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

Nº 5

Sealing systems

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Advisory Assistance Programme (AAP) of the
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Sealing systems

by

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Recommendations of the International River Basin commission for sealing systems

1. The tightness of sealed systems must be in accordance to the physico-chemical properties of the substances handled, and this must be demonstrated by a generally accepted and recognised testing method.
2. Where the material of the collecting troughs, secondary containment or containing surfaces is not itself sufficiently tight, suitable sealing methods such as a coating, laminates or covering with foils should be used or an equivalent safety measures taken.
3. The installation of the sealing systems must be done according the corresponding rules.
4. If the substances hazardous to water are flammable liquids, the sealing systems used for the secondary containment must be fire-resistant.
5. In the event of an accident, the tightness must be guaranteed for at least as long as is necessary to detect the leakage, clean-up the substance and repair the leak.
6. Verification of the tightness should be subject to recurrent checks by experts.
7. When handling substances whose behaviour in relation to the sealing system is not known, the surfaces potentially affected are to be inspected regularly for substance leaks and penetration. If this is not possible, additional safety measures should be taken.
8. Laying of pipelines and cables through sealing systems on the floors and walls should basically be avoided.
9. When assessing collecting trough, secondary containment or surfaces of containments, the same criteria should be also applied to the joints.

Checklist for monitoring the implementation of the recommendations

0 Introduction

Sealed surfaces are liquid impermeable facilities for containing liquid hazardous to water in case of leakage of above ground plant facilities or plant components handling liquids hazardous to water in normal operation.

Sealed surface can be divided into:

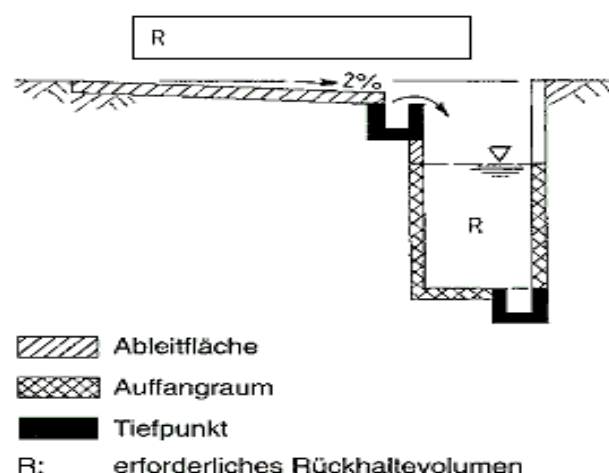
Draining surface: Facility for draining liquid hazardous to water using a slop (as a rule $\geq 2\%$).

Containment: Facility for collecting liquid hazardous to water for short period of time

Trough: Facility where liquid hazardous to water is first collected or contained

Into which parts a sealed surface is divided can be seen in the figure below:

A possible structure of a sealing surface is specified in the following example.





Example of the structure of a possible sealed surface

- covering seal
- anti-static layer
- conducting layer
- tear-bridging intermediate layer
- layer
- priming coat

General details about sealed surface

To which plant does the sealed surface belong:

Name of the substance that can flow over the surface:
(for further details see [Checklist No. 1 „Substances“](#))

Type of sealed surface: ☐ Draining surface ☐ containment ☐ Trough

Sealing layer: ☐ Concrete ☐ Metal ☐ Plastic
☐ Foil ☐ coating ☐ others

Joint: ☐ yes ☐ no

Remarks:

1 Dimensioning and proving the tightness of sealing

1.1 Were these substances considered in accordance with the [Checklist no. 1 "Substances"](#)?

☐ Yes ☐ No → Checklist N°1 ☐ Not applicable

☐ Action ☐ No action

Remarks:

Examples of actions:

Short-term measures

- Collection of details on the substance (see also [checklist no. 1 "Substance"](#))
Possible sources: Safety data sheets, database of substances hazardous to water at the Federal Environmental Agency, <http://webrigoletto.uba.de/rigoletto/public/welcome.do>

1.2 Is there any proof of the resistance and tightness of the sealing system towards the substances being handled?

☐ Yes ☐ No ☐ Not applicable

☐ Action ☐ No action

1.3 Is the construction of the sealing system done according to a recognised manufacturing process?

- ☐ Yes ☐ No ☐ Not applicable
- ☐ Action ☐ No action

1.4 Has the tightness of the sealing system been demonstrated by an approved testing method?

- ☐ Yes ☐ No ☐ Not applicable
- ☐ Action ☐ No action

Remarks:

Examples of actions:

Short-term measures:

- In case there is no written proof issued by the manufacturer or by a testing laboratory for the durability and tightness of the sealing system, the efficiency of the sealing should be documented in writing.
- Repair of damages
- Regular visual inspection of the sealing.

