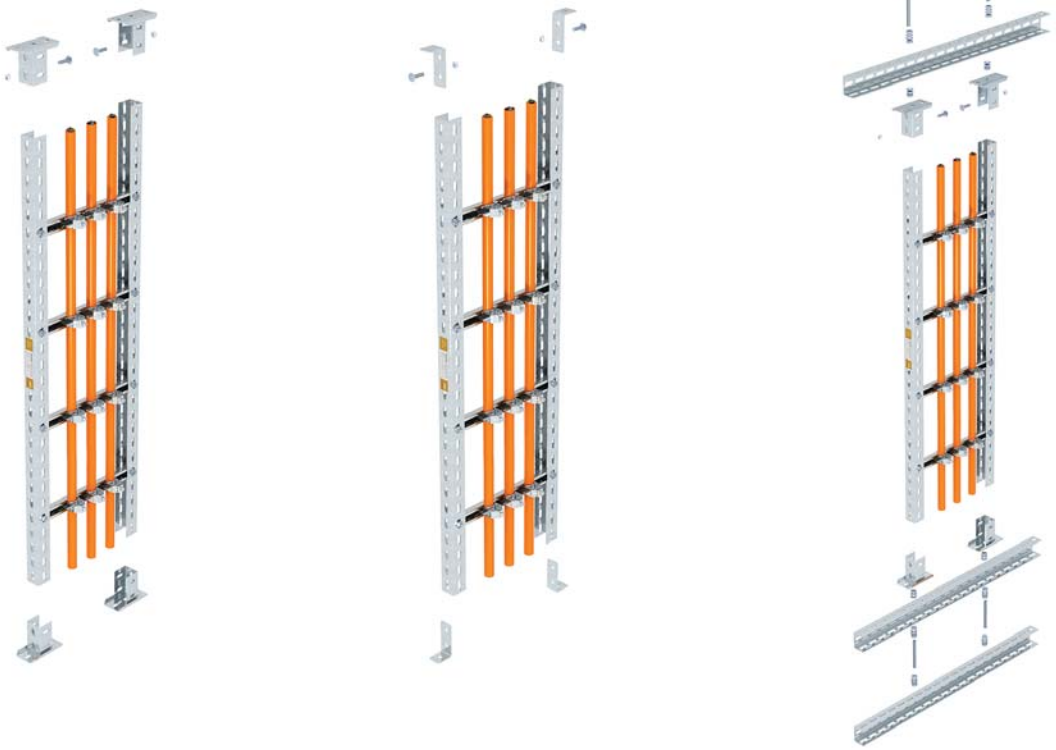


Certificates

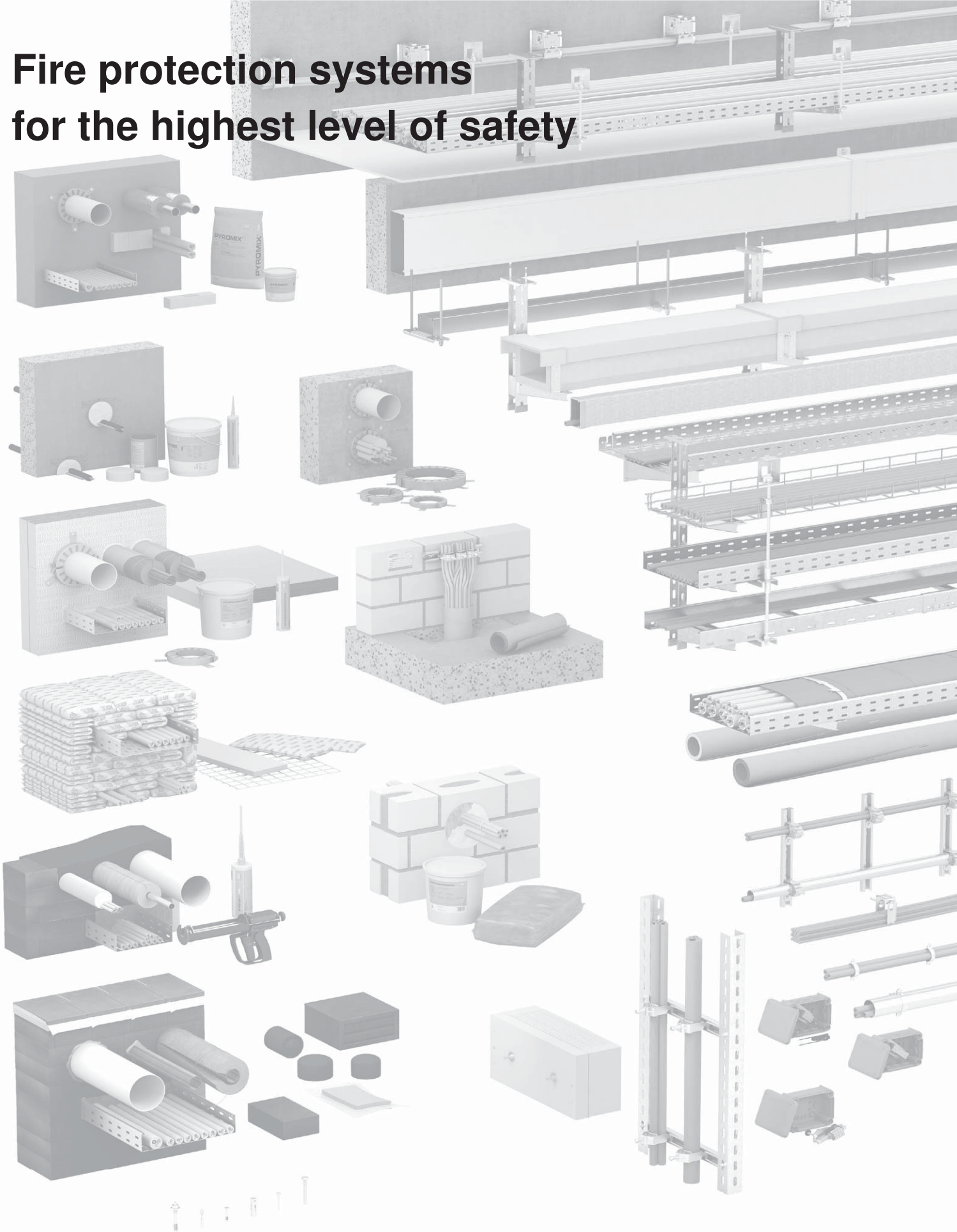
Maintaining electrical functionality

Standard constructions - suspended vertical cable ladders SLM

Expert opinion no. GA-2023/056 - Nau, valid until 12-06-2028

OBO BETTERMANN

Fire protection systems for the highest level of safety



Be it in a residential building or an industrial complex – OBO has the appropriate solution for fireproof electrical installations. Our tested and certified fire protection systems cover all the relevant fire protection guidelines and provide you with an electrical installation that really serves its purpose.
We will be happy to provide you with more details – on our website or personally.

