

17 Dec 2019

Building Division

**Approved For Issue  
27/02/2020**

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Invercargill Central  
D.S Anchor - Zone 1  
33 Esk Street, Invercargill  
Mechanical and Hydraulic Services Specification

**Consent Issue  
22 October 2019  
Reference: CS18007-1**

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## **MECHANICAL AND HYDRAULIC SERVICES SPECIFICATION**

### **INVERCARGILL CENTRAL**

#### **D.S ANCHOR - ZONE 1**

#### **CONSENT ISSUE**

##### **A. PRELIMINARY AND GENERAL**

##### **A1. SEISMIC PERFORMANCE SPECIFICATION**

###### MECHANICAL

- C. PROJECT SPECIFIC MECHANICAL AND ELECTRICAL FOR MECHANICAL SCOPE**
- D. MECHANICAL STANDARD CLAUSES**
- E. ELECTRICAL FOR MECHANICAL AND AUTOMATIC CONTROLS STANDARD CLAUSES**
- F. MECHANICAL EQUIPMENT SCHEDULES**

###### DOMESTIC WATER

- G. PROJECT SPECIFIC DOMESTIC WATER SCOPE**
- H. DOMESTIC WATER STANDARD CLAUSES**
- I. DOMESTIC WATER EQUIPMENT SCHEDULES**

###### SANITARY SEWER

- J. PROJECT SPECIFIC SANITARY SEWER AND STORMWATER SCOPE**
- K. SANITARY SEWER AND STORMWATER STANDARD CLAUSES**
- L. SANITARY SEWER AND STORMWATER EQUIPMENT SCHEDULES**

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SECTION A

PRELIMINARY AND GENERAL

HWCP INVERCARGILL

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## SECTION A

### A.1 SCOPE OF WORK

The scope of work covered by this section, is the trade general and contractual requirements for the supply, delivery, assembly, installation, and commissioning complete working systems for the;

- Heating, Ventilation and Air Conditioning,
- Domestic Water,
- Sanitary Sewer, and
- Stormwater

The scope of works are set out in each of the relevant specific sections of this specification and the associated Cosgroves drawings.

### A.2 CONTRACT CONDITIONS

The conditions of contract shall be as specified in the Principal Consultants Contract Conditions.

### A.3 PRELIMINARY

The specification shall be read in conjunction with all other relevant contract documents. If further information is required refer to the building tenderers for details but these shall include, but not necessarily be limited to, the following:

- Principal Consultants Contract Conditions
- P & G Clauses
- Construction Programme
- Architectural Drawings
- Structural Drawings
- Cosgroves Mechanical & Hydraulic Drawings
- Fire Protection Drawings
- Electrical Drawings

Examination of the Architectural, Structural, Hydraulic and Mechanical drawings is necessary to ensure full allowance is made for all required coordination works, penetrations, access, etc

Tender price shall include allowances to ensure that the staging and completion dates, as detailed within the Construction Programme, are met.

The Sub-contractor shall observe and comply with such provisions of the Head Contract as are relevant to the sub-contract works, including the General and special Conditions of Contract.

### A.4 STANDARD DOCUMENTS

The work carried out by the Sub-contractor must comply with the following:

- a) The Building Consent and NZ Building Code (NZBC) requirements

- b) Current issue of relevant NZ and overseas standards
- c) Health and Safety in Employment Act.
- d) The relevant Acts governing installation of the sub-contract works in this class of building.
- e) Territorial Authority requirements.
- f) The requirements of the Chief Inspectors of the relevant Statutory Authorities.
- g) Any other regulations / code of practices that apply directly or indirectly to installations of this type.

Nothing within this specification or on the drawings is to be interpreted to permit sub-standard materials or allow workmanship of a standard inferior to that required by the regulations and standards.

Where conflicts between the design, referenced codes and/or standards exist, the most stringent of any requirement shall apply.

For the avoidance of doubt specific standards are referred to in the relevant sections of this specification, where the identifying year is omitted in the reference the standard shall be taken as the version referenced from the NZBC. Where a standard is not referenced by the applicable NZBC clause the identifying year shall be taken as the most recent edition at the time of tender.

## A.5 ROLES, OBJECTIVES AND EXPECTATIONS

### 5.1 CONSULTING ENGINEER

During the construction phase the Consulting Engineer's role is: -

- Analysis of schedule of technical data and alternatives offered.
- Review of construction and shop drawings.
- Review of samples for the purpose of establishing compliance with the design intent.
- Periodic review of the progress of the works, noting any observations with respect to quality of the installation or materials used.
- Issue of any clarification instruction required to interpret the specification or drawings
- Issue of any variation instructions (via the Lead Consultant) requiring a change to the specification or drawings
- Inspect the works at Practical Completion and schedule any defective or incomplete items.
- Review "As Installed", and operating and maintenance documents.

### 5.2 SPECIFICATION OBJECTIVES

The intent of this specification and the associated documents is: -

- To provide a basis for competitive tendering
- To allow competent contractors to price the works



- To provide a clear statement of contractual requirements against which compliance can be assessed.
- To provide documentation required by Authorities to demonstrate design compliance with statutory requirements.
- To provide documentation to demonstrate to the Client the scope and quality of the project
- To define the expectations upon the installer.
- To define the requirements of the Sub-contractor with respect to Quality Assurance

### 5.3 OBLIGATIONS OF THE SUB CONTRACTOR

The Consulting Engineer expects and relies upon the tenderers' possessing specialist trade expertise necessary to complete the works. In addition, the tenderer has the following obligations;

- To raise in good time, issues requiring design input or clarification particularly in respect to: -
  - i. interpretation of the specification or drawings
  - ii. problems in complying with the specification
  - iii. omissions from the tender documents
  - iv. suggested alternatives/substitutions
- To allow the design verification costs by the Consulting Engineer when suggesting alternatives and departures from the specification.
- To certify compliance with contract documents, including all variation instructions, at Practical Completion.
- To certify compliance with Authority requirements
- To pay all fees
- To obtain all Authority permits and certificates in a timely manner to allow the progress of the work.
- To implement procedures to ensure only competent trades people are used for the works.
- To contribute, in the spirit of partnering, towards the successful execution of the contract
- To fully understand the role of all relevant parties during the construction phase of the project and to assist them in the conduct of their duties wherever possible.

- To provide manufacturer's and construction drawings
- To provide samples and prototypes

### 5.4 SUB CONTRACTORS DESIGN RESPONSIBILITIES

The Sub Contractor shall be responsible for the detailed design activities listed below, in addition to those activities normally undertaken through the custom and practice of the industry.

The Sub Contractor shall be responsible for ensuring that the detailed design, which is undertaken, is fully co-ordinated and compatible with the remainder of the project design. The Sub Contractor's design obligation shall include:

- Detailed design of the plant and ductwork.
- Interface details with other trades.
- Size and location of penetrations in walls, floors and ceilings.
- Physical coordination of installation with other trades.
- Coordination of the construction of the installation.
- Bracket and supports - detailed design and locations.
- Capacity, location and design of equipment support systems, etc.
- Accommodate thermal expansion, seismic and construction joint movement in all services taking into account final installation details and consistency with specified requirements.

**5.5 SUB CONTRACTOR NAMING CONVENTION**

Through out this specification the following descriptive naming convention is used for various trades involved in this project.

Main Contractor / Builder with the overall responsibility for the works and site.

Mechanical Services Sub-contractor with the overall responsibility for Section C through F including the following sub-contractor.

Mechanical Services Electrician responsible for scope of works set out in sections E, including the electrical for mechanical and the automatic controls sub-contracts.

Specialist Controls Vendor / Automatic Controls responsible for the control of plant installed from this specification.

Main Electrical Sub-Contractor/Main Electrician responsible for the electrical supply to the site and all electrical works, scope of works as defined by the Electrical Engineering Consultants documentation.

Plumbing Sub-Contractor/Plumber with the overall responsibility for Sections G through I.

Drain laying Sub-Contractor/Drainlayer with the overall responsibility for Sections J through L.

**A.6 DRAWINGS AND SPECIFICATIONS**

Drawings and Specification shall be read together as they explain the intent of the required works. Clarify any doubtful items with the Engineer prior to submitting tender.

Any items included on the drawings but not within the specification, or vice versa, shall be deemed to be included.

Unless specifically stated otherwise the specification drawings shall be deemed to be diagrammatic and approximate only. Items partially shown on such or briefly described in this specification and which are clearly intended to be included or are obviously necessary or intended by trade practice for the satisfactory completion

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of the Sub-Contract Works shall be provided and installed unless specifically excepted.

All minor parts that are necessary for the completion of the work or to meet the requirements of any statutory authority having jurisdiction over the Sub-Contract Works shall be supplied and installed by the Sub-Contractor.

The Plans and Specifications shall remain the property of the consultant and shall not be used for any purpose other than for this project.

It shall be the Sub-Contractor's responsibility to ensure that all materials and work are carried out in accordance with the latest issue of each specification and drawings.

When a revised edition of any document is issued it is the Sub-Contractor's responsibility to ensure that all previous issues are recalled and destroyed or unmistakably marked CANCELLED. Errors arising from use of out of date information shall be the responsibility of the Sub-Contractor.

The Sub-Contractor shall check all dimensions and verify on site before commencing construction drawings or ordering any labour or materials or fabricated work. Before any work is commenced all shop drawings shall be submitted to the Contractor for approval. The Sub-Contractor shall advise the Contractor in writing of any conflicting dimensions and proceed on his direction.

The Sub-Contractor shall check dimensions levels and templates as necessary and take responsibility for their accuracy.

## **A.7 POSITIONING OF FITTINGS AND FIXTURES**

The layout of equipment shown on the drawings is diagrammatic only, and exact positions shall be determined on site.

Positions of all visible fittings shall be chalked up to show the intended position. Approval of the Architect & Engineer shall be obtained before finalising the placement.

Equipment shall be symmetrically located in relation to other equipment and devices, the building module and general aesthetic treatment, including but not limited to horizontally and/or vertically alignment when items are in close proximity.

## **A.8 SITE INSPECTION**

Tenderers shall inspect the site before submission of the tender. No claims will be considered through lack of knowledge of the site or documents.

## **A.9 SUB-CONTRACT TIME**

Within 7 days after the signing of a Sub-Contract Agreement or within 7 days of notification of award of Sub-Contract, whichever is the shorter period, and prior to commencement of any manufacture, the Sub-Contractor shall submit for approval 2 copies of a schedule of execution of the Sub-Contract works. This schedule shall show the sequence of operation intended for ordering of equipment, manufacturing and installation and shall show the dates for commencement and completion of each major activity in both sections of operation as further specified in the following sections. This schedule shall be prepared in collaboration with the Contractor to suit the Contractor's program.

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The works programme shall allow for providing attendance on site to support the Contractor's programme. The Sub-Contractor shall determine what restrictions if any are placed on the time of work by local authorities or others and shall comply with these conditions.

The Sub-Contractor shall be responsible for informing the Contractor when any cause arises that may affect the Works programme and to liaise with the Contractor accordingly.

The Sub-Contractor shall work within the Works Programme and shall carry all tasks necessary or desirable to complete the Sub-Contract Works or section of the Sub-Contract Works so as to maintain the Works Programme subject to approved extensions of time.

Once a Works Programme has been established for the Sub-Contract Works and provided that the Contractor does not prevent the Sub-Contractor from maintaining the schedule then the Sub-Contractor shall work as necessary to complete the Sub-Contract Works in accordance with the Works Programme. All dates and periods shall be subject to adjustment to meet the Works Programme without increase in the Sub-Contract amount.

The Sub-Contractor shall update the Works Programme when requested in writing by the Contractor and present the revised Programme acceptable to the Contractor within 2 days of such request.

The Sub-Contractor shall ensure that sufficient experienced trades people are on site to enable completion in accordance with the Works Programme.

## **A.10 RESPONSIBILITY OF SUB-CONTRACTORS**

It will be deemed that the Sub-Contractor before signing the Sub-Contract has investigated and satisfied themselves of everything and every condition affecting the Sub-Contract Works and the labour and materials to be provided and all contract details and the execution of this Sub-Contract by the Sub-Contractor is founded upon his own examination, knowledge, information and judgement. The Sub-Contract Amount shall be accepted by the Sub-Contractor as full compensation for everything furnished and finished complete and for all loss or damage arising out of the difficulties in the execution of the work.

The Sub-Contractor shall be wholly responsible for all work and materials included in the Sub-Contract Works including items of a particular proprietary brand not manufactured by the Sub-Contractor but supplied by him at the Contractor's request or nominated in Sub-Contract documents.

The Sub-Contractor shall be wholly responsible to the Contractor for the Sub-Contract Works from the time of signing the Sub-Contract Agreement until the completion for the workmanship, materials, discipline and any damages or omissions caused by acts of his employees, servants and agents.

Where the Contractor has instructed the Sub-Contractor to use such particular materials or equipment the Sub-Contractor may advise the Contractor in writing at the time of receipt of such instructions that they are not prepared to include such materials or equipment within the responsibility referred to herein and the reasons for non-inclusion. If the Contractor instructs that non-preferred items are to be included they shall only be entitled in respect to the supply of such materials or equipment to the benefit of any guarantees given to the Sub-Contractor in respect thereof by the manufacturer or supplier.

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The Sub-Contractor shall be responsible for making good at his expense any damage to services, fencing, piping or paths, roadways, kerbs and guttering or any adjoining property which may be disturbed and/or damaged due to the execution of the Sub-Contract Works. Any necessary repairs shall be carried out promptly to approval.

### A.11 INSURANCES

Provide all statutory insurances and all insurances detailed in the Contract Documents, as applicable and appropriate to the work.

### A.12 DAMAGE TO WORKS AND PROPERTY

The Sub-Contractor shall be liable for any damage caused by his equipment or material while under his control or that of his servants or by any act or omission arising from his negligence.

Such liability shall extend under the completion of the Maintenance and/or Defects Liability Period and any extensions thereof.

### A.13 ROYALTIES, PATENT RIGHTS AND FEES

All payments for royalties patent rights and fees due or payable for or in connection with any matter or thing used or required to be used in performance of the Sub-Contract or to be supplied under the Sub-Contract whether payable in one sum or by installments or otherwise whether payable in New Zealand or elsewhere shall be included in the Sub-Contract Amount and shall be paid by the Sub-Contractor to those to whom such payments may be due or payable.

The Sub-Contractor shall indemnify the Contractor against any action, claim or demand, cost or expense arising from or incurred by reason of any infringement or alleged infringement of letters, patent, design, trademarks or name, copyright or other protected rights in respect of any machine, equipment, work, materials or thing, system or method of using, fixing, working or arrangement used or fixed or supplied by the Sub-Contractor.

The indemnity shall not cover any use of the Sub-Contract Works or any part thereof otherwise than in accordance with the Sub-Contract.

In the event of any claim being made or action brought against the Contractor in respect of any matters covered by the indemnity, the Sub-Contractor shall be immediately notified thereof and he shall with the assistance if he requires of the Contractor but at the sole expense of the Sub-Contractor, conduct all negotiations or litigation without making any admission which might be prejudicial thereto.

Should any requirements of the Specification result in the infringement of letters, patent, design, trademark or name, copyright or other protected rights in respect of any item, the Sub-Contractor shall refer the matter in writing to the Contractor who shall inform the Engineer. If after having been so advised the Contractor insists upon the item the Sub-Contractor shall not be held to indemnify the Contractor. In the event of the Sub-Contractor failing to obtain such instructions from the Contractor, the requirements of this clause will remain valid and the Sub-contractor shall bear full responsibility.

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**A.14 HEALTH AND SAFETY**

Allow to carry out the responsibility required within the terms of the Health and Safety in Employment Act. Take all reasonable steps on the site to ensure the safety of all concerned and to exclude all unauthorised personnel.

**A.15 PROJECT STAFF**

Experienced registered trades persons shall carry out the installation to the highest standard. A competent person (supervisor) shall be in charge of the mechanical works who shall be familiar with progress and all aspects of the work and through whom all instructions, explanations etc can pass.

A competent foreman responsible for the day to day activities and approved by the Contractor shall be employed continuously on the Sub-Contract Works. The Supervisor and foreman shall be empowered to receive instructions from the Contractor. The Sub-Contractor shall ensure as far as possible that the same staff stay on the job from the day of possession to the day of completion of the Sub-Contract Works.

The foreman shall on reasonable request of the Contractor dismiss from the Sub-Contract Works any person employed therein by the Sub-contractor who may be incompetent and/or misconduct themselves on the Site and such person shall not again be employed on the Sub-Contract Works without the permission of the Contractor.

**A.16 MATERIALS AND EQUIPMENT**

All materials, equipment, components and devices shall be new and unused, of current manufacture and of the highest quality.

The Sub-contractor shall provide all items specified. If it is deemed necessary to substitute any materials in lieu of the specified materials, written consent must be obtained prior to any deviation from the specification. No materials or equipment shall be of a lower quality than those specified. The manufacturer shall be approved where this has not been specified.

Where any item is referred to in the Sub-Contract by specific brand type, style, model, finish or manufacturer or approved equivalent the Sub-Contractor shall comply with the following:

The specified brand, type, style, model, finish or manufacturer is intended as a minimum standard and in no way diminishes the responsibility of the Sub-Contractor to ensure the satisfactory installation and operation of all the Sub-Contract Works.

The Sub-Contractor may install equipment not specifically referred to but substantially similar only after approval.

Unless specified otherwise, the manufacturers recommendations shall be followed with regard to workmanship and associated materials, equipment, components and devices, whether or not the particular manufacturer has been specified.

Where a particular manufacturer has been adopted for fittings or equipment, all such fittings and their components shall be uniform throughout the project.

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The Sub-Contractor shall be responsible for proper storage and protection of apparatus, materials and equipment on any site adjacent to, associated with or the subject of the Works.

Upon delivery to site all materials and equipment shall immediately be secured properly stacked and protected from the weather, dampness and dust with particular attention to preventing ingress to working parts and pipes.

The Sub-Contractor shall confer with the Contractor and accept their instructions with regard to storage of materials particularly heavy loads. All equipment and materials shall be stored clear of floor slabs on timber packers.

When any room or area in the building is used as a shop or storeroom in connection with these works, all resulting making good and repairs, patching or cleaning of the room arising from such use shall be carried out prior to completion of the Works.

Materials and/or goods shall not be delivered prematurely to site unless they apply to the Main Contractor in writing for permission to make such deliveries stating reasons why such materials and/or goods should be delivered earlier than would be normal or is required for the Sub-Contract Works and such permission is given.

Where materials and/or goods are delivered earlier than is required for the Sub-Contract Works they shall be stored on or adjacent to the Site and shall be protected against weather and accident or theft.

The Sub-Contract shall be based upon a guarantee that all materials and equipment required for the work shall be obtained at such time as to enable the work to be completed in each element in accordance with the Contractor's programme. If any doubt exists regarding dates of supplies full information shall be included in the tender.

The Sub-Contractor shall be responsible for ordering all materials in ample time. Lack of such materials due to delay in ordering shall not constitute grounds for extension of time for completion.

### **A.17 WORKMANSHIP**

The whole of the work shall be carried out by skilled trades people using adequate and proper equipment and methods in accordance with best trade practice. The standard of workmanship throughout shall be of consistently high quality and entirely to the Engineers satisfaction. Nothing less than top quality work will be acceptable and any work not acceptable shall be rectified without question and without charge but to the proper standard.

The whole of the Sub-Contract Works and all operations related to them shall be carried out in such a manner as to minimise inconvenience or nuisance to occupants or adjacent buildings or tenancy and to the public. The Sub-Contractor shall be solely liable for and shall indemnify the Contractor against any claims that may arise from such nuisance.

The Sub-Contractor shall remove from site all rubbish, debris, material cuttings and other redundant materials that result from the works of this Sub-Contract, progressively and whenever directed by the Contractor.

On completion of the work, promptly remove all materials and equipment from site, except such materials and equipment which the Proprietor has agreed to store for use during the Maintenance Period or as are required for testing.

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## **A.18 QUALITY ASSURANCE**

Provide a Quality Assurance plan in order to propose, establish, maintain, monitor and document a quality assurance system covering all aspects of the design, purchase, fabrication, installation and completion of the works. The plan shall be in accordance with ISO 9001./2 (as appropriate).

Designate a Project Quality Inspector to discharge the quality plan, which must include the following minimum:

- Check all shop drawings for conformance to requirements prior to submission.
- Check equipment compliance schedule against the particular specification requirements and equipment schedules prior to submission.
- Check all samples for conformance to requirements prior to submission.
- Check all tests required for proper manufacturing of the equipment.
- Check all manufactured items for compliance prior to dispatch to site.
- Check installation of all items fixed under this specification.
- Check all materials, welding, joining, terminations, fixing and finishes.
- Check all on-site tests required to commission the works.
- Check operating and maintenance manuals to ensure they contain adequate information to permit systems to be operated by the Client at the end of defects liability period. (Including adequate training and tuition of the client's representative).

Submit the following documentation:

- Quality System third party certification, if any, to the Standards specified by the Joint Accreditation System of Australia and New Zealand.
- Quality manual detailing, corporate Q.A. policy statement, system element description, register of procedures and project specific ITPs.

## **A.19 ASSIGNMENT AND SUB-LETTING**

The Sub-Contractor shall not assign or sublet any portion of the Sub-Contract Works beyond that nominated in the Sub-Contract documents without referring the matter to and receiving approval in writing from the Contactor.

## **A.20 MATERIALS AND WORK NOT SPECIFIED BUT REQUIRED**

Materials and work not specifically mentioned shall be supplied as required by normal trade practice to enable completion of the work even if not specifically mentioned in these documents. The Mechanical services installation shall be complete and fully operational.

## **A.21 FIXINGS AND PLUGS**

Holes shall be drilled by electric or compressed air drill wherever possible. Explosive charge fixing devices shall not be used.

Where devices are required for attaching materials or equipment to the building, approved method expansion devices shall be used when and where approved by

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the Contractor. Wooden plugs will not be permitted. Approval of the Contractor shall also be obtained prior to drilling to ensure that any embedded items such as post tensioning or electrical cables in the slab are not damaged. The Contractor will mark the location of all such cables.

Zinc plated expanding metallic type masonry anchors shall be used for fixings in concrete, clay or concrete brickwork.

Bolts or machine screws with nuts, washers and anti-vibration devices shall be used where necessary for fixings into metal.

Plugs may be used for screw fixing to masonry construction including plastered expanded metal. Such plugs shall be used only for minor shear loadings. Holes and inserts and PVC screw anchor plugs, "Expandite" brand or equivalent shall be correctly sized.

Zinc plated and passivated bolts, screws and washers shall be used.

## **A.22 APPROVALS**

Approval of drawings, samples, workmanship, methods or other matters pursuant to the Sub-Contract or in respect of the Sub-Contract Works shall not be deemed to waive or prejudicially affect any right of the Contractor or diminish the responsibility of the Sub-Contractor in respect of the Sub-Contract Works or to derogate from or affect any other requirements. No expression of approval or reasonable satisfaction shall be deemed acceptance of materials or workmanship not complying with this Sub-Contract nor shall it constitute an authority for any variation except when such variation is authorised as provided in the Contract.

## **A.23 INSPECTIONS**

The Contractor and Engineer shall have access during normal working hours to factories, assembly shops, storage areas of the Sub-Contractor for the purpose of inspection of any component intended for the Sub-Contract Works provided prior notice is given to the Sub-Contractor who shall retain the right to be present at such inspections.

This requirement shall also mean reasonable access to factories and assembly shops of suppliers and Sub-Contractors to the Sub-Contractor.

The Main Contractor and Engineer shall have access to the Sub-Contract Works at all times without notice and the Mechanical Sub-Contractor shall co-operate by attending pre-arranged site inspections.

If the Specification, ordinances or authorities require any work to be specially tested, inspected or approved, then timely notice shall be given to the Contractor of its readiness for inspection. If any such work shall be covered without approval or consent, it must if required and at the Sub-Contractor's expense be uncovered for examination and recovered after approval.

The Sub-Contractor shall provide sufficient safe and proper facilities at all times for inspection of work. No inspection will be carried out on weekends or public holidays unless by arrangements with the Sub-Contractor who shall pay the additional cost of these inspections if they have been made necessary by the Sub-Contractor.

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## **A.24 VIBRATION ISOLATION**

All vibration isolation mounts required for reciprocating and rotating equipment, pipework, and ductwork shall be as manufactured by Mason Industries, G.P. Embelton or approved alternative manufacturers.

Vibration isolation mounts shall incorporate restraining devices to prevent excessive movement of pipework and equipment, and subsequent failures of support systems, in earthquake situations.

Neoprene type mounts may be used for all static deflection up to and including 9mm, however above that, combined springs and neoprene pads shall be used.

Spring mounts shall be free standing type, selected and positioned so as to produce uniform deflection for all springs.

Spring mountings shall incorporate leveling screws with locknuts and shall be used in conjunction with ribbed neoprene pads. Holding down bolts shall be used. Spring housings, mounting plates and frames shall be hot dip galvanised.

Anti-vibration hangers shall contain a spring and double deflecting neoprene cups in series. Neoprene cups shall have a static deflection of 9mm. The complete hanger shall have a total deflection of 25mm.

## **A.25 SEISMIC SUPPORT, FIXING AND RESTRAINT**

All equipment shall be provided with seismic restraints. Producer statements covering the Contractors fixing systems may be required by the Local Authorities.

Allow to supply details of the restraints proposed and shall be submitted to the Engineer and written approval obtained before construction is commenced. Unless agreed otherwise, all restraints shall be in accordance with NZS 4219:2009.

This specification contains a number of references to NZS 4219. We confirm that all calculations completed by the contractor shall be fully compliant with this standard and be based on the appropriate z factor for the location, noting that  $z = 0.3$  shall be used for all Christchurch projects.

The complete installation, including all fixings, shall be able to withstand normal operating loads plus seismic acceleration forces. The basic ultimate limit state seismic coefficient at plant deck level is 2.0g (gravity).

For cable support systems the normal operating loads shall be the weight of the support and all associated cabling plus 25% (spare capacity for future cables).

### **25.1 DESCRIPTION**

It is the intent of the seismic restraint portion of this specification to provide restraint of building system non-structural components irrelevant of fragility levels. Restraint systems are intended to withstand the stipulated seismic accelerations applied through the component centre of gravity.

All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers and construction standards, the most stringent shall apply.

This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, construction requirements (i.e. New Zealand Building Code).

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This section is to provide for seismic control for the "equipment" as listed below. This specification is part of the general conditions for the Mechanical Services contracts.

The work in this section includes:

- Seismic restraints for isolated equipment
- Seismic restraints for non-isolated equipment
- Producer Statement Certification of seismic restraint designs and installation supervision
- Producer Statement Certification of seismic attachment and housekeeping pads

## 25.2 OEM EQUIPMENT AND ISOLATION PACKAGES

### 25.2.1 Internal and/or External Systems

Substitution of internally or externally restrained equipment in lieu of the restraints specified in this section is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their engineering department stamped and certified stating that the seismic restraints are in full compliance with these specifications.

All costs for converting to the specified restraints shall be borne by the equipment manufacturer.

## 25.3 SUBMITTAL DATA REQUIREMENTS

The submittal material shall include descriptive data for all products and materials including the following:

### 25.3.1 Descriptive Data

Catalogue sections or data sheets on specific restraints to be utilised detailing compliance with the specification.

An itemised list of flexible and rigidly mounted equipment. Detailed schedules showing seismic restraints proposed for each piece of equipment, referencing material drawing number.

### 25.3.2 Shop Drawings

Show base construction for equipment; include dimensions, structural member sizes and support point locations.

Show all methods of suspension and support for ceiling hung equipment.

When walls and slabs are used as seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers must indicate static and seismic loads at all attachment and support points.

Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

### 25.3.3 Seismic Certification and Analysis

Seismic restraint calculations must be provided for all connections of equipment to the structures. Calculations to support seismic restraint designs must be stamped by a Chartered Professional Engineer with current competency in seismic design.

Analysis must indicate calculated dead loads, derived loads and materials utilised for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or weld length.

## 25.4 CODE AND STANDARDS REQUIREMENTS

### 25.4.1 Applicable Codes

- New Zealand Building Code.
- SMACNA Guidelines for seismic restraint of HVAC systems.
- NZS 4219 - Seismic Resistance of Engineering systems in buildings.
- All applicable trade standards as they pertain to seismic restraint and installation methods.

Where conflicts between codes exist, the more stringent requirement shall apply.

## 25.5 MANUFACTURER'S RESPONSIBILITY

Manufacturer of seismic control equipment shall have the following responsibilities:

- Determine seismic restraint sizes and locations.
- Provide equipment seismic restraints as scheduled or specified.

Provide installation instructions, drawings and field supervision to ensure proper installation and performance of systems.

## A.26 FIXING TO STRUCTURE

Explosive charge fixing devices shall not be used without approval.

Where devices are required for attaching materials or equipment to the building, expansion type devices designed for the application shall be used.

Wooden plugs shall not be used.

Approval shall be obtained prior to drilling to ensure that post tensioning cables or similar in the slab are not damaged.

## A.27 SAFETY DEVICES

All safety devices required by statutes, regulations or local authority bylaws, or those which are consistent with good trade practice, shall be fitted. These shall include, but not be limited to, such items as guards, cover plates, Mechanical-mechanical interlocks, pressure and temperature relief valves, isolators and warning notices etc.

All parts of the system shall "fail-to-safety" wherever practicable.

## A.28 ALTERNATIVE EQUIPMENT

Nomination of a particular manufacture, model, reference or source of supply for materials or equipment shall be used as the basis for tendering.

Alternatives from that specified shall be formally requested and will only be allowed upon meeting all of the criteria in terms of the type and quality for the original item. Failure to obtain formal approval may result in the item being replaced at the contractor's expense.

Where alternatives are specifically allowed to be offered, provide evidence that the proposed alternatives are 'equivalent' and to submit prices for these alternatives for evaluation without additional cost.

## A.29 NOISE LEVELS

Noise or vibration from operating equipment shall not exceed noise levels permitted by the Local Authority.

Ensure that all installed equipment operates at a noise level suitable for its immediate surroundings and as specified.

## A.30 BUILDER'S WORK

Confirm in conjunction with all relevant trades, the suitability and compatibility of all items being supplied or installed, such as excavation, structural penetrations, ducting, plant and equipment location and mounting.

Identify the need for builder's work associated with this trade and co-ordinate the execution of this work. This includes structural penetrations, floor or wall chases, cast bases for machinery, framing, drawings and timber work necessary for the support or enclosure of equipment and cabling.

All penetrations required for the installation of the Mechanical services, including penetrations through floor slabs, concrete walls, block work, etc., are the responsibility of the Mechanical Sub-contractor.

Approval must be gained prior to formation of all penetrations. Boring and checking that may weaken framing members will not be permitted.

Ensure all penetrations are correctly sized and that the penetrations are formed at the correct stage of the contract works.

Ensure that all building work is carried out in accordance with the relevant sections of the specification.

Noise rating and waterproofing must be maintained after making good. This trade is responsible for filling and sealing around cables and ducts.

Where sealing of penetrations is not stated allow for making good to equal performance for sound, etc.

No additional payments for builders work not allowed in the mechanical tender will be approved, if deemed necessary for the proper execution of the mechanical works.

## A.31 CO-ORDINATION AND LIAISON

Allow to co-ordinate and liaise with other Trades to determine the most practical method of installation and connection to equipment supplied by them.

The Contractor shall be responsible for co-ordination of the installation of the ceiling and the installation and commissioning of the services located above, below and within the ceilings and floors.

The co-ordination shall be such as to ensure that all services within false ceilings and walls are completely installed so that it will not be necessary to remove any ceiling tiles sections or panels to finish any other work, or to test, commission or adjust the installed systems.

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Allow to liaise with specialist equipment suppliers to determine suitable connection methods and confirm actual ratings and connection requirements before delivery to site.

The Contractor will be solely responsible for supervising the coordination of all trades and Sub-contracts and for settling disputes between trades.

The Sub-contractor shall cooperate and coordinate with other trades in all areas to conform to the building construction programme as directed by the Contractor, each shall wait upon and assist the others.

The Sub-contractor shall accept the authority of the Contractor in all matters in connection with site performance and shall work in areas and in the sequence, as directed.

### A.32 SEALING OF PENETRATIONS

All penetrations provided shall be sealed water or air tight and acoustically rated as appropriate. The acoustic ratings of the structure must be maintained after the installation of the Mechanical services.

#### 32.1.1 Air Tight Seals

All penetrations through building fabric subject to suction or pressurisation shall be sealed air tight, with an approved sealant and flanges.

#### 32.1.2 Waterproofing of Penetrations

Floor penetrations for cable risers shall be made weather-proof progressively during construction of the works to minimise weather damage or affects of internal flooding within the building.

#### 32.1.3 Holes in Roof

Continuous welded weather collars for over-flashing shall be supplied and installed for all external ducts.

Pipes forming part of the work shall be sealed using Aquaseal flashings and sealed with an approved silicone sealant.

#### 32.1.4 Fire Rated Penetrations *(Not part of this sub contract)*

Where services penetrate fire walls, ceilings, floors and other fire rated barriers, penetrations shall be sealed strictly in accordance with the requirements of the New Zealand Building Code.

- Metal pipes – fire rated mastic sealant
- Plastic pipes – either intumescent wraps or fire collars (denoted 'fc' on the drawings)
- Sheet-metal ducting – fire dampers (denoted 'fd' on the drawings)
- Flexible ducting – fire dampers
- Electrical services – fire rated mastic sealant

All conduits 55mm outside diameter and above installed through fire walls shall be steel.

The preferred method of sealing penetrations around cables and cable trays shall be by the use of fire retardant pillows packed tightly both sides of the penetration.

Internal fire barriers using proprietary fire dampers shall be used within all duct work passing through fire rated walls or floors.

All fire retardant materials used shall have been tested by a recognised authority, to maintain the fire rating of the construction medium through which the penetration passes.

### 32.1.5 Acoustic Penetrations

Where services penetrate walls, floors or ceilings. acoustic sealant shall be supplied and installed to maintain a degree of acoustic separation at least equal to the materials penetrated.

Where electrical flush boxes are installed in an acoustically rated walls acoustic rated flush boxes shall be used and flush boxes on opposite wall surfaces shall not be installed back to back.

## A.33 PAINTING AND FINISHES

### 33.1 GENERAL

Equipment supplied in a factory finished condition will be acceptable provided that the finish is of high standard, acceptable in colour, and does not require extensive touching up. Otherwise factory finished equipment shall be cleaned, wire brushed and painted on site with not less than two coats of approved finishing paint and appropriate primers.

All exterior steelwork or steel subject to wet conditions is to be hot dip galvanised.

All exterior ductwork is to be formed from galvanized sheet metal painted with a minimum three coats of exterior grade paint.

All exterior pipework is to be painted with a minimum three coats of exterior grade paint if un-insulated. If insulated the pipework shall be painted prior to the application of the insulation.

All paints and their intended use shall meet the requirements of AS 1580 BS 4800, NZS 7703 and NZS 7702.

Exact colours will be determined in consultation with the Architect. Paint shall be applied to equipment in accordance with the specific recommendations of the paint manufacturer using correctly prepared surfaces. Brushes, paint containers and other painting accessories used for hand painting shall be kept clean and in good condition.

Where necessary, finished paint work shall be protected during the progress of site works, using suitable dust covers.

Unless already galvanised, factory assembled steel components and pre-fabricated metal parts shall be painted before dispatch with one coat of self etch primer to provide adequate protection against the action of dampness and weather during the transport to site and subsequent erection.

### 33.2 PAINTING

Surfaces shall be cleaned and prepared in an approved manner prior to painting to remove dust, scale, dirt, oil, including spatter and concrete or mortar droppings. Surfaces that cannot be suitably cleaned, particularly due to excessive rusting, shall be replaced.

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Paints, fillers, temporary surface dressings and other painting materials are to be products of an approved manufacturer and of the best quality in their respective types. All painting materials shall be delivered to site in the original manufacturer's sealed and labeled containers where painting on site is required.

All painting shall be carried out in strict accordance with the specific instructions of the manufacturer to obtain and retain a finish of true colour, which does not fade, tarnish, peel or otherwise deteriorate except by fair wear and tear, for a minimum of 3 years.

All surface edges shall be ground smooth and filled prior to painting as follows allowing ample time for thorough drying between coats.

Surfaces shall be finish coated as follows:

- a) one coat of zinc chromate or similar self etching primer
- b) one coat of lacquer primer surface
- c) three coats of lacquer finished to a high gloss equivalent to 50 micrometers

All coats shall be of different colours. Alternatively powder coated painting to an equivalent standard and colour may be proposed. Full details of this alternative shall be provided for the consideration with the tender.

Unless the complete paint finish is applied off site, all equipment brackets, support frames, metalwork and ungalvanised steel shall be painted with 1 coat of self etc primer, 1 coat of undercoat and 1 coat of finishing full gloss enamel of selected colour. Unless specified otherwise, galvanised surfaces need not be painted. All sealers, primers, undercoats and finishing paints shall be of a type specified by the paint manufacturer as appropriate for the particular application.

### 33.3 REPAIRS TO EQUIPMENT DAMAGED ON SITE

Where factory painted or enameled surfaces to equipment have been chipped or damaged on site, the repair work shall be carried out by filling, painting and restoring the equipment to the exact finish and colour of the surrounding paintwork.

Where possible damaged parts shall be returned to the original Supplier for the above work to be carried out.

Any damage caused to the finished building resulting from work found to be defective shall be made good. The Supervisor's approval for all such rectification work carried out shall be obtained.

### 33.4 COLOUR SCHEME

Where any parts of the installation are required to be painted, or the supplier offers a range of standard powder coat colours (grilles, diffusers etc) the final colours will be subject to the Architect's approval.

### 33.5 SUBMITTAL REQUIREMENTS

Within the period given below, the submittals shall be prepared for review by the Engineer for the information as indicated.

This review relates to general principle of design only. If errors, omission and interferences are noticed, bring same to the Engineer's attention. Review of drawings will not in any way relieve the Sub-contractor from responsibility of such

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errors or omissions and interference or from the necessity of furnishing such workmanship or materials as may be required for the completion of these Works in accordance with the Specification.

In no way is this review by the Engineer to be construed as a check that the submissions are detailed correctly, contain the necessary co-ordination with other work, are necessarily complete in all aspects, or that they allow ease of installation.

If any comments are made on the above items they are without prejudice and are provided for the Mechanical Sub-contractors assistance.

#### Submissions Required at Tender

The Sub-Contractors tender shall be based on the specified equipment.

Tender submissions shall include a signed Statement of Compliance with the provisions of the Specification indicating details of all areas of non-compliance.

Where the Sub-Contractor wishes to offer alternative equipment to that specified full details of any cost saving and alternative materials or construction techniques proposed shall accompany the Sub-Contractors tender.

Additional details provided shall include construction, capacities and performance characteristics.

Manufacturer's original trade literature is acceptable where an Alternative Submission Form is not provided if the information particular to this project is clearly marked and provided that the information is complete. Photocopied trade literature is not acceptable.

#### Submissions Required for Review

- For Construction Shop Drawings: Refer 'Construction Drawings and Equipment Data Submissions' clause.
- Any other items requested by the Engineer during the course of the Contract.
- Details of any changes to the work as shown on the Drawings arising from the acceptance of an offered alternative as set out in the relevant clause of this Specification. Details to be drawn at the same scale as the Drawings and in accordance with the CONSTRUCTION DRAWING Clause of this Section.
- Schematic system diagrams where designs are part of the contract.
- Completed Commissioning Check Lists and Commissioning Programme.
- Testing and Commissioning Results.
- Draft and Final Installation Manuals:
- "As-Built" Drawings:

Complete copies of all commissioning test results shall be supplied to the Engineer correctly filled out and any other information as called for under the TESTING AND COMMISSIONING Section.

Samples and Prototypes:

Samples of materials and items described as 'to be approved' or which are intended for fixing in public areas or are visible to the building occupants, shall be submitted to the Engineer for approval at least 8 weeks prior to being required on

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site for installation. Two samples shall be supplied of each item required, each one to be properly identified and marked with the supplier's name.

The Engineer will be at liberty at any time to test or analyse samples of any materials brought on to the site and intended for these Works.

**Identification and Label Schedules:**

Prior to any identification or labels being carried out, a complete schedule of all labels, depicting size, wording and materials shall be submitted to the Engineer for approval.

Timing of Submissions

- a) Equipment Items: At least 1 weeks prior to ordering of equipment.
- b) Fabrication/Installation Details: 1 weeks prior to fabrication
- c) System Design Information: 1 weeks prior to the use of the design information.
- d) Commissioning Check Lists and Commissioning Programme: 2 weeks prior to commissioning. Equipment installation and commissioning instructions shall be ordered with the equipment to be delivered with the equipment. Commissioning Check Lists shall be prepared and submitted for approval not less than 3 weeks prior to the programmed start of commissioning. Submit the detailed Commissioning Programme at the same time.
- e) Installation "As-Built" Drawings and Draft and Final Installation Manuals: Refer appropriate specification section.

Equipment operating and maintenance instructions shall be ordered with the equipment to be delivered with the equipment. Installation Manuals shall then be prepared and submitted, in draft, for approval no later than 2 weeks prior to the programmes start of commissioning. Manuals shall be approved in final form prior to Practical Completion and prior to Instruction of the Principals staff.

Submission and Approval Procedure

In addition to whatever copies are needed on-site for use by the Contractor, two (2) copies of the Equipment Items, Fabrication/Installation Details, System Design Information, Blank Commissioning Check Lists and Draft Installation Manuals shall be submitted to the Engineer for approval.

Where submissions are returned for amendment, such submissions shall be amended and a further two (2) copies shall be resubmitted within sufficient time to prevent delay to the completion of the Works. Necessary re-submissions shall be made until such time as they are marked as satisfactory.

Neither failure to make these submissions on time nor any requirement by the Engineer calling for amendment to or resubmission, shall relieve the Contractor of his obligations under the terms of the Contract.

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**15 CONSTRUCTION DRAWINGS & EQUIPMENT DATA SUBMISSIONS**

For Construction Shop Drawings

2 copies of all Construction Drawings from which the subject works shall be built shall be prepared and submitted for review before commencing manufacture or installation. The standard of drawing production shall be to NZS/AS 1100.

Construction drawings shall be on the same size drawing sheets and shall be to a scale of not less than 1:50 and larger where necessary. Duct sizes shall be shown as internal airway dimensions. All Construction Drawings shall be fully co-ordinated with other trades.

Construction drawings shall cover the following parts of the work:

- f) All structural penetrations, including full dimensions to enable block out and sleeve placement.
- g) All roof penetrations with full dimensions to enable up stands and flashing to be constructed by the Contractor.
- h) Details of erection of major plant items indicating supports, anchoring, expansion fixings etc.
- i) Ductwork and pipework layouts, including details of construction, supports, anchoring, expansion, fixing, etc.
- j) Plant layouts including full manufacturing details of built up or site constructed items of plant including air handler units, attenuators, chiller package, axial fans, fan coil units, cooling towers.
- k) Automatic control schematics including control equipment.
- l) Electrical schematics and switchboards.

Drawings of air handler units shall include full details of the following:

- Heating and cooling coil physical dimensions and performance water side and air side.
- Fan size, motor size, drive details, and isolation detail, duty curves shall be supplied.
- Filter detail and fixing arrangement.

Shop drawings shall be submitted for review in adequate time to enable the building programme to be complied with.

Construction Drawings shall contain reference to all Builders work and work required by other trades, such as plinth dimensions, drain positions, penetrations, termination's and the like, to enable the Contractor to co-ordinate these requirements with the trades concerned.

Where drawings are returned for amendment, such drawings shall be amended and resubmitted within sufficient time to prevent delay to the completion of the works. Necessary resubmissions shall be made until such time as the drawings are accepted.

The Engineer's review of any drawings submitted shall not in any way relieve the Contractor of his obligation under this Specification or the drawings nor shall such review imply the correctness of any dimension or other specific properties shown on the drawings.

Construction Drawings and Equipment Data submitted to and retained by the Contractor and the Engineer will not be used for purposes other than those covered by these Works.

All construction drawings shall be produced using a CAD system, AutoCAD release 2004 or later.

Equipment Data

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Equipment Data submissions shall be prepared and submitted for review before ordering, details of construction, weights, physical dimensions and performance characteristics of all equipment and components.

Manufacturers standard trade literature is acceptable provided that the information applicable to the specific items is clearly identified and complete.

In addition to the above two copies of the manufacturers Installation and Operating and Maintenance manuals shall be provided for each item of equipment at the time of submittal. The Engineer will retain these manuals

#### Review Procedures

When requested, two (2) copies of the up-dated schedule of drawings shall be submitted to the Engineer detailing the following information:

- m) Reviewed drawings marked as satisfactory.
- n) Current drawings and Equipment Data submitted for review.
- o) Dates for resubmission for unsatisfactory drawings and Equipment Data
- p) Dates for submission of balance of drawings and Equipment Data

Alterations shall not be made to any drawing and Equipment Data marked as satisfactory unless resubmitting such drawings and Equipment Data for further review.

### **A.36 LABELLING AND MARKING**

### **A.37 FINAL OR PRACTICAL COMPLETION**

The Sub-Contractor shall subject to the provisions hereof finally complete each section of the Sub-Contract Works on or before the date of Final Completion for each section of the Sub-Contract Works set out in the Works Programme.

When in the opinion of the Sub-Contractor the Sub-Contract Works are finally completed the Sub-Contractor shall give written notice thereof to the Contractor.

Unless otherwise stated, the date of Final Completion shall coincide with that for the Main Contract.

Pursuant to the conditions of the provisions of Sub-Contract a Certificate of Final Completion will not be issued until:

All parts of the Sub-Contract Works are ready for handing over to the Contractor.

All services are tested and operating satisfactorily and approved by the Engineer and appropriate authorities. All test results must be submitted in the form of a written report.

All painting and other finishes are completed to approval. All work included in the Contract is performed including such rectification as may be required to bring the Sub-Contract Works to approved standards.

The completion of a 'producer statement' for the Main Contractor at the completion of the Works (Building Services) stating that it has been carried out in full accordance with the contract documents and the Building Consent and Building Code requirements.

"As-Installed" drawings and operating manuals, brochures and instruction data as specified are supplied and approved.

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If it is found that items that have been notified as being complete prove to be defective or otherwise unsatisfactory, to the extent of requiring an addition inspection, the costs of the re-inspection shall be paid for by the Mechanical Sub-contractor. This may include airfares, travel, accommodation, meals and incidental expenses.

### **A.38 PRODUCER STATEMENT**

A "Producer Statement - Construction" shall be provided by the Contractor at the completion of the works stating that it has been carried out in full accordance with the contract documents and the Building Consent and Building Code requirements.

The Sub-contractor shall provide for the Contractor Producer Statements for their sections of the completed Works.

At the completion of the Works a Code Compliance Certificate is to be issued by the Territorial Authority. The furnishing of a Producer Statement prior to the application (by the owner or authorised agent) is necessary for the Territorial Authority to issue the Code Compliance Certificate.

Until the Code Compliance Certificate has been issued, no Final Completion Certificate will be issued, unless the non-issue of the Code Compliance Certificate is due to factors entirely removed from the Contractor's responsibility.

### **A.39 GUARANTEES AND WARRANTIES**

The completed installation work defined within the scope of the contract shall be guaranteed for a period of 12 months against faulty components and workmanship from the date of Practical Completion, fair wear and tear accepted.

All faulty parts shall be replaced and the labour required shall be free of charge.

Written guarantees and/or warranties shall be supplied with respect to all items of plant or equipment or the performance thereof or the performance of entire systems as is required by the Sub-Contract.

