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Petroleum products — Guide for good housekeeping

Part 3: Prevention of cross contamination

ICS 03.100.50; 75.160.20; 75.200

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National foreword

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Foreword

This document (CEN/TR 15367-3:2009) has been prepared by Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic or 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 [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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

— *Part 1: Automotive diesel fuels;*

— *Part 2: Automotive petrol fuels;*

— *Part 3: Prevention of cross contamination.*

This part of this Technical Report describes the control of potential sources of contamination of one fuel type by usually small amounts of a different fuel type that was previously transported. For guidance concerning diesel distribution , Part 1 is published to specifically address biodiesel or FAME (according to EN 14214). For guidance concerning distribution of petrol and ethanol (as specified by EN 15376) in specific detail, Part 2 is published.

Introduction

At its meeting in Naantali, Finland, on the 30th November 2006, CEN/TC 19/WG 21 agreed to adopt the Work Item titled "Fuels supply chain – Guide for preventing cross contamination between petrol and diesel" on its Work Programme with the intention to begin work on a CEN Technical Report in 2007. This resulted from the report of an internal TF that had investigated detection and prevention of the occurrence of high boiling components in petrol and its relation to occurrence of some increased oil dilution problems in bench testing of gasoline engines.

This work has been carried out with support from CONCAWE[1)].

Automotive fuel specifications generally apply at the point of sale to the final customer. To ensure fuel quality at this point in the supply chain, the best practice is to ensure that the product meets specification when it is dispatched from the refinery or terminal (if final blending takes place at the terminal) and to have quality systems in place to ensure that the fuel product does not become contaminated on its way to the final customer. There will typically be more than one method or procedure to control potential sources of contamination throughout the supply chain. For this reason, this document outlines the principles to apply but does not necessarily specify the precise detail of the methods to be adopted in all cases. Nevertheless, it is strongly recommended that all of the procedures or measures to be applied along the supply chain should be defined using a Total Quality Assurance methodology.

Although the term "cross contamination" can suggest the contamination of one fuel by another of the same type, "cross contamination" is used in this Technical Report in a more general sense, that is, the contamination of one fuel type by usually small amounts of a different fuel type that was previously stored, loaded, blended, or transported in the same container, tank, or vessel.

1) CONCAWE is the oil companies' European association for Environment, Health and Safety in refining and distribution.

1 Scope

This document provides general guidance on automotive fuel handling. It does not pre-empt national or local regulations. It only addresses the issue of cross contamination between petrol and diesel automotive fuels that may occur in the supply chain, during manufacturing, storage, transportation or distribution. There may also be a risk of contamination with other products such as kerosene/jet fuel and off road diesel. The guidance principles described in this document would apply equally to managing these risks although some details may be different.

2 Normative references

The following referenced documents are indispensable for the application 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.

NOTE This Technical Report incorporates provisions from other publications based on undated references. These normative references are cited at the appropriate places in the text and the publications are listed in the Bibliography.

EN 228, *Automotive fuels – Unleaded petrol – Requirements and test methods*

EN 590, *Automotive fuels – Diesel – Requirements and test methods*

EN 14214, *Automotive Fuels – Fatty acid methyl esters (FAME) for diesel engines – Requirements and test methods*

EN 15376, *Automotive fuels – Ethanol as a blending component for petrol – Requirements and test methods*

3 Fuels under consideration

Quality requirements for the products under consideration, that need to be fulfilled at the point of supply or sales, are:

— for petrol: EN 228;

— for the petrol component (bio)ethanol: EN 15376;

— for automotive diesel: EN 590; and

— for biodiesel and FAME blending component: EN 14214.

Prevention of contamination with other products, like kerosene or non-road diesel, is of course also included in this document, but no European quality designations exist for these products.

4 Supply chain definition

For the purposes of this document, the supply chain consists of the following four parts:

— refineries, where products are manufactured and mainly exported by ship, pipeline or other means of transport;

— terminals, where trucks are loaded for delivery to filling stations and where some product blending may also take place;

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

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

5 Potential sources of cross contamination in the supply chain

Cross contamination can occur at any stage of the supply chain and can be caused by inadequate design of equipment and facilities, by inadequate inspection or maintenance, or by inadequate management of operations. These issues are addressed below.

