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Checklists for surveying and assessing industrial plant handling materials and substances, which are hazardous to water

№ 14

Equipment of tanks

For our Environment

Umwelt Bundesamt

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№ 14

Equipment of tanks

by

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Recommendations of the International River Basin commission for tank equipment

Generals and definitions

These recommendations apply to stationary tanks of all kinds (aboveground and underground, with and without internal over pressure).

Stationary tanks are facilities that serve the purpose of storage and are constructed as non-movable objects.

Underground tanks are stationary tanks, which are completely or partly embedded beneath the surface of the earth.

Aeration and venting devices

1. Tanks should be equipped with aerating and venting devices to prevent dangerous underpressure and overpressure.
2. Venting devices should not have shut-off valves.
3. Venting devices should be compact and resistant to vapour of the stored liquids in regard to the strain that could be expected. Furthermore they should be sufficiently durable and resistant to the effects of fire.
4. Venting devices should be sized to prevent the occurrence of dangerous under and overpressure at high flow rate of pumps and fluctuating temperatures in the tank.
5. The aeration and venting of several tanks through a joint pipe is only allowed if they contain liquid of the same danger class and only such liquid that can not form dangerous mixture with one another.
6. The discharge port of the venting devices should be protected from rainwater.
7. Necessary safety devices should be installed to provide a safe discharge of evaporating vapour/air - mixture during filling processes.

Fittings with flame arrester

Openings or ports of tanks which can act as a source of intrusion of flame into the tank must be equipped with fittings having flame resisting mechanism compatible with the requirements of the operating condition and design.

Liquid Level gauge

1. Each tank must be provided with a device for detecting the level of the liquid stock. This device can be left out for overground tanks if the shell is made of a transparent material (e.g. plastic).
2. Liquid level glasses must be protected from damages and must be partitioned into sections of not more than 2,5 m. If liquid level glasses are not equipped with a safety device to prevent release of liquid when damaged, then they should be fitted with fast-closing shut-off device. The shut-off device should only be opened when checking the liquid level.

Overfill safety device

1. Each tank must be equipped with an overfill safety device, which automatically interrupts the filling process in time before the permissible capacity is reached or trigger off an acoustic alarm.
2. This does not apply to overground vessels (tanks) with volume of not more than 1 m^3 if they are being filled with automatic dispensing valve.

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Leakage indicator

Leakages on the wall of double shell containers must be indicated with an automatic indicator. Their functionality of it must be verified.

Shut-off valves for Pipelines

1. Each pipe connected below the permissible level of liquid in the tank must be fitted with a shut-off valve.
2. Pipe connections above the permissible level of liquid in the tank must be fitted with a shut-off valve, if it is possible to pump out the contents of the tank through the pipe.
3. The shut-off valve must be installed as close as possible to the tank, must be easily accessible and easy to operate.
4. Tank fittings of underground tanks should only be mounted on the top or in the vertex of the tank. The fittings must be easily accessible.
5. For the process of filling and emptying, each tank must be fitted with a system that allows a safe connection of a stationary or a detachable pipeline.

Filling and emptying mechanism

1. The filling device must have a tight closing cap.
2. Containers for the storage and supply of liquids hazardous to water should only be filled from stationary pipeline and only when the tanks is equipped with an overfill safety device. This does not apply to container standing alone and with a capacity of not more than 1000 l, if they are filled with an automatic dispensing valve. The same applies to mobile containers in a filling unit.
3. There shouldn't be the danger of bursting due to sparks when attaching and detaching pipelines.
4. The filling system for transferring flammable liquids to a storage must be designed in a manner that dangerous electrostatic charges can not develop. The discharge point of the filling pipe must be mounted near the bottom of the tank to avoid spillage of flammable liquid on to the environment.

Access hatches (Entry and inspection ports or manhole)

1. Each tank must be provided with at least an entry or inspection port (manhole).
2. A liquid-tight dome shaft must be mounted above the access hatch of every tank which is completely buried beneath the earth surface.

