schenckprocess

Load cells, Load application elements and cable boxes

Instruction Manual

DKI200 GB

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Note: The original manual is in German. This is a translation.

(162129586832472459 V19.Korr. 15/09/2014)

Table of Contents

1 How to Use this Manual

Who is this manual written for?

This manual is aimed at project engineers who intend to use mechanical components from Schenck Process in a scales and assemblers and service technicians who will assemble or service scales containing these components.

Assembly may be carried out by qualified personnel only:

- Welding work must be carried out professionally.
- Knowledge of electronic measuring devices will be required for inspecting the load cell connection.
- Experience with weighing equipment will be required for handling load cells.

What does this manual specify?

In this manual you will find:

- Notes on the *project planning* of a scales (chapter »Notes on Project Planning for the Mechanical Components [→3]«)
- General assembly instructions to be observed when *assembling* Schenck Process components (chapter »Installation Instructions [→11]«)
- Instructions on the mechanical assembly of the most commonly used Schenck Process components (load cells, load cell bearings, installation fittings) and a short description of those components (chapter »Assembling the Components [→14]«)
- Instructions for wiring the *load cells* and for *corner balancing* (chapter »Corner Balancing and Cable Length Compensation [→87]«)
- Notes on »Troubleshooting [→93]« and »Maintenance [→99]«

The data sheets of the components supplied are part of the mechanics documentation. You will find in each data sheet technical details such as dimensional drawings, tables with dimensions and information on the mode of operation and the possible applications of the respective components.

The chapters in this manual will refer you to the data sheet needed for particular information.

What to do if you encounter unfamiliar technical terms?

You can refer to the »definitions [→101]« chapter at the end of the manual if you come across any unfamiliar technical terms. It contains a limited selection of technical terms from the field of weighing equipment and is not intended to be a comprehensive reference source.

List of references

The manual will make reference to the following data sheets. Some of them contain further information and detailed technical data.

Number	Document
BV-D 2182	VFN pivot
BV-D 2121	DKK, VAK, VKK and FAK cable boxes
BV-D 2025	VPN pendulum bearing for RTN compact load cells
BV-D 2083	Compact bearing for RTB ring torsion load cells
BV-D 2044	Elastomer bearings for ring torsion load cells
BV-D 2019	Compact RTN ring torsion load cells
BV-D 2226	RTB ring torsion load cells
BV-D 2228	Accessories for VKN and VEN
DDP 8 483	Chemical resistance of RT load cells
BV-H 2059	Overvoltage protection

2 Notes on Project Planning for the Mechanical Components

Schenck Process scales weigh materials by converting their measured weight into an electrical signal in the load cell. This signal is measured and further processed by a specific indicator.

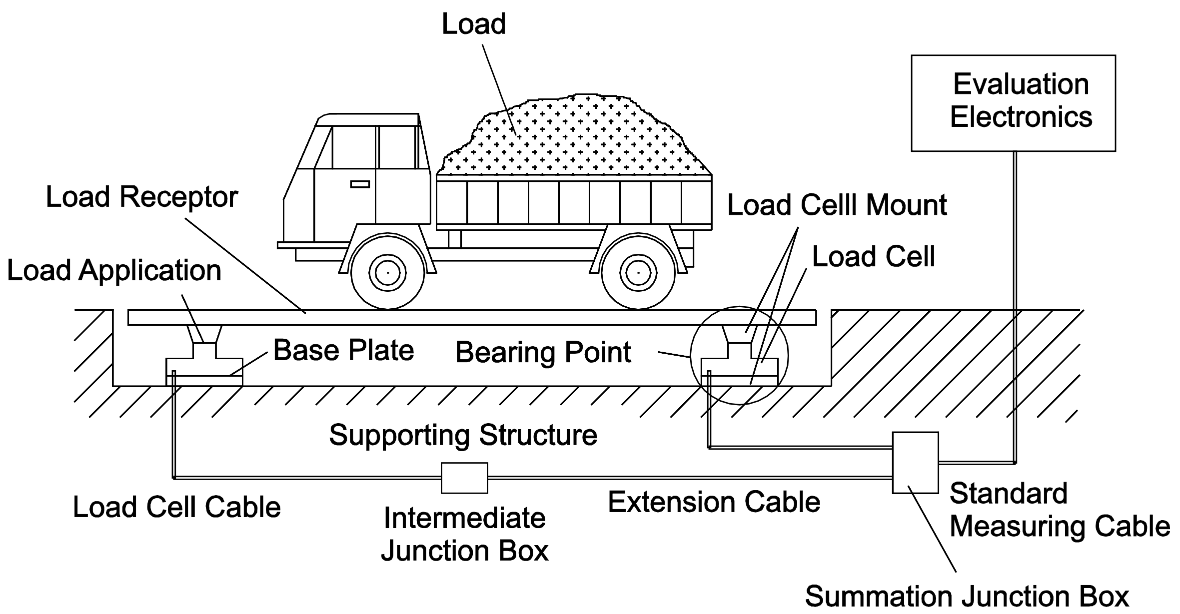


Fig. 1: Schematic representation of a Schenck Process scales

Mechanical and electrical interferences can impair weighing accuracy. In order to prevent this, the load application must fulfil certain minimum requirements. These requirements become stricter as the desired accuracy of the scales increases.

Certain rules must therefore be followed in the planning, calculation and assembly of the scales.

Some of these rules are listed below. Please note that additional measures may be required depending on the installation situation and the problems posed.

2.1 Selecting the Load Cell Load

The required load cell load is determined by the following formula:

$$L / C \; rated \; capacity = \frac{(weighing \;\; range + tare \;\; load) \; x \; safety \;\; factor}{no. \; of \;\; load \;\; points}$$

A safety factor of at least 25% must be allowed for if 3 supporting points are used. As a general rule, 3 supporting points are used as a basis for four-point mounting. In very stiff constructions, the worst-case situation is a load that may rest on as few as 2 supporting points.

The corresponding data sheet should be referred to to determine load cell to be used with regard to the nominal load and quality.

For example:

Scales type:	Bin weigher with 4 supporting points
Weighing range	60 t
Tare load:	15 t
Safety factor:	1.33 (assuming 3 supporting points)
LC nominal load:	At least 25 t
Nominal load selected:	33 t (next available)

The load cells of legal-for-trade scales must be subjected to the minimum utilization given in their data sheets. Utilization = weighing range/sum of the load cell nominal loads (at least 15 % for RT load cells).

3 - 5 % load cell utilization is usually sufficient for non legal-for-trade scales, depending on the situation and application.

The minimum input signal for the particular weighing electronics used must be observed.

Calculation of the load cell output signal / division (Ua/d):

$$Ua / d = \frac{weighing\ range \times sensitivity \times supply\ voltage \times 1000}{no.of\ L / Cs \times L / C\ rated\ capacity \times resolution}$$

For example:

Weighing range	15,000 kg result: 4.275 µV/d
Sensitivity:	2.85 mV/V
Supply voltage:	12 V
Quantity of load cells	4
Load cell nominal load:	10 t (RTNC3)
Resolution:	3000 divisions (5 kg increments)
Result:	4.275 yV/d

If fixed bearings are used (partial load measurement) the load on each weighing supporting point first must be determined. Then the load cell output signal must be calculated as described previously.

The accuracy achievable is dependent on the product (solids, liquids, see chapter »Fixed Bearing [➞45]«)

2.2 Load Application

2.2.1 Rules for Load Application

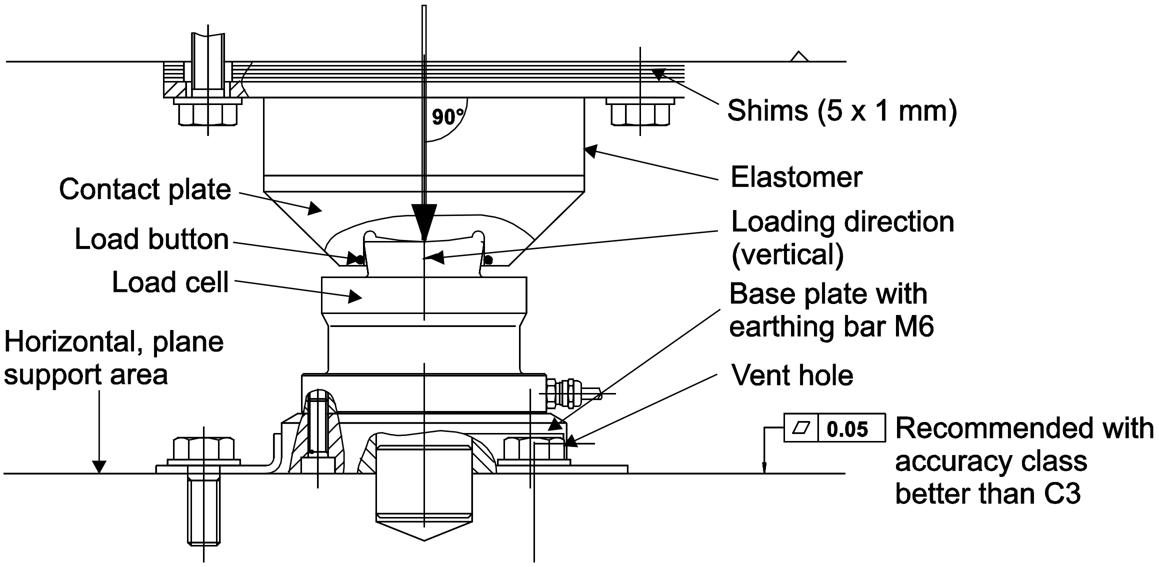


Fig. 2: Load application

1. The base plates for the load cells must be mounted on horizontal, smooth surfaces!
   The base plate must fulfil particular requirements (coefficient of thermal expansion 10 x 10^{-6}/°C, surface finish).
   We recommend that you use base plates supplied by Schenck Process.
2. Direction of load (= axis of symmetry) of the load cell must be vertically downwards!
3. The point of application on the load cell is the center of the load button:
   – Point-shaped, centered load application!
4. Complete load application:
   – The load to be determined is 100 % distributed among defined supporting points, there are no force shunts!
5. Load cells may be subjected to compressive forces only!
6. The load cells must be installed in a manner that makes them continuously loaded and so that the nominal load of each load cell is not exceeded with regard to the maximum loading.
7. Observe the permissible dynamic loading of the load cells. Generally this is lower than the static loading capacity. The following applies to RTN load cells:
   – Permissible vibration stress according to DIN 50100: 70 % $E_{max.}$
   Peak loading values may not exceed $E_{max.}$.
8. Lateral forces (= forces perpendicular to the direction of load) must be avoided or limited.
9. Bending and torsional moments should be avoided.

Note on 4: A supporting point is generally a load cell with a load cell bearing. Up to two fixed bearings can be combined with one or two load cells for simple weighing tasks that do not require great accuracy. Fixed bearings can be used as economical support points for such applications.

STRICTLY OBSERVE

Avoid measuring errors and damage

Measuring errors can occur if these rules are not observed, and in extreme cases load cells may become damaged.

Special notes on the different types of bearing can be found in the corresponding chapters.

2.2.2 Sources of Error and Notes on Avoiding Errors

Lateral forces

The direction of load of the load cell is not vertically downwards:

- This may occur if, for example, the supporting structure is not sufficiently resistant to bending or if the load cell was incorrectly installed.
- The lateral forces will cause a measuring error that could have been avoided with more careful installation.

Unavoidable lateral forces will arise during operation of the scales. Causes of such lateral forces may be:

- Bending of the load receptor upon application of a load
- Braking forces when a vehicle drives onto a platform scales and brakes
- Expansion of a hopper due to temperature changes
- Wind forces
- Agitator oscillations

The load cell can absorb lateral forces to a certain extent. It will become damaged only if the lateral force threshold is exceeded (see data sheet BV-D 2226 or BV-D 2019).

Small, generally negligible measuring errors will occur if the lateral forces do not exceed the threshold value.

If there is a risk that the lateral forces could exceed the threshold, bumpers must be used to limit the horizontal displacement of the load receptor.

Suspension arms may even be necessary in exceptional cases to prevent horizontal displacement of the load receptor.

The load receptor must be sufficiently stiff to keep bending under high loading to a minimum.

Force shunts

The load to be calculated may only be applied to defined supporting points. Measuring errors arise if partial loads bypass the defined supporting points (force shunts).

Force shunts can occur:

- If the load receptor is in contact with the fixed structure (foundation, frame)
- If tube connections and other connections to the scales (e.g. cables leading to the agitator) are not sufficiently elastic in the direction of load of the load cell
- If moving parts such as suspension arms become blocked due to soiling, product residues or corrosion, or if they are incorrectly installed
- Due to insufficiently elastic or dirty expansion joints (especially due to product residues in the case of bellows expansion joints)

Force shunts must be prevented at the design stage (see the following figure).

Non-centered load application

During the assembly, all bearing elements must be aligned so that the weight of the load is applied to the center of the load cell button.

A centered application can be ensured by a parallel alignment of the connecting face of the base plate and the pressure piece and alignment of the axes of the load cells and pressure pieces.

Applications requiring high accuracy and/or low minimum scales intervals (low load cell utilization) call for particular care.

Non-centered load application can cause measuring errors and damage the load cell (overloading).

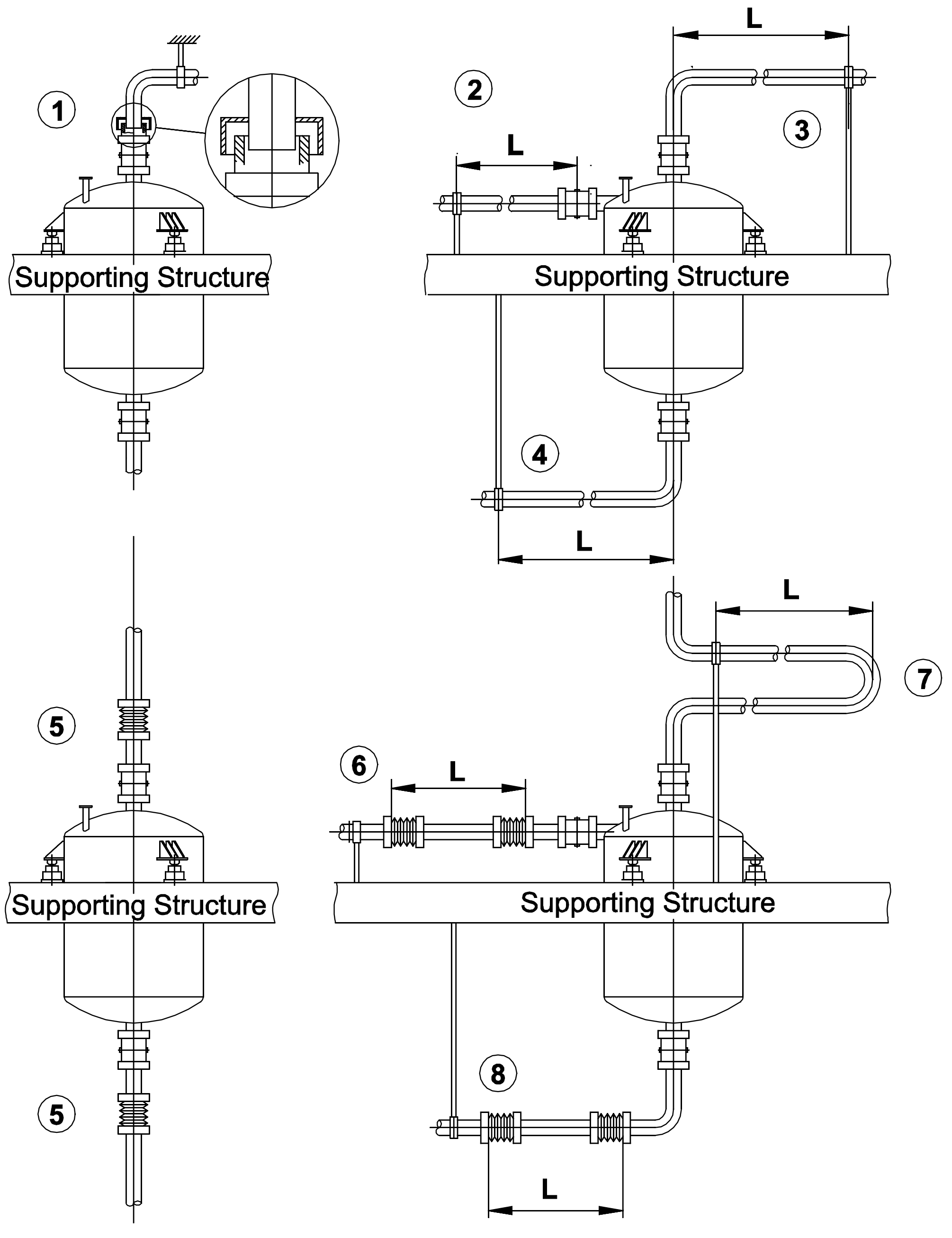


Fig. 3: Example of how to avoid force shunts

1	Free-mounted flanged inlet connection, may have labyrinth seal/cover
2, 3, 4	Horizontal inlet pipe sufficiently long to avoid small errors due to deformation of the pipe. **Important:** there should be no inlet pipe supports near the vessel.
5	If fill and discharge weighing is performed using compressed air, ensure that the flexible joints have identical diameters! Rule of thumb: L > 30 x D (D = pipe diameter)
7	As with 4, dimension L can be halved using a pipe loop: ▪ Ensure that the loop is of sufficient length. ▪ Support the upper pipe loop only ▪ Better: horizontal pipe loop, supported on the side away from the vessel.

2.2.3 Arrangement of the Supporting Points

The weight force of the load to be determined and the load receptor are generally distributed across 1, 3, 4 or more supporting points.

If several supporting points are used, these must be arranged geometrically so that:

- the dead load is as evenly distributed across all supporting points as possible.
- all supporting points bear weight if statically indeterminate suspension (more than three supporting points) is used.
- none of the load receptors in any of the supporting points lifts if the load is arbitrarily distributed.
- if two or more load cells are interconnected, a minimum load of 1 % of their nominal load acts on each load cell at all times.
- the frictional connection is not broken if using one load cell (e.g. hybrid scales).

2.2.4 Layout of the Load Transfer Element

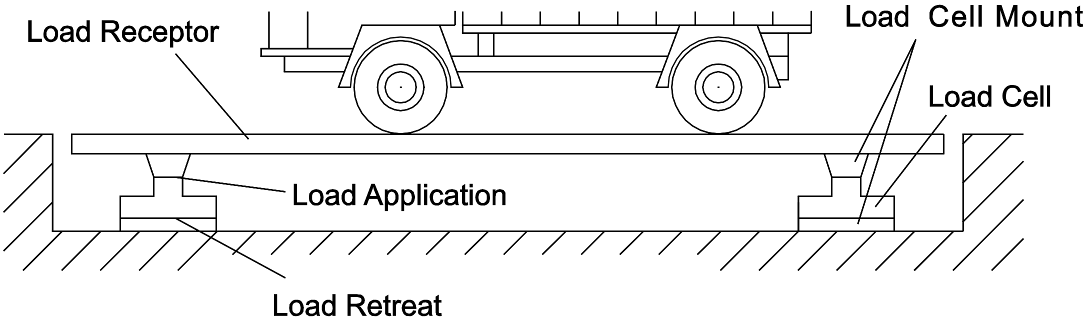


Fig. 4: Load transfer element

The load transfer element of the load cells (e.g. foundation or supporting structure) must be horizontal, plane-parallel to the load application and resistant to bending.

Lateral forces and the ensuing measuring errors will result If the load transfer element bends or if the load cells' bearing surface is deformed.

A material of sufficient tensile strength (> 700 N/mm^2) and matched coefficients of expansion (approx. 10 x 10^{-6}/K) should be used for the installation area of the load cells (e.g. X20 CrNi 172/1.4057).

If the load cells are to be mounted directly onto the supporting structure and/or without the use of the standard bearing elements, these conditions must be fulfilled exactly in order to avoid measuring errors (see above). We recommend that you use original bearing elements supplied by Schenck Process.

Load cells and base plates must be mounted on uncoated metal surfaces. Painted surfaces are fundamentally unsuitable for installation.

2.3 Structural Assembly Aids

We recommend that, for heavy containers and weighbridges or in complicated installation situations, you arrange structural help for lifting and supporting loads during assembly, disassembly and maintenance.

For example:

- Assembling aid support structure
- Sufficient space for a lifting device
- Lifting eyes

See also chapter »Assembly Preparations [➞12]«.

Space should be left next to each load cell bearing for a lifting device (e.g. a hydraulic cylinder) that can lift loads during assembly or disassembly of the mounts.

Also refer to the figure in chapter »Assembly Preparations [➞12]«.

2.4 Load Cell Dummies

During extensive assembly work - and welding work in particular - we recommend that you replace the load cells with dummies and install the load cells once the assembly has been completed.

The combination of dummy and mount also represents an alternative to fixed bearings, with the advantage that they can later easily be turned into weighing supporting points.

2.5 Lifting Lock

If the load receptor can raise up or even tip over during or after assembly, a lifting lock must be introduced at each supporting point

This is the case e.g.:

- for scales with low dead loads (light containers)
- with external influences such as wind or impacting forces.

Refer to the figures in chapter »Assembling the Components [➞14]« and »Lowering the Load Receptor [➞18]«.

If VKN and DKM compact bearings are used, the respective supporting point arrangement as described in chapter »Compact Bearing DKM/VKN [➞34]« must be observed to guarantee that there is no horizontal movement.

3 Installation Instructions

Observe the **notes on project planning**, in particular the rules on load application. (See chapter »Notes on Project Planning for the Mechanical Components [➞3]«.)

STRICTLY OBSERVE

Assembly may be carried out by qualified personnel only

Welding work must be carried out professionally. Safety precautions for load cells and weighing electronics are to be observed at all times.

Knowledge of electronic measuring devices will be required for inspecting the load cell connection.

The following steps are among those that must be followed for the mechanical assembly of a scales:

- Assembly Preparations
- If possible or necessary, rest the load receptor onto assembling aid supports
- Assembling the Components
  - Load cells with load cell bearings
  - if applicable, bumpers, suspension arms, lifting locks, fixed bearings
  - Interconnecting box
- Connect the load cells in the interconnecting box
- Lower the load receptor onto the supporting points
- Align the load receptor
- If necessary, adjust the play of the suspension arms, bumpers and lifting locks
- Check the load cell connection at the interconnecting box

(the sequence depends on the respective installation situation)

3.1 Assembly Preparations

Inspection of the installation location

Check the dimensions given in the installation drawing and the dimension sheets against the installation location for the load receptor (platforms, containers, etc.)

Does the installation area fulfil the requirements - e.g. are the surfaces uncoated?

Use of assembling aid support structures

The assembling aid supports must be 10 - 20 mm lower than the installation height of the load cell bearings and must be able to bear the **maximum weighing load including the dead load**.

If there are no assembling aid supports available, a **provisional support** must be obtained for the duration of the assembly.

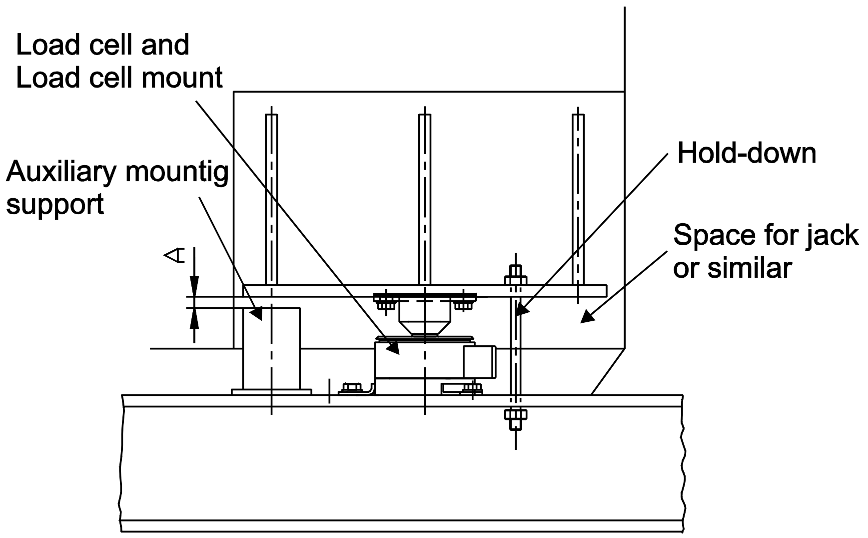


Fig. 5: Bunker bracket, arrangement of the assembling aid support structures

- Dimension 'A' = 10 - 20 mm
- Dimension 'A' is filled with filler plates for the duration of the assembly of the load cells.
- Filler plates of suitable thickness must be supplied on-site.

Lifting lock for weigh hoppers

The lifting lock limits the degree of the weigh hopper's vertical freedom against external acting forces. It thus prevents the weigh hopper from being lifted out of the load cell bearings.

For this reason one is located in the immediate vicinity of each load cell bearing, preferably in the outlined layouts that prevent force shunts from affecting the system.

The strength of tension bolts, threaded fittings and welded seams required for assembly must be dimensioned adequately by the plant planner.

In the layout shown in the following figure, the annular gap 'L' must be greater than the permissible horizontal play of the bearing bracket and the vertical gap must be set to 'K' = 1 - 2 mm.

