Annex 1

Information for setting the overfill cut-out device of tanks

1 General

The following prerequisites must be fulfilled so that the overfill cut-out device can be set correctly:

- Filling height at 100% filling volume of the tank according to specification of the nominal volume on the type plate of the tank must be known,
- Filling curve must be known,
- Filling height that corresponds to the permissible fill level*) must be known,
- Filling height change that corresponds to the expected after-flow quantity must be known.

2 Permissible filling level

(1) The permissible filling level of tanks must be dimensioned so that the tank cannot overflow and that excess pressures, which affect the leaktightness or strengths of the tanks, do not develop.

(2) When determining the permissible filling level the coefficient of expansion of the liquids intended for filling a particular tank and the temperature increase possible during storage and consequent increase of the volume of the liquid must be allowed for.

(3) To store liquids without additional hazardous properties in stationary tanks, the permissible filling level at filling temperature must be determined as follows:

1) For above-ground tanks and buried tanks less then 0.8 m below ground level

$$\text{Filling level} = \frac{100}{1 + \alpha \cdot 35} \text{ in \% of capacity}$$

2) For buried tanks with a soil coverage of at least 0.8 m

$$\text{Filling level} = \frac{100}{1 + \alpha \cdot 20} \text{ in \% of capacity}$$

3) The mean coefficient of expansion α can be determined as follows:

$$\alpha = \frac{d_{15} - d_{50}}{35 \cdot d_{50}}$$

At this, d_{15} or d_{50} mean the density of the liquid at 15 °C or 50 °C.

(4) Paragraph (1) for liquids, regardless of the flash point, without additional hazardous properties, where their coefficient of expansion does not exceed 150 x 10^{-5}/K it can also be considered complied with if the filling level at filling temperature:

a) at above-ground tanks and buried tanks less then 0.8 m below ground level, does not exceed 95% and
b) with buried tanks with a soil coverage of at least 0.8 m does not exceed 97% of the capacity.

(5) If the liquid is heated more than 50 °C during storage or if it is filled in while cooled, the consequential expansion must be allowed for when determining the filling level.

(6) For tanks for the storage of liquids with toxic or caustic properties a filling level of at least 3% lower than specified in paragraphs (3) to (5) shall be observed.

3 Determination of the after-flow quantity after triggering of the overfill cut-out device

3.1 Maximum volume flow of the delivery pump

The maximum volume flow can either be determined by measurement (re-pumping of a defined amount of liquid), or can be taken from the basic pump data. The volume flow for tanks according to DIN 4119 is indicated on the plate of the tank.

3.2 Closing delays

(1) The response times, switching times and running times of the individual system parts must be measured, unless they are known from the corresponding datasheets.

(2) If manual activation of fittings is required for interrupting the filling process, the time between triggering of the overfill cut-out device and the interruption of the filling process must be estimated in accordance with the local conditions.

3.3 After-flow quantity

The total closing delay is obtained by adding the individual closing delays. The after-flow quantity is obtained by multiplying the total closing delay with the volume flow determined according to Number 3.1 and adding the volumetric capacity of the pipelines that should be discharged after triggering of the overfill cut-out device, if necessary.

4 Determination of the response height for the overfill cut-out device

The after-flow quantity determined according to Number 3.3 is subtracted from the liquid volume that corresponds to the permissible fill level.

The response height is determined from the difference with the help of the filling curve either through arithmetic determination or by volumetric measurement. Determination must be documented.

Calculation of the response height for the overfill cut-out device

Site of operation: _____

Tank No.: _____ Capacity: _____ (m^3)

Overfill cut-out device: Manufacturer/type: _____

Approval number: _____

1 Max. volume flow (Q_{max}): _____ (m^3/h)

2 Closing delays

2.1 Level sensor acc. to measurement/datasheet: _____ (s)

2.2 Switch/relay/etc.: _____ (s)

2.3 Cycle times for bus devices and process control: _____ (s)

2.4 Feedpump, Flowtime _____ (s)

2.5 Shut-off valve

- mechanical, manually operated

  time between alarm and beginning of closing _____ (s)

  closing time _____ (s)

- electrically, pneumatically or hydraulically operated

  closing time _____ (s)

Total closing delay (t_{ges}) _____ (s)

3 After-flow quantity (V_{ges})

3.1 After-flow quantity resulting from total closing delay:

$V_1 = Q_{max} \times t_{ges} / 3600 =$ _____ (m^3)

3.2 After-flow quantity from pipelines:

$V_2 = \pi/4 \times d^2 \times L =$ _____ (m^3)

Total after-flow quantity ($V_{ges} = V_1 + V_2$) _____ (m^3)

