Railcar filling tube systems

for loading of railcars according to the ON-SPOT principle

ON-SPOT

Loading Terminal

LOADING YOUR FUEL

Dipl.-Ing. SCHERZER GmbH

www.scherzer.net

key facts

ON SPOT Loading Terminals boost your loading capacities

- FULLY AUTOMATED FILLING PROCESS
- SAFER OPERATION DUE TO INTEGRATION OF HIGHLY SOPHISTICATED MONITORING SYSTEMS
- HIGH SPEED FILLING PROCESS UP TO 720 M^3/H (APPROX. 4,500 BBL PER HOUR OR 190,000 GAL/HR)
- SMALLER FOOTPRINT YIELDS LESS HAZARDOUS AREA
- LOWER LABOR RATE DUE TO LESS OPERATOR PERSONNEL REQUIRED
- LOWER NUMBER OF FILLING POINTS COMPARED WITH SERIAL LOADING SYSTEMS
- FUEL AND VAPOUR RETURN CONNECTION IN ONE STEP. VAPOUR RETURN IS INTEGRATED IN THE FILLING TUBE

Introduction

ON SPOT Loading Terminal

Functional description

ON SPOT rail car loading terminals rapidly transfer bulk liquid hydrocarbons and mixtures thereof while meeting the highest standards of fire protection, operational safety and user-friendliness of the complete automated plant.

Dipl.-Ing. SCHERZER GmbH has extensive practical experience with providing loading systems for rail cars using the ON SPOT principle for discerning customers worldwide and for all types of rail car configurations.

ON SPOT facilities are filling stations for rail cars with a top loading system and an extremely high filling capacity. The telescopic filling tube is arranged inside the ON SPOT facility and above the rail cars on a hydraulically movable filling tube slide. The slide can be moved in all horizontal directions, and the filling tube is retractable in the vertical direction.

The rail cars are put in place by a locomotive and decoupled in front of the ON SPOT facility. The first rail car is pulled in by a car pulling device or a remote-controlled shunting vehicle and positioned under the filling station.

The filling pipe is operated / moved from the control panel in the operator room located close to the track or between the tracks and inserted into the rail car dome. Then, the rail car is loaded in an automatic mode. When loading is completed , the filling tube is extracted and then the car pulling device/shunting vehicle positions the next rail car under the filling station. This process repeats until the last rail car of a group of coupled rail cars has been loaded.

Types of On Spot Terminals:

ON SPOT facilities are differentiated by the number of tracks and filling points. Facilities range from single-track with one filling point to double-track facilities with four or more filling points.

The design depends on the required daily and annual loading capacities and the footprint available for the coupled rail cars as well as the pump capacity.

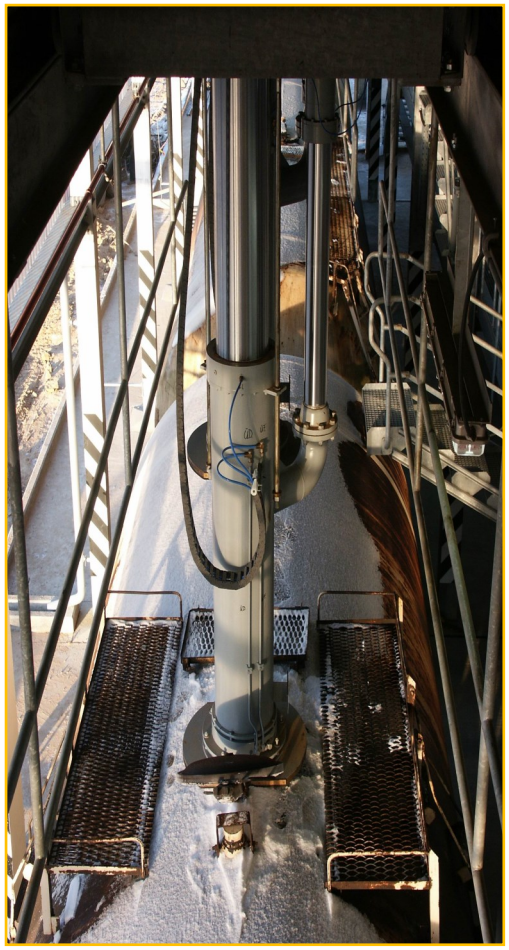
Filling tube system

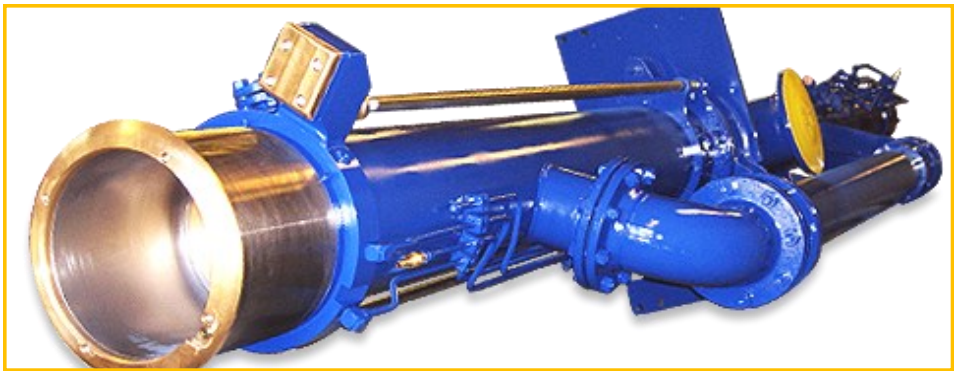
Combustible liquids are supplied to the railcars via the hydraulically actuated telescopic filling tube system according to the On-Spot principle. The products can be supplied to the filling tube system via different product lines and the relevant product headers. At every track there is an option for loading a wide variety of products through one or more filling tube systems (1, 2 or more active filling points per track are possible). Another option includes the possibility of installing multiple filling tubes per filling tube point for loading of products that are incompatible with one another.

The filling system is automatically drained completely after every loading operation based on the block valve arrangement and piping geometry.

Filling tube system basically consists of:

1) Filling Tube Slide Car
2) Telescopic Filling Tube
3) Articulated piping
4) Hydraulic unit
5) Filling Tube control system
6) Pneumatic control cabinets on the filling tube slide and monitoring features
7) Hermetically sealed system at the RTC dome
8) Electrical Ground Tester
9) Drop collector
   (Option - for more information please refer to our separate brochure)
10) Camera supported filling tube positioner
    (Option - for more information please refer to our separate brochure)
11) Rail car number detection
    (Option - for more information please refer to our separate brochure)





1) Filling Tube Slide Car

The filling tubes of a track are installed either parallel to one another or along the track . The filling tube sled is mounted on rollers and permits with the aid of the hydraulic system movement crosswise (+/- 100 mm (4 Inch)) and lengthwise (up to approx. 10 m (33 ft)) of the filling tubes. The crosswise movement is implemented with the aid of one or two hydraulic cylinders, which operate in parallel. The lengthwise movement is actuated by means of a hydromotor.

The commands for the crosswise and lengthwise movement are initiated by joystick operation at the operator console in the control room. Operating personnel can visually monitor the filling point through the windows in the control room and can thus position the selected filling tube for loading operations precisely over the dome opening by means of the crosswise and lengthwise movement. The limits of the lengthwise and crosswise movement are scanned by sensors.

