete shall be placed in position by the Mechanical Contractor before the concrete is poured. Proper care shall be taken by the Mechanical Contractor to check and ensure that the sleeves remain in the correct position whilst concreting takes place and until the concrete is set.

Pipe sleeves shall be sized to allow clearance around the pipe so that the annular opening can be packed with heat resisting string or rope and sealed at both ends with water and fire retardant mastic. Where services penetrate external building elements they shall be completely weatherproof.

Where pipes pass through walls, floors, ceilings, partitions, false ceilings and fixed items of furniture, in occupied rooms, they shall be fitted with chromium plated wall plates. Plates shall be hinged and suitable for copper or steel tube of the appropriate size. The plates shall be fixed snugly to the surface to provide a neat appearance.

Protective means shall be taken to prevent dissimilar metals being in contact where the presence of water or moisture could promote deterioration through electrolytic action. Where copper pipes connect to ferrous cisterns, equipment or pipework, whether galvanised or not, approved fibre washers or gaskets must be used.

2.3. SCHEDULE OF PIPEWORK MATERIALS

All pipework shall be in accordance with the B.S. given, in random lengths unless otherwise called for, straight and free from blemish and rust. Ends shall be screwed to the correct length to the B.S. where screwed pipe is called for and the ends shall be protected from damage by means of half sockets firmly screwed on.

All pipework shall be suitably stored not less than 300mm clear of the ground with adequate protection from the weather.

Service:	**Steam**
Piping:	Up to and including 125mm.
Material:	Mild steel heavyweight to B.S.1387.
Fittings:	Service pressure up to 4.0 bar:- M.S. or wrought iron (B.S.1740) heavy grade screwed to B.S.21 up to and including 40mm with unions. Flanged and welded on all sizes 50mm and above Carbon steel butt welded fittings to B.S.1965 thickness to suit pipe. Service pressure exceeding 4.0 bar:- Fully flanged and welded as previously described.
Piping:	Over 125mm.
Material:	Carbon steel, seamless fully killed, to B.S.3601.
Fittings:	Carbon steel butt welded to B.S.1965 thickness to suit pipe. Flanged on all connections.
Service:	**Condensate**
Piping:	All sizes.
Material:	Up to 7 bar Copper to EN1057 Part 2 tables 5 and 7. Over 7 bar Copper to EN1057 Part 2 tables 6 and 8.
Fittings:	Up to and including 42mm "steam" quality high duty integral solder ring, with unions. Over 54mm brazed fittings and flanges all pressures.
Service:	**L.P.H.W. Heating**
Piping:	Up to and including 150mm.
Material:	Mild steel heavyweight to B.S.1387.
Fittings:	Screwed to B.S.21 up to and including 50mm, malleable cast iron to B.S.143 with unions. Flanged and welded 65mm and above, carbon steel butt welded fittings to B.S.1965 thickness to suit pipe.
Piping:	Over 150mm.
Material:	Carbon steel, seamless fully killed, to B.S.3601.
Fittings:	Carbon steel butt welded to B.S.1965 thickness to suit pipe. Flanged on all connections.

OR

Where so specified on the drawings or in the particular Specification, copper pipework generally as detailed for Domestic Hot Water.

Service: **Domestic Hot Water**

For clarification of pipework material, galvanised or copper, refer to Part D.3. of this Specification and Contract drawings.

All screwed joints shall be made using P.T.F.E. tape to B.S.5292 type C and B.S.4375.

Piping: Up to and including 150mm.

Material: Mild steel medium weight to B.S.1387, galvanised after manufacture.

Fittings: Screwed to B.S.21 up to and including 50mm, with unions. Flanged 65mm and above. Malleable cast iron to B.S.143 galvanised after manufacture.

OR

Piping: Up to and including 159mm.

Material: Copper half hard temper tube to EN1057 table X.

Fittings: Copper alloy fittings integral solder ring to EN1254 Part 1, i.e. I.B.P. Conex Triflow solder ring of the Potable range (lead free) up to and including 42mm. Over 54mm brazed fittings and flanges. (No end feed fittings allowed). I.B.P. Conex - Delbraze.

Service: **Cold Water Downs Service.**

As for Domestic Hot Water.

Service: **Mains Water Service (Internal)**

As for Domestic Hot Water.

Service: **Mains Water Service (External Buried)**

Piping: Up to nominal size 63mm.

Material: Blue polyethylene (MDPE) to B.S.6572 SDR11 (12 bar).

Piping: Nominal size 90mm and over.

Material: Blue polyethylene (MDPE) to Water Industry Specification WIS4.32.03 SDR11 (10 bar).

Fittings: Electrofusion or butt fusion welded in accordance with Water Industry Guidance Note WIGN4.32.08. Fittings to comply with WIS 4.32.04 and 4.32.06. Mechanical fittings to EN1254 and WIS 4.24.01 not to be used on buried pipelines unless instructed by the Engineer.

Manufacturer: Stewarts and Lloyds Plastics.

Service: **Mains Water Service (External Exposed)**

Piping: Up to nominal size 63mm.

Material: Blue polyethylene (MDPE) to B.S.6572 SDR 11 (12 bar).

Piping: Nominal size 90mm and over.

Material: Blue polyethylene (MDPE) to WIS 4.32.09 SDR 11 (10 bar).

Fittings: As for 'external buried'.

Manufacturer: Stewarts and Lloyds Plastics.

Service: **Fire Mains**

As for Domestic Hot Water.

Service: **Cold feeds and vents on Heating and Domestic Hot water and all other exhausts and vents. Safety valves and three-way cock drip pipes.**

As for Domestic Hot Water.

Service: **Compressed Air (non-medical applications)**

As for Domestic Hot Water - Galvanised.

Service: **Natural Gas (internal)**

For clarification of pipework material, steel or copper, refer to Part D.3. of this Specification and Contract drawings.

All screwed joints shall be made using British Gas approved P.T.F.E. tape, all in accordance with the latest edition of IM/16 as published by British Gas.

Piping: All sizes.

Material: Mild steel heavyweight to B.S.1387.

Fittings: Screwed to B.S.21 up to and including 50mm malleable cast iron to B.S.143. Above 65mm welded with carbon steel butt welded fittings to B.S.1965 thickness to suit pipe.

OR

Piping: Up to and including 42mm.

Material: Copper half hard temper tube to EN1057 table X.

Fittings: Integral solder ring fittings to EN1254 Part 1. Compression joints shall only be used in accessible locations to facilitate removal.

Service: Natural Gas (external buried)

As above but double wrapped with Denso tape.

OR

Piping: All sizes.

Material: Yellow Polyethylene (MDPE) to BGC PS/PL2 Part 1.

Fittings: All to BGC PS/PL3 Parts 4 and 6, BGC PS/PL3 Parts 1 and 2, BGC PS/LC6.

All pipework and fittings shall be suitable for working pressures up to 4 bar and temperatures up to 40oC.

All gas services, internal and external, shall generally conform with the British Gas Document IM/16 "Guidance Notes on the Installation of Gas Pipework, Boosters and Compressors in Customers Premises".

The completed pipework installation shall be generally tested in accordance with British Gas Document No. IM/5 entitled "Soundness Testing Procedures for Non-Domestic Gas Installations".

Immediately following the above, the system shall be purged generally in accordance with British Gas Document No. IM/2 entitled "Purging Procedures for Non-Domestic Gas Installations".

Service: Fuel Oil

Piping: All sizes.

Material: Mild steel medium to B.S.1387.

Fittings: Up to and including 50mm screwed to B.S.21, malleable cast iron to B.S.143. 65mm and above welded with carbon steel butt welded fitting to B.S.1965.

All fuel oil services, other than light grade oil, shall, where necessary, be trace heated and insulated.

Service: Final connections to taps and sanitary fittings, run-outs to shower outlets and exposed pipework within shower booths. Connections to later heaters, drip pipes, pump gland drains, condensate drains.

Piping: All sizes.

Material: Copper half hard temper tube EN1057 table X.

Fittings: Integral solder ring fittings to EN1254 Part 1 potable range on all water draw offs. Compression joints to be used to facilitate removal for maintenance.

Pipework and fittings exposed in shower rooms/cubicles to be chromium plated.

Service: Refrigeration for Air Conditioning

Piping: Up to 159mm.

Material: Refrigeration quality copper to B.S.6017:1981/CU-DHP, annealed in coils or half hard tempered in straight lengths.

Fittings: Heavy duty capillary or brazed.

Service: Chilled Water

Piping: Up to and including 125mm.

Material: Mild steel heavyweight to B.S.1387.

Fittings: Screwed to B.S.21 up to and including 50mm malleable cast iron to B.S.143 with unions. Flanged and welded 65mm and above, carbon steel butt welded fittings to B.S.1965 thickness to suit pipe.

Piping: 150mm and above.

Material: Carbon steel, seamless fully killed, to B.S.3601.

Fittings: Carbon steel butt welded to B.S.1965 thickness to suit pipe. Flanged on all connections.

2.4. PIPE SUPPORTS AND EXPANSION

The Mechanical Contractor shall provide for all pipe supports on all runs of pipework. Supports shall be either pipe hangers and rods, clasp, rollers and chairs, etc., as required for the particular duty and for stable and efficient support. Channel and angle iron "A" or support brackets shall be provided for the supporting of pipework as necessary. The supports shall be chosen for the particular duty they are to perform and shall allow free movement and expansion of the pipework. All supports shall be graded to the required levels for air elimination and drainage.

Pipe fixings and supports shall be arranged at intervals not greater than the following distances apart:-

Pipework	**Pipe Size Millimetres**	**Horizontal Metres**	**Vertical Runs Metres**
Mild Steel	15	2.0	2.0
and	20	2.0	3.0
Wrought	25	2.5	3.0
Iron	32	2.5	3.0
	40	2.5	3.0
	50	2.5	3.5
	65 and above.	3.0	4.5
Heavy Gauge	15	1.2	2.0
and	22	1.2	2.0
Light Gauge	28	1.5	2.5
Copper	35	2.0	3.0
	42	2.0	3.0
	54	2.0	3.0
	67 - 108	2.5	3.5
	133 and above.	3.0	3.5
Cast or	50	2	2
Spun Iron	80 - 100	2.75	2.75
	150	3.5	3.5

Vertical pipes shall be stayed from the wall with a minimum of two clips spaced equally between floor and ceiling.

Flanges, sockets and unions where installed shall coincide with support positions so far as is practicable. Where vertical take offs from horizontal pipes and mains occur, the horizontal mains shall have a support positioned at this point.

Supports for natural gas pipework shall comply with British Gas publication 1M/16.

Plastics pipework shall be continuously supported where possible as CP312 Parts 2 and 3.

Supports shall be positioned adjacent to all valves, and other special components installed in pipe lines, to avoid undue strain on the adjoining pipework and to allow the component to be removed for maintenance leaving the pipework adequately supported at the free ends.

Pipework in Plant Rooms shall be supported from mild steel hanger rods and clips carried on purpose made angle, channel iron or unirax/unistrut bearers secured with bolts firmly fixed to the building structure.

Pipework installed in the vertical and horizontal ducts, internal and external to the building shall be supported by channel iron supports firmly bolted to the structure as indicated on the drawings.

The Contractor shall drill these members and provide hanger rods and clips, U" bolts, or roller and chairs as applicable or as detailed on the drawings.

Where these supports are not detailed on the drawings, their design and manufacture shall be submitted to the Engineer for approval before they are manufactured or installed.

Pipes fixed both horizontally and vertically to walls in rooms shall be supported by malleable iron school-board pattern brackets with split pipe holders built into walls or with drilled back plates where they are to be screwed to wood or ironwork.

For copper pipework, pipe holders supports, etc., shall be of gunmetal or brass pre-fabricated brackets.

Where pipework is covered with non-conducting covering, supports shall be as described above, except that the design shall be such that the face of the covering shall be supported at least 25mm clear of the building.

All brackets, hanger rods, clips and roller and chairs shall be arranged to give ample movement for expansion of the pipework.

All necessary "U" bolt or other guides shall be provided to counteract side or vertical movement to piping due to expansion.

The Mechanical Contractor shall be responsible for position and alignment of all built-in brackets and supports before concreting commences and that the positions are maintained until the concrete is set.

All pipework shall be arranged so that expansion may be readily taken up by bends or changes in direction. Where expansion cannot be accommodated in this manner, then expansion compensators with flanged ends (for axial type) shall be used.

Where bellows type are called for and fitted, these shall be capable of the full expansion of the pipe and shall be able to withstand both axial and transverse stresses when in operation and shall be installed strictly in accordance with the manufacturer's instructions. Bellows shall be as manufactured by Engineering Appliances Ltd., or Teddington Bellows Ltd.

Gland type expansion fittings shall not be used.

Expansion compensators shall be fitted generally in accordance with the drawings and in other positions where in the Mechanical Contractor's opinion the use of an expansion compensator will create undue stress being set up in the pipelines.

The pipework shall be stressed initially when cold by leaving gaps at the appropriate points equal to 50% of the total expansion calculated for that section. This cold spring shall be taken up only after all anchor points and brackets are grouted in and are rigidly fixed and proved firm by the Engineer or his representative.

Before the final pull up is made, the amount of cold pull allowed shall be checked by the Engineer and proved correct.

All pipes shall be fixed with sufficient clearance from walls, joists, floors or other obstructions capable or resisting lengthwise expansion and special care shall be taken to avoid pipe fixings or supports near junctions with main pipe runs preventing movements of branches.

Connections of branch mains wherever possible shall be taken as near to anchor points as is practicable to avoid undue movement or stress in the branch connection.

Where such connections are impracticable, the branches shall be pre-stressed by cold springing and due allowance made for the movement of the main pipe at that point.

Approved guides shall be provided to ensure that the pipe expands co-axially with the pipe run and that the expansion compensator takes up the full expansion of the pipe without any undue bowing of the pipe. Expansion compensators shall be fitted in the horizontal plane unless otherwise specified.

Where expansion compensators are specified to be fitted vertically downwards or horizontal steam pipe runs, they shall have a trap set immediately before the loop in the direction of flow of the steam.

Expansion compensators shall be of suitable thickness for the pipe to which they are fixed, and where fitted to hot water services, shall be galvanised or stainless steel.

Prefabricated expansion compensators on hot water services shall be heavily galvanised after manufacture.

Each expansion compensator shall be flanged either side to the appropriate BS Flange Table, as specified.

Anchors shall be provided as shown on the drawings and as necessary for any additional changes in direction or additional expansion compensators authorised by the Engineer.

Anchors shall be positioned such, that the pipe expansion is controlled in the direction intended.

Anchors shall be either forged steel clamps of adequate cross sectional area, bolted to a sole plate, or formed of MS sections welded to the pipe and bolted to a sole plate.

The sole plate in each case shall be rigidly fixed to the building structure, subway or duct wall by means of Rawlbolts or rag bolts firmly grouted in.

Anchors shall not be fixed to structural steel work unless the written approval of the Engineer is obtained.

2.5. FLANGED JOINTS

All flanges on steel pipelines shall be forged steel.

Flanges shall be raised face to B.S.4504 Part 1, Tables 6/2, 6/5 or 6/6 where joints are welded and Table 6/4 where the joints are screwed, rated PN16.

Where flanged connections are made to existing equipment having flanges of Imperial sizes, the flange shall be flat faced to B.S.10. and of Table suitable for the appropriate services temperature and working pressure.

Flanges on copper pipework shall be composite type to B.S.4504 Part 2.

Flanged joints shall be made with gaskets to B.S.4865 Part 1, or B.S.3063, as appropriate. They shall be of a grade and thickness suitable for the temperature, pressure and operating conditions of the service.

Metric bolts of the correct diameter shall be used with flanges to B.S.4504. Washers shall be fitted under the bolt heads and nuts. When pulled up, the bolt shall not protrude more than one thread through the nut.

Joints on copper pipework shall be as for steel flanges and either high tensile or Admiralty brass hexagonal headed nuts and bolts with two brass washers shall be used.

Mild steel flanged joints shall be used in all positions on mild steel pipework within plant rooms.

All flanges on galvanised D.H.W.S., M.W.S., C.W.S. and Fire service pipework shall be heavily galvanised.

All flanges on screwed pipework shall be screwed on to the full flange depth and expanded on. The end of the pipe shall finish flush with the face of the flange. Boiled oil or other lubricant shall not be used on the screwed joint.

Flanges on welded steel pipework may be of the slip pattern welded at the back and to the pipe, and seal welded to the end of the pipe.

