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شرکت ملی گاز ایران

مدیریت پژوهش و فنآوری

امور تدوین استانداردها

IGS

مشخصات فنی خرید

دستگاه جداکننده ذرات از گاز طبیعی، نوع اسکرابر

Particle Separator From Natural Gas ,Scrubber Type

ابلاغ مصوبه هیأت مدیره

مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۲۰۱۵ مورخ ۱۴۰۲/۰۴/۰۴ هیات مدیره، نامه شماره گ۹/۵۰۹۱۴/۰۰۰ مورخ ۱۴۰۲/۰۳/۲۹ آن مدیریت درمورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

۱- مشخصات فنی خرید دستگاه جداکننده ذرات از گاز طبیعی نوع اسکرابر

IGS-M-PM-108(0)

۲- مشخصات فنی خرید حوضچه و دریچه کامپوزیت پایه پلیمری برای تجهیزات گازرسانی

IGS-M-DN-007-1(0)

سیدمحمد پیشوایی
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رونوشت : مدیرعامل محترم شرکت ملی گاز ایران و رئیس هیات مدیره
اعضای محترم هیات مدیره
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Foreword

This standard is intended to be mainly used by NIGC and contractors, and has been prepared based on interpretation of recognized standards, technical documents, knowledge, backgrounds and experiences in natural gas industry at national and international levels.

Iranian Gas Standards (IGS) are prepared, reviewed and amended by technical standard committees within NIGC Standardization division and submitted to the NIGC's "STANDARDS COUNCIL" for approval.

IGS Standards are subject to revision, amendment or withdrawal, if required. Thus the latest edition of IGS shall be checked/inquired by NIGC employees and contractors.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation from normative references and / or well-known supplier’s specifications must be reported to Standardization division.

The technical standard committee welcomes comments and feedbacks about this standard, and may revise this document accordingly based on the received feedbacks.

General Definitions

Throughout this standard the following definitions, where applicable, should be followed:

1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.

2- "COMPANY": refers to National Iranian Gas Company (NIGC).

3- "Supplier": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or supplier or a trading firm.

4- “INSPECTOR”: The Inspector referred to in this specification is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

5- "SHALL ": is used where a provision is mandatory.

6- "SHOULD": is used where a provision is advised only.

7- "MAY": is used where a provision is completely discretionary.

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Contents

1. SCOPE

This standard covers the minimum requirements for the technical specification, materials, fabrication, and welding, testing, inspection, piping and packing for shipment of the natural gas scrubbers used in natural gas industry.

This specification is part of the enquiry and purchase order, it shall be the supplier's responsibility to clearly indicate any deviation from the specifications, otherwise it is understood that the equipment conforms to the requirements of this specification.

The specification does not supersede the accepted pressure vessel codes but only supplements them with regard to certain conditions not fully covered in the codes.

The equipment shall be designed for full load, unattended continuous operation without the provision of special housing or shelters etc.

The unit shall be completely assembled, tested and painted according to the standards, codes and specification quoted herein and shall require only pipe connections before being placed in to service.

2. REFERENCE

Throughout this standard specification the following standards are referred to. For all references, the latest edition of the following referenced documents shall be applied. The applicability of changes in standards that occur after the date of this standard specification shall be mutually agreed upon by the purchaser and the supplier.

2.1. Normative References

IGS-M-PL-002-3	"Flanged/Welded End Ball Valves 2" to 24" Class 150,300, And 60"
IGS-M-PL-040	"Carbon Steel Flanges, Class 150 up to 900"
IGS-M-PL-002-1	"Flanged/Welded End Plug Valves 2" to 24" Class 150,300, and 60
IGS-O-CH-042	"Painting Procedure for Gas Industry
IPS-G-GN-210	"Packing & Packages"
IPS-D-ME-100	"Nameplate for Pressure Vessel"
IPS-G-ME-150(1)	"Towers, Reactors, Pressure vessel and internals"
IPS-D-ME-010	"Vertical Vessel Support"
IPS D-ME-104	"Saddle Details for Horizontal Vessels"
IPS-E-PR-850(1)	"Process Requirements of Vessels and Scrubbers"
API 12J	"Specification for Oil and Gas Separators"
ASME Sec. VIII	"Rules for Construction of Pressure Vessels" Div. I
ASME Sec. VIII	"Alternatives Rules for Construction of Pressure Vessels" Div. II
ASME Sec. II	"Materials and Specifications"

ASME Sec. IX	"Welding Procedure and performance qualification"
ASME B16.5/B16.47	"Pipe Flanges and Flanged Fittings"
ASME B16.9	"Factory-Made Wrought Butt welding Fitting"
ASME B16.11	"Forged Fittings, Socket-Welding and Threaded"
ASME B16.20	"Metallic Gaskets for Pipe Flanges"
ASME B18.2.1	"Square and Hex Bolts and Screws (Inch Series)"
ASME B18.2.2	"Square and Hex Nuts (Inch Series)"
ASTM A193	"Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service"
ASTM A194	"Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature"
ISO 4572	"Hydraulic Fluid Power Filter Elements"
Osha 1926.1053	"ladders"

Ludwig's applied process design for chemical and petrochemical plants

2.2. Informative References

2.2.1. Shell Design and Engineering Practice "Gas/Liquid scrubbers Type selection and design rules'' DEP 31.22.05.11-Gen December 2007 and DEP 31.22.20.31 Gen February 2011.

2.2.2. Gas Processors Suppliers Association (GPSA) Engineering Data book -12th Edition

2.2.3. Pressure vessel handbook tenth edition F. megyesy

3. Definitions

Scrubber(multi cyclone scrubber)

Scrubber (multi cyclone scrubber) is a vertical vessel in which an array of parallel small cyclones is fitted between a top and bottom plate. In this way, a chamber is created which is shielded from the top and bottom compartment of the vessel. The feed flows directly into this compartment and enters the cyclones via their tangential inlets. Solid or liquid separation takes place in these cyclones. Subsequently the cleaned gas flows to the upper vessel compartment and the separated liquid is drained to the bottom compartment.