Markings or Labelling

1. Each tank must be furnished with a manufacturer's label, which contains all tank characteristics.
2. Each tank must be furnished with legible and permanent labels to reflect the kind of substances hazardous to water which are being handled in the plant and at which operating pressure.
3. Filling ports of storage tanks that are mounted next to each other and containing liquids of different danger class or liquids that can form dangerous compounds when they come in contact must be characterised with a storage goods label.

Additional requirements on tanks with internal overpressure and underpressure

1. Tanks with internal overpressure must be equipped with a device to control the pressure.
2. Tanks with internal overpressure must be equipped with a safety device to control excess pressure as long as the permissible operating overpressure could be exceeded.
3. Liquids or their vapour being released through safety relief valves must be safely discharged.
4. In very special cases, other safety devices can be used instead of safety relief valves to control excess pressure (e.g. bursting disc safety device).

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5. If the permissible operating pressure of a tank is less than the possible pressure from the pressure generator by 2 bars or more, an automatic device must be installed in the pressure supply line to reduce the pressure, so that the permissible operating pressure will not be exceeded.
6. Tanks in which underpressure could occur but are not designed to resist such underpressure must be fitted with an appropriate device to prevent underpressure.
7. Each pressure pipe connection of a tank must be fitted with a shut-off device.
8. Inspection glass must be resistant to internal overpressure, the effects of the stored flammable liquid as well as their vapour and be protected from damages.

Checklist for monitoring the implementation of the recommendations

General details on surveyed tank

Name of operation:

❒ underground ❒ overground ❒ outdoor ❒ in a room

❒ single shell ❒ double shell ❒ coating

❒ sec. containment ❒ leak indicator ❒ overfill safety system

❒ cylindrical horizontal ❒ cylindrical vertical ❒ spherical

❒ flat bottom ❒ rectangular

communicating tanks – number of tanks:

Volume of each tanks: m^3

Total volume: m^3

Name of material (compound):

(for further details see Checklist No. 1)

WRI:

Material of tank:

Design pressure: bar

Max. allowable operating pressure: bar

Operating temperature: °C

Remarks:

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1 Aeration and venting systems

1.1 Is the tank equipped with aeration and venting devices to prevent the development of dangerous overpressure and underpressure?

❒ Yes ❒ No → 2 ❒ Not applicable

❒ Action ❒ No action

Remarks:

1.2 Does the venting device have a shut-off device?

❒ Yes (not shut off) ❒ No (is shut-off) ❒ Not applicable

❒ Action ❒ No action

1.3 Do the ventilation systems have the following characteristics?

	❒ Not applicable	
Compact	❒ yes	❒ no
Resistant to the stored substance	❒ yes	❒ no
Durable	❒ yes	❒ no
Resistant to the effects of flame	❒ yes	❒ no

❒ Action ❒ No action

1.4 Is there the possibility of any functional restriction due to the development of condense water and their deposits?

❒ Yes (excluded) ❒ No (condense/deposits are possible) ❒ Not applicable

❒ Action ❒ No action

Remarks:

1.5 Were the following points considered when sizing the venting systems so that no dangerous overpressure and underpressure can develop?

	❒ Not applicable	
Maximal productivity of the pump	❒ yes	❒ no
Temperature fluctuations in a vessel	❒ yes	❒ no

❒ Actions ❒ No action

Remarks:

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1.6 Do several tanks have a common venting system?

❒ Yes ❒ No → 1.7 ❒ Not applicable

❒ Action ❒ No action

1.6.1 Are substances of the same danger class stored in connected tanks?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

1.6.2 Can all these different substances form dangerous mixtures?

❒ Yes (safe mixtures) ❒ No (dangerous mixtures) ❒ Not applicable

❒ Action ❒ No action

1.7 Is the discharge port of the venting system protected from the entry of rainwater?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

1.8 Are safety devices available to guarantee a safe discharge of evaporating vapour/air mixture during the filling process?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:

Short-term measures:

- If no aerating and venting devices are installed, make an opening in the tank or install venting device.
- To shut-off the venting devices disassemble the control systems.
- Cover the orifice of the vent with rain hoods or bend the vent pipe into a U form with the orifice downwards.