6 Housekeeping guidelines

6.1 Elements of good housekeeping

6.1.1 Operations

To ensure good quality of the product at the point of delivery to the customer, the best practice is to verify that the product meets specifications when it is dispatched from the refinery and then to have systems and procedures in place that will prevent contamination on its way to the customer. Proper attention to detail during all operations from product manufacturing to final delivery is essential for guaranteeing product quality. For this reason, there should be operating procedures in place covering receipt, delivery, sampling, inspection, testing, documentation and volume accounting. These procedures should be reviewed and updated as required especially when product quality changes are taking place as a result of new regulations, the introduction of new fuel types, or during seasonal transitions. It is essential that personnel involved at each link in the product supply chain, both company employees and contractors, are properly trained so that they are aware of and understand the importance of applying standard operating procedures.

6.1.2 Hardware

Although the age and design of existing hardware along the supply chain can vary widely, it is still reasonable to expect that fuel product quality can be properly controlled with differently engineered installations. Quality control is much easier, however, if hardware is designed to facilitate product segregation as described in the following sections.

6.1.3 Maintenance

Even if an installation is well designed, equipment faults can develop over time if the installation is not inspected and properly maintained. These may eventually affect the ability of the operator to maintain product quality at the required level.

6.2 Detailed recommendations

6.2.1 General

Recommendations are split into four sections, each covering various elements for refineries, terminals, filling stations and transportation. They represent current industry experience and are based on predominantly handling hydrocarbon petrol fuels, but should equally apply to the handling of fuels containing bio-components.

6.2.2 Refineries

6.2.2.1 Testing and sampling

All batches of automotive fuels should be tested to ensure compliance with EN 228, EN 590 or other relevant national product specifications. Test records and samples should be kept for a sufficient period to cover market needs and regulatory requirements.

Imported products should be tested using the same approach as recommended for terminals (see below). An upper, middle and lower sample from fixed off-take storage tanks should be taken for analysis [10]. All three samples should be examined for visual appearance and separately measured to confirm that the tank is well mixed (e.g. by comparing density).

Composite samples may be used for the other routine specification tests unless otherwise specified in the respective test methods. An appropriate settling time after blending and before sampling for specification testing should be provided depending upon the tank configuration, filling level and similar factors. Additional line sampling or on-stream quality monitoring may be taken during delivery to ships or pipelines in order to allow identification of potential contamination problems.

6.2.2.2 Operations

Line up of component or product rundowns or transfers to final product tanks and from product tanks to the point of delivery should be such that incompatible or unwanted oil streams are prevented from entering the petrol or diesel tank, ship or pipeline.

6.2.2.3 Hardware requirements

Storage and piping systems should be designed to minimise cross contamination risk. Dedicated and segregated systems for petrol and diesel are preferred but, if the use of common piping systems is unavoidable (e.g. en-route to multi-product pipelines), proper line clearing facilities should be in place. Double block and bleed systems or twin seal valves should be installed to avoid the ingress of unwanted material and piping systems not in use should be disconnected or positively isolated from the main product streams using blinds. Dead legs are to be avoided.

Tanks should have convenient facilities for taking the following 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; and

— 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.

Delivery lines should be fitted with sample points to allow sampling during export to ships or pipelines and should be located as close as possible to the point of custody transfer [11].

6.2.2.4 Maintenance

Control and isolation valves used for product movements should be able to open and close smoothly and shut completely. They should be repaired or replaced when there are signs of malfunctioning.

6.2.3 Transport and operations

6.2.3.1 Operations

Procedures should be in place to minimise contamination risks during transport. These may include the ones given below.

— Refinery and terminal procedures for visual inspection (if allowed by HSE regulations) of sea-going vessels, barges, delivery vehicles and railcars prior to loading to ensure that they are empty and clean. Where inspection is not possible, details of previous journeys (e.g. product grade, quantities loaded and discharged, etc.) can be used to establish whether or not there is a contamination risk. These procedures should include instructions on what to do in case of potential contamination risk and how to deal with any incompatible product that may have been left on board.

— Refinery and terminal procedures to ensure that products are loaded in the correct sequence by qualified personnel and that the right product is loaded into the correct compartments of the transport vessel or vehicle. These procedures should make clear whether the responsibility for proper loading lies with the supplier or with the transport company.

— Terminal and filling station procedures to ensure that the product has not been tampered with during transport. These procedures may include frequent volume accounting and stock reconciliation (i.e. imbalances can indicate potential contamination risk or fraud).

