

Safety is no accident
Observe, think and act



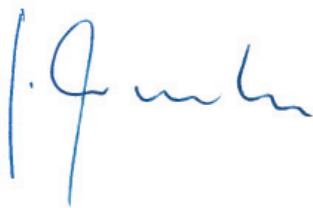
Safe Handling of Bitumen



Nynas Policy for Health Safety Security Environment & Quality (HSSE&Q)

- We want to be the preferred long term supplier of high performance specialty oil products and services, meeting and, where possible, exceeding the expectations of our customers.
- We assess the health, safety and environmental impact of our products and do our utmost to minimise it. We provide guidance for safe use of our products.
- We comply with both applicable regulatory and internal requirements as documented in our management system. We constantly strive to improve the HSSE&Q performance by minimising the risk of major and minor accidents, the risk to people's health and the environment as well as optimising the efficiency of our activities and use of resources.
- We promote a strong and positive HSSE&Q culture, where the line management are responsible. All employees are individually aware and responsible for their working activities.
- We operate a fully integrated and certified management system which meets the requirements of ISO 9001 and for our technical and operational sites also meets the requirements of ISO 14001 and OHSAS 18001. Our system provides a framework for establishing and reviewing HSSE&Q objectives and targets and to continuously evaluate and improve the effectiveness of the management system.

The aim of the Policy is to support Nynas vision and deliver a performance we all can be proud of, so that confidence can be earned of customers, employees, shareholders, suppliers, authorities, neighbours and society at large.



Gert Wendroth
President Nynas AB



About Nynas

Nynas is a different kind of oil company – we want to use oil, not burn it. We take oil further to bring value to customers and the world we live in.

With ninety years' experience, we are one of Europe's leading suppliers of bitumen. We continue to develop bitumen and its functional performance in a wide variety of applications. Our long standing focus on bitumen has earned us the reputation of being the 'bitumen specialist' - and that is something we are very proud of.

We are recognised as a reliable supplier of specific quality bitumen to meet our customers' changing needs and performance requirements.

We have refineries and a network of terminals across Europe. Operating as a coordinated European company we are geared to meet each customer's local or regional needs as well as pan European requirements.

By controlling each step of our supply chain - shipping crude oil, refining and final product dispatch - we are able to provide consistent products with assured performance. Our customers often require deliveries on very short notice at any time of the day or night, at remote locations. Our customer

driven logistics system and non stop, year round operations consistently meet these demanding requirements. This is verified by our certified ISO 9001 quality management systems. In addition all Nynas operational sites are certified for ISO 14001 (environmental) and OHSAS 18001 (safety and health) management systems.

Nynas provides CE marked bitumen for paving applications in accordance with the applicable EN specifications. CE marking is an EU official confirmation that our products fulfil the product specifications and the essential requirements of the Construction Products Regulation.

Nynas has piloted several initiatives to securing the future and creating value by demonstrably contributing to sustainable development. Examples include:

- extension of our ISO 50001 Energy Management System certification, which now includes all Nynas UK operations as well as Harburg refinery
- setting of a company-wide sustainable development ambition. This was developed alongside an external stakeholder materiality assessment
- evaluation of the operational carbon footprint baseline of our Bitumen Business. Conducted in line with the GHG (Greenhouse Gas) Protocol, Corporate Standard.

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Nynas Policy for Health Safety Security
Environment & Quality (HSSE&Q)

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Preface

Nynas' HSSE&Q initiative 'Observe, think and act' encourages people to be observant of any risks, think what should be done to mitigate them and then actually do something about the situation.

Bitumen in its solid phase is not hazardous, but due to high temperatures for storage, handling and transportation there are risks when working with the material. The main aim of this guide is to provide the reader with a clear, useful understanding of bitumen from a product health and safety perspective so that bitumen can be handled safely within the supply chain. This creates a good knowledge base and an appreciation of the product and its potential risks.

The information in this 'Safe Handling of Bitumen' guide is primarily intended for those who work operationally with bitumen: road tanker drivers, operating personnel in asphalt works and bitumen depots, surfacing teams and other production personnel. Other groups that we hope will use this publication include safety managers, human resource managers of the above groups, training coordinators and technicians of all kinds.

The advice given in this publication reflects the current knowledge of the hazards and risks associated with the handling of bitumen products. If the product is mixed with other materials, the users shall take these into account when identifying any additional hazards and risks which might arise.

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This guide, Nynas Safety Data Sheets and other safety-related information are available on www.nynas.com

Product information



Bitumen - general

Bitumen is manufactured from the distillation of crude oil during petroleum refining. It is produced to meet a variety of specifications based upon physical properties for specific end uses. Its main characteristics as an adhesive, as well as being waterproof, thermoplastic, durable, modifiable and recyclable make it ideal as a construction and engineering material.

There are many different bitumens and bitumen products with many different fields of application in both road construction and industrial manufacturing. Bitumen is defined as a construction material according to the Construction Products Regulation (CPR).

Bitumen should not be confused with coal tar, which is produced from black coal by destructive distillation at high temperatures. Coal tar is completely different in chemical composition and physical properties and is classified as carcinogenic while bitumens are non classified.

Bitumen should not be confused with natural asphalts, which are unrefined products.



Bitumen composition

Bitumens can generally be described as complex mixtures of hydrocarbons containing a large number of different chemical compounds of relatively high molecular weight. There is considerable uncertainty as to the molecular weight distribution of bitumen. The smallest size, approximately 300 Dalton, is determined by the distillation 'cut point' during the manufacture of the bitumen. The largest size has not been finally concluded; earlier research suggested that molecular weights up to 10 000 Dalton are present, while some research indicates that there are probably very few, if any, molecules larger than 1 500 Dalton in bitumen. The molecules present in bitumens are combinations of alkanes, cycloalkanes, aromatics and heteromolecules containing sulphur, oxygen, nitrogen and metals.

Bitumens are regarded as chemical substances although they contain a complex mixture of high molecular weight hydrocarbons.

The information above is an excerpt from The bitumen industry - a global perspective (IS-230), 3rd Edition.

* Dalton (Da) is a unit used to indicate the mass on an atomic or molecular scale.

Types of bitumens

There are three main types of bitumens.

Paving bitumens are usually produced from the atmospheric distillation of petroleum crude oil followed by further processing such as vacuum distillation, thermal conversion, air-rectification or solvent precipitation. A combination of these processes can be used for production of different bitumen grades. Road paving as the name indicates is the principal use.

Hard bitumens are manufactured in similar processes to paving bitumens, but are harder and more brittle (with lower penetrations and higher softening points). The principal use is in the manufacture of flooring, bitumen paints, preservation of fibreboard etc.

Oxidised bitumens (air-blown) are produced by passing air through a bitumen feedstock. This gives a product with higher softening point relative to penetration, with reduced temperature susceptibility. The properties of the final bitumen product depend on the degree of blowing and the process conditions.

A mild degree of air-blowing, known as air-rectification, is commonly used to adjust the physical properties in order to manufacture substances used in paving.

The penetration index for air-rectified bitumens is ≤ 2 .



An intense degree of blowing (oxidation) is commonly used to adjust the physical properties in order to manufacture substances used in industrial applications. The oxidation process may use flux oil to soften the feed. A catalyst (phosphoric acid, ferric chloride etc) may also be used to increase the speed of the reaction. The main uses for oxidised bitumen include roofing material, waterproofing, electrical insulation and many other building and construction materials.

The penetration index for severely oxidised bitumens is > 2 .

Bitumen mixtures

Bitumen is also used as a raw material to manufacture mixtures with improved handling and application characteristics or to enhance the physical properties of bitumen.

Modified bitumen can contain polymers, waxes or other additives. The main purpose of modification is to achieve improved performance characteristics.

In the case of polymer modified bitumen the desired end performance of the product influences the selection of the polymer type. Typical polymers used in the bitumen industry are elastomeric polymers, e.g. SBS (Styrene Butadiene Styrene co-polymer).

One application area where modification of bitumen can offer benefits is warm mix asphalt, which allows production and laying at lower temperatures compared to traditional hot mix asphalt. This leads to improved working conditions and reduced emissions. Modified binders for warm mix applications can be produced using organic or chemical additives.

Wax, an organic additive, can be added to produce binders that exhibit lower viscosity than unmodified bitumen at elevated temperatures.

This reduced viscosity allows end users to either:

- reduce mixing temperatures
- maintain conventional mixing temperatures and improve the workability and time available for effective compaction when compared to standard paving grade bitumen.

