

दूरभाष :
TELEPHONE :
तार : बार्क-मुंबई, चेम्बूर.
TELEGRAMS : BARC-MUMBAI, CHEMBUR.
फेक्स संख्या : ९१-२२-२५५० ५१५१
FAX NUMBER : 91-22-2550 5151



ट्रॉम्बे,
मुंबई-४०० ०८५.
TROMBAY,
MUMBAI-400 085.

भारत सरकार
GOVERNMENT OF INDIA
भाभा परमाणु अनुसंधान केन्द्र
BHABHA ATOMIC RESEARCH CENTRE

Enquiry No. – BARC/ RTD/RK/MF/ OPA/60661/2019/

Dt– 01/04/2019

To,

SUB: Procurement of raw material, fabrication, inspection and assembly for installation & commissioning of an existing hydraulic system at BARC, Trombay, Mumbai, Maharashtra as per Technical specification- RTD/S&CS/03.

Dear Sirs,

Sealed Quotations are invited on behalf of President of India by Head, RTD in sealed envelope for “: Procurement of raw material, fabrication, inspection and assembly for installation & commissioning of an existing hydraulic system at BARC, Trombay, Mumbai, Maharashtra as per Technical specification- RTD/S&CS/03.”

- 1. Scope of Work :** As per attached specification ((Technical Specification. No.: RTD/S&CS/03).
- 2. Work completion and Validity period:** Within 4 (four) months after confirmation of order. Price should be firm throughout period of contract. The rates quoted shall remain valid for 60 days.
- 3. Price:**
Bidder should quote for the entire job in lump sum (including all taxes and duties) as per our technical specification No.: RTD/S&CS/03, which involves Procurement of raw material, fabrication, inspection and assembly for installation & commissioning of an existing hydraulic system at BARC, Trombay, Mumbai, Maharashtra as per Technical specification- RTD/S&CS/03. The lumpsum cost will be used for cost comparison.
- 4. Payment:**

- a) Payment will be made as per rules, after the completion of the work to purchaser's satisfaction against submission of original bill in triplicate and advance stamped receipt. Advance/Part payment cannot be made.
- b) 100% payment shall be made by cheque / ECS (Please furnish details) after completion of job subjected to the satisfaction of purchaser.
- c) **Deduction of Taxes: Income tax @2% and Educational cess as applicable will be deducted from the bill**
- d) A penalty @ 0.5% per week (max. 5%) shall be levied for delay in completion of work.
- e) Payment shall be made only on satisfactory completion of work and on production of bill & advance stamped receipt.

9. Guarantee/Warranty :

The entire job shall be guaranteed for 12 months from the date of completion.

10. Delivery :

All the work shall be completed and delivered to BARC, Trombay, Mumbai, Maharashtra within 4 (Four) months after confirmation of Work Order.

11. Confidentiality clause :

- a) Confidentially:
Party shall not disclose any information to any third party concerning the matters under this contract generally. In particular, any information identified as "Property" in nature by disclosing party shall be kept strictly confidential by receiving party and shall not be disclosed to any third party without the prior consent of the original disclosing party. This clause shall apply to sub-contractors, consultants, advisors or the employees engaged by the party with equal force.
- b) Restricted information:
Categories under section 18 of the Atomic Energy Act, 1962 and "Official Secrets" under section 5 of the official Secret Act, 1923 - Any contravention of the above-mentioned provisions by any contractor, sub-contractor, consultant, adviser or the employees of a contractor will invite penal consequences under the aforesaid legislation.
- c) Prohibition against use of BARC'S name without permission for publicity purpose:
The contractor or sub-contractor, consultant, adviser or the employees engaged by the contractor shall not use BARC'S name for any publicity purpose through any public media like press, Radio, T.V. or Internet without the prior written approval of BARC.

12. General:

- a) Proof of ability: A brief list of similar jobs executed, if any, and name of the organization to be furnished.
- b) The bidder shall comply with each and every condition specified in the tender document. The bidder's attention is drawn to the fact that no tender will be considered

unless the bidder shall satisfy the purchaser about his technical capability.

- c) The purchaser reserves the right to accept the tender in whole or in part or reject any or all the tenders without assigning any reason. The lowest or any tender shall not necessarily be accepted. Tender not supported by the information requested in the tender document or not complying with the tender document will not be accepted.
- d) The price quoted must be firm for the entire period of contract and shall not be subjected to any change.
- e) Work extension, if any required, the request letter for the extension shall be forwarded before expiry of contract period to the Engineer-in-charge indicating the current progress and reasons for extension.
- f) Supplier should have GST registration. He should clearly write GST No. and PAN No. in his quotation, otherwise the quotation will not be considered.
- g) Sealed envelope containing quotation must reach on or **before 15.00 hrs., 07/5/2019**
To: Head, RTD Engg. Hall No. 7, BARC, Trombay, Mumbai -400 085.
- h) The envelope **must be sent by "speed post" only** to reach within above mentioned period. Any other mode of delivery is not acceptable.
- i) Following information shall be clearly written on the envelope containing the quotation
Attention: Shri. Ramakrishna.P, SO/G, RTD Ref. no. BARC/ RTD/RK/MF/OPA-60661/2019/ , **Due date: 07/05 /2019 till 15:00 hrs.**
- j) The Bids will be opened on **09/05/2019** at 14.00 hrs.
- k) For any clarification regarding the job bidder shall contact Shri Ramakrishna.P **Ph.022-25593980.**

Thanking you,

Yours Sincerely,

Handwritten signature

Handwritten signature of S. Raghunathan

(S. Raghunathan)
Head, RTD

Technical specification for commissioning of hydraulic system.

Introduction

There exists an 300KW oil hydraulic power pack at BARC. This has to be hydraulically connected to the free issue materials like Hydraulic actuators, Hydraulic manifolds, Hydraulic Accumulators and Table Top partly by rigid piping and partly by hoses. Work involves measurements, procurement of raw materials, fabrication and assembly of components with the existing free issue materials. Work also involves preparation of signal cables and Routing of electrical cables from one point to another as per required length and required end connections.

