We touch your electricity everyday!

GLOBAL SPECIALIST FOR POWER BUSBARS

Cast Resin Insulated Busway System

C&S electric

betobar

Manufacturing Facilities

Greater Noida - India, Plant

Haridwar - India, Plant

Boom-Belgium, Plant

C&S Electric Ltd. was founded in 1966 and is amongst the leading suppliers of electrical equipment in India. It's wide range of electrical and electronic products find application in power generation, distribution, control, protection and final consumption.

C&S employs over 4000 people including 400 engineers, and has 17 state-of-the-art manufacturing plants. It has 22 sales/marketing offices across India and its products are exported to more than 80 countries. C&S Electric also has joint venture companies with global leaders.

The Power Busbar Division of C&S founded in 1982 has been meeting the evolving needs of power generating stations, process and manufacturing industries, infrastructure establishments, technology and technological centers and real estate developments with its complete and fully tested product line of Busduct, Bustrunking and associated equipment.

The Eta-com group was founded in 1979 and ever since markets a full range of cast resin insulated busway systems. The concept which was already in use in the sixties in industrial installations is now in the third generation form. Due to the typical characteristics, the system guarantees the integrity of many projects world-wide, providing safe and maintenance free electrical power supplies in both Low Voltage and Medium Voltage installations.

With the acquisition of Eta-com in December 2011, the co-operation between the two companies give birth to a Global Power Busbars Specialist.

betobar is the leading technology in the world for cast resin insulated busbars in low & medium voltage installations.

This concept is unique as it is based on the direct encapsulation of copper or aluminium conductors with an insulation compound, B.I.M. casting mix, consisting of epoxy-resin mixed under vacuum. This B.I.M. casting mix has excellent electrical characteristics and high mechanical withstand with specific physical properties. It is moisture- resistant, fire-resistant and self extinguishing. A flexible fabrication method, universal moulds and an integrated process controlled mixing technique allow the production of an almost unlimited number of element forms for L.V as for M.V applications. The prefabricated elements are self-supporting and are interconnected electrically by joining the conductors with 2-sided compression contacts, ensuring an excess of contact surfaces and a maximum of adjustment. Junctions and element extremities are overcast with a B.I.M. casting mix resulting in a homogeneous insulation over the full length of the connection.

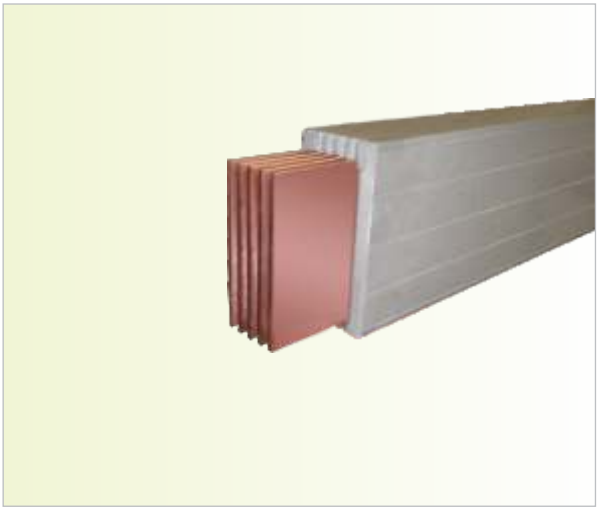
betobar busbars can be supplied in the following standard types:

For Low Voltage

LA - series
Up to 1000 V AC / 1500V DC
Three phase conductors and/or
Protective earth / 50,100,150 % neutral

Al-conductors range up to 5000 A
Cu-conductors range up to 6300 A

DC application on request
Other frequencies on request



For Medium Voltage

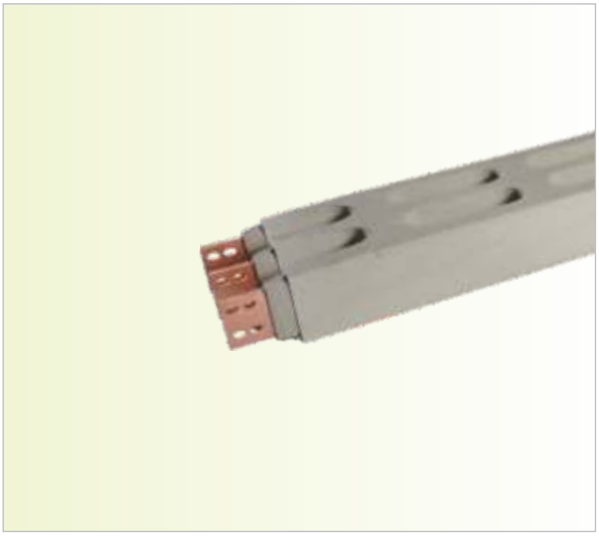
Type	Current Rating	Voltage Rating
SH - Series	Al upto 1600A Cu upto 1600A	3.6 KV to 12 KV
PH - Series	Al upto 4000A Cu upto 5000A	3.6 KV to 17.5 KV

Other current and voltage ratings on request.

IP68
degree of protection

IK10
mechanical resistance

Ex
explosion proof



isobar range covers Isolated Phase Busduct, Segregated Phase Busducts and Non-Segregated Phase Busducts.
C&S is a market leader in India and amongst the major global companies for design, manufacture, erection and commissioning of Isolated Phase Bus Ducts upto 1000MW power plants.

Today, we have an enviable track record of having associated with 14 Units of 660 MW, 25 Units of 500 MW, 35 Units of 250 MW, 30 Units of 150 MW Thermal Power Stations, Hydro Power Plants and Nuclear Power Plants, besides many Captive/Private Power Projects of capacity less than 100 MW. The largest proportion of power generated in India flows through C&S isobar busducts.

isobar Busduct have been successfully type tested for highest peak current during short circuit test and also for temperature rise test at world famous laboratories like KEMA-Holland and EDF-France, CPRI-Bhopal & Bangalore and at IIT-Roorkee (For Seismic tests)

Isolated Phase Busduct

C&S offers a wide range of natural air cooled Isolated Phase Busducts from 11 kV to 36 kV upto 30000A with a maximum Short Circuit Current withstand capability of 300 kA rms for 1sec. and 840 kA peak. These IPB's have applications in all generating station from 60 MW and above.

Segregated Phase Busducts

C&S offer a wide range of Segregated Phase Busducts for Medium Voltage applications from 3.3 kV to 33 kV upto 5000A. Segregated Phase Busducts find applications in Power Generating Stations and Industrial or Distribution Plants for lower capacity generator connections, inter-connections between switchgear and transformers.

Other Products

- Non-Segregated Phase Busducts (415 to 1100V upto 6500A)
- DC Busbar Systems
- PTSP Cubicles
- Generator Auxiliary Compartments (GAC)
- Neutral Grounding Cubicles
- Line & Neutral Side Terminal Boxes
- Pressurization System for IPB's
- Hot Air Blowing Equipment

metabar range cover Sandwich Bustrunking, Air Insulated Bustrunking & Lighting Trunking.

Energy Saver: Bustrunking has lower impedance in comparison to cable and conventional busducts for the same application. Lower impedance means less energy lost during distribution and this translates into cost savings.

Flexible Distribution: Plug-in type arrangement at regular intervals or as per customer design provides efficient power distribution.

Less Space: Bustrunking system require less space for Installation in a building / industry as compared to conventional busduct and cable system, so optimum utilization of space.

Conserves Raw-materials & Produces less waste: Material and manpower used in busway is lower than cable & conventional busduct. It saves money on raw materials and create less waste by buying pre-engineered lengths of busway.

Reusable: Bustrunking system comes with provision of expansions, changes, replacement and reusing.

SB - Sandwich Type

Compliance of Standard	IEC 61439 (1&6) & IS 8623 (1&2)
Independent Certificate Authority	ASTA - UK, CPRI-India
Conductor Material & Ratings	Copper 630A ~ 6600A, Aluminium 400A ~ 5000A
Rate Operational Voltage (Ue)	1000 Volt, AC
Rated Impulse Withstand Voltate (Uimp)	12 KV (1.2/50 s)
Enclosure Material	G.I/AL
Busbar Insulation	Multi layer Class - 'F' Insulation
Degree of Protection	IP 54/ IP55 /IP65 /IP67
Fire Rating	240Min. (ISO 834) 55
Seismic Compliance	Zone -5 (IS: 1893/IEEE 693)
Section Jointing	Uniblock Joint
Plug - in Box	32~800A

CB-Compact Air Insulated Type

Compliance of Standard	IEC 61439 (1&6) & IS 8623 (1&2)
Independent Certification Authority	ASTA-UK, CPRI-India
Conductor Material & Ratings	Copper 125~2000A, Aluminium 200~1250A
Rated Operational Voltage (Ue)	1000 Volt, AC
Rated Impulse Withstand Voltage (Uimp)	12 KV (1.2/50 s)
Enclosure Material	G.I
Busbar Insulator	Class-F
Degree of Protection	IP 54 /55
Fire Rating	120Min. (ISO 834) 55
Seismic Compliance	Zone-5 (IS:1893/IEEE 693)
Section Jointing	Uniblock Joint
Plug in Box	32 ~ 800 A

LB-Lighting Trunking

Compliance of Standard	IEC 61439 (1&6) & IS 8623 (1&2)
Independent Certificate Authority	CPRI - India
Conductor Material & Ratings	Copper - 25A, 32A, 40A, 63A
Rated Operational Voltage (Ue)	500 Volt, AC
Enclosure Material	Aluminium
Busbar Insulation	Flame Retardant PVC (Class 'A'-105 Deg C)
Section Jointing	Inbuilt push fit joint
Plug in Box rating	Upto 16 A (with/without fuse)
Degree of Protection	IP 55 / IP 54

betobar

CAST-RESIN INSULATED BUSWAY SYSTEMS

Extensive application and Element Range

betobar busbars are suitable for application in large buildings, industrial plants, power stations, sub-stations and large switchrooms, such as:

- Factory distribution of low and medium voltage power.
- Rising mains with tap-offs to sub-distribution boards in high rise buildings.
- Transformer switchboard connections.
- Main switchboard feeders to distribution panels.
- Generator and large motor feeders.
- 400 Hz distribution systems.
- Refineries, offshore and onshore platforms.
- Zone 2 & Zone 3 Explosive areas.

For special Application, contact our betobar agent.

betobar busway system is available in a wide range of standard element shapes, forms, and lengths which are fabricated to suit the typical project requirements. Our element range consists of :

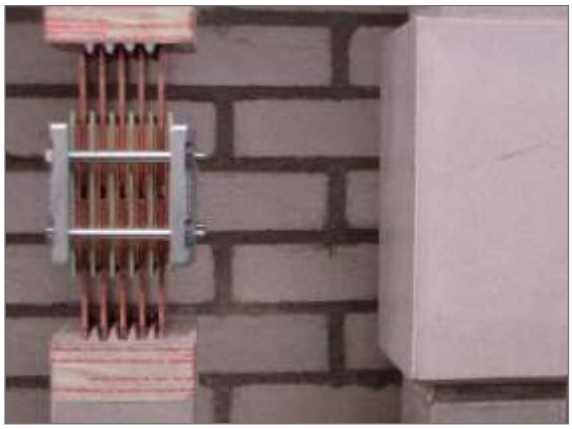
- Straight elements.
- Flat and edge elbows.
- Z (double elbow) and T elements.
- Flanged terminal elements.
- Tap-off facilities and phase-transfer elements.
- Thermal expansion compensation elements.
- Tailor-made terminal elements for transformer or generator and switchboard connection.

High- Quality Production

betobar busbars have been developed as a modern, all-purpose means of efficient and safe transmission of electrical energy. They have been in manufacture for more than thirty-five years.

betobar system complies with all the requirements for current distribution at low and medium voltage.

The busbar consists of copper or aluminium conductors, embedded in an enclosure of a fire retardant, self extinguishing and homogeneous insulation mix based on epoxy cast-resin with mineral fillers ensuring high mechanical strength and chemical withstand.



Standard types are available for current ratings up to 5000 A and Voltage ratings up to 17.5kV. Systems for higher current ratings or DC applications are possible on request.

The busbar line consists of a number of prefabricated elements. The electrical joining of the conductors is achieved by means of double fish plates and high tensile steel bolts.

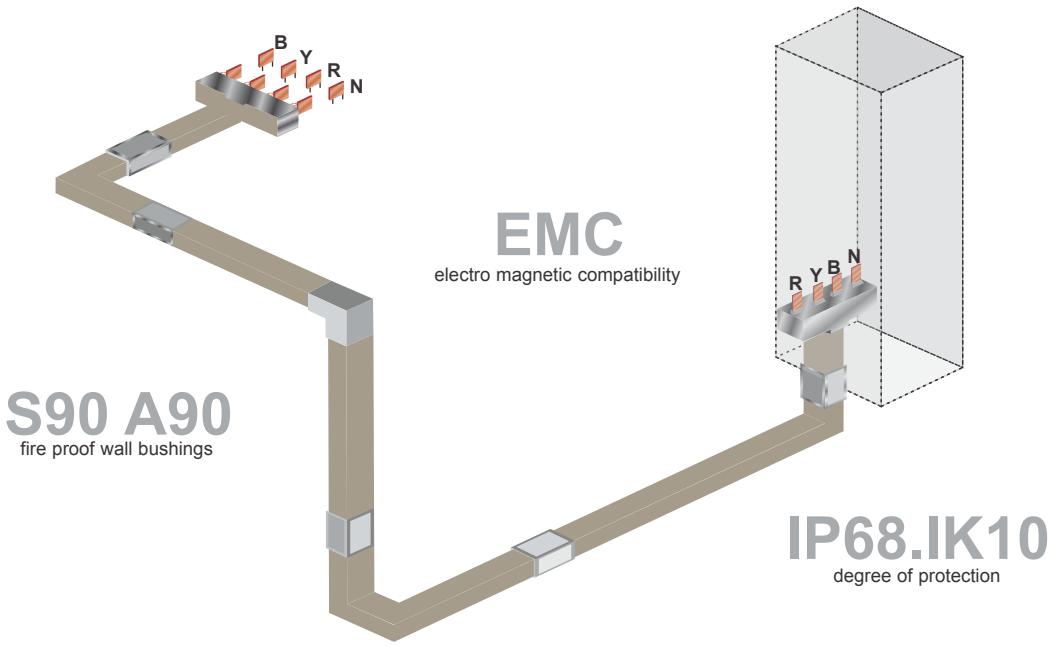
The junctions and the element ends are overcast with the same insulation mix as used for the elements. In this way an integral insulating enclosure to IP68.IK10 is guaranteed over the full length of the busbar run. Straight junctions and also elbow junctions are available each facilitating installation adjustments of 10-20 mm per standard junction.

