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भारतीय मानक प्रारूप

सड़क वाहन - तरलीकृत प्राकृतिक गैस (एल/ एन/ जी/) ईंधन प्रणाली घटक - प्रदर्शन और सामान्य परीक्षण विधि

Draft Indian Standard

ROAD VEHICLES-LIQUEFIED NATURAL GAS (LNG) FUEL SYSTEM COMPONENTS - PERFORMANCE AND GENERAL TEST METHODS

ICS 75.180

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FOREWARD

(Formal Clause will be added later)

In the formulation of this standard, considerable assistance has been derived from the following national and International standards:

AIS-024: Safety and procedural requirements for type approval of gaseous fuel vehicles.

AIS-028: Code of practice for use of CNG/Bio-CNG/LNG fuel (Dedicated/Bi-fuel/Dual fuel) in internal combustion engine vehicles.

ISO 12614 (Part 1-18) : Road Vehicles-Liquefied natural gas (LNG) fuel system components

UN Regulation No. 110: Uniform provisions concerning the approval of:

I. Specific components of motor vehicles using Compressed Natural Gas (CNG) and/or Liquefied Natural Gas (LNG) in their propulsion system;

II. Vehicles with regard to the installation of specific components of an approved type for the use of Compressed Natural Gas (CNG) and/or Liquefied Natural Gas (LNG) in their propulsion system.

This standard is one of the series of Indian Standards published on LNG on-board fuel system components. Other standards in this series are:

IS No.	*Title*
XXXXX:2020	Road Vehicles -Liquefied Natural Gas (LNG) Fuel System Components - General Requirements and Definition
XXXXX:2020	Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Check Valve
XXXXX:2020	Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Manual Valve
XXXXX:2020	Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Tank Pressure Gauge
XXXXX:2020	Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Pressure Regulator
XXXXX:2020	Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Pressure Relief Valve

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Excess Flow Valve

XXXXX:2020 Road Vehicles- Liquefied Natural Gas (LNG) Fuel System Components - Gas Tight Housing and Ventilation Hose

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Rigid Fuel Line in Stainless Steel

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Fittings

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Rigid Fuel Line in Copper and its Alloys

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Pressure Control Regulator

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Differential Pressure Fuel Content Gauge

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Capacitance Fuel Content Gauge

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Heat Exchanger – Vaporizer

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components- Natural Gas Detector

XXXXX:2020 Road Vehicles - Liquefied Natural Gas (LNG) Fuel System Components - Gas Temperature Sensor

The composition of the committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirements of this standard is complied with, the final value, observed or calculated, expressing the result of test or analysis, shall be rounded off in accordance with IS 2:1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be same as that of the specified values in the standard.

Draft Indian Standard

ROAD VEHICLES-LIQUEFIED NATURAL GAS (LNG) FUEL SYSTEM COMPONENTS-PERFORAMCE AND GENERAL TEST METHODS

1 SCOPE

1.1 This standard specifies performance and general test methods for LNG on-board fuel system components, intended to use on motor vehicles defined in IS 14272 (Part 1), two wheelers and construction equipment vehicles (CEV).

1.1.1 This standard is applicable to LNG fuel system components intended to use on vehicles using Liquefied Natural Gas (LNG) in accordance with IS XXXXX for mono fuel or bi-fuel or dual fuel applications.

1.1.2 It is not applicable to the followings:

a) Fuel containers;
b) Stationary gas engines;
c) Container mounting hardware;
d) Electronic fuel management
e) Fuelling receptacle

1.1.3 This standard is based upon a working pressure for natural gas as fuel of 1.6 MPa (16 bar). Other working pressure can be accommodated by adjusting the pressure by the appropriate factor (ratio). For example, a 2 MPa (20 bar) working pressure system will require pressures to be multiplied by 1.25. All references to pressure are to be considered gauge pressures unless otherwise specified.