Cyclones

A cyclone is a device without moving parts in which the velocity of an inlet gas stream is transformed into a confined vortex from which centrifugal forces tend to drive the suspended particles against the wall of the cyclone body.

Separation (Filtration) Efficiency

The rate at which solids / Liquids in the feed are retained by the filter. It depends on the characteristics of the filter, the particle size distribution and nature of the solids or liquid droplets.

Design Pressure

The maximum operating pressure used for vessel mechanical calculations. Design pressure shall be selected based on ASME Sec. VIII Div. I.

It is recommended to design a vessel and its parts for a higher pressure than the operating pressure. A design pressure higher than the operating pressure with 30 psi or 10 percent, whichever, is the greater, will satisfy this requirement.

M.A.W.P (Maximum Allowable Working Pressure)

Maximum pressure for selected material, thickness, weld quality, etc. calculated from ASME Sec. VIII Div. I for each specific part or nozzle. M.A.W.P of complete package is the minimum allowable working pressure of all vessel parts.

4.Materials

4.1. Scrubbers furnished to this specification shall conform to the material requirements stipulated in the latest edition of the ASME Sec. II, as follows:

4.1.1. Pressure-containing parts

4.1.2. Attachments subject to stress not induced by pressure (e.g. supporting skirts, lugs, baffles, reinforcement pads, etc.).

4.2. Material selection for corrosive fluids should be selected based on a review of related API or NACE publications for materials. Consideration should be given to material selection as it relates to weight loss, sulfide stress cracking, chloride stress cracking, or other forms of corrosion. It is the responsibility of the user to determine what consideration for corrosion should be made to the vessel during its intended life.

4.3. Minimum corrosion allowance of 1.6 mm (0.0625 inch) shall be provided for all carbon steel and low alloy steel vessels, unless otherwise noted.

4.4. For carbon steel scrubbers, all steel plates for scrubber's supports shall have weld-ability to shell.

4.5. All external attachments material to shell such as pads, wear plates, and materials for supporting lugs, skirts, baffles and similar non-pressure parts welded directly to a pressure component, shall be established identically and shall be compatible with the material to which they are attached and shall have the same material as shell.

4.6. All materials used in the fabrication of parts under pressure shall have a material certificate issued by the steel mill, specifying chemical analysis and mechanical tests, in

accordance with appropriate specifications. Certificates relating to additional examinations and tests requested by the Company shall also be submitted. In the case of materials used in the fabrication of components that are not under pressure, material certificates issued by the steel mills or a declaration of conformity issued by the vessel fabricator shall be submitted. Supplier shall keep original copies of the above- mentioned certificates, which shall specify the identification code marked on semi-finished products. A copy of these certificates shall be submitted to the company.

4.7. Materials of construction for scrubber's components shall be selected to produce an economical design for the specified design service conditions.

4.8. External bolting shall be continuous-thread alloy steel bolt studs in accordance with ASTM A193, Grade B7 and Carbon and Alloy Steel Nuts ASTM A194 Grade 2H.

4.9. Flanges shall be forged and hot formed and shall comply with IGS-M-PL-040.

5. Technical specification

5.1. General

5.1.1. Gas velocity

5.1.1.1. To ensure protecting of all parts against erosion, maximum gas velocity in all section of scrubbers shall be calculated and compared with each part erosion critical velocity. Type and amount of liquid/solid particles in gas may decrease the critical gas velocity and shall be calculated by designer.

5.1.1.2. Minimum gas velocity in cyclones shall be calculated in which all of impurities removes from gas stream at the end of centrifugal part according to 5.1.1.3

5.1.1.3. Due to the usual conditions of limiting pressure drop, entrance velocity range shall be from 5 m/s to 20 m/s. The average of velocity should be 15 m/s.

5.1.2. Pressure drop in a cyclone with collection efficiency is important in evaluating its cost, and it shall be up to ΔP=0.360 psi.

5.1.3. Liquid efficiency

The scrubber shall generally remove 90% of 10 microns (μm) and larger liquid particles.

5.1.4. Solids efficiency

The scrubber shall generally remove 70% of 10 microns (μm) and larger solid particles.

5.1.5. The diameter of the scrubber shall be large enough to hold sufficient cyclones in order to meet the gas handling capacity criterion.

5.1.6. Scrubbers shall be designed to ensure safe operation in the specified internal pressure.

5.1.7. Scrubbers including their supports shall be capable of supporting a full load of water in the installed position.

5.1.8. Scrubbers shall be designed to withstand the loads exerted by internal pressure, weight of the vessels, wind, earthquake, reaction of supports, impact, and temperature.

5.1.9. The Supplier shall furnish complete operating units including all necessary items such as valves, piping system, gages and etc. to ensure satisfactory, safety operation according to relate standard.

5.2. Design temperature and and pressure

5.2.1. Design temperature and pressure shall be in accordance with ASME Sec. VIII Div. I.

5.2.1.1. Design temperature shall be between -29 C to 85 C.

5.3. Design load

Loading shall be in accordance with ASME Sec. VIII Div. I.

5.4. Nozzles, Connections and Openings

5.4.1. Feed inlet and nozzles shall be positioned to enhance uniform distribution of the feed over the cyclones.

5.4.2. Nozzles on the scrubbers (except instrument nozzles) shall be flanged (Raised Face Type) and minimum nozzle size shall be 2" NPS. However, when a connection must be smaller, a reducing flange matching a 2" nozzle neck may be used. Alternatively, a concentric reducer may be inserted between a 2" pipe neck and the required smaller flange.