— Filling station procedures covering responsibilities of filling station personnel and truck drivers, connections from truck to tank, and handling of delivery documents.

— Transport company procedures covering loading at terminals, unloading at filling stations, and documentation, as described above. These are important as some modern automated terminals and unmanned filling stations rely on correct operation by the delivery truck driver alone.

— In the case of multi-product pipelines, procedures at the supply end (refinery), at any gathering station, and at the receiving end (terminal) covering the use of pipeline pigs, the preferred sequence of products to be pumped, buffers between product batches, batch tracking, sampling and testing requirements, on-line quality monitoring, and cutting out interfaces (overwash or underwash).

6.2.3.2 Hardware and maintenance

Filling connections should be clearly labelled, preferably with the same product coding as used on transport documents. Materials of construction and surface finish should be such that contamination from walls or hoses is prevented or minimised. Ships, trucks and railcars should be inspected regularly to prevent cross contamination caused by cracks between adjacent compartments.

6.2.4 Terminals

6.2.4.1 General

There should be a documented procedure for product sampling and quality monitoring upon receipt of product at the terminal. Receipt checks should establish the quality of the product (shipping documents, quality certificates) and confirm that the product has not become contaminated with other products. These principles also apply to product imports into refineries.

6.2.4.2 Testing

Visual checks should always be carried out to assess the quality of the product. Visual inspection will not always show possible contamination of petrol with diesel or vice versa, however, and additional analyses may be carried out, if needed.

Contamination of petrol with diesel can be detected by analysing the back end distillation characteristics. Flash point is a good test for detecting petrol contamination in diesel. Annex A contains information on the approximate percentages of cross contamination that will cause statistically significant deviations of selected petrol or diesel quality parameters, based on the reproducibility of the test methods specified in the fuel product quality standards (EN 228 and EN 590).

EXAMPLE A difference of 3 kg/m^3 (twice the reproducibility of the EN ISO 3675 density test [5]) between the measured density of a delivered diesel fuel and the density on the quality certificate would be an indication of possible contamination with another product and indicate the need to do further testing.

Batches delivered by barge and especially by seagoing vessel need more careful attention to ensure conformance to quality specifications. Test records and samples, where applicable, should be kept for a sufficient period to cover market needs and regulatory requirements. Testing should be done by properly trained personnel in a reputable laboratory, preferably one that meets recognized quality standards (such as EN ISO 9001 [1] or EN ISO/IEC 17025 [2]).

6.2.4.3 Sampling

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

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

— product transfer to the receiving tank; in some cases, e.g. for pipeline deliveries, on-line or running samples may be monitored; and

— storage tank after receipt.

As the receipt tank will be used for deliveries, it should be sampled in any case, based on upper/middle/lower samples as in the refinery situation. The quality of the existing product in the receipt tank, prior to transfer, should also be known.

6.2.4.4 Operations

It is not recommended that a product be dispatched from a running tank, that is, a terminal tank which is a dispatching product at the same time that it is a receiving product. Where terminal operations cannot avoid product delivery from a running tank, additional precautions should be taken to ensure that the quality is maintained, for example, by completing pre-delivery checks on the product in the receiving tank and on the incoming product.

Similar procedures to those employed at refineries should be in place to avoid cross contamination caused by line up errors during import or delivery.

The introduction of petrol and diesel grades containing bio-components may result in blending operations being carried out at terminals. In-tank blending followed by full testing of the product, as occurs at refineries, is usually not an option at terminals because of the absence of a fully equipped laboratory, tank mixing facilities, etc. For this reason, blending at the loading rack will normally be the preferred approach (either in-line or sequential). Such operations shall be covered by detailed procedures.

6.2.4.5 Hardware

As is the case in refineries, storage and piping systems at terminals should be designed to minimise cross contamination risk.

Piping from storage tanks to loading racks should be dedicated to one product grade to ensure that the loaded quality is the same as in the storage tank (except for any additives that may be injected at the loading rack).

Filling connections should be clearly labelled with the same product coding as used on transport documents in order to ensure that the driver or operator makes the correct connections between loading rack and truck or railcar compartments.

Where loading rack blending operations are practiced, the loading rack shall be designed so that incompatible components cannot be blended.

6.2.4.6 Maintenance

Proper maintenance of piping systems and components is as important at terminals as it is at refineries in order to avoid cross contamination risk.

