

# COMPREHENSIVE SOLUTIONS FROM DESIGN TO DELIVERY



# BUSBAR TRUNKING SYSTEM

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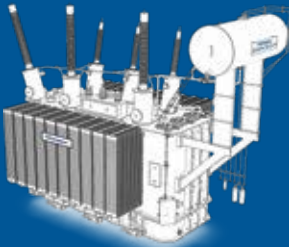
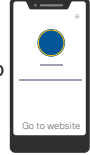
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POWER TRANSFORMER



DISTRIBUTION TRANSFORMER  
(OIL FILLED)



DISTRIBUTION TRANSFORMER  
(DRY TYPE)



INSTRUMENT TRANSFORMER



VACUUM CIRCUIT BREAKER



SWITCHGEAR



BUSBAR TRUNKING SYSTEM



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# INTRODUCTION

Energypac Engineering is a country leader in providing end-to-end power solutions for over three decades. It is a member of Energypac Group, a Bangladeshi multinational conglomerate comprising of 10 companies. With years of expertise, advanced manufacturing technology, and testing facilities, Energypac has its production centers both in **Bangladesh (Energypac Engineering)** and **Italy (Energypac Europe)**. The quality and standard of products are perfectly maintained with international and local standards.

With a combination of technical skills and competencies, Energypac has been able to develop new products and innovative solutions. These power solutions are offered to the European as well as the global market. Energypac-Europe guarantees full cooperation and efficiency to produce elegant yet simple solutions for complex problems.

Today Energypac operates globally with two main poles of technology and productivity.

Energypac-Bangladesh, headquartered in Dhaka, is a center for research and development as well as a production center with more than 3000 employees as well as a benchmark for the Asian market.

Energypac-Europe: based in Italy (Brescia), a center of excellence of the group for research and development and production of the product lines, is the manufacturing center for the European and American market.





## CERTIFICATES

The Energypac sandwich busbar has been given type approval certifications by the most prestigious electro-technical agencies

- For certificate of compliance with standard: 61439-6:
- ACAE - LOVAG
- Bangladesh University of Engineering & Technology
- Central Power Research Institute, India





# Reliable solution

Energypac Busbar Trunking System is a flexible and reliable electrical distribution system with superior performance. It is a safe and robust system with high electrical efficiency, low temperature rise, efficient heat dissipation, low voltage drop, high mechanical strength and easy installation. It is suitable for alternating current three-phase three-wire, three-phase four-wire and three-phase five-wire power supply and distribution system, with frequency of 50Hz or 60Hz, rated insulation voltage up to 1000V, and rated current between 25A-5000A.

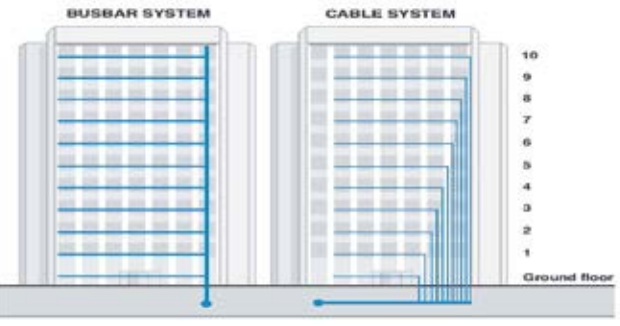
# ADVANTAGES

## Fail-safe behaviour

Because of its specific highlights, a busbar trunking system does not regularly use excess amount of plastic material as insulation which is conceivably more risky material if there should arise an occurrence of fire. The plastic material utilized for the insulating parts of busbar trunking system are self-extinguishing type (from V0 to V2) and for the most part have low smoke discharge (Halogen Free). Busbar trunking system is in its low electromagnetic discharge compared to conventional cable system. The structure of Busbar Trunking System considerably reduces the magnetic component and the shielded enclosure serves as a shield of electric field. All these features of busbar trunking system are the best choice for emergency clinic offices, information and data centers and any place where it is important to supply higher amount of power for working environments.

## Flexible

The Busbar Trunking system provides high level of flexibility both during the planning stage and during installation of the system as a result of using tap off box outlets situated on the straight pieces. Keeping the busbar line live, tap-off box can be removed from one outlet and can be inserted in another tap-off outlet. During designing the busbar trunking system, it is not necessary to know the exact position of machines that will be installed in the building. The designer's plan will take into consideration the end-customer's modifications and variations which will be determined during the operation of the system. There will be no requirement for point-to-point connections but just one power distribution system where the power can be tapped-off wherever there is a free tap-off point. Due to its flexible and long-lasting features, the installation of Energypac's busbar in a building allows easy modification of its use within business premises, thus providing benefits even to those who manage and rent out different parts of the building.



## Quick installation

Energypac BBT joining systems have been made and designed to allow easy installation of busbar trunking systems. When using a traditional cable system, the time needed to install only one cable tray is equal to the time needed to install a complete busbar trunking system. Furthermore, given the same capacity, a busbar trunking system is much lighter than an equivalent one made with cable trays and (copper) cables: lighter weights require a lower number of supports or at least simpler and less expensive supports. This is why the time to install a busbar trunking system is obviously shorter than a similar traditional cable installation.

## Reduced dimensions

The traditional cable system requires more dimensional space than busbar trunking system, especially when the current to be carried exceed 1000A and when several cables in parallel are required to ensure such ratings. Moreover, cables have a minimum bending radius to avoid damage to the insulation; the busbar trunking systems allow route changes with 90° angles, thus maximizing the use of the reduced spaces available within technical premises.

## Easy to rate

The electrical rating of busbar trunking systems are carried out by Energypac in compliance with the product Standards. The rated current of Energypac busbars is guaranteed for room temperature at 40°C (the standard requires 35°C). After choosing the appropriate current requirements for the busbar, it is extremely easy to check the voltage drop as well as the protection against over currents. To do so, use the technical charts available for all Energypac product lines. These charts basically specify: the short-circuit currents and the peak current withstand of the busbar while waiting for the protection device to start operating upstream, the voltage drop of the average cosθ of the loads, the losses as well as a series of additional data (R, X, Rpe, etc.) which allow the designer to make calculations using the results from tests carried out in accredited LOVAG laboratories for heat and short-circuit tests. With busbar trunking systems, the protection device is located close to the load (decentralized protection); as a result, protection devices such as thermal magnetic circuit breakers, fuse carriers and motorized switches can be housed in the tap-off boxes, thus allowing easy and effective management of the system.

# PRODUCT RANGE



Lighting BBT

25A-63A

Low Power

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# LX - LIGHTING BBT

## LOW POWER, 25A-63A

### General features

**LX (Low Power – Lighting Busbar)** supplied by Energypac is the ideal solution for supplying power to light fittings within the service sector and in most manufacturing industries and wherever it is necessary to hang very heavy accessories. It can also be used for supplying power to three-phase and single phase devices: industrial refrigerators, lathes, handheld tools etc.

