



## DRAFT TANZANIA STANDARD

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### Fuel Additives – Specification

Draft for Public Review Only

**TANZANIA BUREAU OF STANDARDS**

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## Foreword

This Draft Tanzania Standard is being prepared by the Petroleum and petroleum products Technical Committee under the supervision of Chemicals Divisional Standards Committee and it is in accordance with the procedures of the Bureau.

This is second draft cancels and replaces the first edition, TZS 1247:2012 which has been technically revised

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value observed or calculated expressing the result(s) of a test or analysis shall, be rounded off in accordance with TZS 4 *Rounding off numeric values*

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## Introduction

The petroleum additive industry is a research and development intensive industry and its products are marketed almost exclusively to industrial users. A very wide range of additives has been developed to meet the needs of an industry which converts principally hydrocarbon fuels into heat energy, either to provide transportation or to generate electricity for industrial and domestic consumption.

The wide range of products required reflects both the range of fuel types that benefit from additive use and also the range of performance features that can be improved, or operational problems that can be overcome, through the use of additives. These may be encountered at the refinery, in distribution systems and storage tanks or in use, for example, in numerous different transport applications.

An additive may be used as a single stand-alone product to resolve a specific issue, for example at the refinery or, frequently, may be combined with other products to create a multi-functional package for use in finished fuels for the automotive industry. Fuel additive treat levels are generally low, with some additives dosed at single figure mg/kg (ppm) levels. Others are employed at treat levels ranging from 50 – 3500 mg/kg (0.005 – 0.35 %) depending on the extent and range of benefit desired. Additive treat levels employed do not approach those of fuel blending components (such as ethanol for use in gasoline, or fatty acid methyl esters – FAME – in diesel fuel), where use levels are typically 3 – 20% of hydrocarbon base fuel volume.

## Fuel additives — Specification

### 1 Scope

This Draft Tanzania Standard specifies requirements, sampling and test methods for fuel additives used in gasoline (petrol) and/or gas oil (diesel) engines.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3170, *Petroleum liquids - Manual sampling*

ISO 3171, *Petroleum liquids — Automatic pipeline sampling*

TZS 672/EAS 158, *Automotive gasoline (premium motor spirit) — Specification*

TZS 674/EAS 177, *Automotive gas oil (automotive diesel) — Specification*

TZS 2260, *High performance engine lubricating oil for diesel engines*

TZS 2261, *High performance engine lubricating oil for petrol engines*

TZS 983, *Air Quality – Vehicular Exhaust Emissions Limits*

TZS 698, *Road vehicles – Code of practice for inspection and testing of used motor Vehicles for road worthiness*

TZS 836 – 1, *Air quality – General considerations – Part 1 – Vocabulary*

TZS 836 -2, *Air quality – General considerations Part 2 – Particle size fractions definitions for health related sampling*

TZS 985/ISO 3929, *Road vehicles – Measurement methods for exhaust gas emissions during inspection or maintenance*

TZS 986/ISO 3930, *Instruments for measuring vehicle exhaust emissions – Metrological and technical requirements; Metrological control and performance tests*

ISO 1998-1, *Petroleum industry — Terminology — Part 1: Raw materials and products*

ISO 14396, *Reciprocating internal combustion engines — Determination and method for the measurement of engine power — Additional requirements for exhaust emission tests in accordance with ISO 8178*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1998-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **fuel**

any material which is capable of releasing energy or power by combustion or other chemical or physical reaction

#### 3.1

##### **fuel additives**

chemical substances that are designed to be added to fuels for the purpose of improving engine performance; reducing fuel consumption and reducing emissions. They also make fuel burn more uniformly and completely. They are normally grouped into cleaners or catalysts

#### 3.2

##### **baseline fuel**

fuel that conforms to the requirements of TZE 672 and TZE 674

#### 3.3

##### **reformulated fuel**

fuel into which additives has been added

#### 3.4

##### **exhaust emission limit**

highest permissible quantity of pollutants released into the atmosphere from a vehicle, expressed as the concentration of pollutants in relation to one unit of production or to the degree of air pollution caused by these sources (e.g., dark color of smoke)

#### 3.5

##### **emission**

shall mean transfer of pollutants from the source to the atmosphere

### 4 Types of fuel additives

#### 4.1 Main additives component families;

Additive can be sub-divided in terms of their point of application as indicated below:

##### a) Refinery products

- Antioxidant and stability improver additives
- Octane/cetane enhancing additives
- Cold flow improver additives

- Metal deactivator additives
  - Dyes
- b) Distribution system products
- Corrosion inhibitors
  - Pipeline drag reducing additives
  - Anti-static additives
- c) Automotive performance enhancement products
- Deposit control additives
  - Cetane improvers
  - Lubricity additives
  - Friction modifiers
  - Antifoam additives
  - Corrosion inhibitors
  - Demulsifiers/dehazers
  - Ant-valve seat recession additives
  - Fuel borne catalysts for particulate filters

## **4.2 Multi-functional additives**

**4.2.1** Combined packages of a number of selected additive components should be assembled to provide a bespoke performance-enhancing additive for use by fuel retailers for their products.