Guarantees and/or warranties shall be in a form acceptable to the Main Contractor and shall be delivered to the Contractor on completion of the Sub-Contract Works. No guarantee and/or warranty shall be drafted in a form that shall relieve the Sub-Contractor of their responsibility in respect of the matters specified and covered by the guarantee and/or warranty.

Final payment will not be issued until this requirement has been fulfilled.

Guarantees and/or warranties shall state that workmanship, materials and installations are guaranteed for a period specified above, from the date of Certificate of Final Completion and that any defects that may arise during the Defects Liability Period shall be made good and any work in other trades resulting from such making good shall be done at the expense of the Sub-Contractor upon written notice from the Main Contractor to do so.

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### **A.40 OPERATOR INSTRUCTION**

Prior to handing over the completed installation, instruct the Operating Staff in the correct use of all equipment and systems

To assist with the instruction, supply a copy of the Operating Instructions as part of the Operations and Maintenance Manual.

Prior to the end of the Maintenance Period, Instruct the Maintenance Staff in the correct maintenance procedures of all equipment and systems.

#### A.41 HANDING OVER

The following procedure shall be adopted prior to handing over the installation:

- q) All preliminary testing, checking, adjusting and balancing of the installation shall be carried out before forwarding notification that the installation is considered to have reached Completion.
- r) After inspection, and when the Engineer are satisfied and agree that the installation is ready for handing over to the Client, the installation shall be finally commissioned and Installation Manuals together with Installation Drawings shall be provided as specified.

Completion will be certified only after the plant has been inspected and approved and the above requirements fulfilled.

Also prior to Handing Over ensure all rubbish, packing, tools and other items used in carrying out the installation, but no longer required, are removed. All items of Mechanical equipment forming part of the installation shall be left clean and immaculate.

#### A.42 WORK DURING BUILDING OCCUPATION

No work shall be carried out by ANY contractor at any time in the building once the building stage has been occupied without the full knowledge and approval of the building supervisor in whom has been vested the responsibility for the overall operation of the building plant and services and the maintenance of acceptable environmental conditions and service facilities for the building occupants.

#### A.43 TESTING AND COMMISSIONING

The Subcontractor shall engage an independent testing and commissioning specialist for all systems installed under this contract. And allow to test all systems in the presence of the Engineer.

Each test will include full sequential operation of all components supplied and demonstrations of their competence to perform to the requirements as laid down in or as may be interpreted from the Specification.

The Subcontractor shall bear all cost, including fuel and power, incurred in making these tests, and any subsequent tests required.

If such tests are satisfactory and acceptable to the Engineer, then the Engineer will advise the Principal and Main Contractor accordingly.

If any section of the works fail to meet the above tests, or fail to meet the requirements of the Specification and drawings, then after rectification of all such faults, the Subcontractor shall again demonstrate the competency of the works and shall pay on this occasion, and on the occasion of any subsequent tests, all expenses incurred and shall in addition pay for the attendance of the Engineer at the rate of \$140.00 per man hour plus expenses incurred.

Such payment by agreement with the Employer may be a deduction from the final Payment Certificate, if the Engineer's account for these charges has not previously been settled.

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All tests required by statutory authorities such as the Local Fire Authorities and Health Authorities shall be carried out to prove that the systems operate to their satisfaction and in accordance with the appropriate Codes or Regulations.

**43.1 GENERAL**

The installation shall be tested to the satisfaction of the Engineer and the Statutory Authorities, prior to the acceptance of the installation and the commencement of the Defects Liability Period.

The necessary skilled and competent personnel together with all equipment, fuel and electric power required to test and commission the works shall be provided.

All testing and commissioning shall be carefully preplanned and scheduled in order that it is fully co-ordinated with other relevant trades and shall be carried out in a safe and efficient manner with a minimum of inconvenience to all concerned. Where work is being carried out in an occupied building, the management of the building shall be kept fully informed regarding the nature of the testing and commissioning. Steps shall be taken that any possible hazards or inconvenience that may arise due to the testing and commissioning shall be minimised.

The installation shall be tested progressively as the work is carried out then finally tested once it is completed to ensure compliance with the specification, is mechanically and electrically safe and that it will operate correctly under normal, emergency and fault conditions. Control, protection and operative devices shall be checked for correct adjustment and rating.

All equipment or materials found to be faulty during testing shall either be replaced or repaired free of charge.

Should a trial or test be deemed unsatisfactory by the Engineer it shall be repeated at no further charge after necessary rectification, until such time as a satisfactory result is obtained.

**43.2 TESTING**

Where tests are required by relevant New Zealand and/or British Standards, the tests shall be carried out and certified manufacturer's test certificates shall be submitted in duplicate within two weeks of the equipment leaving the manufacturer's works.

The Engineer shall be given 5 working days notice of any proposed tests and shall be given the opportunity to attend all such tests.

Arrange for a qualified inspector to test the entire installation.

**43.2.1 Air Systems**

All air systems shall be adjusted and balanced so that airflows at all points in the system are within -5% to +10% of the specified flow rates.

Make due allowance to vary fan speed by pulley change or by change in electrical connections in order to achieve design flow rates.

In addition, air distribution from supply air outlets shall be checked and adjusted as necessary, to ensure that the direction and 'throw' of air is adequate for the application, free from unacceptable draughts and generally uniform over the face of each outlet.

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Air volumes at grilles, registers and diffusers are to be measured by means of hood and anemometer. Air volumes in all major duct branches are to be measured in straight lengths of duct by means of a pitot-static tube and inclined manometer.

#### 43.2.2 Piping

After installation and before any piping is concealed, the Sub-Contractor must provide all necessary equipment for pressure testing of services as specified and/or as directed.

All pipework sections shall be thoroughly flushed of all swarf and other deleterious material prior to connection to central systems.

#### 43.2.3 Sewage

Arrange for all testing of work as required by the Territorial Authority and in accordance with the Quality Assurance Program. On completion of all work, lodge the Authorities' certificate of approval with the Engineer.

#### 43.2.4 Water systems

All pressure and flow actuated controls, relief devices, bleeds, vents and drains shall be checked and proven for approval.

All temperature control valves shall be fully opened during balancing of water flows. Final settings of all regulating valves shall be permanently marked in an appropriate manner.

Particular care shall be taken to achieve the correct balance at all zones.

Any major adjustment necessary to water flow rate shall be made by changing pump impeller sizes. Minor adjustments may be made by partial closing pump discharge valves when such valves are suitable for throttling. Valves used to regulate final flows of equipment shall be clearly and permanently marked in the balance position.

#### 43.2.5 Hydraulic Commissioning

Copies of all data recorded during commissioning of the installation as detailed for performance tests, together with all necessary inspection certificates from local authorities and appropriate Manufacturers' pressure test certificates and performance curves or tables for the following items shall be provided:

- Pumps (including flow quantity versus head pressure efficiency and power input curves, applicable to the diameters and speeds of the installed impellers)
- Control Valves
- Other specific items of equipment

#### 43.2.6 Relief Valves

Fix to pressure relief valves the manufacturer's tags indicating the set pressure of valves.

#### 43.2.7 Electrical Control Panels and Switchboards

The operation of all indicating and recording instruments and associated equipment and the indicating lights and associated timing devices and relays etc, shall be proved under full working conditions.

The operating current from each major item of plant (fan/pump/hot water cylinder/etc) shall be measured at the switchboard and the test results submitted to the Engineer to verify that the loadings on each switchboard are balanced.

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Electrical Certificate of Compliance for all electrical works completed under this contract.

Refer also to the 'Electrical' Section of this Specification for other electrical testing and commissioning requirements.

#### **43.2.8 Controls, Gauges and Instrumentation**

All controls shall be adjusted and activated by competent personnel provided by the manufacturer or his authorised agent. A complete log of the settings and readings of all controls, gauges in instruments shall be maintained throughout the Commissioning period.

In addition, hand instruments shall be provided as necessary to check and log reading for which permanent gauges or instruments may not have been installed:

- Ammeter current reading for all motors.
- Megger tests of all electrical equipment.
- Air pressure drops through all air filter banks, across fans etc.
- Speeds of all fans, pumps, motors etc.
- Ambient and internal dry and wet bulb temperatures.
- Water flow rates at all pumps, Calorifiers, regulating valves and heating zones.
- Regulating valves, including number of turns, measured flow and pressure drop across the valve

#### **43.2.9 BMS Alarms**

The correct operation of each individual BMS/automatic control alarm signal shall be verified under simulated alarm conditions prior to handing over the installation to the client. Including the illumination of any fault light, BMS graphic alarm, etc.

#### **43.3 COMMISSIONING**

Carry out all commissioning tests necessary to put the systems into commercial use and to approval before Completion is granted. Each item of equipment individually and each complete system as a whole shall be checked and adjusted to achieve satisfactory performance.

One month before the commencement of commissioning, the Sub-Contractor shall submit for the Engineer's approval, a commissioning check list.

The list shall comprise a comprehensive sequence of events for the entire commissioning of the installation and shall have provision for signatures of both the Sub-Contractor and the Engineer carrying out the checks.

#### **43.4 TESTS AND INSTALLATION INSTRUMENTS**

All instruments, appliances and test loads shall be provided for the duration of the tests as necessary to complete the test procedures specified.

Gauges and instruments provided as permanent parts of the installation may be used during performance testing providing evidence as submitted of their calibration accuracy.

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All instruments shall be checked and calibrated during commissioning and again after 6 months of normal operation. Any instrument that will not hold calibration shall be replaced.

**43.5 TEST RESULTS**

All test procedures used and results obtained for both works and site tests shall be submitted in the form of a written "Test Report".

Records shall be kept of test results and 2 copies shall be submitted to the Supervisor at the completion of the work. Approval of the format required for the test results shall be obtained prior to the submission.

**A.44 AS-BUILT DRAWINGS**

As-built drawings shall be provided and shall be defined as a set of the drawings that have been updated to record every instance where the work, as built, varies from that shown on the original documents and shall incorporate any additional information required by the contract.

As-built drawings shall be based on and generally compatible with the contract drawings. They shall not rely on colour for differentiation.

Submit one set of drawings for approval. Make any modifications requested and resubmit the drawings. Repeat the procedure until agreement is reached that the drawings are a true representation of the final installation.

As-built drawings shall: -

- a) Be the same size and scale as the Contract drawings.
- b) Have the Sub-contractors/Contractor's name clearly indicated on each drawing.
- c) Have the "As-built" date.
- d) Be certified by the Sub-contractor/Contractor as "As-built".

When the drawings have been prepared to an acceptable and approved standard of accuracy and presentation the following copies shall be provided:

- a) Two complete sets of prints (full size) bound as sets between rigid and durable covers to approval.
- b) One set of prints reduced to A3 size to be included in each copy of the Maintenance Manual.
- c) One set of drawings on CD in AutoCAD2004 drawing format.

CAD files of the contract drawings can be provided by the Engineer, within one week of receiving a written request.

**A.45 MAINTENANCE AND OPERATIONAL MANUAL**

Prior to the issue of the Certificate of Practical Completion, submit one draft copy of Maintenance and Operational Manuals

The Maintenance and Operational Manuals and drawings incorporating comments will be returned within two weeks of the receipt of the draft copies.

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Supply three copies of the approved draft Maintenance and Operational Manual within three weeks of their provisional acceptance and prior to the issue of the Certificate of Final Completion.

If there is failure to meet the above requirements, then the cost of producing the Maintenance and Operational Manuals, by other parties, shall be deducted from the Contract Sum.

Maintenance and Operational Manuals shall be bound in hard backed plastic ring binders A4 size with embossed titles on the front and spine. The manuals shall be produced on a word processor utilising a laser jet printer for reproduction. Paper shall be white bond 80 g/m<sup>2</sup>. The project identification, and names of the Services Consultant, Sub-contractor/Contractor and Principal shall be shown on the cover. A table of contents that schedules the contents of the manual shall be at the front of the manual. Include in the table, section headings, sub-sections and the page number for each entry.

Also provide an introduction that identifies:

- a) The Contractor and Engineer.
- b) The Sub-contractors for the various systems that form part of this contract.
- c) The approving authorities.
- d) Name of the Inspector. (if relevant).
- e) A schedule of other relevant documents that have not been included as part of the manual.

The Maintenance and Operational Manual shall cover the following major aspects and be arranged in the indicated sequence:

- f) General description of the Mechanical services
- g) Operating instructions for all equipment.
- h) Routine maintenance requirements including detailed schedules of all periodic routine maintenance (schedules to be approved).
- i) Manufacturer's detailed instructions for disassembly, overhaul, assembly and fault correction.
- j) A full copy of all final test results.
- k) Spare parts lists.
- l) A copy of the compliance certificate.
- m) Schedule of equipment and a description of their operation and control.

#### A.46 MAINTENANCE PERIOD

Routine maintenance and servicing shall be carried out for a period of 12 months from date of Completion to the end of the Maintenance and Defects Liability Period.

Routine maintenance shall be carried out by a monthly basis and emergency service shall be carried out on a 24 hour call out basis.

The Maintenance Programmes shall fully comply with the following:

- a) Shall fully comply with the requirements of the Maintenance Compliance Schedules issued under the Building Act 1991, and clarified by the New

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Zealand Building Code categories CS1 through CS16 inclusive.  
As part of the maintenance program the subcontractor should prepare detailed Maintenance Schedules to full compliance with the New Zealand Building Code (including the requirements imposed by the Jun 2007 amendments to G4/AS1).

- b) The maintenance carried out in accordance with the Compliance Schedules prepared in item (a) shall be certified by and Independent Qualified Person (IQP) a defined in the New Zealand Building Code. The Engineer shall be advised of the proposed date and service programme for the last major visit not less than 7 days prior to the date of the proposed visit so that a representative may be present to inspect the equipment records.

Provide an emergency call out of service that shall:

- a) Be available and be able to be contacted by telephone 24 hours per day, and 7 days per week.
- b) Immediately investigate within two (2) hours on site when notified of the occurrence of systems failure, blockages, alarms, or fault of the installation.
- c) Notify the Engineer in writing the circumstances surrounding each call out. Notification shall be forwarded on the first working day following the call out.

Replace and/or repair any malfunctioning equipment. Negotiate replacement costs associated with equipment malfunctioning due to blockages and/or vandalism with the Engineer.

Provide a log sheet, detailing the labour and material costs used on each call out.

Pay out the total costs incurred at the end of the defects liability period.

Maintaining a dated record of servicing performed on each system in a servicing record book to be retained under the Proprietors control on site.

The last maintenance visit prior to the end of the Maintenance and Defects Liability Period shall be a major visit for complete service.

At the conclusion of each maintenance visit, a check list of items serviced shall be completed, the service book shall be signed and checklist shall be submitted to a responsible person on site. Within 7 days of the date of the service visit a report shall be forwarded together with a copy of the checklist to the approving authority.

The cost of maintenance during the Maintenance Period shall be included in the Sub-Contract Amount.

#### A.47 DEFECTS LIABILITY PERIOD

The Sub-Contractor shall warrant the whole of the Sub-Contract Works against defective workmanship and materials and against non-compliance of equipment of complete system with specified performance and operation for the Defects Liability Period.

The Defects Liability Period for the Mechanical Services Installations shall be 12 months. After the date of Final Completion, the Sub-Contractor shall be responsible for making good with all possible speed any defects arising from defective design materials or workmanship or from any act of the Sub-Contractor

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or his servants or agents that may develop in the work under the conditions provided for in the Sub-Contract and under proper use.

If during the currency of the Defects Liability Period any defects are not remedied within a reasonable time the Contractor may proceed to do the work or have it carried out at the Sub-Contractor's risk and expense but without prejudice to any other rights which the Contractor may have against the Sub-Contractor in respect of the failure of the Sub-Contractor to remedy such defects.

If the Sub-Contractor replaces or renews any portion of the Sub-Contract Works the provisions of this clause shall apply to the portion of the Sub-Contract Works so replaced until the expiration of the specified period from the date of such replacement or renewal.

If during the currency of the Defects Liability it becomes necessary to repair or replace a defective part and the repaired or replaced part causes damage to other portions of the Sub-Contract Works the Sub-Contractor's liability shall be the same as if the losses, damage or injury incurred thereby had occurred before any part of the Sub-Contract Works had been taken over.

If the replacement or renewals during the Defects Liability Period are of such a character as may affect the efficiency of the work or any portion thereof the Contractor may within one month of such replacement or renewal give to the Sub-Contractor notice in writing requiring that tests on completion be made in which case such tests shall be carried out as directed by the Contractor.

During the Defects Liability Period the Sub-Contractor or his duly authorised representative, whose name has been previously communicated in writing to the Contractor, shall be given the right of access at all reasonable working hours and at their own risk and expense to all parts of the Sub-Contract Works for the purpose of inspecting the working thereof. Subject to approval which shall not be unreasonably withheld, the Sub-Contractor may at their own risk and expense make any tests which are considered desirable.

Any faults or defects that become apparent during the period shall be promptly remedied by the Contractor/Sub-Contractors.

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Section A1: Seismic Services Standard Clauses

Building Division

**SECTION A1  
SEISMIC PERFORMANCE SPECIFICATION**

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**A1.1 SEISMIC PERFORMANCE****1.1 GENERAL SCOPE**

The Mechanical & Hydraulic services sub-contractors are to allow for code compliant seismic restraint of all building services plant and services to NZS 4219:2009. Reference should be made to the performance criteria stated below and to the various parts of sections D, G & J of the Mechanical & Hydraulic Services specification. Sections 1,2,3 and 5 and Appendices A, B and C of NZS 4219:2009 are to be used as an acceptable Solution to achieve compliance with NZBC B1, G10, G12 and G14

The services sub-contractors should note that this is a performance-based specification for a design and build contract. The specification is not intended to be prescriptive, but to provide guidance to the services contractors for competitive tender pricing and later detailed design. The services contractors are responsible for carrying out the detailed design, including any calculations required and provision of PS1 and PS3 Producer Statements. Ultimate design responsibility rests solely with the contractor.

**1.2 PROJECT SPECIFIC SEISMIC**

- Design of seismic bracing and fixings for linear components (ducts, pipes, rigid cable support), suspended equipment (for example, fan coil units) and tall floor-mounted equipment where applicable (for example, floor-mounted switchboards) and includes design to allow for impact on gravity supports and impact of load eccentricity and prying actions on fixing selections.
- Design of floor/roof-mounted equipment fixing for seismic loads, including overturning.
- Details of plinth size/location/thickness including equipment weights, plus horizontal and vertical seismic loads at each anchor point. These are to be submitted to the main contractor/builder who then is responsible for submission to the structural engineer and agreement of appropriate details:
  - NZS 4219:2009 prescriptive solution.
  - Specific plinth anchoring/reinforcement design by structural engineer.
- Design of wall-mounted equipment support and fixing for seismic loads.
- Ensure that the selection of vibration isolators and their fixings for seismic loads or design of separate seismic limit stops / snubbers.
- Design of vertical pipe flexibility for structural deformation during a seismic event.
- Design/coordination of pipe expansion/contraction and seismic restraint/movement provisions.
- Ensuring that proprietary equipment and components are capable of withstanding seismic loads at seismic restraint fixing points.
- Design of air diffuser/grille and grille box fixings to structure above ceiling suspension system.
- Coordination of seismic clearances with all other building components.

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**PROJECT SPECIFIC DESIGN CRITERIA**

The following design criteria shall be used as a basis for the selection and specification of plant and equipment seismic restraints. The performance specification relates to the specific requirements

**1.3.1 Project Specific Design Criteria**

All components of engineering systems shall be configured with a clearly defined load path to transfer the actions (horizontal and vertical) generated in an earthquake, together with the gravity loads, and process including actions (for example, thermal expansion) to the supporting structure.

**Building Classification:**

Building Classification please refer to the highlighted section below:

Criteria	Importance Level
Normal buildings. And buildings not in other importance levels	1, 2
<b>Buildings that may contain people in crowds, or contents of high value to the community, or pose risks to people in crowds</b>	<b>3</b>
Buildings with special Post disaster functions	4

**Determination of Category**

Components of the engineering systems shall be classified into the categories show below:

Criteria	Category	Limit State
Component representing a hazard to life outside the building	P1	ULS
Component representing a hazard to a crowd of greater than 100 people within the building	P2	ULS
Component representing a hazard to individual life within the building	P3	ULS
Component necessary for the continuing function of the evacuation and life safety systems within the building	P4	ULS
Component of a system required for the operational continuity of the building	P5	SLS2
Component for which the consequential damage caused by its failure is disproportionately great	P6	SLS1

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All other components	P7	SLS1
<p>Note – Category P5 only applies to importance level 4 buildings as this is a requirement of the NZS 1170.5. The design loads derived for the components contained in lower importance level buildings may be increased unnecessarily if category P5 is applied instead of P6 or P7 to other components in importance level 1, 2 and 3 buildings.</p>		

**Earthquake Zone Factor:**

#	Location	Z
128	Invercargill	0.17

**Life Safety Building Systems:**

The building services systems listed below shall be deemed 'Life Safety Systems' and components shall be categorised P4 or P5 or greater.

- Emergency Lighting

**IL4 Buildings (if applicable):**

Identified below of all systems that shall remain operational during and after an SLS design strength earthquake.

- Emergency Lighting

**1.3.2 Services Elements Requiring Specific Design**

Note that NZS 4219:2009 stipulates specific design shall be provided (by the services contractor) for the following:

- Components connected to the building structure at more than one level without flexible joints or connections (clause 3.5.2)
- Components outside the scope of clauses 3.6–3.8, for example, wall-mounted components, floor-mounted components without single definable centre of gravity (clauses 3.9 and 3.7.1.1)
- Pipes > 200 mm diameter (clause 5.8.1)
- Steam and gas piping requiring restraint under clause 5.8.1 (clause 5.8.5 and 5.8.6)
- In-ceiling and above-ceiling components > 25 kg (clause 5.13)

**1.3.3 Sub-Contractor Coordination Responsibilities**

Building Services Sub-Contractor shall allow to attend coordination meetings which shall include all relevant trades. The aim of these meetings shall be to agree methodologies and key coordination issues such as:

- Coordination of ceiling and above ceiling services restraints and seismic clearances.

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**Table 15**

Condition Being Considered	Minimum Clearance (mm)	
	Horizontal	Vertical
Unrestrained component to unrestrained component.	250	50
Unrestrained component to restrained component.	150	50
Restrained component to restrained component.	50	50
Penetration through structure (such as walls and floor).	50	50
NOTE – Ceiling hangers and braces are considered to be restrained components for the purposes of this table.		

**Note:**

Some services that may not otherwise need to be restrained may need such restraint to reduce seismic clearance requirements).

**1.3.4 Documentation Submittals**

The building services contractor should undertake to provide to following documents:

- Layout drawings of all pipe, duct and rigid cable support systems identifying seismic restraint and gravity support location and orientation, maximum allowable transverse and longitudinal brace spacing and (by notation) services that do not require specific restraint and the reasons therefore. Seismic restraint layout drawings and design details as required to enable installation of services. Drawings shall be submitted to Structural, Mechanical, and Electrical Engineer for review.
- Seismic calculations and details for (also refer to section 1.3.1):
  - All P1, P2 and P3 equipment and linear systems.
  - All P4 (Life Safety) equipment and linear systems.
  - All P5 equipment and linear systems (required for operational continuity) in IL4 buildings (if applicable).
  - Floor, roof and stand-mounted equipment > 200kg.
  - Ceiling-mounted equipment > 10kg i.e. equipment mounted at or directly below ceiling level and either supported and restrained by the ceiling requiring specific design of ceiling to suit) or independently supported and restrained.
  - Above-ceiling equipment > 25kg.

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- Other suspended equipment > 100kg.
- Wall-mounted equipment > 50kg.
- All horizontal pipework requiring seismic restraint, including vertical offsets, drops to equipment and so on
- All multi-floor pipe risers.
- All pipes crossing seismic structural separations.
- All ducts requiring seismic restraint.
- Flues and stacks.
- Design Producer Statement(s) (PS1) confirming that the design meets the performance requirements of NZS 4219:2009 (as modified by NZBC B1/VM1 section 13.1 for projects within the Canterbury Earthquake region).
- Producer Statement(s) for Construction (PS3) stating their view that all parts of the building works meet the performance requirements of NZS 4219:2009 (as modified by NZBC B1/VM1 section 13.1 for projects within the Canterbury Earthquake region).

### 1.3.5 Main Contractor

The main contractor shall supply the various building services contractor with the following documentation:

- Architectural Drawings
- Structural Drawings.

The main contractor shall also facilitate onsite coordination meeting and ensure that coordination between the various sub-contractors undertaken.

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**SECTION C**

**PROJECT SPECIFIC MECHANICAL AND ELECTRICAL FOR MECHANICAL  
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## SECTION C

### C.1 SCOPE OF WORK

The contract comprises the mechanical service aspects of the new D.S. Anchor Zone 1 portion of the new Invercargill Central Shopping Mall Development to be located at 33 Esk St. Invercargill.

The building comprises of a large two level, department store incorporating open plan retail shop floor, reserve storage areas, offices and amenity areas, a separate Childcare facility on Level 2 as well as several smaller ground floor tenancies associated with the Mall accessed via Esk St. shopfront and other Mall Storage and services areas on the south side of the building.

The contractor shall supply, manufacture, install, test and commission the Mechanical systems and associated works.

#### 1.1 PROJECT SPECIFIC MECHANICAL

- a) Items of plant and equipment are specified in Section F of this specification.

##### Department Store Anchor Tenancy Specific Works

- b) Provide roof mounted Temperzone OPA (Eco) packaged Air Handling Units (AHUs) to provide conditioned air to the department store shop floor and Reserve Storage Areas.
- c) Outdoor Air Supply and Spill Air systems serving each AHU including variable speed Spill Air fans and motorised volume control dampers shall be regulated and controlled via the associated AHU integral Economiser mode controls and associated department store Specialist Controls BMS system controller and field devices by Specialist Controls Contractor (BTL).
- d) Specific Zones within the Shop floor have also been demarcated for future changing rooms and cosmetics area fitout and are provided with additional Variable Air Volume (VAV) with electric heating control assemblies to allow for added temperature and airflow control of these areas.
- e) Provide Mitsubishi Electric VRF Airconditioning systems and associated controls to all department store Back of House (BOH) Offices and Staff areas with outdoor units located on rooftop plant platforms as detailed. Allow to coordinate with hydraulic services contractor for tundish points for condensate drainage.
- f) Provide ducted outdoor air supply to all occupied department store BOH Staffroom/Office areas and sanitary exhaust ventilation to Amenities areas via SIMX VHR EC in-ceiling heat recovery ventilation systems with non-permeable heat transfer cores to separate the airstreams.
- g) Provide Split System Airconditioning systems to department store BOH Secure Comms/CCTV Room and Loading Bay areas with outdoor units located on roof. Allow to coordinate with hydraulic services contractor for tundish points for condensate drainage.
- h) Provide ducted outdoor air supply to all occupied department store BOH Staffroom/Office areas and sanitary exhaust ventilation to Amenities areas via in-ceiling heat recovery ventilation systems with non-permeable heat transfer cores to separate the airstreams.

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Section C: Project Specific Mechanical And Electrical For Mechanical Scope

- i) Provide local general exhaust ventilation to the department store Staffroom Kitchen, CCTV/Comms and Rubbish room via a dedicated extract fan.
- j) Department store Building Management System shall be supplied and installed under the Mechanical Services Scope of works by the department store Specialist Controls Sub-Contractor, Building Technologies Ltd (BTL). Allow to coordinate with Specialist Controls Sub-Contractor for connection of all Mechanical Plant and Controls to the department store Ethernet and Building Management Systems and associated controls and devices. (All mechanical plant and systems in the zone 1 tenancy areas and the childcare centre shall form part of the Mall BMS with the head end located in the zone 2 centre management offices.)
- k) Provide high level wall vent from lift shafts to external roof plant area including ducting to external wall louvre and fire damper where applicable. Coordinate final size and location with lift supplier.
- l) Provide Smoke Extract Fans on the roof above the central shop floor escalator for smoke exhaust as detailed. These systems shall comply with AS1668.1 and be activated via a signal from the Fire Alarm system to the fire fan control and indicator panel but they shall also have their operation and alarms monitoring via the department store BMS.

Mall Esk St. Tenancies and BOH Storage/Cleaner Room Specific Works

- m) Provide local extract fan c/w backdraft damper and associated controls to each of the Ground Floor Tenancy Toilets connected to a common discharge duct and vent.
- n) Provide passive ducted outdoor air supply to all Ground Floor Tenancies via ducted Mitsubishi Electric VRF Airconditioning systems and associated controls with outdoor units located on rooftop plant platforms as detailed. Allow to coordinate with hydraulic services contractor for tundish points for condensate drainage.
- o) Note: plant located within each Tenancy is to be typically wired from the associated local distribution board however VRF systems including Roof top plant serving multiple Tenancies shall be wired from the Zone 2 Main Electrical Switchboard to allow for energy monitoring and control from the associated Zone 2 Central Controller and Future Mall BMS systems (By others). Allow to coordinate with Zone 2 Electrical and Mechanical Contractors where necessary.
- p) Provide extract and relief air systems as detailed to the Mall Back of House (BOH) Storage and Cleaners Room located on Ground Level Part 2. Plant shall be wired from the local Electrical Switchboard with controls as detailed to allow for future connection to the Zone 2 Mall ethernet and BMS (by others).
- q) Mall Building Management System and Mall VRF Systems Central Controller shall be supplied and installed under the Zone 2 Mechanical Services Scope of works contract by others. Allow to coordinate with Mall Specialist Controls Sub-Contractor, (Setpoint Solutions) and Zone 2 Mechanical Contractor for interfacing and connection requirements of all Mechanical Plant in the Zone 1 area associated with the Mall.

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Level 2 Childcare Facility Specific Works

- r) Provide Mitsubishi Electric VRF Airconditioning systems and associated controls to all Childcare Facility Care Areas and Reception areas with outdoor units located on rooftop plant platforms as detailed. Allow to coordinate with hydraulic services contractor for tundish points for condensate drainage.
- s) Provide ducted outdoor air supply to all internal occupied areas and sanitary exhaust ventilation to Amenities areas via SIMX VHR EC in-ceiling heat recovery ventilation systems with non-permeable heat transfer cores to separate the airstreams.
- t) Provide local extract fan c/w backdraft damper and associated controls to Toilet and Laundry Room as detailed.
- u) Install proprietary kitchen rangehood including extract fan, filters, controls (provided by others) above cooktop in Kitchen. Allow to provide a suitable duct and roof exhaust cowl kit for extract discharge above.
- v) Supply and install local ceiling mounted electric radiant heater panels and associated controls to smaller occupied spaces as detailed.
- w) Childcare facility mechanical services plant shall typically be wired from local Electrical Distribution Board and controlled by a Mitsubishi Electric Central Web Controller at the DB. All systems shall allow for future connection to the Zone 2 Mall ethernet and BMS (By others).

General Works

- x) Manufacture, supply and install support steelwork including Monkey Toe type platforms, for all air handling systems, outdoor plant, ducting, pipework, and other equipment. Drawings of the steelwork shall be submitted to the Engineer for approval.
- y) All builders work including cutting of holes, making good all ceilings including any damaged tiles and wall linings, and weather flashings to penetrations through external walls.
- z) All wiring to plant and controls installed under this contract
- aa) Supply and install all controls for plant installed under this contract.
- bb) All mechanical ventilation plant shall be linked to the fire alarm system and shut down upon activation of an alarm, with automatic restart once the alarm has been reset.
- cc) Allow for code compliant seismic restraint of all mechanical plant and services to NZS 4219:2009, refer to various parts of section D of this specification for further details.
- dd) Allow to test and commission all systems installed under this contract prior to practical completion.
- ee) Allow to supply and install all other equipment and to supply all labour not specifically mentioned above and necessary to render the system fully functional.
- ff) Maintain the installation in accordance with the Schedules and Instructions in the Operating and Maintenance Manual for a period of 12 months from the date of Practical Completion.

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- gg) Guarantee the completed installation against defects in materials and/or workmanship for a period of 12 months from the date of Practical Completion. Faulty equipment and defects shall be replaced or repaired without delay and at no cost to the Principal.
- hh) Provide Producer Statements for the Construction of the systems.
- ii) Provide Shop drawings for Engineers approval.
- jj) Provide "As Built" drawings, Operating and Maintenance Manuals.
- kk) Allow to maintain the installation for a period of 12 months from the date of Practical Completion.
- ll) Principals Instructions.

## 1.2 PROJECT SPECIFIC ELECTRICAL FOR MECHANICAL

The electrical works to be supplied and installed shall include, but not necessarily limited to the following items and equipment:

- a) Supply and install department store Mechanical Services Switchboard including all wiring from MCBs to plant. Refer Section E for details of Mechanical and Hydraulic Plant to be installed for tendering purposes, allow to coordinate with Mechanical, Electrical and Hydraulic Trades for determination of final switchboard design and loads prior to construction.
- b) Supply and install all wiring from MCBs to plant from switchboards/distribution boards supplied by Main Electrical Contractor.
- c) All cables shall be selected and sized by the Electrical for Mechanical subcontractor liaise with the Mechanical Sub-Contractor to obtain details of plant as required.
- d) All wiring and controls associated with Mechanical Services Plant.
- e) All wiring to smoke exhaust fans and associated controls shall be in fire rated cable and comply with the requirements of 1668.1.
- f) All wiring and controls associated with Hydraulic Services Plant, HWCs, Pumps, Urinal Magic Eyes, Sensor Taps, etc.
- g) All wiring required for Automatic Controls.
- h) All controls as defined in the Automatic Controls Description.
- i) Allow to coordinate with the department store Specialist Controls Sub-Contractor, Building Technology Ltd. (BTL) for supply and installation of Department store Ethernet, Devices and Controls associated with the department store Building Management System (F-BMS).
- j) Allow to coordinate with the Mall Specialist Controls Sub-Contractor, (Setpoint Solutions) for future connection provisions for Ground Level Mall BOH Cleaners, Stores and Retail Tenancies and the Level 2 Childcare Facility plant/controls to the Invercargill Central Mall Building Management System (M-BMS) provided as part of the Zone 2 works contract.
- k) Allow to provide all wiring trunking conduit etc between controls and devices required by the Controls Specialist. Wiring media including cable sizes, number of cores and type shall be entirely suitable for the device served and shall be selected by the control's specialist.

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- l) Mechanical Services Electrician shall within 2 weeks of tender award confirm the Mechanical Services loadings on the Switchboard to the Main Electrician.
- m) Allow all builders work including cutting of holes, making good all ceilings including any damaged tiles and wall linings, and weather flashings to penetrations through external walls.
- n) Allow to test and commission all systems installed under this contract prior to practical completion.
- o) Maintain the installation in accordance with the Schedules and Instructions in the Operating and Maintenance Manual for a period of 12 months from the date of Practical Completion.
- p) Guarantee the completed installation against defects in materials and/or workmanship for a period of 12 months from the date of Practical Completion. Faulty equipment and defects shall be replaced or repaired without delay and at no cost to the Principal.
- q) Provide Producer Statements for the Construction of the systems.
- r) Provision of Electrical Certificate of Compliance for all works completed
- s) Provide "As Built" drawings for inclusion in Operating and Maintenance Manuals.

### 1.3 WORK BY BUILDER

Forming of all penetrations required for the installation of the Mechanical services, including penetrations through floor slabs, concrete walls, block work, etc., are the responsibility of the Mechanical Sub-contractor. The Mechanical Sub-contractor may negotiate to have the builder undertake this work on their behalf.

Noise rating and waterproofing must be maintained after making good. This trade is responsible for filling and sealing around mechanical services cables, pipes and ducts.

Where sealing of penetrations is not stated allow for making good to equal performance for sound, etc., and seek final details from the Contractor.

No additional payments for builders work not allowed in the mechanical tender will be approved, if deemed necessary for the proper execution of the mechanical works.

### 1.4 ELECTRICAL FOR MECHANICAL ELECTRICIAN

Electrical for Mechanical electrician shall provide all wiring & controls, switchboard rails and breakers within dedicated mechanical services switchboards (by Zone 1 Electrical for Mechanical Electrician) or shall wire from breakers at mechanical panel of Tenancy Distribution Boards (by Main Electricians) designated for Mechanical plant as follows:

Plant associated with Shopping Mall such as smaller Retail Tenancies and Mall BOH Cleaner and Storage Facilities shall be wired by the Zone 1 Mechanical for Electrical Electrician from breakers at Mall switchboards and BMS (supplied by Others). Allow to coordinate regarding switchboard loadings and locations.

Plant associated with the larger (department store) Retail Tenancy including associated BOH Office, Storage and Amenity areas shall be wired from Mechanical Services Switchboard (MSSB – entirely by Zone 1 Electrical for Mechanical Electrician) and from breakers at Local Distribution Boards (By Zone 1 Main Electrician) and BMS (entirely by Zone 1 Electrical for Mechanical Electrician and

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Controls Specialist). Allow to coordinate regarding switchboard loadings and locations with Zone 1 Main Electrician.

Plant associated with Upper Floor Childcare Centre Tenancy shall be wired by the Zone 1 Mechanical for Electrical Electrician from breakers at Local Dedicated Switchboard (By Zone 1 Main Electrician) and BMS (entirely by Zone 1 Electrical for Mechanical Electrician). Allow to coordinate regarding switchboard loadings and locations with Zone 1 Main Electrician.

Allow to provide soft starters for all 3-phase plant where specified.

## 1.5 MAIN ELECTRICIAN

Main electrician shall provide power to Zone 1 Famers Tenancy MSSB and mechanical panels with switchboard rails and breakers designated for mechanical plant within electrical switchboards and distribution boards as specified. Allow to coordinate regarding switchboard loadings and locations.

Main electrician shall provide all wiring, controls, switchboard rails and breakers designated for hydraulic plant within electrical switchboards as specified. Allow to coordinate regarding switchboard loadings and locations.

## 1.1 DESCRIPTION OF THE WORK

The extent of works required in the Mechanical Subcontract comprises of the supply, manufacture, installation, commissioning, testing, placing into service, maintenance and warranty of the ventilation and other mechanical systems and includes (but is not limited to):

- All mechanical systems for heating, cooling and ventilation associated with the new D.S. Anchor Zone 1 portion of the new Invercargill Central Shopping Mall Development and commissioning of the entire systems upon completion.
- All electrical for mechanical including power and electronic controls for all mechanical services.
- Liaison with the project manager and all other contractors to coordinate and complete the work described.

## 1.2 MECHANICAL SYSTEM DESCRIPTIONS

### 1.2.1 Building Overview

Heating, ventilation and air conditioning requirements will be provided by mechanical systems in the following spaces:

- Ground Level Esk St. Frontage – 4 of Specialty Retail Tenancies associated with Central Mall including open plan retail area and Toilet facility to each.
- Ground Level South – Cleaners Room, Storage and Services areas associated with Central Mall.
- Ground Level 1 – department store Retail Tenancy incorporating open plan shop floor, specialty retail zones such as fitting rooms and beauty room, as well as staff areas for office and staff room facilities, general reserve storage and services spaces including rubbish store and loading bay areas.
- Level 2 – Childcare Facility 4 main childcare areas with associated amenities in addition to communal corridors and staff offices, amenities and services areas.

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### General Exhaust

Exhaust systems are provided to extract air from the department store Rubbish Room and Mall BOH Cleaners and Storage areas. The systems shall comprise of duct and roof mounted extract fans/cowls, ceiling mounted grilles, balancing dampers, uninsulated rigid and acoustic-flex flexible ducting and power and controls wiring.

Fans shall discharge via roof vent with weather protection and insect screen and shall connect to ceiling mounted grilles, via uninsulated rigid and acoustic-flex flexible ducting complete with balancing dampers and relief air shall be drawn from wall or door mounted relief vents. This system shall be set to run continuously during standard operating hours via time clock via the associated department store or Mall Central Controller and BMS systems.

All plant shall be wired from the Miniature Circuit Breaker (MCB) in the MSSB provided by the Electrical for Mechanical Contractor and shall include a local isolator to be installed adjacent to rooftop plant.

### 1.2.3 HRV Outdoor Air Supply/Exhaust

In-ceiling ducted HRV units shall supply outdoor air and remove sanitary exhaust from the Childcare Facility and department store BOH staff occupied spaces of the building.

Air will be distributed in insulated low velocity sheet-metal and flexible ducts with balancing dampers as required via weather protected outdoor air intakes and exhaust vents to ceiling and wall mounted grilles and diffusers or directly into the return air plenum of ducted AC units.

HRV units will incorporate fans, filters and non-permeable heat recovery sections to transfer heat from the exhaust/spill air to the supply air stream.

All units shall be operated by the associated central controller for relevant AC systems interlocks and programmable timeclock controls.

The following shall be provided as part of the HRV systems:

- All ductwork connections from the HRV's to the diffusers, grilles and/or ducted AC units. Supply and install all ducts, connections, flexible joints, structural, seismic joints and anti-vibration supports and restraints, hangers, dampers and diffusers/grilles as part of this fit-out, this work is to include all commissioning, testing and air balancing required.

All plant shall be wired from Miniature Circuit Breakers (MCBs) in the local Electrical DB by the Electrical for Mechanical Contractor and shall include a local isolator to be installed adjacent to the plant.

### 1.2.4 Rooftop Air Handling Units

Department store main retail shopfloor and reserve areas shall be heated and cooled by Temperzone Packaged Rooftop Ducted Air Handling units (OPA (Eco)). Each system shall consist of rooftop air handling unit incorporating economiser modulating outdoor air inlet and electric heating elements within the mixing plenum, fans, washable panel filters, heating cooling coils (served by the packaged unit air cooled compressors) and associated controls.

Each system shall also have an associated Spill air fan and actuated damper to regulate spill air in accordance with the outdoor air flow rate.

Air will be distributed in insulated low velocity sheet-metal and flexible ducts with balancing dampers as required to ceiling mounted grilles and diffusers. Specific

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areas within the shopfloor nominated for future internal fitout by department store tenant have been provided with VAV control assemblies.

Each AHU is to be provided with a wired BMS controller by the BMS controls specialist in addition to inbuilt controls modules provided within each unit to allow for operation of all systems from the department store BMS system.

All plant shall be wired from Miniature Circuit Breakers (MCBs) in the Main Mechanical Switchboard (MSSB) by the Electrical for Mechanical Contractor and shall include a local isolator to be installed adjacent to rooftop plant.

### 1.2.5 VRF Air Conditioning Systems

Childcare Facility and Department store BOH staff occupied spaces shall be heated and cooled by Mitsubishi Electric Variable Refrigerant Flow Simultaneous Heating and Cooling (City Multi R2 VRF) air conditioning systems consisting of wall mounted and ducted in-ceiling type indoor units with rooftop mounted outdoor units.

Air will be distributed in insulated low velocity sheet-metal and flexible ducts with balancing dampers as required to ceiling and side wall mounted grilles in coffered ceilings and shall be either ducted return or via ceiling return plenum in care rooms.

The air source heat recovery system has the ability to provide simultaneous heating and cooling in adjacent areas and provide a high efficiency operation.

AC system shall have individual BC Units located in ceiling (preferably corridors) provided as per the manufactures guidelines including power supply and condensate drainage routes to tundishes by hydraulic trade. Contractor shall allow to verify all system refrigerant volumes for code compliance upon determination of final pipe routes on site.

Each A/C unit is to be provided with a local wall mounted wired controller in addition to Central Controller located at the local Electrical DB. Ducted units shall also be provided with remote temperature sensors.

The AC units and BC unit condensate drains are to discharge above tundish provided with a HepVo self-sealing trap, connected to sanitary drainage system. The mechanical contractor shall liaise with the drainage contractor regarding the location of tundishes and condensate connections. Condensate tundish layouts have been indicatively shown on the sanitary services drawings.

All plant shall be wired from Miniature Circuit Breakers (MCBs) in the Local Electrical DB by the Electrical for Mechanical Contractor and shall include a local isolator to be installed adjacent to rooftop plant.

### 1.2.6 Loading Bay and Secure/ Comms Room Split System Air Conditioning Systems

The split system air conditioning units provided for Ground Level Loading Bay and Level 1 BOH Offices Secure/Comms room shall be Mitsubishi Electric wall mounted and ceiling cassette type indoor unit respectively. Insulated refrigerant pipework is to be installed on metal tray in ceiling from each indoor unit to its corresponding roof level outdoor unit.

All mechanical pipework and wiring shall typically run at low level over roof or in ceiling spaces. Provide uPVC sleeves to insulated pipes at all support points and penetrations to prevent damage, compression and cold tracking at these points and provide sealants where necessary. All exposed pipes and wiring shall be concealed by removable covers painted to match the building exterior.

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The outdoor units are to be installed with a suitable seismic restraint and structural support (Monkey Toe platform) and sufficient clearance around the units for airflow, maintenance access etc. Each unit is to be provided with plastic feet and anti-vibration slips to limit vibration transmission to adjacent structures. Each outdoor unit is to be provided with a drain which will be piped to low level and discharge to nearest rooftop gutters so as not to cause a nuisance on or near walkways. Allow to coordinate with builder for all penetrations and/or built up support structure requirements on roof.

The indoor and outdoor units shall be wired from the local Distribution Board and their operation shall be manually controlled via a local wireless controller.

All AC units are to be provided with condensate pumps and pipe connections to aid the removal of condensate from the AC units. Condensate drains are to be reticulated to the nearest suitable drainage point with a tundish connection being provided to connect the condensate pipework to sanitary drainage system. Refer to the accompanying mechanical and hydraulic layouts for further details.

### 1.2.7 Department Store Smoke Exhaust System

Smoke Extract Fans shall be supplied and installed on the roof above the central shop floor escalator for smoke exhaust as detailed. The smoke extract fans shall be activated via a signal from the Fire Alarm system to the fire fan control and indicator panel (FFCP) which will be located in the fire control room in the south east corner of the site. Their operation shall be linked via a signal from the fire alarm and the security system to open the entry doors for make-up air and drop smoke curtains if installed. The FFCP shall be supplied and installed by the mechanical contractor's electrician and located on the ground floor in the fire control room in the south east corner of the site. The FFCP shall incorporate manual override controls and status indication. Power and control wiring to the smoke extract fans and from the mechanical panel and the FFCP shall be in fire rated cabling. The mechanical panel and electrical control components associated with the smoke extract fans shall be located in a fire rated enclosure/room with an FFR not less than -/120/120

The smoke exhaust system shall fully comply with the requirements of AS1668.1 and shall also have its operation and alarms monitored via the department store BMS.

### 1.2.8 Childcare Amenities Local Exhaust Air Systems

Local exhaust systems shall be provided to one Childcare Area WC and the Laundry of the Level 2 Childcare Facility. Each extract system shall comprise of a roof mounted exhaust fan with associated power and controls wiring. Fan shall discharge via a roof mounted fan/cowl with insect screen and shall connect to ceiling mounted grille/complete with OBD, via uninsulated rigid and acoustic-flex flexible ducting and relief air shall be drawn from adjacent spaces via 20mm door undercut and door grille.

Childcare Area Toilet system shall be set to run automatically from activation of the associated room lighting contactor.

Laundry system shall operate automatically upon use of the labelled dryer power supply outlet with adjustable 10min. run-on timer.

All plant shall be wired from the Miniature Circuit Breaker (MCB) in the local Distribution Board provided by the Main Electrical and shall include a local isolator to be installed adjacent to the plant. Main electrician shall also supply a volt free

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contact from light switches or dryer power outlets in all amenities areas served to switch exhaust fans.

**1.2.9 Childcare Kitchen Rangehood Exhaust Air Systems**

Proprietary rangehood and exhaust fan systems to be provided above oven/cooktop as specified by the Architect to be provided by the builder discharging to a roof mounted cowl above by Mechanical trade.

**1.3 PROJECT SPECIFIC DESIGN CRITERIA**

The following design criteria shall be used as a basis for the selection and specification of plant and equipment.