2 REFERENCES

The following standards contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standard list below:

IS No.	*Title*
14272 (Part 1) : 2011	Automotive vehicles-Types-Terminology: Part 1 Three and four wheelers
XXXXX:2020	Liquefied Natural Gas- Designation of quality of liquefied Natural Gas for use as a fuel for vehicles

3 TERMS AND DEFINITIONS

For the purpose of this standard, the following terms and definitions given in IS XXXXX:2020 shall apply.

4 GENERAL

4.1 Unless otherwise stated, the tests shall be conducted at room temperature, i.e. 27 ± 5^{0}C.

4.2 Components shall comply with the tests specified in their relevant specifications, as well as the applicable tests specified in this standard. Because of the peculiarities of some components, the list of tests given in this standard (see 5 to 15) is not exhaustive. Where additional tests are required, their provisions are given in another, relevant standard.

4.3 Unlesss otherwise specified, all tests shall be conducted using dry air or nitrogen. Qualified personnel may also test with natural gas provided that appropriate safety measures are taken, The dewpoint of the test gas at the test pressure shall be at the temperature at which there in no icing, hydrate or liquid formation. For testing at low temperatures, liquid nitrogen will be used, which will be specifically mentioned at the respective parts of the standard.

4.4 It is recognised that new technology may not be covered in the relevant specifications of components.

5 HYDROSTATIC STRENGTH

A component shall not rupture when subjected to the following test method:

a) Outlet opening of the component shall be plugged. Valves or internal blocks shall be ensured in the open position. The hydrostatic pressure specified for each component in the respective Indian Standard shall be applied with a test fluid to the inlet of the component for a period of at least 3 min.

b) Test sample shall not be used for any other testing.

6 LEAKAGE

Prior to conditioning, the device shall be purged with Nitrogen and then sealed at 30 percent of working pressure using Nitrogen, dry Air, or Natural Gas. All tests shall be conducted while devices are continuously exposed to the specified test temperatures. The device shall either be bubble free or have a leakage rate less than 20 Ncm^3/h according to the following test method.

6.1 External Leakage

6.1.1 Each device outlet shall be plugged with the appropriate mating connection and the test pressure applied to the inlet.

6.1.2 Pressurized Air, Nitrogen, or Natural Gas shall be applied to the test devices. At all the test temperatures, immerse the components in a suitable test medium for 2 minutes or use a helium vacuum test (global accumulation method) or other equivalent methods.

6.1.3 If there are no bubbles for the specified time period, the sample passes the tests. If bubbles are detected, then the leak rate shall be measured by an appropriate method.

6.2 Internal Leakage

The internal leakage is applicable only to devices having a closed position. The aim of this test is to check the pressure tightness of the closed system. The inlet or outlet of the device (as applicable) shall be connected with the appropriate mating connection while the opposite connection(s) shall left open.

6.3 Test conditions for internal and external leakage

a) The device shall be conditioned at a low temperature of < -162^{0}C and pressurized at 100 percent and 25 percent of working pressure.

b) The device shall be conditioned at room temperature of 20^{0}C and pressurized at 25 percent and 150 percent of working pressure.

c) The device shall be conditioned at a high temperature of 85^{0}C/120^0 C and pressurized at 25 percent and 150 percent of working pressure.

7 EXCESS TORQUE RESISTANCE

7.1 A component designed to be connected directly to threaded fittings shall be capable of withstanding without deformation, breakage, or leakage a torque effort of 150 percent of the rated installation value.

7.2 The following test method shall apply.

a) An unused component shall be used for this test. The torque shall be applied adjacent to the fitting.

b) For a component having threaded connection(s), the turning efforts shall be applied for 15 minutes, then released, and the component removed and examined for deformation and breakage. The component shall then be subjected to the leakage test specified in **6**.

c) Subject the component to the leakage test specified in **6**.

d) Subject the component to hydrostatic strength test specified in **5**.