Additionally, wax modified binders are designed to enhance the performance characteristics of asphalt at different stages during the construction phase and in-service life.

Commonly used chemical additives in binders aimed at warm mix applications regulate and reduce frictional forces at the interface between the binder and the aggregate. This reduction allows the asphalt mix to be produced and compacted at lower temperatures than mixes using standard paving grade bitumen.

Bitumen emulsions are fine dispersions of bitumen or modified bitumen in water where the bitumen commonly is the dispersed phase and water is the continuous phase.

Bitumen emulsions are normally produced using a high shear rate mill, which disperses the bitumen in the water.



Bitumen emulsion surface treatment.

The bitumen content of an emulsion typically varies between 40 %-80 % and the application temperature ranges from ambient to about 90 °C. A higher content of bitumen usually leads to a higher application temperature.

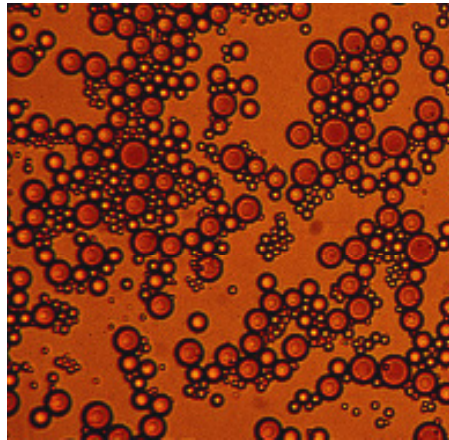
Bitumen emulsions are identified by the type of electrical charge of the emulsifier. Three types of emulsifiers are used: anionic (alkaline), cationic (acidic) and non ionic. In Europe the cationic emulsions are most frequently used for bitumen applications.

Cutback bitumens are mixtures of bitumen with volatile petroleum diluents (kerosene, white spirit etc) to render them more fluid for ease of handling and application at ambient temperature. Depending on the type of diluent the original properties of the bitumen may be partly or completely recovered as the solvent evaporates. Cutbacks are mainly used in road surface dressings and tack coating.

Fluxed bitumens are mixtures of bitumen with relatively non volatile oils to make the product softer for ease of application. The flux oils are commonly high boiling distillates or process oils which tend to remain in the binder after application. Fluxed bitumen are mainly used for very flexible road pavements in areas with a cold climate.

For all of the above types of bitumen an adhesion agent is sometimes added to improve the adhesive performance of the asphalt mix.

The bitumen types and bitumen mixtures described above represent the most commonly used types and mixtures available on the market.



Greatly enlarged picture of bitumen emulsion. Bitumen particles are “floating” in the water.

Product quality

The quality and performance of bitumen can be compromised if it is contaminated by light oil products during transportation or laying. If there is any doubt the product should be retested to check the quality.

Even small amounts of solvent, petrol, fuel oil or diesel can considerably alter the properties of bitumen films and lead to deterioration of their adhesive properties, which in turn may lead to failure of the asphalt.

It is essential that bitumen is handled and stored at the correct temperature.

If the temperature is too low, coating of the aggregate will be uneven; whereas if the temperature is too high, the properties of the bitumen will deteriorate and it may drain from the aggregate leading to run off.

The temperature at which bitumen can be pumped and mixed depends on the grade. These temperatures are calculated on the basis of viscosity measurements and are supported by operational experience.

For more information on storage and handling temperatures, see Appendix 6.



Deterioration and softening of asphalt due to fuel spillage.



A damaged road that suggests the defects could be due to a poorly mixed asphalt.

Product information

Nynas offers a wide range of bitumen products.

Safety Data Sheets, Product Data Sheets, Declaration of Performance and CE Data Sheets can be found on www.nynas.com or will be sent upon request.

For additional information please contact one of the Nynas regional sales offices.



Health, safety and environment



REACH and CLP

REACH is the European regulation on chemicals and their safe use. It stands for Registration, Evaluation, Authorisation and Restriction of Chemicals. REACH requires manufacturers and importers of chemicals to register the substance(s) to the European Chemical Agency (ECHA). As of 30 November 2010 all substances manufactured or imported above 1000 tonnes/year need to be fully registered.

Classification Labelling and Packaging (CLP) is the European version of the UN based system for classification and labelling, the Globally Harmonised System (GHS).

European bitumen manufacturers have completed a review of the health and environmental impacts of bitumen, required as part of the REACH registration process. Based on the published data at that time bitumen is considered unlikely to present a hazard that requires classification for human health, safety or the environment according to CLP. However, it should be noted that the REACH dossier only covers use of bitumen within the safe handling temperatures; 200 °C for straight-run bitumens and 230 °C for oxidized bitumens.

Animal studies on fume condensates from severely oxidized bitumen (penetration index > 2) generated at high temperature indicate that repeated exposure to fumes may present a weak carcinogenic hazard. The classification criteria are not fulfilled, but additional risk management measures are communicated in the Safety Data Sheets for these products.

Bitumen mixtures that contain solvents, flux, emulsifiers and other additives may be classified as dangerous to health and/

or to the environment. The classification of these mixtures is product specific since they depend on the classifications and amount of the different ingredients. Therefore, it is important to check the SDS.

Safety Data Sheets (SDS).

According to REACH, suppliers are required to provide their customers with SDSs for all classified substances/mixtures.

Bitumen is not classified as hazardous and there is currently no legal requirement to provide SDSs for bitumen. However, SDSs do contain very important information regarding safe handling of bitumen and therefore it is industry practice, which is followed by Nynas, to provide them.

Bitumen burns

Bitumen is normally manufactured, stored, transported and handled hot. Hence the most significant hazard posed by bitumen is the potential to cause severe burns.

There are several cases where there is a risk of personnel being covered with hot bitumen, for example:

- if a hose bursts
- boil-over of a truck or storage tank
- if a valve has been blocked and the plug is released
- sampling without correct Personal Protective Equipment (PPE) or experience of how to open the valve.

To minimise the risk of burns it is essential to always wear PPE and to follow proper working procedures. The required PPE is shown in Appendix 1. It is recommended to have a safety shower in the vicinity (20 m radius) of the loading/unloading areas.



Contact with hot bitumen causes severe burns on exposed skin.

Safety showers

Safety showers must be installed to the following standards (this is occupational safety advice for site design):

- It is recommended that the shower should be positioned at a minimum distance of 6 m and must be no further than 20 m away from the discharge point. If the shower is positioned within 6 m of the discharge point it must be screened from the possible effects of bitumen spray.

For more information, refer to the Eurobitume guidance on safety showers.

First aid in case of burns

Bitumen burns should be cooled for at least 15 minutes, first with cool water to reduce pain, then with warm water to prevent hypothermia if the burned surface is larger than the size of a hand. Burns to the eyes should be irrigated for at least 5 minutes.

No attempt should be made to remove the bitumen at the work site by unqualified personnel.

For more detailed information, see the Eurobitume Bitumen Burns Card in Appendix 5.

Hot bitumen in contact with water

If hot bitumen comes into contact with water there is a risk of a violent reaction. In contact with hot bitumen the water evaporates and expands in volume, which leads to splattering. In a storage tank or truck the pressure can increase and result in a violent eruption of hot bitumen. If closed, the truck or tank could explode or rupture.

As a consequence it is of utmost importance to ensure that tanks and trucks are free from water. See 3.2, 3.5 and 4.1 for more information.

Examples of risks of boil-over:

- previous load of bitumen emulsion or any product with water content
- cold truck (water condensation/mist)
- trapped water in storage tank
- after tank maintenance - high pressure water jet cleaning.

The most common reason for boiling over is hot bitumen being loaded in a tank that has previously contained bitumen emulsion. The water in the emulsion vaporises and expands. The pressure will increase and eventually become so high that the steam will push the bitumen through the manhole. If the tank is closed the increase of pressure can cause an explosion.



Still from CCTV footage of an eruption of bitumen from a tanker.

Exposure to bitumen fumes

Heated bitumen emits fumes consisting of a gas phase and an aerosol phase. The gas phase is often called the semi volatile phase. Bitumen fumes are not considered harmful to the public. Exposure to high concentrations when handling hot bitumen can cause irritation of the eyes and nose and/or respiratory tract.

Working at the correct temperature and using the correct bitumen products for each specific application can reduce the fuming of bitumen during normal handling.