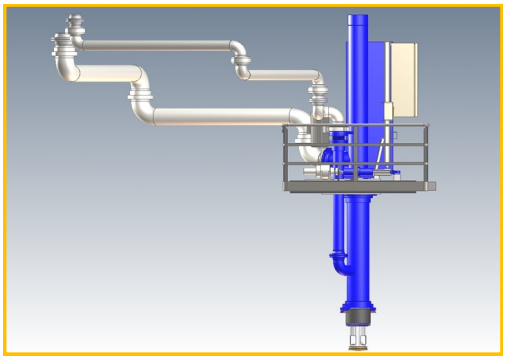
2) Telescopic Filling Tube

The filling tubes are manufactured in tight tolerances, using quality materials and sophisticated machinery. The weight of a filling tube depends on the design and typically ranges between 1,800 –2,200 kg (4,000 - 4,800 lbs). The guide surfaces are plated with hard chromium and include bronze elements. The wall thickness is designed for a 10-20 mm range (1/2 - 3/4 Inch) depending on the filling tube components to ensure a very long service life. If maintenance is carried out on a regular basis, it is possible to achieve service lifes of up to 45 years.

For extending and retracting, the filling tubes are equipped with internal or external hydraulic cylinders, allowing the filling tubes to extend to different lengths in order to accommodate different types of country-specific rail cars. The end positions "filling tube up" and "filling tube inserted in railcar" are monitored with the aid of proximity switches. The filling tube is also optionally equipped with a mechanical stop for its upper end limit. The product is supplied through filling tubes having an inner diameter of 200 to 300 mm (standard filling tube 230 mm, or 9 inches) and the product connecting nozzle of the articulated or telescopic lines. The gas return also takes place in the filling tube and the vertical telescopic pipe via the product connecting nozzle of the articulated or telescopic gas line. The inflatable sealing bellows mounted on the filling tube or the sealing plate provide for a hermetic seal with the railcar during the loading process. The filling tubes are equipped with an overfill safety based on the bubble gauge principle or with a special mechanical overfill safety sensor (PTC thermistor technology or vibration technology) and pressure monitoring to ensure tank car backpressures remain below suitable thresholds during the loading process.

All parts that come in contact with railcars are made of bronze. The railcars are grounded upon contact with the filling tube by means of ground contacts at the filling tube and monitored with the aid of an optional grounding system tester (automatic grounding). If the automatic grounding system should indicate a failure in the grounding of the railcar, the grounding is then provided by a second grounding tester. The ground monitoring system for railcars is based on country-specific requirements. In Germany, for instance, a separate ground monitoring system is not necessary for railcars.

Other monitoring systems are implemented in the associated pneumatic cabinet and hydraulic cabinet.



The decision on which system is to be used for connecting the filling tube equipment with the plant equipment depends on the necessary working range of the filling tubes. This working range in turn depends on the dimensions of different railcars that are to be loaded.

The vapor return of the filling tube is connected to the vapor return line via an articulated vapor line or a telescopic vapor line. The continuous pressure monitoring of the gas phase in the railcar and the vapor line protects the vapor system from any unacceptable overpressure or negative pressure.

The filling tubes are connected to the different product manifolds via the articulated or telescopic lines. The articulated or telescopic lines used for product lines and vapor line allow the filling tube to move in a horizontal plane (to the left and right, forwards and backwards).

4) Hydraulic Unit

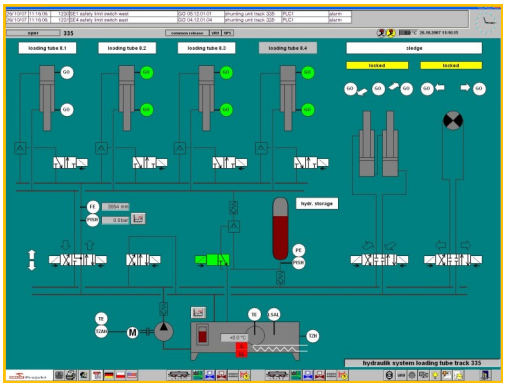
One hydraulic system is usually installed for every filling tube system. The hydraulic system (designed according to ATEX directives and/or country-specific requirements on explosion protection) is responsible for controlling the filling tube mechanism. The hydraulic pressure necessary for the required hydraulic movement is provided by a hydraulic pump.

The hydraulic motor is only actuated if hydraulic pressure is required by the corresponding functions. The following functions are provided:

- Selection of filling tube
- Filling tube up and/or down
- Filling tube slides to the left and/or right
- Filling tube slides forward and/or backwards
- Filling tube upwards via hydraulic accumulator
- Bypass valve

General Hydraulic System:

The hydraulic system is installed in a sealed protective housing. The protective housing accommodates the hydraulic oil tank with hydraulic heating, the hydraulic motor, filters, the control valves, the volumetric counter, holding tank for the emergency raising of the filling tube and the associated measuring sensors which are wired to the terminal box. The hydraulic system is usually mounted on the filling tube slide so that it move with the slide. The necessary connections are implemented with a drag chain. All magnetic valves are directly controlled and thus have a very reliable and durable design.



Hydraulic Oil Tank

The welded steel hydraulic tank is equipped with an oil drain cock and an oil level glass. The tank is also equipped with a filling filter with vent and a level controller for oil level gauge. A heater cartridge is mounted under the tank for heating up the hydraulic oil. A PT 100 thermocouple is installed with a transmitter (4-20 mA) for monitoring the temperature of the hydraulic oil. The hydraulic tank has a collective return line filter mounted on the tank plate and a level controller.

Motor Pump Drive

The motor pump unit is mounted on the tank cover. Motor and pump are joined with a clutch housing via a flexible coupling. The motor is protected against inadmissible overheating by means of a temperature monitor.

Hydraulic Receiver for Emergency Raising of Filling Tube

The hydraulic pump conveys the hydraulic oil to the receiver circuit via a check valve and fills the hydraulic receiver.

The electrical contact manometer that is monitored with a proximity switch to display "Hydraulic receiver full" is set to 125 bar (~ 1800 psi). At the customer's request, pressure transmitters (4-20 mA) may also be used.

The receiver shall be filled prior to every hydraulic movement. Movement is only released after the pressure switch "Hydraulic receiver full" has been triggered.

In case of power failure or emergency off, the filling tube or the filling tubes are raised to their park positions using the hydraulic receiver.

Filling Tube Slide Crosswise Movement

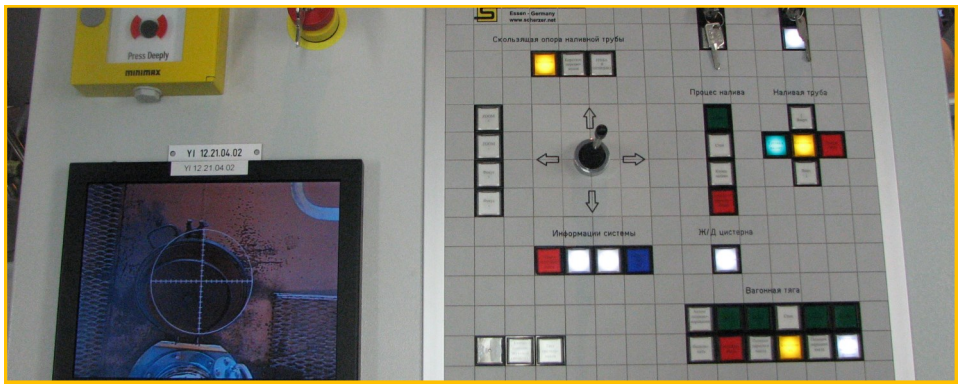
The crosswise movement of the filling tube slide (perpendicular to track) is implemented by one or two hydraulic cylinders and the actuation of the related hydraulic valves. The travel speed of the cylinders is adjusted at the existing flow control valves.

