



	Page
Distribution and instrument cabinets / current carrying capacity	15-02
Distribution and instrument cabinets / condensation	15-03
Distribution and instrument cabinets / UV protection	15-04
IP types of protection / definition	15-05
Utilization categories / fuse combination units	15-06
Temperature-rise limits / fuse combination units	15-07
Low voltage assemblies / TTA/PTTA verification	15-08
Low voltage assemblies / compartmentalization	15-09
Current carrying capacity / aluminium busbars	15-10
Current carrying capacity / copper busbars	15-11
Current carrying capacity / correction factor for busbar/air temperatures	15-12
Transformers / nominal and short-circuit currents	15-13
North American conductor cross-sections / conversion	15-14
Transformers / terminal studs	15-14
General Conditions of Supply and Delivery for Products and Services of the electrical and electronics industry	15-15
Contact Addresses	15-20

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector fuses (SASIL) BS system

Switch-disconnector-fuses (SASIT) DIN and BS systems

Switch-disconnector (SALIT)

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

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Current transformers

Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

Distribution and instrument cabinets

Current carrying capacity of distribution and instrument cabinets for outdoor use

Determination of the nominal power dissipation P_V and the rated current I_e of standard cable distribution cabinets, "KVS/222" and "KVS/10" series,	equipped with LV HRC strip-fuseways, types L and SL. Temperature-rise tests were conducted at the standard cable distribu-	tion cabinet of the "10" series, size 0, type KVS0-10/SV/5L2, equipped with 5 size 2 (400A) LV HRC strip-fuseways in accordance with VDE 0660 Part 503.	The load current I_B was set to the limit current of the LV HRC fuse-links. Temperatures were measured at the following locations:
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Test values:

I_e	Rated current	315 A
T1	Surface of the central top LV HRC fuse-links	120 °C
T2	Internal temperature of cabinet below top	75 °C
T3	Max. connection temperature of the central strips	60 °C
T4	Exhaust air temperature at cabinet	70 °C
T5	Surface temperature, top, external	46 °C
T6	Surface temperature, door, external	36 °C
Room temperature		25 °C

1. Nominal power dissipation P_V of KVS0-10: 550 W.

2. Rated current I_e of KVS0-10: 315A.

Nominal power dissipation values P_V for maximally equipped standard

cable distribution cabinets of all sizes:

KVS-222 size ^{*)}	Surface m ²	Nominal power dissipation P_V (W)
KVS 00/222	1.26	400
KVS 0/222	1.46	470
KVS 1/222	2.01	650

^{*)} DIN 43629 / T.4

KVS-10 size ^{**)}	Surface m ²	Nominal power dissipation P_V (W)
KVS 00-10	1.50	490
KVS 0-10	1.75	550
KVS 1-10	2.15	700
KVS 2-10	2.82	900
NKVS 3-850	3.49	1110

^{**)} DIN 43629, Parts 1 and 2

Evaluation:	JEAN MÜLLER standard cable distribution cabinets is determined by the continuous loading	capability of the LV HRC fuses, not by overheating. If the individual power dissipation values of the	built-in devices are known, the rated currents I_e can be calculated.
The nominal power dissipation P_V of equipped			

Distribution and instrument cabinets

Avoiding condensation in distribution and instrument cabinets

Due to the outdoor atmospheric conditions, condensed water develops in cable and distribution cabinets and precipitates at the inner surfaces. This humidity may lead to the corrosion of the metal parts and to the formation of creepage currents.

Measures for avoiding excessive condensation:

1. Ventilation of the cabinet through existing ventilation slots in accordance with IP44

The existing ventilation slots in the lower part of the door and the rear panel and in the upper area between the top plate and door or rear panel are capable of dehumidifying the cabinet interior with the support of the heat produced by the power dissipation of fuse elements under the condition that the size of the ventilation slots is proportional to the width of the cabinet. This condition is fulfilled by the design of JEAN MÜLLER

distribution and instrument cabinets, whose ventilation slots are located at the lower and upper sides of the door and rear panel.

2. Protection against ground moisture

An effective dehumidification of the cabinet interior can only be achieved if the latter is

protected against rising ground moisture. Such a protection can be implemented by filling in fine-grained sand up to the ground surface level.

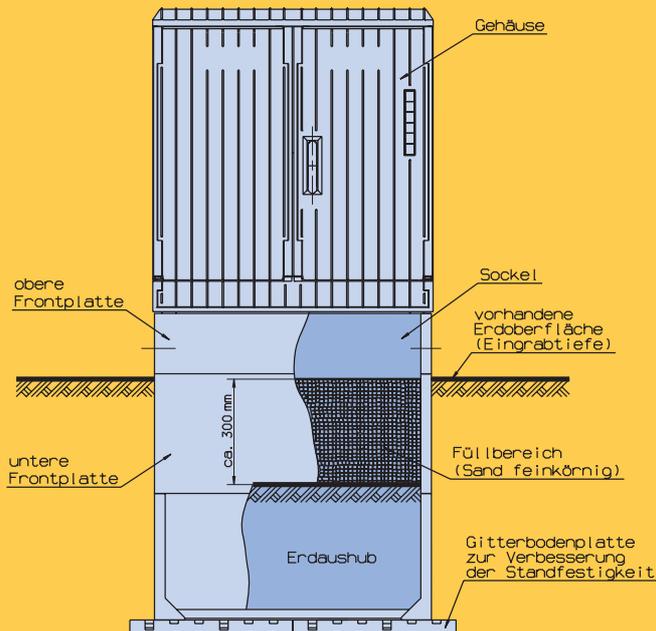
Application:

The foundation is filled with excavated soil up to a height of approx. 300 mm below the ground surface level.

A layer of sand of approx. 300 mm height is filled above this. This sand layer effectively prevents the rising of moisture, as has been proven many times in practice.

Filling cross-section of the base:

- see illustration -



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Current transformers

Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

Distribution and instrument cabinets

UV protection of cabinets made of glass-fibre-reinforced polyester

Depending on the site and climatic zone, the surface of a distribution and instrument cabinet is more or less damaged by UV radiation. Such damage takes the form of surface erosion. This particularly affects surfaces facing the sun. The reduction in material thickness involved is very low (50 µm in 20 years), so that the mechanical properties of the case are not impaired.

