



GEL File Tracking System



TECHNICAL SPECIFICATION

SUPPLY OF TYPE – I CNG STORAGE CASCADE
(3000 WLC/ 4500 WLC)

Document No: GGL/TS/CNG/SUPPLY/TYPE-1 CASCADE/SPEC

REV. NO	CLAUSE NO.	REVISION DESCRIPTION	DATE OF ISSUE

INDEX

Contents

1.0	SCOPE.....	4
2.0	AMBIENT CONDITIONS	4
3.0	INSTRUCTIONS TO BIDDERS.....	4
4.0	GAS COMPOSITION	5
5.0	CODES AND STANDARDS TO BE FOLLOWED	5
6.0	EXTENT OF SUPPLY AND SERVICES	6
7.0	DATA SHEET OF CNG CYLINDER	7
8.0	TECHNICAL SPECIFICATIONS	8
9.0	INSPECTION AND TESTING.....	12
10.0	WARRANTY	13
11.0	SAMPLE DRAWING & BILL OF MATERIALS	14

1.0 SCOPE

This specification along with drawings/ documents attached herewith covers minimum requirements for design, engineering, fabrication/ manufacture, assembly, packaging, inspection, testing at vendor works, supply at site, transportation, loading, unloading of Storage Cascades (Mobile/ Stationary).

2.0 AMBIENT CONDITIONS

2.1 The climatic conditions to be considered for selection, design and de-rating of equipment shall be as indicated below;

- a. Design Ambient temp min/max °C : -5°C / 50 °C
- b. Design relative humidity : 90 %
- c. Design Temp : 60 °C
- d. The equipment offered shall be suitable for smooth, efficient and trouble-free service in the tropical climate prevailing at site as indicated above.
- e. The equipment shall be designed to give efficient and reliable performance under industrial conditions and shall be rendered proof against rats, lizards and other vermin.

3.0 INSTRUCTIONS TO BIDDERS

3.1 This specification describes the technical specification of the equipment to be supplied and/ or installed at CNG stations/ CNG Decompression Station.

3.2 Various parts of the specification shall be read in conjunction with each other. In cases where requirements given in different parts differ, the most stringent shall govern.

3.3 The specification indicates the scope and requirements completely and clearly as to be extent possible. Any additional work/equipment or technical requirement not mentioned in the specification but required to make the offered system complete in accordance with the specification or required for safe operation shall be deemed to be included in the offer.

3.4 The drawings and reference information mentioned elsewhere in this specification shall be considered as part of this document. Anything specified in this specification but not clearly shown in the drawings, or vice versa shall be treated as indicated in both specification and drawings.

3.5 It will be the responsibility of the Bidder to comply fully with relevant National/ International standards, Indian Explosives Act, Regulations of Insurance association of India and Factories Act, while supplying materials and/ or carrying out work as per this specification.

3.6 Bidder's responsibility shall also include to prepare and submit all necessary drawings, calculations, test certificates etc. as required by concerned inspectorate.

3.7 The Bidder, free of cost and without affecting agreed milestones, shall carry out modifications suggested by the statutory bodies.

3.8 The Bidder shall be deemed to be fully conversant with the complete requirements of the work.

3.9 Civil engineering work i.e. foundation, trenches etc. shall be arranged by Owner. The Bidder shall submit foundation drawings indicating requirement of work to be carried out by Owner

within two weeks of placement of order.

- 3.10 All work shall be carried out to the satisfaction of the Owner. Any work which is considered to be unsatisfactory and of poor quality of workmanship shall be rectified by the Bidder without any additional cost.
- 3.11 Bidder shall carryout the work as per approved drawings and documents only.
- 3.12 The Bidder shall complete and fulfil all formalities with the statutory authorities (in India). Bidder shall also arrange for inspection at bidder's site.
- 3.13 The Bidder/ Representative shall attend meetings called by the Owner. The Bidder's representative shall have the authority to make all decisions related to the Contract.
- 3.14 The periodic progress report shall be submitted by Bidder in duplicate. The reports shall clearly define all major activities completed during till the previous report and identify manning levels, programs etc. The report format and the periodicity shall be provided by/ finalised after discussion with the purchaser for adherence by the Bidder.
- 3.15 All pages of the offer shall be numbered and contents with page numbers shall be given at the beginning. All pages of the offer shall be submitted in bound volume.
Bidder shall replace cylinders which are rejected during first hydrotesting (after commissioning of cascade) due to manufacturing defects like mispunch/ double punch of cylinder serial number/ weight, illegible information on cylinder, tare weight loss due to thickness reduction, thickness reduction, bulge observed during hydrostatic stretch test, arc or torch burns observed after shot blasting on the bare metal. A criterion for rejection as mentioned above is as per latest version of IS 8451.

