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مدیریت پژوهش و فنآوری

امورتدوین استانداردها

IGS

مشخصات فنی خرید

دستگاه گرم کننده گاز ، نوع لوله گردابی

Vortex Pilot Gas Heater

Foreword

This standard specification is intended to be mainly used by N.I.G.C. and contractors , and has been prepared base on interpretation of recognized standards and technical documents, as well as knowledge, backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Specification (IGS) are prepared, reviewed and amended by technical standard committees within NIGC standardization division of research and technology management and submitted to "the standards council of NIGC" for approval.

IGSs are subjected to revision, amendment or withdrawal, if required, and thus the latest edition of IGS shall be checked / inquired by NIGC'S users.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation or conflicts between this specification and other applicable standards, codes, procedure or well-known manufacturer's specifications must be resolved in writing by the user or its representative through Manager, Engineering Department or standardization division of NIGC.

The technical standard committee welcomes comments and feedbacks from concerned or interested corporate and individuals 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 manufacturer or a trading firm.

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

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

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

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Contents

Introduction

As high pressure gas passes through the inlet tangential nozzles of vortex heater, undergoes pressure reduction and flow velocity increase. The vortex heater converts this high kinetic energy flow into the low and high temperature vortex currents (vortex phenomenon). Since the high temperature vortex currents is located close to the vortex heater's walls, the stream's thermal energy is transferred through the vortex heater's wall to the pilot gas flow passing through the heat exchanger setup on the vortex heater walls. The depressurized gas flow is discharged from the vortex heater to the low pressure line downstream of the pressure regulator. Since the vortex heater flow is a fraction of the main flow, the vortex heater discharge pressure will always be equal to the current downstream gas pressure. A pilot gas, taken upstream of the pressure regulator enters the vortex heater's heat exchanger, picks up the heat and with the same upstream pressure, is directed to the pilot. At the stations low flow, the vortex heater performs as a main regulator, providing for a main regulator shut-off and thus reducing the regulators maintenance.

1. Scope

This specification covers the minimum requirements for designing, material, fabrication, testing, inspection, marking, packing and shipment of Vortex pilot gas heater to be used in natural gas pressure reducing stations. Vortex pilot gas heater prevents pilot regulator gas from freezing at natural gas transmission and distribution pressure regulation stations .Heating of a secondary flow (e.g. pilot gas) is provided via a primary flow of natural gas or, if available, any other compressed gas (e.g. air, nitrogen, etc.).

2. References

Throughout this standard specification the following standards are referred to. The editions of these standards that are in effect at the time of issues of this standard specification (2018) shall, to the extent specified herein, form part of this standard specification. 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 and/or manufacturer.

ASME-V ASME Boiler and Pressure Vessel Code "Nondestructive Examination"
ASME-VIII-D1 ASME Boiler and Pressure Vessel Code "Rules for Construction of Pressure Vessels" for Coil Tubes
ASME-IX Welding, Brazing, and Fusing Qualifications
ASME B1.20.1 "Pipe Threads, General Purpose (Inch) Revision and Redesignation of ASME/ANSI B2.1"
ASME B16.5 "Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24"
ASME B16.9 "Factory Made Wrought Butt Welding Fittings"
ASME B.16.11 "Forged Steel Fittings, Socket Welding & Threaded"
ASME B16.25 "Butt Welding Ends"
ASME B16.28 "Wrought Steel Butt Welding Short Radius Elbows and Returns"
ASME B16.34 "Valves – Flanged, Threaded and Welding End"
ASME B18.2.2"Square and Hex Nuts (Inch Series)"
ASME B36.10"Welded and Seamless Wrought Steel Pipe"
ASME B31.3"Process Piping, ASME Code for Pressure Piping, B31"

EN 837 "Pressure Gauges"
IEC 61520 "Metal Thermo Wells for Thermometer Sensors - Functional Dimensions"
ISO 3834-2 "Quality requirements for fusion welding of metallic materials"
IPS-E-IN-120 "Temperature Instruments"
IPS-C-IN-110 "Pressure instruments"
IPS-G-GN-230 Basic design package and recommended practice for front end engineering design.
IGS-M-IN-202[2]-"GAS PRESSURE REGULATORS FOR NOMINAL INLET PRESSURES 5 TO 100 BAR"
IGS-M-PL-010(0)-5 "for Ball Valves, Class 150,300,600,size 1/2" to 1-1/2"
IPS-G-IN-160 "Engineering and Material Standard for Control Valve"