After a number of years, the glass fibres immediately below the surface will be exposed. Skin contact may thus produce irritations. In addition, the increased roughness will accelerate the development of moss.

Effective protection against UV radiation and thus surface erosion is provided by coating with UV varnish.

1. Surface coating is to ensure the following:

- a) Prevention of surface erosion of the cabinet as a consequence of UV radiation.
- b) UV protection as sub a) with an additional

anti-adhesive for spray varnishes (graffiti).

- c) UV protection as sub a) with an additional anti-adhesive for posters.

2. Potential measures for new cabinets:

- a) Surface coating with a two-component acrylic resin:
This surface coating effectively prevents the yellowing and subsequent erosion of the glass-fibre-reinforced polyester resin. Depending on the site, surfaces with a poly-acrylic coating are protected against UV radiation for a period of 15 to 20 years. After that period, the cabinet may be revarnished if a loss of brilliance has occurred.

- b) Surface coating with a two-component acrylic resin which comprises an additional anti-adhesive for spray varnishes (anti-graffiti coating).
This provides the same UV protection as sub a) but with an option to

remove spray varnishes with a cleaning paste.

- c) Surface coating with a two-component acrylic resin which comprises an anti-adhesive for posters (anti-poster coating).

3. Potential measures for secondary treatment:

- a) Coating with a single-component acrylic resin. This provides effective protection against UV radiation, but has to be repeated after a short period of time (8 - 10 years) because of the low durability of the varnish.
- b) Coating with a two-component acrylic resin.
This provides the same protection as sub 2a).
- c) Surface coating with a two-component acrylic resin which comprises an anti-adhesive for spray varnishes (anti-graffiti coating).
This provides the same protection as sub 2b).

- d) Surface coating with a two-component acrylic resin which comprises an anti-adhesive for posters (anti-poster coating).
This provides the same protection as sub 2c).

4. Required surface preparation for secondary treatment:

Degreasing by washing with a detergent dissolved in water. Subsequently, removal of dirt and loose material particles with a cleaning brush or fleece. To ensure good adhesive properties of the surface coating, the varnish must be pigmented (coloured), generally light grey (RAL7035), as the polyester used. Transparent varnishes are not capable of filtering UV radiation. The surface below the varnish will thus erode, which will deteriorate the adhesive properties.

IP types of protection

IP types of protection given to electrical equipment by cases and covers, in accordance with IEC/EN 60529 (extract)

1st numeral		2nd numeral
Protection against contact	Protection against foreign bodies	Protection against water
IP00 No special protection	No special protection	No special protection
IP20 With fingers	Solid particles, $\varnothing > 12\text{mm}$	No special protection
IP41 With tools etc.	Solid particles, $\varnothing > 1\text{mm}$	No harmful effect from water dripping vertically
IP43 With tools etc.	Solid particles, $\varnothing > 1\text{mm}$	No harmful effect from spray water (any direction up to 60° from the vertical)
IP54 Complete protection	Harmful dust deposits in interior	No harmful effect from splashing water (any direction)
IP55 Complete protection	Harmful dust deposits in interior	No harmful effect from hosed water
IP65 Complete protection	Dust protection (dust-proof)	No harmful effect from hosed water
IP66 Complete protection	Dust protection (dust-proof)	No harmful effect from temporary flooding
IP67 Complete protection	Dust protection (dust-proof)	No harmful effect from temporary immersion
IP68 Complete protection	Dust protection (dust-proof)	No harmful effect from permanent immersion
IP69 K Complete protection	Dust protection (dust-proof)	No harmful effect from water directed against the case under very high pressure and from any direction (high pressure / steam jet hoses, 80 – 100 bar)

Protection against electric shock in accordance with IEC 60536 and VDE 0106 Part 100

IEC 60536 covers the erection of electrical equipment and its arrangement in electrical systems with rated voltages of up to 1000 VAC ~ and 1500 VDC, with regard to protection against direct contact where actuators such as push-buttons and toggle switches are located in the vicinity of live	parts. “Finger-proofing” relates only to the actuator, and only to the normal direction of operation. A clearance of at least 30 mm radius must be ensured from the centre point of the actuator to any live parts. Type of protection IP20 is superior to “finger-proofing” in that it embodies	protection against contact with electrical equipment in any direction. Devices which are “finger-proof” and are protected to IP00 can be provided with further protection against contact in the form of covering if required.
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Switch-disconnector-fuses (SASIL) LV HRC system

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Switch-disconnector-fuses (SASIT) DIN and BS systems

Switch-disconnector (SALIT)

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

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Current transformers

Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

Utilization categories

Utilization categories for fuse combination units in accordance with IEC/EN 60 947-3 and VDE 0660 Part 107

AC

Utilization category	Typical applications	Verification of electrical endurance						Verification of making and breaking capacities							
		Make				Break		Make				Break			
		I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	$\cos\varphi$	$\frac{I_c}{I_e}$	$\frac{U_r}{U_e}$	$\cos\varphi$	I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	$\cos\varphi$	$\frac{I_c}{I_e}$	$\frac{U_r}{U_e}$	$\cos\varphi$
AC-20A(B) ¹⁾	Connecting and disconnecting under no-load conditions	³⁾	²⁾	²⁾	²⁾	²⁾	²⁾	²⁾	³⁾	²⁾	1.05	²⁾	²⁾	1.05	²⁾
AC-21A(B) ¹⁾	Switching of resistive loads, including slight overloads	³⁾	1	1	0.95	1	1	0.95	³⁾	1.5	1.05	0.95	1,5	1.05	0.95
AC-22A(B) ¹⁾	Switching of mixed resistive and inductive loads, including slight overloads	³⁾	1	1	0.8	1	1	0.8	³⁾	3	1.05	0.65	3	1.05	0.65
AC-23A(B) ¹⁾	Switching of motor loads and other highly inductive loads	³⁾	1	1	0.65	1	1	0.65	⁴⁾	10	1.05	0.45	8	1.05	0.45
									⁵⁾	10	1.05	0.35	8	1.05	0.35