4.0 GAS COMPOSITION

COMPONENTS	RANGE (% by Volume)
methane	91.9132 (May vary up to 97)
ethane	5.8181
propane	1.18705
i-butane	0.1993
n-butane	0.28415
i-pentane	0.0143
n-pentane	0.00685
C6+	0.00745
N2	0.54685
Co2	0.02085
Neo pentane	0.0019
Odourant	10 PPM

5.0 CODES AND STANDARDS TO BE FOLLOWED

- 5.1 Oil Industry Safety Directorate (OSID) -179
- 5.2 Gas Cylinder Rules - 2016
- 5.3 Vehicular Fuel Systems Code : NFPA-52
- 5.4 Design and construction code for Pressure vessels: ASME Section VIII & IX, BS 5500
- 5.5 Pressure Safety Valve Design Code : API-520
- 5.6 IS – 7285, IS 3224 -2002

- 5.7 ANSI, ASTM, NEC, NEMA
- 5.8 ANSI NGV 4.6-CSA 12.56 Manual operated Valves
- 5.9 Indian Explosives Act
- 5.10 Gujarat Factory Rules
- 5.11 All latest versions of the above mentioned and all applicable standards to be followed.
- 5.12 All the applicable statutory codes, national laws and local regulations for safety and environment protection shall be followed by the vendor for design, engineering, fabrication etc. The bidder shall obtain from concerned authorities all necessary approvals.

6.0 EXTENT OF SUPPLY AND SERVICES

6.1 SUPPLY

Supply of CNG storage cascades of water litre capacity specified 3000 WL/ 4500 WL (-0%/ +5%) at 15°C with following minimum details:

- 6.1.1 Cylinders
- 6.1.2 Each cylinder equipped with cylinder shut -off valve and fusible burst disc.
- 6.1.3 Cascade frame.
- 6.1.4 Interconnecting tubing / piping, fittings, valves.
- 6.1.5 Non return valves (NRVs) as required for three-bank operation.
- 6.1.6 Pressure gauge on each bank.
- 6.1.7 Any other item required for completing the cascade assembly.
- 6.1.8 Commissioning spares

6.2 SERVICES

The services to be rendered by bidder shall include but not limited to the following:

- 6.2.1 Preparation and submission of documents/ drawings as per schedule.
- 6.2.2 Obtaining approvals from concerned departments/ agencies/ authorities.
- 6.2.3 Procurement of raw materials, bought out components, fabrication, shop assembly.
- 6.2.4 Shop inspection and testing including third party inspection and statutory approvals.
- 6.2.5 Packaging, crating (if required), Purging of Nitrogen with positive pressure (upto 5 Barg) and dispatch of cascades.
- 6.2.6 Bidder shall appoint a site coordination for the following activities:
 - Competent manpower for loading and unloading of cascade at site
 - Safety training as per GEL matrix for deployed manpower
 - Crane/ Hydra and accessories for loading/ unloading have all safety features as per GEL safety guidelines
 - Proper PPE during the activities performed at site by deployed manpower
 - Permit to work as per GEL safety guideline
 - Commissioning assistance (if required)
 - Installation and commissioning is excluded from the bidder scope.

In case, defect observed in cascade within 18 months from the date of supply of cascade, service support and spares at free of cost, in-case of any manufacturing defect and/or

assembly like: fitment, painting etc. Bidder to deploy manpower with required spares within 7 days from written intimation by GEL. Penalty of Rs. 500/- per day will be applicable for non-deployment of manpower with required spares, which will be deducted from future invoice/CPBG etc.; as applicable.

