Petroleum road tanker design and construction

4th edition

energy institute

PETROLEUM ROAD TANKER DESIGN AND CONSTRUCTION

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FOREWORD

This publication has been prepared by Robert Harris (Amber Engineering Consultancy Ltd.) at the request of the Energy Institute's (EI's) Road Tanker/Distribution Contractors Panel. It is intended to provide comprehensive recommendations for the design and construction of complete road tankers for the conveyance of the petroleum products petrol, kerosene, diesel, gas oil and aviation fuels. It is complementary to EI *Model code of safe practice Part 2: Design, construction and operation of petroleum distribution installations*.

This publication replaces EI *Petroleum road tanker design and construction* (3rd edition); it expands on the requirements of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) 2019 and associated European Committee for Standardization (CEN) standards for tank service equipment, and combines them with the requirements and published recommendations from a number of other sources concerning the design and construction of road tankers, including the UK Approved Tank Requirements (which enact European Directive 94/63/EC Control of the emissions of Volatile Organic Compounds (VOCs) concerning the control of emission of petrol vapour in the distribution network Annex IV), PD CEN/TR 15120 *Tanks for transport of dangerous goods. Guidance and recommendations for loading, transport and unloading* for operating conditions, and other published guidance such as the control of electrostatic hazards given in *CLC/TR 60079-32-1:2015 Explosive atmospheres. Electrostatic hazards, guidance* and the Defence Standard 91–66 *The segregation, handling and quality assurance of petroleum fuels, lubricants and associated products* for aviation fuels.

This publication provides further recommendations, based on good design practice established and proven over a number of years, including that gained through operational experience, which are deemed necessary for safe loading, transport and unloading.

Although the design and construction recommendations included in this publication are primarily intended for, and based on, current UK operations, they may also be considered for road tankers that are intended for service in other countries.

This publication is intended to be of benefit to manufacturers, and road tanker operators including distribution contractors and oil companies, by providing a common standard for design, construction and operation, and by raising awareness of design factors that may affect safe operation, compatibility with loading gantries and product quality. Compliance with relevant sections of this publication may be a prerequisite for the issue of a 'safe loading pass' to a road tanker where such schemes are operated. Details of such compliance requirements should be obtained from the relevant scheme operator(s).

Amendments to this publication will be issued by the EI as considered necessary, and users are invited to send comments or suggestions for improvement to the Technical Department, Energy Institute, 61 New Cavendish Street, London W1G 7AR.

Although it is believed that adoption of the recommendations of this publication will help to improve operating safety and reduce the risk of accident, the EI cannot accept any responsibility, of whatever kind, for damage or alleged damage arising or otherwise occurring in or about the premises, areas or vehicles to which this code has been applied in whole or in part. In addition the EI is not undertaking to meet the duties of employers, manufacturers or road tanker operators in meeting their obligations under local and regional laws and regulations.

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The author wishes to acknowledge the assistance and support given by members of the EI's Distribution and Marketing Safety Committee, and Road Tanker/Distribution Contractors Panel, who reviewed earlier drafts of this publication, and provided technical comments.

A number of technical comments were received from vehicle, tank and service equipment manufacturers. The author gratefully acknowledges the time spent reviewing earlier drafts.

Development of this publication was steered by the EI's Road Tanker/Distribution Contractors Panel, at the time of publication comprising representation from the following companies and organisations:

BP Oil UK Ltd.
Certas Energy
CLH
DHL
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Phillips 66 Ltd.
Purfleet Commercials Ltd.
Shell International Ltd.
Society of Motor Manufacturers and Traders Ltd.
The Freight Transport Association Ltd.
Total UK Ltd.
Turners Ltd.
Wincanton Group Ltd.

Project coordination and technical editing was undertaken by Toni Needham (EI).

1 INTRODUCTION

It continues to be apparent, through operational experience, that certain design and construction details which are critical or desirable for the safe and efficient operation of road tankers during loading, conveyance and discharge of petroleum products are not prescribed by legislation, standards or other sources of information.