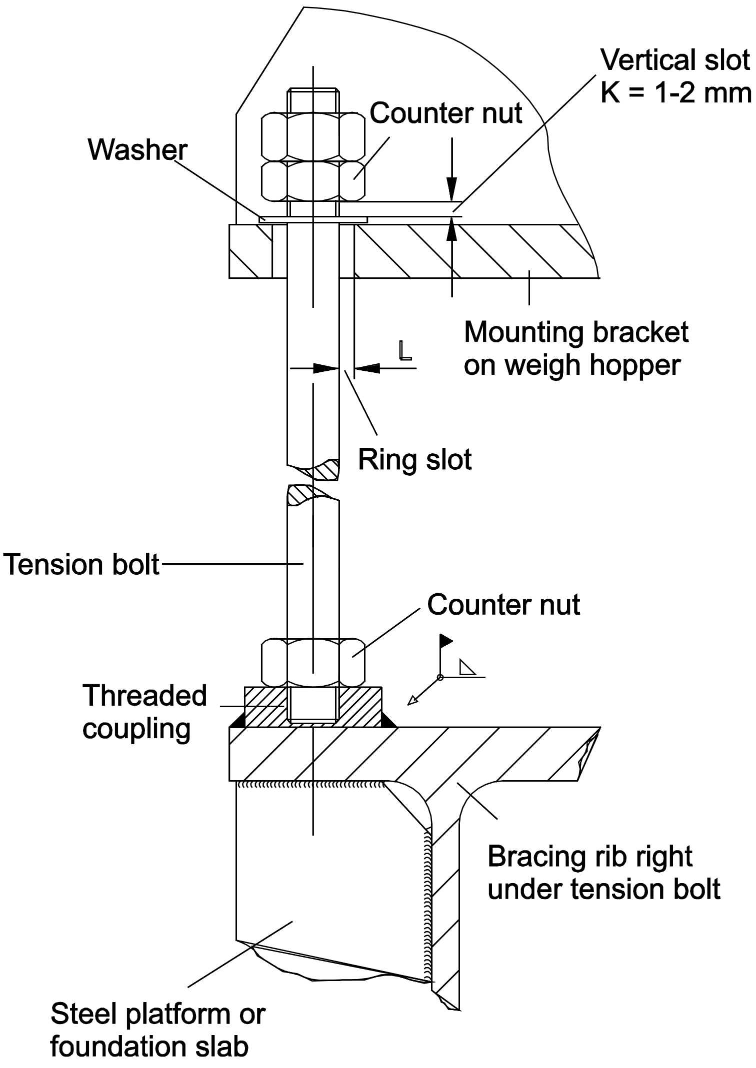


Fig. 6: Lifting Lock

Assembling the lifting lock

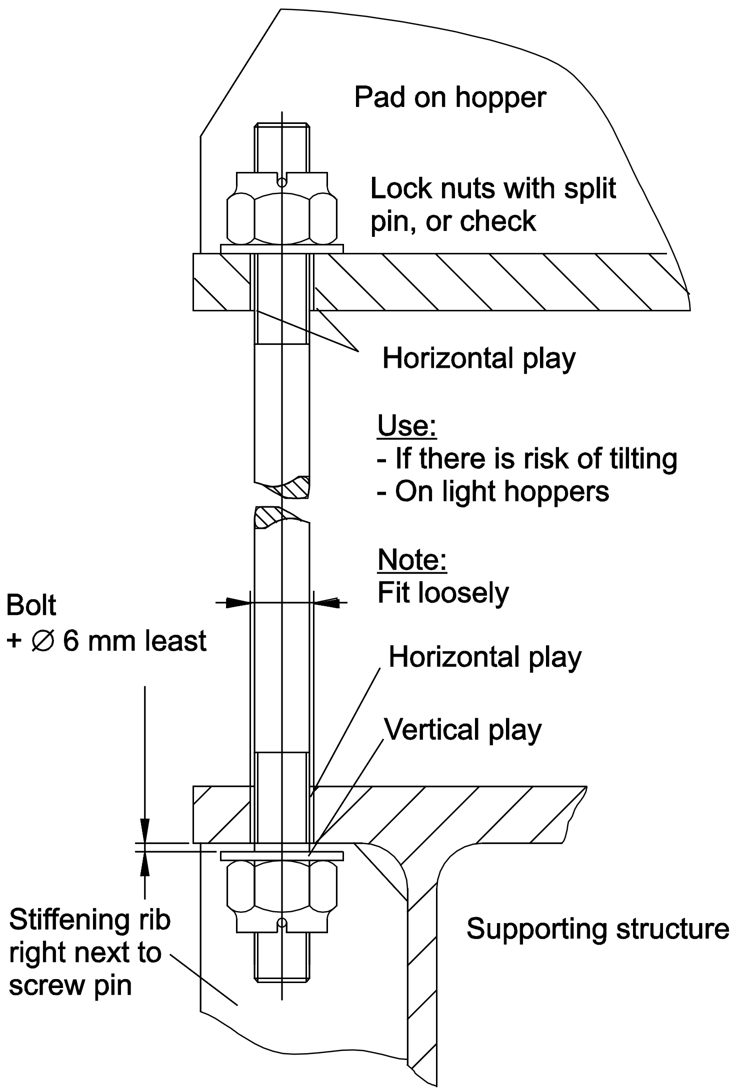


Fig. 7: Lifting lock, assembling the components

3.2 Assembling the Components

Avoiding a force shunt

Please observe the information on selecting a load cell nominal load.

HINT

Check for force shunts

Force shunts can be detected using a reproducibility test.
Further details can be found in section »Troubleshooting [→93]«.

General information on the installation of the load cells with load cell bearings

Load cells are high-precision sensors. Great care must therefore be taken during assembly in order to avoid damage or measuring errors.

This is particularly true of applications with a low minimum scales intervals and/or with load cells in the accuracy classes C4, C5 or C4 Mi 7.5.

Generally:

The higher the accuracy class and the lower the load cell utilization, the greater the care taken during installation must be.

Load cells are protected against overloading to an extent. Details on the limit load can be found in data sheet BV-D 2226 (RTB load cell) or BV-D 2019 (RTN compact load cell).

As protection against overloading is dependent on the nominal load, load cells with low nominal loads are at particular risk of being overloaded during assembly. Refer to chapter »Selecting the Load Cell Load [→3]«.

In order t o protect the load cells during assembly, we recommend that you rest the load receptor on temporary supports or replace them with dummies.

You must also protect the load cells against:

- strong heat radiated onto or conducted into them, in particular if one-sided
- sudden temperature changes
- the effects of welding work (weld beads)
- strong drafts

We suggest using heat sinks or applying heat insulation at a suitable point of the supporting point.

The load cell bearings must be assembled so that no lateral forces arise once assembly has been completed. To ensure this, the load cell bearings must be aligned before the load receptor is lowered onto them.

If using elastomer supports take any potential equalization measures necessary to protect against electrostatic charging. Refer to chapter »Potential Equalization [→59]«.

The load cells must be equipped with an anti-rotation device if it is possible for them to become completely unloaded during operation. Otherwise the cable may become damaged.

Under no circumstances may the measuring cable lead-in support the anti-rotation device. One recommended method of preventing rotation is to insert the load cells with optional boreholes into the base and secure them to the base plate, which then can be bolted or similar to prevent rotation.

Installing the measuring cable

The term 'measuring cable' refers to all cables that connect the load cells to the weighing electronics.

- Load cell connection cable (attached to the load cell)
- Extension cable (4-wire)
- Standard measuring cable (4 x 2 x 0.23 mm^2 or 4 x 2 x 0.5 mm^2)
- Special measuring cable for particular applications

As the measuring voltage of the load cells **(mV)** is low, the measuring cables must be handled with care.

You should therefore follow these rules:

- The measuring cable is suitable only for fixed installation. It may not be laid in a cable drag chain or in cable reels.
- Special measuring cables (7 x 0.5 mm^2) are available for flexible installation (e.g. for crane scales), for cable drag chains, for cable reels and for non-standard features (e.g. use in high-temperature areas).
- Do not kink the standard measuring cable!
- Smallest laying radius:
  - Standard measuring cable= 125 mm
  - Load cell connection cable = 30 mm
- Do not damage the outer sheath (guarantees protection class IP68)!
- It is imperative that this be observed when feeding the cable into pipes or cable conduits!
- The cable is not to be laid underground directly!
- Do not allow the measuring cable (in particular the ends) to lie in dirt or moisture. Install the cable in the cable box immediately after assembly!
- Remove the moisture proofing on the cable end at a point close to the electrical connection!
- Do not place the cable under tensile stress!
- Do not twist the measuring cable at the cable screw connection!
- Fasten the measuring cable to prevent it from swinging!
- A corrosion-proof cable lug must be used (for ground terminal) if laid in an aggressive atmosphere!
- If the measuring cable is too short, the extension cable must be attached in an intermediate cable box.

Take care when shortening load cell cables:

- If several load cells are to be interconnected then the measuring cables should be of equal length to ensure that the resistance of the cables is the same. There will be differences in sensitivity in the supporting points with load cells if the measuring cables are shortened to different lengths.

Rule of thumb:	A 4 Ω difference in resistance corresponds to a 1 % difference in sensitivity, i.e. a 1 m difference in length will result in a measuring error of approx. 0.002 %.
By comparison:	The combined error F_{comb} of RTN/RTK load cells is 0.02 %

- It may be necessary to equalize the sensitivities of the load cells. A brief description can be found on the rear of the DKK cable box lid and in chapter »Cable Boxes [➞55]«.

Electromagnetic signals can falsify the measuring signal.

Among the potential sources of error are:

- Parallel control and power cables with high currents at short distances from one another.
- Neighboring powerful transmitters (e.g. broadcasting stations), if the measuring cable is laid on open ground.

STRICTLY OBSERVE

Measuring errors due to electromagnetic interference

Lay the measuring cable in a steel conduit or maintain a distance between parallel power cables of at least 30 cm!

To protect the measuring cable from rodents, lay it in e.g. a flexible steel conduit.

Load cell cables can only be replaced with cables from Schenck Process, as a special seal is necessary to maintain the high protection class.

Do not unfasten the cable screw connection at the load cell!

STRICTLY OBSERVE

Protective measures during welding

Welding will damage load cells or the connected weighing electronics if carried out without the proper protective measures. Therefore when welding:

1. Cover the load cell (use a damp cloth); weld spatter can compromise the corrosion protection.
2. The welding current may not be routed via the load cell; the welding leads must be connected so that this does not occur, use load cell dummies if necessary.
3. Ensure during welding that there is sufficient potential equalization (50 mm^2) between the load receptor and the supporting structure (ground cable), even if using elastomer bearings.
4. The evaluation electronics may otherwise be damaged as the welding current flows through the electronics' potential equalization cables.
5. Protect the elastomer bearings against the effects of heat.

See also

Notes on Project Planning for the Mechanical Components [→3]

3.3 Lowering the Load Receptor

If necessary, first rest the load receptor on a temporary support aid structure before the components are assembled and lower it onto the supporting points only once assembly has been completed.

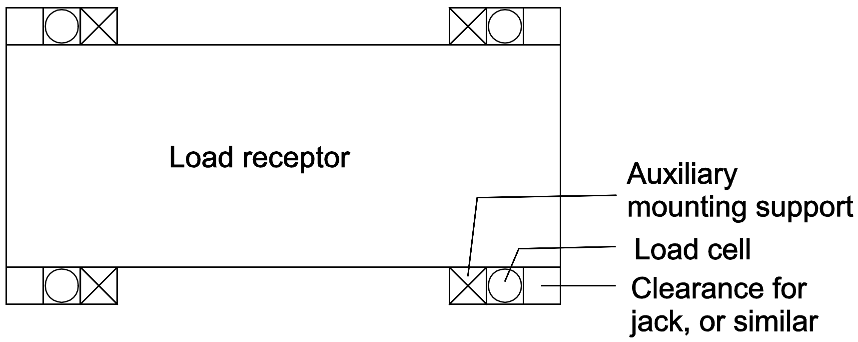


Fig. 8: Arrangement of the assembling aid support structures

Place filler plates on the assembling aid support structure and, if necessary, secure them with short tack welds.

Once the load cells and suspension arms or bumpers have been installed, remove the filler plates.

The load receptor must be placed on the assembling aid support structure with as little torsion as possible to ensure that the dead load is distributed as evenly as possible across the supporting points.

Three-point bearing

The load distribution in a three-point bearing system is determined by the design and cannot be affected by the assembly.

Four-point bearing

The difference in load between the load cells must be measured electrically in the case of a four-point bearing to ensure an even load distribution. To do this, the load cells are successively supplied with a direct voltage (from a battery), the output voltage of each load cell is measured and the results of each cell are compared with each other.

Differences of up to 30 % have no effect on scales accuracy. However, there is a risk that one of the load cells may be loaded beyond its nominal loading range. This will result in measuring errors and, if the load limit is exceeded (see data sheet BV-D 2226 or BV-D 2019), will permanently damage the load cell!

The differences in the output voltages must therefore be compensated for using filler plates beneath the bearing plates of the load cell with the lowest output voltage. (This load cell bears the least load.)

This measure is important above all when the load cells utilization is high (> 75 %) and for torsionally rigid load receptors (danger of overloading or of complete unloading)!

Tolerances

The maximum angle error between the load receptor and the supporting structure may be 0.6° ≙ 10 mm/m. The lower installation surface may deviate from the horizontal by maximum 0.2° ≙ 3 mm/m.

Larger deviations must be corrected by grinding the connecting surfaces or by using tapered shims (to be welded in place!) (refer to the following figure).

Load cell bearings may not be grinded off under any circumstances!

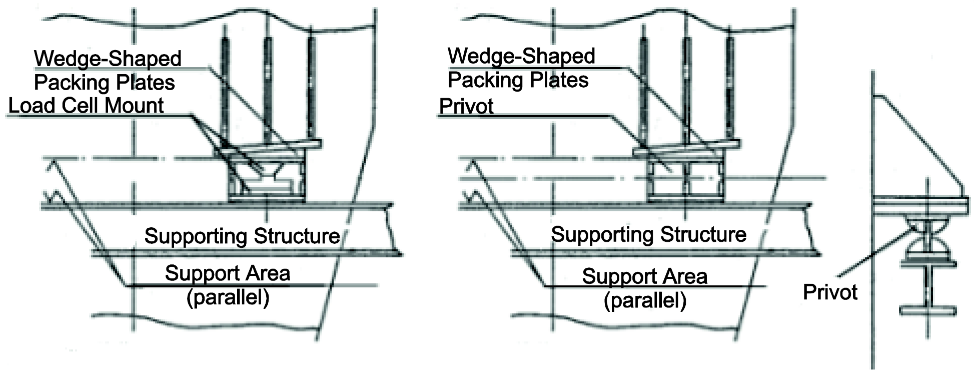


Fig. 9: Use of tapered shims

Fill level measuring devices with two fixed bearings (and one or two load cell bearings) generally require no assembling support aids for the fixed bearings.

The bin can be placed onto the fixed bearings immediately. Load bearings surfaces in the vicinity of the fixed bearing must be plane and parallel.

Connecting surfaces can be ground off or wedge plates can be used if there are divergences. Both fixed bearings must be aligned along a single axis.

The load receptor must be aligned once it has been lowered, e.g. by moving it horizontally on the assembly support aid. Observe the critical areas such as e.g. rail crossovers, bunker in- and outlets, expansion joints, etc.

4 Load Cells

Schenck Process has two different RT load cell models:

- the RTB series, nominal loads 130 kg – 500 kg
- the RTN series, nominal loads 1 t – 470 t

The series differ in their geometric dimensions and their design principles.

4.1 Technical Data

Application	**RTB (0.13 ... 0.50 t)**	**RTN (1 ... 470 t)**	**F_{comb}**
Legal-for-trade scales up to 5000 d or multi-interval scales	RTB C6	C5/C4 Mi7.5	0.01 %
Legal-for-trade scales up to 3000 d	RTB C3	RTN...C3	0.02 %
Scales in the accuracy class 0.05 %		RTN...0.05	0.05 %

Tab. 1 : Load cells

RTB technical data

Nominal characteristic value (Cn):	Nominal-load dependent		
Input resistance (Re):	1100 Ω	±50 Ω	
	1260 Ω	±100 Ω at RTB 130 kg	
Output resistance (Ra):	1025 Ω	±25 Ω	
	1020 Ω	±0.5 Ω at RTB 130 kg	
Cable allocation:	pink	Input +	(82)
	brown	Output +	(28)
	gray	Input -	(81)
	white	Output -	(27)
	green-yellow	Shielding	

RTN technical data

Nominal characteristic value (Cn):	2.85 mV/V		
Input resistance (Re):	4480 Ω	±50 Ω	
Output resistance (Ra):	4010 Ω	±0.5 Ω	
	4010 Ω	±2 Ω (for RTN 0.05)	
	4010 Ω	±10 Ω (for RTW, RTN 0.1)	
Cable allocation:	black	Input +	(82)
	red	Output +	(28)
	blue	Input -	(81)
	white	Output -	(27)
	green-yellow	Shielding	

Dimensional drawings, dimension tables etc. can be found in the data sheets BV-D 2226 (ring torsion load cell RTB) and BV-D2019 (compact ring torsion load cell RTN).

4.2 General Notes

The base plates of RTN load cells with rated loads of up to 4.7 t and RTB load cells have a or must be given a ventilation bore hole to balance the air pressure in order to avoid measuring errors caused by variations in pressure.

Never cover this vent!

It must not become blocked by dirt such as e.g. grease, oil or product residues and it must be protected against splash water.

The installation surfaces at the load cells, the base plate and the supporting structure must be plane and clean. Applications requiring a high accuracy class and/or low minimum scales intervals call for particular care

The load application (plane surface of the load button) must be coated with a thin film of grease (a suitable grease will be supplied with the device).

4.3 Explosion Protection as per ATEX

Schenck Process load cells can be supplied in explosion protection variants as defined by directive 94/9/EG (ATEX) for:

- Category 2 GD (zone 1 and 21)
- Category 3 GD (zone 2 and 22)

WARNING

Use in explosion hazard areas

Please ensure to observe the safety instructions supplied with the load cell and any additional instructions in the weighing electronics manuals (connection plans, suitable safety barriers).

Load cells for category 2 G areas are intrinsically safe.

The load cell measuring cable must in this case be blue.

Draw the blue sheath provided over the measuring cable or mark it with blue duct tape at intervals of around 50 cm.

4.4 Eventuality of Damage

STRICTLY OBSERVE

Possible damages

RT load cells are precision sensors for transforming the force of weight into electrical signals. In spite of their high measuring quality, the load cells (LC) are mechanically robust and function many years without malfunction if they are properly used.

Nevertheless there is of course a range of influencing factors that can damage or destroy the LC, but these for the most part do not arise under the intended operating conditions. In the following we will give an overview of possible sources of fault and how to avoid them. We will also give instructions on analyzing faults that occur.

4.4.1 Corrosion

RT load cells are made of high grade stainless steel. In this case, 'high grade' means that the steel possesses special mechanical properties without which the measuring characteristics of the load cells would not be attainable.

Unfortunately, highly corrosion-resistant steels do not possess the necessary elastic properties, i.e. they are unsuitable for the production of high-precision load cells. This means that aggressive materials can damage end even destroy the stainless steel load cells. This is an issue that affects not only Schenck Process RT cells, but also other manufacturer's load cells.

Substances such as chlorine that contain free halogens are particularly aggressive. The kind of corrosion that occurs is generally so-called 'pitting corrosion', i.e. along grain boundaries scratches form that are only tenths of a millimeter wide but up to a millimeter deep. Eventually this would result in the LC cover plate being 'bored through'. This usually occurs in the vicinity of weld seams, where the microstructure of the material has been altered by the welding process.

The data sheet DDP 8483 provides an overview of the load cell's chemical resistance.

If contact between the substances being measured and the load cells to be expected, we recommend a preventative treatment with the anti-corrosion agents KS 101 (bitumen based) or KS 105 (2 component varnish).

We do not recommend subsequent treatment of already-installed load cells. Bear in mind that possibly damaged areas may not at first be visible, rather they may merely be covered over. The corrosion will continue under the covering.

4.4.2 Moisture

The load cell's measuring elements are electrically insulated from the load cell body. The insulating resistance of a new load cell lies in the range of several G Ω. Moisture will reduce the insulating resistance of a load cell if it enters it. This will result in shifts in the zero point as well as instability.

Moisture can get into the load cell:

- as a result of pitting corrosion
- as a result of a defective cable (i.e. the sheath is damaged)
- from moisture in the interconnecting box.
  This moisture can migrate into the cell along the cable wires for several meters.

Prevent:

- Corrosion, see chapter »Corrosion [➝23]«
- Cable damage → handle the load cell carefully and lay the cables in protecting conduits.
- Carefully seal the cable boxes

4.4.3 Overvoltage

Overvoltage is probably the most common external cause of load cell damage. The load cell does have built-in overvoltage protection (gas eliminator). However, its charge dissipation capability is limited. It must be complimented by other measures, in particular if the cables to the measuring electronics are long.

Overvoltage in the load cell either will interrupt a measuring element (DMS) or cause a flashover to ground.

Please refer to manual BV-H 2059 for more information on overvoltage protection and suitable protective subassemblies.

4.4.4 Static Overload in the Direction of Measurement

Beyond their nominal load, RTN load cells have a permissible overload (i.e., limit load) in the direction of measurement that is as high as 90 % of the nominal load (depending upon the model; you can find detailed data in the respective data sheets). Occasional overloading in this range will not damage the load cell - they will result only in diverging characteristics curves in the overload range.

Loads above this limit load will permanently deform the load cell, which generally becomes noticeable due to a (positive) shift in the zero signal.

Exception: in the RTN 22 t, negative shifts in the zero point due to overloading may also be observed.

It is easy for overloading to occur, especially with load cells with a small nominal load, such as when the scales are asymmetrically loaded – even if the scales are still in the weighing range (for example: if a fork-lift truck were to run over a corner of a floor scales).

Overloading can be avoided by using suitable limit stops - a solution not without its problems due to the short measuring displacement of a load cell - or by correctly selecting the nominal loads; for more information refer to the chapter 'Selecting the Load Cell Nominal Loads'.

4.4.5 Dynamic Overload

Many people overlook the fact that not only static overloading is dangerous to a load cell. Alternating dynamic loads can cause permanent damage, generally zero point shifts, at a point far below the limit load.

The maximum acceptable vibration loading for an RTN load cell is in the range of 70% of the nominal load (refer to data sheet BV-D 2019).

The following helps prevent these problems:

- Properly laying out the load cells and possibly choosing a higher nominal load level
- Increasing the dead load, if applicable
- Preventing dynamic alternating loads, for instance by reducing approach impacts on a rail weighbridge.
- Meticulous height adjustment
- Use of shock absorbers

4.4.6 Overload in the Transverse Direction

The maximum acceptable transverse loading for an RTN load cell is in the range of 30 % of the nominal load. Permanent damage can result to the cell if this limit is exceeded - starting with zero point shifts and, in the worst case, leading to a broken load button or a torn weld seam at the load button.

The following are at particular risk:

- Road weighbridge on which the vehicles brake.
- Bin weighers with which transverse forces develop due to thermal expansion.

To prevent this:

- Use proper bearing elements that allow the scales to move in the transverse direction without transferring excessive forces to the load cells (elastomer bearings, pendulum bearings).
- Provide limit stops. Elastomer bearings also generate a transverse force that is proportional to the deflection. Data sheet BV-D 2044 gives the maximum permissible horizontal deflection of the entire bearing unit.

The bearing and the limit stop are ideally combined in the VKN compact bearing (‘the carefree solution’).

5 Load Cell Bearings

Load cell bearings are used for the installation of RT load cells between the load receptor and the support structure. They transmit to the load cell the load to be measured.

The following table gives an overview of the general technical data.

	Elastomer bearing		**Compact bearing (bearing unit)**		**Pendulum bearing**	**Fixed bearing**
	DEM	VEN	DKM	VKN	VPN	VFN
Data sheet	BV-D2044	BV-D2044	BV-D2083	BV-D2083	BV-D2025	BV-D2182
Load cells used	RTB	RTN	RTB	RTN	RTN	RTN
Nominal load range in t	0.13 ... 0.50	1 ... 470	0.15 ... 0.50	1 ... 470	1 ... 470	1 ... 470
Self-centering	Yes					---
Lifting Lock	Required only if at risk of tipping over		Built-in		Required only if at risk of tipping over	---
Bumpers[1]	Required only if the transverse force limit may be exceeded		Built-in		Required	Not required
Suspension arm[1]			---			
Corrosion protection	galvanized Pressure piece: stainless steel	galvanized Pressure piece: stainless steel	Stainless steel	33 ... 470 t galvanized 1 ... 22 t Stainless steel	Stainless steel	33 ... 470 t Varnished 1 ... 22 t Stainless steel
Legal-for-trade use	Yes					---
Max. permissible inclination	0.2° (corresponds to 3 mm/m)					---

[1] *Either bumpers or suspension arms are used for elastomer bearings.*

Tab. 2 : Load Cell Bearings

All bearings can be adjusted up to +5 mm in height relative to the nominal dimension.

5.1 Elastomer Bearings DEM/VEN

Elastomer bearings provide ideal load application to the Schenck Process ring torsion load cells. They are used in all industrial scales, such as e.g. bin weighers, roller train scales, crane scales and road weighbridge.

Assembly instructions

Check that the scope of delivery is complete and that it tallies with the specifications.

Follow the project planning guidelines and the assembly instructions in this manual!

Prepare the grease supplied for the assembly of the load cells and load cell bearings.

Tools required:

- Welding equipment, if load receptor and supporting structure are not to be connected by threaded connections.
- High-precision spirit level
- Monkey wrench, hexagon socket wrench

STRICTLY OBSERVE

Protective measures during welding

Welding will damage load cells or the connected weighing electronics if carried out without the proper protective measures. Therefore when welding:

1. Cover the load cell (use a damp cloth); weld spatter can compromise the corrosion protection.
2. The welding current may not be routed via the load cell; the welding leads must be connected so that this does not occur, use load cell dummies if necessary.
3. Ensure during welding that there is sufficient potential equalization (50 mm^2) between the load receptor and the supporting structure (ground cable), even if using elastomer bearings.
4. The evaluation electronics may otherwise be damaged as the welding current flows through the electronics' potential equalization cables.
5. Protect the elastomer bearings against the effects of heat.

Measurement cable

- Protect all measuring cables against moisture and mechanical damage! (More detailed instructions can be found in the measuring cable installation section.)
- If the electrical equipment is to be installed at a later moment, we recommend that you introduce the measuring cable into the interconnecting box when laying the cables. This will prevent it from being exposed to moisture in the surroundings.
- Read the load cell data sheet included in the packaging.

Tolerances

The maximum angle error between the load receptor and the supporting structure may be 0.6° ≙ 10 mm/m. The lower installation surface may deviate from the horizontal by maximum 0.2° ≙ 3 mm/m.

Larger deviations must be corrected by grinding the connecting surfaces or by using tapered shims (to be welded in place!) (refer to the following figure).

Load cell bearings may not be grinded off under any circumstances!

