Performance Specification
Mechanical Services
Russell School

December 2014

ATKINS

Plan Design Enable

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Document History

Job number: 5127940		**Document ref:** 5127940/ME/SP/001				
Revision	**Purpose description**	**Originated**	**Checked**	**Reviewed**	**Authorised**	**Date**
P1	For Client Review	MT	RH	ML	EM	Dec 2014
P:\GBEMF\PDG\PC\Documents\Bse01\5127940 - The Russell School - Refurb and Extension\05 Design & Spec\03 Mech\Spec						

CONTENTS

1 PREAMBLE

1.1 Introduction

This document is issued to define the requirements of the proposed Mechanical building services installations for the proposed new build works at Russell School. The package forms part of a develop and construct works whereby the contractor shall be responsible for the final design from RIBA Stage 3 onwards.

The works shall include all of the works described within this specification.

The contractor shall allow for phasing of the works as part of the detail design package for elements of the works contained within this specification.

The Contractor shall design, supply and install the building services generally as described within this document. The Mechanical services shall include all of the works associated with the installation of the heating systems, ventilation services, controls and energy monitoring.

This document shall be read in conjunction with the Employers Requirement Documents and other contract documents.

Following appointment, the Contractor shall develop and complete the outline design information provided within this document and shall complete the design work and details suitable for installation and construction.

Design Work: The outline designs contain information to identify the design requirements of the project. To develop the outline designs suitable for construction the contractor shall prepare and issue: design calculations, drawings and details; technical information for mechanical plant selections based upon the contractor designs; schematic details and tables confirming distribution system design criteria (e.g. pipework, ductwork etc).

The developed design information shall be issued (to employers design team for approval etc) together with necessary technical information to confirm design adequacy.

Construction Work: The Contractor shall carryout the construction of the Mechanical installations to achieve completion in accordance with the contractors' designs and the employers' requirements.

The works shall be designed to comply with Part L2B and Part L2A where applicable, Building Bulletin's for schools and the Non-domestic Heating and Compliance Guide issued by the Department for Communities and Local Government.

1.2 Scope of Works

The scope of the mechanical building services installations shall include but not be limited to;

- The mechanical services design and installation part of this project serving Russell School.
- Carry out Part L calculations and ensure the building meets the target CO_2 emission reduction of 35% below the TER.
- Plantroom including Gas Fired Boiler system, Flues, Pumps, Pressurisation Unit, Dosing, De-aerator/Dirt separator, Pipework, Valves and all ancillaries.
- Gas meter.
- Heat Meters.
- LTHW Underfloor Heating system.
- LTHW LST radiators in stairwells.

- New gas supply and gas pipework services.
- Natural ventilation to comply with BB101 including louvres with actuated dampers, transfer ducts/attenuators and additional mechanical ventilation where required.
- Thermal model on the Building using dynamic thermal modelling software IES Virtual environment in line with CIBSE AM10.
- Heat recovery type mechanical ventilation to WCs, Kitchens, Hygiene rooms and internal areas where not possible to use natural ventilation. Include associated grilles, diffusers, louvres, ductwork, dampers, attenuators, controls and ancillaries.
- Kitchen ventilation system including kitchen canopy, louvres, ductwork, dampers, attenuators, controls and ancillaries.
- Building Management System (BMS) Controls and MCC panel.
- **General**
- Liaise with all parties to ensure the work is carried out in accordance with the overall programme and that all necessary information is made available to other trades to enable due completion of those other works.
- Unless indicated otherwise, all equipment and materials shall be new.
- The Contractor shall ensure that all equipment can be installed in the allotted spaces and shall be provided with adequate access for maintenance and repair as required by CDM regulations.
- All equipment shall be installed in accordance with manufacturers' instructions.
- The Contractor shall take all measures necessary to protect the existing building fabric, fixtures, fittings and services.

The works shall include but not be limited to:-

- Carry out site survey,
- Site measurements,
- Detail design,
- Dynamic thermal modelling to prove that the natural ventilation systems can offset the heat gains to meet BB101 and that the design complies with Part L2A of the building regulations. Include for any renewable technologies and enhanced efficiency services required to achieve the requirements of Part L2A.
- Installation drawings,
- as built drawings,
- co-ordination,
- manufacture,
- provide information to the Building Control Officer in line with building regulation requirements,
- provide requirements for power points and wiring diagrams to the Electrical Contractor,
- production of the as built Energy Performance Certificate
- works testing,
- Removal and disposal of existing mechanical services.
- supply, delivery to site,
- installation, site testing,
- commissioning,
- operational testing,
- making good of defects that may occur during the defects liability and/or rectification period,
- system maintenance during the defects liability and/or rectification period,
- the provision of design, working, as fitted and record drawings,
- the provision of documents and details for inclusion within the Health and Safety file
- the provision of an operation and maintenance manual and building log books,
- demonstrations prior to handover on all systems to the client representatives of the school,
- System Operational Training of key members of the Facilities Maintenance team.

- Provide all necessary labour and materials to form a complete and operational installation.
- Thermal model.

The Contractor shall provide all services necessary for the application of fixed and loose equipment supplied and installed under the contract and any equipment listed elsewhere which shall be provided by others for these works.

Development and construction of the mechanical services systems shall be carried out in accordance with the design criteria and standards of workmanship noted elsewhere within the contract documents and aesthetically acceptable to the Employer's Agent. During the Development and Construction process the Building Services Systems shall be designed to provide the appropriate environment, in accordance with the function and use of the building.

The Contractor shall ensure that any subcontracted portions of the work (e.g. Mechanical Services Works) shall be adequately managed and that any activities associated with sub contracted elements (i.e. Builderswork in connection with the services installations, planning, programming etc) are clearly defined as part of the sub contract process. The contractor shall perform all duties relating to the contract documents.

1.3 Standards of Workmanship

Workmanship shall be of the highest standard and shall be carried out by personnel skilled in the appropriate trade. Unskilled persons shall work only under the supervision of, or in conjunction with, appropriately skilled persons.

Plant, equipment and materials shall be new. Due to the high levels of wear and tear associated with this type of building, plant, equipment and materials shall be suitably durable.

Maximum internal sound levels shall be as indicated in the CIBSE Guides and Building Bulletins. External sound levels shall be in accordance with local authorities and statutory requirements for noise criteria/rating at site boundary using site noise survey information. Due consideration shall be taken where new installations may impact on residential/accommodation areas.

Where trunking, ducts, pipes, conduit and cables etc., pass through fire walls or cavity barriers, fire penetration barriers or proprietary transit system shall be installed to maintain the fire integrity of the wall and gas and water-tight seals shall be provided.

Ease of future maintenance and removal of equipment shall be a high priority in the design, assembly and site erection. All components shall be installed in assemblies so that they are easily accessible for replacement purposes. Where assemblies are mounted in housings, the assembly shall be easily replaceable and accessible. The Contractor shall ensure plant is designed to enable future removal, or able to be dismantled in sections to enable future removal.

Access panels required for routine maintenance shall be secured utilising re-useable machine threaded screws or bolts. Self tapping type screws for this purpose shall not be used. No screw heads (except for labels) shall appear in the faces of instruments and/or control panels.

The Contractor shall take care to run pipework and ductwork etc., in such a manner above false ceilings that it shall enable the ceiling tiles to be fixed in position or to be easily removed. Where access is required to valves, dampers, ceiling void heaters, control equipment, etc. the Contractor shall advise the Employer's Agent and General Contractor of the position and size of removable access panels needed. Details of requirements shall be given early in the contract. Each access panel shall be identified by the fixing of a self adhesive white matt finish painted disc located in the centre of the tile.

Pipework, ductwork and brackets shall not be fixed to ceiling supporting frames. All services shall be independently supported from the building structure thus preventing the possibility of vibration transfer through the building.

The Contractor shall ensure that the safety requirements for all systems are satisfied. All equipment shall comply with the requirements of the Health and Safety at Work Act and Factories Act.

Building Services systems shall be adequately spaced from other services and from the building structure and adequately arranged for proper application of thermal insulation, and to undertake routine maintenance. Domestic hot water pipes shall be suitably separated from domestic cold water pipes to avoid heat transfer. Plant items shall be installed in accordance with the manufacturer's requirements.

All building services plant and equipment shall be labelled to an agreed numbering and item description system. All cable and wiring termination's shall be labelled to an agreed alpha-numeric reference system (maximum 5 characters) on a white background and incorporating the duty of the equipment where this is not incorporated in other labelling.

The Basic and Minimum Standards of Workmanship and Material shall be those specified in:

All design and installation work shall comply fully with:-

- Current Regulations
- Building Regulations
- Building Bulletin's for Schools
- Partnerships for Schools Guidance Documents
- British Standards
- International Standards
- European Standards and subsequent amendments governing such works, together with established design guides
- CIBSE Guides
- BSRIA Guides
- BREEAM
- Good Practice
- Codes of Practice
- Requirements of the Health and Safety Executive and CDM Regulations
- The Control of Asbestos at Work Regulations
- Control of Substances Hazardous to Health (COSHH) Regulations
- Local and Authorities Regulations and Bye-Laws
- Requirements of the Local Water Company and Water Regulations
- Requirements of the Local Authority Public Health Engineers Department
- Local Drainage Authority Regulations
- The Gas Safety (installation and Use) Regulations
- Recommendations of the Institute of Gas Engineers Publications
- Recommendations within publications of the HVCA
- DW144, DW172 and DW154
- Workplace (Health, Safety and Welfare) Regulations
- HSE Approved Code of Practice L8 - The Control of Legionella bacteria in water systems.
- Clean Air Acts
- Environmental Protection Act and associated Technical Guidance Notes
- Employer's Requirements
- Institute of Engineering and technology IET
- Utility Board Regulations and Manufacturers Requirements/Recommendations.
- WRAS publications.

Services shall be so arranged and jointed to permit ease of installation, ease of removal for future maintenance, access to finished works, avoid clash points, termination in similar positions (for ease of operation and maintenance) of all service cocks, stop cocks, drain cocks, air vents, regulation and isolation valves etc. Services shall be installed so as to be self venting through open vent pipework or automatic air vents. Heating appliances shall be complete with all necessary control and isolating valves in all branches, drain cocks at all low points, automatic air vents at all high points, stop cocks and gas cocks to ensure efficient venting, draining, isolation and regulation of the completed installation.

Pipe brackets, hangers, anchor points, guides, sleeves, floor plates, expansion loops and joints shall be in accordance with the system requirements. All services pipework supporting brackets and pipework sleeves shall be designed to enable free movement and natural flexing of the pipework without imparting any strain or stresses on pipework or fittings, bracket support points or any item of plant. Pipe sleeves shall be oversized to enable lateral movements to be taken up in the space between pipe and sleeve. Pipework shall not be held solid at these points by sleeves or branch pipework brackets positioned too close to the main service runs so as to restrict the longitudinal movement of expanding and contracting pipework.

On completion, all Mechanical services shall be cleaned, tested, thermally insulated and put into full commission.

1.4 Sustainability, Energy Usage and Whole Life Revenue Expenditure

The building services shall be installed with due regard to sustainability and low energy consumption.

The building shall be designed and constructed to meet the requirements of Building Bulletins for schools and in particular BB101 Ventilation of School Buildings, BB87 Environmental Design in Schools, and BB90 Lighting Design for Schools.

The entire construction and installation shall be the same or better than the data or details used by the contractor in the Part L2A compliance calculation to ensure compliance is achieved.

1.5 Suitability of Materials and Products

The installation shall comprise materials and products which are new (unless specified otherwise) and shall be suitable for the services and conditions of use normally expected to apply after the installation is complete. They shall be able to withstand the testing and commissioning conditions specified.

All equipment, materials, accessories and enclosures shall have the degree of protection necessary to ensure safe and durable operation under the environmental conditions in which they are to be installed and operated.

All materials, equipment and accessories shall be quality control tested at works by the manufacturer prior to delivery and installed in accordance with the manufacturer's recommendations and in accordance with the Standards of Good Practice to be expected of first class tradesmen.

Materials used shall not use CFC's at any stage of manufacture, installation or subsequent operation except where specified. They shall be free from objectionable odours at the maximum or normal working conditions of operation.

Materials and products used shall not be a fire hazard, and shall not evolve dense or toxic fumes when subjected to excessive heat, such as fire.

Whenever possible products are to be manufactured and/or stocked under one of the following:

BSI Kitemark Scheme
BSI Safety Mark Scheme
From companies of assessed capability to BS 5750
From stockist of assessed capability to BS 5750

No material product or part of installation shall contain the following:

Asbestos products
Urea formaldehyde

1.6 Equal and Approved, Contractors Alternative Proposals

Should the contractor wish to deviate from this specification in any way with regard to the installation of alternatives to the specified equipment this shall be considered (post contract) only on an equal and approved basis. In order to ensure compliance with the technical requirements of this specification, the contractors' alternative proposals shall be clearly communicated, marked, distinguished, highlighted and formally submitted for approval together with a technical appraisal stating all reasons to justify the proposed alternative.

Subject to the above, consideration to alternative products shall not be unreasonably withheld. A 14 day period shall be required to assess the alternative proposal. The alternative proposal shall be communicated in sufficient time to ensure compliance with the project programmed time-scales.

The suppliers / manufacturers' bona fide invoice or price list (including trade discount) for any approved alternative goods or equipment shall be used as the basis of cost adjustment. Increased costs to the contract sum shall not be permitted. Costs for transportation, insurance, storage etc. shall not be considered over and above those included within the tender price for the specified equipment.

The clients' representative reserves the right to reject any goods or equipment installed without adherence to the above process at any time before expiry of the defects rectification period. Rejected goods or equipment shall be changed without additional cost to the contract sum.

1.7 Tender, Design Development Information and Working Drawings

At Tender Stage the Contractor shall provide a list of proposed major equipment and manufacturers with consideration given to the Part L requirements, a price Breakdown for all Building services together with names of the Building Services Contractors.

Submission of these documents shall not be considered as an approval of Tender qualification. It shall be the responsibility of the Contractor at all stages to ensure that the complete design and installation complies with the specification in every respect. Any proposed deviation from the Employers Requirements shall be highlighted separately and confirmation of acceptance of variation shall be obtained in writing from the Employer's Agent prior to proceeding with the design.

Prior to undertaking the work the Contractor shall provide a detail design package production drawings, working drawings, plant selection schedules, installation drawings, builders work drawings, design calculation and specifications and issue same to the EA for records and comments.

The Contractor shall provide two copies of each working drawings for comment by the EA. These comments shall be incorporated by the Contractor on future revisions. The E.A's comment shall not relieve the Contractor of contractual responsibilities and obligations. The Contractor shall be responsible for any discrepancies, errors or omissions on drawings or other documentation issued as part of the design submission, whether or not those documents have been commented upon by the E.A, provided such discrepancies, errors or omissions are not as a result of incorrect information issued in writing by the E.A. The Contractor shall be shall ensure that all goods, equipment and services are performed in compliance with the specified requirements.

The Contractor shall provide the following drawings post tender for comment by the EA. The drawing standard shall comply with BS308, BS1192, BS 5070 and BS EN 61082 with key symbols, notes etc. In addition to production of the drawing these shall be proof checked by the Contractor prior to submission, checked and signed by competent authorised personnel with appropriate title box, revision numbers etc fully noted.

- Site plan showing routes of existing and new services including pipework, cable work, gas, water, drainage routes where they have a bearing on the new works. A below ground services drawing is available upon request.

- Builders work drawings, showing foundations, supporting structures, holes, ducts, and bases required to be provided.

- Installation drawings, showing the Contractor's proposals for the execution of the services elements comprising the building services and drainage works, including coordination details and fixing details where necessary.

- Equipment drawings, showing details of major equipment manufactured by specialist suppliers.

- Control drawings, showing functional relationships of the control system to the system controlled, and describing the controls operation and associated interlocking.

Working drawings and documents, including diagrams and schedules, shall show the details of the Contractors Proposal's for the execution of the works and shall include everything necessary for the following purposes:

a) To illustrate in detail the arrangement of the various sections of the works and to identify the various components.

b) To integrate and co-ordinate the works with the detail of the building structure and other installations, including the mechanical services.

Installation drawings shall include:

a) General layout drawings showing the location of plant and equipment, associated pipework, heat emitters, access panels and controls, general layout drawings of water services (minimum 1:50 scale).

b) General layout drawings showing location of grilles and diffusers, associated ductwork and controls (minimum 1:50 scale).

c) Assembly drawings of factory built equipment and site built assemblies.

d) Detailed layout drawings showing the connection of heating, gas and domestic water services to mechanical equipment and sundries (minimum 1:50 scale).

e) Detailed layout drawings showing sections through bulkheads, voids and ducts (minimum 1:20 scale).

f) Detailed Manufacturers Wiring Diagrams of mechanical plant and Control Wiring Drawings.

The Contractor shall visit the site before tendering for the project and before commencement of the work to establish all necessary site information for the design and execution of the work.

The Contractor shall carryout investigations with the appropriate statutory authorities and carry out site survey work to be satisfied as to the nature and location of any services and obstructions and the adequacy of any incoming services and drainage based on the project load requirements. Any concerns regarding incoming services and drainage shall be notified at the time of tendering and costed separately. The Contractor shall initiate communication immediately on award of the Contract with appropriate public utility companies for all incoming services and drainage to ensure no delays in programme.

1.8 Inspection and Testing

Provide for progressive inspection and testing of building services during construction such as, but not restricted to, pressure tightness of pipework, air tightness of ductwork, earth continuity of electrical conduits, cables and equipment.

Provide suitable notice for witnessing of tests which may comprise part or the whole of the installation.

Provide all necessary tests equipment and consumables for progressive inspection and testing. Tests certificates shall be signed, witnessed and dated by competent personnel before being forwarded to the EA.

Provide records of all progressive inspection and testing for inclusion in the Operation and Maintenance manuals.

1.9 Commissioning and Testing

Prior to sectional handover of the completed building services for each section the building services installations shall be put into commission and tested to demonstrate correct operation of the installation in accordance with the specification.

The system shall be demonstrated and training shall be provided to authorised personnel nominated by the client in the use of the plant and all Emergency Procedures. An O & M manual shall be handed over during this meeting and a signed document forwarded to the EA to indicate that the system has been commissioned and O & M manuals have been handed over.

The EA shall be informed at least one week prior to this handover meeting taking place.

The Contractor shall visit the site during the heating season and re-adjust the system as necessary to the satisfaction of the Establishment.

Commissioning shall include for the advancement of the services installations from static completion to full working order and adjusting the system to the specified tolerances.

Commissioning and testing shall be in accordance with the appropriate codes and guides of the Chartered Institution of Building Services Engineers, HVCA Guides, the Institution of Electrical Engineers, Chartered Institute of Plumbing and Heating Engineers and British Standards Institution.

Commissioning and testing of certain specialised installations shall, for reasons of safety or commercial confidence, be subject to established standard practices.

The commissioning and testing process shall ensure that control system functions, emergency circuits, alarm circuits, safety controllers, electrical overloads and the like are demonstrated to operate satisfactorily.

Commissioning tests shall be witnessed by a competent and qualified person. Prior to the tests being initiated a check list of the tests to be performed shall be forwarded to the EA for information and comment at least two days before the tests are due to commence. Any abortive time incurred by the EA spent in witnessing tests shall be charged to the Contractor.

Provide all necessary spares, fuel and consumables used during the commissioning and testing processes.

Provide and maintain records of all commissioning and testing for inclusion in the Operation and Maintenance manuals.

Commissioning and Efficiency Tests

General

Before the user occupies the premises it is necessary for the building and the services thereto to be put into commission and set to work. The services shall be clean, dust free and operating in a settled down condition, providing a clean environment, to minimise access and attendance by the Contractor's commissioning personnel.

The installation shall be systematically cleaned, section by section as the work progresses, section tested and temporarily sealed to facilitate the full system tests.

The Contractor shall carryout seasonal commissioning during the first year of occupation to cover all building services systems. This shall include the testing of all services under full loads (i.e. heating equipment in mid winter, cooling equipment in midsummer), part loads (spring/autumn) and during periods of extreme (high or low) occupancy.

Prior to the commencement of commissioning, the Contractor shall advise the Employer's Agent, giving fourteen days' notice, when the Employer's Agent is required to inspect the works to establish final lists of snags.

Separate Senior Commissioning Engineers of the Contractor for the Mechanical works, fully experienced in commissioning techniques for building services, shall carry out the commissioning activities by following the Project Engineer's direction. Progress and problems shall be reported on a weekly basis.

All water circuits shall be balanced, by the regulating valves provided, on a temperature and pressure basis.