7.0 DATA SHEET OF CNG CYLINDER

7.1 The datasheet shall be read and completely filled data sheet shall be furnished as below;

7.2 * - Indicates data to be furnished by the bidder/ supplier

- | | | | |
|----|-------------------------------|---|--|
| a) | Capacity of cylinder | : | 75 Ltrs. Approx. |
| b) | No. Of cylinders | : | 40 for 3000 liters /60 for 4500 liters |
| c) | Design and Construction code | : | IS:7285-1988/ Equivalent International standard |
| d) | Max. Operating pressure | : | 250 to 255 kg/cm ² (g) |
| e) | Design pressure / Design Temp | : | * kg/cm ² (g) / * °C |
| f) | Hydrostatic stretch pressure | : | * kg/cm ² (g). |
| g) | Material of Construction | : | Seamless Chrome Moly Alloy steel or as per design/ drawings approval by Petroleum and Explosive Safety Organization (PESO), Govt of India for CNG application. |
| h) | Manufacturing process | : | From tubes Hot Spinning process |
| i) | Neck threads | : | * |
| j) | Painting | : | White paint on body with white bands on neck (as per Gas Cylinder Rules- 2016) |

7.3 All CNG cylinders shall be manufactured, inspected & marked as per guidelines given in the Gas cylinder Rules 2016 and Oil Industries Safety Directorate (OISD 179).

7.4 Bidder shall ensure that there are no mis-punch, double punch, etc on the cylinders which are used in the cascade.

7.5 Full bore ball valves (bidirectional) for isolation shall be provided at inlet of each fill line and at each bank outlet line. Valve handle and wheel to be removable type.

7.6 All horizontal cylinders shall have the valves fitted on the same side within the cascade and arranged in such a manner that any gas leakage is discharged upwards.

7.7 Each Storage cascade with manifold isolation valve at operating height shall consists of three cylinder banks i.e. Low pressure, Medium pressure and High pressure, and each bank shall have certain nos. of cylinders, connected to common manifold of that bank.

7.8 Each storage cascade shall have tube fittings, isolations valves, NRVs, Vent manifolds, Pressure gauges on each bank. 3/8" QRC nipple on each bank (low, medium & high bank) with isolation valve shall be provided by bidder.

7.9 Bidder shall supply cascade with valid filling permission from PESO for filling gas inside cylinder. Cylinder first filling permission issued by PESO shall not be older than 6 month during inspection of cascade.

7.10 All cylinders should be new and unused. Re-certified cylinders are not acceptable. All cylinders in a cascade shall be of same capacity.

7.11 These cylinders are to be permanently and clearly marked for "CNG only" and also labelled "CNG ONLY" in letter at least 25 mm high in contrasting colour in a location which shall be visible after installation.

8.0 TECHNICAL SPECIFICATIONS

The following specification is to give the bidder the technical and operating conditions the cascades must fulfil. Features other than those indicated herein but which call for a better design, increase in efficiency, enhance reliability, optimization may be accepted subjected to Gujarat Energy Ltd approval. The Bidder may submit their bid for any alternative design as optional item which may be indicated separately describing all advantages. The cascade shall be shipped in completely assembled condition by bidder except for the vent pipes which shall be supplied in 2 pieces (1.5 mtr. each). Gas supply line and delivery connection shall be made at site.

The bidder shall bid in their main offer, items according to the technical specifications outlined below.

8.1 General

- 8.1.1 Cascade shall be a group of CNG storage cylinders of specified capacity.
- 8.1.2 The cascade shall comprise of following but not limited to:
 - 8.1.2.1 Free standing welded, painted steel frame structure.
 - 8.1.2.2 2 coats of epoxy with primer and shot blasting shall be applicable for cylinder.
 - 8.1.2.3 Frame shall be painted with zinc phosphate primer and applied epoxy golden yellow paint. Canopy frame shall only be cleaned with Shot/ Sand blasting and epoxy painted.
 - 8.1.2.4 CNG cylinders with high-pressure valves
 - 8.1.2.5 Interconnected SS tubing and manifold
 - 8.1.2.6 Isolation valves.
 - 8.1.2.7 Vent system: - SRV, pressure gauge and bleed valve vent connected with common header shall be such that it is terminated at 3 mtr. height from Finished Ground Level. Vent system shall be supplied in two piece i.e. 1.5 m +1.5 m (total 3 mtr).
 - 8.1.2.8 3 Nos. of Pressure gauges (4" dial, liquid filled)
 - 8.1.2.9 2 nos. of Clamps to fit the cylinder at the neck side and 1 no. of Clamp to fit the cylinder at the rear side on steel frame structure along with neoprene rubber paddings.
 - 8.1.2.10 Inlet and outlet manual isolating valves for Operations and maintenance.
 - 8.1.2.11 Weather proof, Yellow Color enclosure for instruments, SRV, NRV, 3/8" QRC etc.
 - 8.1.2.12 Any accessories which bidder feels necessary for better performance.
- 8.1.3 However all isolation valves shall be provided at operational height i.e. about 1200 mm to 1500 mm from man standing point elevation.
- 8.1.4 The bidder shall carryout 4-G static calculation of one complete assembled cascade with all the cylinders mounted and filled and submit the same.
- 8.1.5 New designs or unproven designs will not be acceptable.
- 8.1.6 All end connections for pressure gauges, valves and fittings of cascade shall be tamper proof, wire cage enclosure/ panel box. These shall be on one side of cascade for ease of operation.
- 8.1.7 Each bank shall be identified for pressure levels with permanent ink or embossing of

