Contents

Industrial Connectors – Series Summary

Economic and Reliable Connections

Specifications

VDE 0110 table 4, concerning clearance and creepage distances

VDE 0627 Connectors

Note
Connectors should not be coupled and decoupled under electrical load. Connectors of the same or different series being mounted side by side may be protected against incorrect mating by the use of coding options.

Standard

DIN 43 652 for series Han D
CECC 75 301-801

Approvals

UL, CSA, SEV
for inserts and hoods/housings

State Mining board
BVS-certification no. T 6365

CERCHAR-France
„MS 83.9011 U“

SABS
South African Bureau of Standards

Certified according to EN ISO 9001 in design/development, production, installation and servicing

Terminations
- Screw terminal
- Crimp terminal
- Cage-clamp terminal
- Wrap terminal
- Solder terminal
- Axial-screw terminal

Inserts
- Leading protective ground
- Polarised for correct mating
- Interchangeability of male and female inserts in hoods and housings
- Captive fixing screws
- Can be used with hoods and housings, or for rack and panel applications

Hoods/Housings
- Standard Hoods/Housings
- Hoods/Housings for harsh environmental requirements
- Hoods/Housings for intrinsically safe plant
- Degree of protection IP 65
- Electrical connection with protective ground
- High mechanical strength and vibration-resistance ensured by locking levers
- Spring-loaded covers in shockproof thermoplastic or metal covers, both lockable

Accessories
- Extensive range of cable protection and sealing accessories
- Protective covers available
- Coding options for incorrect mating protection
- Test connectors for testing equipment under electrical load

For "non standard applications" we can manufacture designs to match your requirements.
Please discuss requirements with us.

HARTING components help you to construct top quality products – economically and in line with market requirements.

har-kis CD-ROM
This catalogue is partly available on CD-ROM.
Please contact your local HARTING Sales Department

General information

It is the user's responsibility to check whether the components illustrated in this catalogue comply with different regulations from those stated in special fields of application which we are unable to foresee.

We reserve the right to modify designs in order to improve quality, keep pace with technological advancement or meet particular requirements in production.

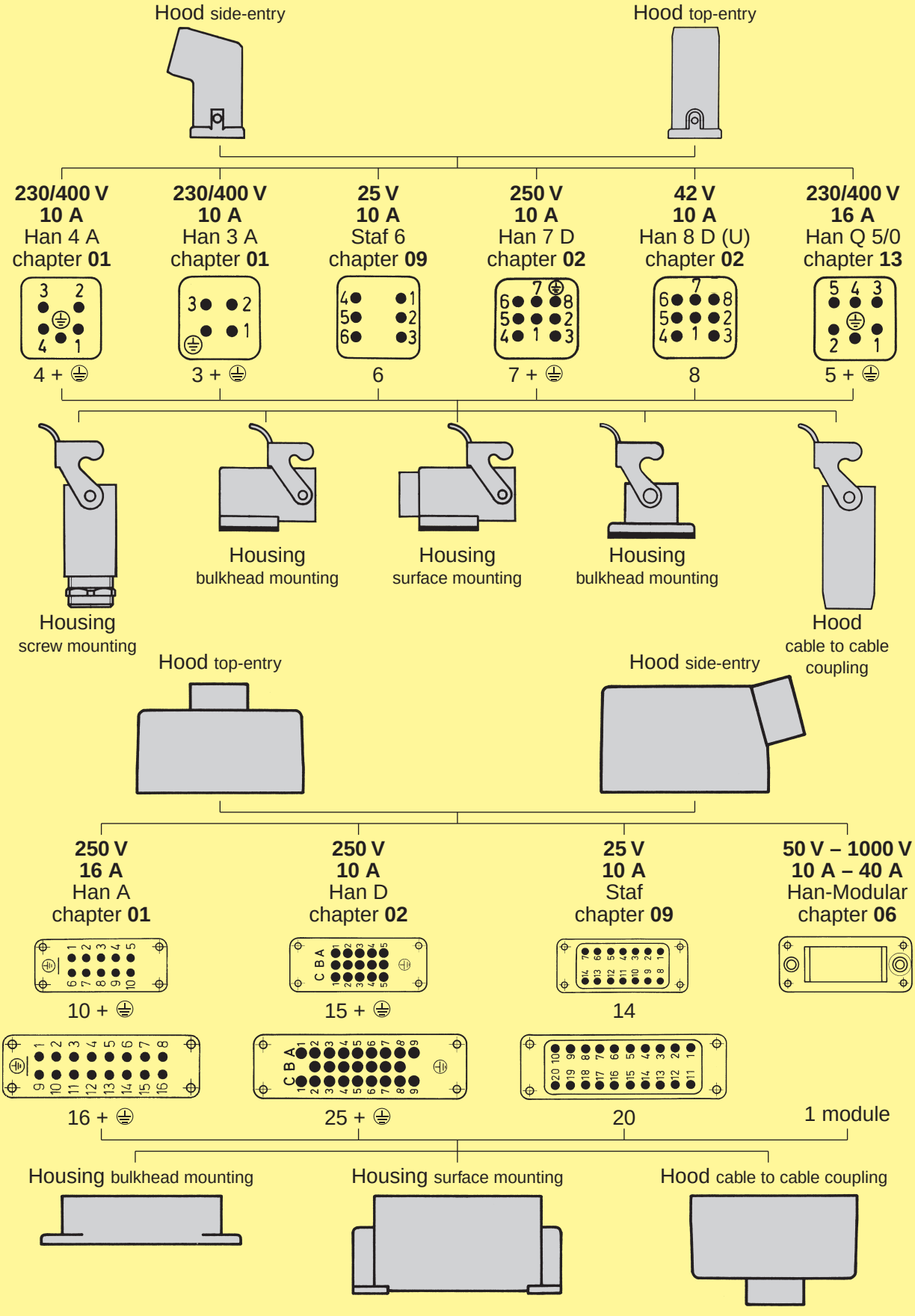
Contents

Industrial Connectors – Technical Characteristics

Size | Description

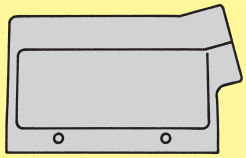
Han

A

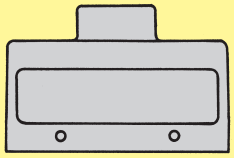


Size	Description

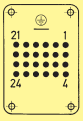
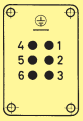
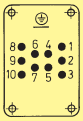
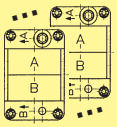
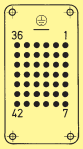
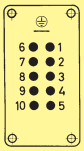
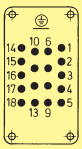
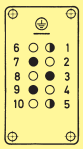
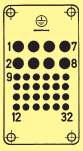
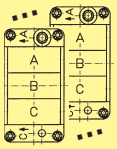
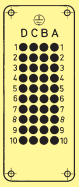
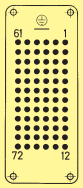
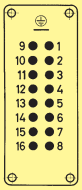
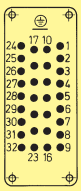
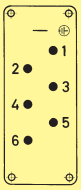
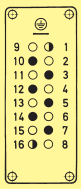
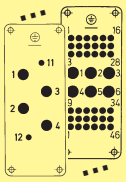
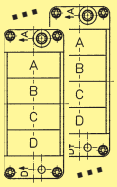
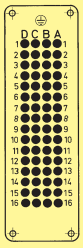
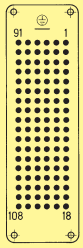
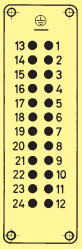
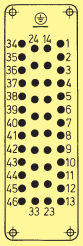
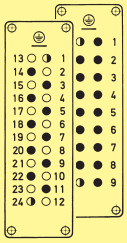
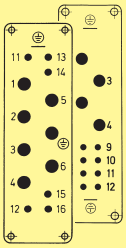
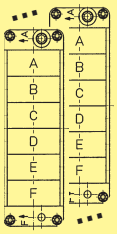
B