Generally commissioning procedures shall comply with "Commissioning Codes" published by the Chartered Institution of Building Services Engineers, for the appropriate service and procedures, checks and tolerances given in BSRIA Application Guides. Use record sheets as described in BSRIA Application Guides.

Should it be necessary for the installations to be commissioned under mild weather conditions and it is not possible to check the full design performance in relation to the external temperature the Contractor shall carry out the above check when suitable conditions occur, and give at least 14 days notice to the Employer's Agent when he has arranged for the access to the building etc.

Details of all double regulating valve settings, thermostat, compensator, time-switch, and all control settings shall be recorded in the operation and maintenance manuals, together with details of flow rates etc.

Each system of ductwork shall be completely balanced so that each branch duct, together with its air diffusers and grilles are carrying the required quantities of air. All diffusers and grilles shall be regulated by means of the regulating dampers provided to ensure they are correctly balanced.

Air flow test results on site including test results of air flow balancing shall be properly tabulated on schedules or drawings and submitted to the Employer's Agent.

The Contractor shall, in conjunction with the Electrical Contractor and Controls specialist, test, commission and set up the automatic controls to suit the design and requirements of the building occupants.

Test certificates containing details of all control settings shall be submitted to the Employer's Agent.

The contractor shall conduct a commissioning validation visit to the site/building when occupied by the Employer, one month prior to the end of the twelve months "Defects Period" to check the operation of the systems and, if necessary, re-adjust the balancing of the systems and control settings.

1.10 Operation and Maintenance Manuals

The following details are indicative of the Operating and Maintenance requirements for a new and complete installation and shall form the basis of the requirements for the extended parts of the installations required by this specification.

Provide two hard copies and two electronic copies on CD of all necessary operation and maintenance manuals and information prior to the date of Practical Completion of the Works.

The Contractor shall provide Operating and Maintenance manuals containing full documentation and CAD 'Record' drawings incorporating retained and modified existing services, as well as the new services installations, to provide a complete and clear set of information for all the buildings services. The O&M manuals shall be in accordance with BSRIA - Application Guide for O & M Manual for Building Services installation.

Copies shall be forwarded to the Project Manager in draft form for comment before official issue. The official issue shall address all comments made on the draft copies.

The operating and maintenance manuals shall include, but not be limited to, at least the following:-

- A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided.
- A description of the mode of operation of all systems including services capacity and restrictions.
- An index of record drawings.
- Diagrammatic drawings of each system indicating principal items of plant, equipment, valves etc.
- Details of how to re-commission so that complex plant services within the building can be recommissioned by an engineer without any historic knowledge of the systems.
- A set of "full size" drawings
- Legend of all colour-coded services.

- Schedules, system by system of plant, equipment, valves, etc., stating their locations, duties and performance figures. Each item shall have a unique number cross-referenced to the record and diagrammatic drawings and schedules.
- The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list numbers.
- Manufacturer's 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.
- A copy of all Test Certificates, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, corrosion tests, type tests, boiler flow and return temperatures, hot water storage/flow/return and tap discharge temperatures, cold water storage, water flow rates at taps, start and commissioning tests) for the installations and plant, equipment, valves, etc., used in the installations.
- A copy of all manufacturers' guarantees or warranties, together with maintenance agreements offered by Specialist Contractors and manufacturers.
- Copies of Insurance & Inspecting Authority Certificates and Reports.
- “Functional Check List” for Automatic Controls.
- Full description of the control system and brief description for resetting controls for non-technical personnel.
- Start up, operating and shut down procedures for all equipment and systems installed.
- Control sequences for all systems installed.
- Schedules of all fixed and variable equipment settings established during commissioning.
- Detailed recommendations for the preventative maintenance frequency and procedures which shall be adopted by the Employer to ensure the most efficient operation of the systems.
- Details of lubrication systems and lubrication schedules for all lubricated items.
- Details of regular tests to be carried out
- Details of procedures to maintain plant in safe working conditions.
- Details of the disposal requirements for all items in the works.
- A list of normal consumable items.
- 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.
- A list of any special tools needed for maintenance cross referenced to the particular item for which required.
- Procedures for fault finding.
- Emergency procedures, including telephone numbers for emergency services.
- Back-up copies of any system software.
- Documentation of the procedures for updating and/or modifying software operating systems and control programs.
- Contractual details of design team, consultants, installation Contractors and associated specialists; start date for installation, date of practical completion and expiry date for the defects liability period; details of warranties for plant and systems including expiry dates, addresses and telephone numbers.
- Building Logbook as required by Building Regulations.

System descriptions to include data on general design parameters, normal associated operating conditions and manufacturers information concerning correct operation, etc.

Copies of all items incorporated in the plant room and switch room schedules and schematics.

Manuals shall be A4 size, in plastic covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover titled. Drawings larger than A4 shall be folded and accommodated in the binders so that they may be unfolded without being detached from the rings. Each binder shall be a maximum of 66% full to facilitate easy turning of the pages. The

Contractor shall provide one electronic copy on CD and 2 hard copies of the manuals and as fitted drawings.

In addition building log books shall be developed and provided to give details of installed services and controls and their correct operation, in accordance with Building Regulations Part L2 requirements and generally as defined within CIBSE guidelines TM31. The building logbook is independent from the building O & M manuals.

1.11 As Fitted Drawings

As Fitted / Record drawings shall be provided no later than practical Completion of the Works, for comment. All final cable, ductwork and pipework routes plus actual location of equipment shall be indicated on these drawings. After receipt of any comments the Contractor shall incorporate such comments and supply two sets of prints and two electronic copies on CD of the record drawings within ten working days.

The Contractor shall produce ‘as fitted’ drawings to show the location of mechanical services installed and altered during the works. The ‘as fitted’ drawings shall include plan layout drawings and schematics of the installed works.

Prepare Record Drawings and Schedules to a scale not less than 1:50. Endorse all such documents "AS FITTED". Where agreed with the Engineer certain detailed information may be provided in schedule form.

Record drawings shall be cross-referenced to other record documentation where this is necessary for ease of use by the end user during fault finding and maintenance.

Record drawings shall be produced by a CAD system and shall be in accordance with BS308 Part 1:1993, Part 2:1985 and Part 3:1990, BS1192 Part 5 and BS5070. All symbols used on electrical drawings shall be strictly in accordance with the relevant parts of the British Standard for graphical symbols, BS3939.

The record drawings shall also show any other information, even if previously shown on working drawings, which may be useful in the operation, maintenance or subsequent modification or extension to the installation. The drawings shall show reference numbers or letters for the controls plant items or any parts thereof, corresponding to the lettering, numbering or any other identification fixed to plant or equipment.

Record Drawings and Schedules shall include, but are not limited to

a) Schematic drawings of each system indicating principal items of plant, equipment, zoning, means of isolation, etc. in sufficient detail to make it possible to comprehend the system operation and the inter-connections between various systems. Drawings shall also indicate the names of the manufacturers, model and type numbers and all details of duty and rating of all items of plant including thermostatic control equipment where fitted.

b) Details of the principles of application of automatic controls and instrumentation.

c) Diagrammatic dimensioned plans and sections of each system or service showing sizes and locations of all ancillaries, plant, equipment controls, test points, and means of isolation etc. including any items forming an integral part of the engineering systems provided by others (such as plenum ceilings, builders' work shafts, chimneys etc.).

d) Identification of all terminals/cables etc. by size/type and duty/rating as recorded from the approved commissioning results.

e) Detailed wiring drawings/diagrams/schedules for all systems, including controls, showing origin, route, cable/conduit size, type, number of conductors, length, termination size and identification, and measured conductor and earth continuity resistance of each circuit.

Ensure routes indicate if cable/conduit is surface mounted, concealed in wall chase, in floor screed, cast in-situ, above false ceiling etc.

f) Details of co-ordination of wiring and connections with cable core identification, notation of fire alarm, security, control and instrumentation and similar systems provided as part of the Works.

g) Manufacturers' drawings of equipment indicating:-

General arrangement and assembly of component parts which may require servicing.

Internal wiring diagrams together with sufficient physical arrangement details to locate and identify component parts.

Schedules as required to locate reference and provide details of ratings and duty of all items incorporated into the Works together with all fixed and variable equipment settings established during commissioning.

h) For each programmable control item, schedules indicating:-

For each input and output point connected, full data in respect of that point including reference, type of input/output, connected equipment reference, set values of temperature or pressure etc., set values of start/stop/speed change times, alarm priority, control specification reference and any other such parameters as are applicable.

Each spare input and output point including reference, type of input/output and space for future entry of appropriate parameters as listed above.

Logic flow diagrams for each individual control or monitoring specification and for each building services engineering system to illustrate the logical basis of the software design.

Schedules setting out details of all initial values of user-defined variables, text statements for alarm messages etc

In addition to the provision of record drawings, framed, glazed plantroom signs, schedules and schematics shall be provided fixed to the wall of plantroom, which shall comprise:-

- Schematic diagrams of the electrical distribution.

- Circuit layouts, showing identification and duties of equipment, numbers, locations, controls and circuits.

- Valve schedules showing number, size, type, location, service and normal operating positions of each valve.

- Drawings including site services, layouts and schematics shall be signed by a competent person prior to forwarding to the EA indicating that the drawings have been checked.

- Control functional diagrams.

- First aid instructions for treatment of persons after electric shock. Fire protection and warning notices. All notices required under statutory or other regulations.

1.12 Training of Employer's Staff

The Contractor shall explain, demonstrate and instruct the Premises Manager, and / or other nominated representatives as to the purpose, function and operation of the building services and automatic controls, together with the maintenance requirements and frequency of maintenance. This shall be conducted two weeks prior to practical completion and shall be arranged after the various systems have been set to work, demonstrated and proved in accordance with the project requirements. The demonstration shall be delivered to the Employer's Agent and client representative and sufficiently for acceptance by all parties.

1.13 Fixing to Structure

All fixings to the building fabric shall be detailed by the Contractor.

1.14 Existing Services

The contractor shall carry out a survey of the existing services to gain familiarity with the operational features to ensure that interconnection of new services shall not cause existing systems or services to malfunction. The contractor shall advise the Project Supervisor accordingly.

Where interruption of existing services is unavoidable the work shall be carried out in accordance with the agreed programme of works with service interruption time scales clearly indicated. The contractor shall coordinate the shut-down of existing services with the caretakers and the local management staff to ensure that the programme of works is agreed by all interested parties. Final agreement of the programme of works and the interruption times shall be obtained from the Project Manager.

1.15 Utility Board Approval/Public Utilities

The Contractor shall be responsible for obtaining all applicable statutory approvals from the Local Authority and Approving Bodies as appropriate for this package. Where applicable, these shall include but is not limited to the electric, gas, drainage and water supply, Building Control Officer, Fire Officer and Environmental Health Officer. Approvals shall be sought and received prior to commencement of the works.

The Contractor shall make all necessary allowances in the tender price for negotiations with the public utility companies, associated utility companies fees, all necessary notices, liaising and placing an order, co-ordination of services etc.

The Contractor shall confirm with the utility company the specific requirements of his proposed scheme.

The Contractor shall co-ordinate all works of the statutory authority/authorities (or contract gas supplier) concerned, in relation to their incoming supplies in close co-ordination with all parties concerned.

1.16 Manufacturers Recommendations

The Contractor shall install all equipment strictly in accordance with the manufacturer's recommendations and requirements.

1.17 Cleaning of the Mechanical Installation Plant & Equipment.

The Contractor shall carryout thorough cleaning of all plant and equipment and associated services installed under this contract.

During the progress of the work the Contractor shall supply and fix protective sheeting to minimise the cleaning work and to prevent internal damage to working parts and to other trades and services.

Final cleaning work shall be carried out after the application of thermal and sound insulation, painting etc has been completed.

1.18 Maintenance During Defects Period

The Contractor shall carryout routine maintenance and servicing of the new installation works relating to this contract during the 12 month defects period, including any specialist maintenance which may be required.

The Contractor shall provide as part of the O & M Manuals a complete planned preventative maintenance schedule, complete with asset registers, defining routine maintenance and servicing tasks by action and frequency for each service installed under the Contract. This schedule shall be prepared at an early stage to enable the Employer's Agent sufficient time for approval.

1.19 Asbestos

Prior to the contract commencement date, the Employer shall arrange for a project specific Refurbishment and Demolition survey to be undertaken (in accordance with HSG264). The resulting survey report shall clarify if Asbestos Containing Materials (ACM's) are present and what actions need to be undertaken.

The results of this project specific R&D survey (along with the briefing document under which the survey is to be undertaken) shall be presented to the Contractor as soon it becomes available. Should the report recommend that asbestos works are required; these shall be added to the contract works and executed by the Contractor. The Contractor shall employ the services of an Asbestos Removals Specialist. That specialist shall be the holder of a current Asbestos Removals License issued by the Health & Safety Executive and shall carryout the asbestos removals work in accordance with the Control of Asbestos Regulations 2012.

The Contractor shall not carry out work in areas outside of the project specific survey areas. If subsequent works are intended by the Contractor outside of the asbestos survey areas then Contractor shall inform the Project Manager/Supervisor via an early warning notice and then appoint and manage the asbestos specialist to carry out a supplementary R&D survey (in accordance with HSG264). The Contractor shall then carry out any asbestos actions resulting from the supplementary report in accordance with the Control of Asbestos Regulations 2012 as described above.

The asbestos work shall be completed prior to the commencement of the original Contract works.

Should the presence of further asbestos be suspected within the works area, the contractor shall immediately cease work in that area and inform the Project Manager/Supervisor. If necessary, further supplementary survey work would be required as above.

2 GAS SERVICES

2.1 Performance Objectives

To design, supply, install, test and commission a new gas supply to serve new gas fired plant and equipment in Russell School.

The installation shall be designed and installed in accordance with The Institution of Gas Engineers guides, the CIBSE Guide and the requirements of the gas supplier and shall comply with all relevant current British Standards, Health and Safety Executive Regulations or Guidance documents.

The gas supply and meter location to the building shall be approved by the architect before installation. It shall be sympathetic to the architectural design and within a suitable architecturally approved enclosure.

2.2 System description

Installation Works

The contractor shall contact the gas supply authority to provide a new gas service to the boiler house. The Contractor shall carry out co-ordination between any existing services on site and the new gas route to the boiler House.

Mains gas shall be provided within the building, serving outlets in the plantroom and kitchen. Gas shall be brought into the building via an underground pipe which shall enter into the plantroom with a stop valve and meter. A branch shall serve the kitchen and another branch shall serve the heating and hot water plant in the plantroom.

All voids and risers housing gas distribution pipework shall be adequately ventilated to comply with regulations on gas safety.

Solenoid isolation valves shall be installed in the plantrooms to each gas pipe branch.

Below ground gas pipework shall be run in MDPE at a depth of no less than 600mm below ground level. This supply shall enter the plant rooms to serve the building where it shall be sub-metered as required to satisfy BREEAM and Part L requirements.

Above ground gas pipework downstream shall be installed using mild steel tube to BS 1387.

Each energy use area shall be provided with sub-metering in accordance with the Building Regulations.

The main and check meters shall be of the electronic pulsed output type and the gas consumption shall be monitored and recorded by the BMS.

A manual gas shut off valve shall be provided on the connection to each gas fired appliance.

An emergency gas shut off safety system shall be provided in each plantroom and kitchen, comprising gas detectors, emergency shut off buttons located by entrance doors, magnetically retained solenoid gas shut off valves with 24hr battery back up and gas cocks each side of the solenoid valve. The gas solenoids shall be interlocked with the appropriate equipment i.e. new gas fired boilers, mechanical ventilation systems and the fire alarm system.

The gas solenoid valves shall be closed on activation of any of the following:

- Building fire alarm system
- Gas detector
- Emergency knock off button

The solenoid valves shall reset once an emergency situation has been resolved. Each emergency gas shut-off button shall have a wall mounted label adjacent noted 'Emergency Gas Shut-Off'.

2.3 General

A manual gas shut off valve shall be provided on the connection to each gas fired appliance.

The maximum pressure drop between the main incoming gas meter and the most distant gas appliance must not exceed 1 mbar. The gas pipework shall be sized to ensure that the minimum gas pressures and flow rates to the new gas fired equipment is provided.

In addition to the record drawings required for the service installations in general the Contractor shall provide a record drawing/schematic of the Gas Distribution System. The record drawing shall be displayed in a framed chart mounted adjacent to each incoming gas supply.

2.4 Pipework

All below ground pipework shall be MDPE to BS3412 and coloured yellow. Above ground pipework shall be heavy-duty mild steel to BS1387 or BS3601 with screwed joints to BS21 up to and including 50mm, flanged above.

2.5 Pipeline Ancillaries

Gas Solenoid Valves

Valve type - Two way safety shut off valve
Mounting
Horizontal pipeline
Ends
Flanged to BS EN 1092-1 PN
Screwed to BS 21
Solenoid
24V, 50Hz
Method of actuation
Knock off button
Sensor on ceiling
Remote signal from fire alarm
Reset
Manual
Accessories
Strainer
Pressure test points
Install in accordance with manufacturer's instructions.

Gas Cocks to BS 1552:

Manufacturer and reference: refer to list of manufacturers
Supply and install gas cocks to BS 1552.

Stop Valves

Isolation valves for natural gas, sized between 15mm and 40mm shall be ball type to BS5159 and BS EN 13828 and manufactured by Crane model D191 or equal and approved. Sizes 50mm and above shall be gate type to BS5150 and BS EN 13828 and manufactured by Crane model FM63 or equal and approved.

2.6 Control Requirements

See Controls Section 6.

3 LOW TEMPERATURE HOT WATER (LTHW) HEATING

3.1 Performance Objectives

To design, supply, install, test and commission a new low temperature underfloor hot water heating system to serve Russell School.

Note: The method of LTHW generation is to be determined by the lowest energy solution whereby the building **must achieve a carbon emission reduction of at least 35% better than the requirements of Building Regulations Part L2A 2013. This reduction shall be achieved by 15% improvement in the building performance and 20% by the inclusion of renewable energy generation in the form of photovoltaic panels.** The building performance improvement shall be achieved in each building with the inclusion of gas boilers and a CHP installation.

Testing and commissioning of the new installation works shall be carried out in accordance with the CIBSE Commissioning Codes.

3.2 Design Parameters

Dynamic calculations shall be carried out using the CIBSE Test Reference Year weather file as prescribed by the building regulations and BB101.

The heating system shall be installed in accordance with BB87 Guidelines for Environmental Design in Schools.

Internal design temperatures shall be accordance with the room data sheets.

Winter external design conditions: -4°C saturated

3.3 System Description

Installation Works

The Design and Installation of the new system shall provide the following:
- Suitably sized underfloor heating to take account of the heat loss of each space.
- LST radiators serving staircase
- Heater battery to temper supply air to the kitchen.
- Installation in accordance with BB87 Guidelines for Environmental Design in Schools.
- Provide LTHW circulating pumps per zone/floor.
- Suitably sized steel distribution pipework concealed within an aesthetic enclosure.
- Suitable valves and pipeline accessories to control and enable water and air removal and to facilitate balancing and closing of circuits.

A pumped constant temperature boiler circulation circuit shall serve a distribution header from which a weather compensated variable temperature secondary pumped circuit shall serve the underfloor heating manifold's.

The heating system shall have the following heating zones:

Circuit 1: Weather compensated Variable Temperature Heating Circuit serving ground floor underfloor heating circuit and LST radiators.
Circuit 2: Weather compensated Variable Temperature Heating Circuit serving first floor underfloor heating circuit and LST radiators.
Circuit 3: Constant temperature heating circuit serving AHU heating coils.
Circuit 4 Constant temperature circuit serving HWS calorifiers.

Heating pipework shall run from the plantroom, below the halls within a services trench to the riser next to the lift shaft. Access shall be provided in the floor for the full length of the trench for access to any bend, fitting or other joint and to provide sufficient access for future replacement of pipework.. Pipework shall rise and distribute horizontally within the ceiling void, dropping locally to serve manifolds.

Temperature control shall be provided for each heated space.

Duty and Standby boiler circulation pumps shall be located in the common boiler return to maintain continuous water flow across the boilers.

Underfloor Heating

The Contractor shall employ a Specialist Underfloor Heating Contractor (Warmafloor or equal and approved) to design and carry out the installation of the Underfloor heating system

The Specialist Underfloor Heating Contractor shall be responsible for the thermal insulation, pipework, valves, testing commissioning, water treatment, Under Floor Heating Manifolds, under screed insulation and controls etc.