3. Abbriviation

VPGH – Vortex Pilot Gas Heater
SP-Single Path
DP-Double Path

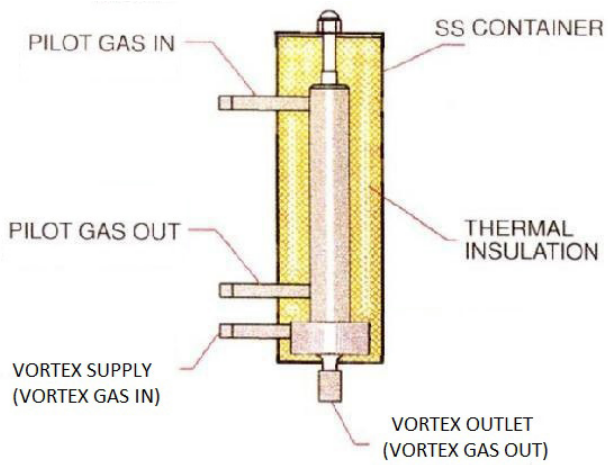
4. Specific Definitions

4.1. Vortex Tube

The Vortex tube is a device without moving parts. As a high-pressure gas passes the vortex tube tangential nozzles, its pressure decrease and velocity increases. The vortex energy/temperature division takes place in a highly rotated gas expanding in the cylindrical low-pressure part of the vortex tube. This part of the vortex tube has an orifice at one end to discharge the vortex cold flow and a valve at the opposite end for the vortex hot flow discharge. The valve is used to regulate value of the inlet flow split into the vortex cold and vortex hot flow. In the Self-Heating vortex tube a portion of the vortex hot flow is applied to warm the vortex tube inlet nozzles, thus providing for the high-pressure inlet gas non-freeze pressure reduction. Since the vortex tube inlet orifice is non-changeable ('no moving parts') the vortex tube upstream monitor in pressure regulation applications serves to change the flow through the unit by adjusting the vortex tube inlet pressure, based on the current flow demand.

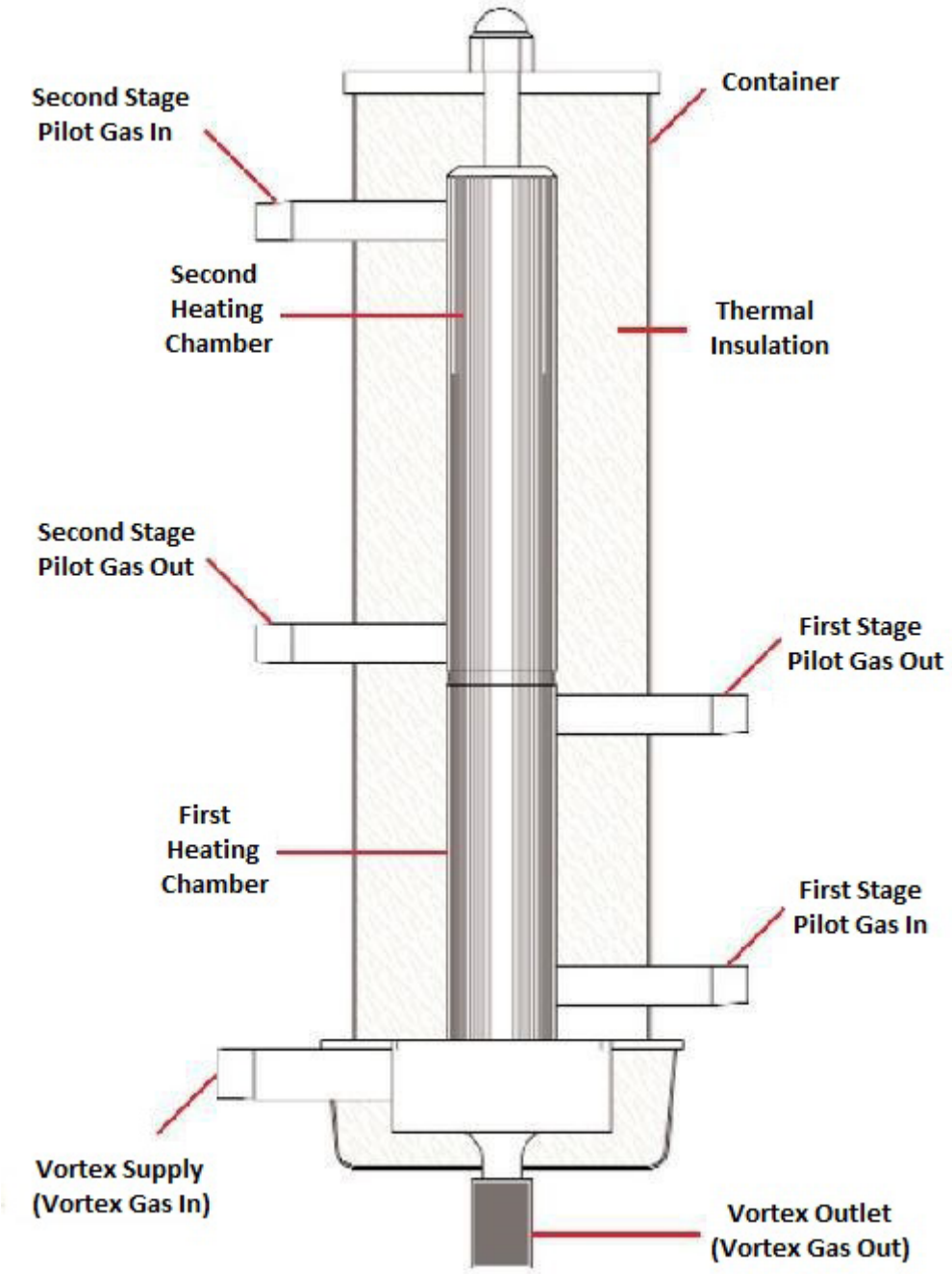
4.2. Vortex Pilot Gas Heater, Single Path

