Hager Electro GmbH & Co. KG – Zum Gunterstal – 66440 Blieskastel – Germany
Solution Development and Marketing, Product Marketing Enclosures
Tel. +49 6842 945 0
www.hagergroup.net

Technical Product Documentation

Product / Product Range:
Public Electricity Network Distribution Assemblies (PENDA) in accordance with IEC 61439-1 /-5
Rated operational voltage (U_e) **400 VAC / 800 VAC –** Rated insulation voltage (U_i) **1000 VAC –** Rated frequency (f_n) **50 Hz –** Rated current of the assembly (I_{nA}) **up to 653 A (680 A) / 288 A –** Rated conditional short-circuit current (I_{cc}) **60 kA / 30 kA**

Designation: **Outdoor Enclosures CDC (Cable Distribution Cabinets)**

Manufacturer: **Hager Electro GmbH & Co. KG**
Zum Gunterstal
66440 Blieskastel
Germany

This document is intended for internal use.

The results verify the requirements given by the above-mentioned standard.

The results of test reports listed in this certificate are exclusively linked to the tested samples and compared or assessed variants.
This document shall not be reproduced except in full, without written approval.

Pascal Polster
SDM PM Enclosures

Date: 30/06/22 Ver. 1.1

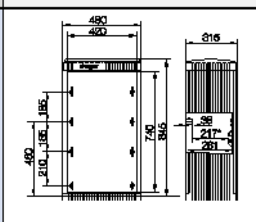
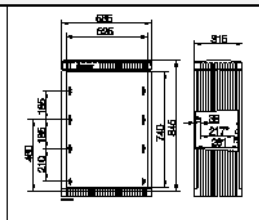
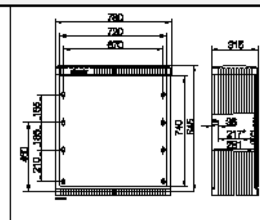
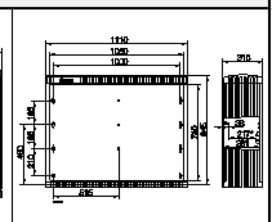
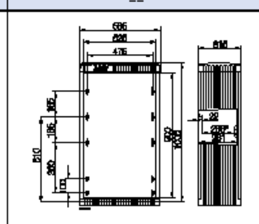
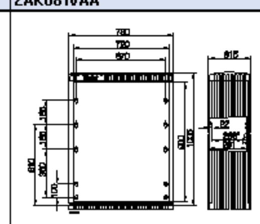
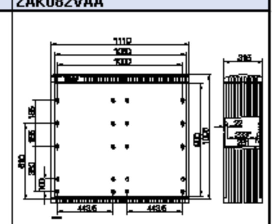
List of Design Verifications

No.	Characteristic to be verified	Clause or sub-clause	Verification by	Applicable document(s)	Verified product / range / series
1	Resistance to corrosion	10.2.2	Test	HPB18040315	ZAK…GA
	Thermal stability	10.2.3.1	Test	18-037LAB-BLK	ZAK…GA
	Resistance to abnormal heat and fire due to internal electric effects	10.2.3.2	Test	252839-TL3-1	ZAK…GA
	Dry heat	10.2.3.101	Test	18-037LAB-BLK	ZAK…GA
	Category of flammability	10.2.3.102	Test	252839-TL3-1	ZAK…GA
	Resistance to ultra-violet (UV) radiation	10.2.4	Test	131339-18_Hager	ZAK…GA
	Lifting	10.2.5	N/A	-	-
	Resistance to static load	10.2.101.2	Test	18-037LAB-BLK	ZAK…GA
	Resistance to shock load	10.2.101.3	Test	18-037LAB-BLK	ZAK…GA
	Resistance to torsional stress	10.2.101.4	Test	18-037LAB-BLK	ZAK…GA
	Impact force withstand	10.2.101.5	Test	18-037LAB-BLK	ZAK…GA
	Mechanical strength of doors	10.2.101.6	Test	not necessary	-
	Resistance to axial load of metal inserts in synthetic material	10.2.101.7	N/A	-	-

	Resistance to mechanical shock induced by sharp objects	10.2.101.8	Test	18-037LAB-BLK	ZAK…GA
	Mechanical strength of a base intended to be embedded in the ground	10.2.101.9	Test	18-037LAB-BLK	ZAK…GA
	Marking	10.2.7	Test	18-037LAB-BLK	ZAK…GA
2	Degree of protection of enclosures	10.3	Test	18-011PM-L 21-146LAB-BLK	ZAK…GA
3	Clearances	10.4	Test	21-013LAB-BLK	ZAK…GA
4	Creepage distances	10.4	Drawing	21-013LAB-BLK	ZAK…GA
5	Effective continuity between the exposed conductive parts of the assembly and the protective circuit	10.5.2	N/A	-	-
	Short-circuit withstand strength of the protective circuit	10.5.3	Test	209425-CC3-1	ZAK…GA
6	Incorporation of switching devices and components	10.6	Manufacturer	see pages 12ff.	ZAK…GA
7	Internal electrical circuits and connections	10.7	Manufacturer	see manufacturer documentation	ZAK…GA
8	Terminals for external conductors	10.8	Manufacturer	see manufacturer documentation	ZAK…GA
9	Power frequency withstand voltage	10.9.2	Test	18-037LAB-BLK, 21-013LAB-BLK	ZAK…GA

	Impulse withstand voltage	10.9.3	Test	18-037LAB-BLK, 21-013LAB-BLK	ZAK…GA
10	Temperature-rise limits	10.10	Test	18-037LAB-BLK, 21-013LAB-BLK	ZAK…GA
11	Short-circuit withstand strength	10.11	Test	209425-CC3-1, 14600-21-0272-d	ZAK…GA
12	Electromagnetic compatibility (EMC)	10.12	N/A	-	-
13	Mechanical operation	10.13	Test	18-037LAB-BLK	ZAK…GA

Overview of series Outdoor Enclosures CDC (Cable Distribution Cabinets)

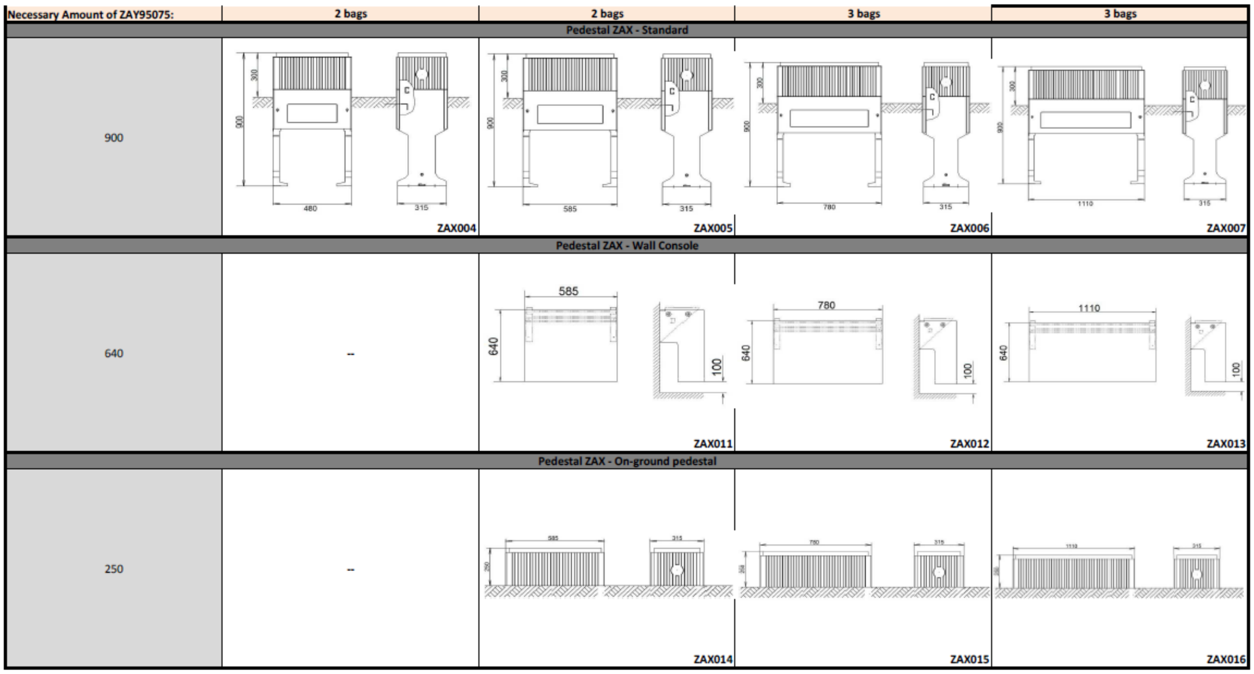
Cable Distribution Cabinets KVS (CDC)				
Size	00	0	1	2
Width in mm	480	585	780	1110
Height in mm	Depth: 315 mm			
845				
Enclosure w/ busbar system:	**ZAK084GA**	**ZAK080GA**	**ZAK081GA**	**ZAK082GA**
Asymmetrical enclosure (2 doors):	--	--	**ZAK081VAA**	**ZAK082VAA**
1005	--			
Enclosure w/ busbar system:	--	**ZAK100GA**	**ZAK101GA**	**ZAK102GA**

