

Australian Standard[®]

Automotive diesel fuel



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- Australian Institute of Petroleum
 - Department of Defence
 - Department of Energy, N.S.W.
 - Department of Primary Industries and Energy (Commonwealth)
 - Environment Protection Authority of Victoria
 - Federal Chamber of Automotive Industries
 - Society of Automotive Engineers—Australasia
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Automotive diesel fuel

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PREFACE

This Standard was prepared by Standards Australia Committee CS/48, Automotive Diesel Fuel to supersede AS 3570—1988. This edition specifies a new set of limits for cloud point in order to provide better control of vehicle operability in cold conditions by more closely matching the fuel specification limits to the fuel distribution areas and the local weather patterns in those areas.

The new limits for cloud point were developed not only following detailed computer analysis of long term weather data ('Climatic Averages Australia') provided by the Australian Bureau of Meteorology but with a more conservative allowance above the 14 percentile minimum temperature. Although the new specification is still based on cloud point it has taken into account that some refineries have been successful in the use of wax modifiers to reduce Cold Filter Plugging Point.

The main benefit to consumers is the inclusion of 12 supply regions and 12 (monthly) periods. Regional boundaries have been re-drawn to ensure that each supply point delivers the required grade into its appropriate region at the appropriate time. A winter season lead time has also been incorporated. Accordingly, diesel fuel used within two or three months from the date of supply should not present cold weather operability problems. The specification recognizes cold weather problem locations and indeed the list in this edition has been extended.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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FOREWORD

The purpose of this Standard is to specify requirements which will ensure that difficulties associated with the use of diesel fuel will be eliminated or at least minimized.

One area of concern for diesel fuel users has been the cetane number (see Paragraph C4, Appendix C). It was argued by some members of the Committee that some passenger cars, light commercial vehicles, and light tractors will have engine problems if the cetane number is below 48. In particular, white smoke emission during cold start-up was cited as a typical problem. However, other members argued that because the demand for diesel fuel is increasing while at the same time the availability of local crude (having high cetane number) is dwindling, more and more imported crude (having low cetane number) is needed for blending. Accordingly, in order to ensure sufficient supply of diesel fuel, a minimum limit for cetane number of 45 is essential. As to the concern about engine performance, it was generally agreed that only a very small percentage of vehicles would be adversely affected by fuel having a cetane number of 45. As such, it was considered most unfair to penalize the majority of diesel fuel users with increased costs and the possibility of fuel shortages in order to produce a higher cetane fuel necessary to satisfy the small minority. Further, it was argued that low cetane fuels affect cold weather starting only and that this problem could be improved by a number of other means (e.g., injection of additives into the intake manifold) rather than by increasing the cetane number. Moreover, it was stated that as there are no locally produced diesel engines and the world trend for diesel fuel is to reduce the cetane number, it would be unrealistic to encourage the development of engines capable of only using high cetane number fuels.

Although a consensus was reached to accept a cetane number of 45, the vehicle manufacturer's representatives indicated that they would strongly oppose any attempts to reduce the cetane number at a later date without substantial justification.

Another area of concern has centred around the filterability of diesel fuel. The filterability of diesel fuel is substantially affected by firstly, sediment caused by oxidation, and secondly, by microbiological growth. That is, during storage, diesel fuel may oxidize to form gums and sediments and, in the presence of water, may be contaminated by the growth of fungus and bacteria with resultant sludge formation (see Paragraphs C11 and C13, Appendix C). Accordingly, when such fuel is transferred to the vehicle, these sediments and sludges can cause fuel filter blockages which cannot be removed readily. It was argued that probably the greatest number of complaints about the quality of diesel fuel were related to its filterability. However even though there was some doubt as to the appropriateness of the oxidation stability test as a predictor of storage stability and subsequent filterability, it was argued that this test is the best that is currently available. Further, it was argued that diesel fuel from the refineries should not present any filterability problems as these problems generally occur as a result of the fuel being improperly stored.

Cold weather presents another form of filterability problem. At very low temperatures, small wax crystals start to form in the fuel. These crystals grow and eventually block fuel filters. Current research indicates that diesel engine operability temperature is more closely related to the cold filter plugging point than the cloud point. In order to improve cold weather operability, wax modifiers have been successfully used by some refineries to reduce the cold filter plugging point. However, the inclusion of wax modifiers in diesel fuel does not significantly affect the cloud point. Consequently, the specification takes into account such improved cold weather operability by allowing the cloud point to be relaxed, if the differential between the cloud point and cold filter plugging point is equal to or greater than 4°C. (See Tables 2 and 3 and Paragraphs C5 and C6 of Appendix C.)