A single heating chamber to serve one pilot



4.3. Vortex Pilot Gas Heater, Double Path

Two heating chambers to simultaneously serve two pilots



4.4. Vortex Controller Valve

This controller is required in case of no-flow conditions in pressure regulation stations to prevent downstream over-pressure. This valve operates in two modes: fully open or fully closed and it is monitored by the downstream pressure sensor.

4.5. Heat Transfer Fins

The stainless steel 304 heat transfer fins attached to the slender tube's outer side of vortex tube, increases the energy transferred to the unheated pilot gas.

4.6. Heat Exchanger Shell

The heat exchanger picks up the thermal energy from the vortex tube's walls and then is directed to the pilot regulator.

4.7. Non-frozen Vortex Inlet (Nozzles)

The vortex heater provides non freeze gas depressurization in the vortex tube. At this point, a heated vortex flow prior to exiting the vortex tube is directed to warm up the vortex tube's inlet cross-section (nozzles) where Joule-Thomson temperature drop occurs.

4.8. Pilot Gas Inlet Opening

The unheated pilot gas can be arranged to enter into heat exchanger shell through pilot gas inlet opening.

4.9. Pilot Gas Outlet Opening

The heated pilot gas can be arranged to exit from heat exchanger shell through pilot gas outlet opening.

4.10. Vortex Supply

The high pressure gas taken upstream of main pressure regulator passes through vortex supply and then enters the tangential nozzles of vortex tube so as to undergo pressure reduction and flow velocity increase.

4.11 Vortex Outlet

The depressurized gas flow is discharged from the vortex outlet to the low pressure line downstream of the main pressure regulator.

4.12 Thermal Insulation

Pilot load lines (both heated and unheated) and the Pilot as well as the Vortex inlet manifold should be covered on site with polyethylene foam pipe insulation (or equivalent) for thermal insulation, and after that wrapped with a polyethylene repair tape for waterproofing.

4.13 Primary Flow

The primary flow is the gas flow taken upstream of main pressure regulator, passes through vortex supply and then discharges from the vortex outlet to the downstream of main pressure regulator.

5. Requirements

5.1. Design and Service Conditions

5.1.1. Vortex supply and vortex outlet lines (4.10 & 4.11) should be 1/2" ID minimum with minimum practical length and bends.

Note: Excessive length or restricted vortex supply and vortex outlet flow (e.g., bends …) can prevent proper pilot gas heater operation.