Expert Opinion No. GA-2023/056 -Nau dated 12.06.2023

Client:	OBO BETTERMANN Produktion Deutschland GmbH & Co. KG Hüingser Ring 52 D-58710 Menden
Order date:	11.05.2023
Order No.:	Mr. Fabry / Order no. 06O019933
Order receipt:	11.05.2023
Content of order:	Expert opinion on the fire and functional behaviour of electrical cable systems required to maintain circuit integrity when using suspended vertical cable ladders from OBO Bettermann Produktion Deutschland GmbH & Co. KG, Menden, with regard to the assessment as “standard support construction” according to DIN 4102-12 (installation type: suspended vertical cable ladders)

This expert opinion has 10 pages, cover sheet included and 8 annexes.

Index

1 Order and Occasion

IBB GmbH was commissioned by OBO BETTERMANN Produktion Deutschland GmbH & Co. KG, Menden, by order no. 06O019933 dated 11.05.2023 to prepare an expert opinion on fire and functional behaviour of electrical cable systems required to maintain circuit integrity when using suspended vertical cable ladders from OBO BETTERMANN Produktion Deutschland GmbH & Co. KG, Menden, when laying electrical cables on suspended vertical cable ladders with regard to the assessment as a “standard support construction” in accordance with DIN 4102-12 [2].

Within the scope of this expert opinion, a comparison is to be made between the cable support construction "suspended vertical cable ladder" from OBO Bettermann Produktion Deutschland GmbH & Co. KG, Menden, with the design features of the "standard support construction" according to DIN 4102-12.

2 Basis and documents of the expert opinion

The documents listed below are the basis for the expert opinion:

(1) Test certificates and test reports as well as „allgemeine bauaufsichtliche Prüfzeugnisse“ with regard to electrical cable systems required to maintain circuit integrity in conjunction with “standard support construction” according to DIN 4102-12,
(2) DIN 4102-12: 1998-11,
(3) DIN 4102-4: 2016-05,
(4) Detailed construction drawings according to annexes 1 to 8 of this expert opinion
    Annex 1 – No. 122613 (Floor height max. 3.5 m, fastening with head plate)
    Annex 2 – No. 122778 (Floor height max. 3.5 m, fastening with mounting angle)
    Annex 3 – No. 122817 (Floor height max. 3.5 m, fastening with head plates and U-supports)
    Annex 4 – No. 159511 (Floor height max. 3.5 m, fastening with head plates and U-supports)
    Annex 5 – No. 150695 (Floor height max. 3.5 m to max. 7.0 m, fastening with head plates)
    Annex 6 – No. 150699 (Floor height max. 3.5 m to max. 7.0 m, fastening with head plates and U-supports)
    Annex 7 – No. 159491 (Floor height max. 3.5 m to max. 7.0 m, fastening with head plates and U-supports)
    Annex 8 – No. 159232 (connection point)
(5) Calculations of the maximum tensile and shear stresses occurring in the individual components of the cable support constructions from OBO BETTERMANN Produktion Deutschland, which are stored at IBB GmbH, Groß Schwülper.

In addition to these documents, the extensive fire protection experience of the authors of this expert opinion from fire tests on various support constructions of electrical cable systems required to maintain circuit integrity are incorporated into the fire protection assessment. The more than 30 years of professional experience was gained by the author of this expert opinion, among other things, in the course of continuous work at approved testing institutes, so that this provides an equivalent level of information as from an approved material testing institute. This is also confirmed by the fact that expert opinions with regard to fire protection from the author are accepted by both the lower and higher building supervisory authorities on an equal basis with expert opinions from approved material testing institutes.

This expert opinion only applies in terms of fire protection and functional integrity. Further requirements may arise from the technical building regulations applicable to the constructions being assessed and the respective “Landesbauordnung” (*state building regulations)* or the regulations for special buildings.

The overall fire protection concept of buildings is not the subject of this expert opinion.

3 Description of the construction

3.1 General

Only details regarding the fire protection and the functional integrity are described as follows.

The load on the suspended vertical cable ladders due to the cable dead weight is a maximum of 20 kg/m. The vertical alignment takes place at a maximum height of up to 3.5 m or > 3.5 m to a maximum of 7.0 m (Upper edge of bare ceiling to lower edge of bare ceiling).

With an installation height of up to 3.5 m of the vertical cable ladder, the design of an additional effective support measure for strain relief can be dispensed with. If the installation height of the vertical cable ladder is > 3.5 m, effective support measures must be arranged at a distance of ≤ 3.5 m.

The steel components of the supporting constructions subjected to tension or shear must be designed in such a way that a maximum steel stress of $\sigma = 9$ N/mm² (E30) or $\sigma = 6$ N/mm² (E90) or $\tau = 15$ N/mm² (E30) or $\tau = 10$ N/mm² (E90) based on Table 11.1 of DIN 4102-04 [3] is not exceeded.

The supporting construction must be fastened to the solid constructions using fire protection fasteners ≥ M8 designed for the corresponding load.

All screw connections must be made with screws of at least strength class 4.6 and nuts of at least strength class 4.

The side rails are fastened to one another (e.g. joint connectors) in the slotted hole of the vertical cable ladder. The fastenings must be designed in such a way that no movement in vertical direction can take place in the slotted hole of the vertical cable ladder (fastening is set to stop in the slotted hole (top)). If a vertical movement cannot be ruled out in the event of fire, additional fixings must be used to secure the position.

3.2 Description of the cable support construction

3.2.1 General

The support constructions for suspended vertical cable ladders essentially consist of vertical arranged suspended cable ladders, which are force-fit connected to solid ceiling constructions (fixed at the top and vertically sliding at the bottom). The vertical cable ladders must not be attached to adjacent, non-load-bearing wall constructions classified for fire protection.

The "SLM 50 C40F" vertical cable ladders consist of "US5" side rails that are force-fit connected to "C40" profile rungs (mounting distance of the side rails ≤ 600 mm, rung spacing 300 mm, side rail height h = 50 mm, material thickness t = 2.5 mm).

The cable is fastened to the rungs of the vertical cable ladders using "BS-U1-M" clamp clips (vertical installation). The clamp clips are arranged in the rungs of the vertical cable ladders at a distance of ≤ 300 mm.

The penetration seal measure of the electrical cable penetrations in the ceiling aperture is carried out on the basis of a valid "allgemeiner bauaufsichtlicher Anwendbarkeitsnachweis“ *(certificate of usability)*.

3.2.2 Mounting variant 1 (H ≤ 3,5 m, drawing no. 122613)

In the design variant shown in annex 1, the suspended vertical cable ladder is installed over a maximum floor height of 3.5 m. Effective support measures for strain relief can therefore be omitted on the basis of DIN 4102-12 [2].

In this variant, each of the two ladder side rails is attached directly under the reinforced concrete ceiling using a screwed-on head plate with one M12 dowel/anchor, each. The same head plate is mounted on the floor, but the ladder side rail is not screwed to the head plate. The ladder side rail is held in position by the head plate due to the shape of the head plate. A minimum distance of 40 mm must be maintained between the end of the ladder rail and the floor to allow for length expansion under fire exposure at a maximum height of 3.5 m.

3.2.3 Mounting variant 2 (H ≤ 3,5 m, drawing no. 122778)

In this design variant according to annex 2, the suspended vertical cable ladder is installed over a floor height of max. 3.5 m. Effective support measures for strain relief can therefore be omitted based on DIN 4102-12 [2].