Reference table outdoor enclosures CDC

Reference	Description
ZAK084GA	CDC, size 00/845, w/ 4 pole busbar system 30 x 6 mm
ZAK080GA	CDC, size 0/845, w/ 4 pole busbar system 30 x 6 mm
ZAK081GA	CDC, size 1/845, w/ 4 pole busbar system 30 x 6 mm
ZAK081VAA	CDC, size 1/845, w/ 4 pole busbar system 30 x 10 mm, with 1 x NH2, 2 x NH2
ZAK082GA	CDC, size 2/845, w/ 4 pole busbar system 30 x 8 mm
ZAK082VAA	CDC, size 2/845, w/ 4 pole busbar system 30 x 10 mm, with 1 x NH2, 4 x NH2
ZAK100GA	CDC, size 0/1005, w/ 4 pole busbar system 30 x 6 mm
ZAK101GA	CDC, size 1/1005, w/ 4 pole busbar system 30 x 6 mm
ZAK102GA	CDC, size 2/1005, w/ 4 pole busbar system 30 x 8 mm

Measurements in accordance with DIN 43629-1

Pedestals

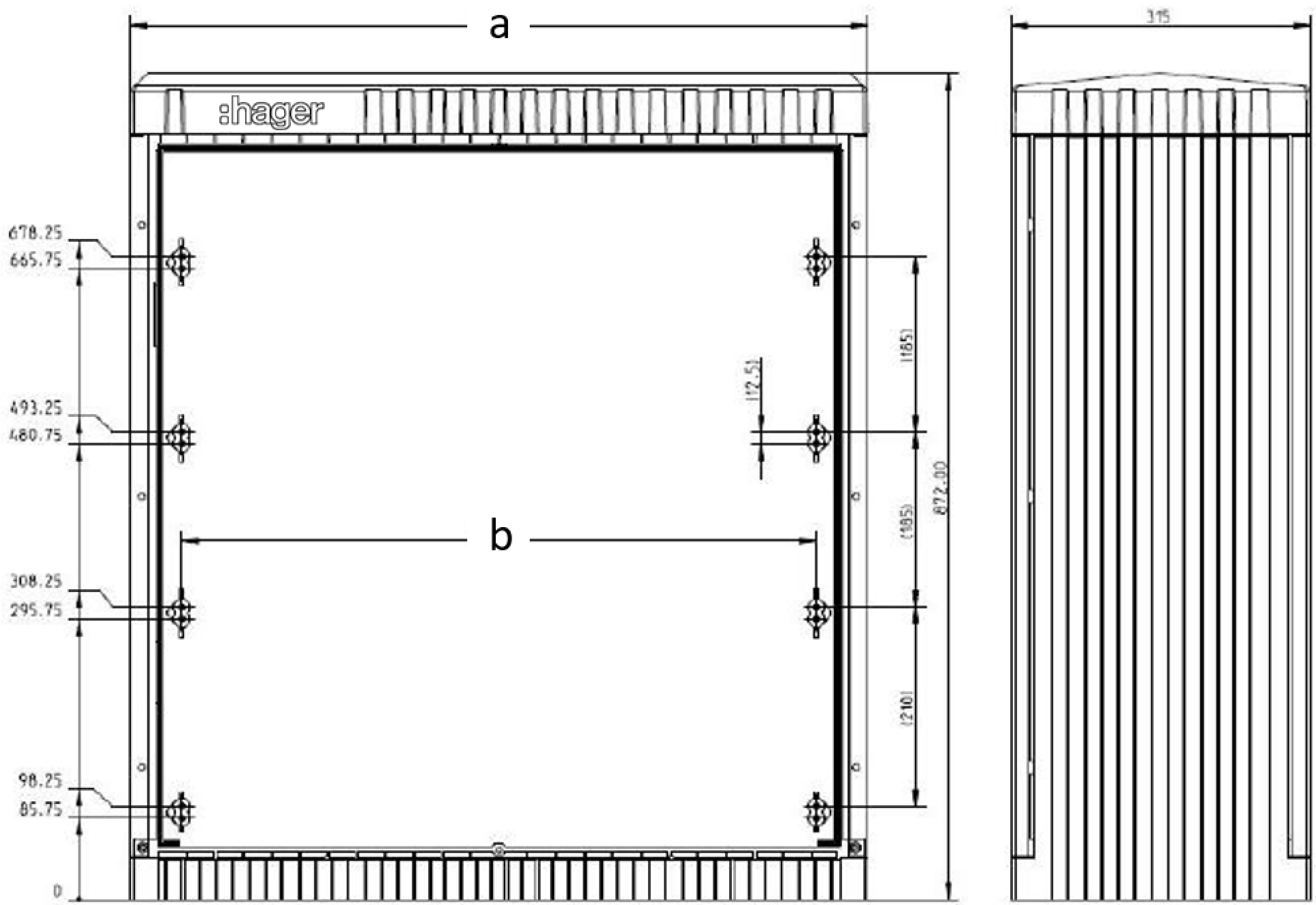


Reference table Pedestals for Cable Distribution Cabinets

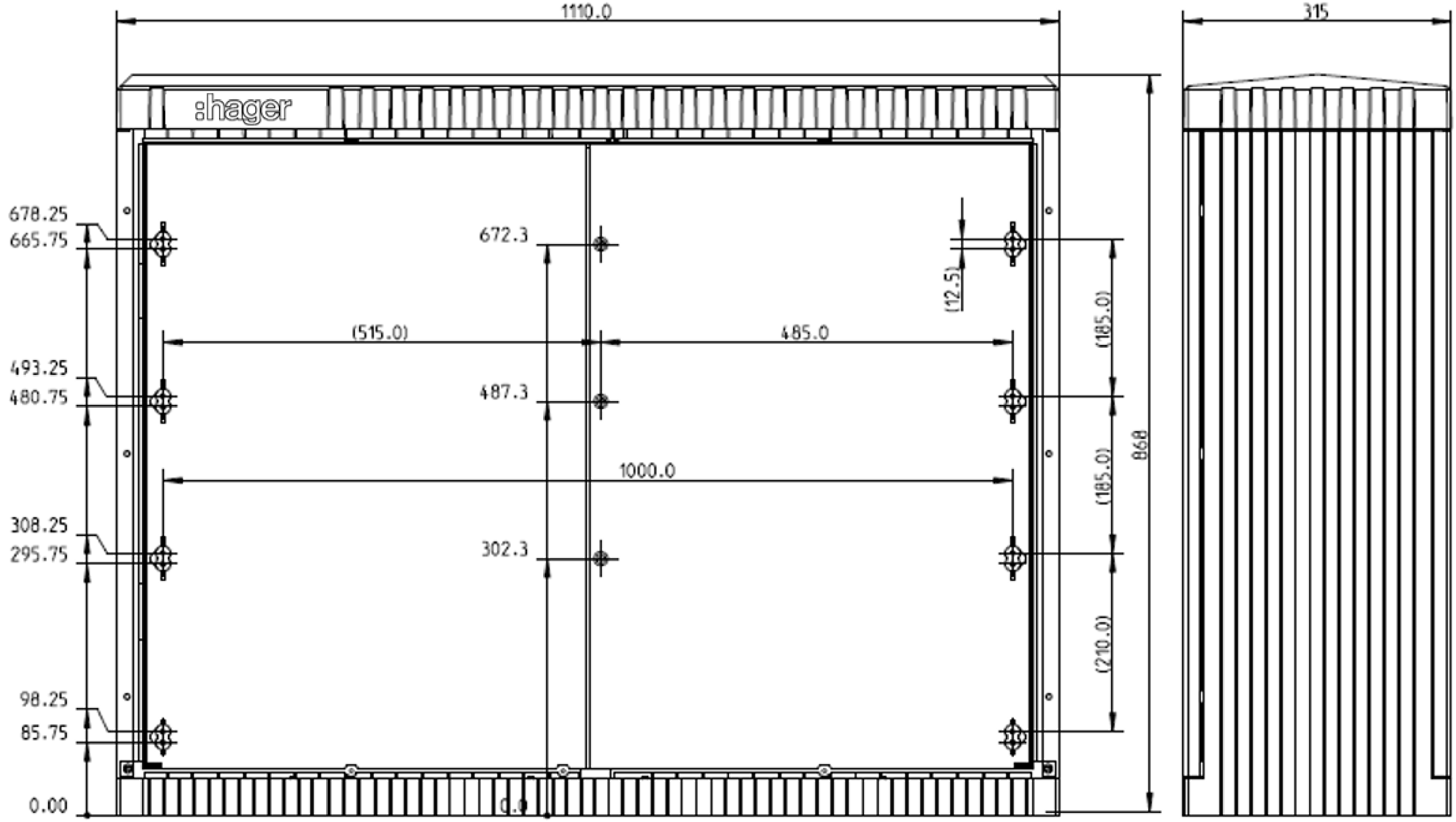
Reference	Description
ZAX004	Embedded pedestal, size 00, height: 900 mm
ZAX005	Embedded pedestal, size 0, height: 900 mm
ZAX006	Embedded pedestal, size 1, height: 900 mm
ZAX007	Embedded pedestal, size 2, height: 900 mm
ZAX011	Wall console, size 0, height: 640 mm
ZAX012	Wall console, size 1, height: 640 mm
ZAX013	Wall console, size 2, height: 640 mm
ZAX014	Surface-mounted base, size 0, height: 250 mm
ZAX015	Surface-mounted base, size 1, height: 250 mm
ZAX016	Surface-mounted base, size 2, height: 250 mm