Medium-term measures:

- Guaranteeing that the flow rate is throttled in such a way that no dangerous overpressure can develop in the tank (e.g. by installing an orifice)
- Dismantling of shut-off devices in the venting systems
- Heating of sections where condensate can be deposited.

Long-term measures:

- Increasing the cross section of the vent pipe by installing new venting systems.
- Installation of gas feedback device for filling processes or discharge of dangerous vapour/air mixtures to an exhaust gas treating plant.

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Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

2 Fittings with flame arrester

❒ relevant ❒ not relevant → 3

2.1 Are the opening ports of tanks equipped with fittings having flame arrester to prevent naked flame entry into the tank?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:
Medium-term measures:
- *Installation of fittings with flame arrester.*

Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

3 Liquid level gauge

3.1 Is the tank equipped with a system with which the level of liquid can be gauged?

❒ Yes→ 3.2 ❒ No→ 3.1.1 ❒ Not applicable

❒ Action ❒ No action

3.1.1 Is the tank made of a transparent material such that the level can easily be gauged without installing a gauging system?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

3.2 Are liquid level glasses installed?

❒ Yes ❒ No → 4. ❒ Not applicable

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3.2.1 Are the level glasses protected from damages?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.2.2 Is the scaling gap on the level glasses not more than 2,5 m?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.2.3 Are the level glasses equipped with automatic devices to prevent a discharge in case of damages?

❒ Yes→ 4. ❒ No→ 3.2.4 ❒ Not applicable

❒ Action ❒ No action

3.2.4 Are fast response shut-off systems provided instead of the automatic systems?

❒ Yes→ 3.2.5 ❒ No→ 4. ❒ Not applicable

❒ Action ❒ No action

3.2.5 Could the fast response shut-off systems only be opened when gauging the liquid level?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:

Short-term measures:

- Ensure the immediate closure of the shut-off systems of the level glasses after recording the liquid level by training the staff to always follow operating instructions.
- Regular inspections of the gauge glasses for damages.

Medium-term measures:

- Installation of protective grates or similar devices to protect the level glasses
- Installation of devices for gauging liquid level.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=50	RC=100

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4 Overfill safety systems

See Checklist No. 2 „overfill safety systems“ for overfill preventive devices

4.1 Is the tank equipped with an overfill safety device which automatically interrupts the filling process or triggers off an acoustic alarm before the maximum permissible level is reached?

automatically interrupts the filling process ❒ yes ❒ no

triggers acoustic alarm ❒ yes ❒ no

❒ Yes (once) → 5 ❒ No → 4.2 ❒ Not applicable

❒ Action ❒ No action

4.2 The filling of a vessel without using an overfilling prevention device may only take place in exceptional cases. Do you have an exceptional case?

Note: Exclusion is possible, if a vessel will be filled by overfilling prevention device or if overfilling is technically impossible.

❒ Yes→ 4.2.1 ❒ No→ 5 ❒ Not applicable

4.2.1 In this exceptional case, is the overfilling of the vessels or vessel reliably prevented by other means?

❒ Yes ❒ No ❒ Not applicable

4.2.2 Do you fill vessels manually using a dispensing device with automatic response (dispensing valve or pistol)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:

Short-term measures:

- Training and instructing the staff to check the level gauging devices regularly and on how to take the right decision if there is a danger of overfilling.
- Perform filling processes with at least two operating staff present.
- Ensure direct observation of the level in the vessel when filling.

Medium-term measures:

- Install a certified overfill safety device.
- Install dispensing devices with automatic response or weight-controlled filling devices if the vessel or mobile containers are filled manually by the operating staff.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=100

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5 Leakage indicator

❒ relevant ❒ not relevant → 6

5.1 Is a leak indicating device fitted to automatically indicate leakages on the wall/bottom of a double shell tank?

❒ Yes ❒ No→ 6. ❒ Not applicable

❒ Action ❒ No action

5.2 Has the effectiveness of the leakage indicating device been established?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.3 Is the leakage indicating device protected against unauthorised switching off of the power supply?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:

Short-term measures:

- Take measures to avoid the leakage indicator being switched off electrically (lead seal the switch).