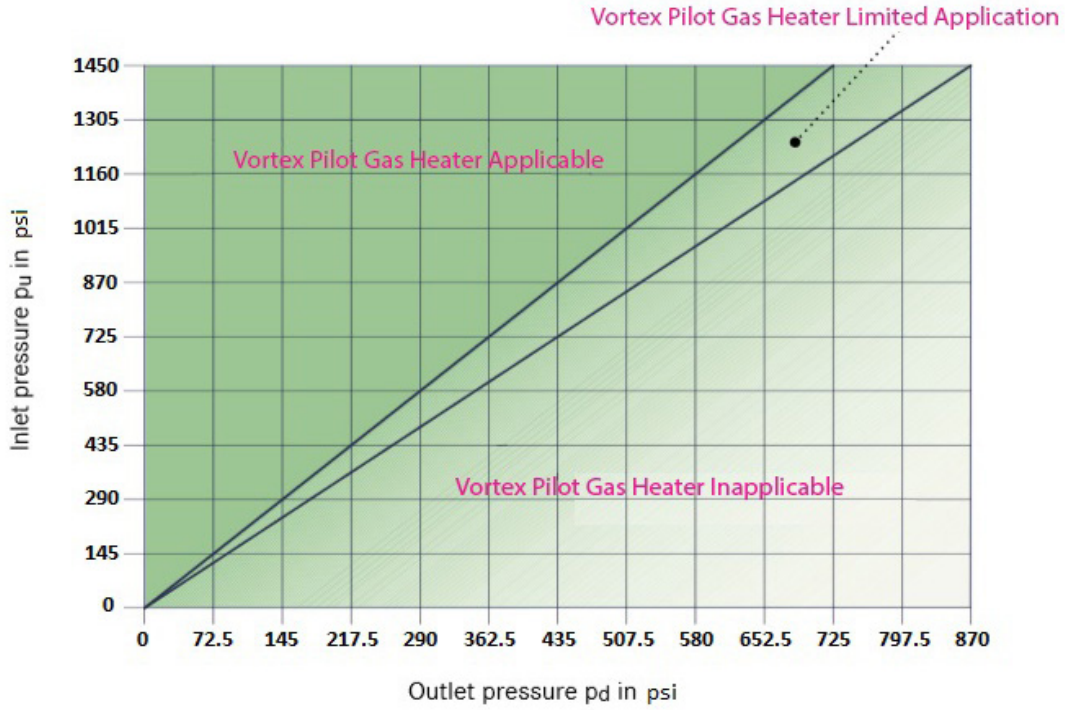
5.1.2. Pilot load lines (4.8 &4.9), upstream and downstream of the pilot gas heater, should be 3/8" ID minimum with minimum practical length and bends.

Recommended Note:

The maximal flow rate takes place when the VPGH inlet pressure is 2 and more times greater than its outlet pressure.

Table 1- Maximal Flow Rates

Gas inlet pressure, psig	Flow Rate, VPGH-DP (scfm/scmh)	Flow Rate, VPGH-SP (scfm/scmh)
300	170/288	100/169
500	280/474	165/279
700	390/661	230/389
900	510/864	300/508
1100	600/1017	353/598
1300	710/1203	417/706
1500	820/1390	482/817



5.1.3. The heating of the pilot gas by vortex pilot gas heater shall be in 15°C to 30°C temperature range when the VPGH inlet pressure is 2 and more times greater than its outlet pressure.

5.1.4. A Primary Flow Controller is required in case of no-flow conditions in the Pressure Regulating Stations to prevent downstream overpressure.

Flow controller is required with maximum orifice size for designing inlet/ outlet pressure with set point above main regulator delivery pressure. (The set point should be according to acceptable lockup range of regulator within 5% of outlet pressure)

Note: For selecting flow controller in the pilot gas heater applications, it is required to use proper orifice size and pressure spring range.

5.1.5. A pressure gauge between the Primary Flow Controller and pilot gas heater is recommended for use during setup and operational checks. At normal pressure regulation stations, the Primary Flow Controller should be full open such that the gas pressure at its outlet should be almost equal to the pressure regulation stations upstream pressure.

5.1.6. The performance of the VPGH is almost independent of the upstream gas temperature and flow rate of natural gas pressure reducing stations.

5.1.7. The performance is measured (at site) based on the pressure ratio and the pressure difference of main regulator.

5.1.8. The manufacturer must have type test certificate from valid sources for each type of VPGH. In addition, a functional test on the site can also be performed on the buyer's request.

5.2. Material

5.2.1. The Vortex Pilot Gas Heater body material (Annex B & C) shall be at least stainless steel 304 or equivalent.

5.2.2. The Vortex Pilot Gas Heater and each Pilot Load Line thermal insulation material (4.12) shall be polyethylene or equivalent.

5.3. Quality Assurance System

The manufacturer shall establish and maintain a quality assurance system in accordance with ISO 9001, or an approved equivalent. The Purchaser's nominated inspector(s) or representative(s) shall have the right to undertake such audits as he deems necessary to assess the effectiveness of the manufacturer's quality assurance system.

6. Documentation

The supplier and/or manufacturer shall provide technical information as a minimum requirement as follows:

6.1. Approval test reports, original technical catalogues, manufacturing product data sheet and application procedure recommendation and guidelines.

6.2. Filled, signed and stamped data sheet stating in Annex A.

7. Welding

7.1. Welders Qualification Test (WQT)

Welder Qualification Test shall be in accordance with ISO 3834-2 or section IX of the ASME code.

7.2. Welding Procedures

All welding shall be performed according to welding procedure specification (WPS). The contractor shall submit Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) according to ISO 3834-2 or ASME Code section IX for purchaser’s review and approve before welding process started.

