10 SCOPE OF WORK:

The scope of work includes supply, installation, testing and successful commissioning and handing over of complete compressed air Pipeline Work.

SCOPE: This specification covers the general requirements for on site shop fabrication, erection, commissioning, testing and cleaning of compressed air pipelines. All pipe work shall be in conformity with the requirements of the applicable drawings and specifications. Where specific details of fabrication are not shown on the drawings or specified herein, fabrication shall be in accordance with BS 3351/ ASA B 31.3

Piping shall also comply with applicable state, local or other Governmental laws and codes. All work shall be performed in accordance with the best modern practice for this type of work and shall be of highest quality workmanship.

Any deviations from these specifications, must have the approval of Consultant /

Owner. LIST OF BUILDINGS:

2. 19/1 - ARMAMENT AGGREGATE O/H SHOP (Shop: 206)
3. 20/1 - MECHANICAL & AVIONICS AGGREGATE O/H SHOP (Shop: 204 & 207)
4. 21/1 - TEST STATION FOR HYDRO-PNEUMATIC FUEL AGGREGATES (Shop: 204B)
5. 22/1 - LANDING GEAR O/H SHOP (Shop: 205)

11 DETAILED SCOPE OF WORK FOR PIPING WORK:

(s) No changes without prior approval
(t) Site safety, security and cleanliness
(u) Project schedule
(v) Discrepancies / interferences resolved before installation.
(w) Supply of piping materials to work site/shop, fabrication and erection, testing and commissioning of all piping system in accordance with the specification.

(e) Fabrication and erection of pipe supports, brackets, as per pipe support standards and drawings and instructions of Engineer-in-Charge.

2. The contractor shall also bear the cost of repair, changes, replacement, etc. due to noncompliance with the standards, codes or due to disregard of instructions given by Engineer-in-Charge.

(ix) It is the responsibility of the contractor to take care of all the material brought inside the HAL until the time of handing over to the Owners.

(vii) Any other items as required in the drawings/specifications are to be fabricated and erected from the available materials.

a. All incidental jobs connected with Industrial piping work such as cutting chasing in concrete and brick work and making good cutting/drilling holes through walls, floors and grouting for fixing of supports etc. complete.

(l) The contractor for this work shall be required to work in Co-operation with other civil engineering, Electrical etc Contractors should give them all reasonable assistance and help for the execution of the work in an efficient manner as directed. Any work done without regard or consultation with other trades shall be removed by the Contractor.
without additional cost to the Owner, to permit the proper installation of all other works as desired by the Architects.

(ix) Repair all damages done to the premises as a result of this installation and removal of all debris left by those engaged for this installation to the satisfaction of the Owner.

12 **PIPE JOINTS:**

In general joints shall be butt welded as specified in the applicable valve and piping specifications, with flanges and butt weld fittings used where required. Flange faces shall be in a plane perpendicular, true and square to the centerline of the pipe to which they are welded. 

Bolts on flanged joints shall be drawn up to provide even and adequate pressure on gaskets.

**WELDING**

Fabricated piping system shall be erected as detailed on piping layout drawing and as advised by the consultant and / or owner. The contractor shall provide adequate field joints bearing in mind the fact that there may be variations in locations of equipments, equipment nozzles, inserts, structures, etc. but not limited to the aforesaid contingencies only. In certain cases site measurement may have to be taken before commencement of fabrication.

Flange joints shall be used at connections to equipments, valves, flanged fittings and wherever required for ease of erection and maintenance as indicated in the drawings.

13 **MEASUREMENTS:**

The measurements (for the payment purpose) shall be considered as per actual laid quantity. The mode of measurement shall be in running meters for the compressed air pipeline including fittings such as bends, elbows, tees, unions, nuts, bolts, washers, gaskets, nipples, expanders/reducers complete with adequate supports, and wrapping/coating for the underground pipeline.