Medium-term measures:

- Tightness test of the sealing with an approved testing method (e.g.: testing the penetration depth of the liquid hazardous to water in a sample under defined conditions. The liquid must not penetrate more than 2/3 of the sealing thickness during the whole duration of the test... The test period should be determined according to the topic no 5 of this check list).

Note:

For existing sealing surfaces made of concrete used to contain liquids hazardous to water of water hazard class WHC 0 up to WHC 2 and gasoline (petrol, diesel, fuel oil, engine oils) this test is not required, if:

- The concrete surface has no visible damages,
- The concrete surface has a minimum thickness of 15 cm,
- The concrete has a nominal strength of 25 N/mm² (concrete B25).

Long-term measures:

- If the tightness can not be proofed, new sealing should be installed and the tightness of the sealing should be demonstrated. This sealing can be made of, for example:
 - Concrete
 - Steel sheet,
 - Tiles,
 - Foils,
 - laminate.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

RC=1

Partially

RC=40

No

1

RC=90

2 Coating of sealed surfaces

☐ relevant

☐ not relevant → 3

2.1 Can the tightness of the surface over which the material can flow be achieved by an additional sealing layer (e.g., a coating, a fibreglass plastic, a foil, tiles, etc.)?

☐ Yes

☐ No → 3

☐ Not applicable

Type of additional sealing layer:

☐ Coating

☐ fibreglass plastic

☐ tiles

☐ foils

2.2 Can the tightness of this additional sealing layer be determined by a visual inspection?

☐ Yes

☐ No

☐ Not applicable

☐ Action

☐ No action

Remarks:

Examples of actions:

Short-term measures:

- In case an additional sealing is required, regular internal checks of the systems' tightness shall be carried out until the implementation of this measure.

Medium-term/long-term measures:

- Installation of an additional sealing that is resistant and tight. Their resistance and tightness to the medium must be demonstrated by the manufacturer of the sealing.
- Equivalent safety measure: A sealing system incorporating a leakage detecting system which guarantees the detection of leakage on the upper layer of the sealing either automatically or when necessary at intervals (vacuum system, chemical analysis).

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

No

☐

RC=10

3 Proof of professional job execution

3.1 Was the construction of the sealing system executed by professionals (manufacturer's certificate to prove this)?

☐ Yes

☐ No

☐ Not applicable

☐ Action

☐ No action

Notes: The correct execution of works at the industrial plant, handling substances, hazardous to water, should be certified by the executing enterprise.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

Partially

☐

RC=5

No

☐

RC=10

4 Fire resistance of the sealing system

☐

relevant

☐

not relevant → 5

4.1 Can the sealing system be used to contain and retain combustible (F, F⁺) substances hazardous to water?

☐

Yes

☐

No → 5

☐

Not applicable

☐

Action

☐

No action

4.2 Is the sealing system fire resistant?

☐

Yes

☐

No

☐

Not applicable

☐

Action

☐

No action

Remarks:

Examples of actions:

Short-term measures:

- Covering of the sealing system with a non-combustible substance (e.g. sand).

Medium-term measures:

- Construct a fire-proof sealing system, e.g., of concrete, steel, ceramics, guss asphalt.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

Partially

☐

RC=5

No

☐

RC=10

5 Requirements on the tightness of the sealing system

5.1. Is the necessary time period set up?

- Detect release

☐

yes

☐

no

- Of substances hazardous to water

☐

yes

☐

no

- To remove leakage

☐

yes

☐

no

- To remove released substance

☐

yes

☐

no

If all the answers are negative for the paragraphs from a...c (3 "no") then →6.

Definition of time in hours or days:

a) Detection

☐ ____ hours☐ ____ days

b) Leakage removal

☐ ____ hours☐ ____ days

c) Removal of the released substance

☐ ____ hours☐ ____ days☐

Action

☐

No action

Remarks:

Examples of actions:Short-term measures:

- Determination of the time required to detect the leakage and to remove the released substance. This should be done in cooperation with experts from danger prevention.
- Determine technical and organisational measures for sealing leakage.
- Determine the necessary measures for the disposal of the released substances stipulate the technical equipment needed and make them available... Determine who takes up the responsibility.

5.2. Is the tightness of the sealing system guaranteed for this period of time due to relevant proofs or due to sufficient operating experience?