The crosswise movements are limited by sensors positioned at the end positions. The middle proximity switch for crosswise movement indicates the position of the filling tube over the exact center of the track. The number and position of the proximity switches are to be tailored to the customer's specific requirements.

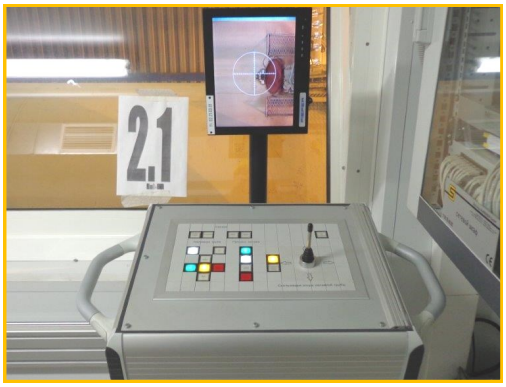
Filling Tube Slide Lengthwise Movement

The lengthwise movement of the filling tube slide (in track axis) is driven by means of a hydromotor or a hydraulic cylinder. The hydromotor moves the filling tube slide on the filling tube frame to the right and left using the gearbox and rack gears.

The travel speed of the hydraulic motor is adjusted at the flow control valves. The lengthwise movement is limited by the limit switches (proximity switches) at the end positions on the left and right. The filling tube must be raised for lengthwise movement.



5) Filling Tube control system



The filling tubes are controlled by means of the valve block. The filling tube that is to be moved is selected by using the respective servo valve. The solenoid valves for moving the filling tubes regulate the hydraulic pressure at the hydraulic cylinder installed in the filling tube and thus facilitate movement up and down. The travel speed can be adjusted continuously at the speed throttle valves.

The respective solenoid valve is actuated when extending a filling tube. After the filling tube is extended, the respective solenoid valve is switched off.

The respective solenoid valve is actuated when extending a filling tube.

The filling tube is optionally equipped with a mechanical stop in the park position. This reliably prevents the filling tube from lowering, regardless of the hydraulic. The stop is a mechanism, which automatically clicks in place when raising the filling tube and holds the filling tube in the park position.

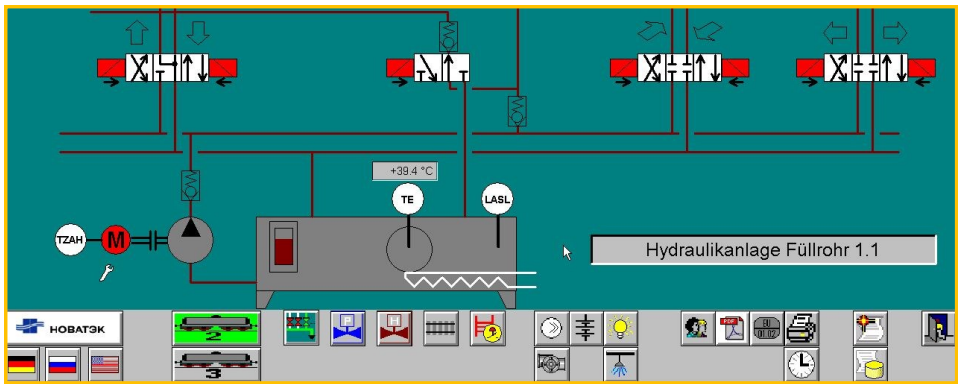
The filling tube has two proximity switches, which facilitate the monitoring of the filling tube's position. The "Filling tube up" proximity switch indicates that the filling tube is in the park position. The "Filling tube retracted" proximity switch indicates that the filling tube has been extended already roughly 1.5 m (5 ft) and thus the discharge opening is located in the railcar.

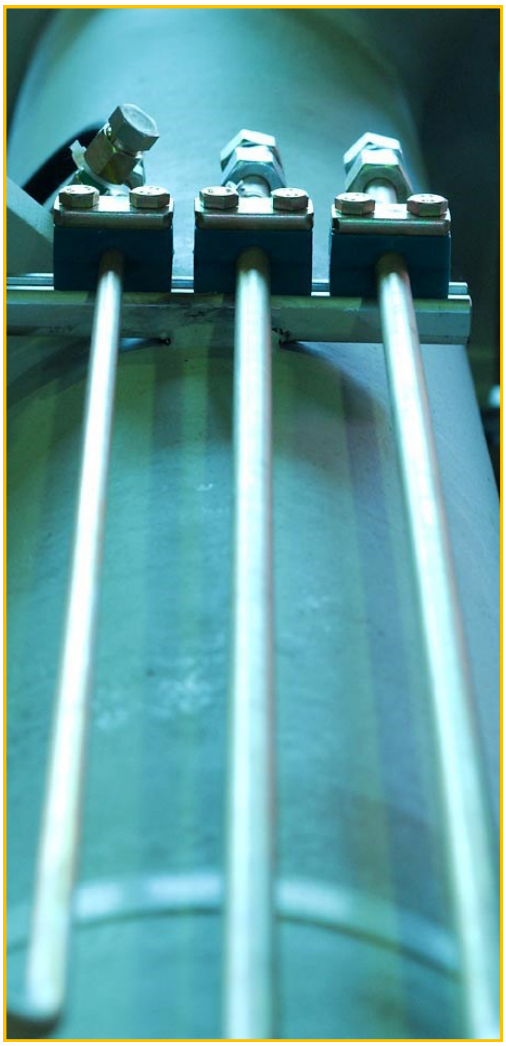
The downward movement is switched off when the set pressure is attained. Depending on the distance travelled already, it is possible to evaluate by using a hydraulic meter, whether the bottom of the railcar was reached (loading position) or the filling tube was moved up to an obstacle.

To prevent any electrostatic charges arising during the filling process, the product flow rate is limited to a maximum 730 m^3/h (4592 bbl/h) per filling point.

The filling process control system is also implemented for the following functions:

- Preadjustment of loading quantities per railcar
- Maintenance of rate of flow
- Automatic and controlled shutdown, as soon as the preset quantity has been reached without causing any pressure surges.





Bypass Valve

By actuating the bypass valve, the hydraulic oil is directly drawn off pressurelessly to the hydraulic oil tank.

Hydraulic Pressure and Hydraulic Meter

There is a pressure transmitter and a small flow meter installed in the hydraulic system. The measurements are used for positioning and monitoring of filling tubes in the railcar.

The counter pulses of the hydraulic meter are converted in the travel of the filling tube and can be shown on the visual display system in the control room.

This facilitates the implementation of the drip/drain position or similar with millimeter accuracy.

Safety Feature in Case of Power Failure and Emergency Stop

In case of power failure or emergency shutdown, the power of all solenoid valves is switched off and the hydraulic pump stops. The filling tube travels automatically to the upper safe end position with the aid of the hydraulic receiver.

Visual Display System and Service Functions of Hydraulic System

The hydraulic system may be indicated in a separate visual display screen with all valve controls, measurements and error messages (if controllers are used by Dipl.-Ing. SCHERZER GmbH). Here it is also possible to make manual changes for servicing and maintenance purposes.

