

LCPRS LIMITED

LOW CHARGE PRESSURE RECEIVER SYSTEMS

INSULATION SPECIFICATION

for

REFRIGERATION PIPEWORK AND PRESSURE VESSELS

when using

METAL CLADDING WITH MACHINE INJECTED POLYURETHANE FOAM

The purpose of this Specification is to document the minimum standard of workmanship acceptable to LCPRS LIMITED. Failure to comply with any part of this specification will result in the Contractor being required to repair or replace the sub-standard work at a time acceptable to the Client and LCPRS LIMITED.

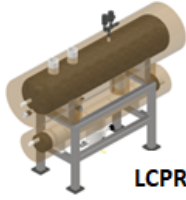
Variance from this Specification requires written approval from the Engineer responsible for the Contract prior to commencement of work.

WORKMANSHIP

GENERAL:

A high standard of general workmanship is required. The pipework and vessel insulation is the 'finishing coat' to much of the refrigeration pipework and pressure vessels. It is important for future and on-going work that the impression given to the Client is of a smart, well made job.

Great care is taken by LCPRS LIMITED Foremen to ensure that all pipework, especially in the Compressor Plant Rooms, are true and square. Poorly applied bends and cladding will not be tolerated as they create a bad visual impression every time the Client or potential Client enters the plant room.



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MATERIAL

Unless otherwise specified cladding material will be stucco aluminium sheet to the following thickness:

Vessel Cladding: 0.9 mm minimum thickness

Pipe Cladding, Bends, etc.: 0.6 mm minimum thickness

Where pre-insulated pipe is supplied for straight runs, care must be taken to ensure compatible materials are used for the cladding of joint sections, bends, etc. In most cases a spiral wound P.G.I. case is used which means P.G.I. should be used for the bends, couplers and valve boxes.

Where a transition is made from P.G.I. to aluminium cladding care must be taken to ensure a suitable barrier is used to prevent corrosion due to contact of dissimilar metals. An ideal transfer point will often be at a panel wall.

BENDS

Segmented bends only are to be used. The number of segments will vary according to the nominal pipe size and thickness of insulation.

The following chart dictates the minimum requirements for Standard Schedule 40 fittings as typically used in all our refrigeration pipework.

Minimum number of segments in segmented bends:

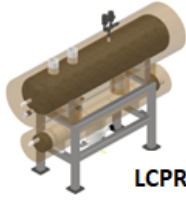
TEE'S

It is important that execution of all Tees and brackets be neat, tidy and made with a definite mechanical connection to the matching casing. To this end we would expect a rolled flange on the branch piece securely rivetted and sealing to the 'run' casing.

CONES

Where pipework to be insulated is supported by pipe hangers fixed to the pipework, the hanger protrusion through the insulation cladding must be coned off to minimise condensation due to cold tracking up the pipe hanger.

In general, all Control Valves and Solenoids will not be insulated, and the insulation should be neatly coned down either side of the valve.



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PANEL WALLS

Where refrigeration pipes, which pass through an insulated panel wall, are to be lagged, the pipe cladding must protrude into the panel wall by approximately 25 mm. The pipe must be sealed to the panel wall with a silicon sealer to preserve the vapour barrier. A sealed flange should be used if required to ensure a neat appearance.

The pipe insulation can then be foamed through ensuring a good seal to the wall and elimination of any voids in the wall penetration. Alternative arrangements, in particular sleeved penetrations, may be accepted if agreed to prior to the

commencement of the contract or specified by client or his consultant.

It is the responsibility of the Insulation Contractor to ensure adequate clearance between the pipe and metal wall cladding is maintained to ensure condensation will not occur on the surface of the insulation panel because of 'cold' leakage from the refrigeration pipe to the insulation panelling skin.

VALVE BOXES

Poorly executed valve boxes are very unsightly. All valve boxes must be squarely and symmetrically placed on the valve. Inverted dishes are not permitted on the valve spindle end of the valve when the valve spindle is in the vertical position as this allows condensation to pool around the valve spindle. Blanks which are slightly raised at the centre are preferred as this encourages the condensation to drain away from the valve spindle. Care should always be taken to ensure a Serviceman or Engineer can securely grasp the valve handle without risk of skinning his (or her) knuckles in the process. Please note, several smaller valves have rising spindles. The Contractor must ascertain which valves this applies to and ensure that, whether open or shut, adequate clearance is available.

Valve box design is not critical, the governing factor being clean execution and maintenance of the specified insulation thickness over all parts of the valve. A simple branch tee design coning down to the pipe insulation is acceptable.

STRAIGHT RUNS

On most sites a combination of pre-insulated pipe in spiral wound casings and in-position cladding will be used. In all cases it is imperative that the refrigeration pipes be accurately placed in the centre of the cladding for the full length of the pipe. Sufficient polyurethane foam spacers must be used to ensure the positioning of the cladding be maintained symmetrically round. For in-position cladding and coupling sections the overlapping ends of the Sheetmetal sections will be neatly swaged to ensure a tidy appearance.



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VAPOUR BARRIER

For refrigeration pipework insulation to be effective the integrity of the Vapor Barrier must be maintained in all areas. To ensure this is the case we require all joints, seams and overlaps to be sealed with clear U.V. Stable Silicon sealer as the cladding is fastened. This is designed to ensure a tight vapor-proof seal at all joints and will undoubtedly help seal joints for foaming.

All rivets used are to be of a sealed variety to ensure a vapor-proof joint is maintained. They shall be used in sufficient numbers to not only ensure the mechanical strength of the seam or joint, but maintain the neat appearance required.

A final seal coat of silicon sealer over all joints to ensure a complete vapour barrier may be appropriate.

VESSELS

The same high standard of workmanship and appearance applies to the insulation of pressure vessels. As with the pipework cladding, Clear Silicon Sealer will be used during assembly to ensure the integrity of the vapor barrier is maintained.

Sealed rivets are to be used, and care must be taken to ensure the specified insulation thicknesses are maintained. Where difficult or awkward areas are encountered a written instruction must be obtained from the Contracts Engineer with respect to an acceptable resolution to the problem.

Vessel Control Columns will normally have several Level Eye fittings installed. As these tend to ice up, we require a special insulation detail around these fittings. Please use the detail shown on the attached sketch for quoting and installation purposes.

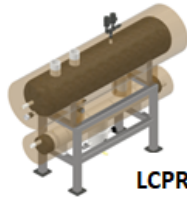
FOAMING

Machine injected polyurethane foam is the required insulation medium. Application is to be by, or under the direct supervision of, an experienced operator. The operator must ensure he uses enough injection points to ensure he achieves 100% filling of the cladding. Foam used shall be of a nominal 32 kg/m³ density or better. Where the joints and fittings between lengths of pre-insulated pipe are being foamed a higher density foam is required. This should be in the 50 – 60 kg/m³ range to match that used in the pre-insulated pipe. All injection points are to be vapour sealed with clear silicon sealer and a secure cap.

No voids will be tolerated and must be remedied as soon as discovered, if possible, or at the convenience of the Client. Hand pouring will only be allowed if prior approval in writing is obtained from the Contracts Engineer.

A 48-hr cure time is required for pipework to allow maximum foam stability. Ideally vessels should be allowed to stand for 3-4 days. Care must be taken to ensure correct cure temperatures are maintained to achieve the best result. Where cut-ins are undertaken a minimum of 24 hrs curing time must be allowed to ensure the manufacturers warrantee on the foam will be honoured. If this is not possible then other options such as solid PU sections must be explored.

Prior to foaming all cladding and surrounding areas must be either lightly oiled or masked to ensure no foam can mark or stain the surrounding area. Care must be taken to anticipate the consequences of blown joints or seams. Where foaming takes place over or beside colour steel walls or roofs protection must be provided to prevent foam



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spillage.

All Engine Room Plant must be covered prior to foaming. All rubbish including foam, metal off-cuts, rivet nails, etc. are to be cleaned up immediately after foaming. All pipework must be cleaned down within 3 days of foaming with all foam over-runs and stains removed from pipe and any other areas.

Any blown bends or seams must be repaired immediately after foaming.

Any variation to this must be agreed upon with the Contracts Engineer and confirmed in writing.

WARRANTY

All refrigeration pipe and vessel insulation to be guaranteed for a minimum period of two years against failure of vapour barrier due to bad workmanship. Failure of insulation due to voids in the foam insulation are to be repaired immediately upon discovery or at a time convenient to the Client if it is not practical to repair immediately.

The guarantee period for failure of insulation due to voids in the foam shall be 5 years.

HEALTH AND SAFETY

The Health and Safety in Employment Act and the Health and Safety in Employment Regulations, has made it necessary for LCPRS LIMITED to formalize its site safety policy to ensure conformance with their requirements. It is also a contractual requirement that we comply with our principal's health and safety policies.

Any company working on our behalf will be required to fulfil the same requirements whilst on site.

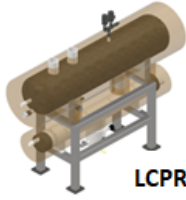
To formalize this arrangement the sub-contractor may submit a copy of their company's health and safety rules to us, or alternatively, they may prefer to use those published in the

"LCPRS LIMITED Health and Safety Rules and Guidelines", a copy of which is available upon request.

An additional requirement of the Regulations is: "**Notification of Particular Hazardous Work**" to the nearest OSH Office before commencing the work. To standardise procedures and avoid confusion or oversights, LCPRS will notify OSH when such work is to be performed, but it will be necessary for the contractor to liaise directly with the local OSH Inspector so that they can perform their inspection before actual work is commenced.

Compliance with these Regulations is mandatory for all contractors working on our behalf.

All contractors are required to sign a statement agreeing to abide by the required Health and Safety policies prior to commencement of work on site.



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INSURANCES

Contractor to supply documents detailing current insurances for:

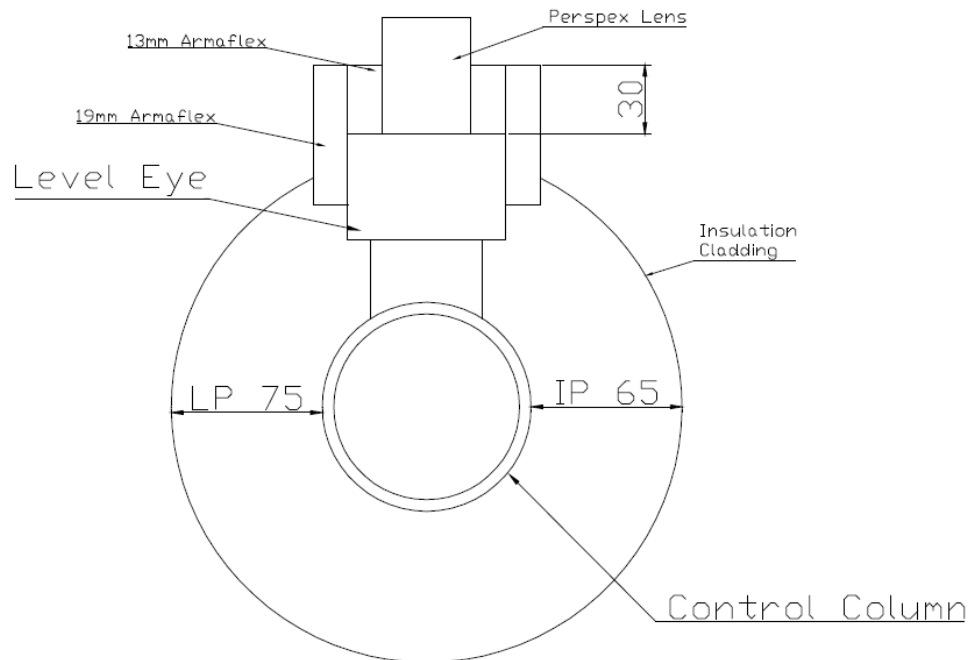
- Public Liability
- Contractor's Risk
- Worker's Compensation

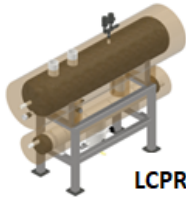
TERMS OF PAYMENT

Normal terms are payment on the 20th of the month following date of invoice acceptance.

Any company working on our behalf will be required to accept the same conditions of contract and terms of payment as imposed under the Principal's Contract.

Vessel Control Column Insulation Detail





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Detail of Pipe Penetration Through Wall