DC

Utilization category	Typical applications	Verification of electrical endurance						Verification of making and breaking capacities							
		Make				Break		Make				Break			
		I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	L/R ms	$\frac{I_c}{I_e}$	$\frac{U_r}{U_e}$	L/R ms	I_e A	$\frac{I}{I_e}$	$\frac{U}{U_e}$	L/R ms	$\frac{I_c}{I_e}$	$\frac{U_r}{U_e}$	L/R ms
DC-20A(B) ¹⁾	Connecting and disconnecting under no-load conditions	³⁾	²⁾	²⁾	²⁾	²⁾	²⁾	²⁾	³⁾	²⁾	1.05	²⁾	²⁾	1.05	²⁾
DC-21A(B) ¹⁾	Switching of resistive loads, including slight overloads	³⁾	1	1	1	1	1	1	³⁾	1.5	1.05	1	1,5	1.05	1
DC-22A(B) ¹⁾	Switching of mixed resistive and inductive loads, including overloads (e.g. shunt motors)	³⁾	1	1	2	1	1	2	³⁾	4	1.05	2.5	4	1.05	2.5
DC-23A(B) ¹⁾	Switching of highly inductive loads (e.g. series motors)	³⁾	1	1	0.75	1	1	7.5	³⁾	4	1.05	15	4	1.05	15

I = Making current
 I_c = Breaking current
 I_e = Rated operational current
 U = Voltage
 U_e = Rated operational voltage

¹⁾ A: frequent actuation, B: occasional actuation.

²⁾ If the switching device has a making and/or breaking capacity, the values for the current and the power factor (time constants) must be stated by the manufacturer.

³⁾ All values

⁴⁾ $I_e \leq 100$ A

⁵⁾ $I_e > 100$ A

Temperature-rise limits

Temperature-rise limits of fuse combination units in accordance with IEC/EN 60 947-1 and VDE 0660 Part 100

a) Temperature-rise limits of connections

Connection material	Temperature-rise limit in K
Copper, blank	60
Copper-zinc alloy, blank	65
Copper or copper-zinc alloy, tin-plated	65
Copper or copper-zinc alloy, silver-plated or tin-plated	70
Other metal parts	65

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector fuses (SASIL) BS system

b) Temperature-rise limits of accessible parts

Accessible part	Temperature-rise limit in K
Manually operated actuators:	
• Metallic	15
• Non-metallic	25
Parts which are touched but not gripped:	
• Metallic	30
• Non-metallic	40
Parts which need not be touched during normal actuation:	
Outside surface of cases, near the cable inlet	
• Metallic	40
• Non-metallic	50
Outside surface of cases which contain resistors	200
Air from ventilation apertures of cases which contain resistors	200

Switch-disconnector-fuses (SASIT) DIN and BS systems

Switch-disconnector (SALIT)

Terminals

LV HRC strip-fuseways

Temperature-rise limits of low voltage assemblies in accordance with IEC/EN 60 439-1 and VDE 0660 Part 500

Assembly components	Temperature-rise limit in K
Built-in equipment	In accordance with the relevant standards, if such standards exist, or in accordance with the manufacturer's specifications taking into account the internal temperature of the assembly.
• Conventional switchgear	
• Electronic modules	
• Equipment components	
Connections for insulated conductors introduced from the outside	70
• Busbars	Limiting factors: • Mechanical strength of the conductor materials • Potential influence on neighbouring equipment • Permissible temperature-rise limit of the insulating material touched by the conductor • Effects of the conductor temperature on connected devices • Type and surface of the contact material for plug-in contacts
• Conductors	
• Plug-in contacts of removable parts	
Actuators which are accessible from the outside	
• Metallic	15
• Insulating material	25
External surfaces of cases or covers which are accessible from the outside	
• Metallic	30
• Insulating material	40
External surfaces of cases or covers which are accessible from the outside but need not be touched during normal operation	
• Metallic	40
• Insulating material	50
Plug-in connections	Limiting factors are the values for the equipment of which they form part

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

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Current transformers

Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

Low voltage assemblies

TTA/PTTA verification

Verification and testing of type-tested and partially type-tested assemblies

Ser. no.	Requirement	TTA	PTTA
1	Temperature-rise limit	Verification of compliance by - (Type) testing	Verification of compliance by - (Type) testing - Extrapolation/calculation in accordance with VDE 0660 Part 507; 1997-11
2	Insulation properties	Verification by - (Type) testing	Verification by - Testing or - Verification of the insulation resistance
3	Short-circuit strength	Verification by - (Type) testing	Verification by - Testing or - Extrapolation of similar type-tested assemblies / calculation in accordance with VDE 0660 Part 509; 1993-09
4	Effectiveness of the protective-conductor circuit Correct connection between the assembly components and the protective-conductor circuit Short-circuit strength of the protective-conductor circuit	Verification of correct connection between the assembly components and the protective-conductor circuit by - Inspection or - Resistance measuring (type testing) Verification by - (Type) testing	Verification of correct connection between the assembly components and the protective-conductor circuit by - Inspection or - Resistance measuring Verification by - Testing or - Corresponding design and arrangement of the protective conductor
5	Clearances and creepage distances	Verification by - (Type) testing	Verification by - Testing
6	Mechanical function	Verification by - (Type) testing	Verification by - Testing
7	IP type of protection	Verification by - (Type) testing	Verification by - Testing
8	Wiring and electrical function	Verification by - Inspection of the assembly including the wiring and electrical function testing (if required) (routine testing)	Verification by - Inspection of the assembly including the wiring and electrical function testing (if required)
9	Insulation	Verification by - Insulation testing (routine testing)	Verification by - Insulation testing or - Verification of the insulation resistance
10	Protective measures	Verification by - Checking of the protective measures and the continuous protective-conductor circuits (routine testing)	Verification by - Checking of the protective measures
11	Insulation resistance		Verification of the insulation resistance if no insulation property test has been conducted (see ser. nos. 2 and 9)