Scope:

Scope of Work at Site:

1. Precision dimension and alignment measurement at premises using theodolite / laser based equipment. Measurements to be used to fabricate actuator extension and spacers to achieve necessary alignment of the table top and assembly of the same at required locations.
2. Fabrication and laying out of main piping 3"SCH 160(Pressure line), 3"SCH40 (Tank line), 1"SCH40 (Drain line) and 2"SCH160, 2"SCH40, 1"Sch40 & 1/2"Sch40 branching lines as listed in Table -1 and layout shown in Fig. 5. Carrying out welding, radiography of the joints, liquid penetrant testing and ultrasonic testing of joints and hydro test of complete piping as per specifications.
3. Placement of Hydraulic accumulators, high pressure gas bottles, hydraulic manifolds in to the pit as per the approved layout. Design and Fabrication of support structure to securely mount them w.r.to pit. Interconnection of these hydraulic components using prefabricated piping. Providing piping support wherever essential.
4. Erection of Support structure into the pit. Mounting of the table top on the structure at appropriate spacing.
5. Erection of four horizontal hydraulic actuators using actuator support structure and bolting of the same with pit EP and to the table top. Adjust length and alignment of each actuator using necessary spacers and shims. Spacers shall be so adjusted that each actuator will remain at the centre of its stroke.
6. Erection of four vertical actuators and connecting them to pit EPs and table top. Adjust length and alignment of each actuator using necessary spacers and shims. Spacers shall be so adjusted that each actuator will be equally extended and are at centre of stroke.
7. Connecting hydraulic hoses from manifolds to the individual actuators.
8. Routing of electrical cables in the pit from nearest junction box. Preparation of signal cables as per required length and end connections. Routing of these cable in the pit and up to control room. Tagging of the cables. Preparation of as build drawing.
9. All eight actuators will be simultaneously actuated by the controller. Perform any correction as suggested by purchaser.
10. Transporting and Rigid mounting of a 5 Te inertial mass on the table top for load tests during commissioning. Commissioning test of hydraulic testing system will be carried out by the purchaser. Problems, if any, will be analysed by the purchaser and vendor has to take necessary corrective action viz. adjust spacers/shims as suggested by the purchaser.
11. Provide skilled and semi-skilled man-power to execute complete job.

Scope of Supply:

1. Hydraulic pipes, elbow, tees, reducer and valves as listed in Table -1 and technical specifications.
2. Hydraulic hoses as listed in Table – 2 and technical specifications.
3. Pneumatic piping elbows and tees as per specification.
4. Electrical cables, shielded signal cables, connectors, 230V supply boards/junction box, UPS, cable trays/wire management system as per specifications.
5. Structural steel for making supports, frames, brackets, piping support etc. wherever required for rigidly installing various components and inertial mass.
6. Manpower, tools, fixtures, material handling equipment etc. necessary for all works. The tools and fixture shall be retained by purchaser after its use

Detailed scope of work and its Technical specifications:

1. Dimension measurement at Site, Design and fabrication of extension / spacer.

A 5m x 5m wide, 2.5 m deep pit (as shown in Fig. 1) at the ground floor has been built in purchaser premises. There are eight numbers of embedded parts (EP's) built in the pit for mounting the actuators. Four EP's are built in the top sides of the pit and four EP's are built at floor of the pit. The vendor has to take exact positional measurements (accuracy of 10microns) in three dimensions of each EP w.r.t each other using theodolight / laser based system. Relative orientation accuracy is important as this forms the base of the structural system to be mounted and based on this the extension/ spacer/shims has to be designed by the vendor. This extension/ spacer will be used to accommodate the gap between the actuator (extended at half of its stroke) and space between EP and mounting bracket on the table top (centrally located) as shown in Fig 1. The table top and the hydraulic actuators will be supplied by purchaser at the time of installation. The as built dimension of table top and the hydraulic actuators shall be measured by the vendor at the time of design of extension/ spacer. Each horizontal spacer should be able to withstand an axial dynamic load of 160KN. Each vertical spacer should be able to withstand an axial constant compressive load (vertical g force) of 25KN with an axial dynamic load of 160KN. All spacers should be sufficiently rigid and stiffened appropriately so that it can withstand lateral loads of 80KN. Design of the spacers shall be submitted for approval and fabrication can be started only after approval from purchaser. The dimensions of spacer should be such that it meets the following needs.

- 1 In park position, the table top should be in flush with ground. When the vertical hydraulic actuators are fully retracted, the table top will be in park position. This length of actuator should be used in design of vertical spacer so that vertical actuator exactly fits in the space between the mounting bracket on the table top and the vertical spacer.
- 2 In the park position of the table top, the horizontal hydraulic actuators will be extended at half of its stroke thus keeping the table top square (not rotated) with respect to the pit. This length of horizontal actuator should be used in design of horizontal spacer so that horizontal actuator exactly fits in the space between the mounting bracket on the table top and the horizontal spacer.