vent tubing shall be SS316.

- 8.1.8 A pressure relief safety valve on each bank shall be used, to release of excess pressure set at a rating 5% less than the pressure rating for fusible burst disc.
- 8.1.9 Electrically conductive earthing locks shall be provided
- 8.1.10 Cascade Storage Capacity

The water storage capacity of each cascade shall be 3000/ 4500 (-0%/+5%) water litres at 15degree C for Daughter station/ Daughter Booster Station/ Decompression station.

8.1.11 Cascade storage dimension

Sr. No.	Dimension	3000 WLC	4500 WLC
1.	Length	3700 mm	5300 mm
2.	Width	2000 mm	2000 mm
3.	Height	2000 mm	2000 mm
4.	Weight of cascade with gas	~6.3 MT	~9.7 MT

- 8.1.12 The design of cylinder shall be as per IS 7285 (Part 1 & 2) - 2004 and approved by Chief Controller of Explosives (CCoE), Government of India for use in India for specified conditions.
- 8.1.13 Working Pressure of cascade cylinder shall be minimum 250 to 255 bar(g) at 15 °C.
- 8.1.14 Cylinder material shall be seamless alloy steel (Cr-Mo) as per design/ drawing approved by Chief Controller of Explosives (CCoE), Government of India.
- 8.1.15 Cylinder neck threading shall be as per IS 3224- 2002 or as per design approved by Chief Controller of Explosive (CCoE) Government of India.
- 8.1.16 The cylinder shut-off valve shall be with fusible burst disc confirming to requirements of IS: 3224 or as per design approved by Chief Controller of Explosives (CCoE), Government of India.
- 8.1.17 The burst disc shall rupture on excess pressure as well as excess temperature either individually or combined. The burst disc discharge shall be manifolded to a common header for safe venting. Bidder shall indicate burst pressure and temperature.
- 8.1.18 The cylinder shut-off valve orifice shall be designed for high flow to permit the combined flow of 100 kg/min from each bank at pressure of 250 to 255 bar g. Number of cylinders in the cascade shall be divided into three independent banks of low, medium and high pressure of different storage pressures. Bidder shall optimize the number of cylinders in each bank for maximizing the recovery from the cascade storage and submit the calculations along with the bid. Bidder may assume the residual cylinder pressure of the vehicle coming for refill at 50 bar g and 28-bar g in case of booster compressor at daughter station.
- 8.1.19 The interconnecting tube work of cylinders manifold in configuration suitable for priority filling and sequential dispensing system by the electronic CNG dispensers at the Retail Outlets.
- 8.1.20 Full bore ball valves (bidirectional) for isolation shall be provided at inlet of each fill line and at each bank outlet line. Valve handle and wheel to be removable type.
- 8.1.21 The interconnecting tube work shall be minimum 3/4" OD tubing except 1/4" OD SS316 tube for pressure gauge and SRV line and 3/8" OD SS316 tube (minimum 3/8" OD) for vent loops. The sizing of connecting tubing between each outlet and its associated cylinders shall be such that where they join the total incoming flow areas shall not be less than outgoing area.
- 8.1.22 The loops in tube work shall be provided for absorbing contraction, expansion and

vibration Piping/ tubing shall be suitably clamped to the frame structure.