8 BENDING MOMENT

A component subject to bending moment tests shall be capable of operation without cracking, breaking, or leaking when subjected to the following test method.

a) The connections of the component shall be assembled leak-tight to an appropriate mating connection(s), representative of design intent. After assembly, the length of the inlet tubing shall be greater than 300mm (see Fig. 1).

b) The outlet connection shall be rigidly supported 25mm from the component outlet, unless the following exceptions apply:

1) When the component has an integral mounting means independent of the inlet and outlet connections, the component shall be mounted using the integral mounting means as specified by the manufacturer;

2) When the component is intended to be mounted by either the integral mounting means or the component outlet, the mounting means which produces the most severe test condition shall be used.

c) The assembly above shall be checked for leaks prior to section d).

d) With the component in the closed position, the system shall be pressurized to 5 kPa and a force as specified in Table 1 at 300mm from the inlet shall be applied and maintained for 15 minutes. Without removing the force, the component shall be checked for leakage, in accordance with the test method in **6** at room temperature.

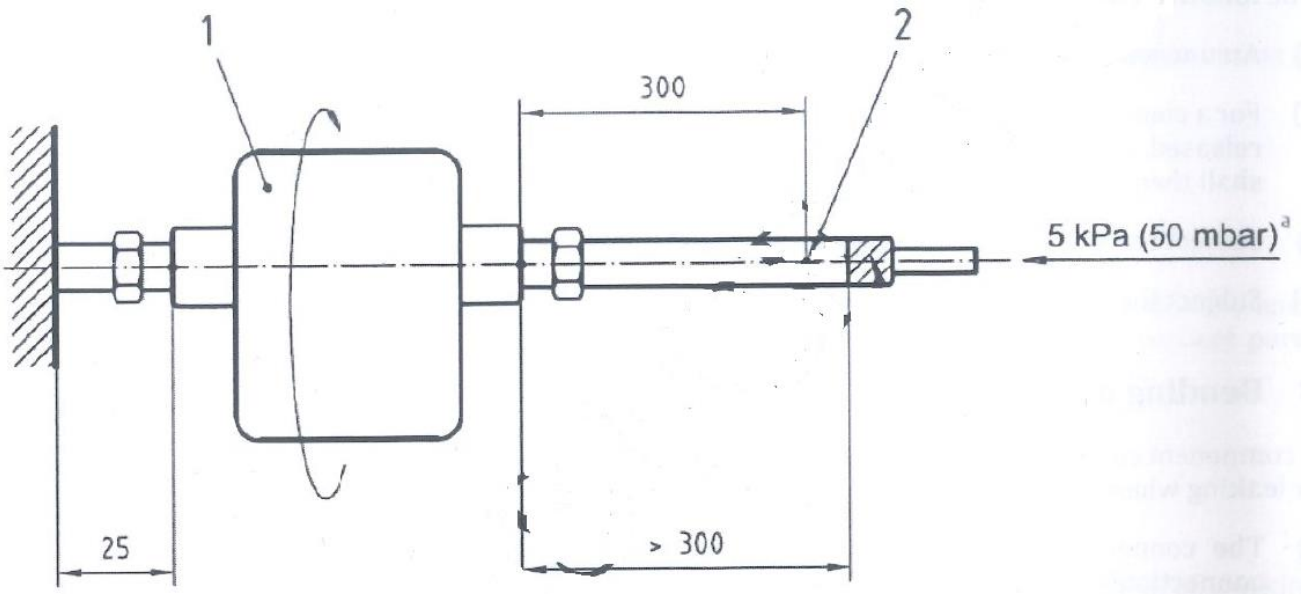
NOTE - Depending on how this is performed, raising the load to compensate buoyancy could be necessary.

e) The test in section d) shall be conducted four times with the component being rotated 90^0 around the horizontal axis between each test. Between tests, the component shall be opened and closed (if applicable) three times with the bending moment removed.

f) At the completion of above tests, the component shall be removed and examined for deformation and then subjected to leakage test as specified in **6** and to the hydrostatic strength test according to **5**.