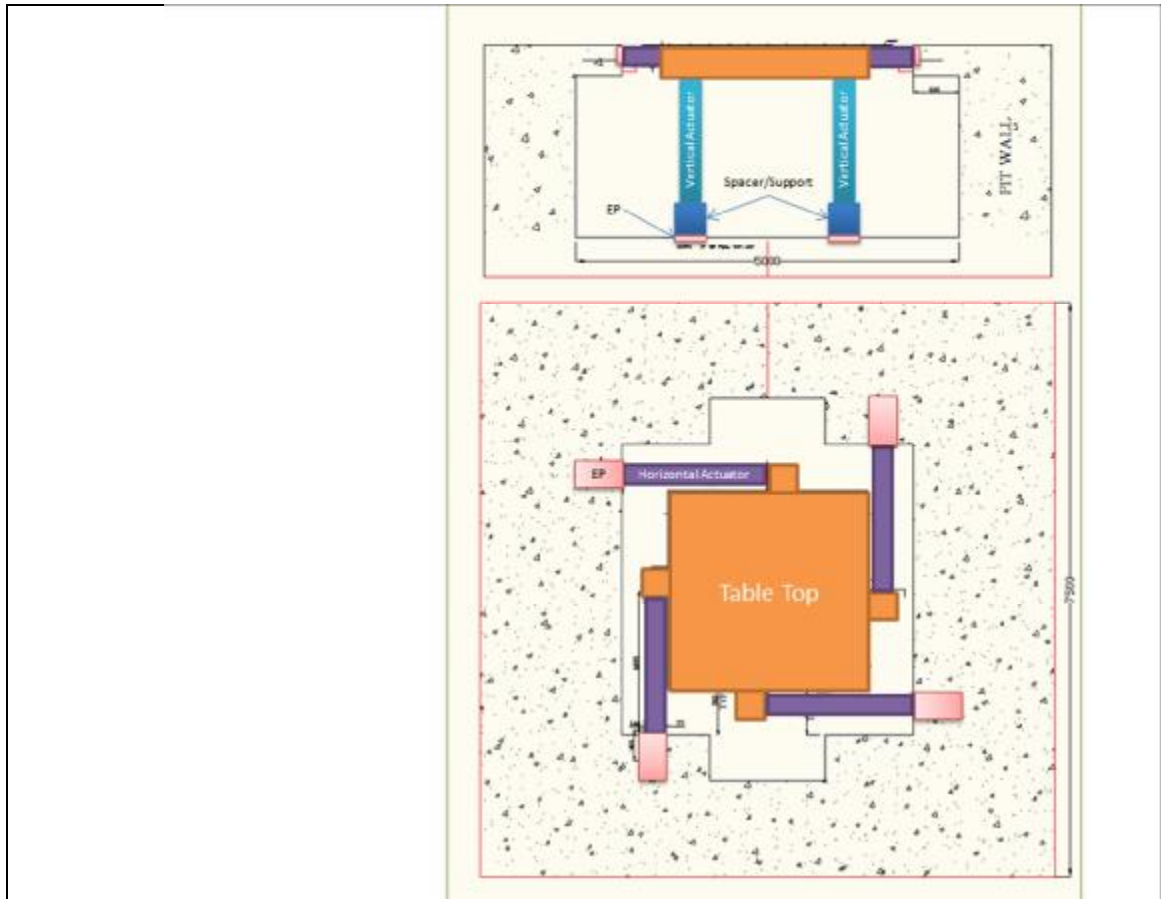


Fig. 1 – Pit with EPs and Mounted actuators and Table Top

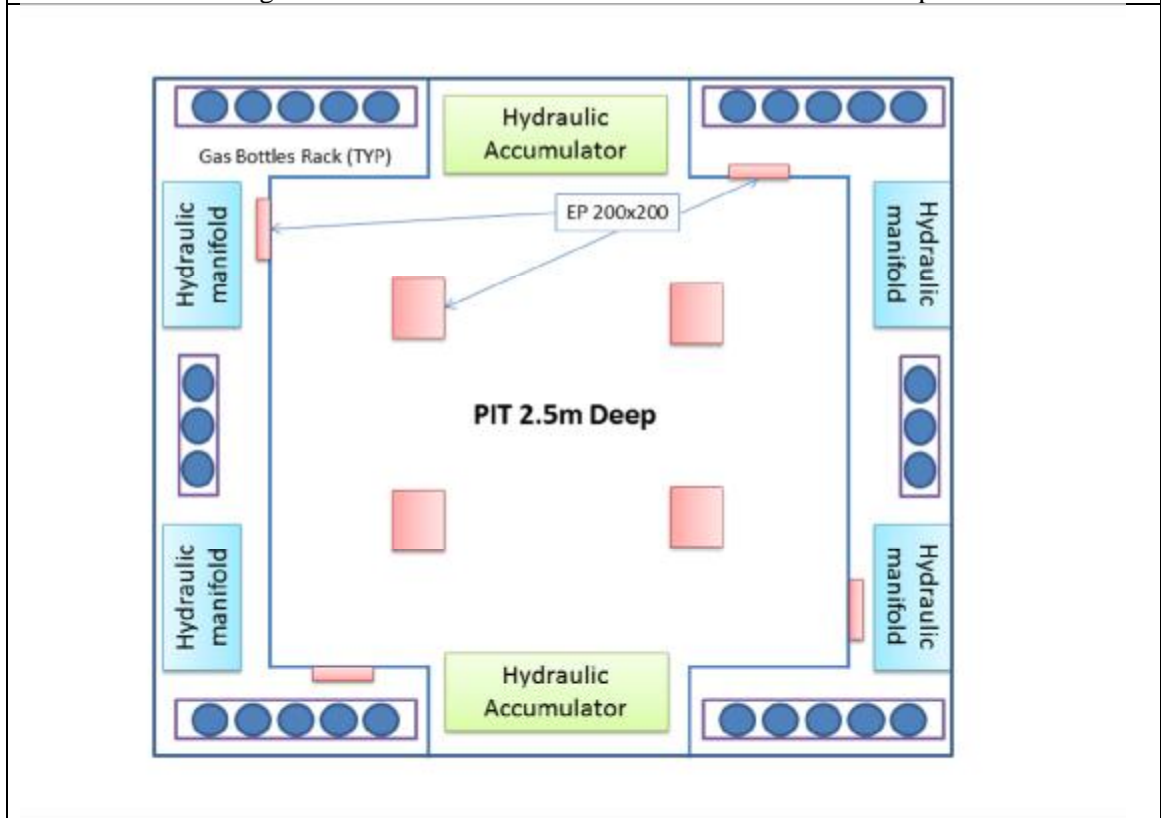


Fig. 2: Typical hydraulic component layout in the Pit.

2. Erection of hydraulic and pneumatic components in the pit:

Two hydraulic accumulators, four hydraulic manifolds and different sizes of high pressure gas-bottles are to be lowered in the pit and erected at the designated positions (as shown in Fig.2). Hydraulic accumulator and manifolds are self-standing, however they should be securely placed in-side the pit. Where ever required support structure shall be fabricated and installed securing these components. If required bottom support shall be provided for leveling purpose. Various sizes of racks shall be fabricated to place gas bottles securely at the designated position. The racks shall be clamped to the pit walls using grouted bolts. All structural material shall be procured by the vendor and fabrication shall be carried out.

3. Hydraulic piping of various sub-systems with the supply manifold:

Fig. 3 shows the general layout (flow sheet) of hydraulic connections of various systems and components in the pit. Hydraulic oils supply from the power pack is available at blind flanges for P, T and D line terminations located at ~10m from the pit.

The piping starts from three blind flanges for P, T and D lines of hydraulic power pack and should arrive in the floor of pit (2.5m below ground).

Vendor need to provide SS Pressure Line (3"NB SCH 160) with a 3" Gate Valve, Zero leakage, operating pressure=250bar, Tank line (3"NB SCH 40) with 3" Gate Valve, Zero leakage, operating pressure=10bar and Drain line (1" NB SCH 40) piping with 1" Gate Valve, Zero leakage, operating pressure=10bar from blind flanges to the pit through the trench of cross section of trench 500mm width and 200mm deep, Fig.4. The vendor shall neatly layout SS304L Piping through these trenches for connections from blind flanges to the pit (Fig-5). It should be properly clamped with cushion support (Fig 4) at regularly spaced places in the trenches and sufficient space for conduit with electrical wires should be left in the trench. The actual piping layout with the length indicated is shown in Fig.5. Piping layout shall be designed and submitted for approval and fabrication shall be started only after receiving approval from the purchaser.

These Pressure Line (3"NB SCH 160), Tank line (3"NB SCH 40) and Drain line (1" NB SCH 40) piping should be reduced to Pressure Line (2"NB SCH 160), Tank line (2"NB SCH 40) and Drain line (1/2" NB SCH 40) piping respectively to form Zone-1 & Zone-2 connections in the pit.

Also the Pressure line (3"NB SCH 160) in the pit should be connected to accumulator assembly as shown in Fig.3. Two accumulators shall be given by the purchaser, the vendor has to rigidly mount them to the walls of the pit as shown in Fig(2). The two accumulators are to be mounted on the opposites sides of the pit in the location as shown in the Fig(2). There is a hydraulic safety manifold in each of accumulator. Hence the vendor has to establish piping connection from 2" SAE 6000 flange -P line and 1" SAE 6000 flange-T line on hydraulic safety manifold of accumulator to Pressure line (3"NB SCH 160) and Tank line (3"NB SCH 40) respectively as shown in Fig(3). These piping connections has to be carried out for both the accumulators mounted on the opposites sides of the pit in the location.