The Contractor shall liaise with the Underfloor heating Specialist with regard to programming the installation of the Underfloor Heating systems and insulation with the screed installer.

Underfloor heating pipework shall be insulated where heat output is not required.

The underfloor heating pipework shall be 5 Layer PEX-AL-PEX high density cross linked polyethylene pipe with an integral oxygen barrier having a minimum operating life of 50 years.

General information

An air purger/separator shall be installed in the boiler circulation circuit, location of the air purger shall be in accordance with the manufacturer's recommendations.

Supplied by SPIROTECH UK Ltd (or equal and approved)
PO Box 818 Altrincham
Cheshire WA15 5GZ
Tel: 0208 451 3344

Model ref: 1 No. SPIROCOMBI

Dial type thermometers and pressure gauges shall be installed where required in the plant room and around the underfloor heating manifolds.

Commissioning stations shall be installed in the return water pipes to allow balancing and commissioning of the heating system. Isolating valves shall be installed to facilitate maintenance, as a minimum isolation valves shall be provided on each branch connection taken from the main heating run e.g main heating pipework running the length of the building. Isolation valves shall also be provided on each item requiring isolation and maintenance or replacement. Drain cocks shall be provided on the equipment side of the isolation valves and at all low points to ensure the system can be drained.

Supplied by BOSS UK limited (or equal and approved)
LONDON DOCKLANDS Units 6 & 7, Thomas Road Industrial Estate,
Limehouse, London E14 7BN
Tel: 020 7531 3900 Fax: 020 7537 4849
Model ref: 1 No. BOSS® 900SC Venturi FODRV DN15-50

Heating pipework shall be fixed and hydraulically tested before the application of thermal insulation or paintwork. Pipework shall be pressure tested to twice the system working pressure.

New heating distribution pipework shall be assembled utilising screwed type black mild steel heavyweight tubing up to and including 50mm and flanged above 50mm.

Screwed joints shall not be fitted in inaccessible positions such as within the thickness of walls and floors or in inaccessible floor or roof spaces.

Reducing tees shall be used of easy sweep pattern. Reducing sockets shall be eccentric whether fixed on horizontal or vertical Pipe connection unions shall be of heavy pattern malleable iron with hexagon ends and gunmetal spherical faced seatings.

During progress of the works open ends shall be fitted with plastic or malleable iron threaded plugs or caps as appropriate.

The Contractor shall take all necessary precautions within the heating distribution system to cater for thermal expansion of pipework and fittings.

All exposed pipe drops and low level pipework shall be insulated and boxed-in.

All heating pump sets unless otherwise specified shall be the twin pump type with variable speed selection, providing duty and standby. The pump sets shall be provided with auto changeover in the event of pump failure. Pump sets shall be fitted with non return valves

Suitable valves and pipeline accessories shall be provided to control and enable water and air removal and to facilitate balancing and closing of circuits.

Drain cocks shall be provided on the equipment side of the isolation valves and at all low points and air vents shall be provided at all high points. Radiators shall be provided with air vents. Drain cocks shall be Hattersley Fig 371.

Generally, heating distribution pipework shall be selected for an average pressure drop of 200 Pascals per metre.

The Contractor shall, in addition to fully flushing and cleaning the new systems, introduce a suitable corrosion and algae inhibitor prior to handover. The quantity of inhibitor introduced shall be for the entire system, and shall be suitable for all types of materials within the system. This part of the work shall be carried out by a Specialist Company employed by the Contractor and a certificate issued.

All heating pipework shall be thermally insulated unless contributing a useful heating surface to the space e.g. heating pipe coils.

The system shall be designed with a pressure relief valve if required to bypass the system in the likely event that all manifold/radiator valves are shut down or other circumstances which may require this facility to avoid any chattering from the valves.

The LTHW distribution system shall incorporate adequate valves for isolation, control, balancing, drain down, air release, pressure and temperature control and monitoring for the purpose of safety and maintenance. All appliances shall be provided with isolating valves readily accessible for maintenance purposes.

3.4 Automatic Controls

Systems shall be controlled in accordance with CIBSE Part L and CIBSE Guide H: Building control systems and Good Practice Guide 132.

See Controls Section 6.

During the heating season the underfloor heating system controls shall be set to have a night time set back temperature rather than turning off and would also be installed with an optimum start feature. This shall ensure that the buildings mass does not cool significantly during unoccupied hours and ensures the building is up to temperature for all occupancy hours, thus reducing issues associated with the slow response times of underfloor heating systems.

3.5 Valves manufacturer

Valves shall be manufactured by Boss, Crane, Hattersley or Danfoss.

3.6 Control Pipelines and Ancillaries – Materials

See Section 4 – Gas Fired boilers.

3.7 Installation Generally

See Section 4 – Gas Fired boilers.

3.8 Commissioning and Testing

See Section 4 – Gas Fired boilers.

4 GAS FIRED BOILERS

4.1 Performance Objectives

To design, supply, install, test and commission a new boiler system to provide low temperature hot water (LTHW) to the new variable temperature underfloor heating circuits.

Note: The method of LTHW generation is to be determined by the lowest energy solution whereby the building **must achieve a carbon emission reduction of at least 35% better than the requirements of Building Regulations Part L2A 2013. This reduction shall be achieved by 15% improvement in the building performance and 20% by the inclusion of renewable energy generation in the form of photovoltaic panels.** The building performance improvement shall be achieved in each building with the inclusion of gas boilers and a CHP installation.

A minimum of 3 No. gas fired high efficiency condensing boilers shall be provided in the plantroom. The required load shall be proportioned across the boilers and CHP plant so that if one boiler or CHP unit is out of commission the remaining boilers shall provide at least 75% of the steady state heating load and the total capacity of all boilers shall not exceed 125% of the steady state heating load. Boilers shall have NOx emissions of 40mgram/kWhr or less and a minimum efficiency of 95%.

Testing and commissioning of the new installation works shall be carried out in accordance with the CIBSE Commissioning Codes.

4.2 Design Parameters

Boiler LTHW Circulation Temperatures: Primary LTHW flow & return temperatures designed to achieve full condensing of boilers and maximum efficiency. .....

Dynamic calculations shall be carried out using the CIBSE Test Reference Year weather file as prescribed by the building regulations and BB101.

The heating system shall be installed in accordance with BB87 Guidelines for Environmental Design in Schools.

The heating system shall be installed to ensure that the building is compliant with the 2013 edition of the Building Regulations Part L and the planning requirements.

The boiler and heating systems shall be in accordance with but not limited to the following:

Gas safety in (installation and use) regulations
HSE - Safety in the installation and use of gas systems and appliances
HSE - Design, construction and installation of gas service pipes
HSE - Codes of practice and guidance

Fuel Gas Design Criteria:

Type: Natural Gas
Nominal Gross Calorific Value 38.7 MJ/m3 British and European standards

4.3 System Description

Installation Works

Provide a new boiler system in the plantroom, the boiler system shall include but not limited to:

- Gas fired high efficiency condensing boilers (minimum of 3 No.)

- CHP (minimum 2No.)
- LTHW primary pumps
- LTHW circulating pumps
- BMS
- Pressurisation units and expansion vessel
- Flues and fan dilution system
- Gas Solenoid Valve
- De-aerator
- Dirt separator
- Dosing pot
- Heat meters
- Temperature and pressure gauges
- Valves and strainers
- Automatic Controls

Provide a minimum of 2No. Dachs (or equal and approved) mini-CHP (each with a capacity of 12.5 kW heat output and 5.5 kW electricity output) with condensing unit and buffer vessel required to satisfy IES calculations carried out at design stage 3. The CHP units shall be sized to match the base load of the building and operated as the lead heat source in tandem with a gas fired conventional boilers. The CHP units shall be operated based on the thermal load of the building as opposed to the electrical demand. As such any excess electricity generated would be re-exported to the grid using an import / export meter. The hot water storage capacity shall be optimised in order to maximise the CO_2 emission reduction and to help limit stop start operation of the CHP units.

The heating system feed and expansion shall be provided by a packaged heating pressurisation unit with integral control panel and separate expansion vessel. The pressurisation system shall be complete with a quick fill loop.

General

New heating distribution pipework shall be assembled utilising screwed type black mild steel heavyweight tubing up to and including 50mm and flanged above 50mm.

Condensate from the boilers shall discharge via a tundish into the floor gulley located within the plant room.

Boiler combustion air plant room ventilation shall be provided by louvred plantroom doors in accordance with BS6644 as required.

A combined de-aerator and dirt separator shall be provided in the boiler circulation flow.

A system quick filling point shall be supplied local to the new boilers. A flexible filling connection pipe shall be installed for initial filling of the system. This shall be of a temporary nature, allowing the connection to be removed on complete filling of the system. An RPZ valve shall be provided to comply with WRAS.

If a system quick filling point is not used a pressurisation unit suitable for filling the system shall be used. Either way the pressurisation unit shall provide automatic water make up.

Provide a water treatment pot type dosing vessel for the LTHW primary circuit.

Circulating and shunt pumps provided shall be of twin head type with auto changeover.

The flues, should the total boiler capacity exceed 150 kW shall be terminated above the highest point of the roof in accordance with the Clean Air Act. The flue shall be sited to prevent nuisance from pluming. Flue design shall be carried out by a specialist flue contractor.

Where a flue is not visually acceptable to the Architect or Client a suitably sized fan dilution system shall be designed into the boiler flue system.

To facilitate commissioning, regulating valves and flow measuring devices shall be installed in the return water lines of all main circuits and in the main returns to the boilers.

Dial type thermometers shall be installed in the plant room on the heating flow and return pipes including any branch within the plant room and each boiler. Pressure gauges shall be fitted on either side of each pump and each boiler.

Generally, heating distribution pipework shall be selected for an average pressure drop of 200 Pascals per metre.

The pipework system shall be provided with a means of sampling water in the system and convenient means of dosing water (dedicated dosing pot) in the system to correct any deviation of the quality from a pre-determined norm.

The Contractor shall, in addition to fully flushing and cleaning the new systems, introduce a suitable corrosion and algae inhibitor prior to handover. The quantity of inhibitor introduced shall be for the entire system, and shall be suitable for all types of materials within the system. This part of the work shall be carried out by a Specialist Company employed by the Contractor and a certificate issued.

All heating pipework shall be thermally insulated unless contributing a useful heating surface to the space e.g. heating pipe coils.

The system shall be designed with a pressure relief valve if required to bypass the system in the likely event that all manifold/radiator valves are shut down or other circumstances which may require this facility to avoid any chattering from the valves.

Generally strainers shall be provided to protect each pump, pressure gauges on suction and discharge side of each pump, flexible connections to each pump where required, air vents at all high points, commission stations on return pipework for each branch to boiler room. Commissioning sets shall also be installed within the building where required to balance and commission the system. In addition, a valved bypass for flushing to each heating coil shall be provided.

The LTHW distribution system shall incorporate adequate valves for isolation, control, balancing, drain down, air release, pressure and temperature control and monitoring for the purpose of safety and maintenance. All appliances shall be provided with isolating valves readily accessible for maintenance purposes.

4.4 Control Requirements

See Controls Section 6.

4.5 Control Pipelines and Ancillaries - Materials

Pipes - copper to bs en 1057:
Application lthw system
Kitemark certified
Material: copper to bs en 1057.
R250 half hard.
Finish - uncoated.

Copper fittings, capillary for copper tubes:
Application lthw system

Kitemark certified
Material
Copper (dezincifiable resistant).
Standard
Bs en 1254-1.
Ends
Socket - pre-soldered.
Jointing materials - capillary joints
Solder
Bs en iso 9453.

Copper fittings, compression for copper tubes:
Application lthw system
Kitemark certified
Material
Copper (non-dezincifiable).
Standard
Bs en 1254-2.
Type
Type a - non-manipulative.
Type b - manipulative.
Ends - socket.
Finish - cast.

Copper fittings, push fittings:
Material - dezincifiable resistant copper alloy and brass.
Standard - manufacturer's standard.
Size range - 15mm to 54mm.
Dimensions - to suit copper tube to bs en 1057.
Ends
Push-fit with epdm o ring.
Finish
Natural.

Pipes - steel to bs en 10255 - screwed:
Application
All pipelines up to and including 50mm nominal diameter.
Lthw system
Pipes to bs en 10255 grade
Medium.
Finish - varnished.
Fittings
Malleable cast iron to bs 143 and 1256 or bs en 10242.
Finish - black.
Jointing: threaded to bs 21 and bs en 10226-1.
Use hemp and jointing compound to bs 6956-5 or bs en 751-2.
Use ptfe tape to bs 7786.
Use union connections with spherical seating
Bronze to bronze, navy pattern.
Bronze to iron, railroad pattern.

Pipes - steel to bs en 10255 - welded:
Application
All pipelines from 65mm nominal diameter up to and including 150mm.
Lthw system
Pipes to bs en 10255 grade
Medium.
Finish - varnished.
Fittings

Carbon steel, butt welded to bs en 10253-1, grade as pipes.
Finish - varnished.
Jointing: welded and flanged.
Welding to class 2.
Use welding rods
Gas welding, bs 1453 type a2 or a3.
Electric arc welding bs 2971.
Flanges
Provide flat faced hubbed slip-on flanges for welding with pn to suit system working pressure.
Material
Bs en 1092-1, ferritic steel
Bolting
In accordance with bs en 1092-1.
Jointing rings, use
Corrugated copper nickel alloy to bs 6956-1.
Non-metallic flat gaskets to bs en 1514-1.

Stop valves - screwed/copper ends:
Application lthw system
Manufacturer and reference hattersley
Or approved equivalent
To bs 5154 series b, straight pattern.
Materials - manufacturer's standard.
Ends
Threaded to bs 21 and bs en 10226-1.
Capillary fittings to bs en 1254-1.
Compression fittings to bs en 1254-2.

Stop valves - flanged ends:
Application lthw system
Manufacturer and reference hattersley
Or approved equivalent
To bs en 1171 materials - manufacturer's standard.
Ends flanged to bs en 1092-2, pn to suit working pressure.

Double regulating valves - globe type to bs 7350:
Application lthw system
Manufacturer and reference hattersley
Or approved equivalent
To bs 5154 series b, oblique or y pattern.
Materials - manufacturer's standard.
Ends
Threaded to bs 21 and bs en 10226-1.
Compression fittings to bs en 1254-2.
Flanged to bs en 1092-3, pn to suit working pressure.

Radiator valves to bs 2767:
Type thermostatic radiator valves (trv) on flow and lockshield valves on return
Application radiator control and isolation
Manufacturer and reference danfoss
Or approved equivalent
Material - bronze or brass body type 4.
Pattern
Angle or straight valves to suit application.
Ends
Female, threaded to bs 21 and bs en 10226-1.
Compression joints to bs en 1254-2.
Finish
Chromium plated.

Check valves - swing check type to bs 5154:
Application lthw system
Manufacturer and reference hattersley
Or approved equivalent
Series b, straight pattern.
Materials - manufacturer's standard.
Ends
Compression fittings to bs en 1254-3, or bs 864-5.
Compression fittings to bs en 1254-2.
Capillary fittings to bs en 1254-1.
Threaded to bs 21 and bs en 10226-1.
Flanged to bs en 1092, pn to suit working pressure

Direct acting safety valves to bs en iso 4126-1:
Application lthw system
Manufacturer and reference hattersley
Or approved equivalent
Material
Cast iron body.
Cast steel body.
Bronze or dzr copper alloy body.
Ends
Flanged to bs en 1092-1 pn to suit working pressure
Flanged to bs en 1092-2 pn to suit working pressure
Flanged to bs en 1092-3 pn to suit working pressure
Flanged to bs en 1092-4 pn to suit working pressure
Threaded to bs 21 and bs en 10226-1.
Spring type
Single spring loaded high lift type.
Double spring loaded high lift type.
Protection from unauthorised adjustment

Drain cocks:
Application lthw system
Manufacturer and referencehattersley
Or approved equivalent
Throughway gland cock type incorporating
Screwdown cock type to bs 2879 type 1, incorporating
Bronze or dzr copper alloy body threaded male to bs 21 and bs en 10226-1. Screw down plug with square shank for loose lever. Serrated outlet to accept hose pipe, fixed or union pattern.

Temperature gauges:
Use temperature gauges with pocket, and gland attachment on thermometer stem.
Type
Mercury in steel, mounted direct in pocket.
Vapour pressure to bs en 13190, mounted direct in pocket with horizontal or vertical stem as appropriate.
Use separable type pockets, threaded 15/19mm bsp and manufactured from
Stainless steel.
Screw pockets into tapped bosses or stools set in pipelines or vessels. Fill pockets with oil to bs 7207 to ensure contact with thermometer bulb.
Provide gauges with dial graduation in degrees celsius marked on a logarithmic scale. Ensure pointer movement is clockwise for increase in temperature.

Pressure and altitude gauges:
Use vapour pressure type gauges to bs en 837-1. Connect to pipeline systems via matched gauge cocks and cock connectors.

Ensure dial graduation is from zero to between 1.5 and 3.0 times normal working pressure. Graduate in bar (gauge) on gauges reading head or working pressure, or in pascals where pressure differences across plant items are to be established. Where fitted on boilers and pressure vessels, clearly mark with operating and maximum permissible working heads in accordance bs 759-1. Elsewhere provide gauges with normal working pressure. Ensure dial movement is clockwise for an increasing in head.
Provide flexible piping where gauge is subject to noticeable vibration.
Fit gauge cocks preceding all connections to altitude and pressure gauges. Copper alloy, tapered ground plug, with ebonite lever. Unless flanged joints are required, screw inlet ends female and fit outlet ends with union connections allowing removal of gauges.

Wall, floor and ceiling masking plates:
Material
Copper alloy, chromium plated.
Type
Heavy, split on the diameter.
Fixing
Chrome raised head fixing screws.

Valve labels:
Supply and fit engraved plastic labels to all valves (except isolating and regulating valves on heat emitters). Engrave with
Description of function.
Valve number

Pipework identification:
Colour code and label to bs 1710.
Apply 300mm wide colour bands to each pipe at intervals of 15 metres maximum.
Apply 50mm wide colour bands and superimpose a legend identifying circuit and direction of flow.
Apply legends to colour bands by transfers of an approved type.

4.6 Installation Generally

Pipeline workmanship
Appearance:
Arrange all exposed pipe runs to present neat appearance, parallel with other pipe or service runs and building structure, subject to gradients for draining or venting.
Ensure all vertical pipes are plumb or follow building line.

Isolation and regulation:
Provide valves, cocks and stop taps for isolation and/or regulation
On mains to isolate major sections of distribution.
The base of all risers and drops except in cases where one item of apparatus only is served which has its own local valve or stop tap.
At points of pipe connection of all items of apparatus and equipment except where the item could conveniently be isolated or regulated by valves provided for other adjacent items.
On all branches connected to the main pipework runs.

Spacing:
Space pipe runs in relation to one another, other services runs and building structure, allow for thermal insulation and ensure adequate space for access to pipe joints, etc.
Minimum clearances to pipe or pipe insulation:-

From	Minimum clearance (mm)
Wall	25
Ceiling	50
Floor	150

Other pipes	25
Electrical cables, conduit, switchgear, etc	150

Gradients:
Install pipework with gradients to allow drainage and air release.
Provide a means of venting the pipe system at all high points.
Grade pipework to allow system to be drained. Provide a means of draining the system at all low points.

Expansion and contraction:
Arrange supports and fixings to accommodate pipe movement caused by the thermal changes. Isolate pipes from structure to prevent noise or abrasion due to thermal movement.

Bends, springs and offsets:
Machine bend and ensure that machine guides and formers are smooth and clean, free from any scores, or other damage. Deformed bends shall not be accepted.

Pipes through walls and floors:
Enclose pipes passing through building elements, (walls, floors, partitions, etc.) Concentrically within purpose made sleeves.

Pipe sleeves:
Cut sleeves from material same as pipe one or two sizes larger than pipe. Do not use sleeves as pipe supports. Install sleeves flush with building finish.

Temporary plugs and caps:
Seal all open ends as installation proceeds by metal, plastic or wooden plugs or caps, to prevent ingress of foreign matter.

Capillary joints, copper pipes:
Preparation
Ensure that plain ends are cut square. Reamer out bore at plain ends to full bore size. Clean plain ends with fine steel wool.
Making and sealing
Use specified flux ensuring no excess material used. Make joint in accordance with manufacturer's instructions. Clean off traces of flux when joint is completed. Protect building fabric from heat when forming joints.
Polyethylene sheathed pipe
Follow manufacturer's recommendations to avoid damage to plastic coating. Make good with pvc tape of matching colour.

