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شرکت ملی گاز ایران
مدیریت پژوهش و فنآوری
امورتدوین استانداردها

IGS

# مشخصات فنی خرید

# تجهیزات گرم کننده گاز ( غیر مستقیم-آبی)، نوع مشعل دمنده دار

# ابلاغ مصوبه هیأت مدیره

## مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۹۴۸ مورخ ۱۴۰۰/۰۹/۰۱ هیات مدیره، نامه شماره گ۹/۹۱۸۴۶/۰۰۰ مورخ ۱۴۰۰/۰۷/۲۶ مدیر پژوهش و فناوری درمورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

۱-مشخصات فنی کاتالیست های واحد مرکاپتان زدا IGS-M-CH-052(0)

۲-مشخصات فنی کاتالیست های واحد بازیافت گوگرد IGS-M-CH-054(1)

۳-مشخصات فنی خرید تجهیزات گرم کننده گاز غیرمستقیم آبی نوع مشعل دمنده دار IGS-M-PM-106(2)

۴-مشخصات فنی خرید کنتورهای نوع توربینی IGS-M-IN-102(3)

۵-مشخصات فنی خرید اتصال سه راهی انشعاب گرم IGS-M-PL-033(2)

۶-مشخصات فنی خرید اتصالات جوش لب به لب در اندازه های ۱/۲ الی ۵۶ اینچ IGS-M-PL-022(2)

۷- مشخصات فنی و نقشه های اجرایی انشعابات در شبکه های توزیع گازرسانی پلی اتیلن IGS-C-DN-011(0)

**الهام ملکی**

**دبیر هیات مدیره**

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## Foreword

This standard specification replaces IGS-M-PM-106(1), which has been technically revised based on API specification 12k (2009), and up dated, it 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 manufacturer'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 NIGC 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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## 1. SCOPE

This specification covers the minimum requirements for designing, material, fabrication, testing, inspection, marking, packing and shipment of indirect water bath heaters with forced draft burner to be used in natural gas pressure reducing stations.
Each deviation of this specification, shall be clearly stated on the technical information submitted by the supplier/manufacturer. The supplier/manufacturer shall furnish unit completely, including all necessary parts to insure satisfactory, economical and safe operation.

## 2. REFERENCES

Supplier shall refer to the latest editions of all the following mentioned standards.
All heaters shall be in design and fabrication in accordance to:

**API 12K (2009)** "Specification for Indirect Type Oilfield Heaters"

**DIN 580(2007)** "Lifting eye bolts"

**DIN 4788-1(1977)** "Gas Burners without Blowers June; Superseded in Parts by DIN EN 298**"**

**EN 50156-1(2015) "**Electrical Equipment for Furnaces and Ancillary Equipment, Requirements for Application Design and Installation**"**

**EN 676(2003) "**Amd 1 Automatic Forced Draft Burners for Gaseous Fuels AMD 9857**"**

**EN 837-1(1998) "**Standard pressure gauges"

**EN 60529(1992) "**AMD 2 Degrees of Protection Provided by Enclosures (IP Code) AMD 10931**"**

**EN 303-1(2003) "**Heating Boilers with forced draft burners"

**EN161 (2007) "**Automatic shut off valves for gas burners and gas appliances**"**

**ISRI 7595(1387)** "Automatic forced draft burners for gaseous fuels- specification and test methods"

**IEC 60034-1(1998) "**Rotating Electrical Machines**"**

**IEC 60079(2007) "**Exclusive Atmosphere"

**IEC 60529C (1992) "**Degrees of protection provided by enclosures (IP Code)**"**

**IEC 60770-1(1999) "**Transmitters for Use in Industrial-Process Control Systems**"**

**IEC 61520(2000) "**Metal Thermo Wells for Thermometer Sensors - Functional Dimensions**"**

**IEC/EN 60204-1(ISO/IEC/EN 81346:2010) "**Safety of Machinery - Electrical Equipment of Machines - Part 1: General Requirements**"**

**EN 12953-11(2003)** "Shell boilers. Acceptance tests"

**IPS-c-el-115(1386) "**Construction Standard For electrical Installation**"**

**IPS-c-tp-101(1386)** "Surface Preparation"

**IPS-c-tp-102(1)(1388)** "Construction standard for painting"

**IPS-g-gn-210(1997)** "General standard for packing &packages"

**IPS-m-pm-115(1386)** "Material & equipment standard for centrifugal pumps for general services**"**

**IGS-O-CH-042(1385) "**دستورالعمل رنگ‌آمیزی تأسیسات صنعت گاز با رنگ‌های مختلف**"**

**IGS-R-CH-055(1395) "**پایش وضعیت سیال گرمکن‌های آبی غیر مستقیم ایستگاه‌های تقلیل فشار گاز**"**

**IGS-M-CH-033(1)(1393) "**Specification for Iranian Natural Gas Quality"

**IGS-M-IN-103(2002)** "Domestic 2-PSI gas"

**IGS-M-IN-102(2)(2015)** "Turbine meters"

**IGS-E-EL-032(0)(1396)** "Explosion proof electrical equipments layout in risk areas for pressure reduction stations (TBS/CGS) and measuring stations (MS)"

## 3. DEFINITIONS

**Ambient Temperature**

Usually used to refer to the temperature of the air in which a structure or a device operates.

**Burner Turn Down**

An important function of burners is turndown. This is usually expressed as a ratio and is based on the maximum firing rate divided by the minimum controllable firing rate.

**Forced Draft Indirect Water Bath Heater**

Indirect Water bath heater that equipped with burner in which the total air for combustion is supplied by means of a fan.

**Instrumentation**
Any system or combination for measurement and control.

**Fail – Safe**

The action of a device to go to a safe operating condition when a failure occurs.

**Pressure Relief Device**
A device which is installed to vent gas from a system being protected in order to prevent the gas pressure from exceeding a predetermined limit by venting the gas into atmosphere.

**Primary Gas Pressure Regulator**

Device on pressure skid which maintains the outlet pressure constant independent of the variation in inlet pressure and/or flow rate within defined limits.

**Inlet Pressure**

Pressure at the inlet of the regulator.

**Outlet Pressure**

Pressure at the outlet of the regulator.

**Heater Capacity**

The rate of flow through station under standard condition with minimum inlet pressure.

**Burner Capacity**

Heat input range of the burner the maximum and minimum heat inputs shall be measured under the standard conditions and shall be in accordance with the values stated by the manufacturer within ±5%.

**Shut off device**

An ancillary designed to quickly shut off the gas flow in the event of an abnormal pressure being detected within system it protects.

**Burner System**

System for firing the heater designed for the specific fuel to be used.

**Coil Area**

Heat transfer area and is normally calculated using the outside surface area of the pipe.

**Heater Bath**

Indirect heating medium, limited to water or water solutions.

**Shell**

The vessel which contains the coil, fire-tube and heater bath.

**Stack Rain Shield**

Device attached to the top of the stack to prevent rain from falling directly into the stack. It may also serve as a stack downdraft diverter.

**Expansion Tank**

A chamber that may be directly connected to the heater shell to permit the shell to be completely filled with water.

**Forced Draft Burner**

Burner in which the total air for combustion is supplied by means of a fan.

**Fire Tube**

Part of the appliance in which the combustion takes place. It consists of combustion chamber and flue gas return.

**Filter**

Device that enables foreign elements, which might otherwise cause failures in the system, to be collected.

**Standard Condition**

The conditions to which a volume of gas is converted (i.e. base gas temperature 15.56°C (60°F) base pressure 1013.25 mbar (14.696 psi).

