

# Guidelines for Safe Degassing of Rail Tank Cars



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TABLE OF CONTENTS

- 1. INTRODUCTION AND SCOPE ..... 3
- 2. SAFETY MANAGEMENT SYSTEM ..... 4
- 3. DEGASSING FACILITIES ..... 9
- 4. DEGASSING OPERATIONS ..... 11
- 5. GAS TESTING ..... 15
- 6. TANK ENTRY ..... 16
- 7. PREPARING A RAIL TANK CAR FOR DEPARTURE ..... 21
- 8. GLOSSARY..... 22

Disclaimer

This document is intended for information only and sets out guidelines for safe degassing of rail tank cars. The information contained in these guidelines is provided in good faith and, while it is accurate as far as the authors are aware, no representations or warranties are made about its completeness. It is not intended to be a comprehensive guide to all detailed aspects of safe degassing of rail tank cars. No responsibility will be assumed by CEFIC in relation to the information contained in these guidelines.

## 1. INTRODUCTION AND SCOPE

In Europe, degassing of Rail Tank Cars (rtc's) is mostly done at rtc workshops and not at specialised cleaning stations. Workshops offer this activity as an extra service to their customers.

The degassing operations and associated activities like tank entry and nitrogen purging, are hazardous activities which require the right equipment, skilled personnel, detailed procedures and, above all, a proper safety management system.

The scope of this document includes:

- Degassing (gas freeing) of rtc's containing flammable gases (LPG, propylene, butadiene, C4 mixtures...)
- Testing the rtc atmosphere during and after degassing
- Tank entry after degassing
- Nitrogen purging
- Labelling and marking of rtc's, degassed or to be degassed

Some elements of this guideline can also be used for other products example: tank entry, nitrogen purging, labelling, etc

These guidelines are aimed at advising rtc workshops in order to perform these activities in a safe way.

## 2. SAFETY MANAGEMENT SYSTEM

### 2.1 Safety Policy

A strong safety culture is only possible if the management is committed to safety and if this is reflected in the daily operations. It should be clear to all personnel that the management wants to maintain a safe work environment. Safety should be the first priority in all circumstances.

Therefore a written safety policy should be established which should include:

- A statement which clearly articulates the company's safety objectives and goals and the management's commitment to achieve these.
- A clear description of duties and responsibilities of employees at all levels in order to ensure a maximum level of safety and occupational health in the organization.

Roles, duties, responsibilities and accountabilities, related to safety, of every individual in the organization should be clearly identified.

The policy should be endorsed by the Chief Executive Officer of the company to demonstrate commitment of top management.

The policy should be publicized (e.g. displayed at the workplace) and understood by all staff and external contractors.

The policy should be reviewed and revised (if necessary) on a regular basis.

### 2.2 Safe operating procedures and risk assessments

For all activities, safe operating procedures (SOP's), ensuring the safety of work, should be developed and implemented.

Before doing this, risk assessments should be conducted in order to identify all potential hazards.

For example, following risks should be assessed:

- moving rtc's in the degassing area
- release of gas, health hazard, fire and explosion risk
- line systems under pressure
- flashback of flame into the rtc
- use of mechanical tools (creating sparks)
- entry into rtc's (asphyxiation, explosion hazard)
- working at height
- noise
- high temperature (steam,...)

There are several methods to identify the risks. One of these is the Fine & Kinney method:

- For each risk the following factors should be determined and a rating should be given:
  - Probability of occurrence (from "virtually impossible" till "will certainly happen" - from 0,1 to 10).
  - Severity of the effect (from "first aid" till "fatality" - from 1 to 100).
  - Exposure (from "very rarely" till "permanently" - from 0,5 to 10).
- The risk is the product of these 3 factors.
- After determining the risks, the control measures, actions and residual risks should be identified.

French regulations require to establish (and keep up to date) the 'Document Unique' as a system to identify and mitigate the risks of all operations.

All SOPs should be clearly written in an easy-to-understand format and should be effectively communicated. The appropriate persons should receive adequate briefing and training on these SOP's. All SOP's should be readily available to all personnel concerned.

SOP's should be reviewed regularly and revised, if necessary.

For some activities like tank entry and hot work, a Permit To Work system should be used.

### 2.3 Training

The training needs of each function need to be identified and a training programme should be implemented to provide all employees with the required skills and knowledge to carry out their job safely and effectively. The training status of each individual employee should be recorded.

The training programme shall cover as a minimum:

- The degassing operations (installation, safety systems, local permit, work procedures...)
- The handling of dangerous goods
- The risks of dangerous goods
- Labelling and marking of rtc's
- Use of Personal Protective Equipment
- Permit To Work system
- Entry into confined spaces
- Gas testing (oxygen content, explosion limits...)
- Emergency procedures
- Fire fighting
- First aid
- Incident and near miss reporting

Refresher trainings should be organised at regular intervals but at least every 3 years.