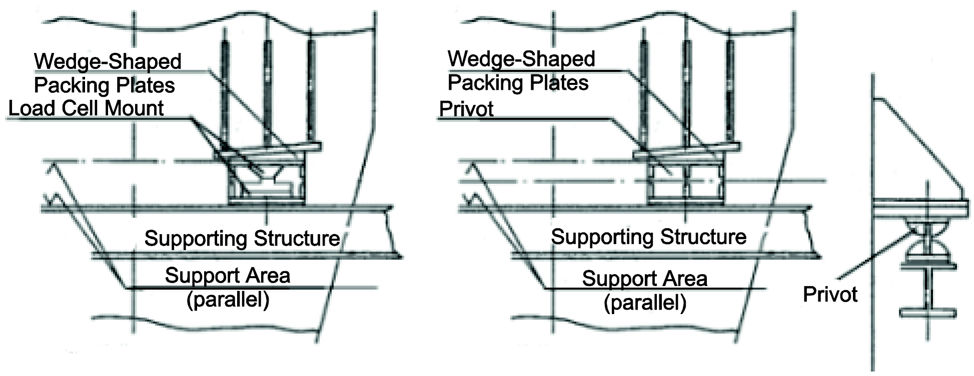


Fig. 10: Use of tapered shims

Mechanical installation

- The load cells and their bearings are installed as per the installation drawings.
- Secure with screws one bearing element.
- Align the second:
  - The central axes of the upper and lower bearing elements should fall in line.
- Secure the second bearing element (protection against shearing) with:
  - screwed- or welded-on brackets
  - screwed-on lugs or lugs welded to the front side
- Lower the load receptor to its intended height. Verify the correct positioning of the load receptor.

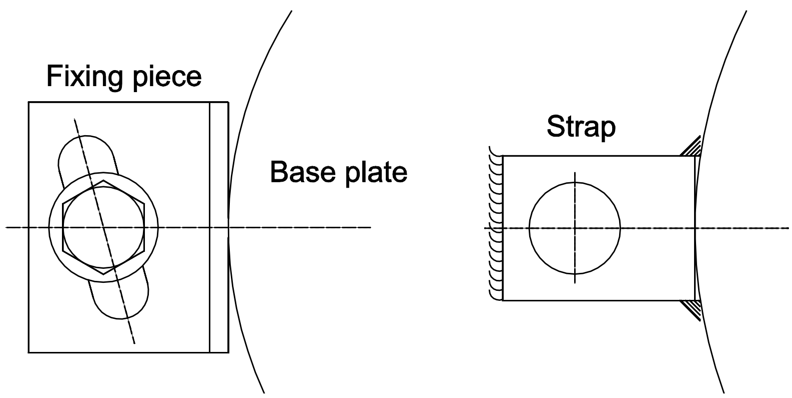


Fig. 11: Protection against shearing

The optional welding plates can be used as an alternative to the screw connections or the need weld directly to the bearing elements. The welding plates are screwed onto the bearing and welded once the load carrier has been positioned.

The increase in installation height due to the plates is:

1 ... 4.7 t	15 mm each	use above and/or below
10 ... 22 t	20 mm	use above; the elastomer is not welded
33 t	25 mm	above
> 33 t		on request

Evening up the differences in height:

- Divergences from the prescribed installation height can be evened up using the filler plates supplied.
- If the on-site installation height is too great, filler plates of suitable thickness must be provided.
- Set the horizontal play.
  The tolerances are dependent on the nominal loads (refer to the following figure).
- Any anti-rotation device required may not rest against the load cells' threaded connectors.

STRICTLY OBSERVE

Prevent shunt forces

The load cell cable must be free enough to move that it does not hinder the play allowed the load receptor.

Potential equalization

- Due to the insulating effect of the elastomer, it is essential that a potential equalization be established through the load cells.
- If the on-site construction itself does not provide such a potential equalization, then it must be made using a **fine-wired** multi-wired cable (cross section ≥ 50 mm²) at **one** supporting point.
- Suitable cables are available from Schenck Process in a range of lengths.

See also

Assembling the Components [→14]

5.1.1 Installation Drawing for DEM Bearings

5.1.1.1 DEM 0.13 ... 0.50 t

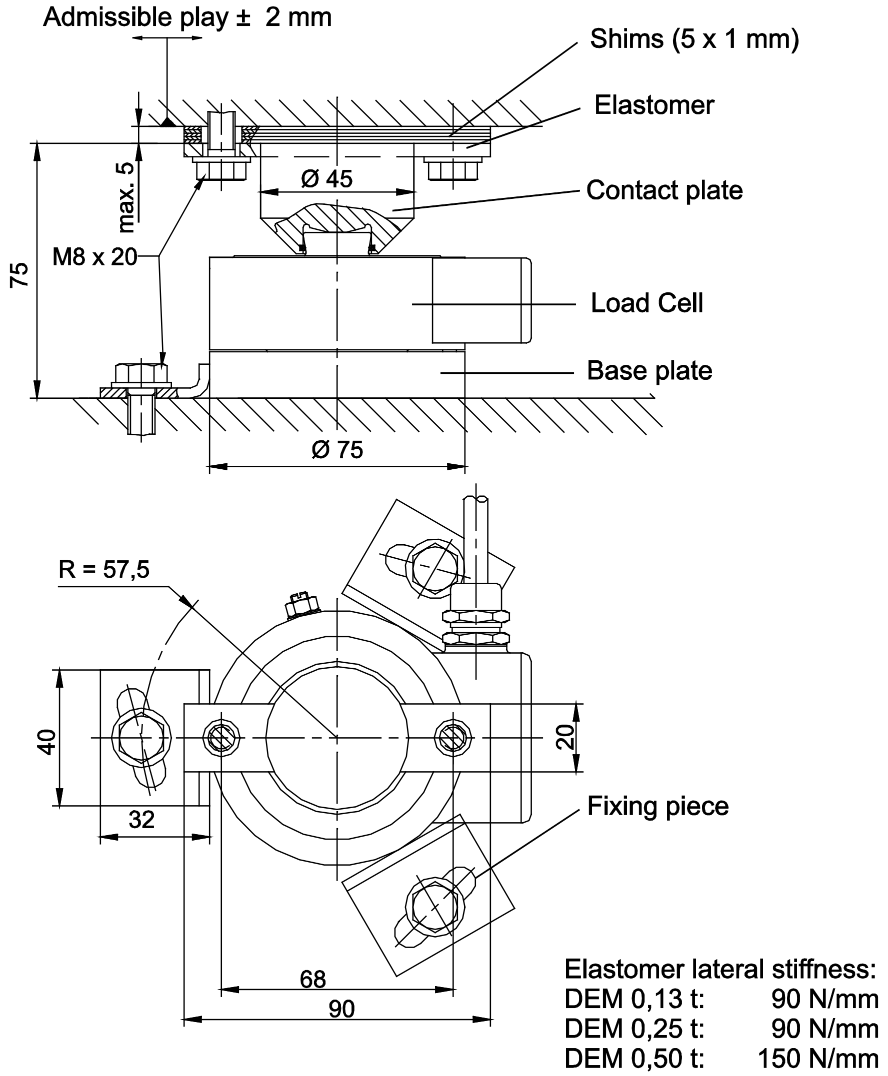


Fig. 12: Installation of the 0.13 ... 0.50 t DEM bearing

5.1.2 Installation Drawing for VEN Bearings

5.1.2.1 VEN 1 ... 4.7 t

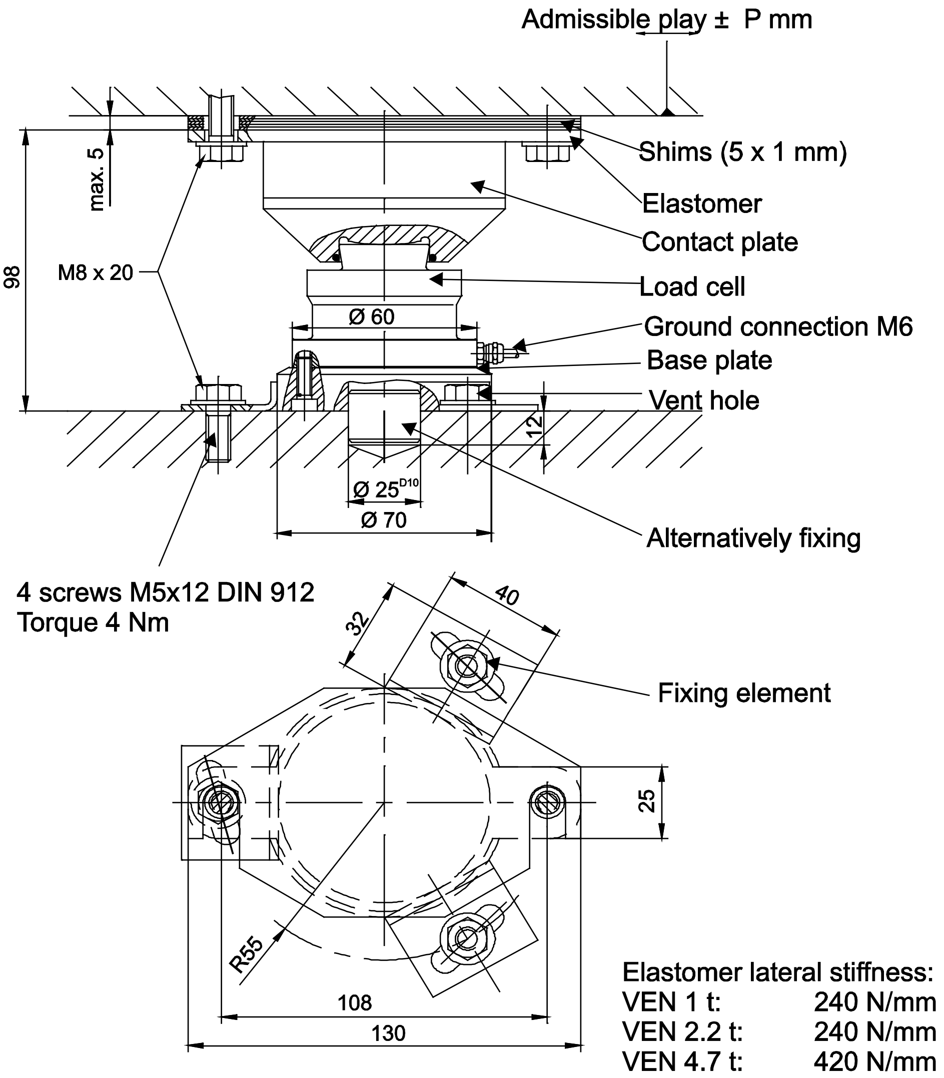


Fig. 13: Installation of the 1 ... 4.7 t VEN bearing

5.1.2.2 VEN 10 – 470 t

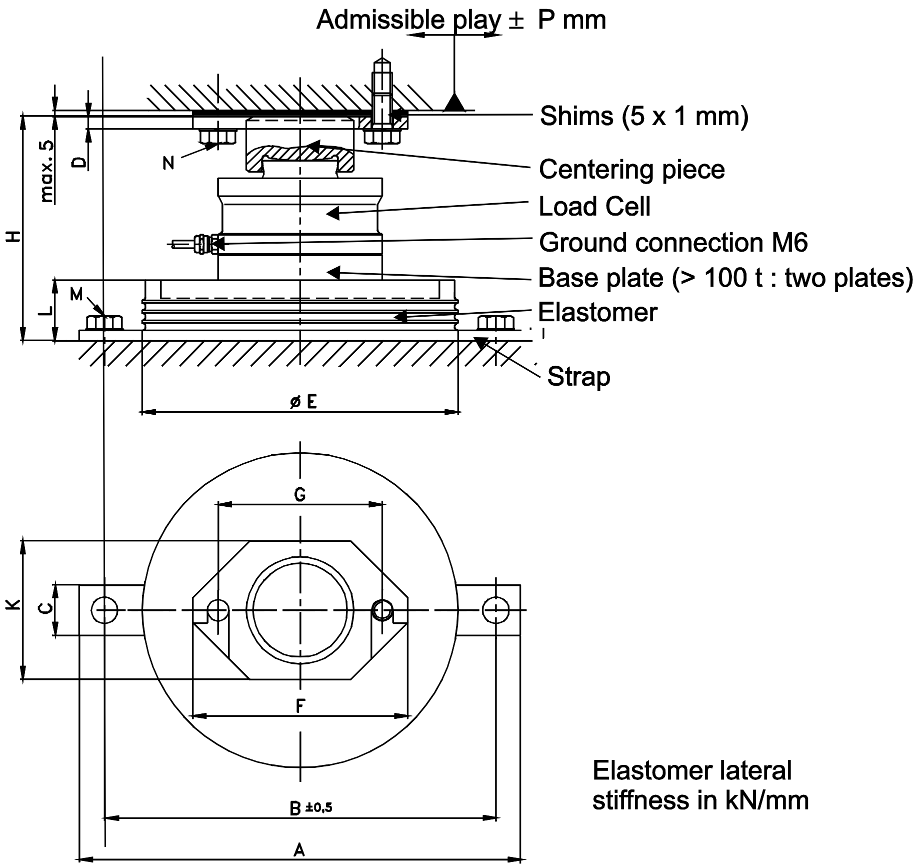


Fig. 14: Installation of the 10 ... 470 t VEN bearing

Technical Data and Variants of the VEN Bearing

Model VEN	Dimensions [mm]													
	A	B	C	D	E	F	G	H	K	L	M	N	P	Q
10 ... 22	190	170	25	6	130	90	68	130	60	41	M 10 x 25	M 10 x 25	6	1.4
33	280	250	25	6	170	120	90	168	80	56	M12 x 25	M 12 x 25	6	1.7
47	350	310	40	10	250	170	130	198	110	63	M 16 x 30	M 16 x 30	6	3.1
68	350	310	40	10	250	170	130	220	110	63	M16 x 30	M 16 x 30	6	3.1
100	400	360	40	10	300	180	140	239	130	68	M16 x 30	M 16 x 30	6	4.3
150	510	460	50	10	400	180	140	320	130	81	M 20 x 45	M 16 x 30	8	6.8
220	560	510	50	12	450	260	200	373	180	81	M 20 x 45	M 20 x 45	8	8.7
330	680	620	60	12	550	260	200	428	180	96	M 24 x 40	M 24 x 40	10	7.3

Tab. 3 : Technical data of the VEN bearing

5.2 Compact Bearing DKM/VKN

Technical Data

These installation instructions consider weighing-related factors only. The operator is responsible for checking and verifying the structural safety and stability.

The DKM/VKN compact bearing comes completely preassembled and is intended for installation between the load receptor and the support structure. It already contains a limit for play in the horizontal direction in the form of adjustable bumpers and a lifting lock.

STRICTLY OBSERVE

Arrange correctly the horizontal limit stops

The correct functioning of the DKM/VKN bearing is only then ensured when the arrangement of the horizontal limit stops has been implemented as per the installation drawing. This arrangement only guarantees that the limit stops will limit in all directions movement of the bin.

The permissible loads per supporting point are given in the following table.

Nominal load	Up to 33 t	Above 33 t
Max. horizontal force	10 % x Ln	10 % x Ln
Max. vertical lifting (tensile) force:	15 % x Ln	10 % x Ln
L_n = nominal load per supporting point		

Tab. 4 : Permissible loads per supporting point

Separate measures must be implemented if the loads that act on the horizontal limit stops and the lifting lock are too high.

A fixed connection between the DKM/VKN bearing and its connecting structure must be guaranteed in order for the above mentioned permissible force components to be reliably transmitted into the connecting structure.

The connecting structure must be rigid enough to guarantee a uniform, parallel load application. If necessary, this may require load distribution plates.

Tolerances

The maximum angle error between the load receptor and the supporting structure may be 0.6° ≙ 10 mm/m. The lower installation surface may deviate from the horizontal by maximum 0.2° ≙ 3 mm/m.

Larger deviations must be corrected by grinding the connecting surfaces or by using tapered shims (to be welded in place!) (refer to the following figure).

Load cell bearings may not be grinded off under any circumstances!

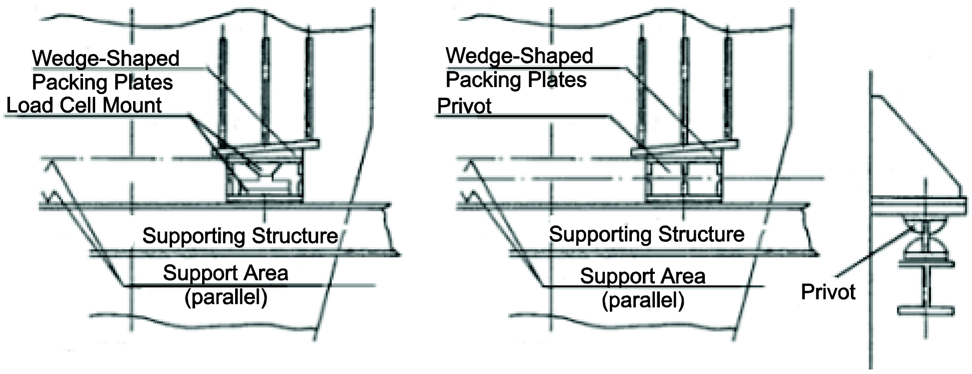


Fig. 15: Use of tapered shims

Assembly instructions

Check that the scope of delivery is complete and that it tallies with the specifications.

STRICTLY OBSERVE

Loosen the pretensioning before installation

The bearings must be introduced with no pretensioning. Therefore, unscrew the vertical limit stop screws before installation and loosen the lifting lock.

Tools required:

- Welding equipment, if load receptor and supporting structure are not to be connected by threaded connections.
- High-precision spirit level
- Monkey wrench, hexagon socket wrench

STRICTLY OBSERVE

Protective measures during welding

Welding will damage load cells or the connected weighing electronics if carried out without the proper protective measures. Therefore when welding:

1. Cover the load cell (use a damp cloth); weld spatter can compromise the corrosion protection.
2. The welding current may not be routed via the load cell; the welding leads must be connected so that this does not occur, use load cell dummies if necessary.
3. Ensure during welding that there is sufficient potential equalization (50 mm^2) between the load receptor and the supporting structure (ground cable), even if using elastomer bearings.
4. The evaluation electronics may otherwise be damaged as the welding current flows through the electronics' potential equalization cables.
5. Protect the elastomer bearings against the effects of heat.

Measurement cable

- Protect all measuring cables against moisture and mechanical damage! (More detailed instructions can be found in the measuring cable installation section.)
- If the electrical equipment is to be installed at a later moment, we recommend that you introduce the measuring cable into the interconnecting box when laying the cables. This will prevent it from being exposed to moisture in the surroundings.
- Read the load cell data sheet included in the packaging.

Alignment:

- If possible or necessary, rest the load receptor onto an assembling aid support (strap, container, platform).
- The load receptor and the supporting structure should be plane-parallel and horizontal.
- The maximum angle error between the load receptor and the supporting structure may be 0.6° ≙ 10 mm/m. The lower installation surface may deviate from the horizontal by maximum 0.2° ≙ 3 mm/m.

Use e.g. tapered shims to compensate for greater divergences (not supplied).

Install the load cells and the load cell bearings as shown in the installation drawings for the compact bearing DKM/VKN or VKN.

Secure a bearing plate with screws and affix it if necessary.

Position the second bearing plate:

- The central axes of the pressure piece and the base plate should fall in line.
- The bore holes for the fastening bolts have been given sufficient clearance to compensate easily even for connecting steel structures with larger tolerances.

Lower the load receptor to its intended height. Verify the correct positioning of the load receptor.

Evening up the differences in height:

- Divergences from the prescribed installation height can be evened up using the spacer plates supplied.
- If the on-site installation height is too great, filler plates of suitable thickness must be provided.

Tighten

Tighten the screws permanently or weld the bearing plates.

Bearing model DKM/VKN	0.25 ... 15 t	22 ... 33 t
Thickness of weld seam a	3 mm	4 mm
Weld seam length L	20 mm	40 mm

Tab. 5 : Weld seam table

Once the DKM/VKN bearings have been permanently affixed to the supporting structure and the weigh-bridge, adjust the permissible play and secure the adjusting screws with the hex nuts.

Play and lifting lock

The permissible play in all directions is as below at room temperature:

DKM 0.25 t and 0.5 t	1 mm
VKN 1 t ... 4.7 t	1 mm
VKN 10 t ... 22 t	1.5 mm
VKN 33 t	2 mm
VKN 47 t ... 470 t	2 mm

Regulate the play in the horizontal direction and the lifting lock play. The tolerances are dependent on the nominal loads.

STRICTLY OBSERVE

Prevent shunt forces

The load cell cable must be free enough to move that it does not hinder the play allowed the load receptor.

Note on adjusting the play:

- Screw in the limit screws until contact is made with the limit stops. Then loosen by the amount of permissible play and secure with hex nuts.
- The weighbridge and/or the bin must be raised by approx. 3 mm when dismantling the VKN 1 t ... 4.7 t.
- Then loosen the fastening screws and push out the entire unit (LC - elastomer) sideways. This may require the removal of a fastening screw.

5.2.1 Installation Drawing for Compact Bearing DKM 0.25 ... 33 t

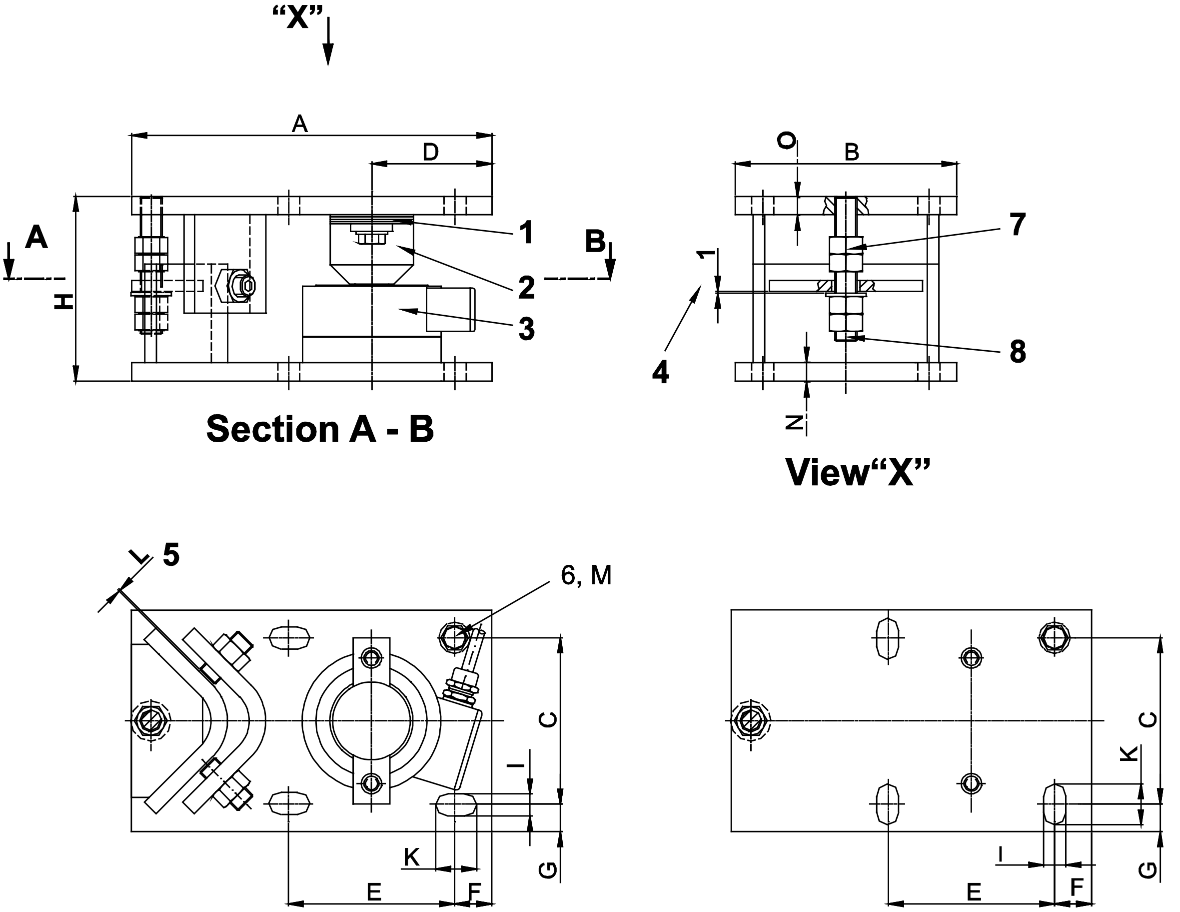


Fig. 16: Installation drawing for the compact bearing DKM 0.25 ... 33 t

5.2.2 Installation Drawing for Compact Bearing VKN 47 ... 470 t

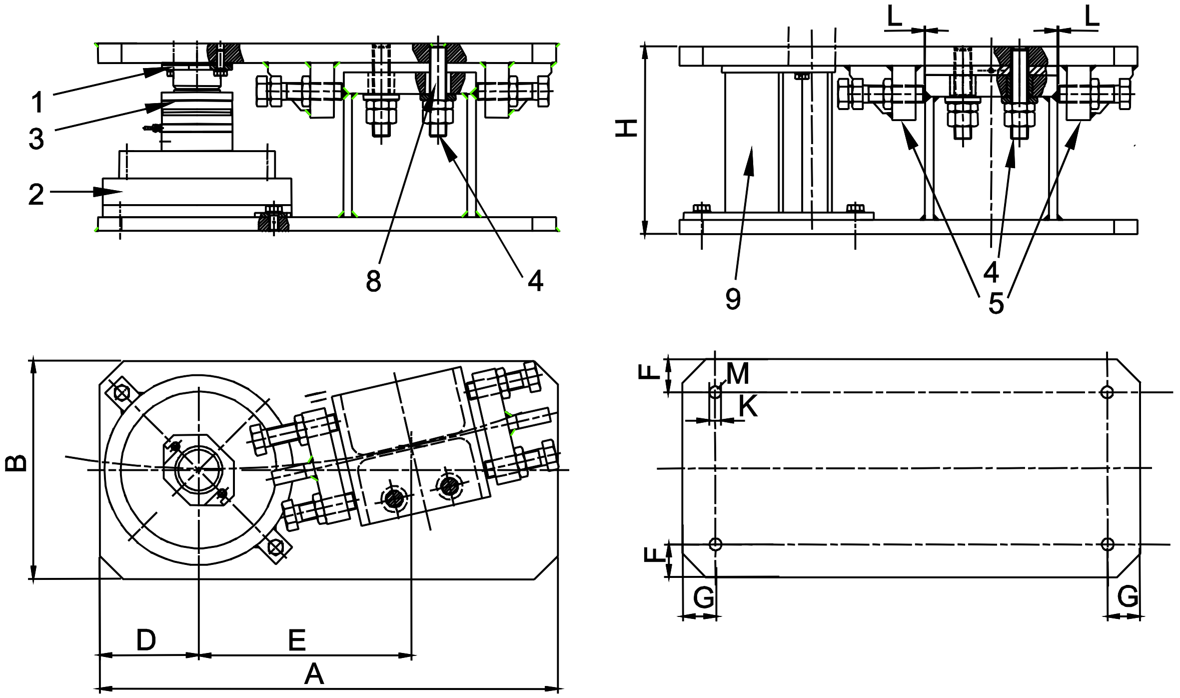


Fig. 17: Installation drawing for the compact bearing VKN 47 ... 470 t

1	Shims included	2	Elastomer, the elastomer is located beneath the load cell for nominal loads of 10 t upwards
3	Load cell	4	Set the lifting lock - allow for 1 mm of play for nominal loads of up to 10 t, 2 mm from 15 t upwards.
5	Adjust the pendulum limit stop with play L	6	On-site fastening screw and plate, see dimension M
7	Unscrew the nuts of the transport securing device approx. 10 mm upwards once it has been assembled on site and again lock with the nut	8	If assembling on a workshop or on-site, the bolts should be aligned centrally to the borehole
9	Transport support is replaced after assembly by the load cell.		