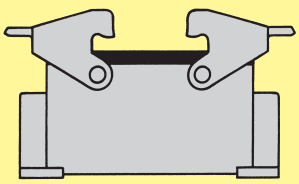
Hood side-entry



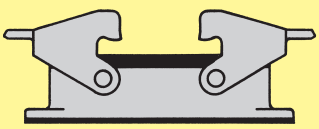
Hood top-entry

	250 V **10 A** Han D chapter **02**	**250 V** **10 A** Han DD chapter **02**	**400 V – 500 V** **16 A** Han E Han ES chapter **03**	**500 V** **16 A** Han EE chapter **03**	**500 V** **35 A** Han HsB chapter **07**	**660 V – 750 V** **16 A** Han Hv E Han Hv ES chapter **04**	**250 V – 690 V** **10 A – 100 A** Han-Com chapter **05**	**50 V – 1000 V** **10 A – 100 A** Han- Modular chapter **06**
6								
		24 + ⏚	6 + ⏚	10 + ⏚				2 modules
10								
		42 + ⏚	10 + ⏚	18 + ⏚		3 + ⏚	8/24 + ⏚	3 modules
16								
	40 + ⏚	72 + ⏚	16 + ⏚	32 + ⏚	6 + ⏚	6 + ⏚	6/36 + ⏚ 4/2 + ⏚	4 modules
24								
	64 + ⏚	108 + ⏚	24 + ⏚	46 + ⏚		16 + ⏚ 10 + ⏚	4/8 + ⏚ 6/6 + ⏚	6 modules

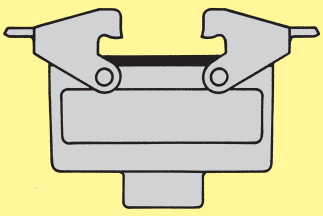
Housing surface mounting



Housing bulkhead mounting



Hood cable to cable coupling



32 **suitable for 2 inserts of size 16 B**

48 **suitable for 2 inserts of size 24 B**

For a complete connector components may be ordered from the following sub headings

Male insert with

screw terminal or
crimp terminal (order contacts separately)
or cage-clamp terminal

Female insert with

screw terminal or
crimp terminal (order contacts separately)
or cage-clamp terminal

Hoods

low or high construction
top or side cable entry
1 or 2 locking levers

Housings

Housing (bulkhead mounting)
with or without thermoplastic
or metal covers
1 or 2 locking levers

Housing (surface mounting)
low or high construction
with or without thermoplastic
or metal covers
1 or 2 locking levers
1 or 2 cable entries

Hood (cable to cable)
low or high construction
for cable to cable connections

Cable entry protection

Universal cable glands

Special cable clamp with strain relief, bell mouthed cable fitting and anti-twist devices

Cable gland with normal or multiple seal

Extensive range of accessories

Accessories

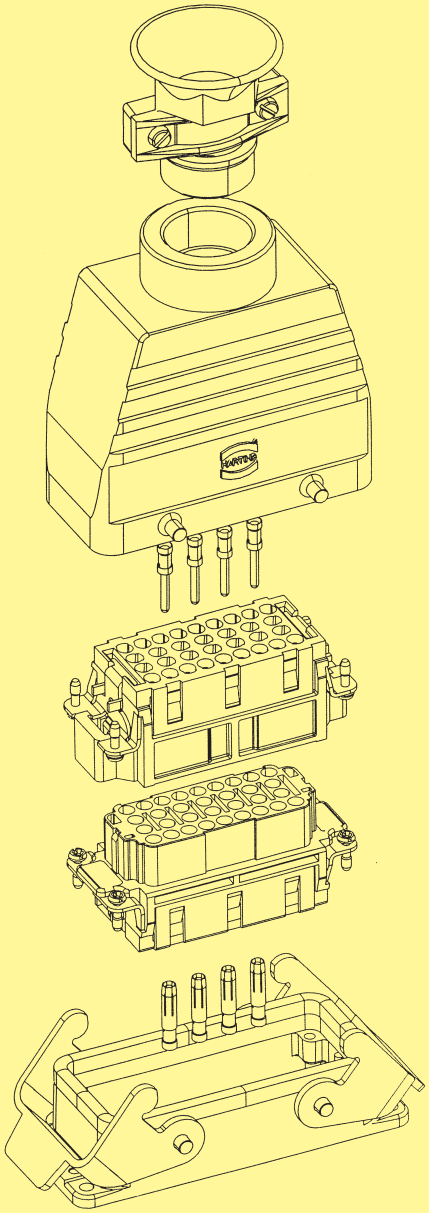
Protective covers available

Code and guide pins for coding

Special insert fixing screws for use without hoods and housings

Label according to CSA-approval

Suitable hoods and housings will be found on the same page.



Part number explanation

Our computerized ordering system uses the following code:

09	33	024	2601

Product-group (connectors)

Series (i. e. Han E)

Number of contacts (i. e. 6, 10, 16, 24)

Part of connector assembly (hoods/housings, inserts)

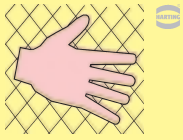
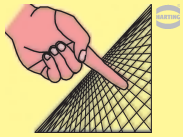
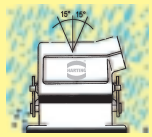
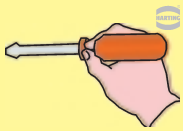
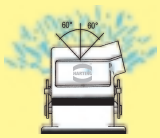
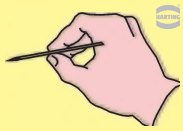
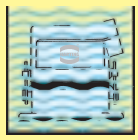
The connector's housing, sealing and locking mechanism protect the connection from external influences such as mechanical shocks, foreign bodies, humidity, dust, water or other fluids such as cleansing and cooling agents, oils, etc. The degree of protection the housing offers is explained in the IEC 529, EN 60 529, standards that categorize enclosures according to foreign body and water protection.

The following table shows the different degrees of protection.

Code letters (International Protection) — **IP**

First Index Figure (Foreign bodies protection) — **6**

Second Index Figure (Water protection) — **5**

Index figure	Degree of protection			Index figure	Degree of protection		
0	No protection		No protection against accidental contact, no protection against solid foreign bodies	**0**	No protection against water		No protection against water
1	Protection against large foreign bodies		Protection against contact with any large area by hand and against large solid foreign bodies with Ø > 50 mm	**1**	Drip-proof		Protection against vertical water drips
2	Protection against medium sized foreign bodies		Protection against contact with the fingers, protection against solid foreign bodies with Ø > 12 mm	**2**	Drip-proof		Protection against water drips (up to a 15° angle)
3	Protection against small solid foreign bodies		Protection against tools, wires or similar objects with Ø > 2.5 mm, protection against small foreign solid bodies with Ø > 2.5 mm	**3**	Spray-proof		Protection against diagonal water drips (up to a 60° angle)
4	Protection against grain-shaped foreign bodies		As 3 however Ø > 1 mm	**4**	Splash-proof		Protection against splashed water from all directions
5	Protection against injurious deposits of dust		Full protection against contact. Protection against interior injurious dust deposits	**5**	Hose-proof		Protection against water (out of a nozzle) from all directions
6	Protection against ingress of dust		Total protection against contact. Protection against penetration of dust	**6**	Protected against flooding		Protected against temporary flooding
				7	Protected against immersion		Protected against temporary immersion
				8	Water-tight		Protected against water pressure