On the basis of certificates

☐ No

On the basis of the production experience

☐ No☐ Yes☐ No☐ Not applicable☐ Action☐ No action

Remarks:

Examples of actions:Short-term measures:

- Definition organisational measure for regular checks and visual inspection of the sealing and their stipulation in the operating instructions.
- Documentation of positive operating experience relating to the tightness of the sealing system over a defined period of time.

Medium-term measures:

- Demonstrate the tightness of the sealing system for the defined period of time until the disposal of the substance with a laboratory test (The penetration depth of the liquid hazardous to water must not exceed 2/3 of the thickness of the sealing system).
- If it can not be proofed: Installation of detectors (leakage probes) sending alarm signals (optical, acoustical) to a central station when any substance is being released. Subsequent inspection of the sealing system by the staff.

Note: For existing sealing surfaces made of concrete for the collection of liquids hazardous to water WHC 1 and WHC 2 and gasoline (petrol, diesel, fuel oil, and engine oils) this Proof may not be required, if:

- The concrete surface has no visible damages,
- The concrete surface has a minimum thickness of 15 cm,
- The concrete has a nominal strength of 25 N/mm² (concrete B25).

Long-term measures:

- Construct new sealing surfaces. The following requirements have to be considered for concrete:
 - Construct a waterproof concrete of B35 quality (nominal strength 35 N/mm²).
 - Construction should be properly and professionally executed to guarantee the quality of the concrete. The construction should be supervised.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

Partially

☐

RC=40

No

☐

RC=90

6 Check of the tightness of the sealing system through regular inspections

6.1 Is the tightness of the sealing system checked regularly by experts and are the checks documented?

- ☐ Yes
 ☐ No
 ☐ Not applicable
☐ Action
 ☐ No action

Remarks:

Examples of actions:

Short-term measures:

- Regular check by an in-house expert and documentation of the check.

Medium-term measures:

- Check carried out by an external and independent expert.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

Partially

☐

RC=5

No

☐

RC=10

7 Sealing system for special substances

☐

relevant

☐

not relevant → 8

7.1 If the behaviour of the substances towards the sealing?

☐

Yes

☐

No → 7.1.1

☐

Not applicable

7.1.1. Are the surfaces affected regularly examined for leakage, damage and penetration?

☐

Yes → 8.

☐

No → 7.1.2

☐

Not applicable

7.1.2. Are other safety measures taken (for example, installation of detecting feelers, detecting any leakage), if the inspections mentioned above in the paragraph 7.1.1 are necessary, but were not undertaken?

☐

Yes → 7.1.3

☐

No → 8.

☐

Not applicable

☐

Action

☐

No action

7.1.3. Are these additional safety precautions suitable?

☐

Yes

☐

No

☐

Not applicable

☐

Action

☐

No action

Remarks:

Examples of actions:

Short-term measures:

- Planning of organisational measures and their documentation in the operating instructions.

Medium-term measures:

- Additional safety measure: Installation of detectors (leakage probes) sending alarm signals (optical, acoustical) to a central station. Whenever there is an alarm, the sealing system should be checked by the staff for possible leakage and penetrations.
- Demonstrate the resistance of the sealing system with a laboratory test (The penetration depth of the liquid hazardous to water must not exceed 2/3 of the thickness of the sealing system for the defined period of time according to topic no 5 of this check list).

Long-term measures:

- If a proof of the resistance of the sealing system is not possible and other suitable technical measures are not possible, the substance hazardous to water should be substituted.
- If a proof of the resistance of the sealing system is not possible and other suitable technical measures are not possible, then install a resistant sealing system.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

Partially

☐

RC=5

No

☐

RC=10

8 Penetration of the sealing systems by other technical installations☐

relevant

☐

not relevant → 9

8.1 Is the sealing system being penetrated by pipelines, cable or other construction material (floor, wall)?☐

Yes

☐

No → 9

☐

Not applicable

☐

Action

☐

No action

8.2 If the sealing system is being penetrated by pipelines, cable or other construction material, are the point of penetrations sealed with suitable sealants?☐

Yes

☐

No

☐

Not applicable

☐

Action

☐

No action

Remarks:

Examples of actions:Short-term measures:

- Sealing of floor and wall penetrations using appropriate aids to sufficiently prevent the substance from penetrating.

Medium-term measures:

- Prevent penetrations of floors, exceptions: Drainage outlet with shut-off device.
- Seal penetrations on wall surfaces properly to ensure a safe prevention of substances hazardous to water from penetrating the surfaces.