Major Advantages

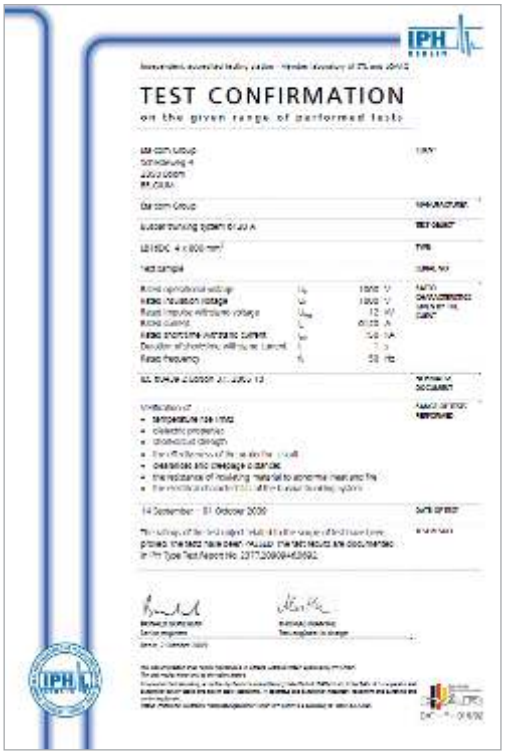
E30-E120
electrical continuity

- Compact Smaller Dimension.
- Simple and easy for Installation.
- Low Voltage Drop and High Short Circuit withstand Capacity.
- Overload Capacity of +20% for 2 Hours.
- Degree of Protection of IP68 for L.V bus ways and IP67 for M.V bus ways as per IEC 60529.
- High Mechanical Impact strength of IK.10 as per DIN 52453 & IEC 62262.
- Fire proof property : Tested for 750°C for 3 Hours in accordance with IEC 60331-21.
  Tested for 850°C for 2 Hours in accordance with BS 7346.
- Fire Wall Bushings of S90 & S120 in accordance with EN1366-3 and NBN 713.020.
- Fire Retardant Bushings A90 for Normal fire and H60 for Hydrocarbon Fire In Offshore Applications.
- Self-extingusihing insulation as per IEC 60332.
- Electrical Continuity E30-E120 finishing available under fire conditions as per DIN 4102-12.
- EMC Compatible. (For sensitive environment)
- Insulation level of CLASS 'B', 130°C.
- Explosion Proof ATEX, & IEC Ex Certified.
- Excellent Resistance to atmospheric pollution & wide range of chemicals.

explosion proof



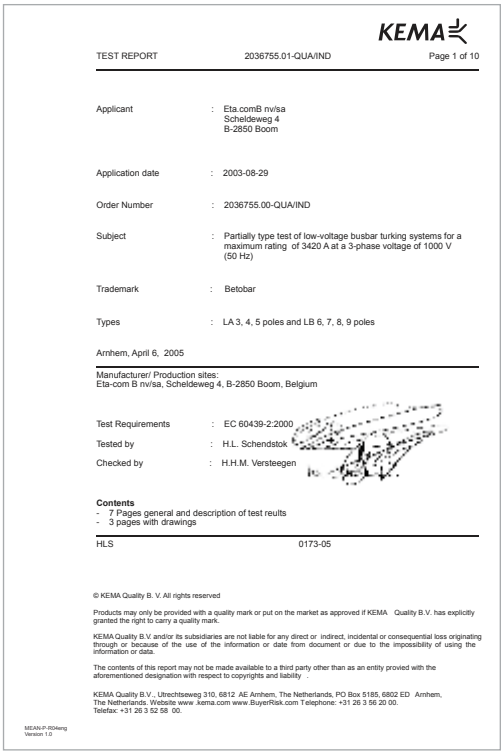
Product Certifications



TEST CONFIRMATION

on the given range of performed tests

IPH Type Test Certificate for L. V. Betobar



KEMA

TEST REPORT 2036755.01-QUA/IND Page 1 of 10

Applicant : Eta.comB nv/sa
Scheldeweg 4
B-2850 Boom

Application date : 2003-08-29

Order Number : 2036755.00-QUA/IND

Subject : Partially type test of low-voltage busbar turking systems for a maximum rating of 3420 A at a 3-phase voltage of 1000 V (50 Hz)

Trademark : Betobar

Types : LA 3, 4, 5 poles and LB 6, 7, 8, 9 poles

Arnhem, April 6, 2005

Manufacturer/ Production sites:
Eta-com B nv/sa, Scheldeweg 4, B-2850 Boom, Belgium

Test Requirements : EC 60439-2:2000

Tested by : H.L. Schendstok

Checked by : H.H.M. Versteegen

Contents
- 7 Pages general and description of test reults
- 3 pages with drawings

HLS 0173-05

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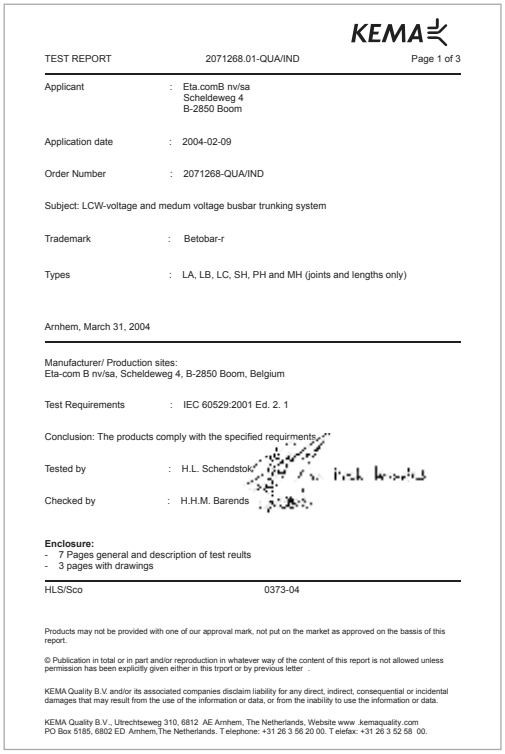
MEAN-P-R04eng
Version 1.0

KEMA Type Test Certificate for L. V. Betobar



KEMA

TEST REPORT 2071268.01-QUA/IND Page 1 of 3

Applicant : Eta.comB nv/sa
Scheldeweg 4
B-2850 Boom

Application date : 2004-02-09

Order Number : 2071268-QUA/IND

Subject: LCW-voltage and medum voltage busbar trunking system

Trademark : Betobar-r

Types : LA, LB, LC, SH, PH and MH (joints and lengths only)

Arnhem, March 31, 2004

Manufacturer/ Production sites:
Eta-com B nv/sa, Scheldeweg 4, B-2850 Boom, Belgium

Test Requirements : IEC 60529:2001 Ed. 2. 1

Conclusion: The products comply with the specified requirments

Tested by : H.L. Schendstok

Checked by : H.H.M. Barends

Enclosure:
- 7 Pages general and description of test reults
- 3 pages with drawings

HLS/Sco 0373-04

Products may not be provided with one of our approval mark, not put on the market as approved on the bassis of this report.

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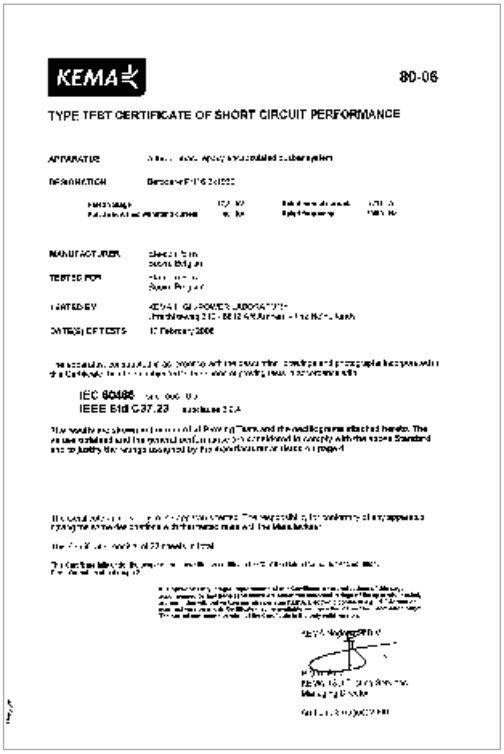
PO Box 5185, 6802 ED Arnhem,The Netherlands. Telephone: +31 26 3 56 20 00. Telefax: +31 26 3 52 58 00.

KEMA Type Test Certificate for Degree of Protection



KEMA

80-06

TYPE TEST CERTIFICATE OF SHORT CIRCUIT PERFORMANCE

APPARATUS

INFORMATION

MANUFACTURER

TESTED FOR

TESTED BY

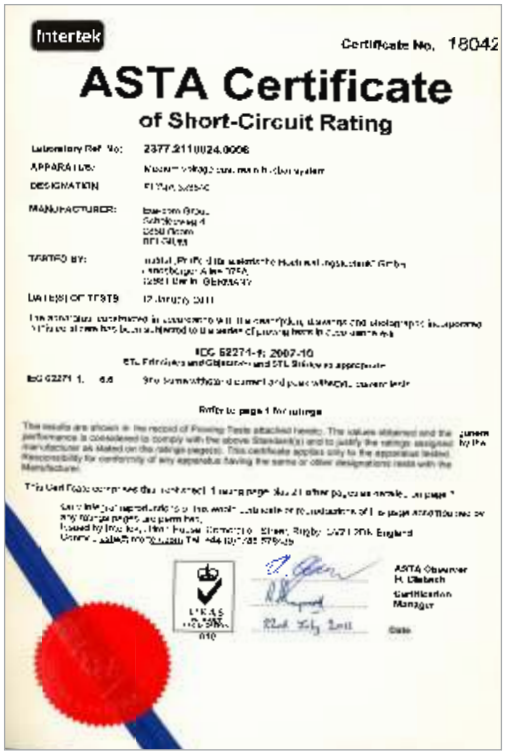
DATE(S) OF TESTS

IEC 60486

IEEE Std C37.23

KEMA Type Test Certificate for M. V. Betobar

Product Certifications



Intertek

Certificate No. 18042

ASTA Certificate

of Short-Circuit Rating

Laboratory Ref. No: 2377.2110024.0006

APPARATUS:

DESIGNATION

MANUFACTURER:

TESTED BY:

DATE(S) OF TESTS

IEC 62271-1: 2007-10

Refer to page 1 for ratings

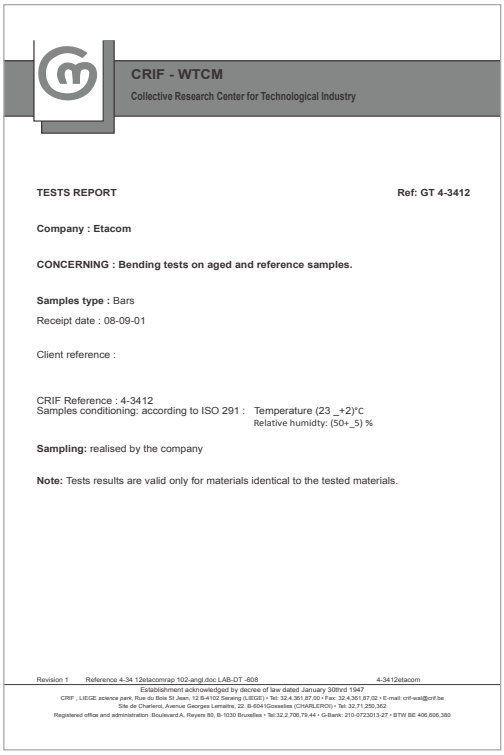
ASTA Observer

H. Dietsch

Certification Manager

Date

ASTA Type Test Report



CRIF - WTCM

Collective Research Center for Technological Industry

TESTS REPORT

Ref: GT 4-3412

Company : Etacom

CONCERNING : Bending tests on aged and reference samples.

Samples type : Bars

Receipt date : 08-09-01

Client reference :

CRIF Reference : 4-3412

Samples conditioning: according to ISO 291 : Temperature (23 _+2)°C

Relative humidty: (50+_5) %

Sampling: realised by the company

Note: Tests results are valid only for materials identical to the tested materials.

Revision 1 Reference 4-34 12etacomrap 102-angl.doc LAB-DT -608 4-3412etacom

Establishment acknowledged by decree of law dated January 30thrd 1947

CRIF , LIEGE science park, Rue du Bois St Jean, 12 B-4102 Seraing (LIEGE) • Tel: 32.4.361.87.00 • Fax: 32.4.361.87.02 • E-mail: crif-wal@crif.be

Site de Charleroi, Avenue Georges Lemaître, 22 B-6041Gosselies (CHARLEROI) • Tel: 32.71.250.362

Registered office and administration :Boulevard A. Reyers 80, B-1030 Bruxelles • Tel:32.2.706.79.44 • G-Bank: 210-0723013-27 • BTW BE 406.606.380

Ageing Test Report

IEP

Institut Scientifique de Service Public

Liège, 26 October 2004

TEST REPORT

Nr. 1183/2004

Tests for vertical flame spread of vertically-mounted cast-resin insulated busway systems

1. Test applied for by : Mr Goethals for Eta-com B n/v/sa, Schelderweg 4, B-2850 Boom, Belgium.

2. Type of product (* : information given by the sponsor) :
   * Reference : Low Voltage Betobar-t LALB series.
   * Description : Electrical busbar epoxy based cast resin insulation.
   * The general reference of this range of products is

     LXMx n-sec

     where X is the letter A (for 3 to 5 conductors) or B (for 6 to 9 conductors);
     hb is the height of the conductors in cm (4 possibilities: 04, 08, 12, 16);
     n is the number of conductors (3 ≤ n ≤ 9);
     sec is the section of each conductor in mm² (3 thickness possible : 4, 5 or 6 mm).