### 2.4 Safety meetings

Regular safety meetings should be organised. Employees at all levels should be encouraged to participate in the discussion of safety and health issues arising from the workplace.

Matters discussed in these safety committee meetings should be recorded and communicated to all personnel.

Tool-box meetings should be organised at shift or section level.

Safety reminders and warnings, safety precautions, DOs and DON'Ts and other relevant safety information should be made available to the employees concerned.

## 2.5 Reporting of incidents

All incidents should be properly investigated and effective measures should be taken to prevent recurrence.

There should be written procedures which should include the criteria for the degree of seriousness of incidents to be formally investigated in order to determine the root causes.

A system should be in place to ensure that the recommendations are properly addressed and that the information on root causes, remedial actions and lessons learned are disseminated to all personnel concerned.

Incident statistics should be analysed to identify major problematic areas so that appropriate recommendations/measures can be taken.

## 2.6 Reporting of Near Misses and Unsafe Situations

A system should be in place to report and investigate near misses and unsafe situations.

*Near Misses and Unsafe Situations* include near miss events, learning events, unsafe conditions, unsafe acts, etc..

In order to achieve an effective reporting system, the following requirements should be met:

- All employees should be informed on what are *Near Misses and Unsafe Situations*;
- All employees should be encouraged to report Near Misses and Unsafe Situations;
- People should be encouraged to report *Near Misses and Unsafe Situations* (e.g. award 'near miss report of the month');
- The system to report should be simple and effective (e.g. write on a 'post-it'), but well documented;
- There should be a no-blame culture. Reports are intended to look for deficiencies in the system and to improve it, not to blame people;
- Make sure that the reports are analysed and that corrective actions are taken.
- Communicate back what actions have been taken;
- Close the PDCA (Plan, Do, Check, Act) loop to make sure that actions are effectively carried out.

Examples of near misses and unsafe situations:

- An event with no injury, damage or loss of containment but which, under different circumstances, could have resulted in an incident (e.g. employee nearly hit by a rail car during shunting operations)
- Not wearing the right Personal Protective Equipment
- Not using the right tools for the job
- Working at height without adequate protection
- Put wrong labels on rtc
- Use of non-calibrated gas detection equipment
- Entry into rtc without permit, without gas testing
- Not using the rail hook for opening the bottom valves
- Smoking in the degassing area
- By-passing/ ignoring safety systems (alarms, trips..)
- Etc

## **2.7 Safety promotion**

The management should establish promotional programmes that clearly demonstrate the strong commitment towards providing and maintaining a safe and healthy work environment.

Examples:

- Install a safety bulletin board in each department
- Organise in-house safety campaigns
- Display safety posters

Set up an incentive scheme to recognize and acknowledge good safety performance or recommendations by an individual or a group.

## **2.8 Evaluation, selection and control of contractors**

There should be a system for the assessment and evaluation of contractors (e.g. by means of VCA or similar assessment systems) to ensure that only competent and qualified contractors are selected and permitted to carry out works.

The selection criteria should consist of safety performance indicators (safety track records, safety management system, safety training etc...).

All written contracts should contain the safety, health and environmental responsibilities and obligations that the contractors have to comply with.

Prior to commencing the work, a safety induction should be organised.

The contractor's safety performance should be monitored and evaluated.

## **2.9 Safety tours / Spot checks / Audits**

An inspection programme consisting of periodic safety tours, spot checks and safety audits should be set up. These should be carried out by competent persons. The inspection programme should include observation of safe/unsafe work situations and behaviours. Daily routine inspections should be carried out.

The findings of the inspections should be recorded and appropriate recommendations should be communicated. It is recommended to use checklists to assist the inspection team in identifying and classifying potential hazards. Examples of unsafe behaviours/potential hazards which can be recorded as Near Misses (see section 2.6).

## **2.10 Maintenance regime**

There should be a practical maintenance regime for all equipment and tools used, to prevent accidents because of failure of this equipment and machinery.

The maintenance programme should include:

- A list of all tools, machineries and equipment. Only tools suitable for the work to be done may be used.
- An inspection and maintenance schedule
- Inspection / maintenance reports

The checklists should be reviewed at least on a bi-annual basis.

All inspection and maintenance should be carried out by competent personnel.

## **2.11 Emergency preparedness**

A written response plan for on-site emergencies should be in place.

It should include as a minimum:

- Identification of emergency situations and their impact;
- The emergency team and its responsibilities;
- Procedures for raising and notifying alarms;
- Procedures for evacuation and rescue;
- First aid;
- Procedures for involvement of (local) authorities
- Communication plan (authorities, local communities, media).

The emergency response plan should be documented and effectively communicated to all employees concerned.

An emergency response drill should be conducted at least once a year, preferably with the assistance of the local emergency services.

## **2.12 Document control and review**

All documents should be controlled, maintained and updated according to ISO 9001 standards.

