KGS Code

KGS AB231 2018

Code for Facilities, Technology and Inspection for Manufacturing of Gas Heaters

Deliberation/Resolution by Gas Technical Standards Committee : November 23, 2018

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History of Establishment and Revision of KGS Code	
Code Number	KGS AB231 2018
Code Title	Code for Facilities, Technology and Inspection for Manufacturing of Gas Heaters

Date of Establishment/Revision	Description
December 31, 2008	Established (Notification of the Ministry of Knowledge Economy No. 2008-380)
May 15, 2009	Revised (Notification of the Ministry of Knowledge Economy No. 2009-193)
June 26, 2012	Revised (Notification of the Ministry of Knowledge Economy No. 2012-313)
December 28, 2012	Revised (Notification of the Ministry of Knowledge Economy No. 2012-549)
May 20, 2013	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2013-087)
November 17, 2014	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2014-589)
November 4 , 2015	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2015-578)
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December 13, 2018	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2018-607)

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Code for Facilities, Technology and Inspection for Manufacturing of Gas Heaters

1. General

1.1 Scope

1.1.1 This Code applies to the facilities, technology and inspection for manufacturing of the liquefied petroleum gas heaters or city gas heaters (hereinafter referred to as "gas heaters") which come under the following (1) to (2) among the combustors in conformity to the Enforcement Regulation of the Safety Control and Business Regulation of Liquefied Petroleum Gas Act (hereinafter referred to as "Enforcement Regulation"), Table 3, No. 10 and Table 7, No.4-j. However, this Code does not apply to gas heaters incorporated with gas cylinders. <Revised on November 4, 2015>

(1) The total heat input rate is not over 232.6 kw (200,000 kcal/h).

(2) The working gas pressure is not over 3.3 kPa.

1.1.2 The combustors excluded from the gas appliances subject to license in conformity to the Enforcement Regulation, Table 7, No.5-b are as follows:

(1) Gas torches used for welding and cutting,

(2) Dryer combustors used in casting sand dryers, printing ink dryers, concrete dryers, etc.,

(3) Combustors for heat treatment furnaces or heating furnaces used as metal heat treatment furnaces, glass and ceramic furnaces, atmosphere gas furnaces, etc.,

(4) Melting furnace combustors used in metal melting, glass melting, etc.,

(5) Combustors attached to gas canisters of which internal volume is less than 100 mL, and

(6) Other combustors accepted by the Minister of Trade, Industry & Energy to be free from any problem in safety control.

1.2 Validity of Code

1.2.1 This Code has passed the deliberation and resolution by Gas Technical Standards Committee (Bill No. 2018-9, November 23, 2018) in conformity to the High Pressure Gas Safety Control Act

(hereinafter referred to as "High Pressure Gas Act"), Article 33, Clause 2 in accordance with the Safety Control and Business Regulation of Liquefied Petroleum Gas Act (hereinafter referred to as "Act"), Article 45, Clause 1, has been approved by the Minister of Trade, Industry & Energy (Notification No. 2018-607 of the Ministry of Trade, Industry & Energy, December 13, 2018), and is valid and effective as the detailed standards in conformity to the Act, Article 45, Clause 1. <Revised on November 4, 2015>

1.2.2 Conformity to this Code is deemed to conform to Table 7 of the Enforcement Regulation in accordance with the Act, Article 45, Clause 4. <Revised on November 4, 2015>

1.3 Reference Codes and Standards

1.3.1 Inspection standard for new technology products

In case the Minister of Trade, Industry & Energy accepts that the new manufacturing and inspection methods of gas heaters developed through technology development do not meet the standard for facilities, technology and inspection conforming to this Code in accordance with the Enforcement Regulation, Table 7, No. 5-a but do not hinder safety control, such manufacturing and inspection methods of those gas appliances may restrictively apply only to them. <Revised on May 15, 2009>

1.3.2 Registration standard for manufacturing of foreign products <newly established on June 26, 2012>

The "foreign manufacturing facility standards and manufacturing technology standards" specified the Enforcement Regulation, Article 17, proviso of Clause 3 mean the detailed standards specified by the regulations of the Act, Article 45. <Revised on November 4, 2015>

1.4 Definitions

The terms used in this Code are defined as follows:

1.4.1 "Regular quality inspection" means the inspection on product performance by taking samples from products manufactured in mass production to check whether the products which are to undergo production stage inspection are the same products as those which have undergone design stage inspection.

1.4.2 "Routine sample inspection" means the inspection performed to check on the basic product performance by taking samples from the same products manufactured in the same production lot for the products to undergo product identification inspection.

1.4.3 "Occasional quality inspection" means the inspection performed by taking samples without any advance notice from products produced in mass production in order to check whether the products which have undergone production process inspection or comprehensive process inspection are manufactured in the same way as those which have undergone design stage inspection.

1.4.4 "Process identification audit" means the audit conducted to check on the conformity of quality system operation to the manufacturing and self-inspection processes required for manufacturing of the products which have undergone design stage inspection.

1.4.5 "Comprehensive quality control system audit" means the audit conducted to check on the conformity of quality system operation to the whole gas heater manufacturing process range such as design, manufacturing and self-inspection.

1.4.6 "Type" means the unit of products distinguishable in their construction, material, capacity and performance.

1.4.7 "Process inspection" means production process inspection and comprehensive process inspection.

1.5 Application of Codes and Standards

Matters necessary for the materials, construction and dimensions, performance and other technical standards of the gas heaters not covered in this Code shall conform to Korean Industrial Standards (KS).

2. Manufacturing Standard

2.1 Manufacturing Facilities

A person who intends to manufacture gas heaters shall be furnished with the following manufacturing facilities to manufacture the gas heaters in accordance with this manufacturing standard. However, in case the licensing authority recognizes that it is necessary to utilize the facilities of specialist parts companies which manufacture the parts or to use the parts manufactured by them for quality improvement, the facilities may be utilized or the parts may be used.

(1) Drilling machines, presses, tube benders, and casting processing machines
(2) Surface treatment and painting facilities
(3) Ultrasonic cleaning facilities (for heater cocks and governors only)
(4) Gas welding machines or electric welding machines, power assembly jigs and tools for gas heater assembly

2.2 Inspection Facilities

2.2.1 The person who intends to manufacture gas heaters shall be furnished with the following inspection facilities required to check on and maintain product performance.

2.2.1.1 The kinds of inspection facilities shall be sufficient for the self inspection in conformity to the safety control regulation and include the followings:

2.2.1.1.1 Kinds of inspection facilities which must be furnished
(1) Dimension measurement devices such as vernier calipers, micrometers, thread gauges
(2) Surface thermometers
(3) CO/CO2 analyzers

2.2.1.1.2 Kinds of inspection facilities which shall be furnished when required
(1) Liquefied petroleum gas or city gas dip test facilities
(2) Pressure test facilities
(3) Gas tightness test facilities
(4) Safety device function test facilities
(5) Durability test facilities
(6) Test gas supply facilities
(7) Insulation resistance testers and withstand voltage testers
(8) Heat input measurement facilities
(9) Barometers

(10) Voltage regulators and power consumption watt meters
(11) Vibration testers
(12) Thermal efficiency measurement facilities
(13) Other necessary inspection facilities and tools

2.2.1.2 The capacity of the inspection facilities shall match the product production capacity of the relevant manufacturing plant.

2.2.2 Notwithstanding 2.2.1, in case the test and inspection of design stage inspection items are ordered to one of the following authorized agencies to be performed or a lease contract for test and inspection facilities required for design stage inspection items is awarded to one of the following authorized agencies, the relevant test and inspection facilities among the inspection facilities in 2.2.1 shall be deemed to have been furnished.
(1) Korea Gas Safety Corporation (hereinafter referred to as "KGS" or "Korea Gas Safety Corporation) in conformity to the High Pressure Gas Act, Article 28
(2) Test and inspection agencies authorized in accordance the High Pressure Gas Act, Article 35 (hereinafter referred to as "test and inspection agencies")
(3) Test and inspection agencies authorized in accordance with the Framework Act on National Standards

3. Manufacturing Technology Standard

3.1 Materials

The metal parts of gas heaters shall be made of the materials which are corrosion resistant or of which surfaces are treated for corrosion resistance.

3.2 Construction and Dimensions <Revised on December 28, 2012>

Gas heaters shall be of a construction and dimensions conforming to the following standard for its safety, convenience and exchangeability.

3.2.1 The gas heaters shall be of a construction which is not directly coupled to gas cylinders.

3.2.2 The opening direction of the handle of a rotary cock or valve for gas or water service shall be counterclockwise. However, in the case of bidirectional multi-function rotary cocks, this provision shall not apply.

3.2.3 The gas heaters provided with a pilot burner shall be of a construction of which main burner gas circuit will not be opened unless the pilot is ignited.

3.2.4 The gas heaters provided with an air supply fan and an exhaust gas fan shall be of a construction of which fans shall be operated before ignition and gas circuit will be automatically cut off if the fans are stopped.

3.2.5 Each part of the gas heater shall be of a construction which is safe and durable against gas leakage and fire and free of breakage or deformation harmful to its use due to its normal transportation, installation or use.

3.2.6 The functioning of each part shall be smooth and certain.

3.2.7 Gas heaters shall not be easily moved around or toppled by operating activities in their normal installed conditions.

3.2.8 It shall be possible to check whether the burner is ignited with the eye, mirror or signal lamp from the location where the ignition operation is performed.

3.2.9 The gas lines shall be installed in locations free from excessive heat or corrosion or protective measures shall be taken.

3.2.10 The connections through which gas flows shall be firmly made to be gas tight by means of welding, threading or tightening bolting.

3.2.11 The gas passages shall be gas tight and their gas tightness shall not be damaged due to normal transportation, installation or use.

3.2.12 The burner and pilot burner shall be stably installed in their specified positions, firmly maintain their specific distances from the nozzle, combustion chamber, electric ignition device and safety device, and not be moved around or shifted in their normal service conditions.

3.2.13 The burner and pilot burner shall be installed in locations where they will not overheat or

damage other equipment parts.

3.2.14 In case a copper tube is used as the gas passage of the pilot burner, its inside surface shall be surface-treated or its nominal inside diameter shall not be less than 2 mm.

3.2.15 The burner and other major parts shall be able to be adjusted or replaced.

3.2.16 In principle, the orifice shall be able to be assembled and disassembled, and shall not be installed in a location where it can be easily smeared or clogged by dust or foreign matters from the outside.

3.2.17 The set point of the air register of the Bunsen burner shall not be shifted in normal operating conditions, the handle of the air register shall be in a location where it can be easily manipulated, and the manipulation shall be smooth.

3.2.18 The ignition unit which utilizes jumper sparks shall conform to the followings:

3.2.18.1 The electrode shall be positioned where yellow flame cannot reach.

3.2.18.2 The electrode gap shall be fixed so that it will not be changed in normal operating conditions.

3.2.18.3 The spatial distance between a live part of high voltage wiring and an uncharged metal part shall be maintained to be sufficiently wide enough and more than the electrode gap. However, in case effective electric insulation measures which never cause leakage current during ignition operation have been taken, the spatial distance may not be maintained.

3.2.18.4 High-voltage wiring which may be in danger of being touched by the hand during normal operation shall be protected with effective electric insulation sheathing.

3.2.19 The ends of parts to be touched by the hand during operation or cleaning shall be smooth.

3.2.20 In principle, parts required to be disassembled for cleaning and maintenance shall be able to be disassembled and assembled using ordinary tools.

3.2.21 Screws used in assembly of each part shall be tightly fastened and screws in the parts which are required to be disassembled for repairs and inspection shall be able to be repeatedly

used.

3.2.22 Equipment mounted on walls, columns and floors for use shall be able to be installed and disassembled, and to be firmly installed so that there will be no abnormality caused by normal piping connection.

3.2.23 The gas connectors shall conform to the followings:

3.2.23.1 The gas connector shall be exposed to the outside in principle or be installed in locations where it can be easily noticed from the outside.

3.2.23.2 The threads of the gas connectors (inlet side threads of the gas connectors integrated with the hose connectors) shall be the pipe threads conforming to KS B0222, and free from being loosened or deformation which may impair gas tightness when connected.

3.2.23.3 The shape and dimensions of the hose connector used at the gas connector shall conform to one of those in Figure 3.2.23.3 and be free from being loosened or deformation which may impair gas tightness due to repeated hose connection and disconnection.

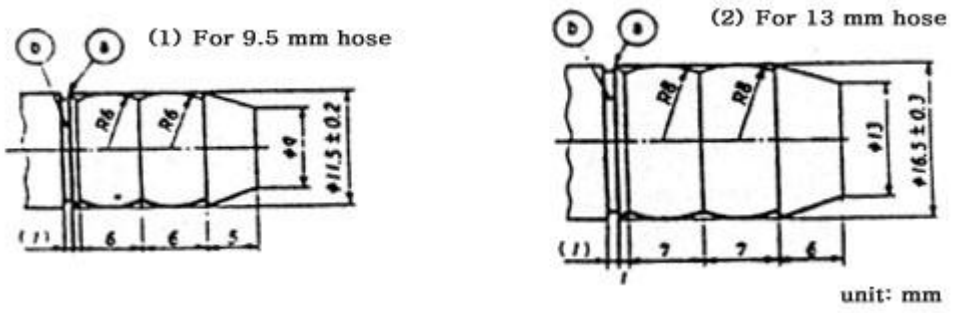


Figure 3.2.23.3 Shape and Dimensions of Hose Connectors

Note:

1. Part ⓐ shall be chamfered.
2. Part ⓑ shall be grooved, and the grooved part shall be painted red.
3. The part to be inserted for reinforcement may be rounded.
4. The unspecified tolerance shall conform to the coarse class of KS B ISO 2768-1. However, radius R and the value in ( ) are their reference values.