   Color : grey.
   Date of samples reception : 5 October 2004.

3. Sampling : not carried out by the Laboratory.

4. Procedure :

   The tests were performed in the equipment described in the IEC 60332-3-10 (2000) standard. We followed the procedure described in the par. 5 of IEC 60332-3-22 (2000) standard with the following restriction : the length of the Betobar-t submitted was deliberately limited to 2 m due to the weight of such products.

   NB : the IEC 60332-3-## series of standard specifies methods of test for the assessment of vertical flame spread of vertically-mounted bunched wires or cables, electrical or optical, under defined conditions.

   Two tests were performed: one on a LA busbar and one on a LB busbar. The types were chosen taken into account that the total width should not exceed 300 mm and to have at least two busbars submitted to the flames.

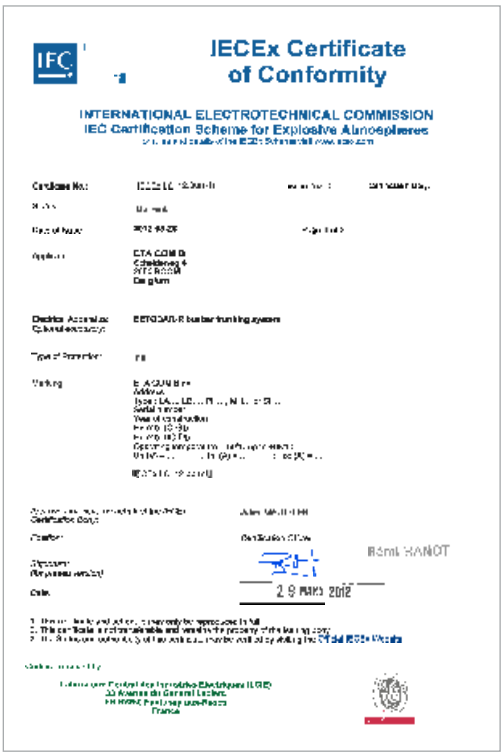
5. Date of the test : 5 October in the presence of Mr E Goethals from Eta-com.

Remarks : - Tests results are valid only for materials up to tested samples.
- This report can only be reproduced in full, except with the laboratory's agreement.

Siège social et site de Liège : Rue du Chéra 200 - B-4000 Liège (Belgique)
Tél. 04 229 83 11 - Téléfax 04 252 46 65

Site de Carlsbourg : Zoning A. Schweitzer, rue de la Plasmerie - B-7340 Colfontaine (Belgique)
Tél. 065 61 08 11 - Téléfax 065 61 08 08

Flame Spread Test as per IEC 60332



IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC Certification Scheme for Explosive Atmospheres

Certificate No:

Date of Issue:

Applicant:

Electrical Accessories:

Type of Protection:

Marking:

Certification Body:

Certificate Officer:

Signature:

Date:

Rémi HANOT

29 MARS 2012

IEC Certification for Explosive Atmospheres

Product Certifications

APPAREILS ET SYSTEMES DE PROTECTION POUR UTILISATION
EN ATMOSPHERES EXPLOSIBLES
EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED
FOR USE IN EXPLOSIVE ATMOSPHERES

Le LCIE, organisme notifié sous la référence 0081 conformément à l'article 9,
LCIE, notified body number 0081 in accordance with article 9 of,

de la Directive 94/9/CE du Parlement Européen et du Conseil du 23 mars 1994,
the Directive 94/9/EC of the European Parliament and Council of 23 March 1994,

certifie que la Société, *certifies that the company :*

ETA-COM B
Scheldeweg 4
2850 BOOM - BELGIQUE

applique un système approuvé d'assurance qualité de production,
operates an approved production quality assurance system,

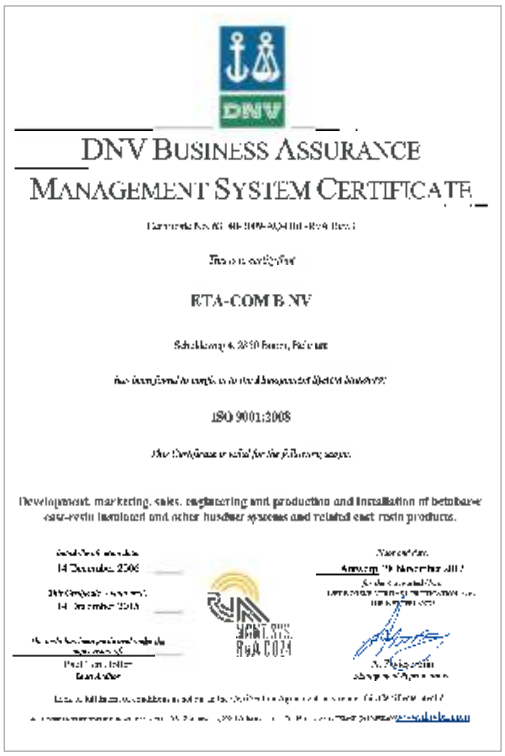
N° LCIE 08 ATEX Q 8016

Validité : du 05 mai 2011 au 04 mai 2014
Validity : from 5 May 2011 to 4 May 2014

Marc GILLAUX
Responsable de certification ATEX
ATEX Certification Manager

32-Diploma notification quality ATEX-rev0

ATEX Certification for Explosive Areas



DNV BUSINESS ASSURANCE
MANAGEMENT SYSTEM CERTIFICATE

ETA-COM B NV

ISO 9001:2008

Development, marketing, sales, engineering and production and installation of betobar-ex-resin insulated and other busbar systems and related cast resin products.

ISO 9001:2008 Certificate

KEMA

CERTIFICATE
ELECTROMAGNETIC COMPATIBILITY

Electromagnetic Compatibility

Product Certification

СИСТЕМА СЕРТИФИКАЦИИ ГОСТ Р

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ТЕХНИЧЕСКОМУ РЕГУЛИРОВАНИЮ И МЕТРОЛОГИИ

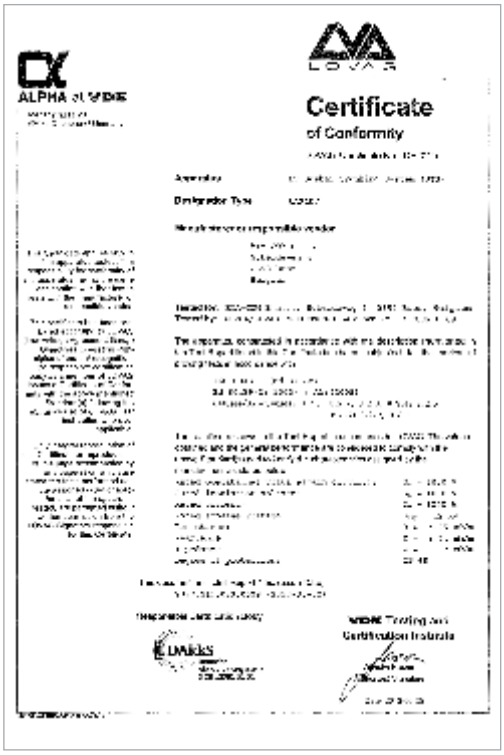
СЕРТИФИКАТ СООТВЕТСТВИЯ

№ 0813810

СООТВЕТСТВУЕТ ТРЕБОВАНИЯМ НОРМАТИВНЫХ ДОКУМЕНТОВ

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

GOST Certificate



ALPHA

Certificate

of Conformity

Type Test Report for L. V. Betobar

ASTA Certificate

of Short-Circuit Rating

Laboratory Ref. No: 2377.2110025.0015

APPARATUS: Medium voltage cast resin insulator system

DESIGNATION: PIGAO 5 x 3840

MANUFACTURER: Elia-com B nv, Scholdewerg 4, B-2850 Boom, BELGIUM

TESTED BY: Institut „Prüffeld für elektrische Hochleistungstechnik" GmbH, Landsberger Allee 378A, 12681 Berlin, GERMANY; FGH Engineering & Test GmbH, Haßlerweg 40, 68219 Mannheim, GERMANY; RST Hall System Testing GmbH, Environmental Lab, 16761 Hennigsdorf, GERMANY; Elia-com B nv, Scholdewerg 4, B-2850 Boom, BELGIUM

DATE(S) OF TESTS: 09 March 2011 to 04 April 2012

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this certificate has been subjected to the series of proving tests in accordance with:

IEC 62271-1: 2007-10

BTL Principles and Objectives and BTL Guides as appropriate

IEC 62271-1: 6.6 • Short-time withstand current and peak withstand current tests

This Certificate includes also:
- Temperature-rise test
- Dielectric tests
- Partial discharge tests
- Verification of the degree of protection
- Verification of the resistance of insulating material to abnormal heat and fire
- Verification of structural strength
- Verification of crashing resistance
- Verification of impact strength

Refer to page 1 for ratings

The results are shown in the record of Proving Tests attached hereto. The values obtained and the general performance contained to comply with the above Standard(s) and to justify the ratings assigned by the manufacturer as stated on ratings page(s). This certificate applies only to the apparatus tested. Responsibility for conformity of any apparatus bearing the same or other designations rests with the Manufacturer.

This certificate comprises this front sheet, 1 rating page plus 94 other pages as detailed on page 3.

Only integral reproductions of this whole certificate or reproductions of this page encompassed by any ratings program are permitted.

Issued by Intertek, Hilton House, Corporation Street, Rugby, CV21 2DH England.

UKAS 010

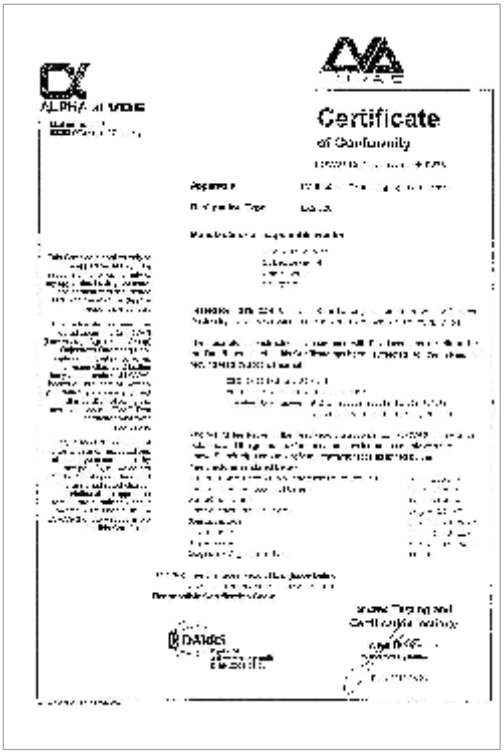
ASTA Observer H. Gledsch

Certification Manager

25th May 2012

Date

Type Test Report for M. V. Betobar



ALPHA

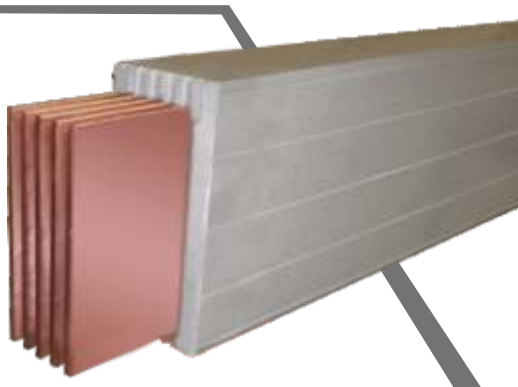
Certificate

of Conformity

Type Test Report for L. V. Betobar

betobar

Low Voltage



Applications

Technical Specifications for Low Voltage

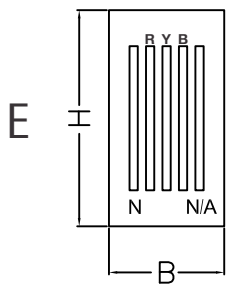
Compliance Standard	IEC 61439 (1 & 6)
Independent Certification	KEMA, MPA (Germany), ISSeP, LCE, ASTA, IPH
Type of Series	LA - Single Duct & Double Duct - 3, 4, 5 Pole
Busbar Configuration	3 Phase 3 Phase + 100% Neutral 3 Phase + 100% Neutral + 100% Isolated Earth
Ratings	**LA Copper Series** 800A to 3000A (Single Duct) 3200A to 6300A (Double Duct) **LA Aluminium Series** 630A to 2250A (Single Duct) 2500A to 5000A (Double Duct)
Rated Operating Voltage	1000V, AC
Rated Insulation Voltage	1000V, AC
Rated Impluse withstand Voltage (U_{imp})	12kV (1.2/50µs)
Rated Frequency	50Hz
Busbar Material	Copper - 99.9% Pure ETP Grade Aluminium - 99.5% Pure Grade
Insulation	CLASS 'B' (130°C)
Degree of Protection	IP68 as per IEC 60529
Mechanical Impact Strength	IK.10 as per DIN 52453 & IEC 62262
Tap Off Box (on request)	Upto 400A - Pluggable From 400A to 630A - Fixed Type
Conditions of use	Altitude upto 5000m, indoor as well as outdoor Ambient temperature ; -50°C/ +55°C Ambient Humidity : 0% - 100%

Aluminium betobar

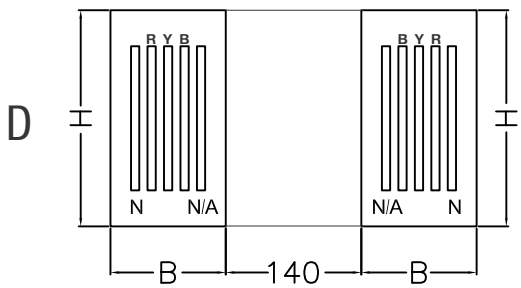
Type	3-4 cond BxH (mm)	5 cond BxH (mm)	Current rating	Alum. N,L1,L2,L3 mm²	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M		
												3 cond.	4 cond.	5 cond.
E single duct														
LA 04EA	104x80	104x80	630	240	22	46	120.8	157.2	54.7	166.4	190	20.7	20.9	21.1
LA 08EA	104x120	104x120	1000	480	37	78	60.4	79.5	33.5	86.3	282	31.3	31.8	32.3
LA 12EA	104x160	104x160	1250	720	48	101	40.3	54.0	24.2	59.2	322	42	42.7	43.4
LA 16EA	104x200	104x200	1600	960	55	121	30.2	41.8	19.0	45.9	387	52.7	53.6	54.5
LA 20EA	104x240	104x240	2000	1200	71	156	24.2	34.2	15.7	37.63	448	63.4	64.5	65.7
LA 24EA	104x240	104x240	2250	1440	76	167	20.1	27.0	13.3	30.10	475	75.3	76.7	78

Type	6-8 cond BxH (mm)	9-10 cond BxH (mm)	Current rating	Alum. N,L1,L2,L3 mm²	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M		
												6/7 cond.	8 cond.	10 cond.
D double duct														
LA 12DA	348x160	348x160	2500	2 x 720	79	166	20.1	27.0	12.1	29.60	612	84	85.5	86.8
LA 16DA	348x200	348x200	3200	2 x 960	115	253	15.1	20.9	9.5	23	732	105.4	107.2	109.1
LA 20DA	348x240	348x240	4000	2 x 1200	117	257	12.1	17.1	7.8	18.8	735	126.7	129	131.3
LA 24DA	348x285	348x240	4500	2 x 1440	112	246	10.1	13.5	6.7	15.1	796	150.6	153.3	156.1
		368x285	5000	2 x 1920	149	328	7.6	10.4	7.0	12.5	796	153.3	157	174.4

* Total average weight of the system with junctions.