STANDARDS AUSTRALIA

Australian Standard **Automotive diesel fuel**

1 SCOPE This Standard specifies requirements for automotive diesel fuel intended for use in high speed diesel engines.

NOTES:

- 1 Automotive diesel fuel is also commonly known as 'diesel', 'distillate', 'automotive distillate', and 'automotive diesel oil'.
- 2 See Clause 4.2 for the definition of a high speed diesel engine.
- 3 This Standard does NOT apply to diesel fuel intended for use in medium or low speed engines.

2 OBJECTIVE This Standard is intended to specify properties of automotive diesel fuel which, when used in high speed engines, would minimize engine problems, particularly, cold weather starting problems. The Standard will provide a benchmark which refineries as well as users can reference when the quality of diesel fuel is in dispute.

3 REFERENCED DOCUMENTS The documents below are referred to in this Standard.

ASTM

- | | |
|--------|---|
| D 86 | Test method for distillation of petroleum products (IP 123) |
| D 93 | Test methods for flash point by Pensky-Martens closed cup tester (IP 34) |
| D 95 | Test method for water in petroleum products and bituminous materials by distillation (IP 74) |
| D 129 | Test method for sulfur in petroleum products (general bomb method) (IP 61) |
| D 130 | Method for detection of copper corrosion from petroleum products by the copper strip tarnish test (IP 154) |
| D 189 | Test method for Conradson carbon residue of petroleum products (IP 13) |
| D 445 | Test method for kinematic viscosity of transparent and opaque liquids (and calculation of dynamic viscosity) (IP 71) |
| D 473 | Test method for sediment in crude oils and fuel oils by the extraction method (IP 53) |
| D 482 | Test method for ash from petroleum products (IP 4) |
| D 524 | Test method for Ramsbottom carbon residue of petroleum products (IP 14) |
| D 613 | Test method for cetane number of diesel fuel oil |
| D 1298 | Test method for density, relative density (specific gravity), or API gravity of crude petroleum and liquid petroleum products by hydrometer method (IP 160) |
| D 1796 | Test method for water and sediment in fuel oils by the centrifuge method (IP 75) |
| D 2274 | Test method for oxidation stability of distillate fuel oil (accelerated method) |
| D 2500 | Test method for cloud point of petroleum oils (IP 219) |
| D 2622 | Test method for sulfur in petroleum products by X-ray spectrometry |
| D 2709 | Test method for water and sediment in middle distillate fuels by centrifuge |
| D 4052 | Test method for density and relative density of liquids by digital density meter (IP 365) |

ASTM

D 4057 Practice for manual sampling of petroleum and petroleum products

D 4737 Test method for calculated cetane index by four variable equation (IP 380)

BS

3195 Methods for sampling petroleum products

Part 1: Manual sampling of liquid hydrocarbons

IP

170 Flash point by the Abel apparatus

309 Cold filter plugging point of distillate fuels

336 Sulphur in petroleum products by energy-dispersive X-ray fluorescence (non-dispersive X-ray fluorescence)

4 DEFINITIONS For the purpose of this Standard, the definitions below apply.

4.1 Additives—chemical substances added to automotive diesel fuel, usually in small quantities to impart desirable properties to, or prevent deterioration of the automotive diesel fuel.

4.2 High speed diesel engine—a compression-ignition engine which operates faster than 800 r/min and typically powers medium and heavy duty trucks, buses, passenger cars, farm machinery, industrial and construction machinery, stationary generating sets, pump sets, and work and pleasure boats.

NOTE: Besides the above definitions, because it was not practicable to use full expressions, this specification (e.g. Table 3, Figures B1 and B2) also includes the following acronyms:

- (a) ADF—automotive diesel fuel.
- (b) CP—cloud point.
- (c) CFPP—cold filter plugging point.

5 COMPOSITION Automotive diesel fuel—

- (a) shall consist of hydrocarbons derived from petroleum;
- (b) shall not include any inorganic acid;
- (c) shall not include any suspended material (e.g. undissolved water or sediment) that is visible to a person of normal vision; and
- (d) may include additives.

6 REQUIREMENTS When a representative sample is obtained by the method specified in Appendix A, and tested in accordance with the appropriate method indicated in Table 1, automotive diesel fuel shall have properties that conform to the limits specified in Table 1.

For cloud point, the maximum limit shall be—

- (a) the limit specified in Table 2; or
- (b) where the differential between the determined cloud point and cold filter plugging point is greater than or equal to 4°C, the relaxed cloud point shall comply with the limit specified in Table 2, after the determined cloud point is reduced by the appropriate amount allowed in Table 3.