Compression joints, copper pipes:
Preparation
Ensure that plain ends are cut square. Reamer out bore at plain ends to full bore size. Clean plain ends with fine steel wool or fine sandpaper. Then if using
Type 'a' fitting - no further preparation.
Type 'b' fitting - in accordance with fitting manufacturer's instructions.
Making and sealing
In accordance with fitting manufacturer's instructions.

Screwed joints - steel pipes:
Preparation
Ensure that plain ends of pipe are cut square, reamer out bore and cut taper thread.
Making and sealing

Coat male pipe threads with jointing compound and hemp, or ptfe tape on small sizes. Immediately after applying coating, connect with female end of socket or fitting, and tighten ensuring that coating does not intrude into pipe. Leave joint clean.

Welded joints – steel pipes:
Use skilled craftsman in possession of a current certificate of competence appropriate to type and class of works, issued by an approved authority.
Mark each weld to identify operative. Submit specimen welds, representative of joints and conditions of site welding for each craftsman.
Welded joints class 2 - weld pipeline joints to bs 2971 and hvca tr/5, code of practice for welding of carbon steel pipework, as appropriate.
Preparation, making and sealing.
Arc welding, conforming to bs 2971 appropriate to system temperature and pressure. Use arc welding process on piping greater than 100mm.
Unless pipework is being prepared for galvanizing after manufacture, wire brush and paint all welds with red oxide paint when welds are complete.

Flanged joints - steel pipes:
Use number and diameters of bolts to standard specified. Fit bolts of length to give not less than one thread, or more than 3mm protrusion beyond nut when joint is pulled up. Fit washers under each nut.
Weld neck and bore of "slip on" flange.
Preparation
Ensure that flange mating faces are parallel; flange peripheries are flush with each other; and bolt holes are correctly aligned.
Making and sealing
Insert jointing between flange mating faces. Pull up joint equally all round.

Pipe rings and clips:
Select type according to the application and material compatibility.

Pipe supports:
Arrange supports and accessories for equipment, appliances or ancillary fitments in pipe runs, so that no undue strain is imposed upon pipes.
Ensure that materials used for supports are compatible with pipeline materials.

Pipe support spacing - copper pipes:
Pipe bore (mm)maximum support spacing (mm)

Nominal	Horizontal	Vertical
15	1200	1800
22	1400	2100
28	1800	2400
35	2400	3000
42	2400	3000
54	2700	3000

Pipe support spacing - steel pipes:
Pipe bore (mm)maximum support spacing (mm)

Nominal	Horizontal	Vertical
15	1200	2400
20	2400	3000
25	2400	3000
32	2700	3000
40	3000	3600
50	3000	3600
65	3700	4600
80	3700	4600
100	3700	4600

125	3700	5400
150	4500	5400

Maintenance and renewal:
Arrange pipework, valves, drains, air vents etc., for convenient routine maintenance and renewals.

Protection of pipes in screeds:
Wrap pipework with two protective tapes prior to laying.
Sheath pipework with pvc.

Cleaning:
Remove cement and clean off all pipework and brackets.

System flushing and chemical cleaning:
Application lthw system
Carry out flushing of water systems in accordance with bsria application guide 1/2001 pre-commission cleaning of pipework systems.
System filling
Temporary connection from mains in compliance with the water supply (water fittings) regulations 1999.
Temporary connection from fire hydrant pipework.
By installation of temporary tank and pump arrangement.
Carry out chemical cleaning procedure in accordance with bsria application guide 1/2001 pre-commission cleaning of pipework systems.
4.2 cleaning options. Removal of surface oxides.
Inhibited acid cleaning.
Formulated products.

Thermal insulation to pipelines:
Application lthw pipework at high level, in roof voids, concealed in ceiling voids, risers and boxed in.
Thermal insulation sub-contractor use specialist thermal insulation contractor to install the thermal insulation.
Use mineral fibre pipe insulation, to bs 3958-4, with nominal density 80 kg/m3 to 120 kg/m3.
Thermal conductivity not exceeding 0.038 w/mk at a mean temperature of 50oc.
Finish
Reinforced aluminium foil with at least 25mm overlap.

Thermal insulation to pipelines:
Application lthw pipework exposed in plantrooms.
Thermal insulation sub-contractor use specialist thermal insulation contractor to install the thermal insulation.
Use mineral fibre pipe insulation, to bs 3958-4, with nominal density 80 kg/m3 to 120 kg/m3.
Thermal conductivity not exceeding 0.038 w/mk at a mean temperature of 50oc.
Finish
Reinforced aluminium foil with at least 25mm overlap.
Protection
Ensure that where protection is applied to insulation, the joints fall blind side and that all joints are made to shed water and sealed with waterproof tape, adhesive or joint sealant where appropriate.
Mild steel continuously hot dipped with 150gm aluminium-zinc coating 0.4mm thick to bs en 10346, applied directly to insulating material.
Finish - ribbed sheet.

Thermal insulation workmanship:
Do not apply thermal insulation until installation has been fully tested and all joints proved sound.
Ensure that all materials are kept dry.

Insulate each unit separately. Ensure clearance between insulated pipes.
Apply insulants, facings, coatings and protection strictly in accordance with manufacturer's instructions.
Neatly finish joints, corners, edges and overlaps, where possible arrange overlaps to fall on blind side.
Ensure overlaps are neat and even and parallel to circumferential and longitudinal joints.
Arrange insulation of feed and expansion cistern to allow removal of access covers.

Installation of insulation on pipework:
Ensure joints are close butted together. Secure overlaps with adhesive or matching class "o" tape, a minimum of 50mm wide, on both longitudinal and circumferential butt joints. Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary, taped as above.
Where fibre containment is required tape exposed insulation membrane and return to pipe surface.
Insulation with canvas finish
Apply two coats of class "o" polymer solution.

Calculation of insulation thickness - building regulations (england and wales):
Provide insulation of thickness conforming with the values given in the tables below. These figures are derived from the requirements of the building regulations (england and wales) part l approved documents, and the calculation methods given in bs en iso 12241.

Non-domestic heating installations, building regulations - mineral wool:
Environmental insulation thickness for non-domestic heating installations to control heat loss, in accordance with the requirements of the building regulations (england and wales) part l2 approved documents.

Outside diameter of steel pipe (mm)	Temperature of contents (0c)		
	<95	96-120	121-150
	Thickness of mineral wool insulation (mm)		
17	25	25	25
21	30	30	30
27	35	40	40
34	35	45	50
42	35	50	60
48	40	50	70
60	40	60	70
76	45	60	80
89	45	60	80
114	45	70	80
140	50	70	90
168	50	70	90
219	50	70	90
273 and above	50	80	100

Use this table for insulation thickness of copper pipework of the nearest equivalent outside diameter.

4.7 Commissioning and Testing

Pressure testing:
Advise appropriate personnel, at least 3 days in advance, of the time that pressure tests may be witnessed.
Test concealed or buried pipework before any permanent covering is applied.
Complete pressure testing before applying thermal insulation.
Isolate or remove pump and thoroughly flush out the whole system.
Replace pump, fill system, vent all air from system and check for leaks, repair any leaks and re-check.
Pressure test the system for a period of one hour, and check for and repair any leaks. Repeat pressure test if leaks have been found.
Pressure test to twice the working pressure.
Light boiler and run system to maximum temperature and check for leaks. Repair any leaks and repeat test.
Add an approved corrosion inhibitor.
Test and purge gas pipelines in accordance with bs 6891and ige/up/1a.

Commissioning:
Commission boiler in accordance with the procedures laid down by the boiler manufacturer. With boiler operating check and adjust all equipment and controls. Balance system to give approximately equal return temperatures from all heat emitters.
Carry out commissioning of installations in accordance with the procedures, checks and tolerances given in the cibse commissioning codes and bsria application guides.

5 VENTILATION

5.1 Performance Objectives

To design, supply, install, test and commission a natural ventilation system in accordance with BB101 and mechanical ventilation to WCs, Kitchens and Hygiene rooms.

Carry out a thermal model on the Building using dynamic thermal modelling software IES Virtual environment in line with CIBSE AM10.

5.2 Design Parameters

Shall meet the requirements of BB101, BB87, Building Regulations Part F and the room data sheets.

Dynamic calculations shall be carried out using the CIBSE Test Reference Year weather file as prescribed by the building regulations and BB101.

The supply and extract systems shall be in accordance with but not limited to the following:-
Unless indicated otherwise supply and extract AHU/fans shall be provide with speed control to facilitate balancing of the ventilation systems.

Specific fan power: Ensure the specific fan powers of the ventilation systems comply with the requirements of the Building Regulations Approved Document L2A.

Winter external design conditions: -4°C saturated

5.3 System Description

The Building shall be served by natural ventilation wherever possible and mechanical ventilation shall be used for WCs, kitchens, Hygiene rooms and any other internal areas where it is not possible to use natural ventilation.

Natural Ventilation

Ventilation shall be natural wherever possible. For classrooms this shall be achieved with air flow into classrooms via opening windows and louvres. There shall be acoustically treated transfer ducts at high level which shall be accommodated within bulkheads in the classroom ceiling. These shall allow air to flow into the corridors, through corridor voids and out the roof via a roof ventilation opening.

Each naturally ventilated room shall be provided with openable windows and louvres. The windows shall be manually controlled by the room occupants. The louvres shall incorporate actuated dampers that shall be automatically controlled by the BMS. The BMS shall monitor inputs from CO2 and temperature sensors in each occupied space and open or close the louvres accordingly.

Where additional mechanical ventilation is required in naturally ventilated areas it shall be designed for minimum energy consumption and minimum impact on the architectural and structural design. All mechanically ventilated spaces shall be served by relatively small local systems which shall be installed within roof/ceiling voids and use small local risers to drop to ground floor where necessary.

All natural ventilation external louvres shall be automatically controlled to allow 24 hour ventilation as required. Natural ventilation external louvres shall be thermally insulated and incorporate insulated damper blades, in compliance with Building Regulations Part L.

The external louvres shall meet the following requirements;

Slim line design for window, masonry or curtain wall installation

Ultra low U value at less than 1Watt/m2/K

Ultra low leakage at less than 5m3 per hour per sq m

High weathering and rain resistance (Up to Class A - BS EN 13030)

High Free Area

Complimentary controls package

Provision shall be made for four number visits to carry out seasonal commissioning in line with BREEAM requirements.

All opening windows shall be confirmed as safe for pupils inside the school building and for pedestrians external to the building. On final selection of the windows, the mechanism for window opening shall be confirmed as safe and acceptable by the client before ordering.

Mechanical Ventilation

Mechanical ventilation shall be provided to toilets and occupied rooms with inadequate external openings including the Music Room, Group Rooms, MI Room, Hygiene Rooms, Practice Room, Reprographics Room, Kitchenette and Laundry. Local mechanical extract shall be provided to the workstations in the Food Tech room.

Mechanical ventilation serving the Music Room, Group Rooms, MI Room, Hygiene Rooms, Practice Room, Reprographics Room, Kitchenette and Laundry shall be demand controlled and designed to minimise the energy consumption required for operation. The mechanical ventilation systems shall incorporate high efficiency heat recovery systems.

The new WCs shall be provided with a ducted mechanical extract. Extract air shall be ducted from an extract grille in the ceiling void of each WC. Replacement air shall be provided via supply air ductwork system with ceiling mounted diffusers or make up air from adjacent areas via door transfer grilles.

The toilet extract fan shall be a twin fan to provide for duty standby operation.

Each toilet extract fan unit shall be provided with auto rotation integral control and auto changeover in the event of a fan failure and shall be fitted with non-return dampers. Each extract fan unit shall be provided with a remote fan status/fault.

Local extract ventilation to be provided to kitchen work stations in food technology rooms.

All ventilation shall be compliant with BB93 – Acoustic Design for Schools. All, teaching spaces and other SEN pupil occupied spaces shall be designed for an upper limit of NR25.

All mechanical ventilation shall be fully coordinated with other building elements and services including the hoist tracks.

All cowls or other roof penetrations shall be selected by the contractor to ensure that their installed maximum height is no higher in section than the top of the parapet wall. If this is not possible then they shall be lower than the top of the PV panels, however this shall only be by approval of the architect where proven to be impractical to be lower than the parapet wall.

Kitchen Ventilation

The kitchen shall be mechanically ventilated to suit the design, cooking equipment and expected use. Kitchen extract and tempered/heat recovery make up air supply shall be via a commercial type hood that shall be supplied by a kitchen specialist. The kitchen ventilation system shall be complete with extract and make up air fans, attenuation, ductwork, LTHW heater battery, external louvres and controls.

The kitchen ventilation system shall be in accordance with DW172.

Thermal Model

The building shall be thermally modelled in line with CIBSE AM10 using the dynamic thermal modelling software IES Virtual Environment. The design shall be tested against the criteria set out in Building Bulletin 101, Ventilation of School Buildings. The results from the model shall be used for design development with items such as ventilation openings and additional thermal mass being added to the design as required.

General

The plant room shall be naturally ventilated by the provision of louvred double external doors.

The ventilation systems shall consist of discharge external louvres with insect screens, fans, heat recovery, LTHW heater batteries, anti-vibration mounts, controls, dampers, fire dampers, combined fire/smoke dampers, silencers, access doors, ductwork, flexible ductwork connections as required.

Turning vanes should be used on all duct bends where possible.

Supply air shall be filtered to grade G4.

Ductwork shall be constructed and manufactured in accordance with HVCA DW144 & DW172.

The ductwork system shall be provided with all necessary supports, dampers, access points as required to form a complete installation.

During Testing & Commissioning procedures the installation contractor shall regulate and set the air flow volumes through the ductwork system and extract grilles utilising the volume control dampers.

During installation the Contractor shall liaise with the Main Contractor to ensure that clear access is provided to all ventilation plant and ancillaries.

Plant and ductwork shall be installed ensuring suitable access for future maintenance.

Fire dampers shall be provided when passing between fire compartments, all fire dampers shall be CE marked and installed in accordance with DW 145.

Provide access hatches in ductwork for cleaning for a level of cleanliness and protection as defined in HVCA document TR17 & DW172.

TOILET EXTRACT UNIT:

Application: Toilet Extract
Manufacturer and reference: refer to list of manufacturers.
Operation
Twin fan unit with automatic changeover.
Location
Ceiling Void
Materials

Galvanised steel.
Manufacturer's standard.
Electrical safety to BS EN 60335-2-80.
Motor
Electrical supply to BS 7697
Motor starter Comply with BSEN60947-4-1
Starters for motors of up to and including 4.5kW shall be direct on line. .
Accessories
Access - provide access via
Hinged casing.
Removable panel.
Controls –
PIR
On/off, auto changeover.
7 Day Programmer
Back-draught dampers.
Anti-vibration mounts.
Guards.
Testing
Where fans approved under CAME scheme are used provide certified data for type.
Where fans are not approved under CAME scheme provide results of aerodynamic performance tests in accordance with BS 848-1; noise tests in accordance with BS 848-2 and fan vibration tests in accordance with BS 848-6.

5.4 Control Requirements

The WC extract fans shall be on / off controlled via the associated room PIR sensors with adjustable fan run on timer set at 15 minutes. Where an extract fan serves more than one room a PIR sensor shall be located in each room.

The WC extract fan units shall be provided with auto changeover in the event of a fan failure and shall be fitted with non-return dampers.

Each extract fan shall be fitted with a remote fan status/fault indicator located in the closest WC to the fans position. These locations shall be indicated on the Contractors drawings.

The supply and extract ventilation systems and LTHW heater battery serving the Music Room, Group Rooms, MI Room, Hygiene Rooms, Practice Room, Reprographics Room, Kitchenette and Laundry shall be time clock controlled with the addition of local manual on/off control located in a suitable location. Supply and extract fan run and fault indication and LTHW heater battery on and fault indication shall be provided. Temperature control of the supply air shall be by a duct mounted temperature sensor mounted in the supply air ductwork. The supply air shall be tempered to 20^{o}C (adjustable).

See Controls Section 6.

5.5 Ductwork And Ancillaries

DUCTWORK FABRICATION:
Prepare fabrication drawings and carry out fabrication of ductwork in accordance with DW144, DW172 and DW154 as appropriate.

DUCTWORK DIMENSIONS:
Sizes of ductwork are internal dimensions. Where applicable make allowance for any internal lining.

INSTALLER SELECTION:
Use a member of the HVCA specialising in the trade of manufacturing and installing ductwork.

GENERAL DUCTWORK AND FITTINGS:
Design Information
Supply ductwork in accordance with classification in DW144 Table 1.
Ductwork Classification and Air Leakage limits
Low pressure - Class A - Positive.
Low pressure - Class A - Negative.
Ductwork air leakage testing
Testing plant items, DW144, Part 8, A.8.
Plant connections.
Make connection between air handling assembly and ductwork system in accordance with DW 144.
Flanged connections.
Provide bolted flanged joints for connecting ductwork to flanged items of plant, builder's work frames and where removable sections of ductwork are required.

KITCHEN DUCTWORK AND FITTINGS:
Design Information
Supply ductwork in accordance with DW172.
Ductwork Classification and Air Leakage limits
Low pressure – DW144 Class A - Positive.
Low pressure - DW144 Class A - Negative.
Ductwork air leakage testing
Testing plant items, DW172 and DW144.
Plant connections.
Make connection between air handling assembly and ductwork system in accordance with DW172 and DW144.
Flanged connections.
Provide bolted flanged joints for connecting ductwork to flanged items of plant, builder's work frames and where removable sections of ductwork are required and in accordance with DW172.

GENERAL DUCTWORK TO DW 144:
Application, General supply and extract ductwork
Material, DW 144 Part 2 - Standards, paragraph 7.
Zinc-coated steel.
Construction
Rectangular ductwork - DW144 Part 3.
Circular ductwork - DW144 Part 4.
Spirally wound.
Straight seamed.

KITCHEN DUCTWORK TO DW 172:
Application, Kitchen supply and extract ductwork
Material, DW 172.
Zinc-coated steel.

FLEXIBLE DUCTS:
Application: General supply and extract systems, final connections to terminals only
Supply and fasten flexible duct connections as DW144 Part 7 Section 25. Use flexible duct connections in applications listed in DW144 paragraph 25.1.
Material
Metal
Coated steel.
Stainless Steel.
Aluminium.
Fabric
P.V.C/Polyester laminate.
Aluminium/Polyester laminate encapsulating high tensile steel wire helix.

ACCESSORIES - METAL DUCTWORK:
Flexible Joints
Application: final connections
Supply and install flexible joints as detailed in DW 144 Part 7 Section 26 and DW171 as appropriate.
Comply with BS 476-6, BS 476-7, BS 476-20, BS 476-21, BS 476-22, BS 476-23 and BS 476-24.
Position
On fan inlet/outlets.
To make connections to air diffusers, grilles and air registers.
Access openings
Provide access openings in accordance with DW 144 Part 7 Section 20, TR19 and DW171 as appropriate.
Provide hangers and supports throughout in accordance with DW 144 Part 6
Regulating dampers
Provide regulating dampers in accordance with DW 144 Part 7 Section 21 and DW171 as appropriate.
Supply and install fire dampers in accordance with DW 144 Part 7 section 22 and DW171 as appropriate.
Fit bird screens of 13mm square mesh wire on all intake and extract louvres to atmosphere. Wire gauge to be not less than 1mm or in accordance with DW171 as appropriate.

DUCTWORK WORKMANSHIP:
Install ductwork in accordance with DW 144, DW 154 and DW172 as appropriate. Ensure that there are no sharp edges or corners on cut edges on ductwork, flanges and supports. Arrange ductwork to drain any entrained moisture and ensure the lapping of joints minimises moisture leakage.
Connection to builder's work. Comply with DW 144 Part 7 Section 28 and DW172 as appropriate.
Space supports in accordance with DW 144 Part 6, DW172 or DW 154 Part 5 as appropriate.
Internal cleanliness
Provide the level of cleanliness and protection as defined in HVCA document TR17.
Basic.
Weatherproofing
Fit ductwork with trimming angle and weather cravat, skirt, flashing plate and cowl where ductwork passes through or terminates in roof, to ensure a weatherproof seal to building structure
Enclose ducts passing through building elements, (walls, floors, partitions, etc.) within purpose made sleeves. Cut sleeves of the same material as the duct and pack with mineral fibre or similar non-flammable and fire resistant material to form a fire/smoke stop of adequate rating and to prevent air movement and noise transmission between duct and sleeve.
Provide test holes in ductwork system to allow complete testing and balancing of system in accordance with CIBSE Commissioning Code Series A.
Site drill test holes on site in accordance with DW144 Part 7 Section 20.6.
Provide holes in metal ductwork, in accordance with DW144 Part 7, paragraph 20.7, to accommodate thermostats, humidistats and other control sensors in positions and sizes as required.
Install sensors and test points in plastics ductwork to suit specialist control and sensing equipment in positions and fixing configurations as required.
Fit sensors, damper motors and other control equipment as indicated on drawings.
Provide instrument connections as required.
GRILLES, DIFFUSERS
Grilles fixed internally in buildings, unless otherwise specified, shall be of the secret fixing type, securely fixed to a wood frame where required, or via a sub-mounting frame where connection is required direct to the ductwork.
Dampers for mounting behind supply and extract grilles shall be of the opposed blade, key operated type, controlled through the front of each grille.
Grilles, generally, shall be constructed from extruded aluminium sections and each corner carefully mitred to give a clean, neat appearance.