**The main features of the lighting busbar are:**

- Speed, simplicity and flexibility when planning and installing the lines;
- Capable of being installed both in false ceilings and below floating floors

**Standard**

- Complies with international and domestic standards.
- Complies with IEC 61439-1, IEC 61439-6

**Degree of protection:** IP 55

**Dimensions:** 17x47 mm

**Number of Conductors**

- 4 Conductors

**Construction**

Conductor type: Copper (99.9% pure)

**Product Range**

- 25A
- 40A
- 63A

**Casing:** Painted or anodized Aluminum casing.

Thickness: 0.9mm



Fig: Lighting BBT

# COMPONENTS OF BBT

## Straight piece

The straight piece allows plug in outlets equidistant every 1m (3 outlets every 3m) or 0.5m (6 outlets every 3m). A junction block ensures electrical continuity. The connection between two straight elements is quick; with one operation. The mechanical and the electrical connection is ensured between two joined elements. The continuity of the protective conductor (casing) is guaranteed by tightening the special connection screw.



Fig: Straight piece

## End feed unit

These enable the LX range to be supplied by cable; the assembly is carried out with a quick joint arrangement as with the straight pieces.

**The feed units** have terminals for the connection of flexible copper cables for sections of up to 6mm<sup>2</sup>. There is an anti-pull cable clamp inside the unit. The entrance point for the cables is located at the base of the end feed unit.



Fig: End feed unit

## End cover

End caps are used to safely cap off the end of a busbar run. The end cap units can be easily removed to allow for the extension of the system. End covers ensure the IP55 degree of protection at the end of the run. Two versions of end cover are available, depending on the end feed unit used at the start of the run:

- The right end feed unit requires a right end cover
- The left end feed unit requires a left end cover

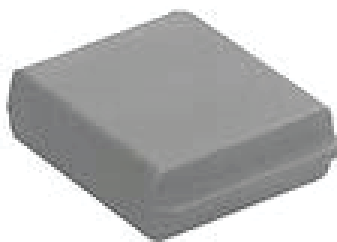


Fig: End cover

## Hanger

The LX series offers brackets and fixing accessories those enable quick and simple installation for a wide range of applications. The LX series can be mounted on horizontal or vertical surfaces or mounted directly on to beams to meet the requirements of complex installation. Custom mounting solutions are available upon request. The universal designed hanger can also be used for light fixing.

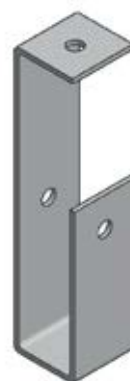


Fig: Hanger

# COMPONENTS OF BBT

## Flexible elbow

Flexible elbow is used for changing direction or to avoid possible obstacles along the busbar run. They have the same quick joint connection as the straight pieces. Similarly, they give a mechanical connection and an IP55 degree of protection. The continuity of the protective conductor, made from the casing of the element itself, is ensured by tightening the special connection screw.

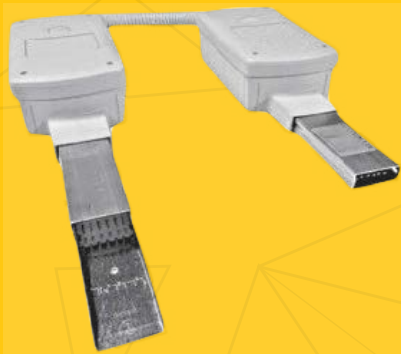


Fig: Flexible elbow

## Tap-Off plug

Tap-off plugs are used for connecting and energizing light fixtures; their features include:

- Can be inserted and removed when the busbar is energized and when the fixture is under load;
- The PE (protective earth) contact is the first to make an electrical connection when inserting the plug into the outlet and it is the last to disconnect when pulling it out.

The tap-off plugs are common for the LX offer. These include:

- a) 10A pre-wired, pre-positioned phase tap-off plugs with 0.8m cable.
- b) 16A phase selection tap-off plugs, with terminals for connecting L+N+PE cable.
- c) 16A phase selection tap-off plugs, with 5x20mm cylindrical ceramic fuse and with terminals for connecting L+N+PE cable.



Fig: Tap-off plug

# TECHNICAL DATA

## LX

NORMS CONFORMITY IEC439-2 EN60439-2		LXT4001	LXT4002
LIVE CONDUCTORS		4	4
WINDOWS STANDARD		3	3
WINDOWS ON DEMAND		5	5
HOUSE THICKNESS		0,9	0,9
RATED CURRENT	$I_n$ [A]	25	40
FREQUENCY	$F$ [Hz]	50/60	50/60
RATED INSULATION VOLTAGE	$U_i$ [V]	660	660
RATED OPERATIONAL VOLTAGE	$U_e$ [V]	230/400	230/400
PROTECTION DEGREE/ACCESSORIES IEC 592		IP41/55	IP41/55
RESISTANCE at 20°	[mΩ/m]	6.8	3
RESISTANCE at 35°	[mΩ/m]	8.3	3.8
REACTANCE FREQ. 50Hz	[mΩ/m]	0.21	0.19
IMPEDANCE	[mΩ/m]	7.2	4
PE HOUSING	mm <sup>2</sup> AL	100	100
PHASE/NEUTRAL SECTION	mm <sup>2</sup>	2.5	5.3
JOULE LOSSES	$I^2R$ [W/m]	3.8	5.8
SHORT CIRCUIT 3 PHASE	kA	2.8	3
VOLTAGE DROP FOR 3-PHASE 50Hz CURRENT, IN VOLTS PER 100m AND PER AMPERE WITH LOADS DISTRIBUTED ALONG THE RUN. VOLTAGE DROP FOR SINGLE PHASE 50Hz CURRENT: DIVIDE THESE VALUES BY 0.866.	$\cos\phi=0.8$		0.25
	$\cos\phi=0.9$		0.29
	$\cos\phi=1$		0.31
AVERAGE LOOP RESISTANCE BETWEEN LIVE CONNECTORS	Rb1 ph ph OR ph N (at thermal stabilization temperature 01) mΩ/m	16.66	7.1
	Rb1 ph ph OR ph N (I) (at conventional short-circuit temperature) mΩ/m	20.9	8.52
AVERAGE LOOP REACTANCE	Xb ph ph mΩ/m	1.68	0.79
	Xb ph N mΩ/m	2.08	0.83
AVERAGE LOOP RESISTANCE BETWEEN LIVE AND PE CONDUCTORS	Rb1 ph PE (at thermal stabilization temperature 01) mΩ/m	9.08	3.81
	Rb2 ph PE (I) (at conventional short circuit temperature)	10.9	4.57
AVERAGE LOOP REACTANCE	Xb ph PE mΩ/m	1.3	1.28
IPK	IPK Ka	4.4	5.3
PT	kA <sup>2</sup> s	195x10 <sup>3</sup>	900x10 <sup>3</sup>
ALL THESE PRODUCTIONS COMPLY WITH THE IEC 60439 - 1 and 6 STANDARDS			

# PRODUCT RANGE



Air Insulated BBT    160A-1000A

Medium Power

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# AX - AIR INSULATED BBT

## MEDIUM POWER, 160A-1000A

### General features

AX (Medium Rating – Air Insulated) is part of the Energypac range used for the distribution of power in medium – large installations. It is also particularly suitable in rising main applications (trunking systems) within buildings used for the service sector.

Very compact size, high short circuits strength, low voltage drop and good corrosion strength make AX system suitable for installation in small spaces and difficult environments. Any section can be taken out without moving the adjacent ones. At any moment it is possible to modify the path of the run, which makes AX a very flexible system.

Energypac AX busbar can be installed quickly due to the single-bolt joint. It is easy to manage and suitable for modification and extension, which is always necessary for installation where AX is used.