It is recommended to strive for a good working environment where all unnecessary exposure is avoided. In certain applications, for example indoor mastic asphalt works (in tunnels, buildings or multi storey car parks), the exposure level can be high.

In these cases adequate ventilation must be provided, e.g. tunnel fans, and it is essential to use the recommended protective equipment.

Due to the presence of solvent, cutbacks may cause dizziness or nausea when used in confined spaces. Again in these circumstances adequate ventilation is always recommended.

There is no EU occupational exposure limit (OEL) set for bitumen fumes, but several European countries have established their own threshold value and/or short term exposure limit. Please note that these values are country specific. For more detailed information please refer to section 8 of the Safety Data Sheets.

The Derived No Effect Level (DNEL) which has been derived in the REACH process is 2.9 mg/m³ (Total Hydrocarbon Concentration, TWA*, 8h) for bitumen based on irritative effects.

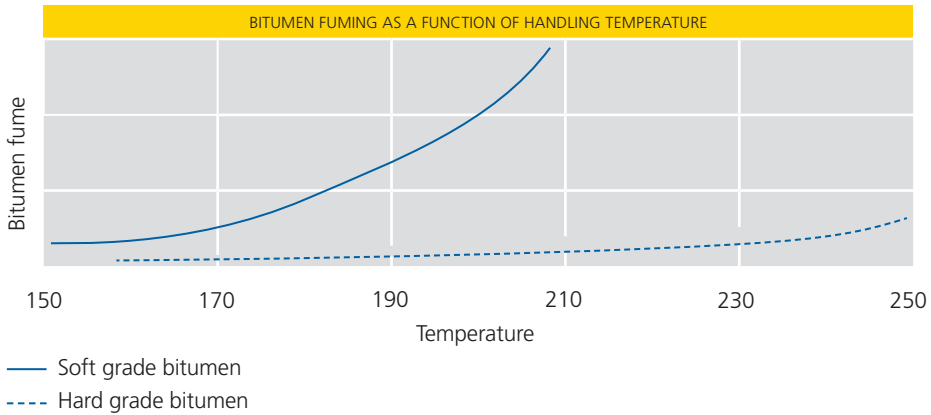
Exposure measurements during paving works have shown that the light oil molecules which are present in inhaled air largely come from solvents such as diesel oil which was historically used as a release and cleaning agent when applying the bitumen.

Bitumen contains a small amount of Polycyclic Aromatic Hydrocarbons (PAHs) of which some are classified as carcinogenic. As a consequence there have been many studies to evaluate if there is an increased risk of cancer among asphalt workers. The International Agency on Research on Cancer (IARC) has done an epidemiological study on asphalt workers in several European countries. This study showed a small increase of lung cancer among asphalt workers in some countries, but it was not possible to see if the cancer was related to bitumen or other factors, e.g. tobacco smoking. As a follow up IARC conducted a study where the reasons behind the cancers were evaluated. The outcome of this study showed that there was no direct link between bitumen and lung cancer. The increase was probably more linked to tobacco smoking.

In 2013 IARC published the Monograph 103, 'Bitumens and bitumen emissions, and some n- and s-heterocyclic polycyclic aromatic hydrocarbons', where IARC concluded the following:

- Occupational exposures to oxidized bitumens and their emissions during roofing are 'probably carcinogenic to humans' (Group 2A);

*Time Weighted Average



- Occupational exposures to hard bitumens and their emissions during mastic asphalt work are ‘possibly carcinogenic to humans’ (Group 2B); and
- Occupational exposures to straight-run bitumens and their emissions during road paving are ‘possibly carcinogenic to humans’ (Group 2B).

The IARC Monograph on bitumen and bitumen emissions is about occupational exposure to bitumen. The majority of studies reviewed by IARC refer to exposure to bitumen fumes and bitumen fume condensates and therefore Nynas interprets that the conclusions is related to exposure to bitumen fumes and not to bitumen in-situ.

The Monograph points out that concentration and composition of exposure is highly variable and depends on where and under which circumstances the bitumen is being used. Furthermore, the Monograph emphasises the importance of the influence of temperature on the exposure to bitumen fumes.

This confirms and follows the manufacturing industries guidelines given for many years. Nynas actively supports continued work on ways to decrease exposure, e.g. temperature reduction, engineering controls, working practices, etc.

For many years the bitumen industry has provided maximum temperatures for storage and handling; 200 °C for bitumen and 230 °C for oxidized bitumen. Nynas sees no need to change these recommendations as long as Occupational Exposure Limits (OELs) are not exceeded. If OELs are exceeded and if temperature cannot be decreased, exposure must be controlled by exhaust ventilation, closed system and/or personal protection.

If oxidized bitumen is used above 200 °C, exposure needs to be controlled by exhaust ventilation, closed system or personal protection. For manual construction applications such as rolling and brushing, a respiratory protection should be used. These recommendations are in line with the existing guidance on safe use for oxidized bitumen, which was implemented in Nynas Safety Data Sheets in 2011.

Although there is no currently available study showing that even long term exposure to bitumen fumes is harmful, it is nevertheless recommended to avoid all unnecessary exposure.

The following should be noted:

- control temperature to reduce fuming
- do not use diesel fuel as a release and cleaning agent.

Hydrogen sulphide (H₂S)

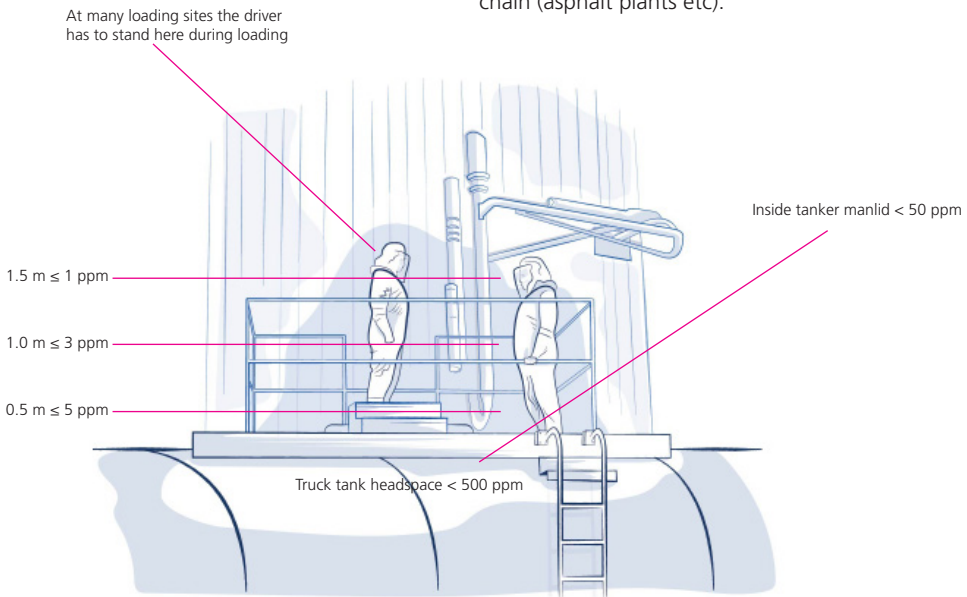
The release of hydrogen sulphide (H₂S) from both crude oil and certain types of oil products such as heated bitumen is and has been a common occurrence in the petroleum industry.

H₂S (CAS # 7783-064, EINECS # 231-977-3) is a toxic and flammable gas which is heavier than air and may accumulate in low areas and confined spaces. It is characterised by a strong odour of "rotten eggs" at low concentrations. But this odour cannot be relied upon to warn of the presence of dangerous concentrations because the gas rapidly deadens the sense of smell even at concentrations below hazardous levels. When handled hot, bitumen odour will also camouflage the rotten egg odour of H₂S.

The principal symptoms of exposure to H₂S are irritation of the eyes, nausea, vomiting, dizziness and headaches. Prolonged exposure to concentrations above 50 ppm produces irritation of eyes, nose, throat and lungs. Any exposure to concentrations above 500 ppm can be fatal. Levels above 700 ppm cause unconsciousness and a person can collapse within seconds.

In open working areas H₂S is unlikely to pose a risk to health. However, H₂S can accumulate in closed spaces and in the headspace of storage tanks containing bitumen and can reach potentially hazardous concentrations (lethal concentrations may occur).

There is also a risk of potentially hazardous concentrations in the headspace of trucks and in storage tanks further down the supply chain (asphalt plants etc).