When complete, the seal weld shall not project or stand proud of the flange face nor shall the weld obstruct the bore of the pipe.

All flanges shall be truly parallel on face and bolts proved free in holes before pulling up.

Flanges or unions shall be provided in runs of pipework at intervals of 18m and at all changes of direction to facilitate maintenance. Flanges or unions shall be provided in rooms where shown on the drawings to enable any item of plant or run of pipework to be dismantled. Pump and plant connections shall be provided with flanged valves.

Welding fittings on copper pipework shall be self-bronze welded using a proprietary flux. Welding of flanges shall confirm in all respect to that of steel. After welding, the pipework shall be thoroughly cleaned of flux residue.

2.6. WELDING

Welding at site will be permitted to be carried out by either oxy-acetylene or electric arc process, by welders holding a certificate of competency in either or both processes issued by a recognised Authority.

The welders shall have past the tests within the past twelve months recognised by the following Authorities:-

Lloyds

The Association of Heating and Ventilating and Domestic, Engineering Employers

British Oxygen Co. Ltd.

City & Guilds

The tests shall be as are set out in Clauses 4 and 10 of B.S.2645.

All welding shall be carried out strictly in accordance with the Codes of Practice for Welded Pipelines issued by the Associated Officers Technical Committee and the Rules and Regulations of the Insurance Company appointed.

Subject to the Insurance Company's approval of the welding process, site welding of pipework for use on pressures up to and including 7 bar will be permitted. All fittings above 80mm in diameter shall be shop fabricated and welded from templates prepared from site dimensions.

Branches of 15mm to 32mm diameter welded into large size mains will be permitted. The larger main shall be properly prepared to receive the branch by drilling the correct size hole for outside diameter of the branch. The cutting of holes for branches by means of oxy-acetylene flame will not be permitted.

The branch pipe shall have the end shaped to fit the bore of the larger main and when welded in position shall not protrude below the inner face so as to obstruct the flow of fluid. Branch connections not meeting these requirements shall be removed and replaced by the Contractor at his own expense.

Unions or flanges shall be provided to allow ease of disconnection for maintenance purposes.

All pipework and fittings for welding shall have their ends properly prepared and bevelled for BUTT welding.

Only welding elbows to BSS giving an equivalent radius of not less than 11 times the pipe diameter, dependent on the bore of the pipe shall be used. For welds to seamless butt welded fittings and butt welded pipe joints, the joint shall be fused to a penetration weld and finally finished off with a fillet weld of ample dimensions. All welds shall be of good clean metal, free from slag inclusions and porosity and shall be of even thickness and regular contour well fused with the parent metal.

No welded joint shall be made within 600mm (2'0") of any anchor point.

Arc welding shall be in accordance with the requirements of B.S.2971.

All oxy-acetylene welding shall be in accordance with the requirements of B.S.2640 and filler rods shall be to B.S.1453 type A2.

Copper pipework shall be welded in accordance with B.S.1724.

The use of fittings welded into random lengths of pipe to form bends, off-sets, etc., will not be permitted.

Where welding fittings are on protracted delivery, permission may be given by the Engineer for off-sets to be fabricated on pipework 80mm (3") bore and above, by welding. Such off-sets shall be formed by a regulation cut and shut operation and not by one obtuse angled weld.

The Mechanical Contractor's attention is drawn to the fact that the Engineer can request the cutting out of any weld for inspection and the pipeline re-welded at no extra cost and the Mechanical Contractor shall allow accordingly.

Where a number of welds done by a welder are unsatisfactory, the Engineer reserves the right to refuse to allow any further welding to be carried out by that welder.

2.7. VALVES, COCKS AND STRAINERS

The following valves, cocks and strainers shall be provided for the works described in this Specification. Particular specialist items not described hereafter shall be detailed in Part D.3. of this Specification.

All valve references are metric. Where connections are to be made to existing fittings with imperial dimensions, the Mechanical Contractor shall ascertain the availability of the new fittings with matching imperial dimensions.

For all valves the Mechanical Contractor shall supply and hand to the Engineer all necessary tools and keys supplied by the valve manufacturer, to enable full adjustment and regulation of the valves.

2.7.1 Mains Water Stop Cocks

(i) Outside Buildings:- 50mm and above to B.S.5163 Hattersley M598
40mm and below to B.S.5433 Samuel Booth valves.

Compression ends to suit copper or polyethyelene pipe as appropriate.

All externally buried stop cocks shall be supplied with 'T' handle.

If installed above ground 80mm and below to B.S.1010 Pegler 744FGK/I.B.P. Conex 1004

(ii) Inside Buildings:-

65mm Fe and 54mm Cu and above to B.S.5154 Hattersley FIG 35/I.B.P. Conex 1101/100

50mm Fe and 42mm Cu and below to B.S.5154 Hattersley FIG 30/30C/I.B.P. Conex 1001

Bibtaps to B.S.1010 incorporating double check valve

I.B.P. Conex 1333
Pegler 142 HU or 142HU FGK where lockshield.

2.7.2. Low Temperature Hot Water Heating, Chilled Water, Hot Water, Cold Water, Isolating Valves and Servicing Valves

(i) Copper Service:-

54mm and over to B.S.5154 Hattersley FIG 35 or FIG 35LS where lockshield.
I.B.P. Conex 1101/100
1101/100LK

42mm and under to B.S.5154 Hattersley FIG 30C or FIG 30CLS where lockshield.
I.B.P. Conex 1001.

OR
Where ballvalves specified.

42mm and under
Hattersley FIG 100 or
FIG 100 CLS where lockshield or FIG 100 CEXT where pipes insulated.

(ii) Steel Service:-

65mm and over to B.S.5150
Hattersley FIG M541

OR

Where butterfly valves specified to B.S.5155
Hattersley FIG 950

50mm and under to B.S.5154 Hattersley FIG 30 or FIG 30LS where lockshield

OR

Where ball valves specified Hattersley FIG 100 or FIG 100LS where lockshield or
FIG 100 EXT where pipes insulated

Where valves are specified to be lockable, a proprietary locking device shall be supplied with the valve.

(iii) Servicing Valves:- Up to 22mm to B.S.6675
Pegler 806, 807 or 808 as appropriate.
I.B.P. Conex 722.721.720.

2.7.3. Steam Service Isolating Valves
(Including condensate service up to trap set)

(i) Service Pressure up to 4.0 bar:- 50mm and above
Spirax Sarco A1 stop valve

40mm and below
Spirax Sarco HV3 stop valve

(ii) Service Pressure exceeding 4.0 bar:- All sizes
Spirax Sarco A1 stop valve

2.7.4. Condensate Service Isolating Valves

54mm and over
Spirax Sarco Model 20 ball valve

42mm and below
Spirax Sarco Model 10 ball valve

2.7.5. Commissioning and Regulating Valves

(i) LTHW/Chilled Water:- 65mm and over to B.S.5152
Hattersley M2733

50mm and below to B.S.7350 Hattersley 2432 or 2432C on copper service.

15mm medium flow set (.024 - .05 L/S)
Hattersley 2473M or 2473MC on copper service.

15mm low flow set
(.01 - .023 L/S)
Hattersley 2473L or 2473LC on copper service.

(ii) HWS Return Service:- Where commissioning sets are specified, these shall be as generally detailed above for 50mm and below.

2.7.6. Gas Cocks

(i) Steel Service:-

65mm and over to B.S.5150
Hattersley FIG M519
50mm and below to B.S.1552
Hattersley FIG 100

(ii) Copper Service:-

42mm and below to B.S.1552
Hattersley FIG 100C

2.7.7. Fire Hose Reel Mains Isolating Valves

(i) Steel Service:-

65mm and over to B.S.5163
Hattersley FIG M599 INT

50mm and below to B.S.5163
Hattersley FIG 33X LDI

(ii) Copper Service:-

54mm and over to B.S.5154
Hattersley FIG 35 LDI
42mm and below to B.S.5163
Hattersley FIG 33X LDI

2.7.8. Fuel Oil Service Isolating Valves

65mm and over Hattersley FIG 201M
50mm and below Hattersley FIG 200M

2.7.9. Compressed Air Isolating Valves

(i) Main Distribution:-

50mm and under
Spirax Sarco NV (Non-Venting)

(ii) Final Sub Circuits:-

25mm and under
Spirax Sarco V (Venting)

2.7.10. Non-Return Valves

(i) Water Services:-

54mm Cu and 65mm Fe and over
Crane FM 450

42mm Cu and 50mm Fe and below to
B.S.5154 Hattersley FIG 47

(ii) Steam, Condensate and Air Services:-	Welded, flanged and all Air pipework Spirax Sarco DCV 1 Screwed pipework Spirax Sarco check valve

2.7.11. Single/Double Check Valves

(i) Single Check Valve:-	SOCLA Type 211 (up to 28mm) I.B.P. Conex A30
(ii) Double Check Valve:-	SOCLA Type 2211(up to 28mm Cu) Type 2231 (up to 25mm Fe) I.B.P. Conex A33

Alternative arrangements if required will be specifically detailed later in this Specification.

2.7.12. Strainers

(i) Water Services:-	54mm Cu and over to B.S.1400 LG2 Hattersley FIG 808 65mm Fe and over to B.S.1452 Hattersley FIG 810 42mm Cu and 50mm Fe and below to B.S.1400 LG2 Hattersley FIG 807
(ii) Steam and Air Services:-	Welded and flanged pipework Spirax Sarco FIG 33A Screwed pipework Spirax Sarco FIG 12
(iii) Condensate Services:-	54mm and over Spirax Sarco FIG 3A 42mm and below Spirax Sarco FIG 12

The mesh screen supplied with all strainers shall be checked with the manufacturer for suitability prior to order and installation.

2.7.13. Safety Valves

All safety valves listed hereafter shall be of National Vulcan Safety Products, NABIC, manufacture to B.S.6759 and A.O.T.C. certified. Flange and screwed connections shall be as appropriate to the service type and size. Sizes of valve and settings shall be as detailed elsewhere in the Specification.

(i) Hot Water:-	Up to 80mm Vented System FIG 542
	Up to 50mm Unvented Htg System FIG 500
	Up to 50mm Unvented HWS System FIG 500T
(ii) Cold Water	Up to 80mm FIG 542L
(iii) Steam:-	Up to 50mm FIG 500S or Up to 80mm FIG 542
(iv) 3-Way	Escape Valve:- Up to 65mm FIG 503
(v) Anti-vacuum Valve:-	Up to 50mm FIG 168

Valves of larger sizes if required shall be specified elsewhere in the Specification.

2.7.14. Ball Float Valves

15mm to B.S.1212 Part 2
Pegler FIG 858 (High Pressure) I.B.P. Conex 52033
FIG 860 (Low Pressure) I.B.P. Conex 52063

15mm to 50mm to B.S.2870
Hattersley FIG 340

65mm and above to B.S.2870
Hattersley FIG 337

Note (i) All floats to be Copper or plastic to B.S.2456
(ii) All valves to have current WRC approved.

Delayed Action Ball Valves where called for shall be as specifically detailed.

2.7.15. Pipeline Ancillaries

(i) Drain Cocks:- (15mm unless otherwise noted on drawings)	Plant rooms and major plant Hattersley FIG 81 HUCC I.B.P. Conex S746 General distribution Hattersley FIG 371
(ii) Test Points:-	Hattersley FIG 631 or FIG 633 on insulated pipes.
(iii) Manual Air Cocks:-	Where manual vents are specified as 6mm Hattersley FIG 425

	Where manual vents are specified as 15mm Hattersley FIG 5NLS
(iv) Automatic Air Vents:-	Engineering Appliances 'Spirotop' Ref DA01 015B
(v) Dosing Pots:-	Barfield Water Treatment or equal complete with valved connections for flow and return pipework drainair vent tundish for chemical addition

All air vents shall, unless specifically detailed otherwise incorporate air bottles on the piped service.

2.7.16. Radiator, Natural Convector, Cill Line and Skirting Heating Valves

Valves shall be of the angle or straight pattern and size as specified elsewhere, and shall be of Hattersley Manufacture to B.S.2767. Thermostatic valves shall be as specified elsewhere.

	Handwheel (Flow)	**Lockshield (Return)**
(i) Angled Copper:-	2386C.CP	2386C.CP.LS
(ii) Angled Screwed:-	2386.CP	2386.CP.LS
(iii) Straight Copper:-	2407C.CP	2407C.CP.LS
(iv) Straight Screwed:-	2407.CP	2407.CP.LS
(v) Thermostatic Valves:-	Where thermostatic valves are specified, the finish of the lockshield valve shall be adjusted if necessary to match the finish of the thermostatic valve.	
	The TRV's shall be mounted in the flow connection completely in accordance with the manufacturers instructions. TRV's are to be locked to the required setting. The TRV shall be installed in such a manner to ensure that the head is not exposed to draught, heat sources and does not obstruct access ways or items of furniture.Where remote sensing heads are specified, the capillary tube shall be run in a neat fashion following the contours of the building fabric and shall be secured with adequate clips.	

2.8. INSTRUMENTATION

Pressure Gauges

Pressure gauges shall be provided, whether indicated on the drawings or not at the following positions:-

(a) Each boiler flow, cylinder, calorifier or other vessel.

(b) All pump suction and delivery connections.

(c) All pressure reducing stations on both high and low pressure sides.

(d) At all other positions as indicated on the drawings.

Pressure gauges shall be direct mounting, dual reading (Bar/psi), pressure range to read zero to twice the working head minimum, stainless steel, weatherproof case with bright polish finish, phosphor bronze Bourdon tube, brass connection and fitted with brass gauge cock and ring pattern or 'U' pattern syphon to suit on site circumstances.

All pressure gauges shall be as manufactured by Sydney Smith Dennis from the Zeal range.

Temperature Gauges

Temperature gauges shall be provided, whether indicated on the drawings or not, at the following positions:-

(a) Each boiler flow, cylinder, calorifier or other vessel.

(b) Individual heating and hot water circuit flows and returns.

(c) Common flow and return headers/pipes.

(d) Common flue pipes.

(e) At all other positions as indicated on the drawings.

Temperature gauges shall be Bimetal, dual reading (oC/oF), direct mounting (horizontal or vertical to suit on site circumstances), 100mm dia, 0oC to 120oC range, stainless steel, weatherproof case, bright polish finish, brass stem with 100mm stainless steel pocket. Pockets shall be filled with suitable oil to provide proper thermal contact.

Where thermometers are to be provided on pipelines where the pocket length exceeds the pipe bore, the Mechanical Contractor shall either insert the pocket in a square tee or provide a stub pipe bushed down to accept the pocket, as agreed with the Engineer.

All temperature gauges shall be as manufactured by Sydney Smith Dennis from the Zeal range.

Test Points

Test points of the type specified elsewhere shall be installed whether indicated on the drawings or not at the following positions:-

(a) Flow and Return connections to all major plant items including boilers, calorifiers, cylinders, other vessels, heating/cooling coils, etc.

(b) All pump suction and delivery connections.

(c) Individual hot and cold water circuit branches/circuits in plant rooms and distribution ducts.

(d) Adjacent to all ports of automatic control valves (whether electric, pneumatic or hydraulic), strainers and blending valves.

(e) All other positions as indicated on the drawings.

2.9. HEAT EMITTERS

All heat emitters (radiators, convectors and the like) shall be as detailed on the drawings and or in the schedules, and shall not be deviated from in any way without prior agreement with the Engineer.

Each emitter shall be fixed true and level and where sited beneath a window, the unit shall be laterally centred on the window opening, and in no instance shall the emitter project above the cill line. The final positioning of all emitters shall be checked at site against actual room layouts (with due regard for furniture, etc.) and Architects drawings. All dimensions of emitters shall be checked by the Mechanical Contractor prior to ordering.

All emitters shall be provided with the manufacturer's standard paint finish unless specifically noted otherwise. In all instances emitters shall be installed completely in accordance with the manufacturer's instructions utilising purpose provided bracketing and any other such components as may be necessary to ensure a minimum amount of movement (un-piped) to the satisfaction of the Engineer. The Mechanical Contractor shall provide any such additional supports/frames/fixings as may be necessary, if for whatever reason, the building structure is unsuitable for accepting the emitter(s).

Each emitter shall be installed with due regard for venting and draining and for the passage of pipework under, through or around the emitter and for connections thereto. No emitter shall be installed in such a manner or position, whereby its subsequent performance will be reduced. All emitters shall be provided with local valves for isolation and regulation purposes of the type specified elsewhere.

