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Indian Standard

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मोटर गैसोलिन — विशिष्टि

(छठा पुनरीक्षण)

Motor Gasoline — Specification

(Sixth Revision)

ICS 43.060.01; 75.160.20

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Price Group 8

Petroleum and their Related Products of Synthesis or Biological Origin Sectional Committee, PCD 3

FOREWORD

This Indian Standard (Sixth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Petroleum and their Related Products of Synthesis or Biological Origin Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Motor Gasoline (earlier also known as Motor Spirit) is a complex mixture composed of relatively volatile hydrocarbons that vary widely in their physical and chemical properties. Motor Gasoline (MG) is exposed to a wide variety of mechanical, physical and chemical environments. Thus, the properties of motor gasoline must be balanced to give satisfactory engine performance over an extremely wide range of operating conditions. The performance of motor gasoline in spark ignition engines depends on a number of factors like engine design, engine maintenance, driving cycle, environment and fuel quality parameters like octane number, volatility, stability, etc.

This standard was first published in 1964 and covered motor gasoline of 83 octane only. Subsequently, it was revised in 1971 by enlarging its scope to cover motor gasoline of 93 octane also keeping in view the increasing demand of 93 octane motor gasoline in the country. Since the test method IS 1448 [P : 37] 'Determination of tetraethyl lead (TEL) by chlorate oxidation method' was withdrawn, the reference to this method was deleted from the standard through amendment No. 1, October 1979 and the latest test method IS 1448 [P : 82] 'Determination of lead content in motor gasoline by iodine monochloride method' was introduced. On the recommendations of vehicle manufacturers the octane number requirements of 83 octane motor gasoline were again revised through Amendment No. 2 in November 1984 and the same was upgraded to 87 octane motor gasoline, keeping the other requirements unchanged. Amendment No. 3 in 1992 was issued with a view to provide for use of methanol blended (3 percent *v/v*) motor gasoline, as desired by the Ministry of Petroleum and Natural Gas (MoP&NG) with the purpose of conserving petroleum products and also utilizing the surplus methanol available. The requirement for water tolerance of motor gasoline-methanol blends was also incorporated. Methanol being known as a highly toxic substance, precautionary note against its safe use was incorporated in the Amendment.

The second revision of this standard was published in 1995 in accordance with the requirement of engines available at that time and exhaust emission norms in vogue. The requirement of anti-knock rating (octane number) was replaced by the anti-knock index which is the average of Research Octane Number (RON) and Motor Octane Number (MON), that is, (RON+MON)/2, since anti-knock index is a better representation of the road octane requirements for a vehicle. Vapour-Lock Index (VLI) was introduced in addition to distillation and Reid Vapour pressure to prevent 'vapour-lock' problem in cars under hot weather conditions.

In India with an increasing use of Fluidized Catalytic Cracking (FCC) units in the refineries, the amount of cracked stock in motor gasoline drastically increased which adversely affected the storage stability and consequently the fuel economy, emission and drivability. However, by appropriate combination of refining process and use of multifunctional additives the deposit formation could be avoided. In the second revision two major requirements were introduced:

a) Requirement of potential gum in place of induction period, and

b) Engine test method for ensuring engine intake system cleanliness (Carburettor, induction manifold and intake valves) as a 'Type Test' to provide trouble-free operation of cars.

Investigations had established that the potential gum corresponding to 4 h of ageing at 100°C and under oxygen pressure of 690 kPa (ASTM D 873) represents gum content after storage for three months at 43°C. The engine evaluation was introduced to establish the carburettor and intake system deposition tendency. This test helped in identifying the potential additive candidates for the type of fuel produced and also to establish and optimize the additive dosage to achieve cleanliness level in fuel and intake system of the engine.

In addition to get octane boost particularly for unleaded motor gasoline and to incorporate oxygen in fuels, use of organic oxygenates like methyl tertiary butyl ether (MTBE), methanol, ethanol and higher alcohols containing 2.0-3.7 mass percent oxygen (O_2) in motor gasoline was being practiced in advanced countries. Accordingly, use of organic oxygenates was permitted as blending components along with stabilizing agents to prevent phase separation of the motor gasoline/alcohol blends. The properties of motor gasoline-oxygenate blends can differ considerably from those of motor gasoline alone. Consequently, additional requirements were needed for motor gasoline – oxygenate blends. These requirements involved evaluation of compatibility with plastics and elastomeric material in fuel systems, corrosion of metals, and especially in the case of motor gasoline-alcohol blends, water tolerance which was used to indicate the ability of a motor gasoline-oxygenate blends to dissolve water without the phase separation. The Reid Vapour Pressure Method (wet) was made applicable to motor gasoline and motor gasoline-ether blends but not to motor gasoline-alcohol blends. The dry vapour pressure method as described in Annex A (ASTM D 4953) shall be used for motor gasoline-alcohol blends. Considering the availability of unleaded motor gasoline in near future, methods of sampling and test for 87 octane unleaded motor gasoline was incorporated.

Amendment No.1, March, 1997 was issued to reduce the sulphur content for unleaded motor gasoline from 0.20 to 0.15 percent by mass, *Max.* The requirement of sulphur content was aligned with Notification No. GSR 176(E) dated 2.4.1996, issued by the Ministry of Environment and Forests (MOEF).

Amendment No.2, March, 1999 was issued to restrict the lead content from 0.56 to 0.15 g/l, *Max* for 87 octane leaded grade motor gasoline.

Amendment No.3, March, 2000 was issued to introduce the requirement of benzene content as 3 percent by volume, *Max* for the metros.

Amendment No.4, September, 2000 incorporated the requirement of Research Octane Number (RON) in addition to AKI.

The third revision of this standard was published in December 2000 with a view to take into account the requirement of newer engines being introduced and stricter exhaust emission norms being mandated by the Government with penal provisions for contravention, incentives (duty concession) for fuel efficient engine designs and the increasing users awareness to problems of drivability, safety, equipment life and fuel economy. Besides, some of the requirements had been modified as below:

a) Leaded regular grade motor gasoline deleted and only two grades of unleaded motor gasoline, namely, regular and premium retained;
b) Requirement of density provided as 710 to 770 kg/m^3;
c) Sulphur content restricted to 0.10 percent, by mass, *Max*;
d) Range of Reid Vapour pressure modified as 35 to 60 kPa;
e) Requirement of benzene content stipulated as 3 percent *(v/v), max* for metros and 5 percent (*v/v*)*, Max* for the rest of the country; and
f) Provision had been made for use of multifunctional additives (MFA) from internationally accepted test laboratories/authorities in place of evaluation of motor gasoline engine intake system deposition by twin carburettor Ambassador Motor Gasoline Engine Test.

Subsequently, following five amendments of third revision were issued to incorporate various requirements including the motor gasoline specifications for vehicles meeting Bharat Stage II (BS II) and Bharat Stage III (BS III) emission norms:

Amendment No.1, January 2002 was issued primarily with the note that the twin carburettor ambassador motor gasoline engine test may be retained to be employed concurrently up to April 2003 and change in requirement in characteristics of Sulphur, Benzene and Engine intake system cleanliness in the Table 1, as well as modifications in the note 6 of the table pertaining to Multi-Functional Additives (MFA) and fuel intake system cleanliness.

Amendment No. 2, February 2003, was issued incorporating the reworking of footnote 6 of Table 1 on the Amendment No. 1 and the Euro III/Bharat Stage III emission norms compliant specifications for motor gasoline.

Amendment No. 3, July 2003, was issued incorporating the effect of 5 percent *v/v*, maximum ethanol in motor gasoline on RVP, and VLI and their of relaxation. In view of the different brands of motor gasoline launched by marketing companies, the provision was made for different colours under Table 1, serial no. 1.The test method for analysis of ethanol content was also incorporated.

Amendment No. 4, August 2004, was issued on Table 1 footnote 6 for redefining the test methods for assuring adequate fuel system and intake system cleanliness performance of engine.