4 Response height

4.1 Quantity at permissible fill level: _____ (m^3)

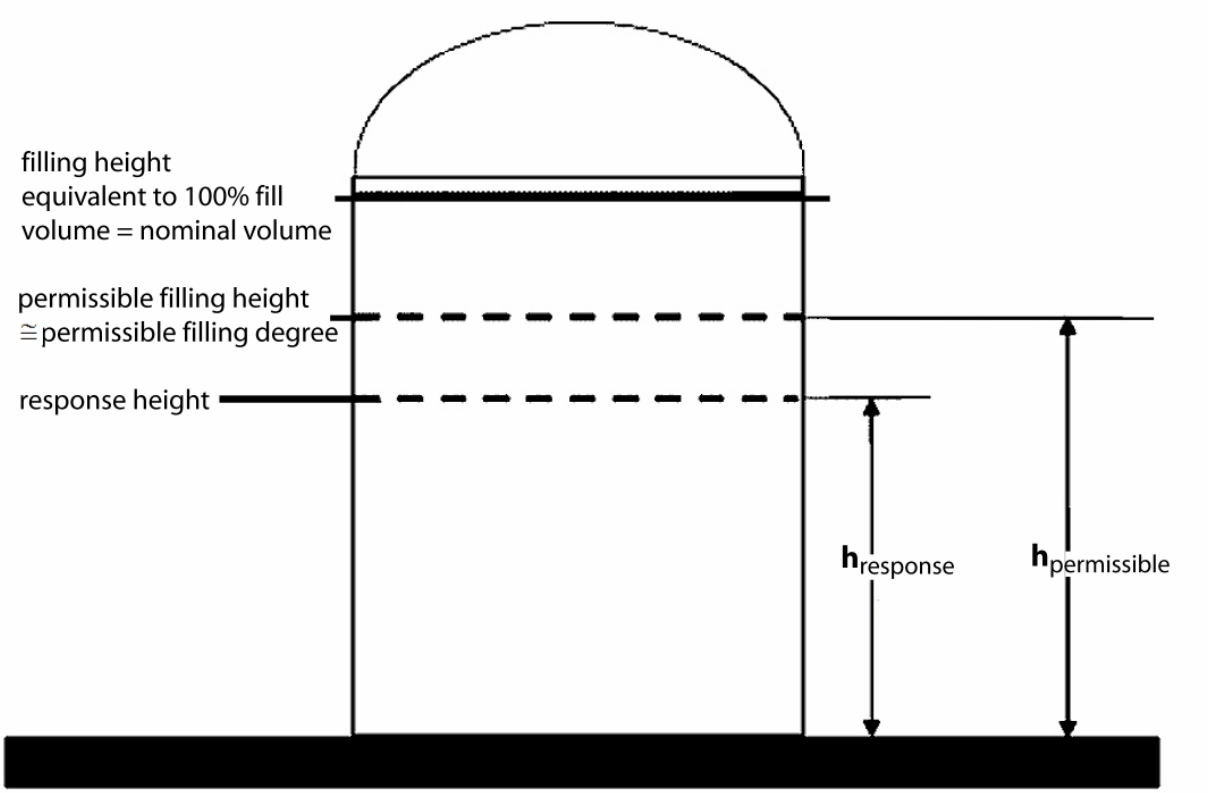
4.2 After-flow quantity: _____ (m^3)

Quantity at response height (difference of 4.1 and 4.2): _____ (m^3)

The response height is determined from the filling curve, through arithmetic determination or by volumetric measurement _____ (mm)

Example calculation of the limit signal amplitude for the overfill alarm for overfill cut-out devices with continuous level measuring unit

Other formula symbols see VDI/VDE 3519.



Response height determined according to Annex 1 to ZG-ÜS

X = amplitude of the limit signal that corresponds to the response height.

Calculation of the amplitude of the limit signal for

a) Standard signal between 0.02 MPa up to 0.10 MPa = at 0,2 bar up to 1,0 bar

$$X_P = \frac{h_{response}\ (0{,}10 - 0{,}02)}{h_{permissible}} + 0{,}02\ (MPa)$$

b) Standard signal between 4 and 20 mA

$$X_e = \frac{h_{response}\ (20-4)}{h_{permissible}} + 4\ (mA)$$

measuring range	standardized signal	
	MPa	mA
100%	0,10	20
	X_P	X_e
0%	0,02	4

Annex 2

Installation and Operating Guideline for the Overfill Cut-Out Device

1 Scope of application

This Installation and Operating Guideline is applicable to the installation and operating of overfill cut-out devices composed of several system parts.

2 Definitions

(1) Overfill cut-out devices are devices that interrupt the filling process or trigger an acoustic and optical alarm in good time before the permissible fill level in the tank has been reached (Calculation of the response height for overfill cut-outs, see appendix 1).

(2) All system parts required for interrupting the filling process or respectively for triggering the alarm are summarised under the term overfill cut-out device.

(3) Apart from containing parts with general building-authority approval, overfill cut-outs may also contain parts without general building-authority approval. Figure 1 indicates which parts require approval (parts to the left of the dividing line).

(4) Total pressures of between 0.08 MPa up to 0.11 MPa = 0,8 bar up to 1,1 bar and temperatures between -20°C and +60°C are considered atmospheric conditions in this context.