3.2.24 The valves shall conform to the following standard:

3.2.24.1 The gas passage of the burner shall be able to be firmly opened and closed. In case a

valve opens and closes several gas passages, the valve shall be able to firmly open and close each gas passage.

3.2.24.2 The opening direction of the rotary type valve shall be counterclockwise in principle. However, in the case of a valve incorporated with a gas connector, this provision shall not apply if the valve body is installed in an exposed state or the valve serves several burners.

3.2.24.3 In order to firmly close the gas passages, the appliance valve of a cock construction shall have effective contact lengths sufficient for gas tightness in the supporting surface between the appliance valve body and the cock and in the circumferential contact surface when all the gas passages are closed up.

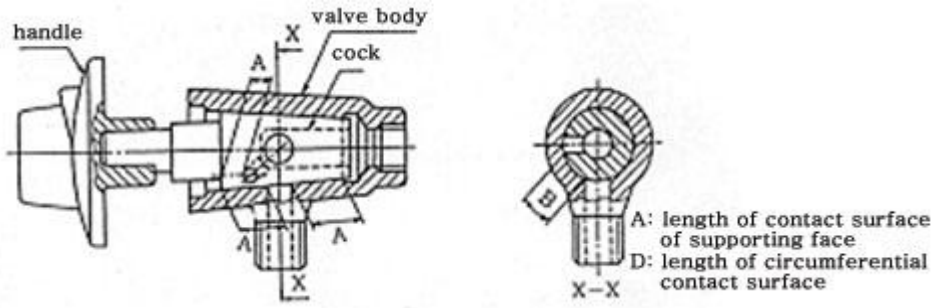


Figure 3.2.24.3 Cock Valve

3.2.24.4 The valve and valve seat of an appliance valve of a valve construction shall be in close contact to maintain gas tightness so that the gas passage can be firmly closed.

3.2.24.5 The grease applied to the cock valve shall be compatible with the gas and not cause gas leakage or other service problems.

3.3 Devices

The gas heater shall be provided with the devices conforming to the following standard for its safety and convenience:

3.3.1 Power failure safety device

Gas heaters of which gas circuits are opened or closed by AC power shall close the gas circuits when the power is out and shall be provided with a power failure safety device which prevents the gas circuits from being automatically opened or makes the pilot burner reignited when the

power is on again. However, this provision shall not apply for the gas heaters of which pilot flame is not extinguished when the power is out.

3.3.2 Head wind prevention device

The gas heater with an exhaust tube connection shall be provided with a head wind prevention device which will prevent head wind from affecting the burner.

3.3.3 Flame supervision device

The gas heater shall be provided with a flame supervision device.

3.3.4 Other devices <Revised on December 28, 2012>

Other devices to be provided shall be as follows:

(1) Governor (restrictive to gas heaters with ceramic burners)

(2) Incomplete combustion prevention device or oxygen deficiency safety device [restrictive to open type gas heaters for homes or business places of which gas input rating is not over 11.6 kW(10,000 kcal/h)]

(3) Anti-toppling safety device (for gas heaters other than fixed type gas heaters)

(4) Exhaust closure safety device (restrictive to FE type gas heaters)

(5) Excessive wind pressure safety device (restrictive to FE type gas heaters)

(6) Overheat prevention safety device (restrictive to forced convection type gas heaters)

(7) Low temperature cutoff device (restrictive to catalyst type gas heaters)

3.4 Performance

The gas heater shall have performances in conformity to the following standard to secure its safety and convenience:

3.4.1 Product performance

3.4.1.1 Gas tightness performance <Revised on December 28, 2012>

3.4.1.1.1 The leakage of a gas heater shall not be over 70 ml/h when undergoing a gas tight test performed at an air (or nitrogen) pressure not less than 1.5 times the working pressure.

3.4.1.1.2 There shall be no external gas leakage from the gas connector to the flame orifice. However, in case the gas tightness test is difficult to be performed, the test may be replaced by leak test in operation.

3.4.1.2 Durability performance

3.4.1.2.1 The cock and electric ignition device shall be free from gas leakage and maintain their normal function after a 12,000-cycle cyclic test

3.4.1.2.2 The flame supervision device and hose connection shall be free from gas leakage and maintain their normal function respectively after a 1,000-cycle cyclic test

3.4.1.2.3 The governor shall be free from gas leakage and the change in regulated pressure shall not exceed [0.05P (regulated pressure before the test)+0.03] kPa after a 30,000-cycle cyclic test

3.4.1.3 Vibration-proof performance

The gas heater shall be free from leakage and pass the normal combustion test after one hour vibration test in its packed state

3.4.1.4 Insulation resistance performance

The insulation resistance shall not be less than 1 ㏁ between an electrically charged part and an uncharged metal part.

3.4.1.5 Withstand voltage performance <Revised on December 28, 2012>

The withstand voltage of a combustor using AC power shall not be abnormal when tested by impressing the AC voltage in Table 3.4.1.5 for one minute without interruption between its electrically charged part and uncharged part in danger of being grounded.

Table 3.4.1.5 Test Voltage for Withstand Voltage Test Depending on Insulation Condition

Insulation Condition	Test Voltage (V)	
	Before Normal Temperature Rise Test	After Normal Temperature Rise Test
Basic insulation impressed with safe very low voltage	500	500
Basic insulation	1250	1000
Additional insulation	2750	2750
Reinforcing insulation	3750	3750

3.4.2 Material performance <Newly established on December 28, 2012>

3.4.2.1 Heat resistance performance

(1) The materials of the burner, nozzle, nozzle holder, air register, pilot piping and heat exchange part shall not be molten when kept for one hour in a gas or electric furnace of which temperature is 500℃.

(2) The metallic materials of the governor and the parts from the gas connector to the inlet of the nozzle holder shall not be molten when kept for one hour in a gas or electric furnace of which temperature is 350℃.

3.4.2.2 Gas resistance performance

3.4.2.2.1 The (rubber) packing and plastic material in the parts in contact with gas in the combustor which uses liquefied petroleum gas shall have a rate of change (weight) not exceeding 20% after being immersed for no less than 72 hours in n-pentane of which temperature is 5 to 25℃ and being left alone in the atmosphere for 24 hours, and shall be free from softening or brittleness which is harmful to their use.

3.4.2.2.2 The rate of change (weight) of the sealing material in the parts in contact with gas shall not exceed 10% for a gas temperature of 20℃ and 25% for a gas temperature of 4℃ after being left for one hour in butane gas at 5.0 kPa in a constant temperature tank of which temperature is 4 to 20℃.

3.4.2.3 Corrosion resistance performance

The corrosion resistance test of the metallic materials shall be performed in accordance with KS D 9502 (Neutral, Acetic and Copper-Accelerated Acetic Acid Salt Spray) for 24 hours and the metallic materials shall be free of corrosion. Painted metallic materials shall be free from rust, blistering and peeling after 24-hour salt water spray test on their paint films.

3.4.3 Operation performance <Revised on December 28, 2012>

3.4.3.1 Electric ignition performance

The electric ignition unit shall successfully ignite no less than 8 times when it is operated 10 times and shall not successively fail twice to ignite.

3.4.3.2 Heat input performance

The tolerances of the total heat input of the gas heater and the heat input of each burner shall be within ±10% of their indicated values.

3.4.3.3 Electromagnetic wave conformity performance

The electromagnetic wave of a gas heater with an electronic controller shall conform to the following standard and the test method shall conform to the latest edition of IEC 61000-4 Series.

(1) Tolerance test of electric fast transient phenomena

After the test equipment and its installation condition are set in accordance with IEC 61000-4-4, each of the test level voltages of standby, operation and locking modes as shown in Table 3.4.3.3(1) shall be impressed while the gas heater is being impressed with the rated voltage. At this time, the gas heater shall be normally operating in accordance with the performance standard of this code at Severity Level 2 and maintain a safe condition at Severity Level 3. However, in case it is specified in the operation manual that the cable length shall not exceed 3 m, the tests of I/O signals, data and control terminals are not performed.

Table 3.4.3.3.(1) Electrostatic Discharge Test Levels of Electric Fast Transient Phenomena

Severity Level	Power Supply Terminal (kV)	I/O Signals, Data, Control Terminals (kV)
2	1.0	0.5
3	2.0	1.0

(2) Tolerance test of instantaneous power failure and voltage drop

After the test equipment and its installation condition are set in accordance with IEC 61000-4-11, the gas heater shall be impressed with the test voltage for the duration shown in Table 3.4.3.3.(2). At this time, instantaneous power failure and voltage drop shall be respectively performed 3 times or more at the random phase of the rated frequency while the gas heater is in each of standby, operation and locking modes. The interval of instantaneous power failure or voltage drop shall not be less than 10 seconds, In case the continuation period of instantaneous power failure or voltage drop is not over one cycle, the gas heater shall be normally operating in accordance with the performance standard of this code. In case the continuation period exceeds one cycle, the gas heater shall maintain a safe condition.

Table 3.4.3.3.(2) Instantaneous Power Failure and Voltage Drop

Test Level	Continuation Period (cycle)	% of Rated Voltage or Rated Voltage Range against Average Voltage	
		50% (voltage drop)	0% (power failure)
1	0.5	Not tested	○
	1.0	Not tested	○
2	2.5	○	○
	25	○	○
	100	○	○

(3) Instantaneous voltage variation test

After the test equipment and its installation condition are set in accordance with IEC 61000-4-11 and the gas heater is impressed with the rated voltage, the following test levels shall be impressed while the gas heater is in each of standby, operation and locking mode. At this time, the impression shall be performed three times at intervals of 10 seconds.

① The gas heater shall be normally operating at 85 to 110 % of the rated voltage if AC power is used and at 80 to 120 % of the rated voltage if DC power is used.

② The gas heater shall have no stability problem when tested in a voltage condition less than 85% of the rated voltage if AC power is used or in a voltage condition less than 80% of the rated voltage if DC power is used.

(4) Surge tolerance test

After the test equipment and its installation condition are set in accordance with IEC 61000-4-5 and the gas heater is impressed with the rated voltage, the test levels in Table 3.4.3.3.(4) shall be impressed while the gas heater is in each of standby, operation and locking mode. At this time, the gas heater shall be normally operating in accordance with the performance standard of this code at Severity Level 2 and maintain a safe condition at Severity Level 3. However, if locking mode cannot be generated, pulse shall be impressed in a shutoff condition.

Table 3.4.3.3(4) Surge Test Level

Severity Level	Between Lines (kV)	Between Line and Terminal (kV)
2	0.5	1.0
3	1.0	2.0

(5) Electrostatic discharge tolerance test

After the test equipment and its installation condition are set in accordance with IEC 61000-4-2 and the gas heater is impressed with the rated voltage, the test levels in Table 3.4.3.3.(5) shall be impressed while the gas heater is in each of standby, operation and locking mode. At this time, the gas heater shall be normally operating in accordance with the performance standard of this code at Severity Level 2 and maintain a safe condition at Severity Level 3.

Table 3.4.3.3(5) Electrostatic Discharge Test Level

Severity Level	Contact Discharge (kV)	Aerial Discharge (kV)
2	4	4
3	6	8

3.4.3.4 Combustion state performance

The detailed test methods of combustion state performance shall conform to Appendixes B and C.

3.4.3.4.1 Windless state

(1) Flames shall be certainly propagated and be free from explosive ignition.

(2) There shall be no lifting after 15 seconds from the ignition.

(3) Flames shall not be extinguished after 15 seconds from the burner ignition.

(4) Flames shall be uniform.

(5) The burner shall not backfire until 30 minutes after the burner ignition.

(6) The combustion noise of a gas heater other than an industrial gas burner shall not be over 60 dB and the explosion noise 80 dB at burner extinguishment.

(7) CO concentration in theoretical dry combustion gas shall not be over 0.10 % (0.07% for open type).

(8) Soot shall not be generated.

(9) Yellow flame shall not be always in touch with the electrode of the ignition unit and the heat exchange part.

(10) The flames of the pilot burner shall not be extinguished or backfire when visually checked until 15 minutes after its ignition.

(11) In the case of a CF type gas heater, there shall be no leakage of combustion gas except in the exhaust opening.

3.4.3.4.2 Windy state

(1) In the case of gas heaters other than open type gas heaters, there shall be no flame extinguishment, backfire or overflowing flames which may cause difficulties in operation.

(2) In the case of gas heaters other than open type gas heaters, there shall be no flame extinguishment or backfire in the pilot burner.

(3) CO concentration in the combustion gas of BF type and FF type gas heaters shall not be over 0.20%.

(4) In BF-W type, FF type and RF type gas heaters, flames shall be firmly propagated and there shall be no explosive ignition.

3.4.3.4.3 Exhaust closure state

In the case of CF type gas heaters, CO concentration in theoretical dry combustion gas leaked from places other than exhaust tubes shall not be over 0.2%

3.4.3.5 Flame supervision device performance

The opening time and closing time of the valve shall not be over 45 seconds and 90 seconds respectively.

3.4.3.6 Excessive wind pressure safety device performance

In the case of a forced exhaust type gas heater, the gas passage shall be shut off before backfire or flame overflow is generated due to wind pressure over 0.08 kPa (0.05 kPa for a gas heater of which heat input is not over 15.1 kW).

3.4.3.7 Exhaust closure safety device performance

In the case of a forced exhaust type gas heater, the gas passage of the burner shall be shut off and not be automatically opened again before flame extinguishment, backfire or flame overflow is generated or within five minutes.

3.4.3.8 Overheat prevention safety device performance

The test shall be performed by a test method used when temperature is abnormally raised, and the gas passage shall be shut off when the temperature of the wooden wall, wooden support or wooden frame is not over 100℃ and not be automatically opened again.

3.4.3.9 Anti-toppling safety device performance

The gas passage to the burner shall be shut off within 10 seconds after the gas heater is toppled, and not be automatically opened again.