Note: figures obtained from Nynas H₂S monitoring measurements 2010/11. Local exhaust ventilation (fume extraction) should be fitted to all bitumen loading facilities.

Areas around manlids and ventilation pipes are risk areas for exposure especially during filling operations.

Access to vents should be restricted with warning signs for H_2S and access prohibited while the tanks are being filled.

When access is necessary, as for manual tank measurements, a full gas mask should be worn.

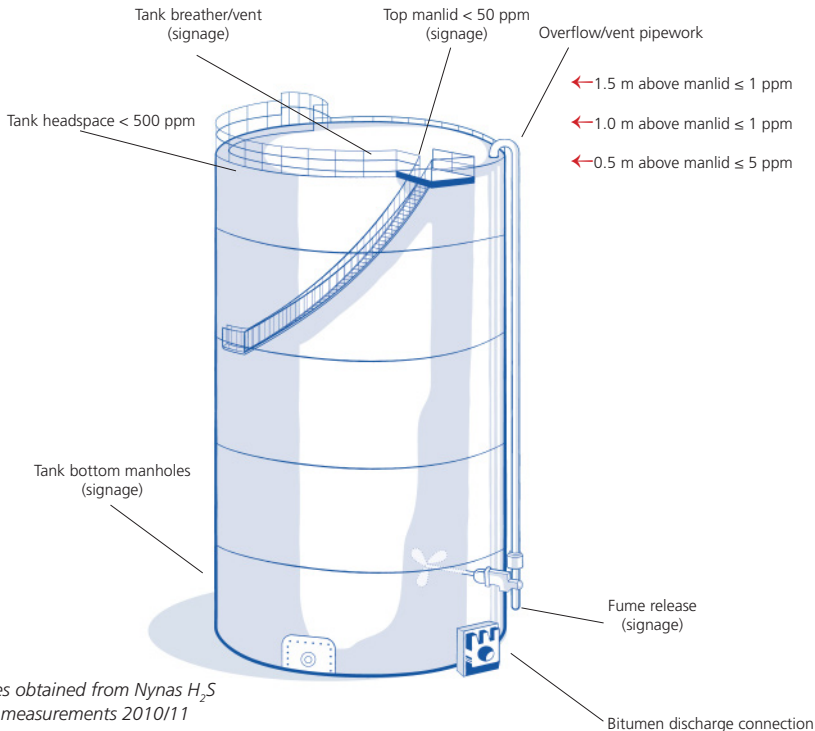
At loading sites there should be signs that warn the loader of possible H_2S . Personal Dose Monitors (PDM) are recommended for those performing the loading. Alternatively, the site can be equipped with permanently installed monitors.

Before entering confined vapour spaces in bitumen tanks always check for H_2S .

There are national Occupational Exposure Limits (OEL) for H_2S . The values can be found in the Safety Data Sheets for bitumen.

First aid in case of H_2S intoxication or excessive fume exposure

Under safe conditions, remove the person from the contaminated atmosphere into fresh air. Rescuers must wear breathing apparatus, belt and safety rope and follow rescue procedures. If trained to do so immediately begin artificial respiration if breathing has ceased. Provision of oxygen may help. Obtain medical advice for further treatment. If the gas has affected the eyes, wash with water for at least five minutes and seek medical attention.



Skin contact with cutbacks and emulsions

Bitumen emulsions contain low concentrations of emulsifiers which can cause irritation to the skin and eyes. Some of the emulsions can also contain small amounts of solvents.

It is therefore essential to wash carefully the parts of the body that have come into contact with a bituminous mixture with soap and water or a vegetable oil. It is recommended to use an appropriate skin cream afterwards.

Bitumen contains very low concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) of which some are known to be carcinogenic. The concentration of PAHs is lower in bitumen than in the crude oil itself since the production process includes a vacuum distillation step where practically all the PAHs are lifted out.

In undiluted bitumen the PAHs are not considered to be bioavailable. However, if the bitumen is mixed with diluents it is believed that such materials may become bioavailable if the product has low viscosity at ambient temperatures.

Cutbacks contain a solvent, e.g. naphtha, kerosene, white spirit or flux oil, which depending on the type of solvent may cause skin irritation at repeated exposure.

Where contact with the skin is repeated over a long time there is a risk, albeit a small one, of permanent skin damage.

Always check the appropriate Safety Data Sheet for more information.



Fire hazard

Danger of fire and explosion

In order to prevent fire in storage tanks the product should be stored sufficiently below its ignition temperature. This provides a safe margin for deviations of any measuring devices. Bitumen should be stored at least 30 °C under its flash point. The auto ignition temperature for pure bitumen is over 300 °C.

There is a risk of self ignition if bitumen has leaked into tank insulation. Heating that leads to self ignition on the surface of porous or fibrous material that has been impregnated with bitumen or by condensed bitumen fume can occur at temperatures below 100 °C.

Carbon deposits that can be pyrophoric may develop on walls and roofs of bitumen storage tanks. In the presence of oxygen, these might develop a risk of self ignition.

Actions to prevent fire and explosions

Clean and repair any damaged insulation. Replace the insulation where it has been contaminated. If there has been a storage tank overfill it is very likely that this will lead to a fire in the insulation unless correct actions are taken. For contaminated insulation that cannot be immediately be replaced, the risk of fire can be reduced by injecting steam through the use of steam lances.

Bitumen road tankers and storage tanks that have contained cutbacks may contain concentrations of flammable vapours in the headspace. Therefore, no open flame such as that of a bottled gas burner, blow torch



Tank insulation that has been impregnated with bitumen should be replaced.

or similar should be in the immediate vicinity during or soon after unloading. However, road tankers and railway wagons can be equipped with heating tubes for heating bitumen with bottled gas. It is essential that heating tubes in a tank are covered by bitumen (between 10 cm and 20 cm) during the heating process. This especially applies to cutbacks that contain solvents with a low flash points. The heating tubes should have a double skin to avoid local overheating.

Flames must never directly heat the tank surface. If this happens there will be a risk of ignition. Ensure that protective tubing is in good condition. A common cause of bitumen ignition is localised overheating during the heating process, for instance during unloading.



Bitumen fires can be very violent.



Fire in a tank is fought with dry powder extinguishers.

Extinguishing bitumen fires

NEVER USE A WATER JET!

Bitumen fires must be extinguished by smothering so that the continued supply of oxygen can be prevented.

Small fires can be put out with a blanket of foam, dry powder or carbon dioxide extinguishers.

Large fires are preferably extinguished preferably by using foam or dry powder extinguishers, but there is a danger of fires flaring up again. Foam and powder do not provide a lasting oxygen free atmosphere in bitumen fires.

Fires in tank insulation can be put out using steam from a spray unit or a dry powder extinguisher. It is essential to always replace contaminated insulation. If it is not replaced the fire could ignite again when oxygen is reintroduced unless the temperature is well below 100 °C. Ensure that workplaces and road tankers are equipped with extinguishers of the correct size and type.

If a bitumen fire arises, always call the local emergency fire services and make sure to inform them that bitumen is involved.

Emissions and other environmental effects

Bitumen as such is not classified as dangerous to the environment.

Bitumen at ambient temperature is inert and does not cause emissions to air, water and soil. However, storage and application at elevated temperatures cause diffuse emissions of mainly hydrocarbons. These emissions increase with the handling and storage temperature.

When bitumen is heated, hydrogen sulphide is given off as well as hydrocarbons. For more information regarding bitumen fumes and hydrogen sulphide, please see 2.4 and 2.5 respectively.

Spill

Bitumen

Spillage of bitumen to ground is relatively harmless. Leaks and spillages will initially consist of molten hot material and there may be a risk of severe burns. The bitumen will cool down and become solid. The affected area can be cleaned up using ordinary equipment such as spades, rakes, wheel mounted loaders and similar.

In water, bitumen will normally sink into the sediment at the bottom although in some circumstances it may float.

The main effect of a spill of bitumen in water or on soil is adsorption to sediment causing physical contamination. The water solubility of bitumen is so low that it could be considered to be negligible. Bitumen is not thought to present any significant hazard to the aquatic environment.

Bitumen constituents are potentially bioaccumulative, but the low water solubility

and high molecular weight make the bioavailability to aquatic organisms limited. Bioaccumulation is unlikely. The use of bitumen in road and roofing construction shows that bitumen is a persistent material, i.e. it is not, and should not be, biodegradable.