**4.2.2** Multifunctional gasoline additive packages will often combine a deposit control additive with a corrosion inhibitor and demulsifier additive. Multifunctional diesel additive packages are frequently more complex and may combine deposit control additive with cetane number improver, antifoam additive, corrosion inhibitor and demulsifier (and possibly also cold improver additives depending on seasonality).

## **5 Requirements**

### **5.1 General requirements**

The fuel additive shall not have harmful side-effects that may cause deterioration in performance of baseline fuel.

### **5.2 Specific requirements**

#### **5.2.1 Chemical and physical properties**

**5.2.1.1** When the fuel is reformulated using the ratios specified by manufacturer of fuel additives, the properties shall conform to requirements of TZS 672 in case of reformulated gasoline and TZS 674 in case of reformulated diesel or both as the claim of the additive may be.

**5.2.1.2** Fuel additives formulator shall specify a range of composition and properties to minimize the variability of performance of reformulated fuels.

### **5.2.2 Emission data**

The exhaust gas emission test shall be performed to evaluate the effect of additive used in fuel and test shall be performed according to TZS 985/ISO 3929 and shall conform to the requirements of TZS 983.

### **5.2.3 Engine performance**

**5.2.3.1** The questionnaire for evaluation of fuel additives (annex A) should be filled in before any certification process continues.

**5.2.3.2** When engine performance test is done according to TZS 986/ISO 3930, there should be no significant differences. Alternatively, the method stated in annex B can be used for engine performance test.

## **5.3 Approval and Registration**

**5.3.1** Each fuel additive shall be approved and registered by relevant authority prior to its introduction into market.

**5.3.2** For the approval of fuel additive, the showing of compliance shall address the following:

- a) that the additive does not have any adverse effects on the operation, performance, durability, or materials of the products intended for use;
- b) that the additive does not have any adverse effects on the performance of the baseline fuel that is intended for use with;
- c) that the additive is compatible with all other additives, or combination of all other additives, permitted for use in the baseline fuel that the additive is intended for use with; and
- d) that the additive does not have harmful side-effects on environment and human health and safety.

## **6 Packaging and labelling**

### **6.1 Packaging**

**6.1.1** The condition of the containers shall be such as not to be detrimental to the quality of the additive during normal transportation and storage. The containers shall be acceptably sealed or leak proof, corrosion resistant, heat resistant, clean, and free from materials soluble in the product.

**6.1.2** The product shall be accompanied by the Material Safety Data (MSD) Sheet.

### **6.2 Labelling**

Each container and bulk package shall bear (in prominent legible and indelible marking) the following information:

- a) manufacturer's name or trade mark or both;
- b) wording to indication that the product is a fuel additive;
- c) instructions for storage, use and disposal;
- d) batch identification;

- e) dates of manufacture and expiry;
- f) net contents in metric units; and
- g) safety precaution as applicable.

## **7 Sampling**

Sampling shall be done in accordance with ISO 3170 or ISO 3171. Samples should be stored in accordance to manufacturer recommendations. The containers should only be opened during testing.

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**Annex A**  
(Normative)

**Fuel Additive Questionnaire for Evaluation Procedure (Petrol and Diesel)**

Complete and send the questionnaire, along with existing data pertinent to the additive's effects, to CERTIFICATION or REGISTRATION AUTHORITY.

The testing laboratory needs to be competent in conducting the appropriate tests.

1 Company name or Patent name:

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2 Address & Phone No:

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.....

3 Contact person (Name & Phone No):

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.....

4 Additive name or code:

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5 Additive description and category (Cleaner, catalyst, etc.):

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.....

.....

5.1 What are the additive's effects on the following engine characteristics, and how long does it take

to observe these effects? Performance (Fuel consumption, Exhaust Temperature, etc)

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.....