**Natural Gas**

The natural gas Specification is according to IGS-M-CH-033(1).

## 4. TECHNICAL SPECIFICATION

### 4.1 Heater Shell

Shell material may be ASTM A36 or equivalent. All bolt and nuts materials used in shell flanges shall be ASTM A193 & ASTM A194 respectively. Heater shell shall provide in normal operation a homogenate temperature in the water bath. Therefore the unit should be equipped with mixers, circulation pumps or other temperature homogenizing devices.

**4.1.1** An expansion tank shall be provided on top of heater shell.

**4.1.2** A ladder including platform, if any, with handrail and back protection, shall be provided for easy access to the expansion tank.

**4.1.3** A 2" gate valve (class 150) with blind flange shall be provided at the bottom of shell for drain purposes.

**4.1.4** The shell and heads shall be insulated with 50mm thickness fiber glass insulation or equivalent having an aluminum cladding with min. thickness 0.8mm.

**4.1.5** Before insulation, shell shall be painted according to painting procedure in this standard (sec.8).

**4.1.6** Shell permissible out of roundness after welding shall be according to ASME sec.

VIII, Div.1 part UG-80.

**4.1.7** Insulating gaskets used in the shell flanges shall be suitable in high temperature services and durability specification in outdoor conditions. It shall have good characteristics in water and ethylene glycol mixtures.

**4.1.8** All T joints welds shall be 100% tested by radiography. for other welds (longitudinal and circumferential) one spot shall be examined on each vessel for each 50 ft (15m) radiography accordance with UW-52 of ASME SEC.VIII Div.1.

100% of nozzle welded connections to shell shall be tested by LPT (Liquid Penetrate Test) method.

**4.1.9** Tightening procedure shall be considered by manufacturer for flanges bolt & nuts fastening.

**4.1.10** Shell shall be reinforced enough to prevent any deformation because of coils, fire-tubes and water-ethylene glycol mixture weight.

**4.1.11** Heater shell shall include permanent lifting lugs.

**4.1.12** Shell shall be equipped with suitable thread-o-let for measuring water temperatures. For performance test calculations according to ANNEX (E) (or some methods that will be approved in related future standards), That should be between coil and fire tube and not to be near the shell. Additionally equipped with 1/2" thermo-well with 1/2" NPT male, stainless steel temperature gauges,100mm dial an appropriate stem length with safety glass and red and black lettering, dual scale in centigrade and Fahrenheit, adjustable pointer. (Gauge range -20°C ~ +100°C).

**4.1.13** Shell shall be equipped with 1/2" thread-o-let and 1/2" thermo well with 1/2" NPT male temperature sensor (by transmitting capability), also an appropriate stem length for controlling of shell high temperature. Thermometer shall be installed on shell via adequate thermo-well and thread-o-let.

**4.1.14** Construction of heater shall be such that the removal of the coil and fire tube/fire box shall be from opposite ends of the shell.

**4.1.15** If pump is utilized for homogenizing temperature, it shall be as follow:

**-** Single-stage in line centrifugal casing pump according to IPS-M-PM-115.

**-** Preferred canned rotor type, without shaft seal and with bearings lubricated by the pump liquid.

**4.2 Expansion Tank**

**4.2.1** Expansion tank material may be ASTM A36 or equivalent. All bolts and nuts materials used in expansion tank flanges shall be ASTM A193 & ASTM A194 respectively.

**4.2.2** The expansion tank is designed to reduce internal corrosion within the heater shell by keeping the heater shell liquid packed and moving the wet dray interface of the expanding bath media from the heater shell into the expansion tank.

**4.2.3** The expansion tank is designed to contain 100% of the expanded bath media from a temperature of 40°C to the maximum operating temperature. Whereas manufacture an client agreement is preferred.

**4.2.4** Bath media expansion reservoir designed to hold 6% of the total bath media. Whereas manufacturer and client agreement is preferred.

**4.2.5** Expansion tank shall be insulated same as main shell insulation instruction. Shell heads shall be insulated same as main shell insulation instruction (mass loss should be Consider).

**4.2.6** Expansion tank shall be equipped with low level alarm and filling connection. Also for prevention of mass lost, the roof of expansion tank shall be always closed.

**4.3 Skid**

**4.3.1** Skid material may be ASTM A36 or other carbon steel material recommended by manufacturer.

**4.3.2** Lifting lugs shall be provided with sufficient strength to allow lifting the entire assembly without causing any damage to the shell and the other parts.

**4.3.3** The heater should be self-contained and skid mounted.

**4.3.4** Structural strength of skid shall be sufficient to withstand forces due to shipping and handling as well as support the vessel and equipment. Skid shall be self supporting rigid steel assemblies having adequately sized members to permit handling of the unit without deformation of the skid members.

**4.3.5** Before insulation, skid shall be painted according to painting procedure as follow by sec. 8

**4.4 Fuel Pressure Reducing Skid**

**4.4.1** The purpose of the pressure reducing skid is to reduce the natural gas pressure to provide low pressure fuel gas to feed the secondary regulator.

**4.4.2** All components shall be easily accessible and removable. For that reason, all in-line components shall be flanged. Threaded ends are allowed for small components smaller than 1" such as drain and vent valves, manometer valves, and valves on water circuit.

**4.4.3** The pressure reducing skid shall be provided with suitable earth lugs.

**4.5 Coil**

**4.5.1** Coil shall be made of seamless pipe, ASTM A53 Gr. B or ASTM A106 Gr. B/C or API 5L Gr .B, Schedule No.80.

**4.5.2** Inter connections of coil passes and header shall be fabricated according to ANSI/ASME B16.9 or standard bend collector according to TEMA, same size and schedule of coil pipe, seamless and with ASTM A234 WPB/C material.

**4.5.3** Proprietary fittings should be ASTM A105 or ASTM A182 material.

**4.5.4** Coil shall be easily field removable and shall be such that the removal of the coil and fire tube/fire box shall be from opposite ends of the shell for periodic inspection and maintenance.

**4.5.5** Supporting wheels shall be run on guiding rails, for coil section weight is over than 2000Kg.

**4.5.6** The entire coil shall be supported on wheels or roll bearing which shall withstand 15 years of operation.

**4.5.7** Precaution shall be taken against buoyancy of the coil.

**4.5.8** All coil tubes shall be supported having allowances for thermal expansion.

**4.5.9** Maximum allowable gas velocity in coil shall be 20 m/sec.

**4.5.10** Inside coil header cross sectional area shall be at least equal to total inside coil branched area.

**4.5.11** Inlet and outlet flanges shall be welding neck, raised face, ANSI 600.

**4.5.12** All joints, shall be butt welded and tested 100% by radiography test methods according to ASME Section IX, V and VIII.

**4.5.13** All weldolet and threadolet shall be down 100% NDT (for accessible parts 100% RT).

**4.5.14** All 4" and smaller connections between coils and headers shall be used weldolet

and more than 4" shall be used sweepolet or standard tee for d≥1/3D and weldolet for d<1/3D, according to MSS SP-97.

**4.5.15** Inlet and outlet shall be equipped with 1/2" threadolet and 1/2" thermowell with 1/2" NPT male, stainless steel temperature gauge,100mm dial with safety glass and red and black lettering, dual scale in centigrade and Fahrenheit, adjustable pointer.
(Gauge range -20°C ~ +100°C).

**4.5.16** Coil outlet header shall be equipped with 1/2" threadolet and 1/2 thermowell with 1/2" NPT male temperature control device for monitoring of gas outlet temperature.