Emitters fitted with thermostatic sensing valves served by pipework running at low level below the emitter shall always, where emitter connections permit, be piped in such a manner as the sensing head of the valve is not adversely affected by local pipework (e.g. TBOE connections on radiators).

Each emitter shall be provided with a flush or countersunk proprietary air cock to suit the style and finish of the said emitter, any unused tappings shall always be capped with countersunk plugs. All such plugs and air cocks shall be chrome plated.

The Mechanical Contractor shall allow for the taking down of all emitters twice for the convenience of other trades.

All emitters shall be hydraulically tested at the manufacturer's works and tested again at site as a composite part of the distribution installation.

All emitters shall be properly filled and vented, adjusted and regulated as necessary to ensure proper distribution of heat.

Where existing emitters are specified as being re-used, all such emitters shall be taken down, flushed through and checked for any damage before being reinstated and reconnected.

2.10. TESTING

2.10.1. General

The general setting to work, regulation and commissioning of the works shall be as detailed in Clause 1.25. of this Specification.

This section covers the testing that is to be carried out to demonstrate the soundness of the works and its ability to perform within the specified operating parameters.

The Mechanical Contractor shall include for all labour, instruments, materials, tools, connections, plant, equipment and consumables as may be necessary to properly conduct the specified tests. The tests to be carried out, may by the nature of the works, require to be completed in sections or stages as opposed to one whole exercise, and it will be deemed that the Mechanical Contractor has included for this fact in the tender.

The Mechanical Contractor shall allow for all necessary valves, drains, blanking plates, plugs, gauges, spigots, dampers, test points, etc., as may be necessary and upon satisfactory completion, to remove such measures as do not provide a useful benefit in the normal operation or monitoring of the system. All materials and workmanship in the provision of such measures shall comply with this Specification. The Mechanical Contractor shall be responsible for supplying or making available as necessary the test medium as required by this Specification.

All test certificates demonstrating that the specified tests have been completed shall be presented in duplicate to the Engineer for his approval, and shall bear the signatures of the Mechanical Contractor's test operator and independent competent witness to the test. Test certificates from the manufacturer's works shall be forwarded in a likewise manner.

The Engineer will be at liberty to test, at the Mechanical Contractor's or supplier's premises, all or any of the materials or equipment to be used in the works. The results of such tests shall in no way relieve the Mechanical Contractor's responsibility to ensure that all the materials and equipment installed in the works are entirely suitable for the applications and conditions of operation.

Any defects of workmanship, materials, performance, maladjustments, non-compliance with this Specification, or other irregularities which became apparent during the tests, shall be rectified by the Mechanical Contractor, at no additional cost to the Contract , and such tests repeated at the Mechanical Contractor's expense until the works are proven free from the defects.

The Mechanical Contractor shall indemnify himself against any claims which may arise as a result of failures under test for which the Mechanical Contractor will be liable. The Mechanical Contractor shall also pursue his own claims in respect of his own works which fail tests as a result of damage by others.

The Mechanical Contractor shall isolate, remove or bypass, any items which have been independently tested of the installations and are not suitable for inclusion in such tests.

The Mechanical Contractor shall give advance notice of when tests are to be completed at site, or elsewhere, such that the Engineer may attend and witness such tests. Under no circumstances shall tests be completed without the presence of the Engineer or the Employer's duly authorised representative.

All services shall, whether specifically detailed or not, be tested in full accordance with the requirements of statutory bodies or authorities, any certification required by them be forwarded in accordance with their own particular requirements.

2.10.2. Hydraulic Testing of Water Based Piped Services

All piped services shall be hydraulically tested with water to a minimum of 4.0 Bar or twice the working head, whichever the greater. Such tests shall be completed prior to the application of any insulation, or concealment of the installation within boxing, voids and the like.

The test pressure shall be applied for a minimum of two hours, during which time there shall be no loss of pressure and the whole installation shall remain dry. A pressure gauge (separate from that on the pumping appliance) shall be installed in the line to verify the test pressure at a point furthest from the said pump.

Upon completion of the test, the water contained within the installation shall be subject to the following:-

(a) If the precommission cleansing operations as specified in Clause 2.12. are to be completed within 48 hours of the testing, then the water may remain at static pressure within the installation. If for any reason the period is to exceed 48 hours, then suitable inhibitor shall be added to reduce corrosion effects.

(b) If in addition to the above there is a frost hazard, the water may be drained from the installation if within 48 hours the precommission cleansing operation is to be completed. Otherwise the water shall be left within the system and dosed with Antifreeze for protection against freezing.

(c) On non ferrous (copper) or suitably corrosion resistant installations (galvanised), the system shall be completely drained of water.

The dosing of water used for pressure testing purposes shall be carried out by a Specialist Sub-Contractor to the Mechanical Contractor, who shall also be responsible for the pre-commission cleansing of the installations.

The Mechanical Contractor's attention is drawn to the inter-relation of pressure testing and pre-commission cleansing operations.

Temporary connections to mains water installations for the purposes of initial filling of systems shall be via a double check valve assembly and in full accordance with the Water Byelaws.

2.10.3. Testing of other Piped Services

Non water based piped services shall be pressure tested using inert bottled gas (e.g. Nitrogen) connected to the installation.

The test pressure shall be a minimum of 4.0 bar or twice the working head, whichever the greater. In the event of the piped service being natural gas, the test pressure shall be a minimum 0.1 bar and all joints checked for leakage with approved solution. Tests shall further be in accordance with the recommendations of British Gas.

The test pressure shall be applied for a minimum of two hours, during which time their must be no loss of pressure other than which could be attributed to temperature fluctuations over the length of the installation. The test pressure shall be verified by a gauge positioned at the extremity of the installation furthest from the bottle connection.

Upon completion of the test, the pressure in the installation shall be safely expelled to atmosphere and the installation left sealed at atmospheric pressure ready to receive priming/commissioning with its service or receive any other such treatment as may be specified.

On all natural gas installations, inert gas (e.g. Nitrogen) shall be used to purge the whole installation immediately prior to livening of the system with gas. The purging procedures as recommended by British Gas shall be followed.

2.10.4. Testing of Welds

The Engineer will be at liberty to have cut out for test up to 2.5% of all welded joints for testing. Should any of these tests fail, a further similar amount of welds shall be cut out. Failure of these subsequent welds, shall require the Mechanical Contractor at his own expense to prove the integrity of the whole welded installation using non-destructive testing techniques.

2.10.5. Testing of Ductwork Leakage

All ductwork, irrespective of pressure classification, shall be leakage testes in accordance with the requirements of DW142, prior to the application of insulation. Only by specific instructions from the Engineer, shall ductwork installations not be subject to the said test.

2.11. STERILISATION OF TANKS, HOT AND COLD WATER SERVICES

The Mechanical Contractor shall allow for all mains water services, hot and cold water services and tanks (cisterns) to be sterilised as generally described herein. These works shall not be carried out until just prior to handover and further to completion of testing. Where the works involve extension of an existing installation, the definition of the extent of the sterilisation works shall be agreed with the Engineer, if not already defined elsewhere.

All sterilisation works shall be carried out by a Specialist acting as a Sub-Contractor to the Mechanical Contractor, the Specialist chosen shall be approved by the Engineer. All works shall generally be in accordance with B.S.6700, although other specifications by Local Water Boards may be followed, providing there is no reduction in standards. The local Water Authority shall be informed when such works are to be carried out.

The Mechanical Contractor shall allow in his tender for all costs associated with the effective sterilisation of the water services including bacteriological analysis and the insertion of valves, spool pieces, drain cocks, temporary connections, phased sterilisation of sections at a time (as may be dictated by the contract programme or nature of the works) and out of hours working.

The sterilisation shall be carried out as follows:-

1. Warning notices shall be displayed at every outlet on the system and at all relevant control valves.

2. All storage tanks shall first be inspected to ensure that all debris and sediment, etc., has been removed. All storage tanks and associated down services, including calorifiers, hot and cold distribution services, and pumped services where applicable, shall be thoroughly flushed with clean water to remove detritus and air. The storage tanks shall then be re-filled, and whilst filling, an appropriate sterilant containing chlorine shall be added gradually to ensure thorough dispersal. This sterilant is to be approved by the local Water Authority. Sufficient sterilant shall be added to obtain a minimum dosage level of 50 parts of free chlorine to one million parts of water 50 p.p.m.). All chlorine levels must be determined chemically (comparator method).

   Each outlet served by storage tanks, shall be run until the chlorine level in and at each of these is above 50 p.p.m. At all times the chlorine level in the storage tanks must be monitored and maintained above 50 p.p.m. by adding more sterilant if necessary. Before the sterilisation of the mains, the storage tanks must be allowed to reach their maximum operating levels.

   All systems and distribution services which are not fed from storage shall be sterilised by injection. Whilst sterilant is being injected, all outlets shall be run until the chlorine level at each of these is 50 p.p.m. This is to be carried out without risk of contamination to any existing services not deemed to be sterilised or the statutory Authority's distribution system.

3. The entire system shall be left fully charged and with a chlorine concentration of not less than 50 p.p.m. throughout. The Specialist shall be responsible for maintaining the system in this condition and ensuring that no water is drawn from it by others. At this stage, all cistern lids and storage tank covers must be in their fixed positions and remain so from this point onwards. After a contact period of not less than 3 hours, tests for residual chlorine shall be carried out at random points on each system. If any of these tests reveal that the chlorine level has dropped below 20 p.p.m., the sterilisation programme shall be repeated until satisfactory levels are obtained. The entire system shall be left undisturbed for a further 12 hours. All valves in the system shall be operated at least twice during this period.

4. Upon successful completion of the sterilisation, the entire installation shall be thoroughly flushed, until the chlorine level throughout each system and at every outlet is below 0.3 p.p.m.

   The Contractor shall ensure that the effluent is directly discharged to main foul drainage and that it complies with the local statutory Authority's effluent discharge regulations. This may require the de-chlorination of the effluent by approved chemical methods and this work shall be carried out by the Specialist.

   The warning notices may then be removed.

5. The Specialist shall arrange for samples of water to be taken for bacteriological analysis after all flushing is complete.

   The techniques for sampling and examination to ensure proficient of laboratory practice, and comparability of results and the interpretation of these results, shall be as recommended in H.M. Government Report "The Bacteriological Examination of Drinking Water Supplies 1982".

   Water Samples shall be collected within 2 hours of flushing in sterile sample bottles from the following points:-

   (i) The incoming mains water service. This shall act as a datum against which all other samples can be compared.

   (ii) The extremities of each of the distribution services sterilised.

   (iii) All individual tanks/tank compartments.

   Samples shall be tested by an independent N.A.M.A.S. approved laboratory and shall as a minimum, be tested for the following:-

   (a) Total viable counts:- 1 day @ 37oC
   2 days @ 37oC
   3 days @ 22oC

   (b) Coliform Organisms.

   (c) E. Coli Organisms.

The biological examination of each and every sample must show the waters to be free from contamination and of a potable standard before the sterilisation programme may be regarded as effective (N.B. the only exception to this will be if the mains water entering the site is conclusively determined to be of poor quality, and this must be confirmed by the local Statutory Authority).

Upon receipt of satisfactory results, the system may be regarded as fully operational. No further or additional work, including draining down shall be carried out on the system without prior consent from the Engineer, as this may result in a resterilisation being called for.

6. The Mechanical Contractor shall obtain from the specialist appropriate reports and certificates relating to the sterilisation programme, and bacteriological examinations, and forward these to the Engineer.

7. Where appropriate (as determined by the Engineer), the Mechanical Contractor, upon successful completion of the sterilisation programme, shall institute a regular daily schedule of water usage which is to approximate normal full-occupancy water consumption. This is designed to prevent bacteriological re-growth within the system. The schedule of water usage is to continue until the end of the contractual period/hand over.

2.12. PRE-COMMISSION CLEANSING WATER SYSTEMS

All heating, chilled water, steam installations and any other such system, shall undergo a pre-commission cleanse, as described hereafter.

Such works shall be completed by a specialist to be approved by the Engineer, acting as a Sub-Contractor to the Mechanical Contractor and shall generally be in accordance with 'BSRIA Application Guide 8/91' "Pre-Commission Cleansing of Water Systems".

These works shall be closely co-ordinated with the pressure testing requirements of this Specification.

The Mechanical Contractor shall provide all valved connections, dirt pockets, drain points, by-passes, temporary connections and the like as may be required by the specialist for proper cleansing of the installation.

The Specialist shall provide all necessary hoses, break tanks, pumping equipment, chemicals, monitoring facilities, dosing pots, filtration units, and the like as may be required to completely and safely cleanse the installation as required.

The Specialist shall ensure that all effluent from the process of cleansing is safely discharged in accordance with the statutory Authority's requirements.

The Mechanical Contractor and the Specialist shall co-ordinate themselves at a sufficient early stage in the works to enable proper provision of facilities. This should extend to other parties on site where the Mechanical Contractor may himself be a Sub-Contractor.

The basic procedure for cleansing shall be as follows:-

1. As a result of pressure testing (2.10.), the installation should be primed with water, including inhibitor and possibly anti-freeze, as appropriate.

   If installations are empty, then they shall be filled and vented.

2. At this stage, all major items of plant (chillers, boilers, heat exchangers, etc.), small bore control valves, terminal units and where applicable minor sub-circuits (i.e. local radiator circuits with small bore copper distribution) shall be by-passed, isolated or removed from the main installation.

3. The main installation shall then be drained and refilled two times, on each occasion emptying strainers, dirt pockets, and distribution headers. The system shall be left full ready for dynamic flushing.

4. The main installation shall then be subjected to dynamic flushing. Such operation shall be carried out twice, first in a forward flush and second in a back flush. The Specialist shall be at liberty to use system circulating pumps for dynamic flushing, but must if necessary provide additional pumping capacity to ensure minimum acceptable flushing velocities (1.25 m/s) are achieved. Isolating valves and by-passes shall be utilised to achieve such velocities in all circuits.

5. The dynamic flushing exercise shall be carried out in such a manner that the primary circuits of the main installation are flushed through first and independant of rising or lateral distribution on the installation.

6. The dynamic flushing should then progress to the vertical distribution on the main installation and then the laterals working from the highest point downwards. Strainer baskets on sub circuits (other than pumps) should be removed.

7. The Specialist shall monitor flushing velocities in all instances with non-invasive techniques, such readings having been witnessed by the Engineer or Employers duly authorised representative. All pump strainers shall be continuously monitored throughout dynamic flushing and cleaned out as necessary to ensure no cavitation problems.

8. Dynamic flushing shall run for as long a period as it takes for strainer baskets to no longer collect sediment and for water discharging to drain to run clear of detritous. It is essential that dynamic flushing of the installation is efficiently carried out such that chemical cleaning is effective.

9. Upon completion of forward and back flushing, the whole main installation shall be generally flushed (velocities not crucial on this exercise) to dilute and replenish the system water. All circuits shall be checked to ensure that circulation is occurring in all areas.

10. Chemical cleaning additives shall be introduced to the system via dosing pots, or by injection methods as determined by the Specialist and circulated in the system for a period again determined by the Specialist (normally 12 to 72 hours).

11. The installation shall be finally drained with the effluent running to a foul drain only. Such effluent must be discharged in full accordance with the Statutory Authority's requirements. Notice to the same shall be given prior to the discharge of effluent.

12 . The installation will, during the discharge period, be subject to static or dynamic flushing as necessary to dilute and remove entirely the cleaning solution from the system. As may be necessary, the installation shall be neutralised to render harmless any remaining chemical and the internal pipe surfaces subjected to passivation.

13. The installation shall be finally treated with suitable corrosion inhibitor added to achieve concentrations recommended by the Specialist. This inhibitor may also include a passivating agent and so become part of the passivation of surfaces as previously referred to.

14. The major items of plant, terminal units, small bore control valves and minor sub-circuits still isolated shall, independently of the main installation, be thoroughly back flushed through with clean water.

15. The sub-circuit strainer baskets can now be replaced and each of the isolated members referred to above shall be systematically brought on line to the main installation and flushed through with dosed water. The by-passes and temporary connections, etc., can be isolated/removed, as appropriate.

16. Finally, the concentration of inhibitor in the whole system shall be checked and adjusted as necessary.

17. The system shall be monitored throughout the course of the works in the event of phased completion and for one month after full handover to check all strainer baskets and inhibitor levels, and to take any corrective action as may be necessary.

18. The Specialist shall submit full reports and certificates in respect of the pre-commission cleanse.

2.13. PAINTING, LABELLING AND IDENTIFICATION

Painting

All surfaces requiring painting shall be suitably prepared by being thoroughly cleaned and keyed.