Medium-term measures:

- Electrical installations of the leakage indicator with firmly installed cable (no plug).

Long-term measures:

- Install a leakage indicator of which the effectiveness has been established.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=50	RC=100

6 Shut-off devices on pipelines

6.1 Are all pipes below the permissible liquid level of the tank equipped with a shut-off device?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

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6.2 Is the siphoning/pumping out of the content of the tank possible?

❒ Yes→ 6.3 ❒ No→ 6.2.1 ❒ Not applicable

❒ Action ❒ No action

6.2.1 Are all pipes above the permissible liquid level of the tank equipped with a shut-off device?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

6.3 Do all shut-off devices have the following characteristics?

❒ Installed near the tank
❒ Easily accessible
❒ Easy to operate

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:

Medium-term measures:

- Install shut-off devices in pipeline which are below the liquid level and where the pumping out of the content is possible.

Long-term measures:

- Revise the operating concept of shut-off devices and use the new concept to make the devices easily accessible and easy to operate and install them near the tank to allow quick response when necessary.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

7 Filling and discharging devices

❒ relevant ❒ not relevant → 8

7.1 Are the fittings on underground tanks located only at the dome cover (top) or the vertex of the tank?

❒ Yes ❒ No → 7.2 ❒ Not applicable

❒ Action ❒ No action

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7.1.1 Are these fittings easily accessible?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

7.2 Is the tank equipped with devices for filling and discharging that allows a reliable connection of a stationary or detachable pipeline?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

7.3 Can the filling device be closed tightly, e.g. with a tight sealing shut-off cap?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

7.4 Are vessel in a plant unit larger than 1000 litres filled only with a stationary pipeline and are the vessels fitted with an overfill safety device?

❒ not applicable

7.5 Only stationary pipeline <u>and</u> ❒ **yes** ❒ **no**

7.6 Only by using overfill safety device ❒ **yes** ❒ **no**

❒ Action ❒ No action

Remarks:

7.7 Are overground vessel smaller than 1000 litres belonging to a plant unit filled with a stationary pipeline and only when the vessel is equipped with an overfill safety device?

❒ Yes→ 7.6 ❒ No→ 7.5.1 ❒ Not applicable

❒ Action ❒ No action

Remarks:

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7.7.1 Are overground vessels in a plant unit smaller than 1000 litres filled only with dispensing valve with automatic response?

❒ Yes→ 7.6 ❒ No→ 7.5.2 ❒ Not applicable

❒ Action ❒ No action

Remarks:

7.7.2 Are mobile vessels in a filling unit smaller than 1000 litres filled with dispensing valve with automatic response?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

7.8 Is there a danger of explosion due to spark when attaching or detaching pipeline?

❒ Yes (no danger) ❒ No (there is danger) ❒ Not applicable

❒ Action ❒ No action

Remarks:

7.9 Is there the danger of electrostatic charge of the filling systems?

❒ Yes (no danger) ❒ No (there is danger) ❒ Not applicable

❒ Action ❒ No action

Remarks:

7.10 Are the filling pipes or ports installed near the ground to make spillage of liquid impossible?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:
Short-term measures:

- Training and instructing the staff to check the level gauging devices regularly and on how to respond in case of threat of overfilling.
- Perform filling processes with at least two operating staff present.

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- Ensure direct observation of the level in the vessel when filling.
- Provide equalization to avoid electrostatic charges

Medium-term measures:

- Install a certified overfill safety device.
- Install dispensing devices with automatic response or weight-controlled filling devices if the vessel or mobile containers are filled manually by the operating staff.
- Install a level gauge when filling process is performed without overfill safety device in exceptional cases.