Low voltage assemblies

Compartmentalization of assemblies in accordance with DIN/EN 60439-1:2000-08

<p>Modern low voltage assemblies must comply with operational safety and personnel protection requirements.</p> <p>The division of switchgear cabinets into separate function sections and their compartmentalization are prerequisites for:</p> <ul style="list-style-type: none"> - High availability 	<ul style="list-style-type: none"> - Exchangeability of the built-in switchgear under operational conditions, i.e. while the system is energized - Short downtimes for maintenance and testing. <p>A switchgear cabinet is divided into the following function sections:</p>	<ul style="list-style-type: none"> - Device compartment - Busbar compartment (main and field distributor busbar system) - Cable compartment <p>Type of protection IP2X or above is required to prevent the ingress of solid foreign bodies from a function unit into an adjacent unit. In addition,</p>	<p>type of protection IPXXB or above is required to prevent contact with live parts of an adjacent unit.</p> <p>The compartmentalization design and higher protection than described above must be agreed between the manufacturer and the user.</p>
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Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector fuses (SASIL) BS system

Switch-disconnector-fuses (SASIT) DIN and BS systems

Compartmentalization by covers or barriers

Design	Main characteristic	Connections	Image
Design 1	No compartmentalization		
Design 2a	Compartmentalization between the busbars and function units	External conductor connections not separated from the busbars	
Design 2b	Compartmentalization between the busbars and function units	External conductor connections separated from the busbars	
Design 3a	Compartmentalization between the busbars and function units and between the function units	External conductor connections not separated from the busbars	
Design 3b	Compartmentalization of the external conductor connections and function units, but no compartmentalization between the conductor connections	External conductor connections not separated from the busbars	
Design 4a	Compartmentalization between the busbars and function units and between the function units including the external conductor connections which are an integral part of the function units.	External conductor connections in the same compartment as the corresponding function unit	
Design 4b	Compartmentalization between the busbars and function units and between the function units including the external conductor connections which are an integral part of the function units.	External conductor connections not in the same compartment as the corresponding function units, but in a separate enclosed and protected section or compartment.	

Switch-disconnector (SALIT)

Terminals

LV HRC strip-fuseways

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Current transformers

Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

Current carrying capacity / aluminium busbars

Continuous currents in accordance with DIN 43 670 for rectangular E-Al busbars used in indoor systems at 35°C air temperature and 65°C busbar temperature

			Continuous current in A							
			AC up to 60 Hz				DC/AC up to 16 ² /3 Hz			
			Painted Number of busbars		Blank Number of busbars		Painted Number of busbars		Blank Number of busbars	
Width x thickness [mm]	Cross- section [mm ²]	Weight ¹⁾ [kg/m]	I	II	I	II	I	II	I	II
12 x 2	23.5	0.0633	97	160	84	142	97	160	84	142
15 x 2	29.5	0.0795	118	190	100	166	118	190	100	166
15 x 3	44.5	0.120	148	252	126	222	148	252	126	222
20 x 2	39.5	0.107	150	240	127	206	150	240	127	206
20 x 3	59.5	0.161	188	312	159	272	188	312	159	272
20 x 5	99.1	0.268	254	446	214	392	254	446	214	392
20 x 10	199	0.538	393	730	331	643	393	733	331	646
25 x 3	74.5	0.201	228	372	190	322	228	372	191	322
25 x 5	124	0.335	305	526	255	460	305	528	255	460
30 x 3	89.5	0.242	267	432	222	372	268	432	222	372
30 x 5	149	0.403	356	606	295	526	356	608	296	528
30 x 10	299	0.808	536	956	445	832	538	964	447	839
40 x 3	119	0.323	346	550	285	470	346	552	285	470
40 x 5	199	0.538	456	763	376	658	457	766	376	662
40 x 10	399	1.08	677	1180	557	1030	682	1200	561	1040
50 x 5	249	0.673	556	916	455	786	558	924	456	794
50 x 10	499	1.35	815	1400	667	1210	824	1440	674	1250
60 x 5	299	0.808	655	1070	533	910	658	1080	536	924
60 x 10	599	1.62	951	1610	774	1390	966	1680	787	1450
80 x 5	399	1.08	851	1360	688	1150	858	1390	694	1180
80 x 10	799	2.16	1220	2000	983	1720	1250	2150	1010	1840
100 x 5	499	1.35	1050	1650	846	1390	1060	1710	858	1450
100 x 10	999	2.70	1480	2390	1190	2050	1540	2630	1240	2250
100 x 15	1500	4.04	1800	2910	1450	2500	1930	3380	1560	2900
120 x 10	1200	3.24	1730	2750	1390	2360	1830	3090	1460	2650
120 x 15	1800	4.86	2090	3320	1680	2850	2280	3950	1830	3390
160 x 10	1600	4.32	2220	3470	1780	2960	2380	4010	1900	3420
160 x 15	2400	6.47	2670	4140	2130	3540	2960	5090	2370	4360
200 x 10	2000	5.40	2710	4180	2160	3560	2960	4940	2350	4210
200 x 15	3000	8.09	3230	4950	2580	4230	3660	6250	2920	5350

¹⁾ Weight calculated with a density of 2.7 kg/dm³

Current carrying capacity/copper busbars

Continuous currents in accordance with DIN 43 670 for rectangular E-Cu busbars used in indoor systems at 35°C air temperature and 65°C busbar temperature

Continuous current in A										
			AC up to 60 Hz				DC/AC up to 16 ^{2/3} Hz			
			Painted Number of busbars		Blank Number of busbars		Painted Number of busbars		Blank Number of busbars	
Width x thickness [mm]	Cross- section [mm ²]	Weight ²⁾ [kg/m]	I	II	I	II	I	II	I	II
12 x 2	23.5	0.209	123	202	108	182	123	202	108	182
15 x 2	29.5	0.262	148	240	128	212	148	240	128	212
15 x 3	44.5	0.396	187	316	162	282	187	316	162	282
20 x 2	39.5	0.351	189	302	162	264	189	302	162	266
20 x 3	59.5	0.529	237	394	204	348	237	394	204	348
20 x 5	99.1	0.882	319	560	274	500	320	562	274	502
20 x 10	199	1.77	497	924	427	825	499	932	428	832
25 x 3	74.5	0.663	287	470	245	412	287	470	245	414
25 x 5	124	1.11	384	662	327	586	384	664	327	590
30 x 3	89.5	0.796	337	544	285	476	337	546	286	478
30 x 5	149	1.33	447	760	379	672	448	766	380	676
30 x 10	299	2.66	676	1200	573	1060	683	1230	579	1080
40 x 3	119	1.06	435	692	366	600	436	696	367	604
40 x 5	199	1.77	573	952	482	836	576	966	484	878
40 x 10	399	3.55	850	1470	715	1290	865	1530	728	1350
50 x 5	249	2.22	697	1140	583	994	703	1170	588	1020
50 x 10	499	4.44	1020	1720	852	1510	1050	1830	875	1610
60 x 5	299	2.66	826	1330	688	1150	836	1370	696	1190
60 x 10	599	5.33	1180	1960	985	1720	1230	2130	1020	1870
80 x 5	399	3.55	1070	1680	885	1450	1090	1770	902	1530
80 x 10	799	7.11	1500	2410	1240	2110	1590	2730	1310	2380
100 x 5	499	4.44	1300	2010	1080	1730	1340	2160	1110	1810
100 x 10	999	8.89	1810	2850	1490	2480	1940	3310	1600	2890
120 x 10	1200	10.7	2110	3280	1740	2860	2300	3900	1890	3390
160 x 10	1600	14.2	2700	4130	2220	3590	3010	5060	2470	4400
200 x 10	2000	17.8	3290	4970	2690	4310	3720	6220	3040	5390