Measurements in accordance with DIN 43629-2

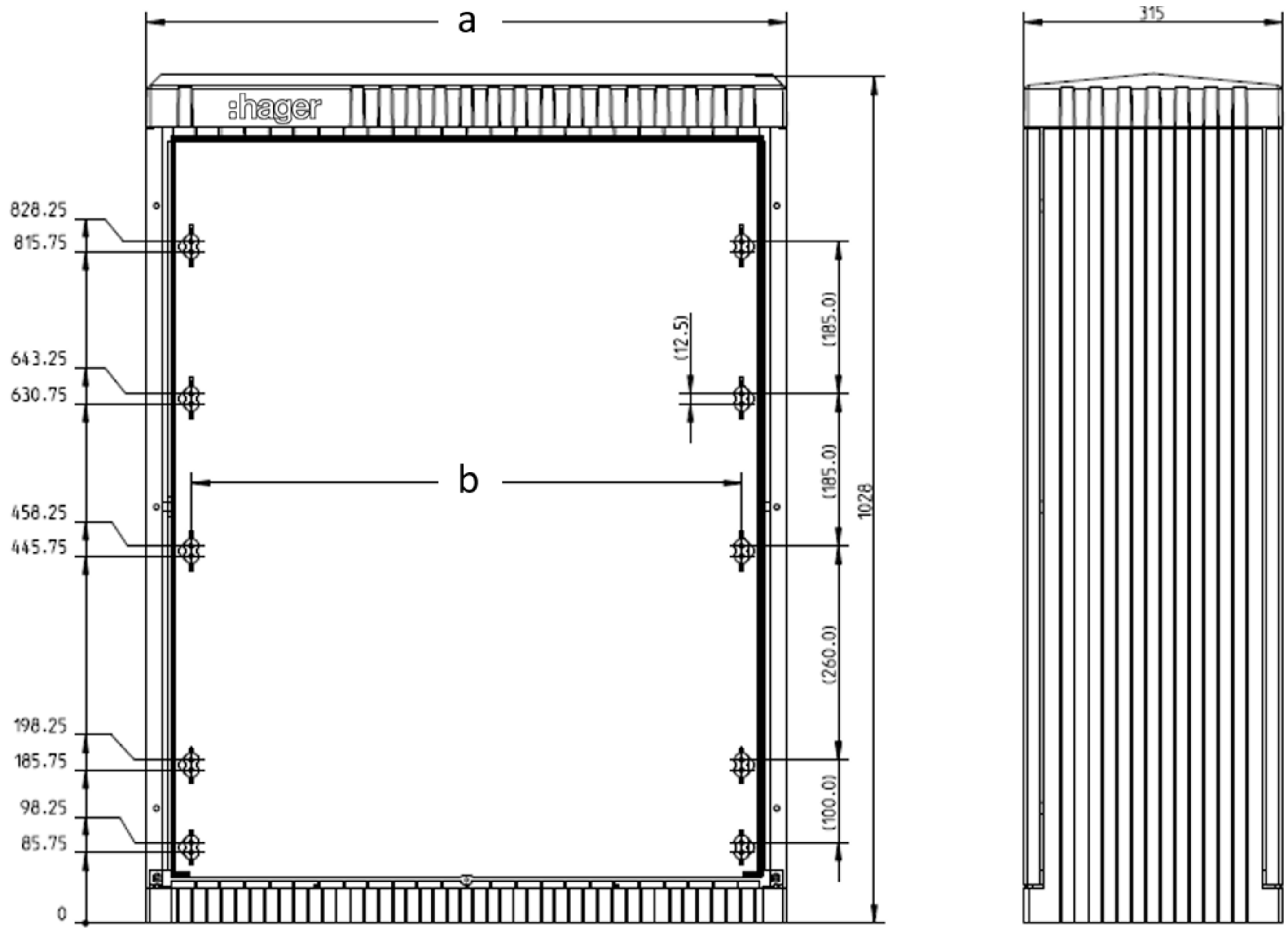
Enclosure Measurements



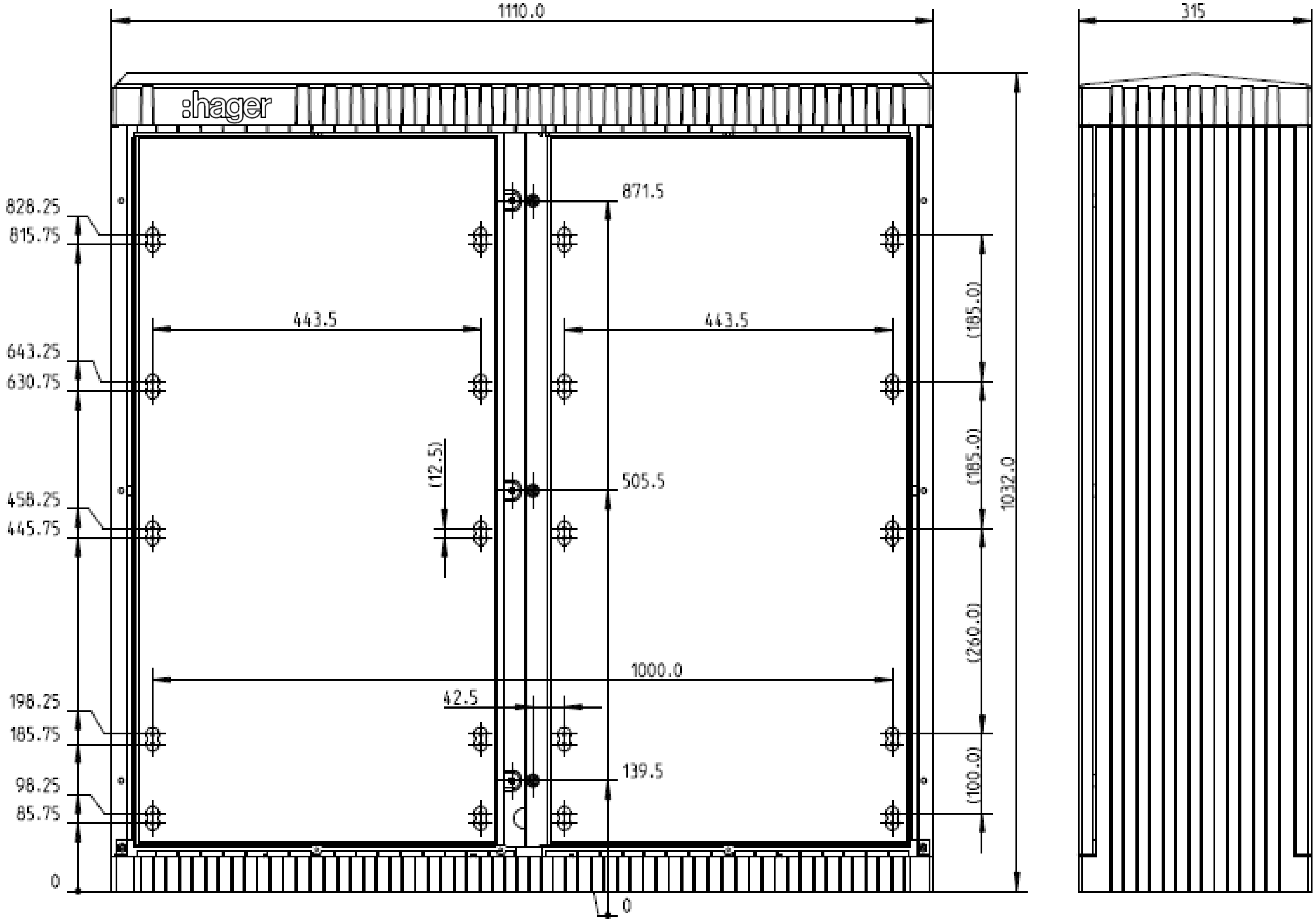
Reference (Reference with busbars)	Distance a in mm	Distance b in mm
ZAL084 (ZAK084GA)	480	370
ZAL080 (ZAK080GA)	585	475
ZAL081 (ZAK081GA)	780	670



