



# **Code for Facilities, Technology and Inspection for Manufacturing of Vaporizers for High-pressure Gases**

Deliberation/Resolution by Gas Technical Standards Committee : October 18, 2019  
Approval by the Ministry of Trade, Industry & Energy : March 18, 2020



## Personnel

### Gas Technical Standards Committee

Chairman	Kwang-Won Lee, Professor of Hoseo University
Vice-Chairman	Seung-Hoon Nam, Principal Researcher of KRISS
Ex Officio Member	Hui-Won Lee, Manager of Energy Safety Department, Ministry of Trade, Industry & Energy Hae-Myeong Yang, Director of Technology and Safety, Korea Gas Safety Corporation
High-Pressure Gas	Seung-Hoon Nam, Principal Researcher of KRISS Beom-Seok Lee, Principal Professor of Kyung Hee University Dong-Myeong Ha, Professor of Semyung University Chang-Gi Kim, Principal Researcher of Korea Institute of Machinery and Materials Hyuk-Myun Kwon, Director General of Occupational Safety & Health Research Institute Su-Dong Byun, CEO of Q-Best
Liquefied Petroleum Gas	Doo-Seon Park, Managing Director of Daesung Industrial Gas Co., Ltd Hyeong-Hwan Ann, Professor of Korea National University of Transportation Byeong-Hak Choei, Professor of Gangneung-Wonju National University Seong-Min Lee, Director of KOGAS Research Institute Yong-Gwon Lee, Vice-President of EG CNE Co.,Ltd Gi-hyeon Jang, Director of Kiturmi Jeong-Sik Chon, Direto of E1 CO., Ltd.



### History of Establishment and Revision of KGS Code

Code Number	KGS AA911 <sup>2019</sup>
Code Title	Code for Facilities, Technology and Inspection for Manufacturing of Vaporizers for High-pressure Gases

Date of Establishment/Revision	Description
December 30, 2008	Established (Notification of the Ministry of Knowledge Economy No. 2008-379)
May 15, 2009	Revised (Notification of the Ministry of Knowledge Economy No. 2009-193)
January 6, 2010	Revised (Notification of the Ministry of Knowledge Economy No. 2009-480)
August 31, 2010	Revised (Notification of the Ministry of Knowledge Economy No. 2010-350)
October 10, 2011	Revised (Notification of the Ministry of Knowledge Economy No. 2011-500)
December 18, 2013	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2013-343)
December 31, 2013	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2013-353)
November 17, 2014	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2014-589)
August 7, 2015	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2015-436)
January 8, 2016	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2016-006)
March 9, 2016	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2016-94)
July 11, 2016	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2016-354)
November 23, 2016	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2016-603)
February 10, 2017	Revised (Notification of the Ministry of Trade, Industry & Energy No. 2017-066)

[illegible]

## **Table of Contents**

1. General.....	1
1.1 SCOPE.....	1
1.2 VALIDITY OF CODE.....	1
1.3 REFERENCE CODES AND STANDARDS.....	1
1.3.1 Inspection standard for new technology products.....	1
1.4 DEFINITIONS.....	2
1.5 APPLICATION OF CODES AND STANDARDS (CURRENTLY NOT USED) .....	3
2. Manufacturing Installation Standard.....	3
2.1 MANUFACTURING FACILITIES.....	3
2.2 INSPECTION FACILITIES.....	4
3. Manufacturing Technology Standard.....	4
3.1 DESIGN (CURRENTLY NOT USED).....	4
3.2 MATERIALS.....	4
3.3 THICKNESS.....	9
3.3.1 Minimum thicknesses of parts other than tubes.....	9
3.3.2 Minimum thickness of tubes.....	28
3.4 CONSTRUCTION AND DIMENSIONS .....	30
3.5 FABRICATION (CURRENTLY NOT USED) .....	34
3.6 WELDING .....	34
3.6.1 Classification of welded joints .....	34
3.6.2 Restriction to welding types.....	36
3.6.3 Welded joint efficiency.....	37
3.6.4 Strength of welds.....	37
3.6.5 Butt welds.....	38
3.6.6 Double full fillet welds .....	40
3.6.7 Welding of heads and shells .....	40
3.6.8 Welding of shells and flat plates.....	41
3.6.9 Welding of nozzles, reinforcing materials, etc. ....	41