**1.3.1 Operating Conditions**

Internal design space temperatures for the air conditioned spaces shall be controlled to the following:

Manufacturer’s performance ratings shall be listed at nominal design conditions. Specific design conditions applicable to this project are:

Room Type	Winter Indoor Temperature °C	Summer indoor Temperature °C
Air Conditioned Spaces	22 +/- 1°K	22 +/- 1°K
Heated / Ventilated Only Spaces	22 - 2°K	

Design parameters are based on the following outside air conditions which represent a 2.5% (Invercargill) frequency of occurrence:

Summer 24.2°C DB/19.4°C WB

Winter -0.7°C

**1.3.2 Mechanical Ventilation**

The Mechanical Services shall be designed and installed in accordance with the requirements of the New Zealand Building Code G4 and the associated Codes of Practice / Standards.

In particular:

AS/NZS 1668.2 “Ventilation design for indoor air contaminant control.”

NZS 4303: 1990. “Ventilation for acceptable indoor air quality.”

**1.4 OUTDOOR VENTILATION RATES**

All occupied spaces are noted to meet natural ventilation requirements in the form of fixed openable doors and windows however mechanical ventilation has also been provided for periods where doors are anticipated to remain closed to retain heating or cooling. Outdoor air supply rates shall meet or exceed the NZ Building Code and NZS 4303 and AS 1668-2 as detailed below.

Room Type	Occupancy Level People/ 100m <sup>2</sup>	Outdoor Air Supply Rate/ Person or m <sup>2</sup>

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Offices	(by nominated seating or) 7 p/m <sup>2</sup>	10 L/s/p
Conference Rooms (intermittent use)	(by nominated seating or) 50 p/m <sup>2</sup>	10 L/s/p
Retail Ground Floor	-	1.5 L/s/m <sup>2</sup>
Retail Upper Floors	-	1.0 L/s/m <sup>2</sup>

### 1.5 EXTERNAL NOISE LEVEL

Comply with local noise control guidelines to ensure the internal noise levels specified and the local Council boundary noise levels are not exceeded.

### 1.6 INTERNAL NOISE LEVEL

Mechanical services plant and equipment shall be provided with acoustic control measures so that the noise levels arising from simultaneous operation of all mechanical systems shall not exceed the maximum recommended design sound levels for each space. Typical maximum design values in accordance with AS/NZS 2107:2000 are listed below:

Room Type	Maximum Design Sound Level
Offices	NC 40-45
Sleeping Areas	NC 30-35
Kitchens and Service Areas	NC 50-55
Conference Rooms	NC 35-40
Corridors and Lobbies	NC 35-40
Toilets	NC 40-45

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**1.7 AUTOMATIC CONTROLS SYSTEM FUNCTIONAL DESCRIPTIONS**

Systems shall be operated from controls devices as described in the Controls Description.

Ref	Location	Description	Input/Output	Alarms
EF 1.01	Department store Rubbish Store Exhaust	<p><u>Normal Operation</u></p> <p>System shall run continuously according to time schedule during normal business hours.</p> <p>System shall also run on demand after hours when lights to rubbish room are switched on. System shall run on for 10 minutes (adjustable) after lights switched off.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p>	<p>Department store BMS –</p> <p>Time schedule</p> <p>After Hours Rubbish Room Light Contactor (contactor by Main Electrician)</p> <p>Run on timer</p> <p>Fire Shut down Relay</p>	Fan fail
EF 1.02	Department store Loading Dock Vehicle Exhaust	<p><u>Normal Operation</u></p> <p>Systems shall be enabled according to reed switch on Loading Bay Door (indicating open).</p> <p>Systems shall run whenever door beam indicates present of vehicle and run on for 10 mins. (adjustable).</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p>	<p>Department store BMS –</p> <p>Door Open Reed Switch Fan Enable</p> <p>Door beam switch Fan Run</p> <p>Run on timer</p> <p>Fire Shut down Relay</p>	Fan Fail

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EF 1.03	Level 1 Department store BOH Secure Comms/CCTV Room Exhaust	<u>Normal Operation</u>  System shall be interlocked to run continuously whenever HRV 1.01 is operating.  All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.	Department store BMS – HRV system run interlock Fire Shut down Relay	Fan fail
EF 1.04	Level 1 Department store BOH Staffroom Exhaust	<u>Normal Operation</u>  System shall run when lights to staffroom are switched on. System shall run on for 15 minutes (adjustable) after lights switched off.  All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.	Department store BMS – Staffroom Light contactor (contactor by Main Electrician)  Run on timer Fire Shut down Relay	Fan fail
EF 1.05	Level 2 Childcare Toilet Exhaust	<u>Normal Operation</u>  System shall be interlocked to activate from local room lighting contactor with adjustable (5min) Run On Timer.  All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.	Mall BMS – Toilet Light contactor (contactor by Main Electrician)  Run on timer Fire Shut down Relay	Fan fail
EF 1.06	Level 2 Childcare Laundry Exhaust	<u>Normal Operation</u>  System shall run via current switch at dedicated dryer power supply point whenever dryer is switched on. System shall run on for 10 minutes (adjustable) after lights switched off.  All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.	Mall BMS – Dryer Current Switch (contactor by Main Electrician)  Run on timer Fire Shut down Relay	Fan fail

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EF T.48	Ground Level Mall BOH Cleaners Exhaust	<p><u>Normal Operation</u></p> <p>System shall run continuously during normal operating hours and when lights are switched on after hours. System shall run on for 15 minutes (adjustable) after lights switched off.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p>	<p>Mall BMS –</p> <p>Time clock</p> <p>Light contactor (contactor by Main Electrician)</p> <p>Run on timer</p>	Fan fail
EF S.1/S.2	Ground Level Mall BOH Stores Exhaust	<p><u>Normal Operation</u></p> <p>Systems shall run continuously during normal operating hours and when lights are switched on after hours. System shall run on for 15 minutes (adjustable) after lights switched off.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p>	<p>Mall BMS –</p> <p>Time clock</p> <p>Light contactor (contactor by Main Electrician)</p> <p>Run on timer</p>	Fan fail

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<p>Department store BOH VRF AC Systems – AC 1.A1-A4/ OU1.A</p>	<p>Department store BOH Offices, Meeting Rm and Staffroom Airconditioning</p>	<p><u>Normal Operation</u> System shall run continuously according to time schedule during normal business hours.  <u>After Hours</u> System shall run afterhours activated for 2 hours (adjustable) run-on before shutting down. Afterhours control On/Off by local AC controller.  All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.  Provide necessary interface cards to allow for AC systems controls to be connected to Department store BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Department store BMS – Time schedule After hours run on timer Delay Start timer</p>	<p>System Fault</p>
<p>Department store Split System - AC 1.AS/ OU1.AS</p>	<p>Department store BOH Offices Secure/Comms Airconditioning</p>	<p><u>Normal Operation</u> System shall run continuously with fault alarm to be sent via SMS MSG through the Department store BMS.  All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.  Provide necessary interface cards to allow for AC systems controls to be connected to Department store BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Department store BMS – Fault alarm call out</p>	<p>System Fault</p>

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<p>Department store Split System - AC 1.B / OU1.B</p>	<p>Department store Loading Bay Airconditioning</p>	<p><u>Normal Operation</u></p> <p>System shall be programmed to enable during normal business hours but shall be manually operated from local room controller on demand.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p> <p>Provide necessary interface cards to allow for AC systems controls to be connected to Department store BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Department store BMS – Time schedule</p>	<p>System Fault</p>
<p>Department store Outdoor Air Supply and Exhaust System (Heat Recovery Ventilation) - HRV 1.01</p>	<p>Department store BOH Office &amp; Amenities Ventilation Supply and Exhaust</p>	<p><u>Normal Operation</u></p> <p>System shall run continuously according to time schedule during normal business hours from Central Controller.</p> <p>HRV systems shall operate on 10 min. adjustable delay start after AC systems activated to allow for Warm-up/Cool down period.</p> <p><u>After Hours</u></p> <p>System shall run when associated AC systems afterhours activated for 2 hours (adjustable) run-on before shutting down. Afterhours control On/Off by local AC controller.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p> <p>Provide necessary interface cards to allow for HRV systems controls to be connected to Department store BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Department store BMS – Time schedule</p> <p>After hours run on timer</p> <p>Delay Start timer</p>	<p>System Fault</p>

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<p>Childcare VRF AC Systems – AC 1.C1-C4/ OU1.C</p>	<p>Childcare Areas and Reception Corridor Airconditioning</p>	<p><u>Normal Operation</u> System shall run continuously according to time schedule during normal business hours.</p> <p><u>After Hours</u> System shall run afterhours activated for 2 hours (adjustable) run-on before shutting down. Afterhours control On/Off by local AC controller.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p> <p>Provide necessary interface cards to allow for AC systems controls to be connected to Mall BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Mall BMS – Time schedule After hours run on timer Delay Start timer</p>	<p>System Fault</p>
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<p>Childcare Electric Radiant Panel Heating Systems</p> <p>EPH 1.01- 1.10</p>	<p>Childcare Staff Areas &amp; Entry Corridor</p>	<p><u>Normal Operation</u></p> <p>System shall run continuously according to time schedule during normal business hours over Winter months with local adjustment via associated room thermostat controller.</p> <p><u>After Hours</u></p> <p>System shall run afterhours activated for 2 hours (adjustable) run-on before shutting down. Afterhours control On/Off by local thermostat controller.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p> <p>Provide necessary interface cards to allow for controls to be connected to Mall BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Mall BMS – Time schedule Local Room Thermostat Controllers After hours run on timer</p>	<p>System Fault</p>
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<p>Childcare Outdoor Air Supply and Exhaust System (Heat Recovery Ventilation) - HRV 1.02/3</p>	<p>Childcare Internal Staff Areas Outdoor Air Supply and Amenities Exhaust</p>	<p><u>Normal Operation</u></p> <p>System shall run continuously according to time schedule during normal business hours from Central Controller.</p> <p>HRV systems shall operate on 10 min. adjustable delay start after AC systems activated to allow for Warm-up/Cool down period.</p> <p><u>After Hours</u></p> <p>System shall run when Reception AC systems afterhours activated for 2 hours (adjustable) run-on before shutting down. Afterhours control On/Off by local Reception AC controller.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p> <p>Provide necessary interface cards to allow for HRV systems controls to be connected to Mall BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Mall BMS – Time schedule After hours run on timer Delay Start timer</p>	<p>System Fault</p>
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Section C: Project Specific Mechanical And Electrical For Mechanical Scope

Building Division

<p>Department store shop floor AHU Systems – AHU 1.01-1.04</p>	<p>Department store shop floor and Reserve Airconditioning</p>	<p><u>Normal Operation</u></p> <p>System shall run continuously according to time schedule during normal business hours with all timeclocks, systems set points and operation monitoring outputs managed via Department store BMS systems controllers.</p> <p>Proprietary AHU systems controllers shall automatically manage internal AHU systems to maintain specified air conditions including electric pre-heating of outdoor air, and engage Economiser mode when suitable ambient conditions occur by adjusting associated motorised damper positions and spill air fans according to Outdoor Air temperature sensor.</p> <p><u>After Hours</u></p> <p>System shall run afterhours activated for 2 hours (adjustable) run-on before shutting down from Department store BMS Control panels.</p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm and automatically reset to programmed operation upon deactivation of alarm.</p> <p>Provide necessary interface cards to allow for AC systems controls to be connected to Department store BMS systems and Fire Alarm Panel for operation as specified.</p>	<p>Department store BMS –</p> <p>Time schedule</p> <p>Temperature/CO2 monitoring systems</p> <p>After hours run on timer</p>	<p>System Fault</p>
<p>SEF 1.01-1.04</p>	<p>Department store AHU Spill Exhaust Fans</p>	<p><u>Normal Operation</u></p> <p>Each System shall be interlocked to run continuously whenever the associated AHU System is operating via Department store BMS systems controllers. Fan speed shall adjust automatically to match outdoor air flow rate during associated AHU Economiser mode.</p>	<p>Department store BMS –</p> <p>AHU control interlocks</p> <p>Fan Speed EC controls</p>	<p>System Fault</p>

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<p>VAV 1.01, 2.01-2.07, 3.01</p>	<p>Department store shop floor VAV Systems</p>	<p><u>Normal Operation</u></p> <p>Each Variable Air Volume Control Assembly with an electric duct heater System shall be interlocked to run whenever the associated AHU system is operating complete with associated VAV heater/AHU fan overrun where required via Department store BMS systems controllers.</p> <p>Flow and temperature shall adjust automatically to maintain required conditions in the nominated future fitout areas according to remote temperature sensor to be installed within each space, setpoints shall be adjusted via the Department store BMS.</p> <p>VAVs 1.01/3.01/2.02 serving potential fitting room areas in future fitout shall incorporate heater elements and shall adjust flow and temperature to maintain local zone temperature by remote temperature sensor to be installed within the spaces. Bulk of Diffusers outside of VAV control shall typically adjust slightly to maintain constant supply air flow from AHU1.01/4.</p> <p>VAVs 2.01/2.03-2.07 (non-heating) shall adjust flow to maintain local zone temperature by remote temperature sensor to be installed within the space. AHU 1.02 fan speed shall adjust according to maintain system pressure.</p>	<p>Department store BMS – AHU control interlocks and supply air system pressure sensing</p> <p>VAV Damper Flow controls VAV Heater Temp controls Remote Temp Sensors VAV interlocks</p>	<p>System Fault</p>
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Department Store BMS	Department store Building Management System	<p>On site systems shall manage operation and monitoring of all Department store Mechanical Systems including but not limited to energy monitoring, operational set points, control interlocks and 24hr, 365 day, programmable timeclock controls including programmed sequential start/stop and delay start coordination between associated air handling systems in accordance with Department store operational standards.</p> <p>Department store BMS shall be integrated with the existing WebCTRL server at Auckland Support Office.</p>	Department store BMS - ALL	System Fault
SEF 1.01-1.04	Department store shop floor Smoke Exhaust Fans	<p><u>Normal Operation</u></p> <p>Smoke Exhaust Fan Systems shall automatically run upon activation by relevant Fire and Smoke alarm (during normal business hours only when main entry doors shall lock open allowing occupant egress and relief air path).</p> <p>Systems shall be enabled from the department store security system interlock to ensure the systems do not run after hours.</p> <p>BMS systems shall allow for SMS MSG notification of system fault.</p>	<p>FFCP Controls</p> <p>DS Security Fan enable interlock</p> <p>BMS-F system fault notification systems</p>	System Fault

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<p><b>Fire Alarm Systems</b></p>		<p><u>Normal Operation</u></p> <p>All mechanical systems required to shut down upon signal from local fire or smoke alarm.</p> <p>Smoke Exhaust Fans shall be operated from the FFCP (refer above for further details).</p> <p>BMS systems shall allow for SMS MSG notification of all fire/smoke alarms.</p> <p>Refer to Fire Engineers Report and Specifications for further details of fire smoke alarms and zoning.</p>	<p>Fire Alarm System relay to FFCP for Smoke Exhaust Fan Operation</p> <p>Fire Alarm System relays to all relevant MSB, MSSB and DBs for shutdown</p> <p>Fire Alarm System relay to BMS-F for all relevant zoned fire/smoke alarm condition outputs for notification systems</p>	<p>System Fail</p>
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**SECTION D  
MECHANICAL SERVICES STANDARD CLAUSES**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

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## D.1 CONDITIONS

The requirements of Section A of this specification "Preliminary and General" shall be read as directly included herein.

## D.2 ALTERNATIVE DESIGNS

Alternative design solutions for the building will be considered, but all tenderers must also price systems as described in this specification.

Submittal requirements for Alternative Designs are defined in Section A under Submittal Requirements.

## D.3 SCOPE OF WORK

Refer Section C.

## D.4 PLANT AND EQUIPMENT

### 4.1 GENERAL

Comply with the Drawings and Equipment Schedule in the Section F of this specification.

### 4.2 QUALITY AND SAMPLES

For all items of plant submit full construction and technical reports for approval. These reports should demonstrate the airflows, external static pressures, coil and filter velocities, and the heating and cooling performance of the all units offered at the specified ambient and space operating conditions.

Submit samples of the following:

- a) Each type of thermostat/control module exposed to view within conditioned spaces.
- a) Finish and colour of equipment cabinets, fans, grilles diffusers etc.

### 4.3 IDENTIFICATION AND SIGNWRITING

#### 4.3.1 Identification

All instruments, gauges, indicators, control equipment, valves and switchboard equipment shall be clearly labelled using engraved traffolyte labels. Lettering shall be upper case and black in colour on a white background. All items of equipment such as pumps, fans, air handling equipment and similar items shall be labelled in accordance with standard symbolism to clearly show the purpose of the equipment and the name of the Service/System. e.g. COLD WATER SUPPLY FROM RIVERSIDE TANKS.

All pipework shall be colour banded and labelled in accordance with NZS5807. Where pipework passes through walls, labels are to be fitted adjacent to each side of the obstruction.

Duct access panels are to be labelled to show their purpose, and to warn of any risks involved with them being opened.

## PLANT INSTALLATION

Provide all interconnecting piping where required, flash all wall and roof penetrations, and make electrical and controls connections.

Ensure all plant including is positioned to provide the manufacturers recommended clearance around units for servicing and maintenance access and airflow.

### 4.5 INLINE FANS

#### 4.5.1 General

Fans shall be of the non-overloading type with capacities listed in the Equipment Schedule, As manufactured by "Fantech" or approved equal selected for a minimum efficiency of 65% at the design air flow rate.

#### 4.5.2 Casing

Fans shall have flanged hot dipped galvanised tubular casings extended over the length of the fan and motor (unless specified otherwise)

Open fan intakes and discharges that are accessible to personnel shall have heavy gauge galvanised or bronze wire mesh guards fitted.

#### 4.5.3 Impellor

Non-overloading aerofoil fans shall have adjustable pitch cast aluminium alloy impellers or polypropylene impellers. All impellers shall be statically and dynamically balanced.

#### 4.5.4 Fan Motor

Fan motors shall be provided with grease packed ball or ball and roller bearings designed for a calculated life of 50,000 hours under the particular duty of the fan. Dust seals shall be provided for all bearings, together with low pressure dust-proof caps, extended to an accessible location.

### 4.6 ROOF TOP FANS & COWLS

#### 4.6.1 General

Fans shall be of the non-overloading type with capacities listed in the Equipment Schedule, As manufactured by "Fantech" or approved equal selected for a minimum efficiency of 65% at the design air flow rate.

#### 4.6.2 Construction

Cowls shall be of UV-stabilised plastic. Steel components shall have a corrosion-resistant finish.

#### 4.6.3 Motors

Bearings shall be sealed-for-life, ball type.

#### 4.6.4 Testing

Air flow tests shall be to BS848:Part 1, 1980.

Noise tests shall be to BS848:Part 2, 1985.

#### 4.6.5 Mounting

Shall be suitable for mounting on roofs at angles up to 30° from the horizontal.



Building Division **4.7 VRF/VRV/MULTI-SPLIT AIR CONDITIONING SYSTEMS**

**4.7.1 General**

Provide factory assembled and tested inverter heat recovery VRF/VRV air conditioning systems in the locations depicted on the drawings of the types the capacities scheduled in Schedule, Appendix B2.

**4.7.2 Equipment Suppliers**

Units prescribed in this specification are Mitsubishi Electric City Multi, Multi Split and Split Systems.

The Contractor may submit a price for alternative systems, refer requirements for Alternatives set out in Submittal Requirements.

Installation of an alternative system shall require the approval of the Engineer prior to placing orders.

**4.7.3 Approved Installers**

Installation of air conditioning systems shall be undertaken only by competent staff with the necessary manufacturer provided training. Evidence of such training for all parties involved in the installation shall be supplied to the Engineer on request.

**4.7.4 Operating Conditions**

Manufacturers performance ratings are listed at nominal design conditions.

Specific design conditions applicable to this project are:

NIWA 2.5% Invercargill Ambient Design Conditions

Cooling: Indoor 22±1°C DB/19°C WB/40-60%RH;  
Outdoor 24.2°C DB/19.4°C WB

Heating: Indoor 22±1°C DB/40-60%RH;  
Outdoor -0.7°C

**4.7.5 External Noise Level**

Comply with local noise control guidelines to ensure the internal noise levels specified and the Invercargill City Council boundary noise levels are not exceeded.

**4.7.6 Internal Noise Level**

Internal noise levels shall not exceed PNC38 as measures 1m away from grilles and diffusers.

**4.7.7 Indoor units**

Indoor units shall be of the type and capacities listed in Section F. Capacities shall be as taken at the space served including all allowances for all capacity losses due to the layout and configuration of the refrigerant system.

**4.7.8 Refrigeration System**

All sizing of refrigerant pipework for the air conditioning system, and selection of fittings (including tees, headers, refnets, couplings etc) shall be completed by the Contractor, and shall be in strict adherence with the system manufacturer's recommendations. Any aspect of pipework installation that is faulty or installed contrary to the manufacturer's recommendations shall be rectified at the Mechanical Contractors expense.

Installation shall be to AS/NZS 5149.3: 2016 Refrigerating systems & heat pumps - Safety & environmental requirements Part 3: Installation site.

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Operation, maintenance, repair & recovery shall be to AS/NZS 5149.3:2016  
Refrigerating systems & heat pumps - Safety & environmental requirements Part 4:  
Operation, maintenance, repair & recovery.

Refrigerants shall be R410A, R407C or equal approved with zero ozone depletion potential. The use of HCFC (R22) shall require the explicit written approval of the Engineer.

Pipework shall be Copper pipe to AS 1571, Copper - seamless tubes for air conditioning and refrigeration.

All brazing of copper pipework joints on R410a and R407c systems shall be conducted in the presence of nitrogen bleeding to the equipment suppliers' requirements to prevent accumulation of scale.

Pipework shall be leak tested for no less than 24 hours prior to the fitting of any insulation or concealing within riser spaces.

All pipework shall be insulated in accordance with the manufacturer's requirements utilising elastomeric foam, FR/Armaflex or equivalent, insulation to pipework conveying liquid refrigerant shall be complete with a vapour barrier between the pipe material and insulation.

External pipework shall be installed within slotted cable tray complete with a colour steel witches hat capping. For the purposes of pricing capping colour shall be selected to match the surface over which the pipework runs, on contract acceptance colouring shall be confirmed with the Owners representative prior to order.

Where refrigerant pipework penetrates through a roof it shall rise up within a uPVC sleeve fitted with an Aquaseal and a pair of elbows creating a gooseneck. Where a wall is penetrated the gooseneck shall be formed from a single elbow uPVC elbow of suitable radius.

#### Branch Controller Boxes

Provide branch controller (BC, BS, PFD) boxes in the locations depicted on the drawings. Wherever possible branch select boxes shall be located over ancillary spaces; corridors, toilets, store areas etc to minimise switching noise.

Where branch controller boxes are not specifically shown the contractors tender shall include all allowances to provide a branch controller box to each terminal unit allowing simultaneous heating and cooling at each terminal unit.

#### 4.7.9 Condensate Pipework

Installation of condensate systems shall be to AS/NZS3666 Air handling and water systems of buildings - microbial control, and shall feature only stock moulded fittings.

Provide trays with screwed outlets under cooling coil sections and under components on which condensation can occur extending downstream to collect water carry over. Fan coil units fitted with cooling coils shall be supplied with drain trays, secondary drip trays, and condensate drains.

Condensate pumps where required shall be installed in an accessible location in the ceiling space, the installation of in wall condensate pumps shall not be accepted.

Allow to connect condensate trays from indoor units, via removable union and flexible pipework section from all indoor AC units to series of common trapped

tundishes, each in an accessible location within the ceiling space. All traps from tundishes shall be insulated to prevent the accumulation of condensation.

Location and termination requirements of tundishes shall be coordinated with plumber.

Where outdoor units are mounted other than directly on or immediately adjacent the ground, or condensate discharge poses a slipping hazard to occupants on a trafficable surface, provide a condensate tray and discharge pipework to appropriate drainage point.

#### 4.7.10 Outdoor Units

Outdoor unit capacities shall be selected to match the capacity of the indoor units and shall feature inverter compressor control.

##### Casings

Provide casing, materials and finishes that are corrosion resistant, and weatherproof where located outdoors.

The casing shall be fabricated from a minimum thickness of 1.6mm zinc enamel or aluminium sheet folded to form panels to accommodate a 25mm thickness of acoustic insulation.

The outside surface shall be finished flush without external framing and shall be supplied in a factory finished paint system suitable for an exterior environment.

Plant construction shall be assembled and reinforced to prevent flexing and drumming. Provide for removal of major components.

Provide provision for access to plant internals for inspection and maintenance. Access Panels shall be readily removable with positive re-usable fasteners and soft gaskets that provide an airtight seal.

Insulate casings where required to prevent external surface condensation under operational conditions. Fit internal acoustic insulation to casings.

Insulation fire tests: Spread of flame index zero and smoke developed index three to AS 1530.3 Simultaneous determination of ignitability, flame propagation, heat and smoke release.

Fixings and all construction details shall comply with the requirements of NZS 4219, Seismic Resistance, Engineering Systems.

##### Fans, Motors and Drives

Belt drives, where selected, shall be suitable for a direct on-line start. Cog belts shall not be permitted.

All motors shall be phased as identified in Section F Schedules where required for inverter speed control.

All fans and motors including compressors shall be resiliently mounted, with flexible pipework and duct connections. Fit inherent overheat protectors to AS 1023:3, inherent overheat protectors.

Short circuit protection shall be supplied to all motors using miniature circuit breakers of adequate fault rating and a contactor (with manual reset thermal overload for each compressor and each 3-phase motor. Provide high motor winding temperature protection.

**Fittings**

Evaporator coil, air cooled refrigerant condenser, compressors, hot gas muffler, liquid line filter drier, thermostatic expansion valve or capillary, refrigeration controls, and speed controlled condenser fans, all mounted within a common casing.

Onboard controls shall be complete with short cycle timer function: To limit compressor starts. Fit pump down cycle.

Units with multiple compressors shall have each compressor fitted with inverter controls and run hours electronically balanced to provide equal wear. Provide separate control and electrical circuits for each refrigerant circuit.

Provide a manual reset high pressure cut-out and an automatic reset low pressure cut-out for each compressor.

Provide refrigeration service valves and test points on compressor suction and discharge.

Heat pump systems shall include effective outdoor coil defrost facilities and refrigerant reversing valve.

**4.7.11 Controls and Wiring**

Each indoor unit shall have the facility for remote on/off control, temperature control, and fault indication via the associated Central Controller and BMS system. Provide BACnet interface cards as appropriate.

Interface cabling between units controllers and branch controller boxes shall not be run smaller than 1.5mm<sup>2</sup> and shall be screened.

Indoor units shall be wired back to the same electrical switch board as the outdoor unit from which they are supplied refrigerant. Isolators in the board shall clearly identify the risks of isolating indoor units for long periods of time.

**4.8 SINGLE SPLIT SYSTEM AIR CONDITIONING SYSTEMS**

**4.8.1 General**

Requirements for split system air conditioning shall be as for VRV/VRF air conditioning systems with the deletion for the requirements related to branch select boxes.

**4.8.2 Warrantee**

Split system equipment shall be supplied and installed complete with a 5 year warrantee for parts and labour.

**4.9 ROOFTOP PACKAGE AIR CONDITIONING**

Roof mounted packaged Air Handling Units (AHUs) shall be supplied by Temperzone, refer plant schedules.

The cabinet and drain tray shall be constructed from high grade galvanised steel - polyester powder coated (colour Grey) for increased durability. External fasteners shall be stainless steel. Cabinets shall be designed with full size large access doors to ensure that all parts are accessible for servicing and replacement.

Heat exchange coils shall comprise aluminium plate fins on mechanically expanded copper tube. The outdoor coil fins shall be epoxy coated for extra protection in corrosive environments, e.g. salt laden sea air.

Fan motor bearings are sealed for life so as not to incur regular maintenance.

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Supply Fans shall be three phase belt driven models. Allow to change pulleys and belts as necessary to ensure specified duty is met. Allow also to change pulleys and belts at commissioning time to ensure commissioning airflows are met.

Units shall be equipped with modulating motorised dampers to permit operation in 100% economiser, 100% recirculation or some combination thereof. Provide all modifications required by the supplier to permit operation with 100% outdoor air.

Compressors shall be digital scrolls, providing capacity control. Units shall feature twin refrigerant circuits to allow staging of the heating and cooling provided.

Units shall be capable of being controlled in a supply air temperature reset scheme with fresh air set by CO<sub>2</sub>/Economiser Control via the site BMS refer also to the Automatic Controls description regarding specific controls features.

Units shall have an automatic lock out on power failure, low pressure control automatic reset, and high pressure control, automatic reset after latching relay reset from control board. Electronic de ice controls.

Some units are intended for displacement conditioning, supply air flow rates are as stated, heating and cooling capacities are significantly lower than for standard units, operating at extended periods within a 6°C degree maximum deviation from space temperature. The full range of the unit will only be used during fast warm up, or fast cool down.

#### 4.9.1 Operating Conditions

Manufacturers performance ratings are listed at nominal design conditions.

Specific design conditions applicable to this project are:

NIWA 2.5% Invercargill Ambient Design Conditions

Cooling: Indoor 22±1°C DB/19°C WB/40-60%RH;  
Outdoor 24.2°C DB/19.4°C WB

Heating: Indoor 22±1°C DB/40-60%RH;  
Outdoor -0.7°C

#### 4.10 VARIABLE AIR VOLUME (VAV) WITH ELECTRIC DUCT HEATER CONTROL ASSEMBLIES

Electric Duct Heaters shall be supplied by Holyoake Industries as specified with all safeties required by AS1668.1-1991 including but not limited to;

- Manual reset hi-limit stat
- Fusible links
- Fan run on interface to associated AHU
- Air flow proving pressure switch
- All contactors and relays

VAV systems shall incorporate controls to automatically regulate airflow volume and temperature to future fitout zones as indicated on base build drawings according to remote temperature sensor to be provided within the space.

#### ELECTRIC DUCT HEATERS

Electric Duct Heaters shall be supplied with all safeties required by AS1668.1-1991 including but not limited to;

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- Manual reset hi-limit stat
- Fusible links
- Fan run on interface to associated HRV
- Air flow proving pressure switch
- All contactors and relays

#### 4.12 FIRE DAMPERS

Fire and smoke dampers shall be installed wherever required to comply with regulations. Fire & Smoke dampers are generally, denoted on the drawings as "FD" or "FD/SKD" and shall be Halton or Holyoake manufacture except where specifically noted otherwise.

Fire Dampers shall be installed in strict accordance with suppliers' requirements, including adherence to installation requirements necessary to ensure that the completed installation reflects the "as tested" damper configuration.

Fire dampers shall be rated to match the fire rating requirements of the wall, floor, ceiling within which they are installed, refer Architectural drawings.

Fire dampers shall be drop tested after installation.

Fire dampers on all firewall penetrations for all ducting where required. The fire dampers are to comply with AS1668.1, AS1668.2 and AS1682. Refer to the drawings and Fire Engineering Services Specification for further details.

Combined Fire & Smoke dampers shall be supplied complete with Belimo BLF-T Spring-return actuator, combined with thermo-electric tripping device for operation via fire/smoke alarm relay.

They shall be tested in accordance with AS no. A30-1958, Section 4, Fire Resistance Test for Structures, and any subsequent amendments for a fire rating equivalent to the surrounding construction.

#### 4.13 FIRE COLLARS (NOT PART OF THIS SUB CONTRACT)

Fire collars, denoted as "FC" or "fc" or as shown in drawing legends shall be installed wherever pipework penetrates a fire rated wall.

Fire collars shall be rated to match the fire rating requirements of the wall, floor, ceiling within which they are installed, refer Architectural drawings.

Where pipework drops or rises within a fire rated wall fire collars shall be installed where pipework

### D.5 DUCTWORK AND FITTINGS

#### 5.1 GENERAL

This Section of the Specification covers the supply and installation of all ductwork systems including air terminals and associated fittings. Air terminals shall mean; diffusers, grilles, registers, louvres and the like.

All ductwork systems shall be complete with transitions, bends, tees, supports, dampers, balancing dampers, perforated balancing plates, offsets, flexible connections, take-offs and similar fittings necessary for the balancing and full operation of the air distribution system and shall be fully detailed on construction drawings.

Fully detailed drawings of all ductwork showing duct sizes and critical dimensions shall be prepared and submitted for approval prior to the commencement of manufacture.

All parts of the ductwork shall have a minimum installed clearance of 25mm from all structures and other service items, except where included in the design. Where this installed clearance is not possible with the appropriate prior co-ordination and allowances, then an approved isolation shall be installed such as 'Malthoid' together with closed cell rubber foam.

**Applicable Codes**

- New Zealand Building Code.
- SMACNA Guidelines for seismic restraint of HVAC systems.
- NZS 4219 - Seismic Resistance of Engineering systems in buildings.
- All applicable trade standards as they pertain to seismic restraint and installation methods.
- Where conflicts between codes exist, the more stringent requirement shall apply.

**Manufacturer's Responsibility**

Manufacturer of seismic control equipment shall have the following responsibilities:

- Determine seismic restraint sizes and locations.
- Provide equipment seismic restraints as scheduled or specified.
- Provide installation instructions, drawings and field supervision to ensure proper installation and performance of systems.

**5.2 DUCTWORK CONSTRUCTION AND INSTALLATION.**

**5.2.1 General**

All ductwork shall be site measured prior to fabrication.

All ductwork shall be fabricated in accordance with the details shown in the SMACNA Standard.

All sheet metal ductwork shall be fabricated from full size galvanised steel sheet specifically manufactured for roll forming such as Galvabond or approved equivalent and comply with NZS 3441, Grade GC.

Galvanising shall remain unbroken after fabrication and installation and in all cases, long runs of ducts up to 2400mm in length shall be fabricated from continuous sheets unless broken by transitions, bends and fittings. Patched ductwork fabricated from small pieces shall not be accepted.

All ducts shall be adequately stiffened and isolated from supports to prevent "drumming" and vibration.

Patented systems of flange fabrication, e.g. 'Ductmate' or approved equivalent, utilising pre-formed galvanised steel channel sections interlocked by pressed steel corner brackets, may be used as an alternative to the methods detailed in SMACNA.

Where patented jointing system are used, the joints shall be sealed strictly in accordance with the manufacturer's recommendations and guaranteed to ensure

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air tightness in accordance with the general requirements of the leak testing section of the Specification.

All "shop" and "on-site" joints, which have not been fully welded or soldered, shall be sealed with a synthetic sealing compound similar to "Expandite", "Ductseal" or approved equivalent applied to the metal surfaces prior to making the joint.

In general, all circular and oval ductwork shall comply with the details shown in SMACNA Standards. Proprietary duct fittings may be used provided that prior approval has been obtained for the particular fittings involved such as reducers, bends and tee-pieces and providing that the Proprietary system employs the duct sizes indicated on the Drawings

For circular ducting alternative machine made heavy ribbed spiral wound ductwork such as "Spiro-Duct" or approved equivalent may be used made in lengths as long as possible with a minimum of site joints.

All duct bends shall be as follows:

- a) Full radius bends shall be used with a minimum centre line radius equal to the duct width in the plane of the bend.
- a) Pressed metal bends may be used for circular ducts in lieu of lobster back bends.

Branches shall be parallel flow type as per SMACNA Fig 2-6 or 45 degree type.

### 5.2.2 Exterior Ductwork

All ductwork shall be constructed of galvanised sheet.

All exterior ductwork shall be supplied complete with internal insulation.

All exterior ductwork shall be sealed weather tight with a synthetic sealing compound similar to "Expandite", "Ductseal" or other approved equivalent applied to the metal surfaces prior to making the joint.

All duct joints on exterior ductwork shall be fitted with folded galvanized steel overflashings.

After manufacture all ductwork that will be installed exposed to the weather shall be treated with one coat of zinc chromate primer before installation, and painted after installation with a minimum of three coats exterior paint installed in accordance with the paint manufacturer's instructions.

### 5.2.3 Ductwork Endpoints

All ducts not being connected to equipment (fans) or fit out ductwork are to be capped and made good. Ensure caps are waterproof, and leave ample protrusion of duct such that on removal of cap there is sufficient duct for connection of exhaust or supply fan or further connecting ductwork.

## 5.3 INTERNALLY INSULATED DUCTWORK

Where required to be internally insulated, ductwork is to be lined with 25mm Siliner. All end pieces shall be complete with sheet metal nosings and all corners shall be held firm with angles formed from galvanised sheet steel.

## 5.4 EXTERNAL DUCTWORK INSULATION

External insulation shall be applied to all air conditioning supply ductwork except where this is internally insulated. Insulation shall comprise 25mm thick Ductwrap



flexible fibreglass, covered with aluminium foil, firmly adhered to ducts with an approved type of non-flammable adhesive.

The insulation shall be applied to form an effective vapour barrier over the whole surface of the ductwork including flanges, stiffeners and support angles with all joints butted together with aluminium foil overlapping at least 50mm, sealed with a vapour impervious tape.

Pins shall be used on the underside of large ducts to prevent sagging of the insulation, provided that the pin is covered and sealed with aluminium foil and vapour impervious tape.

Nylon fixing bands shall be applied to each joint in the insulation and between each joint at approximately 600mm centres and shall be fixed in such a way that damage to the aluminium foil and insulation is avoided.

## 5.5 FLEXIBLE DUCTING

All flexible ductwork shall be of the aluminium spirally wound type, e.g. Holyokes Spiroflex. All flexible supply ductwork shall have factory applied 25mm thick, 24 kg/m<sup>3</sup> density fibreglass. A length of no more than 3 metres is allowable for any one branch.

All bends made in flexible ductwork shall be formed to manufacturers recommendations and shall have a centre-line radius of not less than 1.5 times the diameter of the duct. Bends shall remain at full diameter throughout the length of the bend and all bends deformed or damaged in any way during installation shall be replaced. All fittings such as tee-pieces, Y-pieces and reducers shall be of galvanised sheet metal.

All joints between lengths of flexible ductwork shall be made with short spigots of galvanised sheet metal circular duct to form a slip joint. Similarly, all connections to fittings and terminal boxes etc, shall be of the spigotted slip joint type. All joints shall be sealed with Band-it type clamps c/w screw seal type fixings. All flexible ducts shall be adequately supported with hanger strips located at a maximum of 2 metre centres to prevent undue sagging.

All joints between lengths of flexible ductwork to fittings and terminal boxes etc, shall be of the spigoted slip joint type with shrink-fit duct bands or continuous type metal band. Self tapping metal screws and rivets shall not be used.

## 5.6 DUCT SUPPORTS, FLANGES AND BRACING

Duct supports shall be as detailed in the SMACNA Duct Manual. Provision shall be made on ducts of sides longer than 450mm or over 450mm diameter for seismic restraint in compliance with NZS4219.

All duct supports, brackets, flanges and bracing shall be fabricated from mild steel in accordance with NZS 3404 with welded joints in accordance with NZS 4701.

Hanger straps shall be guillotined from galvanised sheet steel of not less than 1.2mm. Hanger rods and bolts shall be zinc coated or hot dip galvanised after threading. All supports shall be placed as close as possible to transverse joins or bracing.

All flanges, brackets and bracings exposed to view or exposed to moisture, condensation or external elements shall be hot dip galvanised after manufacture or approved equivalent treatment. All other flanges, brackets and bracings shall be treated with one coat of zinc chromate primer before installation and where a

paint finish is required painted after installation with a minimum of three coats exterior paint installed in accordance with the paint manufacturer's instructions.

Flange gaskets shall be of the fireproof and heat retardant type adjacent to fire dampers and in all joints within three diameters or three diagonal measurements from the fire wall or floor slab concerned. All other flange gaskets may be of rubber, neoprene or approved equal.

All gaskets shall be of the full width of the flange angle and not less than 3mm thick.

## 5.7 DUCT MOVEMENT AND VIBRATION

All ducts shall be carefully designed by the installer and provided with all necessary anchoring and flexible connections to prevent transmission of vibration from any equipment such as fans, air handling units and terminal boxes.

All anchor points and flexible connections shall be shown on the construction drawings and specific approval shall be obtained before proceeding with the installation of any anchors or fixings to the building structure.

## 5.8 FLEXIBLE CONNECTIONS

Flexible connections shall be at least 100mm long and manufactured from Wavebar 148-4000 or similar approved. The flexible connections shall be secured to the ducts by way of 25mm wide 1.0mm thick gms strips riveted at 75mm centres.

Fan flexible connections are not to be tensioned axially in a manner likely to allow the transmission of vibration.

All flexible connections shall be secured with not less than 2.5mm thick x 25mm wide mild steel bands. The flexible connections shall be installed with not less than 25mm additional slack length between the flanges to prevent transmission of vibration.

Flexible connections shall not be used to correct misalignment of fan and duct.

## 5.9 PENETRATIONS AND FLASHINGS

The holes in the roof, curbs and flashings should all be included in the price provided by this trade. This trade is to provide all penetrations and all flashings to ensure roof and external wall penetrations are weather tight. This work must only be undertaken after consultation with the builder, and where the work by this trade does not affect any guarantees provided by other trades.

## 5.10 CLEANING AND PROTECTION DURING CONSTRUCTION

All ductwork shall be fabricated undercover, delivered to site and stored in a weatherproof and dry area and covered with a plastic sheet or tarpaulin until required for installation.

Prior to and during installation ducts shall be thoroughly cleaned out and shall have all ends covered in an approved manner to prevent ingress of dust and general building debris.

Ductwork shall not be installed unless adequate cover and protection is available to protect it from possible construction damage and the elements.

### LEAK TESTING

All low pressure supply and exhaust systems shall be tested by hand feel and audio checking of all joints and sealed with a synthetic duct sealing compound, "Expandite" or equivalent.

Each system tested shall have a leakage rate not exceeding 3% of the total airflow rate for the system.

### 5.12 CIRCULAR BALANCING DAMPERS

Balancing and motorised dampers are to be proprietary opposed blade type with galvanised sheetmetal or aluminium blades. Axles are to be bright zinc plated mild steel or stainless steel.

Each balancing damper shall have an operating quadrant in an accessible position capable of moving the blades from the fully open to the fully shut position, and shall have a locking nut so that the blades can be secured in any position. "Open" and "Shut" positions are to be clearly marked on all dampers. All automatic dampers are to have a neat axial cut, 1mm deep across the end of the operating shaft to indicate the blade position. Balancing dampers are to be clearly marked to show their commissioned position.

### 5.13 RECTANGULAR BALANCING DAMPERS

Volume control dampers shall be used where shown on the Drawings and shall be provided as necessary for the correct and proper balancing of all systems.

All dampers shall be proprietary items from an approved manufacturer. Unsupported blade lengths shall not exceed 1200mm. Spindles shall rotate freely in bearings mounted on a damper frame. Bearing and spindle arrangements shall be air tight to the outside of the duct.

All blade tips operating in system where duct velocities may exceed 9 m/s must be rubber tipped.

Dampers shall be controlled by the use of quadrants, control levers and locking device. Blade position, where blades are not visible shall be clearly marked.

### 5.14 FILTERS

All filters shall be in 300mm or 600mm modules and are to be housed within purpose built enclosures fitted to provide an adequate seal to the filter frame. Filter box access doors are to be fitted with quick release catches. Screw fixed access doors are not acceptable.

All filters shall be fitted with Dwyer Magnahelic series 2000 differential pressure gauges of an appropriate range to suit the pressure drop of the filters in a dirty condition, mounted on a powder coated gauge panel. These gauges are to be installed in accordance with the manufacturers instructions and connected to both sides of the filter box using 6mm soft copper tubing. The copper tubing is to be adequately supported.

### 5.15 GRILLES, DIFFUSERS AND LOUVRES

The supply and return grilles/diffusers shall be supplied and installed by the Contractor. These are to be supplied in factory finish approved by the Architect. Supply samples and allow to finish in non-standard colours to be later chosen.

Outlets are to be located where generally shown on the drawings but particular care is to be taken to locate outlets in exact positions relative to lighting, ceiling

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patterns, other equipment and features to provide an aesthetically acceptable installation.

Fixings of grilles, diffusers and louvers shall utilise concealed fixings only.

Provide cushion head plenums to all ceiling mounted supply grilles and diffusers. Cushion heads shall be lined with a 25mm thickness of acoustic (non-fiberglass) insulation. All cushion head plenums shall be supported on straps off the ceiling sufficient to hold the grille box in place in the event the ceiling grid fails.

## 5.16 DUCT ACCESS PANELS

Access panels installed in ductwork for fire damper access and duct work cleaning shall be Holyoake ADC-2 type prefinished removable access panel. Panels shall be fastened to ductwork by cam lock fixings, screw fixings shall not be accepted.

Duct access panels are to be labelled to show their purpose, and to warn of any risks involved with them being opened.

## D.6 PIPEWORK, VALVES & FITTINGS

### 6.1 GENERAL

This Section of the Specification covers the supply and installation of all pipework systems and associated fittings for the Mechanical Services. The systems covered in this section include:

- Refrigerant Pipework
- Ancillary items not specifically detailed

The Drawings indicate the sizes of pipes and the manner in which the various systems are to be installed. They do not purport to show all pipework or bends, offsets and the like which must be co-ordinated with other trades, measured on site or ascertained from architectural and other drawings showing structural, plumbing, lighting, fire services and other features normally encountered in this type of project.

Pipe work runs shall be graded with a fall of at least 1:240, or 4mm in the metre, with the high point or each run at the plant ends of the flow and return runs.

Pipework supports shall be separated from the pipework by Foamglass blocks, Silica gel spacers or timber ferrules to isolate the pipework at all hangers and supports. Under no circumstances are supports to be directly attached to the pipework.

Connections to equipment shall be to the recommendations of the equipment manufacturers and to approval.

Dissimilar metals shall be separated from direct contact with each other. When such contact exists, all necessary gaskets and dielectric couplings of bituminised felt, rubber gaskets, Teflon tape or equivalent means suitable for the duty shall be provided.

Prior to installation all pipework shall be thoroughly cleaned and during installation all open ends shall be kept covered in an approved manner to prevent the ingress of dust and general building debris. Responsibility shall be accepted for all damage to equipment due to dust and debris left in the pipework during installation.

The complete installation shall have all; cavities, openings, tappings, pipe ends, and the like, sealed to fluid and dust in an approved manner. Points for maintenance, commissioning and measuring, such as; drain points, binder and other test points and tappings etc, shall be sealed with approved proprietary metal screw caps with rubber gaskets or seals. Where drain points etc are permanently run to drains as specified sealing of that drain point shall not be required.

Piping shall be manufactured, fabricated and installed by qualified personnel with appropriate experience and where necessary comply with Local Supply Authority regulations, and the New Zealand Building Code.

**6.2 SCHEDULE OF PIPING AND MATERIALS**

The piping systems to be provided shall conform to the following requirements:

System Design Type	Material Range	Material Standard	Piping Design Temperature Range
Refrigerant	Copper	AS 1571	5°C-90°C
Drains/Vents/Liquid Condensate	UPVC	NZS 7648 Class D	5°C-40°C
Hot Drains/Vents/Steam Condensate	Copper	NZS 3501 Table 2	5°C-90°C

All piping shall be of the best available quality and shall be supplied in clean, full standard straight lengths, free from any defects such as mill scale, rust, burns, dents, kinks, etc. and with all ends sealed against the ingress of foreign matter and protected against mechanical damage. All piping shall be kept in a clean condition at all times during storage, fabrication, installation and testing.

**6.3 PIPE SUPPORTS**

**6.3.1 General**

All pipes shall be adequately supported and appropriately restrained by hangers, bracket, pedestals, clips, rollers and expansion joints and anchors designed by the subcontractor to suit the requirements of each piping system complying with NZS 4203 and NZS 4210. All piping exposed to view in such locations such as plantrooms, service tunnels and in corridors without ceilings shall be supported from common supports where practicable and shall be run in neat groups.