In this variant, each of the two ladder side rails is attached directly under the reinforced concrete ceiling using a screwed-on mounting angle with one M12 dowel/anchor, each. The same angle is mounted on the floor, but the ladder side rail is not screwed to the angle. The ladder side rails reach over the mounting angle from the outside, which keeps the side rails in a horizontal position. A minimum distance of 40 mm must be maintained between the end of the ladder rail and the floor to allow for length expansion under fire exposure at a maximum height of 3.5 m.

3.2.4 Mounting variant 3 (H ≤ 3,5 m, drawing no. 122817)

In the design variant shown in annex 3, the suspended vertical cable ladder is installed over a maximum floor height of 3.5 m. Effective support measures for strain relief can therefore be omitted on the basis of DIN 4102-12 [2].

Due to the position and size of the respective ceiling openings, in some cases, it is not possible to directly fasten the vertical cable ladder. To bridge the openings, a transverse steel profile is to be arranged under and over the opening and fastened with M12 dowels/anchors. The actual fastening or load transfer of the vertical cable ladder is carried out using screwed-on head plates and threaded rods that lead through the respective ceiling opening and are fastened to the transverse profile mounted on the ceiling opening. In this way, in combination with closing the ceiling opening with a penetration sealing system on the basis of an “allgemeiner bauaufsichtlicher Anwendbarkeitsnachweis“ (*certificate of usability)*, the load transfer to the other non-thermally exposed fire compartment above the vertical cable ladder is achieved. The transverse profile mounted on the floor therefore remains "cold" and does not have to be dimensioned for load transfer in the event of a fire.

An optional fixing of the head plates with screws to the transverse profile mounted under the ceiling opening is indicated as a possible assembly aid. As the actual load is transferred via the threaded rods, these screws and the transverse profile below the ceiling opening are not relevant in terms of fire protection and therefore do not need to be dimensioned accordingly.

This mounting variant is identical to direct mounting with head plates in terms of fastening the vertical cable ladder to the transverse profiles.

3.2.5 Mounting variant 4 (H ≤ 3,5 m, drawing no. 159511)

The vertical cable ladder according to the variant in annex 4 to this expert opinion is designed with a maximum floor height of 3.5 metres. Effective support measures for strain relief can therefore be omitted on the basis of DIN 4102-12 [2].

The ladder side rails of the vertical cable ladder are attached at both the top and bottom by means of a head plate and an U7-support. The U7-support is fastened transverse to the level of the vertical cable ladder directly to the solid ceiling using 2 x M12 dowels/anchors. The U7-supports or head plates are anchored to the U7-supports or head plates of the continuing vertical cable ladders using M12 threaded rods. At the head point, the side rails are screwed directly into the head plate (M10), whereas at the foot point, the side rails are not screwed into the head plates for possible deformation absorption.

3.2.6 Mounting variant 5 (H = 3,5 m – 7,0 m, drawing no. 150695)

In this design variant according to annex 5, the suspended vertical cable ladder is installed over a floor height of up to 7.0 metres. “VUS 5” connectors according to annex 8 (drawing no. 159232) are used at the joints of the side rails. For floor heights > 3.5 m, additional effective support measures are required.

At the connection points of the ladder side rails, head plates are arranged in the same way as described in variant 1, which are screwed directly into the solid ceiling. At the head point, the side rails are screwed into the head plate, while at the foot point the connection between the side rails and the head plates is designed as a “floating bearing” without screw connection.

A minimum distance of 70 mm must be maintained between the end of the ladder side rail and the floor to allow for length expansion under fire exposure at a maximum height of 7 m.

3.2.7 Mounting variant 6 (H = 3,5 m – 7,0 m, drawing no. 150699)

In this design variant according to annex 6, the suspended vertical cable ladder is installed over a floor height of up to 7.0 metres. “VUS 5” U-support connectors according to annex 8 (drawing no. 159232) are used at the joints of the side rails. For floor heights > 3.5 m, additional effective support measures are required.

The design of the vertical cable ladder and fastening to the ceiling construction is essentially carried out in accordance with variant 3 - section 3.2.4. As an alternative, the U7-supports are arranged lengthwise to the level of the vertical cable ladder and two threaded rods are used per head plate to anchor the U7-supports or head plates to each other in this variant.

A minimum distance of 70 mm must be maintained between the end of the ladder rail and the floor in order to allow for length expansion under fire exposure at a maximum height of 7 m.

3.2.8 Mounting variant 7 (H = 3,5 m – 7,0 m, drawing no. 159491)

This design variant in accordance with annex 7 largely corresponds to the design in accordance with variant 4 - section 3.2.8.

Deviating, in this cable support construction variant, the US7-supports are designed as transverse profiles to the level of the vertical ladder and two US7-supports are arranged per head plate.

A minimum distance of 70 mm must also be maintained between the end of the ladder rail and the floor in order to allow for length expansion under fire exposure at a maximum height of 7000 mm.

3.2.9 Mounting connection point (H = 3,5 – 7,0 m, drawing no. 159232)

In the present design in accordance with annex 8, the connection point is used for suspended vertical cable ladders over a floor height of up to 7.0 m.

The two vertical cable ladders are connected with "VUS 5" U-support connectors and screwed together at the top and the bottom with 3 "FRS 10x20, M10x20" truss-head bolts.

4 Fire protection assessment of the cable support systems

The mentioned maximum permissible tensile stresses and shear stresses of the individual steel components were positively verified by calculation of the manufacturer of the cable support constructions in terms of fire protection and have been deposited with IBB GmbH, Groß Schwülper. Excluded from this are the connector profiles of the mounting version with U-support connector "Type VUS 5" for the above versions, for which a tensile stress of 6.12 N/mm² has been calculated compared to the maximum permissible tensile stress of 6.0 N/mm². However, the slight exceeding of the permissible tensile stress can be neglected, as the cable dead weight will be reduced in the event of fire due to burning of the cable insulation to such an extent that the existing tensile stress will then be significantly below the permissible tensile stress.

A classification of electrical cable systems required to maintain circuit integrity when using cable support constructions in accordance with section 3 can only be carried out in conjunction with valid “allgemeinen bauaufsichtlichen Prüfzeugnissen” from an approved material testing institute. It must be checked in each individual case whether the functional integrity classes of the electrical cable systems required to maintain circuit integrity with support constructions - cable ladders verified in the “allgemeinen bauaufsichtlichen Prüfzeugnissen” were achieved that comply with the "standard support constructions" of DIN 4102-12 [2].

The cable support constructions described in section 3 and shown in annexes 1 to 8 can be assessed and categorised as a standard support construction on the basis of DIN 4102-12 without any concerns regarding fire protection or functional integrity.