3.4.3.10 Incomplete combustion prevention safety device or oxygen deficiency safety device performance

3.4.3.10.1 The incomplete combustion prevention device shall shut off the gas passage within 0.10%.

3.4.3.10.2 The oxygen deficiency safety device shall shut off the gas passage in an oxygen concentration range of 17.5 to 19.4 %.

3.4.3.11 Low temperature shutoff device performance

In the case of catalyst type gas heaters, the discharge amount of hydrocarbon shall not exceed 0.07% when the gas flow rate is 110% of the shutoff flow rate.

3.4.3.12 Electric performance

3.4.3.12.1 When the boiler may use 220 V or 110/220V and the rated voltage is impressed, the maximum power consumption shall be measured in a state that the input is constant, and the

error shall not be over the tolerance specified in Table 3.4.3.12.1.

Table 3.4.3.12.1 Tolerance of Rated Power Consumption

Kind of Equipment	Rated Input (W)	Tolerance
All equipment	≤25	+20%
Electric heater and compound equipment	25< to ≤200	±10%
	200<	(The greater of +5% or 20 W) - 10%
Motor-driven equipment	25< to ≤300	+20%
	300<	The greater of +15% or 60 W

[Remarks] In the case of the compound equipment of which motor input exceeds 50% of the total rated input, the tolerance specified for the motor-driven equipment shall be applied as the tolerance.

3.4.3.12.2 Leakage current

The allowable value of leakage current shall not be over a value specified in Table 3.4.3.12.2.

Table 3.4.3.12.2 Reference Value of Leakage Current Test

Equipment	Leakage Current (in standby and in operation)
Motor-driven equipment	≤3.5 mA
Electric heater	The greater of 0.75 mA or 0.75 mA per kW of rated input of the equipment but not over 5 mA

3.4.3.12.3 Electric shock protection test

The results of electric shock protection test shall conform to the followings:

3.4.3.12.3.1 The test finger and test pin specified in KS C IEC 61032 shall not be in contact with a live part not less than 42.4 Vac (peak value) or 42.4 Vdc in a gas heater.

3.4.3.12.3.2 The live parts shall be protected with an enclosure or at least with a protection wall in conformity to the requirements of IP2X (protection class for solid ingress) of KS C IEC 60529. The surface of an easily accessible enclosure or protection wall shall conform to the requirements of IP3X (protection class for solid ingress).

3.4.3.12.4 Grounding continuity test

After the greater of 1.5 times the rated current of the equipment or 25A is impressed between the grounding terminal or grounding electrode and a metal part which may be touched by man using DC or AC power of which no-load voltage is not over 12 V, the resistance value calculated from

the current and the voltage drop shall not be over 0.1Ω.

3.4.3.13 Temperature rise performance

The difference between the temperature of each of the following parts and the ambient temperature shall not exceed a temperature specified in Table 3.4.3.13① (in normal operating state) and Table 3.4.3.13② (at abnormal temperature rise) when the gas heater is in normal operation and when the temperature abnormally rises (restrictive to forced convention type gas heaters).

Table 3.4.3.13 Temperature Rise at Each Part

Parts to Be Measured		Temperature Rise (K)
Parts to be touched by the hand for operation (handles)	Metal	35
	Ceramic	45
	Plastic	60
Parts in danger of being touched by the hand	Metal	65
	Ceramic	80
	Plastic	100
Surface of dry battery		35
Parts through which gas flows in the body of a gas shutoff valve		65
Surface of gas connector (exclusive of threaded connector)		40
Surface of ignition unit		65
Surface of governor		50
Surface of wooden wall behind a combustor		65
Ceiling surface over a (wall-mounted) combustor or floor surface under a (floor-mounted) combustor		65
Surfaces of wooden walls beside a combustor		65
Surface of wooden wall around exhaust tube		65

[Remarks] The exhaust gas temperature of a gas heater except an open type gas heater shall not be over 260℃.

Table 3.4.3.13.2 Temperature Rise at Each Part in Abnormality

Measured Part	Temperature Rise (K)
Surfaces of wooden walls at the back of, beside, over and under a gas heater	100
Surface of wooden wall which supply air/exhaust tubes penetrate	100
Surface of wooden wall around exhaust tube	100

3.4.3.14 Temperature rise in windings

Temperature rise in windings shall be measured by the resistance method and the temperature rise shall not exceed a value in Table 3.4.3.14. However, in case the windings are irregular or contact with the windings for temperature measurement is difficult, the temperature rise shall be measured using thermocouples.

Table 3.4.3.14 Temperature Rise in Windings

Insulation Class (KS C IEC 60085)	Temperature Rise (K)
Class A insulation	75 (65)
Class E insulation	90 (80)
Class B insulation	95 (85)
Class F insulation	115
Class H insulation	140

[Remarks] In case thermocouples are used (except for AC motors), the values in ( ) shall be used. The insulation class shall be specified by the manufacturer.

3.4.3.15 Semi-enclosure resistance test

In the case of forced convection type gas heaters, the gas heaters shall not set gauze aflame or flames shall not come out from them.

3.4.3.16 Continuous combustion test

(1) The gas tightness of the gas passage shall conform to 3.4.1.1.

(2) Flames shall not go out or backfire and the CO concentration shall not be over 0.10% (0.07% for open type gas heaters).

(3) In the case of a forced convection type gas heater, the heat exchange part shall be free from any abnormality.

(4) In the case of a radiation type gas heater, the radiation part shall be free from any abnormality.

3.4.3.17 Gas tightness at between gas heater and exhaust tube

The maximum leakage at between an enclosed type gas heater and the connection part of the exhaust tube shall not be over 20 m^3/h and the indicated gas input rating shall not be over kW x 0.860 m^3/kWh when an air pressure of 0.1 kPa is applied.

3.4.3.18 Efficiency

3.4.3.18.1 The radiation efficiency of gas heaters other than catalyst type gas heaters shall not be

less than 17%.

3.4.3.18.2 The thermal efficiency of gas heaters other than open type gas heaters shall not be less than 60%.

3.4.3.19 The hot air temperature of a forced convection type gas heater shall not be over 80℃.

3.4.3.20 The humidification quantity shall not be less than the indicated humidification quantity.

3.5 Heat Treatment (currently not used)

3.6 Marking

Gas heaters shall be marked in accordance the following provisions so that they can be safely used.

3.6.1 Product marking

A nameplate and a handling instruction marking shall be attached to each gas heater in a conspicuous place by an un-detachable method, and the nameplate shall be marked with the followings:

(1) Name of combustor (gas heater)
(2) Type (Model No.) of the manufacturer
(3) Type of gas used (usable gas group for city gas) and working gas pressure
(4) Heat input: kw (kg/h for liquefied petroleum gas, kcal/h for city gas)
(5) Manufacture number (lot number) and date of manufacture (import date for imported products) <Revised on December 13, 2018
(6) Warranty period and service
(7) Name or symbol of manufacturer (name of importer for imported goods)
(8) Rated voltage (V) and power consumption (W) (only for the gas heaters using electricity)

3.6.2 Acceptance marking

Gas heaters shall be marked with an acceptance mark to be easily identified as gas heaters which have passed the inspection in accordance with the Act, Article 39, Clause 2. <Revised on November 4, 2015>

3.6.2.1 The acceptance mark shall be as shown in Figure 3.6.2.1. <Revised on June 26, 2012>

Figure 3.6.2.1 Acceptance Mark

3.6.2.1.1 The size of the acceptance mark shall be 30 mm (width) by 30 mm (height).

3.6.2.1.2 The colors of the acceptance mark shall be yellow on its background and black in its letters.

3.6.2.2 In case the gas heaters are manufactured by an integrated production process, the acceptance marks may be marked during their production process.

3.6.3 Enclosure of manual

The gas heater shall be provided with its handling manual appropriate to the kind of gas to be used and its service environment for its safe use.

3.6.4 Marking of gas safety rule

The gas heater shall be marked with the safety rule in accordance with the following standard for its safe use. However, in case the president of Korea Gas Safety Corporation acknowledges that it is not necessary to separately mark the safety rule, the safety marking may not be included.

3.6.4.1 The gas safety rule shall be marked or attached near the gas heater cock or in a place conspicuous when the range cock is opened or closed.

3.6.4.2 The size, form and color of the gas safety rule marking shall match with the construction and appearance of the gas heater.

3.6.4.3 The gas safety rule shall be marked with the phrases or pictures of the following examples in consideration of their characteristics:

[Examples]

"Keep gas safety in our daily life!"

"Check on gas leak."

"Check out before use, check out after use"

"Caution: Ventilation!"

4. Inspection Standard

4.1 Kinds of Inspections

Gas appliance inspections are classified into manufacturing facility inspection and product inspection.

4.1.1 Manufacturing facility inspection

The manufacturing facilities of a person who intends to manufacture gas heaters in accordance with the Act, Article 36, Clause 2 shall undergo manufacturing facility inspection when the installation or modification of the gas heater manufacturing facilities has been completed. <Revised on November 4, 2015>

4.1.2 Product inspection

A person who intends to manufacture or import gas heaters in accordance with the Act, Article 39, Clause 1 shall undergo the following inspections in order to check on and maintain the performance of the gas heaters. However, inspection of the gas appliances specified in the Enforcement Decree may be omitted in whole or in part. <Revised on November 4, 2015>

4.1.2.1 Design stage inspection

In case a product comes under one of the following cases in accordance with the Enforcement Regulation, Table 7, the product shall undergo design stage inspection. However, in case the test report certified by Korea Gas Safety Corporation or an authorized test and inspection agency is submitted, the design stage inspection of the relevant part may be exempted.

(1) A gas appliance manufacturer manufactures a specific product type for the first time.

(2) A gas appliance importer imports a specific product type for the first time.

(3) The material or construction of the products of which type has undergone design stage inspection is changed and the performance of the products is changed.

(4) The product type has undergone design stage inspection but five years have elapsed from its last inspection date.

4.1.2.2 Production stage inspection

The gas heaters of which type has passed design stage inspection in accordance with the

Reinforcement Regulation, Table 7 shall undergo production stage inspection in accordance with the following provisions. In this case, one of product identification inspection, production process inspection or comprehensive process inspection in conformity to Table 4.1.2.2 may be selected as the production stage inspection and be performed depending on self inspection capability and quality control capability.

Table 4.1.2.2 Kinds, Units and Intervals of Production Stage Inspections

Kind of Inspection	Object	Composition Item	Inspection Unit	Interval
Product Identification Inspection	Items other than the objects of production process inspection or comprehensive process inspection	Regular quality inspection	Type	Once every 2 months
		Routine sample inspection	Type	At every application
Production Process Inspection	Items satisfying the conformity requirements of quality system for production process/self inspection process	Regular quality inspection	Type	Once every 3 months
		Process identification inspection	Item	Once every 3 months
		Occasional quality inspection	Representative type	Twice a year or more often
Comprehensive Process Inspection	Items satisfying the conformity requirements of quality system for total process (design, manufacturing and self inspection)	Comprehensive quality control system audit	Item	Once every 6 months
		Occasional quality inspection	Representative type	Once a year or more often

4.1.2.2.1 Product identification inspection shall be performed as follows:

(1) Product identification inspections are classified into regular quality inspection and routine sample inspection and each inspection shall be separately performed. In this case, routine sample inspection is performed when the product has passed regular quality inspection.

(2) Products of which type has passed the inspection in accordance with (1) shall undergo regular quality inspection once every two months. However, regular quality inspection is omitted for the same type products of which manufactured or imported quantity does not exceed 20 units a month.

(3) Routine sample inspection shall be performed in accordance with (1) for the type of products whenever the application for their inspection is made.

4.1.2.2.2 Production process inspection shall be performed as follows:

(1) Production process inspections shall be classified into regular quality inspection, process identification audit and occasional quality inspection, and each inspection or audit shall be separately performed.

(2) The process identification audit of the products of which audit is applied for shall be performed when the applicant has 3-month or longer implementation experience of the quality system documented in accordance with Appendix A.
(3) Occasional quality inspection shall be performed twice a year or more often without prior notice on the product items which have undergone regular quality inspection and process identification audit.
(4) Occasional quality inspection shall be performed for one representative type of products by the same method as that of regular quality inspection.
(5) A person who has undergone production process inspection may apply for product identification inspection as required.

4.1.2.2.3 Comprehensive process inspection shall be performed as follows:
(1) Comprehensive process inspections shall be classified into comprehensive quality control system audit and occasional quality inspection, and each audit or inspection shall be separately performed.
(2) The comprehensive quality control system audit of the products of which audit is applied for shall be performed when the applicant has 3-month or longer implementation experience of the quality system documented in accordance with Appendix A.
(3) Occasional quality inspection shall be performed once a year or more often without prior notice on the products which have undergone comprehensive quality control system audit.
(4) Occasional quality inspection shall be performed for one representative type of products by the same method as that of regular quality inspection.
(5) A person who has undergone comprehensive process inspection may apply for product identification inspection as required.

4.2 Object Audit of Process Inspection

4.2.1 Application for audit

A gas appliance manufacturer who has 3-month or longer gas appliance manufacturing experience in accordance with Appendix A may apply for production process inspection or comprehensive process inspection.

4.2.2 Audit method

The audit is performed for the persons who are to undergo process inspection, who have failed process inspection or who apply for process re-inspection in accordance with 4.4.2.2.2(5).

4.2.2.1 Audit of new applicants, persons who failed process inspection and persons who apply for re-inspection

The audit standard for process identification audit or comprehensive quality control system audit for the persons who apply for process inspection, who have failed process inspection or who apply for process re-inspection in accordance with 4.4.2.2.2(5) (hereinafter referred to as "process inspection applicants") shall conform to Appendix A.