**4.5.17** Inlet and outlet shall be equipped with 1/2" NPT male, stainless steel pressure gauge,100mm dial with safety glass and red and black lettering, dual scale in psi and bar, bourdon tube type, oil filled, adjustable pointer. Gauge ranging shall be 1.5 times the operating pressure.

**4.5.18** Inlet and outlet shall be equipped with 1/2" NPT ball valve as a drain.

**4.5.19** All threaded connection on headers shall be done by threadolet class 6000lb rating.

**4.5.20** Coil shall be supported. Spacing, holes diameters and thickness of support baffle plates shall be considered base on TEMA requirements.

**4.5.21** Coil weight shall be supported by traverse pipe/U beam which are connected to inside shell. Coil shall not have any mechanical stress on its removable flange bolts.

**4.5.22** The Telltale holes on U Turn bend shall be considered accordance with API 12k.

**4.6 Fire Tube**

**4.6.1** Fire tubes material shall be according to EN 303-1.

**4.6.2** The fire tube shall be fully welded. According to EN 303-1 Complete penetration shall be down on all joints and visually inspected by a welding inspector.

**4.6.3** Penetrant test (PT) shall be done for 100% of welded joints by qualified NDT personnel.

**4.6.4** Fire tube shall be field removable.

**4.6.5** Supporting wheels shall be run on guiding rails.

**4.6.6** Fire tube will be fastened on one of the end trays of the Water Bath. It shall be easily removable for periodic inspection and cleaning.

It shall be equipped with:

- a flame sight glass
- an evacuation pipe for condensates to be taken outside the frame

**4.6.7** To optimize efficiency, the combustion chamber is submerged in water and the combustion gases pushed by the burner fan are led through a combustion chamber.

**4.7 Exhaust Stack**

**4.7.1** Stack Material shall be ST.37 or equivalent.

**4.7.2** A self-supporting, removable exhaust stack designed with adequate height and diameter for maximum draft requirements with 3mm minimum wall thickness shall be provided.

**4.7.3** The stack shall have three tapping (distance from bottom of stack shall be 2d (d=inside stack diameter) for connecting of a temperature gauge, a gas sampling port and a draft gauge.

**4.7.4** A pipe shall be used to discharge condensate when this is necessary. The internal diameter of the outside connection of the condensate discharge system shall be at least 13 mm.

**4.7.5** The disposal system, forming part of the forced draft heater, shall be such that:

- It can be easily inspected and cleaned in accordance with the manufacturer's instructions.

- A water trap has a seal of at least 25mm at the maximum pressure in the combustion chamber at the maximum flue length specified by the manufacturer.

**4.7.6** For personal safety the stack shall be insulated with minimum 50mm rock wool or glass wool and clad with aluminum sheet also applying exhaust stack flashing (insulation length with agreement between purchaser and supplier). The maximum surface temperature shall not exceed 60°C.

**4.7.7** The stack shall have a suitable guard to a sufficient height for protection against burn when accidentally touched.

**4.7.8** The end of the exhaust stack conduit shall be equipped with Stack Rain Shield Which acts as an anti-bird protection and hinged with suitable rain hood.

**4.7.9** The Stack shall be designed form a maximum wind load (maximum speed 120km/hr.) The stack may have three suitable earrings for the guy wires for protection against wind load. The same earrings shall also because for lifting the stack.

**4.7.10** The gasket in fire tube and stack connection shall be suitable for high temperature.

**4.7.11** Stack bottom connection to fire tube shall be flanged type.

**4.7.12** Noise level shall not be exceed to 75db at 1m.

## 4.8 Burner

Burner shall be modular type and compatible with EN 676 or ISRI 7595.

Note: All electrical devices, when installed on the burner, shall comply at least with protective category IP 54.

### 4.8.1 Burner Controller

- The burner controller has following minimum requirements:
  - Combustion and control functions manager
  - Gas pressure monitor.
  - Flame guard of automatic self-controlling type, certified for continuous burning.

- Temperature control:

- The thermostatic device shall be installed at water bath shell to shut down the burner in case of water temperature higher than pre adjusted value.
- The thermostatic device shall be installed at heater outlet collector to shut down the burner in case of gas temperature higher than pre adjusted value.
- gas temperature transmitter shall be installed at station outlet header to control burner modulating system to meet the pre adjusted set point of station outlet temperature.

### 4.8.2 Control System Power Supply

- Control system shall be equipped with UPS for minimum of 24 hr. continuous operation only for alarms, in case of power supply failure.

### 4.8.3 Adjustment

Peephole shall be provided and located such that burner flame could be observed during adjustment and operation.

### 4.8.4 Instrumentation and Control for Reduced Pressure Fuel Line

Fuel gas system shall be minimum equipped with following items:

- Inlet isolating ball valve.
- Filtering system, for pneumatic applications 3-5 micron filtration is necessary. Differential pressure gauge should be either bellow or piston type. For bellow differential pressure gauge type, this specification shall be equipped with a 3_way valve for zero calibration. The differential pressure gauge must be connected to the filter body via needle valves in

both the high and low pressure lines. Differential pressure indication shall be from 0 to 25 or 30 psig.

- Regulator and high pressure shut off shall be factory adjusted within working pressure range of the main burner.
- Safety relief valve with a maximum blow down not more than 5% maximum burner

capacity discharge shall be directed away from the firebox.

- Inlet & outlet pressure indicator.
- Outlet isolating ball valve.

**4.8.5** Process control system shall be design the following characteristics:

- If automatic burner failed to shut down, it shall be reset manually.
- Low level protection systems shall be equipped by low level shut down switch (LLS).in case of increasing safety level of control system low level protection shall be equipped by one extra low level alarm (LLA) by client and manufacturer agreement.
- Automatic proportional control temperature on main regulator gas pressure reducing station (gas temperature shall be set to protect regulator from ice formation at outlet reducing gas pressure station)
- Automatic proportional control on water/glycol temperature (maximum bath temperature shall be 88°C)

**4.8.6** At least All safety alarms and shutdown controls of burner management system shall be design in following condition:

- Discontinuity in level switch output
- Discontinuity in Gas/Bath temperature control output
- Discontinuity in UV-Cell/ IONIZATION output
- Discontinuity in Main power supply (only alarm).
- Discontinuity in UPS output (only alarm) – (Ref. IPS–M–EL–176(2) DATED APRIL
- Failure in Ignition system (except manual mode).
- Failure in outputs of control Box to Burner control system.

**4.8.7** All piping and instruments shall be adequately supported.

**4.8.8** Each instrument shall be individually identified by a tag or name plate.

**4.8.9** Instruments and controls shall be designed to withstand the maximum anticipated temperature and pressure.

**4.8.10** Indication of controlled condition shall be provided on each process controller.

**4.8.11** Temperature gauge/indicator shall be bi-metallic type, hermetically sealed, non-reset, heavy duty type, dial size 100mm, white with black and red lettering, dual scale in centigrade, adjustable pointer. (Gauge range -20 ~ +100°C).

**4.8.12** Pressure gauge shall be furnished with stainless steel bourdon tube elements, stainless steel rotary gear, movements with blow out disc, dial size 100mm with black and red lettering, dual scale in bar and psi.

**4.8.13** All gauges shall be equipped by an isolating valve.

**4.8.14** All solenoid valves, electrical valves, electromotors, junction boxes and instrument devices shall be certified acc. to IGS-E-EL-032(0).