AX has a wide range of tap-off boxes which are rated from 6A to 160A, thus allowing the supply and protection of all kinds of loads using different protection devices such as miniature circuit breakers (MCB) and/or molded case circuit breakers (MCCB).

#### Standard

- Complies with international and domestic standards.
- Complies with IEC 61439-1 and IEC 61439-6

### Construction

Conductor type

- Aluminum
- Copper

The conductors are made from an aluminum alloy with a final coat of tin. Alternatively, the AX range is available with copper conductors with purity no less than 99.9% (electrolytic copper). The low inherent impedance and large surface area of the busbars limit the heat build up. The conductor also lowers the voltage drop.

#### Number of Conductors

- 4 Conductors (3P+N)
- 5 Conductors (3P+N+PE)

#### Product range

- 160A to 800A for Aluminum Conductors
- 250A to 1000A for Copper Conductors

#### Casing

The enclosure is made of Prepainted Galvanized Sheet which also provides an excellent earthing path through the busbar system due to its cross-section and electrical continuity.

Thickness: 0.8mm

Color: RAL 9016 (grey white)

**Degree of protection:** IP 55

#### Insulation

The conductors are spaced with plastic insulators reinforced with 20% glass fiber. They have a V1 self-extinguishing degree (as per UL94) and are in compliance with the incandescent wire test as per EN 60695-2-1 (CEI 50.11). The electrical insulation between the conductors and the casing is ensured by air distances maintained by the insulators.

#### Joint

Monobloc is used as a junction unit of different busbar pieces. Energypac AX busway system adopts single bolt joint which assures the electrical and mechanical connection of all conductors including PE, between two adjacent sections. Considering all significant factors including contact resistance and contact corrosion, Cu-Al combination is selected in order to obtain best contact solution. The joint stack consists of a set of copper plates where the plates are interposed in layers with outer plates of insulating material. The insulation material used on the joint withstands temperatures up to 155°C (class F). The standard torque is 60±5 Nm. The monobloc joint used on the AX range allows for the thermal expansion of the conductors.

### Testing

Each piece of Energypac AX busbar is factory tested before shipping. Tests performed include dielectric tests, which are used to ensure integrity of insulation. In addition all Energypac busbar is manufactured and inspected in an ISO 9001 registered facility.

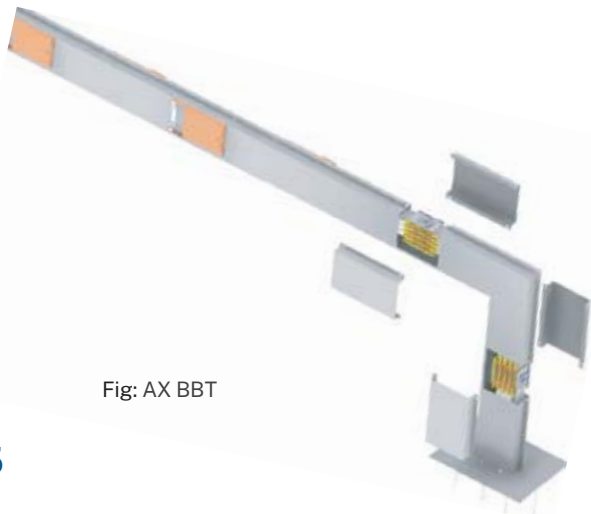


Fig: AX BBT

# COMPONENTS OF BBT

## Straight piece

Straight pieces are used for distributing power and for supplying medium powered loads.

Feeder and plug-in sections are interchangeable. On both sides of the section, the position of the phases as well as of the neutral are marked.

The plug-in version allows for a total of up to 6 tap-off outlets on a three meters section depending on rated current. Straight pieces with outlets are ideal for achieving rising mains or sections with high density of tap-off points.

In order to simplify storage and speed up the installation of the line, straight pieces, trunking components and all components of the AX line are provided from the factory with a monobloc pre-installed at one end.

Straight pieces without outlets are available for feeder applications only. The standard length of straight feeder elements is 3 meters. In order to meet the various installation requirements, elements with shorter length, between 600 to 2,950 mm, are also available.

The standard length of straight plug-in elements are 3m, 2m and 1m.

All components of the AX range are IP55 as standard; therefore, the degree of protection of the line depends only on whether or not plug outlet covers are fitted to the tap-off outlets: with plug outlet covers installed, the line is always IP55.



Fig: Straight piece

## Elbow

Elbows allow the busbar trunking system to change direction of route both horizontally and vertically. Elbows are 90° as standard. They have the same quick joint connection as the straight elements. The protection degree of elbow is IP55.



Fig: Elbow

## Tap-off box

Tap-off box distributes power from busbar trunking system. These are installed on straight plug in sections at a specific interval.

Tap-off box is provided with MCB or MCCB of different current ratings from 6A up to 160A.

The standard tap-off box cannot be removed from the busbar when the tap-off box is on load. These are equipped with an interlock mechanism which prevents tap-off box cover opening before power turning off. These are fixed to busbar by integral fixing clamp & no additional mounting equipment is required.

All Energypac tap-off boxes have a PE (protective conductor) contact, which is the first to make an electrical connection when plugged into the outlet, and the last to disconnect when the tap-off is unplugged.

Air insulated BBT can also be facilitated with plastic tap-off boxes for power supply in a range from 6A to 160A.



Fig: Tap-off box



Fig: Plastic Tap-off box

# COMPONENTS OF BBT

## End feed unit

These enable the AX range to be supplied by cable or directly connected to an electrical distribution panel; the assembly of the line is carried out with a quick monobloc connection as with the straight lengths or elbow. The cable entry is generally located at the base of the end feed unit, in which there is a removable plate; it is also possible to insert the cables from side plates. End feed unit may be removed easily in order to extend a busbar run.

## End feed unit box

End feed unit boxes ensure protection of electrical cable connection to the busbar distribution system. End feed unit boxes may be installed at the end or beginning of a run. Vertical end feed boxes and horizontal end feed boxes can be installed in both horizontal and vertical applications. Extended end feed boxes are available if the application requires additional wire bending space.

An end feed unit box includes a gasketed and accessible termination box, lug and necessary insulation tape .

## End cover

End caps are used to safely cap off the end of a busbar run. The end cap units can be easily removed to allow the extension of the system. End covers ensure the IP55 degree of protection at the end of the run.