Amendment No. 5, July 2005 was issued to align the requirement for motor gasoline with Auto Fuel Policy of the Government of India. Addition of methanol to motor gasoline was discontinued. The anhydrous ethanol for use in automotive fuel was also defined under BIS specification IS 15464: 2004. Ministry of Petroleum and Natural Gas (MoP&NG) vide its Gazette Notification extraordinary Part I – section 1 under Sr. No. 230 and resolution no. P-45018/28/2000-CC dated 3rd September 2002 mandated sale of only 5 percent ethanol blended motor gasoline with effect from 1st January 2003 in the notified States and Union Territories. However, due to non-availability of adequate ethanol /price differential, the dates of implementations as well as mandate were also amended from time to time. Accordingly Table 1 was modified and amended for characteristics, requirements as well as method of tests. Motor gasoline under the requirement was placed in 2 columns with BS –II and BS – III with the grades MS 88, MS 93 and MS 91, MS 95 respectively. Provision had been made under note 7 that MFA which are certified against National Generic Certification Option as per US – EPA – 97 final rule (40 CFR Part 80 certification standards for deposits control additives) can also be used by fuel Refiners/ Marketers at treatment level not less than the lowest additive concentration (LAC) limits, as these MFAs meet the criteria for acceptance.

In the fourth revision requirements for 10 percent ethanol blending in motor gasoline were included for BSIII fuel. All the above mentioned five amendments issued to the third revision of the standard were also incorporated. Further editorial corrections arising in correlating the above mentioned amendments and to incorporate test methods for determination of ethanol content and ISO 4259 for interpretation of test results based on the precision statements of respective test methods was also done.

In the fifth revision, requirements for Bharat stage II (BSII) motor gasoline were deleted and Amendment No.1 issued in March 2010 and Amendment No. 2 were incorporated. With the deletion of BS II motor gasoline, the requirements for distillation at 180°C, anti knock index and potential gum were also deleted. The specification for motor gasoline for the vehicles meeting Bharat Stage IV/Euro IV Vehicular Emissions Norms based on the Auto Fuel Policy, issued by the Ministry of Petroleum and Natural Gas, Government of India were incorporated as Table 3 and Table 4 for normal motor gasoline and 10 percent ethanol (E10) blended motor gasoline, respectively. Table 3 was based on Annex F covered by amendment No. 1 of fourth revision. Assistance was derived from the recommendations of the Expert Committee on Auto Fuel Policy headed by Dr R. A. Mashelkar, Director General, CSIR and Inter-Ministerial Task Force headed by Dr D. K. Biswas, Chairman, CPCB. The date and area for implementation of these specifications are as decided by the Competent Authority.

It is recognized that there are applications where for technical or other reasons, limits different from those in this standard or additional requirements may be necessary. This standard does not cover such special applications which are matters for agreement between the purchaser and the supplier. This specification, unless otherwise, provided by agreement between the purchaser and the supplier, prescribes the required properties of motor gasoline at the time and place of delivery. Nothing in this specification shall, however, preclude observance of the regulations which may be more restrictive.

In the present (sixth) revision, requirements for Bharat Stage III (BS-III) motor gasoline and 10 percent Ethanol Blended motor gasoline BS-III (E10) have been deleted. Also, the contents of amendment No.1 issued in April 2016 and amendment No. 2 issued in January 2017 for Aromatic content in motor gasoline from Assam crude has been incorporated in this standard.

Requirement of final boiling point of permitted components i.e. alcohols and ethers in **4.2.1** of fifth revision has been reduced to 210°C in place of 215°C. After introduction of 10 percent ethanol blending in motor gasoline throughout the country, none of the other oxygenates except ethanol is permitted as oxygen content is limited to maximum 3.7 percent by mass.

For formulating the specification for Motor gasoline fuel for the vehicles meeting Bharat Stage VI Vehicular Emission Norms considerable assistance has been derived from the Report of the Expert Committee to Government of India on Auto Fuel Vision & Policy 2025, and the Extraordinary Gazette Notification No. 651 dated 16th September 2016 Central Motor Vehicles (11th Amendment) Rules, 2016 issued by Ministry of Road Transport and Highways. Comments/Input/Data received from all stakeholders were considered while formulating specification. The date and area for implementation of BS VI motor gasoline specifications shall be as per the directives from the Government of India.

Existing standard test methods have been reviewed and the latest standard methods (IS/ISO/ASTM/IP) have been incorporated in this revision.

The composition of the Committee responsible for the formulation of this standard is given in Annex D.

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 a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rule for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
MOTOR GASOLINE — SPECIFICATION
(Sixth Revision)

1 SCOPE

1.1 This standard prescribes the requirements and methods of sampling and test methods for two octane grades each of Motor Gasoline (earlier also known as Motor Spirit) and up to 10 percent ethanol blended motor gasoline (E10) under each of BS IV and BS VI categories suitable for use as a fuel in the automobile spark-ignition internal combustion engines of vehicles complying with BS IV and BS VI emission norms respectively.

1.2 This standard also applies to blends of motor gasoline with organic oxygenates such as alcohols and ethers.

1.3 This standard does not purport to address all of the safety-problems associated with its use. It is the responsibility of the user of this specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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 the standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS /ISO No.	*Title*
1260 (Part 1) : 1973	Pictorial marking for handling and labeling of goods: Part 1 Dangerous good (*first revision*)
1447 (Part 1) : 2016	Petroleum and its products — Methods of sampling: Part 1 Manual Sampling (*first revision*)
1448	Method of test for petroleum and its products
[P : 15] : 2016/ ISO 2160 : 1998	Petroleum products — Corrosiveness to copper strip test (*third revision*)
[P : 16] : 2013	Density of crude petroleum and liquid petroleum products by hydrometer method (*third revision*)
[P : 18] : 2016	Distillation (*second revision*)
[P : 23] : 2016 / ISO 3837 : 1993	Liquefied petroleum products — Determination of hydrocarbon types — Fluorescent indicator absorption method (*fourth revision*)
[P : 26] : 2013/ ISO 5163 : 2005	Knock characteristics of motor fuels by motor method (*first revision*)
[P : 27] : 2013/ ISO 5164 : 2005	Knock characteristics of motor fuels by research method (*first revision*)
[P : 28] : 2008 / ISO 7536 : 1994	Determination of oxidation stability of motor gasoline — Induction period method (*fourth revision*)
[P : 29] : 2016/ ISO 6246 : 1995	Petroleum products — Gum content of light and middle distillate fuels — Jet evaporation method (*third revision*)
[P : 30] : 2013/ ISO 3735 : 1999	Sediment in crude and fuel oils by extraction (*second revision*)
[P : 34] : 2013	Determination of sulphur in petroleum products (lamp method) (*second revision*)
[P : 39] : 2012/ ISO 3007: 1999	Determination of vapour pressure — Reid method (*second revision*)
[P : 82] : 2013/ ISO 3830 : 1993	Determination of lead content in motor gasoline — iodine monochloride method (*first revision*)
[P : 153] : 2012/ ISO 20847 : 2004	Determination of sulfur content of automotive fuels — Energy-dispersive X-ray fluorescence spectrometry
15464 : 2004	Anhydrous ethanol for use as automotive fuel
ISO 3405 : 2011	Petroleum products — Determination of distillation characteristics at atmospheric pressure
ISO 3675 : 1998	Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method
ISO 12185 : 1996	Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method

IS /ISO No.	*Title*
ISO 13032 : 2012	Petroleum products — Determination of low concentration of sulfur in automotive fuels — Energy-dispersive X-ray fluorescence spectrometric method
ISO 20846 : 2011	Petroleum products — Determination of sulfur content of automotive fuels — Ultraviolet fluorescence method
ISO 20847 : 2004	Petroleum products — Determination of sulfur content of automotive fuels — Energy-dispersive X-ray fluorescence spectrometry
ISO 22854 : 2016	Liquid petroleum products — Determination of hydrocarbon types and oxygenates in automotive — motor gasoline and in ethanol (E85) automotive fuel — Multidimensional gas chromatography method

3 GRADES

There shall be two octane grades each (RON 91 and 95) of BS IV and BS VI categories under motor gasoline and 10 percent ethanol blended motor gasoline (E10) as given below.