5 Special information

- This expert opinion does not constitute a “allgemeiner bauaufsichtlicher Verwendbarkeitsnachweis” *certificate of usability* in the process by building authorities in the federal states of the “Bundesrepublik Deutschland”, but serves as a basis for technical advice from OBO Bettermann Produktion Deutschland GmbH & Co. KG, Menden, for corresponding construction projects, e.g. with regard to issuing the declaration of conformity of the constructor.
- Changes and additions to construction details (derived from this expert opinion) are only possible after consultation with IBB GmbH, Groß Schwülper.
- This expert opinion only applies if the adjoining load-bearing (reinforcing or load-distributing) building elements have at least the same fire resistance class as the electrical cable systems.
- The proper execution is the sole responsibility of the executing companies.
- The manufacturer's valid processing guidelines must be observed when processing the specified building materials or products.
- The validity of this expert opinion ends on 12.06.2028.
- The period of validity can be extended upon request and depending on the state of the art.

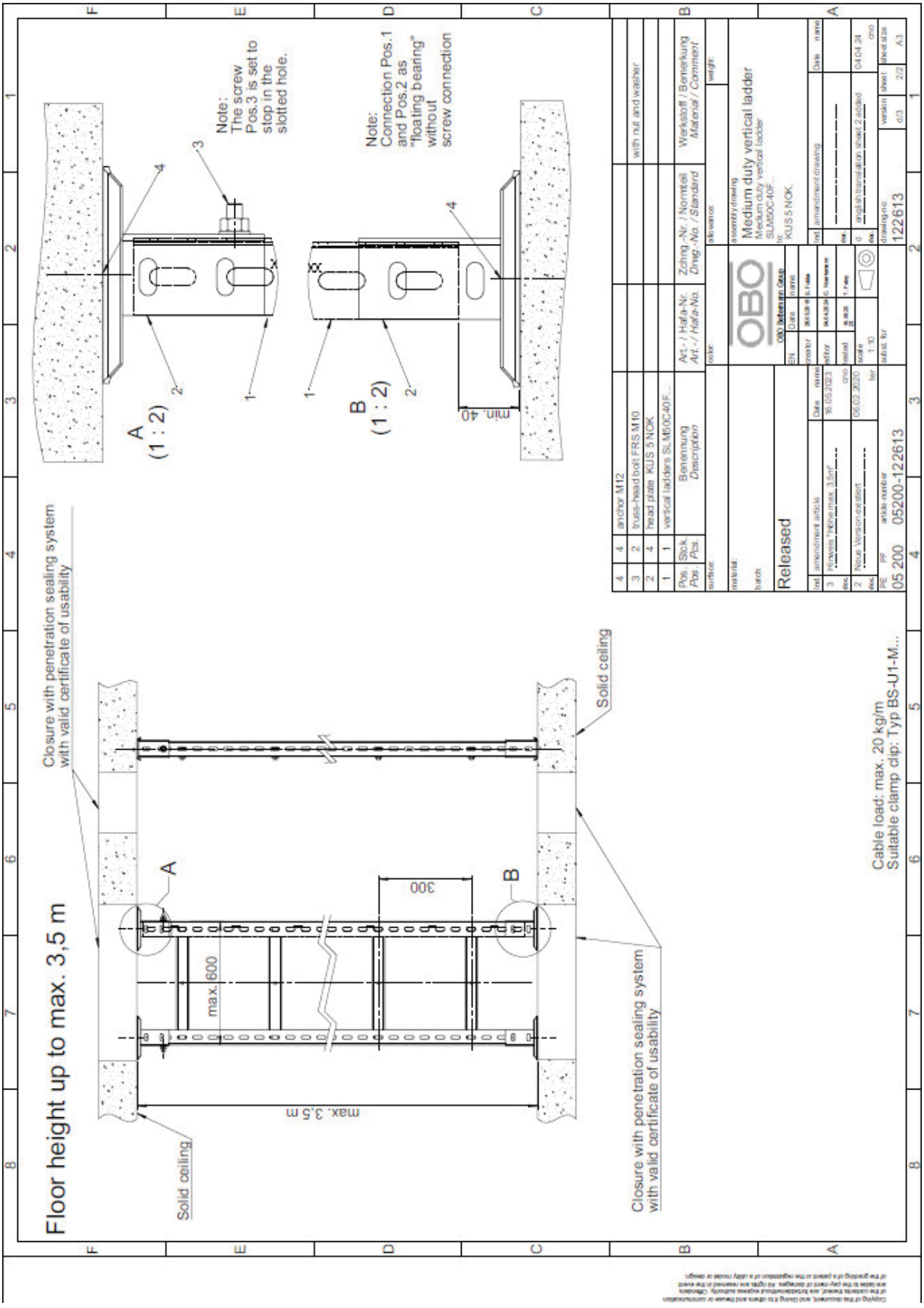
Best regards

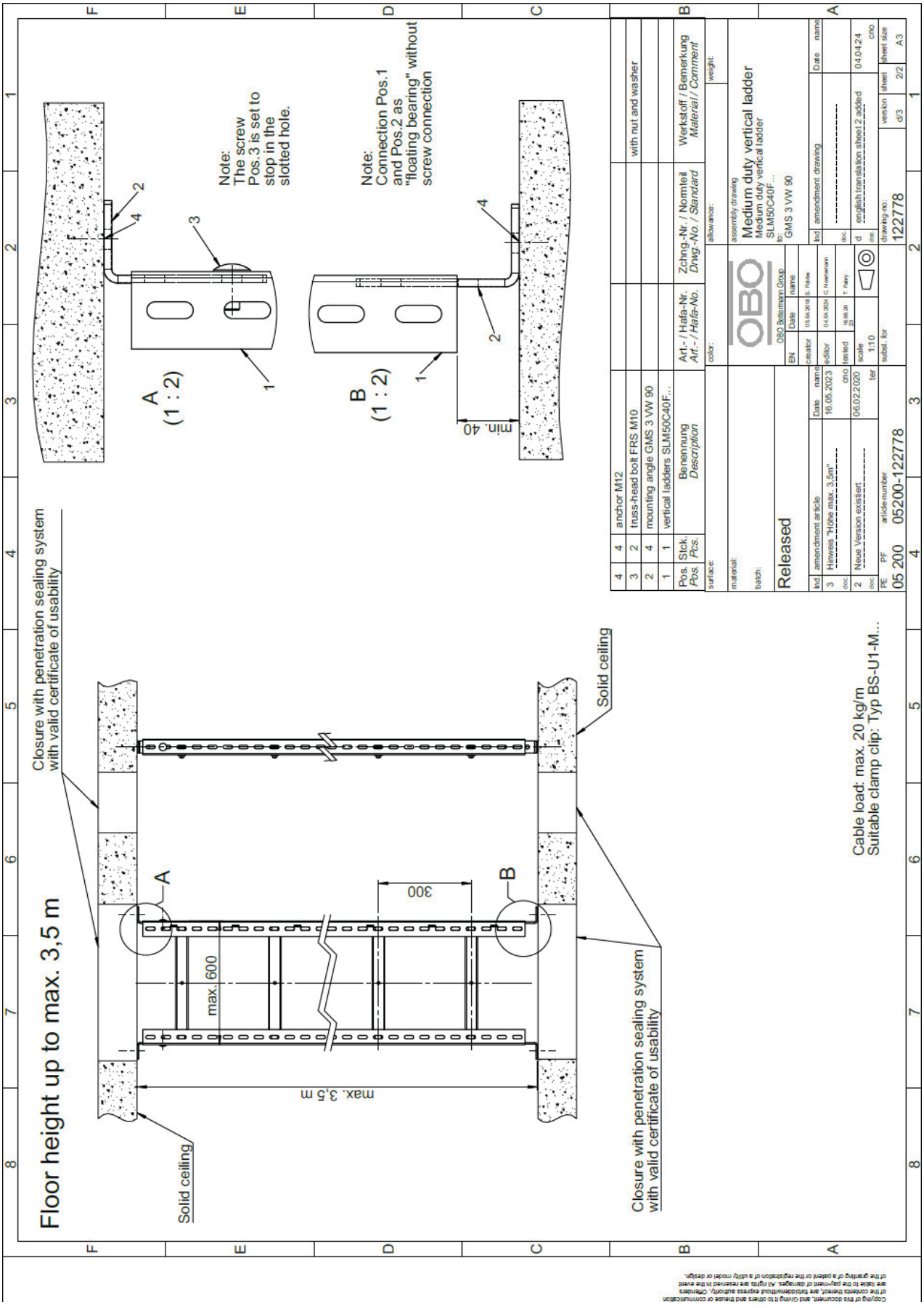
Dr.-Ing. Peter Nause

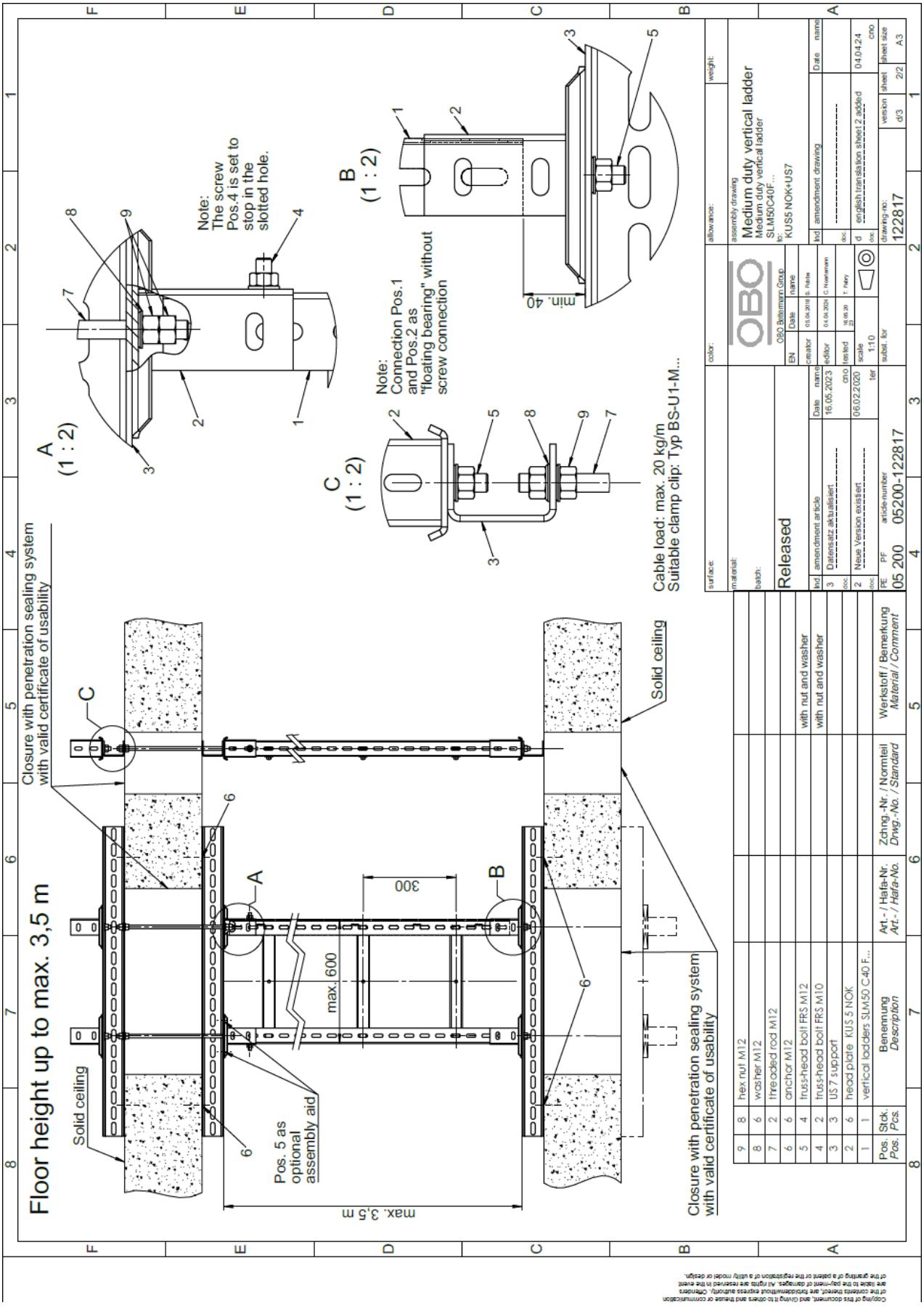
Expert for fire protection

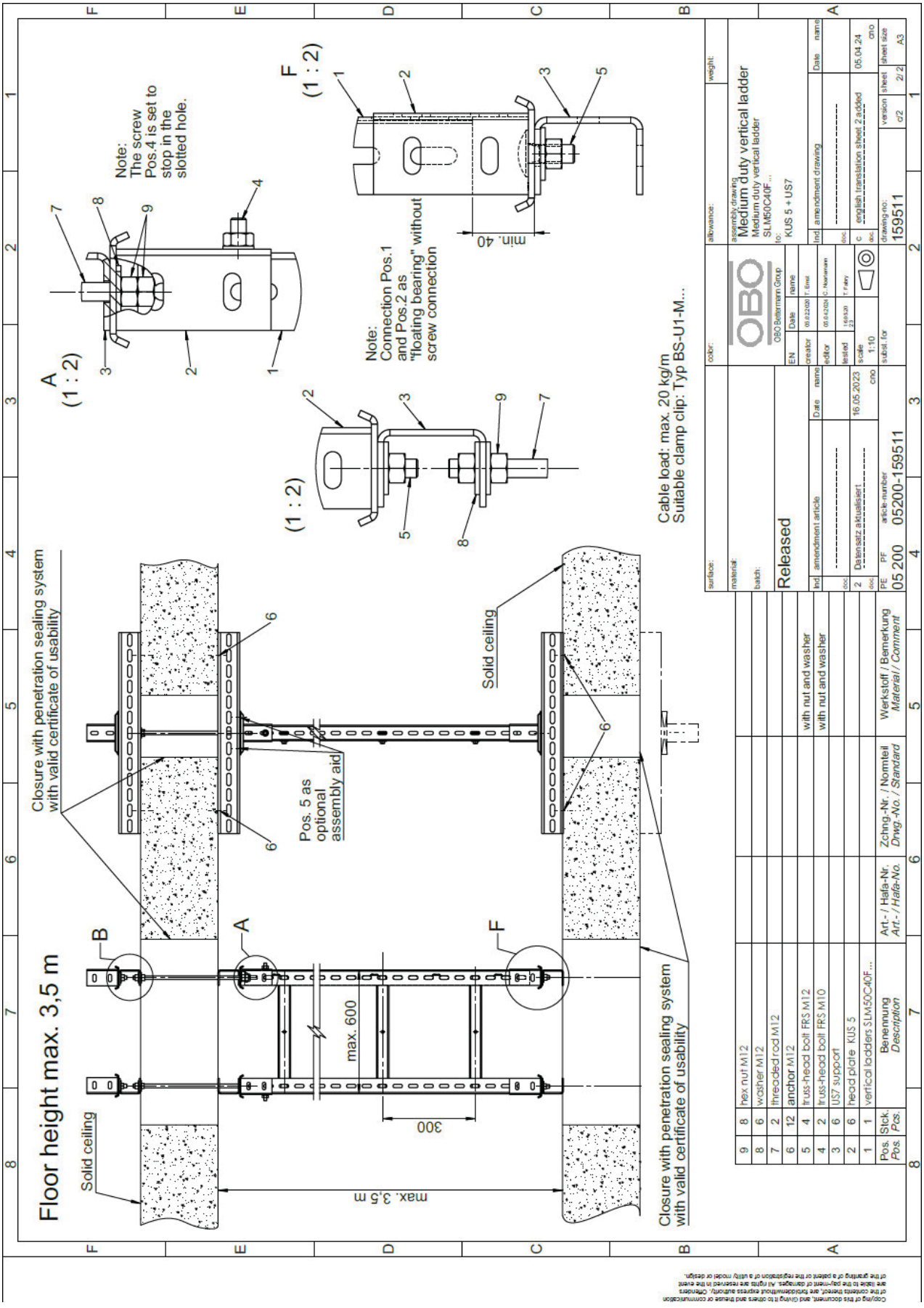
Translation of the original German version not checked by “IBB GmbH, Groß Schwülper”. This translation was commissioned by OBO Bettermann Produktion Deutschland GmbH & Co. KG. This translation is only for better understanding in other countries. In cases of doubt, the original German version of the expert opinion applies exclusively.

Date of translation of this Expert Opinion: 11 April 2024

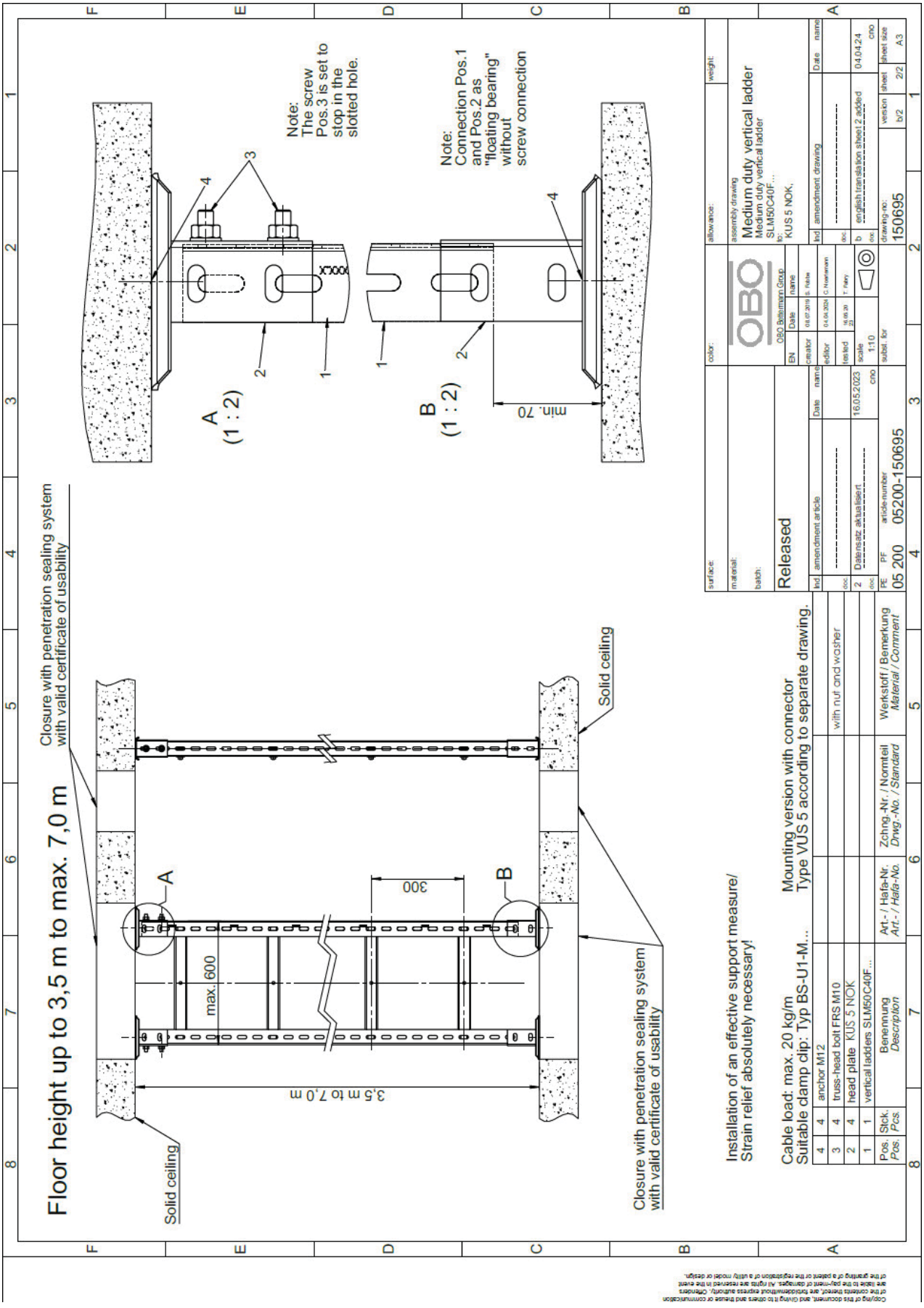

Note:
The screw
Pos.3 is set to
stop in the
slotted hole.
Note:
Connection Pos.1
and Pos.2 as
"floating beaning"
without
screw connection