Long-term measures:

- Install the filling pipeline in such a way that the filling pipe is below the liquid surface (filling below liquid surface).

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

8 Access hatches (Entry and inspection ports)

8.1 Is the tank furnished with at least an entry / or inspection port?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

8.2 Is the tank which is completely buried in the ground fitted with a liquid-proved dome shaft mounted above the access hatch?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:

Medium-term measures:

- Seal the available dome shaft.

Long-term measures:

- Supplementary installation of a liquid-tight dome shaft
- If possible supplementary installation of an entry or inspection port.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

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9 Markings or Labelling

9.1 Is the tank provided with a manufacturer's sign containing all tank characteristics?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

9.2 Is the tank furnished with legible and permanent label to reflect the kind of substances hazardous to water that is being handled in the plant and the operating pressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

9.3 Are the filling ports of storage tanks which are situated next to each other and which contain liquids of different danger class or liquids that can form dangerous compounds when they come in contact with one another labelled with a storage goods sign?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of actions:
Short-term measures:
- Attach a manufacturer's label (if possible ask manufacturer to supply one).
- Label tank with details of contained substance and operational conditions.
- Label the filling ports to reflect the substances passing through them.

Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

10 Tanks in which internal overpressure or underpressure can occur

❒ relevant ❒ not relevant → the list is finished

10.1 Is the tank provided with a system to monitor the internal over- or underpressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

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10.2 Can the permissible operating pressure be exceeded?

❒ Yes→ 10.2.1 ❒ No→ 10.5 ❒ Not applicable

❒ Action ❒ No action

10.2.1 Is the tank in which internal overpressure can occur equipped with safety device against excess pressure?

❒ Yes ❒ No → 10.5 ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.3 Can the liquids or their vapour from safety valves be discharged safely?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.4 Are other safety devices installed to control excess pressure instead of safety valves (e.g. bursting disc safety device)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.5 Is the permissible operating pressure of the tank less than the possible pressure from the pressure generator with more than 2 bars [$P_{Tank} < (P_{Max\ pressure\ generator} - 2bar)$]?

❒ Yes→ 10.5.1 ❒ No→ 10.6 ❒ Not applicable

❒ Action ❒ No action

10.5.1 Is a system installed in the pressure pipe which automatically reduces the pressure such that the permissible operating pressure of the tank can not be exceeded?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.6 Is the tank resistant against underpressure?

❒ Yes→ 10.7 ❒ No→ 10.6.1 → 10.7 ❒ Not applicable

❒ Action ❒ No action

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10.6.1 Is the tank resistant to underpressure?

❒ Yes→ 10.7 ❒ No→ 10.6.2 ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.6.2 Is the tank equipped with a system to prevent the occurrence of a dangerous underpressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.7 Are the fittings of the pressure pipes equipped with shut-off devices?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.8 Are the tanks equipped with inspection glasses?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.8.1 Are they resistant to internal pressure and the effects of the stored liquid and their vapour?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

10.8.2 Are they protected against damages?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

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Examples of actions:

Short-term measures:

- Checking and monitoring of overpressure and negative pressure by the staff.
- Instructing the staff on actions to be taken when the pressure is above or below the permissible pressure
- Test the effectiveness of the safety valves regularly.

Medium-term measures:

- Installation of a system to monitor the internal overpressure and negative pressure
- Installation of safety valves or bursting disc safety device
- Ensure the safe discharge of dangerous substances released from safety valves (e.g. into a separate average container)
- Replace inspection glasses that are not resistant to overpressure.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

Summary of the Checklist

Sub-point of the Recommendation	Possible Risk category	Risk categories
1	1 / 5 / 10	
2	1 / 10	
3	1 / 50 / 100	
4	1 / 100	
5	1 / 50 / 100	
6	1 / 5 / 10	
7	1 / 5 / 10	
8	1 / 5 / 10	
9	1 / 5 / 10	
10	1 / 5 / 10	

Average **R**isk of the **C**hecklist **(ARC)**

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