Each grille shall be supplied and fitted with a foam rubber gasket behind the flange.
Grilles supplied for external use for inlet or discharge louvers shall be constructed from extruded aluminium sections and shall be of the weatherproof pattern complete with bird screen behind the louvre blades. The complete grille/louvre assembly shall be arranged for screw fixing into a timber frame.
Diffuser duct branches shall be securely fixed to the main ductwork. No weight shall be carried or transferred to the false ceiling system.
Where necessary, change section pieces shall be applied to connect the ductwork branch, whether rectangular or circular, to the diffuser neck.
The Contractor shall confirm the final positions of all grilles and diffusers and shall provide all necessary builders' work drawings showing position and sizes of timber or any other supports necessary.
Where grilles and diffusers are connected to flexible circular aluminium ducting the Contractor shall apply all necessary mild steel angle sections, U-bolts and shake proof washers, clips and supporting brackets etc., clamped or fixed in an approved manner to prevent the weight of the diffuser or grille being carried by the false ceiling.
All grilles, transfer grilles, diffusers etc, shall be supplied to an approved colour and finish and shall be agreed with the Employer's Agent.
Final locations of diffusers shall be agreed on site to suit the final ceiling pattern.

DUCTWORK, SUPPORTS AND DAMPERS
Ductwork runs shall incorporate "tags" either side of joints for the Electrical Contractor to carry out the required electrical bonding.
All non-galvanised brackets and drop-rods shall be applied with one coat red oxide primer and ductwork supports exposed on roofs or mounted externally shall be galvanised after manufacture.
Air tight access doors shall be provided in rectangular and circular sheet metal ductwork wherever necessary for the balancing, inspection, cleaning or maintenance of any part of the installation, such doors shall be of sufficiently heavy construction to avoid distortion, provided with substantial hinges and catches and positioned so that access can easily be obtained. Access holes shall be reinforced with galvanised M.S. strip riveted externally to the ductwork.
Die cast non-ferrous quadrant and operating handle shall be fitted to the damper in an accessible position clearly marked "Open - Shut". The handle shall be complete with locking device.
Where fire dampers are installed the fusible link shall be selected to operate when the internal duct temperature reaches 72º. Access doors shall be fitted either side of each fire damper.
On ducts up to 300mm dia or equivalent rectangular area, canvas connections shall be provided to fan suction and discharge spigots. Duct ends shall be reinforced with M.S. flat hoops and the canvas connection stretched over the ducts and secured by a M.S. grip ring to ensure air tightness. Larger ductwork connections shall be flanged and the canvas held between mating flanges a minimum of 75mm flexible canvas between spigot ends.
Test holes shall be drilled, and fitted as required on the drawings. Test hole cover plates shall be supplied and fitted to each test hole.

5.6 THERMAL INSULATION

STANDARDS:
Comply in general with BS EN ISO 12241. Use the description of terms as BS 3533.
MATERIALS:
Employ materials that comply with BS 476-7.
Ensure metals and materials that cause galvanic corrosion are not installed in contact.
Do not use galvanized or zinc coated steel jacketing and accessories on austenitic stainless steel and austenitic nickel steel/alloy equipment and piping.
PRE-INSULATED EQUIPMENT:
Where fire and surface spread of flame certificates relate to factory made products, ensure that certificates are still valid where products are incorporated in pre-insulated equipment.
PROTECTION APPLIED IN SITU:
Where fire and surface spread of flame certificates relate to factory made products, ensure that the certificate remains valid when the finish is site applied.

CLASS A1 EUROPEAN CLASSIFICATION FOR REACTION TO FIRE PERFORMANCE:
Supply insulating materials that comply with Euroclass A1.

CLASS A2 EUROPEAN CLASSIFICATION FOR REACTION TO FIRE PERFORMANCE:
Supply insulating materials that comply with Euroclass A2.

CLASS B EUROPEAN CLASSIFICATION FOR REACTION TO FIRE PERFORMANCE:
Supply insulating materials that comply with Euroclass B.

CLASS C EUROPEAN CLASSIFICATION FOR REACTION TO FIRE PERFORMANCE:
Supply insulating materials that comply with Euroclass C.

CFC'S AND HCFC'S:
- Ensure all thermal insulants for use in the building services are made using materials with zero ozone depletion potential (CFC and HCFC free).
- The following materials must not be used.
  - Polyurethane.
  - Urethane foams.
  - Extruded polystyrene.
  - Phenolic foam.
  - Polyisocyanurate foam.
  - Polyethylene foam.

SPREAD OF FLAME:
When completed, ensure surface-finish complies with BS 476-7 Class 1 spread of flame.

SMOKE EMISSION CHARACTERISTICS:
Supply materials classified as less than 5% smoke obscuration rating when tested in accordance with BS EN ISO 5659-2.

ELECTRICAL BONDING TERMINAL:
Ensure an electrical bonding terminal suitable for connection of 6mm^2 maximum conductor is provided where indicated.

INSPECTION AND TESTING:
Arrange performance test of thermal conductivity on materials selected, carried out at manufacturer's works or at an approved laboratory and in accordance with appropriate British Standard.

THERMAL CONDUCTIVITY:
Ensure values are in accordance with BS EN 12664, BS EN 12667, BS EN 12939 or BS EN ISO 8990.

THERMAL PERFORMANCE LIFE EXPECTANCY FOR PLANT DESIGN LIFE:
Ensure the insulation shall maintain it's thermal performance for a minimum of the plant design life.

THERMAL PERFORMANCE LIFE EXPECTANCY DETAILS:
Provide manufacturer's details which define the life expectancy of the insulation material.

RESTRICTIONS ON USE OF MATERIALS:
Protect insulated stainless steel surfaces from the risk of stress corrosion in accordance with the recommendations in BS 5970.

FOIL FACED MINERAL FIBRE RIGID DUCT INSULATION:
Standard - BS 3958-5.
Nominal density - 45 - 48 kg/m^3.
Thickness - 25mm to 100mm.
Thermal conductivity - Not exceeding 0.04 W/mK at a mean temperature of 50^{o}C.
Finish - Reinforced aluminium foil.

FOIL FACED MINERAL FIBRE FLEXIBLE DUCT INSULATION:
Nominal density - 28 kg/m^3 to 45 kg/m^3.
Thickness - 25mm to 60mm.
Thermal conductivity - Not exceeding 0.04 W/mK at a mean temperature of 50^{o}C.
Finish - Reinforced aluminium foil.

ENVIRONMENTAL THICKNESS ON WARM AIR DUCTWORK:

Temperature difference between air inside ductwork and ambient still air (K)	10	25	50
Heat loss (W/m^2)	7.2	15.3	26.0
Environmental thickness of mineral wool insulation (mm)	40	50	60
Environmental thickness of phenolic foam insulation (mm)	20	25	40

CONDENSATION CONTROL ON CHILLED AIR DUCTWORK - MINERAL WOOL:

Minimum air temperature inside duct ^{0}C	Thermal conductivity of 0.035 W/mK at a mean temperature of 10 ^{0}C Surface coefficients		
	Low (0.05)	Medium (0.44)	High (0.90)
	Thickness of mineral wool insulation (mm)		
15	25	25	25
10	50	25	25
5	65	40	25
0	90	50	30

CONDENSATION CONTROL ON CHILLED AIR DUCTWORK - PHENOLIC FOAM:
Minimum insulation thickness for condensation control on ductwork carrying chilled air in ambient conditions: indoor still air temperature 25^{0}C, relative humidity 80%, dew point

temperature 21.3^{0}C.

Minimum air temperature inside duct ^{0}C	Thermal conductivity of 0.021 W/mK at a mean temperature of 10 ^{0}C Surface coefficients		
	Low (0.05)	Medium (0.44)	High (0.90)
	Thickness of phenolic foam insulation (mm)		
15	25	25	25
10	30	25	25
5	40	25	25
0	50	25	25

INSTALLATION OF FOIL FACED SEMI-RIGID SLAB INSULATION ON DUCTWORK:
Secure the insulation with adhesive in accordance with manufacturer's recommendations. Use insulation hangers spaced at maximum 300mm centres on the underside of ducts.
Cut slabs so that the top and bottom pieces overlap the sides. Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape.
Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface.
Where insulation abuts duct support inserts that have integral vapour barriers seal using class 'O' foil tape to continue vapour barrier.

INSTALLATION OF FOIL FACED FLEXIBLE DUCTWORK INSULATION:
Secure the insulation with adhesive in accordance with manufacturer's recommendations. Use insulation hangers spaced at maximum 300mm centres on the underside of rectangular and flat oval ducts.
Seal joints and pin penetrations using 100mm wide class 'O' aluminium foil tape. Where cut outs for test holes, etc occur tape over insulation membrane and return to the duct surface.
Where insulation abuts duct support inserts that have integral vapour barriers seal using class 'O' foil tape to continue vapour barrier.

5.7 AIR HANDLING UNITS

AIR LEAKAGE:
Ensure air handling unit is sealed to prevent air leakage at design pressure. Determine air leakage in accordance with HEVAC Guide to Air Handling Unit Leakage Testing, Figure 3 at 400 Pa negative pressure.

Ensure air handling unit is sealed to prevent air leakage at design pressure. Determine air leakage in accordance with BS EN 1886, Table 2 at 400 Pa negative pressure and table 3 at 700 Pa positive pressure.

AIR LEAKAGE - FILTER BYPASS:
Determine air bypass around filter cells in accordance with BS EN 1886.
Ensure air leakage rates do not exceed the values given in table 4 of BS EN 1886 at a test pressure of 400Pa.

MANUFACTURER'S STANDARD DOUBLE SKIN CASING AIR HANDLING UNITS:
Outer skin material - Manufacturer's standard.
Inner skin material - Manufacturer's standard.
External casing finish - Manufacturer's standard.
Internal casing finish - Manufacturer's standard.

AIR HANDLING UNIT CONSTRUCTION:
- Insulation to provide

- thermal treatment.
- structural treatment.
- acoustic treatment.

General construction

Construct unit to withstand maximum fan static pressure without plastic deformation.

Ensure panels do not deflect by more than 1/120 of maximum panel dimension when unit is in operation.

Use corrosion resistant fastenings throughout.

Do not use self tapping screws.

Provide panel gaskets to give a durable seal between panels and frames to prevent excessive air leakage.

Construct unit to avoid thermal bridging.

Provide stacking units where indicated.

Casing thermal performance

Ensure the casing thermal performance is tested in accordance with the requirements of BS EN 1886.

Casing Insulation

Ensure insulation complies with BS 476-7. Ensure insulation is fixed securely to panel, and protected to prevent migration of fibre into air flow.

Insulation to provide thermal, structural or acoustic treatment as indicated.

Ensure insulation is vapour sealed throughout and incorporate thermal breaks.

Insulation material

Provide insulation that is inorganic, vermin proof and non-hygroscopic.

Use mineral fibre, minimum of 50mm thick, or CFC free rigid polyurethane foam, minimum of 25 mm thick or CFC free injected polyurethane foam, minimum 25 mm thick.

Framework

Ensure framework is rigid enough to prevent distortion during transportation and after final assembly on site.

Seat panels into folded, rolled or extruded frame with purpose made corner joints; or pentapost type frame with purpose made corner joints.

Ensure framework is self supporting.

For vertical units strengthen framework to support additional weight.

Base

Provide feet under each section; formed base; or RSC base.

AIR HANDLING UNIT ACCESS:

Provide access openings and covers complete with opening devices, and sealed to prevent air leakage.

Ensure seals are designed for normal maintenance operations for a minimum of 10 years.

Provide hinged access doors, 400mm minimum width.

Operating device - key operated door locks.

Provide access to fans, dampers, filters, spray coils, humidifiers and within air handling unit for inspection of nozzles and tanks.

FAN SECTION:

Provide frame for motor and fan and comply with fire regulations.

Ensure frame is isolated from casing.

For blow through units ensure air flow in downstream sections of unit has relatively uniform velocity profile.

Supply fan guards to BS EN ISO 12100.

Accessories

Provide flexible connection between fan discharge and casing spigot. Ensure flexible connections comply with fire regulations.

Provide manometer connections to measure static pressure at fan inlet eye.

Provide manometer connections to measure static pressure at fan discharge.

FILTER SECTION:

Provide frames to allow withdrawal of filters.

DRAINAGE FROM AIR HANDLING UNIT COMPONENTS:
Provide drainage pipework from cooling coils, humidifiers and components where water may collect. Comply with recommendations in CIBSE Technical Memorandum TM13 in connection with Legionnaires' disease.
Material - Glass drainage system.

CONTROL DAMPERS:
Provide manufacturer's standard control dampers in accordance with DW 144 Part 7 Section 21.
Provide motorized control dampers complete with extended spindle; motor; motor linkage; and motor support.

COMPONENT ASSEMBLY:
- Assemble air handling units using gasket to prevent air leakage from casing.
- Do not carry out any site drilling without prior approval.

COMPONENT ASSEMBLY:
Assemble air handling units using gaskets to prevent air leakage from casing.

ACCESS:
Ensure air handling units are positioned to allow adequate space for maintenance and access.

DUCT CONNECTIONS:
Ensure air is straightened as it leaves unit discharge. Ensure ductwork connection is long enough to ensure the aerodynamic performance of the fan is not affected.

SERVICES CONNECTIONS:
Ensure panels are sealed around electrical cable and pipework service entry points to prevent air leakage, using suitable and approved methods to suit individual services applications.
Provide flexible cables between fan motor and local isolator.

ISOLATION OF UNITS:
Provide means of isolating air handling units electrically to allow maintenance and repairs to be carried out.
Provide means of isolating pipework to air handling units to allow maintenance and repairs to be carried out.
Provide means of isolating steam to humidifier when access door is opened.

DRAINAGE OF FREE WATER:
Make provision for free water to be caught, collected and drained away. Provide U-traps on all drains suitable for the negative/positive pressure created by the fan.

SUPPORT AIR HANDLING UNIT:
On builders work base.

5.8 FANS

NORMAL OPERATING CONDITIONS WITH CIBSE NOISE REQUIREMENTS
Sound Power Level
Select fan, motor, drive and speed control system not to exceed typical fan noise level spectra as given in CIBSE Guide. Provide sound power data in accordance with BS EN ISO 5136, BS ISO 13347-1, BS ISO 13347-2, BS ISO 13347-3, BS ISO 13347-4.
Air Density
Relate fan performance to air density 1.20kg/m^3.
Temperature Range
Minimum to maximum operating temperatures -5^oC to 30^oC.

CONSTRUCTION AND HANDLING:
Casings

Construct rigid casing free from drumming under operating conditions. Supply in sections as required for access or handling. Flange dimensions in accordance with BS 848-4.
Safety standards - to BS EN 60335-2-80.
Rotating assemblies
Balance in accordance with BS ISO 1940-1; BS ISO 11342; or BS 7854-1; as appropriate.
Shafts and hubs
Machine impeller bosses and shafts to BS 4500 and key in accordance with BS 4235-1.
Hold impeller to shaft with set screw or taper lock fitting.
Shaft bearings - Sealed for life.
Drives and guards
Provide guards over shaft, couplings and rope in accordance with BS EN ISO 12100 and Factory Inspectorate requirements.
Material - galvanized or sheet steel.
Lifting
Provide lifting eyebolts or similar facilities on fans or sections heavier than 20kg.

TESTING:
Provide results of aerodynamic performance tests in accordance with BS ISO 14695.

MATERIALS, GALVANIZED SHEET STEEL:
Construct casing from galvanized sheet steel in accordance with BS EN 10327 or BS EN 10143.

MATERIALS COATED MILD STEEL:
Construct casing from mild steel coated with epoxy polyester finish.

AXIAL FLOW FANS
Aerodynamic efficiency not less than seventy per cent.
Bearings
Provide bearings suitable for mounting and direction of flow.
Casing - enclosing impeller and motor.
SINGLE INLET SINGLE WIDTH CENTRIFUGAL FANS:
Aerodynamic efficiency
Backward curved type, not less than 75%.
Forward curved type, not less than 65%.
Operation - single.
Impeller Design
Supply fan with impeller to suit operating conditions.
Casing - single inlet single width.
Mounting - channel frame.
Drain
Fit drain connection at lowest point of scroll unless indicated otherwise.

DOUBLE INLET DOUBLE WIDTH CENTRIFUGAL FANS:
Aerodynamic efficiency
Backward curved type, not less than 75%.
Forward curved type, not less than 65%.
Operation - single.
Impeller Design
Supply fan with impeller to suit operating conditions.
Casing - double inlet double width.
Mounting - channel frame.
Drain
Fit drain connection at lowest point of scroll unless indicated otherwise.

PROPELLER FANS:
Drives
When motor spindle is extended for mounting blade hub, connect motor to casing, diaphragm plate or mounting ring with support arms.

Impellers
Supply profile blades designed to give uniform airflow.
Mountings
Support fans on plate with circular opening sized and located in accordance with fan manufacturer's requirements.

MIXED FLOW FANS:
Operation - single.
Provide bearings suitable for mounting and position indicated on drawings.

ROOF MOUNTED SINGLE FANS:
Operation - single.
Vertical or horizontal discharge as shown on drawings.

ROOF MOUNTED TWIN FANS:
Operation - twin with automatic changeover.
Vertical or horizontal discharge as shown on drawings.

IN LINE SINGLE FANS:
Operation - single centrifugal fans.

IN LINE TWIN FANS:
Operation - twin centrifugal fans with automatic changeover.

INSPECTION DOORS - AXIAL FANS:
Fit air-tight inspection doors giving access to drive motors and other components requiring regular servicing or maintenance.

INSPECTION DOORS - CENTRIFUGAL FANS:
Fit air-tight doors in scroll and cover.

INSPECTION DOORS - PROPELLER FANS:
For diaphragm mounted fans fit an air-tight inspection door positioned to give access to drive, or other sub-components requiring regular servicing or maintenance.

INSPECTION DOORS - MIXED FLOW FANS:
Fit air-tight inspection doors giving access to drive motors and other components requiring regular servicing or maintenance.

GUARDS:
Provide guards in accordance with BS EN ISO 12100.
Fit safety guards on air inlet and air outlet connections where these are freely accessible to personnel in accordance with BS 848-5.
Provide bird guards where indicated.

CONNECTIONS TO DUCT:
Provide matching flanges and flexible connections where indicated.

SHUTTERS:
Fit shutters to prevent reverse flow through fan where indicated.

AIR FLOW SENSORS:
Fit air flow sensors or pressure switches on twin fan units to sense fan failure and provide automatic changeover to standby fan.

FLOW MEASUREMENT:
Provide flow measurement facility.

ACCESS:

Provide access via hinged casing or removable panel as indicated.

MOUNTING:
Provide base frames/mounting brackets when this is integral part of fan set.

SPEED CONTROLLER:
Provide speed controller to match fans.

STANDBY MOTOR:
Provide standby motor.

LOCATION:
Install fans in positions indicated, in accordance with manufacturer's instructions and recommendations in the HEVAC Fan Application Guide.

ATTITUDE:
Mount impeller shaft horizontally unless otherwise indicated.

ALIGNMENT:
Ensure fan is installed aligned to allow optimum air flow path.

TESTING:
Ensure fan is isolated from installation during air leakage testing of ductwork.

DRAIN CONNECTION:
Fit trap to drain connection at lowest point of scroll on centrifugal fans where indicated.

5.9 AIR FILTRATION

SEALS:
Provide filters with edge seals as appropriate to prevent air by-passing. Ensure seals remain effective after removal and replacement of cells.

PANEL FILTERS, ALUMINIUM FRAME:
Ensure filter media is retained in frame.
Provide disposable filter media of glass fibre with scrim or composite fibre material.
Filter frame - Aluminium.