A
(1 : 2)
B
(1 : 2)
min. 40
4 4 anchor M12
3 2 truss-head bolt FRS M10
2 4 head plate KUS 5 NOK
1 1 vertical ladders SLM60C40F...
with nut and washer
Pos. Pos. Stck. Pos. Benennung Description Art.-/ Hafa-Nr. Art.-/ Hafa-No. Zchng.-Nr. / Normteil Dwg.-No. / Standard Werkstoff / Bemerkung Material / Comment
OBO
assembly drawing
Medium duty vertical ladder
Medium duty vertical ladder
SLM60C40F...
KUS 5 NOK
Released
ind. amendment article Date name
3 Hinweis "Höhe max. 3,5m" 16.05.2023 cino
2 Neue Version existiert 06.02.2020 cino
ind. amendment drawing Date name
ex. english translation sheet 2 added 04.04.24 cino
drawing-no. 122613
version sheet 2/2
sheet size A3
05 200 05200-122613
Floor height up to max. 3,5 m
Closure with penetration sealing system
with valid certificate of usability
Solid ceiling
A
B
300
max. 600
max. 3,5 m
Solid ceiling
Closure with penetration sealing system
with valid certificate of usability
Cable load: max. 20 kg/m
Suitable clamp clip: Typ BS-U1-M...