**6.3.2 Support Loadings and Spacings**

All piping supports shall be designed to take the combined loads of pipes, valves, fittings, insulation (if applicable) and fluid in the pipes and all re-actions due to thermal expansion or contraction of the piping.

All valves shall be located as close as possible to points of support and all valves in line sizes 200mm and larger shall be separately supported.

All supports shall be capable of keeping the piping in proper alignment and shall conform with all appropriate statutory and code requirements.

Notwithstanding the above, supports for piping shall be located at centres not exceeding the following:

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Pipe Nominal Bore	Minimum hanger rod size in mm	Maximum Spacing of Supports in metres			
		Copper & Stainless Steel	Black & Galv Steel	PP-R, PE, & uPVC	
				Vertical	Horizontal
15	6.4	1.5	2.0	1.2	0.6
20	6.4	1.5	2.0	1.4	0.7
25	6.4	2.0	2.0	1.5	0.75
32	10.0	2.5	2.5	1.7	0.85
40	10.0	2.5	2.5	1.8	0.9
50	10.0	3.0	3.0	2.1	1.05
65	12.0	3.0	3.0	2.4	1.2
80	12.0	3.0	4.0	2.7	1.35
100	16.0	3.0	4.0	3.0	1.5
150	16.0	3.0	4.0	4.0	2.0

Spacings shall be closer than specified where required by relevant Standards or Codes or where recommended by the piping materials manufacturer.

All pipework shall be laterally restrained in a similar manner to maintain alignment under all conditions (at not greater than 6m centres).

### 6.3.3 Pipe Clamps and Saddles

All individually hung pipes shall be provided with bolted, two-piece type clamps with clevis or welded yokes similar to "Unistrut" PC7 or PC10 series or approved alternative. However, for pipe sizes 65 dia. or less, bolted, one-piece type clamps with clevis similar to "Unistrut" PC2 series may be used in approved locations.

### 6.3.4 Hanger Rods

All hanger rods and associated fittings shall be fabricated from hot dip galvanised or zinc plated mild steel bar of not less than the diameters given in the table above.

## 6.4 PIPE PENETRATIONS

Sleeves shall be provided at all pipe penetrations. Where pipework passes through walls, galvanised steel sleeves of 1.6mm minimum thickness shall be installed. Where pipework penetrates floor slabs, galvanised steel sleeves shall be installed which extend at least 100mm above the floor, and provide a water tight seal.

The insulation on pipes shall be continuous through sleeves and shall be sheathed with galvanised steel sheet for a minimum distance of 25mm either side of the sleeve.

The space between the pipe or the insulation sheathing and the wall or floor sleeve shall be filled with high density mineral wool or fibre glass insulation as an acoustic seal. The acoustic rating of the seal shall be equivalent to the partition through which the pipe passes.

Where pipes pass through fire rated walls or floors, the space between the piping (or sheathed insulation) and the sleeves shall be sealed with fire rated seal of rating equal to that of the wall as approved by the New Zealand Building Code and all local authorities. In addition, for fire rated wall and floors, insulation at the penetration shall have the same or greater fire rating as the wall or floor penetrated. Refer to standard details. *(Not part of this sub contract)*

Where lateral movement or excessive linear movement is possible, (e.g. seismic or plant movement) alternative details shall be submitted.

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**SECTION E**

**ELECTRICAL FOR MECHANICAL AND AUTOMATIC CONTROLS  
STANDARD CLAUSES**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

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Building Division **SECTION E**

## E.1 CONDITIONS

The requirements of Section A of this specification "Preliminary and General" shall be read as directly included herein.

## E.2 ELECTRICAL AND CONTROLS

### 2.1 SCOPE OF WORK

Supply and install the complete electrical installation as required for the satisfactory operation, control, maintenance and safety of the mechanical ventilation and air conditioning systems, under all conditions of service and suitable for the working environment.

The automatic controls work to be supplied and installed shall include, but not necessarily limited to the following items and equipment:

- Proprietary controls systems and devices associated with Mechanical and Hydraulic systems as detailed.
- The department store's Specialist controls Sub-Contractor, Building Technologies Limited (BTL) to provide a Building Management Systems (BMS-F) including separate BACnet Ethernet network, AHU Systems Controllers and associated wiring field devices, sensors, controls I/Os and monitoring systems as detailed suitable for connection to the department stores remote management system located in Auckland.
- Allow to coordinate with Mall Zone 2 Works Mechanical Services Contractor and Specialist Controls Sub-Contractor (Setpoint Solutions) where necessary to allow for Mechanical systems within Ground Level Mall Tenancy and BOH Cleaners/Stores and Level 2 Childcare Facility to be connected to Mall Retail Tenancy AC System Central Controller and separate Mall Building Management Systems (BMS-M) including separate Mall BACnet Ethernet network connections, Mech Systems Controllers and associated wiring field devices, sensors, controls I/Os and monitoring systems as detailed.

Read this section in conjunction with Section C of the specification which includes additional project specific information.

### 2.2 RADIO INTERFERENCE

All equipment and/or appliances provided under this Specification shall be designed so that no interference will be caused with any radio or other electronic transmitting or receiving equipment in the same locality, including any electronic control equipment associated with any air conditioning plant and other similar installations, all in accordance with the New Zealand Radio Interference Regulations and subsequent amendments and notices.

### 2.3 REGULATIONS

The entire electrical installation shall be in accordance with the current Regulations and Requirements of the Local Supply Authority, and with the relevant Specifications and Codes in particular, Electricity Regulations and amendments thereto and the New Zealand Electrical Codes of Practice for Electrical Installations.

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AS/NZS 3000 Electrical Installations (Australian/New Zealand Wiring Rules) shall apply.

## 2.4 CABLE SUPPORT SYSTEMS

### 2.4.1 General

Supply and install all cable support systems as necessary for the Mechanical Services plant. The requirements in respect of support systems must be ascertained from survey, and architectural drawings etc.

Cable routes shall be coordinated with all other services, including structural features, plumbing and sprinkler piping, lighting fittings, air conditioning ducts and piping, and building electrical services etc, normally encountered in this type of project. Close liaison shall be maintained on site with other trades to ensure compatibility of proposed routes.

The Tenderer shall allow for all necessary brackets, offsets etc, to suit the installation and shall examine the drawings and all other relevant and available documents.

Unless noted otherwise all electrical and controls cabling within the building shall be run concealed from public view.

Where cables run concealed through false ceiling spaces, use PVC insulated and PVC sheathed cables, supported on a catenary system in accordance with the requirements of the Electricity Regulations. In any case cables shall be supported clear of ceiling tiles.

Alternatively, cables may be single insulated PVC enclosed in conduit or cable trunking. Conduit shall use only stock moulded fittings.

All cabling in lift motor rooms shall comprise PVC cables enclosed in high impact rigid PVC orange conduit. Conduits from lift motor rooms shall not be installed in lift shafts.

All cables exposed to view on finished surfaces eg. Stairwells and outside balconies shall be enclosed in rigid PVC, high impact conduit or PVC trunking in the colour selected by the Architect with matching fittings including bends and elbows

Conduits exposed to weather or dampness shall have all threads, junction box lids and fittings sealed with non-setting silicone compound.

Conduits shall be located such that they are not subject to severe mechanical damage or fixed to the walking area of access ways.

Where services penetrate walls, floors or ceilings acoustic sealant shall be supplied and installed to maintain a degree of acoustic separation at least equal to the materials penetrated.

Flexible conduits to motors and controls shall be made with PVC flexible conduit, using full diameter terminators of approved manufacturer, incorporating screwed female thread locking gland.

Where equipment is mounted on vibration isolated hangers, then care shall be taken to preserve the vibration isolation and cabling to the equipment on the floating slab shall be broken at the transition

### 2.5 CONDUIT AND FITTINGS

All conduits shall be installed in accordance with the Electricity Regulations and amendments.

Conduits shall be circular in cross section, minimum nominal diameter 20mm. Oval conduit shall not be permitted.

All conduits shall be installed in accordance with the Electricity Regulations and amendments.

Rigid PVC conduit shall be of the high impact self extinguishing type, orange or grey in colour as previously specified, complying with NZS 6207, used in conjunction with approved matching high impact fittings and accessories installed in strict accordance with the manufacturer's recommendation.

Flexible conduits to motors and controls shall be made with PVC flexible conduit, using full diameter terminators of approved manufacturer, incorporating screwed female thread locking gland.

**2.6 CABLE DUCT, TRUNKING, & TRAYS**

Ducts, trunking, and trays shall be installed in accordance with the Electricity Regulations.

Cable ducts, trunking, and trays for power and control wiring may be used for groups of cables if desired in plant rooms, accessible rising ducts or accessible ceiling roof spaces.

Cable trunking in plant rooms shall not be installed at a height less than 1.5 metres above finished floor level measured to the underside of the trunking and in any case shall be suitably protected against mechanical damage by virtue of its location, or construction or other approved means.

Enclosed type trunking or trays, with easily removable front or top covers, shall be provided where the cables are liable to mechanical damage, falling objects, or build up of dirt and other foreign matter are liable to occur.

Horizontal cable tray shall be mounted such that the top of the tray can be accessed for the installation of cabling. Vertical cable tray shall be mounted to the wall, via brackets.

Cable duct, trunking, and trays shall be installed in a workmanlike manner parallel to walls, floors and ceilings as applicable prior to cable installation. Where routes are not specifically shown the trays shall be carefully located to approval.

Cable ducts, trunking and trays shall be proprietary items constructed from 'Zintec' zinc coated sheet steel or galvanised mild steel sheet. Trays shall be fully supported over their entire width by suitable metal brackets. The brackets shall be equally spaced at not more than 900mm centres to prevent sagging in horizontal lengths of tray. Where longer support spans are required use ladder tray ensuring that the maximum spacing between supports does not exceed the ladder tray manufacturer's recommendations. Cable trays and ladder shall be braced with opposing diagonal bracing at drop rod locations.

Cable ducts, trunking, and trays shall be sized to suit the total cross sectional area of the installed cables, having due regard for derating factors for operating ambient temperature within the trunking, and for number of circuits, all of which shall be applied to the enclosed cables, in accordance with the Electrical Wiring Regulations.

Cables shall be laid in straight runs avoiding cross-overs wherever possible. Cables rated at 50 amps and above shall be laid in flat formation with a constant phase grouping maintained throughout the entire length of run.

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Cables rated at 250 amps and above shall be laid in trefoil formation, with phase grouping consistent throughout the length of the run.

Where parallel conductors are used on each phase, the cables shall be grouped in 3 phase formation, not single phase formation.

Cables for individual three phase circuits shall be taped together at intervals not exceeding 500mm. Similarly, control cables shall be taped together at intervals not exceeding 500mm and with a maximum of 10 cables in any one grouping.

**2.7 CABLING**

This clause shall apply to switchboard cabling and to field cabling.

**2.7.1 Rating**

Power circuits shall be run in stranded copper conductors having a minimum effective area equal to that of 2.5mm<sup>2</sup> for all motors, heaters etc. All field control wiring shall have a minimum effective area equal to that of 1.5mm<sup>2</sup> unless otherwise specified.

Earthing conductors shall be sized strictly in accordance with Electricity Regulations and in no case shall be less than 1.5mm<sup>2</sup>. Flexible conductors used in switchboards shall be not less than 1.0mm<sup>2</sup>. All conductors shall be continuous between their terminal points and all cables shall have stranded copper conductors unless otherwise specified. Notwithstanding the above, all cables shall be adequately rated for their duty, with due allowance made for voltage drop, method of fixing and derating factors.

Voltage drop shall be calculated in accordance with the requirements of the Electricity Regulations and shall be inclusive of all voltage drops occurring in submain cables between the terminals of the main switch on the building main switchboard and the finally connected item under consideration.

Total voltage drop shall not exceed 2.5% of the supply voltage.

Control cables operating at extra low voltage shall be selected as specified and voltage drop shall not exceed 10% of the nominal voltage at any point in the installation during steady load conditions and in any case, they shall be within acceptable limits for the correct functioning of control relays and associated equipment, as recommended by the equipment manufacturer.

**2.7.2 Separation of Data and Power**

Minimum Separation between Power & Low Voltage Controls/Data Cables			
Separation when Crossing		Separation on parallel Runs	
With Sheetmetal Divider for Protection	Without Protection	Vertical Separation	Horizontal Separation
50mm	150mm	150mm	300mm

**2.7.3 Identification**

The whole of the wiring installation, cables and conductors shall be colour coded, Red, White and Blue colours shall be used for identification of circuits connected to each of the three supply phases respectively, Black for neutral circuits, Green/Yellow for earthing cables. All terminals and each end of each control wire shall be numbered. All numbers shall be indicated on drawings. Cables to

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switchboard terminals shall be provided with adequate fixing adjacent to the terminals.

#### 2.7.4 Extra Low Voltage Circuits

Extra low voltage control cables associated with the operation of the plant, thermostats, interlocks, thermistor sensor cables etc, may be installed in the same enclosure as power and/or control cables operating as mains voltage.

Provided that the extra low voltage cable is insulated to the same standard as the mains voltage cable, and provided also that the low voltage cable is installed in such a manner that induced stray voltages are prevented from affecting the operation of the controls under normal and abnormal conditions.

#### 2.7.5 Cable Installation and Cable Entry to Equipment

Single core cable shall be installed such that inductive effects on surrounding metal work are minimised. Where parallel conductors are used on each phase, the cables shall be grouped in three phase formation and not single phase formation.

Where cables are installed vertically an approved method of clamping shall be provided to support the cable without damage to the insulation. Such support shall be provided at intervals not exceeding 500mm.

Cables shall be installed using the loop-in loop-out system of wiring. Cable joints will not be permitted, except where the length of the cable run exceeds the maximum manufactured cable length, in which case cables shall be joined using the Manufacturer's recommended procedure and equipment.

#### 2.7.6 PVC Cables

PVC cables for switchboards and for field installation shall be minimum V75.0.6/1 kV single PVC insulated stranded conductor.

Field cabling shall be enclosed in conduit or cable duct.

Minimum bending radius shall be six times the diameter.

Cables shall be drawn into the conduit such that twists and cross-overs of cable are prevented. Kinked or damaged cables shall be rejected.

#### 2.7.7 PVC/PVC Cables

PVC insulated and PVC sheathed (PVC/PVC) cables shall be minimum V75.0.6/1 kV stranded conductor.

PVC/PVC cables shall be installed in such a manner that adequate spacing is maintained for fixing and for heat dissipation.

Bending radii of cables shall not be less than the Manufacturer's recommendation and in case shall not be less than 6 times the overall cable diameter. Cables shall run straight for at least 300mm immediately prior to entering switchboards and other equipment.

Multicore cables constraining a maximum of three power conductors and one earthing conductor may be of flat configuration. Cables containing four or more power conductors shall be of circular configuration or other approved type.

### 2.8 SWITCHGEAR, PROTECTION, & CONTROLS

Supply and install all switchgear and protection or the complete system as specified. The power sources shall be capable of continuous operation at the rated

values detailed which are net values after any applicable derating factors have been applied relative to the mounting or enclosure of equipment.

## 2.8.1 Moulded Case and Miniature Circuit Breakers

### General

MCCB and MCB breakers shall be Merlin Gerin type only.

Circuit breakers shall be mounted on a purpose made chassis. Removal of any breakers shall not disturb connections to other circuit breakers. Circuit breakers shall be screw fixed by fixings independent of terminal studs.

Circuit breakers shall have instantaneous short circuit and inverse-time over-current tripping characteristics and shall also have positive identification of breaker status "ON", "OFF" and "CENTRE TRIP", positions.

All moulded case circuit breakers shall be provided with adjustable trip mechanisms. The trip setting specified shall be the minimum setting.

Miniature over-current breakers shall have a minimum fault interrupting capacity of 6 kA where the fault level is 6kA or lower. Where the fault level exceeds 6 kA on an installation suitable miniature circuit breakers of higher fault level rating shall be selected and installed. Evidence that a particular make of circuit breaker complies with the above requirements shall be submitted prior to installation.

Single pole circuit breakers shall be interchangeable with multi pole circuit breakers.

## 2.8.2 Switches / Isolators

The rated thermal current of all switches / isolators shall be as applicable to the unit when installed in the specified enclosure. The rated duty shall be uninterrupted. The rated short circuit making capacity shall be not less than the switchboard fault level. Utilisation category shall be not less than AC-23 for circuits comprising essentially motor or other highly inductive loads or not less than AC-22 for other circuits. All / isolators shall be complete with independent manual operation with a positive manually operated ON-OFF indicator. Provide a facility to lock all units in the OFF position.

## 2.9 SWITCHBOARD ENCLOSURES

Switchboard enclosure for Mechanical Services shall be constructed by Switchbuild using a modular industrial/commercial grade system for either wall or floor mounting.

## 2.10 EARTHING

Supply and install the complete earthing system for the installation.

Separate earth continuity conductors shall be installed in conjunction with each individual submain cable. Earth continuity conductors shall originate from the main earth bar of the switchboard where the supply originates.

All cable tray systems shall be bonded, for each run of tray provide a continuous earth lead that runs the full length. Each section of tray including corners and bends, shall be connected to the continuous bonding lead by means of a nut and bolt (complete with star washers). Bonding system shall be such that if one nut and bolt arrangement becomes loose, the remainder of the trunking run shall remain bonded.

Building Division **E.3 AUTOMATIC CONTROLS**

**3.1 SCOPE OF WORK**

Supply and install the complete electrical installation as required for the satisfactory operation, control, maintenance and safety of the mechanical ventilation and air conditioning systems, under all conditions of service and suitable for the working environment.

**3.2 DEPARTMENT STORE BUILDING MANAGEMENT SYSTEM (BMS-F)**

Building Technologies Limited (BTL) in Auckland is the nominated Department Store Specialist Controls Sub-Contractor and shall be engaged to complete all works associated with the new sitewide department store Building Management System to serve the Tenancy areas. BTL contact is Eddie Boysen, phone: 021 738 444.

The BMS-F controls are to reside on the local department store corporate WAN network and communicate back to the existing centralised BMS server located at the FTC Support Office in Auckland.

The building management system shall control the operation of all Mechanical Services systems and the environmental conditions within each control zone.

The Building Management System shall;

- Communicate between controllers using the BACnet/IP or BACnet/MSTP open protocol. This is to be confirmed by the control's specialist.
- Allow Direct Digital Control (DDC) of all plant attached including time scheduling (recurring and one off) and graphical point trending.
- Use Siemens controllers located in the mechanical services switchboard within the plant room where applicable. For Temperzone units, controllers may be factory fitted. BTL are to supply controllers to Temperzone for installation at the Temperzone factory.
- The controls system shall communicate with the site BMS via a dual Ethernet Cat 6 outlet provided by the telecommunications trade. The controls trade shall make the connection from the controller(s) to the Ethernet outlet. One Ethernet outlet is to be used for the BMS network. The other is for use of a commissioning laptop.
- The scope includes new front end graphics reflecting the site to be on the main FTC server.

**3.3 MALL BUILDING MANAGEMENT SYSTEM (BMS-M)**

The Mall Building Management System shall be provided as part of a separate Zone 2 Works Contract (By others); the contractor shall ensure that all mechanical systems in the Ground Level Mall Tenancies and BOH Areas and Level 2 Childcare Facility are provided with suitable controls and BACnet interface cards to allow for the following integration with Zone 2 systems:

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- Communicate between controllers using the BACnet/IP open protocol, permitting future controls integration without the restrictions of proprietary vendor communications protocols.
- Allow Direct Digital Control (DDC) of all plant attached including time scheduling (recurring and one off) and graphical point trending.
- The controls system shall communicate with the Mall BMS via a dual Ethernet Cat 6 outlet provided by the telecommunications trade. The controls trade shall make the connection from the controller(s) to the Ethernet outlet. One Ethernet outlet is to be used for the Modbus and PEC. The other is for use of a commissioning laptop.
- Run a BUS around the building from the local controllers to allow for future connection to Mall BMS for remote monitoring, alarms, and set point adjustment through the BMS-M.

All control loops shall be Proportional Integral Derivative type with tuneable gains, self-tuning fuzzy logic systems shall not be accepted.

The system shall comprise of electronic plant controls interfacing directly with thermostats, sensors, VSDs, and all plant systems and include all input/output modules, transformers, immersion, water pressure switches, water flow switches, current switches, and with programming as required will be provided for the HVAC systems.

No additional costs shall be accepted for additional inputs/outputs, valves, sensors, sensor pockets, hardware, software, and or programming etc for the proper functioning of the system as intended through the supplier and contractor failing to make due allowance during the tender period.

Failure to raise queries relating to the BMS during the tender period will be seen as confirmation that the controls supplier/contractor fully understand all the requirements of the system and have made due allowance for all incidental items necessary for the complete operation of the system as described within this specification and shown on the tender drawings.

### 3.4 DOCUMENTATION

The specialist Contractor(s) shall provide all schematic wiring diagrams associated with the system, confirmation schedule of all points on the system, a schedule of all hardware and software and a copy of all users manuals.

All descriptions used shall be identical to those shown at user terminals. This shall be site specific data and the following is the minimum requirement.

Wiring diagrams:

- These shall indicate controller number, hardwired points connected and software points utilised complete with mnemonic, point titles and point number.

Description of operation

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- A text description shall be provided per plant type describing the operation of the plant. This shall include references to point titles and shall detail system set values and alarm limits. This shall be indexed.

Documentation of software objects

- A full text listing of Modbus and BACnet objects, interfaces and formats shall be supplied as part of the documentation included in the Operation and Maintenance Manual.

**3.5 SOFTWARE**

- All new system software shall be field proven and not unique or new to this contract. Provide references/contacts to other sites using the software/technology proposed for this project upon request.
- Provide the principal with original installation media and software license keys for all software installed.
- Provide the principal with electronic copies of software sources for BMS front end customisations specific to the site, including any convenience libraries and custom graphics. The current revision at the time of producing the operation and maintenance manual shall be included on a CD-R.
- Provide the principal with electronic copies of any software necessary to configure and operate protocol bridge devices (eg. Grundfos BACnet/IP converters)
- Provide the principal with electronic copies of software sources for BMS program, firmware, written specifically for the site including any convenience libraries and routines which when compiled results a complete working system. The current revision at the time of producing the operation and maintenance manual shall be included on a CD-R.

**3.6 ALARMS**

- Alarms shall be generated under the following conditions:
  - Digital input contact change from normal to alarm condition (either open or closed).
  - Analogue input has exceeded high or low limit alarm level.
- All alarms shall have the ability to be filtered to eliminate “nuisance” alarms and shall incorporate transient inhibit timers to make allowance for fluttering contacts or slow internal responses

**3.7 SCHEDULING**

Controllers shall fall back to internal mirror of central schedule on loss of communications with main controller.

**3.8 FIELD WIRING**

The specialist controls Subcontractor may elect to engage the Electrical for Mechanical contractor to run communications cabling between controllers.

The specialist controls package shall communicate using ethernet technologies, the controls subcontractor shall supply all outlets, patch leads, patch panels, racks,

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cabinets, ethernet switches and power supplies including UPS to same to enable the controls to communicate, independently of the data subtrade.

- Ethernet switch shall include one uplink ports for connection to other future controllers on site and one spare port for connection by service laptop
- All controls system field wiring shall be carried out in screened cable.
- All controls system field wiring cable conductors must be dedicated. Conductors must not be shared.
- All cable types and installation methods must be to the approval of the controls equipment supplier.
- Wiring for sensing devices in rooms shall be co-ordinated with trunking/dropper positions and sensors mounted on the front of faceplates

### 3.9 FIELD DEVICES

- Variable Speed Drives Schneider Altivar 71 series complete with detachable faceplates mounted in the face of the respective mechanical services switchboard

### 3.10 BACNET CONFORMANCE

All BACnet devices utilised on site shall be BTL tested. Provide BTL PICS as part of BMS technical submission.

Devices shall support full "Who Is", "I Am", "Who Has", "I Have" controller and point automatic discovery features. Controls vendor shall expect the Engineer to interrogate the system using these methods during commissioning.

Devices shall have field/software configurable write priorities through the full priority range 1 – 16. Devices supporting only a subset of write priorities shall not be accepted.

Devices shall have read/write/COV/unsolicited COV support

Points as announced within calls shall be named with logical English labels eg, "Outdoor Air Temperature", "Chilled Water Flow Temperature". Point acronyms such as "OAT" and "CHW\_FT" shall not be accepted.

Controller gains ( $K_p$ ,  $K_i$  and  $K_d$ ) shall be visible/configurable via BACnet read/write property calls.

### 3.11 GRAPHICS MODIFICATIONS

Graphics shall feature a floor plan of the site with live temperatures of each space displayed. Floor plan shall permit drilling down to view per space/system operating parameters for each system identified in the functional description.

Graphics shall permit dynamic trending of points. Points included in trends shall be configurable from a pick list accessible from the database. Site attendance to configure trend graphs shall not be accepted. Trend data shall be downloadable in csv format directly from the graphics.

### **PRE-COMMISSIONING CONTROLS**

The specialist controls Subcontractor will be required to check and pre-commission all mechanical/electrical plant and associated control systems.

In addition, this Subcontractor will, as a contractual condition of the control's equipment supply contract, will provide on site technical assistance for all pre-commissioning operations.

The controls subcontractor shall provide remote trend configuration level access to the graphics package and trends to the engineer from the commencement of commissioning plant on site.

#### **3.13 LOOP TUNING**

All control loops shall be site tuned following commissioning of plant and prior to practical completion. Control loops programmed with proportional only gains at practical completion shall not be accepted.

#### **3.14 COMMISSIONING**

The Subcontractor, will undertake all fine tuning and final commissioning operations. The specialist controls Subcontractor will be required to make available, on the job site, an experienced electrician/technician to assist in the commissioning operations, whom will, on completion of commissioning, provide a detailed report on all aspects of the control system for inclusion in the maintenance manuals.

The controls shall be fully tested through a full power shut down, generator start up and restoration of normal mains power supply. The controls shall be set up in such away that nuisance alarms are not generated during this simulation and that all controls return to normal function without remaining in a fault condition and continue to function normally after this time.

#### **3.15 INITIAL TRENDING**

At practical completion the BMS shall be configured with trends operating for;

1. Supply and return air temperatures
2. CO2 levels
3. Outdoor air temperature and RH.

#### **3.16 HAND OVER**

- The contractor shall demonstrate all of the software features contained in this specification.

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- The contractor shall provide on-site training for the client's operating personnel. This shall include the use of the site specific plant to describe the elements of the control system.
- The contractor shall provide ongoing fine tuning of the BMS and controls over the 12 months following practical completion to ensure all HVAC systems are operating at optimum levels.

### 3.17 WARRANTY

The specialist Contractor shall guarantee the system and its operation for a period of twelve months following practical completion.

The controls supplier shall visit site on a quarterly basis during the defect/warranty period and provide a written report to the engineer outlining any changes made to system parameters, temperature setpoints, alarm notification, etc. Final completion will not be granted until all four reports have been received and reviewed.

### 3.18 MAINTENANCE

For the duration of the Maintenance period the controls vendor shall maintain licensed copies of all necessary software development environments, compiler, linkers, firmware loaders etc necessary to take site specific BMS customisations and link with supplier proprietary software to produce a complete working system.

Following any modification to the site specific customisations (front end or firmware) during the maintenance period the controls vendor shall provide the principals nominated representative electronic copy of sources to ensure that at no time does the software in use differ from that held by the Principal as a backup.

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**SECTION F**

**MECHANICAL SERVICES EQUIPMENT SCHEDULES**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

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The attached plant schedules shall be completed by the contractor and submitted for review as part of their design documentation.

The mechanical contractor shall ensure that all plant selections comply with the specification notes which are included with each of the following schedules and the clauses included within the main specification.

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**F.1 GRILLES, DIFFUSERS & LOUVERS**

Ref	System	Type	Size (mm)	Airflow (l/s)	Resist. (Pa)	NC	Throw (m)
S1	Department store shop floor Supply Diffuser	CFPP-600/30	Ø300 – 600 x 600	200-250	12-19	21-28	1.4-3.8
S2	Department store BOH Offices Supply Diffuser	CFP-450/12	Ø200 – 450 x 450	20-110	1-12	10-18	0.2-1.5
S3	Mall Retail Tenancy Supply Diffuser	CSDAI-19/2-SLOT	Ø200 – 1200 x 120	70	<19	<19	1.2-2.4
S4	Mall Retail Tenancy Supply Diffuser	CFP-450/12	Ø250 – 450 x 450	140	<18	<20	1.1-3.6
S5	Childcare Sidewall mounted Supply Diffuser	PMF-LD-1215SD-OB	500x100	60-80	<15	<17	
S6	Childcare Ceiling Mounted Supply Diffuser	ECO-A-250	Ø400	100	25	<16	
S7	Childcare Ceiling Mounted Supply Diffuser	ECO-M-150	Ø270	30 - 60	10 - 34	19 - 23	
O1	Department store BOH Offices Outdoor Air Supply Diffuser	CFP-450/12	Ø200 – 450 x 450	100-110	1-12	10-18	0.2-1.5
E1	Amenities Exhaust Grille	EC-125/OBD	250 x 250	20-115	5	-	-
E2	Loading Bay Exhaust Grille	EC-125/OBD	700 x 700	1000	12	25	-
E3	Childcare Sidewall Mounted Amenities Exhaust Grille	EC-125/OBD	400 x 100	100	<12	-	
T1	Transfer Grille	EC-125	250 x 250	~100	5	-	-

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Ref	System	Type	Size (mm)	Airflow (l/s)	Resist. (Pa)	NC	Throw (m)
DG1	Childcare Amenities and Department store Corridor Door Grilles	DG-52	400x125	~50	15	16	-
DG2	Department store Amenities Door Grilles	DG-52	450x300	~130	15	20	-
R1	Department store shop floor Ceiling Return Grille	EC-125	600 x 600	350-500	5	<13	-
R2	Department store BOH Offices Ceiling Return Grille	EC-125	450 x 450	220-250	3	-	-
R3	Department store BOH Offices Ceiling Return Grille	EC-125	250 x 250	70-130	5	-	-
R4	Department store shop floor Ceiling Reserve and Spill Air Return Grille	EC-125/OBD	600 x 600	700-850	8	19	-
L1	Department store BOH Offices Supply/Exhaust Air Louvres	OHL-D-45	600 x 800	600-630	20	-	-
L2	Mall Retail Tenancies Common Exhaust and BOH Stores Supply Air Louvre	OHL-D-45	600 x 400	130-200	20	-	-
L3	Mall Retail Tenancy Supply Air Intake Louvres	Architectural Facade Louvre by Others	Min. 600 x 150 Plenum Connection through blanking plate at rear of louvre	180	<15	<24	-
L4	Lift Vent External Louvre	OHL-D-45	400 x 400	-	-	-	-

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**NOTES - GRILLES, DIFFUSERS & LOUVERS:**

- All grilles to be installed with an internally lined cushion head boxes.
- Allow for Volume Control Damper or Opposed Blade Damper at all Supply Diffuser and Return Grille Cushion heads to be adjustable via face of grille UNO.

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- Building Division** 3. All to provide insect screens to all external louvres and verify final louver size and position on architectural and structural elevations.
4. Allow to finish all grilles & diffusers to architect's choice of colours.
  5. Core velocity to be less than 2.5 m/s UNO.
  6. Grille quantities to be confirmed before ordering.
  7. Refer to the specification for further information.

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## F.2 VENTILATION FANS AND COWLS

Ref	Space Served	Description	Airflow (L/s)	ESP (Pa)	Motor Data	dBa @ 3m	Control
EF 1.01	Department store Bin Store Exhaust Fan	Fantech RIL-200SW	230	150	1 $\emptyset$ / 0.12kW	47	VA
RC 1.01	Department store Bin Store Exhaust Cowl	Fantech MRV2	230	70	-	-	-
EF 1.02	Department store Loading Bay Exhaust Fan	Fantech GUD636D	3000	150	3 $\emptyset$ / 1.45kW	54	VSD
EF 1.03	Department store BOH Staffroom Ceiling Mounted General Exhaust Fan	Fantech HB12E (c/w Backdraft Damper)	40	150	1 $\emptyset$ / 0.07kW	47	VA
EF 1.04	Department store BOH Secure Store Ceiling Mounted General Exhaust Fan	Fantech HB12E (c/w Backdraft Damper)	40	150	1 $\emptyset$ / 0.07kW	47	VA
EF T.02-T.05	Mall Tenancy Ceiling Mounted Toilet Exhaust Fan	Fantech RESPF150T	30	140	1 $\emptyset$ / 0.06kW	37	VA
EF T.48	Mall BOH Cleaners Ceiling Mounted Exhaust Fan	Fantech VCW304	130	80	1 $\emptyset$ / 0.09kW	47	VA
EF S.1	Mall BOH Stores Roof Mounted Exhaust Fan	Fantech GUE314D	400	150	1 $\emptyset$ / 0.22kW	45	VA
EF S.2	Mall BOH Stores Ceiling Mounted Exhaust Fan	Fantech VCW304	130	80	1 $\emptyset$ / 0.09kW	47	VA
RC 1.02	Mall BOH Stores Exhaust Roof Cowl	Fantech MRV2	130	-	-	-	-

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Ref	Space Served	Description	Airflow (L/s)	ESP (Pa)	Motor Data	dB(A) @ 3m	Control
EF 1.05	Childcare Toilet Roof Mounted Exhaust Fan	Fantech CE192D	80	80	1 $\phi$ / 0.07kW	47	VA
EF 1.06	Childcare Laundry Roof Mounted Exhaust Fan	Fantech CE192D	100	80	1 $\phi$ / 0.07kW	47	VA
RC 1.04	Childcare HRV Roof Cowl	Fantech MRV1	80	-	-	-	-
RC 1.05	Childcare HRV Roof Cowl	Fantech MRV2	310-330	-	-	-	-
SEF1.01	Department store AHU 1.01 Spill Exhaust Fan	CDEC63D	1700-3700	100	3 $\phi$ / 1.5kW	57	EC
SEF1.03	Department store AHU 1.03 Spill Exhaust Fan	CDEC63D	1400-3700	100	3 $\phi$ / 1.5kW	57	EC
SEF1.02	Department store AHU 1.02 Spill Exhaust Fan	CDEC63D	2200-3700	100	3 $\phi$ / 1.5kW	57	EC
SEF1.04	Department store AHU 1.04 Spill Exhaust Fan	CDEC63D	2250-3700	100	3 $\phi$ / 1.5kW	57	EC
SSF 1.01-1.04	Department store Smoke Exhaust Fans	Fantech RSS1004GA6/20	10,000 (ea.)	300	3 $\phi$ / 7.5kW	75	DOL

**NOTES - FANS & COWLS:**

1. Fans are as supplied by Fantech UNO.
2. All exhaust fans shall be supplied complete with suitable backdraft shutters. Roof mounted vertical discharge units shall include maglocks to discharge flaps.
3. Roof Fans and cowls shall be ordered in colours to be approved by the architect.
4. All single phase fans are to be supplied with speed controllers located in accessible positions next to the fan for commissioning purposes.
5. Speed controllers/run on timers must be proprietary units; standard dimmer-type controllers will not be accepted.
6. All fans with VSDs shall be provided with sine filtering as appropriate.
7. Smoke Exhaust fans shall comply with the requirements of AS1668.1 and be wired using fire rated cable. The fans shall be fire rated to 200°C for 2 hrs and tested in accordance with AS4429.
8. Smoke Exhaust Fans shall include Motor Rated/D-Curve Breakers and Soft Starters at MSSB.Z1. The fans shall be provided with lockable local isolators and label stating life safety system do not turn off.

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9. Smoke Exhaust Fans shall be activated via a signal from the Fire Alarm system to the fire fan control and indicator panel (FFCP) and they shall also be interlocked to the building security systems so they are disabled and do not operate after hours.
10. All fans and controls are to be wired by the mechanical contractor's electrician.
11. Noise level in the occupied space shall not exceed 65 dBA when smoke exhaust fans operate.
12. Refer to the specification and drawings for further information.

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### F.3 DOOR AIR CURTAINS

Ref	Location	Model	Description	Electrical Load	Dims (LxDxH) mm	Weight (kg)	Speed Control
DAC 1.01/1.02	Zone 1 Level G D.S Anchor shop floor Nth	Frico PA3525E20	Horizontal over Street Entry Lobby Door Air Curtains	3 $\phi$ / 2 x 20kW (3-Step 6.6/13.2 /19.8)	2549x252 x306	104 ea.	Yes
DAC 1.03/1.04	<b>Prewire Only for Future Installation</b> Zone 1 Level 1 shop floor Nth Carpark Entry	Frico AR3520E18	Recessed Horizontal over Future Carpark Entry Lobby Door Air Curtains	3 $\phi$ / 2 x 18kW (2-Step 9/18)	2073x638 x302	78 ea.	Yes

**NOTES:**

1. Refer to the drawings and specification for further information.
2. Ceiling suspended and recessed air curtains as supplied by Avon Electric.
3. Air Curtains shall be supplied complete with FRICO low-voltage electronic control system (SIReAA) with integral intelligent control hub. Connections to the integral hub are to be via FRICO RJ11 - RJ12 communications cables.

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#### F.4 HEAT RECOVERY VENTILATION (HRV) UNITS

Ref	System	Make / Model	Dimensions (h, w, d, mm	Weight (kg)	Supply Air (L/s)	Exhaust Air (L/s)	Fan Motor Control	ESP (Pa)	dB(A) @ 3m	HRV Fan Motor Power Supply
HRV 1.01	Level 1 Department store BOH Outdoor Air Supply / Amenities Exhaust	SIMX VHR 29EC	430 x 1,030 x 1,585	90	600	550	EC	150	49	1Ø / 2 x 0.5kW
HRV 1.02	Level 2 Childcare Child Area Outdoor Air Supply / Amenities Exhaust	SIMX VHR 04EC	295 x 800 x 860	28	80	80	EC	150	42	1Ø / 2 x 0.085kW
HRV 1.03	Level 2 Childcare Staff Area Outdoor Air Supply / Amenities Exhaust	SIMX VHR 16EC	430 x 1,115 x 1,030	65	330	310	EC	150	52	1Ø / 2 x 0.45kW

#### NOTES:

1. HRV Units are to be SIMX sensible heat recovery only (with non-permeable heat transfer cores).
2. Filter holding frames shall be provided on the fresh air spigots
3. Units shall be supplied with G3 Washable Panel filters on the fresh air spigots.
4. Filter holding frames shall be suitable for nominal filter sizes from any filter manufacturer
5. Associated inlet and outlet vents to units shall be provided with insect screen.
6. All plant shall be installed with antivibration mountings.
7. Refer to the specification, drawings and schematics for further information.

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## F.5 HRV ELECTRIC DUCT HEATERS

Ref	Description	Make / Model	Duct Size (mm)	Airflow (l/s)	Power Supply	Temperature Setpoint
EDH 1.01	Supplementary heating to HRV1.01 serving BOH Offices Outdoor Air Supply	SIMX VCE29	Ø350	600	3Ø / 7.0kW (2-stage 3.5+3.5kW)	22°C
EDH 1.02	Supplementary heating to HRV1.03 serving Childcare Outdoor Air Supply	SIMX VCE09	Ø160	80	1Ø / 2.0kW (2-stage 1+1kW)	22°C
EDH 1.03	Supplementary heating to HRV1.03 serving Childcare Outdoor Air Supply	SIMX VCE17	Ø350	330	3Ø / 5.0kW (2-stage 2.5+2.5kW)	22°C

### NOTES:

1. Electric duct heater shall be supplied complete with all safeties required by AS1668.1-1991 and AS/NZS3102-2002 including but not limited too manual reset hi-limit stat, fusible links, airflow proving switch – air pressure, fan run on interface, all contactors and relays, etc.
2. Duct heater is intended to temper outdoor air to maintain supply air temperature above 20°C following heat recovery from exhaust airstream (assuming min. 60% heat recovery via HRV) assuming Invercargill NIWA 2.5% Ambient Conditions.
3. Proprietary controls via upstream/downstream temperature sensors between Heater and HRV unit shall be included.
4. Refer to the specification for further information.

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## F.6 ELECTRIC RADIANT PANEL HEATERS

Ref	Description	Make / Model	Size (LWH mm)	Power Supply	Temperature Setpoint
EPH 1.01-1.05/1.07-1.09	Level 1, Part 1 Childcare Centre Small room heating	EEP Energostrip EE10	168x16x5	1∅ / 1.0kW	22°C
EPH 1.06/1.10	Level 1, Part 1 Childcare Centre Small room heating	EEP Energostrip EE8	65x29x5	1∅ / 0.8kW	22°C

### NOTES:

5. Electric radiant panel heaters shall be supplied complete with all safeties and installed in accordance with manufacturers recommendations.
6. Proprietary controls via wall mounted thermostat shall be included (one per room).
7. Refer to the specification for further information.

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## F.7 SINGLE SPLIT AIR CONDITIONING UNITS

Ref	Area Served	Model	Description	Nominal Duty (kW)		Airflow (L/s)	dB(A) @3m	Weight (kg)	Dimensions (L x W x H) mm
				Cooling	Heating				
AC 1.AS	Department store Level 1 Part 1 BOH Secure Comms CCTV Room	SSZ-KF25VA3	Ceiling Cassette	2.5	3.0	142	31	15	570 x 570 x 245
AC 1.B	Department store Ground Level Part 2 Loading Bay	MSZ-GB60VA	High Wall	6.0	6.8	305	49	16	1100 x 238 x 325

**NOTES:**

1. Provide one controller per AC unit (Deluxe PAR32 Controller), wiring to be run down within available partition walls. Loading Bay AC 1.B system shall be enabled with programmed seasonal system setpoints locked during normal operating hours from the Department store BMS but shall be manually switched On/Off from the local room Controller. BOH Secure Comms/CCTV Room AC 1.AS shall operate continuously to maintain room temperature at 22°C with monitoring and alarms from the Department store BMS, Local room control shall be for local temperature sensing, servicing and diagnostic purposes only.
2. Wiring of the power and controls for the units shall be by the mechanical contractor.
3. Supply and installation of refrigerant pipework is by this trade, refrigerant shall be R410A.
4. Temperature setpoint adjustment shall be by AC vendors controls devices.
5. Air Conditioning systems shall be provided with high level BACNet gateway/interface cards for communicating with their associated Department store BMS or Mall BMS.
6. Allow to connect all condensate drains to AC tundish points as detailed on the Hydraulic Services (Sanitary Drainage) Drawings and include supply and installation of condensate pumps as required. Allow to coordinate with hydraulic Trade for final termination requirements.

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Ref	Location	Area Served	Model	Nominal Duty (kW)		Power Supply	dB(A) @3m	Weight (kg)	Dimensions (L x W x H) mm
				Cooling	Heating				
OU 1.AS	Roof Plant Area Above Department store Part 1	Department store Level 1 Part 1 BOH Secure Comms/CCTV Room	SUZ-KA25VAD2. TH-A	2.5	3.0	1Ø/ 0.78kW	46	31	800 x 285 x 550
OU 1.B	Roof Plant Area Above Department store Part 1	Department store Ground Level Part 2 Loading Bay	MUZ-GE60VA	6.0	6.8	1Ø/ 1.77kW	55	50	840 x 330 x 880

7. Design conditions shall be Invercargill 2.5% as published by NIWA.
8. Performance ratings are space heat loads at stated conditions. Capacity deratings reflecting refrigerant pipework configuration proposed by contractor, including all junctions, Refnet branches, etc to be confirmed by the Contractor.
9. Diversified capacity on outdoor units including all capacity deratings shall be no greater than 110%. Note that minor derating of OU 1.AS due to max. 20m refrigerant pipe length is accepted.
10. Supply outdoor units with compressor protection devices.
11. Supply outdoor units with interface adaptor for night time noise reduction on account of adjacent childcare facility.
12. Allow to connect to the Department store Centralised Web Controller (Mitsubishi Electric AG-150) at the Level 1 Department store BOH Electrical Distribution Board Mech Panel (DB.Z1.1-2 c/w MSSB.Z1.1-2) as indicated on drawings for all HVAC systems interlocks, programmed setpoints and timeclocks which shall be connected to the Department store Ethernet and BMS systems for remote control and energy monitoring purposes.
13. Refer to the specification, drawings and schematics for further information.