6) Pneumatic Control Cabinets on the Filling Tube Slide and Monitoring Features

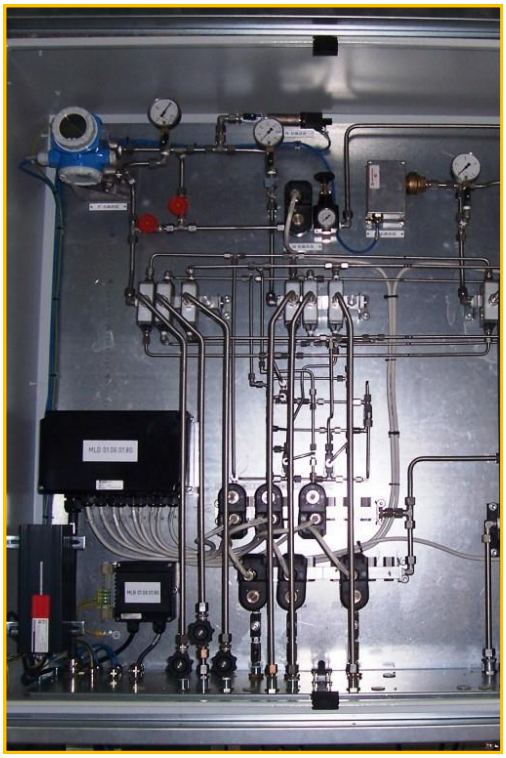
A pneumatic system is installed for each filling tube system of a track. The pneumatic system is responsible for controlling and monitoring the sealing bellows (applicable for railcars without any internals in the dome area), the overflow safety and the overpressure monitor system of the railcars during the loading process. All air lines are routed to the air connections of the outer tube via the vertical drag chain of the filling tube.

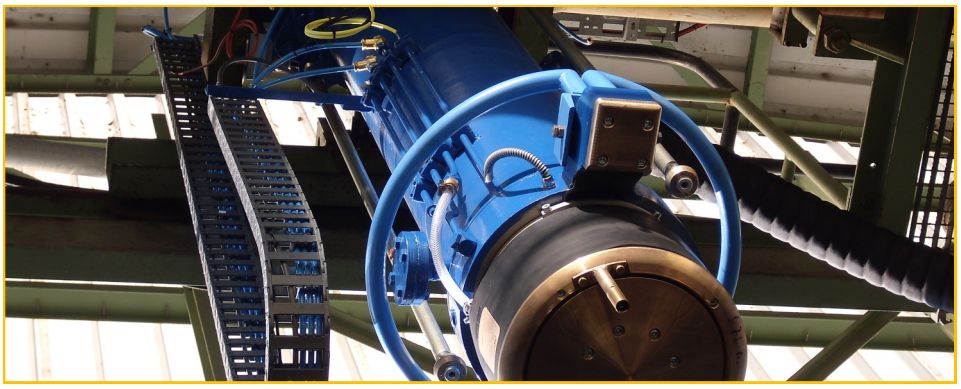
The pneumatic cabinet is usually equipped with an insulation and an electrical heating and is mounted on the filling tube car. The necessary connecting cables (electric and pneumatic) are routed over a drag chain.

General, Actuation of Filling Tube

The instrument air is cleaned by means of the filter and the condensate is discharged by the automatic drain system. In line with the selected filling tube, the assigned 3/2-way solenoid valve is actuated for activating the overfill safety, overpressure monitor and sealing cushions.

A filter controller is installed upstream of the 3/2-way solenoid valve for the filling of the sealing cushion. A high-precision pressure regulator is installed upstream of the 2/2-way value of the overfill safety.





Overfill Safety

The overfill safety can be implemented in 3 different variations. Country-specific requirements or customer requests are also possible:

The following systems are available:

- Limit switches with vibration technology
- PTC thermistor sensor
- Differential pressure meter (pneumatic based on the bubble gauge principle)

Limit switch with vibration technology (usable up to -60°C or –76°F):

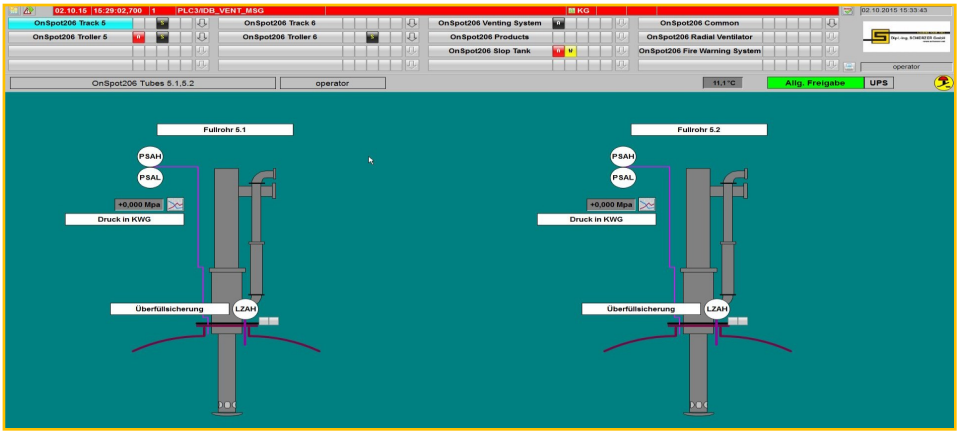
This variation is usually used for filling tubes with sealing plates.

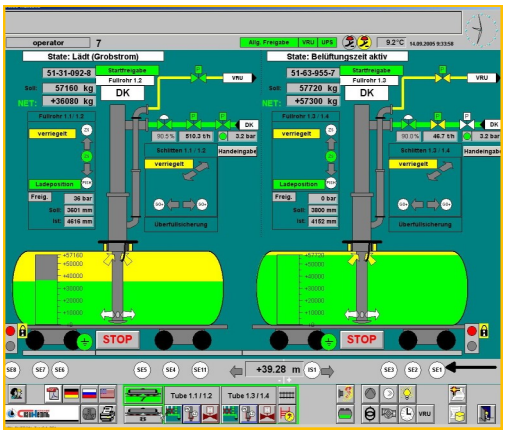
In this case, a vibration sensor is installed in a protective tube and can be set to a fixed length with the aid of alignment screws.

PTC thermistor sensor (usable up to -25°C or -13°F):

Dipl.-Ing. SCHERZER GmbH has relied on this type of overfill safety for the past few years, since the sensor no longer comes in contact with the product, thus achieving a further reduction in the drip quantity. The measuring probe comprises an encoder (encapsulated PTC thermistor) and a probe tube. The changed electrical resistance at the encapsulated PTC thermistor is used to identify the liquid level.

A protective sleeve serves to protect the sensor from any damage during insertion in the dome.





Differential Pressure Meter (Bubble Gauge Principle):

Tried and tested technology in the area of the overfill safeties with 2 connecting lines discharging to the atmosphere at the railcar. A line ends with a tube and a sensor in the railcar's dome area.

The level is determined here by way of the differential pressure during insertion of the sensor in the product and correspondingly shut down.

The system depends on the pressure conditions in the gas displacement system and cannot be used everywhere.

When starting up the filling tube system, the respective overfill safety is adjusted such that the shutdown of the overfill safety is effected if the maximum permissible filling level is attained!

Pressure Measurement of Gas Phase

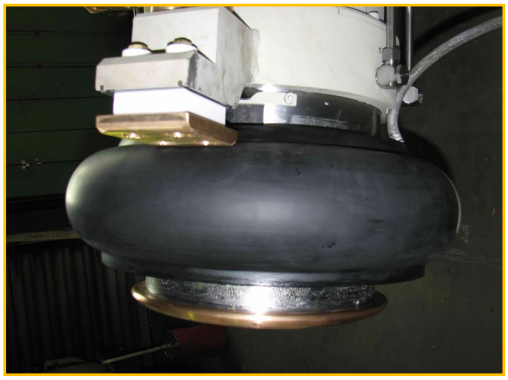
By actuating a filling tube, the pressure compensation line is switched to the corresponding filling tube. The air line of the pressure transmitter is thus connected with the pressure gauge line of the actuated filling tube.