3.1 Motor Gasoline (Without or With 5 Percent Ethanol Blended Motor Gasoline)

a) BS IV Regular (RON 91),
b) BS IV Premium (RON 95),
c) BS VI Regular (RON 91), and
d) BS VI Premium (RON 95).

3.2 10 Percent Ethanol Blended Motor Gasoline (EBMG)

a) 10 percent EBMGBS IV Regular (RON 91),
b) 10 percent EBMG BS IV Premium (RON 95),
c) 10 percent EBMGBS VI Regular (RON 91), and
d) 10 percent EBMG BS VI Premium (RON 95).

4 REQUIREMENTS

4.1 General

Motor gasoline shall be a refined petroleum distillate free from undissolved water, foreign matter and other visible impurities. It shall also contain 4.75 ± 0.25 percent (*v/v*) anhydrous denatured ethanol (99.5 percent *v/v*) conforming to IS 15464 in the areas where blending is required as per the directives of the Government of India apart from the suitable additives (*see* **4.1.1** to **4.1.5**) in appropriate concentration to improve the stability of motor gasoline.

The 10 percent ethanol blended motor gasoline (E10) shall contain 9.75 ±0.25 percent (*v/v)* anhydrous denatured ethanol (99.5 percent *v/v*) conforming to IS 15464 in the areas where blending is required as per the directives of the Government of India apart from the suitable additives (*see* **4.1.1** to **4.1.5**) in appropriate concentration to improve the stability of motor gasoline.

Organic oxygenates used as blending components and/or stabilizing agents shall be as specified in **4.2.1** and the amount of such oxygenates shall comply with the limiting requirements as specified in **4.2.2.**

4.1.1 *Corrosion Inhibitors*

Suitable doses of corrosion inhibitors have to be necessarily added to ethanol to prevent corrosion, due to its hygroscopic nature.

4.1.2 *Antioxidants*

Suitable antioxidants may be added to motor gasoline and shall be added to 10 percent ethanol blended motor gasoline (E10), in sufficient concentration to meet the requirements for oxidation stability as specified in Table 1. Some antioxidants of proven chemistry are listed below (This is not an exhaustive list):

a) N, N′– disecondary – butyl-paraphenylene diamine;
b) 2,4 — dimethyl-6-tertiary butyl phenol;
c) 4 — methyl-2, 6-ditertiary-butyl phenol;
d) N, N′— di-isopropyl-paraphenylene diamine;
e) N — Normal butyl-p-aminophenol; and
f) Mixture of N, N′ — disecondary-butyl-paraphenylene diamine and disalicylidene-N-methyl dipropylene triamine.

4.1.3 *Metal Deactivators*

Suitable metal deactivators may be added to motor gasoline and shall be added in sufficient concentration for 10 percent ethanol blended motor gasoline (E10). Some metal deactivators of proven chemistry are listed below (this is not an exhaustive list):

a) N, N′— disalicylidene-propylene-diamine;
b) N, N′— disalicylidene-ethylene diamine; and
c) N, N′— disalicylidene-methylamine-dipropylene-triamine.

4.1.4 *Dyes*

A suitable dye shall be added in such a proportion so as to satisfy the requirements for colour mentioned in Table 1, Sl No. (ii).

4.1.5 Motor gasoline multifunctional additives (MFA), other than those mentioned in **4.1.1** and **4.1.2** such as detergent/dispersant, dehazer, defoamant additives may be added in appropriate concentration to improve the quality of the fuel. Additives containing metals such as iron, manganese (MMT) shall not be used.

4.2 Organic Oxygenates

4.2.1 *Permitted Components*

The following components shall be used either singly or as mixtures as blending components or as stabilizing agents to prevent phase separation of the motor gasoline/oxygenate components of the blend:

> *Ethers* — Methyl tertiary butyl ether (MTBE), tertiary amyl methyl ether (methoxy-2-methyl butane) TAME, ethyl tertiary butyl ether (2-ethoxy-2-methyl propane) ETBE and other ethers (R-O-R) with final boiling point not exceeding 210°C and with molecules containing five or more carbon atoms.

4.2.2 *Content*

When tested, the content of the individual components listed in Table 1 shall comply with the limiting requirements as given against the respective components.

In motor gasoline blended with ethanol, the individual components defined in **4.2.1** or their mixtures are permitted but the total oxygen content shall not exceed 3.7 percent by mass and the content of any of the individual components given at Sl No. (xxi) of Table 1 shall not exceed the corresponding limiting requirements.

4.3 Other Requirements

In order to protect automotive catalyst systems, no external addition of other metal additives including lead is permitted.

4.4 Motor gasoline and 10 percent ethanol blended motor gasoline (E 10) shall also comply with the requirements prescribed in Table 1 when tested according to the methods referred in col 5 of the Table 1.

5 PACKING AND MARKING

5.1 PACKING

The material shall be packed in suitable containers suitable containers prescribed by Petroleum and Explosives Safety Organization (PESO) from time to time.

5.2 Marking

5.2.1 The material shall be supplied in accordance with the marking and shipping regulations laid down by Petroleum and Explosives Safety Organization (PESO) from time to time.

5.2.2 Each container shall also be marked with the following information:

a) Name and grade of the material;
b) Indication of the source of manufacture, initials or trade-mark, if any;
c) Volume of the contents, in litres;
d) Year of manufacture or packing; and
e) Any other statutory requirements.

5.2.2.1 *Pump marking and labelling*: Information to be marked on dispensing pumps used for delivering motor gasoline to retail consumer. It shall be clearly visible, easily legible and displayed at any point where motor gasoline or motor gasoline blended with 10 percent ethanol (E10) is made available to consumers.

To help customer to identify various grades of motor gasoline (MG), including the E10, labelling shall be used at retail outlets as given below:

a) Normal motor gasoline:
b) 10 percent ethanol blended motor gasoline (E10)

5.2.3 *BIS Certification Marking*

The container may also be marked with the Standard Mark

5.2.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6 SAMPLING

Representative samples of the material shall be drawn as prescribed in IS 1447 (Part 1).

7 QUALITY ASSUARANCE

7.1 Motor gasoline fuel quality assurance is based on batch certification during production at refineries. It is essential that refineries ensure batches are homogenous so that test results are representative of the product supplied.

7.2 At point of manufacture, the refinery shall issue a Quality Certificate certifying that the batch of fuel complies with all of the requirements of this standard.

7.3 The minimum requirements of information to be shown on the fuel's batch Quality Certificate at point of manufacture are as under:

a) Specification name/number and any amendment number if any;
b) Name and address of testing laboratory;
c) Batch number or unique identifier;
d) Properties tested including specification limit, test method and result of test;
e) Identification of the signatory certifying the report;
f) Date of certification and
g) Quantity certified.