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## F.8 VRV/VRF AIR CONDITIONING UNITS

### VRV INDOOR UNITS

Ref	Area Served	Model	Type	Dims (h, w, d) mm	Weight (kg)	Supply Air (L/s)	Return Air (L/s)	Outdoor Air (L/s)	ESP (Pa)	dB(A) @ 3m	Cooling (kW)	Heating (kW)	Power Supply
AC 1.A1	Department store First Floor BOH Meeting Room	Mitsubishi Electric PEFY-P25VMA	In-ceiling Ducted	250 x 700 x 732	23	140	100	40	150	29	2.8	3.2	1Ø / 0.06kW
AC 1.A2	Department store First Floor BOH Management Offices	Mitsubishi Electric PEFY-P40VMA	In-ceiling Ducted	250 x 900 x 732	26	230	180	50	150	34	4.5	5.0	1Ø / 0.09kW
AC 1.A3	Department store First Floor BOH Main/Secure Offices	Mitsubishi Electric PEFY-P32VMA	In-ceiling Ducted	250 x 700 x 732	23	170	130	40	150	34	3.6	4.0	1Ø / 0.07kW
AC 1.A4	Department store First Floor BOH Staffroom	Mitsubishi Electric PEFY-P100VMA	In-ceiling Ducted	250 x 1,400 x 732	42	550	500	50	150	41	11.2	12.5	1Ø / 0.24kW
											<b>22.1</b>	<b>24.7</b>	<b>Total</b>
AC 1.C1	Childcare Level 2 Part 1 Reception/Circulation Area	Mitsubishi Electric PKFY-P63VKM-E	Wall Mounted	365 x 1,170 x 295	21	267-333	-	-	-	39-45	7.1	8.0	1Ø / 0.05kW

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Ref	Area Served	Model	Type	Dims (h, w, d) mm	Weight (kg)	Supply Air (L/s)	Return Air (L/s)	Outdoor Air (L/s)	ESP (Pa)	dB(A) @ 3m	Cooling (kW)	Heating (kW)	Power Supply
AC 1.C2	Childcare Level 2 Part 1 Room 1	Mitsubishi Electric PKFY-P63VKM-E	Wall Mounted	365 x 1,170 x 295	21	267-333	-	-	-	39-45	7.1	8.0	1Ø / 0.05kW
AC 1.C3	Childcare Level 2 Part 1 Room 2	Mitsubishi Electric PKFY-P63VKM-E	Wall Mounted	365 x 1,170 x 295	21	267-333	-	-	-	39-45	7.1	8.0	1Ø / 0.05kW
AC 1.C4	Childcare Level 2 Part 1 Room 3	Mitsubishi Electric PKFY-P63VKM-E	Wall Mounted	365 x 1,170 x 295	21	267-333	-	-	-	39-45	7.1	8.0	1Ø / 0.05kW
AC 1.C5	Childcare level 2 Part 1 Room 4	Mitsubishi Electric PKFY-P63VKM-E	Wall Mounted	365 x 1,170 x 295	21	267-333	-	-	-	39-45	7.1	8.0	1Ø / 0.05kW
											<b>35.5</b>	<b>40</b>	<b>Total</b>
AC 1.T5.1	Zone 1 Ground Floor Mall Retail Tenancy T.05	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1Ø / 0.11kW
AC 1.T5.2	Zone 1 Ground Floor Mall Retail Tenancy T.05	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1Ø / 0.11kW
AC 1.T5.3	Zone 1 Ground Floor Mall Retail Tenancy T.05	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1Ø / 0.11kW
AC 1.T4.1	Zone 1 Ground Floor Mall Retail Tenancy T.04	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1Ø / 0.11kW
AC 1.T4.2	Zone 1 Ground Floor Mall Retail Tenancy T.04	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1Ø / 0.11kW

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Ref	Area Served	Model	Type	Dims (h, w, d) mm	Weight (kg)	Supply Air (L/s)	Return Air (L/s)	Outdoor Air (L/s)	ESP (Pa)	dB(A) @ 3m	Cooling (kW)	Heating (kW)	Power Supply
AC 1.T4.3	Zone 1 Ground Floor Mall Retail Tenancy T.04	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1∅ / 0.11kW
											<b>33.6</b>	<b>37.8</b>	<b>Total</b>
AC 1.T3.1	Zone 1 Ground Floor Mall Retail Tenancy T.03	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1∅ / 0.11kW
AC 1.T3.2	Zone 1 Ground Floor Mall Retail Tenancy T.03	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1∅ / 0.11kW
AC 1.T3.3	Zone 1 Ground Floor Mall Retail Tenancy T.03	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1∅ / 0.11kW
AC 1.T2.1	Zone 1 Ground Floor Mall Retail Tenancy T.02	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1∅ / 0.11kW
AC 1.T2.2	Zone 1 Ground Floor Mall Retail Tenancy T.02	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1∅ / 0.11kW
AC 1.T2.3	Zone 1 Ground Floor Mall Retail Tenancy T.02	Mitsubishi Electric PEFY-P50VMA	In-ceiling Ducted	250 x 900 x 732	26	280	220	60	150	35	5.6	6.3	1∅ / 0.11kW
											<b>33.6</b>	<b>37.8</b>	<b>Total</b>

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**VRF BRANCH CONTROL UNITS**

Ref	Area Served	Model	Location	Connect To	Dims (h, w, d) mm)	Weight (kg)	dB(A) @ 3m	Cooling (kW)	Heating (kW)	Power Supply
BC 1.A	Department store Level 1 Part 1 BOH Offices	Mitsubishi Electric CMB-P106V-J	In-ceiling Level 1 Part 1 BOH Staffroom	AC 1.A1-1.A4/ OU 1.A	246 x 596 x 495	27	56	<b>22.1</b>	<b>24.7</b>	1Ø / 0.123kW
BC 1.C	Level 2 Part 1 Childcare Centre	Mitsubishi Electric CMB-P108V-JA	In-ceiling Level 2 Part 1 Childcare	AC 1.C1-1.C5/ OU 1.C	246 x 911 x 639	45	62	<b>35.5</b>	<b>40</b>	1Ø / 0.161kW
BC 1.D	Zone 1 Ground Level Part 1 Mall Retail Tenancy T.02/3	Mitsubishi Electric CMB-P106V-J	In-ceiling Ground Level Part 1 Showroom	AC 1.T2.1-3/ T3.1-3 OU 1.D	246 x 596 x 495	27	57	<b>33.6</b>	<b>37.8</b>	1Ø / 0.123kW
BC 1.E	Zone 1 Ground Level Part 1 Mall Retail Tenancy T.04/5	Mitsubishi Electric CMB-P106V-J	In-ceiling Ground Level Part 1 Showroom	AC 1.T5.1-3/ T4.1-3 OU 1.E	246 x 596 x 495	27	57	<b>33.6</b>	<b>37.8</b>	1Ø / 0.123kW

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**VRF OUTDOOR UNITS**

Ref	Connect To	Area Served	Location	Model	Dims (mm)	Weight (kg)	dB(A) @ 3m	Cooling (kW)	Heating (kW)	Power Supply
OU 1.A	AC 1.A1-1.A4/ BC 1.A	Department store First Floor BOH Offices	Zone 1 Part 1 Rooftop Plant Area	Mitsubishi Electric PURY-P200YNW-A	1,858 x 920 x 740	229	78	22.4	25.0	3 $\phi$ / 5.98kW
OU 1.C	AC 1.E1-1.E5/ BC 1.C	Zone 1 2 <sup>nd</sup> Floor Childcare Centre	Zone 1 Part 1 Rooftop Plant Area	Mitsubishi Electric PURY-P350YNW-A	1,858 x 920 x 740	273	83	40.0	45.0	3 $\phi$ / 10.86kW
OU 1.D	AC 1.T3.1-1.T3.3/ AC 1.T2.1-1.T2.3/ BC 1.D	Zone 1 Ground Floor Mall Retail Tenancy T.02/3	Zone 1 Part 1 Rooftop Plant Area	Mitsubishi Electric PURY-P300YNW-A	1,858 x 920 x 740	231	86.5	33.5	37.5	3 $\phi$ / 9.97kW
OU 1.E	AC 1.T5.1-1.T5.3/ AC 1.T4.1-1.T4.3/ BC 1.E	Zone 1 Ground Floor Mall Retail Tenancy T.04/5	Zone 1 Part 1 Rooftop Plant Area	Mitsubishi Electric PURY-P300YNW-A	1,858 x 920 x 740	231	86.5	33.5	37.5	3 $\phi$ / 9.97kW

**NOTES – VRV/VRF AIR CONDITIONING UNITS:**

1. Air Conditioning systems shall feature; 250mm body height, fan decks and drain trays removable from below (not side), integral condensate pumps on all units and 450 clear access space requirements beside unit for pipework and electrical connections.
2. Supply a wall mounted wired controller (PAR-31) for each AC unit, complete with screened cable run concealed in wall/ceiling. Install to locations indicated on drawings (bottom edge of controller to be level with light switches) and installed with clearances in accordance with manufacturers recommendations.
3. All units provided with wall mounted wired controller. Allow to install one local controller per space served by multiple units, i.e shall be run down within available partition walls. For units where spare controller is not visible in space (open plan tenancy areas) this shall be affixed to the body of the unit complete with a 4m coil of shielded comms cable to permit future layout changes and individual unit diagnostic review.
4. Typically local controls shall be used for limited temperature adjustment, after hours manual On/Off or limited run on enable (all other functions will be locked out from the associated central controllers/BMS and shall reset to programmed setpoints at each start). Refer to Section C for full controls descriptions.

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5. Ground Floor Mall Tenancy local controls will be connected to the Zone 2 Mall Central Controller (AE-200) to be supplied and installed by others under the Zone 2 Works Construction Contract at Ground Floor Electrical Main Switchboard which will provide programmed operation management with eventual connection to the Mall Ethernet and BMS Systems (By Others).
6. Allow to provide a Centralised Web Controller (AG-150) at the Level 1 Department store BOH Electrical Distribution Board Mech Panel (DB.Z1.1-2 c/w MSSB.Z1.1-2) as indicated on drawings for all HVAC systems interlocks, programmed setpoints and timeclocks which shall be connected to the Department store Ethernet and BMS systems for remote control and energy monitoring purposes.
7. Allow to provide a Centralised Web Controller (AG-150) at the Level 2 Childcare Centre Main Electrical Switchboard as indicated on drawings for all HVAC systems interlocks, programmed setpoints and timeclocks which shall be connected to the Mall Ethernet and BMS systems for remote control and energy monitoring purposes.
8. Wiring of the power and controls for the units shall be by the mechanical contractor's electrician. Supply and installation of refrigerant pipework is by this trade, refrigerant shall be R410A.
9. Temperature setpoint adjustment shall be by the local control devices or remote temperature sensors as detailed on drawings.
10. Provide branch control boxes as required to limit the size of control zones, branch select boxes shall permit the units to simultaneously heat and cool.
11. Allow to connect all condensate drains to trapped tundishes linked to foul drainage system including supply and installation of condensate pumps as required; coordinate with the plumbing contractor regarding termination requirements and required location of tundishes (indicative locations are shown on hydraulic drawings).
12. Air Conditioning systems shall be provided with Mitsubishi Electric supplied current transducers for monitoring power consumed by each outdoor unit (each outdoor unit shall be monitored independently to provide individual tenancy energy consumption monitoring required by Landlord).
13. Air Conditioning systems shall be provided with high level BACNet gateway/interface cards for communicating with their associated Department store BMS or Mall BMS.
14. Specific design conditions applicable to this project are NIWA 2.5% Invercargill Ambient Design Conditions:  
Cooling: Indoor 22±1°C DB/19°C WB/40-60%RH;  
Outdoor 24.2°C DB/19.4°C WB  
Heating: Indoor 22±1°C DB/40-60%RH;  
Outdoor -0.7°C
15. Performance ratings are space heat loads at stated conditions. Capacity deratings reflecting refrigerant pipework configuration proposed by contractor, including all junctions, Refnet branches, etc to be confirmed by the Contractor
16. Diversified capacity on outdoor units including all capacity deratings (refer note 12) shall be no greater than 110%
17. Supply outdoor unit with compressor protection devices and interface adaptor for night time noise reduction.
18. Refer to the specification for further information.

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**F.9 ROOFTOP PACKAGE HEAT PUMPS**

Ref	System	Area	Make / Model	Dims (h,w,d) mm	Weight (kg)	Supply Air (L/s)	Return Air (L/s)	Outdoor Air (L/s)	Fan Motor Control	ESP (Pa) <sup>1</sup>	dB(A) @ 3m	Total Cooling (kW) <sup>1</sup>	Sens. Cooling (kW) <sup>1</sup>	Heating (kW) <sup>1</sup>	Power Supply
AHU 1.01	Department store Ground Floor Part 1 – Shop floor North	1090m <sup>2</sup>	Temperzone OPA 960 RKTM (Eco)	1,860 x 2,150 x 2,790	1,150	4,600	2,900	1,700	EC	285 (310)	67	71.1 (103.4)	48.9 (83.4)	52.9 (78.8)	AHU 3Ø/29.4kW/ 77 FLA/Ø Elec. Heater 3Ø/18kW
AHU 1.03	Department store First Floor Part 1 – Shop floor North	1350m <sup>2</sup>	Temperzone OPA 1370RKTM (Eco)	2,330 x 2,260 x 4,670	2,300	5,500	4,100	1,400	EC	285 (330)	66	96.0 (133)	68.0 (92.5)	70.5 (98)	AHU 3Ø/162 FLA/Ø Elec. Heater 3Ø/27kW
AHU 1.02	Department store Ground Floor Part 2 – Shop floor/Reserve South	1400m <sup>2</sup>	Temperzone OPA 1370RKTM (Eco)	2,330 x 2,260 x 4,670	2,300	5,400	3,200	2,200	EC	320 (370)	66	73.5 (133)	49.5 (92.5)	79.3 (98)	AHU 3Ø/ 162 FLA/Ø Elec. Heater 3Ø/27kW
AHU 1.04	Department store First Floor Part 2 – Shop floor/Reserve South	1470m <sup>2</sup>	Temperzone OPA 1370RKTM (Eco)	2,330 x 2,260 x 4,670	2,300	6,600	4,350	2,250	EC	300 (330)	66	113.8 (133)	82.7 (92.5)	85.0 (98)	AHU 3Ø/ 162 FLA/Ø Elec. Heater 3Ø/27kW

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**NOTES - ROOFTOP PACKAGE HEAT PUMPS:**

1. Total/Sensible Cooling and Heating (kW) are noted as: Calculated Capacity (Available System Capacity) at Specified conditions.
2. Refrigerant shall be R410a
3. Refrigerant compressors shall be digitally controlled to provide capacity control.
4. Units shall be constructed from insulated heavy gauge galvanised sheet metal, finished with baked enamel paint or other approved paint system and be suitable for outdoor installation.
5. Units shall be complete with internal stainless steel drain tray and condensate connection piped to suitable drain points.
6. Filter holding frames shall be provided on both the fresh and return air spigots
7. Units shall be supplied with Washable Type G4 50mm pleated panel filters on both the fresh and return air spigots
8. Filter holding frames shall be suitable for 600x600 and 600x300 nominal filter sizes from any filter manufacturer
9. Specific design conditions applicable to this project are NIWA 2.5% Invercargill Ambient Design Conditions:  
Cooling: Indoor 22±1°C DB/19°C WB/40-60%RH;  
Outdoor 24.2°C DB/19.4°C WB  
Heating: Indoor 22±1°C DB/40-60%RH;  
Outdoor -0.7°C
10. Units shall be supplied with economiser sections and motorised dampers. Stated outdoor air requirements are for normal operation, Economiser mode shall permit operation using maximum outdoor air flowrate based on Outdoor Air DB temperature or Return Air CO<sub>2</sub> level in accordance with Manufacturer's recommendations.
11. Refer to the specification and drawings for further information.
12. Units shall be supplied complete with integral outdoor air economiser, electric heating sections, coils, filters and inbuilt UC6/8 controls as standard.
13. Specialist controls sub-contractor (BTL) shall be responsible for supply of Siemens BMS controllers and field devices for operation of the systems via the Department store BMS.
14. Units shall operate as described in the Automatic Controls Description in Section C of this specification.

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**F.10 MOTORISED VOLUME CONTROL DAMPERS**

Ref	Area Served	Model	Connect To	Dims (h, w, l) mm	Min. Air Flow (L/s)
M VCD	Department store Roof Mounted AHU 1.01/SEF 1.01 Spill Exhaust Air Motorised Volume Control Dampers	Temperzone Motorised TRD	SEF 1.01/ AHU 1.01 Spill Air Duct VCD During Economiser Mode	700x700/ 1,200x500	1,700- 3,700
M VCD	Department store Roof Mounted AHU 1.02/SEF 1.02 Spill Exhaust Air Motorised Volume Control Dampers	Temperzone Motorised TRD	SEF 1.02/ AHU 1.02 Spill Air Duct VCD During Economiser Mode	700x700/ 1,200x500	1,400- 3,700
M VCD	Department store Roof Mounted AHU 1.03/SEF 1.03 Spill Exhaust Air Motorised Volume Control Dampers	Temperzone Motorised TRD	SEF 1.03/ AHU 1.03 Spill Air Duct VCD During Economiser Mode	700x700/ 1,200x500	2,200- 3,700
M VCD	Department store Roof Mounted AHU 1.04/SEF 1.04 Spill Exhaust Air Motorised Volume Control Dampers	Temperzone Motorised TRD	SEF 1.04/ AHU 1.04 Spill Air Duct VCD During Economiser Mode	700x700/ 1,200x500	2,250- 3,700

**NOTES:**

1. Dampers shall be supplied c/w Belimo NM24A 10N Damper Actuator (or approved equal).
2. Refer to the specification and drawings for further information.

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## F.11 FIRE DAMPERS

Ref	Area Served	Model	Nominal Duct Dims (mm)	Penetration Dims (mm)
FD	Department store Level 1 Part 2 Reserve Supply Air Duct Fire Damper	Holyoake IBD-FS-B-V	600x600	630x735
FD	Department store Level 1 Part 2 Reserve Return Air Duct Fire Dampers	Holyoake IBD-FS-B-V	600x800	630x960
FD	Department store Level 1 Part 1 Lift Shaft Vent Fire Control Damper	Holyoake IBD-FS-B-V	400x400	430x510

**NOTES:**

1. Fire Dampers shall be Holyoake manufacture (or approved equal).
2. Refer to the specification and drawings for further information.

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## F.12 VAV BOXES

Ref	Area Served	Model	Connect To	Minimum Airflow (L/s)	Dims (H, W, L) (mm)	Design Airflow (L/s)	Power Supply
VAV 1.01	Department store Ground Level Part 1 – shop floor North (Future Change)	HCV-9200S0-300x300	AHU 1.01 Supply Air Ducting	390	369 x 428 x 1200	450	Damper/ Electric Heater 1Ø / 2.5kW
VAV 2.01	Department store Ground Level Part 2 – shop floor South	HCV-9200S0-600x400	AHU 1.02 Supply Air Ducting	1030	442 x 965 x 471	1400	Damper 1Ø / 0.1kW
VAV 2.02	Department store Ground Level Part 2 – shop floor South (Future Change)	HCV-9200S0-300x300	AHU 1.02 Supply Air Ducting	390	369 x 428 x 1200	400	Damper/ Electric Heater 1Ø / 2.5kW
VAV 2.03	Department store Ground Level Part 2 – shop floor South	HCV-9200S0-350x350	AHU 1.02 Supply Air Ducting	540	398 x 512 x 471	600	Damper 1Ø / 0.1kW
VAV 2.04	Department store Ground Level Part 2 – shop floor South	HCV-9200S0-400x400	AHU 1.02 Supply Air Ducting	710	442 x 636 x 471	1000	Damper 1Ø / 0.1kW
VAV 2.05	Department store Ground Level Part 2 – shop floor South	HCV-9200S0-400x400	AHU 1.02 Supply Air Ducting	710	442 x 636 x 471	1000	Damper 1Ø / 0.1kW
VAV 2.06	Department store Ground Level Part 2 – shop floor South	HCV-9200S0-350x350	AHU 1.02 Supply Air Ducting	540	398 x 512 x 471	600	Damper 1Ø / 0.1kW
VAV 2.07	Department store Ground Level Part 2 – Reserve South	HCV-9200S0-300x300	AHU 1.02 Supply Air Ducting	390	369 x 428 x 471	400	Damper 1Ø / 0.1kW
VAV 3.01	Department store Level 1 shop floor North (Future Change)	HCV-9200S0-350x350	AHU 1.03 Supply Air Ducting	540	398 x 512 x 1200	600	Damper/ Electric Heater 1Ø / 3.75kW

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**NOTES:**

1. Heaters shall have interlocked operation to associated AHU supply for overheat protection to AS/NZS 3102.
2. VAV Airflow and Heater Control Assemblies shall adjust air temperature and flowrate automatically via remote temperature sensor to be located on partition walls within the Future Shop floor Fitout Areas TBA, setpoints shall be adjustable via Department store BMS.
3. VAVs 2.01/2.03 and VAVs 2.02/2.04 shall be interlocked such that as one increases airflow the other shall decrease accordingly to maintain air balance within the system.
4. Refer to the specification and drawings for further information.

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### F.13 MECHANICAL PLANT ELECTRICAL LOADS

Board	Ref	Description	Load (kW)	Speed Control	
Zone 1 Department Store MSSB.Z1	EF 1.01	Department store Ground Floor Bin Store Exhaust Fan	1 $\emptyset$ / 0.12kW	VA	
	EF 1.02	Department store Ground Floor Loading Bay Exhaust Fan	<b>3<math>\emptyset</math> / 1.45kW</b>	EC	
	DAC 1.02/1.02	Department store Door Air Curtains to Ground Floor Street Entrance Lobby	<b>3<math>\emptyset</math> / 2 x 20kW</b>	--	
	Prewire for Future DAC 1.03/1.04	Department store Door Air Curtains to Future First Floor Carpark Entrance Lobby	<b>3<math>\emptyset</math> / 2 x 16kW</b>	-	
	AC 1.B/ OU 1.B		Department store Ground Floor Part 2 Loading Bay Wall Mounted AC Unit		-
			Department store Ground Floor Part 2 Loading Bay Roof Mounted Outdoor Unit	1 $\emptyset$ / 0.78kW	-
	AHU 1.01		Roof Mounted AHU serving Department store Ground Level Part 1 – shop floor	<b>3<math>\emptyset</math>/29.4kW/ 77 FLA/<math>\emptyset</math></b>	EC
			Supplementary Electric Heating Element within AHU1.01	<b>3<math>\emptyset</math> /18kW 3-Stage</b>	-
			Temperzone UC8 Controls, Economiser Damper and control devices provided with AHU 1.01	1 $\emptyset$ / 0.2kW	-
	SEF1.01	Department store Roof Mounted AHU 1.01 Spill Exhaust Fan	<b>3<math>\emptyset</math> / 1.5kW</b>	EC	
	M VCD	Motorised Volume Control Damper serving AHU 1.01 Spill Air Systems	1 $\emptyset$ / 0.12kW	-	
	VAV 1.01	Motorised Variable Air Volume Control Assemblies with Electric Heating Element serving AHU 1.01 Future Fitting Room Supply Air Systems	1 $\emptyset$ / 0.1kW 15kW + 1 $\emptyset$ / 2.5kW Single Stage Electric Heat	-	
	Controls	BMS-F Controls and Devices serving Department store Ground Level Part 1 AHU 1.01 Systems by BTL	1 $\emptyset$ / 0.2kW	-	

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Board	Ref	Description	Load (kW)	Speed Control
Zone 1 Department Store MSSB.Z1 (Cont.)	AHU 1.03	Roof Mounted AHU serving Department store Level 1 Part 1 – shop floor Nth	<b>3Ø / 162 FLA/Ø</b>	EC
		Supplementary Electric Heating Element within AHU1.03	<b>3Ø /27kW 3-Stage</b>	-
		Temperzone UC6 Controls, Economiser Damper and control devices provided with AHU 1.03	1Ø / 0.2kW	-
	SEF1.03	Department store Roof Mounted AHU 1.03 Spill Exhaust Fan	<b>3Ø / 1.5kW</b>	EC
	M VCD	Motorised Volume Control Damper serving AHU1.03 Spill Air Systems	1Ø / 0.12kW	-
	Controls	BMS-F Controls and Devices serving Department store Level 1 Part 1 AHU 1.03 Systems by BTL	1Ø / 0.2kW	-
	AHU 1.02	Roof Mounted AHU serving Department store Ground Floor Part 2 – Shop floor/ Reserve Sth	<b>3Ø / 162 FLA/Ø</b>	EC
		Supplementary Electric Heating Element within AHU1.02	<b>3Ø /27kW 3-Stage</b>	-
		Temperzone UC6 Controls, Economiser Damper and control devices provided with AHU 1.02	1Ø / 0.2kW	-
	SEF1.02	Department store Roof Mounted AHU 1.02 Spill Exhaust Fan	<b>3Ø / 1.5kW</b>	EC
	M VCD	Motorised Volume Control Damper serving AHU1.02 Spill Air Systems	1Ø / 0.12kW	-
	VAV 2.01	Motorised Variable Air Volume Control Assemblies serving AHU 1.02 Future Cosmetics/Beauty Room Supply Air Systems	1Ø / 0.1kW	-
	VAV 2.02	Motorised Variable Air Volume Control Assemblies serving AHU 1.02 Future Cosmetics/Beauty Room Supply Air Systems	1Ø / 0.1kW + 1Ø / 2.5kW Single Stage Electric Heat	-
VAV 2.03-7	Motorised Variable Air Volume Control Assemblies balancing VAV 2.02 Supply Air Systems	1Ø / 5 x 0.1kW	-	

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Building Division

Board	Ref	Description	Load (kW)	Speed Control
Zone 1 Department Store MSSB.Z1 (Cont.)	Controls	BMS-F Controls and Devices serving Department store Ground Level Part 2 AHU 1.02 Systems by BTL	1Ø / 0.2kW	-
	AHU 1.04	Roof Mounted AHU serving Department store First Floor Part 2 – Shop floor & Reserve Storage	<b>3Ø / 162 FLA/Ø</b>	EC
		Supplementary Electric Heating Element within AHU1.04	<b>3Ø /27kW 3-Stage</b>	-
		Temperzone UC6 Controls, Economiser Damper and control devices provided with AHU 1.04	1Ø / 0.2kW	-
	SEF1.04	Department store Roof Mounted AHU 1.04 Spill Exhaust Fan	<b>3Ø / 1.5kW</b>	EC
	M VCD	Motorised Volume Control Damper serving AHU1.04 Spill Air Systems	1Ø / 0.12kW	-
	VAV 3.01	Motorised Variable Air Volume Control Assemblies serving AHU 1.04 Supply Air Systems	1Ø /0.1kW 1Ø / 3.75kW Single Stage Electric Heat	-
	Controls	BMS-F Controls and Devices serving Department store Level 1 Part 2 AHU 1.04 Systems by BTL	1Ø / 0.2kW	-
	BMS-F	Department store Building Management System	1Ø / 0.2kW	-
	SSF 1.01-1.04	Department store 4 of Roof Mounted Smoke Exhaust Fans (Above Escalators)	<b>3Ø / 4 x 7.5kW</b>	NOL
	Zone 1 Department Store DB.Z1.1-2 Mech Panel MSSB.Z1.1-2 (Hydraulic)	HWC 3	Department store Ground Level Part 2 Shop floor Beauty Room Mains Pressure Electric HWC	1Ø / 3kW
HWC 2		Department store Level 1 Part 1 BOH Mains Pressure Electric HWC	1Ø / 3kW	-
HRRP		Department store Level 1 Part 1 BOH HW Recirculation Pump	1Ø / 0.007kW	-
UV		Department store Level 1 Part 1 BOH HW UV Sanitizer	1Ø / 0.019kW	-

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Board	Ref	Description	Load (kW)	Speed Control
Zone 1 Department Store DB.Z1.1-2 Mech Panel MSSB.Z1.1-2 (Mech)	AC 1.AS/ OU 1.AS	Department store Level 1 Part 1 BOH Secure Comms/CCTV Room		-
		Department store Level 1 Part 1 BOH Roof Mounted Single Split Outdoor Unit	1Ø / 1.77kW	-
	AC 1.A1	Department store Level 1 Part 1 BOH Meeting Room	1Ø / 0.06kW	-
	AC 1.A2	Department store Level 1 Part 1 BOH Management Offices	1Ø / 0.09kW	
	AC 1.A3	Department store Level 1 Part 1 BOH Main/Secure Offices	1Ø / 0.07kW	-
	AC 1.A4	Department store Level 1 Part 1 BOH Staffroom	1Ø / 0.24kW	-
	BC 1.A	Department store Level 1 Part 1 BOH VRF Branch Controller	1Ø / 0.123kW	-
	OU 1.A	Department store Level 1 Part 1 BOH Roof Mounted VRF Outdoor Unit	<b>3Ø / 5.98kW</b>	-
	EF 1.03	Department store Level 1 Part 1 BOH Staffroom Ceiling Mounted General Exhaust Fan	1Ø / 0.06kW	VA
	EF 1.04	Department store Level 1 Part 1 BOH Secure Store Ceiling Mounted General Exhaust Fan	1Ø / 0.06kW	VA
	HRV 1.01	Department store Level 1 Part 1 BOH Outdoor Air Supply / Amenities Exhaust	1Ø / 1.0kW	EC
	EDH 1.01	Department store Level 1 Part 1 BOH Outdoor Air Supply Electric Duct Heater	<b>3Ø / 7.0kW</b> (2-stage 3.5+3.5kW)	-
	Controls	Mitsubishi Electric AG150 Controls and Devices serving Department store Level 1 Part 1 BOH Systems	1Ø / 0.15kW	-
	Zone 1 Mall BOH DB.LL-2	EF T.45	Mall Ground Level Part 2 BOH Cleaners Ceiling Mounted Exhaust Fan	1Ø / 0.09kW
EF S.1		Mall Ground Level Part 2 BOH Store S.1- 3 Common Duct Mounted Exhaust Fan	1Ø / 0.22kW	-
EF S.2		Mall Ground Level Part 2 BOH Store S.4- 6 Ceiling Mounted Exhaust Fan	1Ø / 0.09kW	-
HWC 1 (T.45)		Mall Ground Level Part 2 BOH Cleaners Mains Pressure Electric HWC	1Ø / 3.0kW	-

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Invercargill Central - D.S Anchor - Zone 1  
Section F: Mechanical Services Equipment Schedules

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Board	Ref	Description	Load (kW)	Speed Control
Zone 2 Mall MSB.Z2	OU1.D	Ground Floor Mall Tenancy T.02/3 Roof Mounted VRF Outdoor Unit	<b>3Ø / 9.97kW</b>	-
	OU1.E	Ground Floor Mall Tenancy T.04/5 Roof Mounted VRF Outdoor Unit	<b>3Ø / 9.97kW</b>	-
Zone 1 Mall Tenancy T.02 DB.T.02	EF T.02	Ground Floor Mall Tenancy Ceiling Mounted Toilet Exhaust Fan	1Ø / 0.06kW	-
	AC T.02.1-T02.3	Ground Floor Mall Tenancy 3 of Ducted In-ceiling VRF AC Units	1Ø / 3 x 0.11kW	-
	BC 1.D	Ground Floor Mall Tenancy VRF Branch Controller	1Ø / 0.123kW	-
	HWC 1 (T.02)	Ground Floor Mall Tenancy Mains Pressure Electric HWC (in-Ceiling)	1Ø / 3kW	-
Mall Tenancy T.03 DB.T.03	EF T.03	Ground Floor Mall Tenancy Ceiling Mounted Toilet Exhaust Fan	1Ø / 0.06kW	-
	AC T.03.1-T03.3	Ground Floor Mall Tenancy Ducted In-ceiling VRF AC Units	1Ø / 3 x 0.11kW	-
	HWC 1 (T.03)	Ground Floor Mall Tenancy Mains Pressure Electric HWC (in-Ceiling)	1Ø / 3kW	-
Mall Tenancy T.04 DB.T.04	EF T.04	Ground Floor Mall Tenancy Ceiling Mounted Toilet Exhaust Fan	1Ø / 0.06kW	-
	AC T04.1-T04.3	Ground Floor Mall Tenancy Ducted In-ceiling VRF AC Units	1Ø / 3 x 0.11kW	-
	BC 1.E	Ground Floor Mall Tenancy VRF Branch Controller	1Ø / 0.123kW	-
	HWC 1 (T.04)	Ground Floor Mall Tenancy Mains Pressure Electric HWC (in-Ceiling)	1Ø / 3kW	-
Mall Tenancy T.05 DB.T.05	EF T.03	Ground Floor Mall Tenancy Ceiling Mounted Toilet Exhaust Fan	1Ø / 0.06kW	-
	AC T03.1-T03.3	Ground Floor Mall Tenancy Ducted In-ceiling VRF AC Units	1Ø / 3 x 0.11kW	-
	HWC 1 (T.03)	Ground Floor Mall Tenancy Mains Pressure Electric HWC (in-Ceiling)	1Ø / 3kW	-

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Section F: Mechanical Services Equipment Schedules

Building Division

Board	Ref	Description	Load (kW)	Speed Control
Childcare Tenancy DB.Z1.2-1	EF 1.05	Second Floor Childcare Centre Roof Mounted Toilet Exhaust Fan	1Ø / 0.06kW	-
	EF 1.06	Second Floor Childcare Centre Roof Mounted laundry Exhaust Fan	1Ø / 0.06kW	-
	HRV 1.02	Second Floor Childcare Centre Outdoor Air Supply / Amenities Exhaust	1Ø / 2 x 0.085kW	EC
	EDH 1.02	Second Floor Childcare Centre Outdoor Air Supply Electric Duct Heater	1Ø / 2.0kW (2-stage 1+1 kW)	-
	HRV 1.03	Second Floor Childcare Centre Outdoor Air Supply / Amenities Exhaust	1Ø / 2 x 0.45kW	EC
	EDH 1.03	Second Floor Childcare Centre Outdoor Air Supply Electric Duct Heater	<b>3Ø / 5.0kW</b> (2-stage 2.5+2.5kW)	-
	AC 1.C1	Second Floor Childcare Centre Wall Mounted VRF AC Units	1Ø / 0.05kW	-
	AC 1.C2	Second Floor Childcare Centre Wall Mounted VRF AC Units	1Ø / 0.05kW	-
	AC 1.C3	Second Floor Childcare Centre Wall Mounted VRF AC Units	1Ø / 0.05kW	-
	AC 1.C4	Second Floor Childcare Centre Wall Mounted VRF AC Units	1Ø / 0.05kW	-
	AC 1.C5	Second Floor Childcare Centre Wall Mounted VRF AC Units	1Ø / 0.05kW	-
	BC 1.C	Second Floor Childcare Centre Ducted In-ceiling VRF Branch Controller	1Ø / 0.161kW	-
	OU1.C	Second Floor Childcare Centre Roof Mounted VRF Outdoor Unit	<b>3Ø / 10.86kW</b>	-
	Controls	Mitsubishi Electric AG150 Central Web Controller	1Ø / 0.1kW	
	EPH 1.01-1.02	EE10 Energo Strip Electric Panel Heaters	1Ø / 2 x 1.0kW	
	EPH 1.03-1.05	EE10 Energo Strip Electric Panel Heaters	1Ø / 3 x 1.0kW	
	EPH 1.07-1.09	EE10 Energo Strip Electric Panel Heaters	1Ø / 3 x 1.0kW	
	EPH 1.06/1.10	EE8 Energo Strip Electric Panel Heaters	1Ø / 2 x 0.8kW	
	HWC 4	Level 2 Childcare Centre Mains Pressure Electric HWCs	2 x 1Ø / 3kW	-

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Section F: Mechanical Services Equipment Schedules

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Board	Ref	Description	Load (kW)	Speed Control
Childcare Tenancy DB.Z1.2-1 (Cont.)	HRRP	Level 2 Childcare Centre HW Recirculation Pumps	1Ø / 2 x 0.007kW	-
	UV	Level 2 Childcare Centre HW UV Sanitizers	1Ø / 2 x 0.019kW	-

**NOTES:**

1. Plant shall be served from the nominated Mechanical Services Switchboard or Electrical Distribution Board. Allow to provide Manual/Off/Auto switch where required for servicing.
2. All plant served by a Manual/Off/Auto switch shall also have run fault lights mounted in the face of the board.
3. Refer to the detailed specification for further information.

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Invercargill Central - D.S Anchor - Zone 1  
Section G: Project Specific Domestic Water Scope

Building Division

**SECTION G**

**PROJECT SPECIFIC DOMESTIC WATER SERVICES SCOPE**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

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## G.1 SCOPE OF WORK

The contract comprises the construction of the domestic water services aspects of the D.S. Anchor Zone 1 portion of the new Invercargill Central Shopping Mall Development to be located at 33 Esk St. Invercargill.

The building comprises a large two level, department store incorporating open plan retail shop floor, reserve storage areas, offices and amenity areas, a separate Childcare facility on Level 2 as well as several smaller ground floor tenancies associated with the Mall accessed via Esk St. shopfront and other Mall Storage and services areas on the south side of the building.

The contractor shall supply, manufacture, install, test and commission the domestic water systems and associated works.

### 1.1 GENERAL

- a) Allow for new cold water supplies to each tenanted areas of the building (Department store, Childcare Facility, Esk St. Mall Retail Tenancies & Mall BOH Stores) taken from Network Utility Operator (NUO) Mains Pressure site supply as detailed.
- b) Water Supplies typically feed into Zone 1 via the adjacent Mall Zone 2 works site, allow to coordinate with Zone 2 Works contractors as necessary.
- c) Allow to supply and install domestic hot and cold water pipework and fittings for the areas as detailed on the drawings and detailed below. Systems include supplies to hand wash basins, sinks, toilet systems, hoesetaps complete with vacuum breakers, water meters, back flow preventers, tempering valves for sanitary fittings and the like.
- d) Supply and install all tapware and fittings as detailed in the Architects plumbing schedule.
- e) This trade shall install Rheem mains-pressure electric hot water cylinders and tempering valves as detailed to provide hot water to all sanitary fixtures.
- f) Provide hot water recirculation loops including pump and UV sanitiser to Childcare and Department Store Back of House (BOH) HW service. Note: tempering valves are typically to be provided outside of recirculation loop with local tempering provided at fixture (refer to Architectural schedule for details of fixtures supplied by others) or via tempered water supply from cylinder to services near the HWC.
- g) Allow to provide thermal insulation to all hot and cold water pipework.
- h) Allow to coordinate with Main Electrician prior to construction and provide switchboard loadings and wiring for hydraulic services plant and equipment.
- i) Allow to coordinate with Automatic Controls Contractor/s supplying Building Management Systems for installation of any sensors or controls associated with the relevant BMS systems.
- j) Allow all builders work including cutting of holes, making good all ceilings including any damaged tiles and wall linings, painting to match existing finishes, and weather flashings to penetrations through external walls. The builder may be used for the builders work if desired, though the cost of the builder's work must be included in this trade's price.

- k) Allow to manufacture, supply and install support steelwork and seismic restraints for all cylinders, pumps, pipework, and other equipment. Drawings of the steelwork shall be submitted to the Engineer for approval.
- l) Allow to test and commission all systems installed under the contract.
- m) Provide Producer Statements for the Construction of the systems.
- n) Provide "As Built" drawings, Operating and Maintenance Manuals.
- o) Allow to maintain the installation for a period of 12 months from the date of Practical Completion.
- p) Guarantee the complete installation against defects in materials and/or workmanship for a period of 12 months from the date of Practical Completion. Faulty equipment and defects shall be replaced or repaired without delay and at no cost to the client.
- q) Allow to supply and install all other equipment and to supply all labour not specifically mentioned above and necessary to render the system fully functional.
- r) Principals Instructions.

### 1.1.1 Domestic Hot Water Systems

Allow to install hot water cylinders as defined in the schedules, Section I.

Hot water recirculation loops including pump and UV sanitiser to be provided to systems where required in accordance with NZBC H1.3.6.

HW tempering to 55°C or 45°C (Childcare Facility) as applicable shall be provided in accordance with NZBC G12.

This trade shall complete all water connections and fittings, valves and drainage to tundishes, as shown on the drawings.

### 1.1.2 Domestic Water Reticulation

This trade shall reticulate domestic hot and cold-water pipework to all outlets as required including all tempering valves, etc. Refer to the pipework section for details on piping materials.

Pipe insulation for all hot and cold water shall be as prescribed in Section I.

Backflow preventers shall be installed on the cold water supply in accordance with NUO requirements. The valves and associated fittings are specified in the pipework section of this specification.

Hosetaps are to be 15mm brass taps on 400mm risers above the ground and fixed back to the wall. Pipe material shall be "PEX" OR "PERT" with the brand to approval insulated and wrapped with Thermobreak. Hosetap vacuum breakers shall be installed on all external hosetaps. The valves are as specified in the pipework section of this specification.

Submit details of the provisions to allow for pipe expansion

Provide supports for plant including cylinders, cabinets, pumps, etc.; provide interconnecting piping where required; flash all wall and roof penetrations, and make electrical and controls connections. Refer to the Electrical for Mechanical and Controls Section C for further details.

Ensure all plant is positioned to provide the manufacturers recommended clearance around units for servicing and maintenance access and airflow.

Refer to the drawings for further information.

### 1.2 BUILDERS WORK

All penetrations required for the installation of the Domestic Water services, including penetrations through floor slabs, concrete walls, block work, etc., are the responsibility of the Domestic Water Sub-contractor.



Noise rating and waterproofing must be maintained after making good. This trade is responsible for filling and sealing around Domestic Water pipes and ducts. Where sealing of penetrations is not stated allow for making good to equal performance for sound, etc., and seek final details from the Contractor. No additional payments for builders work not allowed in the Domestic Water tender will be approved, if deemed necessary for the proper execution of the Domestic Water works. This trade shall supply/fabricate and install all stands required for hot water cylinders.

**1.3 ELECTRICIANS WORK**

Main Electrician shall wire all plant supplied by the Hydraulic services trade, refer Section C. Allow to coordinate with Main Electrician for switchboard loadings and connection requirements.

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Section H: Domestic Water Services Standard Clauses

Building Division

**SECTION H  
DOMESTIC WATER SERVICES STANDARD CLAUSES**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

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## H.1 CONDITIONS

The requirements of Section A of this specification "Preliminary and General" shall be read as directly included herein.

## H.2 SCOPE OF WORK

Refer Section G

### 2.1 TENDER INFORMATION

The work shall be complete with and full allowance made for all minor and incidental items necessary for the proper functioning of the whole system, including all ancillary items.

### 2.2 DESIGN DETAILS

The Domestic Water services shall be designed and installed in accordance with the requirements of the New Zealand Building Code and the associated Codes of Practice / Standards being accepted by the Territorial Authorities as an acceptable solution.

In particular:

- AS/NZS 3500:2015 (All parts) "National Plumbing & Drainage"

## H.3 PIPING, VALVES & FITTINGS

### 3.1 GENERAL

This section of the Specification shall apply to the supply and installation of all pipework systems including valves and associated fittings. Services this division refers includes (but not necessarily limited to):

- Domestic Water Pipework
- All other incidental pipework including vents and drains.

The Drawings indicate the sizes of pipes and the manner in which the various systems are to be installed. They do not purport to show all pipework or bends, offsets and the like which must be coordinated with other trades, measured on site or ascertained from architectural and other drawings showing structural, plumbing, lighting, fire services and other features normally encountered in this type of project.

All piping systems shall be complete with valves, fittings, vents, drains, expansion facilities, anchors, supports and other items necessary for the satisfactory operation and maintenance of the systems as intended.

The Subcontractor shall accurately set out the various pipelines after conferring with the Engineer and other interested Subcontractors and shall himself carry out all necessary levelling, measuring etc., to position his work, as he will be held responsible for any errors.

All valves, controls and items of equipment are to be located in conveniently accessible positions or are to be arranged to be readily removable.

Pipes are to be run neatly in parallel lines. Risers are to be accurately plumbed.

Pipework shall be installed in continuous standard tube lengths as long as practical.

Offcuts shall not be jointed end to end for use in long runs.

Dissimilar metals shall be separated from direct contact with each other. When such contact exists, all necessary gaskets and dielectric couplings of bituminous

felt, rubber gaskets, teflon tape or equivalent means suitable for the duty shall be provided.

All piping shall be kept in a clean condition at all times during storage, fabrication, installation and testing. Ends of pipes, fittings and equipment are to be effectively sealed by means of suitable plugs or purpose made metal caps during storage and during the progress of the work to exclude the entry of any foreign matter. Responsibility shall be accepted for all damage to equipment due to dust and debris left in the pipework during installation.

### 3.2 PIPING AND MATERIALS

Piping and materials shall be as noted in the attached appendices.

All piping shall be of the best available quality and shall be supplied in clean, full standard straight lengths, free from any defects such as mill scale, rust, burns, dents, kinks, etc. and with all ends sealed against the ingress of foreign matter and protected against mechanical damage. All piping shall be kept in a clean condition at all times during storage, fabrication, installation and testing.

All visible pipework connections to fittings and appliances shall be of chromed finish.

### 3.3 ALTERNATIVE PIPEWORK SYSTEMS

The pipe sizing indicated in the drawings is for outside diameters (i.e. a PE system). For pricing of nominal bore based systems, refer to the comparison tables below for equivalent pipe sizing:

Polypropylene	Copper
20	15
25	20
32	25
40	32
50	40
63	50
75	65
90	80
110	100

Alternatives may be offered, but details, including all compliance and accreditation data must be submitted for approval.

The following conditions must be met:

- Maximum water velocities must not exceed 2.0 m/s or,
- Maximum pressure drop of 1000 Pa/m.

### 3.4 POLYPROPYLENE PIPING, JOINTS & FITTINGS – GENERAL SERVICES

All polypropylene pipework (e.g. Fusiotherm Stabi-Composite) shall be to DIN EN 15874-5 (2003-2003) Plastic piping systems for hot and cold water installations, Polypropylene (PP)- Part 5: Fitness for Purpose of the System and supplied and installed in accordance with manufacturer's recommendations.

#### 3.4.1 Jointing of Polypropylene Pipework

Jointing of polypropylene pipework shall be by electrofusion welding technique carried out in compliance with DIN EN 15874-5 and the recommendations of the pipe and fitting manufacturer and by a certified fusion welder.

### **POLYETHYLENE PIPING, JOINTS & FITTINGS – GENERAL SERVICES**

All polyethylene pipework shall be to:

AS/NZS 4130:2009 Polyethylene (PE) Pipe for pressure applications

AS/NZS4129: 2008 Fittings for polyethylene (PE) pipes for pressure applications.

Installation & jointing of polyethylene pipework shall be carried out in compliance with AS/NZS 2033: 2008 Installation of polyethylene pipe systems & the recommendations of the pipe and fitting manufacturer.

### **3.6 COPPER PIPING, JOINTS & FITTINGS – GENERAL SERVICES**

All copper piping shall be of the seamless type fabricated from Grade 122A phosphorous deoxidised copper to BS 2871 and complying with NZS 3501 and NZS 3502 as appropriate.

All copper piping shall have wall thicknesses not less than the thickness listed in NZS 3501 for the types of tubes specified.

Flanged or screwed fittings shall be used at all connections to all equipment, valves, and similar fittings and shall be arranged to permit removal of any item of equipment without cutting pipework and without breaking any structure.

#### **3.6.1 Jointing of Copper Pipework**

All joints in copper piping shall be silver soldered in accordance with AS 1135, and AS 1585 and other codes as for the particular system involved.

The brazing alloy shall be Copper Silver Phosphorus with a minimum of fifteen percent silver content. All silver soldering shall be carried out by skilled Tradesmen having adequate training and experience in this type of work and complying with the relevant code and adequate fire precautions being taken in compliance with NZS 4781.

#### **3.6.2 Brazed Pipeline Jointing**

Copper to copper joints made on site, shall utilise a copper phosphorus brazing alloy type CP1 or CP4 to BS 1845 and an inert gas shield and no flux.

Copper joints to brass or gunmetal made off-site shall utilise a silver brazing material type AG13 to AG18 to BS 1845, a flux as recommended by the manufacturer and the joint to be subsequently cleaned to meet the requirements in Clause 15.3.4.

### **3.7 PIPE JOINTS**

No pipe joints will be accepted if made in the thickness of walls, floors etc, Where pipework is to become inaccessible, or have limited access only, all joints shall be made by welding and brazing as appropriate or as otherwise specified. Screwed joints will be unacceptable unless specifically specified. No hemp may be used in any pipe joints.

### **3.8 PIPE SUPPORTS**

#### **3.8.1 General**

All pipes shall be adequately supported and appropriately restrained by hangers, bracket, pedestals, clips, rollers and expansion joints and anchors designed by the subcontractor to suit the requirements of each piping system complying with NZS 4203 and NZS 4219. Calculations for anchors shall be performed and certified by a registered engineer. Calculations and drawings shall be submitted.

All steel supports and associated fittings where exposed to moisture, condensation or external elements shall be hot dip galvanised after fabrication.

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Saddle brackets shall be galvanised and have a suitable lining strip to prevent the copper pipes from contacting the galvanised steel.

All piping supports shall be designed to take the combined loads of pipes, valves, fittings, insulation (if applicable) and fluid in the pipes and all reactions due to thermal expansion or contraction of the piping.

All pipework shall be laterally restrained to maintain alignment under all conditions.

All hanger rods, supports, brackets, and associated fittings shall be hot dip galvanised or zinc plated after fabrication. Fixings and restraints shall ensure that all equipment withstands seismic loadings, without undue stress and displacement, to comply with NZS 4219.

All valves shall be located as close as possible to points of support.

Capillary tubing shall be clipped to large pipes or steel battens at 400mm intervals. Supports for piping shall be located at centres not exceeding the following.

Pipe Diameter	Minimum hanger rod size in mm	Maximum Spacing of Supports in metres		
		Copper & Stainless Steel	PP-R, PE, & uPVC	
			Vertical	Horizontal
20	6.4	1.5	1.2	0.6
25	6.4	1.5	1.4	0.7
32	6.4	2.0	1.5	0.75
40	10.0	2.5	1.7	0.85
50	10.0	2.5	1.8	0.9
63	10.0	3.0	2.1	1.05
75	12.0	3.0	2.4	1.2
90	12.0	3.0	2.7	1.35
110	16.0	3.0	3.0	1.5
160	16.0	3.0	4.0	2.0

Spacings shall be closer than specified where required by relevant Standards or Codes or where recommended by the piping materials manufacturer.

All pipework shall be laterally restrained in a similar manner to maintain alignment under all conditions (at not greater than 6m centres).

Secondary fixing brackets and supports shall be of a suitable metallic, non-ferrous material or a ferrous material suitably treated to prevent corrosion and electrolyte action

Ensure that the pipework does not come into contact with any treated timber contained in the building structure.

### 3.9 EXPANSION

Where pipe runs are relatively short it is intended to accommodate expansive movement by means of pipe bends, loops and offsets. Suitable bends, loops and offsets are to be provided and supports are to be so arranged that they accommodate expansion and contraction without undue stress in the pipework.

Allowance for movement due to thermal expansion and contraction shall be in the method of support (e.g. hanger rods) and not between the pipe and the saddle or clamp. Vibration shall be absorbed by the use of anti-vibration hangers.

