

HSE COMMUNICATION NOTE

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Design of facilities for the storage and distribution of bitumen and bituminous products in above-ground tanks: Tankage layout – Minimum safety distances

Introduction

SABITA is often approached to provide advice on the minimum legal and functional requirements for establishing and operating storage and distribution facilities for bitumen and its derivatives. In particular tank safety distances, provision for secondary containment and fire protection seem to be sources of confusion/frustration.

Finding appropriate standards and codes of practice can be problematic as in most cases the referenced standards are generic for petroleum products and seldom (if ever) refer to bitumen or bituminous products specifically.

This communication note aims to identify and reference the most appropriate design and operational standards and codes of practice for bitumen storage and distribution facilities but it is not intended to describe or discuss specific requirements in any depth.

The main objective of this communication note is to provide guidance on interpreting requirements for minimum safety distances of tanks from each other or from property boundaries, public roads, third-party properties, safe areas and other facilities in the depot.

Identifying appropriate standards

Knowing and understanding the properties and characteristics of the product is the key to selecting the most appropriate standard.

Assuming that specific reference to 'bitumen' cannot be found in a search for appropriate standards design engineers have to determine which of the available generic codes of practice are most appropriate? The answer to this "dilemma" is found in the most appropriate classification of the product in the context of recognised Legal or Industry definitions.

Classification of bitumen and its derivatives

Internationally bitumen is classified as a petroleum product because it is derived from crude oil. Therefore, in the absence of bitumen specific standards, a search for standards relating to bitumen and its derivatives must include reference to petroleum products and the class of petroleum product. In South Africa (for storage and handling purposes) "petroleum product" and "class" are defined in SANS Codes of Practice as follows:

"petroleum product" - product composed of liquid hydrocarbons derived from a petrochemical process;

"class" - the class of petroleum product, based on the following classification:

a) class 0: liquefied petroleum gases;

b) class I: liquids, which shall be subdivided as follows:

- **class IA:** liquids that have a closed-cup flash point of below 23°C and a boiling point of below 35°C
- **class IB:** liquids that have a closed-cup flash point of below 23°C and a boiling point of 35°C or above
- **class IC:** liquids that have a closed-cup flash point of 23°C or above, but below 38°C

c) class II: liquids that have a closed-cup flash point of 38°C or above, but below 60,5°C

d) class III: liquids, which are subdivided as follows:

- **class IIIA:** liquids that have a closed-cup flash point of 60,5°C or above, but below 93°C
- **class IIIB:** liquids that have a closed-cup flash point of 93°C or above

In accordance with above definitions the various types of liquid bitumen can be classified as any one of the following:

i. **Straight-run paving grade bitumen** - Class IIIB

ii. **Modified bitumen's**

(a) **Polymer Modified bitumen's and Bitumen emulsions** - Class IIIB;

(b) **Cutback bitumen:**

- Medium curing (cut back with kerosene/illuminating paraffin) - Class II
- Slow curing (cut back with diesel) - Class IIIA **but could be** Class II depending on the specific flash point of the diesel used for cutback blending

Note: Be aware that (notwithstanding the above Class definitions) the classification of petroleum products, flammable liquids, combustible liquids, etc. may vary (and differ from above) in local authority codes of practice.

For example: The City of Johannesburg Metropolitan Municipality: EMERGENCY SERVICES BY-LAWS defines a flammable liquid as follows "*flammable liquid*" means a liquid or combustible liquid which has a closed-cup flash point of 93°C or below;

Check with the approval authority what criteria are applicable in your area!

Other relevant definitions that link bitumen's to generic design standards

"bulk depot"

Premises (sometimes referred to as marketing installations or terminals), on which the capacity for the storage of flammable goods **or combustible goods** (or both) exceeds 200 m³ in above-ground tanks, on which goods are normally received from a refinery or other bulk depot by road, rail, sea or pipeline (or a combination of these), and from which such flammable goods or combustible goods (or both) are delivered.

(Note: SANS 10131:2004 Edition 1 covers the above-ground storage and handling of petroleum products at "smaller" consumer installations with a total storage capacity not exceeding 200 m³.)

"combustible liquid"

A liquid that has a closed-cup flash point of 38 °C or above (All liquid bitumen's are combustible liquids)

"flammable liquid"

In isolated cases local authority by-law definitions include some bitumen types (**by reference to flash point**) as a flammable liquid

Where are standards prescribed?

The regulatory functions in connection with storage and distribution of petroleum products (usually referred to as flammable or combustible liquids in by-laws) have been delegated to local authorities. This is apparent by virtue of the following definition:

"**approving authority**" – means the local authority concerned. (SANS 10089 and 10131 definitions)

The applicable standards and specific requirements will therefore be incorporated by reference in local authority by-laws; for example:

- City of Johannesburg Metropolitan Municipality: *Emergency Services By-Laws*
- Durban Metropolitan Municipality: *Interim Code Relating To Fire Prevention And Flammable Liquids And Substances*
- Province Of Western Cape: *Local Authorities - By-Law Relating To Community Fire Safety*
- Nelson Mandela Bay Metropolitan Municipality: *By-Law Relating To Fire Safety*

The design standards usually referenced are SANS 10089-1:2008 Edition 4.3 and SANS 10131:2004 Edition 1. Within these SANS Codes various other standards (tank construction, material specifications, electrical equipment specifications, etc.) are also referenced and these may or may not be applicable to bitumen.

Applying the standards and requirements to bitumen specific storage facilities

Design responsibility

Plans submitted for approval to the relevant approving authority shall be signed by a "*responsible engineer*" (as defined in the SANS Code) who thereby certifies that such plans comply with the provisions of SANS 10089-1:2008 Edition 4.3 or SANS 10131:2004 Edition 1, whichever is applicable.