5.4.3. Inspection opening (hand-hole) installed instead of manways shall be added to multi cyclone section of scrubbers and the minimum size shall be NPS ٤ (DN ١٠٠).
5.4.4. Nozzle necks shall conform to paragraph UG 45 of ASME Sec. VIII Div. I or AD-602 of ASME Sec. VIII Div. II, as applicable.
5.4.5. Nozzles shall be attached to the scrubbers by complete penetration welds. Partial penetration welding is only acceptable for attachment of reinforcing pad plates.
5.4.6. All bolt holes in flanges on manways, hand holes and nozzles shall straddle the scrubber normal centerlines.
5.4.7. Nozzles in scrubbers shall project a minimum of 150 mm from outside of shell or head.
5.4.8. Manholes, hand holes and blanked-off nozzles shall have gaskets conforming to the piping specification for lines connecting to nozzles in the same zone of the vessel, unless otherwise specified.
5.4.9. Minimum two earthing lugs shall be provided on each scrubber, and shall be in accordance with either IPS-D-EL-413.
5.4.10. Manhole:
All vessels over 18 in (450 mm) ID shall have a manhole on the sump section for inspection, maintenance and operation requirements.
5.4.11. Davits or hinges shall be provided for handling manhole covers. 24" diameter manholes are preferred. Inside diameter of smaller manholes shall not be less than 20 inches (500 mm).
5.4.12. According to Fig 1, N8 shall be considered in the minimum distance of lower tube sheet.

5.5. Scrubber Support

5.5.1. Scrubbers shall be provided with skirts of the same outside diameter as the scrubber shell. Skirts shall be designed to withstand the combined stresses of dead load, live load, wind or earthquake load, whichever is the greater, and reactions of piping more than DN 300.

5.5.2. Scrubber skirts shall have a manhole of NPS 24 (DN 600) for piping is located inside the skirt. Openings for piping connections to the bottom of the scrubber shall be provided in the skirt as required. In addition, two NPS 4 (DN 100) vent holes 180° apart shall be provided in the upper part of the skirt. Reference is made to standard IPS-D-ME-010.
5.5.3. Scrubbers shall be designed to be self-supporting without benefit of braces.
5.5.4. Scrubbers support shall be capable of withstanding the wind load when scrubber is empty and the test conditions when the scrubber is full of water. (e.g. wind velocity 16 m/s).

5.6. Internal specification

5.6.1. Material specifications and construction: Scrubber Materials are as company's specification or other agreement, from standard carbon steel to stainless steel, and other steel alloys.

5.6.2. Cyclone Arrangement and Dimensions:

after particle/droplet removal at the end of centrifugal forced stream, typically seamless pipe is used to lead clean gas to outlet section. The multi cyclone bundle layout should satisfy the following requirements (see fig 1).

5.6.2.1. Cyclone-cyclone pitch should be design, calculate, simulate and prove the gas free movement around cyclone.

5.6.2.2. The arrangement of the cyclones shall be designed according to (5.1.1.3)

5.6.2.3. The number of cyclones and their installation space should be calculated based on capacity as well as the best arrangement to ensure proper inlet velocity to the cyclones.

5.6.2.4. Top and bottom cover shall be gas-tight.

5.6.2.5. Inlet section of cyclone assembly shall have a free space without any installed cyclone to help more efficient distribution of gas between all cyclones.

5.6.2.6. Gas distribution in whole space of cyclonic part shall simulated and modeled by designer to ensure the uniform flow in all of cyclones. Any mistake in arrangement and layout of this part may limit the gas passing from some specific cyclones and result to very high gas velocity. So some of cyclones may deformed/damaged and effect on whole package operation.

5.6.2.7. No welding is permitted in cyclone from inlet section to end of centrifugal decreased outlet. All parts shall be formed by machinery or hot / cold formation. Using pipe or fitting is not allowed instead of rolled and shaped sheets. Piping is just allowed for 1 inch's clean gas outlet part.

5.6.2.8. All of the cyclones in one scrubber shall have a same geometry and design.

5.6.2.9. The distance between lower tube sheet and end of cyclones should be as high as level H (According to Fig.1) to prevent accumulation of particles and clogging the cyclones.

5.6.3. The following engineering design documents shall be provided by the supplier before fabrication.

5.6.3.1. Result of three-dimensional validated CFD simulation of flow distribution inside the scrubber and between the cyclone tubes.

5.6.3.2. Result of separation efficiency and pressure drop inside each cyclone tube according to the minimum, maximum and average flow velocity.

5.6.3.3. Result of stress analysis on the cyclone tubes according to the capacity at the highest inlet velocity.

5.6.3.4. Other engineering documents requesting by the company shall be provided.

5.6.3.5. laboratory tests shall be performed on each cyclone tube or set for ensure separation efficiency and pressure drop. The procedure shall be mutually agreed by the company & manufacturer.

5.6.3.6. Type test shall be performed on each kinds of cyclone design. The procedure shall be mutually agreed by the company & manufacturer.

N1	Inlet
N2	Outlet
N3	Manhole
N4	Safety valve
N5	Vent
N6(A/B)	Drain
N7	Inspection hole
N8	Drain
N9	DP transmitter
N10	Pressure gauge