The Mechanical Contractor shall apply two coats of suitable metal primer to all black steel pipework and fittings to receive decorative finish (by others unless specifically noted otherwise) or insulation finish. Where such pipework and fittings occur in plant rooms, gantries, service shafts, etc., or are generally exposed to view due to breaks in insulation, two coats of black hammerite paint shall be applied.

Galvanised pipework, fittings and steelwork shall be painted two coats of cold galvanising on exposed threads or blemishes on surfaces, however caused.
Copper pipework shall not be painted.

Gas pipework where installed in steel, shall be suitably primed and painted two coats of Yellow Ochre.

Valves, strainers, cocks, plant items and other such proprietary equipment, shall not be painted unless specifically noted otherwise. All such items shall, however, be cleaned of any paint markings received by virtue of painting adjacent services.

All steelwork supplied, and fitted within the works by the Mechanical Contractor, whether it be for pipework bracketing, equipment supports, gantries, platforms, ladders, access doors, etc., shall be suitably primed and painted two coats of black hammerite paint.

Labelling

The labelling requirements detailed hereafter are in addition to those requirements detailed in Part D.1. of this Specification.

Unless specifically noted otherwise, all labelling shall be black on white ivorine labels with lettering/numbering not smaller than 13mm high. All labels shall be fixed by means of pop rivets or screws where attached to walls/equipment casings, etc. (self adhesive not acceptable) and by means of cable ties or similar where fixed to valves, dampers or other such components.

Labels shall always be positioned so as not to interfere with the normal operation of any component and must always be visible from the normal operating position of personnel, etc.

The wording of labels shall generally be in accordance with the wording on the Contract drawings, however, a full schedule shall be prepared by the Mechanical Contractor to be agreed with the Engineer before such labels are ordered and fitted. All labels shall correspond to the operation and maintenance manuals, as installed drawings and charts, etc.
Labels shall be applied to:-

(i) All major items of plant.

(ii) All major components of distribution installations.

(iii) All valves and dampers in plant rooms, service voids and ducts, trenches, compounds, false ceilings, etc.

(iv) Control panels and field control items supplied within the Mechanical Contractor's works.

Labels on valves used for flow regulation, pressure regulation, or form an integral part of a safety circuit (e.g. safety valves, cold feeds, vent cocks, solenoid shut off valves, main gas isolation, etc.) shall be brass discs clearly engraved/stamped as appropriate with reference number, settings, function or other such information as deemed necessary by the Engineer. These discs shall be secured with loosely fitting chain.

The Mechanical Contractor shall provide such labelling and notices as will be deemed necessary by the Engineer in respect of safe operation of the installation.
Identification

The Mechanical Contractor shall provide identification bands to BS1710 on all pipe and duct services after the final application of insulation covering or protective/decorative paint finish. Such identification shall be provided as follows:-

(i) At 8.0 metre intervals on straight runs.

(ii) At all changes of direction.

(iii) Within 300mm in line equipment, valves or dampers.

(iv) At all junctions.

(v) At any point where the building arrangement obscures the normal view of the service from the adjacent identified runs.

The Mechanical Contractor shall verify with the Engineer, prior to application, the extent of identification measures to be applied to exposed services in occupied spaces.

Ductwork identification bands shall be supplemented with direction arrows and wording describing the nature of the duct (e.g. SUPPLY, EXTRACT, RECIRCULATION, FRESH AIR EXHAUST, etc.). Further identification as described in DW142 may be requested at the discretion of the Engineer.

Pipework identification bands shall be supplemented with direction arrows, nominal pipe size, and wording describing the nature of the pipe (e.g. HTG FLOW, HTG RETURN, CHW FLOW, CHW RETURN, HWSF, HWSR, CWDS, MWS, HRS, NATURAL GAS, DRINKING WATER, STEAM, CONDENSATE, etc.).

All symbols, wording and codeing, etc., shall conform to legends and arrangements detailed in the operation and maintenance instructions, record drawings and charts, etc.

2.14. DUCTWORK

2.14.1. General

The Mechanical Contractor shall supply and install all ductwork complete with dampers, fittings, specials and supports, to the sizes indicated and generally as shown on the Contract drawings. Ductwork runs shall be generally as indicated on the Contract drawings, but adjustments may be necessary to suit local conditions, other services and revisions of plant layout. The Mechanical Contractor will be deemed to have allowed in his Tender a sum for variations of this nature. No additional costs will be accepted for revisions of this nature.

The Mechanical Contractor will obtain clearance of all duct runs before the ductwork is manufactured. The Mechanical Contractor shall be responsible for ensuring that the ductwork, hoods, etc. conform to the apparatus or equipment to be installed and also to the building structure and details. Full working drawings shall be submitted to the Engineer for approval, prior to manufacture. Approval of such drawings shall not absolve the Mechanical Contractor from his responsibility to co-ordinate the ductwork installation with other works and plant connections, etc.

All seams, joints and connections to plant shall be so made as to reduce air leakage to a minimum. Internal roughness and obstructions to airflow other than dampers, vanes etc. shall not be permitted. Sharp edges or corners on the outside of ductwork, flanges, supports etc. will not be accepted. Any part of the ductwork where the galvanised protection is damaged during manufacture or erection shall be painted with two coats of aluminium zinc or other corrosion resisting paint.

All rectangular ductwork shall be a minimum of 20 B.G. unless otherwise agreed with the Engineer. All panels shall be stiffened by cross breaking, pleating or beading.

Unless stated to the contrary on the Contract drawings all ductwork shall comply with the latest editions of the relevant HVCA Publications:-

DW/144 Specification for Sheet Metal Ductwork
DW/151 Specification for Plastic Ductwork
DW/191 Code of Practice for Resin-Bonded Glass FibreDuctwork.

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

Bends and offsets shall have a minimum throat radius equal to 1.5 times the width of the duct. Where short radiused elbows are indicated or agreed, due to site limitations, dimensions and internal vane(s) as shown in the HVCA specification shall be provided. All branches from main duct runs shall be swept.

All spiral ducted installations shall utilise prefabricated proprietary fittings where possible.

The Mechanical Contractor's attention is drawn to the requirements of this Specification leakage testing of all ductwork irrespective of classification.

The Mechanical Contractor shall make all necessary allowances for blanking plates, spigot connections, dismantling points, etc., as may be necessary for such tests.

Supports shall be generally as HVCA specification. Where cantilever bracket or other special forms of support are indicated, these supports shall be structurally strong enough to take the load and transfer the load to the building structure.

2.14.2. Flexible Ductwork

Where flexible connections are indicated or required between rigid ductwork and particular components or items of equipment the internal diameter of the flexible duct shall be the external diameter of the rigid ductwork and the spigot served. The use of flexible ducting between rigid sections of sheet metal ductwork to change direction or plan will not be permitted. The flexible ductwork shall be of fireproof construction unless stated otherwise on the Drawing and shall be capable of being manipulated without reduction of cross sectional area.

Flexible ductwork shall be connected to sheet metal ducts and plenum box spigots by worm drive clips or alternatively by any method as recommended by the manufacturers of the flexible ductwork.

Flexible ductwork shall be supported at 2000mm maximum centre with P.V.C. covered 5mm dia galvanised steel rope or metal straps suitably secured to the structure.

Standard flexible ducting shall be 'Euroflex Supertype 140'.

Pre-insulated (thermal) ducting shall be 'Euroflex Thermal Type 200'.

Pre-insulated (acoustic) ducting shall be 'Euroflex Acoustic Type 350'.

All flexible ducting shall be as supplied by 'Specialised Air Movement Equipment Ltd.' or equal and approved.

2.14.3. Regulating Dampers

The Mechanical Contractor shall supply and install in the positions indicated and the drawings and wherever else deemed necessary to achieve proper air distribution, regulating dampers of the type specified hereafter.

The air leakage past such dampers shall be minimal and they shall be free from vibration and chatter under normal conditions of service.

The dampers shall be sited to afford easy access to operating handles or quadrants.

The dampers shall be provided with flanged or spigoted connections as appropriate to the ductwork construction. Any dampers required of a size out of the normal range of those specified shall be of no less quality, details of which shall be submitted to the Engineer for approval.

All regulating dampers shall be rectangular multiblade type served with connections to suit rectangular, circular or oval connections as manufactured by 'NCA Manufacturing Ltd.' types as follows or equal and approved:-

Rectangular:-	MODEL A SERIES 900 CONTROL DAMPER (FLANGED)
	MODEL B SERIES 900 CONTROL DAMPER (SPIGOTED)
Circular:-	MODEL C SERIES 900 CONTROL DAMPER (SPIGOTED)
Oval:-	MODEL D SERIES 900 CONTROL DAMPER (SPIGOTED)

2.14.4. Motorised Dampers

Where damper actuators are not specified as part of a control system package, the type of damper and mounting details, etc. shall be agreed with the Engineer. Any dampers provided as part of a controls package within the Mechanical Contractor's Contract, shall be fitted by the Mechanical Contractor.

All dampers which are operated by hydraulic, pneumatic or electric motors shall be constructed in accordance with the previous clause. The linkages between the propulsion unit and all the damper spindles shall consist of screwed steel rods and clevis pins with brass or nylon bearing surfaces.

The linkages shall be adjusted such that all the damper blades move an equal amount and accurately control the maximum and minimum air quantities.

Where two banks of dampers are connected to a common motor or have two or more motors operate from a master control the Contractor shall ensure that the movement of one damper is proportional to the others. Damper propulsion units shall be securely mounted such that the propulsion units do not flex when operating. The linkage connections to the propulsion unit shall be made in such a manner that undue strain is not placed upon the unit.

The Mechanical Contractor shall be responsible for any damage to propulsion units or dampers caused by incorrect adjustment or installation.

2.14.5. Fire Dampers

The Mechanical Contractor shall provide and install where indicated on the drawings, and wherever else ductwork penetrates deemed fire breaks within the structure, fire dampers of the type specified hereafter.

All fire dampers shall be of stainless steel construction, having 6 hour fire rating, complying with the requirements of BS 476 and DW 142, be of curtain blade type construction (spring operated) whereby operation can be guaranteed in horizontal and vertical planes.

All fire dampers used for building into blockwork, brickwork or concrete, etc., shall be provided with matching HEVAC/HVAC installation frames fitted by the manufacturer. Where fire dampers are to be built into studwork partitioning or similar lightweight construction, the fire damper shall be sleeved in 16 B.G. mild steel and anchored with angle iron either side of the said construction, in accordance with the manufacturer's instructions.

The building in of all fire dampers shall be witnessed and attended on by the Mechanical Contractor. Spacings between adjacent fire dampers and/or frames shall be 225mm minimum.

Fire dampers shall be held in the open position by a resettable fusible link system, rated at 72oC as standard. All fire dampers shall be further supplied with visual position indicators.

Access doors of ample size shall be provided locally to all fire dampers to enable inspection and testing.

Where fire dampers are required of a size greater than the range of that specified, then the quality of such shall not be any less. The Mechanical Contractor shall on such occasions submit full details of proposals to the Engineer for approval prior to installation.

Fire dampers shall be as manufactured by 'NCA Manufacturing Ltd., as follows or equal and approved:-

Series 100:- For use with HEVAC/HVCA frame in new and refurbished masonry construction, etc.
MODEL B - rectangular.
MODEL C - circular.
MODEL D - oval.

Series 200:- For Induct style fire damper use where masonry openings will not accommodate HEVAC/HVCA sub frame. Fire damper to be housed in alternative frame as per manufacturers recommendations.
MODEL B - rectangular only.
Only to be used with prior agreement in writing from Engineer.

Series 300:- Slim line fire damper for use with lightweight stud partitioning or in doors (vertical gravity operation only). Installation framing to be in accordance with manufacturers recommendations. Where installed in a door, matching pressed steel grilles to be provided.

2.14.6. Flexible Joints

Flexible joints shall be provided on all air handling plant inlet and outlet connections and elsewhere on the ducting 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 not be used to take up any misallignment, nor shall they be stressed.

The joint shall consist of, or be protected by, material so as to have a fire penetration time of at least fifteen minutes when tested in accordance with Section 3 BS476, Part 1. The material shall be of the glassfibre cloth type, canvas is not acceptable. The joint shall be not less than 100mm wide (metal edge to metal edge) and not more than 200mm wide.

All flexible joints shall be between flanged ends. The flexible material flange shall be backed by an angle or flat iron flange and the flexible joint securely held between the metal flanges. Riveted, crimped or worm drive secured flexible connections will not be accepted.

2.14.7. Access Doors

Access Doors shall be provided at all positions recommended in DW142 and as shown on the drawings for cleaning down purposes and inspection.

Whether indicated or not, access doors shall be provided at the following:-

Fire Damper assemblies
Regulating Dampers (Upstream)
Coils (Upstream and Downstream)
Humidifiers (Upstream and Downstream)
Filters (Upstream & Downstream)

All access doors shall be of proprietary manufacture and of maximum size relative to the duct in which they are to be inserted. Access doors in curcular ducting shall be in a purpose made transition box on the side of the ducting to accommodate the door.

All access doors shall, where the duct is to be insulated, be of the insulated type also. All doors shall provide an effective airtight seal and be rigid in construction.

The ductwork shall be additionally stiffened as necessary local to access doors.

Where large ducts are provided and it is possible for a man to enter the duct via access doors, such doors shall be lockable and the ducting immediately in front of the doors shall be strengthened to support point loads to be expected. Details of all access doors shall be submitted to the Engineer for approval prior to installation.

2.14.8. Test Holes

Test holes shall be provided as necessary to allow the full and proper commissioning of the installation. Such holes shall be suitably sized to accept commissioning instrumentation and at such positions and configurations to accord with the requirements of the CIBSE commissioning codes and BSRIA Application Guides 1/75 and 1/77. All test holes shall be effectively plugged with re-useable plugs.

2.14.9. Instrument Connections

Instrument connections shall be provided at all positions shown on the drawings, suitably drilled or bossed and screwed to accept the instrument, sensor, other as specified.

2.15. INSULATION

2.15.1. General

All insulation materials shall comply with the Building Regulations to Class 'O' and with British Standard BS 476 in accordance with the following:-

Part 4:- Non combustible
Part 5:- Not easily ignitable
Part 6:- Fire Propagation
Part 7:- Class 1 Surface Spread of Flame

Materials specifications shall comply with BS 3958. Materials shall be tested in accordance with BS 874 and BS 2972. Materials shall be applied in accordance with BS 5970.

All insulation works shall be carried out by skilled tradesmen in accordance with the above and subsequent standards.

All materials shall be applied strictly in accordance with the manufacturers recommendations.

The requirements of this section of Specification shall be met in full unless specifically directed otherwise on the contract drawings, or alternatively detailed later in this Specification.

2.15.2. Damage

Insulation and protective covering shall be:-

Protected during the progress of the works,

Maintained dry as appropriate,

Fabricated to allow for expansion, contraction, maintenance, operation or replacement of equipment without damage to the service or insulation.

Protected against mechanical damage where run exposed on the surface in vulnerable areas e.g. an installation at low level in a corridor may be subject to impact by cleaning machines, trolleys, etc.

The Mechanical Contractor shall take appropriate steps to prevent damage and fouling of new and existing pipework, ductwork and works throughout the progress of the contract. The building and all plant and equipment shall be left clean and free from fouling by insulating materials.

Existing insulation damaged during the installation of new works shall be restored to its original condition using materials similar to those applied to the existing.

2.15.3. Application after Tests and Surface Preparation

Insulation shall not be applied until the systems have been satisfactorily tested, and written approval obtained from the Engineer.

Insulation shall not be applied until any electrical tracing has been completed and tested. The surfaces to be insulated must be thoroughly cleaned down to remove scale, rust, dirt and grease, and painted as specified elsewhere.

2.15.4. Terminations

Terminations of insulation shall be covered with sectional end caps taped into position with 50mm wide adhesive tape.

2.15.5. Walls and Fire Barriers

At fire barriers the integrity of the barrier must be maintained by providing suitably rated fire stopping .

The above requirement shall apply to all ventilation ductwork, except for fire compartment structures where fire dampers will be used.

Where insulated pipes or ducts pass through an external building element adequate precautions shall be taken to prevent the ingress of rain water by fitting cravats etc.

2.15.6. Temperature Range

Insulation shall be suitable for direct contact with the hot/cold face or alternatively be separated by a sealed air space or a higher temperature rated insulation.