5.2 Exhaust emissions (including smoke and particulate emissions)

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5.3 Combustion deposits (including sparking)

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5.4 Lube oil

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5.5 Wear

.....

6 Fuel system (6.1 parameters for diesel fuel and 6.2 parameters for gasoline fuel)

6.1 What are the effects of the additive on the following diesel fuel properties?

- 6.1.1 Cetane number: .....
- 6.1.2: Viscosity.....
- 6.1.3: API Gravity.....
- 6.1.4 Distillation Range.....
- 6.1.5 Sulphur Content.....
- 6.1.6 Carbon Residue.....
- 6.1.7 Flash point.....
- 6.1.8 Cloud point.....
- 6.1.9 Pour Point.....
- 6.1.10 Ash Content.....
- 6.1.11 Corrosiveness.....
- 6.1.12 Aromatics.....
- 6.1.13 Filterability.....
- 6.1.14 Water absorption.....
- 6.1.15 Stability.....
- 6.1.16 Foaming.....
- 6.1.17 Bacterial resistance.....
- 6.1.18 Vapor pressure.....
- 6.1.19 Miscibility Limits.....

6.2 What are the effects of the additive on the following petrol fuel properties?

- 6.2.1 Research octane number (RON).....
- 6.2.2 Motor octane number (MON).....
- 6.2.3 Reid Vapour Pressure (RVP), bar at 37.8 °C.....
- 6.2.4 Density at 20 °C kg/m<sup>3</sup> .....
- 6.2.5 Distillation point, temperature °C:
  - 10% (v/v) evaporated.....
  - 50% (v/v) evaporated at.....
  - 90% (v/v) evaporated at.....
  - Final boiling point °C.....
  - Residual % (v/v).....
- 6.2.6 Flexible volatility index (FVI) =  $RVP + 0.7E70$ .....
- 6.2.7 Oxidation stability (Minutes).....
- 6.2.8 Copper strip corrosion (3hrs at 50 °C).....
- 6.2.9 Existence gum content solvent washed mg/100ml.....
- 6.2.10 Sulphur content % m/m.....
- 6.2.11 Color.....
- 6.2.12 Oxygen content % (m/m).....
- 6.2.13 Total aromatics, % by volume.....
- 6.2.14 Total acidity, mg KOH/g.....
- 6.2.15 Mercaptan Sulphur % by mass.....

7 What are the effects of the additive on polymers, filter media and other fuel system components?

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8 How is this additive used?

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8.1 How is it mixed with fuel?

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8.2 What proportions?

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8.3 How stable is the mixture?

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8.4 How long is the mixture storable?

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8.5 MSDS for safe handling

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.....

9 How stable is the additive itself?

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.....

10 Does the additive contain any zinc?

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.....

11 Are there any chemicals, elements, or physical conditions that can neutralize or otherwise influence the effectiveness of the additive? If so, describe in detail on a separate sheet. What are the claimed effects of the additive? (Attach any pertinent material)

.....  
.....

11.1 What tests have been conducted to substantiate these claims? (attach any pertinent material)

.....  
.....

11.2 What were the results of these tests? (Include formal report issued)

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.....

11.3 Where were these tests performed?

.....  
.....

Depending on the information supplied above, the testing laboratory needs to be competent in conducting the appropriate tests.

## **Annex B**

(normative)

### **Engine performance test**

**B.1** Tests are conducted on a single cylinder research engine (SCRE) with new engine power components such as piston, rings, cylinder liner, intake and exhaust valves, and injector.

**B.2** The tests are conducted in a “baseline-preconditioning-product-baseline” manner. The Preconditioning test is necessary for stabilizing engine performance with additive reformulated fuel. After the product test, a check-up baseline test follows to verify the test results.

**B.3** Engine power is measured either by dynamometer or by an engine-driven generator with load bank.

**B.4** The instruments are calibrated to an accuracy of  $\pm 2$

**B.5** Engine fuel consumption is measured either by weighting scale or flow meter, and instruments are calibrated to  $\pm 1$  % of full scale.

**B.6** Emissions analyzers meeting specifications described in TZO 983 Exhaust emission standard are used for emissions measurements. The analyzers are calibrated before a test according to the procedure recommended by manufacturer.

**B.7** The test is conducted at engine full load (250 hp). Testing at additional engine operating modes is recommended and optional to customers. The test is conducted under the following engine conditions:

**B.7.1** Engine intake air temperature shall be controlled within  $\pm 5^{\circ}\text{F}$  between the baseline and reformulated fuel tests at the same engine test modes. Engine oil sump temperature shall be controlled within  $\pm 5^{\circ}\text{F}$  between the baseline and reformulated fuel tests at the same engine test modes.