Table 1-Bending Test Force

Outside diameter of tubing, mm	Force, N
6	3.4
8	9.0
12	17.0
≥ 16	30.0



Legends
1 component

2 force point
3 4x90^0 rotation

FIG. 1- BENDING MOMENT

9 CONTINUED OPERATION

9.1 General

9.1.1 Detailed test methods for each component can be found in the respective Indian Standard. The test method detailed below is general in nature and applies to miscellaneous components.

9.1.2 Connect the component securely by a suitable fitting to a source of compressed dry air, nitrogen, or natural gas and subject it to the number of cycles as specified in the relevant Indian Standard. A cycle shall consist of one opening and closing (if applicable) of the component within a period of not less than 10 ± 2s. During the off cycle, the downstream pressure of the test fixture shall be lowered to a maximum of 50 percent of the test pressure.

9.1.3 In the case of components downstream of the first stage of pressure reduction, the test pressure shall be based on 100 percent of the working pressure.

9.1.4 Unless otherwise specified, the following conditions apply.

9.2 Components, which are intended to be used at temperature less than -40^{0}C

9.2.1 The component shall be operated through 96 percent of the total cycle at ≤ 162^{0}C temperature and working pressure, and shall comply with the **6** at low temperature.

9.2.2 The component shall be operated through 4 percent of the total cycles at the appropriate maximum temperature specified in **4.4** of IS XXXXX:2020 at working pressure.

9.2.3 The component shall comply with **6** at the appropriate maximum temperature specified in **4.4** of IS XXXXX:2020 at the completion of the low temperature cycles.

9.2.4 This test can be interrupted, if desired, at 20 percent intervals for leakage testing.

9.3 Components, which are not intended to be used at temperature less than -40^{0}C

9.3.1 The component shall be operated through 2 percent of the total cycle at the appropriate maximum temperature specified in **4.4** of IS XXXXX:2020 at working pressure. The component shall comply with **6** at the appropriate maximum temperature specified in **4.4** of IS XXXXX:2020 at the completion of high temperature cycles.

9.3.2 The component shall be operated through 96 percent of the total cycles at room temperature and at working pressure, and shall comply with **6** at room temperature.

9.3.3 The component shall be operated through 2 percent of the total cycles at the appropriate minimum temperature specified in **4.4** of IS XXXXX:2020 at 50 percent of working pressure.

9.3.4 The component shall comply with **6** at the appropriate minimum temperature specified in **4.4** of IS XXXXX:2020 at the completion of the low temperature cycles.

9.3.5 Immediately following the continued operation tests and leakage retesting, perform the hydrostatic test according to **5**.

10 CORROSION RESISTANCE

10.1 All components shall perform safely and in compliance with **6** following exposure to salt spray according to the following test method.

10.2 With the component supported in its normal installed position, expose it for 96h to a salt spray (fog) test as specified in IS 9844.

10.3 Maintain the temperature within the fog chamber at between 33^0C and 36^0C.

10.4 The saline solution shall consist of 5 percent sodium chloride and 95 percent distilled water, by weight.

10.5 Immediately following the Corrosion Test, rinse the sample and gently clean it of salt deposits; the subject it to the tests according to **6**.

11 OXYGEN AGEING

11.1 All synthetic or non-metallic parts of components which provide a fuel containing seal, for which a satisfactory declaration of properties is not submitted by the applicant shall, when tested, not crack or show visible evidence of deterioration after oxygen ageing in accordance with the following test method.

11.2 Subject representative samples to 96 h of exposure to oxygen at a temperature of 70^0C, at 2 MPa (20 bar) in accordance with IS 3400 (Part 4).

12 ELECTRICAL OVERVOLTAGE

All electrical components or devices containing electrical subcomponents shall withstand application of 1.5 times the rated voltage ±5 percent for periods of 3 minutes without failure.

13 NON-METALLIC MATERIAL IMMERSION

13.1 Non-metallic material used in a component shall be subjected by the test agency to the tests described in 13.2, except where the applicant submits declarations of results of tests carried out on the material provided by the manufacturer.'

