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Mineralölerzeugnisse - Leitfaden für eine gute Systemwartung - Teil 1: Dieselkraftstoffe für Kraftfahrzeuge

Produits pétroliers - Guide pour une bonne maîtrise de la qualité du produit - Partie 1: Carburants diesels pour automobiles (gazoles)

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European foreword

This document (CEN/TR 15367-1:2020) has been prepared by Technical Committee CEN/TC 19 "Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin", the secretariat of which is held by NEN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TR 15367-1:2014.

The update to this document primarily addresses quality issues that can be associated with hard abrasive particles in diesel fuel that can cause wear damage to high pressure common rail fuel injection systems.

CEN/TR 15367 consists of the following parts, under the general title *Petroleum products - Guidelines for good housekeeping*:

— *Part 1: Automotive diesel fuels*

— *Part 2: Automotive petrol fuels*

— *Part 3: Prevention of cross-contamination*

This part of this standard describes the distribution of automotive fuels in general and diesel in specific detail. Part 2 was subsequently published to provide guidance on petrol distribution and specifically to address ethanol issues. Finally, Part 3 was published to provide additional guidance on preventing cross-contamination of fuel products in common supply and distribution systems. For further information on the relationship between and the history behind each of the parts, see the Introduction to this document.

Introduction

During its meeting held in Cannes on June 27 2003, WG 24 "Specification for Automotive diesel" decided that a guidance document on good housekeeping could be instrumental in preventing potential motoring problems caused by contamination in the supply chain. This was endorsed by CEN/TC 19 resolution 24.5 and resulted in an effective publication of the first Technical Report in March 2006.

Subsequently at the CEN/TC 19/WG 24 meeting on 18 October, 2017 in Zurich, Switzerland there were technical presentations describing serious wear and damage problems in modern high pressure diesel vehicle fuel injection systems in Northern Germany and the South East of the United Kingdom. A CEN task force was formed in January 2018 to investigate these wear and damage issues.

Investigations by that CEN/TC 19/WG 24 Abrasive Particles task force have shown internal damage to fuel injector moving parts, internal valves and pressure relief valves causing internal injector leakage, engine malfunction indicator light illumination, poor engine operation and in some cases complete engine shutdown [9]. The damage is believed to be caused by hard particulates in the diesel fuel abrading moving components.

This guidance document has been updated to reflect the abrasive particle contamination issue.

When a similar guideline for petrol was being drafted, it was decided to link these two. The best option was to publish them as separate parts of the same CEN document, which is achieved by revising the original CEN/TR 15367:2006 *Petroleum products — Automotive Diesel Fuels — Guide for good housekeeping* as part 1. Apart from some harmonization of wording no changes have been incorporated.

Two additional reports have now been published in this series regarding Automotive Petrol Fuels (Part 2) and the Prevention of Cross Contamination (Part 3). The work on these three documents has been carried out with support from CONCAWE and other stakeholders.

Automotive fuel specifications generally apply at the point of delivery to the customer. To ensure the quality at this point, the best practice is to make sure that the product meets specification when it is dispatched from the refinery and to have systems in place to ensure that it cannot go off-specification on its way to the customer. There will be more than one method or procedure to handle many of the potential contamination issues throughout the distribution chain, thus the advice in this document outlines principles to apply, but does not specify the precise detail of the methods to be adopted in all cases. Nevertheless, it is strongly recommended that all the procedures or measures to be applied along the distribution chain should be defined using a Total Quality Assurance methodology.

1 Scope

This document provides general guidance on diesel fuel housekeeping to ensure appropriate cleanliness and to prevent onward distribution of contaminants.

It does not pre-empt national or local regulations but addresses the issues of contamination by water, sediment, inorganic contaminants, or microbial growth that may occur in the supply chain during manufacture, blending, storage and transportation. It does not address contamination by other fuel products nor does it address possible contamination by water or sediment that may occur on-board vehicles. Information on vehicle factors is presented in Annex A, however.

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.

EN 590,[1] *Automotive fuels - Diesel - Requirements and test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
supply chain
process consisting of the following four parts:

— refineries,

— terminals (storage and blending sites),

— filling stations (including retail and industrial customer sites), and

— transportation from refineries to terminals, terminals to terminals and from terminals to filling stations.

Note 1 to entry: Information on additives beyond the supply chain is given in Annex C.

4 Adulterants and contaminants in the supply chain

4.1 General

EN 590 requires that “Diesel fuel shall be free from any adulterant or contaminant that may render the fuel unacceptable for use in diesel engine vehicles”. This subclause describes some of the more common causes

[1] Impacted by EN 590:2013+A1:2017.