Which standard is appropriate?

Armed with the knowledge of which Class of petroleum product will be handled on site the task of deciding which requirements of the standard/s are applicable to bitumen should be somewhat easier.

The first decision to be made is which of the two SANS Codes i.e. 10089 or 10131 is applicable. *(It must be noted here that in general the SANS Codes and the local authority by-laws do not differentiate between temporary and/or permanent installations. The requirements are therefore equally applicable to mobile, temporary or permanent asphalt plants or bitumen production facilities.)*

The total storage capacity of the facility determines which standard applies:

- i. SANS 10089-1:2008 Edition 4.3 applies to facilities where the storage capacity exceeds 200 m³;
- ii. SANS 10131:2004 Edition 1 applies to facilities with a storage capacity up to 200 m³. This standard also specifies the design, manufacture and construction of above-ground storage tanks not exceeding a capacity of 85 m³.

Applying specific requirements of the selected standard/s

Both standards referenced above cover a wide range of requirements under the headings as listed below:

- Definitions
- Planning/layout of storage depots
- Design and construction of plant, equipment and buildings
- Operations
- Fire precautions and fire control
- Protection and welfare of personnel
- Maintenance of and extensions to depots
- Transportation of petroleum products by road and by rail
- Pollution control

It is not practical to discuss all requirements in any detail (or even briefly) in this document. Responsible engineers should consult the relevant standards to ensure compliance with all the requirements as applicable to bitumen storage.

To achieve the main objective of this document however, it is necessary to briefly discuss the requirements relevant to tankage layout to ensure compliance with local authority by-laws.

Tankage layout – Minimum safety distances

A standard requirement is that precautions shall be taken to prevent the ignition of hydrocarbon vapour and, in the event of fire, to prevent further spread. One aspect of a fire protection program is to reduce the likelihood of a fire by locating facilities at what is considered to be a safe distance from one another.

Safety distances do not guarantee complete protection, but they help to prevent the start of a fire by ensuring that any flammable vapour generated at one facility will diffuse to a concentration well below the lower explosive level (LEL) before it reaches any other facility or area where a source of ignition might exist.

Safety distances of tanks from each other or from property boundaries, public roads, third-party properties, safe areas and other facilities in the depot shall be based on either of two criteria:

- a) the minimum distance through which flammable vapours, **emitted during normal operational venting to the atmosphere**, have to move away from the tank in order to become dispersed and diluted below the lower explosive limit; or
- b) the minimum distance over which available protection measures against radiant heat from the tank would remain effective if the tank were to burn;

The tables in Annexure 1 illustrate the minimum spacing for vertical and horizontal tanks containing bitumen and modified bitumen's. The information has been interpreted and adapted from information as given in SANS 10089-1:2008 Edition 4.3 or SANS 10131:2004 Edition 1. The local authority by-laws usually reference the same specifications however facility designers should check local design standards to ensure that specifications are aligned.

Annexure 1

Table 1 – Minimum safety distances for cutback bitumen’s, polymer modified bitumen’s and bitumen emulsions; Class II & IIIA petroleum products

Type of tank ¹	Level of protection ²	Minimum distance from boundary of a property that is or can be built on, including the far side of a public road	Minimum distance from the near side of a public road, or from the nearest important building on the same property
Vertical with weak roof to- shell seam	None	Double the diameter of the tank (but not less than 2 m)	One-third of the diameter of the tank (but not less than 2 m)

Table 2 – Minimum safety distances for paving grade bitumen ; Class IIIB petroleum product

Type of tank	Tank capacity	Minimum distance from boundary of a property that is or can be built on, including the far side of a public road	Minimum distance from the near side of a public road, or from the nearest important building on the same property
Any type (vertical or horizontal)	0 – 48m ³	1.5 meters	1.5 meters

¹ Liquid bitumen and other bituminous products are usually stored in atmospheric tanks. “atmospheric tank”

A fixed-roof tank, that has a weak roof-to-shell seam, and that is designed to withstand an internal vapour pressure not exceeding (measured at the top of the tank) 3, 5 kPa, and that is generally free venting. Atmospheric tanks can be vertical or horizontal type tanks.

Atmospheric tanks are not designed for storing a liquid at a temperature at or equal to its boiling point.

² Level of protection refers to approved inerting system on the tank or approved foam system on vertical tanks or; water deluge systems for tank cooling in case of exposure to radiation from adjacent fires. In general these levels of protection are not provided for bitumen or other bituminous product tanks.

Table 3 – Minimum shell-to-shell spacing for horizontal bitumen tanks in the same bund

Impounding ³	Tank diameter	
Remote or in the tank bund	≤ 45 m	One-sixth of the sum of adjacent tank diameters but not less than 1 m

³ See SANS 10089-1:2008 Edition 4.3 section 4.5 Tank farms and bunding or SANS 10131:2004 Edition 1 section 4.1.6.3.3 Location and spill containment, whichever is applicable.

⁴ To permit access, the outside toe of a bund wall at ground level shall be no closer than 3 m to any property boundary that is or can be built upon.

⁵ The minimum distance between a tank and the toe of the inside of a bund wall shall be at least 1, 5 m.

⁶ If a class III liquid is stored adjacent to a class I or class II liquid, the larger of the class spacing shall be used.

⁷ Tanks should be so arranged that, in case of a fire, fire-fighting can be carried out effectively with mobile and stationary fire-fighting equipment. Tanks should be so sited that each tank is adjacent to a (fire) road or accessible to mobile fire-fighting equipment.