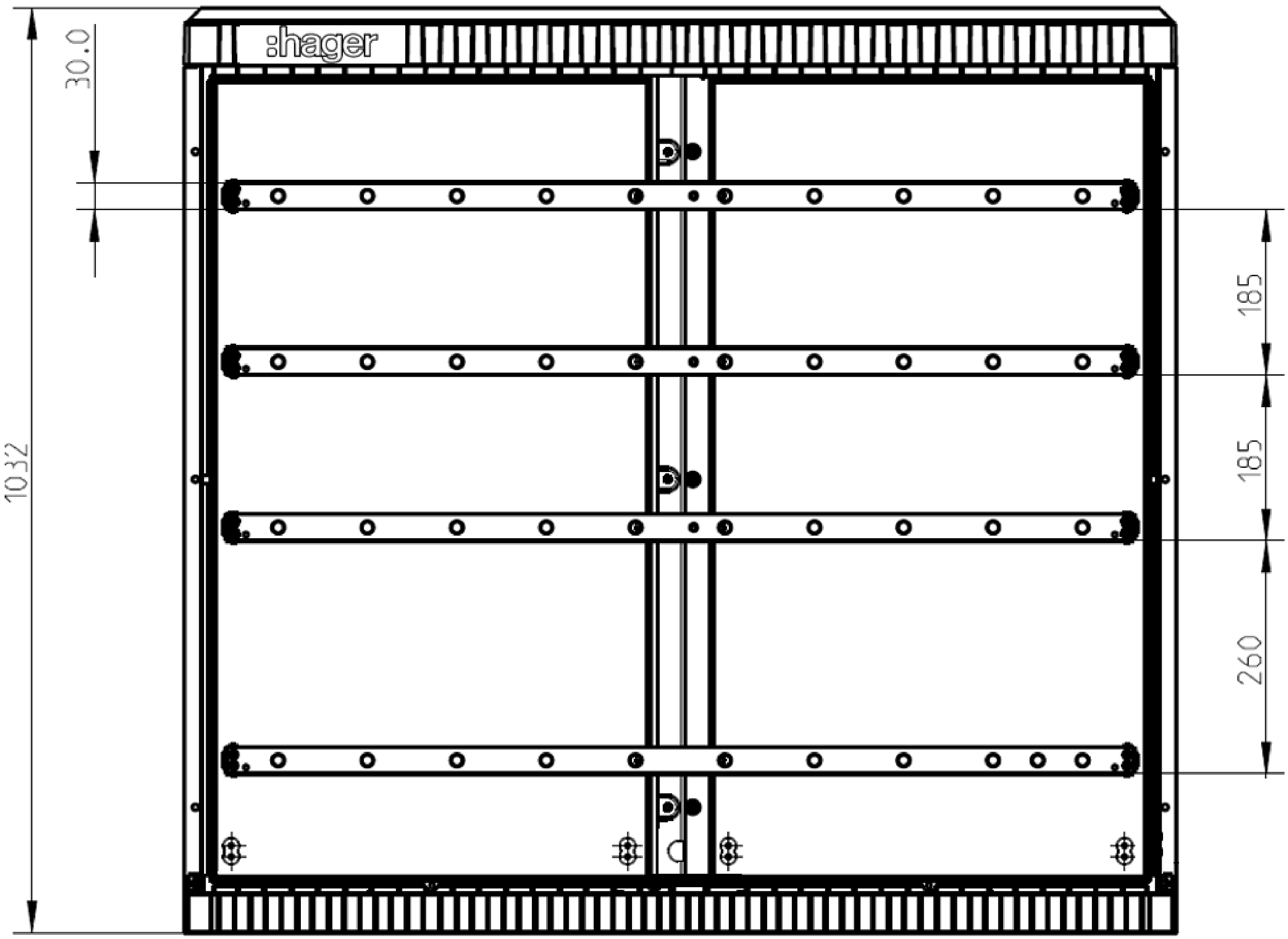
Measurements for ZAL082 (reference with busbars ZAK082GA)



Reference (Reference with busbars)	Distance a in mm	Distance b in mm
ZAL100 (ZAK100GA)	585	475
ZAL101 (ZAK101GA)	780	670



Measurements for ZAL102 (reference with busbars ZAK102GA)



Measurements for busbar system as included in ZAK102GA

Equipment

LVSG vertical switchgear devices

**devices also tested for 800 VAC application*

Type	Reference	I_n / A	Manufacturer
NH00*	LVSG00SPX	160	Hager
NH00	LVSG00RPX	160	Hager
NH00	LVSG00TRPX	160	Hager
NH00	LVSG00TSPX	160	Hager
NH1	LVSG1CPX	250	Hager
NH2	LVSG2CPX	400	Hager
NH3	LVSG3CPX	630	Hager
NH3*	LVSG3CPZ	630	Hager
NH1	LVSR1VPVK4	250	Hager
NH2	LVSR2VPVK4	400	Hager
NH3	LVSR3VPVK4	630	Hager
NH3	LVTG1000CP	1000	Hager
NH3	LVTG1000TP	1000	Hager
NH3	LVSR3TP	630	Hager
NH3	38036-0000	630	EFEN
NH3	438.53.10.XX.YY	630	Pronutec
NH2	L203100103	400	Jean Müller
NH2	9-E-EH241AAG	400	Pronutec
NH2	38864-0020	400	EFEN
NH2	38865-0200	400	EFEN

Low-voltage fuses

**fuses for 800 VAC application*

Type	Reference	I_n / A	U_n / V	P_V / W	Manufacturer
NH00*	N5033814	63	800	7	Jean Müller
NH00	LNH0063M	63	500	5,4	Hager
NH00	LNH0080M	80	500	6,5	Hager
NH00	LNH0100M	100	500	7,5	Hager
NH00	LNH0125M	125	500	10	Hager
NH00	LNH0160M	160	500	12	Hager
NH00	LNH0063MK	63	500	5,4	Hager
NH00	LNH0080MK	80	500	6,5	Hager
NH00	LNH0100MK	100	500	7,5	Hager
NH00	LNH0125MK	125	500	10	Hager
NH00	LNH0160MK	160	500	12	Hager
NH1	LNH1160M	160	500	14,6	Hager
NH1	LNH1200M	200	500	18	Hager
NH1	LNH1224M	224	500	19	Hager
NH1	LNH1250M	250	500	20	Hager
NH1	LNH1160MK	160	500	14,6	Hager
NH1	LNH1200MK	200	500	18	Hager
NH1	LNH1224MK	224	500	19	Hager
NH1	LNH1250MK	250	500	20	Hager
NH2	LNH2160M	160	500	15	Hager
NH2	LNH2200M	200	500	18,5	Hager
NH2	LNH2224M	224	500	19,2	Hager
NH2	LNH2250M	250	500	20,6	Hager
NH2	LNH2300M	300	500	24,2	Hager