Bitumen emulsions

In contact with soil the emulsion will break and the bitumen particulates are adsorbed in the upper layer and are therefore easy to clean up.

In contact with water, the emulsion will spread out on the surface of water and blend with the water. The emulsion will finally collapse on dilution. The emulsifier will partly dissolve in water and the bitumen phase will disperse.

Cutbacks

Cutback spillage to ground can be more complicated since it has a lower viscosity and can consequently penetrate the soil and/or affect nearby watercourses before hardening. In time the solvent will evaporate from the product.

If spilled in water the product will form a film on the surface and spread. The product will adhere to soil and the solvent will evaporate from the product. The bitumen itself is immobile and will remain on the soil surface where it can be removed mechanically.

Actions and advice in case of a spill

Even though most bitumen products are not hazardous to the environment they can cause physical contamination.

Any spill should be controlled as soon as possible without endangering people's health in the process.

Prevent product from entering sewers, rivers or other bodies of water since the solidified product may clog drains and sewers.

Guidance on spillage:

- small spill - allow the bitumen to cool and solidify. Remove mechanically into containers for disposal or reclamation in accordance with local regulations
- large spill - prevent from spreading by making a trench or barrier with sand, earth or other material. Otherwise treat as a small spillage.

Contact the local authorities and/or emergency services. Always act according to the local legislation.



Waste disposal

For the disposal of bitumen products, refer to section 13 of the Nynas Safety Data Sheets. Bitumen itself is not regarded as a hazardous waste.

Distribution, transport, loading and unloading



Transport

The majority of bitumen products are transported in bulk by road tankers or vessels. In some countries rail transport is also used. Smaller volumes can also be supplied in drums or mini containers for example intermediate bulk containers. This is common practice for emulsions and bituminous solutions, but less common for road bitumen. Oxidised bitumen and polymer modified bitumen can also be distributed in pellets or in blocks, stacked on pallets.

Transporting hot bitumen is subject to the international UN regulation regarding the transportation of hazardous goods which applies to:

- road transport (ADR)
- rail transport (RID)
- inland waterways transport (ADN)
- sea transport (IMDG).

Road transportation of dangerous goods in Europe is regulated by the international agreement 'Accord Européen relatif au transport international des marchandises Dangereuses par Route' (ADR). This regulation implies specific requirements regarding for example:

- the vehicle
- labelling of the vehicle (with respect to the goods being transported)
- checking documentation and emergency information relative to the product
- the driver (and co-driver).

For details of ADR refer to Appendix 2.

For the transport of bitumen products refer to section 14 of the Nynas Safety Data Sheets.



Safe truck loading.

Preventing accidents during handling and transportation

All equipment and its maintenance should always follow local, national and international regulations and codes of good practice.

During loading of bitumen

It is important that the tanker does not contain residues from previous loads, for example emulsion or a product with a low boiling point. Bitumen loaded onto water or emulsion can lead to a violent eruption or boil-over. It must therefore be avoided at all times.

Tanks that have carried emulsions have to be steam cleaned and dried before they can be used for bitumen products. Procedure loading procedure must be followed.

If a dead man's handle is to be used during loading, it is strictly forbidden to override the operation of the safety handle.

There is a risk of splashing especially when loading commences. Always use the correct Personal Protective Equipment (see Appendix 1).

In the event of an accident the depot or refinery personnel should always be contacted and the local site instructions followed.

Safe bitumen delivery in brief

- Apply general safety awareness - Observe, think and act
- Always use the required Personal Protective Equipment (PPE)
- Be aware of the emergency equipment locations (fire extinguishers, emergency stop buttons, safety showers, main closure valve)
- Ensure all personnel are kept at least 6 m away from the delivery operation (exclusion zone)
- Driver must stay in attendance at the emergency stop button at all times during delivery
- Check and secure any valves, caps, covers and padlocks
- Leave the delivery point in a clean condition
- Sign and complete delivery documentation
- Report all defects or any problems firstly to the customer, secondly to your Nynas contact.



The supplier's responsibilities

The supplier/consignor is responsible for:

- classification of the products under ADR, RID, ADN and IMDG
- using approved packaging for packaged products
- ensuring correct marking and labelling
- declaring products in accordance with local regulations
- issuing the correct transportation documents to accompany the delivery.

Information regarding the classification of each product is given in the Safety Data Sheets provided by the supplier.

Nynas can, upon request provide additional information for transporters.

The haulier's responsibilities

In order to guarantee the correct delivery it must be ensured that the right product and quantity at the right temperature is loaded on the premises of the bitumen supplier. This should be verified throughout the entire process.

The temperature of the load can fall quickly if the vehicle's tanks are cold. Recommended handling temperatures are given in Appendix 6.

The haulier guarantees that vehicle tanks are approved for transport according to the Nynas instructions. The driver must inform the supplier about the previous load. The supplier is entitled to verify this information at any time.

It is the haulier's responsibility to:

- make sure that vehicles are fully equipped according to the ADR legislation and that they are properly marked and labelled
- provide their driver/s with 'ADR Instructions in Writing 5.4.3'.

Drivers who transport ADR classified goods require a special training certificate. The haulier is responsible for the training and certification of its drivers.

Accredited bitumen suppliers normally have equipment and checking procedures so that the driver can easily monitor the loading process. If anything goes wrong the driver should always immediately stop loading and contact the bitumen supplier's personnel.

The haulier/driver should use the supplier's accident/incident reporting system as well as the one used in his own organisation in order to take preventive and corrective actions as soon as possible.

Use of hose/flex

The delivery hose/flex is a vital piece of equipment for the safe delivery of elevated temperature products. It is therefore very important to use the correct hose/flex for the intended use.

It is recommended that the hose should have a minimum length of 4 m. For products at elevated temperatures, it is important that the hose/flex has both a temperature and a pressure rating.

Testing of the hose/flex should be carried out according to local legislation and codes of good practice. It is recommended to test them at least annually. This will include equipment certification. Records of the testing should be kept by the owner. Hoses that have not been tested should not be used.

Drivers should carry out checks on their hose/flex, connection packings and gaskets before use on a daily basis. If any faults are found defective equipment should not be used and corrective actions should be taken.



Loading plan - tank cleaning - checks

To minimise the risk of accidents and to ensure a high quality standard of delivered products it is very important that a vehicle's tank does not contain residue from previous loads. Special attention should be paid to emulsions (containing water) and products with a low flash point. In case of doubt the bitumen supplier/depot manager should always be consulted.

Due to the dangers of mixing bitumen emulsion and bitumen it is recommended that inspection of the loading vehicle is instigated and site specific procedure loading is followed. Always consult with the bitumen loading facility.

More information regarding safe loading is described under 'Preventing accidents during handling and transportation', 3.2. Loading and unloading checklists can be found in Appendices 3 and 4.

Sampling bitumen products

Hot bitumen sampling is particularly hazardous due to the risk of splashes and spills that can cause burns. It is therefore essential to wear the appropriate Personal Protective Equipment (PPE) as indicated in Appendix 1.

It must be easy and safe to get in and out of the sampling area. It should also have adequate lighting.

Local site specific instructions must always be followed. If in doubt, ask the site representative.



Bitumen sampling point.

In line sampling valves

In this case sampling valves are placed in the pipe and are used to take a sample directly from the bitumen flow.

Samples must be taken after the bitumen product has flowed through the pipework. This will heat the sample valve and clear any bitumen plug residue.

Dip sampling

If unavoidable, dip sampling should be risk assessed and the potential risk of high concentrations of hydrogen sulphide (H_2S) should be taken into account. A Personal Dose Monitor (PDM) for the operators should be considered due to the risk of H_2S exposure.

Labelling of samples

Always fill in the label on the sample container with the following information:

- date of sampling
- delivery depot/place of sampling
- delivery note number
- receiving tank
- sampler's signature.

Handling and storage



Storage of bitumen

All bitumen products should to a certain extent be regarded as perishable goods as their characteristics change when stored for long periods at varying temperatures. This applies especially for packaged liquid bitumen products, which therefore can only be stored for a limited period.

Correct storage temperature of bitumen products will guarantee product quality in the final application. From a quality perspective it is therefore essential that the product is handled correctly. Bitumen is a construction material and should be handled accordingly.

Bitumen should be stored in well insulated tanks. This will reduce the need for extra heating, which in turn will reduce heating costs. The temperature of the heating source can also be kept lower so that the bitumen will not be unnecessarily exposed to excessive contact temperatures. Please note that bitumen at the bottom of a storage tank can have a considerably higher temperature than in other parts of the tank unless it is properly agitated.