Caution: The transport support has not been dimensioned for loading with the nominal load or for receiving horizontal forces.

Technical data and variants of compact bearing DKM/VKN 0.25 ... 33 t

Load cell	Measurements in [mm]													
	A	B	C	D	E	F	G	H	I	K	L	M	N	O
DKM 0.25 t – 0.50 t for RTB	195	120	90	65	90	20	15	100^{-5}	12	12	1	M 8	10	10
VKN 1 t – 4.7 t for RTN	200	140	100	60	100	15	20	115^{-5}	15	20	1	M 12	8	10
VKN 10 t – 22 t for RTN	235	180	140	90	140	20	20	155^{-5}	18	22	1,5	M 16	10	10
VKN 33 t for RTN	340	250	200	135	200	35	25	197^{-5}	22	26	2	M 20	12	12

Tab. 6 : Technical data of compact bearing DKM/VKN 0.25 ... 33 t

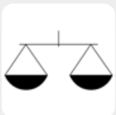
Technical data and variants of compact bearing DKM/VKN 47 ... 470 t

Load cell	Measurements in [mm]										Maximum force in [kN]		Max. vertical loading in [t]	
	A	B	H	D	E	L	F	G	K	M	Horizontal	Vertical	Transport-supports	Limit stop unit
VKN 47 t	730	340	253	140	350	2	50	50	ø 21	M 20	70	70	25	47
VKN 68 t	730	340	275	140	350	2	50	50	ø 21	M 20	70	70	35	68
VKN 100 t	860	410	304	160	420	2	60	60	ø 26	M 24	100	100	35	80
VKN 150 t	970	460	395	210	450	2	60	60	ø 26	M 24	150	150	45	90
VKN 220 t	1150	470	468	235	545	2					220	220	45	110

Tab. 7 : Technical data of compact bearing VKN 47 – 470 t

For this load the transport support must be dismantled and the upper part of the bearing (4, 5) must be recessed. Any height compensation is implemented using shims.

- VKN 330 t, 470 t upon request



STRICTLY OBSERVE

Ensure minimum loading

A non-repeatable transmission of force may occur when raising / resettling the load cell load application elements, causing measuring errors in the scales.

For this reason load cells in compact bearings may never be completely load-free.

The minimum preload should be calculated so that when in operation a permanent friction connection always connects the load cell with the pressure piece or the bearing base plate (≥ 1 % of the nominal load).

Arrangement of supporting points

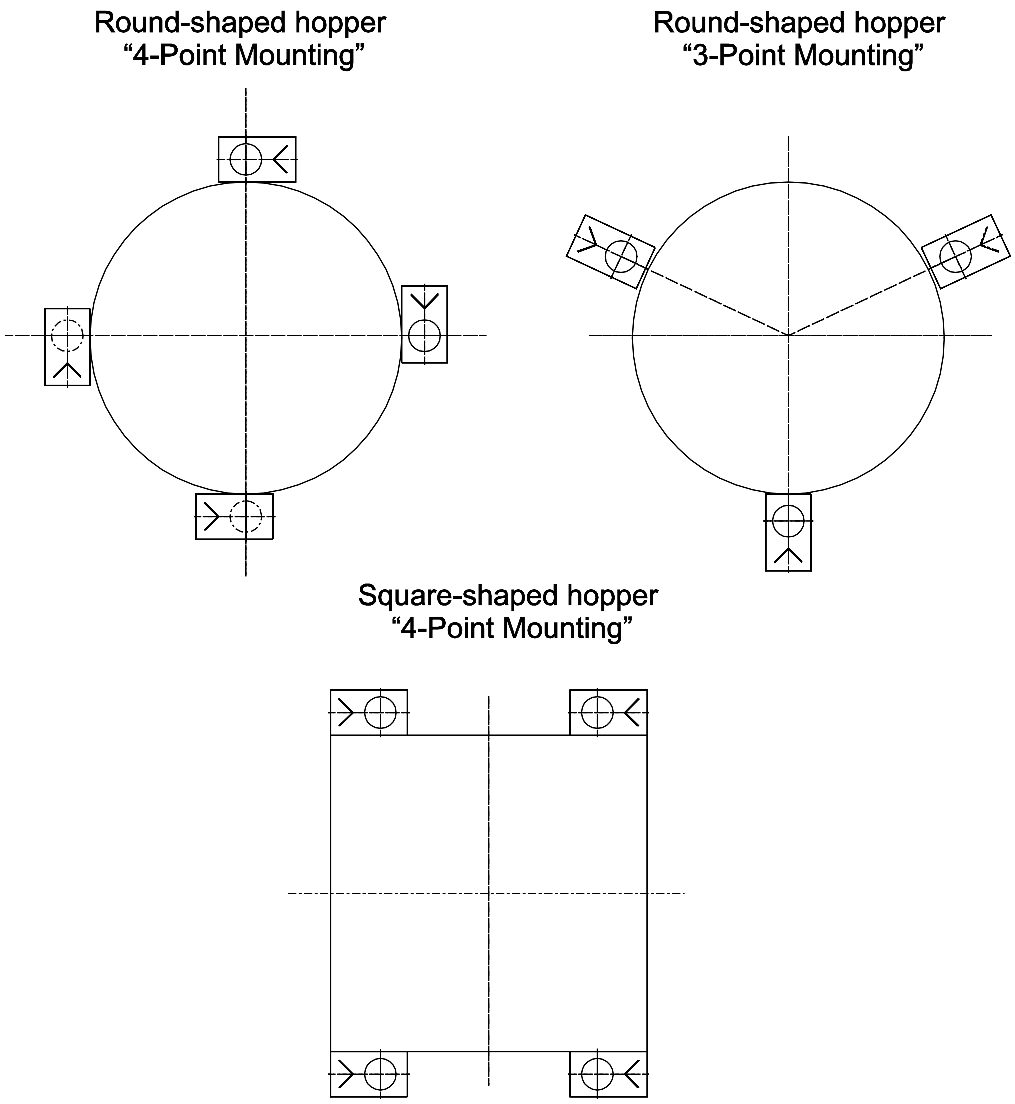


Fig. 18: Arrangement of the supporting points for installation of the compact bearing

The VKN 47 – 150 t bearings are engineered for use in round containers 3 – 6 m in diameter. 3 - 4 bearings are arranged as shown in the diagram shown below.

Arrangement when using 3 supporting points

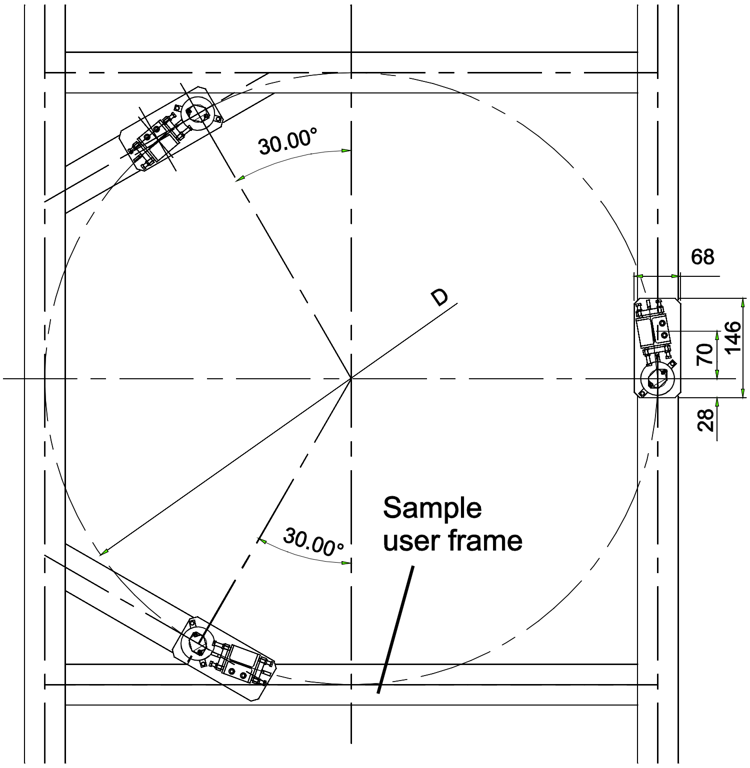


Fig. 19: Arrangement of the supporting points for installation of the compact bearing 47 ... 470 t

5.3 Pendulum Bearing VPN

Technical Data

Description, dimensioned drawings, dimension tables and details of its use can be found in data sheet BV-H 2025.

Assembly instructions

- Check that the scope of delivery is complete and that it tallies with the specifications.
- Follow the project planning guidelines and the assembly instructions in previous chapters.

Tools required:

- Welding equipment, if load receptor and supporting structure are not to be connected by threaded connections.
- High-precision spirit level
- Monkey wrench, hexagon socket wrench

STRICTLY OBSERVE

Protective measures during welding

Welding will damage load cells or the connected weighing electronics if carried out without the proper protective measures. Therefore when welding:

1. Cover the load cell (use a damp cloth); weld spatter can compromise the corrosion protection.
2. The welding current may not be routed via the load cell; the welding leads must be connected so that this does not occur, use load cell dummies if necessary.
3. Ensure during welding that there is sufficient potential equalization (50 mm^2) between the load receptor and the supporting structure (ground cable), even if using elastomer bearings.
4. The evaluation electronics may otherwise be damaged as the welding current flows through the electronics' potential equalization cables.
5. Protect the elastomer bearings against the effects of heat.

Measurement cable

- Protect all measuring cables against moisture and mechanical damage! (More detailed instructions can be found in the measuring cable installation section.)
- If the electrical equipment is to be installed at a later moment, we recommend that you introduce the measuring cable into the interconnecting box when laying the cables. This will prevent it from being exposed to moisture in the surroundings.
- Read the load cell data sheet included in the packaging.

Alignment and securing

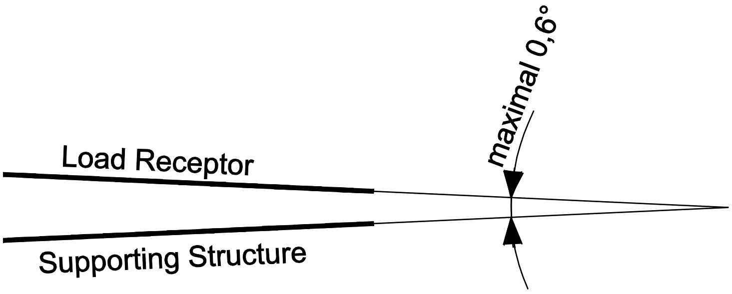


Fig. 20: Maximum angle of inclination between the load receptor and the supporting structure

Use e.g. tapered shims to compensate for greater divergences (not supplied).

- The load cells and their bearings are installed as per the installation drawing.
- Position the centering piece and secure it with screws. The central axes of the upper and lower bearing elements should fall in line.
- Lower the load receptor to its intended height. Verify the correct positioning of the load receptor.
- If possible or necessary, rest the load receptor onto an assembling aid support (strap, container, platform).
- The load receptor and the supporting structure should be plane-parallel and horizontal.

Evening up the differences in height:

- Divergences from the prescribed installation height can be evened up using the filler plates supplied.
- If the on-site installation height is too great, filler plates of suitable thickness must be provided.

Play and lifting lock

- Regulate the play in the horizontal direction. Adjusting equipment must be supplied by the customer.
- The permissible values depend on the nominal loads and can be found in data sheet BV-H 2025.
- An on-site anti-lift device may need to be supplied.

STRICTLY OBSERVE

Prevent shunt forces

The load cell cable must be free enough to move that it does not hinder the play allowed the load receptor.

5.3.1 Installation Drawing for Bearing VPN 1 t ... 100 t

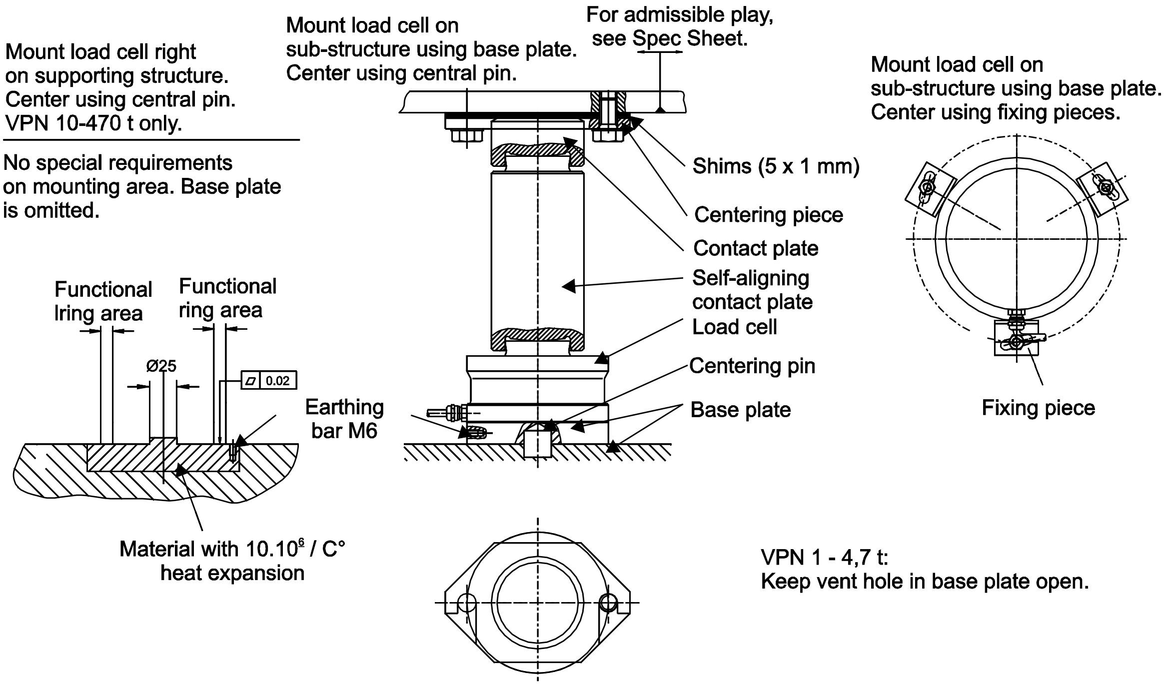


Fig. 21: Installation drawing for the bearing VPN 1 t ... 470 t

Fitting dimension: see data sheet BV-D 2083

5.4 Fixed Bearing

Fixed bearings are economical supporting points and can partially replace supporting points with load cells and load cell bearings in bin weighers, assuming that the point of gravity of the scales will move only minimally during operation due to e.g. changes in the fill level.

They are used together with one or two load cells for uncomplicated tasks, such as fill level analyser devices.

Fixed bearings can withstand vertical and lateral forces (max. lateral force: 10 % of nominal load).

Furthermore they also constrain the bin, making bumpers and suspension arms unnecessary.

Schenck Process fixed bearing points are VFN support bearings.

VFN – bearing 1 – 470 t

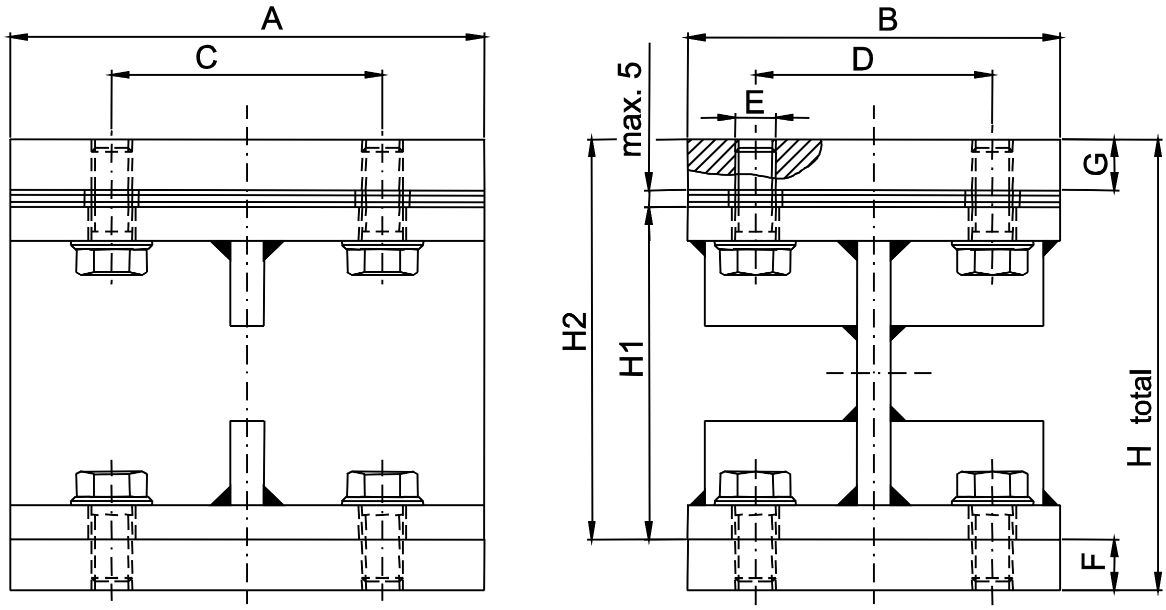


Fig. 22: Installation drawing for bearing VPN 1 t ... 470 t

Technical data and variants

			Measurements in [mm]										[kN]
Model	**Nominal load [t]**	**Weight [kg]**	**A**	**B**	**C**	**D**	**E**	**H1**	**H2**	**H Total**	**F**	**G**	**Q1=Q2**
VFN 4.7	1 … 4.7	9	140	110	80	70	M 12	98	113^{+5}	128^{+5}	15	15	5
VFN 22	10 … 22	27	250	140	150	90	M 16	130	150^{+5}	170^{+5}	20	20	22
VFN 33	33	46	270	180	180	110	M 20	168	193^{+5}	218^{+5}	25	25	33
VFN 47	47	47	270	180	180	110	M 20	168	198^{+5}	248^{+5}	50	30	47
VFN 68	68	94	300	270	180	180	M 24	220	245^{+5}	270^{+5}	25	25	68
VFN 100	100	113	300	270	180	180	M 24	220	240^{+5}	300^{+5}	60	20	100
VFN 150	150	176	380	280	300	190	M 24	320	355^{+5}	390^{+5}	35	35	150
VFN 220	220	251	450	300	330	200	M 30	373	413^{+5}	453^{+5}	40	40	220
VFN 330	330	400	500	350	380	220	M 36	425	475^{+5}	525^{+5}	50	50	330

Tab. 8 : Technical data of the VFN – bearing

Weight in kg incl. all plates

Q1 max. lateral force parallel to the line of tilting
Q2 max. lateral force perpendicular to the line of tilting

Arrangement of the fixed bearings

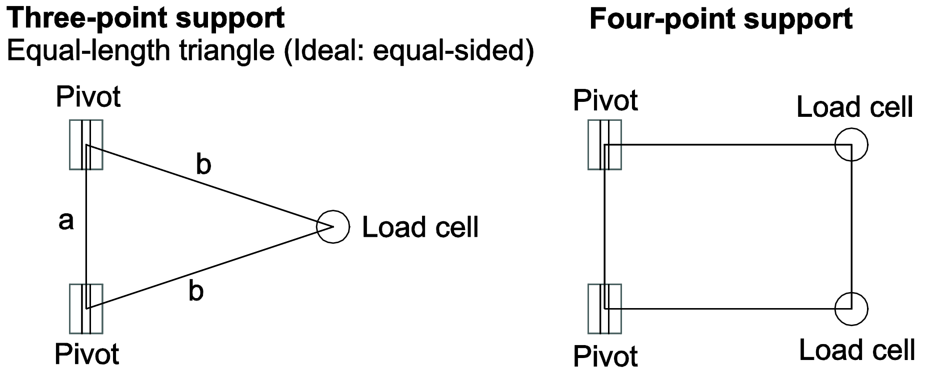


Fig. 23: Three- and four-point support with fixed bearings

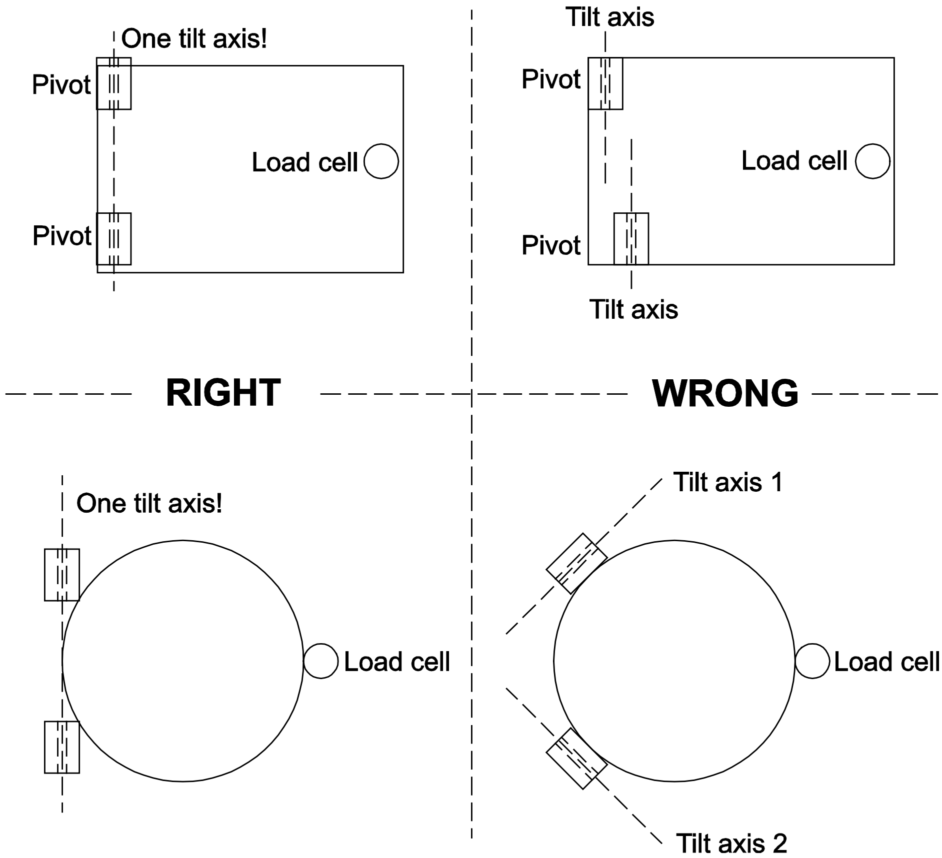


Fig. 24: Fixed bearing tilting axis

Assembly instructions

Check the spacing and the position of the mounting bores against the dimensioned and engineering drawings.

- To introduce the bearing, raise the bin and, if necessary, lower it onto an assembly support aid.
- Position the fixed bearings and secure them to the supporting structure.

Caution: Both bearings must be leveled together and have the same tilting axis (refer to the figures).

Lower the bin to its intended height and equal any differences in height between the supporting points using filler plates.

Introduce the load cells and the load cell bearings and equal out any differences in height between the fixed bearing and the load cells (by placing place filler plates supplied by the customer beneath).

Screw or weld the bin to the bearing. Do not alter the tilting axis set when fastening it.

6 Bumpers

Bumpers absorb lateral forces and limit horizontal movement of the load receptor. They are necessary if lateral forces may arise that could cause the lateral force limit level of the load cells to be exceeded (example: truck scales). The bumper's counter bearing must be able to withstand the impact loading!

The bumpers must be arranged so that lateral forces arising from any direction can be absorbed.

The dimensioning of the bumpers should be oriented towards the maximum occurring lateral force.

The type of bumper to be used depends in large part on the local installation conditions (L x H x D) and the available fastening options.

The following types of bumper can be used:

- Elastic bumper DES
- Impact bumper DAS

The customer may also supply bumpers:

- Bolted bumper
- Bracket-type bumper

Bumpers are installed once the load receptor has been positioned on all sides.

6.1 Basic Sequence of Steps Required for Assembly

1. Lower the load receptor (platform scales, bins, etc.) - onto assembling aid supports if necessary - and position it exactly.
2. Fit the bumpers and fasten them loosely.
3. Fit, align and adjust the load cells and their bearings.
4. Lower the load receptor onto the supporting points
5. Set the same amount of play for each side of the bumpers and secure them against displacement.

6.2 Fitting the Bumper DES

If the load receptor can strike horizontally against the foundation or against a steel structure, elastic bumpers are usually used in combination with elastomer bearings DEL/DEM. This applies primarily to large platform scales (truck scales, rail weighbridges).

The maximum permissible compressive load is 10 t. Several bumpers can be arranged side by side, depending on the maximum occurring lateral force.