Measurements (for the payment purpose) of the Flanges, Long Radius bends, Isolation (Ball) valves, Filters, Pressure gauges, Drip leg drains, Quick fix couplers with plug, Air compressor, Air dryer and Air receiver shall be considered as per the actual quantity used.

14 **RESPONSIBILITY**

(d) **DRAWINGS**

The drawing enclosed herewith is the guidance to the contractor. The contractor shall submit shop floor drawings for the consultant approval. The contractor should execute the pipeline on the drawings enclosed. After the completion of the test and handing over the work, the contractor shall submit 3 sets of hard copies of as-built drawings. If required, draft copies of the same shall be approved by the consultant.

**DRAWING/INFORMATION REQUIRED FROM SUCCESSFUL TENDERER WITHIN 15 DAYS AFTER AWARD OF WORK**

A

Bar chart showing engineering, manufacturing and dispatch of each equipment and erection services.
Drawing, literature and technical particulars of all bought out items.
Schedule for valves and piping material.

(j) **PAINTING**

All piping, furnished under this work shall be properly painted with two coats of a synthetic enamel paint over a coat of primer after installation as per IS Code. Arrow marks for indicating flow direction and stenciling to be done as per Good Engineering Practice.
Colour Code of the piping shall be SKY BLUE

b) SCAFFOLDING:
All scaffolding and ladders required for the proper execution of the work shall be in the scope of the contractor.

c) QUALITY OF MATERIALS AND GENERAL STANDARDS OF WORK
The contractor under this contract commits himself to use the first class materials and assumes full responsibility for the quality of all material incorporated or brought for incorporation in the work. The work shall be executed in accordance with the best engineering practice and as per directions of the consultant.

d) SAMPLES

The samples of all the materials to be incorporated in the work shall be furnished to the consultant and got approved prior to bulk procurement. Necessary certificates / documents required for the bought out items are to be produced.

c) GUARANTEE
The contractor shall guarantee the material and workmanship of the entire system for a period of 12 months from the date of commissioning or 18 months from the date of the supply of the items and hand over necessary documentations. Guarantee / test certificates of equipment from suppliers / manufacturers / contractor shall be handed over to the Owner. In case of any defective equipment / material / workmanship, the contractor shall rectify/modify/replace the defective item at free of cost. Any delay on the part of the contractor in doing so, gives the owner the right to get the defect rectified through other agency and the cost for the same shall then be borne by the contractor.

(u) INSTRUCTION MANUAL/COMPLETION DRAWINGS/TRAINING
The contractor shall furnish detailed instruction and operation manual in quadruplicate. The contractor shall also furnish detailed completion drawings as soft copy (in AutoCAD format) and hard copy on tracing sheet. The drawings shall be inclusive of control schematic, if any. The contractor shall train the Employer's personnel in the operation and maintenance of the system.

1. TESTING
The Contractor shall arrange to test the entire system as per the procedure enumerated under particular specifications, after the erection is completed. The test reports shall be duly signed and sealed by foreman and subsequently submitted to the Owners and Architects in triplicate. If the results of the tests are not found to be satisfactory by the Owners and Architects, necessary rectification shall be done until the test results are found to be satisfactory. The installation shall be deemed to be completed only after successful completion of the tests.

(f) TESTING PROCEDURE:
All piping shall be hydraulically tested for 1.5 times of working pressure after completion of erection to check for leakages. The water shall be held for 6 hours and any leakages found are to be rectified, the water has to be drained out completely, flush out the entire pipe line with the compressed air continuously to remove all traces of the moisture / water traces if any left with in the pipeline. The pipeline where hydraulic testing is not practically feasible there it shall be pneumatically tested at 1.5 times of working pressure after completion of erection to check
for leakages.

e) **PRE-DESPATCH INSPECTION:**
Pre-dispatch inspection to be arranged for representatives of owner for the items like Air compressor, Air dryer and Air Receiver at the suppliers work. Where the performance of the equipments can be checked. The responsibility lies with the contractor for successful installation and commissioning of the equipments towards entire satisfaction to the owner at the site. Final acceptance shall be after entire satisfaction to owner.