On the top side of accumulators, the vendor has to make 2" NB XXS piping as per Section 4 – "pneumatic piping".

In the pit the flow is divided into two zones, each zone supplying oil to two hydraulic manifolds as shown in Fig.3. One hydraulic accumulator as described above is also connected to each zone. Length of piping in Zone-1 & Zone-2 is given in Annexure -I. The piping, elbows, valves, Reducer TEEs and flanged termination of SS304L with appropriate pressure rating shall be procured after approval from purchaser and installed in site for hydraulic piping with appropriate support (Fig.4).

For hydraulic piping connections in Zone-1 & Zone-2, the Pressure line (3"NB SCH 160) shall be reduced to 2inch Sch 160, the Tank line (3"NB SCH 40) reduced to 2inch Sch 40 and Drain line (1" NB SCH 40) piping reduced to 1/2" Sch 40 shown in Fig 3. The piping, TEE, elbows, valves, flanges and should be of SS304L designed for 250 bar operating pressure in the pneumatic system.

Detailed technical requirement of SS Hydraulic Piping is described in Annexure -I-**“Technical specification of SS Hydraulic Piping”**. List of pipes with approx. lengths, valves, Reducer TEEs and flanged termination is specified in Table 1 of this Annexure I.

Further for connection of hydraulic manifold to hydraulic actuators, hoses shall be used. Hydraulic hoses are described in Annexure-II-**“Technical Specification of Hydraulic Hoses”**. List of hoses is specified in Table 2 of this Annexure II.

One horizontal hydraulic actuator is connected to a Hydraulic manifold using 4 hydraulic hoses (1" Pressure hose, 1" Tank Hose, 3/8" Drain hose and 3/8" Pilot hose). One vertical actuator is also connected similarly to the same manifold with one extra 1/2" weight balancing line (i.e. total 9 Hoses connects two actuators to a manifold). The vendor needs to fabricate hydraulic hoses for such four hydraulic manifolds (HMA's). Two additional set of hoses (18Nos of hoses) shall also be supplied as spares. The length has to be kept to minimum (approx. 3mts depending upon the actual measured distance between the HMA-1 and horizontal hydraulic actuator and vertical hydraulic actuators. Hose end connections shall be as per standard SAE Flanges of the required size and rating.

The vendor need to prepare as-built drawing (P&ID, 3D and 2D) of all installed piping and associated components.