### 3. DEGASSING FACILITIES

#### 3.1 Degassing area

- The degassing should take place in open air, at a remote location from the workshop, the site fence and public roads, and should specifically be allocated for this operation.
- The rail track on which the degassing takes place should not be part of a through going rail track and should be segregated from other traffic (e.g. side rail track).
- Signs to warn for the possible presence of flammable gases should be displayed at the entrance of the degassing area.
- The surface under the rtc should be horizontal, impervious, drained, with a shallow gradient to a safe place in order to collect any spillage of product residues. It is recommended to install, at the lowest point, gas detection equipment (LEL), linked to an acoustic and optic alarm. If the degassing station is not permanently manned during degassing operations, the gas alarm can be linked to a mobile phone but, as a minimum, mobile gas detectors should be used to check for leakages during connection and disconnection.
- There should be no connection with the underground drainage systems (sewers), openings to buildings (doors, windows), air intake openings or any air supply within at least 10 m around the degassing area.
- A safety device (e.g. a de-railer) should be installed to prevent other rtc's to enter the degassing area during degassing operations. It is preferred that this de-railer is interlocked (no degassing possible if the de-railer is not in place).
- Precautions should be taken to prevent the rtc moving during degassing (e.g. wheel chocks of a size suited to the maximum mass of the rtc and to the diameter of the wheel).
- An illuminated wind sock should be installed.
- Proper attention should be given to good housekeeping.
- Emissions should be prevented as much as possible, but concentrations should never be higher than allowed in the local permit and regulations on air quality.

#### 3.2 Equipment

- The degassing area should be classified according to the ATEX directive and the equipment in the degassing area should be approved for use in an ATEX area.
- The bottom valves of the rtc should be kept open by means of a rail hook with melting fuse and manual release rope which allows to close the bottom valves in case of an emergency or in case the rtc moves during the degassing operation. An electro-magnetic/electro-pneumatic system to close the bottom valves from a remote location and/or automatically in case of gas alarm is preferred. The bottom valves may NOT be kept open by another means (stone, metal bar etc...).
- Rtc's should be earthed before the hoses are connected. It is recommended to install an earth proving device to ensure that there is a good connection to the earth.
- All hoses used for degassing should be suitable and fit for purpose (pressure rating) and should be tested by means of hydraulic pressure on a yearly basis.
- If the gas is displaced by filling the rtc with water, the rtc should be placed on jacks in order to prevent overloading of the rtc springs. This does not apply when degassing is done by means of nitrogen.
- Water curtains or water sprinklers are preferred. As a minimum, a hydrant with fire hose should be located in the vicinity.
- Other general safety items which should be available and which should be regularly inspected:

- Fire extinguishers
- Emergency escape masks.
- At least one safety shower and eye wash shower.
- A first aid kit.

### 3.3 Lines and flare/incinerator

- The lines and hoses for gas, water, air and nitrogen should be properly marked with the names of products for which they can be used or with colour codes.
- If a compressed air line system is in place, which is also used for independent air supply during tank entry, the couplings of these lines should be different from the couplings used for nitrogen so that one can not connect the breathing apparatus with the nitrogen line.
- The maximum pressure of the compressed air and nitrogen used should not exceed 20 % of the test pressure of the rtc. This can be calculated by checking the tank code and dividing the number by 5 (e.g. Tankcode P26BH -> 5,2 bar).
- In order to prevent flash-back, the line to the flare should be fitted with minimum a water seal drum and a non-return valve (check valve). These should be checked/maintained on a regular basis. The water seal drum should be fitted with a side glass to monitor the water level (should be included in the checklist for de-gassing). It is preferred to fit a high and low level alarm system in the seal drum. A system should be in place to prevent freezing of the water in the drum during winter. A flame arrestor should be installed close to the flare/incinerator regardless of other flashback equipment installed in the line. The flame arrestor should be regularly inspected.
- The flare should be equipped with a flare pilot to reliably light the gases being exhausted to the flare. The flare pilot should be lighted by a flare pilot ignition system.
- The line to the flare, the compressed air line and the nitrogen line should be fitted with pressure gauges. All lines should be fitted with non return valves (check valves) to prevent back flow.
- If water is used to displace the gas, the line to the flare should be fitted with a water detector (e.g. liquiphant) which closes the valves when the rtc is full. This is to prevent that water enters into the flare.
- The main safety issue for the flaring system is thermal radiation. The location of the flare should be at a safe distance from the site operations.
- An incinerator or thermal oxidiser is preferred to a flare, because an incinerator:
  - has a higher combustion efficiency (higher combustion temperature);
  - uses an active control system to ensure that the design parameters affecting efficiency and equipment safe operation are maintained at all times during its operation;
  - can handle a wider range of gases;
  - produces no smoke;
  - will not cause ground level heat radiation.