2.15.7. Adhesive Joints

A final coating of non-inflammable adhesive shall be applied over the surface of all tape and longitudinal overlap joints to prevent lifting.

2.15.8. Aluminium Sheeting

Where aluminium sheeting is specified it shall be smooth, and of minimum 22 gauge and formed to close fit the insulation with 50mm overlaps on all joints and be secured by cadium plated fixing screws or pop rivets at not more than 150 centres. On vapour sealed services the sheeting shall be secured by approved means so as not to puncture the vapour seal of the insulation covered by the sheeting.

All seams on cladding shall be away from normal view.

Cladding for bends and tees shall be prefabricated to fit neatly with overlap joints. Longitudinal joints shall be secured at 150mm intervals and circumferential joints secured at quarter segments or 100m intervals, whichever is the shortest distance.

Terminations of insulation shall be covered with sectional aluminium end caps secured with cadmium plated fixing screws or pop rivets.

All necessary slip joints in the aluminium cladding and insulation gaps shall be included on steam, HTHW, MTHW pipework, heat exchangers and flue installations to ensure that the insulation and cladding is not damaged by expansion movement.

Sliding joints on external cladding to be made fully weatherproof.

The expansion bellows shall have boxes fabricated from aluminium sheeting 0.9mm thick, lined with preformed insulation sections of the same thickness and density as the associated pipework.

The boxes shall be in halves fitted with easy release catches for access to bellows, and constructed to allow for the operation of the bellows and pipe movement.

Aluminium cladding shall be applied as late as possible to avoid damage.

2.15.9. Polyisobutylene Sheeting PIB

Where polyisobutylene sheeting is specified, it shall be of 0.8mm minimum thickness. The sheet material shall be adhered to the external surface of the insulation and all joints shall be lapped, secured and sealed by adhesive or solvent welding. All jointing and sealing materials and methods of application shall be to the recommendations of the sheeting manufacturer. The whole shall provide a completely weather proofed finish.

2.15.10. Cleaning

All fibrous particles remaining after cutting and fabrication shall be removed by suction cleaning.

2.15.11. Inspection, Access Panels, Instrument and Test Holes on Equipment

Edges of insulation around inspection, access panels and test holes shall be finished with 100mm wide foil faced adhesive tape, the insulation shall be discontinuous to permit their proper use. Other such insulation finish as may be provided shall be terminated in a safe and professional manner.

2.15.12. Thickness of Insulation and Standard of Finish

The Mechanical Contractor shall ensure that the correct thickness of insulation, as indicated in this specification, is applied.

Allowance shall be made by the Mechanical Contractor for sections of the finished insulation to be cut away at 15m intervals to verify the thickness and to make good after the test.

If defects are revealed further sections shall be cut out for inspection, and if further defects are revealed the Mechanical Contractor shall at his own expense remove the whole of the insulation and provide and fix new insulation as originally specified.

Particular attention shall be given to the finished appearance of all insulation and cladding; which must present a neat and symmetrical appearance, running true in line with the service insulated.

Any rough, dented or damaged surface shall be stripped down and re-insulated or covered as originally specified.

All insulation faces where adjoining, shall be tightly butted together. All bends and changes in direction shall, where necessary, be insulated with carefully mitred cuts of insulation.

2.15.13. Clearance around Insulation

Each service shall be insulated separately.

Insulation shall not come into contact with the building fabric.

Sufficient space shall be allowed between pipework, ducting and equipment when erecting to enable easy application of insulation and its finishing, with a minimum clearance between insulation of 25mm.

Insulation to pipework and ducting not requiring a vapour seal, shall finish 20mm short of any sleeve support or other termination and be fitted with an end cap.

Insulation to pipework and ducting which passes through walls on services requiring a vapour seal shall continue through an oversized sleeve. Clearance between the sleeve and an aluminium clad finish, shall be caulked with non-combustible sealing compound. The sleeve shall extend 100mm beyond each face of the wall.

Chilled water pipes and ducts carrying chilled air requiring a vapour seal shall be fitted with purpose manufactured high density phenolic foam insulated supports, compatible with general insulation specified. These shall be as Koolphen insulated pipe and duct blocks as manufactured by Kooltherm, thickness shall be of that specified for the general insulation. Alternatively hardwood block inserts may be used subject to the Engineer's approval.

2.15.14. Fixings

Insulation generally shall be held in position by aluminium foil self adhesive tape on all longitudinal face joints. The self-adhesive tape shall be a minimum of 75mm wide, and further applied at all butt joints and circumfrentially at 600mm centres on all pipework installations. The tape shall be Idenden type T303 or equal.

On larger areas such as ducts and tanks, it may be necessary, to avoid sagging, fix the insulation using self adhesive stick pins in addition to an approved adhesive. The stick pins shall be fixed at 300 centres. The excess projection of the pins above washers shall be removed and the washer sealed using the tape as specified above.

These requirements are subject to any additional finishes as may be specified elsewhere.

2.15.15. Services Requiring Insulation Vapour Seal

Cold water services of any description, chilled water, refrigerant circuits, air conditioned ventilation installations, any surface of service or vessel/tank prone to condensation.

Insulation and protective coverings shall be continuous, dry, complete and sealed where a vapour barrier is required before reducing the service to its working temperature.

2.15.16. Valves, Flanges, Supports etc.

Insulation and protective coverings shall be continuous at all valves, flanges, supports etc. Insulation shall be the same thickness, density and finish as that on the adjoining pipework.

Where insulation is not required, as specifically noted or agreed with the Engineer, it shall be finished 20mm short of any valve, flange fitting or support. Insulation shall be neatly squared off and the end covered with a purpose made cap to suit the covering used.

All valves, flanges and unions in services protected with metal cladding, PIB or other finish, shall be fitted with insulated metal boxes. The boxes shall be fabricated from aluminium sheeting and be lined with insulation securely fixed. The thickness of the sheeting and insulation shall not be less than 22 gauge.

For services where a vapour seal is required, the components shall be well wrapped with insulation blanket and well served with tape to hold in position and maintain an integral vapour seal.

Flanges and unions shall have round boxes, hinged in halves and fastened with easy release catches.

All valves shall have 'D' shaped boxes with easily released catches for access to valves. Valve heads shall be left proud.

All joints on boxes externally exposed and in kitchen areas shall be sealed with a water resistant nonsetting mastic, arranged to shed water and be made fully waterproof.

2.15.17. Ductwork

All fresh air, warm or chilled, supply and re-circulation ductwork, including that which conveys exhaust air to be used in any form of heat recovery process, located internally in voids, false ceilings and builders ducts shall be insulated with Pilkington Rigid (for rectangular ducts) or Flexible (for circular ducts) Duct Insulation with Bright Class 'O' finish. The thickness shall be as detailed hereafter all fixings and jointing methods shall be as detailed in this Specification. The insulation shall be further supported by means of 19-22 swg x 50mm mesh zinc coated steel wire netting to B.S.1485:1983, stitched at all joints.

Where one hour fire protection is specified on the Contract drawings or in Part D.3. of this Specification the insulation shall be a minimum of 40mm thick and all circumferential joints shall be overlaid with 300mm wide strips of 40mm thick insulation securely fixed prior to the installation of the wire netting.

Where such ductwork occurs in plant rooms, tank rooms, boiler rooms, service walkways, gantries, is exposed in areas of general circulation or rooms, it shall be insulated as previously specified, but with aluminium cladding finish in lieu of wire netting.

Where such ductwork occurs externally, and including exhaust air ductwork generally (in order to prevent condensation in the ducting) it shall be insulated as previously specified, but with polyisobutylene sheeting finish in lieu of wire netting.

Minimum thickness of Ductwork Insulation:-

Temperature difference between heated air inside duct and ambient still air	**Thickness**	
	Rigid	**Flexible**
+5 deg.C	25mm	25mm
+10 deg.C	40mm	40mm
+25 deg.C	50mm	40mm
+50 deg.C	75mm	75mm

For Chilled Air, minimum air temperature inside duct	**Thickness**	
	Rigid	**Flexible**
15 deg.C	25mm	25mm
10 deg.C	40mm	40mm
5 deg.C	50mm	75mm

Where the Mechanical Contractor has any doubt on the operating temperatures of the system, he shall consult the Engineer.

Any existing ductwork whose insulated is disturbed as a result of these works shall have its insulation made good as detailed above.

2.15.18. Pipework

The following pipes are not to be thermally insulated:-

(a) HWS Deadlegs

(b) CWDS and DWS equivalents to HWS deadlegs exposed in heated spaces

(c) Open vents in boiler rooms

(d) Gas pipes.

(e) Exposed heating pipework where heat emission is usefully employed and where thermal insulation is not specifically mentioned hereafter.

(f) Drain pipes, drips and other such pipes normally empty.

(g) Dry risers

(h) Overflows

All other pipes shall be insulated as specified hereafter.

All pipework shall be insulated to the thicknesses as detailed hereafter with Pilkington Crown Pipe Insulation with Bright Class 'O' finish. Where services are not specifically mentioned, they shall be taken to be insulated to the same thickness and standard as that service operating at similar temperatures.

Finishes to insulated pipework shall be as follows:-

(i) Where exposed in plant rooms, tank rooms, boiler rooms, service walkways, gantries, in exposed areas of general circulation, etc., the insulation shall be finished in aluminium cladding.

(ii) Where exposed in occupied rooms and spaces with decorative finish, the insulation shall be finished with Isogenopak.

(iii) Where concealed and in areas deemed normally inaccessible (i.e. false ceiling voids, boxing in, and the like), the insulation shall be self finish. This level of finish will not apply in any area where pedestrian or maintenance traffic of any description is intended to pass.

(iv) Where exposed externally, the insulation shall be finished with Polyisobutylene sheeting and aluminium clad boxes.

MINIMUM THICKNESS of sectional insulation shall be in accordance with the following table.

Bore of pipe	**Steam, HTHW**	**LTHW,MTHW,CHW HWS, Condense**	**CWS,MWS Internal**	**CWS,MWS External**
15mm	50mm	30mm	30mm	40mm
20mm	50mm	30mm	30mm	40mm
25mm	50mm	30mm	30mm	40mm
32mm	60mm	40mm	30mm	40mm
40mm	60mm	40mm	30mm	40mm
50mm	80mm	40mm	30mm	40mm
65mm	80mm	50mm	30mm	40mm
80mm	80mm	50mm	30mm	40mm
100mm	100mm	60mm	30mm	40mm
125mm	100mm	60mm	30mm	40mm
150mm	100mm	60mm	30mm	40mm

2.15.19. Buried Steel Cold Water Mains, Gas Mains and Oil Feed and Vent Pipes

Pipework shall be wrapped with two layers of 'Denso' anti- corrosion tape. The wrappings shall be applied to the manufacturers recommendations with regard to width of tape and amount of overlap.

The Engineers approval of the standard of application must be given before backfilling of the trench is carried out.

In addition to the above gas service pipework shall have a finish wrapping of Yellow tape as Manufactured by 'Denso'.

2.15.20. Refrigerant Piping

Discharge and liquid lines shall be insulated with 'Armaflex' Class 'O' system closed cell insulation. The vapour barrier shall not be broken between joints of sectional material or at discontinuities at valves or brackets. The 'Armaflex' shall be installed in accordance with the manufacturers instructions.

2.15.21. Cold Water Storage Tanks and Feed and Expansion Tanks

Where so specified all tanks shall be insulated with 50mm Pilkington Crown Rigid Duct Insulation secured as previously specified and with additional lacing straps circumferentially around the tank at 500 centres. All corners on the tank insulation shall be reinforced with aluminium angular uprights to prevent lacing straps penetrating the insulation vapour seal.

Tanks shall be insulated on all four sides, top and where practical undersides and finished with aluminium cladding.

On tanks of smaller sizes where it is not practical to insulate the bottoms then the tanks shall be lifted and roofing felt placed between the underside of the tank and supporting structure.

All tank insulation and finish shall be fixed in such a manner to allow easy removal of lids.

The insulation shall be suitably shaped to clear flanges, brackets and other attachments. Where manholes occur they shall be separately insulated so that the cover can be easily removed.

2.15.22. Oil Storage Tanks

Oil storage tanks containing 3,500 sec and 950 sec oil shall be fully insulated as specified below.

The tanks shall be covered with 50mm Pilkington Crown Rigid Duct Insulation, secured as previously specified with wire netting and the whole encased in 22 s.w.g aluminium sheeting suitably preformed. External installations shall be fully weatherproof arranged as necessary to shed water.

Longitudinal overlaps of aluminium shall be secured with cadmium plated PK screws 13mm x 300mm centres, the end overlaps at 80mm centres.

The insulation shall be neatly cut away round manholes and mountings, etc.

2.15.23. Calorifiers & Cylinders

Unless supplied pre-insulated cylinders and calorifiers shall be insulated with 50mm Pilkington Crown Lamella with Bright Class 'O' finish firmly wired on with galvanised wire and finished with aluminium sheeting. Chests shall be fitted with a detachable cover.

2.15.24. Boiler Flue Pipes

Flues other than twin wall shall be insulated with 50mm thick Pilkington Crown Lamella with Bright Class 'O' finish firmly wired on with galvanised wire and finished in aluminium sheeting.

2.15.25. Engine Exhaust Pipes

Exhausts from generator, CHP or other such engine appliances shall be insulated with 80mm thick Pilkington Crown pipe insulation with Bright Class 'O' finish, finished with aluminium cladding. The insulation shall be applied to all in line fittings including silencers over the full length of the installation.

2.16 SANITARY PIPEWORK INSTALLATION

2.16.1 Scope

This section relates to the installation of above ground sanitary pipework. In the context of this specification "above ground" shall mean all such pipework within or on the building including any basement(s), but excluding any pipework which has entered the ground, either externally or as a result of penetrating the lowest floor level or an outer wall of the building.

2.16.2 Quality of Work

The works shall be installed and tested in accordance with BS 5572 and The Building Regulations to the satisfaction of the Engineer and the relevant Local Authority Inspectorate.

2.16.3 Plastic Installations

All Plastic installations shall be as "Caradon Terrain Ltd." from their soil, waste and overflow systems product range as follows or equal and approved:-

System 100 Soil
System 200 Waste
System 500 Overflow
System 600 Traps and accessories.

UPVC pipe and fittings shall be to BS 4514.
MUPVC pipe and fittings shall be to BS 5255.
Plastic waste traps shall be to BS 3943.

All pipework shall be solvent welded and installed strictly in accordance with the manufacturers instructions, utilising recommended cleaning fluid and solvent cement. Compression fittings shall be used only where maintenance access is required at traps and rodding eyes etc.

Where possible all plastic systems shall be installed in white unless specifically noted otherwise on the drawings or elsewhere in this specification.

2.16.4 Cast Iron Installations

All cast iron installations shall be as "Glynwed Foundries" from their Timesaver range for soil, waste and ventilating pipes and fittings to BS 416.

All pipework shall be jointed, utilising couplings incorporating electrical continuity clips from the timesaver range installed strictly in accordance with manufacturers instructions.

2.16.5 Copper Installations

All copper installations shall be in solid drawn seamless copper to BS 2871 Table X.

All fittings shall be waste pattern as manufactured by "IMI Yorkshire" installed strictly in accordance with the manufacturers instructions.

Pipework jointing upto 54mm diameter shall utilise capillary fittings with easy radius bends and swept entries. Made bends and sets shall be used in preference to fittings where practicable.

Exposed copper waste and vent pipes within rooms shall be chrome plated.

2.16.6 Pipework General

Pipework shall be arranged as generally indicated on the drawings and follow the contours of the building line. Allowance shall be made for bends, offsets and the like as necessary to comply with this requirement whether detailed on the drawings or not.

Pipework shall be properly stored and be free of burrs, rust, scale or other defect and shall be thoroughly cleaned prior to installation.

Proper tools shall be used for the cutting and assembly of pipes. Any deformation of pipe diameter or undue marking to surfaces will result in rejection of the installation by the Engineer.

During the progress of the works all open ends of pipework shall be blanked off with proprietary plugs or caps.

All installations shall be installed by competent tradesmen in a neat and professional manner.

No joints shall be made within the thickness of any wall, floor, ceiling or where they would be built in unless specifically agreed with the Engineer.

Vertical pipework shall be installed plumb and parallel with the building surface.

Horizontal pipework conveying soil and water shall be installed to a minimum 1 in 40 gradient unless noted otherwise on the drawings.

Long runs of pipework shall be erected so that stresses of expansion and contraction, due to temperature variation, are taken up by expansion joints. Where small bore branches are made to mains remote from anchor points, the branches shall be arranged to form a radium arm so that the axial movement of the main does not stress the connecting fittings.