If the bitumen is overheated locally, deposits may be produced. These deposits appear on heating coils and other inner parts of storage tanks. After a while such deposits may fall off and interfere with pumping or mixing actions.

For the selection of a product's storage temperature please refer to the bitumen handling temperature recommendations given in Appendix 6. In the case of specialty products please refer to the manufacturers' recommendations.

Care should be exercised to ensure that the temperature at the bottom of an empty tank does not become so low so as to allow water to condensate.

An empty cold tank should initially be filled up gradually. This will give any remaining moisture time to evaporate. For tanks containing cold bitumen, heating should be carried out at a low level until the bitumen temperature has reached 120 °C. This enables moisture to evaporate before hot bitumen is added to the tank. It is important that bitumen covers the heating tubes when heated.

It is recommended to fill tanks in three stages allowing the temperature in the tank to equilibrate each time one third has been loaded.

Packaged bitumen, for example in drums, is not as likely to be affected by oil or contaminants as is bitumen in bulk. Nevertheless, packaged bitumen should be stored carefully. The warmth of the sun can cause the light components in the product to vaporise and form bubbles when the packaging is damaged. These bubbles can contain flammable vapours.

Oxidation

The characteristics of bitumen products can change when stored for prolonged periods at high temperatures. Bitumen will gradually harden. The penetration, a measure of the bitumen's hardness, may decrease. The hardening process will increase when higher storage temperatures are used and will be worse in partly full tanks where more air is present.

There is a possibility that flammable atmospheres can be generated. Pyrophoric deposits can also be formed. For this reason controlled oxygen depletion is recommended. Continuous purging of the tank vapour space is not recommended because it can promote the formation of pyrophoric deposits. Oxygen concentrations between 4 % and 6 % are normally sufficient to prevent the build up of deposits.

If the tank has been operated under controlled oxygen depletion then any potentially flammable vapours should be displaced, for example with nitrogen before air is allowed to enter the tank, e.g. cooling before maintenance.

Mixing

In some cases it is necessary to blend different grades of bitumen. Such blends seldom become homogeneous if they are not stirred mechanically or blended through an in line blender. Mixing by means of air is not advisable for bitumen products since this will result in an oxidation process. The mixers should be activated occasionally in order to maintain the proper temperature and quality of a tank's contents.



Electric driven agitator side mounted on a bitumen storage tank.

Tank construction and inspection

The construction, equipment and inspection of storage tanks for oil products in general should follow the API standards 650 'Welded steel tanks for oil storage' and 653 'Tank inspection, repair, alteration and reconstruction' and any additional local standards such as the latest 'Bitumen Safety Code (model code of safety practice)' provided by the Energy Institute.

For bitumen product tankage inspection by an independent inspection company is not necessary. Inspection can be handled locally in a self administered programme.

It is recommended that new tanks are inspected after 20 years. Tanks older than 20 years should be inspected every 12 years.

Inspection can be more frequent, e.g. if corrosion has been detected. This evaluation can be done by local expertise on site or in cooperation with Nynas.

A bitumen tank can also be equipped with an inert gas blanketing system to prevent tank breathing, which allows moisture and oxygen getting into the tank.

It is recommended to have a safety shower positioned at a minimum distance of 6 m, but no further than 20 m from the location bitumen is unloaded. For more information on safety showers, see 2.2.

For information about tank entry, see 4.7.



Venting pipes and other attachments

Pipework should comply with local regulations and standards and should be as vertical as possible and minimise acute bends. If the pipework is required to be longer than necessary or is in exposed locations, insulation and additional heat tracing of the pipework are required. The inlet should be between 0.5 m and one metre from ground level and be fitted with a specialist flange fitting.

If the line is full and the inlet line is lower than the bitumen level then syphoning will take place.

It is recommended to have independent low, high and ultra high level alarms installed on bitumen storage tanks.

Ventilation outlets from the tank headspace should be placed so that human exposure to hydrocarbons and hydrogen sulphide (H_2S) is minimised.

Bitumen and bituminous solutions are stable substances that do not tend to corrode metal surfaces they are in contact with. However, vapours from the tank's headspace constantly move in and out through the vent pipes during storage depending on weather conditions and other factors. The tank breathes, which causes a continual mixing of air, moisture and hydrocarbons. This mixture is corrosive.

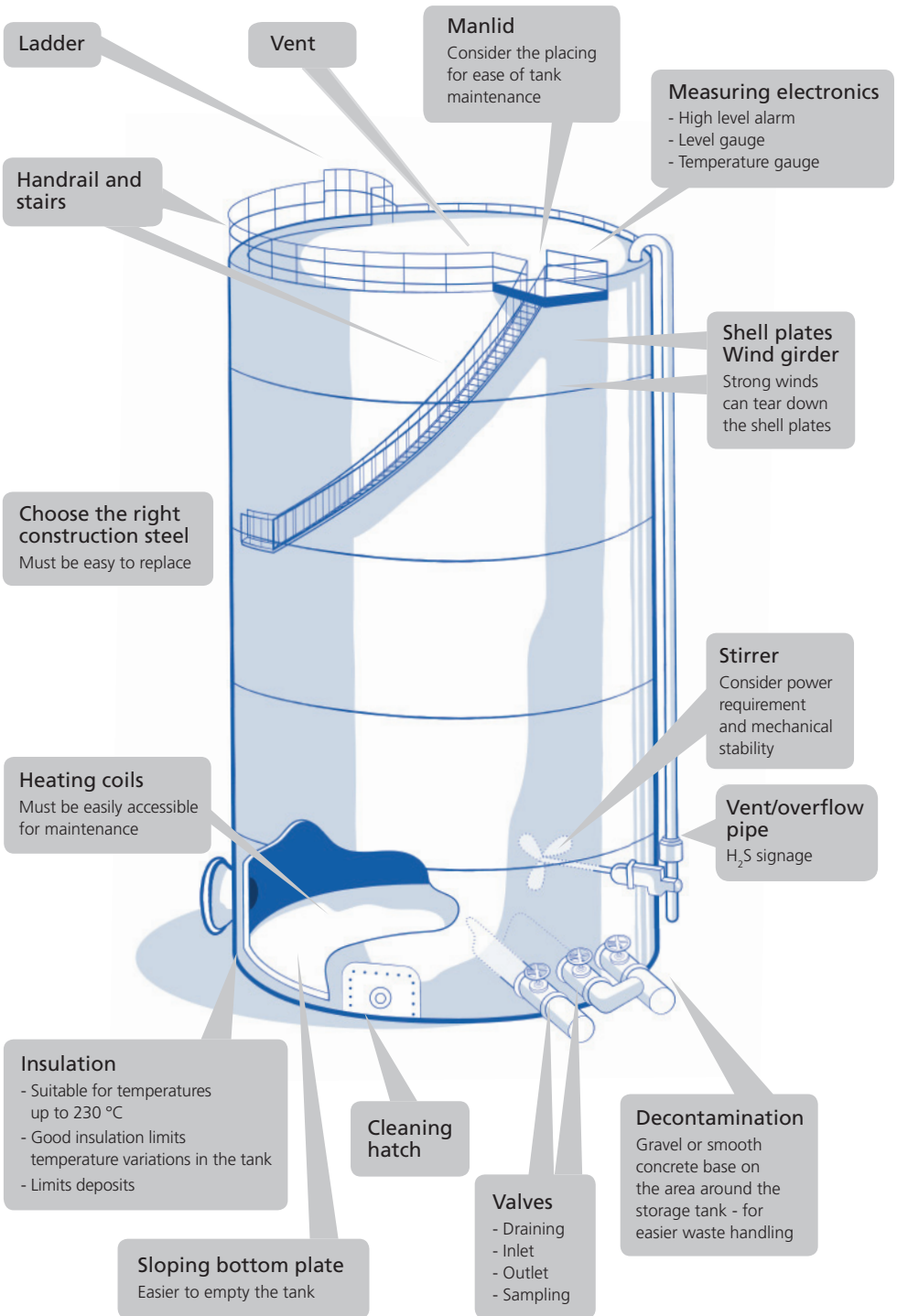
Coke deposits can also be formed in vent pipes and cause a harmful over - or under - pressure inside the tank. This applies especially to tanks containing oxidised bitumen.

Storage tanks for bitumen emulsions are normally not affected by the product.