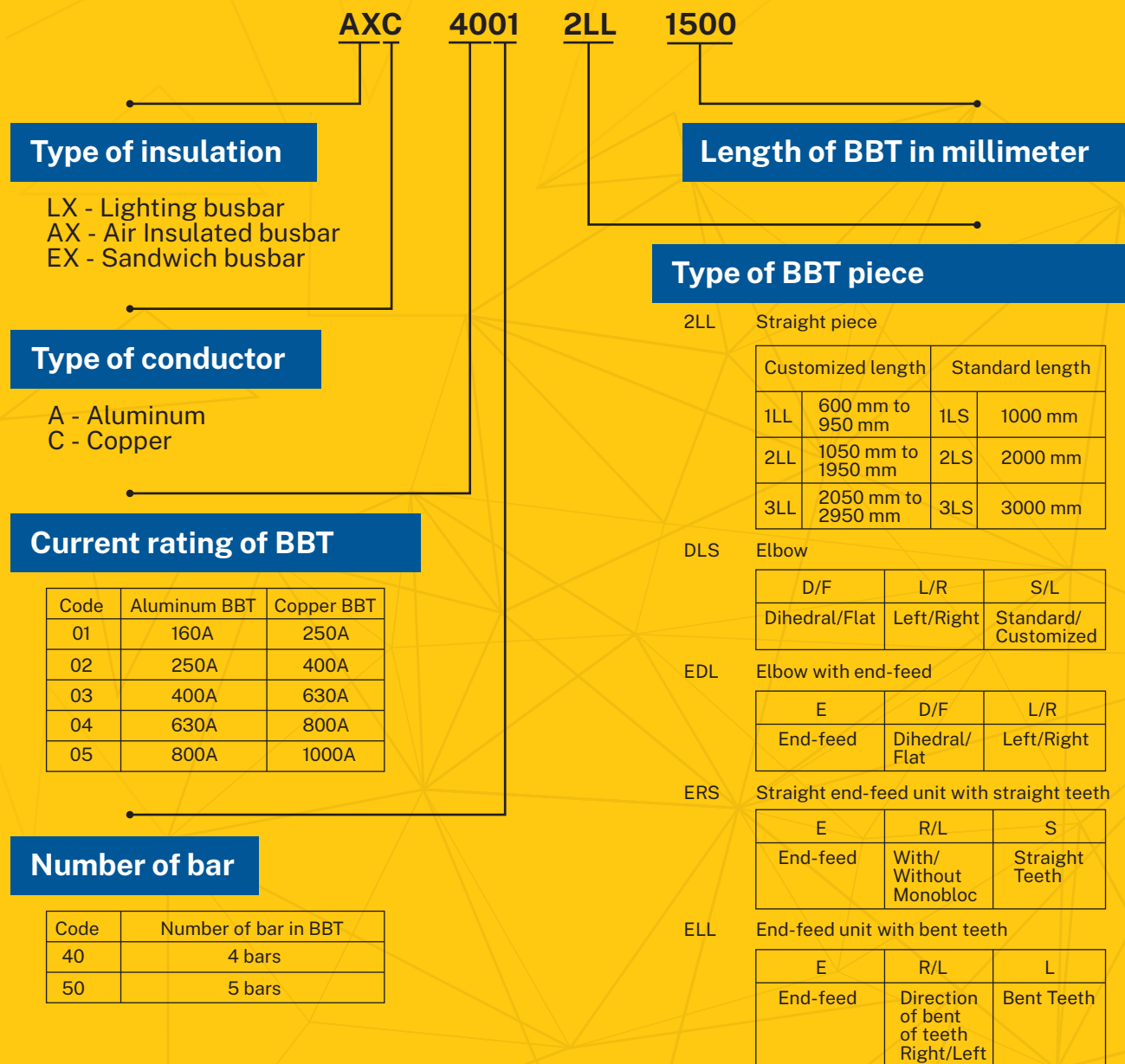
## Hanger

The AX series offers brackets and fixing accessories that enable quick and simple installation for a wide range of applications. The AX series can be mounted on horizontal or vertical surfaces or mounted directly on to beams to meet the requirements of complex installations.



Fig: End feed unit

# CODE OF BBT COMPONENTS



# TECHNICAL DATA

## AXA (Air Insulated Aluminum) BBT



Technical Data					
Rated current (A)	160	250	400	630	800
Casing material	Pre-painted Steel Sheet RAL 9016				
Overall dimensions (mm*mm)	200x70	200x70	200x70	200x120	200x150
Phase and neutral bar cross section (mm <sup>2</sup> )	87	116	300	540	720
Pe cross section (mm <sup>2</sup> Fe)	540	540	540	640	700
Operating/insulation voltage (V)	1000				
Phase resistance @ 20° C (mΩ/m)	0.368	0.276	0.107	0.059	0.044
Phase resistance @ 50 % load (mΩ/m)	0.373	0.288	0.111	0.064	0.048
Phase resistance @ thermal conditions (mΩ/m)	0.389	0.324	0.125	0.077	0.057
Phase reactance (mΩ/m)	0.260	0.210	0.170	0.060	0.052
Impedance @ 20° C (mΩ/m)	0.450	0.347	0.201	0.084	0.068
Impedance @ 50 % load (mΩ/m)	0.455	0.356	0.203	0.087	0.071
Impedance @ thermal conditions (mΩ/m)	0.468	0.386	0.211	0.097	0.077
Resistance of protective conductor (mΩ/m)	0.241	0.241	0.241	0.203	0.186
Rated short-time current for three-phase fault (1s) - kA	15*	25*	25	36	36
Rated short-time current for phase-neutral fault (1s) - kA	15*	25*	25	36	36
Rated short-time current for phase-Pe fault (1s) - kA	9*	15*	15	22	22
Allowable peak current for three-phase fault (kA)	30	53	53	76	76
Allowable peak current for phase-N fault (kA)	30	53	53	76	76
Allowable peak current for phase-Pe fault (kA)	15	30	30	48	48
Allowable specific energy (A <sup>2</sup> s)*10 <sup>6</sup> for three-phase fault	23	63	625	1296	1296

# TECHNICAL DATA

## AXA (Air Insulated Aluminum) BBT

Resistance @ fault loop (mΩ/m)	0.61	0.52	0.35	0.26	0.23
Reactance @ fault loop (mΩ/m)	1.01	0.78	0.44	0.39	0.36
Impedance @ fault loop (mΩ/m)	1.18	0.94	0.56	0.47	0.43
Joule losses at rated current (W/m)	29.9	60.8	60.2	91.2	110.3
Weight (kg/m)	7.4	7.7	8.4	12.3	14.7
Degree of protection	IP 55				
Voltage drop calculation @ rated current and distributed load (V/m/A *10 <sup>-6</sup> )	K parameter				
cos φ					
0.70	396.8	326.5	181.1	83.5	67.0
0.75	401.8	330.9	178.8	84.1	67.1
0.80	404.8	333.8	175.2	84.2	66.8
0.85	405.2	334.5	169.9	83.8	66.0
0.90	401.6	332.0	161.9	82.3	64.4
0.95	390.6	323.6	149.1	79.2	61.3
1.00	337.2	280.8	108.6	66.3	49.7

### Voltage drop calculation

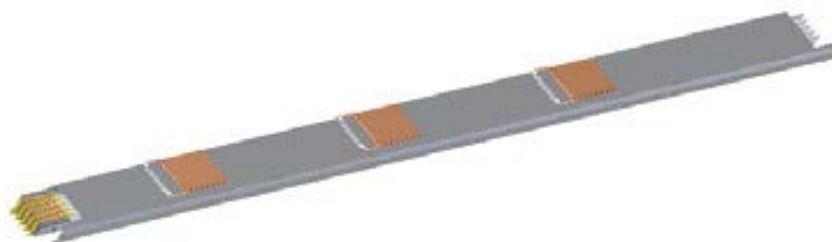
$$\Delta v\% = b \cdot \frac{k \cdot I_b \cdot L}{V_n} \cdot 100$$

Where:

b = 1	for distributed load
b = 2	for load at the end of the line
K	k parameter
L	length of the line
I <sub>b</sub>	current of the line
V <sub>n</sub>	rated voltage of the line