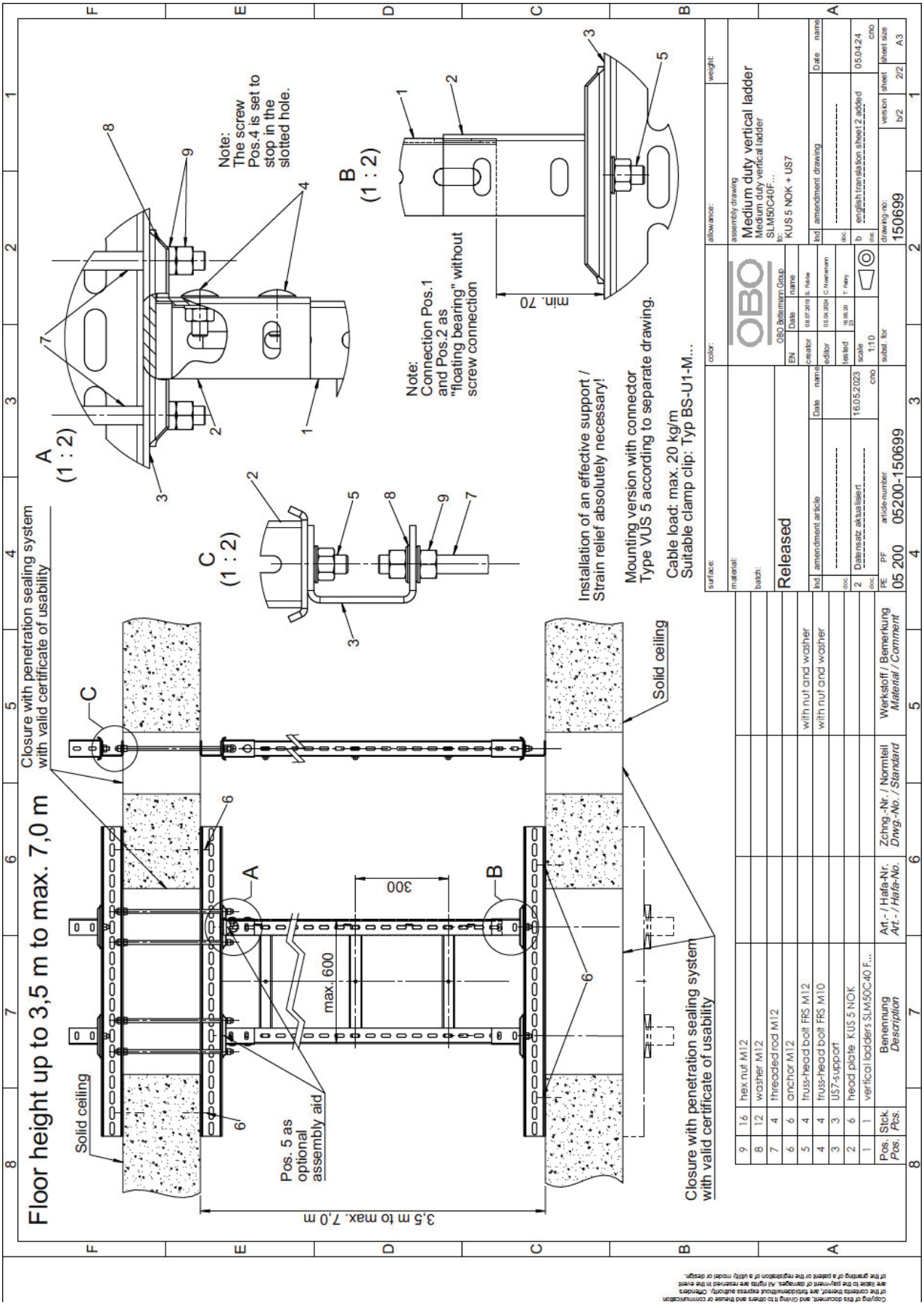

Floor height up to max. 3,5 m
Closure with penetration sealing system with valid certificate of usability
Solid ceiling
max. 3,5 m
max. 600
300
A
B
Cable load: max. 20 kg/m
Suitable clamp clip: Typ BS-U1-M...
Note: The screw Pos.3 is set to stop in the slotted hole.
Note: Connection Pos.1 and Pos.2 as "floating bearing" without screw connection
A (1 : 2)
B (1 : 2)
min. 40
Pos. Stck. Benennung Art.- / Hafa-Nr. Zchng.-Nr. / Nomteil Werkstoff / Bemerkung
4 4 anchor M12 with nut and washer
3 2 truss-head bolt FRS M10
2 4 mounting angle GMS 3 VW 90
1 1 vertical ladders SLM50C40F...
Released
OBO Bettermann Group
Medium duty vertical ladder
SLM50C40F...
GMS 3 VW 90
05 200 05200-122778
122778