Minimum gap width: 17 mm + load receptor play

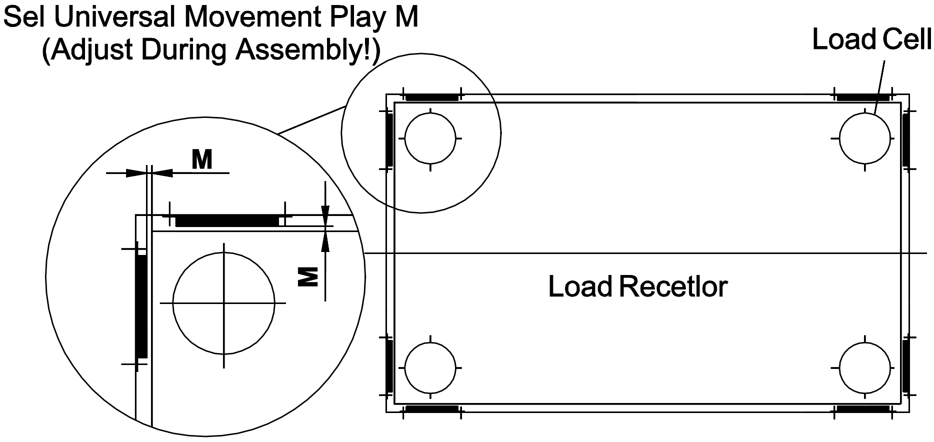


Fig. 25: Bumper DES in a platform scales

Steel structure

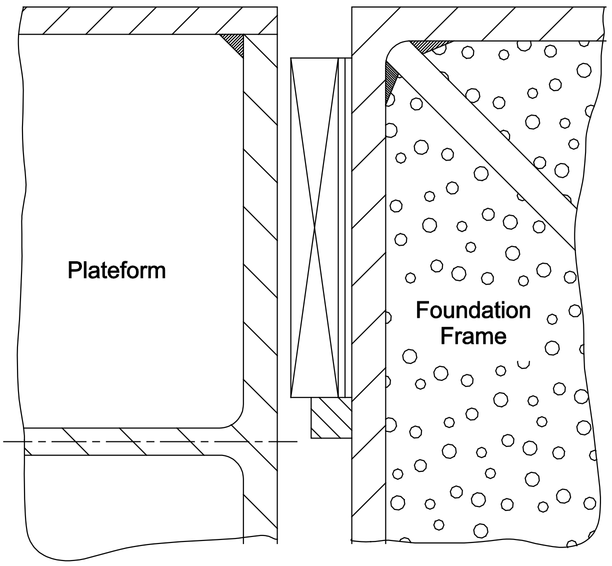


Fig. 26: An elastic bumper DES used in a steel structure

Concrete structure

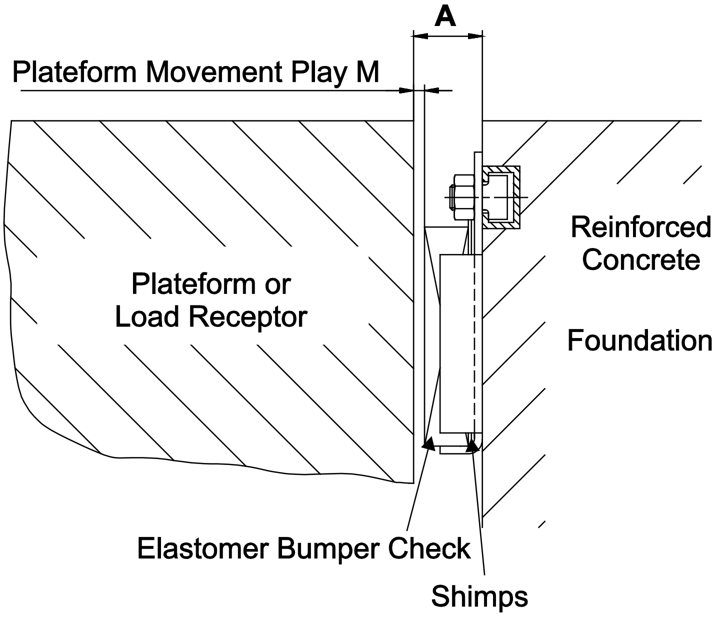


Fig. 27: An elastic bumper DES used in a concrete structure (e.g. vehicle scales)

Assembly instructions:

- Measure dimension A (> 17 mm + M).
- Refer to the engineering drawing or the bearing specifications for the permissible play 'M'.
- Fit the elastic bumper and use filler plates to set the play if necessary.

6.3 Fitting the Bumper DAS

DAS bumpers are welded on. After welding, the play G must be set and the adjusting screw must be secured by locking it with a nut.

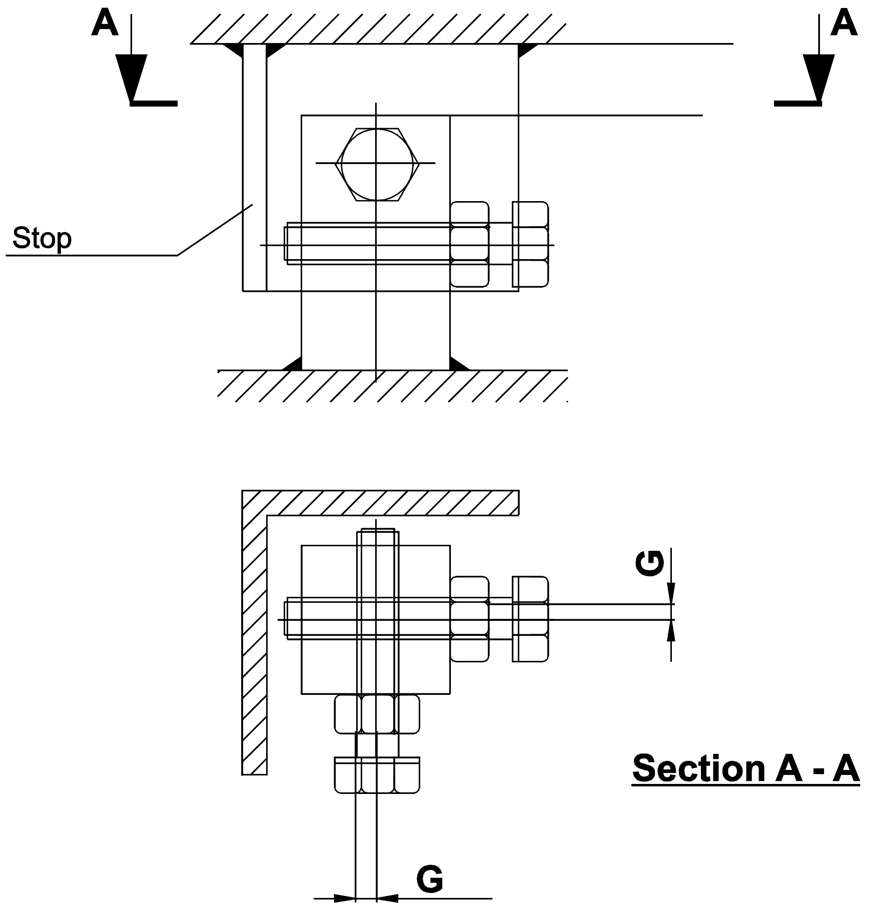


Fig. 28: Using a DAS bumper

6.4 Suggestions for Customer-Provided Bumpers

Bolted bumper

Bolted bumpers are usually combined with elastomer bearings. Two or three bumpers will be required, depending on the type and the structural arrangement.

The bumpers must be modeled and arranged so that lateral forces arising from any direction can be absorbed.

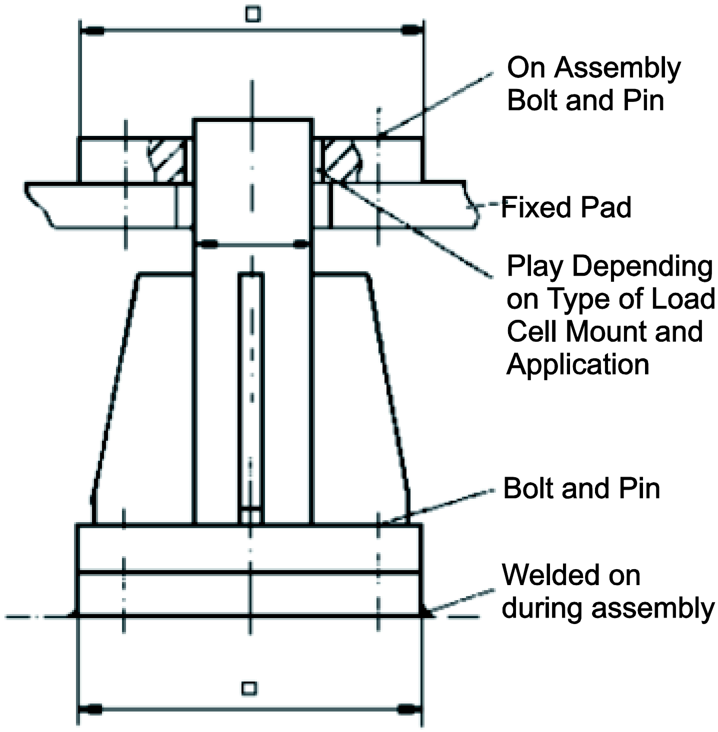


Fig. 29: Operating principle of the bolted bumper

Bracket-type bumper

Bracket-type bumpers are usually used for bin weighers.

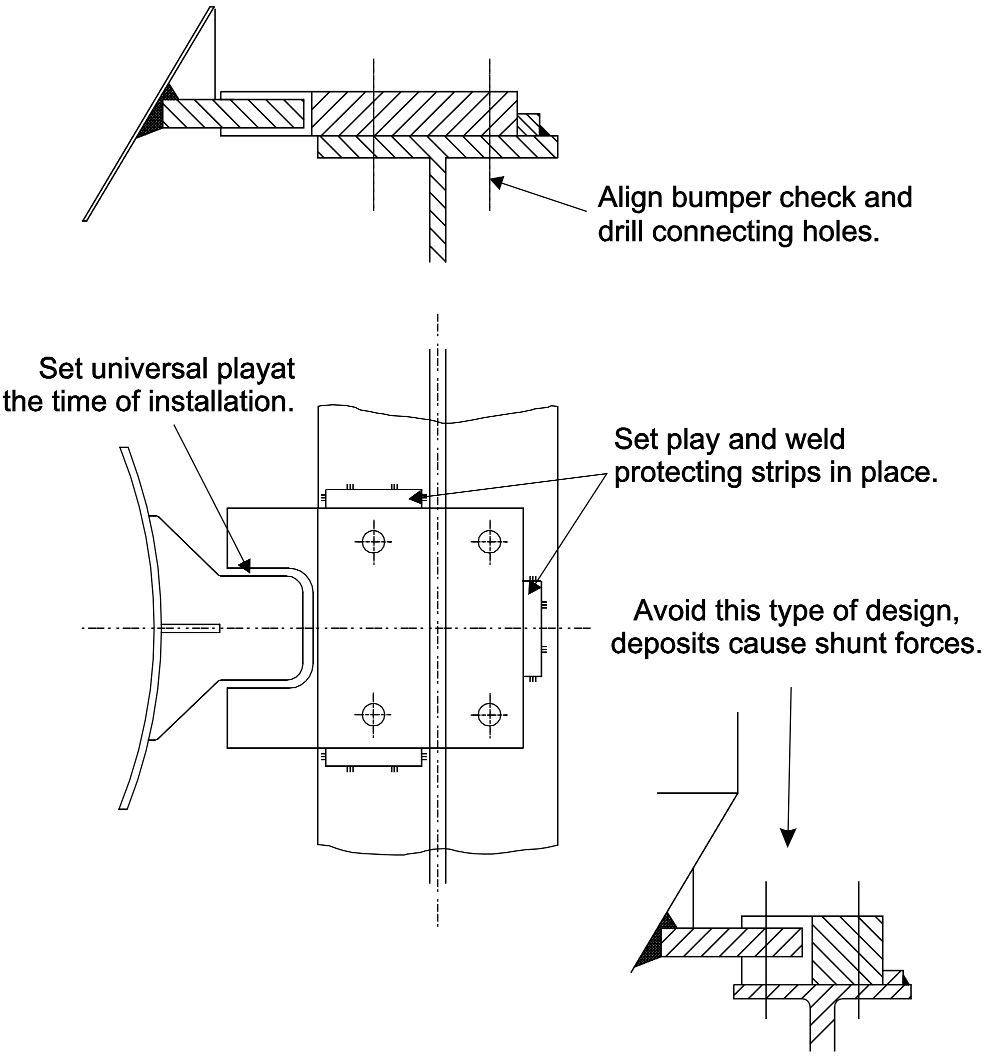


Fig. 30: Operating principle of the bracket-type bumper for bin weighers

7 Cable Boxes

7.1 Application

Cable boxes are used as coupling boxes for cable extensions (VKK 280x1) and as extension and summation boxes (VKK 280x4, DKK 6, VKK 280x6 and VKK 280x8) for the parallel connection of several load cells.

The extension and summation boxes each permit load cells to be connected in 4 and 6-wire circuits. (Exception: DKK 6)

The extension and summation boxes are equipped with resistors for the sensitivity calibration, i.e. the comparison of load cell output voltages.

Schenck Process cable boxes are also available as ATEX models.

As a matter of principle, the cable boxes supplied by Schenck Process should be used in order to maintain protection class IP 65/67:

- To fulfil the requirements on the electrical systems in order to achieve higher accuracy (e.g. potential equalization)
- Additional information can be found in the data sheet BV-D 2121.

7.2 Fitting

The cable boxes must meet the standards of protection class 67 (or 65) in order that the scales can operate trouble-free, that is, no moisture may penetrate the cable box.

They must be carefully fitted to ensure that protection class IP 65/67 can be maintained!

7.3 Selecting their Location

- We recommend placing the cable boxes in a location where they can be inspected after assembly has been completed without requiring extensive scaffolding or dismantling.
- If there is a danger of flooding, we recommend placing the cable box at the highest point beneath a weighbridge.
- The cable box should not come into direct contact with water: e.g. dripping water from above, splashes from the scales facility.

8 Connecting the Load Cells

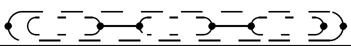
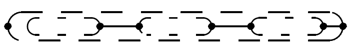
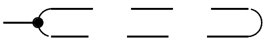
The load cells (LC) must be carefully connected to the control device to guarantee trouble-free scales operation. This requires certain instructions to be followed that are outlined in the following chapter.

Among the important factors are:

- Different shielding concepts for the load cells (shield attached to the load cell body / shield does not touch the load cell body)
- Different methods of connecting the load cell (4 or 6-wire)
- Different types of interconnecting and extension boxes
- Overvoltage Protection
- Types of measuring cable
- Connection to the weighing electronics

Certain symbols will be used on the following circuit diagrams.

The meaning of the most important ones will be explained here:

Circuit diagram symbol	Meaning
	Shield sleeve or Shield connection
PA	Potential equalization connection
	No connection between the inner and outer shields
	Inner and outer shields connected
NC 	NC = shield not connected

8.1 Shielding Concept

The load cell connection shielding concept assumes that the cable shield is arranged in a star-shaped arrangement over all of the cables involved and brought together at **one** central point ('PA point').

- The PA point, or potential equalization point, is located at the entrance to the weighing electronics where the shield is connected to the earth conductor.
- The shield is not earthed at any other point.
- If the cables are double-shielded, the outer shield is used for the continuous shielding.
- The inner shield is connected on one side to the outer shield, this side being the side on which the weighing electronics are located.
- Because of this shielding concept, the shield in most Schenck Process load cells (LC) is **not** connected to the LC body. It is guided along all of the cables and connection boxes to the central potential equalization point.
- Parallel to the cabling, a potential equalizing line (PAL) is guided from the LC bodies to the weighing electronics and connected there to the central PA point.
- The potential equalization rails on some interconnecting boxes are used only to connect the PAL wires, **they are not connected at the boxes to the cable shield**.

- In load cells in which the cable shield is connected to the LC body, this shield is connected to the PA point via the LC and the PAL. In this case it is **not** connected at the interconnecting box.

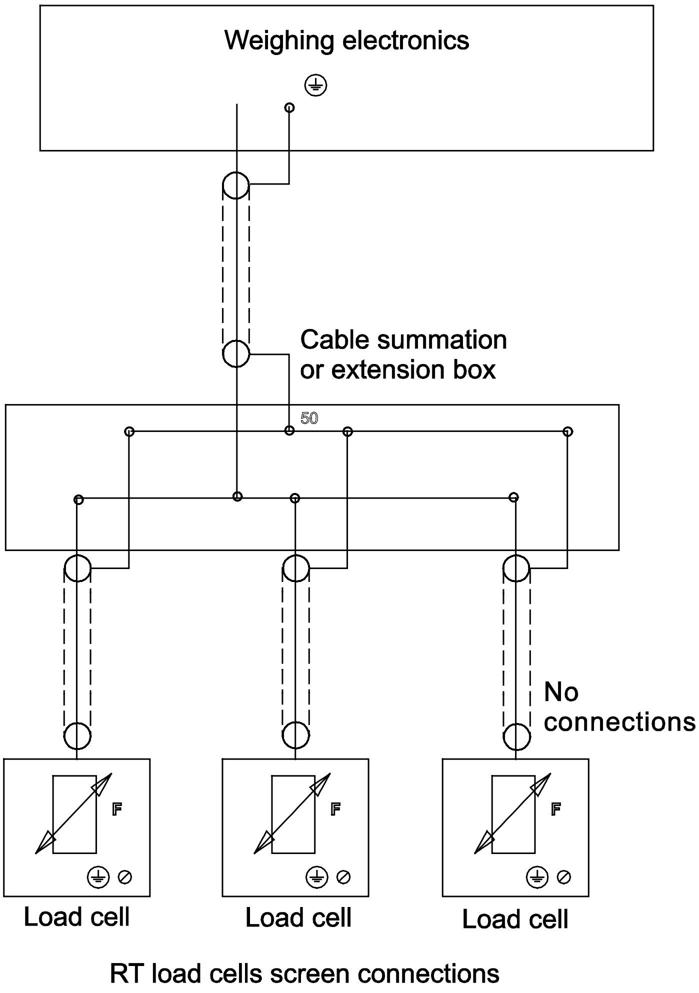


Fig. 31: RT load cells shielding concept

8.2 Potential Equalization

Protection against static discharges and dangerous contact voltages

The load receptor and supporting structure are electrically insulated if elastomer bearings are used. With e.g. bin weighers, granulate material or other materials can cause static charges that can influence weight measurement to form on the load receptor.

A potential equalization supplied by the customer must be fitted between the load receptor and the supporting structure to dissipate these charges. A flexible copper wire with a minimum cross section of 10 mm^2 will suffice. We recommend using Schenck Process earthing cables (highly flexible, 50 mm^2).

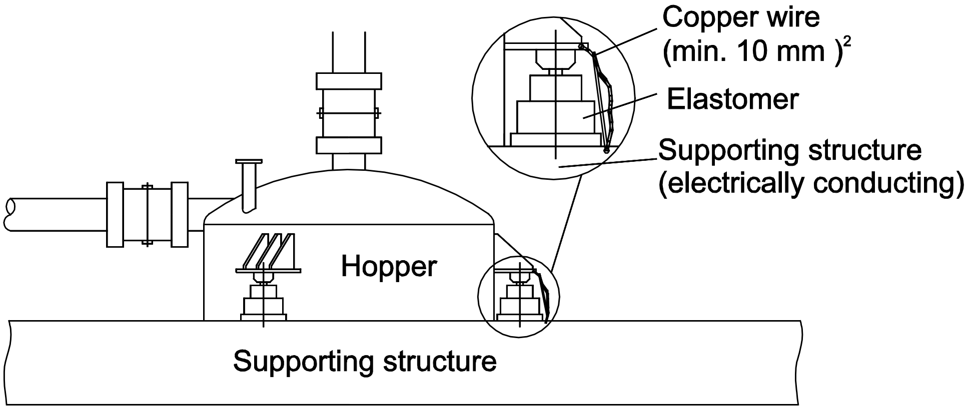


Fig. 32: Protection against static discharges and dangerous contact voltages from elastomer

Protection against dangerous contact voltages will be required if there are electrical assemblies on the load receptor, depending on the size and type of the supply voltage (see DIN VDE 100, part 410). This requires potential equalization (flexible copper wire,10 mm^2 cross section) between the load receptor and the earthed supporting structure.

Uniform reference potential

All of the load cells and the weighing electronics must have the same reference potential. This requires a galvanic connection between the load cells or their base plates and the earth conductor of the weighing electronics.

This galvanic connection is realized either by a metal structure (e.g. crane scales or bin weigher) or by potential equalization circuits from each load cell to the interconnecting box and weighing electronics.

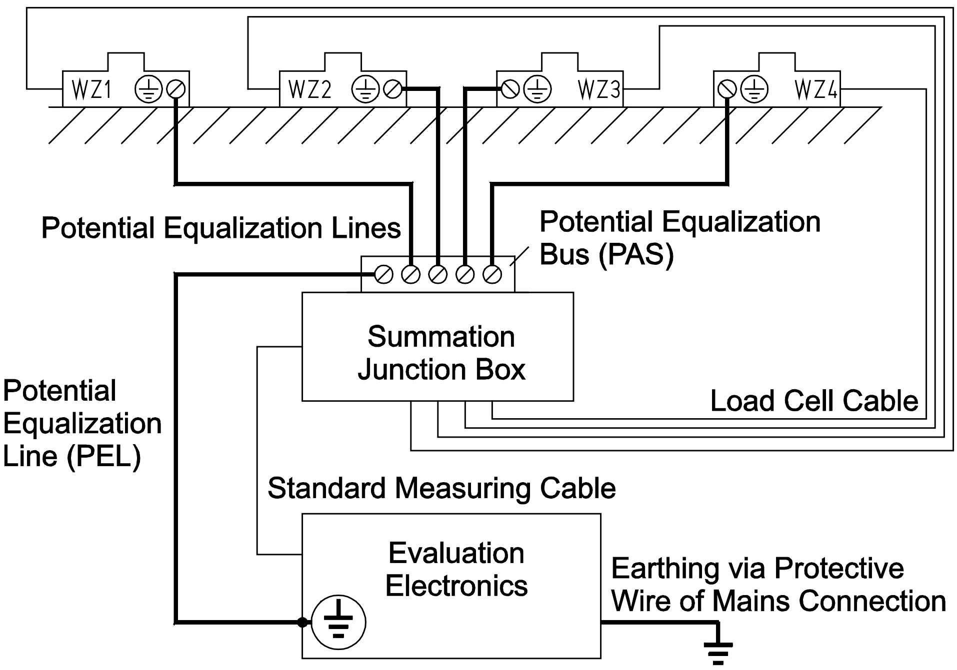


Fig. 33: Potential equalization for a measuring system

Potential equalization using a metal structure may not be possible on certain scales (e.g. platform scales with load cells fitted upside down).

Interconnecting box DKK 69 is equipped with a shunt resistance of 100 kΩ from the cable shield of the load cell cable to the potential equalization rail PAS at the box to dissipate static charges.

An electrical connection must be made between the PAS at the interconnecting box and the metal load receptor to ensure that the current circuit is closed.

8.3 Insulating Resistances

The insulating resistances of an intact load cell are in the range >> 1 GΩ.

Special insulation detectors are needed to measure these values, normal multimeters will not give reliable readings. For an RTN load cell with Ri = 4000 Ω, the following reference values apply for the insulation between each wire in the measuring cable and the load cell body (also applies to shield – LC body):

- New load cell: ≥ 100 GΩ
- Load cell in use: ≥ 10 GΩ
- It must be assumed that the load cell has begun to become damaged if the values < 10 GΩ (corrosion, moisture has penetrated the load cell via the cable). The load cell is unlikely to last another calibration or service interval without a failure of some kind. We strongly recommend replacing the load cell in scales used as legal-for-trade and in plants that make high demands on availability.
- Results showing < 1 GΩ indicated advanced damage; replacement is certainly recommended.
- Values < 100 MΩ (i.e. values measurable by a multimeter) can usually be deduced from deviations in the measured values (zero point, instabilities).

The tolerable values are correspondingly lower for load cells with low internal resistance, approximately 1/10 the above mentioned values for sensors with 350 Ω.

8.4 Connecting the Load Cells to the Interconnecting Box

The connecting cable shield in most Schenck Process load cell models is not connected to the load cell body. The shield is connected in the interconnecting box to terminal 50 or to the shield bus bar. The following figure shows the example of a load cell connected by a 4 wire cable to a 4 channel interconnecting box VKK 28004.