## 4. DEGASSING OPERATIONS

### 4.1 Product information and identification of the product in the Rail Tank Car

- The company should have a list of products which are permitted (by the competent authorities) to be degassed. This list should be subject to competent authority approval. When a degassing order is received, it should be checked whether the product appears on that list.
- For each product that is allowed to be handled on site, an up to date Safety Data Sheet (SDS) should be available. It is the responsibility of the product owner (petrochemical company) to provide the Workshop with the right SDS's in the local language.
- The HSE-responsible of the Workshop has to ensure that the most relevant product info, which is needed to degas an rtc safely, is made available to the personnel. It is preferred that this info is displayed on the work order (see section 4.3).
- Before an rtc enters into the Workshop, the product in it should be identified. The order received from the customer should contain the rtc number and the previous cargo. It should be checked that the data on the customer order form, the transport document (CIM), and the info on the rtc (orange plates/ danger labels and product name on both sides of the rtc) are the same.
- Preferably, the amount of residual liquid still in the rtc should be indicated by the customer who should weigh the rtc before sending it to the workshop. Rtc's that contain more than 1 ton of liquid should not be degassed but should be sent back for discharge first (the weight of the gas phase - which may be up to 800 kg – should not be taken into account) .

### 4.2 Personal Protective Equipment (PPE).

- The minimum requirements for PPE on site should be:
  - safety shoes;
  - protective gloves;
  - safety glasses;
  - helmet
  - warning vest (e.g. EN 471) in area's where there is rail traffic.
- Depending on the task to be performed, extra PPE may be required (safety goggles, chemical resistant gloves, filter masks, independent breathing apparatus, ear protection etc...). These requirements should be indicated on the work order and the tank entry permit.
- PPE should be checked regularly in order to keep it in a clean and operable condition.
- People using breathing apparatus should have received training which is refreshed on a regular basis.
- Canisters of canister respirators should be suitable for the products the operators are exposed to. The type of filter depends on the last product in the rtc: e.g. for flammable non-toxic hydrocarbon gases (low boiling point), the type of filter usually used is AX. These filters can only be used once and have to be replaced after each use. The maximum time of use depends on the concentration of the product in the air. E.g.: For butadiene 1-3 the maximum time of use in concentrations of 100 ppm is 40 minutes!

### 4.3 Operating instructions and checklists.

- Written operating instructions for degassing should be directly accessible to the operators.
- These instructions should cover all tasks that need to be performed during the degassing operation.
- The instructions should also include the procedure for raising an alarm in case of an emergency and the tasks of the operators in the emergency response and evacuation.

- Operating instructions should be handled as controlled documents and it should be ensured that operators use the latest version.
- The use of checklists is recommended as they ensure that all checks are performed consistently.
- Degassing operators should be informed of the hazards of the product in the rtc. Therefore the work order should contain, as a minimum:

	Section in SDS (EN 1907/2006 and 453/2010) where info can be found
The product name	1
The main hazards (e.g. flammable) including health hazards (e.g. carcinogenic properties)	2
The max exposure limit values (TLV, MAC...)	8
The appropriate Personal Protective Equipment	8
The flashpoint	9
The vapour pressure	9
The danger class, the hazard identification code and UN number, danger labels (transport classification)	14
The GHS Hazard and Precautionary statements	15

#### 4.4 Inspection of the rail tank cars

Apart from the product identification, the rtc should be inspected before entering the workshop to look for damages or leakages which may cause a potential safety hazard when the rtc is on site.

#### 4.5 Preparation

- Check the rtc number, danger identification code and UN number on the rtc against the data on the work order.
- Secure the rtc (e.g. wheel chocks)
- Close the track (derailer or barrier or alternative means to prevent collisions)
- Effectively earth the rtc

#### 4.6 Degassing by filling rail tank cars with water

- Put the jacks under the rtc
- Remove the blind caps or blind flanges from vapour and liquid line
- Connect the following hoses :
  - The water hose to the liquid phase of the rtc
  - The hose to the flare with the vapour phase of the rtc
- Open the bottom valves, using the rail hook
- Open the outlet valve of the vapour phase to release the pressure to the flare

- When the pressure has dropped to atmospheric pressure, open the outlet valve of the liquid phase to add water into the rtc.
- When the rtc is full with water, disconnect the hose to the flare and drain the water from the rtc. Take the necessary precautions to avoid underpressure in the rtc. by opening the valves of the vapour phase.
- Open the manlid and all valves and test the internal atmosphere (do not enter the rtc).
- After issuing a tank entry permit (see chapters 5 and 6), drying and removal of rust residues should be done as quickly as possible to minimize the risk of corrosion and discolouration.