8.1.23 Cylinders in the cascade may be vertically or horizontally placed. In case of horizontal configuration, minimum 30mm cylinder to cylinder gap shall be provided.

8.1.24 All cylinders in cascade shall be identical (capacity).

8.1.25 Canopy shall be provided for the cascade to prevent direct sunrays as well as rain water falling on cylinder.

8.2 Cascade frame

8.2.1 The frame shall not allow lateral and rotational movement of cylinders during regular road transport under any circumstances. Bidders shall take into account the rough patches / bumps on roads.

8.2.2 The frame structure shall include a provision for mounting of three plates which should consists of a manufacturing plate fixed on the frame, second slot for mounting a plate with details of last hydro testing date of cascades and third slot for mounting the third plate with details of current hydro test of cascade.

8.2.3 The cascade frame structure shall be tagged with High Pressure, Medium Pressure & Low Pressure for each cascade banks for easy identification.

8.2.4 The frame structure shall include features designed for the handling and transportation of the cascade. Cascade can be lifted typically by fork-lift, lift-jack trolley or overhead crane.

8.2.5 The lifting eyes shall be designed with a factor of safety of 2. Cascade with more than one lifting eye shall be lifted such that a minimum sling leg angle alpha of 45 degree to the horizontal can be achieved during lifting using the lifting eyes.

8.2.6 Where four lifting eyes are used their design shall be such that they are strong enough to allow the cascade to be lifted. Four lifting eyes are used, diametrically opposite lifting eyes shall be aligned with each other to allow for correct lifting using shackle pins.

8.2.7 Where two or four lifting eyes are used, diametrically opposite lifting eyes shall be aligned with each other to allow for correct lifting using shackle pins.

8.2.8 Where a cascade is moved by fork-lift truck it shall feature two fork apertures on each side it is to be lifted from. The fork apertures shall be positioned symmetrically about the centre of gravity and their size shall be appropriate to the forks which are to be used to move the cascade. The fork apertures shall be defined such that the cascade cannot accidentally disengage from the forks.

8.2.9 Bottom and top of frame shall be reinforced to prevent any twisting or strain to inter-connections among cascade cylinders during lifting by crane, forklift and during the transport.

8.2.10 The design shall ensure stability under normal operating conditions. The centre of gravity shall stay within the footprint of the cascade when rotated to an angle of not more than 12 degree in both directions.

8.2.11 Frame structure of each cascade shall be capable of withstanding 4G impact (four times gravity) from any direction without any distortion.

8.2.12 The frame design shall ensure that there are no protrusions from the exterior frame structure which could cause hazards, except for the vent pipe (1.5m + 1.5m) as it is located exterior of the frame.

8.2.13 There shall be no features in which water and debris can collect to increase the tare weight of cascade filled by weight.

The floor of the cascade frame shall not buckle during normal operational conditions

and shall facilitate the drainage of water and debris from around the base of the cylinders.

- 8.2.14 If the frame design includes any movable doors or covers then these shall be capable of being secured in position with latches, which shall not be capable of being dislodged by operational impact loads.
- 8.2.15 Access shall be maintained to all valves which need to be operated in normal service or in an emergency.
- 8.2.16 All items used in the frame shall be weatherproof.
- 8.2.17 Supplier shall submit structural drawing of the frame giving details of the steel, welding procedure, corrosion protection for approval of Gujarat Energy Ltd before commencing fabrication work.
- 8.2.18 Frame shall support the cylinders adequately and enough spacing should be provided to allow the cleaning of the cylinders
- 8.2.19 Frame shall be painted and having provision of Lifting Lug for lifting at full load condition.
- 8.2.20 Frame shall be free standing and fabricated from good quality steel having rigid construction to accommodate all CNG cylinders in pressurized condition.
- 8.2.21 The Frame shall be designed and constructed in such a way so that it can be fixed above frame of the compressor. It should accommodate all CNG cylinders horizontally and each cylinder in a storage cascade shall be separated from another cylinder in the cascade by distance of not less than 30 mm.