All tests shall be performed with equipment calibrated in accordance with applicable national standards or ASTM by an accredited laboratory. Re-qualification or additional qualification tests are required if in the opinion of the purchaser the supporting PQR fails to reasonably simulate the actual conditions during production welding and this could adversely affect weld performance. It will be the responsibility of contractor to carry out all the tests required to the satisfaction of purchaser.

7.3. Welded Joints Inspection and Testing

7.3.1. General

The inspection and test shall be carried out according to a Non-Destructive Testing procedure. Welding inspection personnel shall be qualified according to ISO 3834-2 or SNT-TC-1A.

7.3.2. Visual Inspection

Visual Inspection shall be performed prior to undertake any Non-Destructive Tests. The visual inspection shall be carried out according to the provision of the ASME sec. V, Article 9

7.3.3. Liquid Penetrate Test

Wherever required, penetrate test shall be performed in compliance with the provisions of the applicable procedure and code by qualified personnel.

7.3.4. Radiographic Test

Whenever it is required, radiographic tests shall be carried out according to the provisions of the applicable procedure and code by qualified personnel.

7.3.5. Quality Control

In case of management for executing the contract and the step-by-step approach that ensure the quality of the engineering, design service and products, the examination (i.e. exam by %) according to approved QCP, if a detective joint is found then all welded joints shall be fully tested.

7.3.6. Repair and Re-Inspection

Defects shall be repaired in accordance with approved repair procedures and the joint shall be re-inspected by the same methods, and re-examined to the same extent, and by the same acceptance criteria required for the original weld. All repairs shall be carried out with prior permission of client.

8. Inspection, Tests & Certificates

8.1. Inspection Documents

Prior to the shipment of each vortex pilot gas heater to the designer or the operator, the manufacturer shall perform the specified tests and checks on the vortex pilot gas heater. The results of all tests and checks performed shall be documented and reported.

The manufacturer shall ensure that the complete report is available to the operator for 10 years.

This report shall include minimum the following items:

a. The name and address of the manufacturer
b. The name and address of the test facility
c. The model and serial number
d. The date (s) of the test
e. The name and title of the person(s) who conducted the tests
f. A written description of the test procedures
g. A descriptions of any variations or deviations from the required test conditions
h. Material certificates
i. Drawing and data
j. The result of examination
k. Guarantee and compliance certificate

8.2. Tests

8.2.1. Visual Inspection

Visual inspection including checking of workmanship, connection, internal parts, nameplate, packing, etc.

No apparent imperfection shall be observed.

8.2.2. Dimensional Check

The dimensional checks are including the compliance of the vortex pilot gas heater construction with the pertinent assembly drawing and the dimensional conformity of pressure containing parts with the applicable drawings.

8.2.3. Materials Check

The verification of the material used shall be carried out by the review of material certificates and test reports (if requested by inspector).

8.2.4. Hydrostatic Test

All pressure containing parts of each regulator including those parts that may become pressure containing parts in the event of a failure, shall be pressure tested. The test shall be carried out according to ASME Sec. VIII Div.1. No leakage or permanent deformation shall be observed.

8.2.5. Function Test

Vortex Pilot Gas Heater shall be functionally tested on intensity of heat flux increase by running the VPGH at 100 Psi with air during 5 minutes. The test results should be according to hereunder performance requirement and design specifications as shown in fig. 1:

T2-T1= 25°C to 30°C (Pilot Gas In Preheating or Temperature Differential)