#### **4.7 Degassing by nitrogen purge**

- Remove the blind caps or blind flanges from vapour and liquid line.
- Connect the following hoses :
  - The nitrogen hose to the liquid phase of the rtc
  - The hose to the flare with the vapour phase of the rtc
- Open the bottom valves, using the rail hook.
- Open the outlet valve of the vapour phase to release the pressure to the flare.
- When the pressure has dropped, open the outlet valve of the liquid phase to add nitrogen into the rtc.
- After a few hours, test the concentration of the product in the tank atmosphere. This can be done by opening the outlet valve of the gas phase at the other side of the rtc or through a spool piece fitted on the outlet of the gas phase. If the LEL is **10 %** (use an IR gas tester), stop the nitrogen purging, close the valves and disconnect the hoses. Do not open the dome during and after the purging as nitrogen can create an oxygen deficient atmosphere around the dome.
- If there is no requirement to bring the rtc under air, the maximum oxygen content as required by the customer should be taken into account before completing the nitrogen purge (e.g. max 0,2 % oxygen for butadiene rtc ).
- At low ambient temperatures, it may be difficult to degas some products with a low vapour pressure. In that case, steam may be used to heat up to bottom of the rtc. The conditions under which this may be done should be clearly described in the operating procedures which have to be based on a risk assessment.

#### **4.8 Bringing the rail tank car under air (after nitrogen purge)**

- Connect the compressed air line (or ventilator) to the liquid phase of the rtc and connect to the vapour phase, a hose which is leading to open air, away from the degassing station (install preferably a sound absorber).
- Flush the rtc with air until the gas test shows: minimum 19,5 % oxygen and max 10 % LEL.
- Stop the flushing, close all the valves and disconnect the hoses
- Put new gaskets in the flanges caps of the valves and put the blind flanges/ caps back in place.

#### **4.9 Marking and labelling of the rail tank car for internal use after degassing / nitrogen purging**

- It is essential that, at all times during the stay of the rtc's on site, the condition and composition of the atmosphere inside the rtc's is known. Labels and markings should therefore be clear and unambiguous.

- After degassing, all (danger) labels and orange placards on the rtc referring to the previous cargo should be removed or hidden so that they are no longer visible. This is to avoid confusion with rtc's on site which are not degassed (see section 7.1).
- An internal document mentioning the internal condition (under nitrogen, under air, uncleaned) of the rtc and the latest test results should be fitted to the rtc. Good practice is to use documents that clearly indicate the internal condition of the rtc, supported with different colours: e.g.
  - **Air** for rtc's under air,
  - **Nitrogen** for rtc's under nitrogen
  - **Uncleaned** for rtc's under product vapours.

If a Tank Entry Permit (see section 6.2) has been issued, this document should also be displayed on the rtc.

The labelling as described in section 7.1 can also be used in addition to the documents described above.

- Repair or maintenance work should only be done on rtc's which are gas free and under air (or under inert gas if no tank entry is required). Repair or maintenance work on rtc's which are not gas free should only be allowed under very strict conditions after a risk assessment has been done and a permit for work issued. By means of the danger labels and the permit displayed on the rtc, it should be very clear, at all times, that the rtc contains an hazardous atmosphere.

## 5. GAS TESTING

### 5.1 General

- Gas testing may only be done by authorized persons nominated by the local management and who have received training in the use of the gas measuring instruments.
- Initial gas testing of the internal atmosphere in the rtc should be done from outside the rail tank car (at the outlet valves during the purging or through the dome).
- Access into a rail tank car for which no tank entry permit (see section 6.2) has been issued, should be made impossible and the rtc should be marked with warning labels.
- Warning:
  - An inert and dangerous atmosphere can be present around the open dome of an rtc under (inert) gas.
  - Most flammable gases are heavier than air: residual gases will accumulate at the bottom of an rtc and in the outlet lines.
  - Combustion (welding, heating, cutting etc...) and oxidation (rusting) can cause hazards as these processes consume oxygen or displace oxygen by the combustion products, creating oxygen deficient atmospheres. The oxygen content in a cleaned carbon steel rail tank car which is not ventilated will therefore decrease over time.
  - Even after a rtc has been put under air and found OK for entry, flammable gases can still desorb from the porous walls or from rust residues accumulated on the bottom of the rtc.

### 5.2 Measuring Apparatus and Calibration

- For measuring very low concentrations of **residual gases**, a *Photo Ionization Detector (PID)* is recommended. A PID may produce instantaneous readings and operate continuously. As an alternative, detector tubes (e.g. Dräger) can be used.
- **LEL testers based on the principle of catalytic oxidation do not work in an oxygen deficient atmosphere (< 15 %). If this type of tester is used, the oxygen should be checked before the LEL test.** A tester based on infrared can be used in oxygen deficient atmospheres (e.g. during flushing with nitrogen). As the LEL measuring apparatus is calibrated with a standard gas (e.g. propane), a correction factor should be applied if another gas has to be tested.
- In air, **oxygen** limit testers should indicate 20.8 % (the normal oxygen content in the atmosphere).
- All gas testing apparatus should be registered and periodically calibrated (recommended 6-monthly) in accordance with the manufacturer's instructions to ensure their integrity.
- Calibration due dates should be recorded and be indicated on each detector.
- All users of gas detecting equipment should be trained and certified.