LA Single Duct



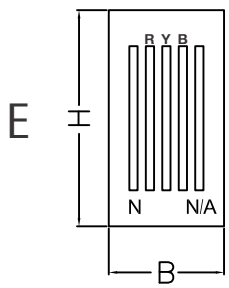
LA Double Duct

Copper betobar

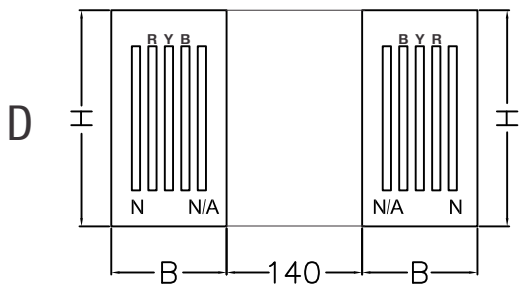
Type	3-4 cond BxH (mm)	5 cond BxH (mm)	Current rating	Copper N,L1,L2,L3 mm^2	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M		
												3 cond.	4 cond.	5 cond.
E single duct														
LA 04EC	104x80	104x80	800	240	30	63	72.9	94.9	54.7	109.5	190	25.9	27.9	29.9
LA 08EC	104x120	104x120	1250	480	50	105	36.5	49.1	33.5	59.44	280	41.9	45.8	49.8
LA 12EC	104x160	104x160	1600	720	65	143	24.3	34.3	24.2	41	322	57.8	63.8	69.7
LA 16EC	104x200	104x200	2000	960	75	165	18.2	26.6	19.0	32.7	387	73.8	81.7	90
LA 20EC	104x240	104x240	2500	1200	97	213	14.6	22.1	15.7	27	448	89.7	100	109.6
LA 24EC	104x285	104x285	3000	1440	103	227	12.2	17.1	13.3	21.7	475	106.9	118.8	130.8

Type	6-8 cond BxH (mm)	9-10 cond BxH (mm)	Current rating	Copper N,L1,L2,L3 mm^2	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M		
												6/7 cond.	8 cond.	10 cond.
D double duct														
LA 12DC	348x160	348x160	3200	2x720	108	227	12.2	17.1	12.1	21.0	609	115.6	127.6	139.5
LA 16DC	348x200	348x200	4000	2 x 960	157	345	9.1	13.3	9.5	16.34	732	147.5	163.4	179.3
LA 20DC	348x240	348x240	4500	2x1200	160	352	7.3	11.0	7.8	13.5	735	179.4	199.3	219.2
LA 24DA	348x285	348x240	5000	2 x 1440	153	337	6.1	8.6	6.7	10.9	796	213.8	237.7	261.5
		368x285	6300	2 x 1920	204	449	4.6	6.7	7.0	9.7	796	237.7	269.5	314.9

* Total average weight of the system with junctions.



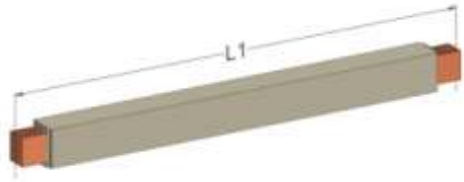
LA Single Duct



LA Double Duct

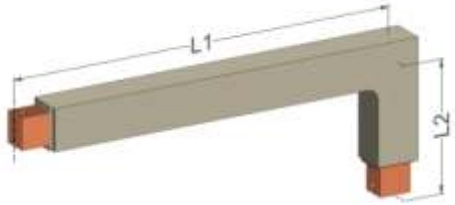
Straight Length

RE	L1 (mm)		
	Norm	Min	Max
RE1	1000	550	1000
RE2	2000	1001	2000
RE3	3000	2001	3000
RE4	4000	3001	4000



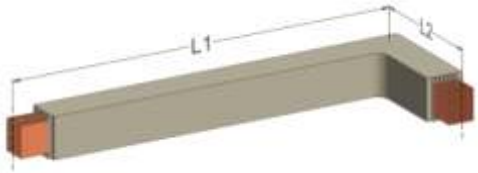
Brazed Elbow Element

HL		L1			L2			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Norm
HL 1	LA04	500	250	750	500	250	600	1000	500	1000
	LA08		270	730		270			540	
	LA12		290	710		290			580	
	LA16		310	690		310			620	
	LA 20		330	670		330			660	
	LA 24		353	647		353			706	
HL 2	LA04	1500	401	1750	1000	250	600	2000	1001	2000
	LA08			1730		270				
	LA12			1710		290				
	LA16			1690		310				
	LA 20	1000		1670		330		1500		
	LA 24			1647		353				



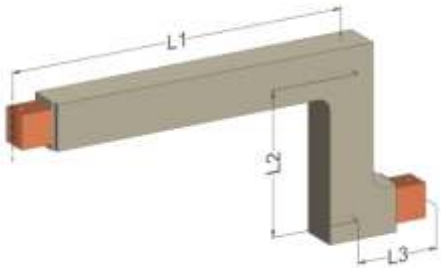
Bent Elbow Element

HB		L1			L2			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Norm
HB 1	LA..-3/5 (104mm)	500	262	738	500	262	738	1000	524	1000
	LA..-3/5 (114mm)		267	733		267	733		534	
HB 2	LA..-3/5 (104mm)	1500	262	1738	500	262	1738	2000	1001	2000
	LA20-3/5 (104mm)	1000	262	1738		262	1738	1500		
	LA24-3/5 (114mm)		267	1733		267	1733			



Brazed 'Z' Element

ZL		L1			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
ZL1	LA04	450	250	705	300	45	500	250			1000	545	1000
	LA08	430	270	685			480	270				585	
	LA12	410	290	665			460	290				625	
	LA16	390	310	645			440	310				665	
	LA 20	370	330	625			420	330				705	
	LA 24	360	353	595	280		397	360				751	
ZL2	LA04	1250	250	1705	500	45	560	250			2000	1001	2000
	LA08	1230	270	1730			540	270					
	LA12	1210	290	1710			520	290					
	LA16	1190	310	1690			500	310					
	LA 20	670	330	1670			500	330			1500		1500
	LA 24	640	353	1640			500	360					

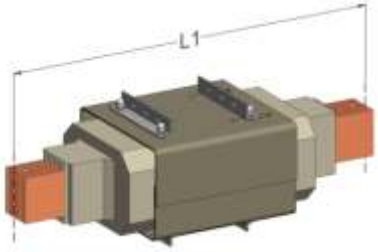


Bent 'Z' Element

ZB		L1			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
ZB1	LA..-3/5 (104mm)	350	262	638	300	100	476	350	262	638	1000	624	1000
	LA..-3/5 (114mm)		267	633			466		267	633		634	
ZB2	LA..-3/5 (104mm)	1000	262	1638	500	100	1476	500	262	1638	2000	1001	2000
	LA20-3/5 (104mm)	500	262	1638			1476		262	1638	1500		
	LA24-3/5 (114mm)		267	1633			1466		267	1633			

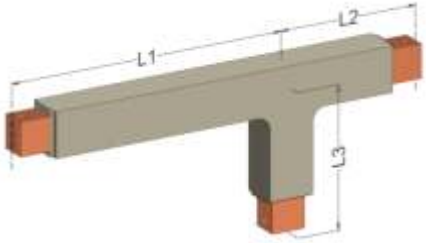
Expansion Joint

Ex	L1 (mm)		
Ex1	Norm	Min	Max
	1000	1000	1000



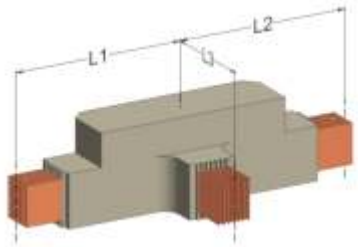
TEE Element - TL

TL		L1			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
TL1	LA04	330	250	500	330	250	500	340	250	600	1000	750	1000
	LA08		270	460		270	460		270			810	
	LA12		290	420		290	420		290			870	
	LA16		310	380		310	380		310			930	
	LA20		330	340		330	340		330			990	
TL2	LA04	1000	250	1500	500	250	1500	500	250	600	2000	1001	2000
	LA08		270	1460		270	1460		270				
	LA12		290	1420		290	1420		290				
	LA16		310	1380		310	1380		310				
	LA20		330	1340		330	1340		330				
	LA24	500	353	1294		353	1294		353		1500	1059	1500



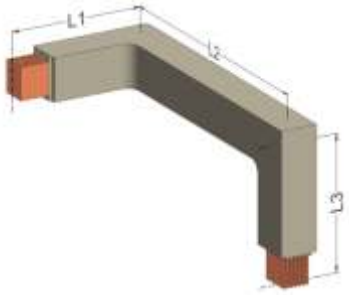
TEE Element - TB

TB		L1			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
TB2	LA04-3/5	380			380			280			1040		
	LA08-3/5	420			420						1120		
	LA12-3/5	510			510						1300		
	LA16-3/5	570			570						1420		
	LA20-3/5 (104mm)	610			610			280			1500		
	LA24-3/5 (104mm)	650			650			280			1580		
	LA24-3/5 (114mm)	655			655			285			1595		

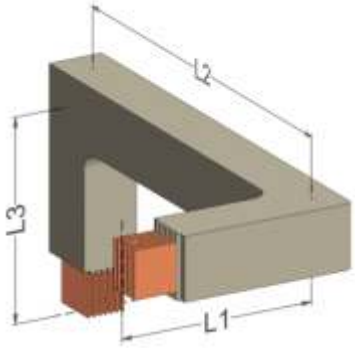


Double Elbow Element

XR/XL		L1			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
XR1/ XL1	LA04- 3/5	330	262	558	330	192	488	340	250	546	1000	704	1000
	LA08-3/5			518		212	468		270	526		744	
	LA12-3/5			478		232	448		290	506		784	
	LA16-3/5			438		252	428		310	486		824	
	LA20-3/5 (104mm)			398		272	408		330	466		864	
	LA24-3/5 (104mm)	310		352		295	385	360	353	443		910	
	LA24-3/4 (114mm)	310	267	347		300	385	360	353	438		915	
XR2/ XL2	LA04- 3/5	500	262	1558	1000	192	1488	500	250	600	2000	1001	2000
	LA08-3/5			1518		212	1468		270				
	LA12-3/5			1478		232	1448		290				
	LA16-3/5			1438		252	1428		310				
	LA20-3/5 (104mm)			1398	500	272	1408		330		1500		
	LA24-3/5 (104mm)			1352		295	1385		353				
	LA24-3/5 (114mm)			1347		300	1385		353				