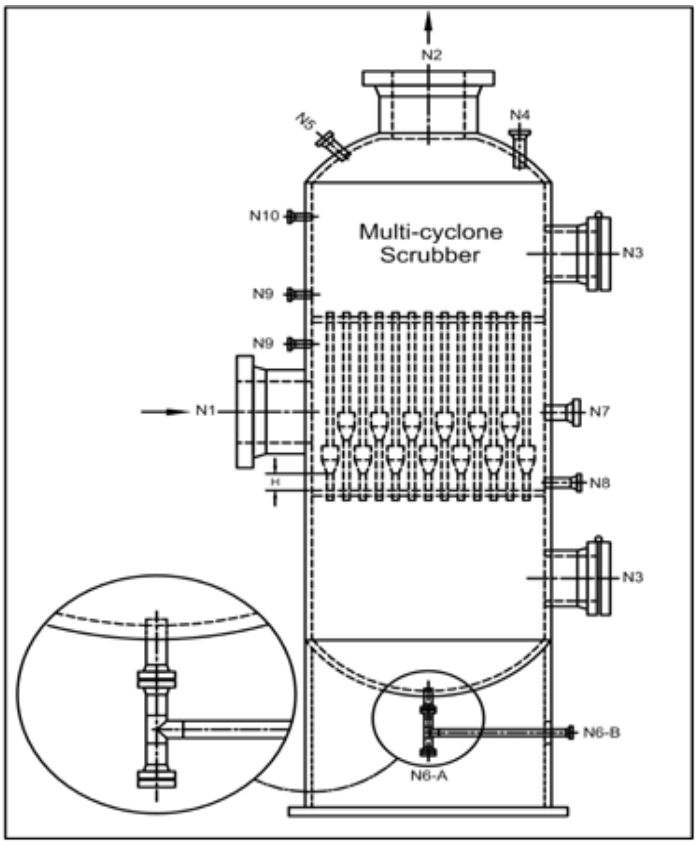

Fig.1. SKETCH OF SCRUBBER

5.7. Miscellaneous

5.7.1. Drainage Accumulator Section (under cyclone part)

5.7.1.1. Minimum capacity for drainage of liquid / solid particles shall be foreseen at the bottom of scrubber according to company basic data for amount of impurities in gas stream. Time for drainage intervals shall be reported to company to manage the operation of scrubber.

5.7.1.2. Scrubber minimum size of flanged drain nozzle in scrubber shall be selected at least 4". Size of drain pipe with Two lubricated plug valves (flanged end and raised face) connected to scrubber accumulation section shall be at least 4".

5.7.1.3. Drainage accumulator section shall have a manhole at least of DN 600.

5.7.1.4. To facilitate the iterance of operator in drainage accumulator section stairs shall be installed.

5.7.2. Safety valve

5.7.2.1. Scrubber shall be equipped with safety relief valve according to ASME Sec. VIII and IGS-M-IN-302(2).

5.7.3. Instrumentation

Scrubber shall be equipped but not limited with the following instrumentation:

5.7.3.1. Instrument for measuring differential pressure (DP gage/DP transmitter) in scrubber shall be considered. And equipped with a three-way manifold. Range of this instrument is 0-15 psig. Differential pressure gauge shall be equipped with a 3-way valve. However, in some cases that using a 3-way valve is not necessary, it shall be approved by the company.

The Piston type can be connected to the scrubber body via needle valves in both the high and low-pressure lines.

5.7.3.2. level indicator shall be considered on scrubber drainage.

5.7.3.3. One pressure indicator for display upper section of scrubber shall be considered.

5.7.4. ladders and platforms

5.7.4.1. For the scrubber operating points are located higher than 2 meters above the deck, shall be provided with ladders and platforms to facilitate access to the following equipment. The maximum lateral reach to the equipment shall not exceed 45 cm according to IPS-G-ME-150.

a) Safety valve
b) Instrument devices
c) vent valve
d) Access openings and manways
e) Inspection points
f) Inlet nozzle

5.8. Support clips for ladders, platforms, and stairs shall be shop-welded to the scrubber. The supports clips shall be welded prior to stress relieving. Material of the attachment clips shall be the same material as shell.

6. Fabrication

6.1. General Requirement

6.1.1. All scrubbers shall be fabricated according to ASME Sec. VIII Div. I.

6.1.2. All requirements contained within ISO 3834 Part II shall be adopted in full.

6.2. Welders Qualification Test (WQT)

6.2.1. Welding shall be done by qualified welders / operators.

6.2.2. The welders / welding operators for welding pressure parts or joining load-carrying non-pressure parts (attachments) to pressure parts shall be qualified in accordance with ASME Sec. IX.

6.2.3. The qualification test for welding operators shall be performed on a separate test plate prior to the start of welding or on the first work piece.

6.3. **Welding Procedures (WPS & PQR)**

6.3.1. All welding shall be performed according to welding procedure specification (WPS). The Supplier shall submit Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) according to ASME Sec. IX for company's review and approve before welding process started.
6.3.2. All PQR tests shall be performed with equipment calibrated in accordance with applicable national standards or ASTM by an accredited laboratory.

6.4. Welding

6.4.1. All welding shall be done by Shielded Metal Arc Welding (SMAW) or Gas Tungsten Arc Welding (GTAW) or semi-automatic or automatic welding.
6.4.2. The supplier shall certify the quality of electrodes, which proposes to utilize in fabrication. Shielded Metal Arc Welding (SMAW) electrodes shall be according to IGS-M-PL-018.
6.4.3. All longitudinal and circumferential seams in shells and all seams in heads shall be full penetration. Lap welds are not permitted.
6.4.4. Welding shall be carried out with calibrated equipment.
6.4.5. All welding shall be completed prior to final heat treatment.
6.4.6. A list of Non-removable parts shall be provided to check by inspector to ensure that all non-removable parts have been welded before stress relieving.
6.4.7. Special welding parameters shall be considered to prevent formation of chromium carbide.

6.5. Repair and Re-Inspection

6.5.1. All repairs shall be carried out with prior permission of company.
6.5.2. Weld repair records shall be provided to the Company as part of the final report.
6.5.3. Defects shall be repaired in accordance with approved repair procedures and the joint shall be re-inspected by the same method, re-examined to the same extent and by the same acceptance criteria required for the original weld.

6.6. Heat Treatment

6.6.1. Heat treatment of scrubber parts shall be carried out in accordance with ASME Sec. VIII Div. I.
6.6.2 All welds after stress relieving shall be MT (magnetic particle test).
6.6.3. Heat treatment shall be carried out according to material specification (carbon steel/ stainless steel).
6.6.4. All face of flanges and threaded connections shall be adequately protected against oxidization during the heat treatment.
6.6.5. If the scrubber is post-welded, no welding is permitted after stress relieving.