Damage to a tank's pipework and equipment can be prevented through regular inspection and an adequate preventive maintenance programme.

Special attention should be paid to the inlets through the insulation because pitting may occur there. Bitumen leakage and condensation of oil mist between the tank plate and insulation is a frequent cause of fire. It is important to replace contaminated insulation as soon as possible!

Bitumen storage tank requirements



Cleaning and emptying of tanks EU Directive – UK Confined Space Entry Regulations

Bitumen deposits created by the oxidation process can often be found in storage tanks with a high storage temperature or uneven temperature distribution. Therefore, tank cleaning should be part of a regular maintenance programme taking into account the tank's history and the applicable local legislation.

When emptying a storage tank it is essential to be familiar with the layout of the bottom of the bitumen tank; the way in which the heating coils are constructed; and how conduits are connected.

The tank is normally heated to the highest temperature the product allows for storage before the content is pumped out. Draining of the final section should be done slowly to allow the bitumen sufficient time to flow and prevent tank implosion.

When a tank is taken out of service always ensure that the tank's temperature is below 40 °C before opening the manhole for ventilation. When the tank has more than one manhole, the lower one should be opened first.

Before personnel can enter the tank, the tank should be ventilated and gas tests should be performed in order to guarantee a safe work environment (with safety permit system/ checklist for work in confined spaces in place).

Bitumen residue that cannot be pumped out or washed out with oil while it is warm is usually allowed to solidify and must be chiselled away. Product remnants should be disposed of in compliance with local and national regulations. Recycling is always recommended.



Cleaning activities inside a storage tank.

Tanks for soft bitumen, bituminous cutbacks and bitumen emulsions can normally be cleaned through successive mixing of the residue with solvent. However, care must be taken to ensure that the temperature is always kept below the flash point of the mixture.

Whenever products are changed in large installations the pipework must be emptied. This can be done by flushing in several stages, which will ensure that only traces of the previous product will remain in the piping system.

Appendices



Appendix 1 - Personal Protective Equipment (PPE)

For all tasks involving bitumen handling, a task Risk Assessment should be performed detailing the required PPE for the associated task.

PPE should be used when working with bitumen and should cover all parts of exposed skin to avoid direct contact.

1. Loading and unloading

Always use:

- a safety helmet **1** and visor **2**.
Eye goggles do not give full face protection
- a neck apron to protect the back of the neck **3**
- coveralls with additional high visibility **4**
- heat resistant gauntlets/gloves **5**.
Ensure that no bitumen can run into the gloves (see latest Eurobitume documentation)
- one piece protective coveralls **6** with **7**
long sleeves and legs worn over rigger-style boots
- safety footwear, calf length **8**.
No shoes, sandals, clogs or trainers.

NOTES:

During loading and discharging it is recommended to wear well fitting long sleeved gauntlets (see picture).

In general, there may be additional PPE requirements from local sites, e.g. Personal Dose Monitor (PDM) for hydrogen sulphide (H₂S) during loading operations and lone worker alarm.



2. Product handling and sampling

Always use:

- lab coat or coveralls
- safety glasses
- protection gloves.

NOTES:

If close fitting wristlet gloves are used, the cuffs should always be worn inside coverall sleeves. As mentioned before, it is important to perform a Risk Assessment detailing the PPE needed for the associated task.

Always follow any site specific laboratory and technical procedures and requirements.

Appendix 2 - ADR regulations

Transport containers (tankers)

Trucks used for bitumen transport should fulfil the technical specifications in the countries where they are to be used.

Furthermore vehicles and tanks must fulfil the demands of the ADR/RID/ADN/IMDG* legislation.

Bitumen tanks should be constructed and should function in such a way that the risk of injuries is reduced to a minimum and the product retains its quality, homogeneity and temperature during transit.

It is essential that tankers are constructed in such a way that they can be completely emptied. (In the UK this is done by means of dump valves. Air is released from the trailer air suspension and this in turn lowers the rear air suspension). This is also the reason why road/railway tanks used for bitumen transportation nowadays are now built with a completely smooth interior.

ADR legislative requirements should be followed for tank manufacture with regard to metal type in order for them to endure high temperatures and large temperature changes. The tanks should be well insulated to maintain the temperature of the product for as long as possible. Some tankers are equipped with heating. Equipment is chosen according to the geographical area of transportation and the type of product handled.

Labelling of vehicles according to ADR regulations

The information in this section describes European and UK marking requirements.

Dangerous goods have been divided into nine different classes.

Within this classification each product is assigned a UN number, packaging group and a safety label code.

Bitumen is classified as dangerous due to its high transport temperature (> 100 °C, below its flashpoint). Also the low flash points of cutbacks may imply classification as dangerous goods.

Bitumen is classified as follows:

- UN 3257, ELEVATED TEMPERATURE LIQUID, N.O.S. at or above 100 °C and below its flash point (bitumen)
- Class 9
- Packaging group III
- Classification code M9.

* see section 14 of Safety Data Sheets (SDS)

For European journeys the marking and labelling for bitumen.



Front and rear



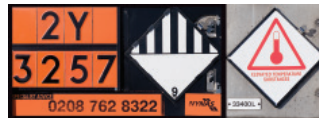
Rear and both sides



For UK domestic journeys the marking and labelling for bitumen.



Front



Rear and both sides



Appendix 3 - Bitumen loading checklist

This is not an extensive list, but can be used as an example to formulate questions on site and address specific requirements for loading bitumen vehicles.

BEFORE LOADING	
1. Vehicle owner	
2. Vehicle number	
3. Load order number	
4. Product required	
5. Last load	
6. Same product (compatible)?	yes - go to number 9/no - cleaning is required
7. Other product (non compatible)?	yes/no
8. Is cleaning required?	yes/no
9. Is tank dry, empty and clean?	yes/no
10. Is procedure loading required?	yes/no
11. Tank/barrel capacity	
12. Number of compartments	
13. Can tank/barrel carry requested amount?	yes/no
14. Are all tank/barrel valves closed shut?	yes/no
15. Vehicle correctly labelled?	yes/no
16. Correct product temperature?	yes/no

AFTER LOADING BUT BEFORE LEAVING	
Delivery note	
Instructions in writing (ADR 4 Page requirement) (Hauliers responsibility)	
Additional information to the ADR 5.4.3 Instructions in Writing	<i>Nynas has additional information sheets for transporters for ADR 5.4.3. in 11 different languages.</i>
Special directions / instructions (if applicable)	
Necessary transport documentation on board	yes/no

Appendix 4 - Bitumen unloading checklist

BEFORE UNLOADING	
Contact with customer's representative?	yes/no
Check that the load corresponds to order	
Is the receiving tank number and labelling correct?	yes/no
Is there enough space in the receiving tank?	yes/no
Customer signature for ullage	
Correct connection for unloading?	yes/no
Is all emergency equipment working?	yes/no
Are high level alarms and tank gauges working properly?	yes/no
Is a safe exit route available?	yes/no

The bitumen industry in the UK use the Bitumen Discharge Permit (BDP), which must be completed before the delivery can proceed.

Appendix 5 - Eurobitume Bitumen Burns Card

Please check for updates of this card at www.eurobitume.eu



BITUMEN BURNS

INFORMATION NOTE FOR FIRST AID AND MEDICAL PERSONNEL

All persons working with hot bitumen should be familiar with these recommendations in order to administer first aid to burn victims.

This document should accompany the patient and be placed in a prominent position before transport to a Doctor or Hospital.

FIRST AID

Bitumen burns should be cooled for at least 15 minutes, first with cool water to reduce pain, then with warm water to prevent hypothermia if the burned surface is larger than the size of a hand. Burns to the eyes should be irrigated for at least 5 minutes.

**NO ATTEMPT SHOULD BE MADE TO REMOVE
THE BITUMEN AT THE WORKSITE**

MEDICAL CARE

(if in doubt do not hesitate to contact a burns centre)

Measures to remove the bitumen layer from the skin should be taken as soon as possible under the supervision of a doctor, or at a hospital. However, this treatment should be carried out with caution because careless removal of the bitumen may result in the skin being damaged further, bringing with it the risk of infection and the possibility of complications.

Initially it is not important to know whether the burn is superficial or deep. The priority should be to remove the bitumen without causing further damage.