²⁾ Weight calculated with a density of 8.9kg/dm³

Switch-disconnector-fuses (SASIL) LV HRC system

Switch-disconnector-fuses (SASIL) BS system

Switch-disconnector-fuses (SASIT) DIN and BS systems

Switch-disconnector (SALIT)

Terminals

LV HRC strip-fuseways

LV HRC strip-type fuse switch-disconnectors

LV HRC fuse-bases

LV HRC fuse switch-disconnectors

C|O|S|M|O® - 60mm Busbar System

Current transformers

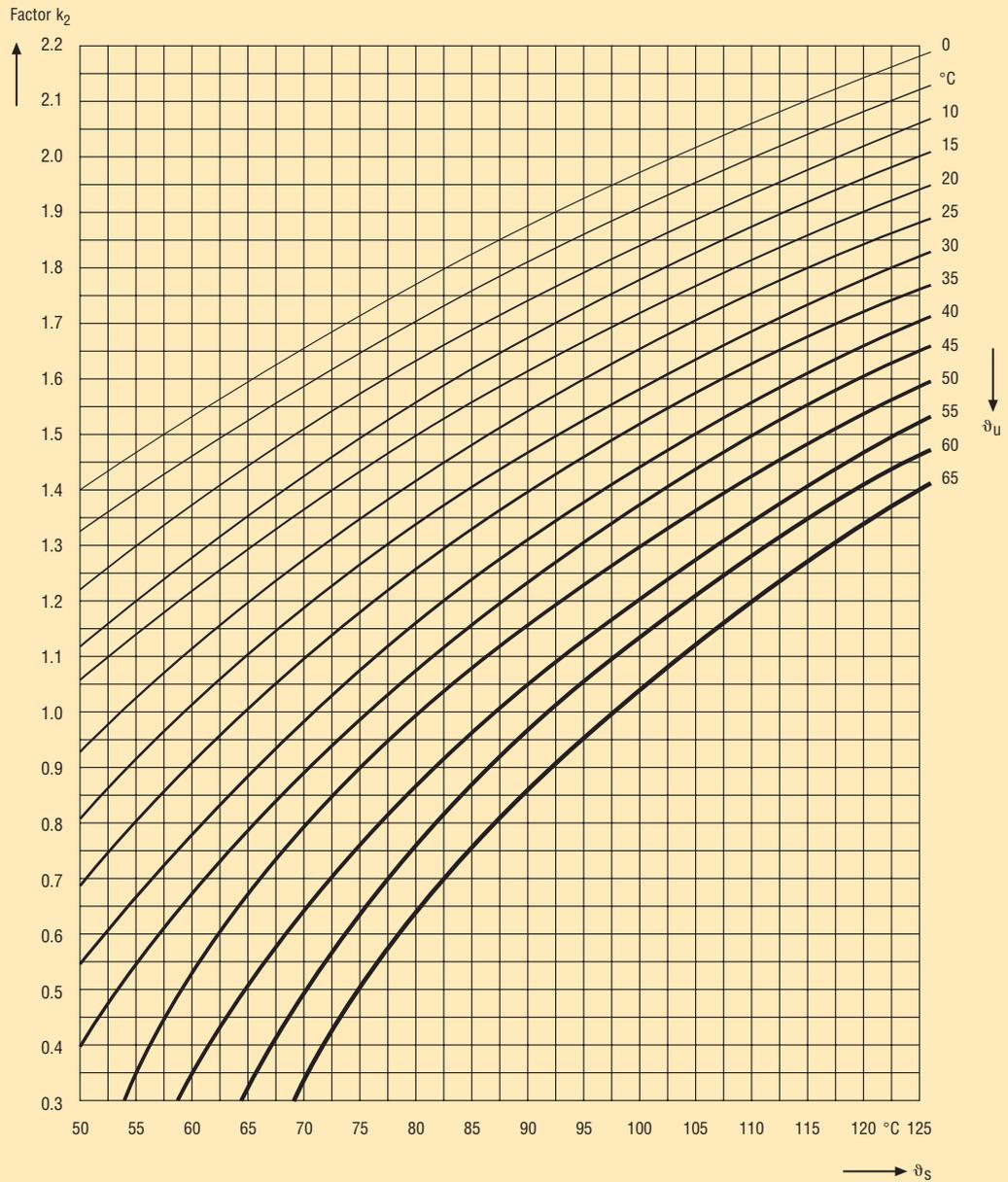
Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

Current carrying capacity / correction factor for busbar/air temperatures

Correction factor k_2 for copper busbars at varied busbar and air temperatures



Factor k_2 to determine the conductor cross-section of copper busbars at ambient temperatures ϑ_u of 0 to 60°C and/or operating temperatures ϑ_s up to 125°C