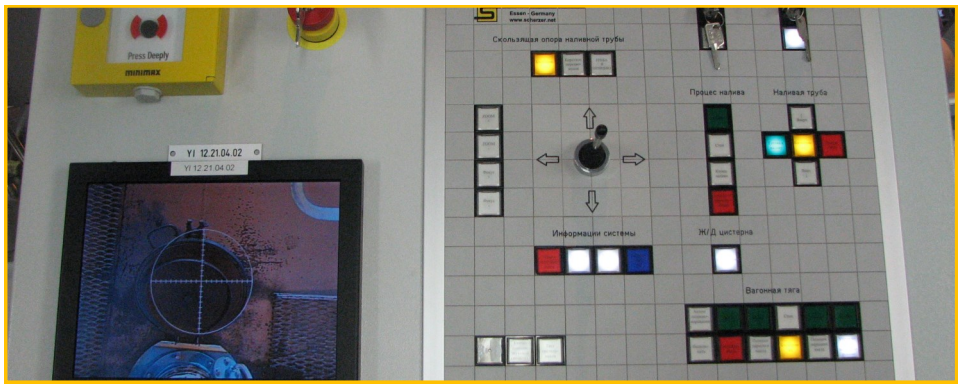
This allows for monitoring the pressure in the railcar. In case of a pressure increase of up to 300 mbar (4.5 psi) in the gas line, the filling process is automatically shut down.

Inflating the Sealing Bellows

By actuating a filling tube, the pressure line of the sealing bellows is connected to the corresponding filling tube. The impermeable cushion seals the dome with an operating pressure of 1 - 1.5 bar, g (14.5—22 psi, g).

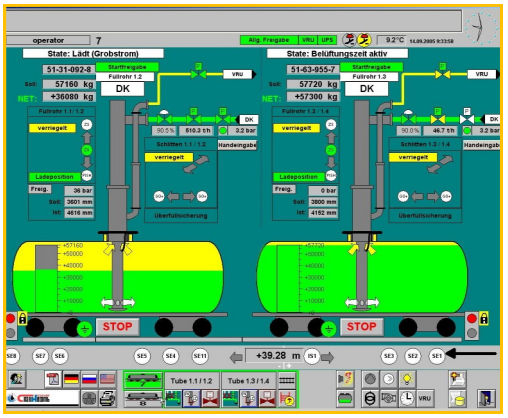
When moving the filling tube upward, the pressure in the impermeable cushion must be decreased (monitoring of pressure switch) to ensure that the impermeable cushion at the filling tube is not damaged. This is monitored by the PLC .





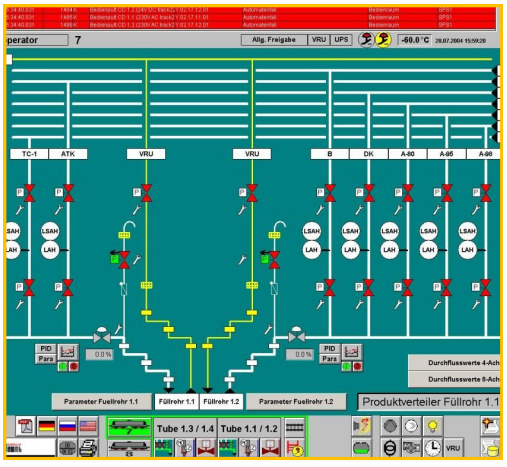
Switchgear Cabinet Heater

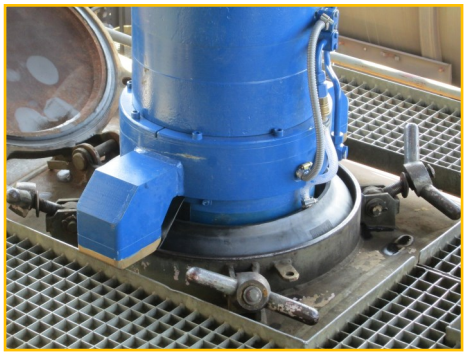
The temperature of the interior of the pneumatic switchgear cabinet should not fall below -5°C to -10°C (23°F to 14°F) . To this end, country-specific switchgear cabinet heaters are installed.

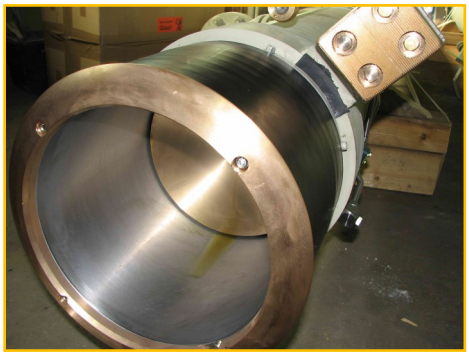


Indication on Visual Display System (with Dipl.-Ing SCHERZER GmbH controllers)

- Current value of overfill safety
- Overfill safety min. (overfill safety ready for operation)
- Overfill safety max. (Overfill safety max. alarm)
- Pressure switch for impermeable cushion
- Pressure in the railcar
- Pressure in the railcar min.
- Pressure in the railcar max.
- Schematic diagram for actuation of the pneumatic valves







7) Hermetically sealed system at the RTC dome

To ensure an emission-free loading process, the filling tube and the railcar dome is hermetically sealed during the filling process.

There are 2 variations in this regard :

A) Inflatable sealing bellows (inner dome sealing)

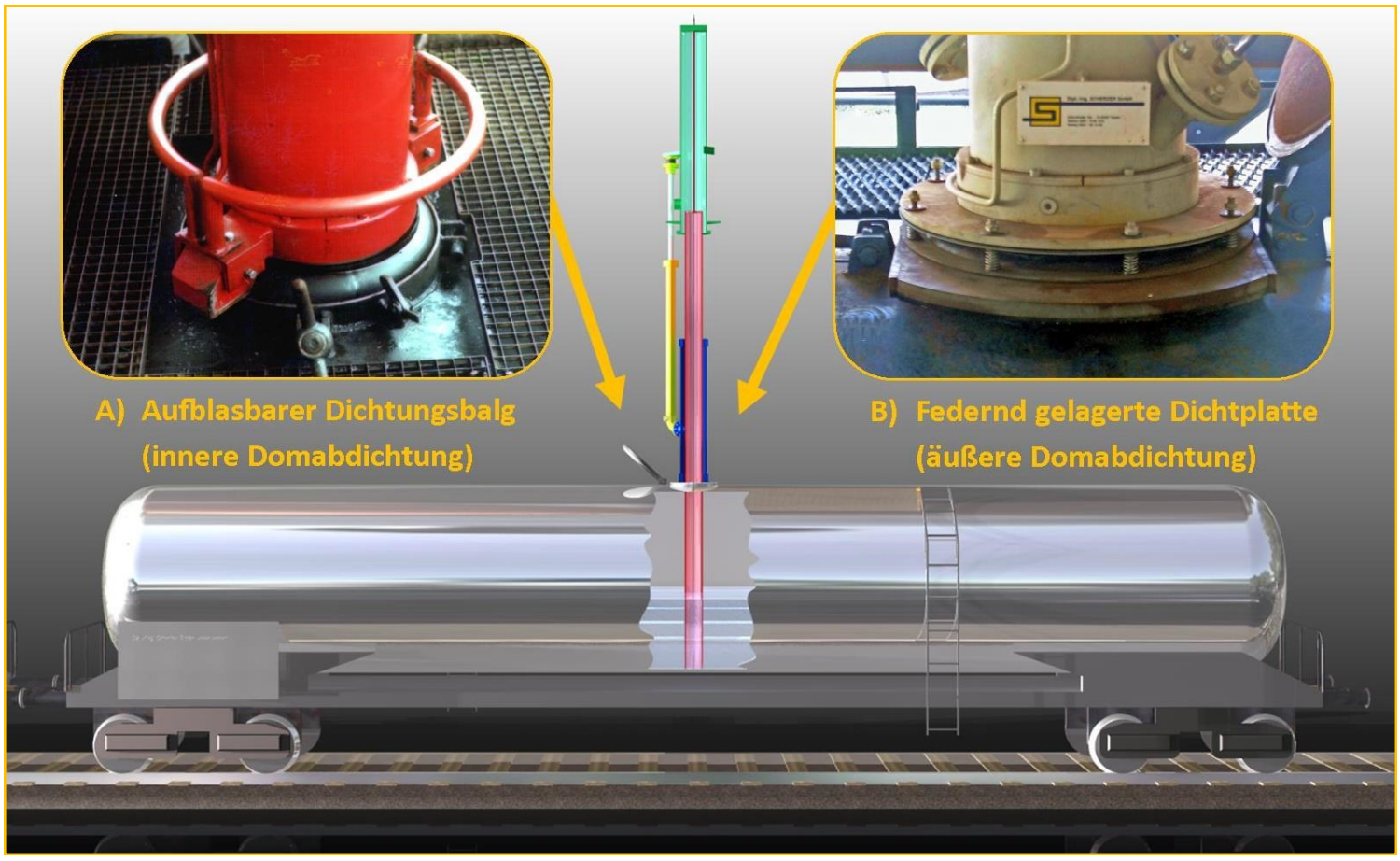
Applicable with railcars without any internal components in the railcar dome, used primarily in WEST EUROPE, USA and Canada