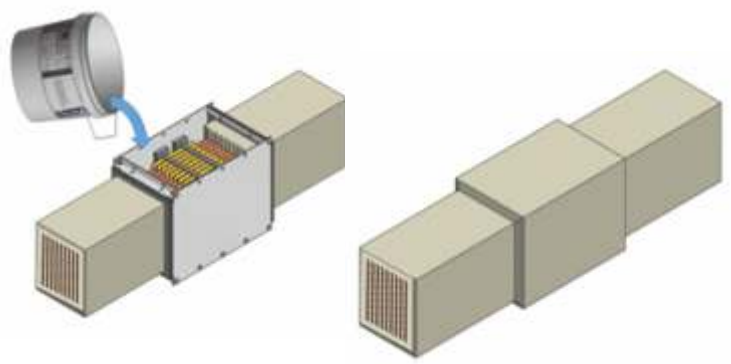
'XR' Type



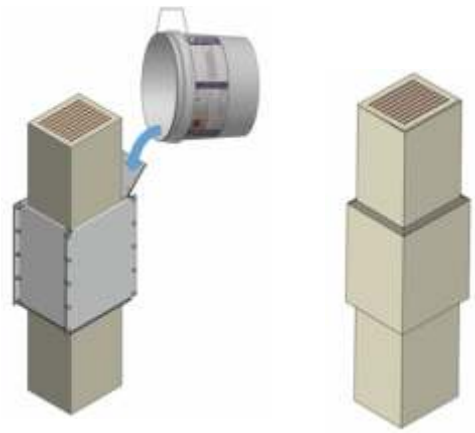
'XL' Type

Joints for Low Voltage

ST26 Joint

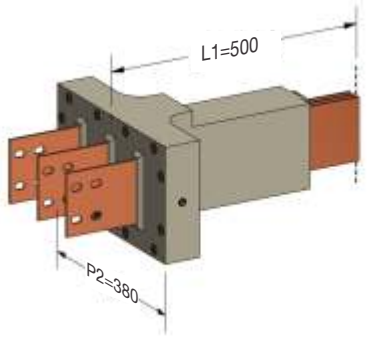


ST29 Joint

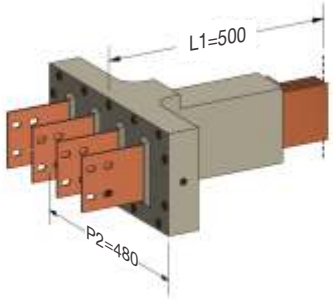


End Termination Element

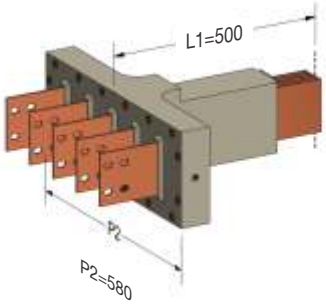
Single Duct



3 Pole

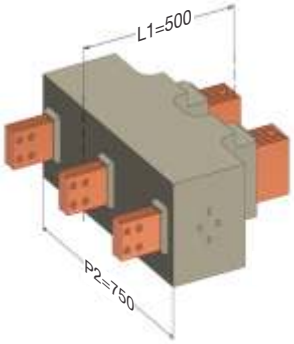


4 Pole

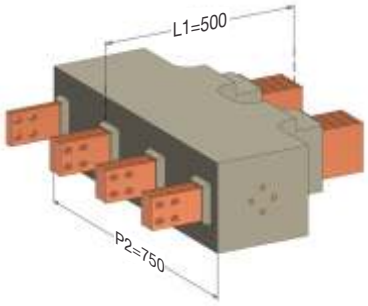


5 Pole

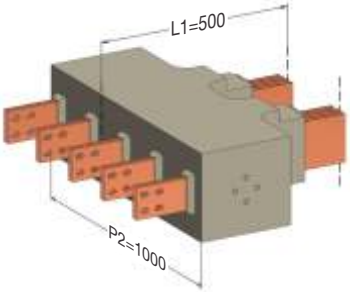
Double Duct



3 Pole

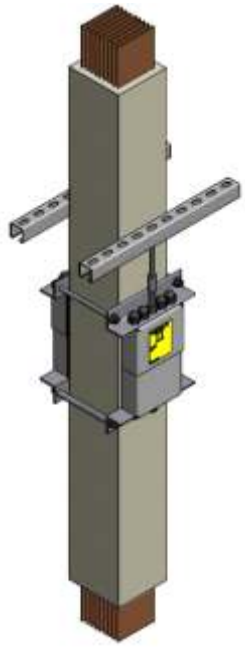


4 Pole

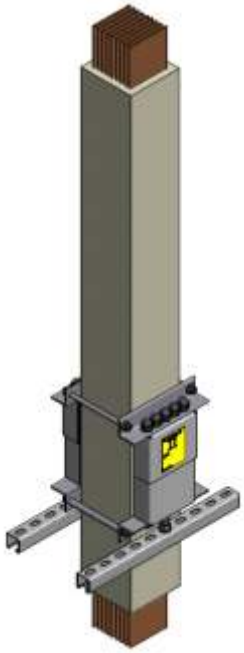


5 Pole

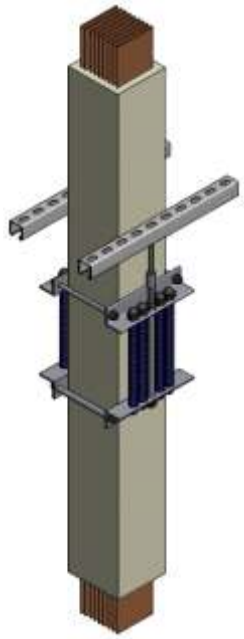
Spring Supports



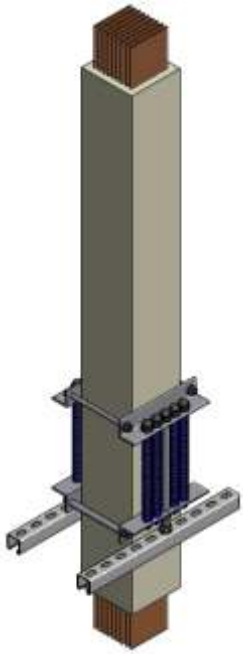
Closed Spring Support in Hanging Arrangement



Closed Spring Support in Standing Arrangement



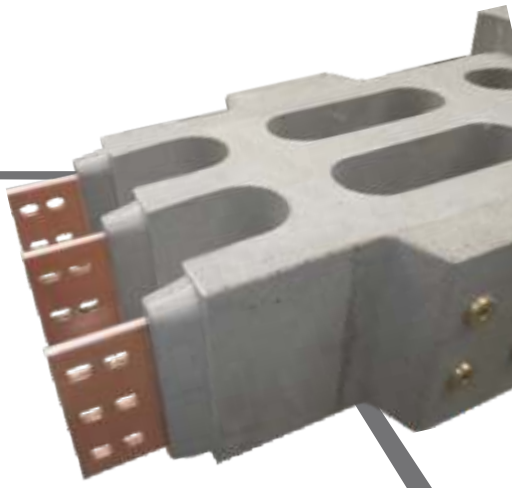
Open Spring Support in Hanging Arrangement

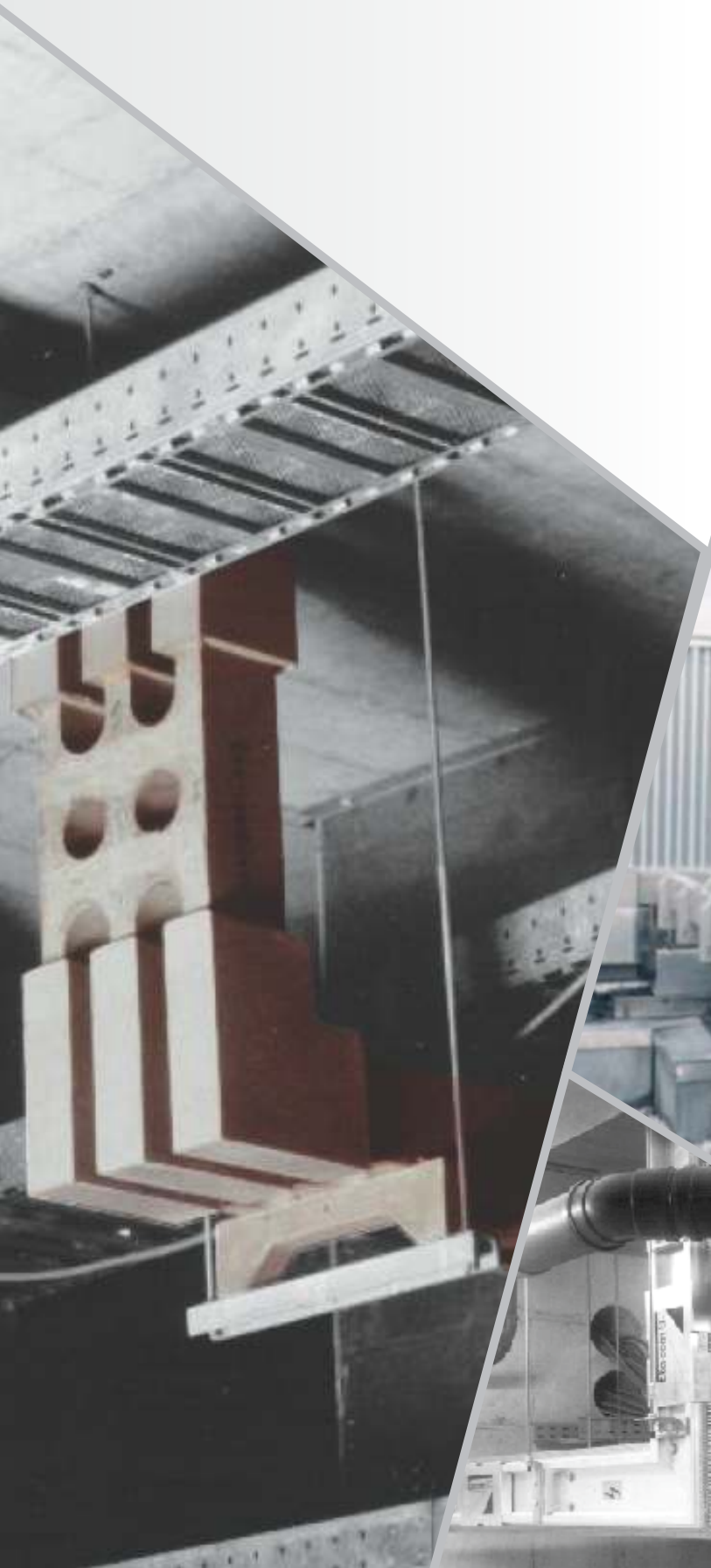


Open Spring Support in Standing Arrangement

betobar

Medium Voltage





Applications

Technical Specifications for Medium Voltage

Compliance Standard	IEC 62271
Independent Certification Authority	KEMA, MPA (Germany), ISSeP, ASTA, IPH
Type of Series	SH & PH Series
Ratings	**SH Series** Aluminium - 1250A to 1600A Copper - 1250A to 1600A **PH Series** Aluminium - 1600A to 4000A Copper - 2000A to 5000A
Rated Operating Voltage	SH Series - 3.6 kV to 12 kV* PH Series - 3.6 kV to 17.5 kV
Rated Frequency	50Hz
Busbar Material	Copper 99.9% Pure ETP grade Aluminium, 99.5% Pure grade
Insulation	CLASS 'B' (130^{0}C)
Degree of Protection	IP67 as per IEC 60529
Mechanical Impact	IK.10 as per IEC 62262 DIN 52453
Conditions of use	Altitude upto 5000m, indoor as well as outdoor Ambient temperature ; -50^{0}C / + 60^{0}C Ambient Humidity : 0% - 100%

* Operating Voltage of 12kV in SH Series is upto 630A.

SH Series

Aluminium betobar

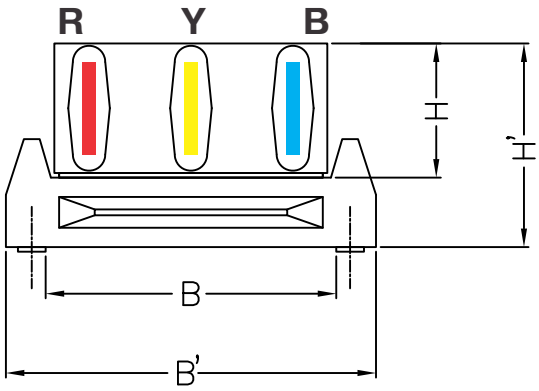
Type	3-4 cond BxH (mm)	5 cond BxH (mm)	Current rating	Alum. N,L1,L2,L3 mm²	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M
3.6-12kV**, 50 Hz												
SH 10A	160 x 140	250 x 195	1250	800	38	95	36.3	48.0	79	92.44	270	57.6
			1600	1200	57	143	24.2	33.0	76.8	83.71	270	59.5

Copper betobar

Type	3-4 cond BxH (mm)	5 cond BxH (mm)	Current rating	Copper N,L1,L2,L3 mm²	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M
3.6-12kV**, 50 Hz												
SH 06C	160 x 100	250 x 155	1250	480	48	120	36.5	48.1	102.9	113.6	261	58.3
SH 10C	160 x 140	250 x 195	1600	800	52	130	21.9	30.3	79	84.6	270	86.9

*Total average weight of the system with junctions

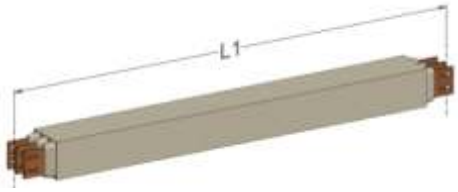
**Operating Voltage in SH Series is upto 630A



SH Series - Element Restricted Dimensions

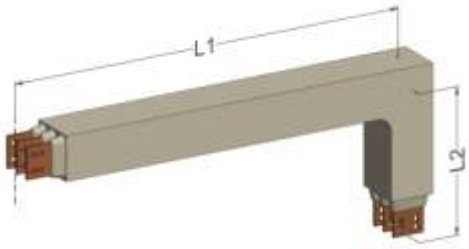
Straight Length

RE	L1 (mm)		
	Norm	Min	Max
RE1	1000	350	1000
RE2	2000	1001	2000
RE3	3000	2001	3000
RE4	4000	3001	4000



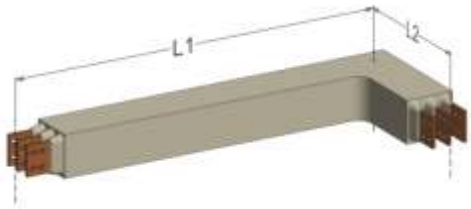
Brazed Elbow Element

HL		L1 (mm)			L2			L-Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
HL1	SH06	500	260	740	500	260	600	1000	520	1000
	SH10		280	720		280			560	
HL2	SH06	1500	401	1740	500	260	600	2000	1001	2000
	SH10			1720		280				



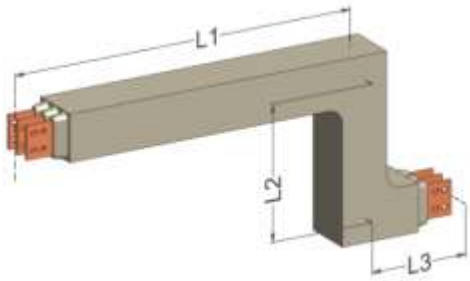
Bent Elbow Element

HB		L1 (mm)			L2			L-Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
HB1	SH06	500	290	710	500	290	710	1000	580	1000
	SH10		290	710		290	710		580	
HB2	SH06	500	290	1710	500	290	1710	2000	1001	2000
	SH10		290	1710		290	1710			



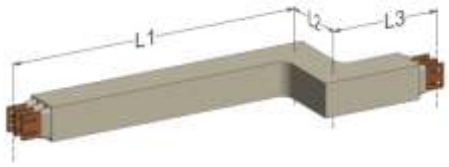
Brazed 'Z' Element

ZL		L1 (mm)			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
ZL1	SH06	440	260	695	300	45	560	260			1000	565	1000
	SH10	420	280	675			520	280				605	
ZL2	SH06	1240	260	1695	500	45	560	260			2000	1001	2000
	SH10	1220	280	1675			520	280					