**4.8.15** Fuel gas system and process control shall be considered to attach informative P&ID.

**4.8.16 Maintenance**

**4.8.16.1** Provisions shall be included so that the burner could be cleaned with a minimum of disassembly.

**4.8.16.2** Burner shall be field removable.

**4.9 Operating Conditions**

**4.9.1 Lifting Lugs and Tailing Lugs**

**-** Lifting lugs shall be provided with sufficient strength to allow lifting the entire assembly without causing any damage to the shell and the other parts.

**-** Lifting lugs and tailing lugs shall be designed taking into consideration a minimum impact factor of 2 on the full weight (without water).

**-** Minimum two (2) lifting lugs are required on the unit.

**-** Center of gravity to be marked up on Manufacturer's General Arrangement Drawing.

**4.9.2 Ergonomics**

**-** The Manufacturer of the Forced draft indirect water bath heater Package is responsible to design the installation in accordance with the ergonomics principles as per applicable standards.

**-** All components, equipment and instrumentation shall be installed in such a way that operation and maintenance can be performed in a safe and easy way (user friendly).

**-** Measuring equipment, such as temperature and pressure indicators, shall be readable from ground level. Indicator housings for temperature and pressure shall be of sufficient large size (100 mm) and shall be visible by operator.

- In function of the weight and dismantling frequency, the Manufacturer shall provide the most appropriate access and dismantling means.
- Field equipment that shall be operated, are preferably installed above a free space. The free space should allow the placement of a platform to improve the accessibility for operation, maintenance or dismantling.

### 4.9.3 Electrical and Instrumentation

#### 4.9.3.1 General

- The electrical and instrumentation installation will be in accordance to IPS-C-EL-115. (International regulations or certifications could be acceptable)
- Emergency shutdown button will interrupt the electrical power via a contactor installed in the Purchaser electrical control panel and will also stop the gas feed to the Forced draft indirect water bath heater Package.
- All hand switches in the control cabinet, for manual hardwired operation of the hot water system, will be equipped with an auxiliary contact. All these contacts will be put in series to form a low priority alarm.
- A minimum spare capacity of 25% in power and space shall be provided in the electrical control panel.
- A one line diagram and an as-built P&I component list shall be delivered with the installation.

#### 4.9.3.2 Process Equipment

- Electrical requirements for the process equipment shall be communicated with the offer (Electrical users list, with voltage and power consumption). Process equipment shall be protected by individual breaker. They shall not be a source of emission of perturbing frequencies. Switching-off overloading protection shall exist on motors or control panel.

#### 4.9.3.3 Control Cabinet Unit

- Electrical details shall be communicated with the offer. See the Data Sheet, in which, when requested, Purchaser’s requirements are indicated.
- Process equipment shall be operable from contactor or push button accessible from outside the cabinet. Means of locking shall exist to prevent fault restart during maintenance.
- Installed signalization and test monitoring shall be visible from outside the cabinet.

At least for Water temperature, station gas outlet temperature, heater gas outlet temperature & low & low-low water level, on/off burner, on/off for mixer/circulation pump.

- Alarm and danger signals shall be treated through adjustable delay timer to eliminate the short erratic events. Readjustment of the timers on site shall be possible.
- The door of control cabinet unit shall be provided with key forbidding access to unauthorized persons.
- In/Out entrances of cables shall be vapor tight and make impossible the accumulation of dirt and liquid at seal area. Cable entrance shall have a spare of 25%. All entries of cable shall have its cable gland. Unused entrances have to be seal plugged.
- Monitoring of electrical circuit by test lamp and push button shall be possible.
- The construction and disposition of all items shall correspond to the electrical layout drawing and one line diagram which documents shall be placed in plastic pocket and placed inside the cabinet.
- The control cabinet of heater unit equipped with the following devices, but not limited (In case of existence the following items in burner control system shall be excluded)

- A flame controller
- A burner valve proving system
- locking relays:
    - by low level of the water bath
    - by maximum temperature of the water bath
    - by minimum pressure of the fuel gas
    - by lack of flame
    - by air pressure switch
- A general power switch
- A 100mA residual current circuit breaker (RCCB).
- Lighting (door switch and manual on/off control)
- Connections for safety functions:
    - Digital input for high temperature switch
    - Digital input for high pressure switch0

**4.9.3.4 Junction Boxes and Cable Terminals**

- Cables and wires shall be fixed on screw fixation type terminals. Their position will bear the identification recorded in the electrical diagrams.

- Different types of signal shall be segregated into separate terminal bars. A reserve of connecting points of 25% shall be foreseen.

#### 4.9.4 Earthling

- Electric equipment and cabinet, cable trays, cable armors shall be connected to the ground via a central earth connection placed in the control unit.

## 5. WELDING

### 5.1 Welders Qualification Test (WQT)

All welders and operators qualification test shall be in accordance with section IX of the ASME code.

### 5.2 Welding Procedures (WPS and PQR)

**5.2.1** All welding shall be performed according to welding procedure specification (WPS).

**5.2.2** The contractor shall submit welding procedure specification (WPS) and procedure qualification record (PQR) according to ASME IX for purchaser's review and approve before welding process started.

**5.2.3** All welding procedure specifications shall have been or shall be qualified in accordance with section IX of the ASME Code.

**5.2.4** All tests shall be performed with equipment calibrated in accordance with applicable ASTM or national standards by an accredited laboratory.

**5.2.5** 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.

## 5.3 Welding Operation

**5.3.1** All welds should be made by the shielded metal arc welding are using electrode sofa composition and quality compatible with the vessel materials, in accordance with ASME code, section VIII and section IX or ISO 3834-2.

**5.3.2** The suppliers shall specify the make and quality of electrodes which the proposes to utilize in fabrication.

**5.3.3** Work involving welding shall not be in conflict to any other codes without the prior approval of purchaser.

**5.3.4** Welding by automatic or semi-automatic equipment is permitted, gas, bare wire, carbon–arc or other technic of welding will not be permitted unless specified by the purchaser.

**5.3.5** All nozzles and small connections and their utilities shall be attached to the all parts of heater with full penetrate.

**5.3.6** Welding shall be carried out with calibrated equipment.

**5.3.7** Each reinforcement pad or segment shall be provided with a ¼" UNC "Tell-tale" hole.

## 5.4 NDT (Non-Destructive Test)

### 5.4.1 NDT Personnel

Non-destructive testing personnel shall be certified in accordance with ASNT Recommended Practice SNT-TC-1A for the test method used approved by the Company. Only level II or III personnel shall interpret the test results.

### 5.4.2 NDT Procedures

**5.4.2.1** Non-destructive testing procedures shall be prepared by manufacturer, confirmed by the level III personnel and approved by client. After approved by the level III personnel and employer shall be used.

**5.4.2.2** Non-destructive tests shall be carried out and interpreted accordance with ASME Sec. VIII.

### 5.4.3 Progress Examination

In case of random examination (exam by %) according to approved ITP/QCP, if a defective joint is found then all welded joints shall be fully tested.

## 5.5 Welded Joints Inspection and Testing

### 5.5.1 General

**5.5.1.1** The inspection and test should be carried out according to a non-destructive test procedure which may be issued for each work piece. Weld inspection may be performed by qualified site staff, quality control personnel or by qualified inspection company. The third part inspector shall have the right to selecting joint and witness the tests according to the provisions of the erection test plan.

**5.5.1.2** Welding inspection personnel shall be qualified according to SNT-TC-1A.

### 5.5.2 Visual inspection

**5.5.2.1** Visual inspection procedure for material, cutting, welding and finishing shall be prepared by manufacturer and approved by client according to the article 9 of the ASME Sec. V.

**5.5.2.2** Visual inspection shall be performed prior to undertake any non-destructive tests.

**5.5.2.3** The visual inspection shall be carried out according to the provision of the ASME sec. V and approved procedure.