6.2.5 Filling Stations

6.2.5.1 Sampling and testing

Filling stations are not a good place to perform blending operations and product quality testing. For this reason, blending of fuel components should not be done at filling stations.

The best practice, therefore, is to ensure product quality at the filling station by taking appropriate actions before the product is delivered to the filling station and dispensed. This includes ensuring that on-specification fuel is delivered to the filling station and that sound procedures are in place to ensure that clean product is delivered into the correct tank at the filling station [12].

6.2.5.2 Hardware and maintenance

The delivery points should also be clearly labelled to ensure that the customer identifies the correct pump to be used for re-fuelling their vehicle.

Annex A
(normative)

Impact of contamination on measured quality parameters

This Annex contains information on the approximate percentages of cross contamination that will cause statistically significant deviations of selected petrol or diesel quality parameters, based on the reproducibility of the test methods specified in the fuel product quality standards. Table A.1 shows the approximate percentage of contaminating product (petrol, diesel or other non-automotive contaminants) in the main product (petrol or diesel) that will cause a change equal to the reproducibility (*R*) of the test method for the indicated quality parameter.

Table A.1 — Impact of the contaminating product on selected specification values for the main product

Fuel property (units)	Test method	R [a]	Specification value	Approximate percentage of contaminating product in the main product			
			Main product	For automotive fuel contaminants		For other contaminants	
			petrol	petrol	diesel	jet fuel	non-road diesel [b]
Density (kg/m^3)	EN ISO 3675 [5]	1,2	720 - 775	==	1,2 – 3,4	2,0 – 8,2	1,2 – 3,4
Sulfur (ppm)	EN ISO 20846 [6]	2,7	< 10	==	n/a	1,2 – 0,22 [c]	0,23
FBP (°C)	EN ISO 3405 [7]	10,5 (summer) 8,9 (winter)	< 210	==	d		[d]
			diesel	petrol	diesel	jet fuel	non-road diesel [b]
Density (kg/m^3)	EN ISO 3675 [5]	1,5	820 - 845	1,2 – 3,3	==	2,9 – 5,4	n/a
Sulfur (ppm)	EN ISO 20846 [6]	2,2	< 10	n/a	==	1,2 – 0,23 [c]	0,22
Flash point (°C)	EN ISO 2719 [8]	4,0 at 56 °C	> 55	0,15	==	9 – 11	n/a
Viscosity (mm^2/s @ 40 °C)	EN ISO 3104 [9]	0,025 – 0,045	2,0 - 4,5	1,0 – 0,4	==	2,5 – 0,8	n/a

a R is the reproducibility of the test method specified in the product quality standard (EN 228 or EN 590) for the main product.

b Containing up to 1 000 ppm of sulphur.

c For an assumed jet fuel sulfur content of (200 – 1 000) ppm sulfur.

d Estimated to be about 2 % to 3 %.

Bibliography

[1] EN ISO 9001, *Quality management systems – Requirements (ISO 9001:2008)*

[2] EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)*

[3] CEN/TR 15367-1, *Petroleum products – Guide for good housekeeping – Part 1: Automotive diesel fuels*

[4] CEN/TR 15367-2, *Petroleum products – Guide for good housekeeping – Part 2: Automotive petrol fuels*

[5] EN ISO 3675, *Crude petroleum and liquid petroleum products – Laboratory determination of density - Hydrometer method (ISO 3675:1998)*

[6] EN ISO 20846, *Petroleum products – Determination of sulfur content of automotive fuels – Ultraviolet fluorescence method (ISO 20846:2004)*

[7] EN ISO 3405, *Petroleum products – Determination of distillation characteristics at atmospheric pressure (ISO 3405:2000)*

[8] EN ISO 2719, *Determination of flash point – Pensky-Martens closed cup method (ISO 2719:2002)*

[9] EN ISO 3104, *Petroleum products – Transparent and opaque liquids – Determination of kinematic viscosity and calculation of dynamic viscosity (ISO 3104:1994)*

Proper sampling procedures are critically important for assessing fuel quality. Information on sampling procedures can be found in the following standards:

[10] EN ISO 3170, *Petroleum liquids – Manual sampling (ISO 3170:2004)*

[11] EN ISO 3171, *Petroleum liquids – Automatic pipeline sampling (ISO 3171:1988)*

[12] EN 14275, *Automotive fuels – Assessment of petrol and diesel fuel quality - Sampling from retail site pumps and commercial site fuel dispensers*

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