# TECHNICAL DATA

## AXC (Air Insulated Copper) BBT



Technical Data					
Rated current (A)	250	400	630	800	1000
Casing material	Pre-painted Steel Sheet RAL 9016				
Overall dimensions (mm*mm)	200×70	200×70	200×70	200×120	200×150
Phase and neutral bar cross section (mm <sup>2</sup> )	87	150	300	540	720
Pe cross section (mm <sup>2</sup> Fe)	540	540	540	640	700
Operating/insulation voltage (V)	1000				
Phase resistance @ 20° C (mΩ/m)	0.207	0.155	0.060	0.033	0.025
Phase resistance @ 50 % load (mΩ/m)	0.210	0.162	0.063	0.036	0.027
Phase resistance @ thermal conditions (mΩ/m)	0.219	0.182	0.071	0.043	0.032
Phase reactance (mΩ/m)	0.260	0.210	0.170	0.060	0.052
Impedance @ 20° C (mΩ/m)	0.332	0.261	0.180	0.069	0.058
Impedance @ 50 % load (mΩ/m)	0.334	0.265	0.181	0.070	0.059
Impedance @ thermal conditions (mΩ/m)	0.340	0.278	0.184	0.074	0.061
Resistance of protective conductor (mΩ/m)	0.241	0.241	0.241	0.203	0.186
Rated short-time current for three-phase fault (1 s) - kA	25*	30*	36	36	36
Rated short-time current for phase-neutral fault (1 s) - kA	25*	30*	36	36	36
Rated short-time current for phase-Pe fault (1 s) - kA	15*	18*	22	22	22
Allowable peak current for three-phase fault (kA)	53	53	76	76	76
Allowable peak current for phase-N fault (kA)	30	53	76	76	76
Allowable peak current for phase-Pe fault (kA)	15	36	30	48	48
Allowable specific energy (A <sup>2</sup> s)*10 <sup>6</sup> for three-phase fault	63	90	1296	1296	1296

# TECHNICAL DATA

## AXC (Air Insulated Copper) BBT

Resistance @ fault loop (mΩ/m)	0.45	0.40	0.30	0.24	0.21
Reactance @ fault loop (mΩ/m)	1.01	0.78	0.44	0.39	0.36
Impedance @ fault loop (mΩ/m)	1.10	0.88	0.53	0.45	0.42
Joule losses at rated current (W/m)	16.8	34.2	33.9	51.3	62.0
Weight (kg/m)	9.3	10.2	13.3	23.9	27.9
Degree of protection	IP 55				
Voltage drop calculation @ rated current and distributed load (V/m/A *10 <sup>-6</sup> )	K parameter				
cos φ					
0.70	293.6	240.4	147.9	63.2	51.7
0.75	291.2	238.8	143.2	62.4	50.8
0.80	286.8	235.5	137.2	61.0	49.4
0.85	279.8	230.1	129.5	59.1	47.5
0.90	268.8	221.4	119.1	56.2	44.8
0.95	250.5	206.9	104.0	51.7	40.6
1.00	189.7	158.0	61.1	37.3	28.0

### Voltage drop calculation

$$\Delta v\% = b \cdot \frac{k \cdot I_b \cdot L}{V_n} \cdot 100$$

Where:

b = 1	for distributed load
b = 2	for load at the end of the line
K	k parameter
L	length of the line
I <sub>b</sub>	current of the line
V <sub>n</sub>	rated voltage of the line

# PRODUCT RANGE

 **EX**

Sandwich BBT

400A-5000A

High Power

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# EX - SANDWICH BBT

## HIGH POWER, 400A-5000A

### General features

The compact system EX (sandwich busbar) line is used for the distribution of power in large industries, for riser end feed units and for commercial and service sector buildings (banks, hospitals, trade and business centers, etc.).

The ultra-compact dimensions of the EX busbar enhances the short-circuit stress resistance features, reduces the impedance of the circuit by limiting voltage drops and enables the installation of high power electrical systems even in extremely cramped spaces.

Any section can be taken out without moving the adjacent ones. At any moment it is possible to modify the path of the run, which makes EX busbar a very flexible system. Energypac EX busbar can be installed quickly. It is easy to manage and suitable for modifications and extensions, which is always necessary for installations where EX busbar is used.

EX busbar has a wide range of tap-off boxes rated from 6A to 1250A, thus allowing the supply and protection of all kinds of loads due to the availability of different protection devices such as fuses, moulded case circuit breakers and motorised switches.

#### Standard

- Complies with international and domestic standards.
- Complies with IEC 61439-1 and IEC 61439-6

### Construction

#### Conductor type

- Aluminum
- Copper

The conductors are made from an aluminum alloy with a final coat of tin. Alternatively, the EX range is available with copper conductors with purity no less than 99.9% (electrolytic copper). The low inherent impedance and large surface area of the busbars limit the heat buildup. The conductor also lowers the voltage drop.

#### Number of Conductors

- 4 Conductors (3P+N)
- 5 Conductors (3P+N+PE)

#### Product range

- 800A to 4000A for Aluminum conductors
- 1000A to 5000A for Copper conductors

### Casing

The enclosure is made of prepainted galvanized sheet which also provides an excellent earthing path through the busbar system due to its cross-section and electrical continuity.

Thickness: 1.6 mm

Color: RAL 9016 (grey white)

**Degree of protection:** IP 55

### Insulation

The EX busbars are insulated with Mylar. Two types of Mylar are used:

1. Class B: Protects up to 130°C
2. Class F: Protects up to 155°C

### Joint

An electrical junction system "monobloc" is used for fast and reliable connection of the live conductors and PE between different busbar pieces. Monobloc consists of insulating plate (Class F), blocking element and copper plates. Considering all significant factors including contact resistance and contact corrosion, Cu-Al combination is selected in order to obtain best contact solution.

Depending on the height of the busbars, the joint has either one or two bolts to guarantee optimum electrical continuity over time. The protective conductor (PE-casing) is also connected through the monobloc. A pair of Belleville washers for each bolt ensures the correct distribution of the contact pressure as well as maintaining the pressure even when exposed to the temperature ranges, during the operation of a busbar trunking system. In order to simplify the storage and speed up the installation of the line, straight pieces, trunking components and all components of the EX line are already fitted with a monobloc pre-installed at the factory.

### Testing

Each piece of Energypac busbar is factory tested before shipping. Tests performed include dielectric tests, which are used to ensure integrity of insulation. In addition, Energypac busbar is qualified IEC standards. All Energypac busbar is manufactured and inspected in an ISO 9001 registered facility.

# COMPONENTS OF BBT

## Straight pieces

Straight pieces are used for distributing power and for supplying high powered loads.

Feeder and plug-in sections are interchangeable. On both sides of the sections the position of the phases as well as of the neutral are marked.

The plug-in version allows for a total of up to 3 tap-off outlets on a three meters section depending on rated current. Straight pieces with outlets are ideal for achieving rising mains or sections with high density of tap-off points.

The EX range is totally painted which offers resistance to chemical agents, improves resistance to galvanised sheet metal corrosion and gives better heat dissipation.

The conductors are packed against each other (sandwiched) so as to minimise the distance between one phase and the other, thus achieving the advantage of minimizing the mutual reactance, hence the impedance of the busbar.