PANEL FILTERS, STEEL FRAME:
Ensure filter media is retained in frame.
Provide disposable filter media of glass fibre with scrim or composite fibre material.
Filter frame
Light gauge mild steel with corrosion resistant coating.

PRESSURE GAUGE, PRESSURE DIFFERENTIAL SWITCH:
Pressure differential switch for visual or audio warning of "Filter Blocked Condition".

SPARES:
Supply sufficient filter media to allow one complete replacement for each filter.

CLEANING:
Supply cleaning materials for metal plate filters, supply sufficient coating solution for one complete cleansing operation.

ACCESS FOR MAINTENANCE:
- Provide access
  - on upstream side of media.
  - on side of filter casing.
  - on bottom of filter casing.

- from chamber on upstream side of media for front withdrawal.
  Provide access for changing filter media. Provide access for maintenance of motor drive and associated control equipment without disturbing filter media. Provide access for total duct maintenance.

5.10 HEATING/COOLING COILS

HEATING/COOLING COILS:

- Materials
  - Tubes
    - Seamless, round tubes to BS EN 12449.
    - Seamless, round copper capillary to BS EN 12450.
    - Seamless, round tubes for heat exchangers to BS EN 12451.
      - Rolled, finned, seamless tubes for heat exchangers to BS EN 12452.
    - Steel to BS EN 10255.
    - Steel, galvanized to BS EN ISO 1461.
    - Stainless steel to BS EN 10216-5.
    - Acid proof steel.
    - Electro-tinned copper.
    - Aluminium.
  - Fins
    - Aluminium.
    - Copper
    - Galvanized steel.
    - Electro-tinned copper in line with BS 1872.
    - Aluminium with epoxy paint.
    - Aluminium with surface treatment.
  - Headers
    - Galvanized steel.
    - Steel painted with anti-corrosion paint.
    - Copper with brass connections.
    - Copper with copper connections.
    - Copper with steel connections.
    - Aluminium.
  - Casing
    - Galvanized sheet steel in accordance with BS EN 10327 or BS EN 10143.
    - Stainless steel.
    - Painted steel.
    - Aluminium.
    - Brass.
- Casing - Make provision for coil expansion.
  - Enclose body of coil, headers and bends within casing.
  - Enclose tube return bends in box structure. Seal tube/header connections with flexible sealing rings where connections penetrate terminal sheet metal.
  - Supply coil with headers and bends exposed outside casing.
  - Provide plugs in headers to permit internal cleaning of coils.
- Draining and venting
  - Provide plugged connections in headers to allow fitting of drain cocks/air vents.
  - Provide coil complete with venting and draining devices.
- Arrangement
  - Supply fins in vertical plate arrangement for cooling coils.
  - Supply cooling coil split
- Drain pan
  - Provide drainage facility to avoid standing water.
- Coil Testing
  Pressure test coils to a minimum of 1.5 times design working pressure to ensure

leak tight manufacture, and provide signed test certificates. Base coil design and sizing on performance test figures in line with

- BS 5141-1, cooling coils.
- BS 5141-2, heating coils.

- Packaging
  - Fit protection for fins prior to despatch.

    Protect coils from dirt after manufacture by fitting blank flanges/caps to pipe connections.

CONNECTIONS:

- Cooling coils
  - Provide a drain line incorporating deep seal trap.
- Heating coils
  - Arrange pipe connections to take up thermal expansion movement without imposing stress on coil.

5.11 SILENCERS/ACOUSTIC TREATMENT

TESTING:
Provide certified insertion loss data in accordance with BS EN ISO 7235. Provide generated sound power levels with insertion loss data.
Where equipment is manufactured in modules ensure performance ratings apply to complete unit.
PROTECTION:
Protect silencers where they are installed in positions exposed to external weather conditions.
Block ends of silencers prior to delivery to site to prevent damage.
DIRECTION OF FLOW:
Clearly mark direction of air flow on silencers.

FIRE PROPERTIES, BS 476-7, CLASS 1:
Use non-flammable adhesives. Ensure that all insulating materials and coverings are non-combustible material covered with a material that complies with flame spread requirements of BS 476-7, Class 1.

FIRE PROPERTIES, BUILDING REGULATIONS, CLASS O:
Use non-flammable adhesives. Ensure that all insulating materials and coverings are to Class O surface rating of Building Regulations.

SILENCERS - CASING TO DW144 WITH CONNECTIONS TO MATCH AHU:
Provide silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic.
Construct splitters with manufacturer's standard ends.
Construct casing to DW 144 with duct connections to match the air handling unit and specified method of assembly.

SILENCERS - CASING TO DW144 WITH EXTERNAL FLANGES:
Provide silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic.
Construct splitters with manufacturer's standard ends.
Construct casing to DW 144 with external flanges drilled for bolting to counterflanges on adjacent plant or ductwork.

SILENCERS - CASING TO DW144 WITH INTERNAL FLANGES:
Provide silencers compatible with ductwork installation.
Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic.
Construct splitters with manufacturer's standard ends.
Construct casing to DW 144 with internal flanges drilled and threaded for bolting to

counterflanges on adjacent plant or ductwork.

SILENCERS - CASING TO DW144 WITH SPIGOT ENDS:
Provide silencers compatible with ductwork installation. Provide infill that is inert, fire proof, inorganic, vermin proof, non-hygroscopic.
Construct casing to DW 144 with plain spigot ends for connection to adjacent plant or ductwork.

ACOUSTIC FLEXIBLE DUCT CONNECTORS:
Provide acoustic flexible duct connectors in accordance with DW 144, Part 7, Section 25.

5.12 Commissioning

COMMISSIONING REQUIREMENTS:
Application - All extract systems.

Clean ductwork before plant is first run, using access openings in ductwork.

Put system to work and demonstrate that specified duties can be achieved.

Carry out commissioning of installations in accordance with the procedures, checks and tolerances given in the BSRIA Application Guide for air systems to achieve the standards set in the CIBSE Commissioning Codes.

Carry out checks and procedures as detailed in CIBSE Commissioning Code A, Section A1.

Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A, Section A2.

Keep a systematic record of commissioning results. Carry out seasonal commissioning within the first year of handover; this shall include no less than three return commissioning visits.

6 CONTROLS

6.1 Performance Objectives:

To design, supply, install, test and commission the control functions to manage the new heating and hot water system. A building management system (BMS) shall be provided. The BMS shall control the heating, hot water and ventilation systems in an optimised way to minimise energy use and running costs whilst maintaining a comfortable and healthy environment.

6.2 Design Parameters:

The controls installation shall comply with all relevant Standards, Regulations, Guidance Documents, Codes of Practice and BS 7671 IET Wiring Regulations.

The location of all field mounted controls shall be agreed with the contractor prior to installation.

All fixed equipment shall be fitted with individual, local (within 600mm) switch disconnectors. These shall be clearly labelled with the equipment and circuit they serve.

6.3 System Description

A building management system (BMS) shall be provided. The BMS shall control the heating, hot water and ventilation systems in an optimised way to minimise energy use and running costs whilst maintaining a comfortable and healthy environment.

Simple and intuitive controls interface between the building occupants and the controls system shall be part of the controls system design.

The boilers, pumps and pressurisation units shall be controlled via their integral control systems. Time Control, monitoring and fault indication shall be provided by the BMS.

BMS ALONG WITH IQ VIEW TOUCH SCREEN INCORPORATED INTO HEATING

CONTROL PANEL:

Supplied by TREND Control Systems Ltd (or equal and approved)
Horsham
West Sussex
RH12 2PQ
Tel: +44 (0) 1403 211888

The controls system shall be carried out by a Specialist Controls Sub Contractor.
The Controls Specialist shall carry out:
The complete detailed design, supply, delivery, assembly, installation, configuration, documentation, inspection and commissioning of the automatic controls including hardware, software to provide a complete controls system.
Isolation, disconnection, removal and disposal of the existing redundant controls and power supplies.
Local heating control shall be provided for each room/zone.
Read 3-port valve open/close conditions from BMS.
Auto pump changeover.
Installation of new MCP panel.
The new controls and wiring installation shall provide for the new plant.
Power and controls wiring within and from the control panels.
Controls wiring including sensors, valves, actuators, inputs/outputs, communications, wiring/wiring systems, etc.
Positioning and mounting of the loose controls

Cable containment required to complete the controls and power
Power wiring to mechanical services plant and equipment unless otherwise detailed.
The production of all design logic flowcharts
All software development
Software licences
Production of detailed installation drawings/point list/data base/cable schedules/ panel details
Production of detailed as fitted drawings/point list/data base/cable schedules/ panel details
Provision of data communications
Pre-commissioning, commissioning and post commissioning.

General

Where new controls are provided they shall meet the specification as outlined in this section of the specification.

The Contractor shall ensure all controls equipment is compatible and does not adversely affect any other equipment installed locally.

All plant and components shall be installed in accordance with manufacturers' instructions and recommendations.

Electronic programmable times and/or controllers shall be provided with rechargeable battery back-up or capacitor to provide back-up power for the timer's/controllers volatile memory for a minimum period of 72 hours.

The controls shall include all control devices, protection devices, relays etc.

The control system shall maintain design conditions; safe operations of plant, display energy consumed by each system and allow optimisation of running costs.

Green 'run' and red 'trip' or 'fault' lamps shall be provided on the Motor Control Centre (MCC) for all items of plant e.g. CHP, boilers, each boiler circulation pump, each VT circulation pump, each CT circulation pump, pressurisation unit, Supply and extract fans etc. CHP & Boilers shall be provided with green 'on' lamps not run lamps.

Time Clock

The clock and calendar shall be programmed with the periods of normal (automatic) operation. The clock time is to change between GMT and British Summer Time and back automatically at the times pre-programmed by the operator.

Summer/winter operation

The change between summer and winter shall be dependent on pre-determined dates. Winter mode is deemed to occur between 1st October and 31st April provided the outside temperature is not above 17°C for a period of at least 30 minutes. Summer mode is deemed to occur at all other times.

Low temperature interlock signals (plant protection)

The low outside air temperature condition signal shall be activated for the variable temperature circuit at all times when the outside air temperature is below a set point of 3°C. The signal shall be present until the outside air temperature rises above the outside temperature set-point plus a differential of 2°C. While this signal is active the duty primary and secondary circuit heating pumps shall be started if they are not already operating. If the primary and secondary heating circuit valves are not already operating they shall be automatically fully opened to enable water to circulate throughout the respective systems, providing the plant is in an operating mode.

The low primary heating return water temperature condition signal shall be activated when the primary heating return water temperature is below a set-point of 8°C. This shall enable the primary and secondary heating pumps (if not enabled due to low outside air temperature) and the boiler plant. The signal shall remain present until either the return water temperature rises above a set-point of 55°C, or a low zone temperature condition signal or a heating plant operation signal becomes active.

Low inside air temperature interlock (building fabric and contents protection)

A low inside air temperature signal shall start all heating plant for the variable temperature circuit at all times. This signal shall activate when any zone temperature falls below a set point of 10°C and shall terminate when the zone with the lowest temperature has risen above 14°C or until it signals a different mode in which the heating plant operates.
The low inside air temperature signal shall be independent of the low outside air temperature and low primary heating return water temperature signals, and it shall take priority over the other two signals.

Optimum start heating

The optimum start heating signal shall be activated prior to normal plant operation when signalled by the self-adaptive control algorithm. The self-adaptive control algorithm shall calculate the latest possible time prior to normal operation when the plant should be activated in order to obtain the zone heating temperature set-point at the beginning of normal operation. To calculate the optimum start time the algorithm shall measure the outside and internal zone air temperature(s) and take into account the thermal response of the building structure and plant. The algorithm is to be self-adaptive using an iterative process after each period of operation to improve its performance. The iterative process shall use knowledge of the time when the zone reached the temperature set-point prior to normal operation and the actual temperature of the zone when the normal operation commenced.

On initiation of a heating demand signal from the optimum start algorithm the heating plant shall operate at maximum output consistent with safe operation.

Optimum stop heating

The optimum stop heating function shall disable the normal plant operation signal when initiated by the self-adapting control algorithm. The self-adapting control algorithm shall calculate the earliest possible time prior to the end of occupancy when the plant can be shutdown while still maintaining the zone air temperature above a minimum acceptable value during the occupied period. The algorithm shall use measured values of the outside and zone air temperatures along with parameters associated with the building and plant. The algorithm is to be self-adapting using an iterative process after each period of operation. The iterative process shall use knowledge of the time when the zone reached the minimum acceptable temperature or the actual temperature at the end of occupancy.

A maximum period of 2 hours between the optimum stop and the end of the occupied period shall be incorporated.

Pump overruns

The pump overrun operation signal shall be activated following any heating plant operating mode during which hot water is distributed to primary and secondary circuits. The pump overrun signal shall remain present for a period of 5 minutes.

Pump control

During plant shutdown periods the pump shall be off and the appropriate valves serving the loads shall be fully closed. The pump shall be enabled when a plant operation signal is active and each valve shall be modulated under PI control to obtain the served zone temperature set-point/other parameter.

The pump shall operate when started by any of the following signals:

i) Optimum heating start.

ii) Low outside air temperature, low return water temperature or low inside air temperature.

iii) Normal plant operation.

iv) Any associated plant items with a hand/off/auto' selector switch being switched to hand' position.

Twin pumps shall operate on a duty-standby basis. The lead pump shall change on a weekly basis or on pump failure. The duty pump shall be proven, allowing for a suitable start up delay, by a differential pressure switch. In the event that the flow rate is not proven in 15 seconds, the standby pump shall start and an alarm shall be raised at the control panel. In the event that the standby pump flow is not proven the system shall be shut down and a further alarm shall be raised at the control panel. A software reset shall be provided at the control panel to reset the pump fail indication on rectification of a fault.

Pumps operating in primary and secondary heating circuits shall operate for a 5 minute run-on period after the plant operation signal is removed.

The pump shall be proven, allowing for a suitable start up delay, by a differential pressure switch. In the event that the heating pump flow is not proven the system shall be shut down and an alarm shall be raised at the controller.

Each twin pump set shall be provided with an Auto, Off, P1a (hand) & P1b (hand) sector switch on the MCC.

Each single pump set shall be provided with an Auto, Off, On sector switch on the MCC.

Toilet Extract Fans

The toilet extract fan units shall be provided with auto change over in the event of a fan failure.

The toilet extract fans shall be on/off controlled via the associated room PIR sensors with adjustable fan run on timer set at 15 minutes.

PIR of Toilets
The Controls specialist shall carry out wiring of PIR activated water services shut off valves to all toilet areas.

Natural Ventilation
The natural ventilation system shall be controlled based on;
Temperature and CO2 Room Controller with manual override.
External temperature sensor.
Precipitation sensor for roof lights.
Air flow velocity sensor.

The louvres shall be automatically controlled via a dedicated room controller located in each area that shall control the damper motor based on CO2 and temperature. The damper shall be openable at any time to allow for night time cooling.

Each room equipped with louvres shall also have a natural ventilation control panel that shall control the louvre dampers.The unit shall consist of;
24V AC/DC supply voltage
High accuracy temperature and CO2 Sensor
Room Temperature Set Point Adjustable 19°C to 26°C
Room CO2 Set Point Adjustable 900ppm to 1600ppm
an 'open' and 'close' push button feature, and LED lights to display the selected mode.
Anti-microbial™ front face touch membrane - eliminate bacteria
CO2 measuring range - 0 ~ 2,000ppm
CO2 measuring accuracy - +/- 30ppm or 5%
Sensing element - Non dispersive infrared detector
Temperature measuring range - 0 ~ 50°C
Temperature accuracy - 1% at 25°C
Power supply - 24vAC / 24vDC
Consumption - 20mA average, 40mA with all LED&s lit (at v24) 100mA for 10ms every 3s when sampling CO2
Analogue outputs - Two 0/10v DC outputs(10mA) AO1 = Ventilation/Cooling, AO2 = Heating

The Control specialist shall carry out all of the wiring required for natural ventilation actuators and the controls systems.

The modulating actuators shall be manufactured by Belimo and shall meet the following requirements;
Sound power level Max. 35 dB (A)
The actuator is overload-proof, requires no limit switches and automatically stops when the end stop is reached.

Natural ventilation controls shall be by Gilberts of Blackpool or equal and approved.

Window openings shall be manually controlled. All windows which have catches or handles that are outside of easy reach or access shall be provided with remote manual controls.

The mechanical supply and extract ventilation system control panels shall consist of;

- High accuracy temperature and CO2 Sensor
- Room Temperature Set Point Adjustable 19°C to 26°C
- Room CO2 Set Point Adjustable 600ppm to 1600ppm
- Traffic light system to indicate the CO2 levels within the room.
- A manual 'start' and 'stop' push button feature, and LED lights to display the selected mode.
- Run and fault indication for the supply and extract fans.
- CO2 measuring range - 0 ~ 2,000ppm
- CO2 measuring accuracy - +/- 30ppm or 5%
- Sensing element - Non dispersive infrared detector
- Temperature measuring range - 0 ~ 50°C
- Temperature accuracy - 1% at 25°C
- Analogue outputs - Two 0/10v DC outputs(10mA) AO1 = Ventilation/Cooling, AO2 = Heating

The heating & Hot water system control panels shall consist of;

Inputs

- External sensor
- Main school space sensor/s
- Extension space sensor
- Common Boiler flow sensor
- Common boiler return sensor
- Extension Mixed flow sensor
- Boiler 1 Run status
- Boiler 2 Run status
- Boiler 3 Run status
- Boiler 4 Run status
- Fire interlock normal status
- Gas valve open status
- Main heating Pump 1 run status
- Main Heating pump 2 run status
- Main Heating pump 3 run status
- Extension Heating pump run status
- Heating extend push button 0-4 hour –status

Outputs

- Boiler 1– SRM
- Boiler 2 - SRM
- Boiler 3 & shunt pump-2RM
- Boiler 4 & Shunt pump-2RM
- Main heating pumps common output(Auto changeover) -2RM
- Main Heating pumps inverter output -0-100
- Extension Heating Pump common output (Auto changeover) -2RM
- Heating pump common fail lamp-SRM

Panel switches and lamps

Note it is assumed the follow boiler switch positions will be interlocked with boiler shunt pumps

Boiler 1 Hand/Auto/off, Supply on and Trip LED lamps
Boiler 2 Hand /Auto/off, Supply On and Trip LED Lamps
Boiler 3 Hand/Auto/off, Supply On and Trip LED Lamps
Boiler 4 Hand/Auto/off, Supply On and Trip LED Lamps
etc

Main Heating Pump 1 Hand/Auto/off switch, Run and Trip LED lamps
Main Heating pump 2 Hand/Auto/off switch, Run and Trip LED lamps
Extension Pump 1 Hand /Auto/off switch, Run and Trip LED lamps
Extension Pump 2 Hand/Auto/off switch , Run and Trip LED lamps

The MCP panels shall provide the following control functions (local control)

- Operating times with independent control of ventilation, heating and HWS heaters.
- Set points of heating system
- Zone temperatures
- Air and water dampers (3 Port Valves); local control of valves and motorised air systems where applicable.

- Ventilation systems (not applicable to fans were control is manual or linked with PIR sensors).

Monitoring - the BMS shall allow the following monitoring to be carried out

- Operating times of heating & HWS heaters.
- Set points of heating system
- Zone temperatures
- Air and water dampers (3 Port Valves); local control of valves and motorised air systems where applicable.
- Domestic hot water flow temperature.
- Ventilation systems (not applicable to fans were control is manual or linked with PIR sensors).
- Gas and electric consumption.
- Hours run for all heating boilers and fans (not applicable to small wall mounted fans, fans controlled via 'PIR sensor' fans controlled manually and boilers used for teaching).
- Cold water service leak detection shut off.
- Emergency lighting test status.
- Critical alarms - Boiler failure, pumps and pressurisation unit failure, ventilation system failure, low domestic hot water temperature, , closure of a solenoid gas valve, emergency lighting test fault.

BMS Reports

The BMS System shall be capable of running and printing off the following reports:-

- Alarm Event Log
- Set Point Data (where available)
- Energy Metering Data

All communications between the BMS outstations and the BMS head end shall include details of the building, date, time and item the communication involves.

7 BREEAM CLAUSES

7.1 Performance Objectives:

The contractor shall be responsible for ensuring the design and installation complies with the requirements of BREEAM.

It shall be wholly the contractor's responsibility for submitting all reports, calculations and other details requested by the BREEAM assessor for compliance with the BREEAM Very Good rating targeted.