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Building Division **3.10 GRADING, AIR VENTS & DRAINS**

All water piping systems shall be installed with a continuous upward grade in the direction of flow.

Any section of the pipework in which air may collect shall be fitted with approved type air vents complete with drain lines to nearest floor waste or drain. Vent points shall be as per the standard detail.

Automatic vent valves shall be Spirax Sarco or equal approved with all drain lines via a tundish so that leaks are clearly visible.

Provision shall be made at all low parts in pipework to enable the pipework to be completely drained (capped with hose union connections).

**3.11 TESTING OF PIPING**

**3.11.1 General**

Each pipework system shall be tested as a whole or in sections as the work proceeds in accordance with all appropriate statutory and Standard or Code requirements and as follows.

Test pressures shall be applied during the construction period and prior to the pipelines being lagged or painted with each section being blanked until further tests are made.

Where necessary, all equipment shall be "blanked off" to prevent excessive pressures to equipment, seals or other similar parts of the system.

Notification shall be given for all tests not less than 48 hours (2 full working days) in advance so that a representative may observe the test.

**3.11.2 Testing of Piping**

Water systems shall be subject to a hydrostatic test pressure of 1500kpa recorded by an approved gauge placed at the highest point of each system.

All tests shall be conducted using treated water and pressures shall be maintained for a minimum of 24 hours without loss of pressure when corrected for ambient temperature change as necessary. Pipe pressure and ambient air temperature shall be recorded by the sub-contractor.

**3.12 THERMAL INSULATION**

All domestic water pipework shall be insulated with Armaflex/FR.

Prior to the application of insulation, all surfaces shall be thoroughly cleaned of scale, rust, grease, oil and dirt. The application of the insulating materials to any part of the installation shall not be commenced until all pressure tests on the relevant part have been completed and approved.

All insulating materials shall be delivered to the site in a dry condition and shall be housed in a dry store until used.

The insulation shall be pre-formed for the required pipe size. Sections of insulation should be slipped over open ends of pipework where practical. Any sections cut longitudinally to the installed must be glued along the full length of the seam. Edges and ends of insulating sections shall be arranged to butt up close to one another over the whole insulated surface. The use of scrap strips for insulation of fittings is unacceptable.

Pressure sensitive tapes shall not be accepted over joints and allowance for thermal movement shall be provided for in the application of insulation.

In all respects the insulation shall be applied in accordance with the Manufacturers instructions. In particular the insulation shall not be stretched or compressed.

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Valves and fittings should be insulated with care being taken in the development of forms from the flat sheet material.

Insulation at elbows (45°, 90°), shall be made by use of a mitre joint or developed from sheet material to provide a clean neat cover. Compression and folding of the insulation around the elbow will be cause for rejection.

Any pipework insulation installed exterior to the building shall be clad with 0.6mm aluminium cladding (neatly coned down at fittings).

**3.13 VALVE IDENTIFICATION**

All valves shall be marked for identification purposes. Each valve shall have a circular aluminium or brass disc attached by wire or chain to the bodies of the valves. The disks shall be stamped with markings 10mm high sufficient to identify the valve. Details of all proposed identification marking numbers shall be provided for approval at the appropriate time.

**3.14 VALVES**

All valves and fittings shall be the standard products of approved manufacturers as scheduled.

All valves shall be suitable and correctly sized for each application and unless otherwise shown shall be of pipeline size. Control valves and bypass valves shall be selected to suit the operating characteristics of the system.

Backflow preventers and water meters are to be supplied and installed as required by the Territorial Authority and in accordance with the New Zealand Building Code. Control valves and valves such as pressure reducing, safety and relief valves, shall be selected to meet the pressures and operating characteristics of the systems in which they are installed with pressure drops and velocities strictly in accordance with the manufacturer's recommendations.

Cold connections and hot connections are to be made to the right and to the left hand side of the fittings respectively.

Pipework to all areas and fixtures shall be connected via line size isolation valves so that maintenance of an item or area can be undertaken with minimum disruption to remainder of system.

All valves, controls and accessories shall be installed in positions readily accessible for operation and maintenance. Thermometers, pressure gauges and similar instruments shall be readily visible after installation. Upon completion of the piping system and before placing it in service valve packings shall be thoroughly examined and where necessary replaced.

All valves shall be entirely suitable and correctly sized for each application and unless otherwise shown shall be of pipeline size except in the case of control valves and by-pass valves which shall be selected to suit the operating characteristics of the system. Sample valves may be required to be submitted for approval.

All valves including control valves, pressure reducing, safety and relief valves, shall be selected to meet the pressures and operating characteristics of the systems in which they are installed with pressure drops and velocities strictly in accordance with the Manufacturer's recommendations.

**3.15 GAUGE AND INSTRUMENT FITTINGS**

Pockets for thermometers and similar purposes shall be located in positions where no adverse effects will occur to flow conditions.

All pockets and steel liners shall be of the removable (screwed) stainless steel type inserted through screwed type bosses welded to the pipe. All pockets in copper

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lines shall be of the fixed copper tube type with the bottom end blanked off and the pocket brazed into the copper pipe.

Pipes smaller than 65mm diameter shall be enlarged to accommodate the pockets without loss in flow areas. Pockets shall be vertical or set at an angle to retain the heat conducting fluid.

Bosses for binder fittings, pressure gauges and similar purposes shall be of the standard internally screwed type, welded or brazed as appropriate at right angles to the pipes and sized as required for each application.

### 3.16 CLEANLINESS

Cleanliness shall be maintained by capping incomplete sections of erected pipework with plastic end caps or tape to prevent the ingress of extraneous material.

### 3.17 SEPARATIONS

Ensure pipelines are physically separate from the metal sheath and armour of electric cables and from metal conduits, ducts, trunking and bare earth continuity conductors associated with any cables.

### 3.18 EXTENSIONS TO EXISTING INSTALLATIONS

Extensions to existing pipe systems shall be physically separated from the existing pipework, and the final connection made only when all tests required on the new pipework sections have been completed.

### 3.19 PIPE PREPARATION

Pipe ends shall be cut clean and square with the pipe axis, using wheel cutters where possible and deburred, re-rounded and cleaned of cuttings  
Allow for pipe ends and inside of fittings to be thoroughly cleaned

### 3.20 PIPE PENETRATIONS

The insulation on pipes shall be continuous through all building penetrations. The space between the pipe or insulation sheathing and wall or floor penetrations shall be fitted with high density mineral wool or fibreglass insulation as an acoustic seal. The acoustic rating of the seal shall be equivalent to the partition through which the pipe passes.

Where pipes pass through fire walls or floors, the space between the piping and the structure shall be sealed with fire rated seal of rating equal to that of the wall as approved by all local authorities. *(Not part of this sub contract)*

### 3.21 EXCAVATION TRENCHING AND BACKFILLING

Excavation and backfilling for underground pipework shall be carried out as part of these works.

All excavated material not required or acceptable for backfill shall be disposed of and removed from site.

Backfilling shall only be commenced on completion of hydrostatic testing and verification of grades followed by inspection and approval from the Engineer and relevant Territorial Authorities.

#### 3.21.1 Excavation/Trenching

Excavation shall be performed in a safe and methodical manner utilising all necessary sheeting, shoring and bracing with means to enable pumping or baling of surplus water from the works.

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Excavation shall be sized to provide a minimum clear space of 1500mm between pipe and trench face and arranged in conjunction with laying of pipe so that it is only as far as necessary to enable satisfactory bedding and excavation of the pipework installation. Unless noted otherwise, the depth of excavation shall be such that a minimum cover of 600mm and 900mm of pipework shall be provided under unpaved and paved area respectively.

Pipework under paved areas shall be protected with a continuous concrete slab 75mm thick and full trench width if cover is less than 900mm. In all cases cover shall not be less than 600mm.

Where over-excavation occurs, approved fill material shall be placed and compacted to the required level to approval.

### 3.21.2 Backfilling

No backfilling shall commence until the testing of that section of the pipe installation (laying and jointing) is complete.

Except where otherwise shown on the drawings or directed by the Engineer, backfilling of trenches and around toby boxes etc shall be 'selected compacted fill' complying with and placed and compacted as specified in AS G13/AS2, E1/AS1.

Heavy construction equipment shall not be operated over or near the pipes until a minimum cover of 900mm has been achieved. Any pipe moved or damaged during compaction shall be replaced at the subcontractor's expense.

### 3.21.3 Surface Reinstatement

All surface reinstatement from trenching is by this trade.

## 3.22 IDENTIFICATION AND SIGNWRITING

### 3.22.1 Identification

Identification colour bands and lettering shall be painted on pipelines or alternatively pressure sensitive tape bands may be used.

Identification shall be applied at:

- a) 8000mm intervals along pipe runs
- b) All branches in the system
- c) Each side of a safety band
- d) Each side of a partition through which the pipe passes
- e) Identified at all junctions, terminations and control points.

## H.4 PLANT AND EQUIPMENT

### 4.1 GENERAL

Comply with the Drawings and associated documents of this specification.

Submit certified unit characteristics, including power, sound and efficiency curves to the Engineer for approval before ordering.

Select equipment having sound power levels that do not exceed the specified space noise levels while operating at the design capacities. Test certificates of sound power levels shall be provided before units are ordered.

### 4.2 DOMESTIC HOT WATER CYLINDERS

The domestic hot water cylinders shall be as specified in the Equipment Schedules, and designed and manufactured to meet the New Zealand Minimum Energy Performance Standards (MEPS). Any suggested alternative must be approved by the Engineer before ordering.

The cylinder shall be supplied pre-wired to meet New Zealand Standards and Building Code requirements. Thermostats and gas cut-out switches are to be prefitted and factory tested.

Allow to supply and install in accordance with the manufacturer's recommendations. Allow to triple-strap each cylinder in accordance with seismic restraint requirements.

#### **4.3 PLANT INSTALLATION**

Provide supports for plant including cylinders, provide interconnecting piping where required; flash all wall and roof penetrations, and make electrical and controls connections.

Ensure all plant is positioned to provide the manufacturers recommended clearance around units for servicing and maintenance access and airflow.

Condensate Drains: Connect condensate trays to nearest drain points using trapped minimum DN 25 drain lines.

#### **4.4 ROOF/ BUILDING PENETRATIONS**

All penetrations through the building fabric are to be weather tight. Use Aquaseal or equivalent and install to manufacturers recommendations.

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27/02/2020**

**BUILDING CONSENT NUMBER  
2019/1381**

Invercargill Central - D.S Anchor - Zone 1  
Section I: Domestic Water Services Equipment Schedules

Building Division

**SECTION I  
DOMESTIC WATER SERVICES EQUIPMENT SCHEDULES**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

**CONSENT ISSUE**

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**i.1 HOT WATER CYLINDERS**

Ref	Supply	Model	Storage Capacity (L)	Size (mm)	Thermostat Setting (°C)	Electrical Input (kW)
HWC1	Zone 1 Mall Retail Tenancies and BOH Cleaners HWC	Rheem MPVE 31204515	45	Ø525 x 490H	65	1Ø/3.0
HWC2	Zone 1 Level 1 Department store BOH Staff Amenities	Rheem MPVE 31225015	250	Ø1555 x 580H	65	1Ø/3.0
HWC3	Zone 1 Grd Level Department store Beauty/Cosmetics HWC	Rheem MPVE 31204515	45	Ø525 x 490H	65	1Ø/3.0
HWC4	Zone 1 Level 2 Childcare	Rheem MPVE 31225015	250	Ø1555 x 580H	65	1Ø/3.0

**NOTES:**

1. Cylinders shall be supplied and installed by the Hydraulics Contractor and wired by the Electrical Contractor.
2. HWCs shall be VE models as supplied by Rheem NZ Ltd.
3. Mount the cylinders with wall brackets, and seismic restraints in accordance with the manufacturer's recommendations and the NZBC. This trade shall supply all supports, frames and seismic restraints for the Hot Water Cylinders.
4. Cylinders shall be manufactured to comply with all relevant NZ standards and regulations.
5. The cylinders shall be factory assembled and tested, manufactured with immersion electric heating units fitted with a surface mounted thermostat incorporating a safety over temperature cut out.
6. Cylinders shall be insulated using CFC free material, and complete with A grade insulation.
7. HWCs shall have a vitreous enamel lining which protects the cylinder from a variety of water impurities and shall be complete with Anodic element protection.
8. Allow for all over temperature relief, safety valves, safety trays, and copper tundish for minimum 25mm connection to waste.

9. Refer to the Specification and Drawings for further details.

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## I.2 TEMPERING VALVES

Ref	Location	Description	Duty (l/s)	Location	Model	Ports
TV1	Point of supply	HWC 4 Childcare Areas Sanitary Fixture Tempering (Supplied with Sanitary Fixtures)	> 0.3	Childcare Areas whb/sinks	Delabie Premix Compact Valve DE733015, Ø1/2", 15mm	3 Port
TV2	Point of supply	HWC 2 Sanitary Fixture Tempering	0.06-0.41	Department Store BOH whbs/sinks	Caleffi TMV521312 Ø15mm	3 Port
TV	Adjacent to HWC	HWC Tempering	0.3 – 1.2	Adjacent HW1-4	Caleffi TV523150 Ø3/4", 20mm	3 Port

### NOTES:

1. Tempering valves shall be supplied and installed by the Hydraulic Services Contractor.
2. All tempering valves shall be supplied with manufacturers check valves on both the hot and cold inlet ports
3. Tempering valves serving childcare sanitary fixtures shall be set to 45°C as permitted by the NZBC G12 clause 6.14.1 b). All others shall be set to 55°C (Adjustable).
4. Tempering valves shall be as supplied by MacDonald Industries, Chch (03 348 2356) or Waterware Group, Auckland (09 273 9191).
5. Refer to the Specification and Drawings for further details.

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### 1.3 PUMPS

Ref	Make	Model	Description	Duty	Motor
HWRP 1	Grundfos	COMFORT 15-14 PM AUTOADAPT – Temperature Controlled (50°C)	Domestic HW Recirculation Pump	0.12 l/s @ 7kPa	1Ø / 0.007kW

**NOTES:**

1. Pump details are as supplied by Grundfos Ltd.
2. Pumps to be supplied with overload protection.
3. All pumps shall be wired from the associated Childcare Facility or Department Store BOH Electrical Distribution Board by the main Electrician with a local isolator provided adjacent to each pump.
4. Pumps are to be installed complete with required couplings, insulation, seismic restraints and acoustic and vibration mounts.
5. Pumps shall be installed in accordance with the manufacturer's recommendations.
6. Refer to the detailed drawings and specification for further information.

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## 1.4 UV STERILIZING UNIT

Ref	Service	Duty	Electrical	Pipe Connection	Description
UV1	Childcare Facility HW Recirculation Water Sterilisation	7.9 l/m (@40 mJ/cm <sup>2</sup> )	1Ø / 19W	½"/15mm	Greenway GAUV-1S

### NOTES:

1. UV sterilisation units shall be supplied and piped up by the Hydraulics Contractor, and wired by the Electrical Contractor,
2. UV Sterilisation unit details are as supplied Taylor Purification, contact [gerard@taylor-purification.co.nz](mailto:gerard@taylor-purification.co.nz), Tel: (03) 4799903
3. All UV systems shall be wired from the associated Childcare Facility or Department Store BOH Electrical Distribution Board by the main Electrician.
4. UV Sterilisation units shall be supplied complete with alarm units to indicate UV lamp failure.
5. The UV Sterilisation Unit shall be interlocked to run when the recirculation pump is operating.
6. Refer to the drawings and specification for further information.

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## I.5 VALVES AND FITTINGS

### Auto Air Vents

Valves shall have bronze bodies, brass ball, integral strainer, stainless steel valve and seat. An isolating valve shall be provided to enable each valve to be cleaned without the need to drain the system. Provide 2 metres of 10mm copper drains from each vent point.

### Backflow Preventers

Backflow preventers shall be factory assembled reduced pressure principle backflow type, with bronze body, stainless steel springs and silicone rubber seats, including all necessary test points to enable a complete function check. Include full bore ball valves or approved butterfly isolating valves on both sides of each backflow preventer valve. Backflow preventers smaller than 65mm diameter shall be Wilkins Series 975XL, larger than 65mm Wilkins 375.

### Check Valves

Bronze Swing Check Valves, Crane B 137 or equal with screwed ends shall be used up to and including 50mm diameter.

Cast Iron Swing Check Valves of the Spring Loaded Split Plate type and having flanged ends shall be used for 65mm diameter and larger.

### Drain valves

Shall be gunmetal screwed plug type with integral washer, hose union fittings and key operation.

### Flexible Hoses

Flexible stainless steel hoses shall be Aquaneckt supply.

### Gauges

All permanent temperature and pressure gauges in pipework shall be of the linear calibrated dial type. Temperature gauges shall be 65mm diameter and read temperature in degrees Celsius. Pressure gauges shall be 100mm diameter and shall read pressure in kilopascals.

### Hose Taps

Hose Tap Vacuum Breakers for protection of the water supply serving hose taps shall be constructed with a bronze body and stainless steel spring. An acceptable model is a Wilkins model BFP-8.

### Isolating Valves

All valves up to and including 50 mm shall be bronze or stainless steel bodied ball valves with a lever handle that opens or closes the valve with a 90° turn of the lever. Valve balls shall be full bore stainless steel.

Keystone or Dezurik Butterfly valves with cast iron lugged body, stainless steel disc, stainless steel stem and EDPM liner shall be used for 50mm diameter and larger

Fixture Isolating Valves shall be ball 'o fix type

Building Division Isolating/Regulating Valves

Tour and Anderson STA-D or STA-F type with a calibrated hand wheel and measuring points suitable for Tour and Anderson's CBI commissioning computer

Pressure Equalising Valves

Shall be supplied by Green Industries New Zealand Limited. 279 Kahikatea Drive, PO Box 5055 Hamilton. Phone (07) 8460850 Fax:(07) 846-0867

Pressure Relief Valves

Refer to Pressure Relief Valve Schedule

Strainers

Strainers shall be line size or larger.

Bronze Body Strainers of the Y type with screwed ends shall be used up to and including 50mm diameter.

Cast Iron Body Strainers of the Y type with flanged ends shall be used for 65mm diameter and larger.

Tempering Valves

Refer to Tempering Valve Schedule.

Test Points

Test points shall be self sealing Tour & Andersson Binder Type suitable for measuring pressure and temperature.

Thermostatic Circulation Valves

Thermostatic circulation valves shall be Tour and Andersson Therm valves and shall be used to control the domestic hot water circulation. The valves shall have corrosion-resistant acetal plastic discs, glass fibre reinforced polyamide plastic handwheels, EPDM rubber O-rings, and all other parts in contact with water shall be manufactured from AMETAL alloy. Valves shall be supplied complete with integrated thermometer for temperature control, stepless temperature setting, shut-off function as standard.

Water Meters

Shall be by Kent/Elster available from Arthur D Riley Ltd, to Dunedin City Council approval. Shall be rated for temperatures up to 50°C, pressures to 16bar, with an epoxy powder coated body and cover and shall feature a pulse output suitable for external monitoring by electronic controls.

Trap Primers

Shall be timed solenoid valves rated for pressures to 8bar minimum and installed in an accessible location.

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## I.6 PIPE MATERIALS & INSULATION

The piping systems to be provided under this Specification shall conform to the following requirements.

Systems	Material	Piping Type	Insulation	Design Pressure	Design Temp Range
Domestic Cold Water	PE-RT Class 2 or PEX-a Cross Linked Polyethylene.	AS 4176.1 -2010 DIN EN 15874-5	15mm 0.38W/mK FR/Armaflex	1000kPa	5°C-40°C
Domestic Cold Water Below Ground	Iplex Blueline MDPE80	AS/NZS 4130:2003	-	PN12	5°C-40°C
Hose Tap Risers	Crosslinked polyethylene (PEX-a) piping	AS 2492 (pipes) AS 2537 (fittings)	20mm 0.038W/mK FR/Armaflex	1000kPa	5°C-40°
Domestic Hot Water	PE-RT Class 2 or Crosslinked polyethylene (PEX-a) piping	AS 4176.1 -2010 DIN EN 15874-5	15mm 0.038W/mK FR/Armaflex	1000kPa	5°C-70°C
Vents & Drains	uPVC or Table 1 Copper	NZS 7648 Class D or NZS 3501	-	-	5°C-70°C

### NOTES:

- All piping shall be of the best available quality and shall be supplied in clean, full standard straight lengths, free from any defects such as mill scale, rust, burns, dents, kinks, etc. and with all ends sealed against the ingress of foreign matter and protected against mechanical damage. All piping shall be kept in a clean condition at all times during storage, fabrication, installation and testing.

The PEX-a product is available in coils and rigid lengths. All sizes 40 mm and larger must be run using rigid lengths.

- At the contractor's discretion the cold water services may also use PERT as this may be easier to manage on the site.

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4. Multilayer PE-RT pipework 20-32 dia push fit; 40 -75 dia pressure fit, with aluminium internal layer.
5. Insulation materials shall utilise only zero ozone depleting blowing agents and meet surface spread of flame requirements.
6. Insulation external to the building (above ground) or exposed to UV light shall be clad in Thermobreak.
7. All pipework shall be colour banded and labelled in accordance with NZS5807. Where pipework passes through walls, labels are to be fitted adjacent to each side of the obstruction.
8. Refer to the Specification and Drawings for further details.

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**SECTION J**

**PROJECT SPECIFIC SANITARY SEWER & STORMWATER SERVICES SCOPE**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

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## J.1 SCOPE OF WORK

The contract comprises the construction of the sanitary sewer & stormwater service aspects of the D.S. Anchor Zone 1 portion of the new Invercargill Central Shopping Mall Development to be located at 33 Esk St. Invercargill.

The building comprises a large two level, department store incorporating open plan retail shop floor, reserve storage areas, offices and amenity areas, a separate Childcare facility on Level 2 as well as several smaller ground floor tenancies associated with the Mall accessed via Esk St. shopfront and other Mall Storage and services areas on the south side of the building.

The contractor shall supply, manufacture, install, test and commission the Sanitary Sewer systems and associated works.

### 1.1 GENERAL

The scope of works shall include;

- a) Supply and installation of new sanitary sewer systems including sanitary plumbing, stacks, rodding eyes, vents, drains, gullies and connections to suit the building and site layout.
- b) Supply and install all sanitaryware and fittings as detailed in the Architects plumbing schedule.
- c) Supply and install charging pipe to Overflow Relief Gullies and Floor Waste Gully from water supply to hose tap provided by Plumber.
- d) Supply and installation of floor waste gullies, and floor wastes.
- e) Allow to coordinate with mechanical services trade for final qty., location and termination requirements of AC system condensate waste connection to Tundishes – indicative locations are shown on drawings.
- f) Final termination to all sanitary fixtures specified in the architectural schedules. Note specifically Architectural requirements for chrome waste pipework where visible from WHBs in some areas.
- g) Supply and installation of Childcare roof stormwater and surface water drainage systems, including overflow pipework. Note that the main department store roof drainage system shall be siphonic as detailed in the Architect's documentation.
- h) All necessary concrete encasement or changes to existing concrete encasement where required by shallow cover.
- i) All necessary trenching, backfilling and surface reinstatement. Including plastic marker tape above all in-ground pipework.
- j) All builders work including cutting of holes, making good all ceilings including any damaged tiles and wall linings, painting to match existing finishes, and weather flashings to penetrations through external walls.
- k) Maintenance of sewerage and stormwater drainage systems in operational conditions as necessary during the contract works.
- l) Identification of any areas where site conditions prevent the installation as outlined in the documentation.

- m) Provision of "As Built" drawings and Operating and Maintenance Manuals as specified.
- n) Testing and commissioning of all systems installed under this contract.
- o) Maintenance of the installation in accordance with the Schedules and Instructions in the Operating and Maintenance Manual for a period of 12 months from the date of Practical Completion.
- p) Guarantee the completed installations against defects in material and/or workmanship for a period of 12 months from the date of Practical Completion. Faulty equipment and defects shall be replaced or repaired without delay and at no cost to the Principal.
- q) Provision of a Producer Statement – Construction covering the systems.
- r) Supply and installation of all other equipment and all labour not specifically mentioned above and necessary to render the systems fully functional.
- s) Principals Instructions.

## 1.2 BUILDERS WORK

All penetrations required for the installation of the Sanitary Sewer and Stormwater services, including penetrations through floor slabs, concrete walls, block work, etc., are the responsibility of the Sanitary Sewer and Stormwater Sub-contractors.

Noise rating and waterproofing must be maintained after making good. This trade is responsible for filling and sealing around Sanitary Sewer and Stormwater services pipes and ducts.

Where sealing of penetrations is not stated allow for making good to equal performance for sound, etc., and seek final details from the Contractor.

No additional payments for builders work not allowed in the Sanitary Sewer and Stormwater services tender will be approved, if deemed necessary for the proper execution of the Sanitary Sewer and Stormwater services works.

## 1.3 ELECTRICIANS WORK

Main Electrician shall wire all plant supplied by the Hydraulic services trade, refer Section C. Allow to coordinate with Main Electrician for switchboard loadings and connection requirements.

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Invercargill Central - D.S Anchor - Zone 1  
Section K: Sanitary Sewer & Stormwater Services Standard Clauses

Building Division

**SECTION K  
SANITARY SEWER & STORMWATER SERVICES  
STANDARD CLAUSES**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

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## K.1 CONDITIONS

The requirements of Section A of this specification "Preliminary and General" shall be read as directly included herein.

## K.2 ALTERNATIVE DESIGNS

Alternative design solutions for the building will be considered, but all tenderers must also price systems as described in this specification.

Submittal requirements for Alternative Designs are defined in Section A under Submittal Requirements.

## K.3 SCOPE OF WORK

Refer Section J

## K.4 DESCRIPTION OF WORK

### 4.1. DESIGN DETAILS

The sanitary plumbing and drainlaying services shall be designed and installed in accordance with the requirements of the New Zealand Building Code and the associated Codes of Practice / Standards.

In particular:

- AS/NZS 3500:2015 (All Parts) "National plumbing and drainage."

Specifically:

- Sanitary Sewer AS/NZS 3500.2:2015
- Stormwater AS/NZS 3500.3:2015
- The technical details of Invercargill City Council Construction Standard Specifications for installation details of all pipework outside site boundaries

The sanitary plumbing, stormwater and drainlaying services drawings and specification have been scoped and designed for the guidance of the Sub-Contractor. Notwithstanding this, the Sub-Contractor is deemed to have full knowledge and experience of sanitary sewer and stormwater systems installed and shall be capable of achieving the conditions specified below under the stated design conditions.

Other guarantees of performance as required in regard to such matters as noise level are stated in the relevant Sections of the Specification.

The contractor shall supply, manufacture, install, test and commission the sanitary plumbing and drainage systems and associated works.

Building Division **4.1.1 Sanitary Sewer**

Sewer pipework from the building shall be completed as shown on the Drawings. The surface reinstatement of all trenching will be by this trade.

The sanitary fixtures, fittings and equipment will be supplied and installed by others. Fit accurately and securely in position the waste, soil lines as applicable.

**4.1.2 Co-ordination of Installation of Services and Finishes**

The Sub Contractor shall be responsible for co-ordination of the installation with all trades and the installation and commissioning of the services located above, below and within the ceilings, walls and floors.

The co-ordination shall be such as to ensure that all services within false ceilings and walls are completely installed so that it will not be necessary to remove any ceiling tiles sections or panels to finish any other work, or to test, commission or adjust the installed systems.

**4.1.3 Performance Guarantees**

Complete and submit Schedule of Deviations for any departures from Contract documents at time of tender and at Practical Completion with written evidence of approval of individual items.

Submit certification of compliance with the Contract documents except for approved deviations at Practical Completion.

Submit certification of compliance with statutory authority requirements and provide evidence of statutory authority approvals at Practical Completion.

Submit signed off commissioning schedules as evidence that the various systems operate in a stable safe and automatic manner under all conditions of full and partial load. Guarantee that capacities and efficiencies of equipment and systems satisfy requirements.

**K.5 SANITARY SEWER AND STORMWATER**

**5.1. WORKMANSHIP**

Where required, work shall be by registered drainlayers and shall pass such tests as the Territorial Authority may require. The Subcontractor shall arrange and pay for all tests required by the Territorial Authority and shall, at not extra cost, remedy any defects to the approval of the Territorial Authority.

**5.2. CONNECTION TO EXISTING DRAIN AND INSPECTION CHAMBERS**

Excavation near any existing sewer, stormwater drain or inspection chambers shall be done with the utmost care to avoid damage. Any damage caused shall be made good at no extra cost. Ensure that no debris, dirt or other foreign material enters the drainage system.

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### MATERIALS

For all the materials and goods described in this Specification use the best of their respective kinds, free from imperfections and complying with the New Zealand Standards.

Materials unless otherwise specified shall be in accordance with the New Zealand Building Code.

Bedding material shall be granular material of 12mm crushed stone, gravel or other approved bedding material.

Refer to the Pipework section for further details.

### 5.4. SOIL PIPES, WASTES, TRAPS AND VENTS

Allow to install all wastes, soil pipes, traps and vents shown on the drawings and specified herein.

Soil and waste pipes, vents, and fittings shall be uPVC in accordance with AS/NZS1260. The maximum fixture unit loading and the minimum grade of vented drains shall be as per Tables 3.3.1 and 3.4.1 respectively, of AS/NZS 3500.2:2015.

Unvented branch drains shall be in accordance with Clause 3.10 and Table 3.10.2 of AS/NZS 3500.2:2015.

The minimum grade of discharge pipes and the maximum fixture unit loadings for graded discharge pipes shall be as per Tables 6.5.1 and 8.2.2(A) & (B), respectively, of AS/NZS 3500.2:2015.

Where the Subcontractor believes it is not possible to obtain the falls specified above, he shall immediately notify the Engineer before proceeding further.

Allow to provide supports to all waste and soil pipes in accordance with Clause 10.2 and Table 10.2.1 AS/NZS 3500.2:2015.

All uPVC vents 50mm diameter or less, which run under suspended floor slabs shall be supported in full length light gauge metal channels securely fixed to the building structure.

*Pipes passing through floor slabs or fire rated walls and ceilings shall be fitted with fire collars, Firepro or approved equal to match the rating of the partition penetrated. (Not part of this sub contract)*

Traps shall be installed under all sinks, wash hand basins, cleaners' sinks, tubs, floor wastes, floor drains, and as elsewhere noted on the drawings.

Provide cleaning eyes at all junctions and 90 degree bends on pipework, where not buried under concrete slabs.

Vent pipes (fixture vents etc) shall be installed and sized in accordance with NZS 3500.2:2015 with particular care to install horizontal runs at an upward gradient of not less than 1:80. Whenever possible, vent pipes shall be run through the soffit of the building to avoid roof penetrations.

Vents shall terminate in the open air in locations complying with Clause 6.8.4 and Figure 6.8.4 of AS/NZS 3500.2:2015.

Vents shall terminate not less than 150mm from the point of penetration through any wall covering and be fitted with an approved PVC vent cowl.



Allow to flash all penetrations for vent pipes at roof level with Aquaseal pipe flashings or similar fixed in accordance with the Manufacturer's instructions.

Before commencing any saw cutting or penetrations for the installation of pipework, inspection chambers and fittings, within the existing structure and floor slab, the subcontractor shall obtain written consent from the Structural Engineer or Architect for this work to be carried out.

Piping run in timber framed and prefabricated walls is to run on the centre lie of the framing. All holes in timber studs and dwangs are to be drilled and notching of framing will not be allowed.

#### 5.4.1 Plumbing Fittings

All sinks, wash hand basins, showers, etc. shall be supplied with wastes to suit the waste pipe sizes shown on the drawings. All wastes shall be complete with chrome plate plugs on chains.

#### 5.5. PIPE JOINTS

UPVC pipes below the slab and/or within the ground shall be jointed using a seal ring mechanical joint. Rubber used in pipe joints is to conform to BS2494:1976 "Materials for elastomeric joints rings for pipe work and pipelines" or approved equivalent.

UPVC pipes above ground floor slab level shall be jointed using the solvent socket jointing method. Jointing of uPVC pipework shall be carried out in compliance with NZS 7643:1979 and the recommendations of the pipe and fitting manufacturer. Do not disturb or stress the assembled joint for a minimum of five minutes or to the manufacturer's recommendations. In cold weather, increase this time.

On all rigid drains entering (and leaving) a manhole, a flexible joint is required. This flexible joint is to be within 2 times pipe diameter or 650mm, whichever is the lesser, of the outside wall of the manhole.

#### 5.6. DRAIN LAYING

Excavate as necessary and lay drains in positions indicated.

Provide all pits and other related works.

Set out the systems to provide maximum falls and lay each pipe to uniform grade with sockets facing upgrade, spigots fully inserted and with full allowance for bedding.

Lay pipes to the lines and invert levels indicated or established by the contractor. No deviation shall be permitted without prior approval.

Marker tape: Lay plastic marker tape 300mm above all pipework.

Granular bedding: Lay pipes on a granular bedding having a minimum thickness of 100mm below the pipe barrel.

Unplasticized uPVC drain pipes shall be laid in compliance with the NZ Building Code acceptable solution G13/AS1 Foul Water Drainage and NZS 7643.

Pipes in and under floor slab:

- Pipes in and under slab shall be supported to provide the required gradient and restrained to resist flotation forces imposed during concrete placement.

## 5.7. PIPE COVER

All pipes in vehicular trafficked areas must have a cover of more than 500mm and installed to meet all the requirements of the Territorial Authority.

All pipes in private property not under roadways are to have cover of 300mm or more or to be provided with approved concrete protection (indication slabs).

## 5.8. CONNECTIONS

Make all applications, pay all fees and do all work related to sewer connections and installation generally. Excavate for and locate existing drains to undertake connection.

### 5.8.1 Inspection and Rodding Points

Provide inspection and rodding points in locations as required for ease of cleaning and future maintenance.

### 5.8.2 Stepirons

Stepirons for manholes shall be of the safety type ex 20mm diameter round mild steel rod, hot-dip galvanised at the rate of 0.7 kg/m<sup>2</sup>.

### 5.8.3 Precast Concrete

Inspection chambers and manholes of precast concrete are built in sections: materials, dimensions and test methods are described in BS5911: Parts 1 and 2. The base may be either of precast concrete or in situ concrete.

Where manholes or inspection chambers are constructed wholly above the water table, rebated joints sealed with cement mortar can be satisfactory. In waterlogged ground or where the water table is above the base, joints should be made watertight, preferably using a non-rigid jointing material such as a mastic sealant or a rubber ring joint.

### 5.8.4 Concrete

The following grades of concrete shall be used which shall comply with the relevant standards:

Grade 1 - A minimum crushing strength at 28 days of 20 MPa.

Grade 2 - A minimum crushing strength at 28 days of 10.5 MPa.

## 5.9. EXCAVATION TRENCHING AND BACKFILLING

Excavation and backfilling for underground pipework shall be carried out as part of these works.

All excavated material not required or acceptable for backfill shall be disposed of and removed from site.

Backfilling shall only be commenced on completion of hydrostatic testing and verification of grades followed by inspection and approval from the Engineer and relevant Territorial Authorities.

### 5.9.1 Excavation/Trenching

Excavation shall be performed in a safe and methodical manner utilising all necessary sheeting, shoring and bracing with means to enable pumping or baling of surplus water from the works.

Excavation shall be sized to provide a minimum clear space of 1500mm between pipe and trench face and arranged in conjunction with laying of pipe so that it is only as far as necessary to enable satisfactory bedding and excavation of the pipework installation. Unless noted otherwise, the depth of excavation shall be such that a minimum cover of 600mm and 900mm of pipework shall be provided under unpaved and paved area respectively.

Pipework under paved areas shall be protected with a continuous concrete slab 75mm thick and full trench width if cover is less than 900mm. In all cases cover shall be not less than 600mm.

Where over-excavation occurs, approved fill material shall be placed and compacted to the required level to approval.

At least 72 hours notice of required inspection shall be given. No new work shall be placed in excavation until these have been approved.

All excavations for the underground Hydraulic Services shall be carried out in materials as found on site.

Excavate for and lay drains in positions indicated. Provide all pits and other related works. Set out the systems to provide maximum falls and lay each pipe to uniform grade with sockets facing upgrade, spigots fully inserted and with full allowance for bedding. Drains shall be laid in different trenches for other underground services.

### 5.9.2 Backfilling

No backfilling shall commence until the testing of that section of the pipe installation (laying and jointing) is complete.

Except where otherwise shown on the drawings or directed by the Engineer, backfilling of trenches and around manholes and other drainage structures shall be 'selected compacted fill' complying with and placed and compacted as specified in AS G13/AS2, E1/AS1. Trenches containing UPVC pipe installations shall be backfilled and consolidated in accordance with NZS 7643.

Heavy construction equipment shall not be operated over or near the pipes until a minimum cover of 900mm has been achieved. Any pipe moved or damaged during compaction shall be replaced at the subcontractor's expense.

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Building Division **5.9.3 Initial Backfill**

The initial backfill around the pipe and for a minimum compacted thickness of 150mm above the top of the pipe shall be granular bedding material of clean sharp sand, quality approved in advance by the Engineer. The backfill material shall be carefully placed in layers not exceeding 150mm loose thickness and compacted simultaneously on both sides of the pipe by hand operated compaction equipment.

**5.9.4 Hardfill Backfill**

Where shown in the Drawings or otherwise directed by the Engineer for use in existing or future roads, backfill for trenches and around manholes and other drainage structures shall be hardfill type AP50 well-graded quality aggregate, approved in advance by the Engineer.

Hardfill backfill shall be spread in layers not exceeding 150mm loose thickness and each layer shall be compacted with approved mechanical compaction equipment before the next layer is placed.

Within existing and under new building areas, initial backfilling around pipe and inspection chambers to a height of 300mm above the pipe shall be compacted granular bedding material, and subsequent backfilling to subgrade level shall be hardfill placed in layers not exceeding 150mm loose thickness and compacted with mechanical compaction equipment. The final 400mm of backfilling in existing pavement areas shall be AP40 basecourse aggregate mechanically compacted in maximum 150mm thick layers to give a tight and smooth surface which when broomed will present a mosaic of large and small aggregate particles when bonded with fines.

UPVC pipes traversing under roadways, drives paths and hard-standing areas shall be protected with a 75mm thick concrete slab extending across the full width of the trench situated on hardfill in accordance with NZS 7643, 100mm above the top of the PVC pipe. The remainder of the trench shall be backfilled and consolidated in accordance with NZS 7643.

Final top soil of similar depth to the existing ground shall be placed to a neat and even finish.

Allow to make good to the Engineers approval any road or path seal top finishes. The surface reinstatement of all trenching will be by this trade.

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## K.6 PIPEWORK AND FITTINGS

### 6.1. GENERAL

This Section of the Specification covers the supply and installation of all pipework systems including associated fittings.

All piping systems shall be complete with fixings, fittings, vents, drains, expansion facilities, anchors, supports and other items necessary for the satisfactory operation of the systems as intended.

Connections to equipment shall be to the recommendations of the equipment manufacturer's and to approval.

Dissimilar metals shall be separated from direct contact with each other whenever possible. When such contact exists, all necessary gaskets and dielectric couplings of bituminised felt, rubber gaskets, Teflon tape or equivalent means suitable for the duty shall be provided.

All pipework shall be installed in an approved manner to meet structural, architectural and seismic conditions and to achieve a neat and workmanlike appearance and shall be laid out with adequate provision for concrete shrinkage, expansion, contraction, grading, alignment and access for maintenance with not less than 50 mm clearance between the external surfaces of pipes (including insulation where applicable) and all adjacent services and building structures.

Any damage caused to equipment due to entry of debris into pipework shall be repaired at no cost variation.

Full allowance shall be incorporated within all Hydraulic Services for building expansion/contraction and seismic restraint and movement.

### 6.2. PIPING AND MATERIALS

The pipe fittings, fixtures and appliances provided under this specification must be certified by the Standard Association of New Zealand as complying with the relevant New Zealand Standard and stamped accordingly.

Pipe sizes as indicated are 'Nominal' as listed in the relevant codes. It should be noted that their sizes do not always approximate to outside diameters.

All visible pipework connections to fittings and appliances shall be of chromed finish.

All pipework penetrating walls shall be provided with chromium plated escutcheon plates (visible to view) or galvanised escutcheon plates (above ceilings, in plantrooms, etc.).

All pipes penetrating basement walls below ground floor level shall be sealed using 'Link - Seals' and matching sleeves.

All escutcheon plates shall be installed to provide a neat finished appearance.

Pipe bends in uPVC shall be long radius 90 degree bends, and shall be in accordance with AS/NZS 7648, superseded by AS/NZS 1477:1996.

All uninsulated pipework embedded within concrete walls, floors or under concrete slabs shall be double wrapped with denso tape bituthene 3000 or equivalent.

Refer to the technical details of Invercargill City Council construction Standard Specifications for installation details of pipework outside site boundaries.

The piping systems to be provided under this Specification shall conform to the following requirements.

Systems	Material	Piping Type	Design Temp Range
Soil (within site boundaries)	uPVC SN10	NZS/AS 1260:1999	5°C-40°C
Soil (beyond site boundaries)	uPVC SN16	NZS/AS 1260:1999	5°C-40°C
Waste (within site boundaries)	uPVC SN10	NZS/AS 1260:1999	5°C-40°C
Vents & Drains	uPVC SN8 or SN10	NZS/AS 1260:1999	5°C-40°C
Stormwater (within site boundaries)	uPVC SN10	AS 1254	5°C-40°C
Stormwater (beyond site boundaries)	uPVC SN16	AS 1254	5°C-40°C

**6.3. SOIL AND WASTE VENT PIPES**

**6.3.1 General**

Pipes shall be complete with all bends, junctions, inspection and cleaning openings selected to ensure that inspection and cleaning openings are correctly positioned and correct radius bends and junctions are installed to provide a first class installation.

Provide and fix soil, waste and vent pipes to all sanitary fixtures and connect to stacks as indicated on the Drawings, in order to complete the works to satisfaction of the Engineer.

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### Expansion Joints

Install expansion joints in the vertical riser drains to the manufacturer's recommendations or approval alternatives to the Territorial Authority approval. Joint design shall allow contraction and expansion, and cause no damage to any other work or itself. Provide and fix expansion joints to all positions as required whether indicated on the drawings or not.

#### 6.3.3 Fixture outlets

To the outlets of all sanitary fixtures, provide and fix soils pipes, traps, waste and soil and anti-siphonage vents to the lines and details indicated on the Drawings.

Double union 'P' and 'S' traps as necessary shall be installed on wash basins, shower and sinks (chrome plated).

#### 6.3.4 Floor Waste Gullies

Provide to each floor waste a suitable, approved trap. Connect to fixture with suitable riser complete with inlet fitting. Reduce trap to size indicated on the Drawings and extend to waste as shown.

#### 6.3.5 Vent Pipes

Provide and install all vent pipes as required. Ensure all vent pipes are complete with necessary cowl and clips and extend to requisite heights above roof.

### 6.4. PIPE SUPPORTS

#### 6.4.1 General

All pipes shall be adequately supported and appropriately restrained by hangers, bracket, pedestals, clips, rollers and expansion joints and anchors designed to suit the requirements of each piping system and in accordance with the requirements of NZS 4219 and NZS 7643.

All piping exposed to view in such locations such as plantrooms, service tunnels and on roof areas shall be supported from common supports where practicable and shall be run in neat groups. Coordinate with the main Contractor regarding other services to be installed within such locations, in order such that uniformity of installation is obtained.

All steel supports and associated fittings where exposed to moisture, condensation or external elements shall be hot dip galvanised after fabrication and dissimilar metals shall be isolated by an approved type of non-conductive materials.

#### 6.4.2 Support Loadings and Spacing

All piping supports shall be designed to take the combined loads of pipes, valves, fittings, insulation (if applicable) and fluid in the pipes and all reactions due to thermal expansion or contraction of the piping.

All valves shall be located as close as possible to points of support and all valves in line sizes 100 mm and larger shall be separately supported. All supports shall be capable of keeping the piping in proper alignment and shall conform with all appropriate statutory and code requirements.

Notwithstanding the above, supports for horizontal piping shall be located on centres not exceeding the following:

Pipe Nominal Bore	Minimum hanger rod size in mm	Maximum Spacing of Supports in metres		
		Copper & Stainless Steel	PP-R, PE, & uPVC	
			Vertical	Horizontal
15	6.4	1.5	1.2	0.6
20	6.4	1.5	1.4	0.7
25	6.4	2.0	1.5	0.75
32	10.0	2.5	1.7	0.85
40	10.0	2.5	1.8	0.9
50	10.0	3.0	2.1	1.05
65	12.0	3.0	2.4	1.2
80	12.0	3.0	2.7	1.35
100	16.0	3.0	3.0	1.5
150	16.0	3.0	4.0	2.0

Provide additional supports at joints, valves, changes of direction and as necessary to ensure that pipework is secure.

All pipework shall be laterally restrained in a similar manner to maintain alignment under all conditions (at not greater than 6 m centres).

#### 6.4.3 Pipe Clamps and Saddles

Pipes in the vertical plumbing ducts shall be supported by 'Unistrut' brackets secured to the plumbing duct structure. Saddle brackets shall be galvanised 'Unistrut' and have a suitable lining strip to prevent the copper pipes from contacting the galvanised steel.

#### 6.4.4 Hanger Rods

All hanger rods shall be fabricated from bright mild steel bar of not less than the diameters listed in the table above.

All hanger rods and associated fittings shall be hot dip galvanised or cadmium plated after manufacture.

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Building Division **6.4.5 Fixed Supports**

Where no allowance is required for expansion, contraction or vibration, hanger rods may be fixed direct to floor slabs, structural members or to support brackets fixed to floor slabs, walls or structural members. Alternatively the pipes may be clamped directly on to support brackets fixed to floor slabs, walls or structural members.

**6.4.6 Moving Supports**

Moving supports shall be provided in all cases where the pipes are subject to movement due to expansion or contraction and the supports shall be designed to allow for the maximum possible movement involved.

Where hanger rods are used to take up this movement, they shall be selected such that the ratio of the effective rod length between pivots, to the maximum movement of the pipe is not less than 6:1.

All hanger rods used for moving type supports shall be provided with 'U' type brackets having over-sized holes for the rods. Similarly the clevis or welded yokes on the pipe clamps shall have oversized holes for the rods. The rods shall be secured at both ends with spherical washers and lock-nuts. Nuts shall not be used on any part of the rod between the bracket and the clevis or welded yoke.

**6.4.7 Anti-Vibration Hangers**

All pipework located in plantrooms and adjacent areas to occupied spaces, where vibration from equipment may be transmitted via the pipework, shall be supported from anti-vibration hangers.

Anti-vibration hangers shall contain a spring and double deflecting neoprene cups in series, Neoprene cups shall have a minimum deflection of 9 mm. Spring pitch diameters shall not be less than 0.8 of the compressed height of the spring rated load. Springs shall have a minimum additional travel to solid, equal to 50% of the rated deflection. Hangers shall have a minimum total deflection of 25 mm.

Approved types of anti-vibration hangers are 'Mason' type DHNS and PDNS.

**6.4.8 Anchors**

Anchors shall be provided where necessary and/or where shown on Drawings to provide reactions for expansion devices and flexible type connections to prevent excessive expansion or contraction forces in pipework from being transmitted to equipment.

On UPVC pipes the anchor shall comprise compression clamp bands arranged each side of the pipe section joints.

The anchors shall be so designed so that all welds are in shear not bending and shall be attached to the building structure in a location and manner which will prevent any damage to the structure to which they are attached.

Details of fabrication and method of fixing all anchors to structural members shall be shown on Shop Drawings for approval of the Engineer.

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No anchor shall be attached to any part of the building structure until full approval has been obtained for the location and method of fixing the anchor.