NH2	LNH2315M	315	500	25	Hager
NH2	LNH2355M	355	500	31,5	Hager
NH2	LNH2400M	400	500	28,5	Hager
NH2	LNH2160MK	160	500	15	Hager
NH2	LNH2200MK	200	500	18,5	Hager
NH2	LNH2224MK	224	500	19,2	Hager
NH2	LNH2250MK	250	500	20,6	Hager
NH2	LNH2300MK	300	500	24,2	Hager
NH2	LNH2315MK	315	500	25	Hager
NH2	LNH2355MK	355	500	31,5	Hager
NH2	LNH2400MK	400	500	28,5	Hager
NH3	LNH3400M	400	500	34	Hager
NH3	LNH3425M	425	500	39	Hager
NH3	LNH3500M	500	500	43	Hager
NH3	LNH3630M	630	500	43,1	Hager
NH3	LNH3400MK	400	500	34	Hager
NH3	LNH3425MK	425	500	39	Hager
NH3	LNH3500MK	500	500	43	Hager
NH3	LNH3630MK	630	500	43,1	Hager
NH3*	N3035900	315	800	29	Jean Müller

Accessories

*included after product material change

Reference	Description
LVZ1230	Screws for fixation of fusegear devices
LVZ00DA185-185*	Double adapter for two vertical switchgear NH00
LVZ00AL185	Cover for terminal compartment, NH00/185mm
LVZAL	Cover for terminal compartment long, NH1-3/185mm
LVZAK1	Cover for terminal compartment short, NH1-3/185mm
LVZ00AL185	Terminal clamp, 95 mm^2, NH00/185mm
LVZ001A	Terminal clamp, 150 mm^2, NH00/185mm
LVZ1230	Terminal clamp, 240 mm^2, NH1-3
ZAY95075	Base filler, 25 l

Interface characteristics

In respect to IEC 61439-5

Characteristic	Standard Application	800 VAC Application
Voltage Ratings		
Rated voltage U_n	400 V	800 V
Rated operational voltage U_e	400 V	800 V
Rated insulation voltage U_i	1,000 V	1,000 V
Rated impulse withstand voltage U_{imp}	up to 12 kV (consider the values of the devices)	up to 8 kV
Current Ratings		
Rated current of the assembly I_{nA}	up to 653 A (standard) / 680 A (custom setup) ➔ see verification of temperature rise	288 A
Rated current of a circuit I_{nc}		
Rated peak withstand current I_{pk}	52,5 kA	52,5 kA
Rated short-time withstand current I_{cw}	25 kA / 1 s	25 kA / 1 s
Rated conditional short-circuit current of an ASSEMBLY I_{cc}	60 kA	30 kA
Rated diversity factor RDF	none	none
Rated frequency f_n	50 Hz	50 Hz

Other characteristics

a) additional requirements depending on the specific service conditions of a functional unit (e.g. type of coordination, overload characteristics)
None

b) pollution degree (see 3.6.9)
III

c) types of system earthing for which the ASSEMBLY is designed
TN, TT

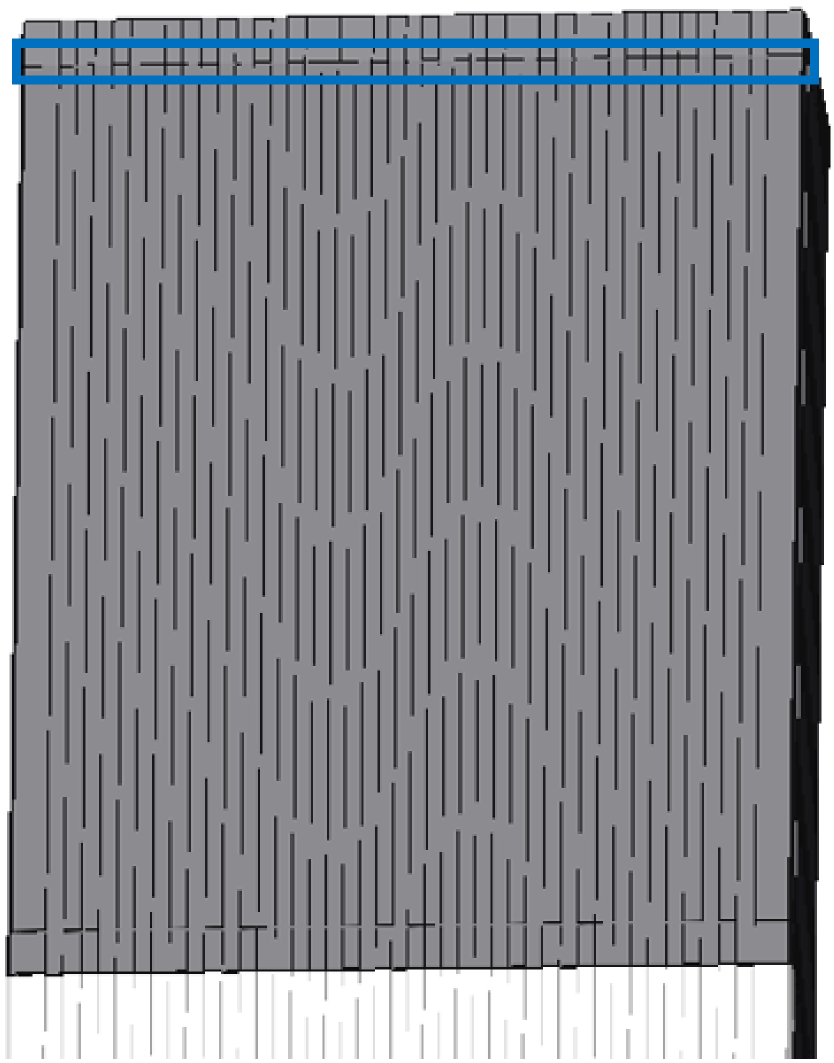
d) indoor and/or outdoor installation (see 3.5.1 and 3.5.2)
Outdoor installation

e) stationary or movable (see 3.5.3 and 3.5.4)
Stationary

f) degree of protection
see table & drawing

References	Degree of Protection	Exemption
ZAK084GA ZAK080GA ZAK081GA ZAK081VAA ZAK082GA ZAK082VAA	**IP44**	**None**
ZAK100GA ZAK101GA ZAK102GA	**IP44 / IP34D**	**IP34D in ventilation area between back wall and roof**

Ventilation area between back wall and roof → IP34D



g) intended for use by skilled or ordinary persons (see 3.7.12 and 3.7.14)
Skilled persons

h) electromagnetic compatibility (EMC) classification (see Annex J)

i) special service conditions, if applicable (see 7.2);
no special service conditions

j) external design (see 3.3)
enclosed assembly (IP44 for enclosures of height 845 mm/ IP44 for enclosures of height 1055 mm, except ventilation area between roof and back wall → IP34D, see f))

k) mechanical impact protection, if applicable (see 8.2.1)
IK10

l) the type of construction – fixed or removable parts (see 8.5.1 and 8.5.2.)
Fixed parts

m) the nature of short-circuit protective device(s) (see 9.3.2)
Vertical switchgear devices

n) measures for protection against electric shock
Protection class II

o) overall dimensions (including projections e.g. handles, covers, doors), if required
Not required

p) the weight, if required.
Not required

q) installation method
in-ground pedestal, on-ground pedestal, wall console (see overview)

r) Environmental temperature (see 7.1.1.2)
Minimum: -25 °C, maximum: 40 °C, maximum average over 24 h: 35 °C

s) Maximum humidity (se 7.1.2.2)
100 % at 25 °C

t) external conductor type
cable

u) direction of external conductors
from below

v) Material of external conductors
Copper/Aluminium

w) external phase conductor, cross sections and terminations
according to table AA.1 for assemblies up to 630 A, termination directly on fusegear devices with screws M12 (NH2/3), M8 (NH00) or directly on busbars with screws M12

x) external PEN conductor, cross sections and terminations
according to table 5, IEC 61439-1, termination directly on PEN busbar with screws M12

10.2 Strength of materials and parts

10.2.2 Resistance to corrosion

The ferrous metallic constructional parts of the listed assemblies were subjected to the damp heat cycling test of IEC 60028-2-30: Severity A – Temperature 55 °C, 6 cycles and variant 1. After the test, no inacceptable deteriorations were observed, in compliance with ISO 628-3:2016.