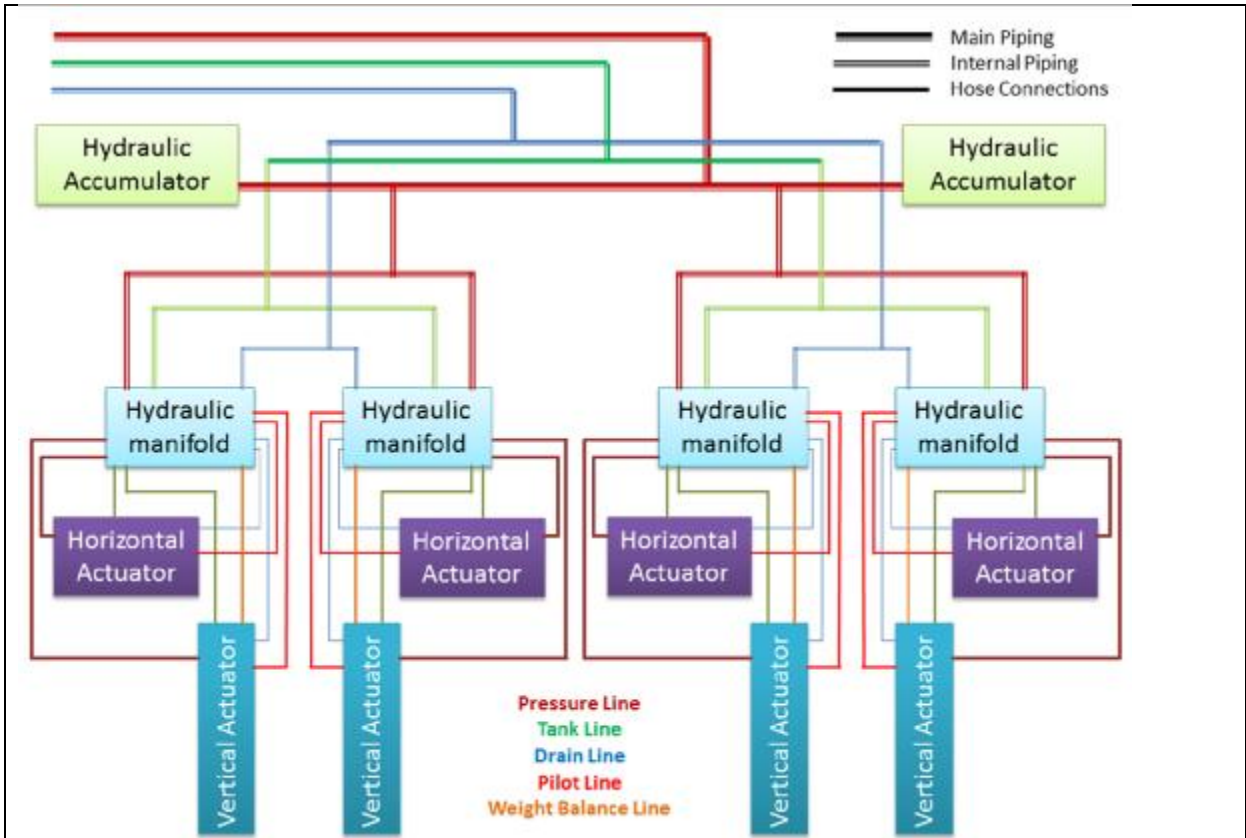


Figure 3: Hydraulic Flow sheet

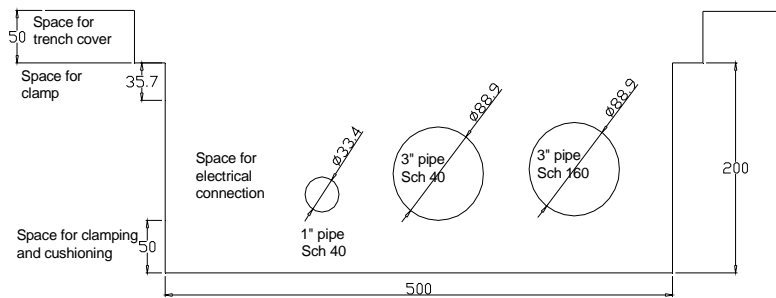


Figure 4: Trench crosssection and Support

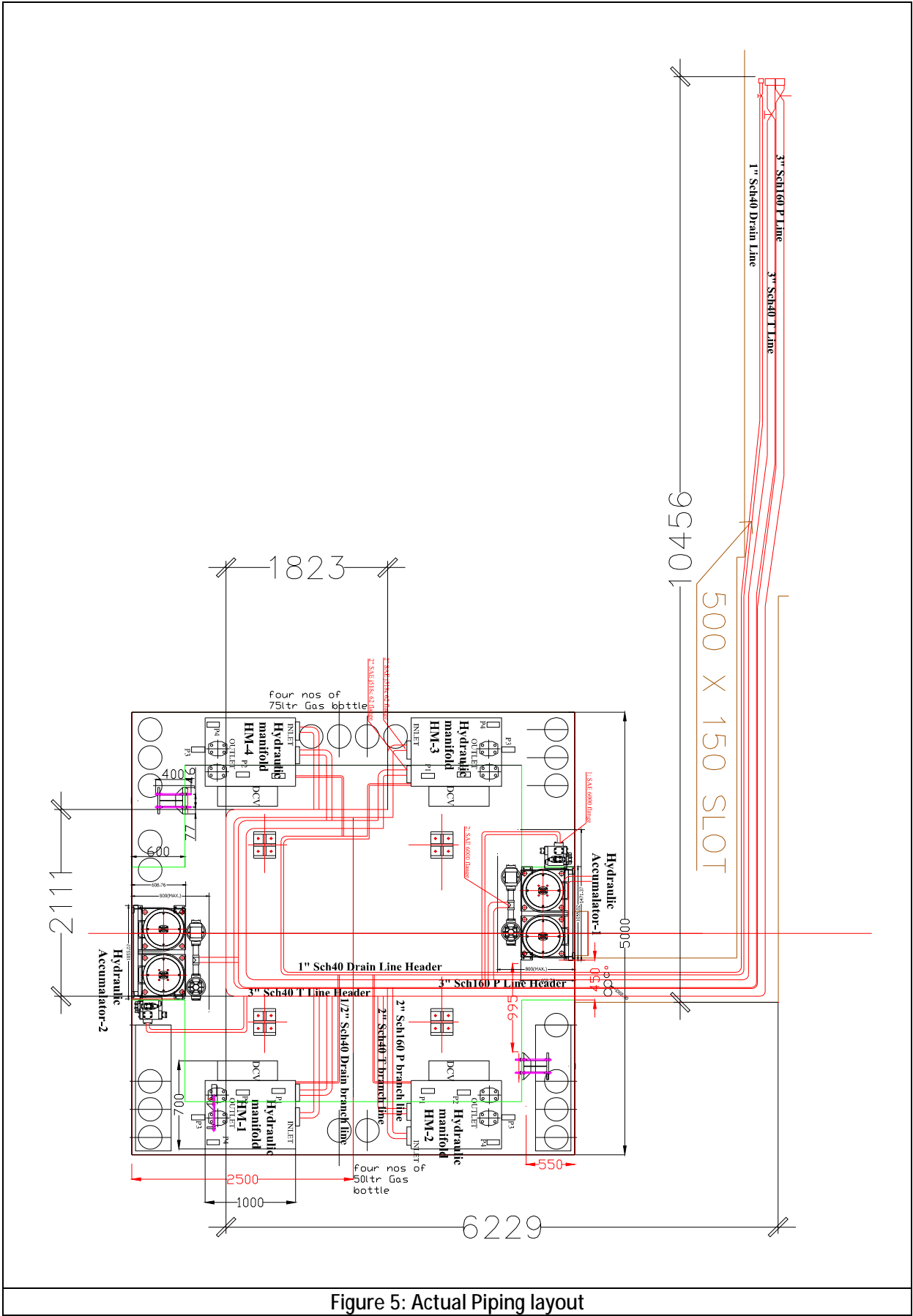


Figure 5: Actual Piping layout

4. Pneumatic piping:

On the top side of accumulators, the vendor has to make 2" NB XXS piping header so that gas side of one accumulator can be connected to 14 numbers of gas bottles (8 numbers of 50ltr gas bottles and 6 numbers of 75ltr gas bottles given by purchaser as shown in Fig(2). All piping shall be seamless cold drawn stainless steel conforming to latest versions of ANSI /ASME B36.19M, ASTM-A-312/A-312M, TP304L normalized, non-destructive hydrostatic and electric tested as per ASTM A999. Starting from 1" SAE flange connection on top of hydraulic accumulator, the 2" NB XXS piping header should branch to appropriate connectors on the gas bottles (thread details given below) and terminate to a port through which gas charging from commercial nitrogen bottle can be carried out. There should be a zero-leakage isolation valve for this gas charging port. There should also be another zero leakage isolation valves to isolate the accumulator and 2" NB XXS piping header. Similarly, another accumulator shall be connected to another 14 numbers of gas bottles as describe above. The vendor needs to design the pneumatic circuit for 250 bar operating pressure, procure high pressure piping, TEE elbows & valves and carryout the piping work interconnecting the components. Proper support at various locations shall be provided to the piping.

The threading details of the gas bottles as given below:

- The neck threads of cylinder conform to type 4 and size 2 of IS 3224:2002 (nominal size 25.4 mm, right handed thread normal to surface cone and with taper 1 in 8, 14T.P.I).
- Threading on the outlet of nitrogen valve is conforming to outlet no. 20 of IS 3224:2002 (ie thread size G3/4 Ext. Right handed (BSP 3/4).

Valves, guards and valve spindle opening keys for the above threads of the gas bottles have to procured by the vendor.

The vendor should also prepare as-built drawing (P&ID, 3D and 2D) of all installed tubing and associated components.

5. Procurement and laying of electrical cables, shielded signal cables, connector, 230V supply boards/junction box, UPS, cable trays/wire management system etc:

Following standards may be applicable:

IS-732 : Code of practice for electrical wiring installation

IS-2148 : Flameproof enclosure of electrical apparatus

The vendor shall prepare a layout of electrical cables from the pit to controller and submit for approval. The controller is located at a distance of 15m from the pit and there are many sensors in the actuators and hydraulic manifolds that has to be connected to controller. The electrical cable shall be multi core shielded (9 strand-22AWG) copper wires. All the electric cables should be neatly laid in plastic cable tray of box type conduits openable for top. After approval he shall procure the electrical cables, shielded signal cables, electrical connectors, 230V supply boards/junction box, cable trays/wire management system and neatly lay the cables from pit to controller. Each hydraulic actuator has five sensors and one servo valve, hence six multi core shielded cables will be required for each actuator. The cable shall be tagged, neatly tied and laid in flexible conduits from the actuator to box type conduits in the pit.