2 **CUTTING AND WELDING PROCEDURE:**

21 **CUTTING:**
Pipe and plates shall be cut as per the standard engineering practice by suitable means. No Electric metal arc cutting shall be allowed.
All edges cut by oxy-acetylene shall be cleaned of impurities prior to welding joints.

22 **CUTTING TOLERANCE SHALL BE AS FOLLOWS:**
   a) For pipe or plates connected at both ends to - 1mm
   b) Elsewhere to - 3mm

2.3 **EDGE PREPARATION OF PIPES FOR WELDING:**
The edge preparation for welding of pipes more than 1/2" wall thickness shall be done by flame cutting and followed by grinding. Cut faces shall not have cracks or irregular. Edge preparation of pipe diameters below 1/2" wall thickness shall be done by Grinding Machine. Sharp edges, rust of cut edges, notches, and irregularities fissures due to faulty cutting shall be chipped, grounded over the length.

Edge preparation for welding joints shall be carefully and accurately made so as to facilitate a perfect weld joints. Generally no special edge preparation shall be required for pipes under 1/6" wall thick.
Edge preparation beveling denotes cutting and grinding of the same so as to result in 'V' or 'X' shapes as per IS: 823.
The pipes to be assembled shall be clean and dry on the welding edges. Under no circumstances wet, greasy rust or dirt covered parts shall be welded.

2.4 **WELDING PROCEDURE:**
Welding shall be carried out only by fully qualified welders as tested and approved by the architects / consultants. Any test carried out in presence of either the architects / consultants or their representative or the inspectors shall constitute a right by them for such tests and the cost involved thereon shall be borne by the contractor himself.
When welding is carried out in open air, steps shall be taken to protect the place of welding against wind, rain or moisture, the welding electrodes and parts being welded shall be dry. Prior to the commencement of the welding, welder has to check the root gaps for all butt welds for single or double 'V' as per IS: 823. The welding joints shall be allowed to cool slowly.
For multilayer welding, before welding the following layer, the formerly welded layer shall be cleaned to metal bright by light chipping and wire brushing. Packing strips shall not be allowed i.e., all slag shall be removed.
Only welding generator / rectifier shall be used for welding.

**Welder Qualification:**
2G welding position qualification test will be conducted in presence of Consultant / PMC / Client. Electrodes: Welding electrodes with a suitable coating shall be in accordance with applicable IS and of a recognized quality of reputed manufacturers.
INSTALLATION
Above Ground piping – All piping shall be erected as shown in the drawings and in accordance with the specifications so as to conform to the applicable codes and engineering design.
Arrangement drawings shall show general location and should indicate special dimensions, locations of valves, fittings etc wherever critical.
Slopes of piping specified on drawings shall be maintained.

INSIDE SHOP PIPELINE: The compressed air pipeline inside the shops should be laid along the walls with necessary brackets and supports. Adequate pipe supports, anchors and guides for piping shall be provided. The fabrication shall be as per the best engineering practice as laid down in the IS.

BRACKETS / SUPPORTS:
All brackets / supports shall be made out of suitable M.S. rolled steel sections, bar and strip with C.I. washers, helical springs, sling eyes, U bolts etc fixed on the walls or hung from the slabs/ roof truss by MS rods / angles including grouting / welding or fixed to special insert plates (already provided in the construction) or fixed to special inserts as the case may be including fasteners, bolts, anticorrosive and color painted etc complete as required and / or by suitable means as per best engineering practice and

WELDING INSPECTION:
All weld joints shall be DP tested after completion of the welding for blow holes, cracks etc.,

2.6 SOCKET WELD:
Allowable diameter range:
Threaded ≤ 2NB
Welded > 2NB

Material of Construction : As per IS: 1239
Type : ERW
Class : Heavy

3.2 FLANGES:
Material : Mild Steel
Material of Construction : As per IS: 1239 Part:II
Type : SORF
Standard : As per ANSI B16.5
Rating : 150 #