- Inflatable bellows especially manufactured for the Scherzer filling tube
- Automatic centering of the filling tube via a expansion joint in the filling tube
- Monitoring of leak-tightness and the bellows via pressure switch
- For more details, see presentation of filling tube seal with sealing bellows

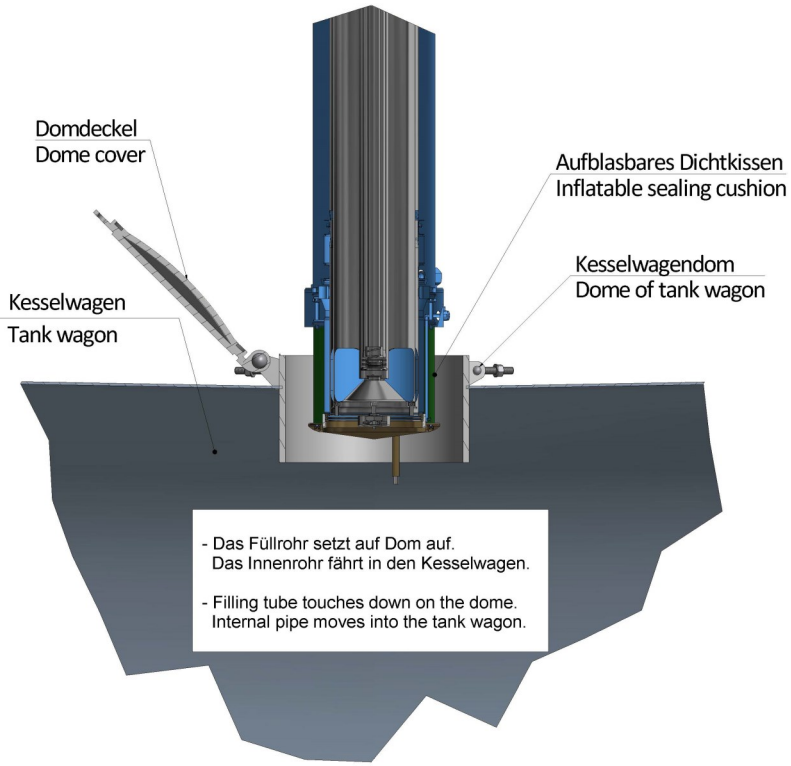
B) Spring-mounted Sealing Plate (Outer Dome Sealing)

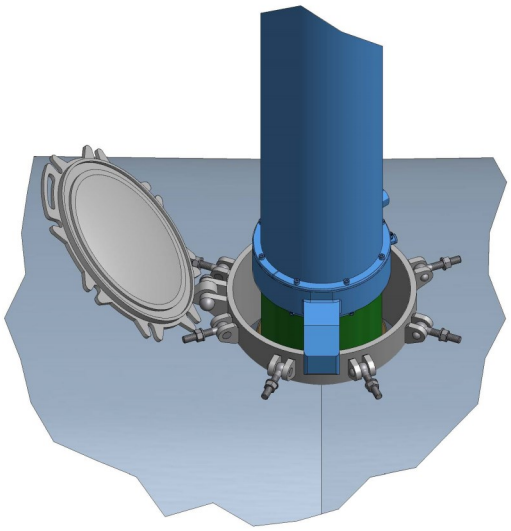
Applicable with internal components in the railcar dome, primarily used in EASTERN EUROPE
(even applicable in installation-free domes)

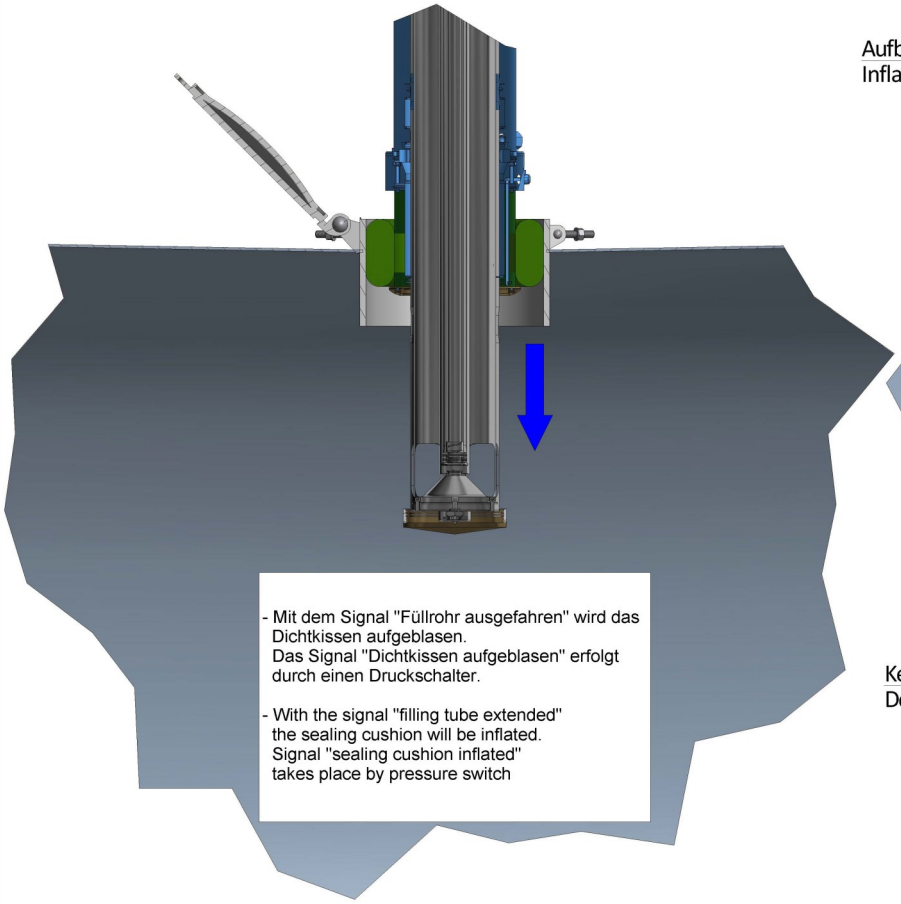
- Spring-mounted sealing plate, specifically manufactured for the Scherzer filling tube
- For more details, see presentation of filling tube seal with sealing plate