13.2 A part made of non-metallic material in contact with natural gas shall not show excessive change in volume or weight when tested according to the following procedure.

a) Prepare, measure, and weigh a representative sample or samples of each non-metallic material used in a component, then immerse the sample or samples at room temperature in natural gas at a pressure 30 bar for a minimum of 70 hours.

b) Immediately following this period of immersion, rapidly reduce the test pressure to atmospheric pressure without causing shredding or disintegration.

13.3 No tested sample shall exhibit swelling greater than 25 percent or shrinking greater than 1 percent. The weight change shall not exceed 10 percent.

14 VIBRATION RESISTANCE

14.1 All components with moving parts shall remain undamaged, and shall continue to operate and meet the requirements of their leakage tests and hydrostatic strength test after vibration, carried out according to the following test procedure.

14.2 Vibrate the component, pressurised to its working pressure with dry air, nitrogen, or natural gas and sealed at both ends, for 30 minutes along each of the three orthogonal axes at the most sever resonant frequency determined as follows:

a) by an acceleration of 1.5g;
b) within a sinusoidal frequency range of 10 Hz to 500 Hz;
c) with a sweep time of 10 minutes.

14.3 At the completion of the test, the component shall not show any indication of fatigue or component damage, and shall comply with the leakage test specified in **6** and the hydrostatic strength test specified in **5**.

15 BRASS MATERIAL COMPATIBILITY

15.1 All brass components or subcomponents which are fuel containing for which a satisfactory declaration of properties is not submitted by the applicant shall be tested as described below.

15.2 Component manufacturers that can provide documentation attesting to the field worthiness of their products can be exempted from this requirement. Otherwise, the following test method is applied.

15.3 Each test sample shall be subjected to the physical stresses normally imposed on or within a part as a result of assembly with other components. Such stress shall be applied to the sample prior to and maintained during the test. Samples with thread, intended to be used for installing the product in the field shall have the threads engaged and tightened to the torque specified in the instruction manual of the sample. Polytetrafluorethylene (PTFE) tape or pipe compounds shall not be used on the threads.

15.4 Three samples shall be degreased and then continuously exposed to a set position for 10 days to a moist ammonia-air mixture maintained in a glass chamber approximately 20 litres having a glass cover.

15.5 Approximately, 600 cm^3 aqueous ammonia having a specific gravity of 0.94 shall be maintained at the bottom of the glass chamber below the samples. The samples shall be positioned 40mm above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber shall be maintained at atmospheric pressure and at a temperature of 34 ± 2^0C.

15.6 After being subjected to the conditions described above, the sample shall show no evidence of cracking when examined during a 25xmaginification.

ANNEX A

COMMITTEE COMPOSITION

Automotive Vehicles Running on Non-Conventional Energy Sources Sectional Committee, TED 26

Organization	*Representative(s)*
Automotive Research Association of India, Pune	Dr S S THIPSE *(CHAIRMAN)*
Automotive Research Association of India, Pune	SHRI A D DELATE SHRI S D RAIRIKAR *(Alternate)*
Advantek Fuel Systems Pvt. Ltd, New Delhi	NOMINATION AWAITED
Ashok Leyland Ltd, Chennai	SHRI M RAVI SHRI VED PRAKASH GAUTAM *(Alternate)*
Automotive Component Manufactures Association of India, New Delhi	SHRI UDAY HARITE SHRI SEEMA BABAL *(Alternate)*
Bajaj Auto Ltd, Pune	SHRI ARVIND V. KUMBHAR SHRI NITIN S KULKARNI *(Alternate)*
Central Institute of Road Transport, Pune	SHRI SAMIR SATTIGERI SHRI V V JOSHI *(Alternate)*
Central Pollution Control Board, New Delhi	SHRI A SUDHAKAR SHRI SUNEEL DAVE *(Alternate)*
CLH Gaseous Fuel Applications (P) Ltd, Gurgaon	SHRI SHISHIR AGRAWAL SHRI GAGAN AGRAWAL *(Alternate)*
Delhi Transport Corporation, New Delhi	SHRI VIKAS BATRA
GAIL (India) Limited, New Delhi	SHRI ASHISH KUMAR MITTAL SHRI LOKESH MEHTA *(Alternate)*
Indian Auto LPG Coalition, Faridabad	SHRI SHISHIR AGRAWAL SHRI SUYASH GUPTA *(Alternate)*
Indian Institute of Petroleum, Dehradun	SHRI WITTISON KAMEI SHRI ROBINDRO LAIRENLAKPAM *(Alternate)*
Indian Institute of Technology, New Delhi	Dr. K A SUBRAMANIAN Prof. K RAVI KUMAR *(Alternate)*