7 MARKING Each dispensing pump and each container of automotive diesel fuel intended for sale to the public shall be marked with the words ‘DIESEL FUEL’ or a brand name or trademark that clearly identifies the contents as being automotive diesel fuel.

TABLE 1
GENERAL REQUIREMENTS FOR AUTOMOTIVE DIESEL FUEL

Property	Unit	Limit	Test method
Ash	% (by mass)	0.01 (max.)	ASTM D 482-IP 4
Carbon residue (on 10% residuum)	% (by mass)	0.2 (max.) or 0.16 (max.)	ASTM D 524-IP 14 ASTM D 189-IP 13
Cetane number		45 (min.)	ASTM D 613
Cloud point	°C	{ As specified in Clause 6	ASTM D 2500-IP 219
Cold filter plugging point	°C		IP 309
Copper corrosion (3 h at 100°C)		2 (max.)	ASTM D 130-IP 154
Density (at 15°C)	kg/L	0.82 to 0.87	ASTM D 1298-IP 160; or ASTM D 4052-IP 365
Distillation (90% recovered)	°C	357 (max.)	ASTM D 86-IP 123
Flash point	°C	As permitted by legislation	ASTM D 93-IP 34 or IP 170, whichever is appropriate
Oxidation stability (see Note 2)	mg/L	25 (max.)	ASTM D 2274
Sulphur	% (by mass)	0.5 (max.)	ASTM D 129-IP 61: or ASTM D 2622: or IP 336
Water sediment or Water and sediment	{ % (by volume) % (by mass) % (by volume)	{ 0.05 (max.) 0.01 (max.) 0.05 (max.)	{ ASTM D 95-IP 74 ASTM D 473-IP 53 ASTM D 1796-IP 75: or ASTM D 2709
Viscosity kinematic (at 40°C)	cSt (see Note 3)	1.9 to 5.5	ASTM D 445-IP 71

NOTES:

1 If the determined cloud point of diesel fuel complies with the limit specified in Table 2, the product may be released by the refinery if the cloud point is specified. That is, the cold filter plugging point test results need *not* be indicated.

If the determined cloud point of diesel fuel does not comply with the limit specified in Table 2, but the relaxed cloud point does, the product may be released by the refinery only if *both* the determined cloud point and cold filter plugging point are indicated.

2 Referring to oxidation stability in Table 1, it should be recognized that the method specified in ASTM D 2274 measures stability under accelerated conditions. Accordingly, the correlation between this test and field storage may vary significantly under different field conditions or with fuels from different sources.

3 Although it is recognized that the unit centistokes (cSt) is not an SI unit for kinematic viscosity, this unit is specified in Table 1 because it is the unit specified in the referenced test procedure (i.e. ASTM D 445-IP 71).

$$1 \text{ cSt} = 1 \text{ mm}^2/\text{s}$$

4 Appendix B provides information relating to climatic consideration relative to automotive diesel fuel.

5 A brief explanation of each of the properties specified in Table 1, has been given in Appendix C.

TABLE 2
MAXIMUM LIMITS FOR CLOUD POINT

Region	Calendar month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AUC	15	10	5	2	1	1	1	4	7	11	14	15
AUN	15	15	12	9	8	8	8	10	14	15	15	15
NSW	9	5	2	0	−1	−1	−1	0	2	5	7	9
QC	15	12	7	4	2	2	2	4	7	12	15	15
QCN	15	15	11	7	6	6	6	8	11	15	15	15
QFNE	15	15	12	7	7	7	7	9	12	15	15	15
QS	11	7	3	0	−1	−1	−1	0	2	7	9	13
SAS	8	6	4	2	1	1	1	2	4	5	6	9
TAS	3	1	−1	−2	−3	−3	−3	−3	−1	0	2	3
VIC	9	6	3	1	0	0	0	1	2	4	6	8
WAC	15	15	9	6	5	5	5	7	11	15	15	15
WAS	10	6	4	3	2	2	2	2	3	5	8	10

- NOTES:
- 1 The months specified in this Table refer to the date of delivery into the respective nominated supply points (see Figure 1 for an indication of the regions and Table 4 for the supply points). However, even though the specification does include a lead time to account for supply distribution patterns, storage periods, existing stocks and turnover rates, diesel fuel actually available to the user at the beginning of each month may vary slightly from that specified in Table 2.
- 2 See Paragraph B1 and Table B1 in Appendix B for the locations where fuel problems may possibly occur because of cold weather.