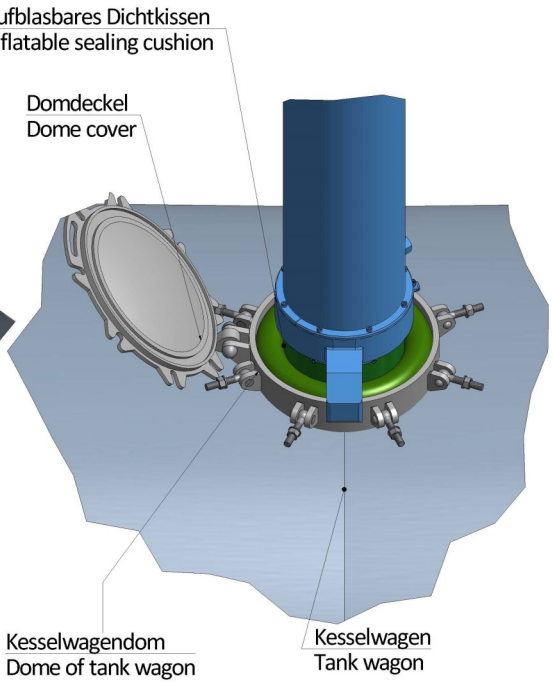


A) West european version with sealing cushion:

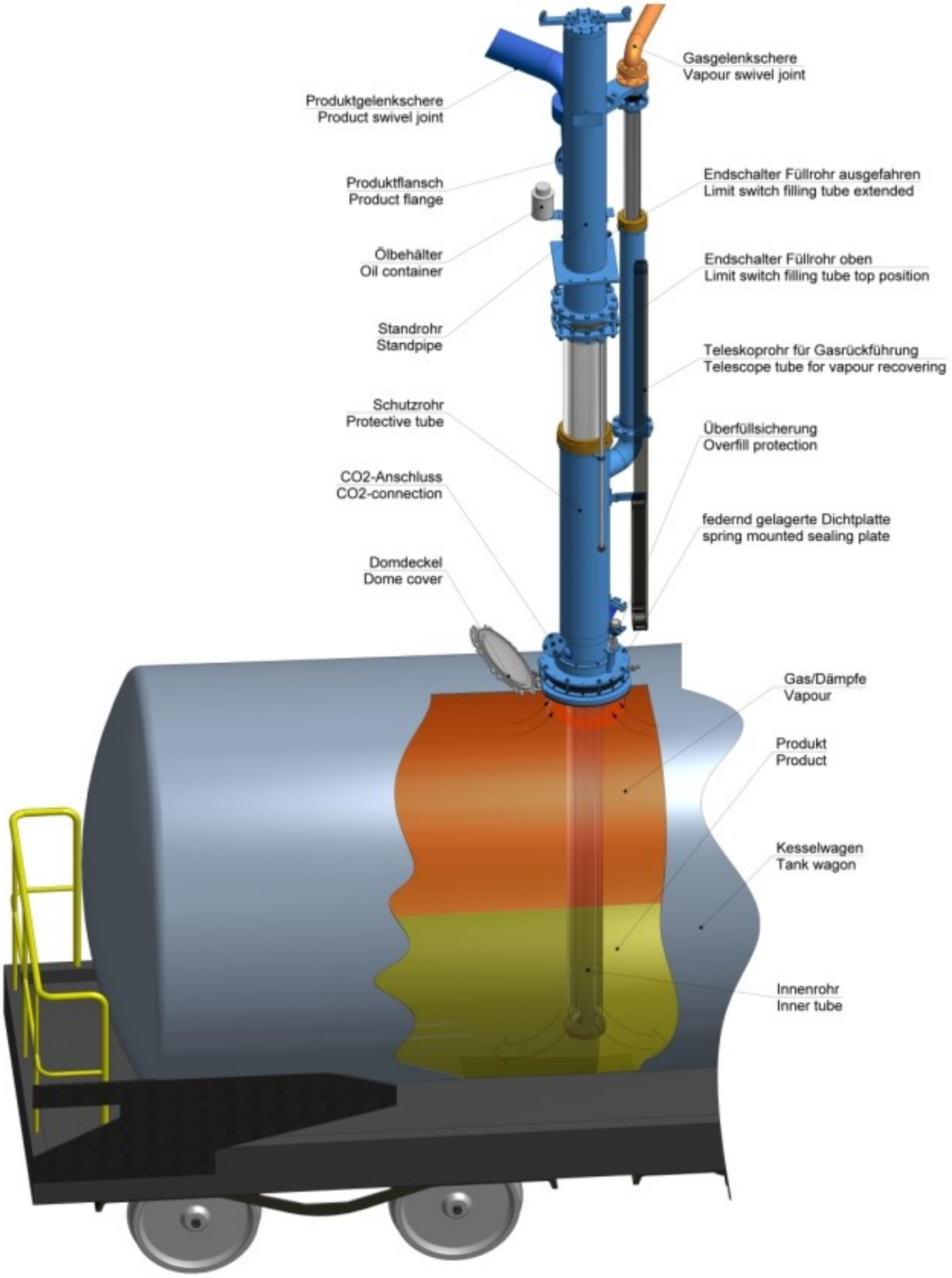






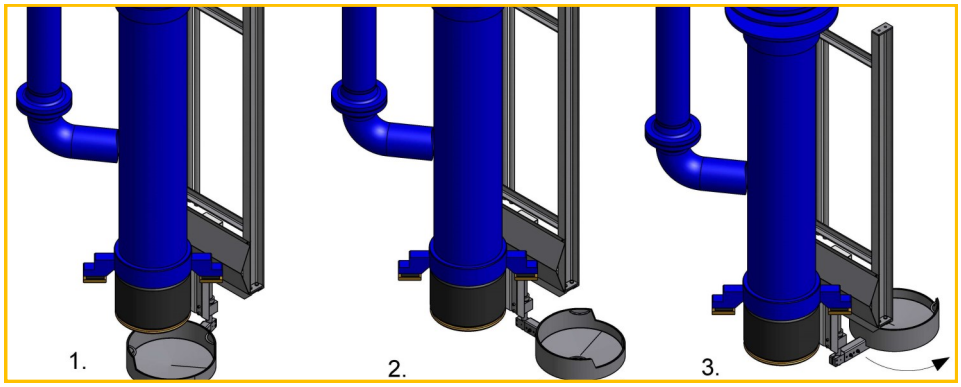


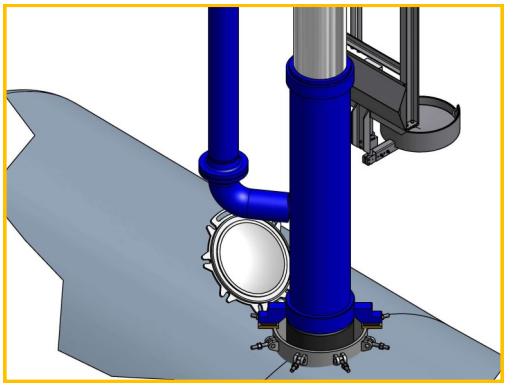
B) East european version with sealing plate:



Advantages of On Spot Loading Terminals with telescopic filling tubes:

- The Scherzer filling tube is made on very sturdy machine equipment. Many filling tubes supplied by us have been in service for more than 40 years.
- The guide faces of the tubes are ground and hard chromium plated. The components in contact with the tank car are made of brass or red bronze such as the sealing plate (East European railcars) and the sealing pad of NBR.
- Longitudinal and transverse movement of the filling tube for exact position is hydraulically remote controlled.
- The compensator allows flexible deflection of the conduit and internal tube. It is not necessary to position the filling tube exactly in the centre on top of the dome opening.
- The lower filling tube is automatically centred by inflating the sealing bellows.
- During the whole loading process, the claws contact the dome tightly. The sealing bellows is not subjected to rubbing movement; thus the bellows have a long lifetime cycle.
- The sealing bellows and can be replaced easily at low cost.
- The gas is returned via a separate high-quality telescopic tube with multiple sealings. Thus will ensure that no condensate can be accumulated in the system can happen with hose return systems.
- Sealing of the filling tube after moving out of the tank car is performed by two O rings. Residual amounts dripping from the inner tube walls will be collected in the tube (max. 10 liters (2.5 gal)). These residual amounts will be drained into the empty tank car during the next loading process. If this mixture (for product changes only) cannot be accepted in special cases it is possible to drain the residue automatically.
- The PCS controlled loading process meets all safety requirements. On request, each filling tube position can be shown visually, and the filling tube lift can be limited depending on the type of tank car used.
- High safety in operation is achieved by the overfilling safeguard, overpressure safeguard and continuous loading display.

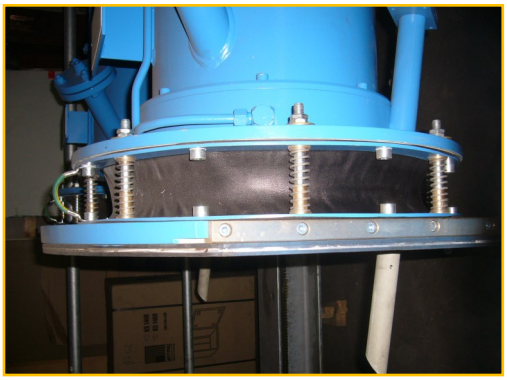




OPTIONS:

8) Ground testers montoring system (Optional)

No ground tester monitoring system is required in most Western European countries, since railcars are deemed grounded by contact with the tracks. An additional ground tester monitoring system is required by the grounding tester in some countries. Dipl.-Ing. SCHERZER GmbH supplies a system ensuring that the ground is automatically established between the filling tube / cover tube and the railcar and is evaluated for further sequence control. If it is not possible to attain the prescribed grounding by way of filling tube contact with the railcar dome, contact must be manually made by way of connection of a ground terminal.



9) Drop Collector (Optional)

After each loading procedure, the hydraulically actuated loading tube returns to its upper position. Although the filling tube is liquid-tight sealed, a few drops of the loaded product can fall onto the rail car.

Especially with highly viscous products (f.e. Bitumen) the draining process can take more time can can result in contamination.

In order to collect these drops, Dipl.-Ing. SCHERZER GmbH offers a pneumatically operated, pivotable drop collector.

As a standard feature, the drop collector comes with a removable insert that can be exchanged and evaporated depending on the product.

The drop collector (cup) can also be supplied with an electrical trace heating, so that certain products remains liquid.

A retrofitting of existing facilities is easily possible in most cases.

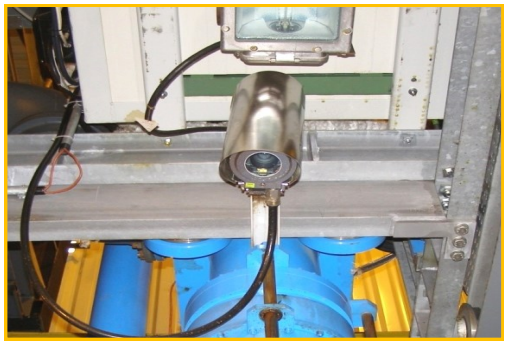
Technical data:

- Pneumatic operated swivel drive
- 180° - swivel range
- Outer hoist limiting
- Final position signal by initiators
- Speed control by throttle valves
- Collector (cup) diameter: 450 mm/18 inch
- Collector (cup) height: 130 mm/5 inch
- Instrument air pressure: 6 bar / 87 psi

Optional electrical heating:
(Heating belt HSB 60):
Power: 450 W (during operating temp. 40°C)
Power: 1000 W (during start-up temp. –25°C)
Retaining temp. 40°C / 104°F
(during outside temp. –25°C / -13°F)
Ex-area: T3
Voltage: 230V AC

10) Camera supported filling tube positioner (Option)

- Camera-supported check of the dome opening and the moving in area for the filling tube down to the railcar bottom.
- Camera-supported residual amount check in the railcar.



Automatic positioning of filling tube – filling point camera

The filling point is provided with a camera which is mounted at the top of the filling tube slide beside the filling tubes. The camera image is shown at the monitor of the operating panel.

As soon as the railcars are positioned below the filling point, first of all, the camera is placed exactly on top of the filling opening. The joy stick is used here. An unhidden circle at the monitor image represents the outside diameter of the filling tube and facilitates exact positioning.

Here, the operator ensures by the camera image that there are no obstacles in the inlet area of the dome and the required free space is available for moving in the filling tube into the tank. If necessary, he/she can use the additional operating keys in the operating panel to zoom into the tank car or to focus the camera image. An additional lamp is used for the optimum illumination.

When actuating the operating button “filling tube position”, the selected filling tube is positioned automatically on top of the dome opening. For this purpose, the filling tube moves into the adjusted offset of the filling tube. This is ensured by the distance measurement at the filling tube slide.

Technical data:

Camera:

- Camera in heated 316L stainless steel housing
- Housing of EX-d protected design
- Zoom: 23x optical and 12x digital
- Image sensor ¼‘‘ inches (6.36mm)
- Design with motor zoom objective
- Viewing angle 47° to 2.2° (with zoom function)
- Camera operated from operating panel
- incl. cross-hair generator
- incl. image memory function (integrated in automatic mode)
- Temperature range -50°C to +55°C (-58°F to 131°F)

Monitor:

- 10.4‘‘ LCD/TFT color monitor (to be installed in desk)
- Screen resolution 800x600 Pixels
- Contrast 400:1
- Voltage 12VDC (with power pack 100 ~ 230VAC); 9.6W

Lighting:

- Flood light 230V / 300W
- of EX-de protected design
- Temperature range -50°C to +55°C (-58°F to 131°F)

Licenses, Certificates and References

As a specialized and experienced company, we do have all legal permits necessary to operate both in Germany and abroad.

Our family owned company started business with plant engineering of facilities for storage and handling of mineral oil and chemical products over 50 years ago.

If you are interested, we could organize reference journeys to one of our satisfied customers in Europe.
We recommend an on-site tour of our facilities to gain a first-hand understanding of ON SPOT system design and operation.

LOADING YOUR FUEL

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Other brochures of Dipl.-Ing. SCHERZER GmbH

- Company profile
- Railcar – Loading systems
- Railcar – Unloading systems
- Railcar – Filling tube and Hydraulic systems
- Options for SCHERZER filling tube systems
- Study to compare Rail Tank Car ON-SPOT loading systems with serial loading systems
- LPG Loading– and Unloading systems
- Tankcar - Loading– and Unloading systems
- Ship - Loading– and Unloading systems
- Tankfarms, including handling plants and Vapor recovery units (VRU)
- Reference lists

We are pleased to send you our brochures on request.

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