Indian Oil Corporation Ltd, R & D, Faridabad	SHRI M SUBRAMANIAN SHRI M SITHANANTHAN *(Alternate)*
Indian Rubber Mfrs Research Association, Thane, Mumbai	SHRI K RAJ KUMAR SHRI BHARAT KAPGATE *(Alternate)*
Indraprastha Gas Limited (IGL), New Delhi	NOMINATION AWAITED
International Centre for Automotive Technology (ICAT), Manesar	SHRI VAIBHAV PRASHANT YADAV SHRI VIJAYANTA AHUJA *(Alternate)*
JCB India Ltd, New Delhi	NOMINATION AWAITED
KPIT Technologies Ltd, Pune	SHRI KIRANKUMAR DAKLE SHRI TEJAS KSHATRIYA *(Alternate)*
Mahindra & Mahindra Ltd, Nasik	SHRI JEEVAN DASS SHRI T VISWANATHAN *(Alternate)*
Mahindra & Mahindra Ltd. (Truck and Bus Division), Pune	SHRI KRISHNA D MISHRA SHRI V G KULKARNI *(Alternate)*
Maruti Suzuki India Limited, Gurgaon	SHRI AJAU KUMAR SHRI AMIT KUMAR *(Alternate)*
Minda Emer Technologies Limited, Gurgaon	SHRI VIVAK JAIN SHRI BIBHUTI KUMAR *(Alternate)*
Ministry of New and Renewable Energy, New Delhi	SHRI DIPESH PHERWANI
Petroleum and Explosive Safety, Organization, Nagpur	SHRI D K GUPTA SHRI V B BORGAONKAR *(Alternate)*
Petroleum Conservation Research Association, New Delhi	SHRI SURENDRA PRATAP SHRI M P BANGWAL *(Alternate)*
Petronet LNG Ltd, New Delhi	NOMINATION AWAITED
Prodair Air Products India Private Ltd, Pune	SHRI RAVI SUBRAMANIAN SHRI ARUN KURUVANGATTIL *(Alternate)*
Rohan BRC Gas Equipment Pvt. Ltd, Ahmedabad	SHRI STEFANO DE CAROLIS SHRI PARTHIV SHUKLA *(Alternate)*
Society of Indian Automobile Manufacturers, Manufacturers, New Delhi	SHRI P K BANRJEE SHRI ATANU GANGULI *(Alternate)*
Swagelok – Bombay Fluid System	SHRI SACHIN KOULGI

Components Pvt. Ltd, Gurugram	SHRI HARISH TAKKE *(Alternate)*
Tata Motors Ltd, Pune	SHRI PALLIPALAYAM S GOWRISHANKAR SHRI SHAILENDRA DEWANGAN *(Alternate)*
TVS Motor Company Ltd, Hosur	SHRI V PATTABIRAMAN SHRI K M SRIKANTH *(Alternate)*
Vanaz Engineers Ltd, Pune	SHRI S J VISPUTE SHRI HEMANT S JOSHII *(Alternate)*
Volkswagen India Pvt. Ltd, Mumbai	SHRI JOREG BOUZEK SHRI PANKAJ GUPTA *(Alternate)*

Member Secretary
SHRI NAVINDRA GAUTAM
Scientist 'E' (TED), BIS