The EI's Road Tanker/Distribution Contractors Panel identified a need for a revision of the third edition of this single comprehensive code of practice which would:

– Update and expand EI Petroleum road tanker design and construction.
– Align its recommendations with ADR 2019.
– Include the design conditions of the Health and Safety Executive's (HSE) L93 Approved tank requirements. The provisions for bottom loading and vapour recovery systems of mobile containers carrying petrol (ATR), expanded as necessary.
– Incorporate other EI codes (or relevant parts of them) including Institute of Petroleum (IP) Testing of vapour containment of petroleum road tankers 2001, Code of practice for petroleum road tanker vapour collection systems and equipment used in unloading operations.
– Take account of project work carried out for the Road Tanker Panel, particularly that concerning vapour flow testing of road tankers.
– Refer to the relevant CEN standards for tanks and their service equipment.
– Take account of the CEN TR 15120 for operating conditions in a UK context.
– Take account of all other legislation relevant to petroleum tankers (excluding construction and use), standards and industry codes.
– Document good practice in tanker design, including that gained through operational experience.
– Expand on relevant references.
– Provide informative notes for recommendations that could otherwise appear obscure.

Section 3 of this publication concerns the design and construction of the vehicle itself and revises the third edition of EI *Petroleum road tanker design and construction*. It should be noted that although much of that section concerns the vehicular aspects of road tanker design principally for consideration by the motor vehicle manufacturer (or modification contractor), certain sections should also be considered by the tank manufacturer, particularly in the case of semi-trailers and trailers.

Section 4 concerns the design and construction of the tank, its service equipment and accessories.

Throughout sections 3 and 4, text is identified as either regulation, guidance, or as an informative note by a coloured bar in the margin.

It should be noted that, whereas the European Commission's guidance on the application of the ATEX Directive 94/9/EC *Equipment intended for use in flammable atmospheres* alongside other directives that may apply (including Directive 94/55/EC *Transport of dangerous goods* and Directive 98/91/EC *Motor vehicles and their trailers intended for the transport of dangerous goods by road*) proposes that road tankers which are only operated in a flammable atmosphere when loading may be excluded from the provisions of the ATEX Directive, it

includes a note that states 'At some sites tankers may have to access a zone (e.g. Zone 1). In this case, users responsible for that site may demand the supplier to use tankers with ATEX compliant products.'

In the UK, it is common practice for all loading gantries within a terminal which handles petrol to be classified as hazardous areas Zone 1 or Zone 2, even though a particular gantry may only have loading arms for diesel, gas oil and kerosene. It follows that road tankers loading on any gantry which is classified as a hazardous area may not be excluded from the relevant ATEX provisions.

Although some of the recommendations in this code (particularly those which refer to hazardous areas) are made with particular reference to petrol, consideration should be given to applying them to other petroleum products, including kerosene and diesel, even though in the UK they are handled above their flash point (which is the normal criterion for applying hazardous area controls). Research has shown that in the event of the generation of a mist or spray (such as may occur during loading or discharge), ignition of these products can occur even below their flash points.

Relevant design recommendations of this publication may be required under an industry safe loading pass scheme; for example, that operated in the UK by the major participating oil companies.