4.2.2.2 Regular audits

In the case of process identification audit which is performed once every 3 months and comprehensive quality control system audit which is performed once every 6 months, the maintenance states of the quality system specified in Appendix A such as changes, process management, self inspection and use of acceptance marks in the period are audited. The audit for production process inspection or comprehensive process inspection is performed as follows:

4.2.2.2.1 Comprehensive process inspections shall be classified into comprehensive quality control system audit and occasional quality inspection, and each audit or inspection shall be separately performed.

4.2.2.2.2 The comprehensive quality control system audit of the products of which audit is applied for shall be performed when the applicant has 3-month or longer implementation experience of the quality system documented in accordance with Appendix A.

4.2.2.2.3 Occasional quality inspection shall be performed once a year or more often without prior notice on the products which have undergone comprehensive quality control system audit.

4.2.2.2.4 Occasional quality inspection shall be performed for one representative type of products by the same method as that of regular quality inspection.

4.2.2.2.5 A person who has undergone comprehensive process inspection may apply for product identification inspection as required.

4.2.3 Adjudication committee

Korea Gas Safety Corporation shall establish an adjudication committee as follows to deliberate the matters related to the judgment of acceptance or rejection of the results of production process inspection and comprehensive process inspection.

4.2.3.1 The adjudication committee shall be comprised of no more than 5 members including one

chairperson.

4.2.3.2 The members of the committee shall be commissioned by the president of Korea Gas Safety Corporation from among persons who have extensive knowledge and experience in gas safety or quality control and persons who can represent consumers' right to secure open and aboveboard deliberation.

4.2.3.3 Necessary matters concerning the operation of the committee shall be prescribed by the president of Korea Gas Safety Corporation.

4.3 Inspection Items

4.3.1 Manufacturing facility inspection

Manufacturing facility inspection shall be performed on the following items in accordance with the Enforcement Regulation, Table 7 to check whether the manufacturing facilities and inspection facilities are fully furnished:

(1) Conformity of manufacturing facilities in accordance with 2.1, and

(2) Conformity of inspection facilities in accordance with 2.2.

4.3.2 Product inspection

Inspection of the gas heaters shall be classified into design stage inspection and production stage inspection, and each inspection shall be separately performed in accordance with the Enforcement Regulation, Table 7 to check whether the gas heaters are manufactured in accordance with the manufacturing standard:

4.3.2.1 Design stage inspection

The inspection items of design stage inspection to check whether the gas heaters conform to the manufacturing standard are as follows. However, in case the test report on a part of which performance is certified by Korea Gas Safety Corporation or an authorized test and inspection agency is submitted, the design stage inspection of that part may be exempted.

(1) Conformity of materials in accordance with 3.1

(2) Conformity of construction and dimensions in accordance with 3.2

(3) Conformity of devices in accordance with 3.3

(4) Conformity of performance in accordance with 3.4

(5) Conformity of marking in accordance with 3.6

4.3.2.2 Production stage inspection

The inspection items of production stage inspection by inspection kinds to check whether the gas heaters conform to the manufacturing standard are as follows.

4.3.2.2.1 Product identification inspection <Revised on December 28, 2012>

(1) Regular quality inspection

(1-1) Conformity of construction in accordance with 3.2

(1-2) Conformity of devices in accordance with 3.3

(1-3) Conformity of insulation resistance performance in accordance with 3.4.1.4

(1-4) Conformity of withstand voltage performance in accordance with 3.4.1.5

(1-5) Conformity of gas passage tightness performance in accordance with 3.4.1.2

(1-6) Conformity of electric ignition performance in accordance with 3.4.3.1

(1-7) Conformity of combustion state performance in accordance with 3.4.3.4.1. However, except for continuous noise and extinguishing noise, the test gas may be the gas with which the performance is tested.

(1-8) Conformity of safety device functioning performance in accordance with 3.4.3.5, 3.4.3.6 and 3.4.3.9

(2) Routine sample inspection

(2-1) Conformity of gas passage tightness performance in accordance with 3.4.1.1.2

(2-2) Conformity of combustion state performance in accordance with 3.4.3.4.1 However, except for CO, combustion noise and extinguishing noise, the test gas may be the gas with which the performance is tested.

(2-3) Conformity of marking in accordance with 3.6

4.3.2.2.2 Production process inspection

(1) Regular quality inspection

The inspection items of regular quality inspection shall conform to 4.3.2.2.1(1).

(2) Process identification audit

The audit items of process identification audit shall conform to Table 4.3.2.2.

(3) Occasional quality inspection

The inspection items of occasional quality inspection shall conform to 4.3.2.2.1(1).

4.3.2.2.3 Comprehensive process inspection

(1) Comprehensive quality control system audit

The audit items of comprehensive quality control system audit shall conform to Table 4.3.2.2.

(2) Occasional quality inspection

The inspection items of occasional quality inspection shall conform to 4.3.2.2.1(1).

Table 4.3.2.2 Items of Process Identification Audit and Comprehensive Quality Control System Audit

<Revised on January 8, 2016>

Classification		Audit Item	Application	
			Process Identification Audit	Comprehensive Quality Control System Audit
General Matters	Organization	Securement of organizations with appropriate technical and business capability	○	○
		Possession of a research or development organization to reflect the causes of potential troubles to product design		○
	Quality System	Operation of appropriate quality system and review of operation results	○	○
	Human Resource	Maintenance of appropriate qualification of employees affecting quality	○	○
	Facility & Equipment	Securement of facilities and equipment conforming to product requirements and quality control	○	○
Design	Design & Development	Securement of design and development system conforming to product requirements		○
		Verification of product design through analysis of effects of potential troubles and assessment of reliability, and supply of output results		○
		Check on feasibility of design and development and operation of change procedure		○
Manufacturing	Purchase	Maintenance of appropriate management system for purchased materials	○	○
		Reflection of evaluation of suppliers to purchase policy		○
	Production	Possession of production process conforming to product requirements and verification of implementation	○	○
		Possession of acceptance criteria for process approval	○	○
		Verification of process management capability utilizing statistical technique		○
		Operation of control plan and work guidelines		○
		Preventive and forecast maintenance and operation of production tool management system		○
		Operation of systems for handling and storage of materials and products	○	○
Self-Inspection	Inspection Method & Procedure	Maintenance of methods and procedures for inspection to secure product conformity	○	○
		Maintenance of the acceptance criteria for tally data sampling at zero defect level		○
		Maintenance of traceability for determination	○	○

		of measuring devices and guarantee of effective results, and maintenance of procedure for record management		
		Analysis of measurement system		○
		Self inspection of whole items of design stage inspection (once a year)	○	
		Self inspection of whole items of design stage inspection (twice a year)		○
	Correction & Preventive Measures	Management of unconformity items and operation of preventive measures for recurrence prevention	○	○
	Internal Audit	Possession of capability to maintain system conformity	○	○
Obligation	Acceptance Marking	Maintenance of documented management regulation for acceptance marking	○	○
		Maintenance of separate documented regulation for manufacturing acceptance marks		○
	Safety Control	Prevention of accidents due to faulty products and circulation of unconformity products	○	○
Others		Other matters related to maintenance of safety	○	○

4.4 Inspection Method

4.4.1 Manufacturing facility inspection

The inspection method of manufacturing facilities is checking whether manufacturing facilities and inspection facilities conforming to 4.3.1 are fully furnished. In case all required facilities are fully furnished, the inspection results shall be deemed acceptable.

4.4.2 Product inspection

4.4.2.1 Design stage inspection

Design stage inspection shall be performed in accordance with the standard specified by the president of Korea Gas Safety Corporation to judge whether each inspection item conforms to the manufacturing standard.

4.4.2.2 Production stage inspection

The inspection method of production stage inspection shall conform to the followings for each inspection item to judge whether the item is manufactured in accordance with the manufacturing standard.

4.4.2.2.1 Product identification inspection

(1) Sampling

(1-1) The number of test specimens for regular quality inspection shall be two.

(1-2) The sampling standard for routine sample inspection shall be as follows:

(1-2-1) The same products manufactured in the same production unit shall be one lot.

(1-2-2) The number of test specimens to be taken from the lot formed in accordance with (1-2-1) shall conform to Table 4.4.2.2.1(1).

Table 4.4.2.2.1(1) Number of Test Specimens for Routine Sample Inspection

Number of Products Forming 1 Lot	10 and less	11 to 100 inclusive	101 to 300 inclusive	301 to 700 inclusive	701 to 3000 inclusive	3001 and over
Number of Test Specimens	All	10 or over	15 or over	20 or over	25 or over	1/100 of quantity applied for inspection

(2) Judgment of acceptance or rejection

(2-1) Product identification inspection shall be performed by performing both of regular quality inspection and routine sample inspection, and the products which have passed both inspections shall be deemed acceptable.

(2-2) Routine sample inspection shall be performed on sampled test specimens. All the products in the lot which has passed the inspection shall be deemed acceptable, and all the products in the lot which has failed the inspection shall be deemed rejected.

4.4.2.2.2 Process inspection

(1) Sampling

The number of test specimens for the regular quality inspection and occasional quality inspection of production process inspection and comprehensive process inspection shall be two.

(2) Judgment of acceptance or rejection

(2-1) Judgment of acceptance or rejection on process inspection applicants

Judgment of acceptance or rejection on production process inspection or comprehensive process inspection for process inspection applicants shall be as follows. In this case, previous inspection results shall be valid until the decision of the adjudication committee meeting.

(2-1-1) Korea Gas Safety Corporation shall prepare the report on the results of regular quality inspection and process identification audit or comprehensive quality control system audit and submit it to the adjudication committee.

(2-1-2) The adjudication committee shall deliberate the submitted report and determine its

acceptance or rejection. In this case, if it is judged that part of quality system shall be complemented according to the deliberation results, conditional acceptance may be granted.

(2-1-3) In case a product has passed regular quality inspection by types and process identification audit for the item, the product shall be deemed to have passed production process inspection.

(2-1-4) In case a product has passed comprehensive quality control system audit, the product shall be deemed to have passed comprehensive process inspection.

(2-2) Judgment of acceptance or rejection on regular process inspection

Judgment of acceptance or rejection on the production process inspection performed once every 3 months and the comprehensive process inspection performed once every 6 months shall be as follows:

(2-2-1) Korea Gas Safety Corporation shall perform regular quality inspection and process identification audit or comprehensive quality control system audit and determine the acceptance or rejection.

(2-2-2) In case a product has passed regular quality inspection by types and process identification audit for the item, the product shall be deemed to have passed production process inspection.

(2-2-3) In case a product has passed comprehensive quality control system audit, the product shall be deemed to have passed comprehensive process inspection.

(2-3) Judgment of acceptance or rejection on occasional quality inspection

Judgment of acceptance or rejection on occasional quality inspection shall be made by Korea Gas Safety Corporation by performing the inspection by the same method as that of regular quality inspection.

(3) Treatment of inspection results

(3-1) Treatment of inspection results of process inspection applicants

The results of the production process inspection or comprehensive process inspection of a process inspection applicant shall be treated as follows:

(3-1-1) In case the inspection results are accepted in their deliberation, Korea Gas Safety Corporation shall issue the acceptance notification to the applicant.

(3-1-2) In case the inspection results are conditionally accepted in their deliberation, the treatment shall conform to the followings:

(3-1-2-1) The applicant shall submit the complement results of quality control system to Korea Gas Safety Corporation within one month.

(3-1-2-2) Korea Gas Safety Corporation shall review the submitted complement results, and accept the inspection results if it is confirmed that the complement has been completed.

(3-1-2-3) In case the applicant who has been conditionally accepted fails to submit the complement results within the time limit, Korea Gas Safety Corporation shall reject the inspection results.

(3-1-3) In the case of rejection in deliberation, it shall be treated as follows:

(3-1-3-1) Korea Gas Safety Corporation shall notify the details of unconformity to the applicant and then perform product identification inspection.

(3-1-3-2) In case an applicant who has been notified the unconformity intends to undergo production process inspection or comprehensive process inspection, the applicant may apply for production process inspection or comprehensive process inspection after 3 months from the date of the unconformity notification issued by Korea Gas Safety Corporation.

(3-1-3-3) Applicants who have failed comprehensive process inspection may convert the inspection to production process inspection.

(3-2) Treatment of results of regular process inspection

Treatment of the results of the production process inspection performed once every 3 months and the comprehensive process inspection performed once every 6 months shall be as follows:

(3-2-1) In case the inspection results are accepted, Korea Gas Safety Corporation shall inform the applicant of the acceptance of production process inspection or comprehensive process inspection.

(3-2-2) In case the inspection results are rejected, Korea Gas Safety Corporation shall inform the applicant of the details of unconformity, withdraw the conformity notification and then perform product identification inspection.

(3-2-3) In case an applicant who has been notified the unconformity intends to undergo production process inspection or comprehensive process inspection, the applicant may apply for production process inspection or comprehensive process inspection after 3 months from the date of the unconformity notification issued by Korea Gas Safety Corporation.

(3-3) Treatment of results of occasional quality inspection

The results of quality inspections performed occasionally shall be treated as follows:

(3-3-1) In case a manufacturer or an importer fails occasional quality inspection, Korea Gas Safety Corporation shall inform the manufacturer or importer of the details of unconformity and then perform the second occasional quality inspection.

(3-3-2) The number of test specimens for the second occasional quality inspection shall be twice the number of test specimens for the first occasional inspection.

(3-3-3) In case the manufacturer or importer fails the second occasional quality inspection, the products shall be rejected, product identification inspection shall be performed and collection inspection shall be performed for the relevant type.

(3-3-4) In case an applicant who has been notified the unconformity intends to undergo production process inspection or comprehensive process inspection, the applicant may apply for production process inspection or comprehensive process inspection after 3 months from the date of the unconformity notification issued by Korea Gas Safety Corporation.