7. Quality Assurance

7.1. For prior evaluation and audit, the company and/or the inspection agency may require the written description of the Suppliers' Quality Assurance System.

7.2. Scrubber shall be purchased only from approved Supplier list accepted by the Company.
7.3. Surveillance requirements shall be established for scrubber constructed in accordance with this SPEC. The requirements shall be established by the company, or by the inspection agency with the approval of the company.
7.4. By agreement, during the meeting to determine inspection requirements, all of the quality control requirements and fabrication specifications according to purchase order shall be defined in QCP.
7.5. The supplier shall submit the inspection and test plan (ITP) to the company for review and approval. Surveillance requirements identified by the Company shall be incorporated into the supplier's ITP.
7.6. On completion of the scrubber the Supplier shall issue document to certify that the vessel has been designed, constructed and tested in every respect in accordance with this specification and with any additional requirements in respect of the company's options covered by this specification. Document shall be countersigned by the inspecting authority as required.

8. Inspection, Testing, Panting

8.1. Inspection

8.1.1. Mandatory inspection shall be carried out to meet the requirements of ASME Sec. VIII Div. I and approved ITP/QCP.

8.1.2. The manufacturer shall give adequate notice to the company prior to all inspection/ test visits required by the ITP/QCP.

8.1.3. The supplier shall afford all reasonable facilities, without charge, to enable Company to verify that scrubber is being fabricated and tested in accordance with this specification.

8.1.4. Supplier's data reports shall be available to the inspector at the time of inspection.

8.1.5. Inspection and testing plan(ITP) shall be prepared in accordance with this specification and other approved codes and standards mentioned by company.

8.1.6. The supplier shall notify the Company representative at least 5 working days prior to the start of fabrication and to the scheduled time of each test according to ITP.

8.1.7. The supplier has responsibility for inspection of scrubber in accordance with this specification. The Company representative will inspect the scrubber at any time during fabrication to ensure that the scrubber materials and workmanship are in accordance with this specification.

8.1.8. Prior to inspection, all slag, loose scale, dirt, grit, weld spatter, print, oil and other foreign matter shall be thoroughly removed for the best advantage.

8.2. Material Inspection

8.2.1. Materials properties shall be tested accordance with ASTM A370, ASTM E350, ASME Sec V and their result shall be accorded with related ASTM or ASME Sec. ll.

8.2.2. For all pressure parts (plates, heads, nozzles, flanges, etc.) as well as for supports (skirt, saddles, legs), the shall provide material test reports showing the results of the required tests and inspection, including supplementary requirements if any.

8.2.3. The material inspection may be conducted to confirm the mill test certificate of pressure retaining parts.

8.3. Welding Inspection

8.3.1. Visual Inspection shall be performed prior to undertake any Non-Destructive Tests.

8.3.2. The visual inspection shall be carried out according to the approved procedure.

8.3.3. Radiographic Examination shall be applied according to latest ASME Sec. VIII Div. I.

8.3.4. The radiographic examination shall be carried out before post weld heat treatment.

8.3.5. Interpretation of the radiographic films and other non-destructive tests shall be carried out by the inspection agency of the NIGC in the related field. Also, Interpreter company of the radiographic films shall be separate from the radiographer company.

8.3.6. Non-destructive tests procedures shall be prepared by Supplier and approved by company in accordance with ASME Sec. V and Sec. VIII, and after confirmation by the level III personnel and employer should be used.

8.4. Pressure Tests

8.4.1. A fully detailed testing procedure shall be submitted to the Company for approval prior to test.

8.4.2. After fabrication is completed and the scrubber stress relieved, vessel shall be tested in accordance with the ASME Sec. VIII rules.

8.4.3. All tests shall be made in the presence of an inspector before being painted.
8.4.4. Prior to testing, the scrubber shall be thoroughly cleaned and free from dirt, debris, loose scale and slag, pieces of metal, weld spatter, oil and grease, etc.
8.4.5. All welded attachments provided with “Tell–Tale” holes shall be tested by pneumatic pressure (according to ASME Sec. VIII) prior to the thermal stress relief and final hydrostatic test.
8.4.6. Service bolting shall be used for pressure testing, bolts and nuts shall be thoroughly inspected after testing and replaced whenever damaged. This inspection shall be witnessed by the Inspector.
8.4.7. Gaskets shall be the same as for the service type. Use of compounds, glue, lead, is not permitted. All gaskets shall be replaced with new ones after testing.
8.4.8. Test reports must be approved by the company before dispatch instructions are given.
8.4.9. Pressure recorder shall be used during the hydro test and all gages shall be calibrated by NIGC approved lab.
8.4.10. After hydrostatic test the water accumulated in the vessel shall be drained and the inner surface shall be dried with compressed hot air.

8.5. Painting
Unless otherwise specified by company, surface preparation and painting shall be in accordance to IGS-O-CH-042.

9. Acceptance
9.1. Release notes shall be issued by the inspector and then approved by company. For each after final inspection and testing. shall not be dispatched until such release notes have been issued.
9.2. The company’s approval of work and acceptance for shop tests etc, and / or releasing shipment note shall in no way release or relieve supplier's responsibility for carrying out all provisions of the specification, codes and/or fulfillment of the guarantee.

10. Cleaning Marking, Packaging and Shipment

10.1. Cleaning
Scrubber shall be cleaned prior to shipment. All slag, debris, grit, scale, weld rod stub ends, sand, water and other foreign material shall be removed from the scrubbers prior to shipment. Additional cleaning may be specified by the Company or on the data sheet or may be required prior to placing in service.

10.2. Marking

The completed scrubber shall be provided with a name plate (with Stainless Steel material) securely attached to the scrubbers. Nameplate configuration shall comply with Standard drawing IPS-D-ME-100. The Company may specify modified nameplate brackets to comply with local requirements.