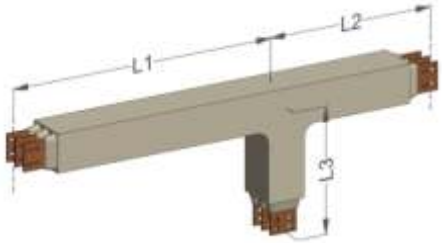
Bent ‘Z’ Element

ZB		L1 (mm)			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
ZB1	SH06	350	290	610	300	100	420	350	290	610	1000	680	1000
	SH10		290	610			420		290	610		680	
ZB2	SH06	1000	290	1610	500	100	1420	500	290	1610	2000	1001	2000
	SH10		290	1610			1420		290	1610			



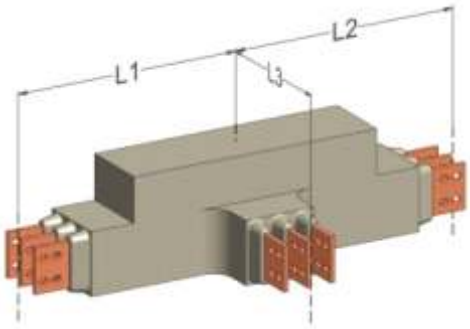
Brazed ‘T’ Element

TL		L1 (mm)			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
TL1	SH06	330	260	480	330	260	480	340	260	480	1000	780	1000
	SH10		280	440		280	440		280	440		840	
TL2	SH06	500	260	1480	500	260	1480	500	260	1480	2000	1001	2000
	SH10		280	1440		280	1440		280	1440			



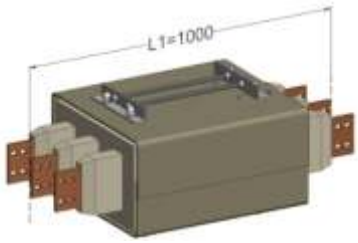
Bent ‘T’ Element

TB		L1 (mm)			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
TB2	SH06	460			460			315			1235		
	SH10	570			570						1455		



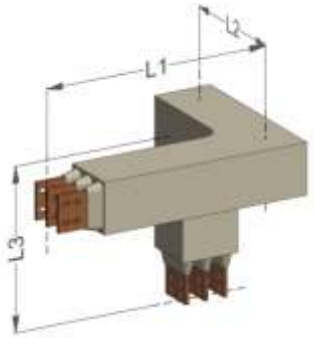
Expansion Joint

EX	L1 (mm)		
	Norm	Min	Max
EX1	1000	1000	1000

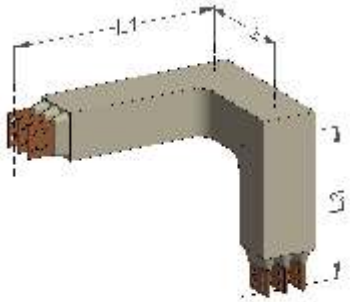


Double Elbow Element

XR/XL		L1 (mm)			L2			L3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
XR1/ XL1	SH06	330	290	450	330	290	450	340	260	420	1000	840	1000
	SH10		290	430		290	430		280	420		860	
XR2/ XL2	SH06	500	290	1450	1000	290	1450	500	260	600	2000	1001	2000
	SH10		290	1430		290	1430		280				



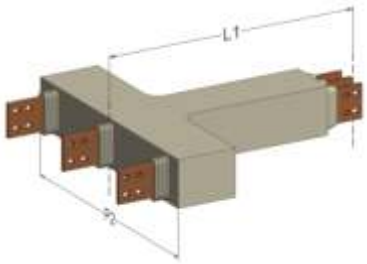
'XL' Type



'XR' Type

End Termination Elements

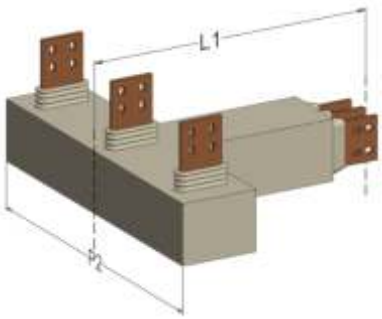
	L1			P2
	Norm	Min	Max	Std
AG1	500	400*	1000	750



'AG' Type

	L1			P2
	Norm	Min	Max	Std
AO1	500	400*	1000	750

* Depending on the geometry of termination head flange etc.



'AO' Type

PH Series

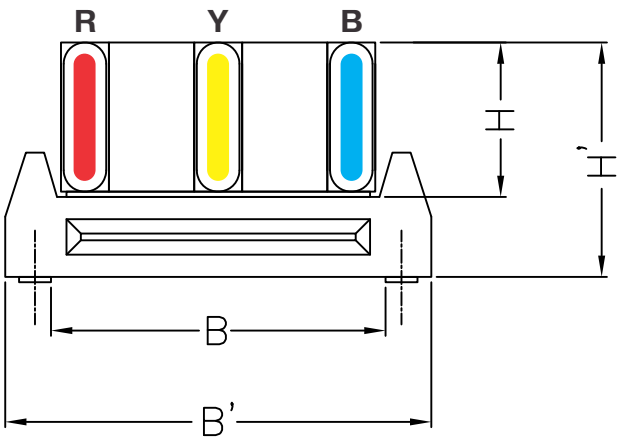
Aluminium betobar

Type	3-4 cond BxH (mm)	5 cond BxH (mm)	Current rating	Alum. N,L1,L2,L3 mm²	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M
3.6-7.2-12-17.5KV, 50 Hz												
PH 10A	301x40	390x215	1600	600	44	110	48.3	62.2	200	209.45	521	60.3
PH 12A	322x170	390x245	2000	1200	53	133	24.2	33.2	209.7	212.31	541	83.5
PH 16A	322x210	390x285	2500	1280	55	138	22.7	31.5	205.6	208.0	628	102.6
PH 20A	322x260	390x335	3200	2 x 1000	61	153	14.5	19.7	243.1	243.89	706	128.2
PH 24A	322x300	390x300	4000	2 x 1200	81	203	12.1	16.6	241.6	242.7	829	148.2

Copper betobar

Type	3-4 cond BxH (mm)	5 cond BxH (mm)	Current rating	Copper N,L1,L2,L3 mm²	Icw 1 sec kA	Ipk kA	Rdc 20°C µO/m	Rac OT (µO/m)	X µO/m	Z µO/m	P Losses @ In W/m	Element Weight *Kg/M
3.6-7.2-12-17.5KV, 50 Hz												
PH 12C	322 x 170	390 x 245	2000	720	44	110	24.3	33.2	271.1	273.13	541	98
			2250	960	58	145	18.2	25.9	270.9	272.1	570	103.9
PH 16C	322 x 210	390 x 285	2500	960	57	143	18.2	25.8	259.0	260.3	628	122.8
			3200	1280	75	188	13.7	20.3	259.0	259.79	628	130.7
PH 20C	322 x 260	390 x 335	4000	2 x 800	67	168	10.9	15.1	291.30	291.69	706	162.2
PH 24C	322 x 300	390 x 375	5000	2 x 1200	96	240	7.3	10.7	284.4	284.6	809	200.9

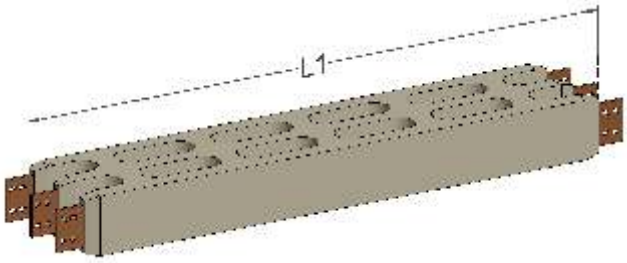
* Total average weight of the system with junctions.



PH Series - Elements

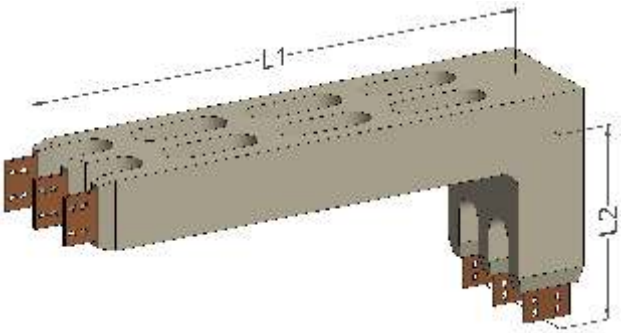
Straight Length

RE	L1 (mm)		
	Norm	Min	Max
RE1	1000	550	1000
RE2	2000	1001	2000
RE3	3000	2001	3000
RE4	4000	3001	4000



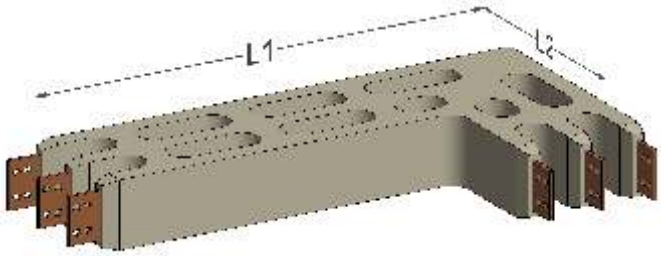
Brazed Elbow Element

HL		L1			L2			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Norm
HL 1	PH10	650	360	1000		350		1000	710	1000
	PH12	595	375			405			780	
	PH16	575	395			425			820	
	PH20	550	420			450			870	
	PH24	530	440			470			910	
HL 2	PH10	1650	651	2000		350		2000	1001	2000
	PH12	1595	596			405				
	PH16	1575	576			425				
	PH20	1550	551			450				
	PH24	1530	531			470				



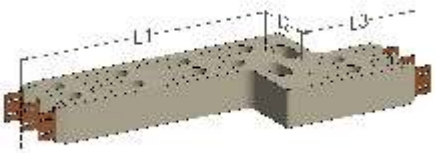
Bent Elbow Element

HB		L1			L2			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Norm
HB 1	PH10	500	370	630	500	370	630	1000	740	1000
	PH12		380	620		380	620		760	
	PH16		380	620		380	620		760	
	PH20		380	620		380	620		760	
	PH24		380	620		380	620		760	
HB 2	PH10	1500	370	1630	500	370	1630	2000	1001	2000
	PH12		380	1620		380	1620			
	PH16		380	1620		380	1620			
	PH20		380	1620		380	1620			
	PH24		380	1620		380	1620			



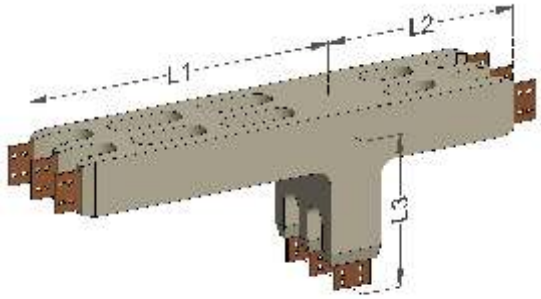
Bent 'Z' Element

ZB		L1			L2			L 3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Norm	Norm	Min	Norm
ZB1	PH10	400	370	430	200	200	260	400	370	430	1000	940	1000
	PH12		380	575		45	240		380	575		805	
	PH16		380	575		45	240		380	575		805	
	PH20		380	575		45	240		380	575		805	
	PH24		380	575		45	240		380	575		805	
ZB2	PH10	1000	370	1430	500	200	1260	500	370	1430	2000	1001	2000
	PH12		380	1575		45	1240		380	1575			
	PH16		380	1575		45	1240		380	1575			
	PH20		380	1575		45	1240		380	1575			
	PH24		380	1575		45	1240		380	1575			



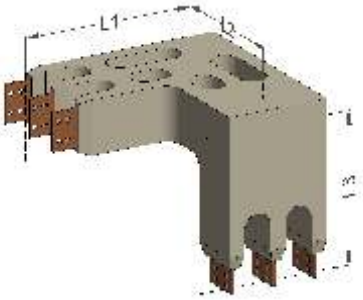
Brazed ‘T’ Element

TL		L1			L2			L 3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
TL2	PH10	650	360	1290	500	360	1290	350			1500	1070	2000
	PH12	595	375	1220		375	1220	405				1155	
	PH16	575	395	1180		395	1180	425				1215	
	PH20	550	420	1130		420	1130	450				1290	
	PH24	530	440	1090		440	1090	470				1350	

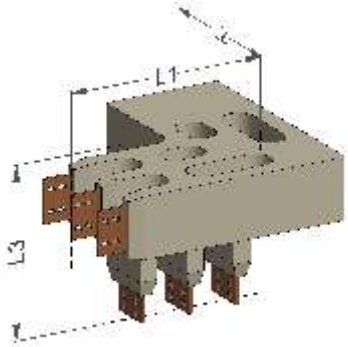


Double Elbow Element

XR / XL		L1			L2			L 3			L Total		
		Norm	Min	Max	Norm	Min	Max	Norm	Min	Max	Norm	Min	Max
XR2/ XL2	PH10	650	370	1339	500	311	1280	350			1500	1031	2000
	PH12	595	380	1259		336	1215	405				1121	
	PH16	575	380	1219		356	1195	425				1161	
	PH20	550	380	1169		381	1170	450				1211	
	PH24	530	380	1129		401	1150	470				1251	



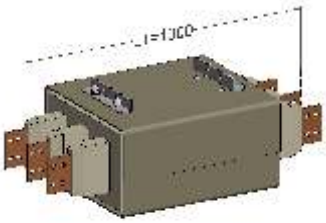
‘XR’ Element



‘XL’ Element

Expansion Joint

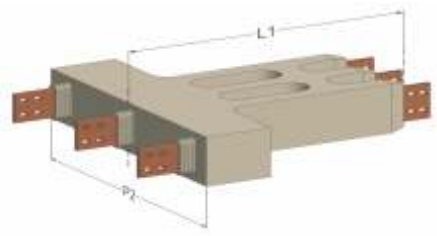
Ex	L1 (mm)		
	Norm	Min	Max
Ex1	1000	1000	1000



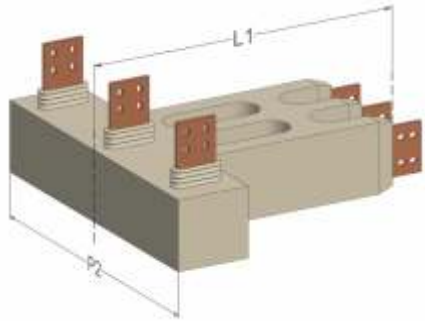
Terminal Elements

	L1		
	Norm	Min	Max
AG1	500	450	1000

	L1		
	Norm	Min	Max
AO1	500	450	1000



'AG' Type

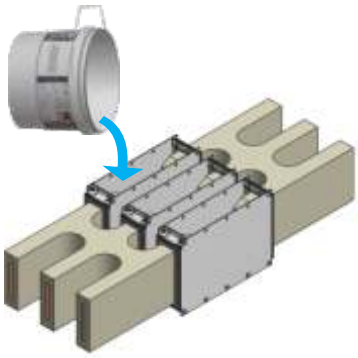


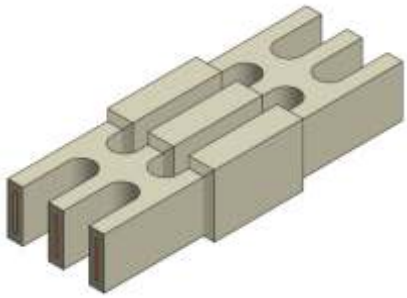
'AO' Type

* P2 Dimensions will depend on connection head of the equipment.