Where expansion devices are used, they shall be of the same material to the pipe, installed in line with the axis of the pipe and shall be free from compression, tension or torsion. Guide supports shall be provided either side of expansion couplings in accordance with manufacturers recommendations. No offsets will be permitted to wet sections of vertical stacks other than where detailed on the drawing or where the Engineer has been given. Offsets authorisation from where installed shall be formed from large radius 45o bends with relief venting either side of the offset.

2.16.7 Pipework Supports

All pipework shall be fully fixed by the pipework manufacturers proprietary support systems suitable for the type of installation. The distance between pipe supports shall not exceed those dimensions detailed in the following table. In vertical pipe runs there shall always be a minimum of teo equi-distant supports between storey heights, one of which shall be load bearing to support the vertical load of the pipework, avoiding downward movement and the loss of expansion gaps.

Soil stacks shall additionally be provided with an extra bracket at the boss pipe position to ensure correct alignment.

Maximum Pipework Support Distances (Metres)

Pipe Material	Pipe Size (mm)	Vertical (M)	Horizontal (M)
Plastic	32 - 50	1.2	0.5
	75-100	1.8	0.9
Cast Iron	All Sizes	3.0	2.0
Copper	25	2.4	1.8
	35-54	3.0	2.4

Plastic pipes upto 50mm size shall be supported with zinc plated split steel clips with back plates. Pipework over 50mm shall be supported with galvanised steel screw to wall holderbats on vertical and wall mounted horizontal pipework and galvanised steel split band clips with drop rods on suspended horizontal runs.

Cast iron pipes shall be secured with GT 38/GT 39 or GT 40"Timesaver brackets" as appropriate. Vertical and wall mounted horizontal runs shall be built in type or bolted to angle iron framework, channel iron or similar purpose made mild steel bracket. Horizontal pipes supported from the soffit shall be suspended on single drop rods.

Copper pipework upto 54mm size shall be supported with split brass clips with back plates. Horizontal pipes supported from the soffit shall be suspended on single drop rods to bossed split band clips.

2.16.8 Sleeves

Where pipes pass through walls and floors, circular sleeves shall be fitted of the same material as the pipe (or other inert material). The internal diameter of the sleeve shall not exceed the external diameter of the pipework by more than 20mm. Wall sleeves shall finish flush with the surface, whereas floor sleeves shall protrude approximately 15mm above finished floor level. The annular space formed by the sleeve shall be filled with fire resistant material.

Slip on cover plates shall be fitted to pipework upto and including 50mm passing through walls and ceilings where visible in occupied rooms.

2.16.9 Access

Access doors shall be provided on all vertical soil stacks at each floor level and at the base of each stack before entry to the underground drainage installation.

Rodding eyes shall be fitted at the end of all horizontal pipe runs, at junctions and changes of direction where practicable.

2.16.10 Sanitary Fitting Connections

All sanitary fittings, unless specified elsewhere in this document, shall be supplied and fitted into position by others.

All such sanitary ware shall be connected to the soil and waste system utilising trapped connections in accordance with the following schedule.

Schedule of Sanitary Ware Connections

Item	**Connection**
Water Closets	Integral Trap 100 PVC pan connector
Wash Hand Basin	32mm x 75mm deep seal tubular trap
Urinal Bowl	40mm x 75mm deep seal tubular trap
Sinks	40mm x 75mm deep seal tubular trap
Showers and Baths	40mm x 50mm tubular trap

Anti-syphon pipework associated with sanitary fittings shall be provided as detailed on the drawings. Such pipework shall always rise above the fitting overflow or flood level as appropriate before entry to the main ventilation pipe.

2.16.11 Termination of Stacks

Appropriate adaptors shall be utilised for the connection of stacks to the underground drainage installation. Where the base of the stack falls within the domain of above-ground drainage, long radius bends shall be used.

Where stacks discharge to atmosphere they should do so in positions to avoid adverse windage effects. The full bore of the stack shall be maintained and terminate vertically not less than 900mm above any openable inlet to the building with proprietary vent guard or copper wire balloon as appropriate.

Proper fittings shall be utilised where necessary to enable correct weather seal/flashings to be applied by others.

2.16.12 Jointing Dissimilar Pipework

Where it is necessary for dissimilar pipe materials to be jointed, the manufacturers proprietary methods shall be used. Any difficulty in achieving such connections should be referred to the Engineer for verification.

2.16.13 Jointing to Existing Systems

Prior to the connection of any new pipework into an existing system, the said system shall be surveyed and inspected to establish its suitability to accept new connections, general soundness, and areas of the building that will be affected by the completion of such work. The Engineer shall be advised accordingly.

Where practicable the same pipeline material and jointing technique shall be utilised for such connections that "break into" the existing installation. From this point, or where the new works are an extension to an existing system, appropriate proprietary adaptors shall be used.

2.16.14 Overflows

Provide 22mm UPVC overflow pipework to any other such cistern, W.C. cisterns, urinal cisterns, sluice cisterns and whether indicated on the drawings or not, to discharge in accordance with the requirements of the Model Water Byelaws.

2.16.15 Inspection and Testing

Inspections and tests shall be made during the progress of the installation to ensure pipework is properly secured, clear of obstructions and that all work to be concealed is free from defects.

On final completion the whole installation shall be inspected again prior to the commencement of soundness testing.

Soundness testing shall be strictly in accordance with BS 5572 and shall incorporate air testing to 38mm water gauge, to remain constant for a period of at least 3 minutes. Any loss of pressure shall be located by either smoke testing (on non-plastic systems only) or application of soap solution to joints. A water test shall be completed for parts of the system below the lowest sanitary fitting. Upon completion of soundness testing, general performance testing shall be completed to test for self siphonage and induced siphonage in branch pipes, and induced siphonage and back pressure in discharge stacks.

All necessary labour, accessories and tools for the proper testing and commissioning of the installation shall be provided.

Testing shall if necessary be completed in sections to compliment the general construction programme and enable other works to proceed. However a final test of the whole system will also be required.

Full certificates shall be provided upon completion of satisfactory testing and shall form part of the O&M Instructions.

All defects shall be made good prior to acceptance of the works and retested as necessary.

PART III - PARTICULAR REQUIREMENTS

3.1 GENERAL DESCRIPTION

This section of the specification details the particular requirements in respect of the New HVAC Installation & Associated Works at **2 Harewood Place, London, W1S 1BX**

The scope of works shall include, but not be limited to the following:-

- Strip-out of all existing services rendered redundant by the extent of the works to include LTHW heating, H&CWS, drainage, split dx systems, ventilation, controls and control wiring etc.
- Installation of new Toshiba VRF A/C system, Fresh air AHU and ductwork etc.
- New LTHW heating installation.
- New CWS booster, H&CWS installation.
- New waste drainage.
- New Control Panels, Controls and Wiring
- Testing, Commissioning and Water Treatment Services
- Provision of record Information

3.2 TENDER DRAWINGS

The Tender drawings associated with the works are as follows:-

SDA 2380/M1-M14 inclusive.

3.3 WORKING DRAWINGS

The Contractor shall produce Working Drawings for the purposes of installation works at site, and for such drawings to be fully co-ordinated with building details and all trades. The tender drawings if used for this purpose, will be at Contractors own risk.

All working drawings produced by the Contractor shall be issued in triplicate to the CA for comment prior to any works commencing. Working drawings shall be endorsed “FOR CONSTRUCTION”.

3.4 SITE VISIT

The Contractor shall be deemed to have visited site. All site visits shall be by appointment only, arranged directly with the Contract Administrator.

3.5 PROVISIONAL SUM

The Contractor shall include in the tender the Provisional Sums as detailed with the form of make up of tender. Such money shall only be expended with the written authorisation of the CA.

3.6 COMPLIANCE WITH REGULATIONS / CODES OF PRACTICE

The Contractor shall comply with the following, including all amendments thereto current at the time of the Works.

(i) The Building Regulations

(ii) Bye-Laws and Regulations of the relevant Local Authority

(iii) Bye-Laws, Requirements and Regulations of the appropriate Gas,Water and Electricity Supply Authority

(iv) I.E.E. Wiring Regulations

(v) Recommendations of the Institution of Gas Engineers and Gas Safety Regulations

(vi) Regulations under the Clean Air, Environmental Protection and Electricity Acts.

(vii) CIBSE Commissioning Codes

(viii) All Health and Safety Legislation and recommendations applicable to the works.

(ix) All products used in the works, shall, where necessary be listed in the Water Fittings and Materials Directory as authorised by the Water Research Centre.

(x) Any other Statutory Regulations governing the works.

3.7 WORKING CONDITIONS

Working conditions shall be as detailed in the main contract preliminaries.

SPECIAL NOTE:
The Contractor shall particularly note that it is a specific requirement to maintain services to these businesses, Basement/Ground/First Floor Restaurant and Kitchen facility (MacDonalds), and Ground Floor/Basement Shoe Shop (Skechers), at all times throughout the works. Any works that may affect normal operation are subject to agreement with the retail tenants and must be completed out of hours. Modification/alteration works to existing services are subject to further negotiation with the retail tenants and will be detailed in a supplementary information/tender package.

3.8 PROGRAMME / ACCESS

Refer to main contract preliminaries for principal programme dates.

The Contractor is to allow for all necessary overtime working and acceleration costs etc. in order to meet the desired programme and allowable access.

The Contractor shall submit a detailed programme for works within seven days of receipt of order.

The Contractor shall not delay in placing of orders for any equipment, in order to secure delivery to meet the stipulated programme.

The Contractor shall allow for a crane as necessary to remove existing/install new roof mounted plant.

3.9 STRIPPING OUT

The Contractor shall strip out all plant and equipment rendered redundant by the extent of the new works.

No existing materials shall be re-used unless specifically instructed to do so by this Specification, or subsequently instructed by way of variation order.

All equipment shall be removal safety and lawfully disposed of.

The Contractor shall determine the full extent of strip-out from site survey.

Note: Prior to any stripping out, the Contractor shall survey and determine the full extent of existing services in order that the effect of the new works/stripping out can be fully assessed, in particular the impact of maintaining services to the retail tenants.

Stripping out shall include but not be limited to the following:-

(i) Existing LTHW heating installation in its entirety.

(ii) Existing H&CWS installation in its entirety, excluding any local pipework distribution etc where serving the retail tenants.

(iii) Existing A/C installations in their entirety, excluding any systems related to the retail tenants.

(iv) Existing ventilation plant and ducting, excluding any systems related to the retail tenants .

(v) Redundant control panels, control equipment, valves and wiring.

(vi) All existing above ground waste installations, excluding any systems related to the retail tenants.

(vii) **General**

Stripping out shall include all supports, fixtures, frames and the like associated with the particular service being removal.

The C.A reserves the right to identify at site any equipment for retention by the Employer, such equipment being safely set aside by the Contractor. Such equipment will be labelled before stripping out commences.

All equipment removed shall be put directly onto removal vehicle(s), and carted away from site on the same day. Accumulated rubbish shall not be permitted to remain on site. The Contractor will be liable for any acts or vandalism arising from misappropriation of such material.

3.10 PIPEWORK MATERIALS

All pipework associated with the works shall be in a accordance with the following generally as of Part II of this Specification.

3.10.1 Heating & Gas

All pipework Black Heavy Grade Steel to BS1387 65mm and over to be welded and flanged 50mm and below to be screwed with unions. All flanges shall be BS4504/PN16 certain smaller sizes within Plant Rooms etc may be required to be welded where connections are flanged. Final small bore connections maybe copper BS-EN1057-R250 at the direction of the CA.

3.10.2 H & CWS

All pipework copper to BS-EN 1057-R250, with Yorkshire ‘Presfit’ or ‘Tectite’ fittings in order to reduce/eliminate hot-work.

3.10.3 Painting

All black steel pipework shall be painted two coats of red oxide or similar anti-corrosion paint prior to insulation of services.

All steel pipework and ferrous supports which are exposed on view and which will subsequently be ‘decorated’ shall be painted two coats of grey metal primer.

Exposed internal steel supports, shall be primed as above and finished with two coats of black hammerite paint. External supports shall be steel, galvanised after manufacture.

Valves and other proprietary pipeline components shall not be painted.

3.10.4 Pipe Supports

The Contractor shall use a proprietary pipe support system such as ‘BOSS FLAMCO’ or equal. ‘Roof Pro’ or ‘Bigfoot’ support systems for plant at roof level.

The system shall include a suitable rail, drop rods (with ball hangers to allow for pipework movement) and strap type pipe hangers with rubber noise suppression liners and ‘T’ caps. This system shall be used on all pipework.

Additional channel iron, angle iron or similar support brackets/frames shall be fabricated at site to support heavier loadings as dictated by the pipe layout, equipment details and building arrangement. Such details shall be agreed at site with the CA. All external supports etc to be hot-dip galvanised.

3.10.5 Pipe Sleeves

Pipe sleeves shall be of the same material as the pipe which passes through the sleeve, and shall generally be in accordance with Part II of this specification. The annulus created shall be fire stopped with intumescent mastic foam or similar approved product.

3.10.6 Pressure Testing

Further to section 2 of this Specification, the Contractor shall install within the heating or hot/cold water pipeline under test a "Selfseal test Point" for use by the CA, to verify the test pressure being applied. Upon satisfactory results of the test and at the discretion of the CA, the test plug will remain as installed or removed and the opening capped off. All pressure testing shall be hydraulic to 6.0 Bar. The Contractor shall note the maximum working pressures/test pressures of all equipment. The Contractor shall "spade off" or otherwise isolate the existing installation from any pressure testing.

All Testing shall be witnessed and signed for by the CA or his authorised representative.

3.11 PIPELINE EQUIPMENT AND ANCILLARIES

3.11.1 General

The following pipeline equipment and ancillaries shall be used. All equipment shall be of Crane Manufacture unless noted otherwise.

3.11.2 Valves Schedule

(a) Heating

(i)	Isolation	50mm and Below:	D171 (exposed/uninsulated) D171 EXS (insulated) D171 LS (lockshield)
(ii)	Regulation	65mm and Over 50mm and Below	DM940 D931
(iii)	Drain Cocks	Plant / Flushing: General Distribution	DM171 MHULS/25mm D340/15mm

(b) H&CWS

(i)	Isolation	50mm and below	As Heating
(ii)	Regulation	25mm and below	D171LS
(iii)	Drain cocks		As Heating
(iv)	Check Valves		D140
(v)	RPZ	15mm	Watts

(c) GAS

(i)	Isolation	50mm and below	D171

3.11.3 Ancillaries

(a)	Air Vents	Automatic	D2001 AAV
(b)	Gauges	Altitude	150mm Dial/Steelcase 'U' or 'Ring' pattern siphon with lever handle gauge cock
		Temperature	Horizontal or vertical to suit application 150mm Dial/Mercury in Steel
(c)	Test Point	Test Plugs Ltd	EP15EX/Selfseal
(d)	Strainers	50mm and below	D297
(e)	Safety Valves		Nabic Fig TBC
(f)	Dosing Pot		Fernox (3Gallon)

3.12 INSULATION

3.12.1 General

Insulation standards, materials and workmanship etc., shall be in accordance with Part II of this Specification.

Pipework Insulation shall be Rockwool Rocklap 800 H & V Pipe sections applied in accordance with the manufacturer's instructions. The insulation shall be secured by integral self adhesive foil lap with further tape applied along all laps and at all circumferential seams. The whole to be further retained by light gauge aluminium bands at 1.0mtr centres.

Final connections and small bore pipework generally (22mm and below) to be insulated with 13mm Armaflex Class 'O' closed cell insulation to accommodate flexible hoses.

3.12.2 Thicknesses

Minimum Insulation Thicknesses shall be in accordance with the following:-

(a)	Heating,H&CWS Pipework	15∅ to 20∅	30mm
		25∅ to 50∅	40mm
		65∅ to 100∅	50mm

3.12.3 Finishes

All plant room and external insulation shall be finished in 22g embossed aluminium sheeting.

Valve boxes are only required on external insulated services. Internal valves to be fitted with proprietary covers, secured with velcro straps

All insulation located internally and not within a plant room shall be self finish.

All finishes shall be neatly applied and dressed/terminated correctly at all equipment, joints, interconnections etc.

3.12.4 Identification

All insulated pipework shall be identified in accordance with the following.