P1= 100 Psi

P2= Ambient Pressure

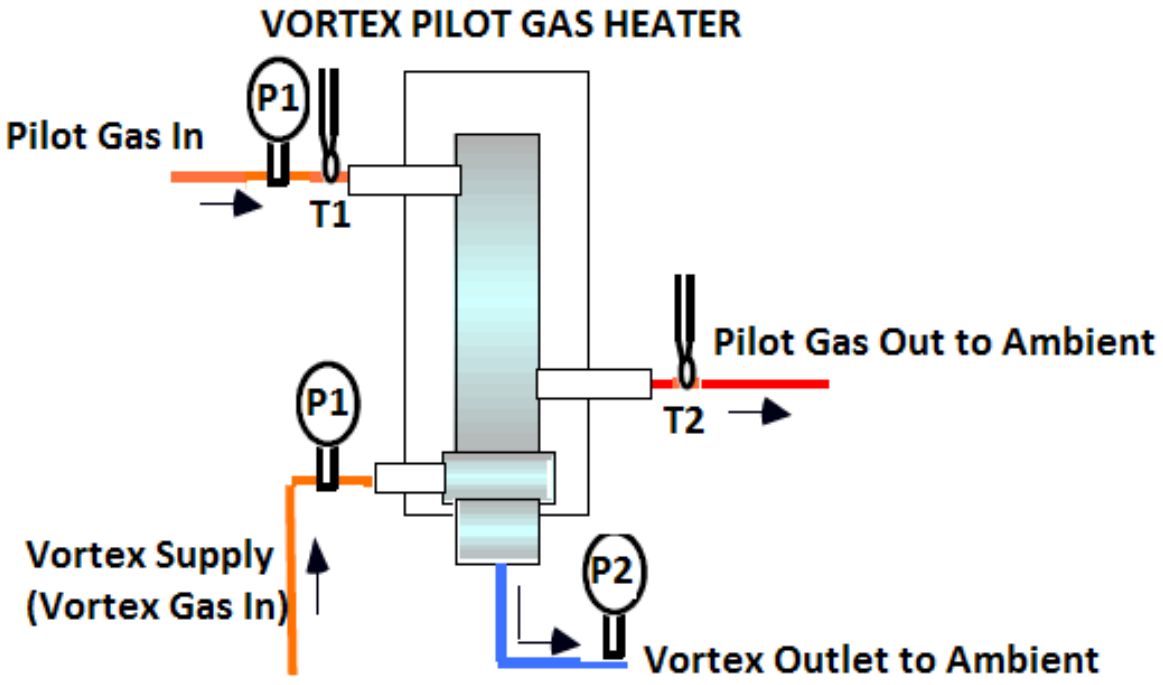


Figure 1

9. Surface Preparation

Metal surfaces shall be free of any contamination, grease, dirt and other foreign matter. Stainless steel surfaces shall be free of any scratches. Cleaning of the surfaces of stainless steel welds shall be carried out according to approved pickling procedure.

10. Packaging

For each vortex pilot gas heater, packing shall be in accordance with N.I.G.C protection, packing, marking and dispatching instruction in accordance to IPS-G-GN-230

11. Marking

11.1. General Requirements

Each vortex pilot gas heater shall carry markings containing at least the following data:

- Manufacturer and/or registered trade – mark
- Vortex pilot gas heater type
- Serial number
- Year of manufacture
- Allowable pressure
- Permissible inlet pressure
- Ambient temperature range

The flow direction shall be marked clearly and permanently on the body by an arrow. If a name plate is used it shall be permanently legible and attached at a clearly visible place. The technical details listed above shall be repeated in operating instructions.

11.2. Markings for the Various Connections

Each connection shall be marked in terms of:

- Function, e.g. breather line, exhaust line
- Minimum nominal size for the pipe work concerned

12. Guarantee

Manufacturer shall guarantee the compliance of material and performance of the supplied equipment with this specification.

The period of guarantee shall be two year after equipment goes on stream or thirty months after date of shipment, whichever occurs first, or according to the contract. Supplier shall agree to repair or replace any equipment which proves to be defective during the above mentioned period free of charge.

13. Installation

13.1. The Vortex Pilot Gas Heater should be installed in the vertical position (Vortex Outlet at bottom) as shown in fig. 2.

13.2. The recommended Vortex Pilot Gas Heater inlet pipe location is on the top of the main gas pipeline.

13.3. Care should be taken to prevent pipe sealant or Teflon tape from entering the Vortex Pilot Gas Heater inlet.

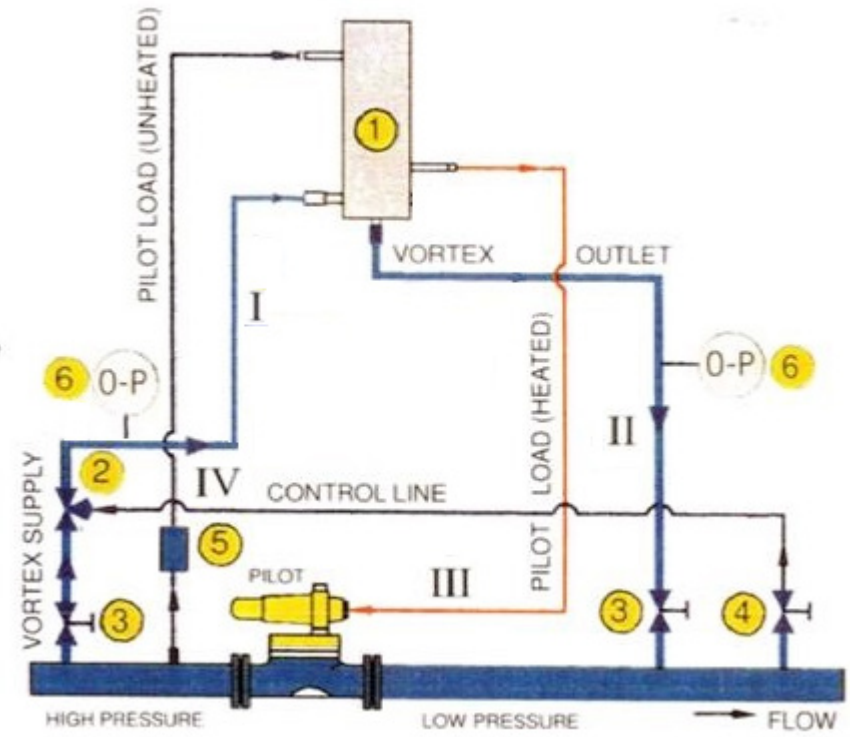


Figure 2

14. Drawings and Data

The following drawing and data sheet shall be furnished to the client at quotation and ordering stages.