#### 6.4.9 Welding

Carry out all welding on supports, brackets, pedestals, anchors and all ancillary items by qualified and competent tradesman and with adequate supervision.

### 6.5. JOINTING

#### 6.5.1 Screwed Joint

Form watertight joint between piping and screwed fittings by use of Teflon tape.

#### 6.5.2 Dissimilar Pipes

Form watertight joints by use of oversized rubber rings, or equivalent, to approval of Authority having jurisdiction over the project.

### 6.6. PIPE PENETRATIONS

Sleeves shall be provided at all pipe penetrations. Where pipework passes through walls, galvanised steel sleeves of 1.6mm minimum thickness or UPVC sleeves shall be installed. Where pipework penetrates floor slabs, galvanised steel sleeves shall be installed which extend at least 100 mm above the floor.

The insulation on pipes shall be continuous through sleeves and shall be sheathed with galvanised steel sheet for a minimum distance of 25mm either side of the sleeve.

Penetration shall be of an annular size to allow 25mm around pipework protruding penetration.

The space between the pipe or the insulation sheathing and the wall or floor sleeve shall be fitted with high-density mineral wool or fibreglass insulation as an acoustic seal. The acoustic rating of the seal shall be equivalent to the partition through which the pipe passes.

*Where pipes pass through fire walls or floors, the space between the piping and the sleeves shall be sealed with fire rated seal of rating equal to that of the wall as approved by all local authorities or in the case of UPVC pipes fitted with approved type fire collars. (Not part of this sub contract)*

All pipes penetrating basement walls below ground level shall be sealed using 'Link-Seals' and matching sleeves.

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Invercargill Central - D.S Anchor - Zone 1  
Section L: Sanitary Sewer & Stormwater Services Equipment Schedules

Building Division

**SECTION L  
SANITARY SEWER & STORMWATER SERVICES EQUIPMENT SCHEDULES**

**INVERCARGILL CENTRAL**

**D.S ANCHOR - ZONE 1**

**CONSENT ISSUE**

L.1	FLOOR WASTE GULLIES/DRAINS.....	1
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## L.1 FLOOR WASTE GULLIES/DRAINS

Ref	Location	Outlet Diameter	Discharge Flow (l/min)	Description	Model	Stainless Steel Strainer
FWG	Cleaners / Accessible Showers	DN80	-	Round Chrome	Allproof Industries VK80CP	N
FD	Childcare External Play Area Surface Water Drain	DN110	270	Floor Drain 300mm Square	Kessel Ecoguss Ø110/48501	N
OD	Childcare External Play Area Overflow Drain	DN110	-	SS Deck Dome	Ardex 19837	Y

### NOTES:

1. Allow to provide Floor Waste Gullies manufactured by Allproof Industries (where none specified by Architect) for tendering purposes only, confirm final selections prior to ordering.
2. Floor Waste Gullies shall be installed complete with matching PVC Tile Leak Control Flange to match specified gully
3. Refer to specification and drawings for further details.

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## L.2 PIPE MATERIALS & INSULATION

The piping systems to be provided under this Specification shall conform to the following requirements.

Systems	Material	Piping Type	Insulation	Design Pressure	Design Temp Range
Soil (within site boundaries)	uPVC SN10	NZS/AS 1260:1999	-	-	5°C-40°C
Sanitary & Stormwater, Acoustic Rated (within site boundaries)	Raupiano Polypropylene	NZS/AS 1260:1999	-	-	5°C-90°C
Soil (beyond site boundaries)	uPVC SN16	NZS/AS 1260:1999	-	-	5°C-40°C
Waste (within site boundaries)	uPVC SN10	NZS/AS 1260:1999	-	-	5°C-40°C
Vents & Drains	uPVC SN8 or SN10	NZS/AS 1260:1999	-	-	5°C-40°C
	Copper	NZS 3501	-	-	40°C-70°C
Stormwater (within site boundaries)	uPVC SN10	AS 1254	-	-	5°C-40°C
Stormwater (beyond site boundaries)	uPVC SN16	AS 1254	-	-	5°C-40°C

**NOTES:**

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1. Refer to the technical details of Invercargill City Council Construction Standard Specifications for installation details of pipework outside site boundaries
  2. Refer to Architectural Specification for additional details regarding Stormwater Siphonic Drainage Systems.
  3. Refer to Specification and Drawings for further details.

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### L.3 FITTINGS

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1. HepVo Self Sealing Traps

A self sealing trap device is to be installed on the condensate line for the air conditioning systems. Refer to manufactures data for further details.

[http://www.hepvO.com/HepvO\\_PIC\\_Aug2003Condensate\\_drain.pdf](http://www.hepvO.com/HepvO_PIC_Aug2003Condensate_drain.pdf)

2. Cleanout and Inspection Points

By 'All proof Industries'. Bronze body spigot to fit inside pipe riser with o-ring seal. O-ring seal on lid to eliminate odours. To suit floor finish as required, pipe size 100mm, Anti slip groves on lid. Finish to be confirmed by the Architect. Security screw option required.

3. Flexible Drainage Connections (Swivel and Expansion Joints)

Size: 100 mm, Product Code: DW100150, Expansion: 150mm, Open Measurement: 470mm, Closed Measurement: 320mm.

Size: 150mm Product Code: SJ15015, Expansion: 60mm, Open Measurement: 435mm, Closed Measurement: 375mm.

Size: 150mm Product Code: DW150240, Expansion: 240mm, Open Measurement: 790mm, Closed Measurement: 550mm.

Fittings are available from Wallace Pumps Christchurch, Contact Brian Mudford, Phone: 09 6229100, Email: [enquiries@dmlwallace.co.nz](mailto:enquiries@dmlwallace.co.nz).

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## Tender specification for Akasison XL siphonic roof drainage

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## Tender specification for Akasison XL siphonic roof drainage

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### 1. Akasison XL siphonic roof drainage

The Akasison XL roof drainage system is a rainwater drainage system engineered on the concept of a full bore flow (a fill rate of 100%) through small diameter pipe work at zero gradient. A full bore flow is created by the (kinetic) energy derived from the hydraulic head, caused by the difference in height between the roof outlet and the discharge point in a building. Special Akasison roof outlets prevent air from entering the system.

The Akasison XL system consists of:

- Akasison siphonic roof outlets
- Akatherm HDPE pipe system
- Akasison fixing system (that fixates the expansion and contraction of the HDPE)

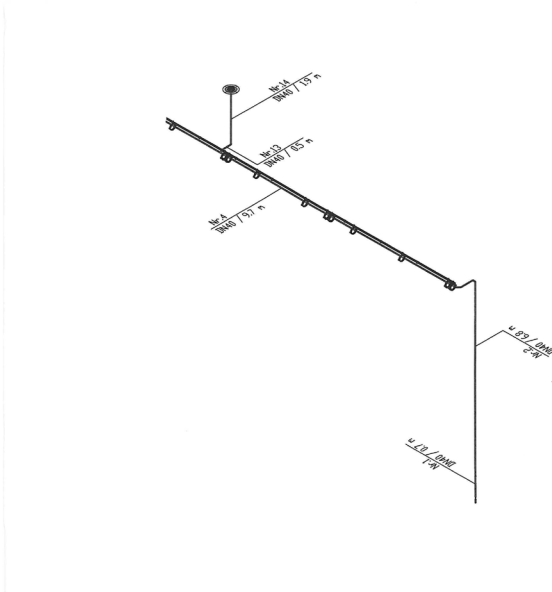
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## Tender specification for Akasison XL siphonic roof drainage

### 2. Design and calculation

#### 2.1 Design software Akacad

The Akasison system can only be installed after a full study has been made with Akacad, software specifically designed for the Akasison system, based on the EN12056 and DIN 1986-100.



#### 2.2 Primary system

The combination of roof outlet placement, pipe diameter and fill rate are calculated specifically to limit the water load on the roof at a specific height (depending on the roof and building construction) at a locally prescribed rain intensity. The capacity of siphonic roof drainage systems is calculated according to national standards and guidelines.

The basic principles of a primary siphonic system are:

- Rain intensity for a standard system is measured in l/s/ha according to national figures
- Collectors can be installed level without any incline.
- For optimum under pressure, the collector should hang between 0,8 m and 1,0 m below the roof.
- Several roof surfaces can be connected to a siphonic roof drainage system provided that the height difference is not too great.
- The connection of a green roof and an ordinary roof on a single system is not permitted.
- Large roof surfaces (> + 5,000 m<sup>2</sup>) must be connected to at least 2 independent down pipes.

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## Tender specification for Akasison XL siphonic roof drainage

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### 3. Roof outlets

Only the following roof outlets can be included in the scope of the project.

#### 3.1 Roof outlet Akasison XL75 with clamp flange

Roof outlet with clamp flange conform EN 1253 for siphonic roof drainage systems. Applied in roofs with roofing membranes that require clamping. The roof outlet body is 60 mm high for installation in roofs with thin insulation. For more installation convenience an EPS insulation block is included with preformed profile of the roof outlet body.

Delivery includes: Akasison air baffle with integrated leafguard (UV-stabilized).  
Clamp flange with prefixed seal.  
Connector to pipe system.  
EPS insulation block.

Application: Cold roof (metal/concrete).  
Warm roof (metal/concrete).  
Insulation thickness: Roof insulation between 60 and 330 mm.  
Connection pipe system: Electrofusion coupler Art. Nr. 410795.  
Outlet: d1 = 75 mm.  
Performance: 1-20 l/s.  
Material: ASA, stainless steel, HDPE, EPS.

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## Tender specification for Akasison XL siphonic roof drainage

### 4. Akatherm HDPE pipe system

#### 4.1 HDPE material characteristics

The Akatherm pipe system is made of HDPE, which stands for High Density Polyethylene. Polyethylene is a semi crystalline thermoplastic that can have different densities. By colouring with 2% of "carbon black" the PE gets its black colour. Akatherm HDPE has a density between 0,94 and 0,97 g/cm<sup>3</sup>.

HDPE has a high resistance against acids, bases and aqueous salt-solutions. Below 60°C it is practically unsolvable in organic solutions. The Akatherm pipes and fittings are all conform the EN1519 specifications as below:

	Unit	Test method	Value
Density at 23°C	g/cm <sup>3</sup>	ISO 1183	0,954
Elasticity modulus	N/mm <sup>2</sup>	ISO 527	850
Bending creep modulus	N/mm <sup>2</sup>	DIN 54852-Z4	1000
Tensile strength at 23°C	N/mm <sup>2</sup>	ISO 527	22
Elongation at break	%	ISO R 527	300
Linear expansion coefficient	mm/mK	DIN 53752	0,13 - 0,19
Indentation hardness	N/mm <sup>2</sup>	ISO 2039	36 - 46
Ignition temperature	°C	-	~350
Thermal conductivity	W/m . K	DIN 52612	0,37 - 0,43
Shore hardness		ISO 868	61
Crystallite melting range	°C		125 - 131
Operational temperature range	°C	-	-40 - +100
Melt Flow Rate MFR 190/5	g/10 min	ISO 1133	0,43

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## Tender specification for Akasisson XL siphonic roof drainage

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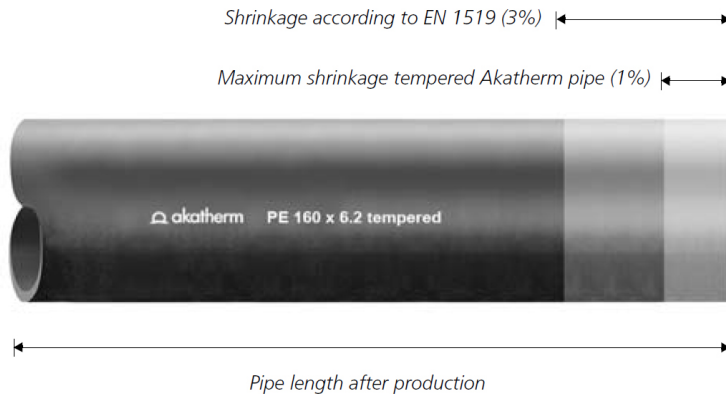
### 4.2 Akatherm pipe

Akatherm pipe is made from HDPE and has a length of 5 m per pipe. Each diameter has a specific wall thickness and pressure class which also results in a maximum under pressure:

<i>Diameter</i>	<i>Pressure class</i>	<i>Maximum under pressure</i>
Ø 40-160	S12.5	-800 mbar
Ø 200-315	S12.5	-800 mbar
Ø 200-315	S16.0	-450 mbar

At no point in the installation should the wall thickness deviate from the Akatherm specifications due to maximum under pressure used in the project siphonic calculations.

Furthermore Akatherm delivers its pipe tempered. The tempered pipe is produced according to the standard EN 1519 but has undergone an extra heat treatment after extrusion (80 °C for 1 hour). The result is less shrinkage when cooled down from high operational temperature. This gives less stress on joints resulting in a longer life of the pipe system.



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## Tender specification for Akasison XL siphonic roof drainage

### 4.3 Akatherm fittings

The Akatherm fittings are made conform EN1519 and all fittings used in an installation have to be supplied from Akatherm. Fittings have to have the same wall thickness as the pipe. Self made fitting or use of additional fittings are not allowed.

All Akatherm fittings are moulded, with exception of specific types of larger size fittings 200, 250 and 315 mm. These fittings are fabricated using butt-weld technique and are clearly marked in the catalogue as being fabricated.

To facilitate the welding of fittings at angles, Akatherm fittings are marked with a graduated arc. This consists of a long line at 45° with intervening short lines at each 15° (the pipe is also marked with two continuous lines).

### 4.4 Connections

In an Akasison system the following connections / jointing techniques are used:

<i>Connection</i>	<i>Where used</i>
Electrofusion	Connection of pipe and fittings (preferred method) Connection of roof outlet XL75 to pipe system
Butt-welding	Connection of pipe and fittings
Expansion socket	Connection of downpipe at specific intervals to absorb expansion
Screw coupler	Connection of metal roof outlets to pipe system

#### 4.4.1 Electrofusion

The preferred connection method of the HDPE pipe system is electrofusion. Akatherm has a complete range of electrofusion couplers from Ø 40-315 mm.

The Akatherm electrofusion couplers have the following characteristics:

- Corrosion free electrical resistance wire
- A unique technical advantage with electrical wire at the surface of the coupler for better heat transfer and melt behaviour
- A centre tab for correct insertion depth, can be removed for slide coupler use
- Two weld indicators
- Control box lead connection points for Akatherm prescribed control boxes

Only Akatherm pipe and fittings must be welded with Akatherm electrofusion couplers.

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## Tender specification for Akasison XL siphonic roof drainage

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### 4.4.2 Butt-welding

Some on site connection can be made with butt-welding. A technique that does not required additional fittings by means of a butt-weld machine that heats both ends of the pipe/fittings which then join conform an exact time and pressure table.

### 4.4.3 Expansion socket

Expansion sockets are used in the (vertical) downpipe in an Akasison system. The socket absorbs the expansion and contraction of the HDPE pipe.

The expansion sockets consist of:

- An insertion section that can absorb the expansion of 6 m
- Temperature scale with specific insertion depth
- A multiple lip EPDM seal (Ø 75-160 mm)
- An integrated anchor point (Ø 75-160 mm)
- Electrofusible spigot end (Ø 75-160 mm)
- A snap ring for a pull-tight connection (Ø 40-63 and 200-315 mm)

### 4.4.4 Screw coupler

The metal Akasison roof- and gully outlets have a screw thread connection with ISO inch thread.

The screw couplers have:

- 2" thread for the 63 mm outlets
- 3" thread for the 90 mm outlets
- Electrofusible spigot end

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## Tender specification for Akasison XL siphonic roof drainage

### 5. Fixing system

The Akasison XL pipe system has to be fixed to the roof construction using the Akasison fixing system. The fixing system is a rigid installation with anchor points that will absorb any expansion and contraction forces of the HDPE under influence of temperature changes and so protects the integrity of the HDPE installation. The pipe system has to be fixed to the roof construction using an installation with rail.

Akatherm has a unique fixing system designed for fast and secure installation using smart design for rail and pipe installation. The Akasison brackets have a 215° hook part freeing both hands for further installation.



#### 5.1 Rail installation

In a rail installation the rail (5m) is supported from the roof by rail suspension brackets. The rail suspension brackets are connected to the roof using a M10 threaded rod. The Akasison XL system uses two sizes rail and one rail connector.

<i>Rail type (mm)</i>	<i>Used for pipe Ø (mm)</i>	<i>Rail Art. Nr.</i>	<i>Rail suspension Art. Nr.</i>
30x30	40-200	70 00 05	70 00 25
41x41	250-315	70 00 07	70 00 27

Install the rail suspension brackets with a maximum distance between each bracket according to the below table.

<i>DN (mm)</i>	<i>Max. distance rail suspension brackets (m)</i>
40-125	2,50
160	2,00
200-315	1,65

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## Tender specification for Akasison XL siphonic roof drainage

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### 5.2 Rail connection to building

The rail itself must be fixed to the construction of the building at specific intervals so the HDPE expansion and contraction forces are transferred to- and absorbed by the building. This will prevent movement of the installation. The rail must be fixed to the building construction at:

- the beginning and end of each horizontal pipe section
- every 12 m of each horizontal pipe section
- a horizontal direction change
- a wall-interruption at both sides of the wall
- a vertical direction change

### 5.3 Guide- and anchor point bracket distances

The Akasison XL pipe system consists of guide brackets and anchor point brackets. Anchor points have to be placed at specific intervals to keep the pipe system fixed in location. Guide brackets are placed in between the anchor point locations to guide and support the pipe weight.

#### Anchor point bracket distances

For each pipe diameter an anchor point has to be placed every 5 m horizontal pipe section but anchor points have to be installed in other locations as well:

- At the beginning and end of the collector
- Before every branch 45°
- Before every change of direction

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## Tender specification for Akasison XL siphonic roof drainage

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### Guide bracket distances

The guide bracket distance depends on the diameter of the pipe and is installed in between the anchor points.

<i>DN (mm)</i>	<i>Max. guide bracket distance (m)</i>
40	0,80
50	0,80
56	0,80
63	0,80
75	0,80
90	0,90
110	1,10
125	1,25
160	1,60
200*	1,65
250*	1,65
315*	1,65

\* When installing guide brackets with diameter 200, 250 and 315 mm the bracket must be installed within 0,20 m from a rail suspension bracket or connection to the building construction.

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## Tender specification for Akasison XL siphonic roof drainage

### 5.4 Wall fixing system for vertical pipe system

The vertical pipe installation is fixed to wall using guide brackets and anchor points with expansion sockets. The expansion sockets accommodate the expansion of the HDPE under influence of temperature changes.

Pipe Ø (mm)	Guide bracket connection	Anchor bracket connection
40-160	M10	½"
200-315	1"	1"

Anchor points with expansion sockets are installed at specific places and guide brackets are positioned between these installed anchor points.

Anchor points must be installed at:

- The top of the vertical pipe
- The bottom of the vertical pipe
- At every 5 m of the vertical pipe

The anchor point at the top of the vertical pipe does not contain an expansion socket. All other anchor points include an expansion socket. The anchor bracket must be fixed to the building in such a way that it can resist the forces caused by the expansion or contraction of the pipe.

DN (mm)	Max. guide bracket distance (m)
50	1,00
56	1,00
63	1,00
75	1,20
90	1,40
110	1,70
125	1,90
160	2,40
200	3,00
250	3,00
315	3,00

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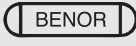


















Standards and quality

### 3 Standards and quality

Akatherm specialist drainage systems are developed and manufactured within an ISO 9001 Quality Assurance system and comply with the EN 1519 and other relevant international standards as well as meeting numerous other national approved standards.

#### 3.1 Standards and approvals

The Akatherm PE system has the appropriate national approval for most countries. All these approvals are based on the international EN 1519 standard or any other national equivalent. These approvals ensure a pipe system of the highest quality standards.

Country		Certificate of approval	Standard
The Netherlands			NEN-EN 1519
Belgium			NBN EN 1519
Germany			DIN EN 1519 DIN EN 12666
Denmark			NKB Product Rules No. 8
Sweden			NKB Product Rules No. 8
Italy			UNI EN 1519
Australia			AS/NZS 4401 AS/NZS 5065
Austria			ÖNORM EN 1519
France			NF-EN 1519
Switzerland			EN 1519 EN 12666
Ireland			NKB Product Rules No. 8

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#### 3.2 Quality management ISO 9001

Akatherm has a quality management system in accordance with ISO 9001.

It comprises all business processes within Akatherm, ranging from development and production to marketing and supply of plastic pipe systems. It emphasises on quality care and continuous improvements in customer satisfaction.

Akatherm is a leading brand of specialist drainage systems which is also reflected in our management systems certified by Lloyd's Register Quality Assurance.



Illustration 3.1 ISO 9001

#### 3.3 Environmental management ISO 14001

Akatherm has integrated the ISO 14001 environmental management system into our quality management.

The ISO 14001 environmental management system is a standard which controls and improves our overall environmental performance. The system structurally focuses our attention to the environment during everyday operation. Two of the most important starting points are to make permanent environmental improvements and conformity with all rules and regulations.



Illustration 3.2 ISO 14001

#### 3.4 Warranty

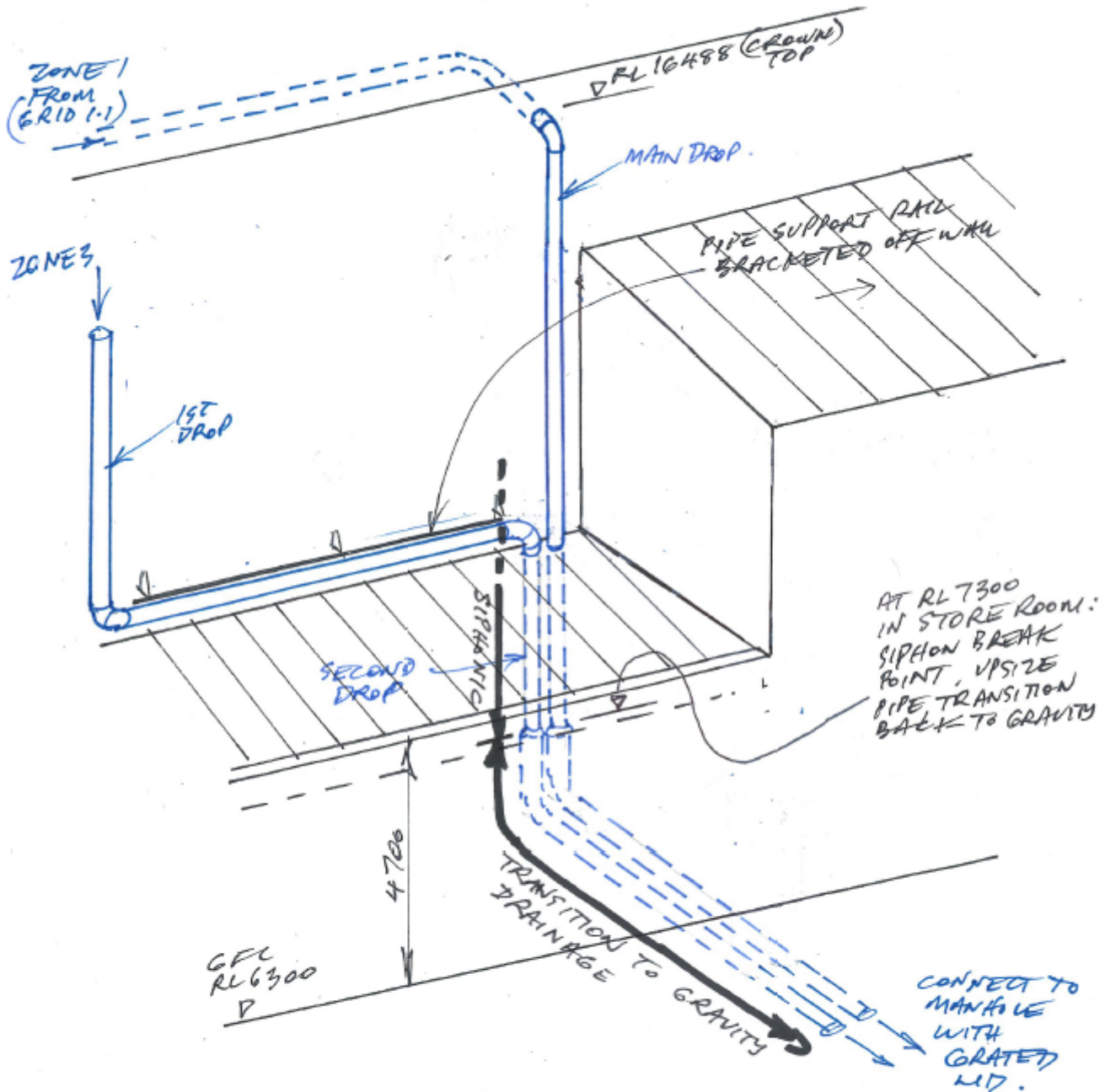
Of course you want the security that after the design and installation of specialist drainage systems it will perform without any problems. Akatherm is able to guarantee the proper functioning of your drainage system by combining training upfront, technical support during construction and even (if required) inspection afterwards.

All the Akatherm products have a warranty of 15 years. This applies for both soil and waste systems for high-rise buildings and for siphonic roof drainage projects. Details are available on request.

#### 3.5 Aliaxis

Akatherm has build a network of connected organisations and institutes which all contribute to the guaranteed quality of the systems and service which Akatherm offers.

Akatherm is a part of Aliaxis which is the largest producer of plastic pipe systems in the world. The Aliaxis group has 15.000 employees and comprises of more than 100 companies with subsidiaries in 40 countries. All companies operate under their own brand and are specialized in specific solutions for building, industrial and utility applications. Akatherm is the brand within Aliaxis focusing on specialist drainage systems in the commercial and industrial building sector.



ISOMETRIC SKETCH OF  
ZONE 3 & ZONE 1  
DOWN PIPE ROUTES  
N.T.S.

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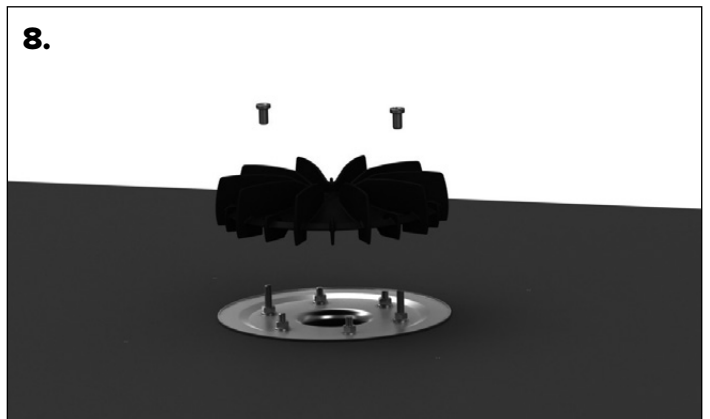
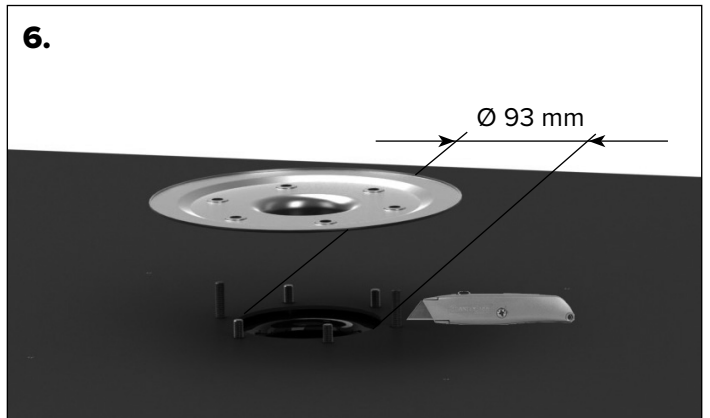
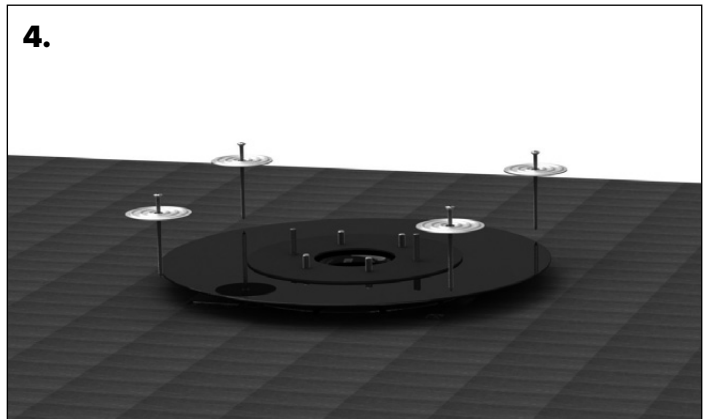
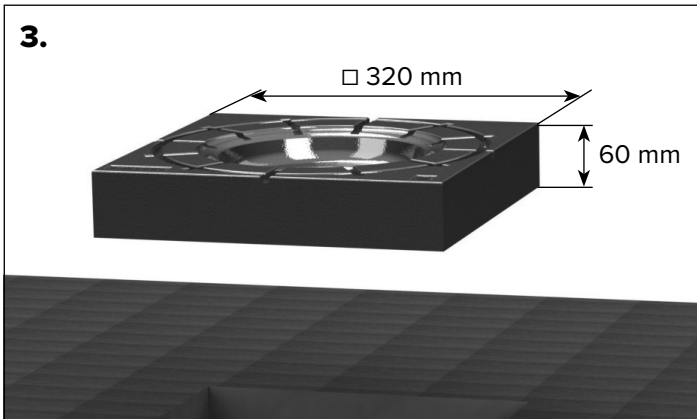
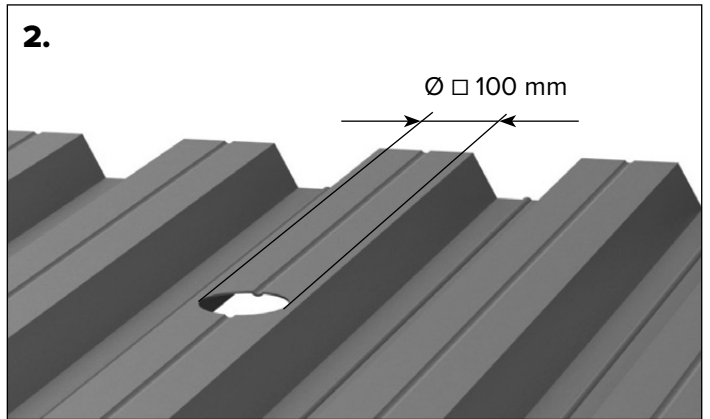
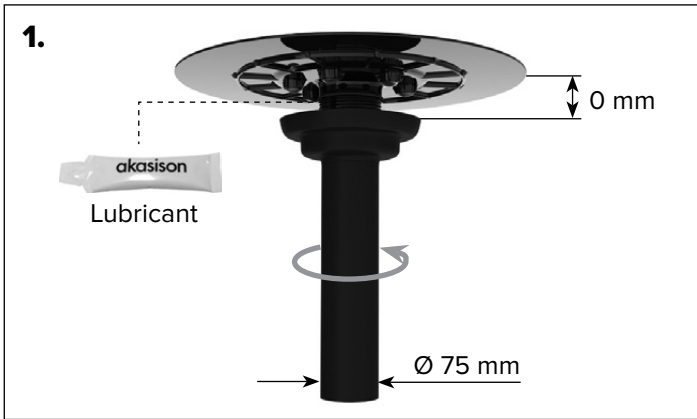
A large, circular, black metal roof outlet with a radial ribbed design. The outlet is shown from a top-down perspective, with a central circular opening. The background is a solid teal color.

**INSTALLATION INSTRUCTIONS**

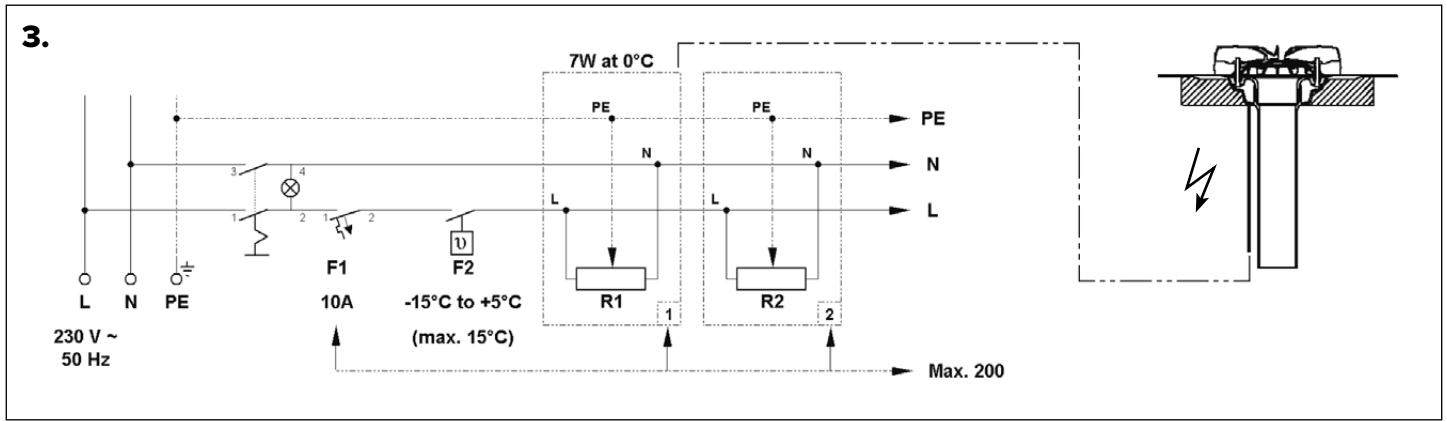
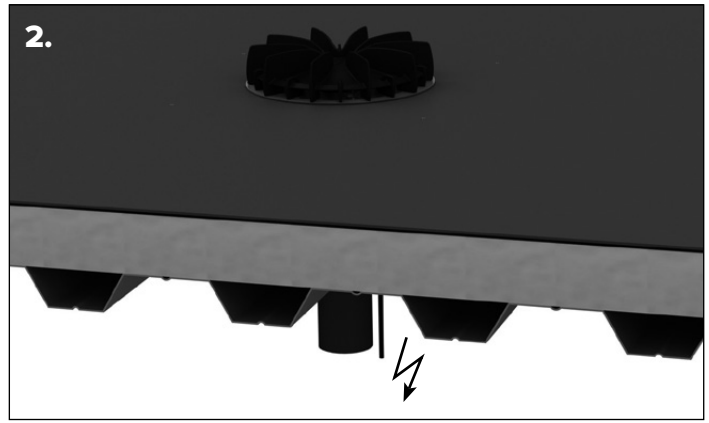
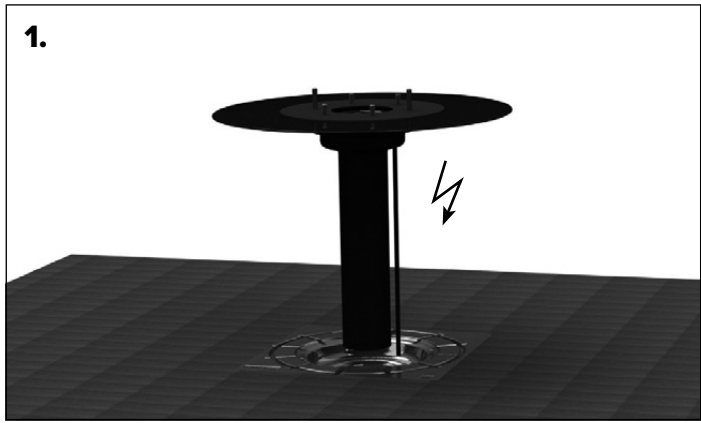
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**AKASISON**  
**ROOF OUTLETS XL 75**

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**ROOF OUTLET 74 75 01**

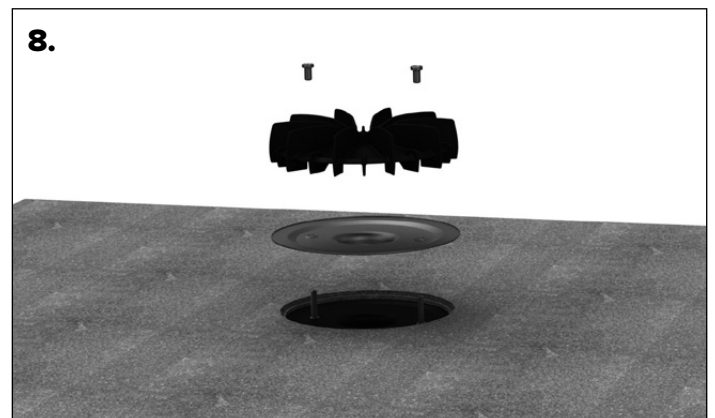
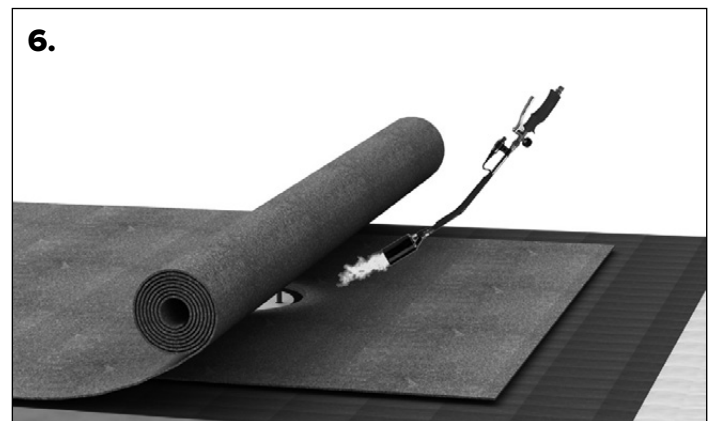
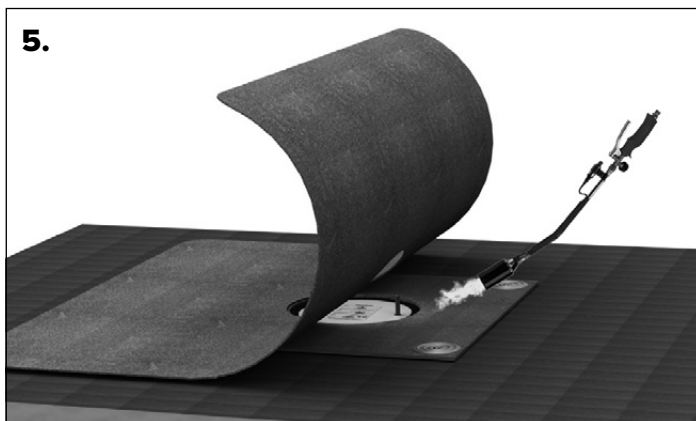
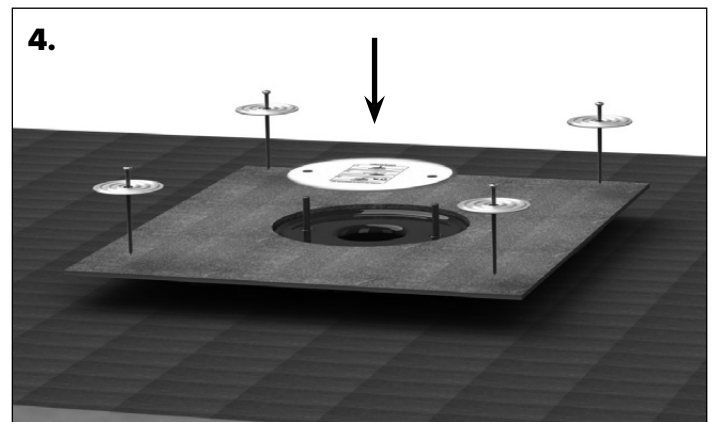
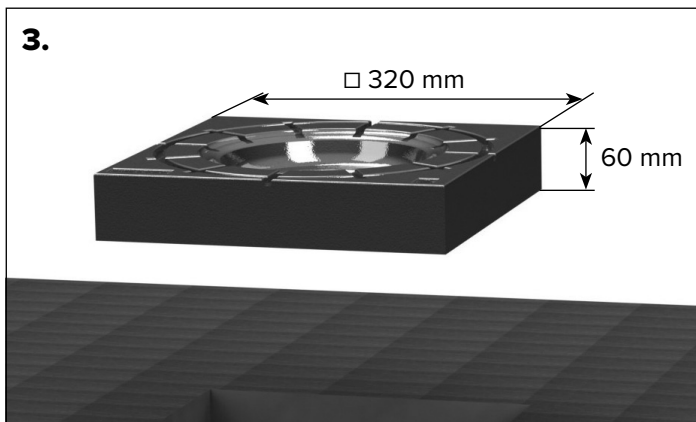
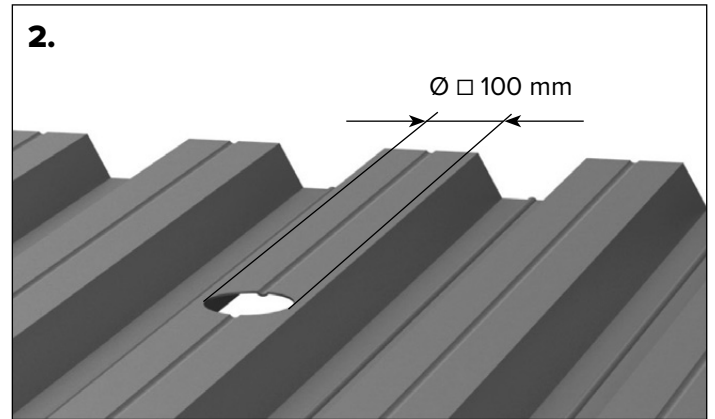
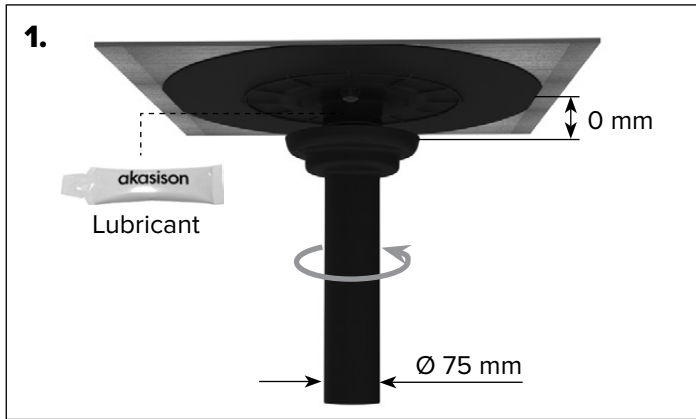


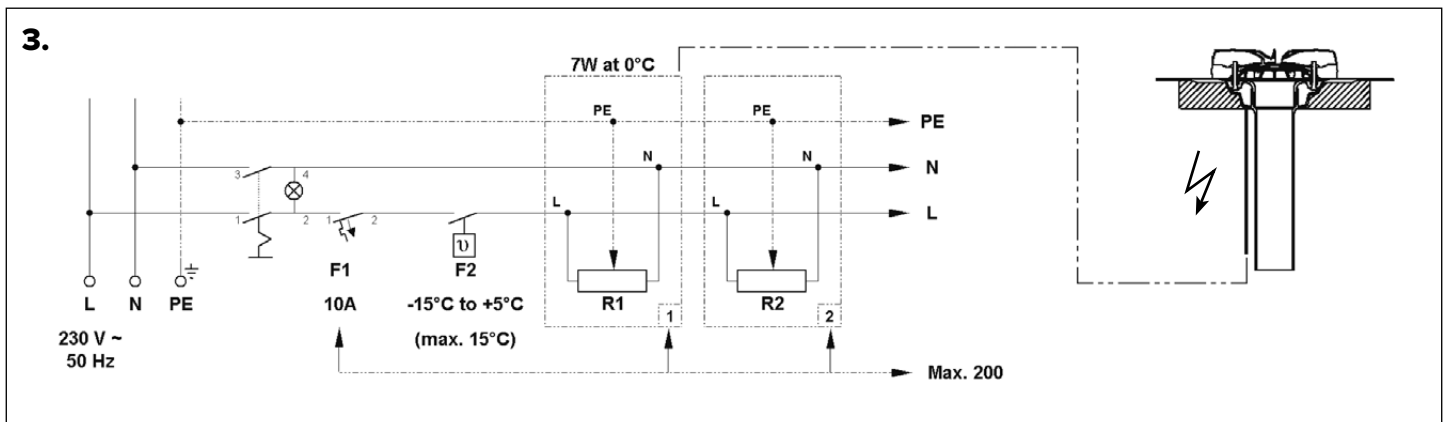
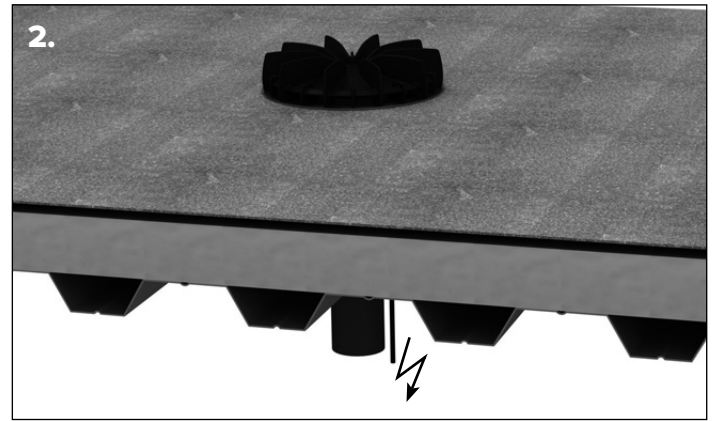
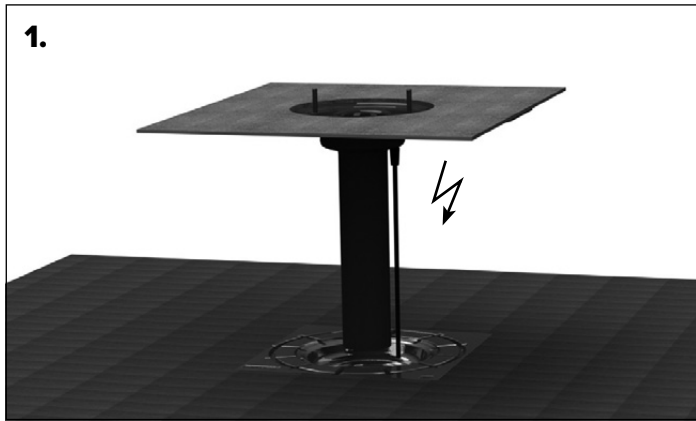
Circuit diagram heating element.