10.2.3 Properties of insulating materials

10.2.3.1 Thermal stability

The listed enclosures were tested in accordance with IEC 60068-2-2:2007, Test Bb, at a temperature of 70 °C, with natural air circulation, for a duration of 168 h and a recovery of 96 h. There appeared no cracks or other deteriorations on the housing surface.

10.2.3.2 Resistance of insulating materials to abnormal heat and fire due to internal electric effects

All insulating materials used in the listed references were subjected to the glow-wire test according to IEC 60695-2-10/-11. All requirements were fulfilled. The temperature of the glow-wire tip was

- 960 °C for parts necessary to retain current-carrying parts in position (housing material)
- 650 °C for all other parts, including parts necessary to retain the protective conductor and

10.2.3.101 Dry heat test

The listed references were heated according to the test specifications for a duration of 2-3 h at a temperature of (100 ± 2) °C and stored for 5 h at this level. No deteriorations occurred.

10.2.3.102 Verification of category of flammability

Representative specimens of each material of the housing, the internal covers and other insulating parts were tested in respect to their resistance against flammability in accordance with test method A – horizontal burning test – of IEC 60695-11-10:2013. All specimens fulfilled the criterion of flammability class HB40.

10.2.4 Resistance to ultraviolet (UV) radiation

Specimens of the housing material of the listed enclosures were UV tested in accordance with ISO 4892-2:2013, method A, cycle 1 for an overall duration of 500 h. The samples fulfilled the requirements and retained their values of flexural strength (ISO 178) and Charpy impact (ISO 179) for at least 70 %.

Test Criterion	Unit	Target	$\bar{x}$	s
Baseline				
Impact strength	KJ/m^2	--	32 C	10
Flexural modulus of elasticity	MPa	--	9080	468
Flexural strength	MPa	--	92	20
Elongation at flexural strength	%	--	1,7	0,3
Values after 500 h of weathering				
Impact strength	KJ/m^2	≥ 22	33 C	11
Flexural modulus of elasticity	MPa	≥ 6356	8790	159
Flexural strength	MPa	≥ 64	92	14
Elongation at flexural strength	%	≥ 1,2	1,8	0,4

10.2.5 Lifting
This clause is not applicable to the product range since there are no lifting devices for the enclosures.

10.2.101 Verification of mechanical strength
To verify the mechanical properties of the product range, the most critical assemblies were tested in order to cover all references. The following table contains the tested enclosures and the corresponding pedestals.

Test Specimens	
Enclosure	**Pedestal**
ZAK084GA	ZAX004
ZAK080GA	ZAX005
ZAK101GA	ZAX006
ZAL132	ZAX007

10.2.101.2 Verification of resistance to static load
The listed references were subjected to the described tests. An evenly distributed load of 8,500 N/m^2 were applied for a duration of 5 minutes to the roof of each enclosure. Afterwards, a force of 1,200 N was applied to the front and back upper edges of the respective enclosure roofs. The necessary minimum degree of protection, the electrical clearances and the function of the doors and closing mechanisms were not impaired by the stress.

10.2.101.3 Verification of resistance to shock load
After the execution of the sandbag test, the minimum degree of protection and electrical clearances were still satisfactory. The function of the doors and closing mechanisms were not impaired.

10.2.101.4 Verification of resistance to torsional strength
The enclosures were strained by a torsional force of 2 x 1,000 N for a duration of 30 s in both directions of rotation as shown in figures 106a and 106b of IEC 61439-5:2014. After the test, the doors remained closed, and the degree of protection remained unchanged.

10.2.101.5 Verification of impact force withstand
The verification was done in accordance with the requirements for switchgear and controlgear assemblies that are designed for operation at ambient temperatures between 40 °C and -25 °C, as described in clause 10.2.101.5.1. Thus, steel ball tests with an impact energy of 20 J were executed as described in this section of the standard, once after storage at room temperature and once after storage at a temperature of -25°C. After the tests, the degree of protection, the electrical clearances, and the functions of the doors and closing mechanisms remained as designed.

10.2.101.6 Verification of mechanical strength of doors
The doors of the assemblies were strained with a force of 50 N for a period of 3 s. No deteriorations were observed. The repetition with a force of 450 N is not necessary since the doors can be removed without tools.

10.2.101.7 Verification of resistance to axial load of metal inserts in synthetic material
No threaded metal inserts are used in this product range, so this part of the standard is not applicable.

10.2.101.8 Verification of resistance to mechanical shock impacts induced by sharp-edged objects
The listed test specimens were subjected to a mechanical shock impact test using a sharp-edged striker element and applying an impact energy of 20 J. Thereafter, there were no cracks in the enclosure walls or inacceptable material penetrations.

10.2.101.9 Test of mechanical strength of a base intended to be embedded in them ground
The test was conducted according to the standard specifications. After the strain, the pedestal was undamaged and the degree of protection unchanged.

10.2.7 Marking
The wipe test was done in sequence with water and a solvent, and the marking was still legible afterwards.

10.3 Degree of protection
The listed enclosures were inspected in accordance with IEC 60529:1989, IEC 60529:1989/AMD1:1999, and IEC 605291989/AMD2:2013. The value IPX4 is fulfilled by all assemblies since no water can enter the protected area inside the cabinet. The value IP4X is also fulfilled, except for the aeration area of the 1005 mm high enclosures where there is a reduction to IP3XD between roof and back wall (for further details, see page 17). Thus, the standard requirements are fulfilled.

10.4 Clearances and creepage distances
The clearances and creepage distances are in accordance with the requirements (electrical clearances ≥ 14 mm, creepage distances ≥ 16 mm).

10.5 Protection against electric shock and integrity of protective circuits
10.5.2 Effective earth continuity between the exposed-conductive-parts of the class I assembly and the protective circuit
This test is not applicable to this product range.

10.5.3 Short-circuit withstand strength of the protective circuit
The short-circuit tests were performed and the results can be seen on page XX ff., clause 10.11.

10.6 Incorporation of switching devices and components
These enclosures are designed to incorporate vertical NH switchgear devices. Those must be tested in accordance with their respective product standard.

10.7 Internal electrical circuits and connections
The products are designed to fulfill the requirements of section 8.6 of IEC 61439-1:2020.

10.8 Terminals for external conductors
The external conductors are terminated connected directly to the busbar system, either by using cable lugs and M12 screws or by using V clamps for both aluminium and copper conductors. Further details are listed in annex A of IEC 61439-1:2020.

10.9 Dielectric properties
10.9.2 Power-frequency withstand voltage
All test specimens were subjected to the test voltage of 2,200 V (from table 8, IEC 61439-1:2020, Ui ≤ 1.000 V) for a duration of 60 s

a) between all live parts of the main circuit connected (including the auxiliary circuits connected to the main circuit) and exposed-conductive-parts, with the main contacts of all switching devices in the closed position or bridged by a suitable low

resistance link.
b) between each live part of different potential of the main circuit and, the other live parts of different potential and exposed-conductive-parts connected, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link.

During the test, there was no detectable current flow and no disruptive discharge.

10.9.3 Impulse withstand voltage
All specimens were subjected to a test voltage of 14.5 kV (400 VAC application) / 9.6 kV (800 VAC application) (from table 10, IEC 61439-1:2020, U_{imp} = 12 kV (400 VAC application) / U_{imp} = 8 kV (800 VAC application))

a) between all the live parts of different potential of the main circuit connected together (including the auxiliary circuits connected to the main circuit) and exposed-conductive parts, with the main contacts of all switching devices in the closed position or bridged by a suitable low-resistance link.

b) between each live part of different potential of the main circuit and the other live parts of different potential and exposed-conductive-parts connected, with the main contacts of all switching devices in the closed position or bridged by a suitable low resistance link.

