

GUIDELINE FOR SAFETY IN THE HANDLING OF FLAMMABLE LIQUIDS

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Replaces the July 2004 edition

1. Purpose

Purpose of present Guideline is to specify conditions for the safe handling of flammable liquids.

2. Field of application

All flammable liquids handled in coatings and printing inks manufacturing sites, as raw materials, finished products or others. This guidance applies to flammable and highly flammable liquids, unless specified otherwise.

3. Definition

3.1 Flammable Liquids and Highly Flammable Liquids

3.1 a according to EU legislation, flammable liquids have a flash point between 21 and 55°C

3.1 b according to EU legislation, highly flammable liquids have a flash point below 21°C

3.2 Lower Explosion Limit (LEL)

The lower explosion limit is the lowest concentration of vapour in air at which the vapour/air mixture is flammable.

3.3 Upper Explosion Limit (UEL)

The upper explosion limit is the highest concentration of vapour in air at which the vapour/air mixture is flammable.

3.4 Flash Point

Flash point is the temperature to which a liquid must be heated before it will produce a flammable mixture of vapour in air that will ignite when an ignition source is applied.

4. Safety measures

List of safety measures of technical and organisational nature that have to be taken in order to ensure the safe handling of flammable liquids:

4.1 Road Tanker transfers

- In a transfer operation involving a road tanker, a temporary earth connection should be made using a clamp to the vehicle before commencing;
- During transfer operations of flammable liquids with conductance below 50 pS/m ($5 \cdot 10^{-11}$ S/m) (for example hydrocarbons) the initial linear velocity should be kept below 1 m/s. After this the pumping rate could be increased to 7 m/s.

4.2 Sampling

- a. The equipment for sampling should be of metal or antistatic material e.g. natural fibre and be earthed;
- b. Sampling of flammable liquids should not be carried out in extreme adverse weather conditions (for example snow or hail storm or during a thunderstorm).

4.3 Storage tanks and pipelines

- All metallic part of storage tanks and pipelines should be earthed and bonded;
- Bonding ensures that all the plant is at the same potential.

It is important to note that the earthing approach does not prevent the generation of static electricity but helps to eliminate the charges built during handling and helps to avoid their discharge as sparks.

4.4 Manufacturing operations

- a. If practically possible, keep solvent vapours below the lower explosion limit (LEL) by working at least 15 to 20°C below the flash point, ensuring adequate ventilation or reducing the amount of flammable liquid e.g. by substitution with a liquid of higher flashpoint or a non-flammable liquid. This applies also to the choice of cleaning solvents;
- b. Inert gas or equivalent measures (e.g. reducing oxygen content, fully closed system) may be used in fixed vessels, provided that oxygen level is kept consistently below 8%;
- c. Free fall of liquids should be avoided.

- It is recommended that liquids be added by directing the flow along the container's wall or, if adding by pump, filling them under the surface of the liquid or close to the bottom of the vessel;
- d. Ensure that the floor of the building/work area is conductive ($< 10^8$ Ohms) and that coating or insulating deposits such as paint or ink spillages are not present;
 - e. Containers e.g. pails, drums, should be fitted with a lid when not being used directly;
 - f. Shrink or stretch wrapping should be removed outside of the production area. If production area is classified as ATEX zone 1 or 2, it is compulsory to remove shrink or stretch wrapping outside;
 - g. Plastic sheets covering vessels should be antistatic;
 - h. Ensure that plastic bags containing raw materials are not insulating, unless the bags are emptied outside of the production area;
 - i. Care should be taken when adding powder and beaded resins to a flammable atmosphere to avoid the build-up of electrostatic charges (the feeding speed should not exceed 60 kg/mn).