(4) Suspension or change of kind of inspection

In case a person who is subject to production process inspection or comprehensive process inspection in accordance with the Enforcement Regulation, Table 7, No.3 intends to suspend

production of an inspection object item for no less than 6 months or to change the kind of inspection, the person shall notify the matter to Korea Gas Safety Corporation and return the acceptance notification.

(5) Process re-inspection

In case a person intends to undergo production process inspection or comprehensive process inspection in accordance with the Enforcement Regulation, Table 7, No.3-b and comes under one of the following cases, the person shall undergo production process inspection or comprehensive process inspection again.

(5-1) The location of the business place is changed,

(5-2) A production item is added,

(5-3) Three years have elapsed from the acceptance date of production process inspection or comprehensive process inspection. However, in case a relevant gas appliance item is added, the period shall be the remaining period of the existing item.

4.5 Other Inspection Standards

4.5.1 Inspection of imported products

In principle, inspection of imported products shall be performed in a place where the importer wants, and the costs and expenses required for inspection such as equipment and materials shall be borne by the applicant.

4.5.2 Partial omission of inspection

4.5.2.1 In case a person who undergoes production process inspection or comprehensive process inspection adds inspection items, part of process identification audit or comprehensive quality control system audit may be omitted.

4.5.2.2 In case a person whose quality assurance system has been certified by a certification body authorized in accordance with the Quality Management and Safety Control of Industrial Products Act applies for production process inspection or comprehensive process inspection, part of process identification audit or comprehensive quality control system audit may be omitted.

4.5.3 Disposal of rejected products (not applicable)

4.5.4 Detailed inspection standards

Other detailed matters necessary for design stage inspection and production stage inspection

shall conform to what the president of Korea Gas Corporation specifies.

Appendix A General Standard for Operation of Quality Control System for Gas Appliance Manufacturing Plants

1. Introduction	
	A. This standard has been established so that gas appliance manufacturers may produce safe and reliable products through production process inspection and comprehensive process inspection in production stage inspections in accordance with the Enforcement Regulation, Table 7, No.3-b-2)-b). B. This standard consists of general, design, manufacturing, self-inspection and obligations, and is intended to be used to assess whether the quality control system of a gas appliance manufacturing plant conforms to the requirements of undergoing process identification audit or comprehensive quality control system audit.
2. General	
A. Organization <Revised on January 8, 2016>	
(1)	The manufacturing plant shall have organizations which have technical and business capability to produce products satisfactory to customers and statutory requirements.
(2)	The top management shall guarantee that processes and procedures required for quality control system have been established and are being executed and maintained.
(3) 【Comprehensive】	Research and development organizations including the followings shall be maintained to study various trouble forms which can appear in design process or after extended use and to reflect them to the design. (a) Person and personnel in charge of research and development (b) Appropriate facilities and equipment required for research and development
B. Quality Control	
(1)	The manufacturer shall establish, document and implement a quality control system in accordance with the requirements of this standard.
(2)	When any change in the quality control system is planned and made, the integrity of the system shall be maintained and the system shall be updated through continuous improvement.
(3)	The top management shall present the implementation evidences for development and implementation of the quality control system and continuous improvement of its effectiveness through the followings: (a) Establishment of quality policy and quality target (b) Implementation of management review (effectiveness of quality system and improvement of products)
(4) <Newly established on January 8, 2016>	Documents necessary for quality system should be managed and documented process necessary for the management of followings should be established. (a) Approval, review, renewal and re-approval of document (b) Management in identification and distribution of document (latest edition, outsourced documents) (c) Prevention on the misuse of nullified documents
C. Human Resources	
(1)	Persons affecting product quality shall be qualified on the basis of appropriate educational background, training, expertness and experiences, and the manufacturer shall implement the followings in accordance with the written procedures: (a) Decision on qualification of personnel (b) Education and training to satisfy qualification requirements and assessment of its effectiveness (c) Maintenance of appropriate records of qualification matters

(2) 【Comprehensive】	In the case of persons in charge of design and development of products, it shall be assured that they are skillful with the tools and in the techniques to satisfy and apply the design and development requirements.
D. Facilities and Equipment	
(1) 【Interval】	Following facilities, equipment and business environment required to conform to the product requirements shall be determined, secured and maintained: (a) Buildings, business places and utilities (b) Process equipment (hardware and software) (c) Supporting services (transportation, communication, etc.)
(2) 【Interval】	The sites shall be maintained in neatly arranged and clean conditions to conform to the requirements of products and manufacturing process.
(3) 【Comprehensive】	The means to minimize potential hazards to employees shall be manifested in design, development and manufacturing activities.
3. Design	
A. Design and Development	
(1) 【Comprehensive】	Design and development capability shall be secured to materialize products conforming to the product requirements.
(2) 【Comprehensive】	The output of product design shall be provided in a form verifiable for the requirements, be approved before distribution, and include the followings: (a) Analysis results such as potential failure mode effect analysis and reliability results (b) Characteristics of products, and specifications when required (c) Measures to prevent mishandling of products, if applicable (d) Definition of products including drawings or mathematical basic data (e) Review results of product designs
(3) 【Comprehensive】	The output of process design shall be provided in a form verifiable for the requirements, be approved before its distribution, and include the followings: (a) Drawings, and specifications when required (b) Flow diagram and layout of manufacturing process (c) Analysis results such as potential failure mode effect analysis, etc. (d) Control plan (e) Work manuals (f) Acceptance criteria for process approval (g) Methods of detection of product/process unconformity and feed back
(4) 【Comprehensive】	The appropriateness of design and development shall be checked, and the records of the results of appropriateness check and all necessary measures shall be maintained.
(5) 【Comprehensive】	Changes in design and development shall be easily grasped and their records shall be maintained. Changes shall be reviewed, verified, checked for their appropriateness, and approved before their implementation, when applicable.
4. Manufacturing	
A. Purchase	
(1) 【interval】	Inspection or other activities required to ensure that purchased materials satisfy their specified purchase requirements shall be determined and implemented.
(2)	Suppliers shall be selected on the basis of their capability to supply materials conforming to the specified purchase requirements. The selection standard shall be established and all records related to the selection shall be maintained.
(3) 【Comprehensive】	Suppliers shall be regularly evaluated, their evaluation results shall be reflected in the purchase policy, and the management methods of suppliers shall be accordingly differentiated.
B. Production	

(1)	The manufacturer shall plan and implement production in the managed conditions including the followings: (a) Use of work manuals as required (b) Use of appropriate equipment (c) Measurement (d) Application of acceptance standard for judgment of process approval
(2) 【interval】	The manufacturer shall identify the states of products in connection with the measurement requirements in manufacturing stages.
(3) 【Comprehensive】 【interval】	The manufacturer shall identify the states of products in connection with the measurement requirements and traceability in manufacturing stages.
(4) 【interval】	Work preparation shall be verified whenever the work is initially started, the material is replaced or the work is changed.
(5) 【Comprehensive】	An appropriate statistical technique for each process shall be determined before mass production and be included in the control plan. Basic philosophy such as distribution and process capacity shall be utilized in the overall organization.
(6) 【Comprehensive】	The manufacturer shall establish and maintain the control plan in consideration of analysis results such as potential failure mode effect analyses in products and manufacturing processes.
(7) 【Comprehensive】 【interval】	Written work manuals shall be prepared for all personnel affecting product quality. These manuals shall be readily available for reference on work sites.
(8) 【Comprehensive】	The manufacturer shall grasp major processes and provide resources for preservation of machines, equipment, jigs and tools, and develop an overall preventive maintenance system. The system shall include the followings: (a) Planned maintenance activities (b) Packing and maintenance of equipment, tools and gauges (c) Availability of replaceable parts for major manufacturing equipment (d) Documentation, evaluation and improvement of maintenance activities (e) Identification specifying the states of production, repairs or disposal
5. Self-Inspection	
A. Inspection Method and Procedure	
(1) 【interval】	The manufacturer shall determine the inspections to be performed, and check whether products conform to specified requirements. Inspections shall be performed in relevant stages of production process.
(2) 【interval】	The evidences that inspected products conform to the acceptance criteria shall be maintained. The person who approves the shipment of the products shall be specified in the record.
(3) 【Comprehensive】 【interval】	The acceptance criteria for tally data sampling shall be of zero-defect.
(4) 【interval】	Measurements shall be made in such a way as to meet the requirements, and the measurement equipment shall be as follows to guarantee effective results: (a) Measurement equipment shall be calibrated or verified to the measurement standard traceable to the international or national standard at specified intervals or before application. In case such standards are not available, the bases for such calibration or verification shall be recorded. (b) Identification to judge the calibrated states (c) Protection from manipulation which may invalidate measurement results

	(d) Protection from damage or deterioration during handling, maintenance and storage
(5) 【interval】	The records of calibration and verification results shall be maintained, and the measured values shall be taken in calibrated states.
(6) 【Comprehensive】	Changes in measurement systems indicated in the results of measurement and test in each form shall be analyzed by a statistical method.
(7) 【interval】	The manufacturer shall inspect the whole items of design stage inspection once a year or more often and maintain the records.
(8) 【Comprehensive】 【interval】	The manufacturer shall inspect the whole items of design stage inspection twice a year or more often and maintain the records. <Revised on November 17, 2014, January 8, 2016>
(9) 【Comprehensive】	The manufacturer's laboratory shall be included in the quality system documentation by specifying the following technical requirements: a) Appropriateness of personnel, equipment and facilities b) Capability to accurately conduct tests in accordance with relevant specifications c) External laboratories authorized in accordance with KS Q ISO IEC 17025 or equivalent standard <Revised on November 17, 2014>
B. Corrective and Preventive Measures	
(1) 【interval】	It shall be assured that unconformable products and suspicious products are identified and separately managed.
(2)	Measures shall be taken to prevent recurrence of unconformity, and the followings shall be specified in the written procedure: (a) Review of unconformity (inclusive of customer complaints) (b) Determination, implementation and recording of corrective measures
(3)	The effectiveness of the quality system shall be continuously improved through utilization of quality policy, quality target, audit results, data analyses, corrective measures, preventive measures and management review.
(4)	Preventive measures shall be taken to remove potential causes of unconformity to prevent its occurrence.
C. Internal Audit	
(1)	The manufacturer shall conduct internal audits at planned intervals to check whether the quality system is effectively implemented and maintained.
(2)	Responsibility for and requirements of planning and implementation of audits, assurance of independence of audit, report of audit results and maintenance of records shall be specified in the written procedure.
6. Obligations <Revised on January 8, 2016>	
A. Acceptance marks	

(1) 【interval】	The manufacturer shall maintain a written management regulation on acceptance marks (certificates or stamps), and the records of awards, utilization, keeping and withdrawal of acceptance marks shall be updated and maintained. The management regulation shall include the followings: (a) Handling of acceptance marks (certificates or stamps) by authorized persons only (b) Use of acceptance marks subject to the approval of top management/ management representative and in accordance with the planned procedure. (c) Record of the use of acceptance marks in detail (d) Establishment of a plan to prevent misuse of acceptance marks (e) Safekeeping of acceptance marks to prevent their damage or robbery
(2) 【Comprehensive】 【interval】	The regulation on manufacturing of acceptance marks shall be separately documented, and all matters related to the manufacturing and change of acceptance marks shall be recorded and updated.
B. Safety Control	
(1)	For recent one year, the manufacturer shall be free from any accident due to product defects and there shall be no unconformity case in the sampling inspection undergone by the manufacturer.
(2) 【Comprehensive】	For recent three years, the manufacturer shall be free from any accident due to product defects and there shall be no unconformity case in the sampling inspection undergone by the manufacturer.
C. Others	
(1)	When any case which may cause quality deterioration of products or serious harm to the users breaks out, the manufacturer shall take appropriate measures.
(2)	When there is any important change in the operation of the manufacturer's quality system, the manufacturer shall inform Korea Gas Safety Corporation of the change within 15 days.

[Remarks]

1. 【Comprehensive】 means that the paragraph is applicable only to the objects of comprehensive process inspection.
2. 【Interval】 means that the paragraph is applicable to the inspection according to its inspection interval.
3. Paragraphs without any mark are common provisions for production process inspection and comprehensive process inspection.

Appendix B General Test Conditions for Gas Heaters

B1. Laboratory Condition

Item	Condition
Temperature in laboratory	The temperature in the laboratory shall be 20±15℃ and temperature variation during the test shall be ±5K.
Indoor atmosphere	The humidity in the laboratory shall be 65±20%.
Indoor atmosphere	Carbon dioxide shall not be over 0.2% and carbon monoxide not over 0.002% in the indoor atmosphere.
※ The temperature in the laboratory shall be measured at four points which are about 1 m from the gas heater and are in front of, in the rear of and on the both sides of the gas heater, while the mercury bulbs of the temperature gauges are fixed at a height almost the same as that of the top of the gas heater (1.5 m if the height from the floor is over 1.5 m). The arithmetic average value of the measured temperature values shall be deemed to be the ambient temperature. However, the mercury bulbs of the temperature gauges shall not be directly affected by combustion gas or radiation heat from the equipment.	

B2. Test Gas Standard <Revised on May 20, 2013>

B2.1 The volumetric component ratio of the test gas shall be as indicated in Table B2.1 on the basis of 15℃ and 101.3 kPa.