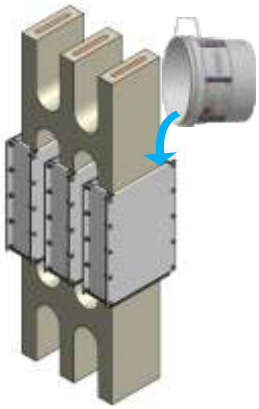
Joints for Medium Voltage

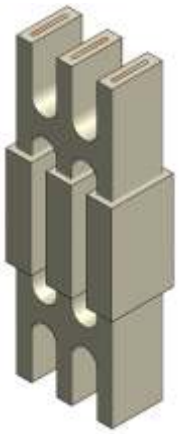
ST 26 Joint





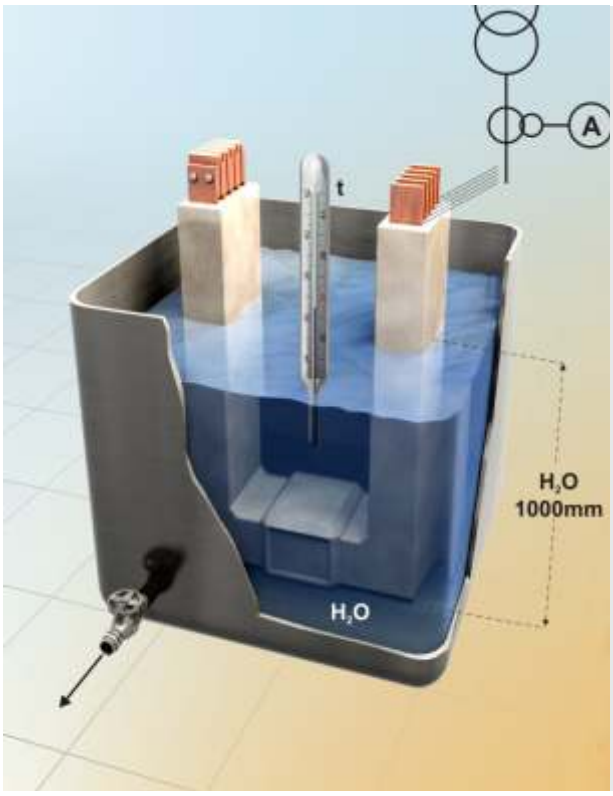
ST 29 Joint





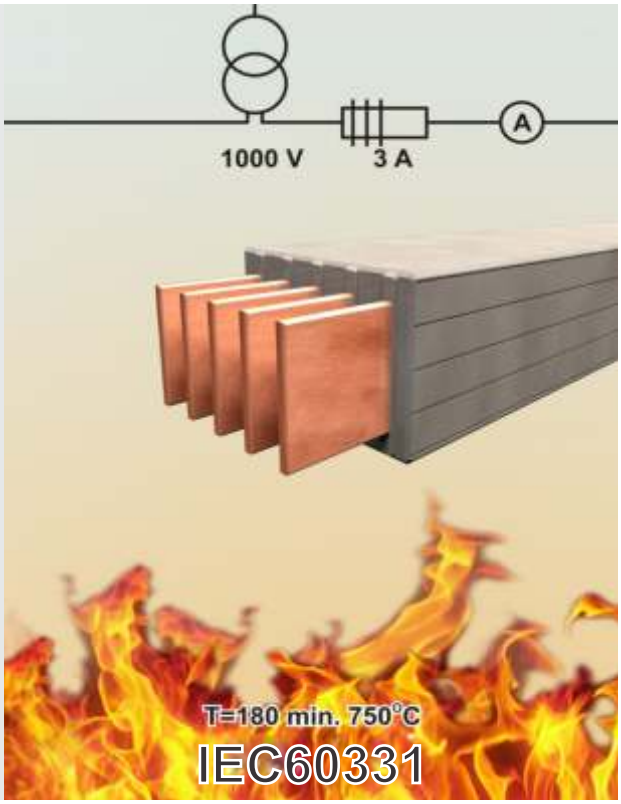
General Information

- Voltage Drop Calculation
- Chemical Resistance
- Standard Work Tests
- Reference List



Combined test
Heat run - Immersion
6 Cycles - Total 2592 hours

Fire resistance to IEC 60331
3 hours flame contact at 750°C
E30 to E120 as per NBN 713020 add 3
(Lab Luik Belgium)



Voltage Drop Calculation

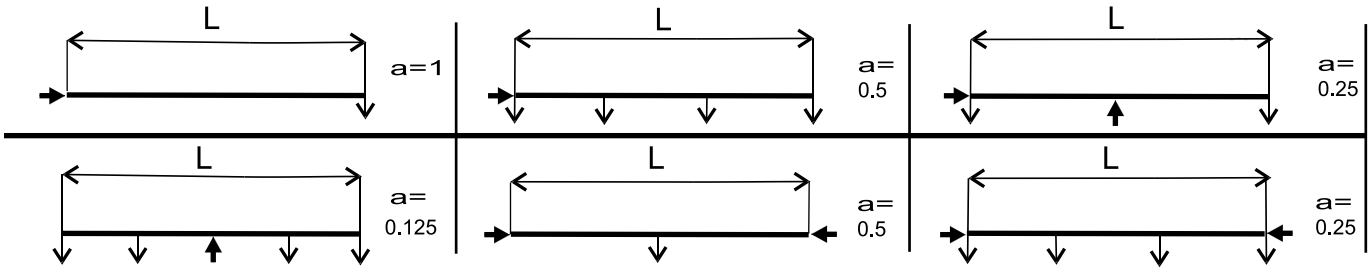
Generally long busduct connections have to be checked for voltage drop with the following formula:

$\Delta U = \sqrt{3} \times I_s \times a \times L \times (Ra.\cos\varphi + X.\sin\varphi) \times 10^{-6} V.$

Whereby :	ΔU	=	voltage drop (between phases)	[Volts]
	IS	=	Normal Full Load Current[1])	[Amps]
	a	=	current distribution factor	see graph.below
	L	=	total busduct length	[m]
	Rac	=	A. C. Resistance at operating temperature[2])	[μΩ/m]
	cosφ	=	power factor	
	X	=	reactance (mean value)	[μΩ/m]
	sinφ	=	rective factor ($=\sqrt{1-\cos\varphi 2}$)	

Notes :

1) For distribution lines, the max. average load current which can be indicated as a % of the full load has to be used in this calculation.
2) The operating temperature is the sum of the ambient temperature and the temperature rise as a result of the load current . For critical calculations Ra has to be corrected according to the tables (Ra_{20} or Ra_{85})



Phase sequence

Phase sequence in documentation and product documents :

is indicated as	R	S	T
to be equal to	R	Y	B
or	L1	L2	L3

General

For all information or technical calculation, please consult Eta-com or your betobar agent.

Chemical Resistance Insulation

The results of the tests carried out at laboratories are given in the table below. They are based upon the conditions prevailing during these tests : carried out at 20°C and fully immersed for at least one year.

The details given in this list have been prepared with maximum care and to the best of our knowledge. However, we cannot assume liability for usage in very specific cases.

Each individual application has to be considered by the factory.

Chemical agents		Results		
		E	G	F
Boric acid	H_3BO_3	X		
Hydrochloric acid 10%	HCl			X
Citric acid 10%	$C_3H_4OH(CO_2H)_3$			X
Lactic acid 10%	CH_3-CHOH-CO_2H			X
Alcohol (ethyl-)	C_2H_5OH		X	
Beer		X		
Ketone (acetone)	H_3CCOCH_3			X
Calcium chioride 50%	$CaCl_2$	X		
Liquid combustibles (petrol, oil,...)		X		
Water (distilled)	H_2O	X		
Water (mineral)		X		
Esters			X	
Ether	$C_2H_5OC_2H_5$			X
Formalin 37%	HCOH		X	
Glycerin			X	
Lubricating grease and oil		X		
Greases and oil		X		
Vegetable oil		X		
Aliphatic hydrocarbide (petroleumether)	C_5H_{12}	X		
Aromatic hydrocarbide (toluene)	C_5H_{12}			X
Chloride carbon	CCl_4			X
Ammonium hydroxide 10%	NH_4OH		X	
Ammonium hydroxide 30%	NH_4OH			X
Millk (fresh and sour)				X
Soda-lime 10%	NaOH		X	
Soda-lime 50%	NaOH		X	
Blood		X		
Soap and detergents		X		
Sugar (saturated solution)		X		
Urine		X		

E = Excellent, suitable even for uninterrupted and prolonged exposure
G = Good, suitable for prolonged exposure
F = Fair, suitable for repeated but brief exposures

In the event of consultations or enquiries regarding chemical resistance, please always state the following :

1. The chemical material, if possible with formula, and in case of trade names, the manufacturer.
2. The mixing ration with a solvent, usually water.
3. The temperature, including temperature changes with the corresponding time intervals.
4. Period of exposure.

Final Works Tests on Elements Low Voltage Un<1000V

A. Electrical Tests

Insulation Resistance and Voltage Test

Test		R-insulation	Voltage tests
Standards		Eta-com B	IEC 61439-6
Types	Un at 50 Hz V	R at 1 KV DC MΩ	U at 50 Hz 1min V
LA Elements	1.000	5.000	5.000

B. Dimensions

All dimensions are to be compared with the order sheet.

Result (yes/no) to be mentioned in final individual **test report

C. Phase sequence

End-and phase switching elements : conductor connections are to be compared with the order sheet.

Result (yes/no) to be mentioned in final individual**test report

D. Visual

The element and its workmanship are to be examined.

Result (yes/no) to be mentioned in final individual**test report

Test on site: The procedure of the tests to be executed on site is stipulated in the LV installation Instructions.

Final Works Tests on Elements Medium Voltage Un>1000V

A. Electrical Tests: Voltage Test And Partial Discharge Test

Tests between each conductor with all other conductors and supports earthed (dry)

Tests		Tests Voltage	Partial discharges		
Standards		IEC 6060	IEC 60270		
Types	Ur max* at 50Hz kV	Ud at 50 Hz kV/1 min	50 Hz 10 sec 1.7 Ur **(kV)**	50 Hz Ue 1.1 Ur **(kV)**	q** **(pC)** at 1.1 Ur **(kV)**
	3,6	10	6,12	3,96	20
SH Series					
	7.2	20	12,24	7,92	20
	12	28	20,40	13,20	20
PH Series					
	17.5	38	29,75	19,25	20

* Ur level for work tests can be specified by customer. If not indicated, the test voltage will be according to the rated voltage Ur equivalent to the operation voltage Us.

** Eta-com standard value. In accordance with IEC 62271-201 the customer can determine here the different values for each project.

QCP4232/128 P2W1 (the internal document numbers for this procedure)

B. Dimensions

All dimensions are to be compared with the order sheet.

Result (yes/no) to be mentioned in final test report

C. Phase sequence

End-and phase switching elements : conductor connections are to be compared with the order sheet.

Result (yes/no) to be mentioned in final test report

D. Visual

The element and its workmanship are to be examined.

Result (yes/no) to be mentioned in final test report

Tests on site : The procedure of the tests to be executed on site is stipulated on page 33 from the MV Installation Instructions.

Nomenclature M.V.: U_s = Operation voltage, U_r = Rated voltage

Busway Route Planner

Customer : _____ Date : _____

Information required for quotation. Please, photocopy this form and attach to your inquiry.