3.3 FITTINGS:
Material : Mild steel
Material of construction : As per IS:1239 Part-II
Standard : As per ANSI B 16.9
Class : Heavy

3.4 GASKET:
Material : Neoprene
Thickness : 3.0mm

3. TECHNICAL SPECIFICATIONS:

3.1 PIPES:
Material : Mild Steel
Standard : As per ANSI B16.21
Sizes : To match RF 1 50# rating flanges

3.5 **BOLTS & NUTS:**
Type : Hexagonal
Material : Carbon Steel
Standard : As per IS:1364 & 1367

3.6 **ISOLATION VALVE:**
Type : Ball Valve (Make: Audco)
Material of construction : Forged carbon steel from 15 to 40 mm NB
                     Cast carbon steel from 50 to 150 mm NB
Body : (<40NB) : ASTM A 105
       (>40NB) : ASTM A 216 Gr. WCB
Ball : AISI 304
Stem : AISI 304
Seat & seal : PTFE
Ends : Flanged to ANSI B16.5, 150#
Lever : Carbon Steel with PVC Sleeve
Hydro Test Pressure : Body : 30 Kg/cm²
                     Seat : 21 Kg/cm²

3.7 **PRESSURE GAUGE:**
Type : Bourdon tube Pressure gauge with shut off cock.
Dial size : 150 MM
Size : 0-10 kg/cm² G.
Mounting : Direct Mounting
Housing : Weather proof housing
Pointer : Micro type adjustable pointer
Case : Stainless Steel

3.8 **DRIP-LEG DRAIN:**
Inlet Port : 1/2” BSP Female.
Max. Pressure : 10 Kg/cm²
Body : Carbon Steel
Bowl : Transparent Polycarbonate bowl.
Draining : Automatic

3.9 **QUICK FIX COUPLING:**
Quick Release Coupling size : As per BOQ
Construction : Poppet Type
Mounting (Ends) : Threaded
Material : Brass with Nickel Plating
Seal : NBR,
Working pressure : 8 kg/cm² G
Check valves : Single check valve in socket., with heavy duty
Sleeve with NBR Rubber Seal.
End Connections Socket : Threaded & Plug
Plug : Feasible for Rubber hose pipe connection.

Important Note : One sample has to be approved from M/s HAL prior to bulk supply.

4. LIST OF APPROVED MAKES:

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>DESCRIPTION</th>
<th>MAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PIPES - MS</td>
<td>TATA / JINDAL</td>
</tr>
<tr>
<td>2</td>
<td>PIPE FITTINGS – MS</td>
<td>BHARAT FORGE / SANGHI IMPEX / METAL UDYOG / or Equivalent - Reputed Make</td>
</tr>
<tr>
<td>3</td>
<td>ISOLATION VALVE</td>
<td>AUDCO</td>
</tr>
<tr>
<td>4</td>
<td>PRESSURE GAUGE</td>
<td>H-GURU / WIKA / FEIBIG or Equivalent - Reputed Make</td>
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<tr>
<td>5</td>
<td>PRESSURE REGULATOR</td>
<td>JANATICS / KUSHAKO / SPIRAX / AUDCO / LEADER</td>
</tr>
<tr>
<td>6</td>
<td>GASKET</td>
<td>CHAMPION</td>
</tr>
<tr>
<td>7</td>
<td>QUICK FIX COUPLINGS</td>
<td>TECHNOIDRIVE (PNEUMAX) / PIONEER / SPIRAX / JANATICS or Equivalent - Reputed Make</td>
</tr>
<tr>
<td>8</td>
<td>DRIP LEG DRAIN</td>
<td>PARKER / NORGREN / SPIRAX / JANATICS or Equivalent - Reputed Make</td>
</tr>
<tr>
<td>9</td>
<td>BOLTS / NUTS</td>
<td>SKANDA / ZION / TVS or Equivalent - Reputed Make</td>
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</table>