### 5.5.3 Liquid Penetrate Test

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

### 5.5.4 Radiographic Test and Interpretation

**5.5.4.1** Whenever required, radiographic tests shall be carried out according to the provisions of the applicable procedure and code.

**5.5.4.2** Interpretation of the radiographic films and other non-destructive tests shall be carry out by the approved companies of the NIGC in the related field.

**5.5.4.3** Interpreter of the radiographic films shall be separate from the radiographer.

**5.5.4.4** Radiographic films shall be stored by the manufacturer in such a way that they can be interpreted for at least 10 years and their quality does not decrease.

### 5.5.5 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.

**6. Tests**

## 6.1Type Tests

The tests shall be performed to verify that the design of the product is appropriate to meet performance requirements specified in this standard and/or those specified separately by the manufacturer or purchaser for special applications.

**6.1.1** Performance of the burner shall be certified by recognized international or national certifying authorities in accordance with EN 676 or ISIRI 7595 (See APP E, F).

**6.1.2** All solenoid valves, electrical valves, electro motors and instrument devices for use in hazardous classified areas (according to IGS-E-EL-032(0)) shall be certified by recognized international or national certifying authorities. The certificate issued by Underwriters Laboratories Inc. (UL) of USA, the Ex Certification Bodies of IEC and the Notified Bodies of ATEX is acceptable. The certifying authority and the certificate number shall be stated in data sheet/s by the heater supplier .

All instruments shall be subjected to approval by purchaser's authorized representative prior to test.

## 6.2 Routine Tests

Routine tests shall be performed on each forced draft heater.

### 6.2.1 Factory Acceptance Tests (F.A.T.)

Factory acceptance tests are done at the factory to make sure that certain requirements

are met, which results in high quality products. the tests are normally done with the customer and also in certain more demanding cases with a third party inspection agency.

- **Heater coils** shall be hydrostatically tested in accordance with the ASME sec. VIII (boiler and pressure vessel code) prior to shipment by the manufacturer. Pressure test procedure shall be issued by manufacture and approved by client.

Coils shall be tested before installation in main shell and after NDT approved reports. Manufacturer shall conduct the test in the presence of the purchaser's authorized representative.

In addition to the ASME code requirements for hydrostatic testing, the following measures shall be taken:

- Commercial tap water filtered with a 100 mesh screen having no additives other than wetting agent, rust inhibitors or fluorescent dye shall be used as the hydrostatic testing medium.

- All openings shall be blinded, capped, or plugged prior to test.

- Each heater coil shall successfully withstand the test pressure without failure, leakage, distress or distortion other than elastic distortion during test period. In the event that a leak or break occurs, manufacturer shall locate and replace the defected part(s).

- The heater coil shall then be re-pressurized and a new test shall be carried out.

-The test shall be accepted when in the judgment of purchaser's authorized representative the assembly is free of leaks.

- All test gages shall be calibrated by NIGC approved Lab.

- The range of pressure gauges shall be min. 1.5 and max. 2 times the test pressure.

- Test shall be carried out by at least two calibrated gauge and one pressure recorder.

- After testing and draining the water, the internal surface of the coil should be completely dry with warm compressed air.

**- Fire tube** shall be pneumatically and soap tested at a pressure of 30 psig before installation in the main body**.**

**- Heater shell and expansion tank** shall be tested for leakage and withstand the full load when filled with water.

- All welded attachments provided with "Tell–Tale" holes shall be tested by pneumatic

pressure prior to hydrostatic test.

**- Fuel line and shell** shall be tested according to client procedure test.

**- Test Record**

A test record shall be made and shall include all descriptive or pertinent information to identify each heater coil. The test information as specified below shall be provided in letter of certification that the heater coil was tested and met all requirements of the applicable codes. All records shall be handed over to purchaser.

- The minimum information required on each letter of certification is as follows:

- Purchase order number, item number
- Destination
- Coil serial number
- Signature of manufacturer's test witness and/or purchaser's representative
- Test duration
- Ambient temperature
- Brief description of test results, including any leaks or breaks
- Complete with remedial action taken to correct the defect.
- All test certificates must be containing the purchaser's name and order number whether they emanate directly from the main supplier or a sub- contractor.

**- Exhaust gas** shall be sampled properly and tested when heater works. Exhaust gas should be comply local regulations regarding with control of emissions to air. According to standards of exhaust gas for industrial workshops and factories (approved by environment protection organization).

**- All electrical and instrument** functional logic and operation shall be tested for operation throughout the full specified range. Tests shall include simulation of field signals and loads and verification of each instrument alarms or control loop.

### 6.2.2 Carbon Monoxide Test

- The CO (Carbon Monoxide) concentration of the dry, air-free combustion products shall not exceed 100 mg/kWh (that measured with combustion analyzer with printed ticket) when the boiler is supplied with the natural gas at the maximum nominal heat input.

NOTE: The method of calculation of CO concentration are summarized in appendix D.

### 6.2.3 $NO_X$ Test

-The $NO_X$ (Nitrogen Oxides) concentration of the dry, air-free combustion products shall not exceed 170 mg/kWh (that measured with combustion analyzer with printed ticket) when the boiler is supplied with the natural gas at the maximum nominal heat input.

### 6.2.4 Useful Net Efficiencies

#### 6.2.4.1 Useful Net Efficiency at the Maximum Nominal Heat Input (see Figure 1)

Under the conditions of 6.2.2 and 6.2.3, the useful net efficiency (that measured with combustion analyzer with printed ticket), expressed in percent, shall be at least equal to the values derived from Table 1.

**Table 1 — Useful net efficiency requirement at maximum nominal heat input**

| **Range of nominal heat input** | **Expression of the useful efficiency requirement at maximal nominal heat input** (%) |
|---|---|
| 4 kW ≤$P_n$≤ 400 kW | 84 + 2 log $P_{n1)}$ |
| 400 kW <$P_n$≤ 1 000 kW | 89,2 |
| 1) *P*n is the maximal nominal heat input in kilo Watts (kW). | |

**NOTE:** The method of calculation of useful net efficiency are summarized in appendix E.

### 6.2.4.2 Useful Net Efficiency at Part Load (see Figure 1)

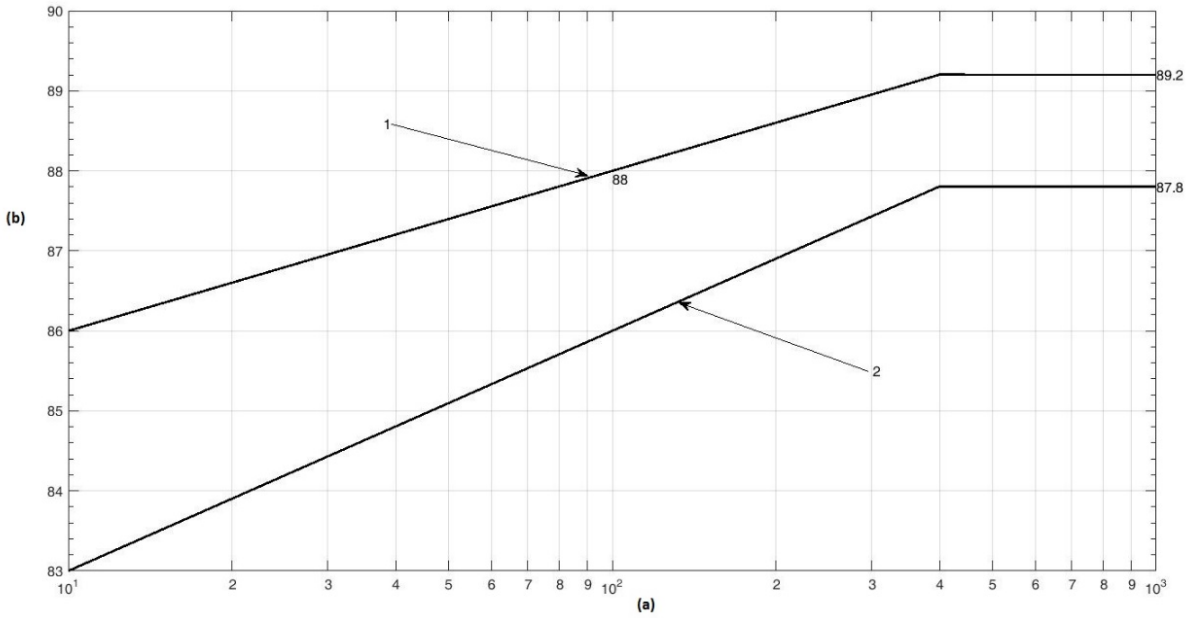
Under the conditions of 6.2.2 and 6.2.3 input, the useful net efficiency (that measured with combustion analyzer with printed ticket)