Fig: Straight piece

## Straight element dimension

CU	Rating	St. element dimension		
		L (mm)	W (mm)	D (mm)
	800 A	Varies from 600mm to 3000mm with an interval of 50mm	140	85
	1000 A			85
	1250 A			85
	1600 A			130
	2000 A			160
	2500 A			200
	3200 A			266
	4000 A			326
	5000 A			406

AL	Rating	St. element dimension		
		L (mm)	W (mm)	D (mm)
	400 A	Varies from 600mm to 3000mm with an interval of 50mm	140	85
	630 A			85
	800 A			85
	1000 A			100
	1250 A			130
	1600 A			200
	2000 A			220
	2500 A			266
	3200 A			406
	4000 A			446

## Elbow

Elbows allow the busbar trunking system to change directions routes both horizontally and vertically. Elbows are 90° as standard. They have the same quick joint connection as the straight pieces. The protection degree is IP55.



Fig: Elbow

## Dihedral elbow dimension

Code	Standard Length (mm)	Min - Max
DRS	400x400	(400 -1000) x (400 -1000)
DLS	400x400	(400 -1000) x (400 -1000)

## Flat elbow dimension

Code	Standard Length (mm)	Min - Max
FRS	500x500	(500 -1000) x (500 -1000)
FLS	500x500	(500 -1000) x (500 -1000)

# COMPONENTS OF BBT

## End feed units

These enable the EX range to be supplied by cable or directly connected to an electric distribution panel; the assembly of the line is carried out with a quick monobloc connection as with the straight pieces. The end feed units are provided with LV connections for the connection of conductor link or cables equipped with hole.

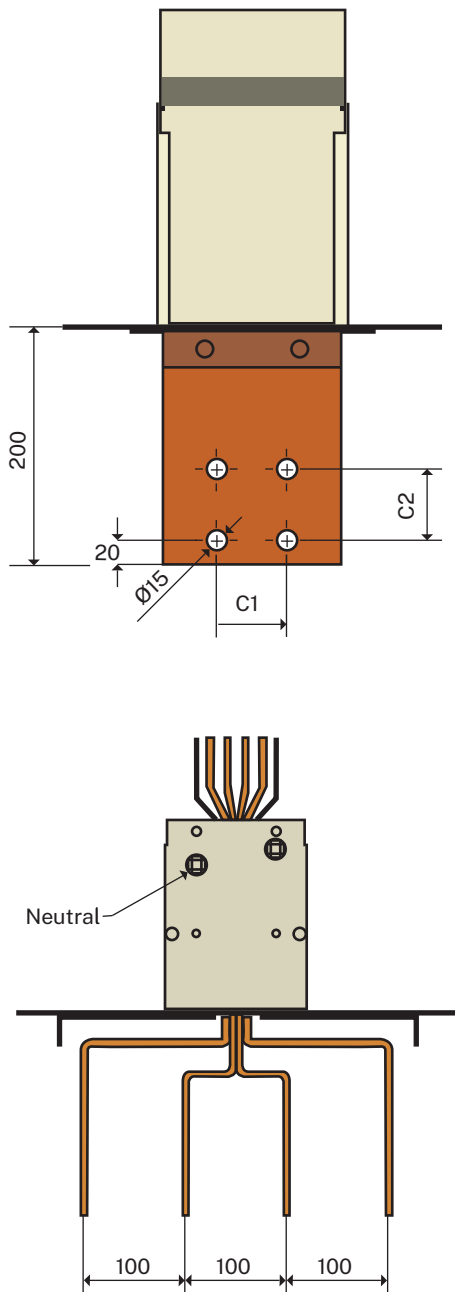


Fig: End feed unit

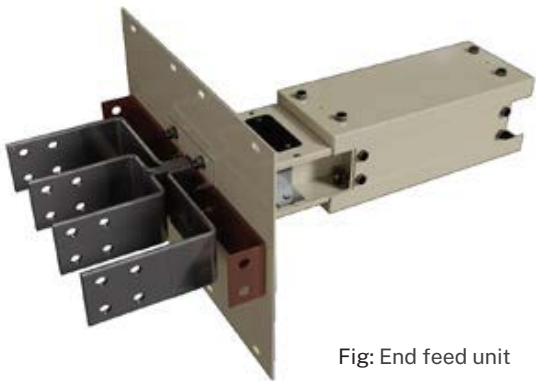


Fig: End feed unit

AL	Rating	St. teeth end feed unit		
		C1	C2	Number of holes
	400A	-	60	2
	630A			2
	800A			2
	1000A			2
	1250A	60		4
	1600A			6
	2000A			6
	2500A			8
3200A	12			
4000A	12			

CU	Rating	St. teeth end feed unit		
		C1	C2	Number of holes
	800A	-	60	2
	1000A			2
	1250A			2
	1600A	60		4
	2000A			4
	2500A			6
	3200A			8
	4000A			8
5000A	12			

## End feed unit box

End feed unit box ensures protection of electrical cable connection to the busway distribution system. End feed unit box can be installed at the end or beginning of a run. Vertical end feed unit box and horizontal end feed unit box can be installed in both horizontal and vertical applications. Extended end feed unit box are available if the application requires additional wire bending space.

An end feed unit box includes a gasketed and accessible termination box, lug and necessary insulation tape .

# COMPONENTS OF BBT

## Tap-off boxes

Tap-off box distributes power from busbar trunking system. Tap-off box is provided with MCB or MCCB of different current ratings for three-phase loads from 6A to 1250A. They can be divided into three main categories:

**a) Plastic tap-off boxes (from 6A up to 160A):** these type of tap-off boxes can be used to distribute power of lower rating. All of the plastic type tap-off boxes of Energypac are plug-in type. They can be operated when energized but not under load condition. The body of the tap-off box is insulated as the material is plastic. A protective earth conductor is used inside the tap-off box to ensure the continuity of protective earthing.

**b) Plug-in tap-off boxes (from 6A up to 250A):** they can be operated when energized but not when under load conditions. When the tap-off box is installed on the busbar, the opening of the cover electrically disconnects its internal parts, in other words no accessible metallic part is live when the cover is open. All Energypac plugin type boxes have a PE (protective conductor) contact, which is the first to make an electrical connection when the tap-off box is plugged into the outlet, and the last to disconnect when the tap-off box is unplugged.

**c) Boxes bolted on the junction (from 125A to 1250A):** these high rated current boxes are rigidly connected to the busbar with a special "monobloc" connection system similar to that of the straight pieces but this also allows for power to be tapped-off from the busbar. The boxes can only be installed and removed when the system is de-energized (isolated busbar).

All insulating plastic components of tap-off box comply with the incandescent wire test (EN 606952-1) and have a V1 self-extinguishing degree (UL94); the standard degree of protection is IP55 without using additional IP protection kits. If the boxes are equipped with a switch, the rotary handle extension is carried out with a handle on the cover of the box which makes it possible to open the switch before removing the box from the busbar.