Table 1 Requirement for Motor Gasoline BS-IV & BS-VI Grades
(*Clauses* 4.1.4, 4.2.2 *and* 4.4)

Sl No.	**Characteristic**	**Requirements MG BS IV Grade**	**Requirements MG BS VI Grade**	**Method of Test, IS 1448 / Annex of IS 2796 / ISO / ASTM Alternate Methods**
(1)	(2)	(3)	(4)	(5)
i)	Appearance	Clear and bright. Free from un-dissolved water, foreign matter and other visible impurities	Clear and bright. Free from un-dissolved water, foreign matter and other visible impurities	Visual
ii)	Colour:			Visual
	a) MG 91	Orange	Orange	
	b) MG 95	Red	Red	
iii)	Density at 15°C, kg/m³	720-775	720-775	[P:16][9]/ ISO 3675 / ASTM D 4052/ISO 12185/ ASTM D 1298 / IP 160
iv)	Distillation:			[P:18][9] / ISO 3405 / ASTM D 86
	a) percent evaporated at 70°C (E 70°C), percent *v/v*:			
	1) Motor gasoline	10-45	10-45	
	2) E10	10-55 (Summer) 10-58 (Other months)	10-55 (Summer) 10-58 (Other months)	(*See* Note 1)
	b) percent evaporated at 100°C (E 100 °C), percent *v/v*	40-70	40-70	
	c) percent evaporated at 150°C (E 150 °C), percent *v/v*, *Min*	75	75	
	d) Final boiling point, °C, *Max*	210	210	
	e) Residue, percent by volume, *Max*	2.0	2.0	
v)	Research octane number (RON), *Min:*			[P:27][9] / ASTM D 2699
	a) MG 91	91	91	
	b) MG 95	95	95	
vi)	Motor octane number (MON), *Min:*			[P: 26][9] / ASTM D 2700
	a) MG 91	81	81	
	b) MG 95	85	85	
vii)	Gum content (Solvent washed), g/m^3, *Max*	40	40	[P : 29][9] / ASTM D 381
viii)	Total sulphur, mg/kg, *Max*	50	10	P: 34 / P: 153/ ISO 20847 /ISO 20846[9]/ ISO 13032[9]/ ASTM D 2622/ D 3120/ D 5453/ D 7220
ix)	Lead content (as Pb), g/l, *Max*	0.005	0.005	ASTM D 5059[9]/ IP 224
x)	Reid vapour pressure (RVP) at 38°C, kPa , *Max:*			P : 39 / ASTM D 323 (wet methods) / D 5191(dry method)/ D 6378/ EN 13016/ [Annex A][9] (dry method) (*see* Note 2)
	a) MG(without ethanol)	60	60	
	b) Ethanol blended MG	67	67	
xi)	Vapour lock index (VLI),*Max*	Summer / (Other months)	Summer / (Other months)	(*see* Note 1),
	a) MG (without ethanol)	750 / (950)	750 / (950)	Calculation : VLI = 10 x RVP + 7 x E 70°C
	b) MG (with 5 percent *v/v* ethanol)	900 / (1050)	900 / (1050)	
	c) E10	1050 / (1100)	1050 / (1100)	
xii)	Benzene content, percent by volume, *Max*	1	1	ASTM D 3606 (*see* Note 3) / ASTM D 5580[9] / D 6277 / D 6730/ D 6839/ ISO 22854
xiii)	Copper strip corrosion, for 3 h at 50°C, *Max*	Not more than No. 1	Not more than No. 1	[P:15][9] / ASTM D130
xiv)	Water tolerance of motor gasoline-alcohol blends, temperature for phase separation:			Annex-B
	a) Winter, °C, *Max*	0	0	
	b) Other months, °C, *Max*	10	10	(*see* Note 4)

Table 1 — (*Concluded*)

(1)	(2)	(3)	(4)	(5)
xv)	Engine intake system cleanliness	Report MFA used	Report MFA used	(*see* Note 5)
xvi)	Olefin content, percent by volume, *Max:*			[P : 23]$^{9)}$ / ASTM D 1319 / D 6730/ D 6839/ ISO 22854
	a) MG 91	21	21	
	b) MG 95	18	18	
xvii)	Oxidation stability, minutes, *Min*	360	360	[P:28]$^{9)}$ / ASTM D 525 / IP 40
xviii)	Aromatics content, percent by volume, *Max*	35$^{6)}$	35$^{6)}$	[P:23]$^{9)}$ /ASTM D 1319 / D 5580/ D 6730 /D 6839 / ISO 22854
xix)	Oxygen content, percent by mass, *Max*	3.7	3.7	EN 1601/ IP 408/ ASTM D 4815$^{9)}$/ D 5599 / D 6839
xx)	Ethanol content, percent by volume:			(*See* Notes 7 and 8) ASTM D 4815$^{9)}$/ D 5599 / Annex C (Water extraction)
	a) Motor gasoline	5.0	5.0	
	b) E10	10.0	10.0	
xxi)	Oxygenates percent by volume, *Max*			ASTM D 4815
	a) Ethers containing 5 or more 'C' atoms per molecules such as MTBE, ETBE or TAME	15	15	
	b) Any other oxygenates	Not permitted	Not permitted	

NOTES

1 Summer shall be the period from April to July.

2 For the motor gasoline-alcohol blends, the dry vapour test method given in Annex A shall be followed.

3 It is applicable only for non-alcoholic motor gasoline.

4 In winter (Nov to Feb) it is expected that temperature may be lower than 0°C in the northern hilly region and hence phase separation shall not take place till –10 °C

5 Use of multifunctional additives (MFA) is a requirement for assuring adequate fuel system and intake system cleanliness performance in engines. Refiners/Marketers of motor gasoline have to ensure the MFA has proper credentials from internationally accepted test laboratories/ authorities, of having passed a minimum of one of the tests in each of the two categories of deposit control performance indicated below:

	Deposit Type	*Test No.*	*Test Equipment*	*Test Method*	*Pass limit (Average IVD (Weight)*
a)	Intake Valve Deposit (IVD)	1	BMW IVD Test	ASTM D 5500-98	100 mg/ valve, *Max*
		2	MB M102E IVD	CEC F-05-A-93	50 mg/ valve, *Max*
		3	FORD 2.3 Litre IVD	ASTM D 6201	90 mg/ valve, *Max*
		4	MB M111-IVD Test	CEC F-20-A-98	50 mg/ valve, *Max*
					Pass limit (percent Injector Flow Loss)
b)	Port fuel injector deposit (PFI)	1	Chrysler PFI Test	ASTM D 5598-01	5 percent, *Max*
		2	PFI Deposit Rig	ASTM D 6421	10 percent, *Max*

Other performance tests may be added as and when they reach qualified/standard test status.

MFAs which are certified against National Generic Certification Option as per US EPA-97 final Rule (40 CFR Part 80 Certification Standards for Deposit Control Additives) can also be used by fuel refiners/Marketers at treatment levels not less than the Lower Additives Concentration (LAC) limits, as these MFAs meet the criteria for acceptance mentioned above.

6 Aromatic content relaxation and time frame, if any, for fuel processed from Assam Crude, may be guided by the notifications issued by Government of India, from time to time.

7 Corrosion inhibitors and/or stabilizing agents shall be added in case of 10 percent ethanol blended motor gasoline.

8 For routine analysis of ethanol content - ASTM D 5845 (FTIR) or Water extraction method shall be employed (*see* Annex C). Blending of ethanol shall be carried out at supply point of Oil Marketing Company's Depot / Terminal as per the directives of Ministry of Petroleum and Natural Gas (MoP&NG) from time to time. OMC shall ensure homogeneous blending of ethanol in motor gasoline in the range 4.5 to 5.0 percent by volume and 9.5 to 10.0 percent by volume for 5 percent and 10 percent ethanol blended motor gasoline respectively. In case ethanol is not blended, Sl no xx) is not applicable.

9 In case of dispute, this method shall be the referee method

10 No external addition of silicon, chlorine based materials and metallic additives are allowed.

11 The colour of the branded motor gasoline can be decided by OMC, subject to such fuel meets all other requirements of the respective motor gasoline grade defined in the table.

12 All the test methods referred to in this standard include a precision statement. The Interpretation of results shall be based on test method and precision data of test method whenever applicable. In case of dispute the procedure described in ISO 4259 shall be used.

ANNEX A

[*Table* 1, *Sl No*.(x)]

TEST METHOD FOR VAPOUR PRESSURE OF MOTOR GASOLINE-ALCOHOL BLEND (DRY METHOD)

A-1 GENERAL

This test method covers the determination of the absolute vapour pressure of motor gasoline and motor gasoline-oxygenate blends.

NOTE — Because the external atmospheric pressure is counteracted by the atmospheric pressure initially present in the air chamber, the 'vapour pressure' is an absolute pressure at 38°C in kilopascals. This vapour pressure differs from the true pressure of the sample due to some small sample vaporization and the presence of air in the confined space.