14.1. Quotation Stage

14.1.1. N.I.G.C data sheet completed by vendor.

14.1.2. General arrangement drawings showing outline dimensions and weights.

14.1.4. List of recommended spare parts to cover initial commissioning and two years operation.

14.2. Ordering Stage

14.2.1. Descriptive final arrangement and last revision (as built drawing) included weight and load on supports (Hardcopy and electronic files).

14.2.2. Comprehensive catalogues and detailed technical drawings of the supplied instruments.

14.2.3. Operating and installation instructions.

14.2.4. Maintenance manual(s)

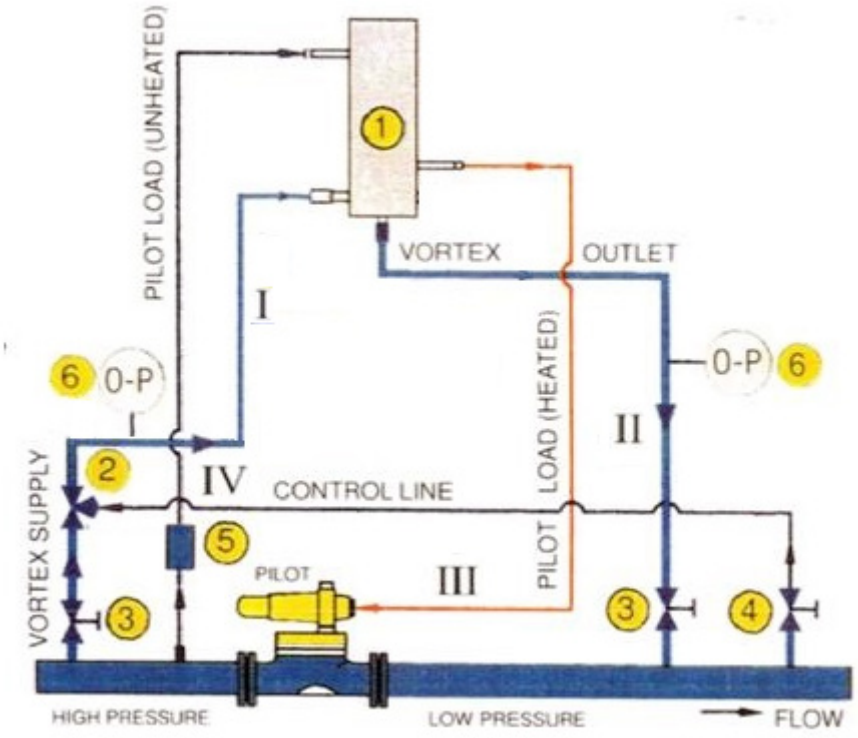
ANNEX A – VORTEX PILOT GAS HEATER DESIGN DATA SHEET

Item	Subject	Unit	To be Filled by NIGC/Client	To be Filled by Manufacturer/ Supplier
General	Tag No.	----------	----------	----------
	Stage Pressure Reduction No.			
	Number of Runs			
	Manufacturer		----------	----------
	Model No.		----------	----------
Vortex Pilot Gas Heater Overall Dimensions and Specifications	No. of Path or Stage	Single Double ----------		
	Material of Construction			
	Pilot Gas In Connection Size of Each Stage	inch		
	Pilot Gas Out Connection Size of Each Stage	inch		
	Thermal Insulation Material			
	Vortex Gas In (Vortex Supply) Connection Size	inch		
	Vortex Outlet Connection Size	inch		
	Container Dia. Size	inch		
	Container Length Size	inch		
Flow Controller	Manufacturer Name			
	Model of Flow Controller			
	End Connection			
	Control Line Connection Size	inch		
	Body Size	inch		
	Control Spring Range	Psig/bar		