## 6. TANK ENTRY

### 6.1 Risks

- Confined spaces are potentially dangerous due to substances they may contain and the nature of the activities undertaken within the space. Poor natural ventilation in these areas allows the build-up of high concentration of substances which are not usually found in breathable air.
- The following key aspects of the atmosphere inside confined spaces should be considered:
  - Low oxygen level.

Gases such as nitrogen can displace oxygen, creating an oxygen deficient atmosphere. Also welding or chemical reactions (e.g. rusting within rtc) can result in depletion of the oxygen content.

Effects of lack of oxygen are:

- The normal concentration of oxygen in air is 20.8 %.
- 15-19 %: first signs of hypoxia. Decreased ability to work strenuously.
- 12-14 %: respiration increases with exertion, increased pulse, impaired muscular coordination, perception and judgment.
- 10-12%: Respiratory further increases in rate and depth, poor judgment, lips blue.
- 8-10% mental failure, fainting, unconsciousness, nausea, vomiting, inability to move freely.
- 6-8%: 50 % probability of death within 6 minutes. 100% probability of death within 8 minutes
- 4-6%: Coma in 40 seconds, convulsions, respiration ceases, death.
- High oxygen level  
There is an increased risk of fire and explosion from high oxygen levels. Higher than normal oxygen levels can result from oxygen leakage during oxy/acetylene welding operations.
- Flammable atmosphere  
A gas mixture is flammable when the concentration of flammable gases in air is within the Lower and Upper Explosion Limits (LEL and UEL).  
High-levels of oxygen widen the range of Lower and Upper flammability limits.
- Toxic atmosphere  
Toxic materials can result in many different adverse health effects.  
Flammable gases like olefins (ethylene, propylene, butadiene...) and LPG gases are usually not toxic. However some have long term carcinogenic effects (e.g. butadiene).

## 6.2 Permit for entry into confined spaces

### 6.2.1 What is a confined space Entry Permit?

A confined space entry permit is a written authorization for entry into a confined space which needs to be filled and signed by relevant authorities before entry can take place. Note: the permit for entry into a confined space only relates to the entry. All other hazardous work to be conducted in the confined space (e.g. welding) is covered by another permit (e.g. hot work permit)

### 6.2.2 General contents of a confined space entry permit:

- rtc number;
- Previous cargo;
- Condition of atmosphere;
- Gas test results with the gas tester's name and signature and date of test;
- Information of the actual hazards;
- Description of the work to be done;
- Names of entrants (people who will enter the rtc);
- Permit validity period;
- Precautions to be undertaken (e.g. regular LEL/oxygen testing, ventilation, stand-by attendant required, motion alarm system to be used...);
- Personal protective equipment (e.g. filter mask, breathing apparatus...);
- Signature of the 'performing authority' (this is the person who will be doing the work and will enter the rtc) confirming that he has read and understood the precautions to be taken;
- Signature of the 'issuing authority' (the person who issues and signs the permit);
- Confirmation on completion of work (the performing authority and issuing authority sign for work completed);
- Cancellation and permit withdrawal (e.g. in case the conditions have changed);
- Extension of validity.

If hot work has to be performed inside the rtc, a hot work permit has to be issued in addition. A confined space tank entry permit should be valid for maximum one working day.

### 6.2.3 Advantages of a Permit system:

- Ensures that proper authorization is obtained.
- Ensures that the management is aware of all confined space entries (who is working in which rtc?).
- Checks that the working conditions are safe.
- Informs workers about potential hazards and the precautions to take.
- Prohibits entry into an rtc after the authorization period.

### 6.2.4 Risk assessment

- Before each entry it should be checked whether all risks related to the work to be performed inside, have been taken into account: e.g.
  - Has the nitrogen line been disconnected?
  - Will paints, coatings, solvents etc. be used?
  - Is there a risk of oxygen depletion (welding/burning fumes...)?
  - Is there a risk of flammable gases being released when removing rust residues from the rtc? In that case continuous monitoring of the atmosphere should be carried out and breathing protection should be worn.

Therefore, a case-by case risk assessment should be done before issuing a permit.

### 6.2.5 The tank entry permit in practice

- The permit can be incorporated in the work-order.
- The 'issuing authority', can be a supervisor with the required skills and training. It is preferred that this person is also doing the gas tests before issuing the permit.
- The 'performing authority' can not be the same person as the 'issuing authority'. However, this person should also be certified to carry out gas tests as gas testing during the entry may be required.
- The permit should be made in twofold: one copy to be kept by the issuing authority, and the other copy, clearly visible fitted to the rtc.