10.3. Packaging

10.3.1. Service gaskets and spare parts shall be separately packaged for shipment. Detailed packing lists, clearly describing the packages and their contents, shall be submitted to the company for review prior to shipment. All packages shall be separately identified by package number
and scrubber tag (serial) number clearly indicated.

10.3.2. Machined surfaces, flange faces other than those furnished with permanent blinds, and other finished or delicate parts shall be well-greased and protected against rusting and damage during shipment.

10.3.3. Nozzles shall be provided with substantial covers, and manways shall have the covers attached with new bolts and a gasket for shipping purposes. All flange faces other than those furnished with permanent blinds shall be covered with a minimum 1/4 in (6 mm) steel of similar P number as flange face, no smaller than the flange O.D, and secured with a minimum of four bolts with a rubber gasket between the cover and the flange. Closures shall prevent the entry of moisture during shipment and subsequent storage.

10.3.4. Bolts and nuts shall be coated with a suitable thread lubricant to prevent galling or corrosion during transport and outdoor storage. The lubricant shall be removable with mineral spirits or a solvent.

10.4. Shipment

10.4.1. The Supplier shall be responsible for loading and anchoring scrubber to prevent damage during shipment. Partially fabricated scrubber shall be braced to prevent any deformation that could affect field construction, and open ends shall be covered to keep out any foreign matter during shipment.

10.4.2. Shipping saddles shall be of steel or of steel reinforced timber construction and shall be contoured to fit with sufficient contact surface to prevent damage or permanent distortion to the scrubber assembly. Auxiliary removable spiders, struts, bands, and/or stiffening rings shall be provided where required. Temporary supports shall not be of a moisture retaining material such as raw wood.

10.4.3. All bolting and other small parts shall be suitably packaged and identified to avoid loss or damage during shipment.

10.4.4. Before shipment is made, the company's written approval of the proposed method of shipment shall be obtained.
10.4.5. Export packing shall be carried out in accordance with good practice, the minimum acceptable standard shall be as defined in the applicable parts of IPS-G-GN-210 standard. The packaging shall be appropriate for storage without cover on site for up to three months prior to installation.

11. Documentation Requirements

Any part for which detail design and drawing(s) is not prepared, shall be designed by the supplier.

11.1 Order Form

The first successful step of a good project could be a correct order from company to supplier. So designing a correct scrubber is highly depending on what initial values is giving to designer. Using a wide range of process parameters (pressure, temperature, flow rate, etc.), reduces design accuracy. Also design of some items requires necessarily all Minimum, Normal and Maximum value of parameters such as pressure.
The Company's Design Specification or data sheet shall be completed for each scrubber.
The detailed data sheet and design specification shall contain the information in Annex A.

12.Guarantee

12.1. The supplier shall guarantee the vessel against defective of material workmanship and improper mechanical and process design for minimum of one year after being placed in service or at least 18 months after date of shipment.
12.2. Supplier shall guarantee the compliance of material and performance of the supplied equipment with this specification.
12.3. The supplier shall be responsible for the completeness and accuracy of all design calculations and for compliance with all applicable requirements of this specification for the whole scrubber. The Supplier shall, as required at various inspecting authority for aspects of scrubber design, material choice, Supplier points in this specification, obtain the agreement of the company and/or inspecting authority for aspects of vessel design, material choice, Supplier and testing. These agreements shall be documented for inclusion in the vessel records. If during fabrication unexpected deviations from the requirements of this specification arise, that the supplier can justify will not impair the intended functionality or integrity of the scrubber, the supplier may submit a justification to the company and inspecting authority for their approval.

Such approved deviations shall be documented for inclusion in the vessel records.

ANNEX A

Typical Datasheet For Scrubber

A	**GENERAL**				
1	**Client:**		4	**Service:**	
2	**Job:**		5	**Quantity:**	
3	**Location:**		6	**Tag No.:**	
7	**Order number**		8	**Item No.:**	
B	**DOCUMENTS**				
1	**Codes/ Standards:**				
2	**Specification:**				
3	**P & ID:**				
C	**OPERATING CONDITIONS**				
1	Fluid:		-		
2	**Design Flow Rate (Startup/Normal/Max):**		**MMSCMD/ NCMH/ SCMH**		
3	**Operating Pressure:**		**psig**		
4	**Operating Temperature:**		**°C**		
5	**Molecular Weight:**		**grams/mole**		
6	**Density (Inlet / Outlet):**		**Kg/m^3**		
7	**Viscosity :**		**cp/st**		
8	**Max. Allowable Pressure Drop (Flange to Flange):**		**psig**		
9	**Actual Pressure Drop:**		**psig**		
D	**DESIGN DATA**				
1	**Design Pressure:**		**psig**		
2	**Maximum Allowable Working Pressure:**		**psig**		
3	**Test Pressure:**		**psig**		
4	**Design Temperature(min/max):**		**°C**		
5	**Design Flow Rate:**		**MMSCMD**		
6	**NDE Code**		-		**ASME Sec. V & VIII**
7	**Welding Code**		-		**ASME Sec. IX**
8	**Location/Position(Outdoor/Indoor/Vertical/Horizontal):**		-		
9	**Type(Single Stage Multi Cyclone/two stage scrubber):**		-		
10	**Inside Diameter:**		**mm**		
11	**Height (Tan-Tan):**		**mm**		
12	**Type of Head:**		-		
13	**Shell/Head Thickness:**		**mm**		
14	**Joint Efficiency (Shell & Head/Other Parts):**		-		
15	**Corrosion Allowance (Pressure Parts):**		**mm**		
16	**Corrosion Allowance (Removable/Fixed Internals):**		**mm**		
17	**Wind Design:**		**Km/hr**		
18	**Seismic Design:**		-		
19	**Heat Treatment:**		-		