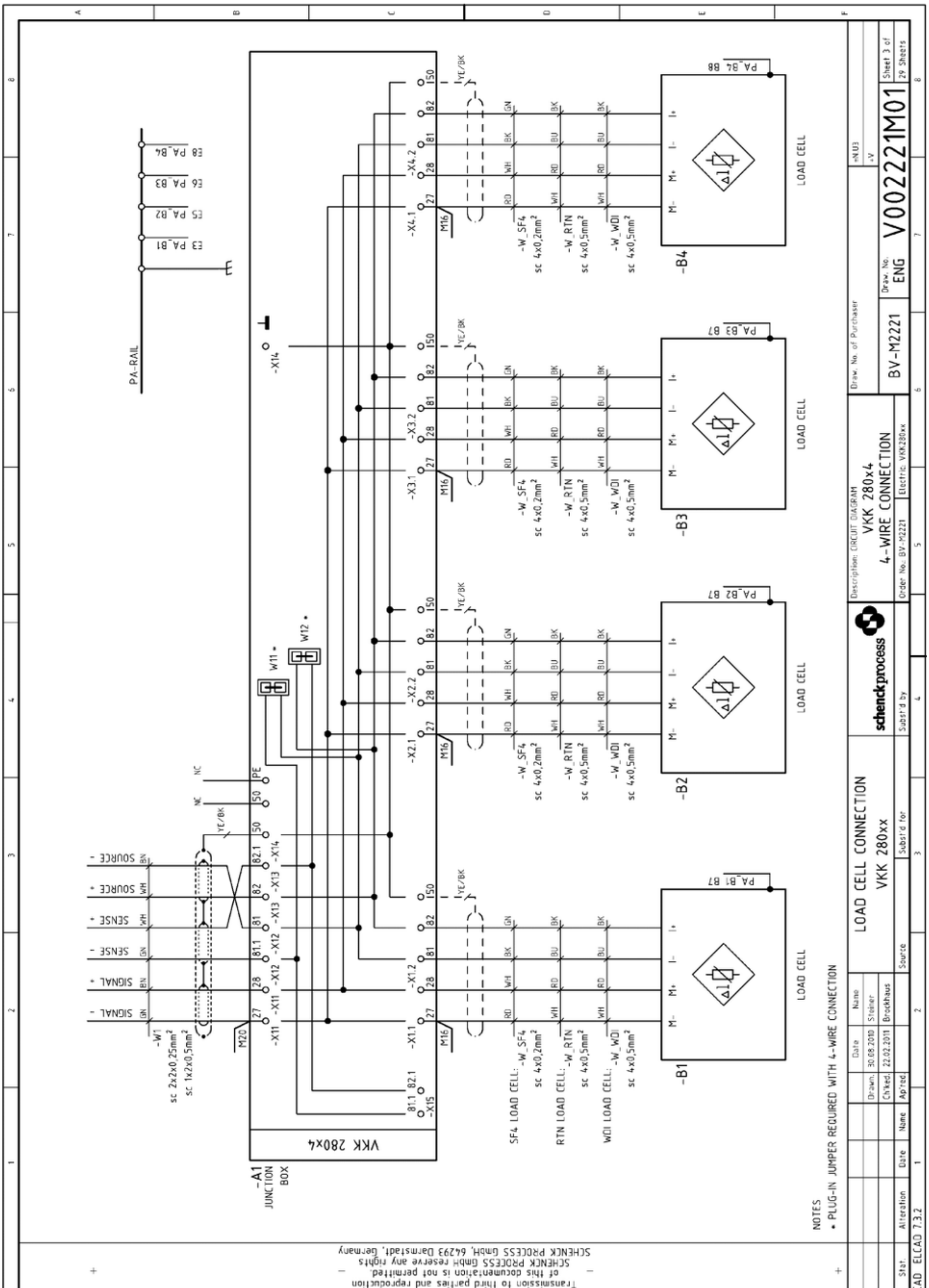


Fig. 34: 4 wire load cell with open shield

The shield is left open with load cells in which the cable shield is in contact with the LC body, see the following example for details - again using a VKK 28004. Please ensure in any case that the open cable is not able to cause any short circuits - insulate it with shrink sleeving or something similar if necessary.

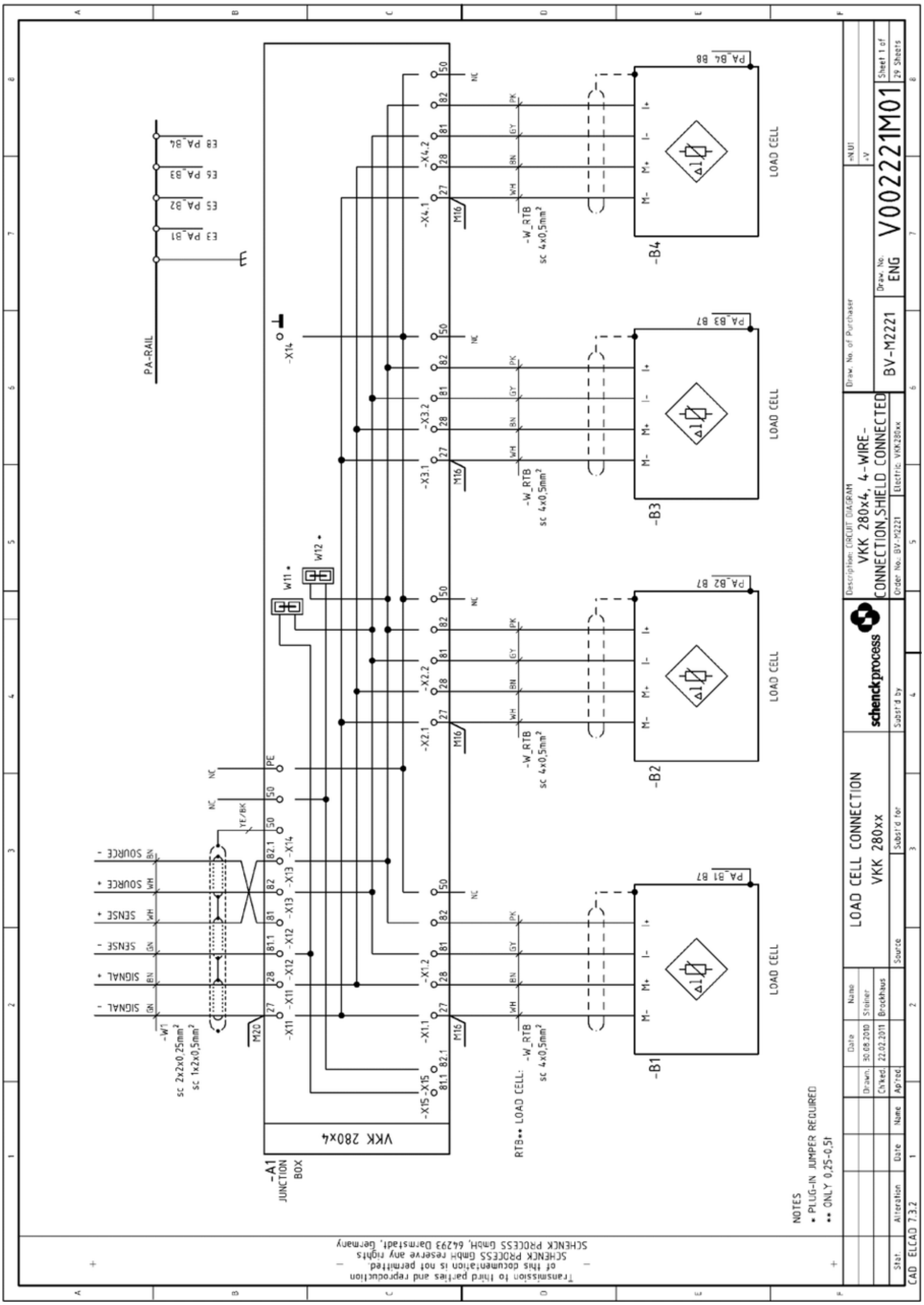


Fig. 35: 4 wire load cell with connected shield

An extension box VKK 280x1 is used if the load cell cable is to be extended.

- The outer shield is connected continuously in any case.
- The inner shield (if there is one) is connected to the outer shield **at the entrance** to the extension box (on the load cell side). The inner shield is left open
  at the exit from the extension box (side towards the weighing electronics).
- 4-wire load cell cables are wired to 6 wire cables in extension boxes, see the next example for details.

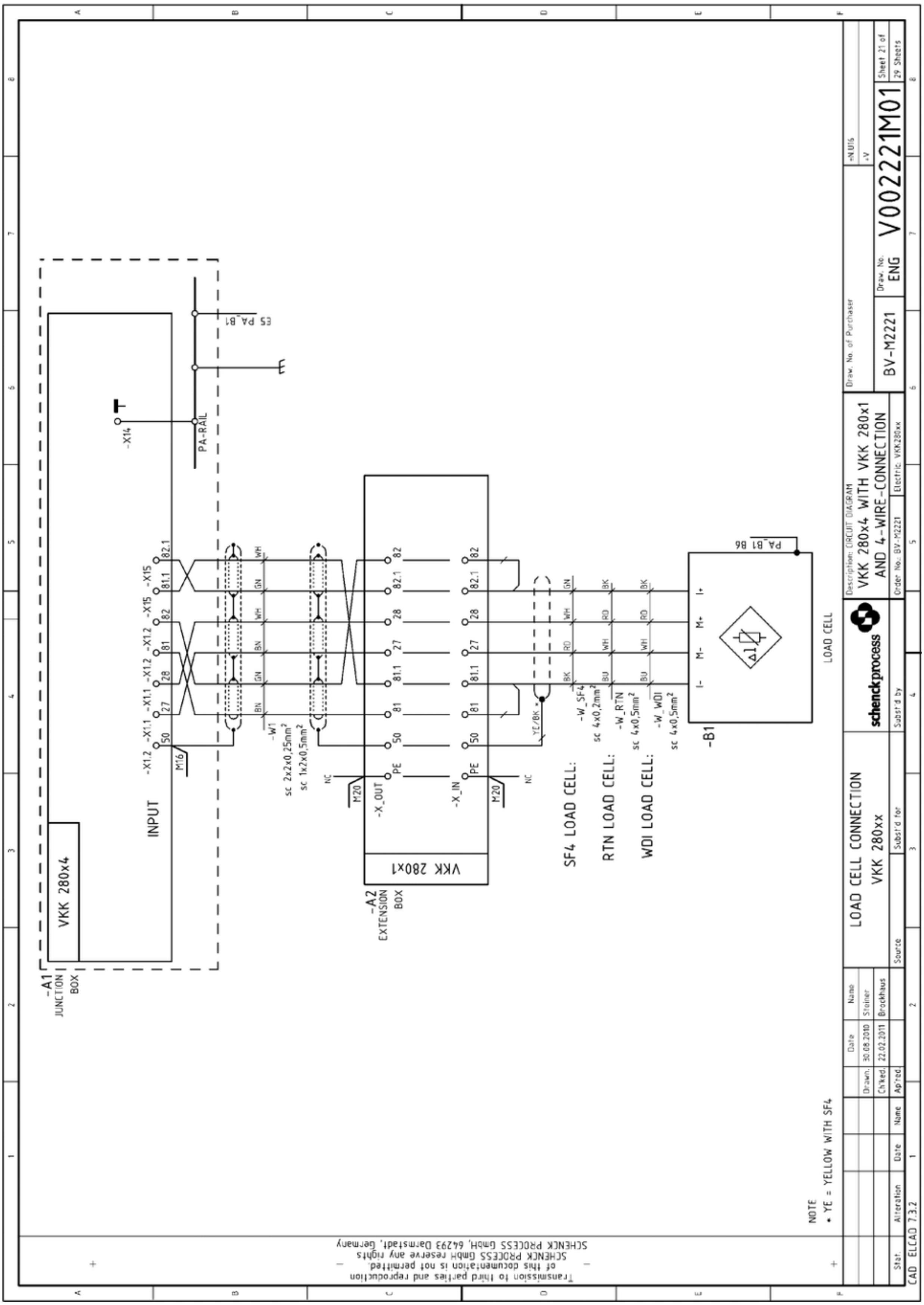


Fig. 36: 4-wire load cell with extension box

If load cells with 6-wire connections are used, the sense lines from one (any) LC only are connected in the interconnecting box. The lines from the other load cells remain open. Again, please ensure that any open wires are properly insulated.

Details of 4 and 6-wire connections to the individual interconnecting boxes can be found on the chapter on the boxes.

As well as a 6-wire connection, the following example also shows

- how the shield is continuously connected through the box,
- that the shield and the PAL are separate from one another.

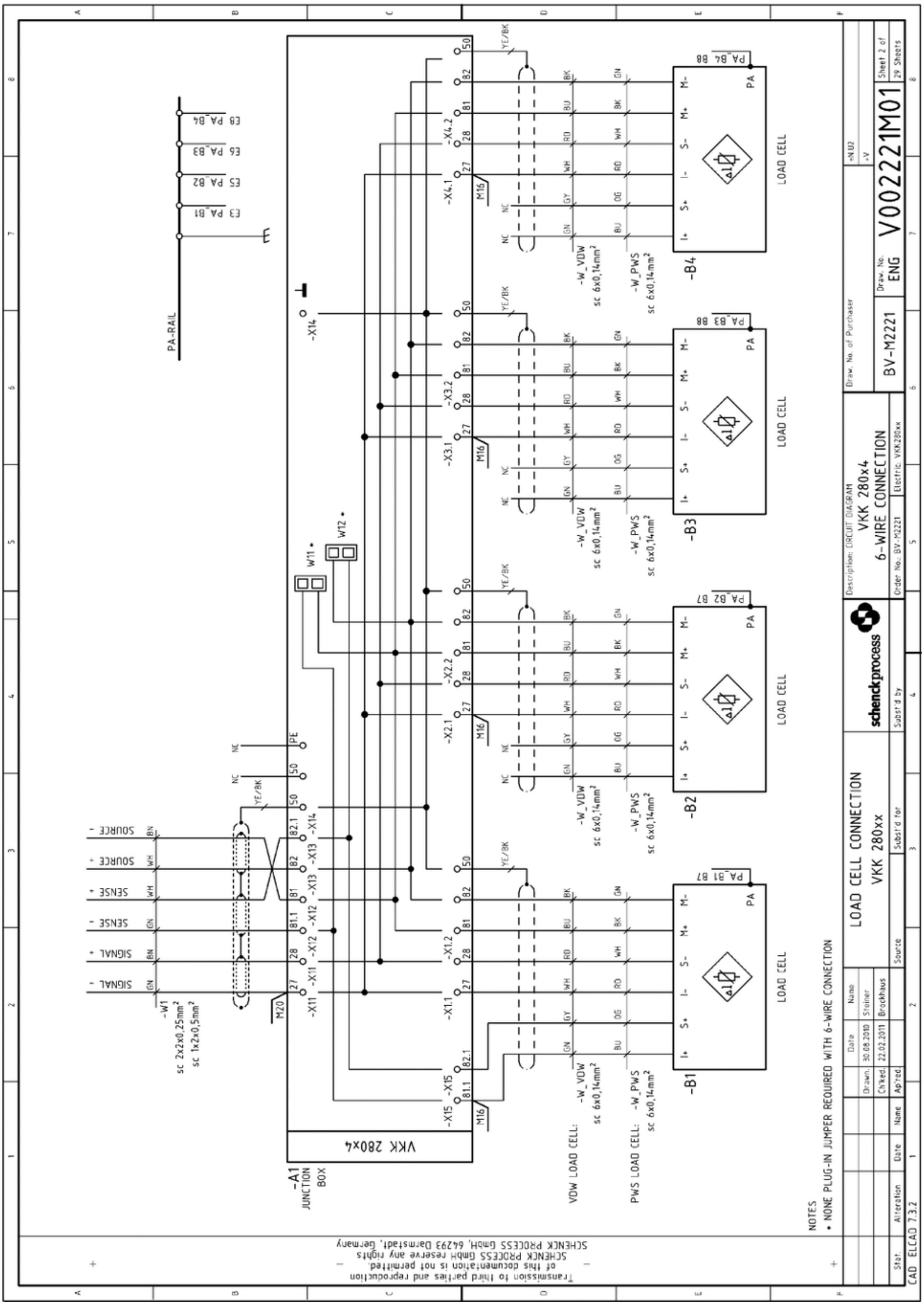


Fig. 37: 6-wire load cell with open shield

Details on the individual extension and summation boxes can be found in chapter »Details on the Cable Boxes [→69]«.

8.5 Details on the Cable Boxes

General information

All Schenck Process cable boxes allow the connection of load cells with both 4 and 6 wire cables.

The sum cable to the weighing electronics is always a 6 wire cable.

The cables can be connected both using open strands (0.13 mm^2 and greater) and connector sleeves (0.25 mm^2 or greater) at the spring-type terminals in the VKK boxes. Cables with connector sleeves may not be doubled-up at the terminals.

Extension box VKK 280x1

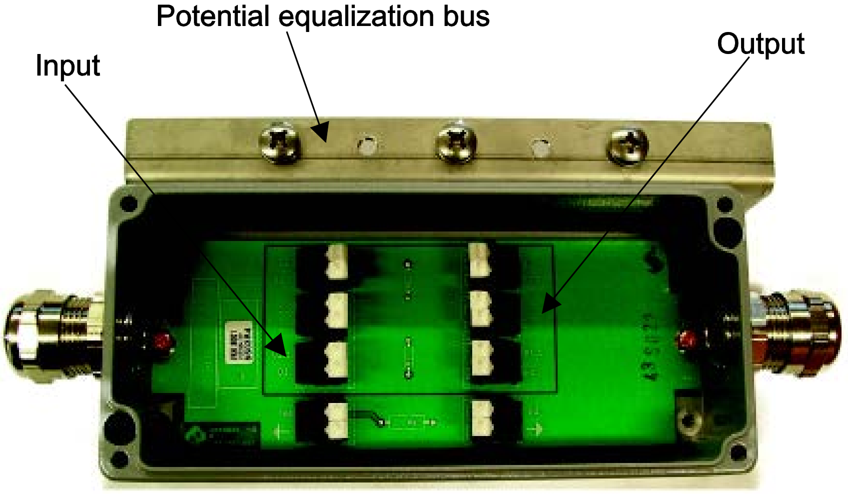


Fig. 38: Connecting the intermediate connection box VKK 280x1

4 Channel box VKK 280x4

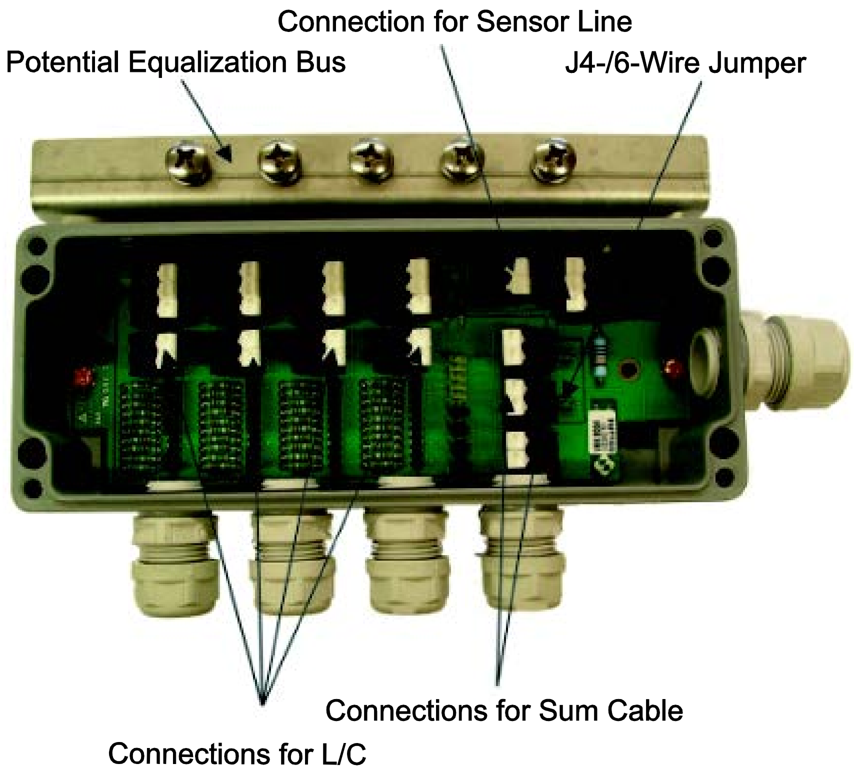


Fig. 39: Overview: intermediate connection box VKK 280x4

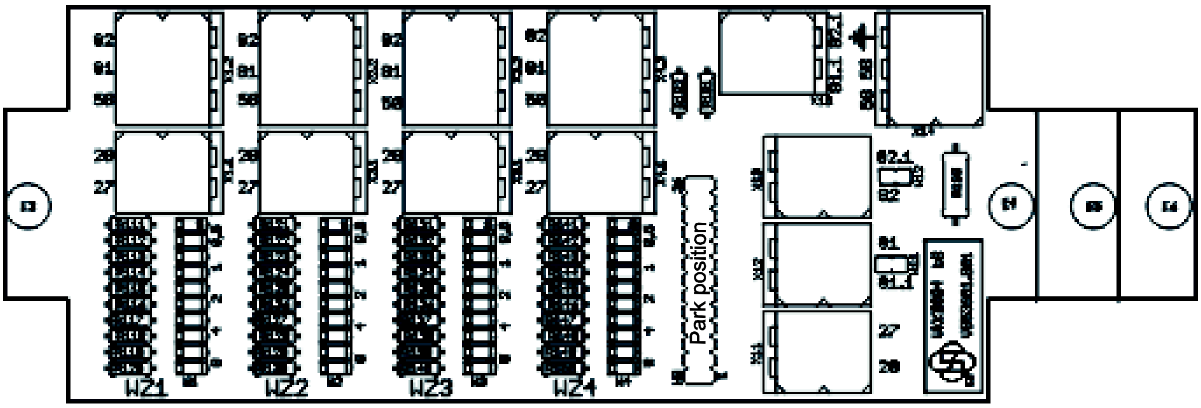


Fig. 40: Location of the connection terminals in the VKK 280x4

4 wire load cells are connected to terminals X1.1 - X4.2. Jumpers W11 and W12 remain connected.

If 6 wire cells are used, the sense lines from **one** load cell are connected to X15. The remaining sense lines remain open (**insulate them well**). Bridges W11 and W12 are unplugged and placed in their neutral position.

The sum cable is connected to X11 - X14.

6 Channel box VKK 280x6

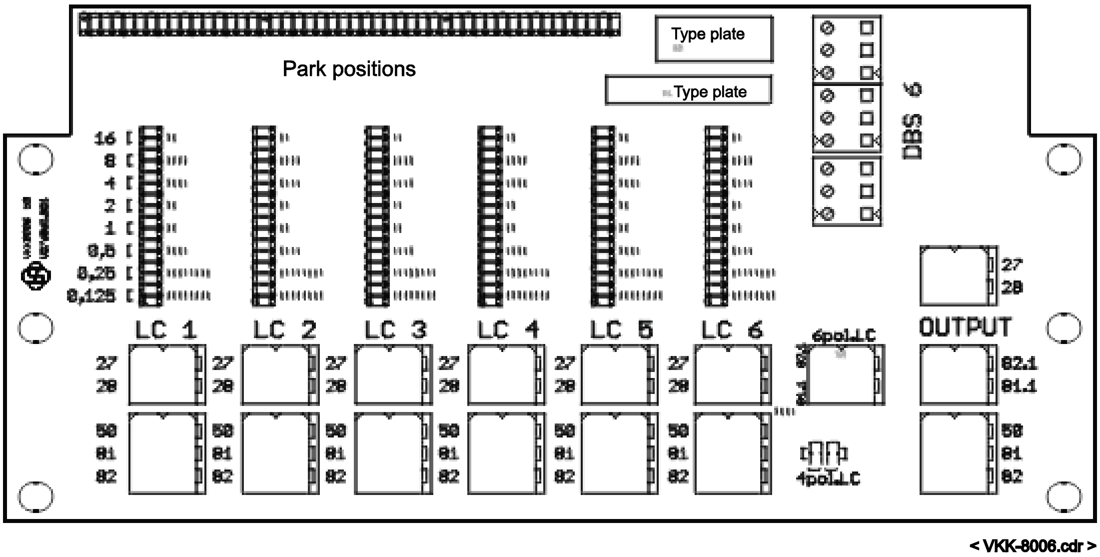


Fig. 41: Location of the connection terminals in the VKK 28006

4 wire load cells are connected to terminals LC1 - LC6. Jumpers W10 and W20 remain connected.

If 6 wire cells are used, the sense lines from one load cell are connected to **6 pol. LC**. The remaining sense lines remain open (insulate them well). Bridges W10 and W20 are unplugged and placed in their neutral position.

The sum cable is connected to **OUTPUT**.

8 Channel box VKK 280x8

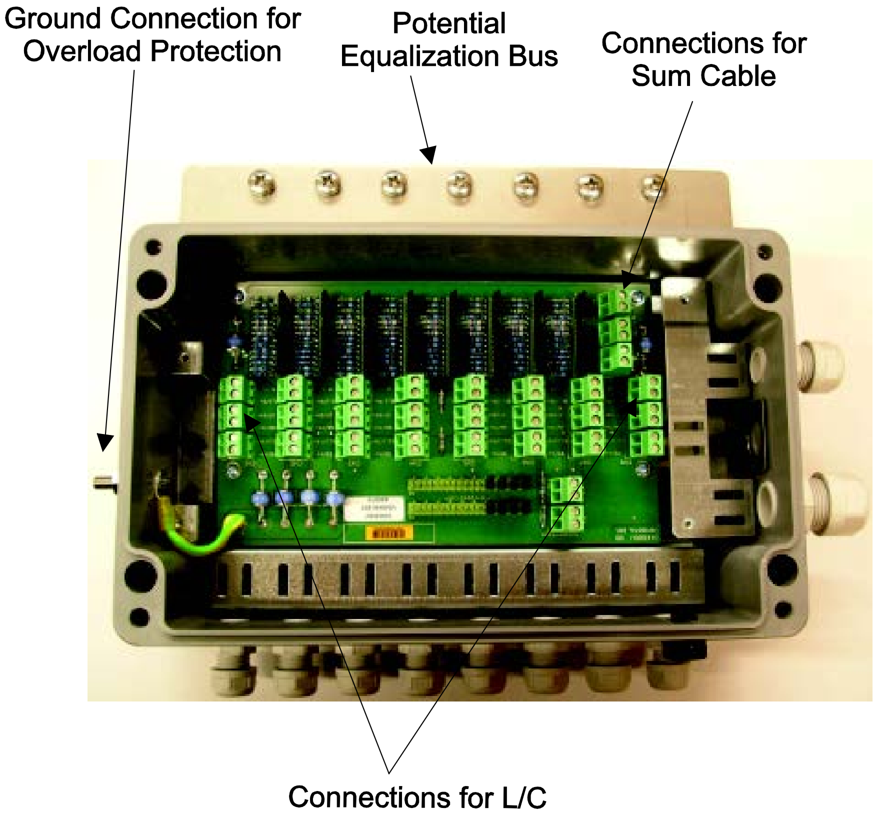


Fig. 42: Overview of the interconnecting box VKK 280x8

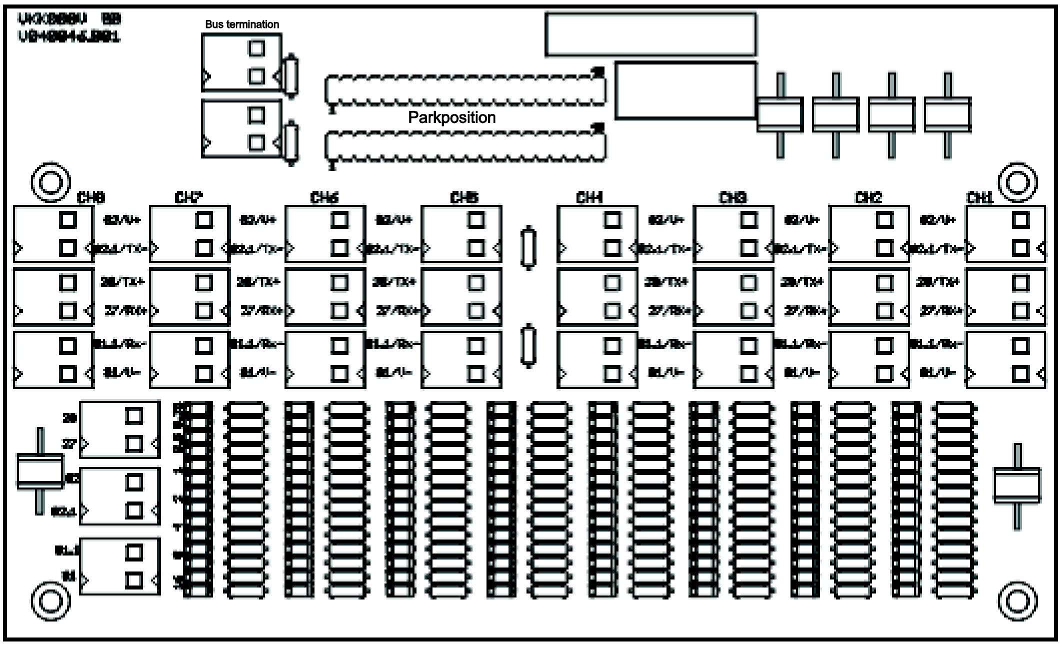


Fig. 43: Location of the connection terminals in the VKK 280x8

4 wire load cells are connected to terminals Ch1 - Ch8. A bridge is introduced from signal 82 to 82.1 and from 81 to 81.1 in one channel or at the output.