4.2 Water

Water may be picked up by the diesel fuel product at various stages of the supply chain and can be present either as free or dissolved water or as an emulsion with small droplets of water suspended in fuel. The presence of FAME can increase fuel/water emulsions. The presence of free water can be a contributory cause of corrosion and biological contamination. Entry points for water include:

a) **dissolved or emulsified water** can occur during diesel fuel or FAME manufacturing. Dissolved or emulsified water can remain suspended in fuel or may separate and become free water further along the supply chain depending on the composition of the fuel and storage conditions. Cooling of the fuel blend can cause the dissolved water to coalesce and separate from the fuel;

b) **free water** can occur due to ingress or leaks as a result of, for example, heavy rainfall or through cracks in equipment;

c) **water vapour** (humid air) can enter storage tanks through air vents followed by cooling or condensation on tank walls or vehicle tanks;

Because it is virtually impossible to stop water from entering the supply chain, proper water management is essential. Tank inspections should routinely look for free water at the bottom of storage tanks.

Free water, along with emulsified fuel, should be drained to ensure that the remaining fuel is clear and bright and free of extraneous material.

4.3 Sediment

Sediment may be due to inorganic or organic contaminants in the fuel. Inorganic contaminants can consist of rust, dirt, dust, corrosion products, and trace materials retained from fuel and FAME production. Organic contaminants can consist of oxidation products, biological growth, and trace materials from fuel and FAME production. Sediments may form over a long period of time under storage conditions.

The Abrasive Particles task force investigations have shown that hard < 4µm sediment particles can cause serious abrasive wear to modern diesel vehicle high pressure fuel injection systems. Soft particles such as those typically found in FAME do not appear to cause abrasive wear.

The total contamination test (EN 12662 [20]) does not provide protection against abrasive particle erosion issues since it is a gravimetric test that is unable to distinguish very small, hard particles with sufficient resolution. As such it does not guarantee product quality with respect to the abrasive particle failure-mode.

Guidance on particulate measurement and levels is found in Annex B.

For more information on preventing contamination by water or sediment that may occur in the supply chain or for avoiding cross contamination, it is advisable to evaluate the 'good housekeeping' practices recommended in CEN/TR 15367 3 and to check the report on the investigation regarding internal diesel injector sticking deposits mechanisms [1].

4.4 Metal ions

Sodium at trace levels in diesel fuel has been found to cause deposit problems in some types of diesel fuel injectors resulting in engine failures. Trace sodium can originate from many sources, cannot be easily controlled or corrected in a multi-product distribution system, and cannot be routinely measured at historical concentrations except in a very well-equipped analytical laboratory. Due diligence is therefore advised for ensuring the integrity of vehicle fuel systems by controlling potential sources of sodium and other deposit-forming materials in fuel. Potential

sources for sodium in diesel fuel are pipeline corrosion inhibitors, refinery process additives, import terminal or refinery salt driers, refinery processing units, biodiesel blending, contamination from sea water due to logistics systems or airborne sodium in coastal locations (sea salt). See for more detail CEN/TR 16680[1]. There are currently no known or intended limits for sodium concentrations in diesel fuel.

Other metal ions of concern are zinc, copper and lead. Zinc has a tendency to accumulate in spray-holes and contributes to nozzle coking. Lead is attacked by fuel acids and forms voluminous soap precipitates. Copper is known to catalytically accelerate fuel oxidation.

4.5 Biological contamination

Biological contamination can result from the action of microorganisms, such as bacteria, fungi, and yeasts, which are ubiquitous in the environment. Microbes can bloom whenever there is a source of water, air (oxygen), and fuel (as food). The presence of FAME in fuel can encourage growth. As a result, biological contamination is more common in diesel fuels containing FAME than in gasoline containing bio-products.

Biological contamination can lead to bio-derived films and sediments in storage tanks, pipelines, and filters, potentially causing serious operational problems including filter-blocking and fuel dispenser malfunctions. Microbiological growth can also lead to corrosion which can become a source of hard particles generation.

While good housekeeping, including the elimination of water bottoms in tanks, reduces biological growth, severely contaminated tanks may require more severe treatment, including biocide additives.

5 Housekeeping guidelines

5.1 Elements of good housekeeping

5.1.1 Operations

Proper attention to detail during all operating activities from product manufacturing to final delivery is essential to guarantee product quality. Operating procedures should be in place covering receipt, delivery, sampling, inspection, testing, and tank draining. These procedures should be reviewed and updated as required, when product quality changes are taking place as a result of new regulations or the introduction of new fuel types.

It is essential that personnel involved at each step in fuel transfers, both company employees and contractors, are properly trained so that they are aware of and understand the importance of applying and continuously improving operating procedures.

Diesel products should not be transported or stored in systems used intermittently for black oil products due to the impact on product quality. Robust quality control needs to be in place to detect and prevent contamination. If the use of chemicals is considered anywhere in the supply chain for housekeeping purposes (e.g. corrosion protection or biological remediation) the potential impact on fuel quality and performance should be investigated thoroughly. Non-chemical solutions are generally preferred.