No. of wires (other than shield) in a multi core cable required in each actuator is as given below:
There are EIGHT such actuators.

1. Pressure sensor 1-two wires
2. Pressure sensor 2-two wires
3. Load cell- four wires
4. Position transducer- six wires
5. Accelerometer-ten wires
6. Servo valve-six wires
7. Spare-ten wires

Above shielded wires (9 strand-22AWG) electric copper wire 15m in length will be required to be laid from pit to controller.

25m of a CAT 6E twisted pair cable with end connector as suggested by purchaser should be used to connect the controller to computer located in control room.

There are FOUR hydraulic manifold (HMA-1,2,3,4) in the pit which has to be connected to hydraulic power pack located at 25m away from pit. Each hydraulic manifold has five sensors and No. of wires (other than shield) in a multi core cable required in each manifold is as given below: There are FOUR hydraulic manifolds

1. Pressure sensor 1-two wires
2. Pressure sensor 2-two wires
3. Pressure sensor 3-two wires
4. Main Pressure Control Valve
5. Pressure Reducing Valve for Weight Balancing -six wires
6. DC valve(24DC, 30W solenoid)--two wires
7. Filter clogging 1 relay-two wires
8. Filter clogging 2 relay-two wires
9. Spare-ten wires

Shielded wire (9 strand-22AWG) electric copper wire 25m in length will be required to be laid from FOUR hydraulic manifolds in the pit to hydraulic power pack.

The following has to be carried out by the vendor:

1. Four nos of tube lights to be mounted in the pit. One on each wall of the pit with switch at eh top. One pedestal fan has to be provided.
2. Monkey ladder to be procured and installed to enter in to the pit.
3. Wiring of emergency switch(free issue), fire sensors (free issue) etc to be done.
4. Small 10lpm hydraulic pump operated by electric pump with 20m ½” PVC hose to transfer oil from pit to the power pack

6. Installation of Hydraulic actuators and Table Top:

After completing the installation of hydraulic components and interconnecting piping, installation of actuators and table top shall be initiated. Initially table top is supported on a four support structures resting on the floor of pit built to take the complete load of table top (approximately 10000Kg) and provide necessary spacers/shims for height adjustment Four vertical actuators shall be mounted to the table top base and spacer heights shall be measured from EP to the actuator end (at its fully retracted condition. The spacer shall be fabricated to the required accuracy and installed connecting the vertical actuators to the floor EPs. If required shims shall be used to achieve required positional and alignment accuracy of the table top after the support is removed. In similar fashion all four horizontal actuators shall be mounted to table

top and wall EPs. Spacers and Shims as required shall be used for mounting horizontal actuator to achieve piston position at the center of the stroke.

7. Design and fabrication of horizontal and vertical actuator support structure.

Following standards are applicable:

- IS-228 : Structural Steel (Standard quality)
- IS-1367 : Technical supply conditions for threaded fasteners
- IS-4218 : ISO metric screw threads
- IS-10481 : Guideline for application and installation of oil hydraulic system
- ANSI B 1.1 : Straight thread standard
- ANSI B16.9 : Carbon and alloy steel butt welding fittings.

The cap ends of four horizontal hydraulic actuators and four vertical hydraulic actuators shall be connected to EPs in the pit with the spacers fabricated by the vendor. The hydraulic actuators are precision devices, hence has to be very carefully handled. These hydraulic actuators each approx weighing 300Kg has to be collected from purchaser's store nearby and lowered in the pit to connect the spacer already mounted to EPs in the pit. Appropriate tools set, gauges and material handling equipments for all works should be procured by the vendor, used and supplied to purchaser after its use. All the hydraulic hose connections and electrical connections to vertical and horizontal actuators shall be established. The hydraulic power pack will be started and operated by purchaser. Now the direction control valve (provided by the purchaser) shall be connected on every actuator one at a time and reciprocated for atleast 20times at 200bar hydraulic pressure. Manpower for all works shall be arranged by the vendor. Supports for each actuator shall be arranged by vendor to keep the four horizontal actuators horizontal to ground and four vertical actuators vertical to ground. These actuators will be simultaneously actuated, hence supports should be provided to all horizontal & vertical actuators. After flushing of all hydraulic actuators with direction control valve, servo valves (given by purchaser) shall be mounted on all hydraulic actuators. With the hydraulic power pack and controller on, all the actuators shall be simultaneously actuated. After verifying the simultaneous motion of all actuators, both the ends of each actuator can be connected to corresponding EP and table top.

8. Design & fabrication of a rigid bracket support for 5 Te inertial mass

5 Te Inertial mass made of iron will be provided by purchaser but this has to be collected from purchaser's store nearby and lowered on the table top. A bracket support for rigidly fixing inertial mass to table top has to be designed and fabricated. The bracket will be mounted to the table top using 120 nos of M 20x2 threads spaced in a square pitch of 250 mm. All the structural welding shall be carried out as per IS-823.

9. Commissioning test of servo hydraulic testing system.

The rod end of every actuator shall be bolted to the table top. In this process the forces in the load cell will be observed and if the forces are high, vendor has to take corrective action as suggested by the purchaser till the forces are negligible.

After ensuring proper hydraulic connection and electrical connection, the controller and hydraulic power pack will be switched ON, all vertical hydraulic actuators will be fully retracted and all horizontal hydraulic actuators will be extended at half of its stroke.

a. Commissioning test without inertial mass

The table will now be reciprocated in all degrees of freedom with complete stroke of the actuators. The motion should be smooth and the forces in load cell shall be observed. If the forces are high, vendor has to take corrective action as suggested by the purchaser till the forces are negligible.

b. Commissioning test with inertial mass

Vendor has to rigidly fixed 5Ton inertial mass to table top for this load tests during commissioning.

The table will now be reciprocated in all degrees of freedom with complete stroke of the actuators. The motion should be smooth and the forces in load cell shall be observed. If the forces are high, vendor has to take corrective action as suggested by the purchaser till the forces are negligible.

Manpower, tools, fixtures etc for all works shall be arranged by the vendor. The tools, material handling equipments and fixture shall be supplied to purchaser after its use

Annexure - I

Technical specification of SS Hydraulic Piping:

Scope; Material testing, Procurement, Supply, Fabrication, Weld qualification (RT/UT) and hydro testing of hydraulic pipes and associated piping components e.g elbow, Tee etc..