Process Data	Station Gas Flow Rate	SCMH	min.( ) max. ( ) normal ( )	min.( ) max. ( ) normal ( )
	Station Gas Inlet Pressure	Psig/bar	min.( ) max. ( ) normal ( )	min.( ) max. ( ) normal ( )
	Station Gas Outlet Pressure	Psig/bar	min.( ) max. ( )	min.( ) max. ( )
	Station Gas Inlet Temperature	ºC	min.( ) max. ( ) normal ( )	min.( ) max. ( ) normal ( )
	Station Gas Outlet Temperature	ºC	min.( ) max. ( ) normal ( )	min.( ) max. ( ) normal ( )
	Ambient Temperature	ºC	min.( ) max. ( ) avg. ( )	min.( ) max. ( ) avg. ( )
	Pilot Gas Supply Preheating Temperature Differential	ºC		15°C to 30°C
	Process Fluid		Natural Gas	
	Guarantee		two year after equipment goes on stream or thirty months after date of shipment, whichever occurs first	two year after equipment goes on stream or thirty months after date of shipment, whichever occurs first

Manufacturer and supplier signature and stamp:

ANNEX B - SWIRLING (VORTEX) PILOT GAS HEATER (SINGLE PATH) INSTALLATION SCHEMATIC



Material Specifications:

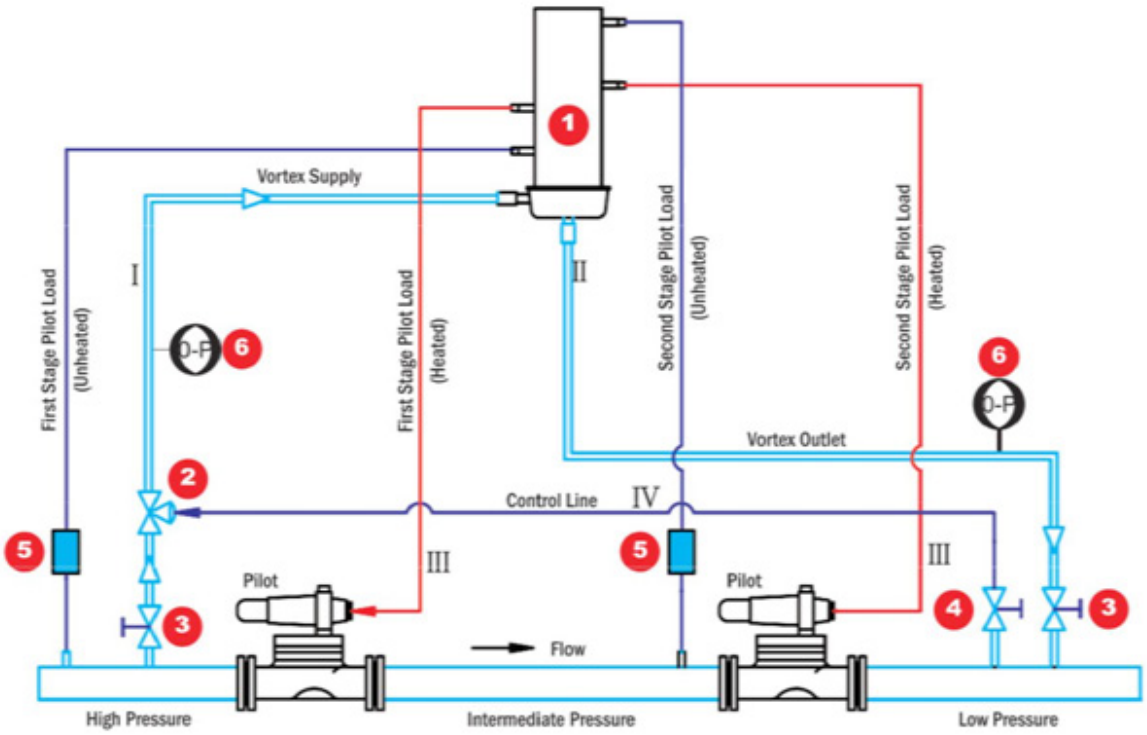
Material Item List:

1. Single Path Swirling(Vortex) Pilot Gas Heater (Material of Construction: 304SS)
2. Flow Controller
3. Lockup Valve
4. Lockup Valve
5. Pilot gas filter
6. Start-up pressure gauge tap connection

Piping:

I. Swirling (Vortex) Inlet
II. Swirling (Vortex) Outlet
III. Pilot Load
IV. Control Line

ANNEX C - SWIRLING (VORTEX) PILOT GAS HEATER (DOUBLE PATH) INSTALLATION SCHEMATIC



Material Item List:

1. Dual Path Swirling (Vortex) Pilot Gas Heater (Material of Construction: 304SS)
2. Flow Controller
3. Lockup Valve
4. Lockup Valve
5. Pilot gas filter
6. Start-up pressure gauge tap connection

Piping:

I. Swirling (Vortex) Inlet
II. Swirling (Vortex) Outlet
III. Pilot Load
IV. Control Line