BITUMEN BURNS

REMOVAL OF BITUMEN ADHERING TO THE BURNED AREAS

Different methods can be recommended:

- The bitumen layer should be left in place and covered with thick gauze containing paraffin or a paraffin-based antibiotic cream, e.g. Flammazine (silver sulphadiazine). Such treatment will have the effect of softening the bitumen, enabling it to be gently removed after a few days.
- Alternatively, olive oil (new bottle) should be applied and left to soak the affected areas for a few hours. Thereafter the bitumen can be removed by rubbing gently with some gauze. Any remaining bitumen can be removed by wrapping the affected areas with gauze soaked in olive oil. The dressing should be changed every 4 hours. After 24 hours any remaining bitumen can be removed and the burn may be disinfected and treated conventionally.

CIRCUMFERENTIAL BURNS WITH TOURNIQUET EFFECT

When bitumen completely encircles a limb, or other body part, the cooled and hardened bitumen may cause a tourniquet effect due to oedema (swelling) in the burn. In the event of this occurring the bitumen must be softened as soon as possible and/or split to prevent restriction of blood flow.

EYE BURNS

No attempt should be made to remove the bitumen by unqualified personnel. The patient should be referred urgently to an ophthalmologist or hospital with an ophthalmology unit for diagnosis and appropriate treatment.

Eurobitume has made considerable efforts to compile this publication on the basis of reliable sources. More specifically this publication was established with the assistance of Professor Stan Monstrey, Head of Burns Unit of the Academy Hospital of Ghent (Belgium) and Jean-Pierre Arnould, Chief Executive officer of the Belgian Burns Foundation and reflects the prevailing opinions in medicine on 13/06/2013.

Neither Eurobitume nor any company participating in Eurobitume can accept liability for any loss, damage or injury whatsoever resulting from the use of this information.

Eurobitume would like to thank Professor Stan Monstrey and Jean-Pierre Arnould for their contribution in compiling this guide.



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Appendix 6 - Bitumen storage and handling temperatures (as recommended by the Energy Institute)

The table gives an overview of best practice* for handling each grade:

PAVING GRADE BITUMEN

		10/20	15/25	20/30	30/45	35/50
Minimum pumping temperature	°C	150	145	140	130	130
Typical storage temperature	°C	175 - 190	175 - 190	165 - 185	160 - 180	155 - 175
Maximum handling/storage temp	°C	200	200	200	200	200

PAVING GRADE BITUMEN

		40/60	50/70	70/100	100/150	160/220
Minimum pumping temperature	°C	125	125	120	115	110
Typical storage temperature	°C	150 - 170	145 - 165	140 - 160	135 - 155	130 - 150
Maximum handling/storage temp	°C	200	200	190	190	190

PAVING GRADE BITUMEN

		250/330	330/430	500/650	650/900
Minimum pumping temperature	°C	100	95	90	85
Typical storage temperature	°C	125 - 145	120 - 140	115 - 135	110 - 130
Maximum handling/storage temp	°C	190	180	170	160

OXIDISED BITUMEN

		R&B < 100 °C	R&B > 100 °C
Minimum pumping temperature	°C	r&b + 80	r&b + 90
Typical storage temperature	°C	200 - 220	210 - 230
Maximum handling/storage temp	°C	230	230

SOFT BITUMEN

		V1500	V3000	V6000	V12000
Minimum pumping temperature	°C	60	65	70	80
Typical storage temperature	°C	80 - 130	85 - 135	90 - 140	100 - 150
Maximum handling/storage temp	°C	130	140	150	150

* Based on guidance from the Energy Institute

Minimum pumping temperature

This indicates the minimum temperature at which the bitumen reaches a suitable viscosity for pumping, typically related to 2 000 mPa.s.

For normal operations, temperatures 10 °C to 50 °C in excess of these may be selected to facilitate transfer or blending operations, but the maximum safe handling temperature must not be exceeded.

Typical storage temperature

A range is given for each grade. These cover the typical temperatures used for storage of the bitumen and are consistent with achieving realistic loading rates and delivery to customer storage tanks. The period during which bitumen is stored and circulated at elevated temperature should be minimised to prevent hardening. If the bitumen is to be stored for an extended period without addition of fresh material, the temperature should be reduced to approximately 20 °C to 25 °C above the softening point with circulation stopped. When reheating the process must be carried out carefully to prevent localised overheating and operating problems.

Maximum handling/storage temperature

The recommended maximum storage and handling temperatures are based on generally satisfactory experience for storage in contact with air subject to avoidance of flammable atmospheres in the vapour space of the tank.

The maximum handling and storage temperatures vary according to bitumen grade, but the recommended maximum for paving grade bitumen is 200 °C. For other grades please refer to the appropriate Safety Data Sheets.

Appendix 7 - Glossary

API	American Petroleum Institute
BDP	Bitumen Discharge Permit
CLP	EU regulation 1272/2008 on Classification Labelling and Packaging of substances and mixtures
Concawe	CONservation of Clean Air and Water in Europe. The oil companies' European association for environment, health and safety in refining and distribution
DNEL	Derived No Effect Level
ECHA	European Chemical Agency
Eurobitume	The European Bitumen Association
FPC	Factory Production Control
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
Hazard	The potential to cause harm
IARC	International Agency on Research on Cancer
OEL	Occupational Exposure Limit
PAHs	Polycyclic Aromatic Hydrocarbons
PDM	Personal Dose Monitor (H ₂ S)
PPE	Personal Protective Equipment
ppm	parts per million
REACH	EU regulation 1907/2006 on Registration Evaluation Authorisation and Restriction of Chemicals
Risk	The likelihood of harm
SDS	Safety Data Sheet
TWA	Time Weighted Average

Appendix 7 - Glossary

Management system standards

ISO 9001	is a global quality management standard. ISO 9001 applies to all types of organisations. It can help both product and service organisations achieve standards of quality that are recognised and respected throughout the world.
ISO 14001	is an environmental management standard. It specifies a set of environmental management requirements for environmental management systems. The purpose of this standard is to help all types of organisations to protect the environment, to prevent pollution and to improve their environmental performance.
ISO 50001	is an energy management standard. The standard specifies the requirements for establishing, implementing, maintaining and improving an energy management system. The standard aims to help organisations continually reduce their energy use, and therefore their energy costs and their greenhouse gas emissions.
OHSAS 18001	is an occupational health and safety management standard. It defines a set of occupational health and safety (OH&S) management requirements for occupational health and safety management systems (OHSMS).
CE Marking	<p>CE Marking is a legal requirement to place bitumen - for use in paving applications - on the EU market, except in those countries where CE Marking is optional to date.</p> <p>CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the Construction Products Directive of the European Union and indicates that the product complies with the relevant national standards transposing the harmonised European standards and that all the tasks linked to attestation of conformity have been completed.</p> <p>CE Marking is not a mark of origin.</p> <p>CE Marking is the evidence of conformity to the requirements described in the harmonised product standards.</p> <p>CE Marking is only possible for those products for which a harmonised European product standard is available.</p>

Appendix 7 - Glossary

The manufacturer must have a system of Factory Production Control (FPC) in place. FPC has a set of procedures, inspections and tests to control and ensure the quality and properties of the finished product. The FPC system covers all manufacturing sites for which CE Marking is required.

External auditing is performed by a certified body whose task is to check that the quality systems and documentation comply with the requirements of Annex ZA in the product standard, by visiting the location and examining the relevant processes, records etc.

Other

Air-rectified bitumen	Bitumen that has undergone a mild degree of air-blowing for adjustment of the physical properties. Penetration index ≤ 2.0 .
Severely oxidised bitumen	Bitumen products that have undergone intensive air-blowing, in some cases with the presence of a flux. Penetration index > 2.0 .
Hazardous substances	Substances that, following exposure, can have an adverse effect on health. Examples of hazardous substances include poisons, substances that cause burns or skin and eye irritation and substances that may cause cancer.
Dangerous goods	Substances or articles that, because of their physical, chemical (physicochemical) or acute toxicity properties, present an immediate hazard to people, property or the environment. Types of substances classified as dangerous goods include explosives, flammable liquids and gases, corrosives, chemically reactive or acutely (highly) toxic substances.

Appendix 8 - References

Concawe publications: www.concawe.eu

Echa publications: www.echa.europa.eu

Eurobitume publications: www.eurobitume.eu

Nynas publications: www.nynas.com

Information relating to ADR/RID/ADN legislation is available on the UNECE Transport Division website page www.unece.org/trans/danger/danger

Information relating to IMDG legislation is available on the website page or www.imo.org/publications

Safe Handling of Bitumen

www.nynas.com