If 6 wire cells are used, 1 x sense line will be connected, please insulate the rest.

The sum cable is connected at the exit.

8.6 Connecting the Interconnecting Box to the Weighing Electronics

The connection between the interconnecting box and the weighing electronics can be made by:

- A 6 wire cable (1 x 2 x 0.5 mm² + 2 x 2 x 0.25 mm²; twisted pair cable, double shielding). That is the standard cable. The pair with the greatest cross section are used for supply.
- An 8 wire cable (4 x 2 x 0.5 mm² or 4 x 2 x 0.23 mm²; twisted pair cable, double shielding). These cables are used if greater cross sections are needed fort the sense line. This case can arise if the ratio between cross section and length of cable required for legal-for-trade scales will not otherwise be reached. In general the supply cross section does not need to be increased.
- A 10 wire cable (5 x 2 x 0.5 mm²; twisted pair cable, double shielding). Used if a greater sense cross section is required or if the supply is also to be doubled.
- A 7 wire cable (7 x 0.5 mm²; twisted cable, single shielding). Special cable for cable drag chains, energy chains and cable reels. This cable is extremely sensitive to external disturbances due to the twisted cable and the single shielding.
- The table shows the wire assignment for Schenck Process measuring cables.

	6-wire	**8-wire**	**10-wire**	**7-wire**	**7-wire**
Construction	1 x 2 x 0.5 mm² + 2 x 2 x 0.25 mm²	4 x 2 x 0.23 mm²	5 x 2 x 0.5 mm²	1 x 7 x 0.5 mm²	1 x 7 x 0.5 mm²
Schenck Process material numbers	V085231.B01 V087819.B01	3849.009	3849.059	V063682.B01	3849.711
Signals					
Power supply + (82)	GN (s1)	GN (s1)	GN (s1) [+ YE (s4)]	GN	BK
Supply - (81)	BN (s1)	BN (s1)	BN (s1) [+ WH (s4)]	BN/BU	BU
Sense + (82.1)	GN (s2)	GN (s2) [+ YE (s4)]	GN (s2) [+ YE (s5)]	GN/BU	YE
Sense – (81.1)	WH (s2)	WH (s2) [+ WH (s4)]	WH (s2) [+ BN (s5)]	WS/BU	GN
Measuring signal + (28)	BN (s3)	BN (s3)	BN (s3)	BN	RD
Measuring signal - (27)	WH (s3)	WH (s3)	WH (s3)	WH	WH
s1, s2, s3, s4, s5:	Twisted pair and shielded				

Tab. 9 : Schenck Process measuring cable wire colors

- We strongly recommend that you use Schenck Process measuring cables. These cables are manufactured specially for these applications and have been thoroughly tested. Other cables are often unsuitable for use as measuring cables, even if they are of the same design.
- Schenck Process measuring cables only may be used in legal-for-trade systems.
- The following figure shows the example of a VKK 28006 connected by a 6 wire cable through additional extension boxes.

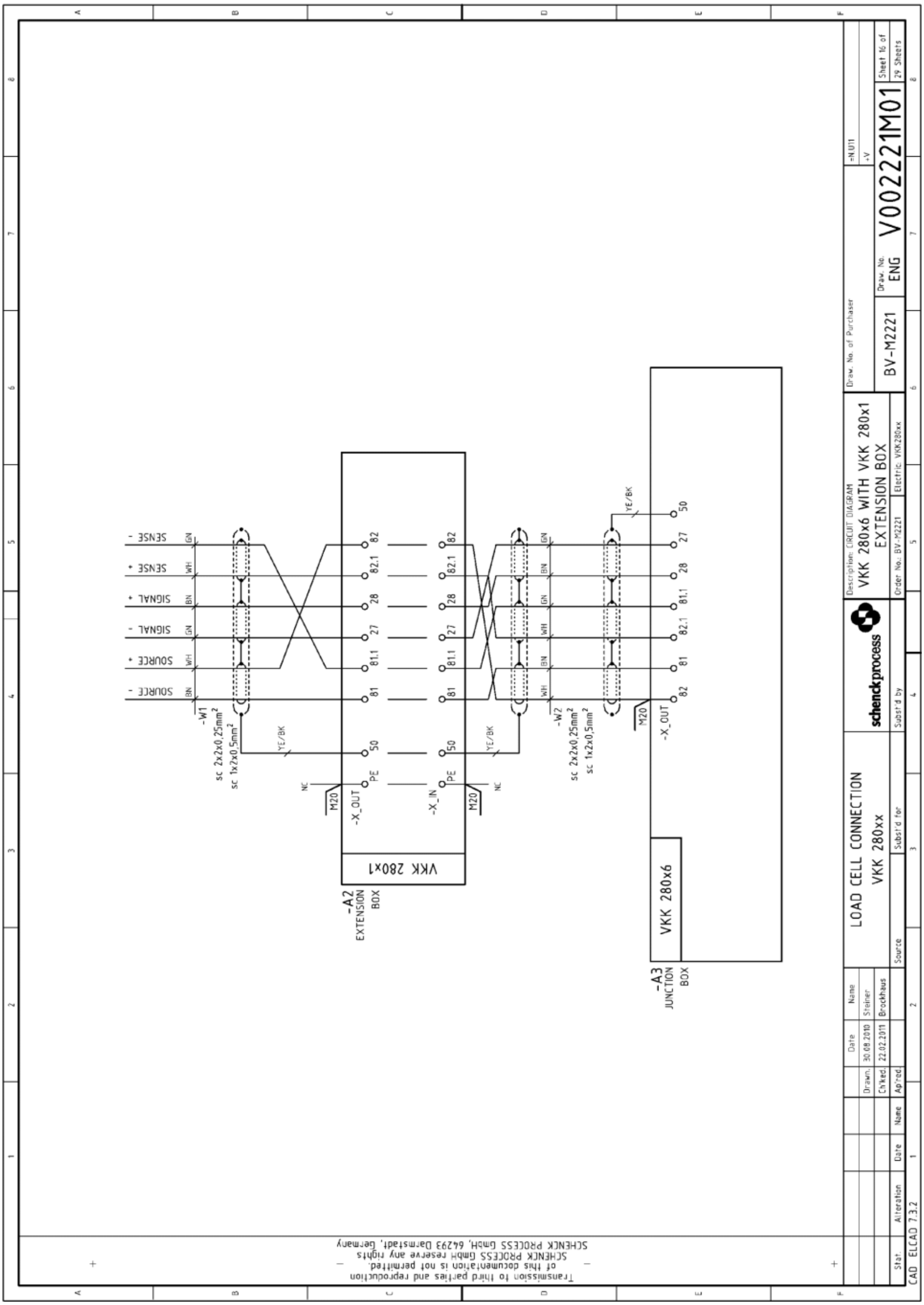


Fig. 44: Connection of a VKK to a DISOMAT with extensions

- All wires and shields are continuously connected through extension boxes.
- Inner and outer shields are connected at the control unit, the connection remains open at the VKK 28006.
- Inner and outer shields are on either side connected at the entrance to the extension box.

8.7 Overvoltage Protection

We strongly recommend using overvoltage modules in the following cases:

- If there is an increased risk of a lightning strike at the installation location of the scales (regional).
- If the scales is in an exposed location.
- If the weighing electronics and the load cells are located in different buildings, or if the load cells are fitted in open air.
- If the plant requires the scales to be available at all times.
- As a general principle for road weighbridges (truck scales and in particular rail weighbridges).

On the interconnecting box side, the following overvoltage protection variants are available:

- The overvoltage protection is an integrated component of the 8 channel box VKK 28008. In order for it to be effective, the earth pin on the box exterior must be connected to the potential equalization line (PAL).
- The 6 channel box VKK 28006 can be equipped with the optional overvoltage module DBS 6. The DBS 6 can also be easily retrofitted. The dissipating cable of the DBS is lead outwards through the screwed cable connection, where it is connected to the PAL; see the following figure for details.

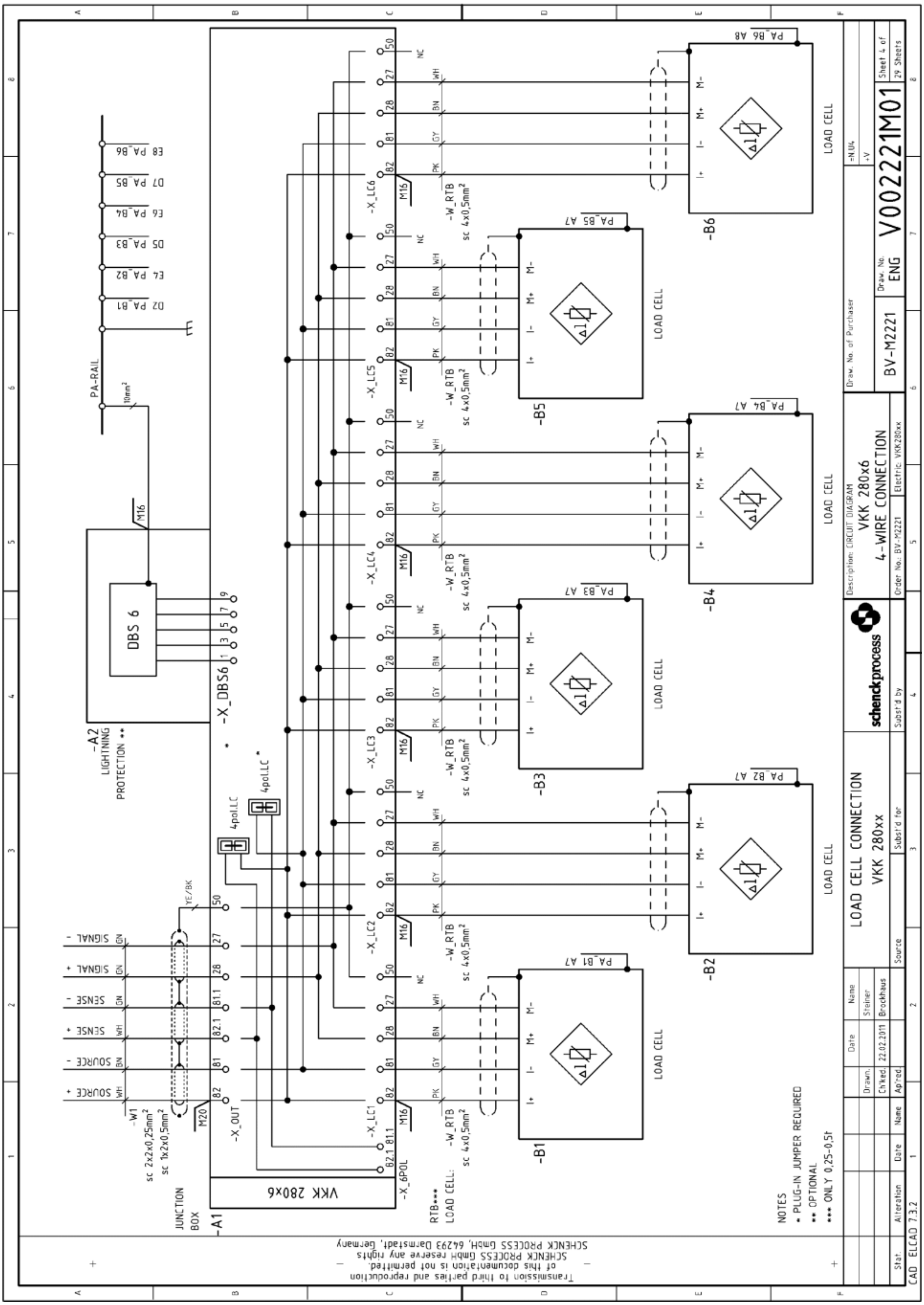


Fig. 45: Overvoltage protection DBS 6

- The external overvoltage module VBS 28011 is used in combination with the 4 channel box VKK 280x4.

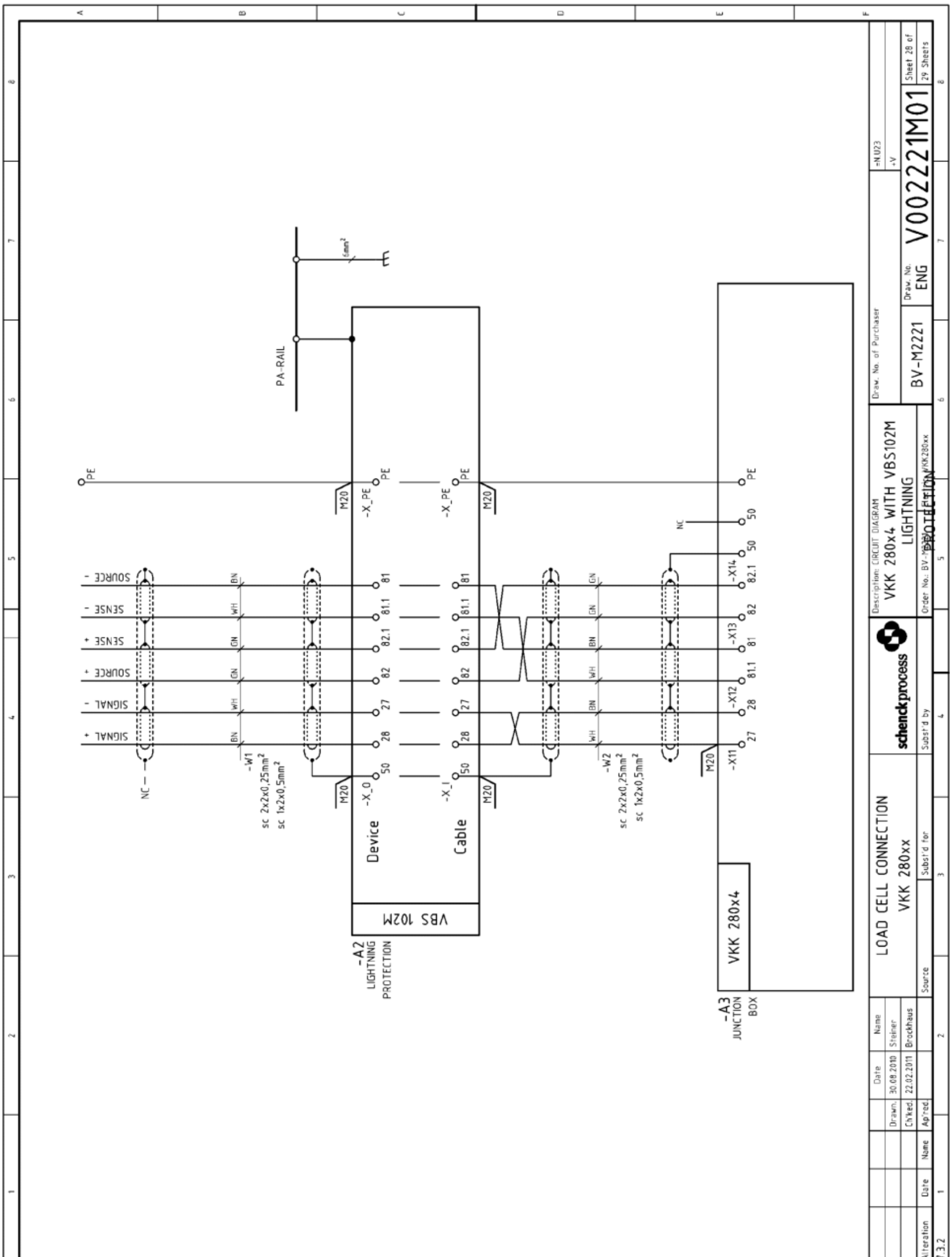


Fig. 46: Overvoltage protection VBS 28011

- Connect continuously all wires and shields.
- Connect the inner and outer shields at the entrance.
- Connect the housing to the PA.

A VBS 28011 is always used as shown on the side of the weighing electronics unit. The connection between the VBS and the weighing electronics should not be longer that 1 m and should be laid in a low-induction manner (no loops of cable).

8.8 Connection to the Weighing Electronics Unit

The connection to the measuring input of the weighing electronics is made according to the drawings in the respective manual.

All Schenck Process weighing electronic units have a shield bus for connecting the outer shield. There the outer shield is connected in a low-induction manner and with a large contact area using the terminals supplied. Remove the outer sheath as shown in the diagram.

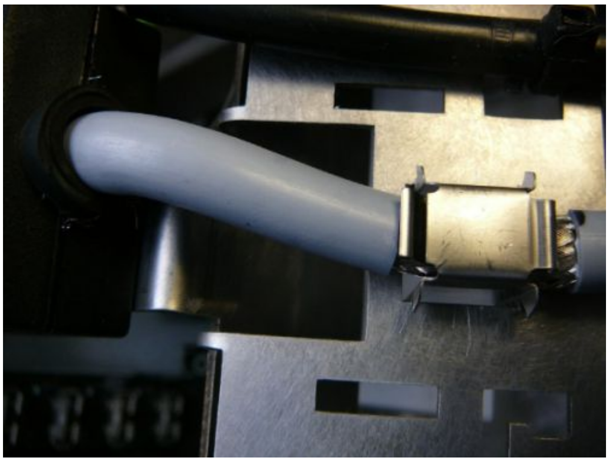


Fig. 47: Connecting the measuring cable to the shield terminal

Insulate the cable in the area of the screen plate and contact the cable screen on the screen plate with the clamps included. Use cable binders to relieve tension.

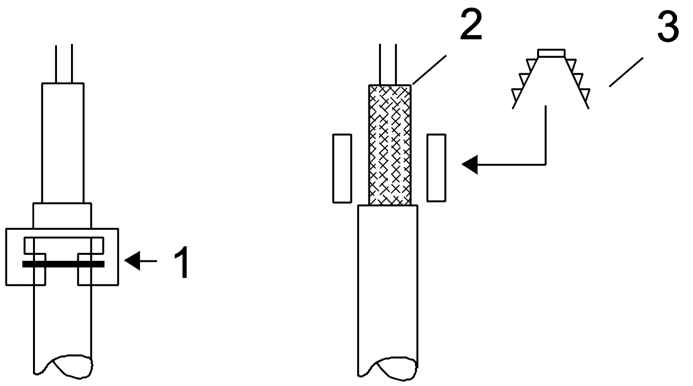


Fig. 48: Fix cable with cable binders and clamps

1	Cable retainer for strain relief
2	Connecting cable shielding braid
3	Screen clamp

The outer and inner shields are connected directly to one another at the measuring input.

- The cable is prepared for this as shown: the outer sheath and the silver filler wires of the inner sheath are turn outwards. (If using a DISOMAT Tersus, first slip on the strain relief jacket.)

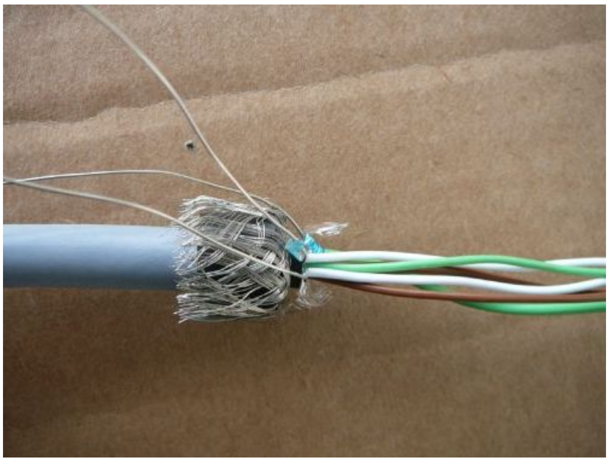


Fig. 49: Preparing the measuring cable

- Then the cable is clamped to the strain relief. The figure shows a DISOMAT Tersus, but the procedure is the same for the DISOMAT Opus and DISOMAT Satus.

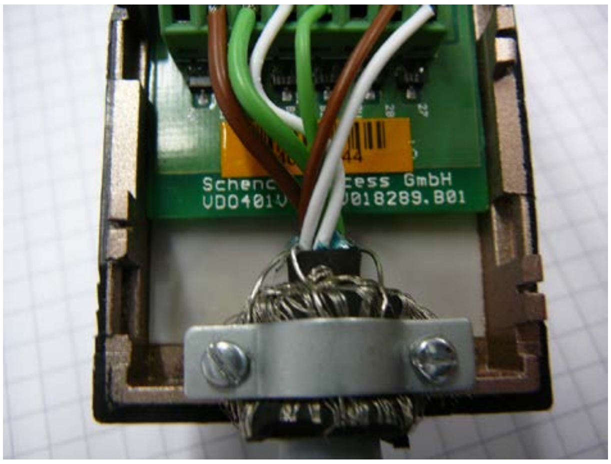


Fig. 50: Connecting the inner and outer shields

- On a DISOBOX Plus, the inner and outer shields are directly connected to the shield terminal (assuming a double-shielded extension cable is used).

If any sense or power lines in the measuring cable are dual lines, we recommend placing an extension box in the vicinity of the weighing electronics unit. Then lay the lines for the remaining distance as single lines only. Otherwise there may be very little room in the weighing electronics unit for making further connections.

The following figure shows an example of a connected unit.

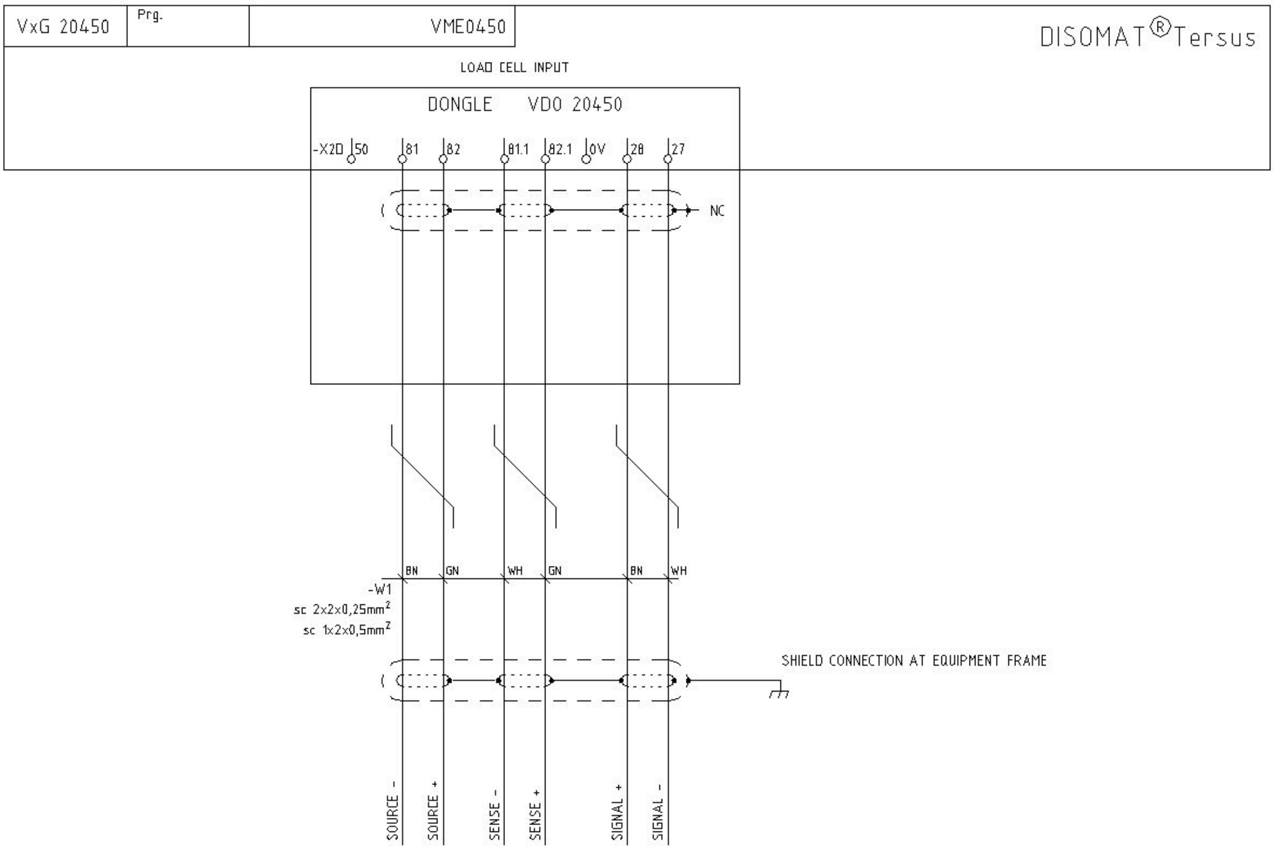


Fig. 51: Connecting the measuring cable to a DISOMAT Tersus

8.9 Assembly directions for cables in energy chains

This chapter relates specifically to the Schenck Process measuring cable with material number V063682.B01.

