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भारतीय मानक प्रारूप

सड़क वाहन - संपीडित प्राकृतिक गैस (सीएनजी) / जैव-संपीडित प्राकृतिक गैस (बायो-सीएनजी) ईंधन प्रणाली के घटक - उच्च दबाव ईंधन लाइन (लचीली नली) अंत कनेक्शन के साथ [2.15 एमपीए (21.5 बार) से अधिक सेवा दबाव होने पर]
(प्रथम संशोधन)

Draft Indian Standard

ROAD VEHICLES — COMPRESSED NATURAL GAS (CNG) / BIO-COMPRESSED NATURAL GAS (BIO-CNG) - HIGH PRESSURE FUEL LINE (FLEXIBLE HOSE) WITH END CONNECTIONS [HAVING SERVICE PRESSURE EXCEEDING 2.15MPa (21.5 BAR)]
(First Revision)

ICS: 43.060.40

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Last date for receipt of comments
is 17/07/2023

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

FOREWORD

(Formal Clause to be added later)

This standard was first published in 2006 to specify definitions, test methods and requirements of high-pressure fuel line (flexible hose) with end connections having service pressure exceeding 2.15 MPa (21.5 bar) of CNG on-board fuel system component intended for use on motor vehicles defined in IS 14272. In this Revision, Bio- CNG is added to the scope of this standard keeping in view the technological advancements that have taken place since its last Publication.

In the formulation of this standard considerable assistance has been derived from the following AIS Standards issued by the Automotive Research Association of India:

AIS 024(Rev.1) (Part A):- Safety and Procedural Requirements for Type Approval of Gaseous Fuelled Vehicles - Part A (Automotive Application).

AIS 024(Rev.1) (Part B):- Safety and Procedural Requirements for Type Approval of Gaseous Fuel Agricultural Tractors - Part B (Agricultural Tractors Application).

AIS 024(Rev.1) (Part C):- Safety and Procedural Requirements for Type Approval of Gaseous Fuel Vehicles - Part C (CEV's Application).

AIS 028(Rev.1) (Part A):-Code of Practice for Use of Gaseous Fuels in Internal Combustion Engine Vehicles - Part A (Automotive Application)

AIS 028(Rev.1) (Part B):-Code of Practice for Use of Gaseous Fuels in Internal Combustion Engine Agricultural Tractors - Part B (Agricultural Tractors Application)

AIS 028(Rev.1) (Part C):-Code of Practice for Use of Gaseous Fuels in Internal Combustion Engine Construction Equipment Vehicles (CEV's) - Part C (CEV's Application).

SAE J 517:1998 — Hydraulic hose

This standard is one of the series of Indian Standards published on CNG/Bio-CNG onboard fuel system components. Other standards in the series are:

<i>IS No.</i>	<i>Title</i>
15710: XXXX ¹⁾	Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – General requirements & definition.
15711: XXXX ¹⁾	Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components –Performance and general test methods

- 15712: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – Automatic valve
- 15713: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components–Pressure regulator
- 15714: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – Gas Air mixer
- 15715: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) / Liquefied Petroleum Gas (LPG) Fuel system components – CNG/Bio-CNG/LPG Conduit (Ventilation Hose/Pipe)
- 15716: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components –CNG / Bio-CNG high pressure fuel line (rigid) with end connections (having pressure exceeding 2.15 MPa)
- 15717: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) / Liquefied Petroleum Gas (LPG) Fuel system components – Petrol valve (Automatic/Manual)
- 15719: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG)/ Liquefied Petroleum Gas (LPG) fuel system components – Electrical Wiring kit
- 15720: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) /Liquefied Petroleum Gas (LPG) fuel system component – Compartments sub- Compartments
- 15721: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) / Bio-Compressed natural gas (Bio-CNG)/ Liquefied Petroleum Gas (LPG) fuel system components – Fire retardant material for seat, upholstery, roof and side lining
- 15722: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) / Bio-Compressed natural gas (Bio-CNG) fuel system components - CNG /Bio-CNG flexible fuel line with or without end connections(having pressure not exceeding 2.15 MPa)
- 15723: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) /Liquefied Petroleum Gas (LPG) fuel system components – Current Limiting devices

Note – Standards Marked with superscript ‘1)’ are under the process of Revision. The year of publication of these standards will be updated at the time of printing of this draft standard.