**B.7.2** Engine coolant water outlet temperature shall be maintained within  $\pm 5^{\circ}\text{F}$  between the baseline and reformulated fuel tests at the same engine test modes. Engine fuel temperature shall be maintained at  $90 \pm 10^{\circ}\text{F}$ , measured at the fuel supply line (or fuel filters) before the fuel pump. Engine intake air pressure shall be maintained within  $\pm 0.1$  psi between the baseline and reformulated fuel tests at the same engine test modes.

**B.7.3** The baseline test and the product test are conducted for minimum of 20 hours (at least three days). The preconditioning test is performed until stable engine conditions are obtained. 35 hours preconditioning period (engine is operated at full load) is recommended;

however, more preconditioning hours may be required due to the nature of the product. A baseline check- up test is performed to validate the evaluation test results.

**B.8** During the baseline and the product test, engine performance data are taken at every half-hour, and emissions (smoke, gaseous, and particulate matter) and combustion pressure data are recorded at least once midway or at the end of the tests. Brake-specific fuel consumption (BSFC) data obtained for baseline and product (after preconditioning) should be plotted as a function of engine operating time to show any discernible trends and consistency of the data.

## **B.9 Data Analysis**

**B.9.1** The two sets of BSFC data should be statistically analyzed to determine whether there is a statistically significant difference in the mean values of the two sets of data. The difference should be evaluated at a 90 % confidence level.

**B.9.2** Engine emissions data is statistically analyzed to determine any change due to the product. To investigate the effects of a product on the engine combustion process, the apparent net heat release rates are calculated from the recorded cylinder pressure data by applying the first law of thermodynamics to the content of the combustion chamber. The combustion temperatures are calculated from the cylinder pressure data by assuming a uniform temperature distribution and ideal gas within the cylinder.

## **ANNEX C**

(informative)

### **General Information on Diesel Fuel Additives**

#### **C.1 Hazard identification**

Diesel fuel additive is not classified as "dangerous" according to Directive 2001/58/EC and its amendments. It is classified as;

Xn: Harmful;

R20/21: Harmful by inhalation;

R22: Harmful if swallowed;

R44: Risk of explosion if treated under confinement;

R65: Harmful, may cause lung damage if swallowed;

R66: Repeated exposure may cause skin dryness or cracking;

S2: Keep out of children.

#### **C.2 First Aid Measures**

**C.2.1** Inhalation: S23: Do not breathe vapour. If vapours inhaled, move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get immediate medical attention.

**C.2.2** Ingestion: S62: If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately.

**C.2.3** Skin contact: S24: Avoid contact with skin. Immediately flush with plenty of water. Remove contaminated clothing and shoes. Thoroughly clean shoes before reuse. Get medical attention.

**C.2.4** Eye contact: In case of eye contact, immediately flush with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

#### **C.3 Fire fighting measures**

**C.3.1** Extinguishing media: Use alcohol foam, water, carbon dioxide or dry chemical.

**C.3.2** Special exposure hazards: Preparation may be exothermically unstable at temperatures above 130 degrees. Use water to keep fire exposed containers cool. Water run off may be slippery.

**C.3.3** Preparation of combustion: Acrid smoke and irritating fumes; including oxides of carbon, oxides of nitrogen and oxides of sulphur.

**C.3.4** Protective equipment: Fire fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in a positive pressure mode.

## **C.4 Accidental release measures**

**C.4.1** Personal precautions: Keep unnecessary personnel away. Use suitable protective equipment (see C.6). Ensure adequate ventilation. Remove all sources of ignition.

**C.4.2** Environmental protection: Do not allow preparation to be release to the environment without government permission.

**C.4.3** Clean-up methods: If emergency personnel are unavailable, contain spilled material. Absorb with vermiculite, dry sand, earth or similar material for disposal as waste according to C.10 Contain and recover all liquid when possible. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

**C.4.4** Additional information: See C.7 for information on safe handling. See C.10 for information on personnel protection. See C.10 for information on waste disposal.

## **C.5 Handling and storage**

**C.5.1** Handling: wash thoroughly after handling. Avoid breathing vapour. Avoid contact with eyes, skin and clothing.

**C.5.2** Storage: Keep away from heat, sparks and flames. Store all containers in a cool, dry and well-ventilated area. Keep all containers tightly closed. Ensure good ventilation/exhaustion at workplace.