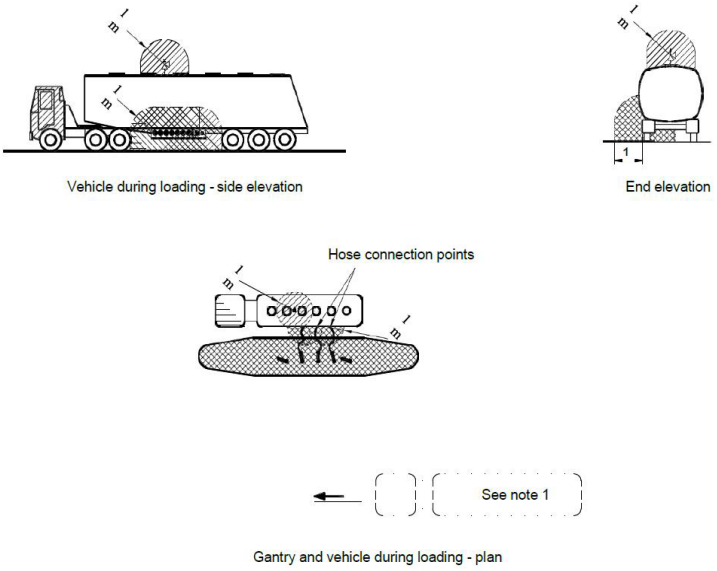

Figure 1: Road tanker equipped for bottom loading with vapour collection, during loading

Notes:

1. Empty bay with no spillage present is in safe condition for vehicle entry/departure, with vents and all connections closed.
2. The ullage space in the tank should be classified as Zone 0.
3. The cab is classified as Zone 2 (ADR 9.2.2.9.1(b)).

Note: this area classification diagram, shown in Figure 1, is taken from EI *Model code of safe practice Part 15: Area classification code for installations handling flammable fluids* and is provided as a generic example only; individual terminals may extend the hazardous area shown to include the whole gantry area on which the tanker stands.

The hazardous area shown around each compartment's breather device (pressure vacuum valve) is based on minor continual breathing releases of vapour through a relatively small cross-sectional area and when mounted on the tank top.

This hazardous area does not take account of:

– releases of vapour through breathing other than when the breather device is mounted on the tank top;
– any venting of vapour, or
– any sudden release of a large volume of vapour, such as might occur either from a vapour manifold vent or emergency pressure relief valve, whether originating from a breathing process or not.

2 SCOPE

This publication provides recommendations for the design and construction of road tankers intended for the conveyance of the main petroleum fuels: petrol; kerosene; diesel and gas oil.

Certain recommendations may also be applicable to other petroleum products.

Note:

1. Petrol UN 1203

   ADR permits the carriage of products having a vapour pressure not exceeding 1,1 bar (absolute) in 'Gravity discharge' tanks with the tank code LGBF.

   In addition, ADR Special Provision TU9 in ADR 4.3 permits petrol (UN 1203) to be carried in LGBF tanks, provided its vapour pressure does not exceed 150 kPa (1,5 bar) at 50 °C. ADR otherwise gives product vapour pressure as absolute pressure (as in 1,1 bar above) (ADR 1.2.2.3) and so in the case of petrol the allowable pressure should be given as 2,5 kPa at 50 °C for consistency.

   Aviation gasoline (AvGas 100LL) is also UN 1203 and therefore may be carried in the same ways. However, it should be noted that its carriage is excluded from the need to comply with the vapour recovery legislation which is applicable only to petrol for use in motor vehicles.

2. Kerosene UN 1223

   Aviation turbine fuel (UN1863) is considered as kerosene (UN 1223) in this document. Specific precautions are included for its loading and carriage.

3. Diesel and gas oil UN 1202

   When complying with EN590:2013 + A1:2017, diesel fuel may be carried on vehicles according to 'AT' as given in ADR 9.1.1.2 and 9.2.1.1. Gas oil may also be carried on AT vehicles where its flash point meets the same requirements.

   However, in the UK these fuels are generally carried on FL vehicles for which, in particular, a battery master switch and an Ex tachograph are required.

4. Ethanol UN 1170

   Whilst not a petroleum product, the scope of this publication may be used to cover certain aspects for the loading and transport of denatured ethanol for use in blended petrol.

5. Petroleum products not otherwise specified (UN 1268)

   Where pipeline interface, terminal slops or petroleum products N.O.S. are to be carried, the use of an LGBF tank may not be permitted if the vapour pressure of the product exceeds 1,1 bar (absolute). In all such cases, reference should be made to ADR 3.2, Dangerous Goods List, Table A. The dispensation to carry petroleum products with a vapour pressure higher than 1,1 bar absolute at 50 °C, 0,1 bar gauge at 50 °C applies exclusively to petrol.