Table B2.1 Volumetric Component Ratio of Test Gas

Gas Group	Kind of Test Gas	Component (volumetric %)						Combustibility			
		H_2	CH_4	C_3H_8	C_4H_{10}	N_2	Air O_2: 21% N_2: 79%	Gross heat value MJ/m^3N	Specific Gravity (air=1)	Webber Index (WIs) MJ/m^3N	MCP
City Gas	1	-	87.0	13.0	-	-	-	45.16 (40.90)	0.682	54.69 (49.53)	37.5
	2	23.0	66.0	11.0	-	-	-	38.07 (34.33)	0.550	51.34 (46.29)	44.1
	3	-	96.5	-	-	3.5	-	36.46 (32.82)	0.569	48.32 (43.50)	35.3
	R[b]	-	96.0	4.0	-	-	-	40.05 (36.13)	0.594	51.97 (46.89)	36.5
	S	Gas of which maximum combustion speed (MCP) is over 35.0 to 44.0 inclusive and of which WI is over 48.80{51.50} to 53.56{56.52} MJ/m^3 inclusive									
Liquefied	Propane	-	-	100.0	-	-	-	95.65	1.550	76.83	41.0

Petroleum Gas								(87.99)		(70.69)	
	Butane	-	-	-	100.0	-	-	126.21 (116.47)	2.079	87.54 (80.78)	38.0
	S	P, B or their mixed gas									
[b] In case the WI of supply gas is within ±1% of the Webber Index of R gas, the manufacturer may use it as test gas for quality control.											

[Remarks]

1. In case the condition of city gas "S" is within the range of the gas group [WI and combustion speed (replaced by the value of MCP)] and "S" is designated as test gas, the supply gas of the gas group may be used.
2. The WI according to the heat value and specific gravity of test gas (1, 2, 3 and R of city gas and P and B of liquefied petroleum gas) shall be within ±1% of the value in the above table.
3. The combustion and measurement standard condition of test gas is 15/15℃, 101.3 kPa and the values in ( ) are low heat values for reference.
4. The values in { } of S gas are the values of WI for commercial transaction and are the reference values for 15/0℃, 101.3 kPa.
5. MCO is calculated by the following formula:

$$\mathrm{MCP} = \frac{\sum(S_i f_i A_i)}{\sum(f_i A_i)}(1 - K)$$

where,

MCP: maximum combustion speed

S_i: combustion speed of combustible gas in the gas in the following table, a value indicated in the table

f_i: coefficient related to each combustible gas in the gas, a value indicated in the table

A_i: content of each combustible gas in the gas (mol %)

K: attenuation coefficient, a value calculated by the following formula:

$$K = \frac{\sum A_i}{\sum(\alpha_i A_i)}\left\{\frac{2.5CO_2 + N_2 - 3.77O_2}{100 - 4.77O_2} + \left[\frac{N_2 - 3.77O_2}{100 - 4.77O_2}\right]^2\right\}$$

where,

α: correction factor of each combustible gas in the gas, a value indicated in the table

CO_2: content of carbon dioxide in the gas (mol%)

N_2: content of nitrogen in the gas (mol%)

O_2: content of oxygen in the gas (mol%)

B2.2 Indication of test gas conditions

The conditions of the test gases used in this technical standard are indicated with the kind and pressure of the test gases and the conditions of the test gas in each paragraph of this technical standard is indicated with "kind and symbol of test gas – pressure and symbol of test gas".

(1) In the case of liquefied petroleum gas

Kind of test gas Pressure of test gas (unit)

Symbol	Kind of Test Gas
P	Propane
B	Butane
S	Propane, butane or any of mixed gas of these gases

Symbol	Pressure of Test Gas (kPa)
1 (maximum pressure)	3.3
2 (standard pressure)	2.8
3 (minimum pressure)	2.3

(2) In the case of city gas

Kind of test gas

Symbol	Kind of Test Gas
1	Gas prone to incomplete combustion
2	Gas prone to backfire
3	Gas prone to extinguishment
R[b]	Gas of which performance is tested
S	Any of 1, 2, 3 or R

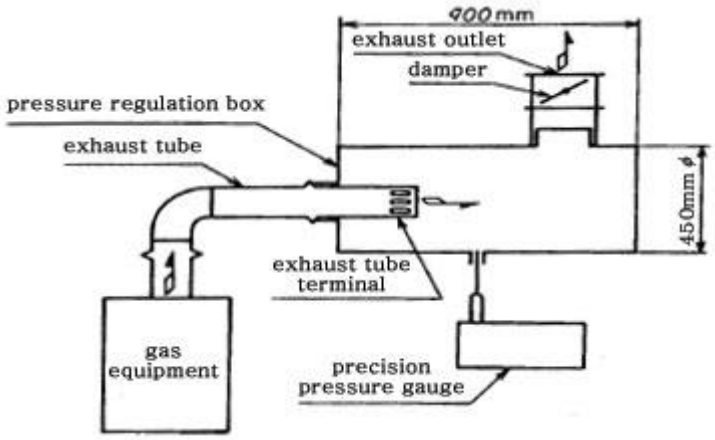
Pressure of test gas (unit)

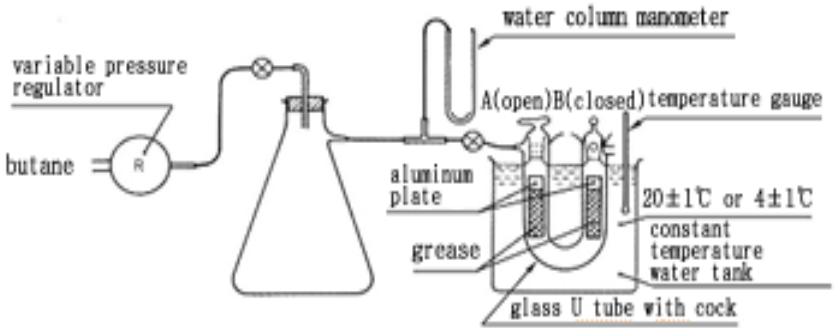
Symbol	Pressure of Test Gas (kPa)
1 (maximum pressure)	2.5
2 (standard pressure)	2.0
3 (minimum pressure)	1.0

B2.3 Conditions of test gas by combustion state test items

Test Item		Condition of Test Gas	
		Liquefied Petroleum Gas	City Gas
Flame propagation		P-2	S-2
Lifting		P-1	3-1
Extinguishment		P-1 & P-3	3-1 & 3-3
Uniformity of flame		S-2	S-2
Backfire		P-3	2-3
Continuous noise		P-1	S-1
Extinguishing noise		P-2	S-2
CO %		B-1	1-1
Soot generation		B-1	1-1
Contact with yellow flame		B-1	R-1
Flame overflow		B-1	R-1
Flame stability of pilot burner	Extinguishment	P-1 & P-3	S-1 & S-3
	Backfire	P-3	2-3
Flame stability of burner	Extinguishment	P-1 & P-3	S-1 & S-3
	Backfire	P-3	S-3
	Flame overflow	B-1	S-1

Appendix C Test Methods of Gas Heaters

C1. Exhaust Closure and Excessive Wind Pressure Safety Device Test	
Test Condition	The condition of test gas shall be S-2.
Exhaust Closure	When the exhaust outlet is closed 15 minutes after burner ignition and when the exhaust fan or combustion air fan is forcedly stopped, whether there is any flame extinguishment, backfire or flame overflow which is harmful to operation shall be checked. The time period from activation of the safety device to shutoff of the gas passage shall be measured.
Excessive Wind Pressure	The damper is adjusted and the pressure in the pressure regulation box is slowly increased, and then whether the safety device is activated and the gas passage is shut off before backfire or flame overflow is generated shall be checked.
Test Equipment	 Figure C1. Pressure regulation box [Remarks] 1. The shape and dimensions of the pressure regulation box is only for reference. Its shape and dimensions shall be appropriate for making the pressure uniform in the box. 2. The damper shall be able to easily adjust the pressure in the pressure regulation box and close the exhaust outlet. In case the exhaust outlet is not closed by the damper, a cover may be used to close the exhaust outlet. 3. The pressure in the pressure regulation box shall be measured at a point

	where the pressure is uniform. 4. The exhaust tube shall be the one specified in the gas heater manual. 5. The exhaust direction of the exhaust tube terminal shall be the longitudinal direction of the pressure regulation box.
C2. Gas Resistance Test	
Packing Test	Three test specimens of which weights have been already measured are immersed for 72 hours in n-pentane of which temperature is 2℃ to 25℃ inclusive and then taken out from the n-pentane and left in the air for 24 hours. The weight of each specimen is measured, and the weight change ratio is calculated by the following formula and the arithmetic average value of the three test specimens is obtained. $$\Delta M = \frac{M - M_o}{M_o} \times 100$$ where, ΔM: weight change ratio (%), M: weight after test (g), M_o: weight before test (g) In addition, whether there is any deterioration or deformation harmful to the use shall be visually checked.
Sealing Material Test	About 1 g of sealing material is uniformly applied to an aluminum plate, is left in a constant temperature condition for 24 hours and then the weight is measured. The sealing material is put into the U tube of the sealing material test equipment shown in the figure below and the air in the U tube is purged by butane gas by opening the cocks A and B. Cock B is closed and a butane pressure of 5.0 kPa (500 mm H2O) is maintained and temperatures of 20±1℃ and 4±1℃ are respectively maintained for one hour. The weight of the sealing material is measured at each temperature and the weight change ratio is calculated by the following formula: $$\Delta M = \frac{M - M_o}{M_o} \times 100$$ where, ΔM: weight change ratio (%), M: weight after test (g), M_o: weight before test (g)  Figure C2. Test Equipment for Gas Resistance Test

C3. Corrosion Resistance Test

Corrosion Resistant Materials

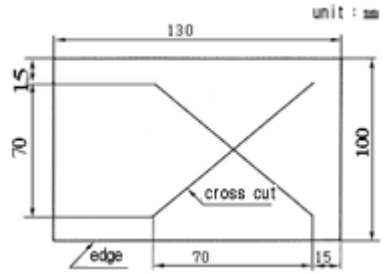
Galvanization and Painting Materials

Material	Standards of Corrosion Resistant Materials
Castings	KS D 6008
Die-castings	KS D 6005, KS D 6006
Stainless steel <Revised on November 17, 2014>	KS D 3534, KS D 3535, KS D 3536, KS D 3576, KS D 3698, KS D 3702, KS D 3705, KS D 3706
Surface-treated steel	KS D 3544
Aluminum and aluminum alloys	KS D 6701, KS D 6713, KS D 6759 KS D 6761, KS D 6763
Copper and copper alloys <Revised on November 17, 2014>	KS C 3101, KS C 3102, KS D 5101, KS C 5201, KS C 5301, KS D 5545

Salt water test shall be performed in a salt water spray laboratory in conformity to KS D 9502, 2 (Equipment) and 8 (Spray Room Condition) by spraying the salt water in conformity to 6 (Salt Solution for Test) for the specified duration and then whether there is any corrosion shall be checked.

(1) Galvanized metallic materials shall be free of corrosion or the rating number shall be 9 to 9.8 after 24-hour spray test.

(2) Cross cuts shall be made as shown in Figure C3 on the surface of a painted specimen (size: 130 X 100 mm) by applying a pushing pressure of 5 N (500 gf) with a single-edged razor knife, and then salt water shall be sprayed for 24 hours. The area outside the 2.5 mm width of the cross cut lines and the 10 mm width of the specimen edges shall be checked to see whether there is any rust or blistering. Next, after the specimen has been washed in water and dried in the room condition for 24 hours, a piece of 12 mm wide adhesive cellophane tape specified in KS T 1058 shall be attached to Cross Cut 1. It shall be checked whether there is any peeling in the area outside the 2.5 mm width of the cross cut line when the tape is pulled away perpendicularly to the painted surface. <Revised on November 17, 2014>

	 Figure C3. Test Specimen for Salt Water Spray Test on Paint Film

C4. Electric Ignition Test	
State of Equipment	The operating state and installation state of each piece of equipment shall be the same as specified by the manufacturer (in the handling manual). In the case of the exhaust tube of forced exhaust type and the air supply/exhaust tube of forced air supply/exhaust type, the tube of the minimum length shall be installed.
Test Condition	In the case of power condition, the voltage of a gas heater using dry batteries shall be 70% of the rated voltage (indicated voltage), and the voltage of a gas heater using household power shall be 90% of the rated voltage at the rated frequency. In the case of test gas condition, the condition shall be P-1 and P-3 for liquefied petroleum gas, and R-1 and R-3 for city gas. However, in product inspection, the test may be performed with the gas to be used for heating operation.
Test Method	The ignition operation shall be repeated 10 times by the ignition method specified in the handling manual or by the followings, and the number of times of ignition and flame overflow to outside the casing as well as whether there is any explosive ignition shall be checked. (1) Preliminary tests shall be conducted several times in advance. (2) The temperatures of the electric ignition device and burner shall be close to the ambient temperature for every ignition operation. (3) In principle, one cycle of ignition operation and ignition speed shall be as follows depending on the ignition source construction: (3-1) In piezoelectric ignition mode, one ignition operation shall be counted as one time for single ignition type, and the speed of one cycle of ignition operation shall be about 0.5 to 1 second. (3-2) In the piezoelectric ignition mode, one cycle shall be counted as one time for the continuous rotary type, and the speed of one cycle of ignition operation shall be the same as that of 1). (3-3) In the continuous discharge ignition mode or heater ignition mode using dry batteries or a household power source, maintenance of “ignition” position for 2 seconds shall be counted as one time.

	After the on-off operation has been repeated 12,000 times at a speed of 2 to 20 times per minute, electric ignition performance and whether there is any trouble in the use of the ignition unit shall be checked.