The Contractor shall provide identification bands to BS1719 on all pipe and duct services after the final application of insulation covering. Such identification shall be provided as follows:-

(i) At 8.0 metre intervals on straight runs

(ii) At all changes of direction

(iii) Within 300mm of in line equipment, valves or dampers

(iv) At all junctions

(v) At any point where the building arrangement obscures the normal view of the service from the adjacent identified runs.

Pipework identification bands shall be supplemented with direction arrows, nominal pipe size and wording describing the nature of the pipe (e.g. HTG FLOW, HTG RETURN, HWSF, HWSR, CWDS, MWS, etc).

All equipment shall be properly labelled in accordance with this specification.

3.13 COMFORT COOLING INSTALLATION (VRF)

3.13.1 General

A “variable refrigerant volume system” shall be provided, manufactured by Toshiba and supplied by AMP Air Conditioning Ltd. The term “variable refrigerant flow” shall be abbreviated to “VRF” in the specification.

The VRF installations are provided for all floors 1st - 5th on an individual basis.

The works shall comprise of a complete package covering the supply, installation and commissioning of the Toshiba system by a “Specialist Contractor”. The term specialist contractor shall mean an approved Toshiba Contractor of Toshiba/AMP.

This specification outlines the design and scope of works. It shall be the specialist contractor’s responsibility to ensure that the VRF systems are installed to the manufacturers instructions.

Necessary equipment, controls, pipework, wiring/fittings and such like to render the installation complete and fully operational, in accordance with all the appropriate installation standards detailed in this specification and in accordance with Toshiba’s design and installation manual.

3.13.2 System Description

The system shall consist of the following components. It shall be the responsibility of the nominated installer to supply and install these system components in accordance with Toshiba Installation Guidelines.

1) Toshiba Super Heat Recovery Multi external air cooled condensing unit*(s)*

2) Toshiba Super Heat Recovery Multi compatible type indoor units

3) Interconnecting U1 & U2 control wiring from Outdoor Unit*(s)* to Indoor Units

4) Interconnecting U5 & U6 control wiring between Outdoor Units (*if required*)

5) Toshiba TCC Link Integrated Controls

6) Interconnecting refrigerant pipe work from Outdoor Units to Indoor Units using Toshiba Y-Branch Kits/Header Kits/ Tee-Piece Kits.

System Operating Range

Mode of operation		**Cooling**	**Heating**
Max. Outdoor Air Temperature	^{0}C db	43	21
Min. Outdoor Air Temperature	^{0}C db	-5	-15
Max. Indoor Air Temperature	^{0}C db	-	29
	^{0}C wb	28	-
Min. Indoor Air Temperature	^{0}C db	-	4
	^{0}C wb	15	-
Maximum indoor Humidity	% RH	80	

The installation shall provide an energy efficient R410A Variable Refrigerant Flow *(VRF)* comfort air conditioning system to the designated areas as per the schematic drawings attached, utilising Toshiba 3-Pipe Super Heat Recovery Multi systems and shall be installed in accordance with relevant codes of practice and regulations.

The systems shall comprise of Toshiba 3-Pipe Heat Recovery Multi outdoor units connected to indoor fan coil units, via the most appropriate and cost efficient combination of Y-Branch Kits.

The system shall be controlled with Toshiba's TCC-Link controls system selected in accordance with the specific control requirements detailed below:

Individual Standard Wired Remote Control per Fancoil, Central Controller cw Schedule Timer per AC system and BMS Interface Controls to suit TREND Operation.

The total refrigerant pipe work circuit can be a maximum linear distance of 125m between the outdoor and the furthest heat pump indoor unit and incorporate a height difference of: -

50m - indoor unit below outdoor unit
30m - indoor unit above outdoor unit

The maximum elevation between the highest and lowest indoor units shall not exceed 35m, in accordance with Toshiba Installation Guidelines. It shall not be necessary to include oil traps, sight glasses, or external driers in any of the pipe work.

All equipment supplied shall have a manufacturer's warranty of at least 3-years on all parts in accordance with Toshiba's warranty guidelines.

Design Criteria

The air conditioning system has been designed and equipment selected to conform to the following design criteria:

Internal Conditions

Summer	22°C db, 50% RH
Winter	21°C db

External Conditions

Summer	29°C db, 21.5°C wb
Winter	-5°C db

System Specification

The systems shall be VRF 3-Pipe Super Heat Recovery Multi and multiple indoor units to provide simultaneous heating and cooling. The system will use non-ozone depleting HFC refrigerant R410A and be able to run with a minimum indoor cooling demand of 2.2 kW.

The air conditioning systems must automatically adapt to the number of fan coil units turned on by the room tenants. The systems shall allow a user-driven operating environment to be established where users can directly request their own choice of temperature and on/off control etc.

The equipment must be suitable for operating on a 220-240 volt, single-phase, 50Hz supply for indoor units and a 380-415 volt, three-phase, 50Hz supply for the outdoor units.

3.13.3 Outdoor Units

Toshiba Model References:

System 1 MMY-AP1202FT8
System 2 MMY-AP1602FT8
System 3 MMY-AP1602FT8
System 4 MMY-AP1602FT8
System 5 MMY-AP2002FT8

Each outdoor unit shall be factory assembled, pre-wired, works tested, supplied with a refrigerant pre-charge and complete with fully sealed pipe work connections. The noise level for each unit shall not be more than 59 dB(A) (for a single condenser) and 63 dB(A) (for the maximum combination of three condensers) when measured 1m horizontally and 1m above the base of the units. The access panel shall be easily removable for servicing. The condensing unit shall be fitted with its own electrical compartment with all necessary electrical and control components. An oil management system is to be fitted, to allow oil transfer between connected outdoor units, thereby ensuring that adequate lubrication is provided to every compressor. Provision must be made to facilitate piping connections to the front or bottom of the unit. The unit must consist of an individual compressor/condenser section and condenser fan housed in a sturdy weatherproof casing manufactured from *Galvatite* steel plate with a Silky shade (Munsell 1Y8.5/0.5) electrostatic spray finish protected to IP X4 and shall contain the following components:

Dual Inverter Driven Twin Rotary Compressors
These are to be contained in a single housing with high-pressure discharge gas, medium pressure liquid, low-pressure gas, oil transport connections and crankcase heater. Each compressor shall be of the twin rotary type, contained in a single housing and driven by a High-Speed Calculation Vector Control Inverter, creating seamless capacity control from 0.8hp upwards to match the connected indoor cooling or heating demand. Fixed speed compressors of any type are not to be used. The compressor shall be mounted on springs and shock-absorbing rubber to minimise vibration.

Heat Exchangers

Each outdoor unit shall be fitted with a main and a sub heat exchanger. The sub heat exchanger is to increase efficiency by providing further sub-cooling to the refrigerant, when appropriate. The two heat exchangers shall be factory constructed of rifled copper tubing, mechanically bonded to aluminium fins. The aluminium fin material shall be coated with a hydrophilic coating to prevent corrosion and to assist condensate dispersal. Each coil shall have a large surface area to minimize noise and maximise heat transfer.

Fan and Motor

The fan shall be a three-blade, flash-wing, low noise type and shall be both dynamically and statically balanced to produce minimum noise and vibration. The fan shall be directly coupled and driven by a drip proof, permanently lubricated variable speed high-efficiency inverter controlled motor. The outdoor fan speed shall be matched automatically to the energy demands of the heat exchanger. The fan shall have a factory set external static resistance capability of 15Pa. However, the fan must be able to be boosted by a simple adjustment to the PCB to overcome a resistance of 35Pa with no loss of performance. A maximum external static resistance of 45Pa must be achievable with no more than 3% reduction in performance.

Suction Line Accumulator

The cylindrical accumulator shall be fabricated from press formed mild steel plates. The accumulator shall have sufficient capacity to prevent any liquid refrigerant from flowing back into the compressor section. The accumulator must be fitted with a heater.

Additional Features & Safety Devices

4-way reversing valve; solenoid valves; pulse motor valves; liquid receiver; strainer; dryer; service valves with gauge ports; high and low pressure transducers; high pressure switch, fuses, over current relay; thermal protectors for compressor and fan motor; recycling guard timer; over-current sensor; compressor suction and discharge temperature sensor and a 3-phase and neutral isolator protected to IP65 containing mains power input, terminals, internal wiring and controls.

3.13.4 Flow Selector Boxes

Toshiba Model Reference:

RBM-Y1122FE

The simultaneous heating and cooling function is to be achieved with the use of Flow Selector Boxes. Generally each indoor unit should be supplied by its own dedicated Flow Selector Unit. However, a Flow Selector must be able to supply multiple indoor units operating as a group if the application allows, but future flexibility with minimal system adjustment must be considered. If a connected indoor unit is only required for cooling, then the relevant flow selector box can be ommitted.

The Flow Selector Box is to be no more than 200mm in height. Each Flow Selector Box is to be powered from the indoor unit via a 5m power and communication lead. A 10m extension kit is to be available to allow a 15m separation between the indoor unit and the Flow Selector Box.

3.13.5 Indoor Units

Each indoor unit shall be from Toshiba's R410A VRF range of units and must operate on 220-240 volt, single-phase, 50Hz supply. It must be fully compatible with all TCC-Link network systems, including a self-diagnostic TCC-Link remote controller or TCC-Link central controller with LCD to set mode, room temperature, timer, louver (as applicable), fan speed and on/off functions. In the event of a fault, a hexadecimal malfunction code will be displayed.

Each indoor unit address is to be automatically set by the system and retained in memory in the event of a power failure. An option to manually set the address must also be available. Electrical isolation of any indoor unit must not affect the operation of the remaining components in the system.

An auxiliary 12V DC output is to be available using the CN32 connection. This can be used to operate a ventilation fan via a relay (RBC-SMFI) when the indoor unit is operated.

The heat exchanger shall be factory constructed of rifled copper tubing, mechanically bonded to aluminium fins. The aluminium fin material shall be coated with a hydrophilic coating to prevent corrosion and to assist condensate dispersal. The coil shall have a large surface area to minimize noise and maximise heat transfer. An electronic expansion valve shall be factory brazed to the inlet of the coil. It shall modulate the refrigerant volume continuously in response to load variations in the room to maintain a precise constant temperature to within +/-0.5°C (the dead band is configurable and may be set as high as 10 K). A fully insulated condensate drip tray must be fitted, which spans the full width of the coil connections and complete with a drain connection point.
All indoor units are provided with a return air temperature sensor.
The heat exchanger will be protected against excessive temperatures both low and high. Cold draughts will be avoided when heating by automatically stopping the indoor fan motor when the heat exchanger is too cold. Excess heat is to be dissipated by operating the indoor fan motor for a further 30 seconds after unit shutdown.

The evaporator fan shall be of the multi-blade type, performance matched to the coil. The fan shall be statically and dynamically balanced to ensure low noise and vibration free operation and be driven by a permanently lubricated motor fitted with maintenance free sealed-for-life sleeve bearings.

Slim Ducted

Toshiba Model References:

MMD-AP0121SPH & MMD-AP0151SPH

The unit will be manufactured from galvanised steel sheet, insulated with closed cell expanded polyurethane foam. An extra high fan speed setting is to be available, allowing a maximum external static resistance of 49 Pa to be overcome. The airflow from the unit is to be configurable from the remote controller to compensate for high ceilings. Air is to return to the unit at the rear via a washable, long life air filter. A knockout is to be provided to allow up to 10% fresh air (un-tempered) to be introduced into the conditioned space. An integral condensate lift pump is to be provided with a 685mm lift capability from the drain outlet.

Chassis

Toshiba Model References:

MML-AP0071BH & MML-AP0091BH

The unit will be manufactured from galvanised steel sheet, insulated with closed cell expanded polyurethane foam and be suitable for concealing behind a facia. It must be complete with a removable flange plate to allow the option of either top, or front discharge. Return air is to flow through washable, long life air filters mounted on the underside of the unit.

3.13.6 Refrigerant Pipe-Work

All pipe-work shall be manufactured using de-oxidised, refrigerant quality copper to BS EN 1057:1996, and must be heat-treated as follows:

6.4mm (1/4") OD to 15.9mm (5/8") OD - Soft, Half Hard or Hard Tempered
19.1mm (3/4") OD to 41.3mm (1 5/8") OD - Half Hard or Hard Tempered

When $1^5/_8$" tube is used, it must be 16 gauge.

The length/height difference parameters and outside diameter of all piping is to be in accordance with the appropriate Toshiba manuals.

All pipe work will be purged with oxygen-free nitrogen when brazing and capped at all other times. The system will be leak tested with oxygen-free nitrogen at a pressure of between 490 and 540 psig for a period of at least 8 hours. The oil balance pipe (if used) will be pressurised separately. The system will be de-hydrated by creating a vacuum deeper than 4 Torr – before the vacuum pump is isolated for a period of no less than 30 minutes. If the vacuum falls during this time, oxygen free nitrogen will be added and the dehydration process repeated until the vacuum is maintained for 30 minutes. Virgin refrigerant (R410A) will be added in liquid form in accordance with Toshiba's requirements.

All interconnecting refrigerant pipe work from Outdoor Units to Indoor Units is to utilise Toshiba joint kits to create the most practical refrigerant piping network. The range consists of:

<u>Tee-Piece Kit</u>

Toshiba Model Reference:

RBM-BT13FE

This kit is to be used when two, or more condensers are to be connected together. It shall consist of components to create tee-pieces for the suction, discharge, liquid and oil balance pipes for all possible pipe sizes required for Super Heat Recovery Multi outdoor units.

<u>Y-Branch Kits</u>

Toshiba Model References:

RBM-BY53FE
RBM-BY103FE
RBM-BY203FE

These kits are to consist of a suction pipe branch, discharge pipe branch, liquid pipe branch and related pre-formed thermal insulation pieces. The branch pieces are to come complete with sockets of varying dimensions to accommodate all potential sizes of refrigerant pipe.

3.13.7 Interconnecting Controls Wiring

The nominated installer shall be responsible for the following interconnecting controls wiring:

2-core, non-polar = Indoor units to Remote Controller *(A, B)*
2-core, twisted, screened, non-polar = Local Area Network *(U1, U2)*
2-core, twisted, screened, non-polar = External Controls Network *(U3, U4 and/or X, Y)*

All electrical wiring, bonding and earthing shall be in accordance with the current edition of BS7671: 2001. The single and three phase voltages stated are EC harmonised voltages, but the equipment shall be suitable for 200-240 volts single phase and 380-415 volts three phase as appropriate.

3.13.8 Controls

The 3-Pipe VRF Super Heat Recovery Multi system*(s)* shall be complete with the following TCC-Link controls.

TCC-Link Remote Controller

Toshiba Model Reference:

RBC-AMT-32E (Standard)

The remote controller shall be mounted adjacent to and hard wired to the indoor units via the AB connections, to provide the user with either local individual control of the air-conditioned space or group control of up to 8 indoor units. The controller shall be manufactured in ABS plastic with a LCD display. A temperature sensor is to be incorporated within the casing to allow the user to set the sensing point at the controller, or at the indoor unit. The controller shall enable the user to interrogate the system and display a hexadecimal fault code in the event of system malfunction. The controller shall display status and provide control of the following primary functions:

- Start/stop.
- Operating mode *(auto, cool, heat, dry, fan only).*
- Temperature set point *(18°C to 29°C).*
- Fan speed *(high, medium, low & auto).*
- Elapsed timer.
- Louver position *(where applicable).*
- Filter check.
- Test run *(heating & cooling)*
- Indoor unit address by system.
- Dead band between heating and cooling.
- Priority indoor unit for mode selection.
- Stratification control.
- Central control address.
- Auto-restart.
- Temperature sensor in use.
- High ceiling compensation.
- Elapsed timer lock.

TCC-Link Central Controller

Toshiba Model Reference:

TCB-SC642TLE (5no.)

The central controllers shall be wall mounted and hard wired to the outdoor unit*3* via the U3, U4 network, to provide the user with individual control of up to 64 master indoor units. The controller shall be manufactured in ABS plastic with a LCD display. It shall be supplied from a 220-240v AC 50Hz power source. A maximum of 10 central control devices must be able to be fitted to a single control network (U3, U4). It must be possible to switch the controller on and off from a remote source via a volt-free contact connected across the A series terminals. The B series terminals must provide operation and general fault outputs.

The controller shall enable the user to interrogate the system and display a hexadecimal fault code for each master indoor unit in the event of system malfunction.

The central controller shall display status and provide control of the following primary functions for each master indoor unit:

- Start/stop.
- Operating mode *(auto, cool, heat, dry, fan only).*
- Temperature set point *(18°C to 29°C).*
- Fan speed *(high, medium, low & auto).*
- Louver position *(where applicable).*
- Filter check.
- Automatic or manual central control addressing – with the further option to provide this from the controller.