A-2 SUMMARY OF TEST METHOD

The fuel chamber of the vapour pressure apparatus is filled with the chilled sample and connected to the air chamber at 38°C. The apparatus is immersed in a bath at 38°C and is shaken periodically until a constant pressure is observed on the gauge attached to the apparatus. The gauge reading, suitably corrected, is reported as the vapour pressure.

A-3 SIGNIFICANCE AND USE

The method IS 1448 [P : 39] cannot be used to determine the vapour pressure of motor gasoline-oxygenate blends which contain water-extractable oxygenates because the fuel sample comes into contact with water. This test method is a modification of IS 1448 [P : 39] where contact with water has been eliminated.

A-4 APPARATUS

The construction of the required apparatus is described in **3** of IS 1448 [P: 39].

A-5 REAGENTS

A-5.1 Purity of Reagents

Use reagent grade chemicals in all tests. Unless otherwise indicated, it is intended that all reagents conform to the relevant Indian Standard where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

A-5.2 Acetone

WARNING — Extremely flammable. Irritating to skin, eyes and mucous membranes.

A-5.3 Naphtha

NOTE — Naphtha [Tag closed cup flash point below –6°C].

WARNING — Extremely flammable. Harmful, if inhaled. Skin irritant on repeated contact. Aspiration hazard.

A-6 HANDLING OF SAMPLES

A-6.1 The extreme sensitivity of vapour pressure measurements to losses through evaporation and the resulting changes in composition is such as to require the utmost precaution and the most meticulous care in the handling of samples. The provisions of this section apply to all samples for vapour pressure determinations.

A-6.2 Sample in accordance with IS 1447 (Part 1) except that water displacement must not be used.

A-6.3 Sample Container Size

The size of the sample container from which the vapour pressure sample is taken as 1 litre. It will be 70 to 80 percent filled with the sample.

A-6.4 Precautions

A-6.4.1 Determine vapour pressure as the first test run on a sample. Do not withdraw more than one sample from the sample container for this test.

A-6.4.2 Protect samples from excessive heat prior to testing.

A-6.4.3 Do not test samples in leaky containers. Discard them and obtain new samples.

A-6.4.4 Discard samples that have separated into two phases and obtain new samples (*see* Note 2 under **A-8.3**).

A-6.5 Sample Handling Temperature

In all case, cool the sample container and contents to 0 to 1°C before the container is opened. To ensure sufficient time to reach this temperature, directly measure the temperature of a similar liquid in a like container placed in the cooling bath at the same time as the sample.

A-7 PREPARATION FOR TEST

A-7.1 Verification of Sample Container Filling

With the sample at a temperature of 0 to 1°C, take the container from the cooling bath, wipe dry with an absorbent material, unseal it, and examine its ullage. The sample content, as determined by use of a suitable gauge, must be equal to 70 to 80 percent of the container capacity.

A-7.1.1 Discard the sample if its volume is less than 70 percent of the container capacity.

A-7.1.2 If the container is more than 80 percent full, pour out enough sample to bring the container contents within the 70 to 80 percent range. Under no circumstances, may any sample poured out, be returned to the container.

A-7.2 Air Saturation of Sample in Sample Container

A-7.2.1 With the sample again at a temperature of 0 to 1°C take the container from the cooling bath, wipe it dry with an absorbent material, unseal it momentarily, taking care to prevent water entry, reseal it, and shake it vigorously. Return it to the bath for a minimum of 2 min.

A-7.2.2 Repeat **A-7.2.1** twice more. Return the sample to the bath and keep it there until the beginning of the procedure (*see***A-8**).

A-7.3 Preparation of Fuel Chamber

Observe the apparatus preparation procedure of **A-8.5**, then store the stoppered fuel chamber and the sample transfer connection in a refrigerator or ice-water bath for a sufficient time to allow the chamber and the connection to reach a temperature of 0 to 1°C. If and ice-water bath is used, keep the chamber upright and not immersed over the top of the coupling threads. The transfer connection is inserted over the top of the coupling threads. The transfer connection is inserted into a plastic bag to keep it completely dry during cooling.

A-7.4 Preparation of Air Chamber

Observe the apparatus preparation procedure of **A-8.5**. Connect the gauge to the air chamber and close the lower opening securely with a dry No.6 rubber stopper. Make sure the stopper is inserted far enough to securely close the vent hole in the air chamber connection. Immerse the air chamber to at least 25 mm above its top in the water bath until the fuel chamber has been filled with the sample as described in **A-8.1**.

A-8 PROCEDURE

A-8.1 Sample Transfer

With everything in readings, remove the chilled sample container from the bath, dry it with absorbent material, uncap it, and dry and insert the chilled transfer apparatus (*see* Fig.1). Quickly place the chilled fuel chamber, in an inverted position, over the sample delivery tube of the transfer apparatus. Invert the entire system rapidly so that the fuel chamber is upright, with the end of the delivery tube touching the bottom of the fuel chamber. Fill the fuel chamber to the overflowing. Withdraw the delivery tube from the fuel chamber while allowing the sample to continue flowing up to the moment of complete withdrawal.

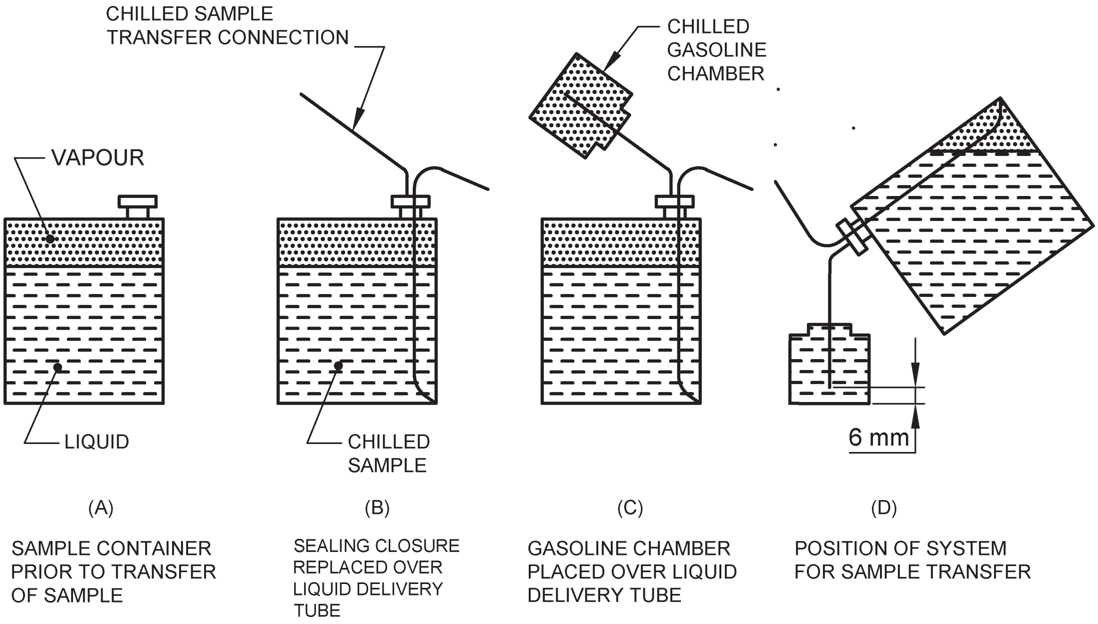

Fig. 1 Simplified Sketches Outlining Method of Transfering Samples to Motor Gasoline Chamber from Open-Type Containers

A-8.1.1 Caution

Make provision for suitable collection and disposal of the overflowing fuel to avoid fire hazard.

A-8.2 Assembly of Apparatus

Immediately remove the air chamber from the water bath and immediately dry the exterior of the chamber with absorbent material giving particular care to the connection between the air chamber and the fuel chamber. Remove the stopper after drying and immediately couple the two chambers. Not more than 10s shall be consumed in coupling the two chambers.

NOTE — When the air chamber is removed from the water bath is dried, and the stopper is removed, connect it to the fuel chamber without undue movements through the air, which could promote exchange of room temperature air with the 38°C air in the chamber.