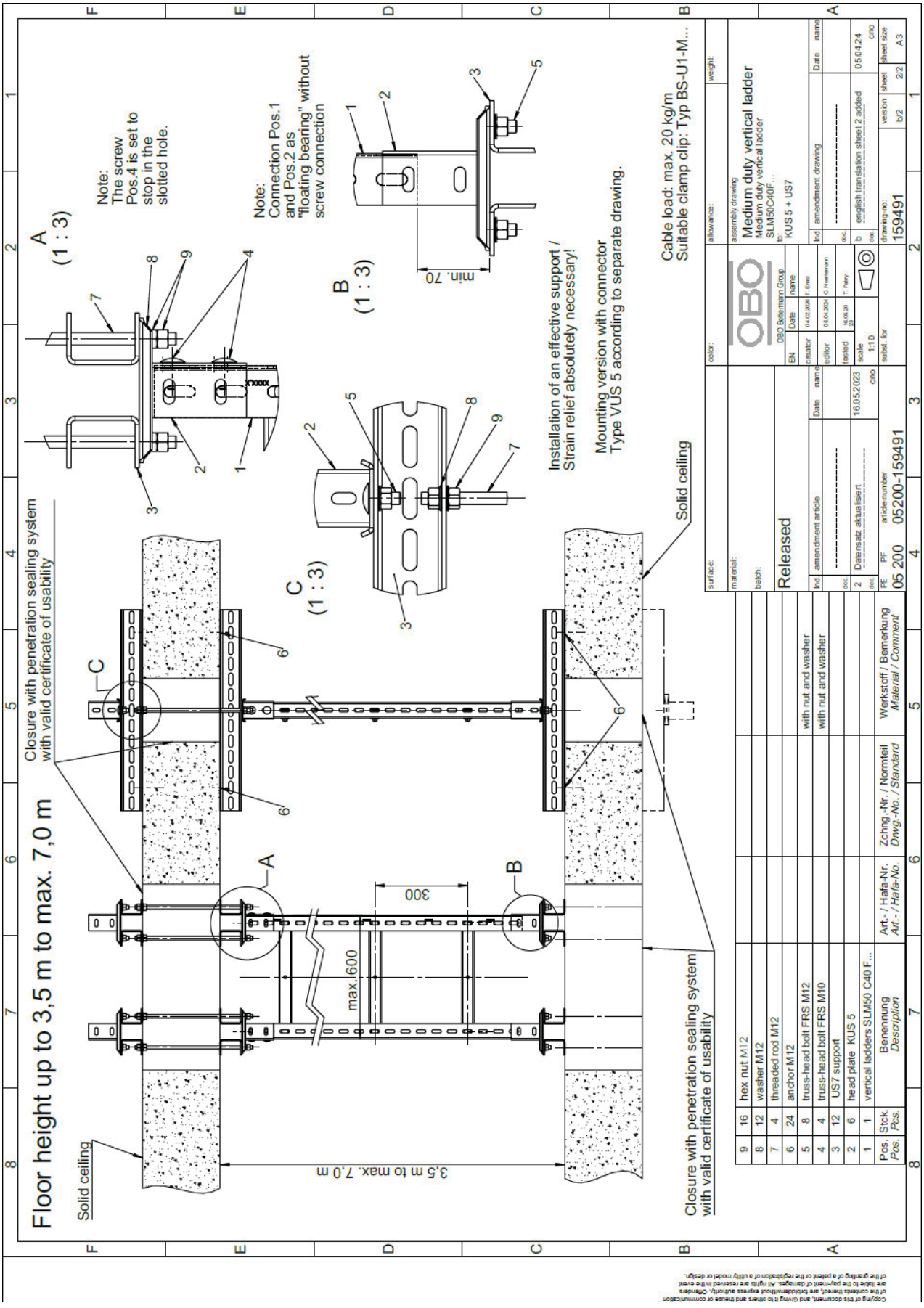


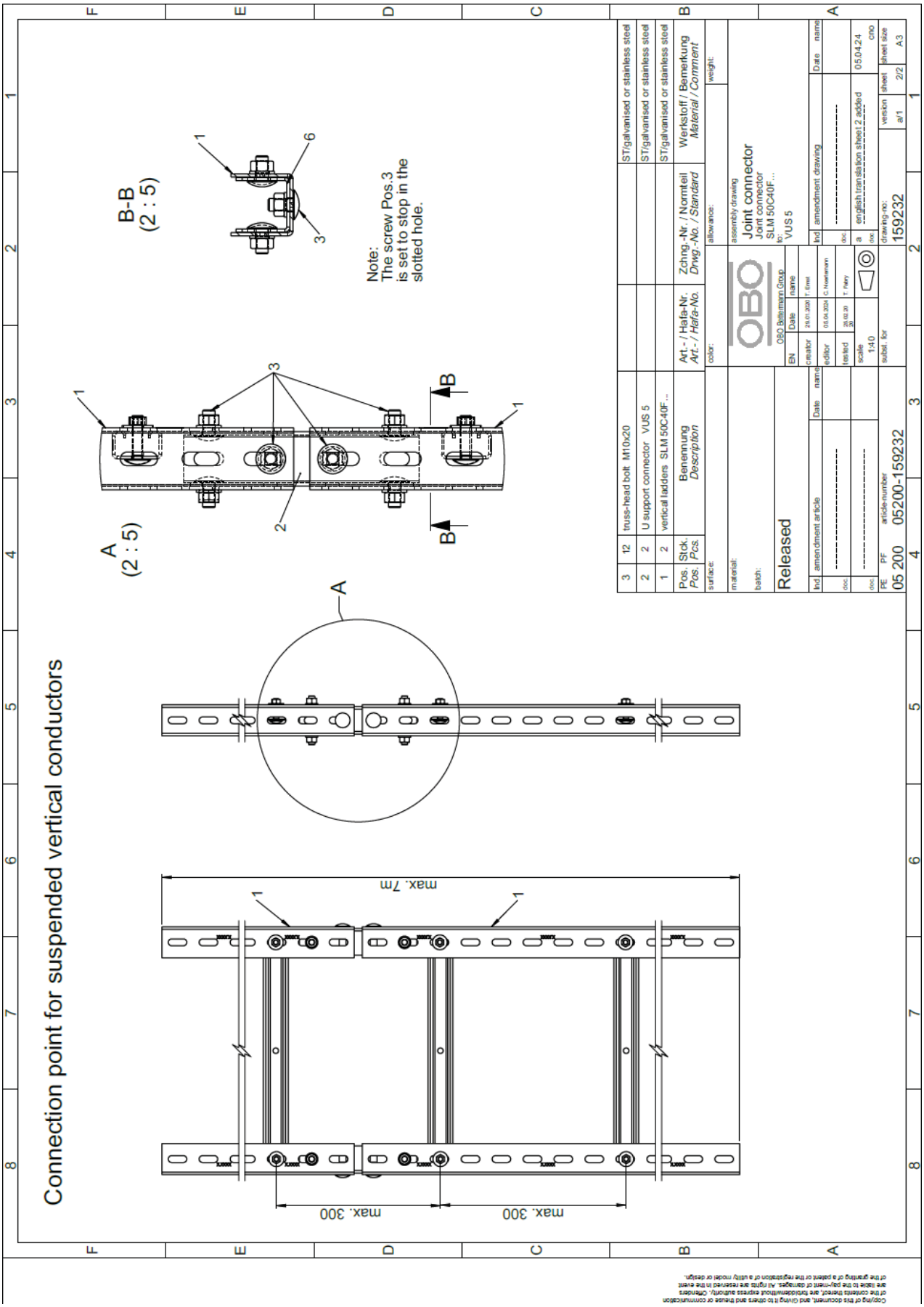


Pos. Pos.	Stck. Pcs.	Benennung Description	Art.- / Hafa-Nr. Art.- / Hafa-No.	Zchng.-Nr. / Normteil Drwg.-No. / Standard	Werkstoff / Bemerkung Material / Comment
9	8	hex nut M12			
8	6	washer M12			
7	2	threaded rod M12			
6	12	anchor M12			with nut and washer
5	4	truss-head bolt FRS M12			with nut and washer
4	2	truss-head bolt FRS M10			
3	6	US7 support			
2	6	head plate KUS 5			
1	1	vertical ladders SLM50C40F...			








Connection point for suspended vertical conductors
B-B
(2 : 5)
A
(2 : 5)
Note:
The screw Pos.3
is set to stop in the
slotted hole.
max. 7m
max. 300
max. 300
Released
OBO Bettermann Group
Joint connector
Joint connector
SLM 50C40F...
for
VUS 5
05 200 05200-159232
159232

OBO Bettermann Holding GmbH & Co. KG
P.O. Box 1120
58694 Menden
GERMANY

Customer Service
Tel.: +49 23 73 89-13 00
Fax: +49 23 73 89-71442
toi@obo.de

www.obo-bettermann.com

Building Connections