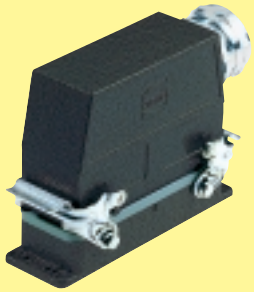
Description according to DIN VDE 0470, DIN EN 60 529, IEC 60 529

Standard Hoods/Housings

Field of application	for excellent mechanical and electrical protection in demanding environments, for example, in the automobile and mechanical engineering industries also for process and regulation control applications
Distinguishing feature	hoods/housings colour-coded grey (RAL 7037)
Material of hoods/housings	Die cast light alloy
Locking levers	Zinc plated/corrosion resistant stainless steel, Han-Easy Lock®
Cable entry protection	Optional special cable clamp for hoods with strain relief, bell mouthed cable fitting and anti-twist devices

Han M Hoods/Housings for harsh environmental requirements

Field of application	for all applications where aggressive environmental conditions and extreme climatic atmospheres are encountered
Distinguishing feature	hoods/housings colour-coded black (RAL 9005)
Material of hoods/housings	Die cast light alloy, corrosion resistant
Locking levers	Corrosion resistant stainless steel
Cable entry protection	Special cable clamp for hoods with strain relief, bell mouthed cable fitting and anti-twist devices



Han EMC Hoods/Housings with high shielding efficiency

Field of application	For sensitive interconnections that have to be shielded against electrical, magnetic or electro-magnetic interferences
Distinguishing feature	Electrically conductive surface, internal sealing
Locking parts	Zinc plated/stainless steel
Material of hoods/housings	Die cast light alloy
Cable entry protection	EMC cable clamp in order to connect the cable shielding to the hood without interruption of the shielding

Han HPR Hoods/Housings, pressure tight

Field of application	For external electrical interconnections in automobiles, in highly demanding environments and wet areas, as well as for sensitive interconnections that have to be shielded
Distinguishing feature	hoods/housings colour-coded black, internal sealing
Locking parts	Stainless steel
Material of hoods/housings	Die cast light alloy, corrosion resistant
Cable entry protection	Optional universal cable clamp for hoods with strain relief, or special cable clamp with bell mouthed cable fitting and anti-twist devices (use of adapter is necessary)

Housing with 2 levers Han-Easy Lock®

- easy operation
- high degree of sealing
- reliable locking guaranteed by 4 locking points
- space saving mounting
- ideal for mounting side by side
- cable to cable connection is possible
- high sealing force

Details of Han-Easy Lock® see chapter 30

Housing with 1 lever

- easily accessible, even with side entry
- possibility to lock protective covers on the housing
- cable to cable connection is possible
- 2 locking points on the longitudinal axis

1 lever in central position

- easily accessible, even with side entry
- 2 locking points on the lateral axis
- space saving mounting
- ideal for mounting side by side
- single hand operation

Screw locking / toggle locking

- hexagon nuts tightened with spanner
- highest degree of sealing
- easily accessible, also with side entry
- use of tools avoids access by unauthorized persons

Hood with 2 levers Han-Easy Lock®

- easy operation
- high degree of sealing
- ideal for mating to housings with protection cover
- high sealing force

Details of Han-Easy Lock® see chapter 30

Screw terminal

Screw terminals meet VDE 0609 / EN 60 999. Dimensions and twisting moments for testing are shown opposite.

The relevant regulations state that in the case of

- Terminals with wire protection.
  No special preparation of the conductor is required – except for the stripping of the insulation.

  Series Han E, Han HsB, Han Hv E

- Terminals without wire protection.
  The insulation is first stripped and then a wire ferrule must be used.

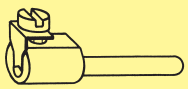
  Series Han K 4/x, Han A, Staf

Tensile strength of conductors

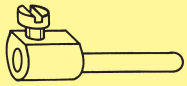
The diagram opposite shows the curve for tensile strength of screw terminations when wire protection is utilised.

Screw thread : M 3
Twisting moment for testing : 50 Ncm

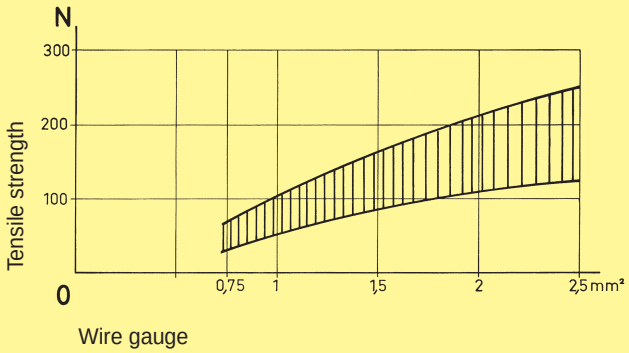
Wire gauge (mm²)	1	1.5	2.5	4	6	10
Screw thread	M 2.6	M 3	M 3	M 3.5	M 4	M 4
Test moment of torque (Ncm)	40	50	50	80	120	120



with wire protection



without wire protection



Axial screw terminal

This termination associates the benefits of screw and crimp terminals.

- Less space required
- Easy handling
- No special tools

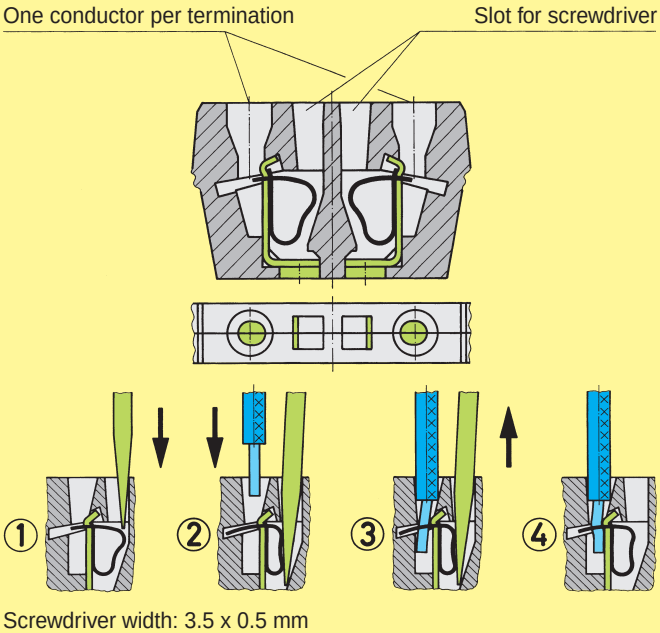
The axial screw termination is suitable for fine strands wires.

	40 A				100 A		
Wire gauge (mm²)	2,5	4	6	10	16	25	35
Tightening torque (Ncm)	100	100	100	100	500	600	600
Retention force (N)	>100	>100	>200	>300	>1000	>1000	>1000
Retention force (N) according to EN 60 999	50	60	80	90	100	135	190

Cage-clamp terminal

This termination method requires very little preparation of the wire and no special tools, leading to a low installed cost and a high degree of mechanical security.

- For all stranded and solid wires with a cross section 0.14 to 2.5 mm².
- Ease of termination. Conductor and screwdriver are in same plane.
- No special preparation of stripped conductor.
- The larger the conductor the higher the clamping force.
- Testing is possible in the screwdriver aperture.
- The termination is vibration-proof.
- Guaranteed constant low resistance connection of the cage-clamp terminal.
- The cage-clamp system is internationally approved. VDE, SEV, CSA, UL, ÖVE, SEMKO, LCIE (France), Germanischer Lloyd, DET Norske Veritas



Screwdriver width: 3.5 x 0.5 mm

Crimp connection

A perfect crimp connection is gastight, therefore corrosion free and amounts to a cold weld of the parts being connected. For this reason, major features in achieving high quality crimp connections are the design of the contact crimping parts and of course the crimping tool itself. Wires to be connected must be carefully matched with the correct size of crimp contacts. If these basic requirements are met, users will be assured of highly reliable connections with low contact resistance and high resistance to corrosive attack.