A-8.3 Introduction of Apparatus into Bath

Turn the assembled vapour pressure apparatus upside down to allow the sample in the fuel chamber to run into the air chamber. With the apparatus still inverted, shake it vigorously eight times in a direction parallel to the length of the apparatus. With the gauge end up, immerse the assembled apparatus in the bath, maintained at 38 ± 0.1°C in an inclined position so that the connection of the fuel and air chambers is below the water level and may be carefully examined for leaks 25 mm above the top of the air chamber. Observe the apparatus for leakage throughout the test. Discard the test at any time a leak is detected.

NOTES

1 Liquid leaks are more difficult to detect than vapour leaks, and because the coupling between the chambers is normally in the liquid section of the apparatus give the coupling particular attention.

2 After the apparatus has been immersed in the bath check the remaining sample for phase separation. If the sample is contained in a glass container, this observation can be made prior to sample transfer (*see* **A-8.1**). If the sample is contained in a non-transparent container, shake the sample vigorously for 5 s and then immediately pour a portion of the remaining sample into a clear glass container. Immediately after shaking this sample again for 5 s, observe the sample for phase separation. If this sample is not clear and bright, and free of a second phase, discard the test and the sample.

A-8.4 Measurement of Vapour Pressure

After the assembled vapour pressure apparatus has been immersed in the bath for at least 5 min, tap the pressure gauge lightly and observe the reading. Withdraw the apparatus from the bath and repeat **A-8.3**.

At intervals of not less than 2 min, perform **A-8.3** until a total of not less than five shakings and gauge readings have been made continue thereafter, if necessary, until the last two consecutive gauge readings are constant, indicating equilibrium attainment. These operations normally require 20 to 30 min. Read the final gauge pressure to the nearest 0.25 kPa for gauges with intermediate graduations of 0.5 kPa or less than to the nearest 0.5 kPa for gauges with graduations of 1.0 to 2.5 kPa and record the values as the 'uncorrected vapour pressure' of the sample. Without undue delay remove the pressure gauge and, without attempting to remove any liquid which may be trapped in the gauge, check its reading against that of the manometer while both are subjected to a common steady pressure which is no more than 1.0 kPa different from the recorded 'uncorrected vapour pressure'. If a difference is observed between the gauge and manometer readings, the difference shall be added to or subtracted from the 'uncorrected vapour pressure' recorded for the sample being tested, and the resulting value shall be recorded as the vapour pressure of the sample.

NOTES

1 Cooling the assembly prior disconnecting the gauge will facilitate disassembly and reduce the amount of hydrocarbon vapour released into the room.

2 *Verification of sample integrity* — Disconnect the air chamber from the fuel chamber. Drain the sample from the air and fuel chambers as completely as possible into a dry (8-oz) 240 ml clear glass bottle. Seal the bottle and shake it vigorously for 5 s. If the sample is clear and bright and free of a second phase, note this observation and record the test is valid. If the sample is not clear and bright and free of second phase. Immerse the bottle in the 38°C water bath up to about 25 mm above the top of the sample level for 15 min in order to heat the sample to the test temperature. Remove the sample from the water bath and immediately shake it vigorously for 5 s and observe the sample. If the sample is not clear and bright and free of second phase, note this observation and record that the test is not valid because of phase separation. A fuel that is not clear and bright and free of second phase at this point of the test indicates that the fuel was contacted with sufficient water to exceed the water tolerance of the fuel during the test procedure. Water can most likely get into the test chambers during preparation of the fuel and air chambers (*see* **A-7.3** and *see* **A-7.4**) or assembly of the air and fuel chambers (*see* **A-8.2**), or both, specially and fuel chambers (*see* **A-8.2**), or both specially, if water baths are used for these procedures.

A-8.5 Preparation of Apparatus for Next Test

Thoroughly purge the air chamber of residual sample by filling it with warm water above 32°C and allowing it to drain. Repeat the purging at least five times. After disconnecting the pressure gauge from its manifold connection with the manometer, remove trapped centrifugal thrusts. This may be accomplished in the following manner hold the gauge between the palms of the hands with the right hand on the face side and the threaded connection of the gauge forward. Extend the arms forward and upward at an angle of 45° with the coupling of the gauge pointing in the same direction. Swing the arms downward through an arc of about 135° so that the centrifugal force aids gravity in removing the trapped liquid. Repeat this operation three times to expel all liquid. Purge the pressure gauge by directing a small jet of air into its Bourdon tube for at least 5 min. Rinse both chambers and the sample transfer connection several times with petroleum naphtha, then several times with acetone, then blow dry using dried air. Stopper the fuel chamber and place it in the refrigerator or ice-water bath for the next test.

NOTE — If the purging of the air chamber is done in a bath, be sure to avoid small and unnoticeable films of floating sample by keeping the bottom and top opening of the chamber closed as they pass through the water surface.

A-9 PRECAUTIONS

A-9.1 Gross errors can be obtained in vapour pressure measurements, if the prescribed procedure is not followed carefully. The following list emphasizes the importance of strict adherence to the precautions given in the procedure.

A-9.1.1 *Checking the Pressure Gauge*

Check all gauges against a manometer after each test in order to ensure high precision of results (*see* **A-8.4**). Read all gauges while the gauges are in a vertical position and after tapping them lightly.

A-9.1.2 Shake the container vigorously to ensure equilibrium of the sample with the air in the container (*see***A-7.2**).

A-9.1.3 *Checking for Leaks*

Check the apparatus before and during each test for both liquid and vapour leaks.

A-9.1.4 *Sampling*

Because initial sampling and the handling of samples will greatly affect the final results, employ the utmost precaution and the most meticulous care to avoid losses through evaporation and even slight changes in composition (*see* **A-6.5** and **A-8.1**). In no case shall any part of the apparatus itself be used as the sample container prior to actually conducting the test.

A-9.1.5 *Purging the Apparatus*

Thoroughly purge the pressure gauge, the fuel chamber and the air chamber to be sure they are free of residual sample [This is most conveniently done at the end of the previous test (*see***A-8.5**)]. It is important to remove all water from the apparatus before cooling the motor gasoline chambers and heating the air chamber. In high-humidity conditions be alert for and avoid condensation on the transfer connection and interior walls of the apparatus.

A-10 REPORT

A-10.1 Reporting Results

Report to the nearest 0.25 kPa or 0.5 kPa the gauge result observed in **A-8.4**, after correcting for any difference between the gauge and manometer, as the vapour pressure in kilopascals without reference to temperature.

A-11 PRECISION AND BIAS

A-11.1 Precision

The following criteria should be used for judging the acceptability of results (95 percent confidence).

A-11.1.1 *Repeatability*

The difference between successive test results obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following value only in one case in twenty:

Component Gauge (*Range*)	*Repeatability* kPa
0 to 100 kPa	4.90

A-11.1.2 *Reproducibility*

The difference between two single and independent results, obtained by different operators working in different laboratories on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following value only in one case in twenty.

ComponentGauge (*Range*)	Reproducibility kPa
0 to 100 kPa	7.790

A-11.2 Bias

There being no criteria for measuring bias in these test-product combinations, no statement of bias can be made.

ANNEX B

[*Table* 1, *Sl No.* (xiv)]

TEST METHOD FOR WATER TOLERANCE (PHASE SEPARATION) OF MOTOR GASOLINE-ALCOHOL BLEND

B-1 GENERAL

This test method determines the ability of motor gasoline-oxygenate blends to retain water in solution or in a stable suspension at the lowest temperature to which they are likely to be exposed in use.

B-2 SUMMARY OF TEST METHOD

The sample of fuel is cooled at a controlled rate to its expected use temperature and is periodically observed for both haze and phase separation. The apparatus as given in **4** of IS 1448 [P : 10] or a dry ice-isopropyl alcohol bath may be used. A maximum cooling rate of 2°C/mm is specified because phase separation in motor gasoline-oxygenate blends has a relatively long but unpredictable induction period.