C5. Gas Input Rating Test <Revised on May 20, 2013>	
Test Condition	The test gas condition shall be P-2 for liquefied petroleum gas and R-2 for city gas.
Test Method	(1) The equipment shall be installed as shown in the following figure. (2) The equipment shall be operated with test gas at its maximum gas input rating as its standard gas and at the standard pressure (R-2, P-2). (3) The gas pressure of the water column gauge ③ shall be matched to the standard pressure. (4) When the gas input rating becomes constant, the measurement shall be started. When the difference between the values measured consecutively is not over 2%, the arithmetic average value shall be obtained. (5) The gas input rating in a dry condition at 15℃, standard gas pressure and atmospheric pressure of 101.3 kPa shall be calculated by the following formula: $$Q_c = Q \times \frac{1000}{3600} \times V \times \sqrt{\frac{101.3 + P_g}{101.3} \times \frac{P_a + P_g}{101.3} \times \frac{288}{273 + t_g} \times \frac{d}{d_r}}$$ where Q_c: gas input rating corrected to gross heat value(101.3 kPa, 15℃, dry gas) (kW) Q: gross heat value of dry standard gas at 15℃, 101.3 kPa (MJ/m^3) V: volumetric gas quantity measured through the gas meter at humidity, temperature and pressure conditions (m^3/h) P_g: gas pressure at gas meter (kPa) P_a: atmospheric pressure at the time of test (kPa) t_g: gas temperature in the gas meter (℃) d: density of test gas d_r: density of standard gas (6) In case a wet type gas meter is used, the density of gas shall be changed from d to d_h in consideration of humidity and the value shall be corrected by the following formula: $$d_h = \frac{d(P_a + P_g - P_s) + 0.622P_s}{(P_a + P_g)}$$ where, P_s is saturated steam pressure and is calculated as follows: $$P_s = 10^{\alpha}\ \text{kPa}\ \left(\text{where}, \alpha = 7.203 - \frac{1735.74}{t_g + 234}\right)$$ (7) The accuracy of the measured gas input rating against the indicated

gas input rating is calculated by the following formula:

$$\Delta Q_c = \frac{Q_c - Q_r}{Q_r} \times 100$$

where,

ΔQ_c: Accuracy of measured gas input rating against indicated gas input rating (%)

Q_c: measured gas input rating (kW)

Q_r: indicated gas input rating (kW)

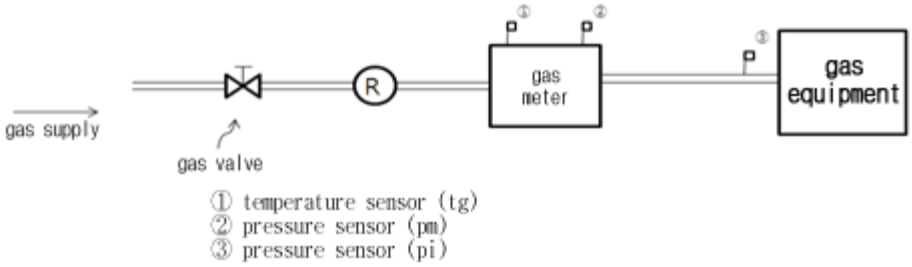


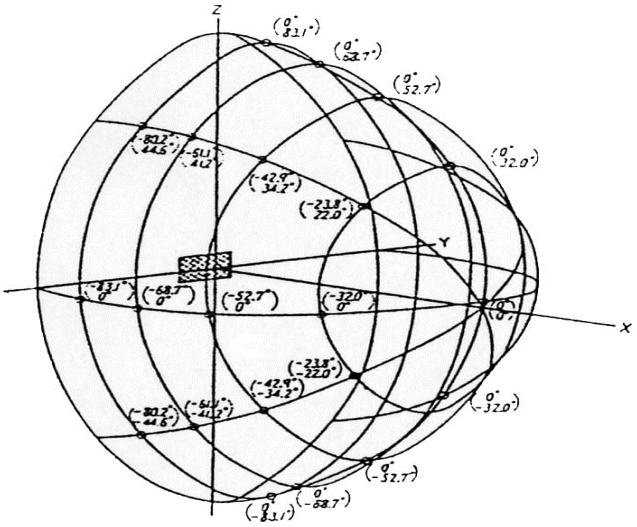
Figure C6. Gas Input Rating Measurement Equipment

C6. Radiation Efficiency Test

Test Condition	The test gas condition shall be P-2 or R-2 and the indicated gas input rating.
Gas in Incorporated Cylinder	The emanating power of 33 points shall be measured on the hemisphere indicated in the following figure and table 30 minutes after ignition, and the radiation efficiency shall be calculated by the following formula: $\eta(\%) = \frac{2\pi r^2 \Sigma E}{33 \times I} \times 100$ where, η: radiation efficiency (%) r: radius of sphere (m) I: input (kcal/n)(kJ/h) E: emanating power at each point (kcal/h·m^2)(kJ/ h·m^2)

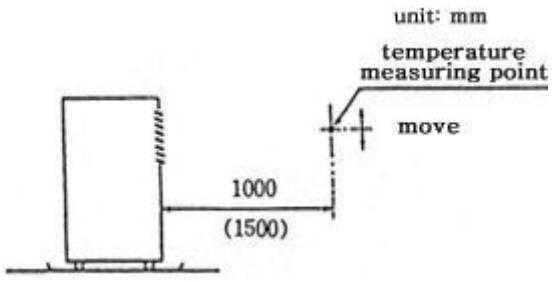
Location of measuring points

Longitude	Latitude	Longitude	Latitude	Longitude	Latitude
80.2°	44.6°	-80.2°	44.6°	83.1°	0°
61.1°	41.2°	-61.1°	41.2°	68.7°	0°
42.9°	34.2°	-42.9°	34.2°	52.7°	0°
23.8°	22.0°	-32.8°	22.0°	32.0°	0°
23.8°	-22.0°	-23.8°	-22.0°	-32.0°	0°
42.9°	-34.2°	-42.9°	-34.2°	-52.7°	0°
61.1°	41.2°	-61.1°	-41.2°	-68.7°	0°
80.2°	44.6°	-80.2°	-44.6°	-83.1°	0°
0°	83.1°	0°	32.0°	0°	-52.7°
0°	68.7°	0°	0°	0°	-68.7°
0°	52.7°	0°	-32.0°	0°	-83.1°

	[Remarks] In the above table, the horizontal plane (XY plane) passing the center of the radiation plane indicates latitude 0° and the vertical plane (XZ plane) passing the center of the radiation plane indicates longitude 0°.  Figure C6. Measurement of Emanating Power [Remarks] 1. The radius r of the sphere shall be 1 m. However, in case the maximum size of the heat radiation surface (radiation body and reflector) of the gas heater exceeds 0.5 m, the radius shall be twice the size. 2. The right half of the hemisphere shall be symmetric to the left half of the hemisphere. (each point of which coordinate is omitted) 3. In the case of a gas heater which emits heat in its rear hemisphere as well (omni-directional radiation type heater), the radiation in the rear hemisphere shall be also measured and the radiation efficiency shall be calculated by the following formula: $\eta(\%) = \frac{4\pi r^2 \Sigma E}{66I} \times 100$

C7. Thermal Efficiency Test	
Test Condition	The test gas condition shall be P-2 or R-2 and the indicated gas input rating.
Test Method	The burner is ignited, the combustion gas temperature at the exhaust tube outlet and the concentration of CO2 in dry combustion gas are measured and the thermal efficiency is calculated by the following formula:

	$$\eta = 1 - \frac{\left[r_1 C_{p1} + r_2 C_{p2} + r_3 C_{p3} + \left[\gamma_2 \left(\frac{100}{CO_2} - 1\right) - r_3\right] C_{p4}\right](t_E - t) + r1 L_v}{Q} \times 100$$ where, η: thermal efficiency (%) Q: gross heating value (KJ/h·m^2) (kcal/h·m^2) r_1: theoretical H2O generation ratio r_2: theoretical CO2 generation ratio r_3: theoretical N2 generation ratio CO_2: measured CO2 concentration value in dry combustion gas t: ambient temperature (℃) t_E: average combustion gas temperature (℃) C_{p1}: average specific heat of H2O at from t℃ to te℃, 1.59KJ(0.373kcal/m^{3}k) C_{p2}: average specific heat of CO2 at from t℃ to te℃, 1.63KJ(0.406kcal/m^{3}k) C_{p3}: average specific heat of N2 at from t℃ to te℃, 1.30KJ(0.302kcal/m^{3}k) C_{p4}: average specific heat of air at from t℃ to te℃, 1.30 KJ(0.302kcal/m^{3}k) L_v: latent heat of vaporization (MJ/ m^{3}N)(480kcak/m^{3}N)

C8. Hot Air Temperature Test	
Test Condition	The test gas condition shall be P-2 or R-2 and the indicated gas input rating.
Test Method	The hot air temperature shall be measured using thermocouples. The maximum hot air temperature is measured by moving backward the thermometric part from 1,000 mm from the heater. However, in the case of a gas heater of which gas input rating is not less than 6.98 kW (25.1 MJ/h) (0.5 kg/h for liquefied petroleum gas, 6,000 kcal/h for city gas), the measurement shall be made at 1,500 mm from the gas heater.  Figure C8. Measuring Location of Hot Air Temperature

C9. Normal Temperature Rise Test

(1) Installation of Gas Heater

The gas heater shall be installed among the temperature measurement plates as shown in the following sketch, keeping the distances between the heater body and the temperature measurement plates specified in Table C9, in accordance with the manufacturer's handling manual. In case the manufacturer specifies distances less than those in C9, the manufacturer's distances shall be observed.

In the case of a forced convection type gas heater, the convection fan of which air flow can be controlled shall be turned down to the minimum air flow. In addition, in the case of a forced convection type gas heater of which gas passage is not shut off when power is out, the air flow shall not be also shut off.

(2) Temperature measurement time

The temperature measurement time shall be the time until when the temperatures at the temperature measuring points do not vary while time passes. However, the time shall be one hour maximum after the burner ignition.

Exhaust temperature is applied to semi-enclosed type and enclosed type gas heaters which are not indicated in the handling manual that the exhaust temperature exceeds 260℃.

Table C9. Distances between Gas Heater and Temperature Measurement Plates unit: mm

	Open Type					Semi-enclosed Type		Enclosed Type		Outdoors Type
	Burner Exposed			Burner Concealed		Natural convection type	Forced convection type	Natural convection type	Forced convection type	
	Omni-directional type	Circum-ferential type	Wall-mounted type, Ceiling-mounted type	Natural convection type	Forced convection type					
Rear	45	1000	45	45	45	45	45	45	45	45
Side	300	1000	600	45	45	45	45	45	45	45
Top	1000	1000	300	1000	45	600	45	600	45	45

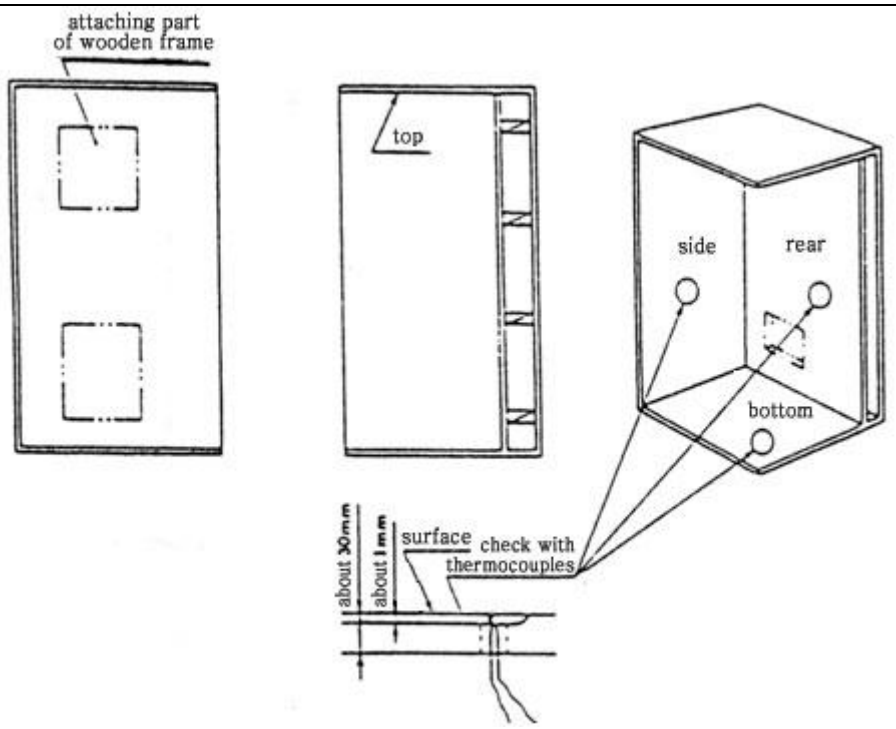


Figure C9. Surface Temperature Measurement Device for Wooden Walls and Platform

[Remarks]

(1) The materials of the wooden walls and platform shall conform to relevant Korean Industrial Standards or be equivalent materials made of 5 to 7 sheets of sufficiently dried plywood. The surface of the wooden platform shall be finished with varnish and the surfaces of the wooden walls with non-gloss black paint.

(2) The sizes of the wooden platform and walls shall be large enough for the gas heater.

(3) The number of thermocouples shall be as many as possible. The thermocouples shall be installed at the same intervals in a grid pattern so that the temperature of any point can be measured.

(4) The thermocouples shall be inserted to a depth of 1 mm from the surface of the wooden platform or wall and be calibrated.

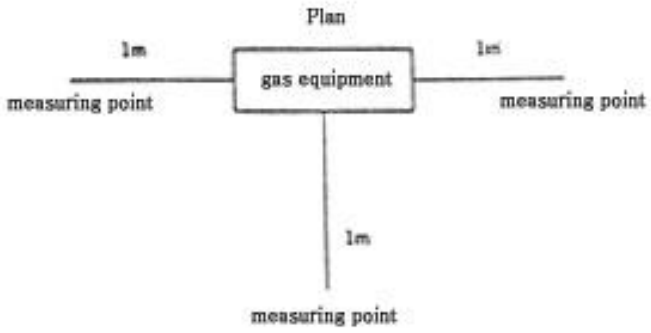
(5) The thermocouples shall be of T type (copper, constantan) and the diameter of the element wire shall be 0.65 mm.