The economic and technical advantages are:

- Constant contact resistance as a result of precisely repeated crimp connection quality
- Corrosion free connections as a result of cold weld action
- Pre-preparation of cable forms with crimp contacts fitted
- Optimum cost cable connection

Requirements for crimp connections are set out in DIN IEC 60 352, part 2.

Pull out force of stranded wire

An essential consideration for good quality crimp connections is the mechanical retention of the wire in the crimp contact. As set out in DIN IEC 60 352, part 2, the tensile strength is in relation to the wire gauge.

The diagram shows the curves of the crimp tensile strength over the stranded wire gauge when HARTING- and BUCHANAN-Crimping tools are used.

In comparison herewith the tensile strength and the yield strength of the stranded wires are displayed.

① Tensile strength of the stranded wire

② Curve of the crimp tensile strength reached when BUCHANAN-Crimping tool and HARTING-Crimping tool is used

③ Limit values of the crimp tensile strength as per DIN IEC 60 352, part 2

Crimping tools

Crimping tools (hand operated or automatic) are carefully designed to produce with high pressure forming parts a symmetrical connection of the crimping part of the contact and the wire being connected with the minimum increase in size at the connection point. The positioner automatically locates the crimp and wire at the correct point in the tool.

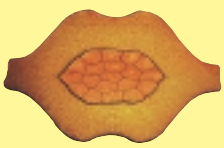
A ratchet in the tool performs 2 functions:

① It prevents insertion of the crimp into the tool for crimping before the jaws are fully open

② It prevents the tool being opened before the crimping action is completed

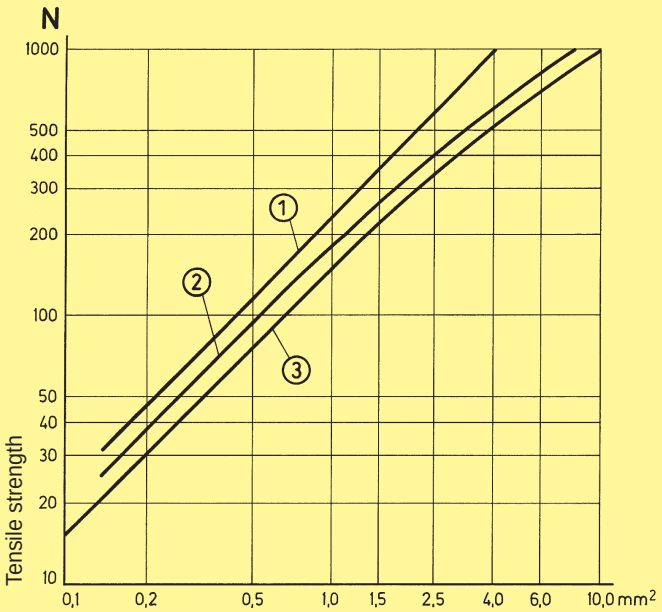
Identical, perfectly formed, connections can be produced using this crimping system.

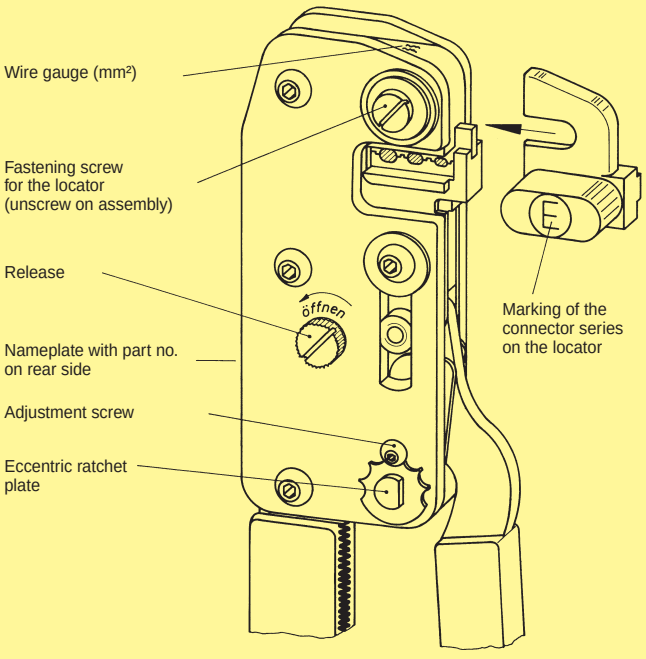
Crimp-cross section



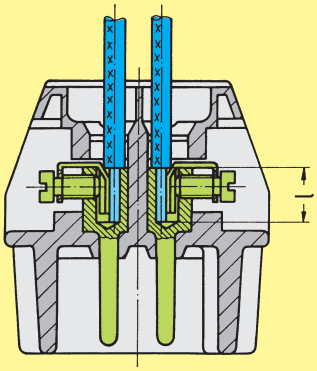
HARTING crimp profile

BUCHANAN crimp profile

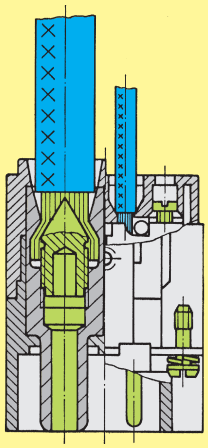




Screw terminal



Inserts	max. wire gauge (mm²)	AWG	Stripping length l (mm)
Han 3 A, Han 4 A	2.5	14	4.5
Han E, Han K, Han A, Han Hv E	2.5	14	7
Han HsB	6.0	10	11.5
Staf	1.5	16	4
Han K 4/. (80 A)	16	5	14



Inserts	max. wire gauge (mm²)	AWG	Stripping length l (mm)
Han K 6/12 (40 A)	2.5–10	13–7	8 … 9
Han K 6/6 (100 A)	16 –35	5–2	13 … 14

Recommended tightening torque and size of screw driver

Size of screw	Connector type	Ø Tightening torque* [Nm]	Ø Tightening torque [lbft]	Recommended size of screw driver
M 3	Screw terminal Han 3 A / 4 A / Q 5/0	0.25	0.20	0.4 x 2.5
M 3	Screw terminal Han 10 A – 32 A	0.50	0.40	0.5 x 3.5 or ± size 1
M 3	Screw terminal Han E, Hv E fixing screws of all kinds, guiding pins and bushes	0.50	0.40	0.5 x 3.5
M 4	Ground terminal Han A, E, D, DD, Ground terminal K (8/24)	1.20	0.90	0.5 x 3.5 or ± size 1 + 2
M 4	Terminal blocks Han HsB	1.20	0.90	0.8 x 4.5
M 5	Ground terminal Han HsB HsC (K 12/2), K 4/., K 6/12	2.00	1.40	0.8 x 4.5 1.2 x 8
M 6	Terminal blocks Han K 4/. (80 A)	1.20	0.90	0.8 x 4.5
–	Terminal blocks Han K 6/12 (40 A)	1.20	0.90	Hexagon recess 2 mm
M 8	Terminal blocks Han K 6/6 (100 A)	6.0–6.5	4.30	Hexagon recess 4 mm

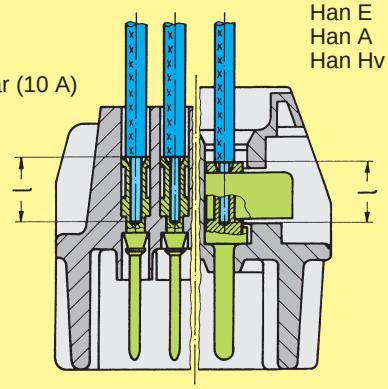
Increasing the tightening torque does not improve considerably the contact resistances. The torque moments were determined when optimum mechanical, thermal and electrical circumstances were given. If the recommended figures are considerably exceeded the wire or the termination can be damaged.