B-3 SIGNIFICANCE AND USE

B-3.1 Some oxygenate-containing fuels, and motor gasoline-alcohol blends in particular have a very limited ability to retain water in solution or in stable suspension, and if the amount of water in the blend exceeds this limit, the fuel will separate into a lower oxygenate-rich aqueous phase and an upper oxygenate-lean hydrocarbon phase. The most important factor governing the ability of a specific fuel to retain water without such separation is its temperature. This method is intended to determine the maximum temperature at which the fuel will separate. The temperatures represent the maximum temperatures above which the fuel must not separate into two distinct phases.

B-3.2 Note that in this test, actual separation of the sample into two distinct phases is the criterion for failure. The following are indications of phase separation.

B-3.2.1 The formation of droplets large enough to be detected by the unaided eye. They may be either clinging to sides of the container or collect on the bottom.

B-3.2.2 The formation of two layers separated by either a common boundary, or a layer of emulsion. Formation of haze without one of these indications of separation is not cause for rejection.

B-4 APPARATUS

B-4.1 Test Container — Any glass container of about 100 ml capacity may be used. This container may be marked at the level of 40 ml.

B-4.2 Thermometers — Meeting the requirements of Specification E-1,ASTM thermometer 6°C (range –80 to +20°C, 1°C graduations, 76 mm immersion. Thermometer 6°F is the Fahrenheit equivalent of 6°C), spans the necessary range of temperatures. A thermometer must be provided for each container, mounted to pass through the stopper.

B-4.3 Viton Rubber Stopper — To fit sample container bored centrally for the test thermometer.

B-4.4 Cooling Bath — May be of similar dimensions to those specified in **4** of IS 1448 [P : 10] and provided with a jacket disk and gasket (as specified in the apparatus section) filled with an equal-volume mixture of water and 'Permanent' antifreeze and provided with refrigeration coils capable of reducing its temperature to – 40°C. Alternatively, a dry ice-isopropyl alcohol bath may be used.

B-5 SAMPLING AND HANDLING

B-5.1 Draw samples in accordance with IS 1447 (Part1), except water displacement shall not be used.

B-5.2 Draw the samples in steel cans that have been solvent washed.

B-5.3 Store the samples in refrigerator (2 to 7°C), whenever not actually transferring sample.

B-5.4 Because motor gasoline-alcohol blends are hygroscopic as well as volatile, minimize contact with the atmosphere by keeping sample containers tightly closed except when transferring sample.

B-6 PROCEDURE

B-6.1 Warm the sample to 15°C and shake, to redissolve any water that may have settled out at the refrigerator temperature.

B-6.2 Cool the test container to 10 to 15°C. Carry out steps **B-6.3** through **B-6.5** as promptly as possible to minimize vaporization losses and absorption of water from the atmosphere.

B-6.3 Rinse out the cooled test container with some of the sample to be tested. Drain.

B-6.4 Pour about 40 ml of the sample into the test container. The precise amount is not critical, but it must be enough to submerge the thermometer bulb adequately, without being so much as to require an excessive amount of cooling time. If the sample has separated, as defined in **B-3.2**, terminate the test.

B-6.5 Seal the test container with the rubber stopper. Locate the thermometer bulb approximately at the centre of the fuel sample.

B-6.6 Cool the sample by intermittent immersion in or circulation of the coolant. The sample is not to be swirled or shaken while in the cooling bath. Starting at a cooling bath temperature not higher than 10°C or 16°C above the test temperature, cool the sample at a maximum rate of 2°C/min until phase separation occurs, or the test temperature is reached.

B-6.7 At 2°C intervals, remove the test container from the cooling bath and shake vigorously for 5 to 10s. Wipe the exterior of the sample container with a towel moistened with isopropyl alcohol to remove any condensation, and observe the condition of the sample for no more than 5s against a light coloured illuminated background.

B-6.8 It is likely that the sample will get hazy prior to actual phase separation as defined in **B-3.2**. Record the sample temperature at the first indication of haze (when cooling); and the temperature when the haze disappears (warming).

B-6.9 Record the temperature of phase separation (*see* **B-3.2**). Then allow the sample to warm at ambient temperature. Shake the sample vigorously after a temperature rise of 2°C, and observe. Record a 'warming' phase recombination temperature, and the haze disappearance temperature. Average these 'cooling' and 'warming' temperatures to determine the actual phase separation and haze point temperatures. Repeat this process for improved accuracy.

B-7 REPORT

Report the averaged haze point and phase separation temperatures found in **B-6.9**.

ANNEX C

[*Table* 1, *Sl No.* (xx)]

METHOD FOR DETERMINATION OF ETHANOL CONTENT IN ETHANOL DOPED MOTOR GASOLINE BY WATER EXTRACTION

C-1 SCOPE

This method covers the determination of ethanol content in ethanol doped motor gasoline as field test at supply point, Retail Outlet, etc, by using water. This method provides a test of online ethanol doped motor gasoline for ethanol content in percentage volume. The method can suitably be used for estimation of ethanol content in ethanol doped motor gasoline and quantification of ethanol up to 16 percent as a referee test method.

C-2 OUTLINE OF THE TEST METHOD

30 ml of water is added to 100 ml of ethanol doped motor gasoline taken in 150 ml graduated stoppered cylinder. The mixture is shaken vigorously for about 30 s and cylinder is set aside for 5 min to observe the separation of aqueous layer. Increase in the volume of aqueous layer over and above 30 ml indicates the presence of extractable ethanol in the ethanol doped motor gasoline sample tested. The exact quantity of ethanol is then worked out referring the observation to the calibration plot. The plot is made on exact quantity of ethanol extracted from 100 ml of various known concentrations of ethanol doped motor gasoline using 30 ml of water *vis-à-vis* the concentration of ethanol used for doping. For better results the calibration chart shall be re-plotted whenever there is change in the source of motor gasoline to minimize the effect of solubility coefficient with respect to different hydrocarbon composition of motor gasoline.

C-3 SIGNIFICANCE AND USE

The test method is employed to check the percentage of ethanol in ethanol doped motor gasoline, as ethanol is having more affinity for mixing with water. The addition of water in ethanol doped motor gasoline extracts the ethanol present in the ethanol doped motor gasoline in to aqueous phase. The increase in the water level indicates the quantity of extractable ethanol in ethanol doped motor gasoline.

C-4 CHEMICAL REQUIREMENTS

C-4.1 Ethanol/Denatured Ethanol, is the pure chemical, otherwise known as hydroxy-ethane, corresponding to the constitution CH_3CH_2OH and molecular formula, C_2H_5OH. Anhydrous Ethanol for an Automotive fuel (*see* IS 15464) which is made unfit for beverage use by the addition of noxious or toxic materials (denaturants) and same is used as ethanol for the purpose of doping motor gasoline.

C-4.2 Motor Gasoline, a volatile mixture of liquid hydrocarbon, generally containing a small amount of additives, suitable for use as a fuel in spark ignition and internal combustion engines conforming to Tables 1 and 2.

C-4.3 Ethanol Doped Motor Gasoline, a fuel consisting primarily of motor gasoline doped with denatured anhydrous Ethanol for fuel.

C-4.4 Water, distilled is to be used.

C-5 APPARATUS

C-5.1 150 ml glass stoppered cylinder with 0.5 ml graduation from 0 to 50 ml and 1 ml graduation from 50 to 150 ml having dimensions as per **C-5.2** (*see* Fig. 2).