, expressed in percent, shall be at least equal to the values derived from Table 2.

**Table 2 — Useful net efficiency requirement at part load**

| **Range of nominal heat input** | **Expression of the useful efficiency requirement at partial load** (%) |
|---|---|
| 4 kW ≤ $P_n$≤ 400 kW | 80 + 3 log $P_{n1)}$ |
| 400 kW <$P_n$≤1 000 kW | 87,8 |
| 1) *P*n is the maximal nominal heat input in kilo Watts (kW). | |

**NOTE:** The method of calculation of useful net efficiency are summarized in appendix E.




Key

(a) Nominal useful output, $P_n$ in kW

(b) Boiler efficiency in %

1 : At the maximum nominal heat input

2 : At part load

**Figure 1- Requirements for standard gas boilers**

## 7. INSPECTION

### 7.1 General

**7.1.1** Inspection shall be done base on manufacturer ITP/QCP which is approved by client.

**7.1.2** The pre-inspection meeting shall be attended by the representatives of the employer, the manufacturer and the inspection.

**7.1.3** The purchaser reserves the right of inspection.

**7.1.4** The manufacturer shall arrange for all necessary inspection for compliance with the ASME boiler and pressure vessel code, this standard and API 12K.

**7.1.5** Each heater shall have a final inspection performed by the purchaser's authorized representative prior to shipment.

**7.1.6** In the final inspection, the coil and fire tube shall be inserted in to the shell once in the presence of the inspector and removed to ensure ease of operation and recorded.

**7.1.7** The inspection and test shall be carried out according to a Non-Destructive Testing

procedures. Welding inspection personnel shall be qualified according to ISO 3834-2 or SNT-TC-1A.

**7.1.8** Prior to final inspection, all slag, loose scale, dirt, grit, weld spatter, print, oil and other foreign matter shall be thoroughly removed so that inspection may be carried out to the best advantage.

**7.1.9** The supplier shall allow free access to the purchaser to all parts of his or his sub contractors works, for the purpose of carrying out any inspection or witnessing test, etc.

**7.1.10** The supplier shall afford the purchaser, without charge, all reasonable facilities to enable him to verify that vessels are being manufactured and tested in accordance with this specification.

**7.2 Supplemental Information**

Certificates of all inspection, welders and material with test report shall be supplied to purchaser.

## 8. SURFACE PREPARATION AND COATING

Before shipment, heaters shall be mechanically cleaned of rust, grease, loose scale, and weld spatter, and the outside of the shell coated with one application of a good grade of commercial metal primer. Finish coats or special painting systems shall be applied if so agreed upon between the purchaser and the manufacturer.

External surface of piping, instruments and Shell shall be painted according to IGS-M-CH-042(0)

## 9. THE HEAT MEDIA SPECIFICATION

Fluid content bath shall be solution of water, when freezing is possible, ethylene glycol shall be added for anti-freeze protection. Corrosion inhibitors shall be added. Information for this volume fraction for ethylene glycol/water solution, based to site temperature recommended APPENDIX C. But manufacturer recommended is preferred to this APPENDIX C.

Note: Media conditioning of indirect water bath heater shall be according to IGS-R-CH-055.

## 10. MARKING

Each heater shall be identified by permanently attached corrosion resistant nameplate. A stainless steel nameplate shall be located so that it is easily visible after installation.

Heater shall have nameplate containing marking and stamping in accordance with the ASME pressure vessel code/API 12K plus the additional information as follows:

- Manufacture's name
- Year built
- Serial number
- Thermal absorption on coil KCal /BTU
- Number of coils and number of flow paths
- Coil wall thickness, outside diameter and schedule number of coil pipes
- Coil outside surface area, $m^2$
- Fire tube outside surface area, $m^2$
- Coil weight, Kg
- Coil design pressure, Psig
- Coil hydrostatic test pressure, Psig
- Purchase order
- Item number
- Shell weight empty/full, Kg
- Bath water capacity, lit
- Expansion tank capacity, lit

## 11. PACKING AND SHIPMENT

For each heater packing shall be in accordance with NIGC protection, packing, marking and dispatching instructions outlined as follows:

**11.1** Prior to shipment, the heater and all parts shall be thoroughly cleaned and all water, dirt, weld metal spatter and other foreign matter shall be removed.

**11.2** All testing liquids shall be removed and units dried before packing.

**11.3** All flanged openings properly protected with suitable covers. Tapped openings shall be protected with threaded steel plugs screwed in.

**11.4** All loose gaskets shall be packed in a separate wooden case.

**11.5** Before shipment is made, the purchaser's written approval of the proposed method of shipment must be obtained.

**11.6** 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.

**11.7** All instruments, control systems, etc. shall be packed in accordance with above instruction but in sufficient cases of appropriate size.

**11.8** All sensing lines (except those which could be packed with instruments) shall be disassembled, covered and wrapped with plastic materials and placed around the heater shell in such a way that they are not damaged during transportation. No. packing for shell is necessary.

**11.9** All separately packed parts of each heater (instruments, stack, etc …) shall be supplied in the same shipment with heater itself and identified accordingly.

**Note 1:** After the functional test is approved, then the required disassembling for packing shall be started.

**Note2:** Supplier shall submit detail installation drawing as well as detail commissioning procedures and all necessary documents prior to shipment.

## 12. GUARANTEE AND ACCEPTANCE

**12.1** Manufacturer shall guarantee the compliance of material and performance of the supplied equipment with this specification during the compliance certificate.

**12.2** 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.

**12.3** Supplier shall agree to repair or replace any equipment which proves to be defective during the above mentioned period.

**12.4** The purchaser's approval of work and acceptance for shop tests and/or releasing shipment note shall not relieve supplier's responsibility for carrying out all provisions of the specification, codes and/or fulfillment of the guarantee, nor does the purchaser by such approval and/or release, assume any responsibility what so ever for such provisions and/or guarantee.

**12.5** Release notes shall be issued by the purchaser . heaters after final inspection and testing at the works, shall not be dispatched until such release notes have been issued.

## 13. INSTALLATION

**13.1** The heater units shall be positioned on site and provided with sufficient access to allow removal of coil section and fire tube section from the two ends of the heater separately for routine maintenance.

**13.2** The heater layout shall be identified in regard to safety and environmental aspects (such as wind direction and speed,…).