* in accordance with DIN EN 60 999

Crimp terminal

Han DD
Han D
R 15
Han-Modular (10 A)

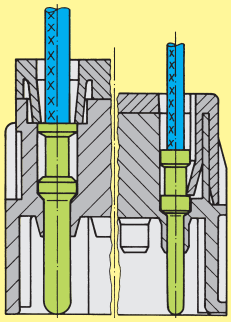
Han E
Han A
Han Hv E



Wire gauge (mm²)	Wire gauge AWG	Internal diameter Ø (mm)	Stripping length l (mm) Han DD, Han D, R 15, Han-Modular (10 A)	Stripping length l (mm) Han E, Han A, Han Hv E	Stripping length l (mm) Han C
0.14 … 0.37	26–22	0.9	8	–	–
0.5	20	1.15	8	7.5	–
0.75	18	1.3	8	7.5	–
1	18	1.45	8	7.5	–
1.5	16	1.75	8	7.5	9
2.5	14	2.25	6	7.5	9
4	12	2.85	–	7.5	9.6
6	10	3.5	–	–	9.6

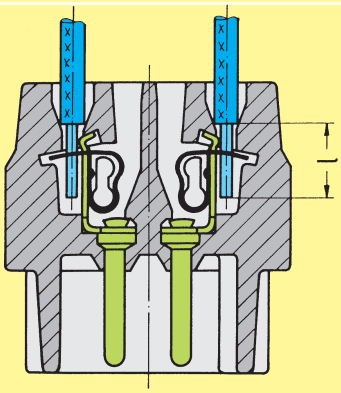
Han-Com (40 A)
Han-Modular (40 A)

Han EE
Han-Modular (16 A)



Wire gauge (mm²)	Wire gauge AWG	Internal diameter Ø (mm)	Stripping length l (mm) Han-Com (40 A), Han-Modular (40 A)	Stripping length l (mm) Han EE, Han-Modular (16 A)
0.5	20	1.15	–	7.5
0.75	18	1.3	–	7.5
1	18	1.45	–	7.5
1.5	16	1.75	9	7.5
2.5	14	2.25	9	7.5
4	12	2.85	9.5	7.5
6	10	3.5	9.5	–

Cage-clamp terminal



Inserts	max. wire gauge (mm²)	max. wire gauge AWG	Stripping length l (mm)
Han ES, Han Hv ES	0.14–2.5	26–14	9 … 11

Dimensioning of clearance and creepage distances

General

The stipulations of the DIN VDE 0110-01.89, part 1 and 2, “Insulation co-ordination for electrical equipment within low voltage systems” are valid for the measurement of clearance and creepage distances on electrical equipment. The above national norm is a document which includes the stipulations of the international reports IEC 60 664/60 664 A and as such explains the method of selecting the correct minimum insulation for equipment.

For connectors the DIN VDE 0627-16.86 is also valid. In this normative document interpretations are given in accordance with DIN VDE 0110-11/72 and VDE 0110-b/2.79. Therefore data which has been determined on the basis of these regulations remains valid for the relevant products.

Extracts from DIN VDE 0110-01.89

Clearances

Clearances shall be dimensioned according to the following circumstances: The dimensioning has to be made in view of the expected overvoltages, taking into consideration the protective measures against overvoltages and pollution. For the dimensioning of clearances the rated impulse voltages in table 1 are appropriate. They derive from the overvoltage category and from the nominal net voltage. The overvoltage categories are defined as follows:

Overvoltage category I

For equipment used in devices or in parts of installations where no overvoltages may occur.

Equipments of this overvoltage category work mainly with low voltages.

Overvoltage category II

For equipment used in installations or in parts of them where transient overvoltages have not to be taken into consideration, but where overvoltages generated by operation of the equipment may occur.

This applies i.e. to electrical appliances.

Overvoltage category III

For equipment used in installations or in parts of them where transient overvoltages have not to be taken into consideration, but where overvoltages may occur. In view of security and availability of the equipment or depending nets there are special requirements.

This applies to equipment for fixed installations, i.e. protective devices, relays, switches and plug devices.

Overvoltage category IV

For equipment used in installations or in parts of them where transient overvoltages have to be taken into consideration.

This applies to equipment to connect open-air lines: i.e. audio-frequency powerline carrier etc.

Nominal net voltage for a.c. voltage systems acc. to DIN IEC 60 038 in V	Rated impulse voltages in V for overvoltage category			
	I	II	III	IV
230 / 400 277 / 480[1)]	1 500	2 500	4 000	6 000
400 / 690	2 500	4 000	6 000	8 000
1 000	4 000	6 000	8 000	12 000
[1)] Including the nominal net voltage of 500 V				

Table 1: Rated impulse voltages

For dimensioning of minimum clearances the rated impulse voltage and the degree of pollution have to be taken into consideration. We distinguish between the following degrees of pollution:

Degree of pollution 1

No pollution at all or dry and non-conductive pollution occurs without any influence.

Degree of pollution 2

Only non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation has to be expected.

Degree of pollution 3

Conductive pollution or dry non-conductive pollution occurs which becomes conductive due to condensation.

Degree of pollution 4

The pollution generates persistent conductivity caused by conductive dust or by rain or snow.

Clearances

The rated impulse voltage and the degree of pollution are necessary to determine the minimum clearances and can be taken from the following table.

Required impulse voltage in kV	Minimum clearances in mm up to 2 000 m over sea level							
	Case A (inhomogeneous field[3])				Case B (homogeneous field[1])			
	Degree of pollution				Degree of pollution			
	1	**2**	**3**	4	1	2	3	4
0.33[2]	0.01				0.01			
0.40	0.02	**0.1**[4]			0.02	0.1[4]		
0.50[2]	0.04				0.04			
0.60	0.06	**0.2** **0.12**[4]			0.06	0.2 0.12[4]		
0.80	0.10	**0.2**	**0.8**		0.1			
1.0	0.15			1.6	0.15	0.2	0.8	
1.2	0.25	**0.25**			0.2			1.6
1.5[2]	0.5	**0.5**			0.3	0.3		
2.0	1.0	**1.0**	**1.0**		0.45	0.45		
2.5[2]	1.5	**1.5**	**1.5**		0.6	0.6		
3.0	2	**2**	**2**	2	0.8	0.8		
4.0[2]	3	**3**	**3**	3	1.2	1.2	1.2	
5.0	4	**4**	**4**	4	1.5	1.5	1.5	
6.0[2]	5.5	**5.5**	**5.5**	5.5	2	2	2	2
8.0[2]	8	**8**	**8**	8	3	3	3	3
10	11	**11**	**11**	11	3.5	3.5	3.5	3.5
12[2]	14	**14**	**14**	14	4.5	4.5	4.5	4.5
15	18	18	18	18	5.5	5.5	5.5	5.5
20	25	25	25	25	8	8	8	8
25	33	33	33	33	10	10	10	10
30	40	40	40	40	12.5	12.5	12.5	12.5
40	60	60	60	60	17	17	17	17
50	75	75	75	75	22	22	22	22
60	90	90	90	90	27	27	27	27
80	130	130	130	130	35	35	35	35
100	170	170	170	170	45	45	45	45

[1] If the clearance values are smaller than case A, values require verification by impulse voltage testing.
[2] Preferred values from table 1.
[3] Point to plane electrode configuration.
[4] These values are valid for printed wiring material although they diverge from IEC-Report 60 664. The relevant German modification proposal has been laid down before the IEC.