8.3 Piping / Tubing / Fitting/ Pressure gauges/ Safety Relief Valve

- 8.3.1 Materials used for the piping shall be stainless steel 316 fully annealed seamless confirming to ASTM A269 with maximum hardness of Rb80 or less and suitable for bending and flaring. OD tolerance shall not exceed 0.005%.
- 8.3.2 All fittings material including valves shall be SS 316 conforming to ASTM A269 and A479. Open ends on fittings and vents shall be provided with caps.
- 8.3.3 Liquid filled pressure gauge of diameter 4", (0-400 kg/cm²) with a 3- valve manifolds on each bank shall be used. Thus each cascade shall have three pressure gauges. Pressure gauges shall be securely mounted. Liquid fill shall be lockable.
- 8.3.4 Liquid filled pressure gauge is to be mounted on local frame.
- 8.3.5 All end connections for quick release coupling, pressure gauges, valves and fittings of cascade shall be within tamper proof, wire cage enclosure. These shall be on one side of cascade for ease of operation. Flexible hose quick release coupling connections to the cascade should be possible only after opening of the door.
- 8.3.6 Each bank shall be identified for pressure levels with permanent ink or embossing.
- 8.3.7 Material of vent tubing shall be SS316 and for vent fitting shall be SS316. Welded/ brazed fitting shall not allowed.
- 8.3.8 A pressure relief safety valve on each bank shall be installed, to release of excess pressure set at a rating 5% less than the pressure rating for fusible burst disc.
- 8.3.9 Inter connecting tubing shall be installed with min. clearance of 20 mm to avoid contact and transfer the vibration of each other during transportation

8.3.10 SRV design shall be as per API 520 or equivalent equipment design standards.

Bidder shall provide Calibration Certificate for SRV tested as per SMPV rules to be certified by competent authority certified under Factories act 1948. Testing shall be performed as per API 527. Testing medium shall be Air/ Gas.

8.4 Painting

Cylinders shall be painted as per Gas Cylinder Rules/IS code as follows:

- White colour on cylinder body
- White colour on cylinder neck portion
- Yellow colour on frame

The paint shall be chosen, primed and applied as to have a service life of three years with corrosion free and fade free life without oxidation of paint surface for three years in an environment of bright sun light with an intense UV content. The frame material shall be shot/ sand blast to remove rust on internal surface as well as remove lamination before the painting. Vendor shall submit pictorial view of the base material as per relevant standard.

Frame surface preparation shall be of SA2.5 finish. Bidder shall follow the frame surface preparation process as per IS 9954 standard or equivalent international standard.

9.0 INSPECTION AND TESTING

- 9.1 Inspection and testing shall be as per Gas cylinder rules 2016 and as per manufacturing code. The bidder shall furnish No Objection Certificate from Chief Controller of Explosive, Nagpur, India.
- 9.2 The frame structural members must be designed as per PNGRB T4S standard and the design stress levels shall not exceed as per IS 800. Bidder shall carryout 4-G static calculation of one complete assembled cascade with all the cylinders mounted and filled and submit the same for Owner review.
- 9.3 New designs or unproven designs will not be acceptable.
- 9.4 Bidder shall carry out all standard shop tests/ QA/ QC as is recommended in applicable standards guideline issued from time to time by Chief Controller of Explosives. Copies of the testing/ inspection carried out shall be furnished to Gujarat Energy Ltd. The details shall be as under but not limited to:
 - a) Material Identification (Material composition & physical properties certificate to be furnished).
 - b) All pressure parts and weld joints shall be DP tested/ MPI tested/ UT tested/ Radiography tested as mentioned in approved QAP.
 - c) Heat treatment, if any.
 - d) Hydrostatic stretch test and leakage test.
 - e) Visual inspection and dimensional checks.
 - f) Inspection and tests required as per the code of construction and statutory requirements like Gas Cylinder Rules 2016/ Oil Industries Safety Directorate (OISD 179).
- 9.5 Bidder shall furnish record of storage capacity check of each cylinder in a cascade and the same record need to be provided to Owner or their authorised representative.

- 9.6 Each assembled storage cascade with all tubing, valves shall be pressure tested to ensure existence of no leakage prior to dispatch. Hydro test and leak test shall be as per code requirements.
- 9.7 Calibration and material test certificates complying with the statutory requirement are to be furnished for future reference.