Transformers

Nominal and short-circuit currents of standard transformers

Nominal voltage U _N	400V/231V			525V			690V/400V		
Short-circuit voltage U _k		4%	6%		4%	6%		4%	6%
Rating	Nominal current I _N	Short-circuit current I _k		Nominal current I _N	Short-circuit current I _k		Nominal current I _N	Short-circuit current I _k	
[kVA]	[A]	[A]		[A]	[A]		[A]	[A]	
50	72	1805	-	55	1375	-	42	1042	-
100	144	3610	2406	110	2750	1833	84	2084	1392
160	230	5776	3850	176	4400	2933	133	3325	2230
200	288	7220	4812	220	5500	3667	168	4168	2784
250	360	9025	6015	275	6875	4580	210	5220	3560
315	455	11375	7583	346	8660	5775	263	6650	4380
400	578	14450	9630	440	11000	7333	336	8336	5568
500	722	18050	12030	550	13750	9166	420	10440	7120
630	910	22750	15166	693	17320	11550	526	13300	8760
800	1156	-	19260	880	-	14666	672	-	11136
1000	1444	-	24060	1100	-	18333	840	-	13920
1250	1805	-	30080	1375	-	22916	1050	-	17480
1600	2312	-	38530	1760	-	29333	1330	-	22300
2000	2888	-	48120	2200	-	36666	1680	-	27840

$$I_k = \frac{I_N}{U_k[\%]} * 100$$

U_k = Short-circuit voltage in %

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CIO|SIM|O® - 60mm Busbar System

Current transformers

Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

North American conductor cross-sections /conversion

North American conductor cross-sections – Conversion into mm²

USA/Canada AWG	Europe		USA / Canada circular mills	Europe	
	mm ² (exact)	mm ² (nearest standard value)		mm ² (exact)	mm ² (nearest standard value)
1	0.823	0.75	250,000	127	120
1	1.04	1	300,000	152	150
16	1.31	1.5	350,000	177	185
15	1.65	-	400,000	203	-
14	2.08	-	450,000	228	-
13	2.62	2.5	500,000	253	240
12	3.31	4	550,000	279	-
11	4.17	-	600,000	304	300
10	5.26	6	650,000	329	-
9	6.63	-	700,000	355	-
8	8.37	10	750,000	380	-
7	10.50	-	800,000	405	400
6	13.30	16	850,000	431	-
5	16.80	-	900,000	456	-
4	21.20	25	950,000	481	-
3	26.70	-	1,000,000	507	500
2	33.60	35	1,300,000	659	625
1	42.40	-	-	-	-
1/0	53.50	50	-	-	-
2/0	67.40	70	-	-	-
3/0	85	-	-	-	-
4/0	107	95	-	-	-

Transformers / terminal studs

Terminal studs for transformers in accordance with DIN 42530

Transformer size / rating [kVA]	Male thread
100	M12
160	M12
250	M20
400	M20
630	M30 x 2
800	M42 x 3
1000	M42 x 3

General conditions for the supply of products and services of the electrical and electronics industry^{*)}

recommended by the Zentralverband Elektrotechnik- und Elektronikindustrie (ZVEI) e.V. – January 2002 –

I. General

1. The scope of deliveries and/or services (hereinafter referred to as „Supplies“) shall be determined by the written declarations of both Parties. General terms and conditions of the Purchaser shall apply only if and when expressly accepted by the supplier or the provider of services (hereinafter referred to as „Supplier“) in writing.
2. The Supplier herewith reserves any industrial property rights and/or copy-rights pertaining to its cost estimates, drawings and other documents (hereinafter referred to as „Documents“). The Documents shall not be made accessible to third parties without the Supplier's prior consent and shall, upon request, be returned without undue delay to the Supplier if the contract is not awarded to the Supplier. Sentences 1 and 2 shall apply mutatis mutandis to documents of the Purchaser; these may, however, be made accessible to third parties to whom the Supplier may rightfully transfer Supplies.
3. The Purchaser shall have the non-exclusive

right to use standard software, provided that it remains unchanged, is used within the agreed performance parameters, and on the agreed equipment. The Purchaser may make one back-up copy without express agreement.

4. Partial Supplies shall be allowed, unless they are unreasonable to accept for the Purchaser.

II. Prices and terms of payment

1. Prices shall be ex works and exclude packaging; value added tax shall be added at the then applicable rate.
2. If the Supplier is also responsible for assembly or erection and unless otherwise agreed, the Purchaser shall pay the agreed remuneration and any incidental costs required, e. g. travel costs, costs for the transport of tools and equipment, and personal luggage as well as allowances.
3. Payments shall be made free Supplier's paying office.
4. The Purchaser may set off only those claims that are undisputed or against which no legal recourse is possible.

III. Retention of title

1. Items pertaining to the Supplies („Retained Goods“) shall remain

the property of the Supplier until each and every claim the Supplier has against the Purchaser on account of the business connection has been fulfilled. If the combined value of the security interests of the Supplier exceeds the value of all secured claims by more than 20%, the Supplier shall release a corresponding part of the security interest if so requested by the Purchaser.

2. For the duration of the retention of title, the Purchaser may not pledge the Retained Goods or use them as security, and resale shall be possible only for resellers in the ordinary course of their business and only on condition that the reseller receives payment from its customer or makes the transfer of property to the customer dependent upon the customer fulfilling its obligation to effect payment.
3. The Purchaser shall inform the Supplier forthwith of any seizure or other act of intervention by third parties.
4. Where the Purchaser fails to fulfil its duties, including failure to make payments due, the Supplier shall be entitled to cancel the contract and take back the Retained Goods in the case of continued failure following expiry of a reasonable time set by the Supplier;

the statutory provisions that a time limit is not needed remain unaffected. The Purchaser shall be obliged to surrender the Retained Goods.

IV. Time for supplies; delay

1. Times set for Supplies can only be observed if all Documents to be supplied by the Purchaser, necessary permits and releases, especially concerning plans, are received in time and if agreed terms of payment and other obligations of the Purchaser are fulfilled. Unless these conditions are fulfilled in time, times set shall be extended appropriately; this shall not apply where the Supplier is responsible for the delay.
2. If non-observance of the times set is due to force majeure such as mobilization, war, rebellion or similar events, e. g. strike or lockout, such time shall be extended accordingly.
3. If the Supplier is responsible for the delay (hereinafter referred to as „Delay“) and the Purchaser demonstrably suffered a loss therefrom, the Purchaser may claim a compensation as liquidated damages of 0.5 % for every completed week of Delay, but in no case more than a total of 5 % of the price of that

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Current transformers

Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

part of the Supplies which because of the Delay could not be put to the intended use.