5.1.2 Hardware

The age and design of existing hardware along the supply chain vary widely and yet it is possible to control product quality properly with differently engineered installations. Quality control, however, is much easier if hardware is first designed with the intention to facilitate good housekeeping as described in the following sections.

5.1.3 Maintenance

No matter how well designed an installation may be, equipment faults and deterioration and corrosion of hardware can develop over time if the equipment is not inspected and properly maintained. Inadequate maintenance can eventually affect the ability of the operator to maintain product quality at the required level.

5.2 Detailed recommendations

5.2.1 General

Recommendations in this section are divided into four sections covering various elements related to refineries, terminals, filling stations and transportation. This guidance represents current industry best practices but is largely based on experience of handling diesel fuels.

5.2.2 Refineries

5.2.2.1 Testing

Batches of diesel fuel should first be visually assessed for clear and bright appearance with no free water and free from visible sediment. When testing for visual appearance [10], the prevailing ambient temperature should be considered. Alternative methods such as online haze meters may be used. The product shall meet the water content and total contamination requirements of EN 590.

When a sample is not visually acceptable, the product should be isolated and analysed to quantify the problem. Analysis at this point enables any issues to be resolved at the refinery and avoid the problem becoming more widespread.

Product imports at refineries should be tested using the same procedures recommended for terminals (see 5.2.3). Batches that are delivered by barge or by sea-going vessels or pipeline should receive special attention to ensure that they conform to quality specifications. Test records and retained samples should be kept for a sufficient period to cover market needs.

5.2.2.2 Sampling

Upper, middle and lower samples should be taken from fixed off-take storage tanks for visual assessment and analysis. All three samples should be examined for visual appearance in addition to any other tests to confirm the product is not layered. Composite samples may be used for the other routine specification tests.

No special requirements are specified with respect to settling time, after blending and before sampling. If product samples do not satisfy the visual appearance, water content or sediment tests, allowing time for settling is one measure that can be employed to bring the product on specification. It should be noted, however, that settling time alone is unlikely to alleviate sediment particles in the low µm size range as well as high water contents in diesel fuels, in particular those containing FAME. Water can remain dispersed in the fuel increasing the potential for water accumulation or biological contamination problems elsewhere in the supply chain.

5.2.2.3 Operations

Although some storage tanks have floating off-take points, most have fixed off-take points so that procedures to avoid build-up of water bottoms are essential. Most storage tanks are flat bottomed, although they can be in a cone-up or cone-down configuration. Procedures to control water build-up (e.g. by regularly checking for water bottoms and draining off water as required) should be established based on local experience with the particular tank configuration, fuel production process and local climate. Water bottom checks should be carried out frequently and tanks should ideally be checked both before and after the receipt of new product. These procedures should ensure that water and sediments are not carried forward to the next stage of the supply chain.

Diesel tanks should also be checked periodically for biological contamination and there should be a procedure in place to deal with such contamination if it is detected. Once established, biological growth can be difficult to rectify – prevention is better than a cure and is best achieved by good water management.

5.2.2.4 Hardware requirements

New tanks should be designed to optimize water draw-off capability and be fitted with anti-swirl systems to minimize mixing of tank bottoms during filling.

They should also have convenient facilities for taking three samples:

— upper sample at one-sixth of the depth of liquid below the maximum level;

— middle sample halfway down the depth of the liquid;

— lower sample at approximately one-sixth up from the bottom level representing the product which will be drawn out of the off take system. The precise height for the lower sample should be based on details of tank configuration including the height of the off-take point.

Filtration of the final product is not generally necessary to control water and sediment. Filters may be installed as an additional safeguard in some situations.

5.2.2.5 Maintenance

Tank cleaning is a major disruptive operation which requires completely draining the tank and physical scraping to remove biofilms, corrosion products and other sediments.

Tanks should be inspected on a regular basis and cleaning should be carried out if there is evidence of a build-up of contamination. Routine cleaning is normally carried out on a several years schedule, coinciding if possible with (statutory) inspection and maintenance requirements. Good housekeeping can help to extend the periods between tank cleaning.

5.2.3 Terminals

5.2.3.1 General

A documented procedure should be in place for product sampling and quality monitoring upon product receipt. Checks should confirm that the product has not become contaminated with water or sediment. These principles should also apply to product imports into refineries.

5.2.3.2 Testing

Visual checks should be carried out to assess the quality of the product and additional analysis may be carried out if needed.

Batches delivered by barge or by sea-going vessels or pipelines need more careful attention to conform to quality specifications.

Test records and retained samples should be kept for a sufficient period to cover market needs.

5.2.3.3 Sampling

In order to avoid possible contamination of clean product tanks or onward distribution of contaminants, sampling should be considered from:

— from the transport unit (e.g. barge) delivering the product before discharging into storage tanks;