The composition of the Committee responsible for the formulation of this standard is given at

Annex A.

For the purpose of deciding whether a particular requirement 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 2:2022 ‘Rules for rounding off numerical values (*Second Revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

ROAD VEHICLES — COMPRESSED NATURAL GAS (CNG) / BIO- COMPRESSED NATURAL GAS (Bio- CNG) HIGH PRESSURE FUEL LINE (FLEXIBLE HOSE) WITH END CONNECTIONS [HAVING SERVICE PRESSURE EXCEEDING 2.15MPa (21.5 BAR)]

1 SCOPE

1.1 This standard specifies definitions, test methods and requirements of CNG / Bio- CNG high pressure fuel line (flexible hose) with end connections having service pressure exceeding 2.15 MPa (21.5 bar) of CNG / Bio- CNG on-board fuel system component intended for use on motor vehicles defined in IS 14272.

1.1.1 This standard is applicable to CNG / Bio- CNG fuel system components intended to be used on vehicles using compressed natural gas / Bio- compressed natural gas in accordance with IS 15320 Part 1 (mono-fuel or bi-fuel applications or dual fuel applications).

1.1.2 This standard is not applicable to the following:

- a) Liquefied natural gas (LNG) fuel system components located upstream of, and including, the vaporizer;
- b) Fuel containers;
- c) Stationary gas engines; and
- d) CNG / Bio- CNG fuel systems components for the propulsion of marine craft.
- e) Hydrogen Natural Gas Blend (HCNG) Fuel system components

1.1.3 This standard is based upon a service pressure for compressed natural gas / Bio-compressed natural gas as a fuel at 20 MPa (200 Bar) settled at 15°C. Other service pressures could be accommodated by adjusting the pressure by the appropriate factor (ratio). For example, a 25 MPa (250 Bar) service 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 standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 3400: Part 1:2021/ ISO 37: Methods of Test for Vulcanized Rubber Part 1 Tensile Stress-2017	Strain Properties

IS 3400: Part 4:2012/ ISO 188:2011	Methods of test for vulcanized rubber: Part 4 accelerated ageing and heat resistance (Third Revision)
IS 3400: Part 6:2018/ ISO 1817:2015	Methods of Test for Vulcanized Rubbers Part 6 Determination of the Effect of Liquids (Fourth Revision)
IS 3400: Part 20:2018/ ISO 1431-1:2012	Methods of Test for Vulcanized Rubbers - Part 20: Resistance to Ozone Cracking - Static Strain Test (Second Revision)
IS 14272:2011	Automotive Vehicles — Types — Terminology
15710: XXXX ²⁾	Road vehicles - Compressed Natural Gas (CNG) / Bio-Compressed Natural Gas (Bio-CNG) fuel system components – General requirements and definitions
15711: XXXX ²⁾	Road vehicles - Compressed natural gas (CNG) / Bio-Compressed Natural Gas (Bio-CNG) fuel system components – Performance and general test methods

Note — Standards Marked with superscript '2)' are under the process of Revision. The year of publication of these standards will be updated at the time of printing of this draft standard.

3 DEFINITIONS

For the purpose of this standard definitions given in IS 15710 shall apply.

4 TYPES

CNG/Bio-CNG high pressure fuel line (flexible hose) shall be of following types:

- a) Type A — This hose shall consist of an inner tube of oil-resistant synthetic rubber, single wire braid reinforcement and an oil-and weather resistant synthetic rubber cover. A ply or braid of suitable material may be used over the inner tube and/or over the wire reinforcement to anchor the synthetic rubber to the wire.
- b) Type AT — This hose shall be of the same construction as Type A, except having a cover designed to assemble with fittings which do not require removal of the cover or a portion thereof.

5 TYPE TESTS

5.1 Dimensions

Dimensions and tolerances applicable to this hose are given in Table 1.