4.5 Loading and filling operations

- a. In a filling operation involving a road tanker, a mobile or intermediate vessel, a temporary earth connection has to be ensured; take particular attention in the case of road tankers because of the resistance to earth of lorry tyres;
- b. All pipelines should be made of conductive material and should be earthed and bonded. Periodically conduct a check of the state of this equipment;
- c. During loading operation the initial linear velocity of flammable liquids with conductance below 50 pS/m ($5 \cdot 10^{-11}$ S/m) should be kept below 1 m/s. After this the pumping speed could increase up to 7 m/s;
- d. In order to have safe conditions the linear velocity (V) has to be kept in a range such as its value remains between 1 and 7 m/s depending on conductance of the liquid;
As an alternative the flow rate (m^3/s) divided by diameter (m) should be in the range between 0.3 and 0.4;
- e. If a fine filter is used the static charge must be allowed to dissipate before the flow reaches the discharge/filling point. Keep the filter clean to maintain its dissipative properties;
- f. Low flash point liquids should not be filled into plastic containers. If plastic containers are used, these should incorporate anti-static features and should be earthed so as to prevent the build-up of electrostatic charges;
- g. The use of compressed air or water for line clearance of products with low flash point should be avoided;
- h. Pay particular attention to containers/tanks without maximum level alarms to ensure that overflow can not occur;
- i. Pay particular attention to vessels without minimum level alarms in order to avoid pump dry running;
- j. For manual filling of pails and drums, the use of dead-man valves is recommended.

4.6 General

- a. Addition of antistatic agents or equivalent measures may be applied to non conductive liquids ($< 10 \text{ pS}$ (10^{-11} S), see Annex 1) or liquids that can accumulate static electricity in order to reduce the risk;
- b. All electrical equipment used in solvent service must be explosion proof ('EX' marked);
- c. Forklift trucks lifting flammable liquids should be explosion proof ('EX' marked depending on the ATEX zone and risk assessment);
- d. All equipment should be made of conductive material. The use of plastic funnels, paddles, pails etc should be avoided. Wheels for mobile equipment such as trolley and vessels should have at least on conductive wheel. During mixing or transferring operations use only equipment made from material which can dissipate static electricity;
- e. Operating instructions should be in place to manage all operations regarding flammable liquids and to regularly check equipment requirements in relation to earthing resistance and electrical conductance of hoses;
- f. It is recommended to check annually the efficiency of the earth bonding system;
- g. Operators must be trained to understand the characteristics of the flammable liquids and safe handling of them. This applies also to contractors;
- h. Eliminate sources of ignition:
 - i. Do not smoke, weld, or use naked lights
 - ii. Work permit procedures must be followed with due diligence
 - iii. Use explosion-proof equipment
 - iv. Eliminate hot spots
 - v. Minimise the risk of static electricity;
- i. All workers should wear working garments made from antistatic materials as well as dissipative safety shoes (between 10^5 and 10^8 ohms);
- j. Ensure that in the case of a fire alarm activating, solvent pumps as well as solvent vapour exhaust extraction systems automatically shut down;
- k. Fire detection and fire extinguishing systems are recommended;
- l. Good ventilation should be ensured to minimize formation of flammable atmosphere. Six air exchanges per hour should be provided for manufacturing processes;
- m. Ensure that earthing clamps penetrate any insulating coating on containers.

Disclaimer: This guideline does not supersede any regulation in force.

ANNEX 1

Solvents conductance

Solvent	Conductance (S/m)
Citrosolv	
Hexane	$1 * 10^{-17}^2$
Isopar E	$3,0 * 10^{-12}^3$
Octane	
Heptane	$1 * 10^{-14}^2$
Xylene	$1 * 10^{-13}^2$
Solvesso 150	$1,0 * 10^{-9}^3$
Toluene	$8 * 10^{-14}^1$
Solvesso 100	$1,0 * 10^{-9}^3$
Solvesso 200	$2,0 * 10^{-9}^3$
Cyclohexane	$2,0 * 10^{-12}^2$
Pinewood oil	10^{-12}^1
n-Butylacetate	$1,12 * 10^{-8}^2$
Ethyl acetate *	$4,6 * 10^{-8}^2$

Sources:¹ BGR 132² Britton³ BASF AG