Long-term measures:

- For new installations: avoid penetrations of floors and walls.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

No

☐

RC=90

9 Joints of sealing systems☐

relevant

☐

not relevant

9.1 Are there joints within the sealing system?☐

Yes

☐

No → checklist is finished

☐

Not applicable

9.2 Can those joints fulfill the requirements on tightness and resistance towards the released water-hazardous substances?

- Is the sealing material sufficiently resistant toward the medium?

☐

Yes

☐

No

☐

Not applicable

- Is the joint free of cracks?

☐

Yes

☐

No

☐

Not applicable

- Does the material for filling the joints adequately adhere to the sealing system?

☐

Yes

☐

No

☐

Not applicable

☐

Action

☐

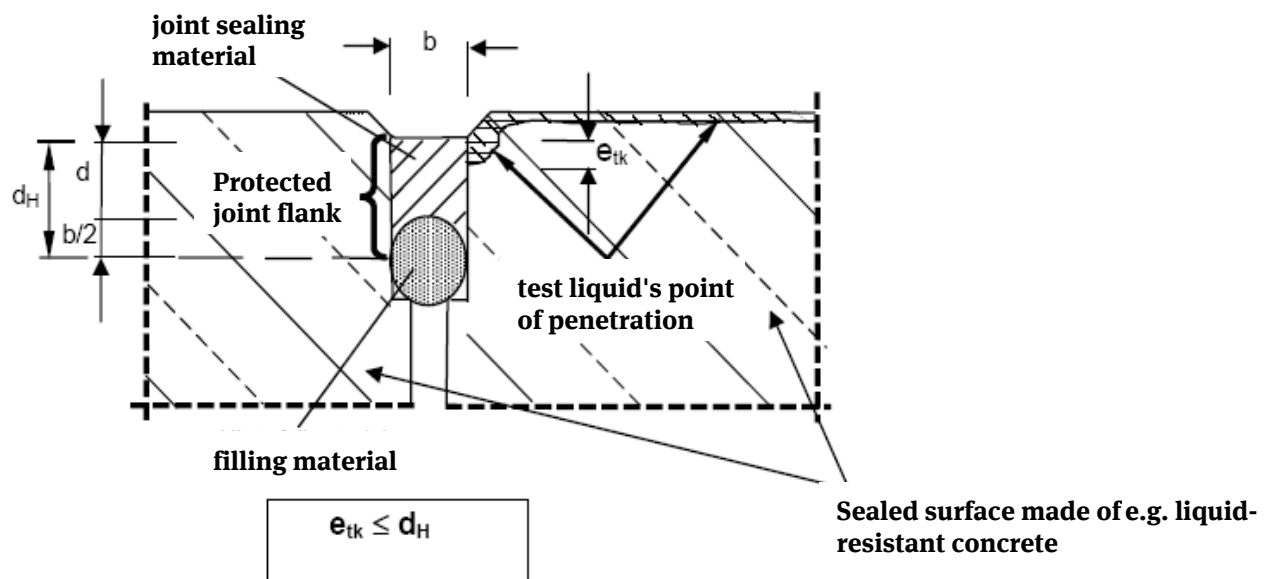
No action

*Remarks:****Examples of actions:******Short-term measures:***

- Repair existing joints when they are damaged. Ensure that regular checks are carried out by internal experts.
- Seal damaged joints with suitable material (e.g., asphalt).

Medium-term measures:

- Use of suitable material for filling the joints.
- Work concerning the joints should be executed by skilled personnel (e.g., providing the sealing system with flanks to guarantee a better binding, use under filling materials).
- Execution of jobs by a specialised firm.

Example: Seals construction with integrated joint sealing system

- d_H = contact surface of the joint sealing material at the joint $d_H = d + b/2$
 b = Breadth of joint sealing material
 d = thickness of joint sealing material ($d = 0,8$ to $1,2 \times b$)
 e_{tk} = typical penetration depth of liquid hazardous to water

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes

☐

RC=1

Partially

☐

RC=40

No

☐

RC=90

Summery of the Checklist

Sub-point of the Recommendation	Possible Risk category	Risk categories
1	1 / 40 / 90	
2	1 / 10	
3	1 / 5 / 10	
4	1 / 5 / 10	
5	1 / 40 / 90	
6	1 / 5 / 10	
7	1 / 5 / 10	
8	1 / 90	
9	1 / 40 / 90	

Average Risk of the Checklist (ARC)