## **C.6 Exposure controls and personal protection**

**C.6.1** Respiratory protection: Use a properly fitted, air purifying or air fed respirator complying with an approved standard if a risk assessment indicates that this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the preparation and safe working limits of the selected respirator.

**C.6.2** Hand protection: Chemical resistant, impervious gloves or gauntlets complying with an approved standard should be worn at all times when handling chemical preparations if a risk assessment indicates this is necessary.

**C.6.3** Eye protection: Safety eyewear complying with an approved standard if a risk assessment indicates that this is necessary to avoid exposure to liquid splashes, mists or dusts.

**C.6.4** Skin protection: Personal protective equipment for the body should be selected based on the tasks being performed and the risks involved and should be approved by a specialist before handling this preparation.

**C.6.5** Hygiene measures: wash hands after handling preparation, before breaks and eating, smoking, using lavatory and at the end of the work shift. Keep away from beverages and food.

**C.6.6** Occupational exposure: Ensure that eyewash stations and safety showers are close to work areas containing larger quantities of preparation.

Exposure limits for ingredients are as indicated in Table C.1 below;

**Table C.1 – Exposure limit for fuel additives ingredients**

<b>Component</b>	<b>Weight (%)</b>	<b>8 hours TWA</b>
Aliphatic solvent	20 - 40	1,200 mg/m <sup>3</sup>
Ethylene glycol	9 - 13	60 mg/m <sup>3</sup>
2 – Ethylhexyl nitrate	4 - 8	1 ppm (skin)
Glycol ether	2 - 4	100 ppm
1 - Butanol	0.5 – 1.5	50 ppm

## **C.7 Stability and reactivity**

**C.7.1** Stability: This preparation is stable under ordinary conditions of use and storage.

**C.7.2** Conditions to avoid: Exothermally unstable above 210 °C, risk of explosion.

**C.7.3** Thermal decomposition: When heated to decomposition, may emit acrid smoke and toxic gases.

**C.7.4** Materials to avoid: Avoid strong oxidizers.

## **C.8 Toxicological information**

**C.8.1** Inhalation: Harmful if inhaled. Avoid breathing vapours.

**C.8.2** Ingestion: Harmful if swallowed.

**C.8.3** Skin contact: Irritating to skin, may cause an allergic skin reaction in susceptible individuals.

**C.8.4** Eye contact: Irritating to eyes.

**C.8.5** Acute toxicity: Contains from 9 – 13 % ethylene glycol and also from 4 – 8 % of 2 – Ethylhexyl nitrate.

- Oral LD<sub>50</sub> for ethylene glycol is 4,700 mg/kg (rat)
- Dermal LD<sub>50</sub> for 2- Ethylhexyl nitrate is 4,800 mg/kg (rabbit)



- Inhalation LC<sub>50</sub> for 2- Ethylhexyl nitrate is 4.6 mg/litre (1 hour)

### **C.9 Ecological information**

Daphnia: 48 hours EC<sub>50</sub> for 2- Ethylhexyl nitrate is over 12.6 mg/litre.

Algae: 72 hours EC<sub>50</sub> for 2- Ethylhexyl nitrate is over 12.6 mg/litre.

Do not release preparation to the environment without government permission.

### **C.10 Disposal consideration**

**C.10.1** Methods of disposal: The generation of waste should be avoided or minimized whenever is possible. Avoid dispersal of spilled material and runoff. Avoid contact with soil, waterways, drains and sewers. Disposal of this [preparation, solutions and any by-preparations should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements.

**C.10.2** Waste preparations: Collect all waste in suitable labelled containers and dispose of according to requirements of environmental protection and waste disposal legislation and any regional local authority requirements.

**C.10.3** Contaminated packaging: Wastes, including emptied containers, are controlled wastes and should be disposed of in accordance to the requirements of environmental protection and waste disposal legislation.

### **C.11 Transport information**

**C.11.1** Land Transport, ADR (cross border) regulations: Diesel fuel additive is not classified as dangerous under ADR regulations.

**C.11.2** Maritime Transport, IMDG regulations: Diesel fuel additive is not classified as dangerous under IMDG regulations.

**C.11.3** Air transport, IATA regulations: Diesel fuel additive is not classified as dangerous under IATA regulations.

## **Bibliography**

TZS 1247:2012 *Fuel additives – Specification (1<sup>st</sup> Edition)*

RS 366:2018 *Fuel additives – Specification*

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