### 6.3 Tank entry

- Never enter an empty uncleaned rtc wearing only a filter mask.
- When preparing to work in a confined space, the proper condition and functioning of several items need to be examined/ checked:
  - Low voltage, intrinsically safe lamps/lights.
  - Electrical tools with earth/ground leakage or residual current protection.
  - Communications equipment.
  - Ingress and egress equipment (e.g. ladder).
  - Recovery equipment (e.g. winch) to recover unconscious persons
  - Signs and barriers.
  - Rescue services (see below).

Before entry, all hoses (water/nitrogen/air) should be disconnected from the rtc.

- Depending on the risks (e.g. if flammable gases can be released during removal of rust residues, during welding etc...), a stand-by attendant should be present outside the rtc. The main duties of a stand-by attendant is to:
  - continuously monitor changes in the atmosphere;
  - see that the entrant leaves the rtc when a hazardous situation arises;
  - raise the alarm and summon rescue services in case of an emergency;
  - **the stand-by person should never enter the rtc to attempt rescue**
  - assist the rescue services as necessary **without** entering the confined space;
- When the risk assessment indicates that breathing apparatus (independent air supply) should be worn, the entrant should wear a full body harness and a lifeline that extends outside the rtc. The stand-by attendant should be able to pull an affected person out of the rtc using the lifeline.
- If the risks of changes in the tank atmosphere during the work are low and if no hazardous activities like welding are to be performed (e.g. replacing a gasket in a valve), the stand-by person may be replaced by a 'lone worker alarm system' which is carried by the entrant and which raises an acoustic and/or visual alarm if the entrant is not moving for a short period. The lone worker can also use this system to raise an alarm. When this system is used, it is good practice to warn all people working in the area that someone has entered an rtc e.g. by means of a flag.

- If natural ventilation is inadequate to keep the atmospheric levels safe, provide continuous ventilation. Direct heat from the sun on an rtc can aggravate the situation. Heat stress can affect productivity and safety severely.
- Permanent monitoring of the oxygen level is a minimum requirement.
- At completion of the work, the rtc should be cleared of all tools and debris. The 'entrant' needs to sign off the permit, which is then signed by the 'issuing authority'. The permit is then withdrawn and the rtc can be closed.
- The original permit should be filed and copies should be destroyed.
- Never take cylinders with compressed gas into an rtc.

### 6.4 Respiratory protection

	Oxygen	Flammable	Toxic
	20,5 - 20,8 %	< 1% LEL	< 10 % OEL
Conditions: <ul style="list-style-type: none"> <li>- Adequate ventilation.</li> <li>- The rtc has been thoroughly cleaned of sludge, rust residues and other material likely to give off harmful gases or vapours.</li> <li>- The work inside the rtc cannot give rise to hazardous gases or vapours.</li> <li>- Gas testing after a break of 30 minutes.</li> <li>- Use <i>Motion Alarm System</i>.</li> </ul> <b>Entry without breathing apparatus</b>			
	19,5 - 20,5 % 20,8 - 23,5 %	1 - 20 % LEL	up to STEL
Conditions: <ul style="list-style-type: none"> <li>- Flammable gases should be below <b>10 % LEL</b> for entry. 20% LEL is an exit criterion.</li> <li>- Competent person to determine the degree of respiratory protection required based on a risk assessment of the measured concentration of gases and the work to be carried out (e.g. removing residual rust and sludge...).</li> <li>- Stand-by person or motion alarm system (depending on risk assessment).</li> <li>- Permanent gas testing.</li> </ul> <b>Specific Risk Assessment needed</b>			
	< 19,5 % or > 23,5 %	> 20 % LEL	> STEL
<b>Life threatening atmosphere: no entry, even with breathing apparatus</b>			

### 6.5 Emergency Rescue

There should be a procedure describing the means of rescue and allocation of resources to carry out a confined space rescue. The presence of an AED (Automated External Defibrillator) is recommended.

### 6.5.1 Rescue by own personnel

If rescue is organised by own personnel, it should be ensured that each member of the rescue team:

- Is provided with and is trained to properly use the Personal Protective Equipment and rescue equipment necessary for making rescues from confined spaces.
- Is trained to perform a rescue.
- Practises in making confined space rescues at least once every 12 months (by using dummies).
- Is a trained first aider (including cardiopulmonary resuscitation).

### 6.5.2 Rescue by local emergency services

If rescuing a person from a confined space is considered to be the responsibility of the emergency services, clear arrangements should be made about the methods of rescue and the equipment that has to be kept available for the emergency services. Rescue exercises with the local emergency services should be organised at least every 12 months.

**Note: Good practice is for all personnel entering a confined space to wear a safety harness (under or over coveralls) to aid in rescue if require**

## 7. PREPARING A RAIL TANK CAR FOR DEPARTURE

### 7.1 Labels

- According to RID regulations, orange placards and danger labels may no longer be displayed after cleaning/degassing of rtc's. Therefore all danger labels and orange placards on the rtc referring to the previous cargo **should be removed or completely hidden** so that they are no longer visible.