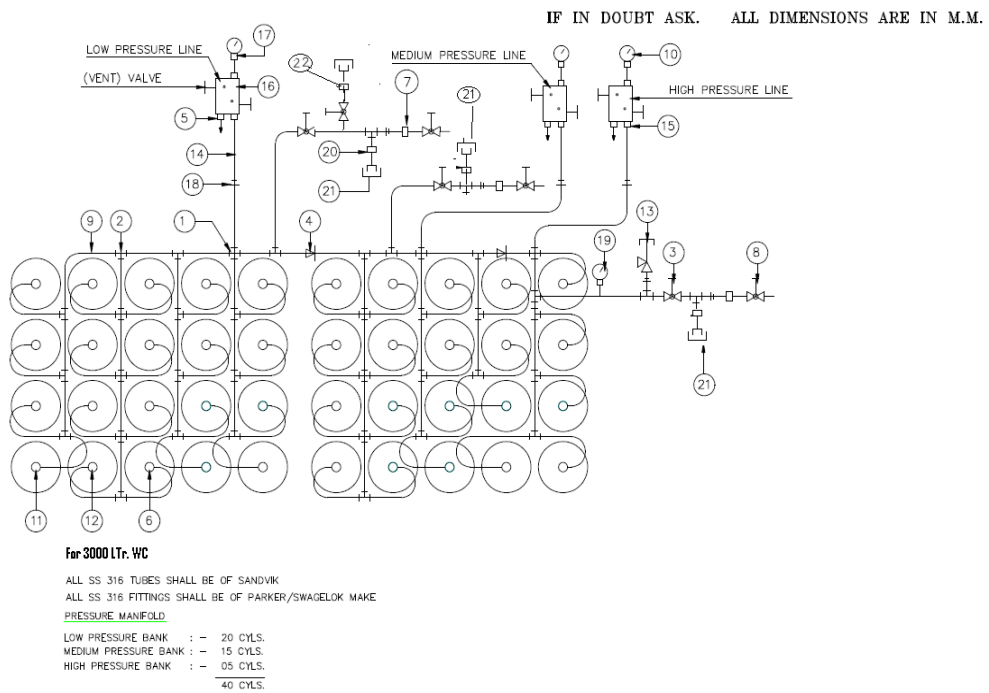
10.0 WARRANTY

- 10.1 Bidder shall give comprehensive warranty for all material and equipment to be free from defects in design, material and workmanship.
- 10.2 Bidder shall give warranty on all cylinders satisfying the requirement of intended use.
- 10.3 Replacement of any defective item/ equipment found damaged by Owner or their authorised representative at the time of delivery.
- 10.4 Assume responsibility for obtaining manufacturer's warranty of all bought out items.

Replacement of any part found not performing to the specified requirements for at least 18 months from date of delivery.

11.0 SAMPLE DRAWING & BILL OF MATERIALS

11.1 Sample Drawing



11.2 Typical Bill of Materials

The Below mentioned quantity are tentative and for reference only.

Sr. No.	Item Description	Actual Make / MOC	3000 Ltr WC	4500 Ltr WC
			Qty.	Qty.
1	3/4" OD -4 way fitting		9	21
2	3/4" OD -3 way fitting		30	28
3	3/4" OD 2 way ball valve		3	3
4	Non Return Valve 3/4" OD		2	2
5	Male Connector 1/4" x 1/2" NPT (M)		3	3
6	Male Connector 3/4" x 1/4" NPT		40	60
7	Female Bulk Head Connector 1/4" OD x 1/4" NPT (F)		3	3
8	Bleed Valve 1/4" NPT		3	3
9	SS Tube 3/4" OD x 0.095" THK		Lot	Lot
10	Glycerin filled Pressure Gauge (4" Dial) 0-400		3	3
11	Nut With Bull Nose		40	60
12	Cylinder Valve with Burst Disc		40	60
13	Safety Relief Valve		3	3
14	SS Tube 1/4" OD x 0.035" THK		Lot	Lot
15	Male Connector 1/4" x 1/2" NPT		6	Lot
16	Three Valve manifold		3	3
17	Female Adaptor (1/4" OD x 1/4" NPT)		3	3
18	Straight Reducer 3/4" OD x 1/4" OD Tube		7	7
19	Male Connector 3/4" x 1/4" NPTM		1	1
20	QRC Nipples 3/8" NPTF		3	3

21	$\frac{3}{4}$ " Tube OD to 3/8" NPT Male Convertor		3	3
----	---	--	---	---

*Bidder shall select any make provided in approved vendor list.