Table 2 a: Minimum clearances

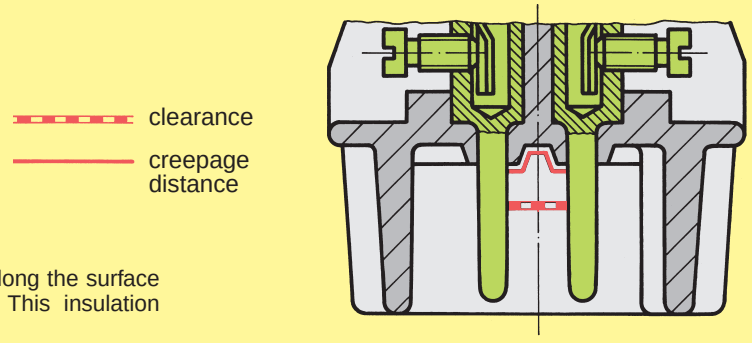
Bold values are the most common values for industrial connectors.

Creepage distances

For dimensioning of creepage distances the rated voltages depending on the relevant kind of net have to be determined.

The different degrees of pollution defined for the clearances apply also to the creepage distances.

The creepage distance is defined as the shortest distance along the surface of the insulation material between two conductive parts. This insulation material be suitable for continuous voltage load.



Single phase three- or two-wire a.c. or d.c. systems

Nominal voltage of the energy supplier[1] U_{rms} or U_ in V	Rated voltage in V: line to line all nets (between the wires of different polarity for U_) U_{rms} or U_	Rated voltage in V: line to earth U_{rms} or U_
12.5	12.5	–
24 25	25	–
30	32	–
42 48 50[2]	50	–
60	63	–
60/ 30	63	32
100[2]	100	–
110 120	125	–
150[2]	160	–
220	250	–
220/110 240/120	250	125
300[2]	320	–
440/220	500	250
600[2]	630	–
960/480	1000	500
1000[2]	1000	–

[1] This voltage can be identical to the device's nominal voltage.

[2] These values correspond to the values given in table 1.

Table 3a

The manufacturer selects the insulation material on the basis of the CTI (Comparative Tracking Index). Insulation materials are divided in 4 categories:

Table for insulation materials:

I	600 ≤ CTI
II	400 ≤ CTI < 600
IIIa	175 ≤ CTI < 400
IIIb	100 ≤ CTI < 175

Three-phase four- or three-wire a.c. systems

Nominal voltage of the energy supplier[1] U_{rms} or U_ in V	Rated voltage in V: line to line all nets U_{rms} or U_	Rated voltage in V: line to earth[3] U_{rms}	Rated voltage in V: line to earth U_{rms}
60	63	32	63
110 120 127	125	80	125
150[2]	160	–	160
208	200	125	200
220 230 240	250	160	250
300[2]	320	–	320
380 400 415	400	250	400
440	500	250	500
480 500	500	320	500
575	630	400	630
600[2]	630	–	630
660 690	630	400	630
720 830	800	500	800
960	1000	630	1000
1000[2]	1000	–	1000

[1] This voltage can be identical to the device's nominal voltage.

[2] These values correspond to the values given in table 1.

[3] In countries where both kind of nets, Star and Delta, earthed and non-earthed, occur please apply only the Delta-values. Nets which are earthed by impedances have to be treated as non-earthed nets.

Table 3b

Procedure for the user:

To select the connector the user first confirms which type of net he has and which voltage.

Taking into consideration the degree of pollution and the insulation material the minimum creepage distance is taken from table 4.

Rated voltage $U_{\sim rms}$ or $U_{\_}$ in V	Minimum creepage distance in mm													
	Printed board connector		Other components											
	Degree of pollution		Degree of pollution											
	1	2	1	2			3				4			
				Insulation material			Insulation material				Insulation material			
	[2]	[3]	[2]	I[1]	II	IIIa IIIb	I	II	IIIa	IIIb	I	II	IIIa	IIIb
10	0.025	0.04	0.08	0.4	**0.4**	**0.4**	1	**1**	**1**		1.6	1.6	1.6	
12.5	0.025	0.04	0.09	0.42	**0.42**	**0.42**	1.05	**1.05**	**1.05**		1.6	1.6	1.6	
16	0.025	0.04	0.1	0.45	**0.45**	**0.45**	1.1	**1.1**	**1.1**		1.6	1.6	1.6	
20	0.025	0.04	0.11	0.48	**0.48**	**0.48**	1.2	**1.2**	**1.2**		1.6	1.6	1.6	
25	0.025	0.04	0.125	0.5	**0.5**	**0.5**	1.25	**1.25**	**1.25**		1.7	1.7	1.7	
32	0.025	0.04	0.14	0.53	**0.53**	**0.53**	1.3	**1.3**	**1.3**		1.8	1.8	1.8	
40	0.025	0.04	0.16	0.56	**0.8**	**1.1**	1.4	**1.6**	**1.8**		1.9	2.4	3	
50	0.025	0.04	0.18	0.6	**0.85**	**1.2**	1.5	**1.7**	**1.9**		2	2.5	3.2	
63	0.04	0.63	0.2	0.63	**0.9**	**1.25**	1.6	**1.8**	**2**		2.1	2.6	3.4	
80	0.063	0.1	0.22	0.67	**0.95**	**1.3**	1.7	**1.9**	**2.1**		2.2	2.8	3.6	
100	0.1	0.16	0.25	0.71	**1**	**1.4**	1.8	**2**	**2.2**		2.4	3.0	3.8	
125	0.16	0.25	0.28	0.75	**1.05**	**1.5**	1.9	**2.1**	**2.4**		2.5	3.2	4	
160	0.25	0.4	0.32	0.8	**1.1**	**1.6**	2	**2.2**	**2.5**		3.2	4	5	
200	0.4	0.63	0.42	1	**1.4**	**2**	2.5	**2.8**	**3.2**		4	5	6.3	
250	0.56	1	0.56	1.25	**1.8**	**2.5**	3.2	**3.6**	**4**		5	6.3	8	[4]
320	0.75	1.6	0.75	1.6	**2.2**	**3.2**	4	**4.5**	**5**		6.3	8	10	
400	1	2	1	2	**2.8**	**4**	5	**5.6**	**6.3**		8	10	12.5	
500	1.3	2.5	1.3	2.5	**3.6**	**5**	6.3	**7.1**	**8.0**		10	12.5	16	
630	1.8	3.2	1.8	3.2	**4.5**	**6.3**	8	**9**	**10**		12.5	16	20	
800	2.4	4	2.4	4	**5.6**	**8**	10	**11**	**12.5**		16	20	25	
1000	3.2	5	3.2	5	**7.1**	**10**	12.5	**14**	**16**		20	25	32	
1250			4.2	6.3	9	12.5	16	18	20		25	32	40	
1600			5.6	8	11	16	20	22	25		32	40	50	
2000			7.5	10	14	20	25	28	32		40	50	63	
2500			10	12.5	18	25	32	36	40	[4]	50	63	80	
3200			12.5	16	22	32	40	45	50		63	80	100	
4000			16	20	28	40	50	56	63		80	100	125	
5000			20	25	36	50	63	71	80		100	125	160	
6300			25	32	45	63	80	90	100		125	160	200	
8000			32	40	56	80	100	110	125		160	200	250	
10000			40	50	71	100	125	140	160		200	250	320	

[1] Insulation material I or insulation material II, IIIa, IIIb, where the possibility of generation of creepage distances because of the conditions of paragraph 10.8 (of the IEC 60 664/60 664 A) decreases.
[2] Insulation material I, II, IIIa, IIIb.
[3] Insulation material I, II, IIIa.
[4] Values for creepage distance are not determined in this area. The insulation material IIIb is generally not recommended for the degree of pollution 3 over 630 V and for degree of pollution 4.