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Building Division  
**ROOF OUTLET 74 75 02**

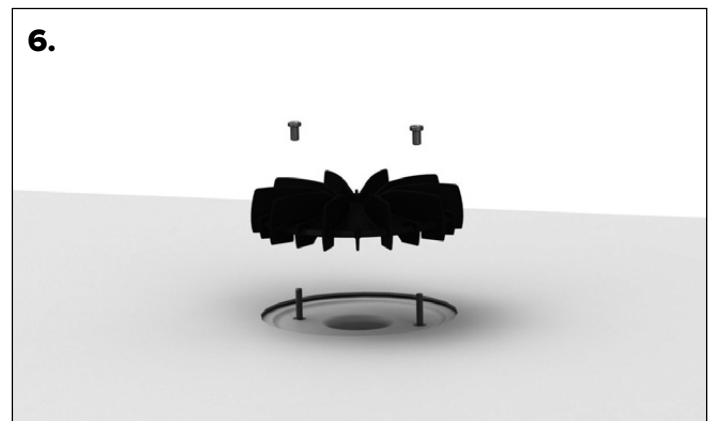
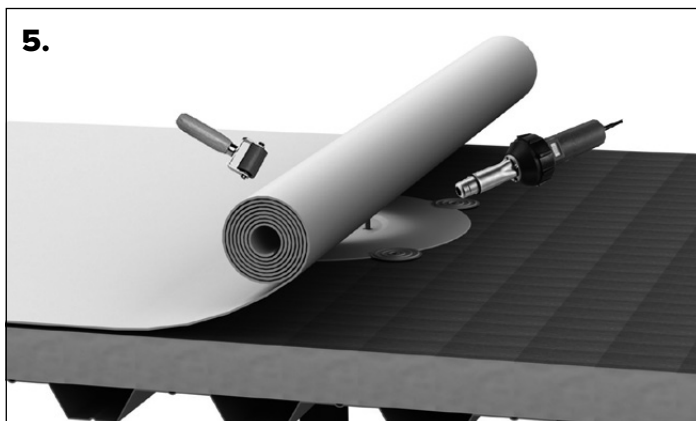
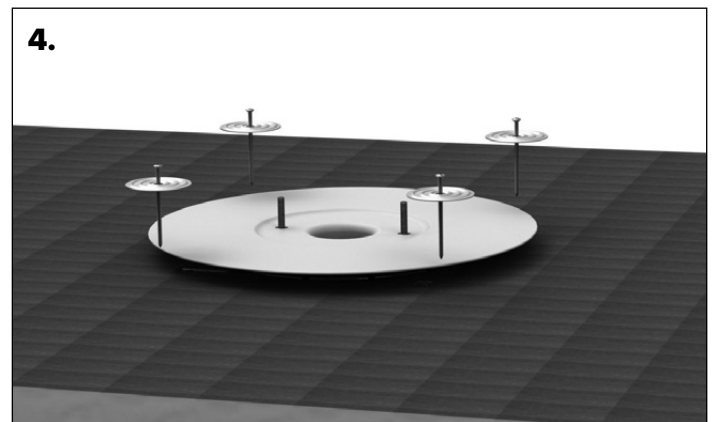
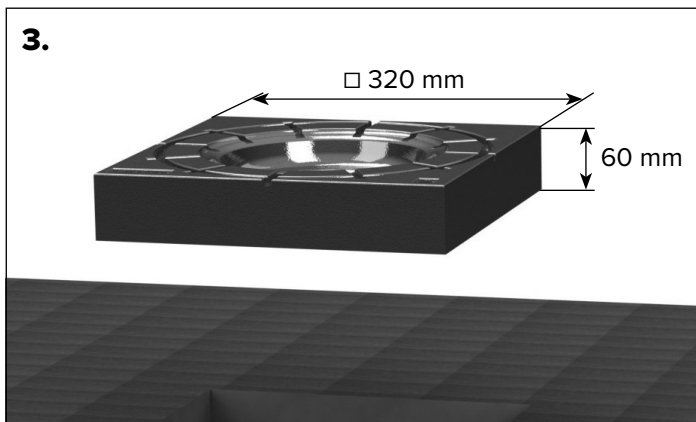
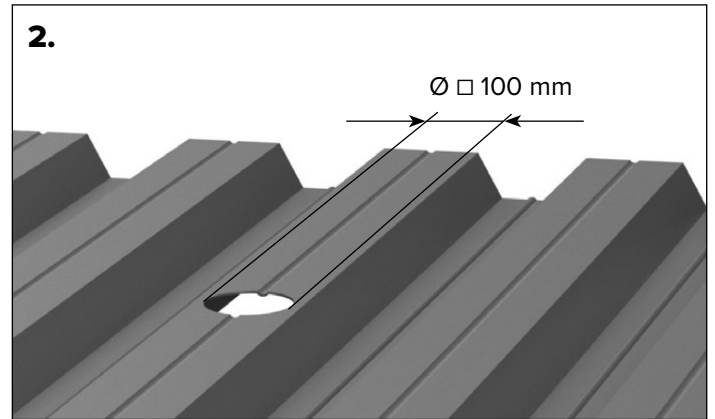
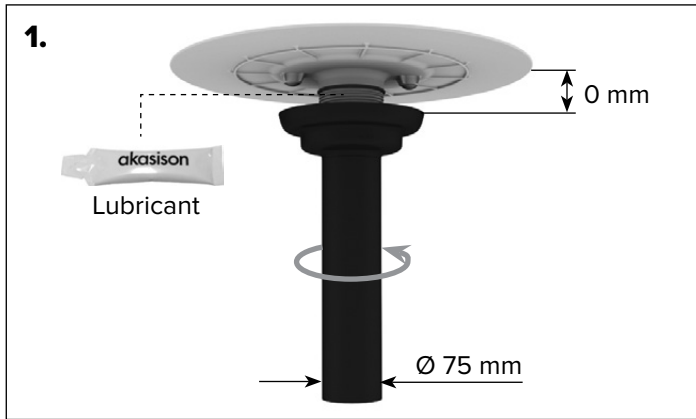




Circuit diagram heating element.

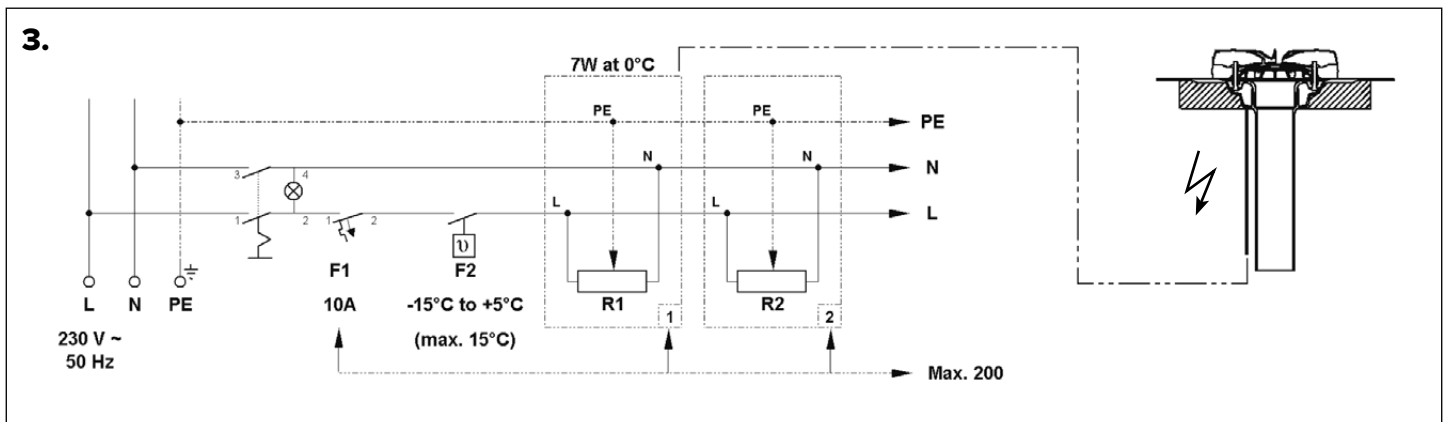
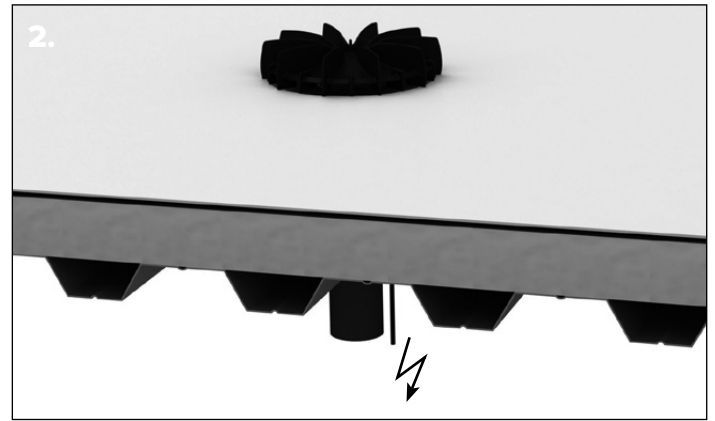
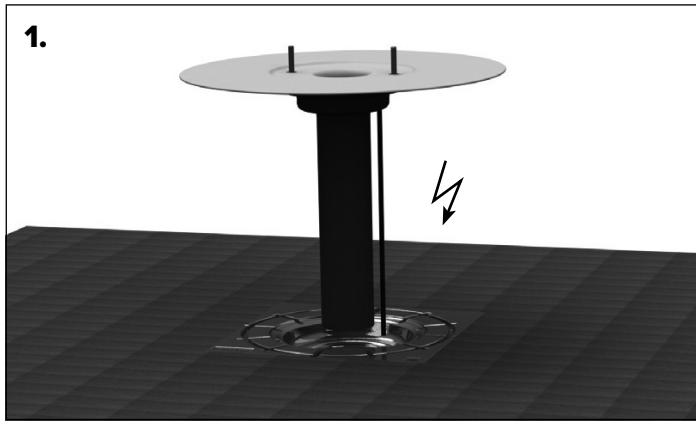
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**ROOF OUTLET 74 75 04**



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**ROOF OUTLET 74 75 05**



Circuit diagram heating element.

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**MOUNTING SYSTEM**

The Akasion XL system includes a unique fixing system. This system ensures the correct installation of the Akasion drainage system.

**6.1 AKASISON FIXING SYSTEM**

The Akasion XL system has to be fixed to the roof construction using the Akasion fixing system. The fixing system is a rigid installation with anchor points that will absorb any expansion and contraction of the HDPE as a result of temperature changes. It protects the integrity of the HDPE installation.

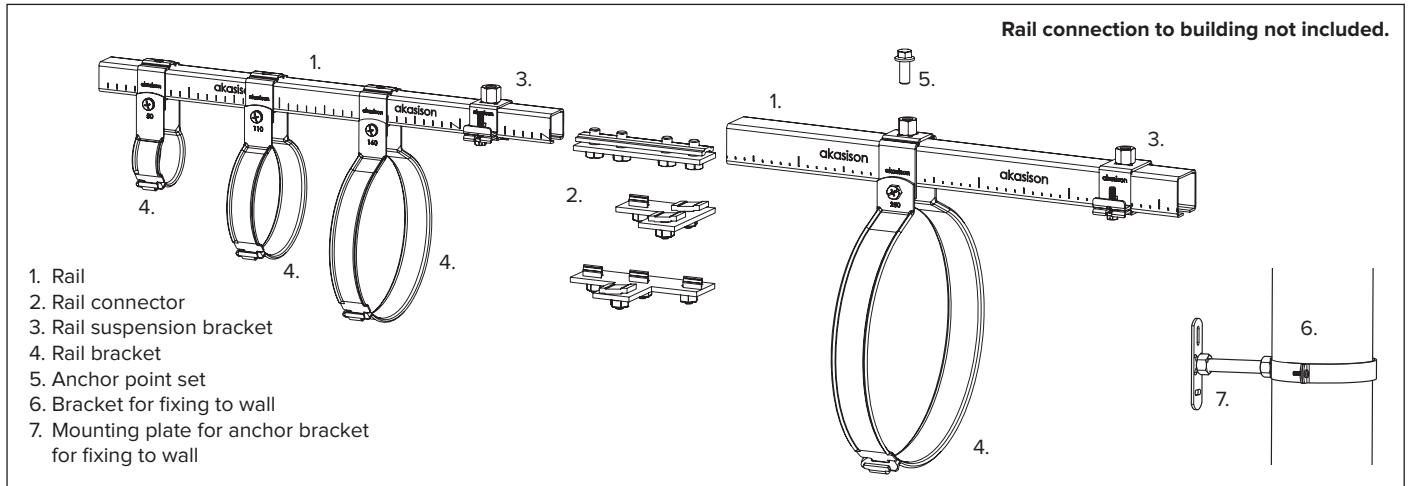


Image 6.1

**Rail**

Type	Code	Application
30x30 mm x 5 m	700005	Rail bracket 40-200 mm
41x41 mm x 5 m	700007	Rail bracket 250 and 315 mm

Table 6.1

**Rail connector**

Type	Code	Application
Rail connector straight	700015	Rail 30x30 and 41x41 mm
Rail connector L	700016	Rail 30x30 and 41x41 mm
Rail connector T	700017	Rail 30x30 and 41x41 mm

Table 6.2

**Rail suspension bracket**

Type	Code	Application
30x30 mm	700025	Rail 30x30 mm
41x41 mm	700027	Rail 41x41 mm

Table 6.3

**Rail bracket**

Type	Code
40 mm	750435
50 mm	750535
56 mm	755635
63 mm	750635
75 mm	750735
90 mm	750935
110 mm	751135
125 mm	751235
160 mm	751635
200 mm	752035
250 mm	752535
315 mm	753135

Table 6.4

**Anchor point**

Type	Code	Application
M10x20 (Set of 2)	730025	Anchorpoint for $d_1 = 200$ mm
M10x45 (Set of 2)	730027	Anchorpoint for $d_1 \geq 250$ mm

Table 6.5

**Bracket for fixing to wall**

Diameter	Code	Thread
40 mm	700478	1/2"
50 mm	700578	1/2"
56 mm	705678	1/2"
63 mm	700678	1/2"
70 mm	700778	1/2"
90 mm	700978	1/2"
110 mm	701178	1/2"
125 mm	701278	1/2"
160 mm	701678	1/2"
200 mm	702080	1"
250 mm	702580	1"
315 mm	703180	1"

Table 6.6

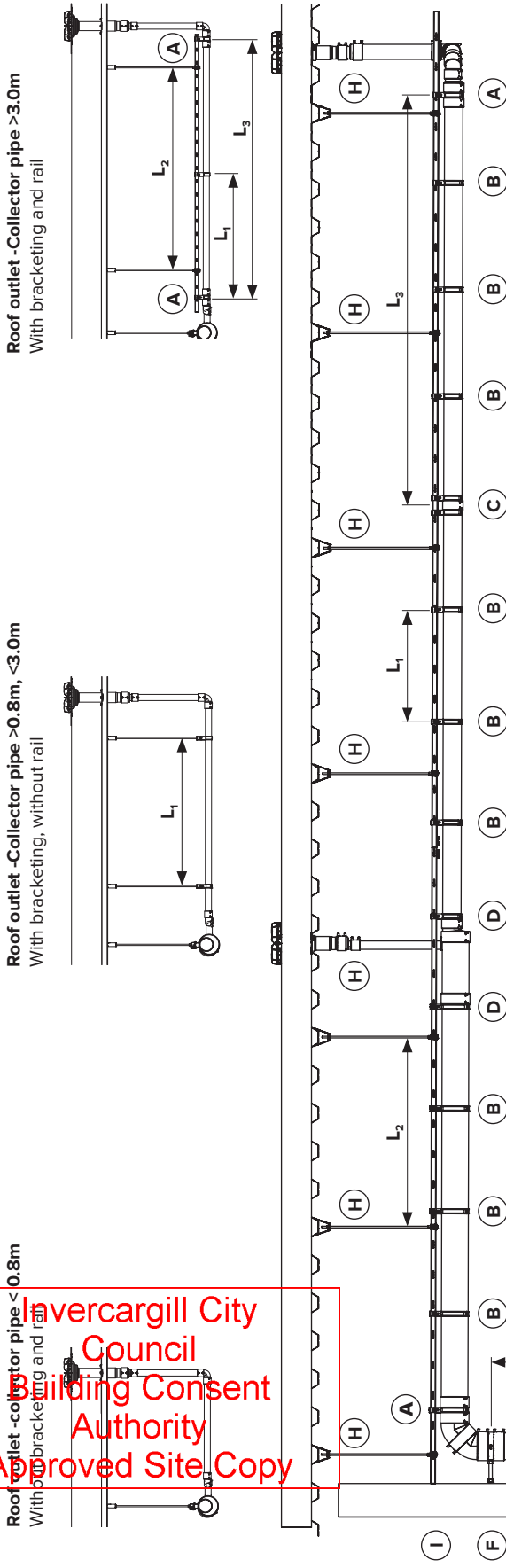
**Mounting plate for 1/2" and 1" anchor bracket**

Thread	Code
1/2"	709478
1"	709480

Table 6.7

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Building Division **6.2 OVERVIEW OF AKASISON FIXING SYSTEM**



Diameter pipe $d_1$ (mm)	Rail (mm)	Max. guide bracket distance Horizontal $L_1$ (m)	Max. distance rail suspension $L_2$ (m)	Max. anchor point bracket distance $L_3$ (m)	Guide bracket distance vertical $L_4$ (m)
40	30 x 30	0.85	2.50	5.00	1.00
50	30 x 30	0.85	2.50	5.00	1.00
56	30 x 30	0.85	2.50	5.00	1.00
63	30 x 30	0.85	2.50	5.00	1.00
75	30 x 30	0.85	2.50	5.00	1.25
90	30 x 30	0.85	2.50	5.00	1.25
110	30 x 30	1.00	2.50	5.00	1.65
125	30 x 30	1.25	2.50	5.00	1.65
160	30 x 30	1.65	2.00	5.00	2.50
200	30 x 30	1.65	1.65	5.00	2.50
250	41 x 41	1.65	1.65	5.00	2.50
315	41 x 41	1.65	1.65	5.00	2.50

Table 6.8

- A** Anchor point at end of collector
- B** Guide bracket horizontal
- C** Anchor point horizontal
- D** Anchor point horizontal at y-branch
- E** Anchor point vertical
- F** Anchor point at end of stack
- G** Guide bracket vertical
- H** Rail suspension bracket
- I** Rail connection to building

**Guide and anchor points bracket distance**  
The Akasison XL drainage system consists of guide brackets and anchor point brackets. Anchor points have to be placed at specific intervals to keep the drainage system in a fixed position. Guide brackets are placed in between anchor points locations to guide and support the pipe weight.

- Anchor point bracket distances**  
Anchor points must be installed in these locations:
- Every 5 m horizontal pipe
  - At the beginning and the end of the collector
  - At every 45° branch
  - At every change of direction
  - At the beginning and end of the pipe from roof outlet to collector (>3m)

**Guide brackets distance**  
The guide bracket distance depends on the diameter of the pipe. To increase the distance between each guide bracket, support trays can be used up to diameter 160 mm. The support trays are fixed in place using straps every 0.5 m.

- Rail connection to the building**  
The rail itself must be fixed to the construction at specific intervals so the HDPE expansion and contraction are transferred to the building. This will prevent movement of the installation.  
The rail must be fixed to the building at:
- The beginning of each horizontal pipe section
  - Every 12 m of each horizontal pipe section
  - A horizontal direction change
  - A wall-interruption at both sides of the wall
  - A vertical direction change

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**GUIDELINES FOR THE PERFORMANCE OF  
HORIZONTAL ANCHOR POINT AND HORIZONTAL  
GUIDE BRACKET**

**6.3.1 OVERVIEW**

The Akasion XL drainage system consists of guide brackets and anchor points brackets. Anchor points have to be placed at specific intervals to keep the drainage system in a fixed position. Guide brackets are placed in between anchor point locations to guide and support the pipe weight.

When installing an Akasion rail system, an anchor point needs to be applied:

- Every 5 metres of horizontal pipe section
- At the beginning and end of the collector
- At every 45° Y-branch
- At every bend and every change of direction
- At the beginning and end of the drain connection line > 3,0 m

Between anchor points, horizontal guide brackets need to be installed. The maximum distance between the brackets (guide-guide or guide-anchor point) are indicated as  $L_1$  in the table of paragraph 6.2. A standard anchor point is installed with two rail brackets and an electrofusion coupler. The rail brackets are mounted on both sides of the electrofusion coupler. It is also possible to use two electrical couplers and one rail bracket. This is mainly used in combination with fittings. To prevent the brackets from sliding, the screws of the brackets need to be firmly tightened. Extra anchorpoint screws are also used for 200-315 mm brackets.

**6.3.2 EXAMPLES OF ANCHOR POINTS AND GUIDE BRACKETS**

**Anchor point in the horizontal collector**

Diameter 40-160 mm

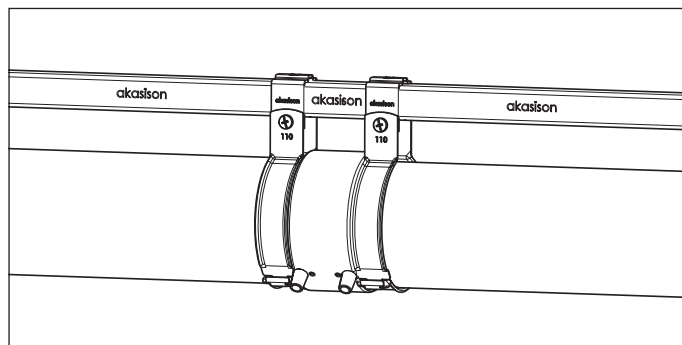


Illustration 6.1

- 1 x electrofusion coupler
- 2 x rail brackets

Diameter 200-315 mm

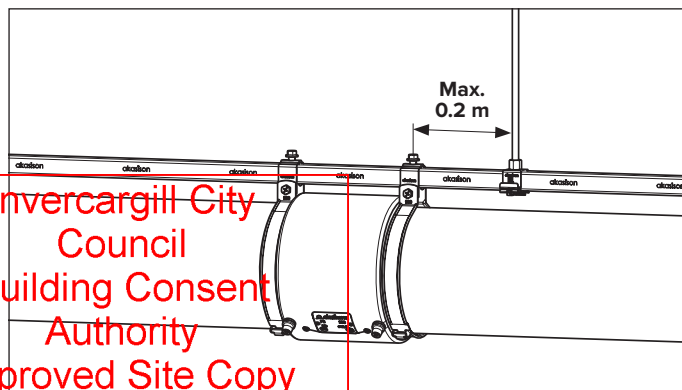


Illustration 6.2

- 1 x electrofusion coupler
- 2 x rail brackets
- 2 x anchor point sets

**Anchor point at the beginning of the collector**

Diameter 40-160 mm

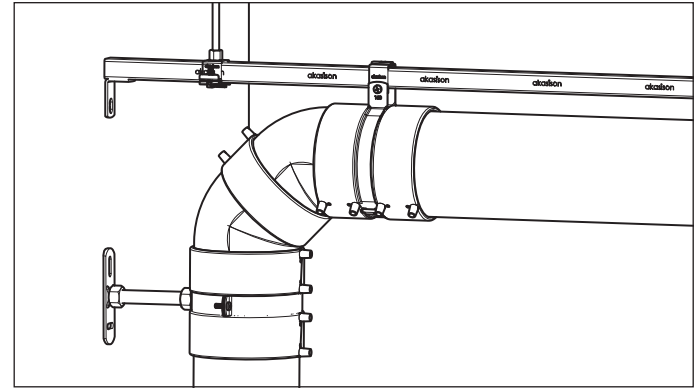


Illustration 6.3

- 2 x electrofusion couplers
- 1 x rail bracket

Diameter 200-315 mm

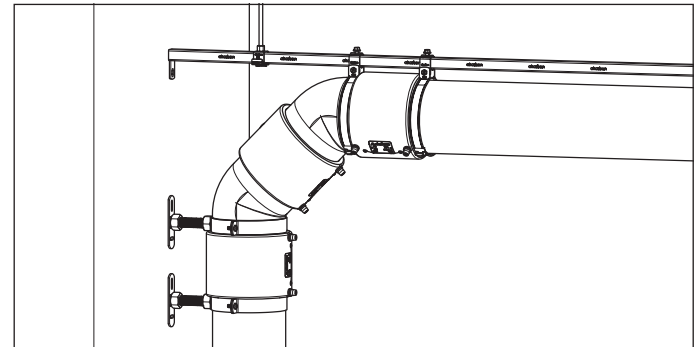


Illustration 6.4

- 1x electrofusion coupler
- 2 x rail brackets
- 2 x anchor point sets

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**OVERVIEW AKASISON FIXING SYSTEM**

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**Anchor point at the end of the end of the collector**

Diameter 40-160 mm

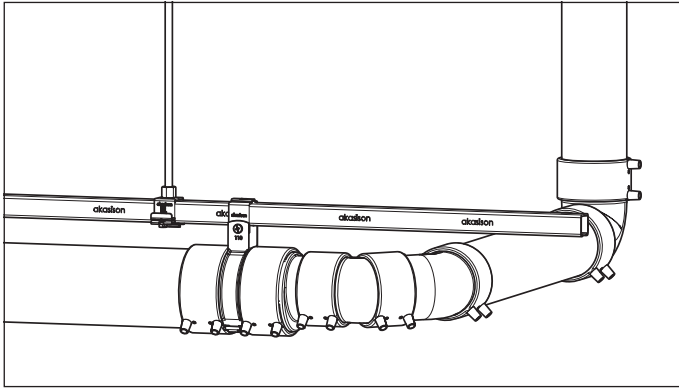


Illustration 6.5

- 2 x electrofusion couplers
- 1 x rail bracket

**Anchor point by change of direction**

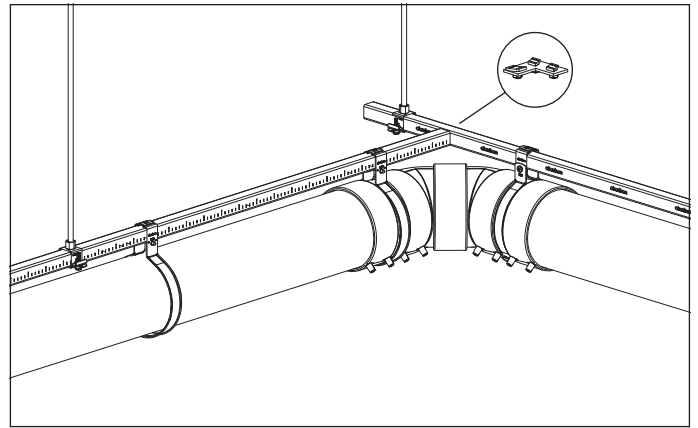


Illustration 6.7

- 2 x electrofusion couplers
- 1 x rail bracket

**Anchor point 45° Y-branch**

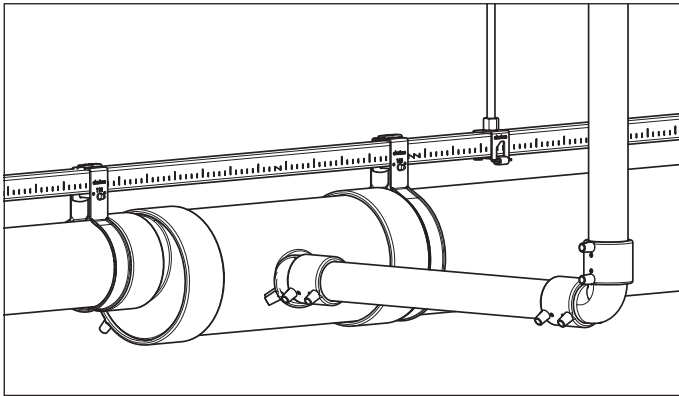


Illustration 6.6

- 2 x electrofusion couplers
- 2 x rail brackets

**Guide bracket**

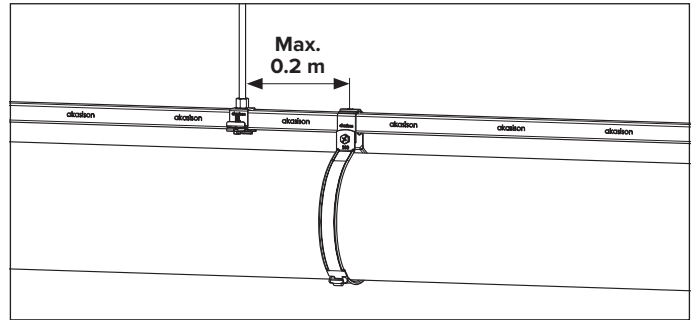


Illustration 6.8

- 1 x rail bracket

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**GUIDELINES FOR THE PERFORMANCE OF  
VERTICAL ANCHOR POINT AND GUIDE BRACKET**

**6.4.1 OVERVIEW**

When installing an Akasion rail system, an anchor point needs to be applied:

- Every 5 metres in the vertical collector tube
- At the beginning (top) of the vertical collector tube

Between anchor points, vertical guide brackets need to be applied. The maximum distance between the brackets (guide-guide or guide-anchor point) are indicated as L4 in the table 6.8 of paragraph 6.2.

For the installation of the system to the wall, a mounting plate and a wall-bracket is used. For diameters up to 160 mm 1/2" is used. For diameters above 200 mm 1" is used. The required threaded rod is not included. For an anchor point, an electrofusion coupler and a expansion socket are also used.

**6.4.2 EXAMPLES OF ANCHOR POINTS AND GUIDE BRACKETS**

**Anchor point**

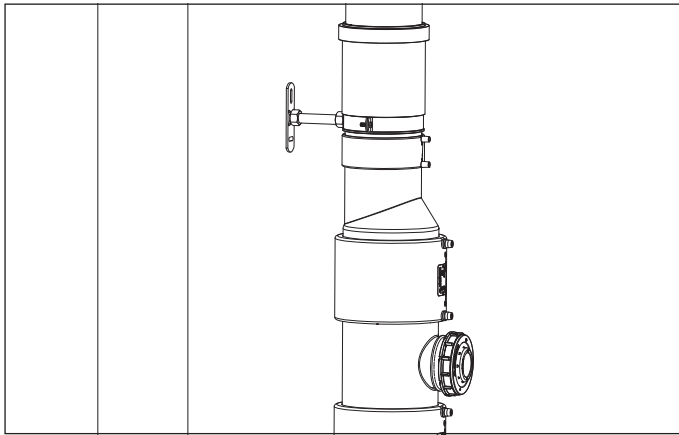


Illustration 6.9

- 1 x expansion socket
- 1 x electrofusion coupler
- 1 x rail bracket
- 1 x mounting plate

**Anchor point at the beginning of the collector**

Diameter 40-160 mm

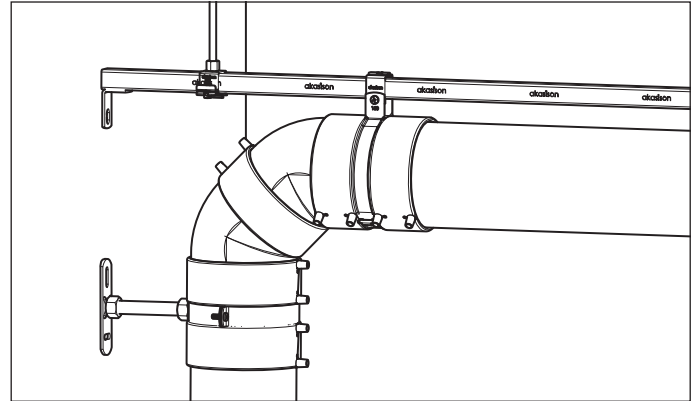


Illustration 6.10

- 2 x electrofusion couplers
- 1 x rail bracket
- 1 x mounting plate 1/2"

Diameter 200-315 mm

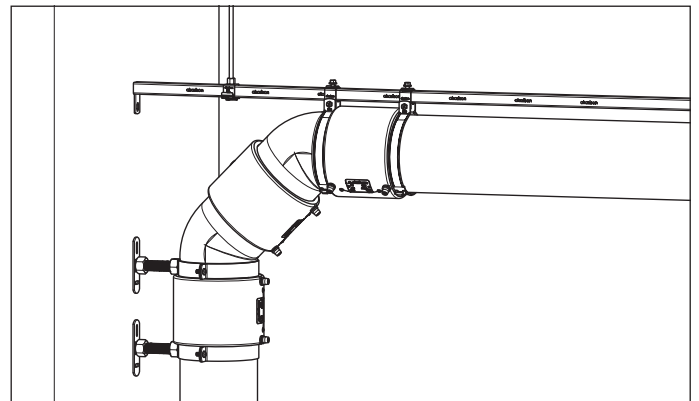


Illustration 6.11

- 1x electrofusion coupler
- 2 x rail brackets
- 2 x Mounting plates 1"

**GUIDELINES FOR PERFORMANCE**

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**Anchor point at the beginning of the collector with reduction**

Diameter reduction 200-300 mm

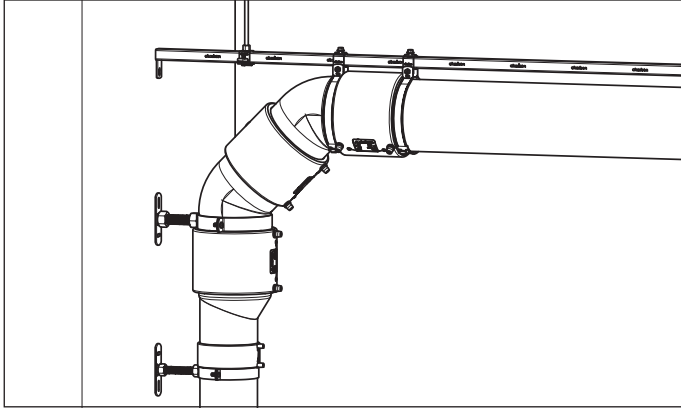


Illustration 6.12

- 2 x electrofusion couplers
- 2 x rail brackets
- 2 x mounting plates 1" (when diameter after reduction is > 160 mm)

or

- 2 x electrofusion couplers
- 2 x rail brackets
- 1 x mounting plate 1"
- 1 x mounting plate 1/2" (when diameter after reduction is ≤ 160 mm)

Diameter 40-160 mm

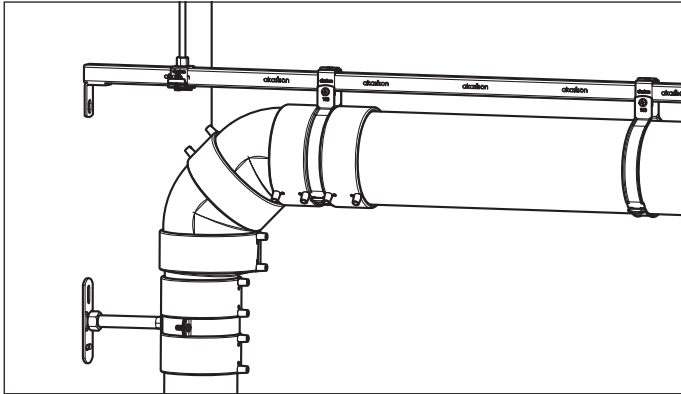


Illustration 6.13

- 2x electrofusion coupler
- 1 x rail bracket
- 2 x mounting plate 1/2"

**Guide bracket**

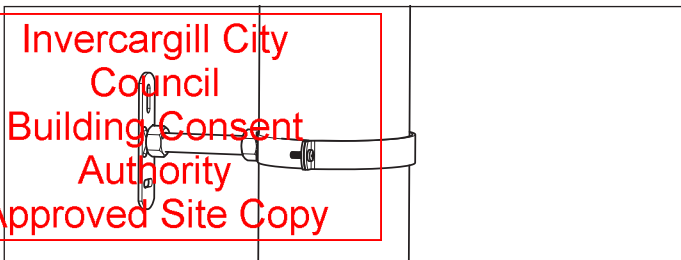


Illustration 6.14

- 1 x rail bracket
- 1 x mounting plate 1/2" (diameter ≤160) or 1 x mounting plate 1" (diameter > 160 mm)

**6.4.3 MAXIMUM DISTANCE BETWEEN WALL AND DRAINAGE SYSTEM**

The threaded rods for the fixation of the mounting plate to the bracket is limited.

For a distance up to 100 mm of 40-160 mm pipe, a 1/2" bracket and mounting plate is needed. For 200-315 mm pipe, a 1" mounting plate and bracket is required.

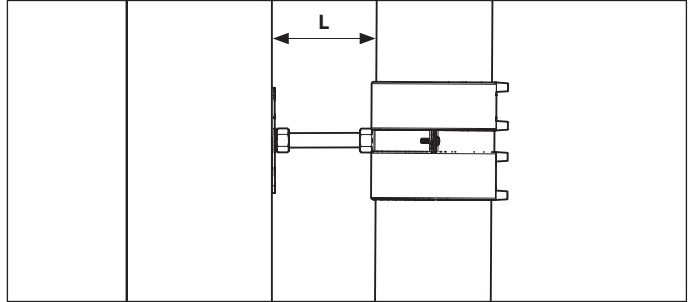


Illustration 6.15

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**ATTACHMENT OF THE MOUNTING SYSTEM TO THE BUILDING CONSTRUCTION**

**6.5.1 OVERVIEW**

Akasion rails need to be attached the building:

- at the start and end of a horizontal collector tube
- at every 12 metres of the collector tube
- at every transit of the wall, at both sides of the wall
- at every vertical change of direction

**6.5.2 EXAMPLES THE ATTACHMENT OF THE SYSTEM TO THE BUILDING**

At the beginning of the horizontal collector tube

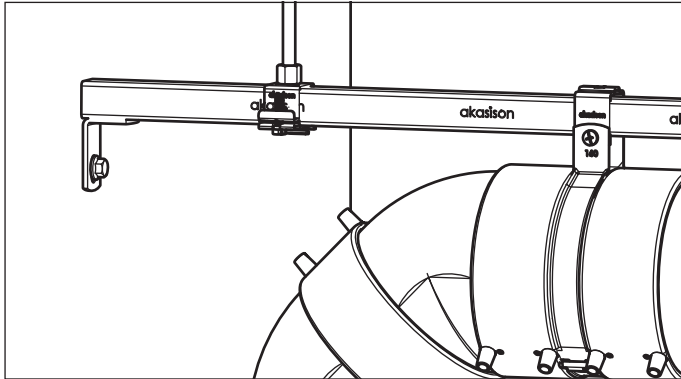


Illustration 6.16

Connection with a horizontal beam (both sides)

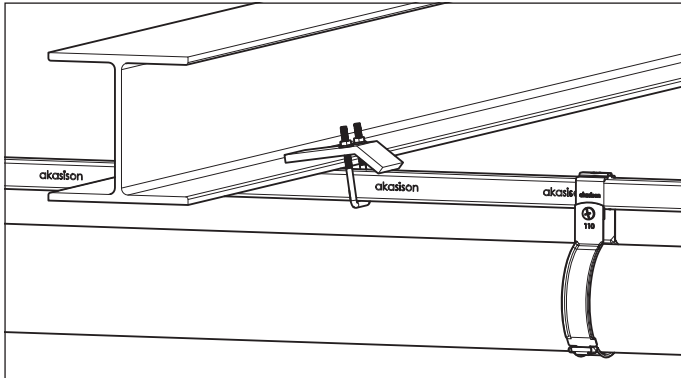


Illustration 6.17

Connection with a concrete beam (both sides)

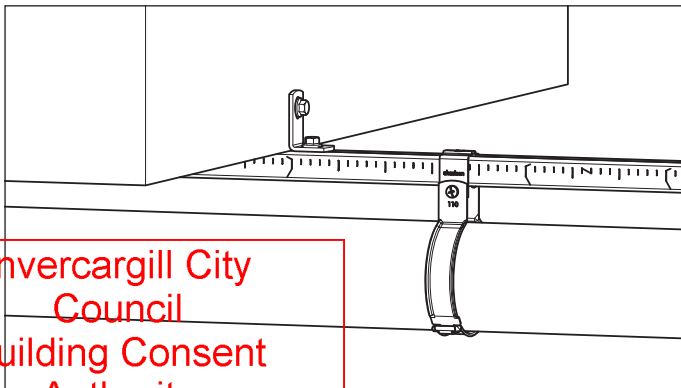


Illustration 6.18

Connection with the transit of a wall (both sides)

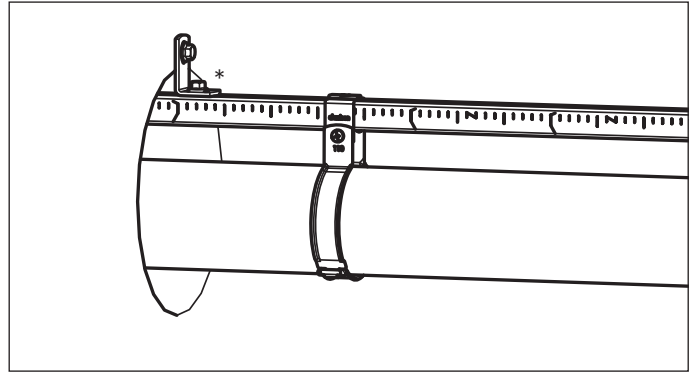


Illustration 6.19

\* Rail can be used upside down.

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## ATTACHMENT OF THE RAIL SUSPENSION BRACKET

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6.6 ATTACHMENT OF THE RAIL SUSPENSION BRACKET  
TO THE TRAPEZOID ROOF PROFILE

## 6.6.1 OVERVIEW

The maximum distance of the rail suspension (as defined in the table of paragraph 6.2) must not be exceeded. The construction of the roof might limit this maximum distance. The impact on the construction of the drainage system needs to be approved by the constructor responsible before starting the installation the system.

In the table below the total weight and forces of the system are given, by the maximal distance of the suspension brackets.

## Operational system (tube, mounting system, totally filled with water)

$d_1$ [mm]	40	50	56	63	75	90	110	125	160	200	250	315
G [kg/m]	2,9	3,7	4,2	4,8	6,2	8,1	11,2	14,0	21,8	33,3	51,9	81,0
F [kg/T]	7,4	9,1	10,4	12,1	15,4	20,3	28,1	35,0	43,7	55,0	85,7	133,7

Table 6.8

## Non-operational system (tube, mounting system, no water)

$d_1$ [mm]	40	50	56	63	75	90	110	125	160	200	250	315
G [kg/m]	2,0	2,2	2,2	2,2	2,5	2,7	3,1	3,5	4,7	6,5	10,3	14,6
F [kg/T]	5,0	5,4	5,6	5,6	6,2	7,7	8,9	8,9	9,4	10,8	17,0	24,1

Table 6.9

G = weight of the system

F = resulting point load applying the maximum distance between the suspension brackets

In the table below maximum distances between the suspension brackets ( $L_2$ ) are calculated based on a maximum point load.

$d_1$ [mm]	15 kg/m <sup>2</sup> $L_2$ [m]	20 kg/m <sup>2</sup> $L_2$ [m]	25 kg/m <sup>2</sup> $L_2$ [m]	30 kg/m <sup>2</sup> $L_2$ [m]	35 kg/m <sup>2</sup> $L_2$ [m]	40 kg/m <sup>2</sup> $L_2$ [m]	45 kg/m <sup>2</sup> $L_2$ [m]	50 kg/m <sup>2</sup> $L_2$ [m]
40	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50
50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50
56	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50
63	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50
75	2,40	2,50	2,50	2,50	2,50	2,50	2,50	2,50
90	1,80	2,50	2,50	2,50	2,50	2,50	2,50	2,50
110	1,30	1,80	2,20	2,50	2,50	2,50	2,50	2,50
125	1,10	1,40	1,80	2,10	2,50	2,50	2,50	2,50
160	-	-	1,10	1,40	1,60	1,80	2,00	2,00
200	-	-	-	-	1,10	1,20	1,40	1,50
250	-	-	-	-	-	-	-	-
315	-	-	-	-	-	-	-	-

Table 6.10

Distances less than one metre, there is no standard connection possible. In that case a project solution needs to be derived. A possible solution is to divide the load, or mount the system to metal beams.

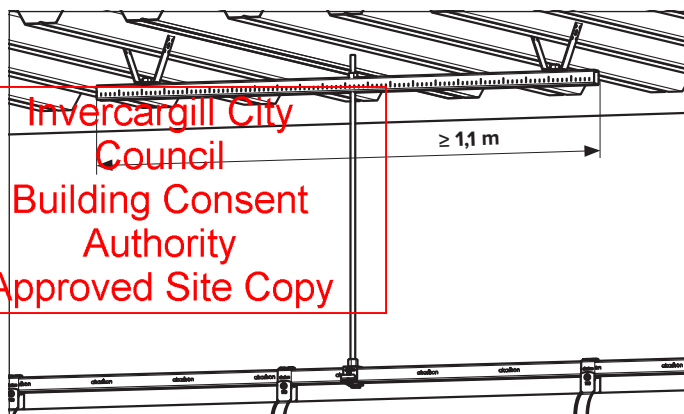


Illustration 6.20

Building Division  
**PIPE SYSTEM**

**7.1 CONNECTION TO THE ROOF OUTLET**

The connection of the roof outlet to the Akatherm PE pipe system depends on the roof outlet.

Roof outlet	Connection method	Art. Nr.
Roof outlet Akasison 75	Electrofusion coupler 75 mm	410795
Roof outlet Akasison 63	Screw coupler	749283
Gutter outlet Akasison 63		749283
Roof outlet Akasison 90	Screw coupler	749285
Gutter outlet Akasison 90		749285
Gutter outlet Akasison 110	Flange connection	741187

Table 71 Roof outlet connection to the pipe system

The isometric drawing will list the outlet and transition to the PE pipe as a separate pipe section (according to VDI 3608). The length of this pipe section is the height of the roof outlet. The parts list will separately specify the connection piece and the possible reduction to the diameter of the following pipe section.

The transition from the vertical to the horizontal pipe section under the roof outlet must be done under a 90° angle for optimal siphonic priming. A 90° bend can be used but requires a butt weld on one end. Use an 88.5° elbow for an installation that can be 100% electrofused.

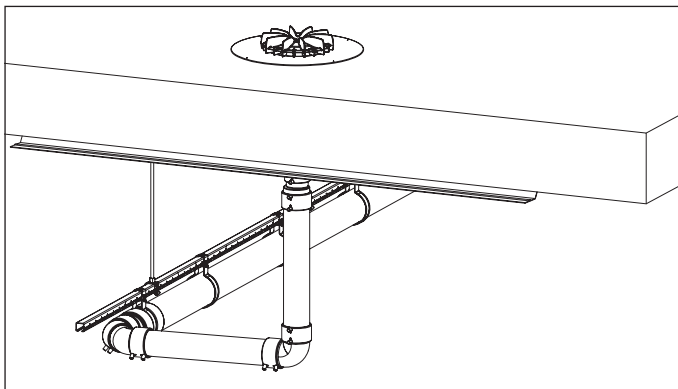


Illustration 71

**7.2 CHANGE OF DIRECTION**

Except for the transition underneath the roof outlet, the pipe system does not include any 90° bends. All changes of direction are made by using 45° elbows.

**7.3 BRANCHES**

Only branches of 45° are used in the PE pipe system. For the connection to the main collector a 45° branch and a 45° elbow are combined to make the angle of 90°. At a horizontal or vertical branch the rules for direction changes and branches are combined.



Illustration 71

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Council  
Building Consent  
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**7.4 REDUCTIONS**

It is not permitted to reduce the pipe diameter in the direction of flow, except in the vertical pipe section directly underneath the roof outlet, and in the downpipe. Only ex-centric reducers are used. When a diameter change is needed directly underneath a roof outlet, a centric reducer can be used.

**7.5 EMERGENCY OVERFLOW**

Every roof should be equipped with an emergency overflow system. This system operates when the primary system cannot deal with the rainwater. This can be the case when the amount of rain exceeds the rainfall on which the system was dimensioned, or by a blocked sewer. For the dimensioning and design of the emergency overflows, the local standards prevail. The system can be designed as a siphonic system, a traditional system, or with spouts in the facade of the roof. In this case the emergency system works as an early warning that something is amiss.

The emergency overflow system cannot be connected to the main sewer but has to exit freely.

**7.6 MAINTENANCE AND CLEANING WHEN IN USE**

It is important that the roof is kept clean in spite of the self-cleaning of the Akasison siphonic roof drainage system.

Items such as leaves and plants that are on the roof should be removed regularly to prevent blocking pipes and obstructing water flow. The frequency of inspection and cleaning depends largely on the surroundings of the building. A location with large trees in the vicinity will need a more frequent inspection than a location in an open field. When cleaning the roof outlet, the air baffle can be easily removed to clean the roof outlet on the inside.

A roof covered with snow needs particular attention. The heating elements in the roof outlets will only melt the snow in the roof outlet and the siphonic system will only drain melted snow. Snow is a good insulator and so even with temperatures above 0°C the bottom layer of snow will not necessarily melt, and draining will be minimal. The outlets have to be cleared of snow. When the snow load exceeds the maximum load allowed on the roof it needs to be removed.