**13.3** All heater accessories (all gauges, name plate,…) shall be considered according to Agronomical aspects (such as accessibility, visibility, …).

**13.4** The erection activities are terminated when all the process equipment, piping, electrical materials, support structures will be correctly positioned and fixed at their location and the unit fully assembled.

## 14. DRAWINGS AND DATA

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

### 14.1 Quotation Stage

**14.1.1** N.I.G.C Data sheet (IGS-M-PM-106) completed by vendor.

**14.1.2** General arrangement drawings showing outline dimensions and weights.

**14.1.3** Preliminary played sectional view of heater internals.

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

**14.1.5** All technical information including description of fuel system, protection and control with relevant drawings and catalogue for each component.

### 14.2 Ordering Stage

**14.2.1** Descriptive final arrangement and technical detail of drawings and last revision (as built DRWNG) included weight and load on foundation 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)

## 15. INSPECTION DOCUMENTS AND REPORTS

**15.1** Prior to the shipment of each heater, the manufacturer shall perform the specified tests and checks on the heater. The results of all tests and checks performed shall be documented and reported.

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

**15.3** Following table should be followed as document index of supplier if there is no other MR or document list agreed with client.

| Document | Type | Required with Offer | Required in Final Book |
|---|---|---|---|
| General Datasheet | P/E | Yes | Yes |
| Detailed Datasheet (Mechanical, Instrument and Process) | P/E | No | Yes |
| General P&ID | P/E | No | Yes |
| General Drawing of all parts of heater | P/E | No | Yes |
| Report of Code Calculation according to Standard | P/E | No | Yes |
| Required Two Years Spare Part | P/E | Yes | Yes |
| Commissioning Manual | P/E | No | Yes |
| Operation and Maintenance (O&M) Manual | P/E | No | Yes |
| Test Procedures | P/E | No | Yes |
| Packing and Shipping Procedure | P/E | No | Yes |
| Equipment Final Book<br>Including all QC document (WPS, PQR, Weld and Test Reports, Instrument Document, Certificate And Function Test Reports And etc.), Final Release Note, As Built Drawings (if any) and all above documents. | P/E | No | Yes |

P= Paper, E= Electrical files

## Appendix A

### Table A.1 Heater Data sheet

| Subject | | To be Filled by NIGC/Client | To be Filled by Supplier |
|---|---|---|---|
| Service Condition | Gas Flow Rate | | |
| | Inlet Pressure | min. ( ) max. ( ) | |
| | Controlling Temperature on Main Regulator Gas Pressure Reducing Station | Temperature limitation shall be provided according to natural gas freezing point | |
| | Net Absorbed Heat Duty | | |
| | Gross Heat Duty: Burner/Fire Tube | | |
| | Min overall Thermal Efficiency at maximum nominal heat input, (heater and burner ) | 89.2 | |
| | Min overall Thermal Efficiency at part load, (heater and burner ) | 87.8 | |
| | Maximum Bath Temperature | 88 | |
| | Maximum Gas Velocity in inlet and outlet Coil | 20 | |
| | Maximum Pressure Drop in Coil | 1.75 | |
| | Design Pressure | 1.1 max. operating pressure | |
| | Design Temperature | 100 | |
| | End Connection Size | | |
| | Fuel Gas Supply Pressure | 4 – 17 | |
| | Ambient Temperature | min. ( ) max. ( ) | |
| | Maximum Wind Velocity | | |
| | Maximum Rain Fall | | |
| | Relative Humidity | | |
| | Maximum Snow Loading | | |
| | Earth Quake Zone (OBCIV) | | |
| | Elevation Above Sea Level | | |
| | Fuel Gas Consumptions | | |
| | NOx | ≤ 170 | |

| | | | |
|---|---|---|---|
| | CO | ≤ 100 | |
| **End Connection** | Type | Flange W.N., R.F. | |
| | Class Rating | 600 | |
| | Inlet and Outlet Size | | |
| **Coil** | Material | Seamless Pipe<br>ASTM A-53, Gr. B, SCH 80/<br>ASTM A106, Gr. B, SCH 80 | |
| | Outside and Inside Diameter | | |
| | No. of Flow Paths | | |
| | No. of Passes per Flow Path | | |
| | Design Pressure | | |
| | Design Temperature | 100 | |
| **Shell** | Material | SA.36 or equivalent | |
| | Diameter | | |
| | Length | | |
| | Insulation Material and Thickness | 50 mm thickness fibber glass / rock wool & aluminum cladding | |
| **Expansion Tank** | Material | SA.36 or equivalent | |
| | Diameter | | |
| | Length | | |
| | Insulation Material and Thickness | 50 mm thickness fibber glass/ Rockwool & aluminum Cladding | |
| **Main Fire Tube** | Material | | |
| | No. of Tubes | | |
| | Size | | |
| | Wall Thickness | | |
| | Surface Area | | |
| **Return Fire Tube** | Material | ASTM A53 | |
| | No. of Tubes | | |
| | Size | | |

| | | | |
|---|---|---|---|
| | Surface Area | | |
| | Wall Thickness | | |
| **Burner** | No. of Burners | | |
| | Total Capacity | | |
| | Type | Forced Draftt | |
| | Manufacturer, Model Number | NIGC vendor list | |
| | No. of Pilots, Type | | |
| **Water Pump** | Type and Model | | |
| | Size | | |
| | Capacity | | |
| | | | |
| | | | |
| **Stack** | Material | ST.37 or equivalent | |
| | Diameter | | |
| | Thickness | 3 | |
| | Height | | |
| | Type of Anti Down Draft Device | Light weight non corrosive material | |
| **Painting** | Standard for Surface Preparation | IGS-O-CH-042<br>API 12K | |
| | Coating Material | | |
| | Total Thickness of Paint (DFT) | | |
| **Instrument Regulator** | Type | | |
| | Size | | |
| | Manufacturer | NIGC vendor list | |
| | Set Pressure | | |

| | | | |
|---|---|---|---|
| **Main Shut-Off Valves** | Type | | |
| | Size | | |
| | Manufacturer | NIGC vendor list | |
| **Fuel Control Valves** | Type | | |
| | Size | | |
| | Manufacturer | NIGC vendor list | |
| **Fuel Line Safety Valves** | Type | | |
| | Size | | |
| | Manufacturer | NIGC vendor list | |
| | Pressure Range | | |
| | Set Pressure | | |
| **Relight System** | Type | PLC control | |
| | Manufacturer | NIGC vendor list | |
| | Output Voltage | 220 V | |

## APPENDIX B

### Carbon Monoxide Concentration

The CO concentration of the dry, air-free combustion products (neutral combustion) is given by the formula:
A sample of the combustion products is taken when the boiler has reached thermal equilibrium.

$$CO = (CO)_M \times \frac{(CO_2)_N}{(CO_2)_M} \quad (1)$$

Where

$CO$: is the carbon monoxide concentration of the dry, air-free combustion products, in percent.

$(CO_2)_N$ : is the maximum carbon dioxide concentration of the dry, air-free combustion products of the relevant gas, in percent.

$(CO)_M$ and $(CO_2)_M$ : are the measured concentrations in the samples taken during the combustion test, both expressed in percent.

The $(CO_2)_N$ : concentrations for the test gases are given in Table F.1.

**Table F.1 — $(CO_2)_N$ concentration of test gases**

| Designation of the gas | G 20 | G 25 | G 30 | G 31 |
|---|---|---|---|---|
| (CO2)N % | 11,7 | 11,5 | 14,0 | 13,7 |

If actually distributed gases are used, their $(CO_2)_N$ value shall be determined by analysis.