In addition the central controller shall facilitate the use of remote controllers *(RBC-AMT32E)* to provide the user with localised control of the air-conditioned space. When remote controllers are used, each master unit must have the capability to control up to 7 slave units if required (all will operate to the same conditions as the master unit).

The central controller can restrict the operation of local controllers, preventing changes being made to:

- On /off settings.
- On/off, mode and temperature settings.
- Mode and temperature settings.
- Mode settings.

When used in conjunction with a weekly timer (RBC-EXW21E) the following configurable relationships must be available:

- Indoor units are turned on/off with the weekly timer and remain open to local override for one time period.
- Indoor units are turned off with the weekly timer and rely on local override to operate for one time period.
- Indoor units have on/off control disabled with the weekly timer and rely on local override to operate for one ON time period.
- Indoor units are stopped and have on/off control disabled with the weekly timer and rely on local override to operate for one ON time period.
- Indoor units have all functions disabled with the weekly timer and rely on local override to operate for one ON time period.

<u>TCC-Link ScheduleTimer</u>

Toshiba Model Reference:

TCB-EX21TE (5no.)

A weekly timer shall be connected either to the central controller and/or each remote controller. It should be connected via a dedicated 4-core lead supplied with the timer. The weekly timer shall be wall mounted and manufactured in ABS plastic with an LCD display. The controller shall provide 3 on/off periods per day in a 7-day cycle with a day omit capability. In addition the controller shall be able to auto-restart the whole system after a power failure and have 100 hours backup memory.

<u>Trend BMS Interface</u>

Toshiba Model References:

RBC-LG1/LTX-21
TCB-PCNT20E

A combination of a Lon Works® interface and RealTime Controls LTX-21 shall allow the Toshiba air conditioning systems to communicate with a Trend BMS. An RBC-LG1/LTX-21 combination shall be hard wired to each indoor unit via the XY terminals on each protocol converter (TCB-PCNT20E), to enable the user to individually control up to 16 master indoor units when connected to a single system. Each master indoor unit is to be fitted with a protocol converter. Multiple interfaces may be connected to a Trend network to enable the user to monitor and adjust indoor units alongside any other integrated building services from a single PC.

The LTX-21 connects directly to the supervisor port on a 2 series Trend outstation to permit all functions and settings to be modified. All of the system fault codes can be passed back through to the BMS that will allow the faults to be managed by the BMS alarm supervisor.

The interface shall permit the user to access the control of the system remotely via the use of a modem connection. In addition the interface shall facilitate the use of Remote Controllers *(RBC-AMT32E)* to provide the user with local control of the air-conditioned space. When remote controllers are used, each master unit must have the capability to control up to 7 slave units if required (all will operate to the same conditions as the master unit).

3.13.9 Condensate Pipework

The specialist contractor shall undertake the supply and installation of condensate pipework form the VRF fan coils.

All VRF ducted fan coils shall be fitted with gravity drainage via the false floor. From this point, condensate pipework shall be installed with a natural fall where possible to the positions indicated on the tender drawings.

Where natural fall condensate pipework is not possible, the specialist contractor shall supply and install suitable condensate pumps.

Condensate pipework should be run in copper pipe, suitably supported and nominally insulated.

Two 54dia condensate drains shall run through the floors and connect into a suitable point on the foul drain via dry trap devices.

3.13.10 Equipment Warranty Maintenance

The complete VRF system shall be subject to a 12 month defects liability period from practical completion. The specialist contractor shall include for the first year’s maintenance of the system.

3.13.11 Commissioning

The complete VRF system shall be commissioned by the specialist contractor in accordance with Toshiba’s engineering data manual.

Both the specialist contractor and AMP shall carry out witnessing of the commissioning and final inspection.

3.13.12 Equipment Schedule

All equipment scheduled below shall be manufactured by Toshiba and supplied by AMP Air Conditioning Ltd, Blenheim House, Blenheim Court, Brownfields, Welwyn Garden City, Herts AL7 1AB. Quotation ref: Status – ra – 15 – 200908 – 2 Harewood Place, Rev 1 latest revision (Tel: 01707-378670).

3.14 NEW FRESH AIR AHU

Supply and set into position a new AHU at roof level. Allow for all craneage and associated coordination, attendance, approvals etc. All craneage work to be carried out on a Sunday. The Contractor shall determine the suitability of positioning the unit during the same operation as the condensing units, etc.

New AHU to be as SWEGON Gold Unit type RX40, of standard W/P manufacture in accordance with the general performance criteria on the drawings. The unit shall be complete with matching TBSA inlet/exhaust dampers and LTHW re-heater battery. The unit shall be commissioned by the manufacturer.

The Contractor shall order the unit with suitable handings and access to suit the configuration required.

3.15 TOILET EXTRACT FAN

Supply and set into position a new twin fan toilet extract unit at roof level. The fan shall be as manufactured by Nuaire, type Quietscroll Ecosmart Twin Fan, model EST9-R. The unit shall be commissioned by the manufacturer.

3.16 GRILLES AND DIFFUSERS

Grilles and diffusers shall be as manufactured by Gilberts and as noted below:-

Perimeter chassis in style fan coil units within architectural boxing shall be fitted with : Fine-Line Linear Grilles, type LH/0/3.9, to be mounted into a prepared opening within the casing. For tender purposes allow for a nominal grille size of 1200L x 150W, to be adjusted to suit fan coil discharge dimensions. Allow for RAL 9010/20% gloss finish.

Horizontally mounted concealed fan coils within the floor void to be connected to Floor Swirl Diffusers, type GFSD 200C, with standard finish.

Within WC’s, extract to be achieved via OPF 150 extract valves. (OPF 100 in cleaners cupboard)

Make-up air to WC’s to be via low level grille, type Broadline Linear Grilles, Type LN/15/16, 300 x 300 (colour TBC).

For all fan coil units, whether perimeter or floor void mounted, each shall be provided with a GFX 600 heavy duty floor grille for return air purposes, to be mounted adjacent the fan coil, standard finish.

3.17 ATTENUATORS

Supply and install duct mounted attenuators to the size noted on the drawings. Attenuators shall be as Allaway Acoustics, type AO2A Rectangular Attenuators. Suitable transition pieces to be provided adjacent each attenuator.

3.18 VENTILATION DUCTWORK

All ductwork and components shall be supplied and installed in accordance with HVCA/DW 144. The Contractor shall produce shop drawings for approval, prior to manufacture or installation. All ductwork to be low pressure.

The installation shall include for access doors at all components, bends and at least 3m intervals on straight runs for cleaning purposes.

Provide and install all necessary fire dampers, VCD's etc., as generally noted on the drawings, to be of Actionair, or equal approved manufacture.

3.19 NEW HEATING INSTALLATION

Provide, install and commission a new heating installation, comprising a sealed system gas fired boiler, at roof level, serving LTHW (55/45ºC), to central AHU heater battery and underfloor heating to landlords communal areas.

The boiler shall be Broag Qunita 65 High Efficiency Condensing Boiler, wall mounted and flued through the wall at roof level. Allow for the manufacturer to supply matching low loss header and shunt pump.

The sealed system expansion equipment shall be as Mikrofill EFD, with N/200/6 expansion vessel.

Heating circulation shall be via twin head inverter controlled pumps of Grundfos manufacture, type Magna D32-120, to be provided with R100 remote controller for commissioning purposes.

All communal heating within the landlord areas shall be as Warmafloor raised floor system, supplied and installed by the manufacturer, complete with manifolds and telestats. Allow for coordinating within raised floor to maximise output to 75w/m². Underfloor heating at ground floor to be conventional with screen on manufacturer supplied 25mm insulation system to achieve min 100w/m² output.

3.20 HOT AND COLD WATER SERVICES

Within the basement level provide, install and commission a packaged cold water booster set rated at 1.5 l/s@5.0 bar. The pump set shall be of twin pump (run/stand-by) inverter controlled complete with all necessary valves, anti-vibration mountings, controls etc as manufactured by Aquatech or equal. The pump control system shall include the manufacturer failsafe control to prevent excessive pressure rise/continual pumping after a power failure situation.

The pump set shall draw from a 1000 litre nominal pre-insulated CWs tank, frame mounted at high level within the boiler room. Allow for 150x75 PFC frame construction to suit. The tank shall include for all normal fixtures and fittings to comply with Water Regulations for potable storage.

The boosted CWS riser shall feed all new tenant toilet accommodation on each floor level (1^{st} - 5^{th}). Within each provide an un-vented local, multipoint, electric hot water heater complete with all necessary fixtures, fittings and discharge pipework. Connect all sanitary ware including IVs on all final connections.

3.21 WASTE DRAINAGE

All for the installation basement - 5^{th} floor of 2No.100 dia x 50 dia cast iron soil and vent pipes to service proposed new tenant WCs and future tea points at each floor level (1^{st} - 5^{th}). The new installations will render the existing external SVP's redundant. Allow for minor offsets in the stack (to be vented) and for connecting into existing main drain connections within the basement area. Provide access doors/rodding eyes at each floor level and at all changes of direction

Within each WC facility, allow for connecting local UPVC waste and vent pipes to all sanitary ware and for testing to the satisfaction of the D.S.

3.22 WATER TREATMENT AND DUCTWORK CLEANING

The Contractor shall allow for a Specialist Sub-Contractor to complete water treatment services to the heating, hot and cold water services.

The specialist shall decommission all existing redundant water treatment services and neutralise the systems before draining down/removal.

The Specialist shall be responsible for the supply of all pumps, tanks, chemicals, hoses, and equipment necessary to complete the works. All certificates shall be forwarded to the CA.

3.17

Heating, H&CWS Services

The Contractor shall allow for the specialist sub-contractor to complete water treatment services to the heating system all as detailed below:

The specialist shall clean water flush, followed by chemical flush, followed by clean water flush, followed by chemical clean and subsequent dosing with corrosion inhibitor incorporating a biocide. All works shall be generally in accordance with BSRIA Application Guide AG 8/91. For the purposes of tendering the water content of the heating system shall be assumed at 1,000 Ltrs.

Water samples shall be taken and independently tested to confirm the effectiveness of the water treatment.

H&CWS throughout the entire building shall be flushed and chlorinated following new works in accordance with BS6700/L8.

Ductwork

All new ductwork shall be installed in accordance with HVCA/TM2/Intermediate Standard.

Attendance by Contractor

The Contractor shall co-ordinate and arrange the specialists work to complement the overall programme. The Contractor shall provide all necessary attendance on the specialist which should be verified with the specialist at time of tender.

3.23 DRY RISER INSTALLATION

A single dry riser installation is to be provided to service the landlord core. The installation shall service 1st - 5th floors, via an inlet breeching adjacent the main entrance at ground floor level, 100mm flanged galvanised (BS 1387) pipework and landing valves at each of the floor levels.

An air admittance valve to be installed at the top of the riser.

All equipment shall be of JD Fire, supply and manufacture to the following:-

2-way Inlet Breeching	: BS 5041 Part 3
Inlet Cabinet	: BS 5041 Part 5 (Colour TBC)
Landing Valves	: BS 5041 Part 2
Landing Valve Cabinet	: BS 5041 Part 4
General Layout	: BS 5306-1 / BS 9990:2006

Upon completion the Contractor shall arrange for a specialist to pressure and flow test the installation and certificate accordingly.

3.24 CONTROLS AND CONTROL WIRING

General

The Contractor shall allow for the following specialist to provide all necessary field control items, control panels in respect of the works and for the installation of all wiring and thereafter full testing and commissioning/verification.

The specialist shall be BMSi Ltd (Tel: 01753-821012, Fax: 01753 821014) in accordance with their quotation, reference: CV/3009/1/157, (Contact, Chris Vaughn).

3.18

Scope of Work

The general scope of work is described below for information. The specialists quotation should be referred to for precise technical details.

(i) To isolate & strip out all existing redundant control installations/equipment.

(ii) To provide 1No. Landlord cabinet control panel, complete with all necessary Trend BMS controllers, relays and wiring to suit, (mounted in roof plant room).

(iii) To provide all new loose controls to be field mounted.
(The Contractor shall allow for installing all pipe mounted controls).

(iv) To fix and wire all equipment, test and commission the entire controls installation.

(v) To provide all necessary earth bonding in respect of the new controls installations.

(vi) To provide all labelling, full panel record drawings and manuals in respect of the controls installation.

The BMS installation shall provide full control and monitoring of all HVAC systems within the building and include for a head end terminal within the electrical intake at basement level.

3.25 INCOMING GAS AND WATER

The existing incoming gas supply is to be disconnected and removed by Fulcrum Connections. A new gas supply and meter will be provided by Fulcrom at the position noted on the drawings. From the new meter position the Contractor shall extend a gas main to roof level, to serve the proposed new boiler plant. The gas meter installation and pipework shall be installed in accordance with details on the drawings, including all necessary attention to venting.

The existing incoming water main and metering shall remain and be re-used. Extend from the existing water meter to serve the BCWES installation. The incoming main shall be fitted with a 32mm Hydrotec “Hydromag” Electromagnetic Water Conditioner, prior to connection the BCWS break tank.

3.26 GENERAL COMMISSIONING

The Contractor shall allow for a commissioning specialist to undertake full waterside and airside system balancing in accordance with CIBSE commissioning codes for the whole building to include the following services:-

- Fresh air ventilation system and AHU
- General extract system
- Toilet extract system
- Fan coil units (secondary air)
- HTG pipework
- Boiler plant
- Controls systems
- Refrigeration systems

For each principal item of plant equipment, the manufacturer shall complete commissioning of the item/system in accordance with their documented requirements.

Full reports to be submitted on completion.

3.27 HANDOVER INFORMATION & EMPLOYERS TRAINING

The CA will insist that Service and Operation Manuals, record Drawings, Wiring Diagrams and Charts etc are all handed over and that labelling is complete on Practical completion of the works. The provision of such information will be precedent to achieving Practical completion.

After the installations are fully completed, tested set to work and handed over to the Employer, the Contractor shall supervise and be completely responsible for the running/supervision of all new installations for a period of **two** weeks following Practical Completion. During this period, the Contractor shall familiarise the Employers' Maintenance Engineers in the running, operating and maintenance of the new installations. The Contractor shall allow for all such time as it is necessary, and where appropriate for the calling out of specialist suppliers and installers of the works to demonstrate their particular installations.

3.28 MAINTENANCE AND SERVICING

Prior to practical completion of the works the Contractor shall present to the CA a full quotation for the proper maintenance and servicing of the whole of the new/modified Installation for the first year, covering the Defects Liability Period. The full extent of the Employers requirement in this respect shall be agreed with the CA prior to Practical Completion. Acceptance or otherwise of such quotation by the Employer shall not in any way relieve the Contractor of any responsibility under the Defects Liability Period.

3.29 CDM REGULATIONS

The works will be subject to the new Construction (Design and Management) Regulations 2007 (CDM 2007) and notifiable to the HSE.

The Pre-Tender Health and Safety Plan has been prepared by the CDM Coordinator and is issued as part of the tender documentation.

The Contractor will be required to comply fully with the Regulations and will be deemed to be the Principal Contractor as defined by the Regulations.

The Contractor should note the hazards within the H&S Plan and allow accordingly in the tender for implicated works.

APPENDIX A
MAKE-UP OF TENDER for MECHANICAL SERVICES in the REFURBISHMENT OF: 2 HAREWOOD PLACE, LONDON, W1S 1BX

For the whole of the works to supply, install and commission the services listed below:

ITEM	DESCRIPTION	Price £	p
1.	Strip out of all existing redundant equipment.		
2.	VRF Installations 1st - 5th floors, including all fan coil secondary ductwork.		
3.	Fresh air AHU and ductwork system including insulation.		
4.	New LTHW heating installation, including gas.		
5.	New H&CWS installation.		
6.	New local toilet extract installations.		
7.	New above ground waste installations.		
8.	Controls and Wiring Installation.		
9.	Dry Riser Installation.		
10.	Provision of record information, resting, commissioning and labelling etc.		
11.	Any other works specified, not included in the above (Contractor to specify). **……**		
12.	Total items 1-11 inclusive.		
13.	Add 1/39th for 2.5% MCD.		
14.	Provisional sum for contingencies.	**£10,000**	**00**
15.	Provisional sum for new incoming gas supply and metering.	**£10,000**	**00**
	Total items 12 to 15 carried to main summary:		