The cable has to be fed free from tensile forces, twists and be freely moveable in the neutral zone.

STRICTLY OBSERVE

Disregarding the assembly procedures

Damage to the cable; blanking the weighing installations

– The following particulars must be observed

1. Maintain stated bend radius of the line
2. Do not exceed maximum movement speed
3. Do not exceed maximum movement distance
4. Note accompanying technical data

When fitting the chain, the following must be observed:

- Avoid tensile forces on the line.
- Draw in lines into the chain without rotations.
- For ring goods and drum goods, do not uncoil the lines transversally to the direction of coil.
- For the chain assembly, use drum goods and lay or hang them free of torsion before assembly.
- Position cables freely moveable next to each other in the chain.
- For a defined cable run in the chain, position the cable through separators individually from each other and leave sufficient play to the face root.
- Feed cables in the chain's neutral zone so that no cables are positioned over each other.

Exception:

If cables have to be positioned over each other because of a lack of space: Position only equal-sized cables in a chamber and place horizontal separators between them.

In order to extend the life of the system, please not the cable guide before and after the chain.

The cable in the energy chain

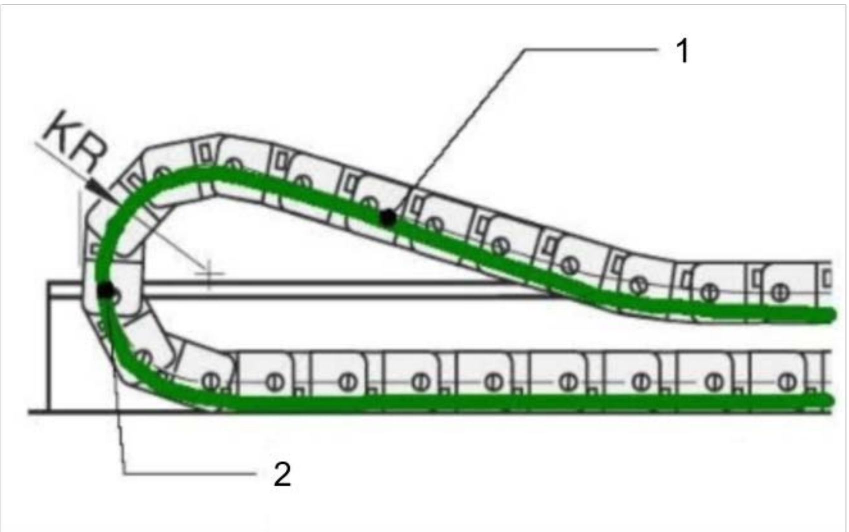


Fig. 52: Location of the cables in the energy chain

1	The cables can pass through the chain bend without any force. In particular, they may not contact the inner radius tightly and be subject to tensile forces, which may lead to a premature system failure.
2	In the chain bend, the cables lie in the neutral fiber.
KR	Minimum bend radius, 80 mm

Tension relief for of the cables on the tappet side is essential.

The life of the system crucially depends on the correct cable length in the chain. The correct cable length is safeguarded as follows:

- As default, the cables on the tappet side and on the fixed side are marked flush to the connection (with a marker, adhesive tape or similar).
- The cables when fitted are moved into the chain such that the markings are flush again. Empirical evidence shows that the markings move as a result of transport and assembly.
- Do not apply tension relief to the fixed side if there are long movement distances in direct proximity to the chain as the cable moves in the opposite direction relative to the chain.

The cable must be able to move freely in the chain. Because of the aging processes and a trend toward cable shortening, sufficient cable length must is required, which allows the cable to be drawn into the chain.

After a chain breaks, also replace the cables as they are mostly overstretched.

STRICTLY OBSERVE

Cables fixed in the chain

Damage to the cables

– The cables may **never** be fixed in the chain.

1. Check again before commissioning.

The following illustration shows the optimum cable routing on the fixed side.

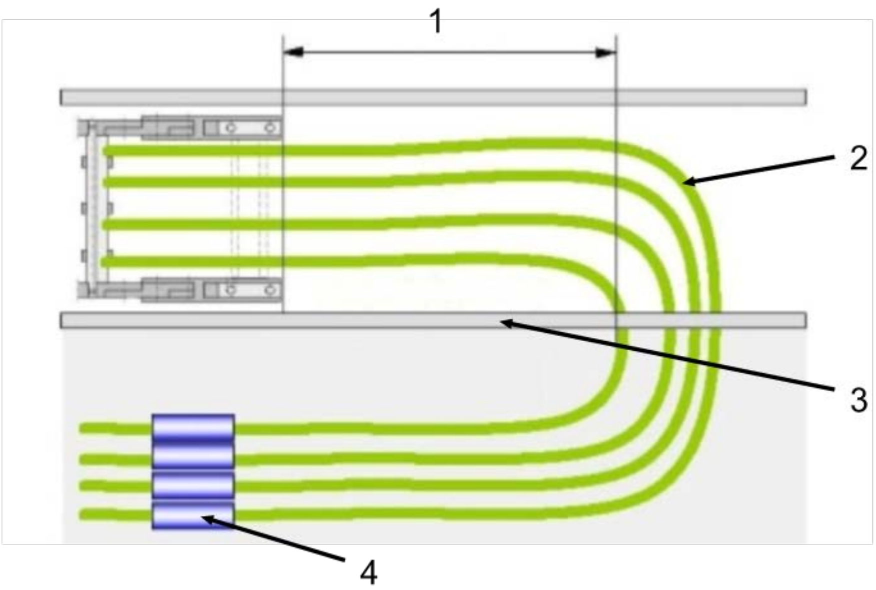


Fig. 53: Plan view of the cable routing on the fixed side

1	Length at least 500 mm.	2	Cables loosely placed cables in loops and not additionally mounted.
3	Feed channel	4	Fixing the cables on the fixed side next to or be-neath the channel

OBSERVE

Recommendation

Check cables and chains after a short operating time and correct if required.

9 Corner Balancing and Cable Length Compensation

9.1 Principle of Corner Balancing

The input of each LC has a decade resistor made of individual resistors for the infeed of the LC voltage signal (pin 27).

The balancing resistor R_{AB} is the sum of all connected single resistors and can be set to values between 0 and the maximum value. A value of 4 Ω is preset for all inputs.

The following table shows the resistance range and the smallest increment.

Model of cable extension box	Smallest resistance = most precise balancing step	Largest single resistance	Max. total resistance
VKK 280x4	0.5 Ω	8 Ω	15.5 Ω
VKK 280 x 6	0.125 Ω	8 Ω	15.75 Ω
VKK 280 x 8	0.25 Ω	16 Ω	31.75 Ω

Tab. 10 : Resistance range

The preset resistance must be increased in order to reduce the load cell signal; it must be decreased to raise it. This is done by switching individual resistors on or off.

Individual resistors are switched on with a jumper and switched off by removing the jumper to its neutral position. The respective positions are marked on the mainboard.

9.2 Performing a Corner Balance

Important:

Before beginning the corner balance, check that the repeatability of the scales (with loads of at least 70 % of the full scales value on 3 x iterations) lies within the permissible limits.

There is otherwise a risk that if the scales' repeatability error is superimposed on the scales' responses, the corner balance may not be repeatable or that the corner balance may be incorrectly set!

Proceed as follows:

- Switch the measurement processing system to ten-fold resolution.
- Load all corners in sequence with approx. 20 % of the full scales value and make a note of the weight value **G**.
- Determine those corners that show almost-identical value (rule of thumb: difference < 0.2 d). They give the **reference value B** and are **not** balanced.

- Balance each of the remaining corners of the weighbridge(s):
  - Identify the balancing resistor RAB, old in the decade resistor $R_{AB,old}$ (basic adjustment 4 Ω).
  - Calculate the new balancing resistor $R_{AB, new}$ according to the formula:

$$R_{AB,new} = ((G - B) / G * R_{i\,(LC)}) + R_{AB,old}$$

where $R_{i\,(LC)}$ is the internal resistance of the LC.

$R_{i\,(LC)}$ = 350 Ω, 700 Ω, 1000 Ω or 4000 Ω

- Round off the value calculated to the nearest adjustable value.
- Set the corresponding decade resistor to this value by switching on or off the individual resistors!

9.3 Numerical Example for a VKK 28006

Range full-scale value = 50.00t, 2500 divisions, Ri(LC) = 4000 Ω, balance with 10 t First weighbridge: 1st corner: G = 10.001 t 5th corner: G = 10.003 t B = 10.002 t				
Corner	3 a) Weight value [G]	3 b) $R_{AB, old}$	3 c) $R_{AB, new}$	3 d) R_{adjust}
2	10.007 t	4 Ω	((10.007 – 10.002) / 10.002 * 4000) + 4	6.00 Ω
3	10.010 t	4 Ω	((10.010 – 10.002) / 10.002 * 4000) + 4	7.25 Ω
4	9.998 t	4 Ω	((9.998 – 10.002) / 10.002 * 4000) + 4	2.50 Ω
6	10.006 t	4 Ω	((10.006 – 10.002) / 10.002 * 4000) + 4	5.50 Ω

Once the resistances have been adjusted, again check the corners by loading them sequentially with loads of 20 % of the weighing range - the formula is an approximation formula, but one that generally gives good results. A fine adjustment may need to be made; proceed in the same manner as above.

Recommendation for balancing

The discrepancy between the individual corners should not be greater than max. 0.5 of the permissible error.

In the example shown of a truck scales with a 50 t full scales value and a resolution of 2500 divisions, the permissible error (commercial scales) with a load of 10 t would equal 0.5 d = 10 kg.

The max. corner error should therefore be smaller than 0.5 x 10 kg = 5 kg.

A second weighbridge in a fixed connected circuit is connected via the load cell input balance 5 or 6 of the first box. The relative sensitivity of both bridges is adjusted using the decade resistor of the respective input (J9/10 or J11/12).

To do this, the relevant resistance value is altered in 0.25 Ω steps (increasing the resistance decreases the sensitivity of the second bridge), or the correct value is calculated using the formula $R_{AB,old}$ (with $R_{i\,(LC)}$ = Total value for all load cells).

For example:

After a corner balancing the weighbridges indicate the following vales:

- Weighbridge: 10.002 t (= **B**)
- Weighbridge: 9.996 t (= **G**)

Each bridge has 4 load cells of 4000 Ω each.

- $R_{AB,old}$ = 4 Ω
- $R_{AB,new}$ = ((9.996 t – 10.002 t) / 9.996 t * 1000) + 4 Ω = 3.40 Ω

The value set is 3.50 Ω. If the calculation should result in a negative value, the balancing resistors of all load cells in the second weighbridge must be increased by the same value, e.g. by 4 Ω.

- $R_{AB,new}$ = ((G - B) / G * $R_{i\ (LC)}$) + $R_{AB,old}$

In most cases it is better to use a multi-channel electronic measuring system and to allow the electronic measuring system to perform the connected circuit calculation than to electrically connect both bridges.

10 Note on the Cable Screw Connections

Most Schenck Process cable boxes and the weighing electronics units in stainless steel housings are equipped with a special 'blue globe' cable screw connection. These connections give a durable seal with a high protection class of up to IP68.

IMPORTANT: This refers to the protection class of the connection only, in many cases the lower protection class of the housing will be a limiting factor.

There are a few tips that should be followed when handling the screw connections in order to achieve this protection class.

- The screw connections have an integrated reduction ring. This allows it a wide clamping range. To be able to use the next largest clamping range, the reduction ring must be removed with a screwdriver or some similar tool.

Fig. 54: Removing the reduction ring in blue globe connections

Size	Clamping range reduced [mm]	Clamping range not reduced [mm]	Torque plastic [Nm]	Torque metal [Nm]
M 12	2 ... 5	5 … 7.5	2	5
M 16	4 ... 7	7 ... 11	2	8
M 20	5 ... 9	9 ... 14	3	10
M 25	11 ... 16	16 ... 20	5	15
M 32	15 ... 20	20 ... 25	6	15

Tab. 11 : Clamping range of blue globe connections

- As the seal inserts deform permanently when tightened, the screw connections are not fully tightened when leaving the factors. Please tighten all connections – **including the unused ones** – to the torque given.
- We recommend using an open pipe wrench developed specially for the purpose of tightening the screw connections themselves and for the sealing screws, see the table for details.
- If cables are later drawn through unused screw connections, or if cables are to be replaced, the seal inserts or even the complete screw unit must be replaced.
- Remove the hexagonal 'globe marker' from new screw connections so that they are not at risk of being clamped in by cables.

Description	Size	Schenck Process part number
Pipe wrench for cable screw connections	M 12	V094460.B01
	M 16	V094460.B02
	M 20	V094460.B03
	M 25	V094460.B04
	M 32	V094460.B05
Replacement seal inserts (50 pieces)	M 12	V094657.B01
	M 16	V094657.B02
	M 20	V094657.B03
	M 25	V094657.B04
	M 32	V094657.B05

Tab. 12 : Accessories and spare parts for cable screw connections

Further notes on maintaining protection class IP 65/IP67

- Under no circumstances may measuring cables be damaged.
- If the outer jacket is damaged, moisture can enter the cable and from there into the load cell or the cable switching boxes by capillary action. Observe the instructions on *Connecting the Measuring Cable*.
- Moisture (rain, snow...) must not be allowed to enter cable switching boxes if the cap is open. If moisture enters, the box must be dried out immediately.
- Check whether the cap's sealing rings have become porous or torn and replace damaged ones.
- Lubricate the seal **thinly** with silicon grease (**not** silicon adhesive).
- Cover the sealing rings with silicone grease before sealing the box.
- Tighten the cap screws equally!

11 Troubleshooting

How will you recognize an error?

Errors in the scales mechanical systems are expressed in particular as unstable or erroneous displayed weights, e.g.:

- The zero point shifts when the scales is repeatedly loaded and unloaded with the same weight, i.e. the original value is no longer shown.
- Negative weight values are indicated. (a portion of the weight [dead load] is diverted as a force shunt.)
- Slowly drifting zero point or slowly drifting displayed weight
- Strongly discontinuous displayed weights

What could be the cause?

The most common cause of mechanical errors are force shunts caused by frictional forces between the load receptor and the supporting structure, and blocked moveable parts such as suspension arms.

Further causes could be:

- damaged measuring cables
- defect load cells
- moisture in cable boxes

What to do in case of an error

If an error occurs you must determine whether it is mechanical or an electrical:

- Check the measuring cable for damage.
- Check the cable connections at the cable boxes (for the effects of moisture).
- The repeatability test can determine whether force shunts in the scales mechanical systems could be the cause of the error.
- The corner balance test can determine whether a load cell is defective.
- Please contact the Schenck Process service if you observe strongly discontinuous displayed weights or a shift in the zero point for no apparent reason.
- If the displayed weight drifts slowly in the positive direction (zero drift):
  – Soiling, product residues, snow or rain can increase the dead load of a scales.
- Regularly clean the scales!

HINT

If your weighing electronics are equipped with the facility, you can switch on the automatic zero point tracking to temporarily suppress a zero point shift.

Corner balance test

- Load each individual load cell sequentially with a weight that corresponds to 20 % of the weighing range.
- For legal-for-trade scales, the weight values may differ by a maximum of ±0.5 d from one another.
- For non legal-for-trade scales, the weight differences must be lower than the scales error tolerance.

Repeatability test using a test weighing

If the weighing electronics have been properly installed, force shunts can be identified using the following method:

- Load and unload the load carrier with small weights (around 0.1 % of the nominal load). A force shunt may exist if the weighing electronics display indicates an error larger than the maximum permissible weighing error in the zero point range.

Localizing force shunts

Do bumpers, horizontal limits and lifting locks have sufficient play?

- You may need to properly set the play!
- Do the weighing and the supporting structures come into contact at e.g. critical locations or because of soiling, corrosion or product residues?
- For bin weighers: do connections to the scales such as e.g. cable, hose and pipe connections yield in the direction of loading of the scales?
- Were expansion joints in pipe connections relieved of stress when fitted?

12 Measuring Protocol

If an RTN load cell is damaged we recommend performing one of the measurements listed below. The results could give an indication as to the cause of the damage.

In many cases, Schenck Process can make a decision on repairs or warranty claims based upon these data without having to have the load cell returned.

If damage occurs, please fill out the attached measuring protocol and send it to Schenck Process.

12.1 Load Cell Data

Model:	
Nominal load:	
Serial number:	
Delivered with order: / date:	
Fault observed on the scale:	

12.2 Impedances

Measured values	Color	Setpoint	Actual value
Input impedance 81 - 82	BU-BK	4450 Ω $^{\pm 100\ \Omega}$	
Output impedance 27 - 28	WH-RD	4010 Ω $^{\pm 2\ \Omega}$ (for class 0.05) 4010 Ω $^{\pm 0.5\ \Omega}$ (for legal-for-trade accuracies)	
81 – 27	BU-WH	3230 Ω $^{\pm 100\ \Omega}$	
81 – 28	BU-RD	3230 Ω $^{\pm 100\ \Omega}$	
82 – 27	BK-WH	3230 Ω $^{\pm 100\ \Omega}$	
82 – 28	BK-RD	3230 Ω $^{\pm 100\ \Omega}$	

Tab. 13 : Impedances

- The pairs (81 - 27) /(81 - 28) and (82 - 27)/(82 - 28) should have the same impedances better than ±10 Ω. This will otherwise cause impermissible zero point discrepancies.
- Readings far outside tolerance (> 6 kΩ or < 3 kΩ) indicate a break or a short circuit in a DMS. Potential causes: overvoltage, defective material.

12.3 Insulation

The insulation resistance of an intact LC lies in the range ≫ GΩ; these values cannot be measured by a normal multimeter. You can assume that moisture has penetrated a load cell if the resistance measured between any given wire of the connection cable and the load cell body is lower than around 10 GΩ. A cell in that condition should be replaced on legal-for-trade scales or scales required to be available at all times - you cannot assume that it will function properly until the end of the next calibration interval. The cell should certainly be replaced at the latest if insulation resistance values < 1 GΩ are measured(all values apply to RT load cells; the threshold values for low-impedance load cells are correspondingly lower).

The cable shield of the RTN load cell is insulated by the load cell body. Measurable conductivity (MΩ) indicates that the overvoltage protection has been destroyed – caused by overvoltage (lightning).

CAUTION

Maximum permissible measuring voltage: 60 V

Measured values	Value	Setpoint
Wire ... ⇔ load cell body		> 10 GΩ
Cable shield ⇔ load cell body		> 10 GΩ

12.4 Zero Signal

The load cell is fed (5 – max. 24 V) via connections 81 and 82 (BK-BU) to measure the zero signal. The output signal is measured on connections 27 – 28 (WH-RD).

Supply voltage	Output signal	Setpoint
		< 0.03 mV/V

- A slightly elevated zero signal is an indication of load cell overload.
- (An exception with RTN 22 t load cells: overload can also cause a negative zero signal).
- A much higher zero signal indicates that moisture has penetrated the load cell.
- Zero signals in the range of half of the power supply are a clear indication of interruptions in the DMS (overvoltage or defective materials).

Beyond the measurements stated above, the observations below can also make it easier to analyze a fault. Furthermore, sending in (digital) photographs may be helpful:

- Traces of corrosion on the load cell
- Cable damage
  Please also inspect the area of the cable inlet.
- Visible indents in the load button
  - Abnormally severe indents (possibly overload)
  - Asymmetrical load conduction (i.e., load is not centrically applied)
  - Oval indents (the load applied is oscillating)

12.5 Leaks

If those tests indicate a load cell leak (moisture), the test below will support these assumptions:

- Immerse the load cell into a container with hot water (min. 60° C). Do not hold the load cell by the cable!

You can identify leaks from rising air bubbles.

However, there are also leaks that cannot be identified in this fashion (too small, defective cables).

12.6 Contact Information

- Name:
- Company:
- Address:
- Phone:
- Fax:
- Email:

13 Maintenance

Visual inspections

- Check that the bumpers, pendulum limits and lifting locks can move freely and inspect them for damage (e.g. from impacts) or wear!
- Replace damaged components!
- The play must be readjusted if discrepancies are found.
- Remove any contaminants such as e.g. product residues!
- Check load cells, bearings, etc. for:
  - Damage to the corrosion protection
  - Contaminants (dirt or product residues)
  - The effects of moisture
- Inspect the outer sheath of the measuring cables for damage!
- Check the cable connections at the cable boxes!

Test weighings

- Repeatability test (see chapter »Troubleshooting [➞93]«)
- Use a known (preferably calibrated) weight to test whether the scales is displaying correct values.

PASS - Process Advanced Service System

Our comprehensive Process Advanced Service System (PASS) can perform the maintenance of your system.

PASS includes the entire range of services, from simple inspections to a complete service program. This will increase the life cycle of your scales and will prevent malfunctions and stoppages of your production or your business.

14 Explanation of Terms

Breaking load:	Load above which mechanical damage will occur
Gross load:	Mass of the load to be calculated, including the mass of its packaging or any transport device weighed along with it
Fixed bearing:	Bearing point with no load cell
Limit load:	Load above which permanent deformation of the load cell will most likely occur.
Limit lateral load:	Maximum permissible lateral force
Supporting point	Load cell with load cell bearing or foxed bearing
Compact bearing:	Load cell bearing with built-in load cell, bumper and lifting lock
Expansion joint	Moveable connection between two pipes
Nominal Load:	Upper limit of the weighing range; the limits of error given apply as far as this limit
Net load:	Load to be calculated (e.g. effective load of a truck)
Lateral force:	Lateral interference force acting on the weighing system
RT load cell:	Schenck Process ring torsion load cell, electromechanical sensor
Tare load:	Weight of packaging or of a transport object
Dead load:	Weight of the load receptor that rests continuously on the support points. This does not refer to e.g. the empty weight of a truck, etc.
Load cell:	Refer to the RT load cells
Load cell bearings:	Essential, scales-specific components for correct application of load to a load cell. Schenck Process load cells require Schenck Process load cell mounts.

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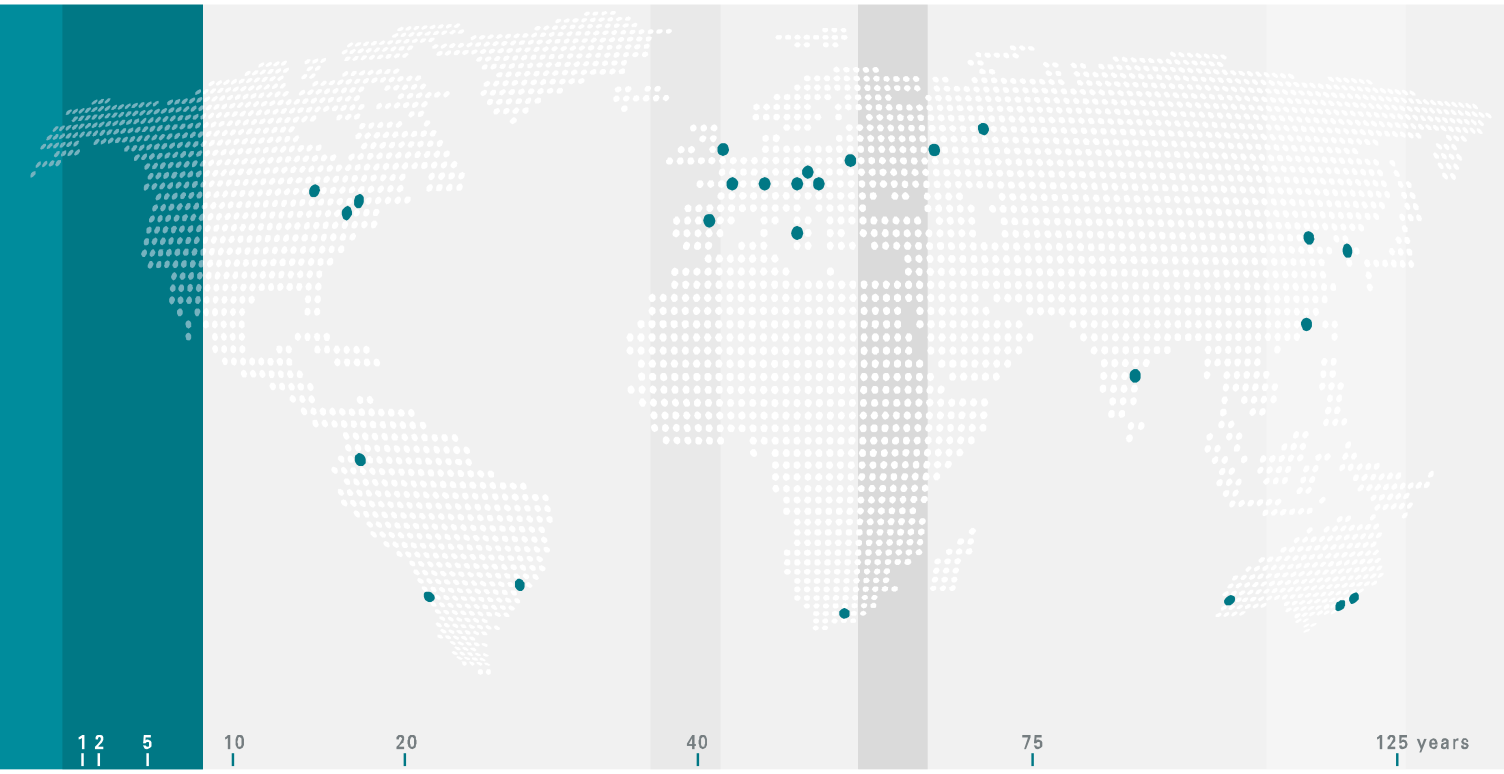

Schenck Process ist weltweit führend in allen Bereichen der Mess- und Verfahrenstechnik und bietet Lösungen für das Wägen, Dosieren, Messen und Automatisieren an.

Schenck Process entwickelt, fertigt, montiert und vermarktet eine Vielfalt an Lösungen, Produkten, Systemen und Komponenten, in denen sich prozesstechnisches Know-how und bewährte Technologien vereinen.

Schenck Process is the global market leader of solutions in screening and process technologies in industrial weighing, feeding, screening and automation.

Schenck Process develops, manufactures, assembles, markets and sells a full range of solutions, products and turnkey systems on the basis of combining process engineering expertise, reliable components and field-proven technology.

we make processes work