Table 1 list of piping

S. No	piping components	Material	Quantity
1	3" NB SCH 160	ASME B36.19M, ASTM-A-312/A-312M, TP304L	22m Approx length
2	3" elbow joints- operating pressure =250bar	ASTM A-182, F304L class 9000 as per ASME B16.9	7Nos
3	3" Gate Valve, Zero leakage, operating pressure=250bar.	ASTM A-182, F304L class 9000 as per ASME B16.9	1No
4	3" NB SCH 40	ASME B36.19M, ASTM-A-312/A-312M, TP304L	22m Approx length
5	3" elbow joints, operating pressure=10bar	ASTM A-182, F304L class 9000 as per ASME B16.9	7Nos
6	3" Gate Valve, Zero leakage, operating pressure=10bar	ASTM A-182, F304L class 9000 as per ASME B16.9	1No
7	1" NB SCH 40	ASME B36.19M, ASTM-A-312/A-312M, TP304L	22m Approx length
8	1" elbow joints, operating pressure=10bar	ASTM A-182, F304L class 9000 -ASME B16.11.	7Nos
9	1" Gate Valve, Zero leakage, operating pressure=10bar	ASTM A-182, F304L class 9000 -ASME B16.11.	1No
10	2" NB SCH 160,	ASME B36.19M, ASTM-A-312/A-312M, TP304L	10m Approx length
11	2" elbow joints, operating pressure=160bar	ASTM A-182, F304L class 9000 -ASME B16.11.	16Nos
12	Reducer TEEs from 3" to 2", operating pressure=160bar		6Nos
13	1" elbow joints, operating pressure=160bar	ASTM A-182, F304L class 9000 -ASME B16.11.	8Nos
14	2" SAE j518c 62 flange to be welded to 2" pipe, operating pressure=160bar	ASTM A-182, F304L class 2500 -ASME B16.5-2013	4Nos
15	2" SAE 6000 flanges to be welded to 2" pipe, operating pressure=160bar	ASTM A-182, F304L class 2500 -ASME B16.5-2013	2Nos
16	2" NB SCH 40,	ASME B36.19M, ASTM-A-312/A-312M, TP304L	10m Approx length
17	2" elbow joints, operating pressure=10bar	ASTM A-182, F304L class 9000 -ASME B16.11.	16Nos
18	Reducer TEEs from 3" to 2", operating pressure=10bar	ASTM A-182, F304L class 9000 as per ASME B16.9	4Nos
19	Reducer TEEs from 3" to 1", operating pressure=10bar	ASTM A-182, F304L class 9000 as per ASME B16.9	2Nos
20	2" SAE j518c 62 flange to be welded to 2" pipe, operating pressure=10bar	ASTM A-182, F304L class 2500 -ASME B16.5-2013	4Nos
21	1" SAE Flanges to be welded to 1" pipe, operating pressure=10bar	ASTM A-182, F304L class 2500 -ASME B16.5-2013	2Nos
22	1/2" NB SCH 40	ASME B36.19M, ASTM-A-312/A-312M, TP304L	10m Approx length
23	1/2" elbow joints, operating pressure=10bar	ASTM A-182, F304L class 9000 -ASME B16.11.	8Nos

24	Reducer TEEs from 1" to 1/2"	ASTM A-182, F304L class 9000 -ASME B16.11.	4Nos
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All piping shall be seamless cold drawn stainless steel conforming to latest versions of ANSI /ASME B36.19M, ASTM-A-312/A-312M, TP304L normalized, non-destructive hydrostatic and electric tested as per ASTM A999.

All socket welded fittings shall be forged fittings of ASTM A-182, F304L grade and class 9000 as per ASME B16.11. All butt welded fittings shall be forged fittings of ASTM A-182, F304L grade and class 9000 as per ASME B16.9. For welding of piping of power pack assembly refer para 5.5.1.

All pipe flanges and flanged fittings should be of ASTM A-182, F304L grade and class 2500 and should also meet the requirements of ASME B16.5-2013.

Following standards may be applicable:

- **IS-663I** : Steel pipes for hydraulic purpose
- **ANSI B16.11** : Forged fittings, Socket welded and Threaded
- **ANSI B16.5** : Pipe Flanges and Flanged Fittings
- **ASME B 36.10M** Welded & seamless wrought steel pipes
- **ANSI /ASME B 36.19** : Stainless Steel Pipe
- **ANSI B 2.1 & BS-2771** : Pipe threads
- **ANSI B31.1** : Code for pressure piping-power piping
- **ANSI B31.3** : Code for pressure piping-process piping
- **ASME Section IX** : Welding and their inspection of B & PV code
- **DIN-17175** : Tolerance of tubes
- **DIN-2391** : Tolerance of tubes
- **DIN-50049** : Work's certificate
- **SAE - J514** : Hydraulic tube fittings
- **ASTM A999** : Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
- **ASTM A 269** : Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- **ASTM A 312/A 312M** : Specification for seamless and welded austenitic stainless steel pipes
- **ASTM A 213/A 213M** : Specification for seamless ferritic and austenitic alloy-steel boiler, super heater, and heat-exchanger tubes
- **ASTM A 276-97** : Specification For Stainless Steel Bars And Shapes
- **ASTM A 370-02** : Test Methods And Definitions For Mechanical Testing of Steel Products

a Full rated flow test of piping

The flow loss has to be kept to minimum, which will be tested by measuring the differential pressure at the P gauge and T gauge of hydraulic power pack and connecting the P line and T line of HMA-1,2,3,4 by an appropriate hydraulic hose in place of actuator i.e., All eight hydraulic actuators will be replaced by a hydraulic hose to connect the P line and T line of HMA. The differential pressure at the P gauge and T gauge of hydraulic power pack should be less than 10bar at full rated flow (660lpm) of power pack. This is very important and has to be continued for ten minutes at full flow so that the complete piping and hoses are flushed. To keep noise in transmission least, all precautions such as rubber couplings, properly clamps with cushion etc should be used by the vendor.

b Radiography & DP test of piping

All butt-welded joints of piping shall be tested by 100% radiography as per ASME Sec IX. All socket weld joints of piping shall be tested with liquid penetrant examination as per ASTM E 165.

S.No.	SERVICE S	TYPE OF WELD							
		BUTT WELD		SEAL WELD		SOCKET / FILLET WELD		SUPPORT STRUCTURE & HANGERS	
		ROOT PASS	FINAL PASS	FIRST PASS	FINAL PASS	FIRST PASS	FINAL PASS	FIRST PASS	FINAL PASS
1.	All lines hydraulic Oil	V +LP	V + R	V	V + LP	V	V + LP	V	V

LEGEND

- V – 100% Visual Examination
 LP – 100% Liquid Penetrant Examination
 R – 100% Radiographic Examination

Acceptance Criteria for RT : The following defects or defects exceeding the limits stated hereunder are unacceptable.

- a. Any type of crack or zone of incomplete fusion or penetration.
- b. Any elongated inclusion such as slag, which has a length greater than 6.3 mm for "t" up to 19 mm inclusive, where "t" is the thickness of the thinner portion of the weld.
- c. Any group of inclusions in line that have an aggregate length greater than "t" in a length of 12 "t", except when the distance between two inclusion exceeds 6L where "L" is the length of longest imperfection in the group.
- d. Porosity in excess of that shown as acceptable by the porosity standards in Appendix IV of ASME Section VIII of the ASME Boiler and Pressure Vessel Code.