4. Purchaser's claims for damages due to delayed Supplies as well as claims for damages in lieu of performance exceeding the limits specified in No. 3 above shall be excluded in all cases of delayed Supplies even upon expiry of a time set to the Supplier to effect the Supplies. This shall not apply in cases of mandatory liability based on intent, gross negligence, or due to injury of life, body or health. Cancellation of the contract by the Purchaser based on statute shall be limited to cases where the Supplier is responsible for the delay. The above provisions do not imply a change in the burden of proof to the detriment of the Purchaser.
5. At the Supplier's request the Purchaser shall declare within a reasonable period of time whether the Purchaser cancels the contract due to the delayed Supplies or insists on the Supplies to be carried out.
6. If dispatch or shipment is delayed at the Purchaser's request by more than one month after notice of the readiness for dispatch was given, the Purchaser may be charged, for every

month commenced, storage costs of 0.5 % of the price of the items of the Supplies, but in no case more than a total of 5 %. The parties to the contract may prove that higher or, as the case may be, lower storage costs have been incurred.

V. Transfer of risk

1. Even where delivery has been agreed freight free, the risk shall pass to the Purchaser as follows:
 - a) if the Supplies do not include assembly or erection, at the time when the Supplies are shipped or picked up by the carrier. Upon request of the Purchaser, the Supplier shall insure the Supplies against the usual risks of transport at the expense of the Purchaser;
 - b) if the Supplies include assembly or erection, at the day of taking over in the own works or, if so agreed, after a fault-free trial run.
2. The risk shall pass to the Purchaser if dispatch, shipping, the start or performance of assembly or erection, the taking over in the own works or the trial run is delayed for reasons for which the Purchaser is responsible or if the Purchaser has otherwise failed to accept the Supplies.

VI. Assembly and erection

Unless otherwise agreed in writing, assembly/erection shall be subject to the following provisions:

1. The Purchaser shall provide at its own expense and in good time:
 - a) all earth and construction work and other ancillary work outside the scope of the Supplier, including the necessary skilled and unskilled labour, construction materials and tools,
 - b) the equipment and materials necessary for assembly and commissioning such as scaffolds, lifting equipment and other devices as well as fuels and lubricants,
 - c) energy and water at the point of use including connections, heating and lighting,
 - d) suitable dry and lockable rooms of sufficient size adjacent to the site for the storage of machine parts, apparatus, materials, tools, etc. and adequate working and recreation rooms for the erection personnel, including sanitary facilities as are appropriate in the specific circumstances. Furthermore, the Purchaser shall take all measures it would take for the protec-

tion of its own possessions to protect the possessions of the Supplier and of the erection personnel at the site,

- e) protective clothing and protective devices needed due to particular conditions prevailing on the specific site.
2. Before the erection work starts, the Purchaser shall make available of its own accord any information required concerning the location of concealed electric power, gas and water lines or of similar installations as well as the necessary structural data.
3. Prior to assembly or erection, the materials and equipment necessary for the work to start must be available on the site of assembly/erection and any preparatory work must have advanced to such a degree that assembly/erection can be started as agreed and carried out without interruption. Access roads and the assembly/erection site itself must be level and clear.
4. If assembly, erection or commissioning is delayed due to circumstances for which the Supplier is not responsible, the Purchaser shall bear the reasonable costs incurred for idle times and any additional travelling of

<p>the Supplier or the erection personnel.</p> <p>5. The Purchaser shall attest to the hours worked by the erection personnel towards the Supplier at weekly intervals and the Purchaser shall immediately confirm in writing if assembly, erection or commissioning has been completed.</p>	<p>irrespective of the hours of operation elapsed, provided that the reason for the Defect had already existed at the time when the risk passed.</p>	<p>ject-matter of the notification of the Defect occurred is justified beyond doubt. Unjustified notifications of Defect shall entitle the Supplier to have its expenses reimbursed by the Purchaser.</p>	<p>thereof shall be likewise excluded.</p>
<p>6. If, after completion, the Supplier demands acceptance of the Supplies, the Purchaser shall comply therewith within a period of two weeks. In default thereof, acceptance is deemed to have taken place. Acceptance is also deemed to have been effected if the Supplies are put to use, after completion of an agreed test phase, if any.</p>	<p>2. Claims based on Defects are subject to a limitation period of 12 months. This provision shall not apply where longer periods are prescribed by law according to Sec. 438 para. 1 No. 2 (buildings and things used for a building), Sec. 479 para. 1 (right of recourse), and Sec. 634a para. 1 No. 2 (defects of a building) German Civil Code („BGB“), as well as in cases of injury of life, body or health, or where the Supplier intentionally or grossly negligently fails to fulfil its obligation or fraudulently conceals a Defect. The legal provisions regarding suspension of expiration („Ablaufhemmung“), suspension („Hemmung“) and recommencement of limitation periods remain unaffected.</p>	<p>5. The Supplier shall first be given the opportunity to supplement its performance („Nacherfüllung“) within a reasonable period of time.</p>	<p>8. The Purchaser shall have no claim with respect to expenses incurred in the course of supplementary performance, including costs of travel and transport, labour, and material, to the extent that expenses are increased because the Supplies was subsequently brought to another location than the Purchaser’s branch office, unless doing so complies with the intended use of the Supplies.</p>
<p>VII. Receiving of supplies</p>	<p>3. The Purchaser shall notify Defects to the Supplier in writing and without undue delay.</p>	<p>6. If supplementary performance is unsuccessful, the Purchaser shall be entitled to cancel the contract or reduce the remuneration, irrespective of any claims for damages it may have according to Art. XI.</p>	<p>9. The Purchaser’s right of recourse against the Supplier pursuant to Sec. 478 BGB is limited to cases where the Purchaser has not concluded an agreement with its customers exceeding the scope of the statutory provisions governing claims based on Defects. Moreover, No. 8 above shall apply mutatis mutandis to the scope of the right of recourse the Purchaser has against the Supplier pursuant to Sec. 478 para. 2 BGB.</p>
<p>VIII. Defects as to quality</p>	<p>4. In the case of notification of a Defect, the Purchaser may withhold payments to a reasonable extent taking into account the Defect occurred. The Purchaser, however, may withhold payments only if the sub-</p>	<p>7. There shall be no claims based on Defect in cases of insignificant deviations from the agreed quality, of only minor impairment of usefulness, of natural wear and tear or damage arising after the transfer of risk from faulty or negligent handling, excessive strain, unsuitable equipment, defective workmanship, inappropriate foundation soil or from particular external influences not assumed under the contract, or from non-reproducible software errors. Claims based on defects attributable to improper modifications or repairwork carried out by the Purchaser or third parties and the consequences</p>	<p>10. Furthermore, the provisions of Art. XI (Other Claims for Damages) shall apply in respect of claims of damages. Any other claims of the Purchaser against the Supplier or its agents or any such claims exceeding the claims provided for in this Art. VIII,</p>
<p>The Purchaser shall be liable for defects as to quality („Sachmängel“, hereinafter referred to as „Defects“) as follows:</p> <p>1. All parts or services where a Defect becomes apparent within the limitation period shall, at the discretion of the Supplier, be repaired, replaced or provided again free of charge</p>			