3.6.10 Welding of stiffening rings.....	42
3.6.11 Welding of jackets.....	42
3.6.12 Welding of stays.....	42
3.6.13 Welding conditions .....	43
Table 3.6.13.4 Classification of Welding Wires .....	50
3.7 HEAT TREATMENT.....	52
Table 3.7.2.6 Correction Constant Depending on Heat Treatment Temperature Reduction.....	55
3.8 PERFORMANCE.....	56
3.9 MARKING.....	63
4. Inspection Standard .....	64
4.1 KINDS OF INSPECTION.....	64
4.1.1 Manufacturing installation inspection.....	64
4.1.2 Product inspection .....	64
4.2 OBJECT AUDIT FOR PROCESS INSPECTION (NOT APPLICABLE).....	64
4.3 INSPECTION ITEMS .....	64
4.3.1 Manufacturing installation inspection.....	64
4.3.2 Product inspection .....	65
4.4 INSPECTION METHODS.....	65
4.4.1 Inspection of manufacturing installation.....	65
4.4.2 Product inspection .....	65
4.5 OTHER STANDARDS.....	66
4.5.1 Inspection of imported products (currently not used) .....	66
4.5.2 Partial omission of inspection.....	66
4.5.3 Disposal of Rejected Products.....	67
Appendix A Maximum Allowable Tensile Stress of Steels <Revised on November 17, 2014 and January 8, 2016 > .....	66
Appendix B.....	98
Appendix C.....	109
Appendix D Ductile Iron Castings and Malleable Iron Castings <Newly established on August 7, 2015>.....	139







# Code for Facilities, Technology and Inspection for Manufacturing of Vaporizers for High-pressure Gases

## 1. General

### 1.1 Scope

This Code applies to the facilities, technology and inspection for manufacturing of vaporizers for high-pressure gases in conformity to High-Pressure Gas Safety Control Act (hereinafter referred to as "the Act"), Article 3, Clause 5 (hereinafter referred to as "vaporizers"). However, this Code does not apply to vaporizers for vehicles, direct-fired vaporizers and pressure vessels for heat exchange (installed in high-pressure gas manufacturing installations).

### 1.2 Validity of Code

**1.2.1** This Code has passed the deliberation and resolution by the Gas Technical Standards Committee (Bill No. 2019-8, October 18, 2019) in accordance with the Act, Article 22-2, Clause 2, has been approved by the Minister of Trade, Industry & Energy (Notification No. 2020-167 of the Ministry of Trade, Industry & Energy, March 18, 2020), and is valid and effective as the detailed standards in conformity to the Act, Article 22-2, Clause 1.

**1.2.2** Conformity to this Code is deemed to conform to Table 12 of the Enforcement Rule of the High-Pressure Gas Safety Control Act (hereinafter referred to as "Enforcement Rule") in accordance with the Act, Article 22-2, Clause 4.

### 1.3 Reference Codes and Standards

#### 1.3.1 Inspection standard for new technology products

**1.3.1.1** In case the Minister of Trade, Industry & Energy acknowledges that the vaporizers do not meet the inspection standard in conformity to this Code in accordance with the Enforcement Rule,

Table 12, 4 B but do not hinder safety control as new type vaporizers developed through new technology development, such manufacturing and inspection methods of those vaporizers may restrictively apply only to them.

**1.3.1.2** Vaporizers inspected by an authorized inspection agency in charge in accordance with an acceptable standard in Table 1.3.1.2 are deemed by the Minister of Trade, Industry & Energy not to hinder safety control in accordance with 1.3.1.1 above and may be inspected in accordance with the relevant acceptable code and standard without the need of applying for inspection exception and undergoing subsequent review. <Revised on July 11, 2016>

Table 1.3.1.2 Acceptable Codes and Standards and Authorized Inspection Agencies for Foreign Vaporizers <Revised on July 11, 2016>

Acceptable Standard	Authorized Inspection Agency
ASME	Authorized Inspection Agencies (AIA) registered with ASME
PED (Pressure Equipment Directive)	Notified Bodies registered with EC (European Commission)
High-Pressure Gas Safety Security Law (Japan)	High-pressure Gas Security Association
Other standards accepted by the Minister of Trade, Industry and Energy	Inspection agencies accepted by the Minister of Trade, Industry & Energy

## 1.4 Definitions

The terms used in this Code are defined as follows:

**1.4.1** A “vaporizer” means a unit of which vaporizer shell is heated with a heating medium such as steam, hot water, air, etc. and which includes associated equipment, valves, instruments and connecting piping (to the valves or flanges attached to the outside of the cabinet for a vaporizer installed in a containment cabinet).

**1.4.2** A “vaporizer shell” means a vaporizer part which vaporizes liquefied gas by being heated with a heating medium such as steam, hot water, air, etc. and includes its internal devices and connection nozzles.

**1.4.3** “Liquefied gas” means gas which is made to be in a liquefied phase by methods such as pressurization, cooling, etc. and of which boiling point is not over 40°C or its normal temperature at atmospheric pressure.