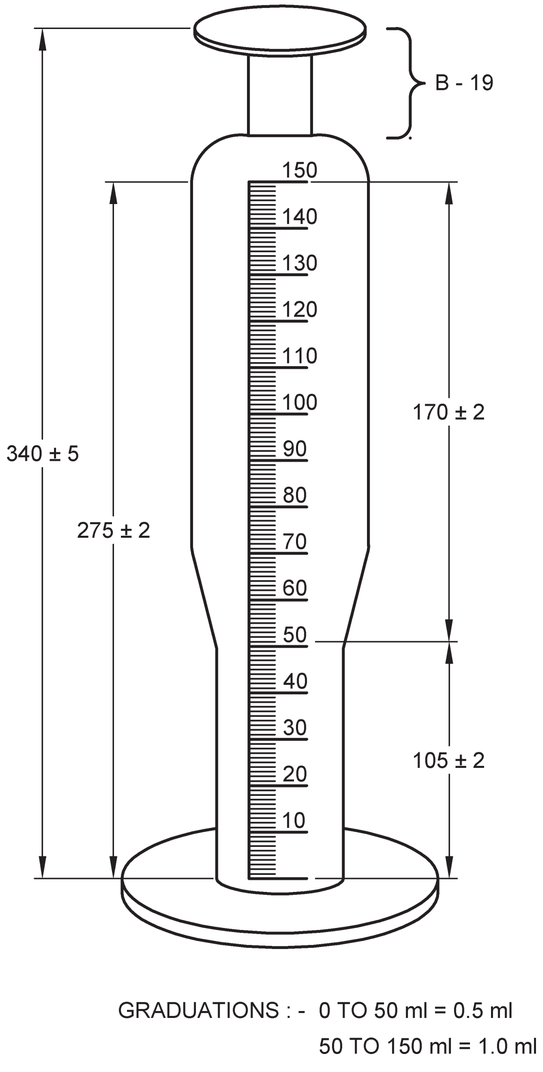

FIG. 2 150 ml GRADUATED STOPPERED CYLINDER

C-5.2 Dimensions of 150 ml Cylinder in Millimetres

a)	Total length	: 340 ± 5
b)	Scale length	: 275 ± 2
c)	Scale length from (0 ml to 50 ml scale)	: 105 ± 2
d)	Scale length from (50 ml to 150 ml scale)	: 170 ± 2
e)	Stopper joint	

C-5.3 10 ml or 25 ml and 5 ml glass pipette (Class 'A' Certificate).

C-6 CALIBRATION ON KNOWN ETHANOL CONTENT IN ETHANOL DOPED MOTOR GASOLINE AND ITS EXTRACTION

C-6.1 Prepare a set of standards of ethanol doped motor gasoline samples with the concentration of ethanol in motor gasoline ranging from 2.0 to 16.0 ml by percentage volume. Take 100 ml of each sample above in 150 ml graduated stoppered clean and dry glass cylinder along with one blank motor gasoline (without ethanol).Add precisely 30 ml of water to the sample. Shake the stopper cylinder vigorously for at least for 30 s. Loosen the stopper of glass cylinder to release the vapor pressure in the cylinder but do not remove the stopper. Tighten the stopper and allow the stopper cylinder to sit undisturbed at ambient temperature upright on the leveled surface for a period of at least five minutes to allow the water-ethanol mixture to settle to the bottom.

C-6.2 If separation of two layers is not complete lightly tap the cylinder to encourage the complete separation. Record the level of aqueous layer in glass cylinder by reading the measurement at the lowest part of the meniscus.

Presence of ethanol percent in ethanol doped motor gasoline = Volume of aqueous layer observed in graduated cylinder – 30 ml (water added during testing).

C-6.3 Plot a graph on various values obtained above as ordinate (*X*-axis) against corresponding concentration of ethanol used in the standard blend as abscissa (*Y*-axis) including that of the observation made on the blank.

C-7 PROCEDURE

C-7.1 Take 100 ml sample of ethanol-blended motor gasoline under test in 150 ml graduated stoppered clean and dry glass cylinder. Add precisely 30 ml water to the sample taken in the glass cylinder and place the stopper tightly. Shake the stoppered cylinder vigorously for at least 30 seconds. Loosen the stopper of glass cylinder to release the vapor pressure in the cylinder but do not remove the stopper. Tighten the stopper and allow the stoppered cylinder to sit undisturbed at ambient temperature upright on the leveled surface for a period of at least 5 min to allow the water-ethanol mixture to settle to the bottom.

C-7.2 If separation of two layers is not complete lightly tap the cylinder to encourage the complete separation. Record the level of aqueous layer in glass cylinder by reading the measurement at the lowest part of the meniscus.

Presence of ethanol percent, in ethanol doped motor gasoline = Volume of aqueous layer observed in graduated cylinder – 30 ml (water added during testing).

C-8 CALCULATION

Observation made under **E-7-2**, is read against the standard plot in **E-6.3** and the corresponding concentration of ethanol value is obtained. Whenever there is a change in source of motor gasoline, for better results, it is recommended to re-plot the graph as mentioned in **E-6.3**.

C-9 REPORT

Report the corrected results obtained as per **E-8** to the nearest 0.5 ml.

C-10 PRECISION AND BIAS

C-10.1 In the absence of calibration plot the value observed in aqueous phase can be calculated to the nearest percentage volume as per the under mentioned precision levels.

C-10.2 Based on the field test data, it was observed that a maximum of 9.0 ml (average) of ethanol content is extracted in to the aqueous phase as against 10 ml ethanol added in ethanol doped motor gasoline.

C-10.3 The standard deviation of the test results at 5 percent ethanol content by volume is ± 0.3 percent and for 10 percent ethanol content by volume is ± 0.50 percent.

C-10.4 Considering the precision of the graduated glass cylinder, the maximum possible measurement can be treated as 9.0 percent by volume with standard deviation of ± 1.0 percent. Thus the repeatability under the method is as under:

Percentage	*Repeatability / Reproducibility*
5 percent (*v/v*)	0.5 ml (Approximately)
10 percent (*v/v*)	1.0 ml (Approximately)

ANNEX D

(Foreword)

COMMITTEE COMPOSITION

Petroleum and their Related Products of Synthesis or Biological Origin Sectional Committee,PCD 3

Organization	*Representative(s)*
Indian Institute of Technology, Delhi	Prof L. M. Das (***Chairman)***
Ashok Leyland Ltd, Chennai	Shri Ravi M.Shri Arun S. (*Alternate*)
Association of State Road Transport Undertaking (ASRTU), Pune	Shri Anand Rao
Bajaj Auto Ltd, Pune	Shri K. Rajan Shri Girish S. Kodolikar (*Alternate*)
Bharat Oman Refineries Lid, Sagar, MP	Shri Anand Pratap Raghav Shri B. Sridhar (*Alternate*)
Bharat Petroleum Corporation Ltd, Mumbai	Shri Debashis Ganguli Shri V. Suresh (*Alternate*)
Centre for Consumer Education, Research, Teaching, Training and Testing (CONCERT), Chennai	Shri R. Balasubranian
Centre for High Technology, New Delhi	Shri Brijesh Kumar Shri S. N. Sukhwal (*Alternate*)
Centre for Science and Environment (CSE), New Delhi	Ms Anumita Roychowdhury Shri Vivek Chattopadhya (*Alternate*)
Chennai Petroleum Corporation Ltd (CPCL), Chennai	Shri S. Kumar Shri H. Ramakrishnan (*Alternate*)
Central Pollution Control Board, (Ministry of Environment & Forests), New Delhi	Shri Dinabandhu Gouda
Petroleum and Explosives Safety Organization, Nagpur	Shri Ashendra Singh
Consumer Guidance Society of India, Mumbai	Dr Sitaram Dixit Dr M. S. Kamath (*Alternate*)
Directorate General of Civil Aviation, New Delhi	Shri Lalit Gupta Shri Hillol Biswas (*Alternate*)
Essar Oils, Mumbai	Shri Shyama S. Mji Shri Dhaval Doshi (*Alternate*)
Gulf Oil Lubricants India Ltd, Mumbai	Dr Y. P. Rao Ms Indu M. Gupta (*Alternate*)
Hero Motocorp Ltd, Gurugram	Shri Ajay Gupta Shri Ashok Kataria (*Alternate*)
Hindustan Petroleum Corporation Ltd, Mumbai	Shri A. K. Jain Shri Sunny C. M. (*Alternate*)
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