In	Un	Freq.	Temp. t_0	t_{max}	Project :
A	V	Hz	^{0}C	^{0}C	Job nr :

Conductors	3P	N	PE	+ -	Line	Length total	Outdoor	ΔU	%	Tap off's In
Cu ☐ Al ☐	☐	☐	☐	☐	nr	m	m			nr

Reference List

Country	City	Project Name	Industry	LV/MV	Year
Algeria	In Salah	Insalah Gas	Oil & Gas	LV	2008
Algeria	Sidi Ben Adda	Terga	Power Plant	LV	2009
Aruba	Oranjestad	Aruba Medical Centre	Hospital	LV	2010
Australia	Onslow	Wheatstone Project LNG Plant	Oil & Gas	MV & LV	2013/14
Australia	Onslow	Gorgon Onplots Project	Oil & Gas	MV & LV	2011/13
Austria	Ös	Telekom Vienna	Telecommunication	LV	2003
Austria	Vienna	Kaiser Franz Jozef Spital	Hospital	LV	2009
Azerbaijan	Caspian Sea	CA-CWP Platform Azeri	Oil & Gas	LV	2003
Bangladesh	Mymensing	Mymensing Power Plant	Power Plant	MV	2005
Belgium	Leuven	UZ Leuven - Cabine 403	Hospital	LV	2008
Belgium	Antwerp	ITC Rubis Terminal	Petrochemical	LV	2009
Belgium	Antwerp	Total Petrochemicals	Petrochemical	MV	2008
Belgium	Mechelen	KBC Data Centre	Data Centre	LV	2008
Belgium	Lommel	Hansen Transmissions	Manufacturing	MV	2008
Belgium	Antwerp	BASF	Chemicals	MV	2009
Belgium	Antwerp	AHPHT - ESSO	Oil & Gas	LV	2009
Belgium	La Hulpe	SWIFT	Banking	LV	2009
Belgium	Leuven	UZ Leuven	Hospital	MV & LV	2009
Belgium	Zwijndrecht	Borealis	Chemicals	LV	2010
Belgium	Feluy	AFTON Chemicals	Chemicals	LV	2010
Belgium	Feluy	TOTAL	Petrochemical	MV	2010
Belgium	Mechelen	DuPont	Chemicals	LV	2010
Belgium	Mechelen	Dow Belgium	Chemicals	LV	2010
Belgium	Mechelen	P&G Mechelen	Manufacturing	LV	2011
Belgium	Tessenderlo	Chevron Philips	Chemicals	LV	2012
Brasil	Offshore	Petrobras P-50 offshore	Oil & Gas	MV	2003
Colombia	Cartagena	Ecopetrol Cartagena Refinery	Petrochemical	LV	2010
Colombia		Petrominerales	Oil & Gas	LV	2010
Colombia	Montelibano	Cerromatoso	Mining	MV	2011
Colombia	Ayacucho	Ecopetrol Ayacucho Colombia	Petrochemical	MV	2011
Congo	Offshore	Libondo Platform Congo	Oil & Gas	LV	2009
Egypt	Damietta	LNG Train 2	Oil & Gas	MV & LV	2004
Egypt	Cairo	Nile Tower 2	Real Estate	LV	2007
Egypt	Alexandria	Sidi Kerir Petrochemicals	Petrochemical	LV	2009
France	Feyzin	TOTAL Feyzin Poste 2	Petrochemical	LV	2009
France	Feyzin	TOTAL P2 - GAB MT	Petrochemical	MV	2009
France		Traversées Etanches - Projet BPC3	Manufacturing	LV	2009
France	Drusenheim	DOW France Drusenheim	Chemicals	LV	2009
France	Pierrelatte	Usine Rec II Pierrelatte	Nuclear Power Plant	LV	2010
France	Lyon	Hôpital Neuro-Cardio Lyon	Hospital	LV	2010
France	Donges	Total Donges	Petrochemical	MV	2011
Germany	Frankfurt	Papermill WEPA	Paper Mill	LV	2003
Germany	Boxberg	Kraftwerk Boxberg	Power Plant	LV	2008
Germany	Frankfurt	Ticona Tiger	Chemicals	LV	2009
Germany	Datteln	Eon Kraftwerk Datteln	Power Plant	LV	2011
Germany	Köln	RWE Kraftwerk Fortuna	Power Plant	LV	2012
Germany	Mannheim	Grosskraftwerk Mannheim	Power Plant	LV	2012
Germany	Gaggenau/Rastatt	Daimler Trucks	Manufacturing	LV	2012

Reference List

Country	City	Project Name	Industry	LV/MV	Year
Germany	Wendefurth	Vattenfall Pumpstation Wendefurth	Substation	MV	2012
Germany	Offshore	Amrumbank	Wind Farm	LV	2013
Greece	Thinon	Wind Hellas Thinon	Telecommunication	LV	2008
Greece	Metamorfosi	Wind Hellas Metamorfosi	Telecommunication	LV	2008
India	Offshore	Offshore Platform	Oil & Gas	MV	2005
India	Greater Noida	JP Sport City Greater Noida	Utility	LV	2011
India	Bangalore	Oracle Bangalore	IT	LV	2011
Iraq	Majnoon	Shell Majnoon	Petrochemical	LV	2011
Ireland	Coolkeeragh	Power Station Coolkeeragh	Power Plant	LV	2003
Ireland	Belfast	BBC Belfast	Media	LV	2003
Ireland	Dublin	IBM SOR 37 IRELAND	Data Centre	LV	2008
Malaysia	Offshore	FPSO-MSE offshore	Oil & Gas	LV	2003
Malaysia	Bukit Rajah	Mox Bukit Rajah	Oil & Gas	MV	2010
Malaysia	Kerteh	Petronas	Oil & Gas	LV	2010
Malaysia	Peninsular Tapis Field	Exxon Mobil Tapis-R CCP Platform	Oil & Gas	LV	2011
Malaysia	Teluk Rubiah	Vale Miop	Mining	MV	2012
Malaysia	Sipitang	Samur Project	Chemicals	LV/MV	2013
Myanmar	Offshore	Yetagun platform	Oil & Gas	LV	2009
Myanmar	Offshore	Zawtika	Oil & Gas	LV	2012
Nigeria	Offshore	Bonny Island Refinery	Oil & Gas	LV	2003
Nigeria		NIPP	Oil & Gas	LV	2010
Norway	Oslo	Stortinget	Utility	LV	2003
Norway	Offshore	Hammerfest LNG plant	Oil & Gas	LV	2003
Norway	Offshore	Ekofisk offshore	Oil & Gas	MV	2004
Norway	Odda	Norzink	Chemicals	MV	2004
Norway	Stavanger	Navion Stavanger	Transportation	MV	2006
Norway	Glomfjord	Sitech Glomfjord	Manufacturing	LV	2008
Norway	Offshore	Valhall Aker	Oil & Gas	LV	2010
Norway	Ulsteinvik	Kleven	Transportation	LV	2012
Norway	Bodø	Kulturkvartalet Bodø	Utility	LV	2012/13
Oman	Qalhat	LNG Oman	Oil & Gas	MV	2003
Qatar	Offshore	Qatar Gas II	Oil & Gas	MV	2007
Qatar	Ras Laffan	Qatar Gas Common Sulphur	Oil & Gas	LV	2007
Qatar	Ras Laffan	Shell Pearl C4 - C5 - C6	Oil & Gas	LV	2007
Qatar	Ras Laffan	Ras Laffan	Oil & Gas	MV & LV	2007
Qatar	Offshore	Al Shaheen Maersk Oil	Oil & Gas	LV	2007
Qatar	Ras Laffan	Ras Gas Train 6&7	Oil & Gas	LV	2009
Qatar	Ras Laffan	Ras Laffan CCWP-II	Oil & Gas	MV	2010
Romania	Campulung	Holcim Cement Campulung	Manufacturing	MV	2010
Russia	Offshore	Sakhalin II Offshore	Oil & Gas	LV	2004
Russia	Moscow	Moscow City	Power Plant	MV	2006
Russia	Moscow	Substation Beskudnikovo	Power Plant	LV	2009
Russia	Khanti-Mansi	Priobskaya	Oil & Gas	MV	2009
Russia	Kodinsk	Boguchanskaya Hydro	Power Plant	MV & LV	2009
Russia	Novosibirskaya	Novosibirskaya	Power Plant	MV	2009
Russia	Nizhny Novgorod	Novogorkovskaya	Power Plant	MV	2009
Russia	Egorlykskaya	Egorlykskaya	Power Plant	MV	2010
Saudi Arabia	Shoaiba	Shoaiba Power Plant Units 1,2,3, 4, 5	Power & Desalination Plant	MV	2000/02

Reference List

Country	City	Project Name	Industry	LV/MV	Year
Saudi Arabia	Shoaiba	Shoaiba Power Plant stage II phase 1 & 2	Power & Desalination Plant	MV	2004/05
Saudi Arabia	Shoaiba	Shoaiba Power Plant stage III	Power & Desalination Plant	MV	2009
Saudi Arabia	Rabigh	Rabigh Power Plant	Power Plant	MV	2012
South Africa	Lephalale	Medupi	Power Plant	LV	2009
South Africa	Mpumalanga	Kusile	Power Plant	MV & LV	2010
Spain	Olivenza	Astexol-2 Solar Plant Badajoz	Power Plant	MV	2010
Spain	Alcazar de San Juan	Solar Power Plant Alcazar de San Juan ASTE 1A/1B	Power Plant	MV	2010
Sweden	Kaarstoe	IBM Kaarstoe	IT	LV	2004
Sweden	Kista	IBM Kista	IT	LV	2005
Switzerland	Gösgen	KKW Gösgen	Power Plant	LV	2009
Syria	Aleppo	Nahas Tower	Real Estate	LV	2007
Syria	Ebla	GTP Syria Project	Power Plant	LV	2010
Taiwan	Hualien	Bi Hai	Power Plant	MV	2004
Thailand	Offshore	Bongkot - Central Facilities	Oil & Gas	LV	2010
Thailand	Mae Moh	Egat Mae Moh Power Plant	Power Plant	MV	2011
The Netherlands	Hengelo	Akzo Salinco	Petrochemical	MV	2005
The Netherlands	Amstelveen	ABN Amro Computer Centre	Data centre	LV	2006
The Netherlands	Amsterdam	AMC Amsterdam	Hospital	LV	2006
The Netherlands	Amsterdam	KPN Amsterdam	Telecom	LV	2007
The Netherlands	Amsterdam	ING Treasury	Data centre	LV	2008
The Netherlands	Sluiskil	Yara	Manufacturing	MV	2009
The Netherlands	Rotterdam	Power Station Maasvlakte	Power Plant	MV & LV	2010
The Netherlands	Zwolle	Enexis Substation Zwolle	Power Plant	MV	2010
The Netherlands	Amsterdam	Schiphol Backbone & KWS 2	Airport	LV	2010
The Netherlands	Almelo	Urenco Hal 7	Manufacturing	LV	2010
The Netherlands	Maastricht	Academic Hospital Maastricht	Hospital	LV	2010
The Netherlands	Rotterdam	ING Wilgenplas	Data centre	LV	2010
The Netherlands	Amsterdam	Nuon Powerstation Hemweg	Power Plant	LV	2011
The Netherlands	Amsterdam	Global Switch Phase 1 - 3	Data centre	LV	2011
The Netherlands	Bergen op Zoom	Sabic MCC 501 en 502	Petrochemical	LV	2011
The Netherlands	Apeldoorn	Taxoffice Walter Bos & Quintax	Data centre	MV & LV	2011
The Netherlands	Arnhem	Duiventil	Data centre	LV	2012
The Netherlands	Terneuzen	Dow Chemical	Petrochemical	LV	2011
The Netherlands	IJmuiden	Motorvessel Carolien	Maritime	LV	2012
The Netherlands	Groningen	Enexis Substation Groningen	Substation	MV	2013
The Netherlands	Beilen	Domo Friesland Campina	Food Industry	LV	2013
U.A.E	Sharjah	Millennium Hotel	Real Estate	LV	2002
U.A.E	Sharjah	Bin Sabath Tower	Real Estate	LV	2005
U.A.E	Abu Dhabi	DIFC Gate Village	Utility	LV	2006
U.A.E	Abu Dhabi	Al Nasser Tower	Real Estate	LV	2006
U.A.E	Dubai	Between the bridges	Real Estate	LV	2007
U.A.E	Sharjah	Sharjah Gate Tower	Real Estate	LV	2007
U.A.E	Abu Dhabi	Yas Island DCP8,9	Disctrict Cooling Plant	LV	2008
U.A.E	Abu Dhabi	BOROUGE 2	Oil & Gas	LV	2008
U.A.E	Abu Dhabi	Gasco Ruwais	Oil & Gas	LV	2009
U.A.E	Ruwais	Green Diesel	Oil & Gas	LV	2009
U.A.E	Habshan	Habshan - 5 Process Plant	Oil & Gas	MV & LV	2010
U.A.E	Dalma Island	Dalma Island	Real Estate	LV	2011

Reference List

Country	City	Project Name	Industry	LV/MV	Year
U.A.E	Abu Dhabi	Shah Gas Project 4	Oil & Gas	LV	2011/12
U.A.E	Ruwais	Ruwais Refinery Expansion 3 - 3.3kV	Oil & Gas	MV	2011/12
U.A.E	Abu Dhabi	Borouge 3 PP/PE	Oil & Gas	LV	2011/12
U.A.E	Abu Al Abyadh	Shah Sulphur Station & Pipelines Project	Oil & Gas	LV	2012
U.A.E	Abu Dhabi	Satah Full Field Development Project	Oil & Gas	LV	2012/13
U.A.E	Habshan	NGI (Pure Case) Project	Oil & Gas	LV	2012/13
U.A.E	Abu Dhabi	LIWA Pumping Station	Water Treatment	LV	2012/13
United Kingdom	Warwick	IBM Warwick	Data Centre	LV	2006
United Kingdom	Cardiff	IDC Cardiff PH2	Data Centre	LV	2006
United Kingdom	Bletchley	BT Bletchley	Telecommunication	LV	2006
United Kingdom	Wynyard	Wynyard (EDS)	Commercial	LV	2008
United Kingdom	Walsall	Walsall Hospital	Hospital	LV	2009
United Kingdom	Cruachan	Cruachan II	Power Plant	MV	2009
United Kingdom	London	Nomura Bank Project Shinkyo	Commercial	LV	2009/10
United Kingdom	Isleworth	BSkyB Harlequin 1	Data Centre	LV	2010
United Kingdom	Fawley	Esso Fawley	Oil & Gas	LV	2010
United Kingdom	Sunderland	EDS DOXFORD	Data Centre	LV	2011/12
United Kingdom	London	Blackfriars Station	Rail	LV	2011/12
United Kingdom	London	79-97 Wigmore Street	Commercial	LV	2012
United Kingdom	Beckton	Beckton STW	Water Treatment	LV	2012
United Kingdom	Gartcosh	Scottish Crime Campus	Utility	LV	2012
United Kingdom	Fife	Markinch Biomass CHP Plant	Biomass	MV	2012
United Kingdom	Shetland Islands	Laggan Tormore	Oil & Gas	LV	2013
Yemen	Kharir	Kharir Project Phase 1 & 2	Oil & Gas	MV & LV	2009
Yemen	Kharir	Total E&P Yemen Kharir Power Plant	Oil & Gas	MV & LV	2011/12

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