7.2 Man 04 Stakeholder Participation (four credits)

7.5.1 *Commissioning and Testing Schedule and Responsibilities*

The Contractor shall account for a schedule of commissioning that identifies and includes a suitable timescale for commissioning and re-commissioning of all complex and non-complex building services, control systems and building fabric. The schedule shall identify all the appropriate standards that all commissioning activities will be conducted in accordance with, such as current Building Regulations, BSRIA and CIBSE guidelines and/or other appropriate standards, where applicable.

CIBSE Commissioning Codes: Set of Seven Codes (2003):

CIBSE Commissioning Code A: Air Distribution Systems (1996 confirmed 2006). ISBN:

9780900953736

CIBSE Commissioning Code B: Boilers ISBN: 9781903287293

CIBSE Commissioning Code C: Automatic Controls ISBN: 9781903287132

CIBSE Commissioning Code L: Lighting (SLL Commissioning Code L). ISBN: 9781903287323

CIBSE Commissioning Code M: Commissioning Management. ISBN: 9781903287330

CIBSE Commissioning Code R: Refrigerating Systems. ISBN: 9781903287286 CIBSE Commissioning Code W: Water Distribution Systems ISBN: 9781906846152.

BSRIA Commissioning Guides:

Application Guide 1/91 - Commissioning of VAV systems in Buildings

Application Guide 20/95 - Commissioning of Pipework Systems

Technical Memoranda 1/88.1 - Commissioning HVAC Systems

Application Guide 3/89.3 - Commissioning of Air Systems in Buildings

Application Guide 29/2011 - Pre-commission Cleaning of Pipework Systems

Application Guide 2/2010 - Commissioning Water Systems

Application Guide 11/2010 – Commissioning Job Book

Where a building management system (BMS) is specified, the Contractor shall account for the following:

1) Commissioning of air and water systems is carried out when all control devices are installed, wired and functional.

2) In addition to air and water flow results, commissioning results include physical measurements of room temperatures, off coil temperatures and other key parameters as appropriate.

3) The BMS/controls installation should be running in auto with satisfactory internal conditions prior to handover.

4) All BMS schematics and graphics (if BMS is present) are fully installed and functional to user interface before handover.

5) The occupier or facilities team is fully trained in the operation of the system.

The Contractor shall ensure that an appropriate project team member is appointed to monitor and programme pre-commissioning, commissioning and, where necessary, re-commissioning activities on their behalf. The Contractor shall account for the commissioning programme, responsibilities and criteria within their budget and main programme of works, allowing for the required time to complete all commissioning activities prior to handover.

7.5.2 *Commissioning Building Services*

In addition to complying with the 'Commissioning and Testing Schedule and Responsibilities' credit, the Contractor shall ensure that for buildings with complex building services and systems, a specialist commissioning manager is appointed during the design stage with responsibility for:

a) Undertaking design reviews and giving advice on suitability for ease of commissioning.

b) Providing commissioning management input to construction programming and during installation stages.

c) Management of commissioning, performance testing and handover/post hand-over stages.

Where there are simple building services, this role can be carried out by an appropriate project team member, provided they are not involved in the general installation works for the building services systems.

7.5.3 *Testing and Inspecting Building Fabric*

The Contractor shall account for a commissioning schedule, and ensure responsibilities are accounted for in line with the commissioning schedule and responsibilities credit. The

Contractor shall ensure that the integrity of the building fabric, including continuity of insulation, avoidance of thermal bridging and air leakage paths is quality assured through completion of post construction testing and inspection. Dependent on building type or construction, this can be demonstrated through the completion of a thermographic survey as

well as an airtightness test and inspection. The Contractor shall ensure that the survey/testing is undertaken by Suitably Qualified Professional in accordance with the appropriate standards:

Air Tightness testing: professionals with membership of ATTMA (Air Tightness Testing and Measurement Association) attained at organisational level maintaining UKAS accreditation (as air tightness testing laboratories to ISO 17025).

Thermographic survey: professional holding a valid Level 2 certificate in thermography.

The Contractor shall ensure that any defects identified in the thermographic survey and/or airtightness testing report are rectified prior to building handover and close out, and that any remedial work shall meet the required performance characteristics for the building/element (i.e.

it shall have the same performance characteristics and life expectancy of the surrounding elements).

The Contractor shall ensure that the thermographic survey covers 100% of the treated space, and all elements of the building fabric that enclose an internal heated and/or conditioned (treated) zone of the building shall be tested.

Note that in the case of large and complex buildings, it may be impractical for the thermographic survey and air-tightness testing to cover 100% of the building. Where a complete thermographic survey is deemed impractical by a Level 2 qualified thermographic surveyor, the guidance in air tightness standard TSL23 shall be followed on the extent of the survey and testing. This could include airports, large hospitals and high-rise buildings.

7.5.4 *Handover*

The Contractor shall ensure that a Building User Guide is developed prior to handover for distribution to the building occupiers and premises managers. The Building User Guide shall provide easily accessible and understandable information relevant to: the building staff; nontechnical facilities management team/building manager; other building users (visitors, community users).

The Contractor shall ensure that the Building User Guide is specific to the building type, including information on the following:

- Overview of the building and its environmental strategy, e.g. energy/water/waste efficiency policy/strategy and how users should engage with/deliver the policy/strategy.
- Building services overview and access to controls, e.g. where to find them, what they control, how to operate effectively and efficiently etc.
- Pre-arrival information for visitors, e.g. access and security procedures/provisions
- Provision of, and access to, shared facilities
- Safety and emergency information/instructions
- Building related operational procedures specific to building type/operation, e.g. laboratories.
- Building related incident reporting/feedback arrangements
- Building related training information/links

- Provision of, and access to, transport facilities, e.g. public transport, cyclist facilities, pedestrian routes etc.

- Provision of, and access to, local amenities

- Re-fit, refurbishment and maintenance arrangements/considerations

- Links, references and relevant contact details

Note that the Assessor recommends that the Building User Guide contains images to help aid the user.

The Contractor shall prepare a training schedule for building occupiers/premises managers, timed appropriately around handover and proposed occupation plans, which includes the following content as a minimum:

a) The building's design intent.

b) The available aftercare provision and aftercare team main contacts, including any scheduled seasonal commissioning and post occupancy evaluation.

c) Introduction to, and demonstration of, installed systems and key features, particularly building management systems, controls and their interfaces.

d) Introduction to the Building User Guide and other relevant building documentation, e.g.

design data, technical guides, maintenance strategy, operations and maintenance (O&M) manual, commissioning records, log book etc.

Maintenance requirements, including any maintenance contracts and regimes in place.

7.3 Man 05 Aftercare (two credits)

7.6.1 *Aftercare Support*

The Contractor shall ensure that operational infrastructure and resources are in place to provide aftercare support to the building occupiers, which includes the following as a minimum:

a) A meeting programmed to occur between the aftercare team/individual and the building occupier/management (prior to initial occupation, or as soon as possible thereafter) to:

i. Introduce the aftercare team or individual to the aftercare support available, including the Building User Guide (where existing) and training schedule/content.

ii. Present key information about the building including the design intent and how to use the building to ensure it operates as efficiently and effectively as possible.

b) Onsite facilities management training, to include a walkabout of the building and introduction to and familiarisation with the building systems, their controls and how to operate them in accordance with the design intent and operational demands.

c) Initial aftercare support provision for at least the first month of building occupation, e.g. onsite attendance on a weekly basis to support building users/management (this could be more or less frequent depending on the complexity of the building/building operations).

d) Longer term aftercare support provision for occupants for at least the first 12 months from occupation, e.g. a helpline, nominated individual or other appropriate system to support building users/management.

The Contractor shall ensure that operational infrastructure and resources are in place to coordinate the collection and monitoring of energy and water consumption data for a minimum of 12 months, once the building is occupied, in order to facilitate analysis of discrepancies between actual and predicted performance, with a view to adjusting systems and/or user behaviours accordingly.

7.6.2 *Seasonal Commissioning*

The Contractor shall account for the following seasonal commissioning activities, to be completed over a minimum 12 month period, once the building becomes substantially occupied:

a) Complex systems - Specialist Commissioning Manager:

i. Testing of all building services under full load conditions, i.e. heating equipment in midwinter, cooling/ventilation equipment in mid-summer, and under part load conditions (spring/autumn).

ii. Where applicable, testing should also be carried out during periods of extreme (high or low) occupancy.

iii. Interviews with building occupants (where they are affected by the complex services) to identify problems or concerns regarding the effectiveness of the systems.

iv. Re-commissioning of systems (following any work needed to serve revised loads), and incorporating any revisions in operating procedures into the operations and maintenance (O&M) manuals.

b) Simple systems (naturally ventilated) - external consultant/aftercare team/facilities manager

i. Review thermal comfort, ventilation, and lighting, at three, six and nine month intervals after initial occupation, either by measurement or occupant feedback.

ii. Take all reasonable steps to re-commission systems following the review to take account of deficiencies identified and incorporate any relevant revisions in operating procedures into the O&M manuals.

7.4 Hea 02 Indoor Air Quality (one credit)

7.8.1 *Indoor Air Quality Plan*

The Contractor shall produce an indoor air quality (IAQ) plan with the objective of facilitating a process that leads to design, specification and installation decisions and actions that

minimise indoor air pollution during occupation of the building. The indoor air quality plan shall consider: a) Removal of contaminant sources.

b) Dilution and control of contaminant sources.

c) Procedures for pre-occupancy flush out.

d) 3rd party testing and analysis.

e) Maintaining indoor air quality in-use.

The Contractor shall provide a copy of this plan to the BREEAM assessor for the interim design stage assessment.

7.5 Hea 04 Thermal Comfort (two credits)

7.9.1 Thermal Modelling

The Contractor shall undertake thermal modelling using software in accordance with CIBSE AM11 Building Energy and Environmental Modelling. The Contractor shall ensure that the software used to carry out the simulation at the detailed design stage provides full dynamic thermal analysis. For smaller and more basic building designs with less complex heating or cooling systems, an alternative less complex means of analysis may be appropriate, i.e. ClassCool (such methodologies must still be in accordance with CIBSE AM11).

The Contractor shall ensure that the thermal modelling results demonstrate the following:

a) For air conditioned buildings, summer and winter operative temperature ranges in occupied spaces are in accordance with the criteria set out in Building Bulletin 101, Ventilation of school buildings (April 2014).

b) For naturally ventilated/free running buildings, winter operative temperature ranges in occupied spaces are in accordance with the criteria set out in Building Bulltein 101, Ventilation of school buildings (April 2014). The modelling results shall demonstrate that the building is designed to limit the risk of overheating, in accordance with the adaptive comfort methodology outlined in CIBSE TM52: The limits of thermal comfort: avoiding overheating in European buildings.

For air conditioned buildings, the Contractor shall provide the PMV (Predicted Mean Vote) and PPD (Predicted Percentage of Dissatisfied) indices to the Assessor, based on the modelling undertaken.

7.9.2 Thermal Zoning and Controls

The Contractor shall ensure the thermal modelling credit is achieved, and shall demonstrate how the thermal modelling analysis has informed the temperature control strategy for the building and its users. The strategy for proposed heating/cooling systems shall demonstrate that it has addressed the following:

a) Zones within the building and how the building services could efficiently and appropriately heat or cool these areas. For example consider the different requirements for the central core of a building compared with the external perimeter adjacent to the windows.

b) The degree of occupant control required for these zones, based on discussions with the end user (or alternatively building type or use specific design guidance, case studies, feedback) considers:

i. User knowledge of building services ii. Occupancy type, patterns and room functions (and therefore appropriate level of control required) iii. How the user is likely to operate or interact with the system(s), e.g. are they likely to open windows, access thermostatic radiator valves (TRV) on radiators, change air conditioning settings etc., iv. The user expectations (this may differ in the summer and winter) and degree of individual control (i.e. obtaining the balance between occupant preferences, for example some occupants like fresh air and others dislike drafts).

c) How the proposed systems will interact with each other (where there is more than one system) and how this may affect the thermal comfort of the building occupants.

d) The need or otherwise for an accessible building user actuated manual override for any automatic systems.

Note: For buildings with less complex heating/cooling systems the thermal comfort strategy does not need to comply with requirements c and d. Compliance can be demonstrated where zoning allows separate occupant control (within the occupied space) of each perimeter area (i.e. within 7m of each external wall) and the central zone (i.e. over 7m from the external walls). For example, adequate TRVs (thermostatic radiator valves) placed in zones around the building perimeter, and the provision of local occupant controls to internal areas, such as fan coil units.

7.6 Hea 05 Acoustic Performance (three credits)

7.10.1 *Sound Insulation*

All room functions:

The Contractor shall ensure that the building achieves the performance standards set out in

Section 2 of the Acoustic Performance Standard for the Priority Schools Building Programme (APS), June 2013, relating to airborne and impact sound insulation of walls and floors. A programme of pre-completion acoustic testing shall be carried out by a compliant test body in accordance with the APS requirements, and the ANC Good Practice Guide, Acoustic Testing of Schools.

7.10.2 *Internal Indoor Ambient Noise Levels*

The Contractor shall ensure that the building achieves the performance standards set out in Section 2 of the APS for all room types. For roofs with a mass of 150kg/m^2 (lightweight roofs), or any roof with glazing or rooflights, calculations shall be undertaken using laboratory data with heavy rain noise excitation as defined in BS EN ISO 140-18, for teaching/learning spaces. These shall demonstrate that the reverberant sound pressure levels in these rooms are not more than 20dB above the appropriate limits in Table 1 of Section 2 of APS.

A programme of acoustic measurements for indoor ambient noise levels (excluding rain noise) shall be carried out in accordance with the ANC Good Practice Guide, Acoustic testing of Schools. For rain noise, a specification compliant with the APS criteria shall be installed to demonstrate compliance.

Note that for heavy weight roofs, or parts of the roof that are heavyweight, with a mass per unit greater than 150kg/m^2 (including those with sedum planting) that do not have any glazing or rooflights, calculations are not required.

7.10.3 *Reverberation*

The Contractor shall ensure the following performance criteria (i.e. for control of reverberation, sound absorption and speech transmission index (STI)) are met:

Teaching and study spaces: Achieve the required performance standards for reverberation times set out in table 5 in section 2 of APS. A programme of acoustic measurements shall be carried out by a compliant test body in accordance with the ANC Good Practice Guide, Acoustic testing of Schools.

Open Plan teaching spaces: Achieve the performance requirements relating to speech transmission index (STI) set out within Section 2.8 of APS. STI Measurements of the STI shall be taken in at least one in ten typical student listening positions in the open plan spaces in accordance with the ANC Good Practice Guide, Acoustic testing of Schools.

Corridors and stairwells: In corridors and stairwells that give direct access to teaching and study spaces, achieve the performance requirements relating to sound absorption in Section 2.7 of APS. Installation of a specification compliant with the APS criteria will demonstrate compliance.

Note that the Acoustic Performance Standard for the Priority Schools Building Programme (APS), June 2013, is due to be replaced by 'Acoustic Design of Schools: performance standards' in 2014. If the new document is published and formally adopted, this will supersede the APS document for BREEAM credit requirements.

Note that where a programme of pre-completion testing identifies that spaces do not meet the standards, remedial works must be carried out prior to handover and occupation and the spaces re-tested to ensure compliance. Remedial works must be carried out to all affected and potentially affected areas, including rooms or spaces previously untested of a similar construction and performance requirement. The test report, or covering correspondence, should include a clear statement that the testing is in accordance with the required standard (where specified) or the BREEAM criteria (see Checklists and tables and Methodology section), and include the relevant pass/fail criteria.

7.7 Ene 01 Reduction of Energy Use and Carbon (ten credits)

7.12.1 Energy Performance

Up to 12 credits are available based on the building's calculated Energy Performance Ratio for New Constructions. This is calculated by the BREEAM assessor using the Part L BRUKL output report based on SBEM calculations.

The Contractor shall provide a copy of the Part L BRUKL output report.

Where design stage calculations have been carried out, the Contractor shall ensure the as built Part L results are at least equal to that of design stage.

7.8 Ene 02 Energy Monitoring (two credits)

7.13.1 *Sub-metering of Major Energy Consuming Systems*

The Contractor shall ensure that energy metering systems are installed that enable at least 90% of the estimated annual energy consumption of each fuel to be assigned to the various end-use categories of energy consuming systems.

For a building with a total useful floor area greater than 1000m^2, energy consuming systems shall be metered using an appropriate energy monitoring and management system, i.e. Automatic Meter Reading systems (AMR) or BEMS. In buildings with a total useful floor area less than 1000m^2, energy systems shall be metered either with an energy monitoring and management system or with separate accessible energy sub-meters with pulsed or other open protocol communication outputs, to enable future connection to an energy monitoring and management system. The end energy consuming uses shall be identifiable to the building users, for example through labelling or data outputs.

Energy consuming systems include:

a) Space Heating

b) Domestic Hot Water

c) Humidification

d) Cooling

e) Air Movement i.e. Fans (major)

f) Lighting

g) Small Power supply (lighting and small power can be on the same sub-meter where supplies are taken at each floor/department).

h) Other major energy-consuming items where appropriate, such as lifts and escalators, drama studios or theatres with large lighting rigs.

Where a modular boiler system is specified, the Contractor shall ensure that modular boiler systems are monitored as a whole.

Note that where an existing building is being extended and the new extension will share existing building services plant and systems with the existing building, the criteria for energy metering only applies to the extension. In this case energy services supplying energy consuming systems from the existing building shall, as a minimum, be metered at the entry points to the extension, e.g. hot water, chilled water, gas and electricity. However the best practice approach would usually be to ensure that the energy metering covers the entire building.

7.13.2 *Sub-metering of Energy Supply to Separate Tenanted and Function Areas*

The Contractor shall ensure that an accessible monitoring and management system, or separate accessible sub-meters with pulsed outputs or other open protocol communication outputs, are installed. These shall enable future connection to an energy monitoring and management system, and cover a significant majority of the energy supply to all tenanted areas, or in the case of single-occupancy buildings, relevant function areas or departments, within the building unit.

Note that examples of an accessible monitoring and management system are Automatic Meter Reading systems (AMR) or Building Energy Management Systems (BEMS). Automatic monitoring and targeting (aM&T) is an example of a management tool that includes automatic meter reading and data management.

Relevant function areas include, but are not limited to:

- Kitchens (excluding small staff kitchens and food technology rooms)
- Computer suites
- Workshops
- Lecture halls
- Conference rooms
- Drama studios
- Swimming pools
- Sports halls
- Process areas
- Laboratories
- High containment suites within laboratories
- Controlled environment chambers
- Animal accommodation areas
- Data centres
- IT work and study rooms, including IT-equipped library space and any space with provision of more than one computer terminal per 5m^2.

Individual sub-metering of standard classrooms/seminar rooms is not required.

Please note that all types of energy supplied to a building area (department/tenancy/ unit) within the boundary of the assessed development; including electricity, gas, heat or other form of energy/fuel which is consumed as a result of the use of and operations within each relevant area must be sub-metered.

In addition, please note that in a development consisting of a number of small function areas or departments, sub-metering the heating, hot water and combined electricity uses is sufficient. Individual electricity energy uses within each unit do not need to be sub-metered. Small function areas/departments are defined as <200m^2.

Note that where an existing building is being extended and the new extension will share existing building services plant and systems with the existing building, the criteria for energy metering only applies to the extension. In this case energy services supplying energy consuming systems from the existing building shall, as a minimum, be metered at the entry points to the extension, e.g. hot water, chilled water, gas and electricity. However the best practice approach would usually be to ensure that the energy metering covers the entire building.

Note that a 'significant majority' of energy supply to the tenanted areas/function areas/departments covers most of the energy uses but does not have to include very small ones. As a guide, energy uses that cumulatively make-up less than 10% of the energy supply for that area may be excluded.

Note that the systems for buildings situated on campus developments must be monitored using either an appropriate energy monitoring and management system or another automated control system, e.g. outstations linked to a central computer, for monitoring energy consumption. The criteria only apply to the assessed building. Where energy services are supplied from an existing building on the campus, they shall be metered at the entry points to the assessed building, e.g. hot water, chilled water, gas and electricity. Provision of a pulsed or other open protocol communication output is not sufficient to award the credit for these building types.