Acceptance Criteria for DP test :

1. Only indications with major dimensions greater than 1.5 mm shall be considered relevant.
2. The following relevant indications are unacceptable:
 - a. Any cracks or linear indications
 - b. Rounded indications with dimension greater than 4.7 mm.
 - c. Four or more rounded indications in a line separated by 1.5 mm or less edge to edge.

c Hydro test of piping

All P-line piping and manifolds fabricated by the vendor has to be hydrotested at 375bar for 15minutes. All T-line and Drain line piping and manifolds fabricated by the vendor has to be hydrotested at 20bar for 15minutes. All pneumatic piping, TEE, elbows and valves has to be hydrotested at 375bar for 15minutes. For all the above test, hydraulic fluid SERVO-68 at room temperature shall be used. All necessary plugs, blind flanges, hydrotest pump etc as required for hydro test shall be arranged by vendor. No external leakage shall be allowed. If any leakage is observed then the piping will be disassembled and the problems analysed. The rejected components shall be refabricated.

Safety during hydrotest.

- a. Pressurise using hand pump only
- b. All personnel Stay away from the testing
- c. Venting of complete line to remove air pockets stuck in line
- d. Isolate various low-pressure instruments and plug necessary ports.
- e. Ensure proper tubing / piping connection seal and gaskets. Usually the component to be tested is kept in a pit else at least stay away from the fly away zone of gaskets/seals.
- f. Wear helmet and safety goggles during the test.

- SAE J 343b
Hose

à Tests and procedures for SAE100R Series Hydraulic

2 Requirements

2a Hose:

Ultra high-pressure hose suitable for oil hydraulic applications (2388 – A / 2380 - N Parker make Polyflex® or Swagelok make or equivalent) shall be provided by the supplier. The hose shall be as per SAE 100 R8 / SAE 100 R11 series having oil, water, and acetone etc. resistant external cover. The technical details of hose are given below:

2b Hose fittings:

The hose fitting should be of Crimped type designed as per SAE J 516a & its operating pressure shall be min 250 bar. The operating pressure and factor of safety of hose fittings shall be mentioned. The hose to hose fitting joint should be type-tested through recognized lab. Impulse cycle test certificates for compatibility of end fitting with hose shall be provided. The end fittings must be Parker or Swagelok or equivalent.

2c Materials:

In hose assembly i.e. fitting & socket shall be made up of austenitic stainless steel ASTM – A 276 – type 304 or higher strength so that it is suitable for 250bar continuous operating pressure. All the material shall be as per this specification. The raw materials shall be of tested quality. All raw materials shall be tested for physical properties, chemical properties, hardness, ultrasonic testing etc. The raw materials of each component shall be identified by marking in presence of our representative. The sample coupons shall be cut from each type and size of raw material in the presence of the representative and send for inspection and testing to an approved laboratory. Vendors will give the choices of the approved material test laboratories from where they are to carry out the testing. The test results will be submitted to the purchaser for their approval. If supplier provides traceability of original material with copy of original test certificate, physical property test can be omitted.

The ultrasonic testing of material will be carried out as per ASTM-A-388 and the acceptance criteria for material of each component shall be submitted to purchaser and shall be approved by purchaser. Supplier shall be responsible for any variation or defect found in material of manufactured component.

2d Threads:

The threads on the swivel nut shall conform to Standard SAE J514g & Standard SAE 516a female 37 degree flared type.

3 Identification:

Identification marking on hose shall be as per SAE J517c or shall have the following marks:

1. Manufactures name
2. Date of manufacture

3. Pressure rating
4. Size of the hose in dash numbers as per SAE Specifications.
5. Type of End Connection/ Fitting.

All hose assemblies shall be tagged at both ends of the respective hose assemblies as per tag markers.

4 Inspections and Testing:

The hose and hose assembly shall be inspected, tested and certified that conforms to SAE specification SAE J-343b- (Test and procedure for SAE 100R series hydraulic hose and hose assembly).

All hose assemblies shall be subjected to following tests:

1. **Dimensional check test:** All the hoses should be visually inspected as per SAE specification SAE J-343b. Date of manufacturing of the bare hose shall be within 2 months.
2. **Proof test:** As per SAE specifications SAE J343 up to proof pressure at twice of operating pressure rating of hose for a period of not less than 30 seconds nor more than 60 seconds.
3. **Hydrotest:** 100% Hydrotest shall be carried out to all assemblies in presence of our representative 1.25 times of its working pressure for 10 minutes.
4. **Burst test:** As per SAE J-343b
5. **Cold flexibility Test:** As per SAE J-343b
6. **Oil resistant test:** As per SAE J-343b
7. **Ozone Resistant test :** As per SAE J-343b
8. **Impulse Test:** As per SAE J-343b
9. **Leakage Test:** As per SAE J-343b
10. **Visual examination Test:** As per SAE J-343b
11. **Electric conductivity Test :** As per SAE J-343b
12. **Resistant vacuum Test:** As per SAE J-343b
13. **Cubical expansion test:** As per SAE J-343b
14. Bare hoses/hose assemblies shall have test certificate as per SAE or any other international standard indicating operating pressure, proof pressure, minimum burst pressure and pressure cycling of the type tested item.
15. The hose to hose fitting joint should be type tested through recognized lab and test certificates for the same shall be submit.

The supplier should provide compliance certificate for hose/hose assemblies.

All inspection and testing of materials shall be provided by the suppliers/ manufacturers. All testing equipment, tool gauges (pre-calibrated) etc. required shall be arranged by the supplier.

5 Packing and installation at site:

Both ends shall be capped with plastic caps/plugs. The hose assemblies shall be covered in thick polythene sheets. The assembly shall be packed in a box, which can be used for long-term storage of the hose and fittings. These should be brought to the purchasers's premises and neatly installed by connecting from hydraulic manifold to hydraulic actuators.

Annexure - III

List of items to be provided by the purchaser at site:

1. Hydraulic power pack
2. Servo hydraulic horizontal actuator - 4nos
3. Servo hydraulic vertical actuator - 4nos
4. Table Top - 1No.
5. Hydraulic manifolds (HMA1, HMA2,HMA3 & HMA4) - 4Nos
6. Hydraulic Accumulators - 2Nos
7. 50 ltr gas bottles – 16 Nos
8. 75 ltr gas bottles – 12 Nos
9. Pit with embedded parts
10. Trench in floor of 500mm width and 200mm deep from the blind flange to pit.
11. Controller
12. 5 Te inertial mass
13. Electricity
14. EOT crane of 10 Te capacity