The CO concentration, in %, of the dry, air-free combustion products, may also be calculated by the formula:

$$CO = (CO)_M \times \frac{21}{21 - (O_2)_M} \quad (2)$$

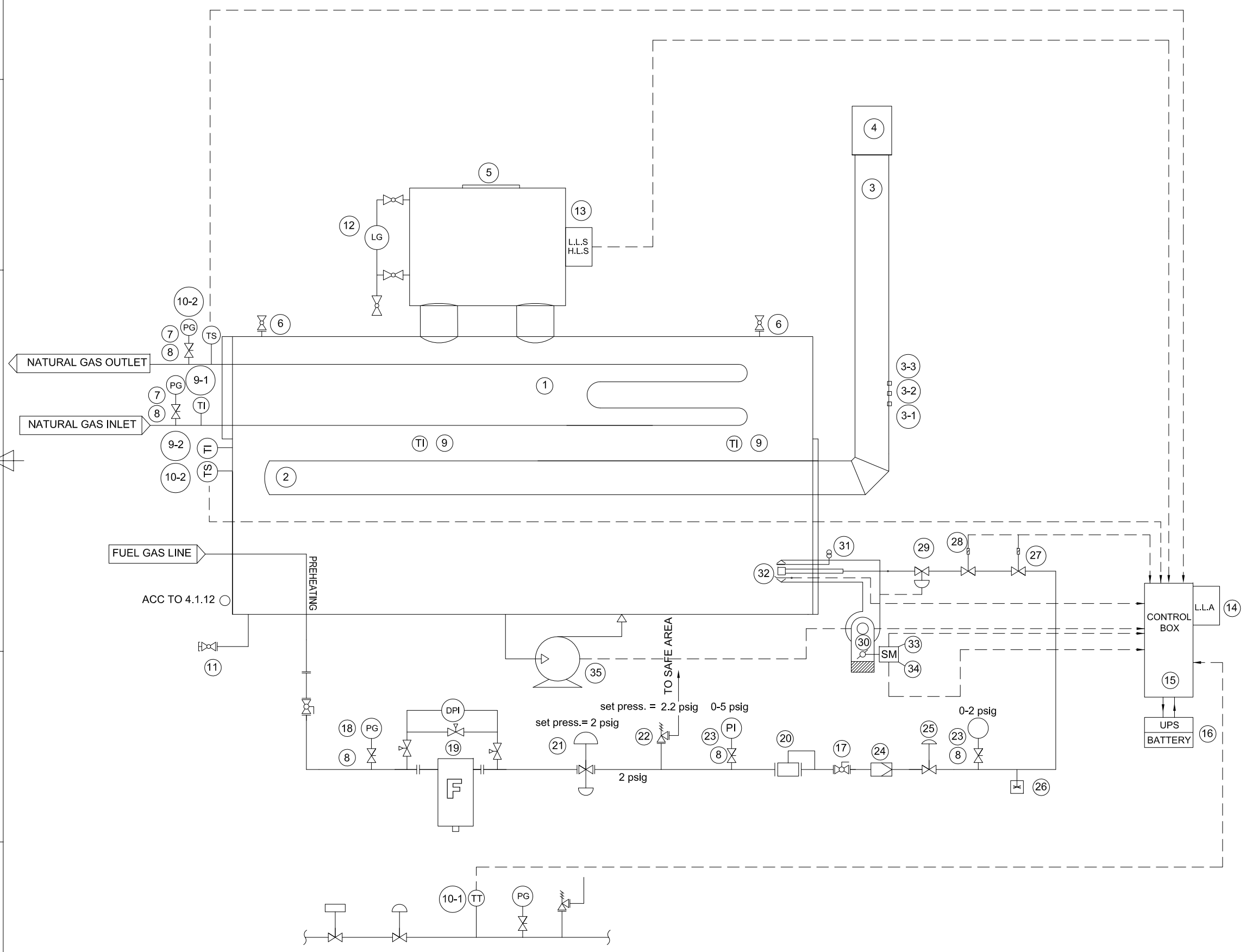
Where:

$(O_2)_M$ and $(CO)_M$ are the measured concentrations of oxygen and carbon monoxide in the samples taken during the combustion test, both expressed in percent.

# APPENDIX C (INFORMATIVE)

## P & ID

# APPENDIX D
# INFORMATIVE P&ID




| | |
|---|---|
| 35 | CIRCULATION PUMP OR MIXER |
| 34 | LOW AIR FLOW POSITION SWITCH |
| 33 | HIGH AIR FLOW POSITION SWITCH |
| 32 | FLAME DETECTOR DEVICE |
| 31 | IGNITER |
| 30 | FORCED DRAFT BURNER EQUIPPED WITH SAFETY DEVICE |
| 29 | AIR/GAS RATIO CONTROL VALVE |
| 28 | SAFETY SHUT OFF DEVICE–(FAST CLOSE/SLOW OPEN) |
| 27 | SAFETY SHUT OFF DEVICE–single step (FAST CLOSE/FAST OPEN) |
| 26 | LOW GAS PRESSURE PROTECTION DEVICE FILTER |
| 25 | GAS PRESSURE GOVERNER |
| 24 | FILTER |
| 23 | PRESSURE GAUGE STL ST 1/2" NPT,0–5PSI, 0–2PSI |
| 22 | SAFETY RELIEF VALVE (SRV) SET PRESSURE 2.2 PSIG |
| 21 | GAS PRESSURE REGULATOR WITH HIGH PRESSURE SHUT OFF VALVEPin=250 OR 60 Psig & Pout=2 Psig |
| 20 | GAS METER (DIAPHRAGM OR TURBINE TYPE that can be changed location) |
| 19 | DRY GASS FILTER EQUIPPED WITH DP GAUGE |
| 18 | PRESSURE GAUGE STL ST 1/2" NPT,0–400PSI OR 0–150 PSI |
| 17 | HAND CONTROLLED VALVE (MANUALLY SHUT OFF DEVICE) |
| 16 | UPS |
| 15 | CONTROL BOX |
| 14 | LOW LIQUID LEVEL ALARM |
| 13 | LOW LIQUID LEVEL FOR BURNER SHUTDOWN AND HIGH LEVEL SWITCH |
| 12 | LIQUID LEVEL INDICATOR |
| 11 | SHELL DRAIN,C.S.BODY,GATE OR BALL VALVE 2" ANSI 150 |
| 10–2 | TEMPERATURE SWITCH (THERMOSTATIC DEVICE) |
| 10–1 | TEMPERATURE TRANSMITTER |
| 9–2 | TEMPERATURE GAUGE 1/2" NPT –20 ~100C,10cm DIAL |
| 9–1 | TEMPERATURE GAUGE 1/2" NPT –20~+100C,10cm DIAL |
| 08 | NEEDLE VALVE STL ST 1/2" NPT |
| 07 | PRESSURE GAUGE,10CM DIAL STL ST 1/2" NPT 0–2000PSI |
| 06 | SHELL VENT OR EXPANSION TANK WENT |
| 05 | EXPANSION TANK FILLING DOOR |
| 04 | STACK ACCESSORIES |
| 3–3 | TAP FOR DRAFT GAUGE |
| 3–2 | TAP FOR GAS SAMPLING PORT |
| 3–1 | TAP FOR TEMPERATURE GAUGE |
| 03 | STACK |
| 02 | REMOVABLE FIRE TUBE |
| 01 | REMOVABLE COIL |
| NO. | PART NAME |

TITLE:

## P & ID
## FORCED DRAFT BURNER
## FOR MODULAR TYPE