3 Structure of overfill cut-out devices

(refer to Figure 1 of the approval principles for overfill cut-out devices respectively Annex 1 of the general building-authority approval)

(1) The level sensor (1) records the level height.

(2) A continuous level measurement device is provided with a corresponding measuring transducer (2), which converts the liquid height into an output signal that is proportional to the level height, e.g. a standardised signal (pneumatic between 0.02 MPa and 0.10 MPa = 0,2 bar up to 1,0 bar, or electric 4-20 mA respectively 2-10 V or digitally via a suitable bus interface). The proportional output signal is sent to a limit signal transmitter (3) that compares the signal to settable limit values and delivers binary output signals.

(3) In level limit switches, the level height is converted in the level sensor (1) or in the corresponding measuring transducer (2) into a binary output signal or forwarded as digital signals to a suitable bus interface.

(4) Signals can be transmitted, for example, through pneumatic contacts or electrical contacts (switches, electronic circuits, initiator circuits) or as digital signals for bus interfaces.

(5) The binary output signal of the measuring transducer (2) or the limit signal transmitter (3) or the BUS communication signals of the measuring transducer (2) can be transmitted directly or via suitable analysis devices/signal amplifiers (4) of the signalling device (5a) or the control unit (5b) with actuator (5c).

(6) The proportional (analogue) or binary output signal can also be analysed through suitable electronic circuits (e.g. PLC, process control systems).

4 Installation and operation

4.1 Failure monitoring

(1) In the event of a failure of the auxiliary energy or in the event of an interruption of the connecting lines between the systems parts or failure of the BUS communication, overfill cut-out devices must stop the filling process or trigger acoustically or optical alarm. For overfill cut-outs according to these approval principles, this can be achieved by means of measures described in paragraphs (2) to (4), which at the same time enable the operating readiness to be monitored.

(2) Overfill cut-out devices must normally be secured in the closed-circuit principles or using other suitable failure monitoring measures.

(3) Overfill cut-out devices with level limit switch the binary output of which is an initiator circuit with standard interface must be connected to a switching amplifier according to DIN EN 60947-5-6. The direction of action of the switching amplifier must be chosen such that, in the event of a failure of the auxiliary energy or an interruption in a connection in the control current circuit, its output signal assumes the same state as in the event that the maximum fill level is reached.

(4) Where closed circuit principle switching is not possible for electrical circuits for hooters and lamps, the proper function of these must be easy to check.

4.2 Control air

The required auxiliary energy as pilot air must not contain any impurities having a particle size of >100 µm and must have a humidity that corresponding to a dew point of -25 ° C.

4.3 Specialist companies

Only firms that are authorised specialists for the installation, maintenance, repair and cleaning of overfill cut-out devices in accordance WHG (according to water law) may be used for carrying out such activities, unless the work is exempt from the obligation to use a specialist company in accordance with the regulations of the state, or unless the manufacturer of the level sensors and measuring transducers carries out above work using its own qualified personnel.

5 Checks and maintenance

5.1 Inspection prior to initial commissioning and recommissioned after close-down

After the installation of the overfill cut-out has been completed or the tank is recommissioned after close-down, inspection for proper installation and flawless function must

be carried out by an expert of the speciality company according to Section 4.3 or the operating company if a speciality company is not mandatory.

A new function test must be performed if due to a change of the storage liquid a change of the settings, e.g. the response height or function, is to be expected.

The performing expert must prepare an attestation with confirmation of proper function of the adjustment of the overfill cut-out and hand it to the operating company.

5.2 Operational test

(1) Proper condition and function of the overfill cut-out must be checked at appropriate intervals but at least once a year by an expert of the speciality company according to Section 4.3 or the operating company if a speciality company is not mandatory. The operator is responsible for determining the type of inspection and the intervals within mentioned period. The inspection must be carried out in a manner that perfect function of the overfill cut-out device in interaction with all components is proven.

- For this, the response height must be approached during a filling.
- If filling up to the response height is not feasible,
- the level sensor must be made to trigger by suitable simulation of the fill level or the physical measuring effect or
- if proper operation of the level sensor/measuring transducer can be determined differently (exclusion of any function-impairing faults), the test can also be performed by simulating the corresponding output signal.

(2) If the operator does not have technically qualified personnel, it must make use of the services of a specialist company for the test.

(3) The requirements of recurring testing regarding proper function may be deviated from for fail-safe parts of overfill cut-outs if

- Components with special reliability (fail-safe properties) or safety-specific devices according to VDI/VDE 2180 (Fail-Safe System) are used or this was substantiated through an equivalent standard.
- and this has been proven for the tested system parts in the general building-authority approval.

5.3 Documentation

The results of the tests according to numbers 5.1 and 5.2 must be recorded and filed.

5.4 Maintenance

The operator must regularly service the overfill cut-out device to the extent as this is necessary for maintaining its proper function. Observe the recommendations of the manufacturers in this regard.