20	Painting:	-	
21	Earthing Continuity:	-	
22	Overturning Moment at Base:	kN.m	
23	Weight - Fabrication / Operating / Test / Packing:	Kg	
24	Type of support:		
E	INSPECTION & TESTING		
1	Third Party Inspection	-	
2	Visual & Dimensional Inspection	-	
3	Hydrostatic Test	-	
4	Liquid Penetrant Test	-	
5	Magnetic Particle Test	-	
6	Ultrasonic Test	-	
7	Radiography Test	-	
8	Others	-	
9	Impact Test:	-	
F	FILTRATION DATA		
1	Solid Filtration - Quality / Particle Size:	% / micron	
2	Liquid Filtration - Quality / Droplet Size:	% / micron	
G	MULTI-CYCLONE		
1	Material:	-	
2	Quantity:	-	
3	Diameter:	mm	
4	Length:	mm	
H	FLUID DATA		
1	Solid Particle load:	mg/sm3	
2	Solid Particle Density:	Kg/m3	
3	Liquid Load	mg/sm3	
4	Liquid Droplet Density:	Kg/m3	
5	Type of Liquid:	-	
6	Liquid Viscosity:	cp/st	

I	MATERIAL				
1	Shell & Head:		7	Internal Stud Bolts/Nuts:	
2	Nozzles / Flanges:		8	External Stud Bolts /Nuts:	
3	Fittings:		9	Gaskets:	
4	Reinforcing Pads:		10	Supports:	
5	Name Plate:		11	Skirt/Base Ring/Top Ring:	
6	Welded Internal parts:		12	Tube sheets/internal parts	

J	NOZZLES DATA								
	ITEM	SIZE	RATE	FACE	TYPE	QTY	PIPE MATERIAL	FLANGE MATERIAL	SERVICE
1	N1								
2	N2								
3	N3								
4	N4								
5	N5								
6	N6								
⋮	⋮								

L	GAS COMPOSITION							
1	Water		7	Propane		13	N-Heptane	
2	Nitrogen		8	I-Butane		14	N-Octane	
3	CO2		9	N-Butane		15	N-Nonane	
4	H2S		10	I-Pentane		16	N-Decane	
5	Methane		11	N-Pentane		17	Undecane	
6	Ethane		12	N-Hexane				

ANNEX B

1. Piping system requirements, arrangement and appurtenances:

1.1. Piping to and from the scrubber shall be designed in such a way as to have the least effect on its performance. According to the process condition and agreement by the supplier, one additional separating stage by installing Filter separator or Dry gas filter shall be considered (see fig 3).

1.2. Piping system include following items:

1.2.1. Inlet / outlet piping and Valves

1.2.1.1. Inlet/ outlet nozzle shall have breakout spool to allow for maintenance and inspection. Removable pipe spools shall be connected to the scrubber feed inlet nozzle.

1.2.2. In gas compression stations both feed line valves shall be ball type, fully open in normal operation. One of the feed line valves shall be automatic type.

1.2.3. The use of bends within 10 pipe diameters of the inlet line should be avoided because they will generate gas flow inadequate distribution in the scrubber and particle removal will be less efficient. Provide 10 diameters of straight pipe upstream of the inlet line without elbows. If bends are fitted within ten pipe diameters of the inlet nozzle, the following rules may apply: in multi-cyclone scrubbers, with a tangential cyclone inlet, a bend in the feed pipe may be fitted in a horizontal plane and the curvature is in the same direction as the vortex induced by the tangential inlet.

1.2.4. A spade or blind spectacle should be inserted downstream of the inlet valve and upstream of the outlet valve to isolate scrubbers from a common inlet and outlet line during maintenance, unless the scrubbers can be isolated by other ways.

1.2.5. Scrubber inlet valve shall have bypass line (start-up line) equipped whit at least 2-inch, ball/globe valve with lever hand, to equalize pressure on both side of inlet valve and scrubber purging.

1.3. Drain line

Blind tee shall replace whit drain elbow to reduce erosion problems. Blind tee is generally perceived as being less prone to erosion than elbows.

1.4. Strainer

1.4.1. strainer shall be provided in upstream of scrubbers (according to IPS-G-PI-230(1)).

1.4.2. The inlet strainer design shall be evaluated to verify that if the strainer screen become completely blocked, the strainer screen will not collapse under any differential pressures, during scrubber operation.

1.4.3. Differential pressure indication shall be provided across the strainer.

1.4.4. Pressure tight covers or flanged access opening shall be provided to permit internal access for inspection, maintenance and strainer element replacement.

1.4.5. Maintenance servicing shall be possible without the necessity for breaking pipe connection.

1.4.6. Screen shall be reinforced with perforated plate, or heavier screen and steel bars.

1.4.7. The open area of the strainer shall have a minimum of 150 % of the open area of the piping.

1.4.8. The piping designer in consultation with the scrubber supplier shall specify the screen mesh or hole size of strainer.