C10. Abnormal Temperature Rise	
Test Condition	The test gas condition shall be S-1.
Test Method	(1) The installation and service conditions of the gas heater shall conform to those for normal temperature rise test. (2) The temperature measurement time shall be the time until when the temperatures at the temperature measuring points do not vary while

	time passes (one hour maximum after the burner ignition). However, in case the overheat prevention device is activated and the main burner gas passage is shut off, the maximum temperature ever reached shall be measured.

C11. Temperature Rise in Windings	
Test Condition	The test shall be performed after the normal temperature rise test.
Test Method	(1) Temperature rise in the windings shall be measured by the resistance method. In case the windings are irregular or contact with the windings for temperature measurement is difficult, the temperature rise shall be measured using thermocouples. (1-1) Windings temperature rise method: motor, solenoid valve, linear trans, etc. (1-2) Thermocouple method: electromagnetic wave filter, switching trans, etc. (2) The electric heater shall be operated at 1.15 times the rated input and the motor-driven equipment at 1.06 times the rated voltage. (3) The winding temperature at the start of the test shall be the same as the ambient temperature and the windings resistance value at the end of the test shall be measured as soon as possible after the switch is off. (4) The winding temperature rise shall be calculated by the following formula: $\Delta t = \frac{R_2 - R_1}{R_1}(k + t_1) - (t_2 - t_1)$ where, Δt: temperature rise of windings R_1: resistance value at the start of test R_2: resistance value at the end of test k : 234.5 for copper windings, 225 for aluminum windings t_1: ambient temperature at the start of test t_2: ambient temperature at the end of test

C12. Noise Measurement	
Test Method	Continuous noise and explosive noise at flame extinguishment shall conform to the followings: (1) The maximum continuous noise including continuous noises shall be

	measured in three locations marked in the following figure which are separated by 1 m from the centers of the outer surfaces of the gas heater when all the burners are ignited. (2) When all the burner valves are manually closed as fast as possible after 30 minutes from burner ignition and flames are extinguished, the explosive noise shall be measured.  Figure C12. Method of Noise Measurement

C13. Measurement of CO Concentration in Theoretical Dry Combustion Gas	
Test Condition	After 15 minutes from burner ignition, the combustion gas of the burner shall be sampled as uniformly as possible as shown in the followings. The test gas shall be S-1 for liquefied petroleum gas heaters or 1-1 for city gas heaters.
Test Method	$CO = CO_a \times \frac{O_{2t}}{O_{2t} - O_{2a}}$ However, in case the components of the test gas is known, CO concentration and CO2 concentration in the dry combustion gas may be measured and calculated by the following formula: $CO = CO_a \times \frac{CO_{2max}}{CO_{2a} - CO_{2t}}$ where, CO: CO concentration in theoretical dry combustion gas (volumetric %) CO_a: measured CO concentration in dry combustion gas (volumetric %) O_{2t}: measured O2 concentration in supply air inlet atmosphere (dry state) (volumetric %) O_{2a}: measured O2 concentration in dry combustion gas (volumetric %) CO_{2max}: CO2 concentration in theoretical dry combustion gas (volumetric %) CO_{2a}: measured CO2 concentration in dry combustion gas (volumetric %) CO_{2t}: measured CO2 concentration in supply air inlet atmosphere (dry

	state) (volumetric %)

C14. Flame Supervision Device Function Test	
Test Condition	(1) Valve opening time: The test gas shall be P-3 for a liquefied petroleum gas heater or R-3 for a city gas heater. (2) Valve closing time: The test gas shall be B-1 for a liquefied petroleum gas heater or R-1 for a city gas heater. (3) Automatic re-ignition construction: The test gas shall be P-3 for a liquefied petroleum gas heater or R-3 for a city gas heater.
Test Method	(1) Valve opening time After the burner is ignited in normal operation, the time from when the valve of the safety device is opened to when the valve can be maintained in its opened state shall be measured. (2) Valve closing time After 15 minutes from burner ignition, the burner is extinguished and gas or air is supplied to the pilot burner or the main burner while the burner is left in an extinguished state, and the time from when the burner is extinguished to when the valve of the safety device is closed is measured.

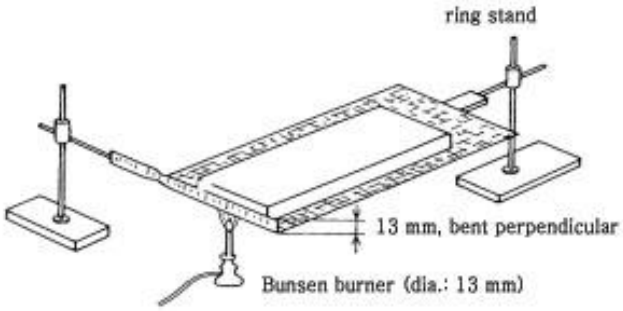
C15. Anti-toppling Safety Device Performance Test	
Test Condition	S-2
Test Method	After the burner is ignited in normal operation, the gas heater shall be toppled in a direction where it can be toppled and time until the gas passage is closed shall be measured.

C16. Performance Tests of Incomplete Combustion Prevention Device and Oxygen Deficiency Safety Device	
Oxygen Deficiency Test Method	(1) The test shall be performed by taking one sample. Temperature is maintained at 20±3℃ in an enclosed room of which volume is not less than 4.5 m^3. (2) The gas sampler and temperature gauge shall be located at the same level as that of the safety device, and measurement shall be made at a distance of 0.5 m from the gas heater in its axial direction. The test gas of oxygen deficiency test shall be S-2. After installing the gas heater in the center of the room and operating it for five minutes while the door of the laboratory is opened up and indoor air is fully ventilated, the door shall be closed and oxygen shall be made deficient until the gas passage is closed. When the gas passage is closed, the

	oxygen amount shall be calculated by the following formula: $O_2(A) = O_2(B) \times \frac{293}{273 + TR}$ where, $O_2(A)$: O2 concentration converted at standard condition when the oxygen deficiency safety device is activated (%) $O_2(B)$: Measured O2 concentration measured when the oxygen deficiency safety device is activated (%) [Remarks] The oxygen concentration shall be the arithmetic average value when the error of two consecutive measured values has become ±0.2.
Incomplete combustion prevention device	Test gas condition: B-1 or 1-1 (1) Poor ventilation test: When the gas heater is operated in a poorly ventilated laboratory and the indoor oxygen is slowly reduced and CO concentration in the combustion gas is not over 1,000 ppm, the gas passage shall be automatically closed and not be automatically opened again. (2) Heat exchange part closure test: The heat exchange part is slowly closed until when CO concentration in combustion gas reaches 1,000 ppm, and the gas passage shall be automatically closed within 10 minutes.

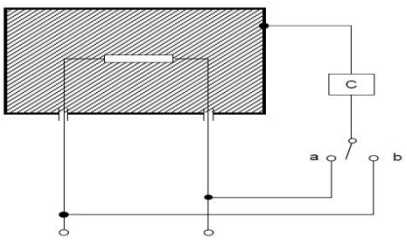
C17. Low-Temperature Shutoff Device Performance Test	
Test Method	Gas supply to the oxygen deficiency monitoring pilot shall be shut off and the shutoff device shall not be activated. It shall be confirmed before the test that there is no hydrocarbon which may affect the test results in the space where oxygen is deficient. After the laboratory door is opened and the gas heater is operated for five minutes, The concentrations of CO2, CO and hydrocarbon shall be monitored. When CO2 concentration has become 2.1%, each concentration shall be recorded and the discharge amount of hydrocarbon shall be calculated by the following formula: $\text{Discharge amount} = \frac{XG}{XG + H - J + K}$ where, G: indoor hydrocarbon concentration at the end of test (%) H: CO2 concentration in indoor air at the end of test J: CO2 concentration in indoor air before the start of test (%) X: Constant of hydrocarbon, 4 K: CO concentration in indoor air at the end of test (%)

	[Remarks] The low-temperature device shall shut off the gas passages of the pilot burner and the main burner when the temperature falls to the allowable effective catalyst oxidation temperature of the catalyst pad. When gas flow is reduced from the normal operating state, the gas passages shall be shut off if the electromotive force of the thermocouple falls to the value specified by the manufacturer.

C18. Fire Retardation Performance Test	
Test Method	A test specimen which is taken in a location where the density is almost uniform and of which dimensions are 50±1 mm (W) by 150±1 mm (L) by 13±1 mm (T) is placed on the following device. After the test specimen is touched by a flame for one minute, the flame is separated from the test specimen by no less than 20 cm and whether the specimen is burning is visually checked.  Figure C18. Fire Retardation Test Device [Remarks] 1. The wire mesh shall be horizontally supported. 2. The blue flame shall be adjusted to be about 38 mm. The burner shall be placed under the wire mesh so that the flame will be in the same line as that of the vertical section of the wire mesh bent perpendicular at the end. In this case, the gap between the wire mesh and the burner tip shall be 13 mm. 3. The test specimen shall be placed in line with the wire mesh bent perpendicular. In addition, in the case of a deformed test specimen, the test specimen shall be placed nearest to the location touched by the flame. 4. The gas shall be propane. [Reference] Dimension of wire mesh: 76 mm x 216 mm, wire size: 0.8 mm,

	mesh size: 6.4 mm

C19. Humidification Performance Test	
Test Method	In accordance with the method specified in the handling manual, a specified amount of water is input into the humidifier and ignition is conducted. The water quantity is measured one hour after the ignition. That time is the starting time of the test. Heating is continued for three hours and measurement is made again. Hourly vaporization quantity is obtained and the humidification quantity is the hourly vaporization quantity.

C20. Leakage Current Test	
Test Condition	Before starting the test, the protection impedance and noise suppression filter are removed.
Test Method	Leakage current is measured by means of a circuit specified in KS C IEC 60990, Figure 9 between one side of power source and a metal part which may be reached by man in contact with an metal foil (of which area in contact with the surface of an insulator which may be touched by man is within 20 cm x 10 cm). In the case of 3-phase equipment, leakage current shall be measured while switches a, b and c are closed. In the next, each of switches a, b and c is opened one by one in order (in this case, the remaining two switches are closed), and measurement of leakage current is repeated. In the case of equipment connected only in star connection, the neutral line is cut off.  Figure C20①. Leakage Current Test Circuit (single-phase 2-line)

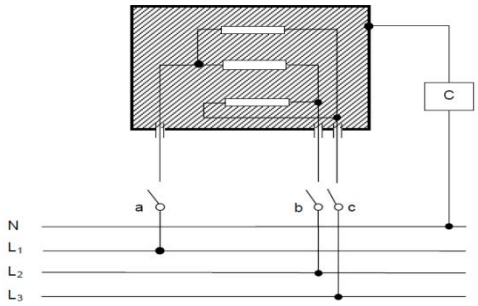
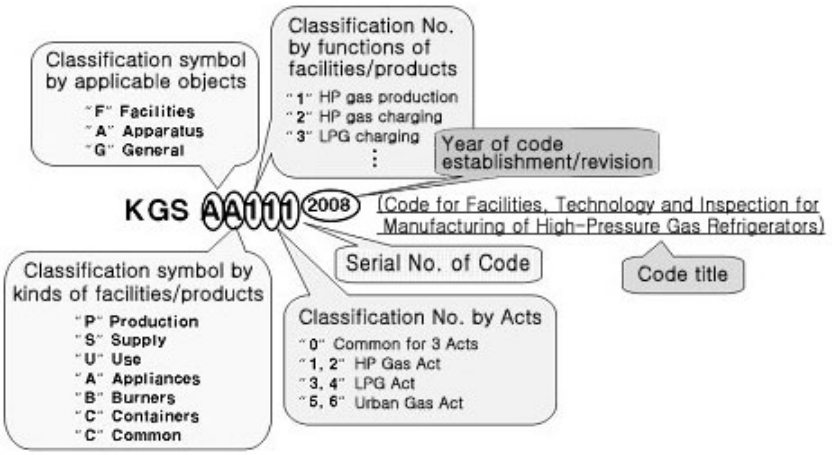


Figure C20②. Leakage Current Test Circuit (3-phase 4-line)

Symbol and Serial Number System of KGS Codes

Korea Gas Safety Codes (KGS Codes) are the codes of detailed standards for technical matters such as facilities, technology and inspection stipulated in gas-related laws and regulations and are the technical standards in gas safety areas deliberated and resolved to be adopted by the gas technical standards committee, and approved by the Ministry of Knowledge Economy.



Classification		Symbol	Facility	Classification		Symbol	Facility
Apparatus **(A)**	**A**ppliances **(A)**	AA1xx	Refrigerators	**F**acilities **(F)**	**P**roduction **(P)**	FP1xx	High-pressure gas manufacturing facilities
		AA2xx	Piping			FP2xx	High-pressure gas filling facilities
		AA3xx	Valves			FP3xx	LP gas filling facilities
		AA4xx	Pressure regulators			FP4xx	City gas wholesales manufacturing facilities
		AA5xx	Hoses			FP5xx	City gas general manufacturing facilities
		AA6xx	Alarm & shutoff devices		**S**upply **(S)**	FS1xx	High-pressure gas sales facilities
		AA9xx	Other appliances			FS2xx	LP gas sales facilities
	Burners **(B)**	AB1xx	Boilers			FS3xx	LP gas complex supply facilities
		AB2xx	Heaters			FS4xx	City gas wholesales supply facilities
		AB3xx	Ranges			FS5xx	City gas general supply facilities
		AB9xx	Other burners		**U**se **(U)**	FU1xx	High-pressure gas storage facilities
	Containers **(C)**	AC1xx	Tanks			FU2xx	High-pressure gas burning facilities
		AC2xx	Cylinders			FU3xx	LP gas storage facilities
		AC3xx	Cans			FU4xx	LP gas burning facilities
		AC4xx	Composite containers			FU5xx	City gas burning facilities
		AC9xx	Other containers	**G**eneral **(G)**	**C**ommon **(C)**	GC1xx	Basic matters
						GC2xx	Common matters

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