Table 4: Minimum creepage distances

Bold values are the most common values for industrial connectors.

For cases where different conditions exist from those mentioned above, the following procedure is recommended.

Determination of clearance

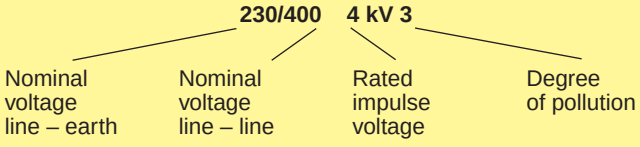
- Determine the overvoltage category
- Determine the degree of pollution
- Determine the rated impulse voltage acc. to table 1
- Determine the minimum clearance acc. to table 2a

Determination of creepage distances

- Determine the rated voltage acc. to table 3a/3b
- Determine the minimum creepage distance depending on the degree of pollution acc. to table 4

The general basis for all technical details of all connectors listed in the catalogue is the insulation group C for products, which were measured acc. to DIN VDE 0627-16.86 or the degree of pollution 3 as well as the overvoltage category III acc. to DIN VDE 0110-01.89 (IEC 60 664/60 664A).

The equipment is identified as follows:



Insulation group according to VDE 0110

Depending on its application, equipment is classified in insulation groups Ao, A, B, C, D relating to reduction in the performance of insulation caused by environmental influences, e. g. dust, dirt, humidity, condensation, ageing and aggressive ambient particles. In addition, these groups are determined both by the effects of damage produced by failure of the performance of an insulation material and also flashover voltages.

Generally, classification of equipment into the various insulation groups will be made in the appropriate VDE specifications by the relevant VDE commission.

Insulation group Ao

relates to low power equipment which is located in air conditioned or clean and dry locations or which is protected by appropriate measures and on which overheating will not be excessive in case of a short circuit. The overvoltage shall not exceed the value:-

$\hat{U}_{max} = \sqrt{2} \cdot (100\ V + 1.25\ U_B)$ (max. voltage includes peaks)

Insulation group A

relates to equipment which is located in air conditioned, clean, dry locations and protected by acceptable measures.

Insulation group B

relates to equipment housed in living rooms, stores, premises, precision engineering, workshops, laboratories, control rooms, medical rooms, etc.

Insulation group C

relates to equipment mainly used in industrial, commercial and agricultural works housed in unheated stores, repair shops or boiler houses or on machine tools, etc.

Insulation group D

relates to equipment used on power vehicles, or rolling stock exposed to dampness resulting from condensation or melting snow and conductive dust caused by braking devices that are not satisfactorily enclosed.

Creepage distances according to VDE 0110 b/2.79

The values for creepage distances a and b in table 4 depend on the form of the path of creepage-distance and the tracking resistance of the insulation material.

Until further notice insulation will be classified as shown in table 3.

VDE 0110 b/2.79, table 4

Minimum values for clearances and creepage distances in mm

Reference voltage (according to table 1) up to:

Voltage d. c.	V	15	36	75	150	300	450	600	800	900
Voltage a. c. (r. m. s.)	V	12	30	60	125	250	380	500	660	750
Insulation group Ao	L	0.06	0.1	0.15	0.25	0.5	0.8	1.1	1.5	1.8
	a	0.1	0.15	0.2	0.35	0.7	1.1	1.5	2.0	2.2
	b	0.15	0.2	0.3	0.5	1.0	1.5	2.0	2.7	3.0
Insulation group A	L	0.15	0.2	0.25	0.4	0.8	1.2	1.6	2.2	2.5
	a	0.2	0.25	0.35	0.5	1.0	1.5	2.0	2.8	3.2
	b	0.3	0.4	0.5	0.7	1.3	2.0	2.7	3.6	4.0
Insulation group B	L	0.4	0.5	0.7	1.0	1.6	2.4	3.0	4.0	4.5
	a	0.6	0.8	1.0	1.3	2.0	3.0	4.0	5.5	6.0
	b	0.8	1.0	1.3	2.0	3.0	4.0	5.5	7.0	8.0
Insulation group C	L	0.8	1.0	1.2	1.6	2.5	3.5	4.5	6.0	6.5
	a	1.2	1.5	1.7	2.2	3.0	4.5	6.0	8.0	9.0
	b	1.7	2.0	2.3	3.0	4.0	6.0	8.0	10.5	12.0
Insulation group D	L	1.6	1.8	2.0	2.5	3.5	5.0	6.5	8.0	9.0
	a	2.3	2.6	3.0	3.5	5.0	7.0	9.0	12.0	13.0
	b	3.2	3.5	4.0	5.0	7.5	10.0	13.0	17.0	19.0

L = clearance $\frac{a}{b}$ = creepage distance according to table 3

VDE 0110 b/2.79, table 3

Creeping current strength

Creepage current strength[1] (Minimum value)	Creepage distances[2]	
	without ribs	with ribs (§ 8a)
KB 100	b	$\frac{a+b}{2}$
KB 380	$\frac{a+b}{2}$	a
KB > 600	a	a

[1] VDE 0303
[2] For insulation group Ao and A generally creepage distance a

Current carrying capacity

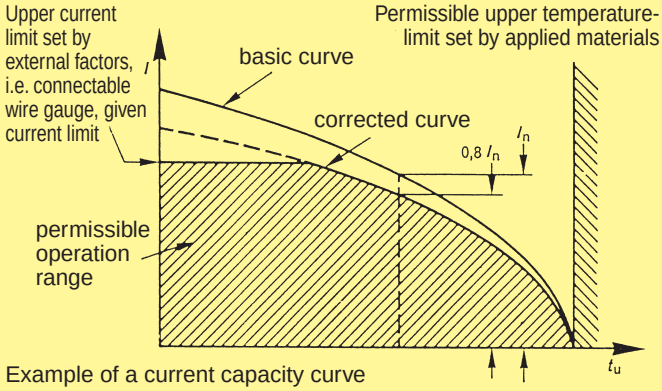
The current carrying capacity is determined in tests which are conducted on the basis of the DIN IEC 60 512 part 3. The current carrying capacity is limited by the thermal properties of materials which are used for inserts as well as by the insulating materials. These components have a maximum temperature which should not be exceeded.

The relationship between the current, the temperature rise (loss at the contact resistance) and the ambient temperature of the connector is represented by a curve. On a linear co-ordinate system the current lies on the vertical line (ordinate) and the ambient temperature on the horizontal line (abscissa) which ends at the permissible upper-limit temperature.

In another measurement the self-heating (Δt) at different currents is determined.

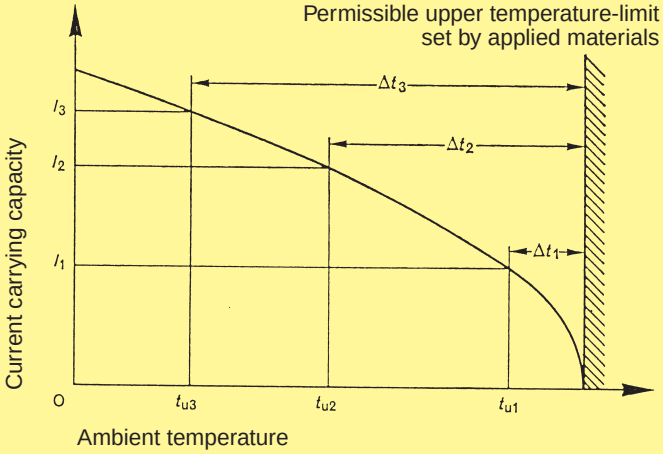
At least 3 points are determined which are connected to a parabolic curve, the basic curve.