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Consumer supply technology

Distribution and instrument cabinets

Powerlizer system electronics

based on a Defect, shall be excluded.

IX. Industrial property rights and copyright; defects in title

1. Unless otherwise agreed, the Supplier shall provide the Supplies free from third parties' industrial property rights and copyrights (hereinafter referred to as „IPR“) with respect to the country of the place of destination. If a third party asserts a justified claim against the Purchaser based on an infringement of an IPR with respect to the Supplies made by the Supplier and then used in conformity with the contract, the Supplier shall be liable to the Purchaser within the time period stipulated in Art. VIII No. 2 as follows:

a) The Supplier shall choose whether to acquire, at its own expense, the right to use the IPR with respect to the Supplies concerned or whether to modify the Supplies such that they no longer infringe the IPR or replace them. If this would be unreasonable to demand from the Supplier, the Purchaser may cancel the contract or reduce the remuneration pursuant to the applicable statutory provisions.

b) The Supplier's liability to pay damages

shall be governed by Art. XI.

c) The above obligations of the Supplier shall only apply if the Purchaser (i) immediately notifies the Supplier of any such claim asserted by the third party in writing, (ii) does not concede the existence of an infringement and (iii) leaves any protective measures and settlement negotiations to the discretion of the Supplier. If the Purchaser stops using the Supplies in order to reduce the damage or for other good reason, it shall be obliged to point out to the third party that no acknowledgement of the alleged infringement may be inferred from the fact that the use has been discontinued.

2. Claims of the Purchaser shall be excluded if it is itself responsible for the infringement of an IPR.

3. Claims of the Purchaser shall also be excluded if the infringement of the IPR is caused by specifications made by the Purchaser, to a type of use not foreseeable by the Supplier or to the Supplies being modified by the Purchaser or being used together with products not provided by the Supplier.

4. In addition, with respect to claims by the

Purchaser pursuant to No. 1 a) above, Art. VIII Nos. 4, 5, and 9 shall apply mutatis mutandis in the event of an infringement of an IPR.

5. Where other defects in title occur, Art. VIII shall apply mutatis mutandis.

6. Any other claims of the Purchaser against the Supplier or its agents or any such claims exceeding the claims provided for in this Art. IX, based on a defect in title, shall be excluded.

X. Impossibility of performance; adaptation of contract

1. To the extent that Supplies are impossible to be carried out, the Purchaser shall be entitled to claim damages, unless the Supplier is not responsible for the impossibility. The Purchaser's claim for damages shall, however, be limited to an amount of 10 % of the value of the part of the Supplies which, owing to the impossibility, cannot be put to the intended use. This limitation shall not apply in the case of mandatory liability based on intent, gross negligence or injury of life, body or health; this does not imply a change in the burden of proof to the detriment of the Purchaser. The right of the Purchaser to cancel the contract shall remain unaffected.

2. Where unforeseeable events within the meaning of Art. IV No. 2 substantially change the economic importance or the contents of the Supplies or considerably affect the Supplier's business, the contract shall be adapted taking into account the principles of reasonableness and good faith.

Where doing so is economically unreasonable, the Supplier shall have the right to cancel the contract. If the Supplier intends to exercise its right to cancel the contract, it shall notify the Purchaser thereof without undue delay after having realised the repercussions of the event; this shall also apply even where an extension of the delivery period had previously been agreed with the Purchaser.

XI. Other claims for damages

1. Any claims for damages and reimbursement of expenses the Purchaser may have (hereinafter referred to as „Claims for Damages“), based on whatever legal reason, including infringement of duties arising in connection with the contract or tort, shall be excluded.

2. The above shall not apply in the case of mandatory liability, e. g. under the German Product Liability Act („Produkthaftungs-

gesetz“), in the case of intent, gross negligence, injury of life, body or health, or breach of a condition which goes to the root of the contract („wesentliche Vertragspflichten“). However, Claims for Damages arising from a breach of a condition of the contract shall be limited to the foreseeable damage which is intrinsic to the contract, unless caused by intent or gross negligence or based on liability for injury of life, body or health. The above provision does not imply a

change in the burden of proof to the detriment of the Purchaser.

3. To the extent that the Purchaser has a valid Claim for Damages according to this Art. XI, it shall be time-barred upon expiration of the limitation period applicable to Defects pursuant to Art. VIII No. 2. In the case of claims for damages under the German Product Liability Act, the statutory provisions governing limitation periods shall apply.

XII. Venue and applicable law

1. If the Purchaser is a businessperson, sole venue for all disputes arising directly or indirectly out of the contract shall be the Supplier's place of business. However, the Supplier may also bring an action at the Purchaser's place of business.
2. Legal relations existing in connection with this contract shall be governed by German substantive law, to the exclusion of the United Nations Convention on

Contracts for the International Sale of Goods (CISG).

XIII. Severability clause

The legal invalidity of one or more provisions of this contract shall in no way affect the validity of the remaining provisions. This shall not apply if it would be unreasonable for one of the parties to continue the contract.

*) Translation of the original German text

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connector-fuses
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