10.9.4 Testing of enclosures made of insulating material
An insulation test was performed where an AC test voltage of 1.5 times of the above-mentioned value (3,300 V) was applied between a metal foil laid on outer surface of the enclosure over openings and joints, and the interconnected live and exposure-conductive parts within the assembly located next to the openings and joints.

During the test, there was no current and no disruptive discharge.

10.9.5 External door or cover mounted operating handles of insulating material
In analogy, an insulation test was performed for the door handles of the enclosures where the voltage was applied between the active parts and a metal foil completely enfolding the housing.

During the test, there was no current and no disruptive discharge.

10.10 Verification of temperature rise
The verification was performed by test as specified in 10.10.2 of IEC 61439-1:2020. The tested configurations were chosen in accordance with clause 10.10.2.2 as the most critical. The test was performed in accordance with 10.10.2.3.5 on the complete assembly.

Built-in Switching Devices and Components

- Fuse Rails

* devices tested also for 800 VAC application

Type	Reference	I_n / A	Manufacturer
NH3	LVTG1000TP	1000	Hager
NH3	LVSG3CPX	630	Hager
NH3*	LVSG3CPZ	630	Hager
NH2	LVSG2CPX	400	Hager
NH2	LVSR2VPVK4	400	Hager
NH2	L203100103	400	Jean Müller
NH2	9-E-EH241AAG	400	Pronutec
NH2	38864-0020	400	EFEN
NH2	38865-0200	400	EFEN
NH00*	LVSG00SPX	160	Hager

- Fuses

* fuses for 800 VAC application

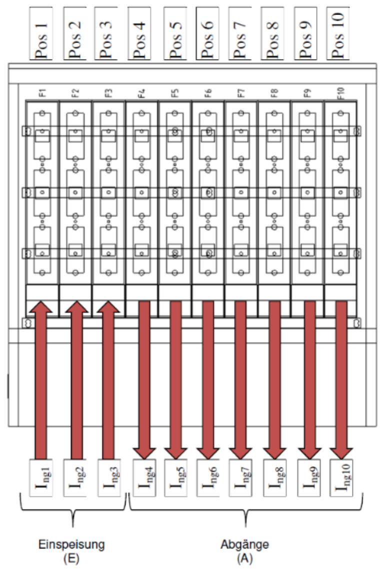
Type	Reference	I_n / A	U_n / V	P_V / W	Manufacturer
NH3*	N3035900	315	800	29	Jean Müller
NH3	LNH3500M	500	500	43	Hager
NH3	LNH3400M	400	500	34	Hager
NH2	LNH2400M	400	500	28.5	Hager
NH2	LNH2315M	315	500	25	Hager
NH2	LNH2160M	160	500	15	Hager
NH00	LNH0080M	80	500	6.5	Hager
NH00*	N5033814	63	800	7	Jean Müller

The given energy dissipation P_V refers to the nominal current I_n.

Tested enclosures

* also tested for 800 VAC application

Size	Height	Width	Depth	Reference	Busbars	Manufacturer	Type of reference
2	1005	1110	315	ZAK102-S	60 x 10	Hager	Sonderanfertigung
2	845	1110	315	ZAK082-S	40 x 10	Hager	Sonderanfertigung
2	845	1110	315	ZAK082GA	30 x 8	Hager	Standard-Produkt
1	1005	780	315	ZAK101-S	40 x 10	Hager	Sonderanfertigung
1	845	780	315	ZAK081-S	30 x 10	Hager	Sonderanfertigung
0	1005	585	315	ZAK100-S	30 x 10	Hager	Sonderanfertigung
0	845	585	315	ZAK080GA	30 x 6	Hager	Standard-Produkt
00*	845	480	315	ZAK084GA	30 x 6	Hager	Standard-Produkt



The ingoing current was evenly distributed over the supplying fuse rails:

$$I_{nA} = \sum_{i=1}^{m} I_{ngi}, \forall\, m = 1 \ldots 3$$

The maximum current rating is therefore the sum of all ingoing currents. The currents must be distributed evenly.

All results are in relation to an average ambient temperature of 35 °C over a period of 24 hours.

400 VAC Application

I_{nA} / A	Supply		Busbar cross section	Minimum Enclosure		Outgoing			Comments
	Fuse rail	Fuse gG / A		Size	Height / mm	Fuse rail	Fuse gG / A	I_{ng} / A	
1110	4 x NH3	500	60 x 10	Gr. 2	1005	5 x NH2	315	252	Coupling unit NH3 open, 2 x NH3 as supply for each circuit (separate busbar system with max. I_{nA} = 625 A)
825	3 x NH3	400				3 x NH2	315	296	
734	2 x NH3	500				3 x NH2	315	295	
681	3 x NH2	315	40 x 10		845	5 x NH2	160	152	
653	3 x NH2	315	30 x 8			5 x NH2	160	152	
621	3 x NH2	315				5 x NH2	160	145	Comparison test with fuse rails by Jean Müller
610	2 x NH3	500	60 x 10		1005	3 x NH2	315	278	Coupling unit NH3 closed
564	2 x NH3	400	40 x 10	Gr. 1	1005	2 x NH2	315	296	
514	2 x NH2	315	30 x 10		845	4 x NH2	160	149	
434	2 x NH2	315	30 x 6	Gr. 0	845	3 x NH2	160	152	
399	1 x NH3	500	30 x 10		1005	2 x NH2	315	294	
303	1 x NH2	400	30 x 6	Gr. 00	845	2 x NH2	160	151	
298	1 x NH2	315				2 x NH2	160	149	
288	1 x NH2	315				2 x NH00	80	72	Two different positionings of the NH00 fuse rails were tested with similar results
						1 x NH2	160	143	
276	1 x NH2	315				2 x NH2	160	138	Comparison test with fuse rails by Jean Müller
274	1 x NH2	315				2 x NH2	160	138	Comparison test with fuse rails by Pronutec

Fuse factor $f = I_{ng} / I_N$.

On using the table above:

Depending on the needed nominal current, one must choose at least the shown ingoing set-up with the corresponding fuses. Furthermore, one must mind the minimal enclosure size that is necessary to dissipate the temperature rise inside the enclosure.

The given maximum current I_{nA} can always be handled with an enclosure that is larger in volume. A bigger cross-section of the busbars is also possible (custom solutions can be delivered if requested).

Concerning the outgoing side, one must make sure to be compliant with the given current I_{ng} for the fuse rails. Should it be necessary to choose a smaller fuse, the maximum current I_{ng} must be reduced by using the fuse factor f.

Example:

InA / A	Supply		Busbar cross section	Minimum Enclosure		Outgoing		
	Fuse rail	Fuse gG / A		Size	Height / mm	Fuse rail	Fuse gG / A	Ing / A
434	2x NH2	315	30x6	Gr. 0	1005	NH2	160	**152**

If a current of 434 A shall be distributed in a cable distribution cabinet, the supply must consist of a minimum of 2 x NH2 fuse rails with fuses of 315 A each.

To distribute this incoming current, a busbar system with a cross section of at least 30 x 6 mm^2 is needed. Thus, a compatible enclosure would be a standard cable distribution cabinet of size 0 in accordance with the German measurements standard DIN 43629-1 with a height of 1005 mm. Also, every cabinet with a higher volume can be used to distribute this current (e.g. size 0 / height: 1355 mm or size 1 / height: 1005 mm).

For the outgoing, NH2 fuse rails can be used. With fuses of 160 A, they can distribute a maximum of 152 A in this assembly configuration. Using three NH2 fuse rails to distribute the incoming current, two rails can distribute 152 A while the remaining one will still distribute 134 A. Every other load configuration of the outgoing fuse rails is also possible as long as no rail distributes more than the maximum I_{ng} shown in the table.

If a smaller fuse size is used, the fuse factor f = Ing/IN = 152 A / 160 A = 0,95 must be applied. If, for example, it is chosen to use fuses of 125 A, the I_{ng} must be reduced accordingly:

I_{ng125} = 0,95 x 125 A = 118,75 A.