7.9 Ene 04 Low Carbon Design (one credit)

7.15.1 *Low Zero Carbon Feasibility Study*

The Contractor shall ensure that a feasibility study is undertaken by an energy specialist to establish the most appropriate recognised local (onsite or near-site) low or zero carbon (LZC) energy source(s) for the building/development. The study shall cover the following as a minimum:

a) Energy generated from LZC energy source per year

b) Life cycle cost of the potential specification, accounting for payback

c) Local planning criteria, including land use and noise

7.15.2 Feasibility of ***exporting*** heat/electricity from the system

d) Any available grants

e) All technologies appropriate to the site and energy demand of the development.

f) Reasons for excluding other technologies

g) Where appropriate to the building type, connecting the proposed building to an existing local community CHP system or source of waste heat or power OR specifying a building/site CHP system or source of waste heat or power with the potential to export excess heat or power via a local community energy scheme.

The Contractor shall ensure that a local LZC energy technology/technologies shall be specified and installed for the building/development in line with the recommendations of this feasibility study, and that this method of supply results in a meaningful reduction in regulated carbon dioxide (CO_2) emissions. This should not be a trivial amount. As a guide, the technology should contribute at least 5% of overall carbon dioxide emissions, and evidence of the LZC specification and the percentage reduction in CO_2 emissions shall be provided to the Assessor.

Note: When undertaking a feasibility study at a stage later than concept design (RIBA stage 2 or equivalent), an additional element shall be included in the report to highlight the local LZC energy sources which had been discounted due to the constraints placed on the project by the late consideration, and the reason for their omission. If

the feasibility study discounted all local LZC as unfeasible due to the late stage in the project that the study was commissioned, then the credit for the feasibility study shall be withheld.

Note: Technologies eligible to contribute to achieving the requirements of this issue shall produce energy from renewable sources, and meet all other ancillary requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. The following shall also be met:

- There shall be a direct supply of energy produced to the building under assessment.

- Where covered by the Microgeneration Certification Scheme (MCS), technologies under 50kWe or 45kWth shall be MCS (or equivalent) certified products installed by MCS (or equivalent) certified installers.

- Combined heat and power (CHP) schemes above 50kWe shall be certified under the CHPQA standard. CHP schemes fuelled by mains gas are eligible to contribute to performance against this issue.

- Air source heat pumps shall only be considered as a renewable technology when used in heating mode. Refer to Annex VI of Directive 2009/28/EC for more detail on accounting for energy from heat pumps.

- Where MCS or CHPQA certification is not available, the design team shall investigate the availability of alternative accreditation schemes in line with the Directives listed above, or an equivalent country/regional directive or standard. Where an accreditation scheme exists it shall be used for the purpose of verifying compliance of the specified LZC technology. If no accreditation scheme exists in the country the design team shall demonstrate they have investigated the competence of the installer selected to install the LZC technology and are confident that they have the skill and competence to install the technology appropriately

7.10 Ene 08 Energy Efficient Equipment (two credits)

The Contractor shall identify the building's unregulated energy consuming loads and estimate their contribution to the total annual unregulated energy consumption of the building, assuming a typical/standard specification. The Contractor shall identify the systems and/or processes that have a major impact on the total unregulated energy consumption of the development and its operation and demonstrate a meaningful reduction in the total unregulated energy consumption of the building through the following solutions:

Small Power, plug in equipment

The Contractor shall ensure that office equipment (computer monitors, desktop computers, scanners, photocopiers, printers, workstations etc.), other small equipment and supplementary electric heating has been awarded an Energy Star rating or has been procured in accordance with the Government Buying Standards. In addition, the following domestic scale appliances, where present, shall have an EU Energy Efficiency Labelling Scheme rating as follows:

a) Fridges, fridge freezers: A+ rating

b) Washing machines: A++ rating

c) Dishwashers: A+ rating

d) Washer-dryers and tumble dryers: A rating.

OR

e) If any of the appliances will be purchased during occupation by the tenant/owner, information on the EU Energy Efficiency Labelling Scheme of efficient white goods must be provided to tenant.

Note that this applies to the following refrigeration equipment:

- Air cooled condensing units
- Cellar cooling
- Commercial service cabinets
- Curtains/blinds for refrigerated display cabinets
- Refrigeration compressors
- Refrigeration system controls
- Refrigerated display cabinets

Note that this also applies to any existing equipment that is to be re-used.

Kitchen and Catering facilities

The Contractor shall ensure that the project has incorporated at least two-thirds of the energy efficiency measures (except as specified) outlined in each of the following sections of CIBSE Guide TM50:

a) Section 8 (Drainage and kitchen waste removal)

b) Section 9 (Energy controls - specifically controls relevant to appliances)

c) Section 11 (Appliance specification - not fabrication or utensil specifications)

d) Section 12 (Refrigeration)

e) Section 13 (Warewashing: dishwashers and glasswashers)

f) Section 14 (Cooking appliance selection)

g) Section 15 (Water temperatures, taps, faucets and water saving controls).

Note that reuse of electrical equipment does not comply by default, as it may not be the most energy efficient option. However, the credit could be awarded if either of the following criteria are demonstrated:

a) The existing electrical appliances meet the criteria for inclusion on the Enhanced Capital Allowance Scheme Energy Technology Product List.

Reusing the old equipment would, over the course of its life, be a more energy-efficient option than specifying new equipment

7.11 Mat 01 Life Cycle Impacts (four credits)

Up to six credits may be awarded based on the building's quantified environmental life cycle impact through assessment of the main building elements:

- External walls
- Windows
- Roof
- Upper floor slabs
- Internal walls
- Floor finishes/coverings

The Contractor shall provide the necessary information to the BREEAM Assessor to allow credits to be calculated (element type, area, Green Guide rating, Green Guide element number). In addition, the Contractor shall provide pdf copies of specifications and drawings for the above building elements.

Note that only new elements need to be assessed. Existing in situ elements adjoining a new construction, e.g. an existing building facade, do not require assessment.

Note that products Environmental Profiles can be used to demonstrate compliance with this BREEAM issue. Products are certified with a "product specific" Green Guide rating as part of a relevant elemental specification, e.g. a manufacturer's concrete block as part of an external wall specification. This rating can be used in the same way as a generic Green Guide rating for this BREEAM issue. A company self-generated Environmental Product Declaration (EPD) that has been independently verified would be acceptable, where evidence is provided to demonstrate that the EPD is produced in accordance with requirements of ISO 14020 series

7.12 Mat 03 Responsible Sourcing of Materials (three credits)

7.28.1 **Pre-requisite:**

The Contractor shall ensure that all timber used on the project is "Legally harvested and traded timber", i.e. from independently verifiable legal and sustainable sources or FLEGT-licensed timber or equivalent sources. This is mandatory for the project. Legal timber and wood derived products are those that originate from a forest where the following criteria are met:

a) The forest owner/manager holds legal use rights to the forest.

b) There is compliance by both the forest management organisation and any contractors with local and national legal criteria including those relevant to:

i. Forest management

ii. Environment

iii. Labour and welfare iv. Health and safety

v. Other parties' tenure and use rights vi. All relevant royalties and taxes are paid.

c) There is full compliance with the criteria of CITES.

7.28.2 Sustainable Procurement Plan

The Contractor shall produce a sustainable procurement plan, and shall source materials for the project in accordance with this plan. The plan shall set out a framework for responsible sourcing of materials to guide procurement throughout a project and by all involved in the specification and procurement of construction materials. The plan shall be prepared and adopted at an organisational level or be site/project specific and for the purposes of BREEAM compliance, will cover the following as a minimum:

a) Risks and opportunities are identified against a broad range of social, environmental and economic issues. BS 8902:2009 Responsible sourcing sector certification schemes for construction products- Specification can be used as a guide to identify these issues.

b) Aims, objectives and targets to guide sustainable procurement activities.

c) Strategic assessment of sustainably sourced materials available locally and nationally. There should be a policy to procure materials locally where possible.

d) Procedures are in place to check and verify that the sustainable procurement plan is being implemented/adhered to on individual projects. These could include setting out measurement criteria, methodology and performance indicators to assess progress and demonstrate success.

7.28.3 Responsible Sourcing of Materials

The Contractor shall ensure that the materials that make up each of the applicable location/use categories are responsibly sourced in accordance with the BREEAM compliance requirements, in order to achieve 36% of the available Responsible Sourcing of Materials (RSM) points.

Relevant location/use categories are:

- Ceiling (including ceiling finishes)
- Door/Window
- Floor (including floor finishes)
- Insulation
- Internal partition/internal walls (including finishes)
- Roof (including roof finishes)

- Structure, primary and secondary
- External wall (e.g. cladding, lining, render, including finishes)
- Building services
- Hard landscaping
- Other
-

Applicable materials are:

- Timber/timber-based products (TBP)
- Concrete/cementitious (plaster, mortar, screed)
- Metal
- Stone/aggregate
- Clay-based (pavers, blocks, bricks, roof, tiles, etc.)
- Gypsum
- Glass
- Plastic, polymer, resin, paint, chemicals and bituminous
- Animal fibre fibre/skin, cellulose fibre
- Other

The Contractor shall ensure that the applicable materials are sourced from a manufacturer with a certified Environmental Management System (EMS) such as ISO14001, EMAS or The Green Dragon Environmental Standard or schemes compliant with BES 6001 (all ratings), covering at least the 'Key Process' stage of the product. For metals, this includes manufacturers with CARES SCS scheme or Eco-reinforcement certification, and timber/TBP from FSC/PEFC/SFI certified sources. The Contractor shall obtain copies of the ISO/EMAS or other relevant certification from the manufacturers and keep this information on file.

The Contractor shall keep records of the above, and provide copies of the purchase orders/delivery notes and relevant product certification as evidence to the BREEAM Assessor.

7.13 Mat 04 Insulation (one credit)

7.29.1 *Embodied Impact*

The Contractor shall provide evidence to confirm that any new insulation specified for use within the following building elements will be/has been assessed:

- External walls
- Ground floor
- Roof
- Building services

The Contractor shall ensure that the Insulation Index for the building insulation is the same as or greater than 2.5. This is calculated by the BREEAM assessor via a BRE calculator and so the

Contractor shall inform the BREEAM assessor of proposed insulation type, volume, Green Guide rating and thermal conductivity. Note that insulation that does not meet this requirement shall not be used so the Contractor should ensure their proposed specification will achieve an Insulation Index of at least 2.5.

Note that if the insulation is incorporated as a component of an element that has been manufactured offsite (in order to maximise material optimisation) e.g. a wall or roof, and that element has been assessed as part of Mat 01, then for the purpose of assessing the insulation for this BREEAM issue, a Green Guide rating of A+ should be used. The same rule applies to insulation that has a significant additional function, such as providing supporting structure e.g. structural insulated panels (SIPS). In the Green Guide the actual insulation will be listed within the element title, rather than under the generic insulation category.

7.14 Mat 05 Designing for Robustness (one credit)

Protecting vulnerable parts of the building from damage

The Contractor shall ensure the building incorporates suitable durability and protection measures or designed features/solutions to prevent damage to vulnerable parts of the internal and external building and landscaping elements. This must include, but is not necessarily limited to:

a) Protection from the effects of high pedestrian traffic in main entrances, public areas and thoroughfares (corridors, lifts, stairs, doors etc).

b) Protection against any internal vehicular/trolley movement within 1m of the internal building fabric in storage, delivery, corridor and kitchen areas.

c) Protection against, or prevention from, any potential vehicular collision where vehicular parking and manoeuvring occurs within 1m of the external building façade for all car parking areas and within 2m for all delivery areas.

Suitable durability measures include:

- Bollards/barriers/raised kerbs to delivery and vehicle drop off areas
- Robust external wall construction, up to 2m high
- Corridor walls specified to Severe Duty as per BS 5234-2

- Protection rails to walls of corridors
- Kick plates/impact protection on doors
- Hard wearing and easily washable floor finishes in heavily used circulation areas Designing out the risk without the need for additional materials.

The Contractor shall ensure that any vehicle impact protection measures specified are positioned at an adequate distance from the building to protect the fabric from impact from any vehicle with a measurable overhang of the body from the wheel track, in particular for any goods delivery areas.

The Contractor shall ensure that in vehicle movement areas only; where the specification of external robust wall construction is specified to comply with the credit, additional protection must be provided to ensure against potential damage to the robust façade from vehicle movement, i.e. specifying bollards or protection rails.

Where relevant, the Contractor shall give consideration to materials specification in public/common areas (especially public waiting areas and toilet areas) to provide protection against potential malicious or physical abuse in as far as it is possible.

Note that the specification or design measures chosen should reflect the need to balance the additional specification of materials with the need to protect building elements to minimise their replacement, insuring against excessive material use and promoting materials optimisation.

Protecting exposed parts of the building from materials degradation:

The Contractor shall ensure that the relevant building elements incorporate appropriate design and specification measures to limit material degradation due to environmental factors.

Material degradation effects include (but are not limited to) the following:

a) Corrosion

b) Dimensional change, e.g. swelling or shrinkage

c) Fading/discolouration

d) Rotting

e) Leaching

f) Blistering

g) Melting

h) Salt crystallisation

i) Abrasion

Environmental Factors include:

I. Environmental agents, including:

a) Solar radiation

b) Temperature variation

c) Water/Moisture

d) Wind

e) Precipitation e.g rain and snow

f) Extreme weather conditions: High wind speeds, flooding, driving rain, snow

2. Biological Agents, including:

a) Vegetation

b) Pests, insects

c) Pollutants, including:

d) Air contaminants

e) Ground contaminants

Applicable building elements are:

a) Foundation/substructure/lowest floor/retaining walls

b) External Walls

c) Roof/balconies

d) Glazing: windows, skylight

e) External doors

f) Railings/balusters (where exposed to the external environment)

g) Cladding (where exposed to the external environment)

h) Staircase/ramps (where exposed to the external environment)

i) Hard landscaping.

7.15 Pol 01 Impact of Refrigerants

7.37.1 *Pre-requisite*

The Contractor shall ensure that all systems (with electric compressors) comply with the requirements of BS EN 378:2008 (parts 2 and 3) and where refrigeration systems containing

ammonia are installed, the Institute of Refrigeration Ammonia Refrigeration Systems Code of Practice.

7.16 Pol 02 NOx Emissions (three credits)

NOx Emissions of Heating Source (three credits)

Three credits:

The Contractor shall ensure that the plant installed to meet the building's delivered heating and hot water demand has, under normal operating conditions, a dry NOx emission level (measured at 0% excess O_2) of ≤40 mg/kWh.

Note that if the assessed building is an extension to an existing building, and heating/hot water demand for the new extension is being met by an existing system, then the NOx emission level for the existing system must be assessed against the criteria of this issue.

Note that where the water heating can be demonstrated to be less than 10% of the buildings total energy consumption, these credits can be awarded based solely on the NOx emissions from space heating. Where this is the case, the Contractor shall provide technical details to the Assessor to confirm the energy demand for the installed water heating systems.

7.17 Pol 05 Noise Attenuation (one credit)

a) ***11.5.1 One credit***

Where there are noise-sensitive areas or buildings within 800m radius of the assessed development, the Contractor shall ensure that a noise impact assessment is undertaken in compliance with BS 7445. This includes the following sections in particular:

a) BS 7445:1 Description and measurement of environmental noise, Part 1: Guide to quantities and procedures, British Standards Institute, 2003.

b) BS 7445:2 Description and measurement of environmental noise, Part 2: Guide to the acquisition of data pertinent to land use, British Standards Institute, 1991.

c) BS 7445:3 Description and measurement of environmental noise, Part 3: Guide to application to noise limits, British Standards Institute, 1991.

The following noise levels shall be measured/determined as part of the noise impact assessment:

a) Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background conditions can be argued to be similar.

b) The rating noise level resulting from the new noise-source.

The Contractor shall ensure that the noise impact assessment is carried out by a Suitably Qualified Acoustic Consultant holding a recognised acoustic qualification and membership of an appropriate professional body. The Contractor shall ensure that the noise level from the proposed site/building, as measured in the locality of the nearest or most exposed

noisesensitive development, is a difference no greater than +5dB during the day (0700hrs to 2300hrs) and +3dB at night (2300hrs to 0700hrs) compared to the background noise level.

Alternatively, where the noise source(s) from the proposed site/building is greater than the levels described in criterion 4 (above requirements), the Contractor shall install measures to attenuate the noise at its source to a level where it will comply with the previous criterion.

Note that BS 8233:1999 gives recommendations for the control of noise in and around buildings. Confirming the specification of attenuation measures in accordance with this Code of Practice can be used as a method of demonstrating compliance with noise levels in criterion 4.

The Contractor shall provide design drawings highlighting all existing and proposed noisesensitive buildings local to, and within, the site boundary, proposed sources of noise from the new development and the distance (m) from these buildings to the assessed development.

Alternatively, the Contractor shall provide a copy of the acoustician's report demonstrating compliance.

Noise sensitive areas include the following:

a) Residential areas

b) Hospitals, health centres, care homes, doctor's surgeries etc.

c) Schools, colleges and other teaching establishments

d) Libraries

e) Places of worship

f) Wildlife areas, historic landscapes, parks and gardens

g) Located in an Area of Outstanding Natural Beauty (AONB) or near a Site of Special

Scientific Interest (SSSI)

h) Any other development that can be considered noise sensitive.

Note that at the design stage of assessment, where noise sensitive areas or buildings are present, actual measurement is unlikely to be possible due to the planned but non-existent installation. In such situations compliance can be demonstrated through the use of acousticians' calculations or by scale model investigations. For such cases BS 7445-2 states that 'as universally agreed prediction models do not exist, the method adopted should be carefully described in the acoustician's report" and that 'when available, prediction models accepted by relevant authorities should be used'.

8 TENDER SUMMARY

	Item	Tender Price
Gas Supply		
	Installation of new gas services pipework to new plantroom/s including gas meters, solenoid valve and gas safety panel.	£
	Testing of new gas services pipework.	£
Heating Services		
	New gas fired boiler system including pressurisation unit, pumps, flues, dosing, de-aerator/dirt separator, valves, pipework and all ancillaries.	£
	CHP plant and buffer vessel.	£
	Underfloor heating system.	£
	Distribution pipework & radiators.	£
	Pipework insulation/boxing.	£
	Heat meters	£
Ventilation		
	Mechanical Ventilation Installation, heat recovery systems and local supply/extract.	£
	Natural Ventilation including louvres with actuated dampers, transfer ducts/attenuators and additional mechanical ventilation where required	£
	Thermal model on the Building using dynamic thermal modelling software IES Virtual environment in line with CIBSE AM10. For overheating, Part L and EPC.	£
Controls		
	BMS control system and MCC panel.	£
Associated Works		
	Designs and Installation Drawings	£
	Builder works	£
	Chlorination	£

	Commissioning	£
	Operating & Maintenance Manual & As Fitted Drawings	£
	System Demonstrations and Handover	£
	12 Months Routine Maintenance for the Mechanical Works	£
Maintenance Summary		
	Maintenance costs for above items	£
Any Additional Items Not Listed Above		
		£
Total		**£**

Signature of Tenderer

……

Name (Block Caps)

……

Tendering Company

……

Date

……

9 PLANT AND EQUIPMENT MANUFACTURES

The following is a list of plant and equipment manufacturers. This list is provided to ensure that a similar standard can be maintained and a comparable tender price can be obtained. The Contractor may provide comparable equal and approved or superior products and shall indicate this at the time of tendering. The contractor shall take note of the requirements for "equal and approved" products (refer to clause 1.6 within this specification).

Plant and Equipment	**Manufacturers/Suppliers**
Ventilation and Local Extract fans	Nuaire Vent-Axia Xpelair
Valves	Crane Hattersley Danfoss
Grilles/diffusers/louvers	Waterloo Air Products PLC Gilberts (Blackpool) Ltd Delta Technical Services
TMVs	Horne Engineering Ltd
Water Control devices	Cistermiser PHS Water savers
LST Radiators	Stelrad Zehnder
Underfloor Heating	Warmafloor
Water Heaters	Andrews Water Heater Rycroft
Boilers	MHS Hamworthy Broag Remeha
Pumps	Armstrong Grundfos Wilo
Air / Dirt Separators	Spirotech TA Controls
Pressurisation Units and Expansion Vessels	Flamco TA Controls Aquatech
Gas Valve	Tengis
BMS	Trend Johnson Controls

10 PROPOSED FIRMS AND PRODUCTS

At the time of submitting the tender the Contractor shall provide full details below of all firms for which it is proposed to sub-let any part of the contract works (including consultants) and the full details of the manufacturers' and products proposed for incorporation into the works.

Works to be Sub-Let	Nature of the Work	Name & Address

Type of Product	Product Details	Firm/Manufacturer details.

(N.B. Tenderer shall insert a separate continuation sheet should insufficient space be available above)

Atkins Limited
Woodcote Grove
Ashley Road
Epsom
Surrey KT18 5BW
England

info@atkinsglobal.com

www.atkinsglobal.com