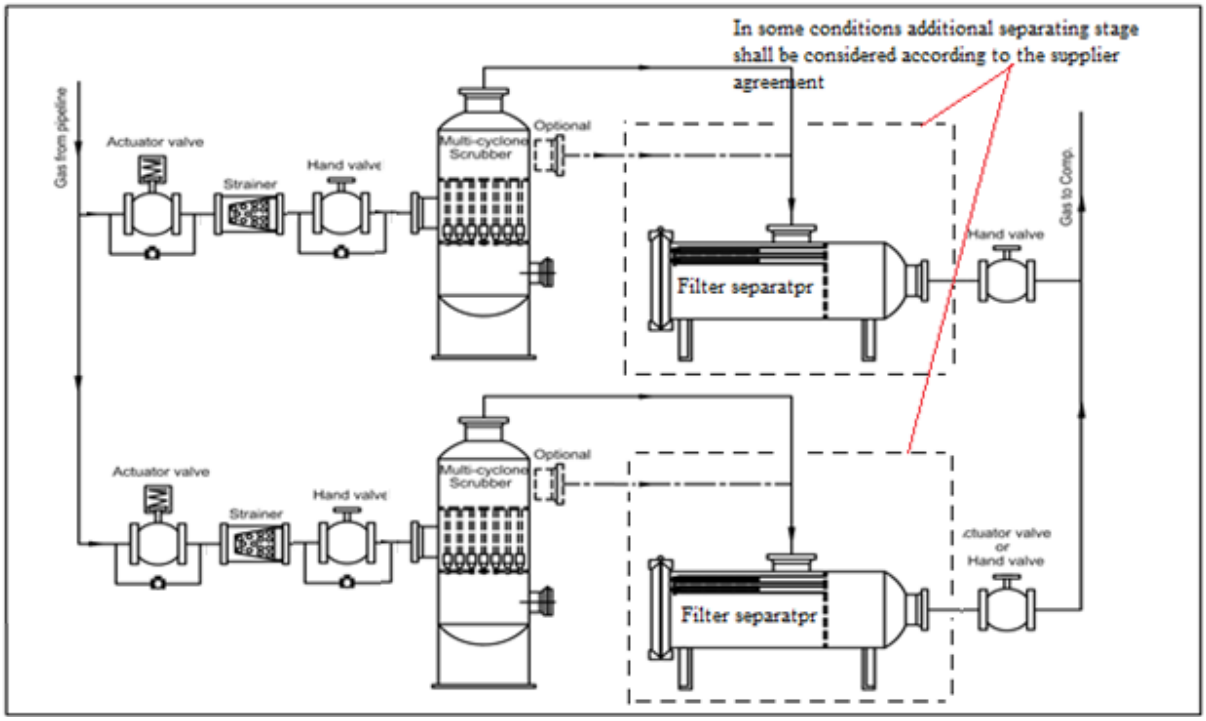

Fig. 2. SKETCH OF SCRUBBERS SCHEMATIC DIAGRAM

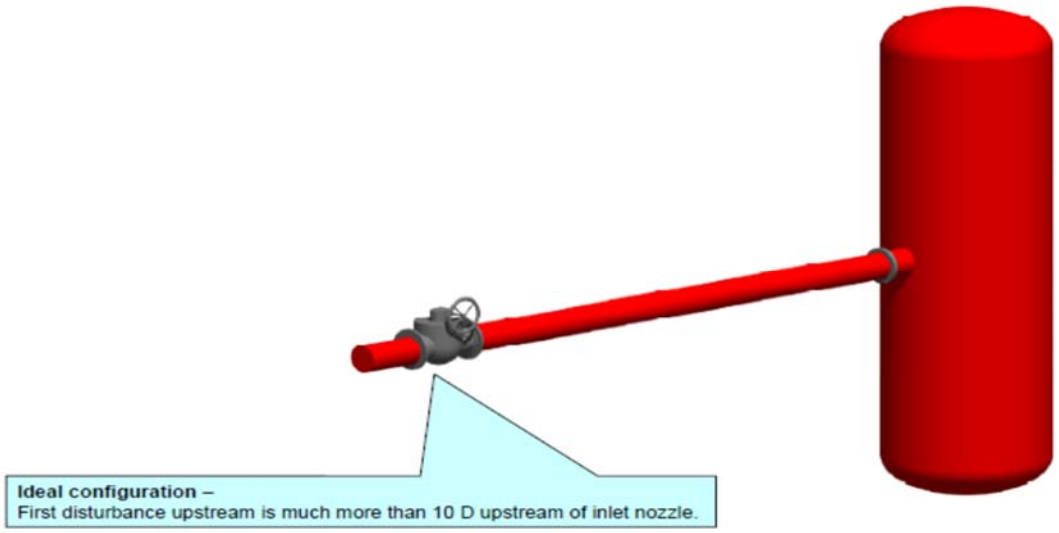

Fig.3. piping upstream of scrubber: Ideal configuration

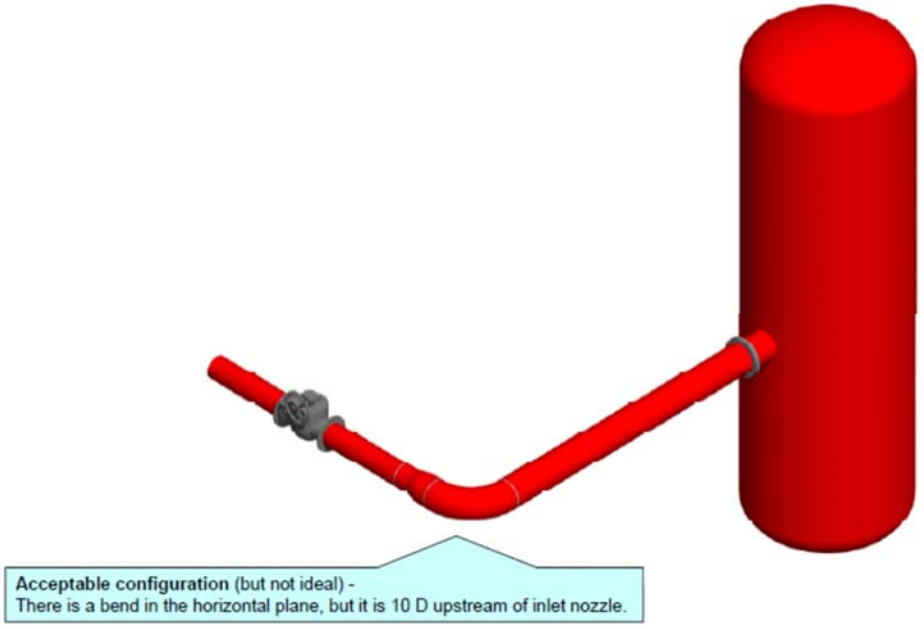

Fig.4. piping upstream of scrubber: bend in horizontal plane