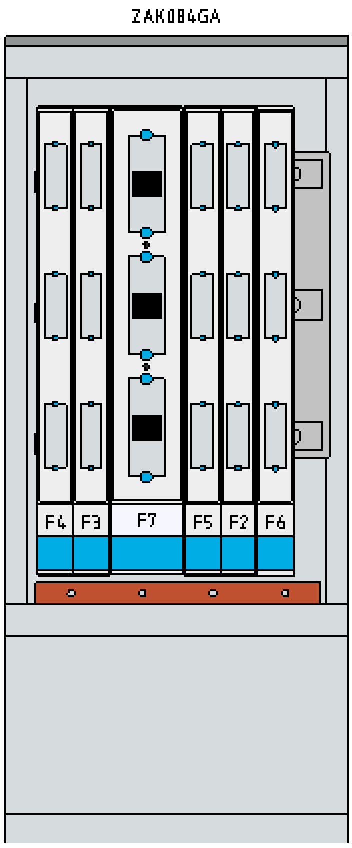
This means that no outgoing fuse rail can distribute more than 118,75 A without causing a prohibited temperature-rise inside the assembly.

800 VAC Application

I_{nA} / A	Supply		Busbar cross section	Minimum Enclosure		Outgoing			Comments
	Fuse rail	Fuse gG / A		Size	Height / mm	Fuse rail	Fuse gG / A	I_{ng} / A	
288	5 x NH00	63	30 x 6	Gr. 00	845	1 x NH3	315	288	I_{ng} reduced to 277 A if NH3 rail positioned on the edge of the busbar system.

Remark: To reach an I_{ng} = 288 A, the outgoing device must be positioned in the middle of the busbar system. A placement at the edge of the busbar system will only allow an I_{ng} = 277 A (see picture below).

Explanation: With the smallest available enclosure ZAK084GA (size 00, height: 845 mm) a nominal current of 288 A can be distributed via an outgoing device NH3 with a 315 A fuse and at least 5 x NH00 devices that are evenly loaded with 288A / 5 = 57,6 A. The current can also be distributed via more devices and a bigger enclosure can always be used.



10.11 Verification of Short-Circuit Withstand

The test was performed as described in IEC 61439-1:2020, clause 10.11.5. The test specimens represent the most critical enclosures in the most critical configuration in accordance with table 13.

Table 13 – Short-circuit verification by comparison with a reference design: check list (10.5.3.3, 10.11.3 and 10.11.4)

Item No.	Requirements to be considered	YES	NO
1	Is the short-circuit withstand rating of each circuit of the ASSEMBLY to be assessed, less than or equal to, that of the reference design?	x	
2	Is the cross-sectional dimensions of the busbars and connections of each circuit of the ASSEMBLY to be assessed, greater than or equal to, those of the reference design?	x	
3	Is the center line spacing of the busbars and connections of each circuit of the ASSEMBLY to be assessed, greater than or equal to, those of the reference design?	x	
4	Are the busbar supports of each circuit of the ASSEMBLY to be assessed of the same type, shape and material and have, the same or smaller center line spacing, along the length of the busbar as the reference design? And is the mounting structure for the busbar supports of the same design and mechanical strength?	x	
5	Are the material and the material properties of the conductors of each circuit of the ASSEMBLY to be assessed the same as those of the reference design?	x	
6	Are the short-circuit protective devices of each circuit of the ASSEMBLY to be assessed equivalent, that is of the same make and series* with the same or better limitation characteristics (I2t, Ipk) based on the device manufacturer's data, and with the same arrangement as the reference design?**	x	
7	Is the length of unprotected live conductors, in accordance with 8.6.4, of each non-protected circuit of the ASSEMBLY to be assessed less than or equal to those of the reference design?	x	
8	If the ASSEMBLY to be assessed includes an enclosure, did the reference design include an enclosure when verified by test?	x	
9	Is the enclosure of the ASSEMBLY to be assessed of the same design, type and have at least the same dimensions to that of the reference design?	x	
10	Are the compartments of each circuit of the ASSEMBLY to be assessed of the same mechanical design and at least the same dimensions as those of the reference design?	x	

*Short-circuit protective devices of the same manufacturer but of a different series may be considered equivalent where the device manufacturer declares the performance characteristics to be the same or better in all relevant respects to the series used for verification, e.g. breaking capacity and limitation characteristics (I2t, Ipk), and critical distances.

**The short-circuit protective devices and fuses of size NH3 of each circuit of the ASSEMBLY to be assessed represent the worst characteristics (I2t, Ipk) based on the device manufacturer's data, compared to the same arrangement of NH2, NH1 and NH00 devices and fuses.

Rated values

Short-circuit values	400 VAC Application	800 VAC Application
Rated peak withstand current I_{pk}	52,5 kA	
Rated short-time withstand current I_{cw}	25 kA / 1 s	
Rated conditional short-circuit current of an ASSEMBLY I_{cc}	60 kA	30 kA

400 VAC short-circuit tests performed on all enclosure types of the smallest height:

Tested enclosures

Specimen	Size	Height	Width	Depth	Reference	Busbars	Manufacturer
1	00	845	480	315	ZAK084GA	30 x 6	Hager
2	0	845	585	315	ZAK080GA	30 x 6	Hager
3	1	845	780	315	ZAK081GA	30 x 6	Hager
4	2	845	1110	315	ZAK082GA	30 x 8	Hager

Built-in Switching Devices and Components

- Fuse rails

Type	Reference	I_n	Manufacturer
NH3	38036-0000	630 A	EFEN

- Fuses

Type	Reference	I_n	U_n	P_V	Manufacturer
NH3	LNH3630MK	630 A	500 V	43,1 W	Hager

Overview of the test results

Specimen		Verified conditional short-circuit current I_{CC}	Verified peak withstand current I_{pk}	Verified short-time withstand current I_{cw}
1	3-pole	60,7 kA	-	-
	3-pole	-	53,0 kA	25,0 kA (1010 ms)
	1-pole	-	32,1 kA	15,4 kA (1014 ms)
2	3-pole	60,7 kA	-	-
	3-pole	-	52,8 kA	25,0 kA (1003 ms)
	1-pole	-	32,0 kA	15,4 kA (1004 ms)
3	3-pole	60,7 kA	-	-
	3-pole	-	61,9 kA	25,2 kA (1000 ms)
	1-pole	-	32,7 kA	15,5 kA (1010 ms)
4	3-pole	60,7 kA	-	-
	3-pole	-	52,6 kA	25,0 kA (1000 ms)
	1-pole	-	31,9 kA	15,4 kA (1014 ms)

800 VAC tests performed on most critical assemblies in accordance with Table 13:

Tested enclosures

Specimen	Size	Height	Width	Depth	Reference	Busbars	Manufacturer
1	00	845	480	315	ZAK084GA	30 x 6	Hager
2	1	845	780	315	ZAK081GA	30 x 6	Hager

ZAK084GA (smallest enclosure with smallest busbar cross section),
ZAK081GA (largest distance between busbar supports)

Built-in Switching Devices and Components

- Fuse rails

Type	Reference	I_n	Manufacturer
NH3	LVSG3CPZ	630 A	Hager
NH00	LVSG00SPX	160 A	Hager

- Fuses

Type	Reference	I_n	U_n	P_V	Manufacturer
NH3	N3035900	315 A	800 V	29 W	Jean Müller
NH00	N5033814	63 A	800 V	7 W	Jean Müller

Overview of the test results

Specimen			Verified conditional short-circuit current I_{CC}
1	NH3	3-pole	30,9 kA
		PEN	18,9 kA
	NH00	3-pole	30,9 kA
		PEN	18,9 kA
2	NH3	3-pole	30,9 kA
		PEN	18,9 kA
	NH00	3-pole	30,9 kA
		PEN	18,9 kA

10.12 Elektromagnetische Verträglichkeit (EMV)

The assemblies are designed in accordance with IEC 61439-1:2020, Annex J.9.4.2, and fulfill the following conditions:

a) the incorporated devices and components are in compliance with the requirements for EMC for the stated environment (see J.9.4.1) as required by the relevant product or generic EMC standard.
b) the internal installation and wiring is carried out in accordance with the devices and components' manufacturer’s instructions (arrangement with regard to mutual influences, cable, screening, earthing, etc.).

A dedicated verification as described in J.10.12 is not necessary. The documentation of the devices’ manufacturers must be considered.

10.13 Mechanical operation

After 200 mechanical cycles of the closing mechanism and the door, the protection degree of the enclosure was not affected. The force necessary for using the door did not change after the test.