Fig: Plastic Tap-off box



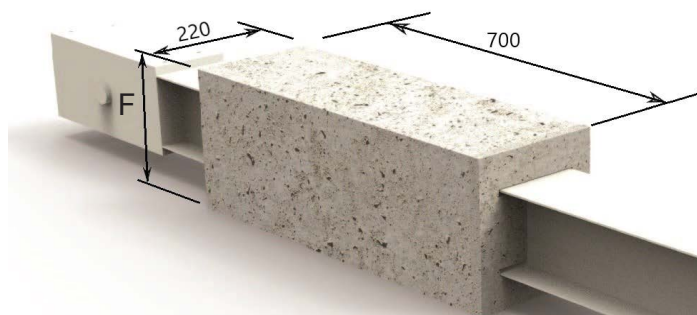
Fig: Regular and Bolt-on Tap-off Box

## Additional elements

Depending on the different installation requirements, Energypac offers different technical solutions:

### Fire barrier

When the busbar trunking system crosses fire resistant walls or ceilings, it must be fitted with appropriate fire barriers. The Energypac fire barrier meets class S 120 (according to DIN 4102 part 9), and may be installed on any trunking component (straight or elbow element). In order to ensure the maximum resistance class, for some ratings it is also necessary to fit at the factory an internal fire barrier. It is therefore necessary to indicate at the order stage which elements will cross fire resistant walls or ceilings. The fire barrier is 700 mm long and must always be positioned in the middle of the fire resistant wall or ceiling crossed by the busbar. After crossing fire resistant walls or ceilings, any cavity must be sealed with material meeting current regulations for the required building fire resistance.



AL	
Rating	External dimensions
	F (mm)
400A	165
630A	
800A	
1000A	180
1250A	210
1600A	280
2000A	300
2500A	346
3200A	486
4000A	526

CU	
Rating	External dimensions
	F (mm)
800A	165
1000A	
1250A	
1600A	210
2000A	240
2500A	280
3200A	346
4000A	406
5000A	486

# COMPONENTS OF BBT

## Face plate

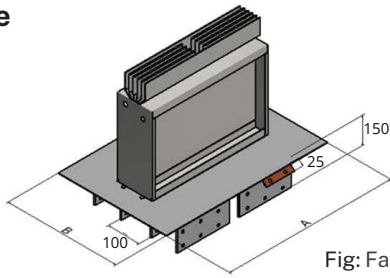


Fig: Face plate

AL		
Rating	A	B
400A	330	430
630A	330	430
800A	330	430
1000A	330	430
1250A	330	430
1600A	330	430
2000A	330	430
2500A	370	430
3200A	540	430
4000A	580	430

CU		
Rating	A	B
800A	230	430
1000A	230	430
1250A	230	430
1600A	230	430
2000A	260	430
2500A	230	430
3200A	375	430
4000A	462	430
5000A	540	430

## Flexible braids

In order to ensure safer connection between transformer and busbar trunking unit, flexible braids are a smart solution. Energypac provides braids type flexible copper which has better vibration damping power than foil type. It reduces temperature rise in junction point and can compensate thermal expansion, if occurs. Depending on rating of busbar, overall dimension of flexible braids changes.



Fig: Flexible braids

## Protection bellows

Due to high vibration of generator, manufacturers often face difficulties to connect busbar with generator. To solve the problem, Energypac introduces this protection bellow which is made of special coated fabric with rigid PVC support in every fold.

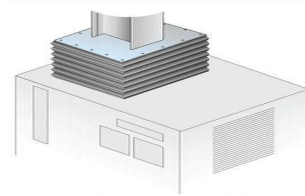


Fig: Protection bellow

## Hanger

The hanger can be installed flatwise or edgewise for both horizontal and vertical runs.

### Horizontal hanger

Suitable for Al or Cu busbar of all ratings. External holes having diameter of 13mm can be used with rods M12 for fixing from ceiling. During installation, a distance of 1.5m is recommended between the brackets.

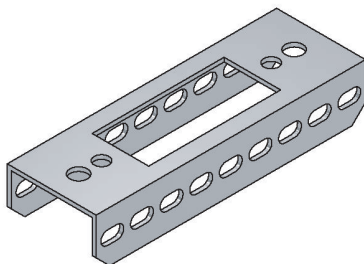


Fig: Horizontal hanger

### Vertical Hanger

In case of rising mains, in addition to the standard brackets it will also be necessary to use vertical hanger equipped with screws fixing the busbar to prevent its sliding. Option with spring can be also supplied.

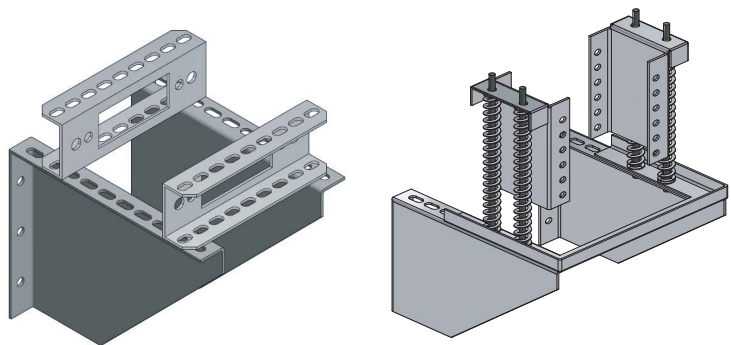


Fig: Vertical hanger

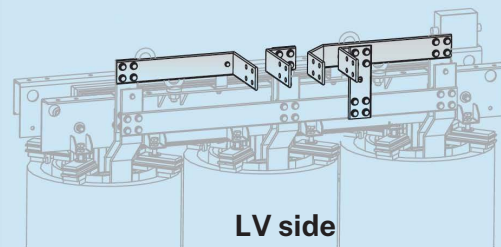
# COMPONENTS OF BBT

## Transformer connecting link:

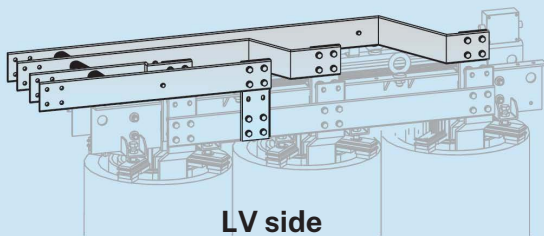
Energypac offers many solutions to connect busbar to the transformer. The solution usually includes a kit with:

- Parallel bars
- Flexible braids

### Front arrangement



### Left arrangement



### Right arrangement

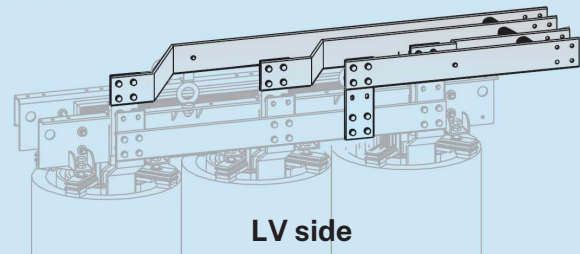
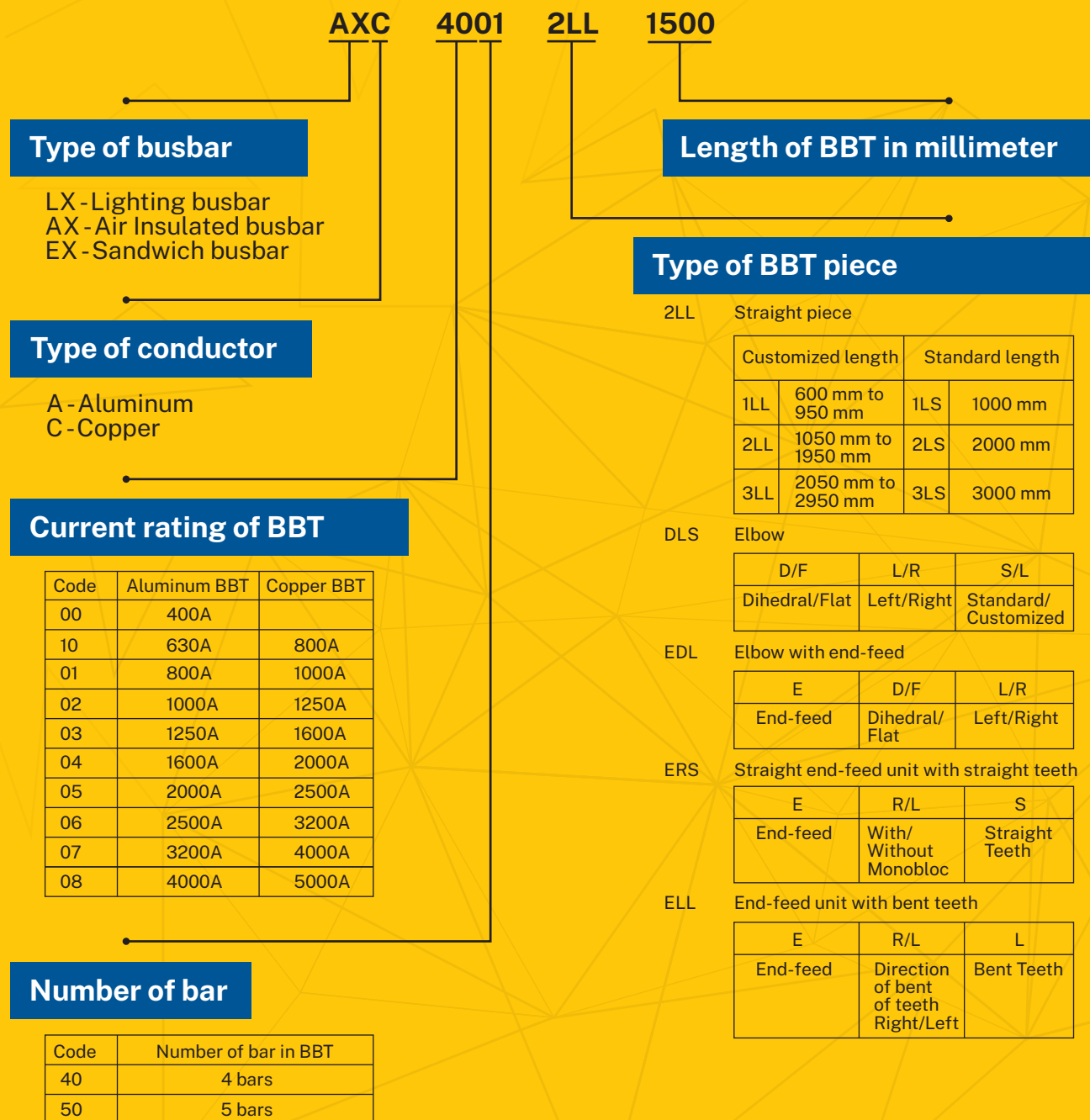


Fig: Transformer connecting link

# CODE OF BBT COMPONENTS



# TECHNICAL DATA

## EXA (Sandwich Type Aluminum) BBT

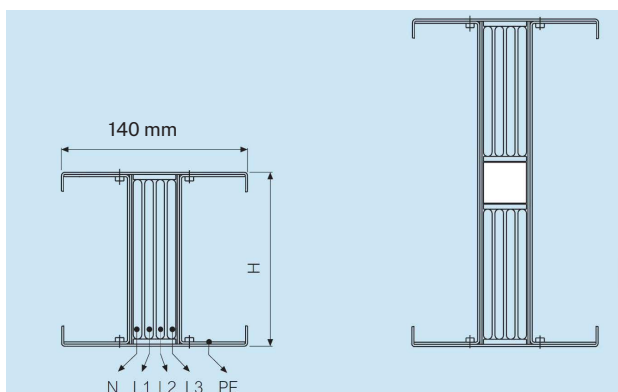


Fig: Single bar BBT

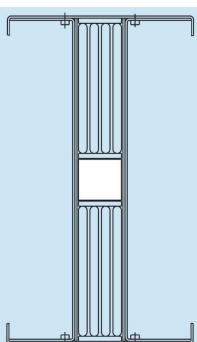


Fig: Double bar BBT



Technical Data										
Rated current (A)	400	630	800	1000	1250	1600	2000	2500	3200	4000
Casing material	Pre-painted Steel Sheet RAL 9016									
Dimension lateral casing (mm)	85	85	85	100	130	200	220	266	406	446
Height of the bar	50	60	75	90	120	190	210	120	190	210
Overall dimensions (mm*mm)	140×85	140×85	140×85	140×100	140×130	140×200	140×220	140×266	140×406	140×446
Phase and neutral bar cross section (mm²)	300	360	450	540	720	1140	1260	1440	2280	2520
Pe cross section (mmq Fe)	1026	1026	1026	1071	1161	1371	1431	1569	1989	2109
Operating/insulation voltage (V)	1000									
Phase resistance @ 20° C (mΩ/m)	0.107	0.089	0.071	0.059	0.044	0.028	0.025	0.022	0.014	0.013
Phase resistance @ 50% load (mΩ/m)	0.109	0.091	0.074	0.062	0.046	0.027	0.027	0.023	0.015	0.014
Phase resistance @ thermal conditions (mΩ/m)	0.117	0.098	0.081	0.069	0.052	0.030	0.032	0.027	0.018	0.016
Phase reactance (mΩ/m)	0.026	0.021	0.017	0.016	0.015	0.014	0.010	0.006	0.005	0.005
Impedance @ 20° C (mΩ/m)	0.110	0.091	0.073	0.061	0.047	0.031	0.027	0.023	0.015	0.014
Impedance @ 50% load (mΩ/m)	0.112	0.093	0.075	0.064	0.049	0.030	0.029	0.024	0.016	0.015
Impedance @ thermal conditions (mΩ/m)	0.120	0.100	0.083	0.070	0.054	0.033	0.034	0.028	0.018	0.017
Resistance of protective conductor (mΩ/m)	0.118	0.118	0.118	0.113	0.106	0.090	0.087	0.079	0.062	0.056
Rated short-time current for three-phase fault (1s) - kA	30	35	40	50	55	60	80	100	100	120
Rated short-time current for phase-neutral fault (1s) - kA	30	35	40	50	55	60	80	100	100	120
Rated short-time current for phase-Pe fault (1s) - kA	18	21	24	30	33	36	48	60	60	72
Allowable peak current for three-phase fault (kA)	66	77	88	110	121	132	176	220	220	264
Allowable peak current for phase-N fault (kA)	66	77	88	110	121	132	176	220	220	264
Allowable peak current for phase-Pe fault (kA)	40	46	53	66	73	79	106	132	132	158

# TECHNICAL DATA

## EXA (Sandwich Type Aluminum) BBT

Allowable specific energy (A <sup>2</sup> s)*10 <sup>6</sup> for three-phase fault	900	1250	1600	2500	3025	3600	6400	10000	10000	14400
Allowable specific energy (A <sup>2</sup> s)*10 <sup>6</sup> for single-phase fault	900	1220	1600	2500	3025	3600	6400	10000	10000	14400
Resistance @ fault loop (mