

# **Method of Statement (Mechanical & Electrical)**

Revision 0  
Prepared for:

**LONZA BIOLOGICS TUAS PTE LTD (LBT):  
Road Runner Expansion Project-  
Subcontract Requisition for Fit-Out**

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## **1. ELECTRICAL**

### **1.1 Installation of cable conduit works**

#### **Purpose**

- ❖ To define the method of installation for Cable Conduits.

#### **Document/Drawing/Standard Reference**

- ❖ Working Drawings.
- ❖ Singapore Standard CP5: 1988 (Code of practice for electrical Installation)

#### **Equipment/Tools/Material Requirements**

- ❖ Concrete Drill.
- ❖ Hand Tools.
- ❖ Hand Drills.
- ❖ Hacksaw.
- ❖ Measuring Tape.
- ❖ Fibre Cutter & Raw plugs.
- ❖ Scaffolding.
- ❖ Ladder.
- ❖ Marker Pen.



- ❖ Conduit Bender and Dies.
- ❖ Conduits & Fittings.

### **Pre-Preparation Work**

- ❖ Ensure that site access and location is clear and free of debris and obstruction.
- ❖ Marked out all relevant positions or locations on the working drawings for the installation to proceed.

### **Safety Precautions**

- ❖ Barricade all work areas relating to the works if required.
- ❖ Wear Proper Protection Equipment (PPE) for personal safety.
- ❖ Proper ladder should be secured by tight rope/wire, proper roller clamp on suitable hook.
- ❖ All electrical tools and equipment shall be properly earth.
- ❖ Proper scaffolding to be provided while working in the heights.

### **Work Procedures**

1. Refer to working drawings and marked out the position of conduit saddle on the Working drawings.
2. Marked out the relevant positions to install the conduit saddle at the walls and ceilings.
3. Cut the conduit to the required length. Use the conduit Reamer or half round file to smoothen the sharp edges at both end of the conduit.
4. Confirm actual location of conduit. Drill the required diameter at the walls and ceilings.
5. Ensure all conduit saddle are provided at one metre apart.
6. Install conduit box by turning the conduit box in to the threaded conduit. Use monkey pliers it tightens up the conduit box.

7. By making use of the conduit bender, fabricate 90-degree bend. Off set to meets the site condition.
8. Insert the raw plugs into the drilled holes of walls and ceilings.
9. Secure the G.I. conduit by saddle and screw nuts.
10. Touch up the edges, bending and scratches areas of conduit ends to touch up with 2nd layer of final coat paint.



### **Forms /Checklist Records**

- ❖ Checklist for Cable Conduits Installation.

## **1.2 Installation of cable trunking works**

### **Purpose**

- ❖ To define the method of installation for Cable Trunking.

### **Document/Drawing/Standard Reference**

- ❖ Working Drawings.
- ❖ Singapore Standard CP5: 1988 (Code of practice for electrical Installation)

### **Equipment/Tools/Material Requirements**

- ❖ Hand Tools.
- ❖ Concrete Drill.
- ❖ Hand Drills.
- ❖ Hack Saws.
- ❖ Measuring Tapes.
- ❖ Fiber Cutter.
- ❖ Scaffolding.



- ❖ Ladder.
- ❖ Marker Pen.
- ❖ Trunking and Fittings
- ❖ Brackets, Threaded Bolts & Nuts.

### **Pre-Preparation Work**

- ❖ Ensure that site access and location is clear and free of debris and obstruction.
- ❖ Marked out all relevant positions or locations on the working drawings for the installation to proceed.

### **Safety Precautions**

- ❖ Barricade all work areas relating to the works if required.
- ❖ Wear Proper Protection Equipment (PPE) for personal safety.
- ❖ Proper ladder should be secured by tight rope/wire, proper roller clamp on suitable hook.
- ❖ All electrical tools and equipment shall be properly earth.
- ❖ Proper scaffolding to be provided while working in the heights.

### **Work Procedures**

1. Refer to the Working drawings and marked out the trunking bracket supports position on the Working Drawings.
2. Marked all positions and locations of trunking bracket supports on the walls and ceiling.
3. Drill all the relevant holes for anchor bolts or insert's on walls and slab areas.
4. Mount the supporting bracket or threaded rod by making use of the anchor bolt or insert.

5. Measure, mark and cut the cable trunking according to shop drawing and site condition.
6. Remove the sharp cutting edges with smooth file.
7. Install the cable trunking together with the necessary factory made 90- degree elbow, tee or reducer joints accordingly.
8. Install all the points with copper earth link to maintain the earth continuity



### **Forms /Checklist Records**

- ❖ Checklist for Cable Trunking Installation.

### **1.3 Installation of cable tray works**

#### **Purpose**

- ❖ To define the method of installation for Cable Trays.

#### **Document/Drawing/Standard Reference**

- ❖ Working drawings.
- ❖ Singapore Standard CP5:1988 (Code of practice for electrical Installation)

#### **Equipment/Tools/Material Requirements**

- ❖ Hand Tools.
- ❖ Impact Drill.
- ❖ Hand Drill.



- ❖ Hack Saw.
- ❖ Measuring Tape.
- ❖ Fiber Cutter.
- ❖ Scaffolding.
- ❖ Ladder.
- ❖ Marker Pen.
- ❖ Tray and Fittings.
- ❖ Brackets, Stud rods, Bolts, Nuts, and Washers.
- ❖ Expansion Bolts

### **Pre-Preparation Work**

- ❖ Ensure that site access and location is clear and free of debris and obstruction.
- ❖ Marked out the relevant positions or locations on the working drawings for the installation to proceed.

### **Safety Precautions**

- ❖ Barricade all work areas relating to the works if required.
- ❖ Wear Proper Protection Equipment (PPE) for personal safety.
- ❖ Identify the proper voltage to use, where hand tools, equipment are concerned.
- ❖ All electrical tools and equipment shall be properly earth.

### **Work Procedures**

1. Refer to the Working drawings and marked out the tray bracket supports position.
2. Marked out all positions and locations of tray bracket supports on the walls and ceiling.
3. Drill all the relevant holes for expansion bolts on walls and ceilings.
4. Mount expansion bolts and bracket supports to walls and ceilings. Tightened to required torque where necessary.
5. Install the trays and fittings with bolts and nuts.
6. Touch up all cut edges with paint.

### **Forms /Checklist Records**

- ❖ Checklist for Cable Tray Installation.





#### **1.4 Installation of cable ladder works**

##### **Purpose**

- ❖ To define the method of installation for Cable Ladders.

##### **Document/Drawing/Standards Reference**

- ❖ Working Drawings.

##### **Equipment/Tools/Material Requirements**

- ❖ Impact Drill.
- ❖ Hand Tools.



- ❖ Hand Drill.
- ❖ Hack Saw.
- ❖ Measuring Tape.
- ❖ Fiber Cutter.
- ❖ Scaffolding.
- ❖ Ladder.
- ❖ Marker Pen.
- ❖ Cable Ladder & Fittings.
- ❖ Brackets, Stud-rods, bolts, washers, & nuts.
- ❖ Expansion bolts.

#### **Pre-Preparation Work**

- ❖ Ensure that site access and location is clear and free of debris and obstruction.
- ❖ Marked out all relevant positions or locations on the working drawings for the installation to proceed.

#### **Safety Precautions**

- ❖ Barricade all work areas relating to the works if required.
- ❖ Wear Proper Protection Equipment (PPE) for personal safety.
- ❖ Identify the proper voltage to use, where hand tools, equipment are concerned.
- ❖ All electrical tools and equipment shall be properly earth.

#### **Work Procedures**

1. Refer to the Working drawings and marked out the ladder bracket supports position on the Working Drawings.
2. Marked out the position of Cable Ladder bracket supports at the slab.
3. Drill the relevant holes for expansion bolts at the ceiling.
4. Install the expansion bolts and bracket supports. Tighten to the required torque where necessary.
5. Mount cable ladder and fittings with bolts, nuts, and washer.
6. Touch up the edges of cable ladder with paint.



**Forms /Checklist Records**

- ❖ Checklist for Cable Ladder Installation

**1.5 Installation of cable and termination works**

**Purpose**

- ❖ To define the method of installation for and Termination.

**Document/Drawing/Standards Reference**

- ❖ Refer to working drawings.
- ❖ Electrical Single Line Diagram.
- ❖ Cable Schedule.

### **Equipment/Tools/Material Requirements**

- ❖ Impact Drill.
- ❖ Hand Tools.
- ❖ Hand Drill.
- ❖ Hack Saw.
- ❖ Measuring Tape.
- ❖ Masking Tape.
- ❖ Scaffolding.
- ❖ Ladder.
- ❖ Marker Pen.
- ❖ Cable Cutter.
- ❖ Flexible Conduit, Cable Glands, Cable Lugs, and Coloured Sleeves.
- ❖ Drum Support with hydraulic jack.

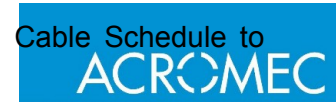
### **Pre-Preparation Work**

- ❖ Ensure that site access and location is clear and free of debris and obstruction.
- ❖ Marked out all relevant positions or locations on the working drawings for the installation to proceed.

### **Safety Precautions**

- ❖ Barricade all work areas relating to the works if required.
- ❖ Wear Proper Protection Equipment (PPE) for personal safety.
- ❖ Identify the proper voltage to use, where hand tools, equipment are concerned.
- ❖ All electrical tools and equipment shall be properly earth.

### **Work Procedures**



1. Check Working drawings, Electrical Single Line Diagram, and Cable Schedule to identify the cable routing and type of cable sizes required.
2. Identify all the cable length required for cable laying and termination for the various locations on drawings.
3. Support the cable drums with hydraulic jacks and supports.
4. With the aid of a suitable marker pen write down the Equipment Number, Cable Size & Type, and Cable Run Length on the masking tape.
5. Next, marked the length of the cable. Affixed one piece of the masking tape at the beginning of the cable.
6. Record the Equipment Number, Cable Size and Type, Cable Run Length in an appropriate form.
7. Now, unroll the cable drum and lay the cables on the cable trays.
8. Cut the cable to the required length after the cable was laid. Marked the other end of the cable with the piece of masking tape Affixed it at the position where the cable was cut at the point.
9. Secure the cable that was laid by temporarily affixing with wires. When all required cables are completely laid, secure the cables permanently to the cable tray with cable ties.
10. Terminate the cables to panels with suitable cable glands, cable adapter, cable lugs, and colored sleeves, where required.

#### **Forms /Checklist Records**

- ❖ Checklist for Cable Installation and Termination.

### **1.6 Installation of sub distribution board works**

#### **Purpose**

- ❖ To define the method of installation for Sub Panel and DB.

#### **Document/Drawing/Standards Reference**

- ❖ Working Drawing.



- ❖ Installation Detail Drawing.

#### **Equipment/Tools/Material Requirements**

- ❖ First Aid Resuscitation Chart.
- ❖ Hand Tools.
- ❖ Hand Drill.
- ❖ Crane/Lorry crane.
- ❖ Measuring Tape.
- ❖ Sling belt.
- ❖ Scaffolding.
- ❖ Ladder.
- ❖ Marker Pen.
- ❖ Rubber Mat.

#### **Pre-Preparation Work**

- ❖ Check plinth size, height level and location according to working drawings.

#### **Safety Precautions**

- ❖ If it is essential, barricade the affected work areas as a safety precaution.
- ❖ Wear Proper Protection Equipment (PPE) for personal safety.
- ❖ Confirm whether documentation for lifting gear equipment is required.

#### **Work Procedures**

1. Check sizes and hole position of mounting base frame for SP and DB panel.
2. Mark out the Expansion Anchor Bolt positions onto the plinth based on the base frame holes.
3. Install the Expansion Anchor Bolt according to Method Statements mentioned in the document.

4. Setting of Equipment on the plinth.



**Forms /Checklist Records**

- ❖ Checklist for Cable Installation and Termination.

**1.7 Installation of LT Main Switchboard works**

**Purpose**

- ❖ To define the method of installation for LT Main Switchboard



## **2. Document/Drawing/Standards Reference**

- ❖ Working Drawings
- ❖ Installation Detail Drawing

## **Equipment/Tools/Material Requirements**

- ❖ Hand Tools
- ❖ Measuring Tape
- ❖ Ladder
- ❖ Crane / Lorry Crane
- ❖ Lifting Tools / Pallet Jet
- ❖ Spanner / Tightening Tools
- ❖ Spirit-Level

## **Pre-Preparation Work**

- ❖ Ensure that site access and location is clear and free of debris and obstruction
- ❖ Marked out all relevant positions or locations on the working drawings for the installation to proceed.
- ❖ Check plinth size, height level and location according to working drawing.

## **Safety Precautions**

- ❖ Barricade all work areas relating to the works if required.
- ❖ Wear Proper Protection Equipment (PPE) for personal safety.
- ❖ Confirm whether documentation for lifting gear equipment is required.

## **Work Procedures**

1. Position the lorry crane at the 1st Basement and set up the crane rigger.





2. Tie up the belt on the C-Channel base frame of the panel to be hoist and lift the panel to ground floor by lorry crane.
3. Shift in the panel to the switch room by pallet jet.
4. Check the plinth width and length is according to working drawing.
5. Mark out the first point and last point on the plinth for LT Main Switchboard
6. Check panel in section labeled with 1, 2, 3... and refer to Panel Layout Arrangement Drawing attached.
7. Position the panel section on the plinth follow by 1, 2, 3... from left to right.
8. Align and level the panel
9. Jointing the panel and bus bar section by section
10. Cover all the rear PVC, fiber cover and metal door with the screw.

**Forms /Checklist Records**

- ❖ Checklist for Electrical Panel Installation.



## **2. HVAC EQUIPMENT INSTALLATION**

### **2.1 Installation of Chiller works**

#### **Purpose**

- ❖ To define the method of installation for Chillers.

#### **Document/Drawing/Standard Reference**

- ❖ Typical Installation Detail Drawing.
- ❖ Working drawings showing DCS Plant room.
- ❖ Chiller supplier's installation manual.

#### **Equipment/Tools/Material Requirements**

- ❖ Measuring Tape.
- ❖ Marking Pad / Ink.
- ❖ General Hand Tools.
- ❖ Impact Drill.
- ❖ Torch Lamp.
- ❖ Water Level.
- ❖ Winch.
- ❖ Hydraulic Jack.
- ❖ Protective Sheet

#### **Pre-Preparation work**

- ❖ Check Chiller for the correct model and type upon delivery at site.
- ❖ Check Chiller's plinth size, location and height according to Plinth Layout and working drawings.
- ❖ Check and verify the correctness in type, size & quantity of vibration isolators.
- ❖ Check on the clearance of delivery route of chillers from ground level to the plant room.
- ❖ Apply for clearance for mobile crane, low bay trailer, at least one day before the actual lifting activities is carried out.



### **Safety Precautions**

- ❖ Barricade the affected work areas as a safety precaution, if required.
- ❖ Wear PPE for personal safety and protection.
- ❖ Confirm documentation for mobile crane gear equipment before use is required.
- ❖ Only qualified lifting supervisor, signaller and rigger shall be in command and control the lifting activities.

### **Work Procedure**

1. Check for chiller orientation and alignment where concrete plinth dimensions provided is in accordance with the shop drawing.
2. Mark, drill and install anchor bolts for vibration isolators to correct position.
3. Check that size and hole positions of vibration isolators are correct.
4. Install Expansion Anchor Bolt to the inertia base according to the Method Statement for "Installation of Expansion Anchor Bolt".
5. Install vibration Isolators for chiller.
6. Place Chiller onto Vibration Isolators.
7. Check equipment level and adjust where necessary.
8. Connect all piping system and other necessary components.
9. Connect electrical supply wiring and other field control wiring system.
10. Cover the Chiller with protective sheet. For prevention of damaged to corners especially when Chiller is located at the common material /equipment delivery route, plywood covers are ideal for protection.
11. Check and adjust the level of Chiller after water filling.

### **Forms / Checklist Record**

- ❖ Checklist for Installation of Chiller.

## **2.2 Installation of cooling tower works**

### **Purpose**

- ❖ To define the method of installation for Cooling Tower.

### **Document/Drawing/Standard Reference**

- ❖ Typical Installation Detail Drawing.
- ❖ Working drawings showing location of Cooling Tower.
- ❖ Cooling Tower Manufacturer's installation manual.

### **Equipment/Tools/Material Requirements**

- ❖ Measuring Tape.
- ❖ Marking Pad / Ink.
- ❖ General Hand Tools.
- ❖ Impact Drill.
- ❖ Torch Lamp.
- ❖ Water Level.
- ❖ Crane
- ❖ Catch Pallet.
- ❖ Hydraulic Jack.
- ❖ Chain Block
- ❖ Protective Sheet

### **Pre-Preparation work**

- ❖ Check Cooling Tower for the correct model and type upon delivery at site.
- ❖ Check Cooling Tower's plinth size, location and height according to Plinth Layout drawing.

- ❖ Check and verify the correctness in type, size & quantity of vibration isolators.
- ❖ Check on the clearance of delivery route of Cooling Towers from ground level to the location where the Towers are erected.
- ❖ Apply for clearance for mobile crane, low bay trailer, at least one day before the actual lifting activities is carried out.

### **Safety Precautions**

- ❖ Barricade the affected work areas as a safety precaution, if required.
- ❖ Wear PPE for personal safety and protection.
- ❖ Confirm documentation for lifting gear equipment before use is required.
- ❖ Only qualified lifting supervisor, signaller and rigger shall be in command and control the lifting activities.

### **Work Procedure**

1. Check for Cooling Tower orientation and alignment where concrete plinth dimensions provided is in accordance with the shop drawing.
2. Mark, drill and install anchor bolts for vibration isolators to correct position.
3. Check that size and hole positions of vibration isolators are correct.
4. Install Expansion Anchor Bolt to the inertia base according to the Method Statement for "Installation of Expansion Anchor Bolt".
5. Install vibration Isolators for Cooling Tower.
6. Place Cooling Tower Base Channel onto Vibration Isolators.
7. Lift Cooling Tower Bottom Module onto the Base Channel and fix by Bolts / Nuts.
8. Lift Cooling Tower Upper Module onto the bottom module connect both modules by bolts & nuts.
9. Lift the fan deck and discharge cowl onto the upper module.
10. Connect all piping system and other necessary components.
11. Connect electrical supply wiring and other field control wiring system.
12. Cover the Cooling Tower with protective sheet. For prevention of damaged to corners especially when Cooling Tower is located at the common material / equipment delivery route, plywood covers are ideal for protection.
13. Check and adjust the level of Cooling Tower after water filling.



### **Forms / Checklist Record**

- ❖ Checklist for Installation of Cooling Tower.

## **2.3 Installation of pump works**

### **Purpose**

- ❖ To define the method of installation for Pumps.

### **Document/Drawing/Standard Reference**

- ❖ Typical Installation Detail Drawing.
- ❖ Working drawings showing the layout areas for Pumps.
- ❖ Plinth Layout drawings for Pumps.

### **Equipment/Tools/Material Requirements**

- ❖ Measuring Tape.
- ❖ Marking Pad / Ink.
- ❖ General Hand Tools.
- ❖ Impact Drill.
- ❖ Torch Lamp.
- ❖ Water Level.
- ❖ Catch Pallet.
- ❖ Hydraulic Jack.
- ❖ Protective Sheet
- ❖ Dial gauge and shime plates

### **Pre-Preparation work**

- ❖ Check Pump for the correct model and type upon delivery at site.

- ❖ Check Pump plinth size, location and height according to Plinth Layout drawing.
- ❖ Check and verify the correctness in type, size & quantity of vibration isolators and inertia block for the pump.

### **Safety Precautions**

- ❖ Barricade the affected work areas as a safety precaution, if required.
- ❖ Wear PPE for personal safety and protection.
- ❖ Confirm documentation for lifting gear equipment before use is required.
- ❖ Only qualified lifting supervisor, signaller and rigger shall be in command and control the lifting activities.

### **Work Procedure**

1. Cast the concrete to inertia base and leave it set and harden for at least one week.
2. Setting out the inertia base position on the plinth. Once completed, shift inertia base onto the plinth.
3. Setting out of the Pump position on the inertia base.
4. Install Expansion Anchor Bolt to the inertia base according to the Method Statement for "Installation of Expansion Anchor Bolt".
5. Shift the pump onto the inertia base position. Secure Pump to the inertia base by Expansion Anchor Bolt and nut.
6. Install vibration Isolators for inertia base.
7. Protect the installed Pump with PVC covering sheet.
8. Align and centre the Pump before actual start up. Pump shall be aligned and centred in water-filled condition. (Alignment procedure and inspection report enclosed).

### **Forms / Checklist Record**

- ❖ Checklist records for Pump Installation.
- ❖ Pumpsets alignment inspection report

## **2.4 Installation of air handling unit (AHU) works**

### **Purpose**

- ❖ To define the method of installation for Heat Exchanger.

### **Document/Drawing/Standard Reference**

- ❖ Typical Installation Detail Drawing.
- ❖ Working drawings showing Location of AHU.
- ❖ AHU Manufacturer's installation manual.

### **Equipment/Tools/Material Requirements**

- ❖ Grinding/Cutting Machine
- ❖ Mechanical Toolkit
- ❖ Drill machine
- ❖ Crane / Chain Block
- ❖ Supports, anti-vibration rubber pads
- ❖ Nuts, bolt, gaskets, bolts
- ❖ Valves

### **Pre-Preparation work**

1. Check the AHUs/FAHUs foundation and ensure it is as per approved drawings.



2. Check the area around the foundation and ensure access to the AHUs/FAHUs from all sides as applicable.
3. Ensure availability of sufficient slope to the drainpipe, for easy draining of condensate drain.
4. Place the anti-vibration ribbed rubber pads of correct thickness as per approved drawings/submittals.
5. In case of multiple rubber pads the pads shall be placed one above the other, with the ribs at right angle to each other.
6. AHUs/FAHUs sections are assembled at site/location by factory trained personal if required by consultant.

The logo for ACROMECH, featuring the company name in white capital letters on a blue rectangular background.

### **Safety Precautions**

- ❖ Barricade the affected work areas as a safety precaution, if required.
- ❖ Wear PPE for personal safety and protection.
- ❖ Confirm documentation for lifting gear equipment before use is required.
- ❖ Only qualified lifting supervisor, signaller and rigger shall be in command and control the lifting activities.

### **Work Procedure**

- ❖ Installation of Air Handling Units AHU
1. Shift the AHUs to the place of installation in safe manner using fork lift and crane as applicable.
  2. Ensure that the correct AHU is shifted to the place of installation.
  3. Air inlet, outlet, fresh air connection and chilled water connection orientation are as per approved drawings.
  4. If the AHUs are shipped in multiple sections, the AHUs will be assembled strictly as per the manufacturer's instructions, and also consider: The AHUs/FAHUs are placed correctly on foundation with vibration isolator rubber pads at right location. Identify the correct sections that are to be bolted together.
  5. Position fan section on housekeeping pad.
  6. Install gaskets at all bolted joints that are required to be joined.



7. Position the next section, to be joined, carefully on housekeeping pad, align the two sections.
8. Jointing brackets will then be used to externally join the sections together.
9. AHUs shall be inspected again for any damage during hoisting/shifting.
10. Upon satisfactory positioning of AHUs any open air/water outlets of AHUs shall be closed properly and area shall be cleaned, complete protection in areas where other trades are working.

❖ **Air, Chilled water, Electrical and Condensate Drain connections**

1. Ducting connection shall be done as per approved shop drawings.
2. Provide flexible duct connections as applicable/as approved submittal.
3. Provide proper supports as per approved drawings.
4. Chilled water connections shall be made as per approved drawings.
5. Ensure supply and return connection is made properly.
6. Provide pipe flexible connection and other piping accessories as per approved drawings and submittals.
7. The piping shall be free of any strain and shall not exert any load on AHUs/FAHUs.
8. Install the control valves, strainer, commissioning set correctly as per direction of flow as per approved drawings and project technical specification.
9. Ensure proper operation of valve handles and sufficient space for valve installation.
10. 1Electrical power connections shall be done as per approved drawings
11. Condensate drain piping shall be terminated at the nearest floor drain.
12. Provide the `U` trap in the condensate drain piping and provision for cleaning of `U` traps, also ensure proper slope to enable easy drainage of condensate water.
13. The piping connections to AHUs/FAHUs shall be pressure tested to 1.5 times the working pressures. Coils not included in test.
14. Strainer shall be cleaned after pressure testing and initial flushing of chilled water piping system.

15. Flow test of the AHUs drain tray should be done for condensate drain pipe and ensure water is drained out completely.

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❖ **Inspection and Testing Of AHU Installation**

- All construction/inspection/testing works shall be carried out in accordance with specifications.
- Work shall be carried out by the site MEP staff under the guidance of respected Engineer and shall further be checked and approved by quality engineer.
- An inspection request for the AHUs/FAHUs installation shall be submitted at least 1-2 days prior to the client/consultant or as agreed.
- Heat recovery testing will be done to ensure smooth operation
- Check the unit model number and relevant accessories are available. Unit name plate as per order.
- Verify the construction of the house keeping base is as per the specification & drawing for floor mounted AHU.
- Verify the presence of approved vibration isolators, installed before the installation of AHU.
- Check anti-vibration mountings are located correctly.
- Service space around the unit as per manufacturer requirement.
- Check the duct is connected to AHU with proper flexible connections
- Check fan moves freely.
- Check the level of the AHU and verify the minimum slope as per drawing in the direction of condensate pipe. Check the drain connection with U trap.
- Check filters are provided as per specification.
- Verify the electrical connection of AHU with control panel as per construction drawing.
- Check and verify all Installation as per approved drawings
- After installation inspect the AHU for physical internal and external damages.
- Verify the absence of any vibration in AHU and its inner like fan, motor and coils etc.
- Verify the process pipe connection with AHU along with valves, accessories and flow switch etc.
- Confirm the additional adequate support for all fittings and valves near AHU as per construction drawings.

- Verify the installation of 2-way modulating & gate valve of approved brand and quality as per approved material.
- Verify the presence of identification labels, safety and warning signs at their positions as per approved materials.

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### **Forms / Checklist Record**

- ❖ Checklist for Installation of Heat Exchanger.

## **2.5 Installation of Heat Exchanger works**

### **Purpose**

- ❖ To define the method of installation for Heat Exchanger.

### **Document/Drawing/Standard Reference**

- ❖ Typical Installation Detail Drawing.
- ❖ Working drawings showing Location of Heat Exchanger.
- ❖ Cooling Tower Manufacturer's installation manual.

### **Equipment/Tools/Material Requirements**

- ❖ Measuring Tape.
- ❖ Marking Pad / Ink.
- ❖ General Hand Tools.
- ❖ Impact Drill.
- ❖ Torch Lamp.



- ❖ Water Level.
- ❖ Lifting Gears.
- ❖ Hydraulic Jack.
- ❖ Protective Sheet

#### **Pre-Preparation work**

- ❖ Check Heat Exchanger for the correct model and type upon delivery at site.
- ❖ Check Heat Exchanger's plinth size, location and height according to Plinth Layout and working drawings.
- ❖ Check on the clearance of delivery route of Heat Exchanger from ground level to the respective location required.
- ❖ Apply for clearance for mobile crane at least one day before the actual lifting activities is carried out.

#### **Safety Precautions**

- ❖ Barricade the affected work areas as a safety precaution, if required.
- ❖ Wear PPE for personal safety and protection.
- ❖ Confirm documentation for lifting gear equipment before use is required.
- ❖ Only qualified lifting supervisor, signaller and rigger shall be in command and control the lifting activities.

#### **Work Procedure**

- ❖ Installation procedure shall follow the Plate type Heat exchanger Procedure issued by specialist vendor
1. When the pipe system is connected with the heat exchanger make sure that no piping loads (including torque effects) are transferred from the piping system to the heat exchanger. The pipe system must be isolated against pressure pulsations, vibrations and any thermal shock when connected to the heat exchanger.
  2. Brazed heat exchangers must be mounted in a vertical position. In order to support the heat exchanger it is advisable to use a mounting bracket fitted at the bottom of the heat

exchanger, however other methods that protect against vibration & thermal shock are acceptable.

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3. Make sure that the unit is not over tightened on the threaded connections as this may damage the internal soldering of the connections. The threads provided are parallel. The unit can be tightened by using an O-ring or a circular gasket which is placed at the end of the connections, alternatively, the use of thread tape is equally acceptable, however be extremely careful “Not” to over tighten the fitting.
  4. To prevent leak on the heat exchanger it is extremely important that NO welding is carried out on the appliance. To secure a correct installation we highly recommend purchasing connection fittings from OEM.
  5. The soldering temperature of a copper brazed heat exchanger must never exceed 800°C, as the structure of the copper brazing will change and result in an internal or external leakage on the connection. Therefore we recommend that all solderings take place with a silver plumb with a silver content of at least 45%. This secures:
    - A relative low soldering temperature and a high flowability.
    - All characteristics are preserved
    - A high thermal stress.
    - Limited, thermal stress.
    - A high corrosion resistance.
    - A short soldering time.
    - Minimum use of soldering material.
    - A tight and strong connection. Good finish.
  6. Connection must always be connected in counterflow.
  7. It is important that the cooling channels in the heat exchanger are encircled by water/brine pipes on both sides. This means that on each heat exchanger the first and last pipe must be in water/brine channel. Refrigerant is normally connected in the left side and the water/brine medium in the right side of the heat exchanger. Left and right are defined by installing the heat exchanger vertically with the connections turned towards you. Furthermore, F2 and F3 are containing an additional cooling channel securing that the cold medium is kept departed from the heads/followers.
- ❖ Installation procedure shall follow the Shell & Tube type Heat exchanger Procedure issued by specialist vendor
1. The nozzles and end caps are covered to protect internal parts against damage in shipping. Do not remove the covers until the piping is ready to be bolted to the exchanger.

2. The covers on the tubeside end caps are secured with bolts of the proper size, length, and material to connect the exchanger to a standard ANSI 150-lb flange. Use these cover bolts or bolts of the same length to avoid bottoming in the tapped blind holes of the end caps.
3. When the tubeside covers are removed, the end cap liners will be exposed. Care should be taken to prevent damage to these liners. If the intermediate flanges or shellside flange covers are removed, care should be taken to prevent damage to the shellside liner of LT units.
4. Do not perform operations which produce sparks or hot slag in the vicinity of the exchanger unless all openings are covered.
5. Exchangers may be mounted horizontally, vertically, or inclined. When low flow rates are involved [less than 50 GPM (11.4M3 /Hour)] for 10" diameter units, either shellside or tubeside, the units should be mounted inclined (120 minimum angle) or vertically to ensure a full vessel. Condensers are always mounted vertically or inclined.
6. Mounting brackets are not included. Suggested brackets are standard pipe riser clamps for vertical mounting or a cradle for horizontal installation.
7. To facilitate removal of the tube bundle for servicing, the exchangers should be installed with adequate working space at one end. A distance equal to the overall length of the exchanger plus one foot is required for removal of the tube bundle. This space may be provided at either end of the exchanger.
8. The exchangers are designed for single pass countercurrent flow operation. Co-current is acceptable, but heat transfer performance may be reduced.
9. Isolation valves and/or bypasses should be installed in the piping systems. This allows the heat exchanger to be removed from service for inspection, cleaning, or repair.
10. Connection piping must be clean and free of rust, scale, and other debris to ensure that the exchanger does not plug with refuse. Thoroughly flush the piping system prior to connection of the exchangers to remove any refuse.
11. Ensure piping is supported and/or properly aligned. Misalignment can cause seal leaks due to uneven forces on the end caps.
12. If the fluid stream is not free of suspended solids, strainers or other solids-separation devices should be installed in the piping upstream of the exchanger. Strainers should be sized to retain all particles larger than 25% of the tubing inside diameter.
13. When the units are mounted vertically, a possible siphon effect can result. Use of a vacuum breaker on the shell outlet is recommended.

### **Forms / Checklist Record**

- ❖ Checklist for Installation of Heat Exchanger.

### **3. PIPEWORK INSTALLATION**

#### **3.1 Installation of piping works**

##### **Purpose**

- ❖ The purpose of this procedure is to determine and control piping installation and inspection activities. The piping installation refer to the construction, erection of all major piping work carried out throughout the duration of the project.

##### **Document/ Standard Reference**

- ❖ Piping Welding Procedure and Qualification Record
- ❖ Hydrostatic Pressure Test Procedure
- ❖ Air Leak Test Procedure





- ❖ Piping NDT Procedure
- ❖ Material Handling and Control Procedure
- ❖ Piping Insulation Procedure
- ❖ API 1104 - “Standard Welding Pipelines And Related Facilities”
- ❖ ASME IX - “Qualification Standard For Welding and Brazing Procedure, Welders, Brazers, and Welding and Brazing Operators”

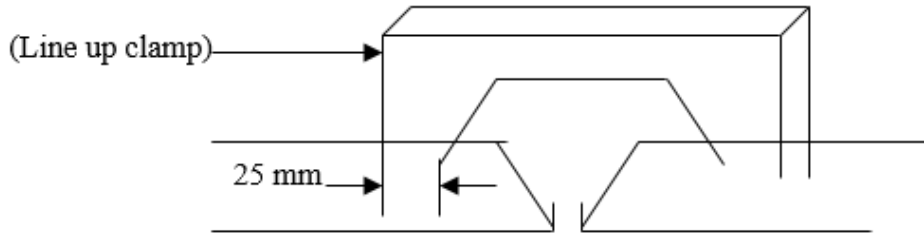
### **Drawing**

- ❖ The drawing applicable for piping installation and work shall be as follows:
  - Working Drawings including Piping Installation typical detail Drawings
  - Piping Schematic Diagram (P&ID)
  - Piping Spool Drawings
  - Equipment Layout and Detail
  - Pipe Support Layout

### **Pre-Preparation Work**

- ❖ Prior to commencement of any piping activity, Acromec shall provide and ensure that AMECFW representative approves respective working drawings, Welding Procedure Specification (WPS) and procedures.
- ❖ Pre-insulation, cutting and preparation of pipe sections shall be carried out as per:
  - Method statement for pipe insulation.
  - Approved working drawing for dimension and material detail.
  - Approved Welding Procedure Specification (WPS) for bevel preparation.
- ❖ Cutting of pipe shall be carried out by torch/machine. Cutting end/bevel shall be grinded smooth prior to alignment and tacking of the pipes.

- ❖ Pipe fitter shall use line up clamp to align the pipes (bridge tack-above the weld/bevel). Temporary support and attachment if necessary shall be established prior to tacking. The temporary attachment, support and bracket, which are to be welded to pipe, shall be same as pipe material.

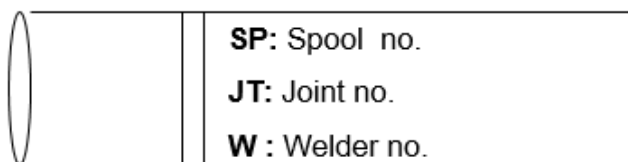


- ❖ Tacking shall be carried out by approved Gas Tungsten Arc Welding (GTAW) Welder (other may specify by respective WPS) Minimum tacking length shall be 2 x of pipes thickness or 25mm, whichever is lesser. Minimum 4 nos. of tack weld shall be carried out around circumferences of pipes.



### **Welding and Erection**

- ❖ Welding shall be carried out by qualified welder, with the guidelines of approved WPS, SC Welder Qualification test procedure.
- ❖ Identification such as spool no, joint no., welder no and inspection status shall be clearly marked (by permanent marker pen) according to the sketch drawing for joint to be welded. (see attached).



- ❖ Welding shall not to be carried out prior to fit-up/material verification inspection.
- ❖ No welding shall be done if there is impingement on the weld area of rain, sleets, and excessive wind or if the weld area is frosted/wet and not properly cleaned. Any paint, oil

rust, scale and foreign materials on groove face and adjacent area shall be removed prior to welding. Welding shall be done in continuous process.

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- ❖ Erection shall be carried out by safe manners and comply with safety requirements.
- ❖ Installation of pipes supports shall be accompanied and in line with piping erection to prevent unsafe working condition.
- ❖ As far as practicable, all permanent specified item such as valves, gasket, strainer and etc. shall be installed during erection. Temporary parts (gaskets, bolts and etc.) may be installed if testing such as pressure test; leak test or flushing will affect the item. Temporary item shall be identified and to be replaced after completion of respective testing.

### **Pre-commissioning**

- ❖ Pre-commissioning activity shall be include the following activities:
  - Hydrostatic test
  - Air Leak test
- ❖ Pre-commissioning shall be carried out to fulfill requirement of system design and ITP. The activity to be carried out shall adhere to Hydrostatic /Air leak test procedure.

### **Testing / Records**

- ❖ The following inspection and testing shall be carried out to fulfill the Inspection and Test Plan:
  - Material Receiving Inspection.
    - Applicable for major items such as reticulation pipe and fittings.
    - Acceptance standard shall be accordance to specification, P.O and/or Mill certificate.
    - Applicable Inspection Form: Goods Inwards Inspection.
  - Fit-up and Material Inspection

- Fit up inspection applicable to joint prior to welding. Criteria such as bevel preparation, root gap and root face shall be in accordance with the approved WPS.
  - Material shall be checked and shall comply with approved technical submittal.
  - Dimension measurement and slope shall confirm with approved working drawing.
  - Check sufficient gap/final spacing for insulation (if applicable)
  - Applicable Form: Material Fit-up Inspection Record For Piping
- In process Welding Monitoring
- In-process welding monitoring is a preventive activity aimed to ensure that welding comply with inspection Test Plan (ITP) and Welding Procedure Specification (WPS) requirement.
  - Inspection / monitoring will consider certain criteria such as welder qualification, consumable and etc. as detailed in Welder Qualification Test Procedure.
  - Any non-conformances of works arise shall be stopped and rectified immediately. NCR may be issued by QA/QC rep. for unresolved site non -conformance / deficiency.
- Weld Visual Inspection
- Upon completion of welding, the weldment and adjacent area shall be properly cleaned for Visual Inspection.
  - Visual inspection shall be carried out prior to commencement of any NDT work.  
Inspection Form: Weld Visual Inspection Record For Piping
- Line Verification / Inspection
- Line verification walk down/inspection shall be carried out upon completion of line(s). This is to ensure complete installation and punch list item identification.
  - Respective working drawing, equipment detail drawing shall be used as an inspection guideline.
  - Outstanding items and major punch list identified shall be recorded and copy to be handed over to the respective subcontractor for further action.

➤ Hydrostatic/Air leak Test

- The above activities shall be carried out in accordance to Hydrostatic/Air leak test procedure.
- Result shall be recorded in Hydrostatic/Air leak test record.



**Forms**

- ❖ Check list for Piping Installation Inspection
- ❖ Goods inwards inspection
- ❖ Material fit-up inspection record for piping
- ❖ Weld visual inspection record for piping

**4. DUCTWORK INSTALLATION**

**4.1 Installation of ducting works and air outlets**

**Purpose**

- ❖ To define the methodology and procedure of installation of HVAC ducts and accessories, and to ensure that all concerned persons are familiar with the sequence of activities, utilization of resources, and execution of the works in compliance with applicable Safety and Quality Procedures, and Project Documents and Specification.



#### **Document/ Standard Reference**

- ❖ SMACNA
- ❖ Air Leak Test Procedure
- ❖ Material Handling and Control Procedure

#### **Scope of works**

This document covers the following scope of works:

- ❖ Outline the activities and the methods used for installation of HVAC ducts and accessories. All activities will be carried out in accordance with the contract details and in full compliance to the Contract Specifications and Documents. All work within the rights-of-way of the standards and specifications will be done in compliance with requirements issued by authorities.

#### **Equipment/Tools Requirements**

- ❖ Measuring Tape.
- ❖ Marking Pad / Ink.
- ❖ General Hand Tools.
- ❖ Grinding/Cutting Machine
- ❖ Riveting tools
- ❖ Water Level.
- ❖ Lifting Gears.
- ❖ Scaffolding

#### **Materials Requirements**

- ❖ Pre-fabricated Ducts of various sizes
- ❖ S-cleat, C-Clamp, duct mate, flanges and angle
- ❖ Acoustic Liner
- ❖ Mechanical Insulation Board
- ❖ AluGlass Duct Insulation
- ❖ Lagging Adhesive



- ❖ Fungicidal Protective Coating
- ❖ Aluminium Foil Tape
- ❖ Woven Glass Cloth (20x20 thread/inch)
- ❖ Stuck up pins

#### **Pre-Preparation work**

- ❖ Check all material delivered to site is inspected properly by QA/QC Engineer and check if it is stored properly as per manufacturer's recommendations.
- ❖ Work shall be carried out by the site staff under strict supervision and guidance of the concerned Supervisors / Foremen / Engineers.
- ❖ The quality Engineer shall check all the installations as per the Installation Check list.

#### **Safety Precautions**

- ❖ Barricade the affected work areas as a safety precaution, if required.
- ❖ Wear PPE for personal safety and protection.
- ❖ Confirm documentation for lifting gear equipment/ scaffolding before use is required.
- ❖ Only qualified lifting supervisor, signaller and rigger shall be in command and control the lifting activities.

#### **Work Procedure**

- ❖ Fabrication Of HVAC Ducts:
  1. Approved fabricated ducts, elbows, transitions, offsets and branch connections with approved Galvanized sheet, which shall be used, as indicated in the approved shop drawings, project specification and SMACNA standards in Workshop or Factory.
  2. Thickness of Galvanized Sheet shall be conforming to BS 2989 or ASTM A653A, 653M G90 (Z275) and having a minimum coating of 1.25 oz/ft<sup>2</sup>.
  3. The galvanizing shall be carefully done and the sheets shall be of such quality that they may be bent flat on themselves with no fracture to the coating or the base metal.
  4. Flexible ductwork shall be lightweight aluminium laminated duct suitable for low and medium pressure systems.
  5. The aluminium laminated construction shall encapsulate a high tensile steel wire helix between two layers of 0.9 micron thick aluminium plus 12 micron thick polyester. Flexible ducts shall be with factory applied thermal insulation and vapour barrier. Insulation shall be 25mm thick, 24 kg/m<sup>3</sup> density.
  6. Approved duct sealant shall be used for joining the ducts by using sealant gun to all flanges.

7. Flanges shall be clamped with nuts, bolts and cleats as required to avoid leakage.
8. Ensure ducts are free from internal roughness, rust formation and sharp edges and corners.
9. Raise inspection request.

❖ INSULATION OF HVAC DUCTS (Acoustic Insulation)

1. Ducts insulation and cladding materials, thickness and density, shall comply project specification.
2. Check all approved materials and accessories are readily available on site.
3. Insulation materials shall be applied during dry condition.
4. Sharp cutters with straight angles shall be used for cutting insulation materials.
5. Impale approved insulation over the ducts and press gently on ducts, elbows, transitions, etc., with full insulation segments for each surface with the least number of joint practical.
6. Unless otherwise indicated insulate all ductwork with 25 mm thick, 24 Kg/M<sup>3</sup> density aluminium foil faced fibreglass duct insulation. Fasten the insulation with adhesive on 200 to 250 mm centres. Butt all joints tightly and seal all breaks and joints by adhering a 75 mm Aluminium foil vapour barrier tape or sheet with a fire retardant adhesive.
7. Insulate flexible connections and connections to diffusers with 25 mm thick, 24 Kg/M<sup>3</sup> density reinforced aluminium foil faced, flame resistant flexible fiberglass insulation overlap onto adjacent Insulation and seal with adhesive duct tape to give good closure.
8. Where ductwork is installed in ceiling voids and masonry shafts, which are not used as return air plenums insulate with 50mm thick, 48 Kg/M<sup>3</sup> density aluminium foil faced rigid fiberglass duct insulation.
9. Finish all duct insulation with an Aluglass Cloth backing (18u I FR Glue 18x8 Mesh Aluglass Cloth), combined with a high performance flame retardant solvent acrylic adhesive, protected by an easy-release silicone release paper.
10. Prepare a mock-up of HVAC Ducting System with insulation and raise request for inspection.
11. As required where ductwork passes through a wall or floor, other than when a fire damper is required, pack around the duct using a fire resistant material to ensure a sound and air-tight joint. Cover the opening with sheet metal flange of the same metal thickness of duct, overlap opening on four sides by at least 38mm.
12. Fire Damper and volume control damper shall be fixed matching the duct layout and shall be fixed with access doors to the ducting layout as per approved details on approved shop drawings.



13. Sound liner shall be installed in the main duct and elbows at the beginning of each unit up to 3 meters of duct length or up to the first branch then VAV up to the outlets or in considering with the contract drawings and approve material.
14. For ducts exposed inside conditioned spaces, insulate as described above for concealed air ducts using 25mm thick aluminium foil faced fiberglass boards with density 48 kg/m<sup>3</sup>. Then apply an Aluglass Cloth backing (18u / FR Glue / 8x8 Mesh Aluglass Cloth), combined with a high performance flame retardant solvent acrylic adhesive, protected by an easyrelease silicone release paper.
15. For ducts exposed in non-air conditioned areas, insulate using the method described for concealed ducts, but using insulation with a minimum thickness of 50 mm, 48 Kg/M<sup>3</sup> density rigid fiberglass insulation. Then apply an Aluglass Cloth backing (18u / FR Glue/ 8x8 Mesh Aluglass Cloth), combined with a high performance flame retardant solvent acrylic adhesive, protected by an easy-release silicone release paper. Then cover with plain sheet Aluminium, 0.9 mm or thicker.
16. All ductwork exposed externally to the building, installed on roof and within plant rooms is to be clad with plain aluminium, 0.9 mm or thicker.
17. Where ducts penetrate the building shell, the duct shall be flashed and waterproofed before any insulation is applied.
18. Approved Lagging Adhesive shall be applied over the entire inner surface of the ducts.
19. Impale approved insulation over the adhesive and press gently on ducts, elbows, transitions etc., with full insulation segment for each surface with the least number of joint practical.
20. Approved insulation sheet shall be cut to the size of duct to be insulated, Adhesive is applied on the inner surface and all over the periphery of ducts. The adhesive is allowed to dry for sometimes and the insulation sheet shall be firmly fixed to the duct.
21. Insulation should be applied with approved woven glass cloth both sides cover with two coats of fungicidal protective vapour barrier adhesive.

❖ INSULATION OF HVAC DUCTS (External)

1. Ducts insulation and cladding materials, thickness and density, shall comply project specification Sections.

2. 25mm thick, 48 kg/m<sup>3</sup> density reinforced aluminium foil faced fiberglass insulation shall be used for exposed duct insulation as per specification and as per approved materials. Then apply an approved woven glass cloth covered adhered between two coats of fire resistant fungicidal protective lagging adhesive.
3. Check all approved materials and accessories are readily available on site.
4. Insulation materials shall be applied during dry condition.
5. Sharp cutters with straight angles shall be used for cutting insulation materials.
6. Install insulation stuck up pins as per manufacturer recommendations in the entire circumference of the ducts and all surfaces of fittings and transitions with proper spacing as per approved detail on shop drawing.
7. Apply adhesives as per approval on the entire circumference of the ducts and to all surfaces of fittings and transitions. Adhesive shall be flexible, fire resistive compound suitable for vapour sealing insulated ducts and pipes. Adhesive shall be suitable for indoor and outdoor use and in high humidity environments. Adhesives shall be UL classified and shall meet or exceed their requirements of NFPA 90A and 90 B 25/50.
8. Impale approved insulation over the ducts and press gently on ducts, elbows, transitions, etc., with full insulation segments for each surface with the least number of joint practical.
9. For ducts exposed in non-air conditioned areas, insulate using the method described for concealed ducts but using insulation with a minimum thickness of 50mm, 48kg/m<sup>3</sup> density rigid fibre glass insulation. Then apply a 20x20 woven glass cloth covered adhered between two coats of approved fire resistant fungicidal protective lagging adhesive.
10. Apply approved plain aluminum sheet 0.9mm or thicker to exposed duct work within conditioned areas.
11. Prepare a mock-up of HVAC Duct with insulation and raise request for inspection.
12. Fire rated walls shall have galvanized steel sleeves.
13. Ductwork passes through a wall or floor, other than when a fire damper is required, pack around the duct using a fire resistant material to ensure a sound and air-tight joint. Cover the opening with sheet metal flange of the same metal thickness of duct, overlap opening on four sides by at least 38mm.
14. Fire damper and volume control damper shall be fixed matching the duct layout and shall be fixed to the ducting layout as per approved details on approved shop drawings.
15. Access doors shall be provided at all fire dampers locations.
16. Sound liner shall be installed in the main ducts up to 4 meter of duct length. Approved adhesives shall be applied over the entire inner surface of the ducts. Where required by project specification and the duct dimensions, it should meet the inside of lining.

17. Main supply and return trunk ducts, first 4 meter minimum should be internally lined with acoustic glass fibre insulation. The insulation should be between 24-48 kg/m<sup>3</sup>, and be at least 25 mm thick.
18. The VAV boxes and diffusers should be selected to achieve maximum NC rating of 25.
19. The ducting from the VAV box to the diffusers should be lined with acoustic insulation, at least 25 mm thick.
20. The ducting to supply air diffusers or VAV boxes should be straight and unobstructed for at least 4 duct diameters upstream of the diffuser.
21. The supply ducting should not include damper within at least 4 duct diameters upstream of a supply diffuser.
22. All ducting in mechanical rooms shall be externally covered with 50mm of glass fibre insulation and lagged with 2 coats of anti fungus coating having a surface density of at least 20 kg/ml.
23. Flexible duct connectors should be provided between all fans and ductwork as per approved materials and its length to not exceeding 1.5 meter for the rectangular ducts.
24. Resilient thrust restraints should be incorporate into the flexible connections to eliminate loading of the flexible connection. The restraints should be steel spring isolators having a static deflection of at least 19mm.
25. Wall or floor duct penetrations should allow for a 13 mm clearance around the duct. The gap should be stipped with glass fibre insulation and sealed with non-hardening caulking. The duct should be supported on both sides of the wall.
26. Variable-Air-Volume (VAV) units should be mounted as high in the ceiling space as possible, at least 2m away from return air opening.
27. Mock-up of sound liner installation for duct internal & external shall be done and inspection to be done.
28. The corners of the insulation shall be applied with the approved woven glass cloth and adhesives.

❖ INSTALLATION OF HVAC DUCTS



1. Fix the box outs with sizes as per schedule shown in the approved shop drawings during the construction of structural elements.
2. Install supports or brackets for ducting as per specification, approved shop drawing and site conditions for each individual case (i.e. Slab and Walls etc.).
3. Mark the location of ducting as per the approved layout and site conditions.
4. Install insulated ducts as per approved layout and conforming to site conditions.
5. S-cleat, C-Clamp, duct mate, flanges and angle shall be used for jointing ducts and plumbed to duct. Jointing shall be in accordance with SMACNA standards.
6. Approved duct mastic will be used in the joints to avoid air penetrations.
7. Volume Control Dampers, Fire Dampers, and accessories shall be installed as per approved shop drawings and manufacturer's recommendations.
8. Insulate all the joints and make air flow labeling with approved materials as per project specification.
9. Apply insulation for ducts continuously crossing walls and partitions except the fire rated walls.
10. For exposed duct work in non-conditioned areas apply approved cladding over the insulated ducts as per specification.
11. Fire dampers will be installed in the ducting layout which is passing through the fire rated walls with access door provided.
12. Non-insulated ducts shall be provided in fire rated walls, fire dampers shall be fixed with insulated ducts. Minimum 25mm gap shall be maintained on all sides of the ducts.
13. Gap between the walls and ducts Fiber Glass Insulation will be rammed properly and sealed with approved mastic both sides of walls.
14. Access panels shall be provided near to all fire dampers for future cleaning, inspecting and maintenance purpose.
15. Flexible ducts shall be connected from branch duct to air outlet as per approved shop drawings and the same shall be supported properly as per manufacturer recommendations.
16. Approved Flexible Duct Connector, shall be installed in expansion joints and between connections of HVAC equipment (packaged units, exhaust fans, etc..) and HVAC ducts by means of S-type cleat joints and will be riveted and sealed with approved duct sealant.
17. Duct leak test shall be carried out after the completion of duct installation.
18. Raise inspection request for installation of HVAC Ducts with Accessories to the client.



❖ INSTALLATION OF AIR OUTLETS

1. Approved make, type and model of grilles, diffusers, registers, slot diffusers, bar grilles and exhaust disc valves shall be installed as per approved material submittal and project specification.
2. Air outlets models and type shall be installed as per approved shop drawing and manufacturer's recommendations.
3. All air outlet shall be reflected with the false ceiling and the architectural approval is required before final selection of air outlet.
4. All air outlets shall be vertically and horizontally checked during fixing.
5. Approved sealant shall be used to seal the connections between the ducts and air outlets.
6. Corners of air outlets shall be sealed by silicon sealant matches to match wall or ceiling finishing.
7. All air outlets shall not have direct contact to supports, in case of contact it will be insulated with approved insulation materials.
8. Paint visible internal surface behind each grille or register flat black.

❖ INSTALLATION OF SOUND ATTENUATORS

1. Approved make, type, and model of sound attenuators shall be installed as per approved material submittal.
2. All sound attenuators sizes shall match the HVAC Ducting and approved noise level calculation.
3. Galvanized angles and channels shall be used for supporting all sound attenuators.
4. Sound attenuators shall be connected with ducting by flange which is already provided by the manufacturer.
5. All sound attenuator shall be insulated as per project specification.
6. Raise inspection request for installation of Sound Attenuators.



### **Testing / Records**

- ❖ The following inspection and testing shall be carried out to fulfill the Inspection and Test Plan:
  - In Process works shall be monitored for quality of workmanship and fabrication against approved shop drawings and standards by the relevant supervisor.
  - All works shall be inspected for conformance to specification.
  - The inspection formats shall be used in accordance with the requirements of the main contractor.
  - An inspection request for INSTALLATION OF DUCTS AND ACCESSORIES shall be submitted one day prior to the consultant

### **Forms / Checklist Record**

- ❖ Check list for Ductwork Installation Inspection
- ❖ Goods inwards inspection
- ❖ Material fit-up inspection record for ducting