Table 1. Dimensions of Flexible Hose
(Clause 5.1)

Sl No. (1)	Nominal Size mm (in) (2)	Hose ¹⁾ Dash Size (3)	Hose ID mm (4)	Tolerance on ID mm (5)		Reinforcement Diameter mm (6)		Hose OD Type A mm (7)		Hose OD Type AT mm (8)	Cover ²⁾ Thickness Type AT mm (9)					
				+	-	Max	Min	Max	Min		Max	Min				
i)	4(3/16)	-3	4.8	0.6	0.2	10.1	8.9	13.5	11.9	12.5	1.52	0.76				
ii)	6(1/4)	-4	6.4			11.7	10.6	16.7	15.1	14.1						
iii)	8(5/16)	-5	7.9			13.3	12.1	18.3	16.7	15.7						
iv)	9(3/8)	-6	9.5			15.7	14.5	20.6	19.0	18.1						
v)	10(13/32)	-6.5	10.3	0.8	0.4	16.4	15.3	21.4	19.8	18.9			1.52	0.76		
vi)	12(1/2)	-8	12.7			19.0	17.5	23.8	22.2	21.5						
vii)	16(5/8)	-10	15.9			22.2	20.6	27.0	25.4	24.7						
viii)	18(3/4)	-12	19.0			26.2	24.6	31.0	29.4	28.6						
ix)	22(7/8)	-14	22.2			29.4	27.8	34.1	32.5	31.8						
x)	25(1)	-16	25.4			34.1	32.5	39.3	36.9	36.6						
xi)	32(1-1/4)	-20	31.8	1.2	0.4	41.7	39.3	47.6	44.4	44.8					2.03	1.02
xii)	38(1-1/2)	-24	38.1			48.0	45.6	54.0	50.8	52.0					2.54	1.27
xiii)	50(2)	-32	50.8			61.9	58.7	68.3	65.1	65.9						

¹⁾ For information only (Hose dash size = Nominal size in inch x 16).

²⁾ Cover thickness shall be measured by means of a dial indicator depth gauge having a round foot placed parallel to the hose bridging a groove obtained by stripping a 12.5 to 25.4 width of cover from the hose. A mandrel should be placed in the hose bore to insure freedom from misalignment.

5.1.1 The inside diameter of hose shall be concentric with outside diameter of hose and the outer surface of the reinforcement within the limits given in Table 2.

Table 2 Hose Concentricity
(Clause 5.1.1)

Nominal Hose ID mm (in)	Concentricity, FIR ID to OD mm	Concentricity, FIR ID to Reinforcement mm
Up to and including 6 (1/4)	0.8	0.4
Over 6 (1/4) to 22 (7/8) inclusive	1.0	0.6
Over 22 (7/8)	1.3	0.8

5.2 Proof Pressure Test

When tested as per 5 of IS 15711 flexible hose shall not leak at the proof pressure test specified in Table 3.

5.3 Change in Length Test

Shall not exceed +2 percent to -4 percent change when pressurized to operating pressure specified in Table 3.

5.4 Burst Test

One 460 mm free hose length assembly shall not leak or fail below the minimum burst pressure specified in Table 3 when tested as per 5 of IS 15711.

5.5 Leakage Test

Two 300 mm free hose length assemblies shall not leak or fail when tested as per 5 of IS 15711 at 1.5 times of operating pressure as specified in Table 3.

5.6 Cold Bend Test

One hose assembly shall exhibit no cover cracks or leakage when bent at a minimum bend radius specified in Table 3 and exposed at -20°C .

5.7 Oil Resistance Test

When tested as per IS 3400 (Part 6) the specimens prepared from the inner tube and the cover shall show a volume increase of not more than 100 percent when measured after removal from Oil No. 3 in which it has been immersed for 70 h at $100 \pm 2^{\circ}\text{C}$.

Table 3 Specifications of Flexible Hose
(Clauses 5.2, 5.3, 5.4, 5.5 and 5.6)

Sl No. (1)	Nominal Size mm (in) (2)	Burst Pressure MPa, Min (3)	Proof Pressure MPa (4)	Operating Pressure MPa (4)	Min Bend Radius ³⁾ mm (5)
i)	4(3/16)	82.7	41.4	20.7	89
ii)	6(1/4)	75.8	37.9	19.0	102
iii)	8(5/16)	68.9	34.5	17.2	114
iv)	9(3/8)	62.0	31.0	15.5	127
v)	10(13/32)	62.0	31.0	15.5	140
vi)	12(1/2)	55.2	27.6	13.8	178
vii)	16(5/8)	41.2	20.7	10.3	203
viii)	18(3/4)	34.5	17.2	8.6	241
ix)	22(7/8)	31.0	15.5	7.8	279
x)	25(1)	27.6	13.8	6.9	305
xi)	32(1-1/4)	17.2	8.6	4.3	419
xii)	38(1-1/2)	13.8	6.9	3.4	508
xiii)	50 (2)	10.3	5.2	2.6	635

³⁾ Bend radius measured at inside of bend.

5.8 Ozone Resistance Test

When tested as per IS 3400 (Part 20) for ozone resistance test to an atmosphere comprised of air and ozone with an ozone partial pressure of 50 MPa (50 parts ozone per 100 million parts of air at standard atmospheric conditions) at an ambient temperature of 40°C for 70 h exposure, specimens shall not show evidence of cracking or deterioration when viewed with seven-power magnification while still in a stressed condition.

5.9 Ageing Test

When hose is aged for 72 h at 125± 2°C in accordance with IS 3400 (Part 4) the change in tensile strength and elongation at break of the lining and cover when tested in accordance with IS 3400 (Part 1) shall not vary from the corresponding pre-determined un-aged values by more than 40 percent.

6 ACCEPTANCE TEST

For the purpose of acceptance test, CNG/Bio-CNG high pressure fuel line (flexible hose) having pressure exceeding 2.15 MPa (21.5 bar) approved under this standard shall be so manufactured as to conform following test requirements as specified in relevant clauses of this standard:

- a) Proof pressure test,
- b) Burst test,
- c) Leakage test,
- d) Cold bend test,
- e) Ozone resistance test, and
- f) Ageing test.

7 MARKING

7.1 CNG/Bio-CNG high pressure fuel line (flexible hose) with end connections shall be permanently marked with:

- a) Manufacturers name, trade-mark or symbol;
- b) Part No. or unique identification mark;
- c) Type;
- d) Nominal size;
- e) Working pressure;
- f) Date of manufacture or batch number, and
- g) CNG/Bio-CNG;

7.2 BIS Certification Marking

Each flexible hose may also be marked with the Standard Mark.

7.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

8 TECHNICAL INFORMATION TO BE SUBMITTED BY THE COMPONENT MANUFACTURER

Technical information to be submitted by the component manufacturer for component type approval/type test shall contain at least following information:

- a) Name of the hose manufacturer;
- b) Manufacturing plant address;
- c) Part No.;
- d) Type No. (Type A or Type AT);
- e) Nominal inner diameter (ID);
- f) Nominal outer diameter (OD);
- g) Maximum operating pressure; and
- h) Drawings with relevant dimensions and materials

9 NUMBER OF SAMPLES FOR TESTING

Samples of free hose length of CNG/Bio-CNG high pressure hose assembly with or without end connections having preferably BSP threading shall be submitted as per Table 4 for complete testing as per this standard:

Table 4 Number of Samples for Testing
(Clause 9)

SI No. (1)	Free Hose Length Sample (2)	Minimum Quantity (3)
i)	460 mm length with end connections	3
ii)	460 mm length without end connections	1
iii)	300 mm length with end connections	2
iv)	300 mm length without end connections	2
v)	150 mm X 150 mm slabs of cover and lining material	4

10 CHANGES IN TECHNICAL SPECIFICATIONS OF A TYPE APPROVED COMPONENT AND EXTENSION OF APPROVAL

Any modification in technical specification of already type approved component shall require re-type test /extension of approval at the discretion of certifying agency, based on the justification provided by the component manufacturer and reviewed by the certifying agency, which has granted type approval.

ANNEX A
(Foreword)

COMMITTEE COMPOSITION

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

Will be Added Later.