The corrected current carrying capacity curve is derived from this basic curve. The reasons for the correction are external factors that bring an additional limitation to the current carrying capacity, i.e. connectable wire gauge or an unequal dispersion of current.



Example of a current capacity curve

Definition: The rated current is the continuous, not interrupted current a connector can take when simultaneous power on all contacts is given, without exceeding the maximum temperature.

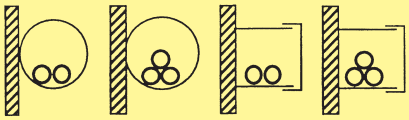
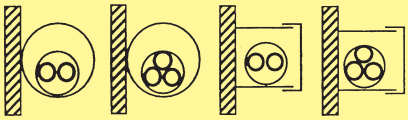
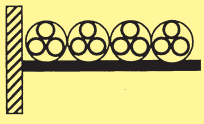


Example of a current carrying curve

In practice it is not usual to load all terminals simultaneously with the maximum current. In such a case one contact can be loaded with a higher current as permitted by the current capacity curve, if less than 20 % of the whole is loaded.

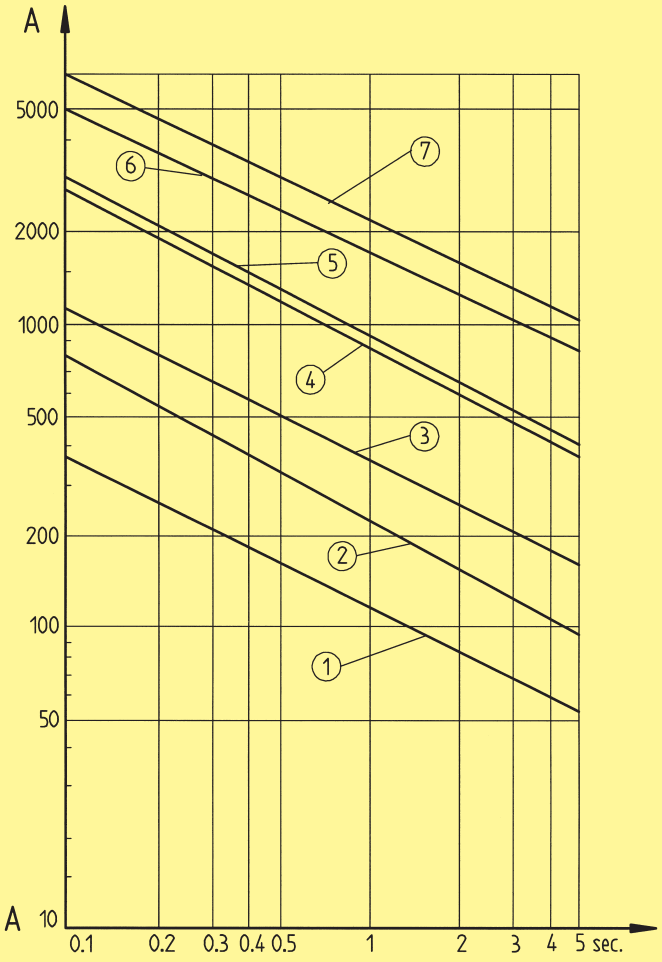
However, for these cases there are no universal rules. The limits have to be determined individually from case to case. It is recommended to proceed in accordance with the relevant rules of the DIN IEC 60 512 part 3.

Current carrying capacity of copper wires

Diameter [mm²] of single wires in a three-phase system	0.75	1	1.5	2.5	4	6	10	16	25	35
Type of installation										
B1  Wires in protective tubes and installation conduits	7.6	10.4	13.5	18.3	25	32	44	60	77	97
B2  Cables and wires in protective tubes and installation conduits	–	9.6	12	16.5	23	29	40	53	67	83
C  Cables and wires at walls	–	11.7	15.2	21	28	36	50	66	84	104
D  Cables and wires on a bed	–	11.5	16.1	22	30	37	52	70	88	114
Depiction in accordance with DIN EN 60 204 for PVC-insulated copper wires in an ambient temperature of + 40 °C under permanent operating conditions.										
For different conditions and temperatures, installations, insulation materials or conductors the relevant corrections have to be carried out.										

Transient current carrying capacity

A transient current in circuits can be generated by switching operations such as the starting of a motor or a short circuit in a faulty installation. This can cause thermal stress at the contact. These short and very high increases cannot be dissipated quickly and therefore a local heating effect at the contact is the result. Contact design is an important feature when transient currents are encountered. HARTING contacts are machined from solid material and are therefore relatively unaffected by short overloads when compared to stamped and formed designs. For guidance please see the table below.



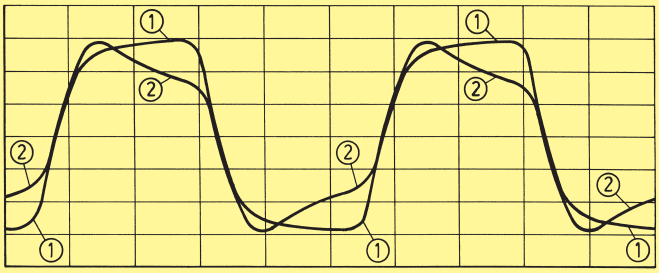
①	Han D	I_N = 10 A
②	Han 3 A / 4 A	I_N = 10 A
③	Han A/E/ES/EE/Q 5/0	I_N = 16 A
④	Han 6 HsB	I_N = 35 A
⑤	Han C/K axial	I_N = 40 A
⑥	Han K 4/8	I_N = 80 A
⑦	Han K 6/6	I_N = 100 A

Short circuit carrying capacity

Low currents and voltages

HARTING's standard contacts have a silver plated surface. This precious metal has excellent conductive properties. In the course of a contact's lifetime, the silver surface generates a black oxide layer due to its affinity to sulphur. This layer is smooth and very thin and is partly interrupted when the contacts are mated and unmated, thus guaranteeing very low contact resistances. In the case of very low currents or voltages small changes to the transmitted signal may be encountered. This is illustrated below where an artifically aged contact representing a twenty year life is compared with a new contact.

In systems where such a change to the transmitted signal could lead to faulty functions and also in extremely aggressive environments, HARTING recommend the use of gold plated contacts.

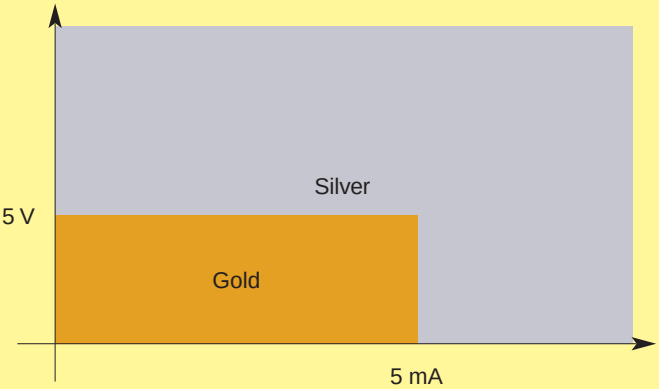


Changes to the transmitted signal after artifical ageing

① new contact

② after ageing

Below is a table derived from actual experiences.



Recommendation