### 7.2 Documents

A cleaning/gas free/purging certificate should be made available to the customer. It should include as a minimum:

- The results of the cleanliness inspection (preferably the UIP cleanliness key)
- Rtc under nitrogen: ... % oxygen (if applicable) or
- Rtc under air (do not mention test results). "*Warning: no entry into the rtc until the atmosphere has been re-tested and an Entry Permit has been issued*"

## 8. GLOSSARY

RTC	Rail Tank Car
Fine & Kinney Method	This is a method to assess the risks associated with a task by ascribing values to the <b>probability (P)</b> that the risk results in an incident, the <b>length of exposure (E)</b> to the risk, and the <b>extent of the possible damage or severity (S)</b> . The Risk ( <b>R</b> ) is calculated as the product of these 3 elements: $R = P \times E \times S$
SOP	Safe Operating Procedure
Toolbox meeting	<p>Toolbox talks are short, daily discussions or presentations by supervisors to their operators. They generally last no longer than 15 minutes or so. Often participants gather around the project tool box, hence the name.</p> <p>A toolbox talk is focused on one specific topic and addresses it in simple terms. While it needs not to be about a safety topic, it is not uncommon for safety to be the topic.</p> <p>A toolbox talk provides an opportunity for a supervisor to emphasise the importance of a particular issue or procedure, and for workers to ask questions or make serious comments.</p>
Near Misses	Unsafe acts, unsafe situations, learning experience events etc
Near Miss of the Month	All employees should be encouraged to report Near Misses. At the end of the month, the best Near Miss report is selected and an award is given to the person who has reported this Near Miss.
VCA	The abbreviation VCA comes from the Dutch VCA ("Veiligheid, Checklist voor Aannemers"). In English: "Safety Checklist for Contractors". The VCA certificate is valid for 3 years after a first audit carried out by a independent organization. Companies who have been VCA certified have proven to have a good safety standard.
LEL UEL OEL STEL	<p>Lower Explosion Limit</p> <p>Upper Explosion limit</p> <p>Occupational Exposure limit (UK) is MAK in D, MAC in NL, VLE in F..</p> <p>Short Time Exposure limit</p>
Derailer	<p>A derailer is a device used to prevent fouling of a <u>track</u> by unauthorized movements of trains or unattended <u>rolling stock</u>. It works (as the name suggests) by <u>derailing</u> the equipment as it rolls over or through the derailer. Although accidental derailment is damaging to equipment and track, and requires considerable time and expense to remedy, derailers are used in situations where there is a risk of greater damage to equipment, injury or death if equipment is allowed to proceed past the derail point.</p> 

ATEX directive	<p>There are two <b>ATEX</b> directives (one for the manufacturer and one for the user of the equipment):</p> <ul style="list-style-type: none"> <li>• the ATEX 95 <i>equipment</i> directive 94/9/EC, Equipment and protective systems intended for use in potentially explosive atmospheres;</li> <li>• the ATEX 137 <i>workplace</i> directive 99/92/EC, Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.</li> </ul> <p>Employers should classify areas where <u>hazardous</u> explosive atmospheres may occur into zones. The classification given to a particular zone, and its size and location, depends on the likelihood of an explosive atmosphere occurring and its persistence if it does.</p> <p>Areas classified into zones (0, 1, 2 for gas-vapor-mist) should be protected from effective sources of <u>ignition</u>. Equipment and protective systems intended to be used in zoned areas should meet the requirements of the directive. Zone 0 requires Category 1 marked equipment, zone 1 require Category 2 marked equipment and zone 2 require Category 3 marked equipment. Zone 0 is the zone with the highest risk of an explosive atmosphere being present. An ATEX zone should be marked with the following label:</p> <div data-bbox="847 987 1098 1205" data-label="Image"> </div>
Jacks	<p>Jacks are used to lift or support heavy equipment.</p> <div data-bbox="914 1272 1034 1464" data-label="Image"> </div>
CIM	<p>Consignment document for rail transport. It confirms that the rail carrier has received the goods and that a contract of carriage exists between shipper and carrier.</p>
PID	<p>Photo Ionisation Detector. Measures <u>volatile organic compounds</u> and other gases in concentrations from sub <u>parts per billion</u> to 10 000 <u>parts per million</u> (ppm). A PID may produce instantaneous readings and operate continuously.</p>

<p>Lone worker alarm system</p>	<p>The Lone Worker Alarm / Man down alarm is used in potentially dangerous area's where staff have to work alone. The Lone Worker alarm transmitter is worn on the belt and held securely with a belt clip. It transmits an alarm message when the panic button is pressed. The transmitter also contains a tilt switch so that an alarm message is transmitted automatically if the person collapses for any reason or if he does not move for a certain period.</p> 
<p>UIP Cleanliness key</p>	<p>Is a system developed by UIP (<a href="http://www.uiprail.org">www.uiprail.org</a>) which indicates by means of figures the internal cleanliness level of an rtc.</p>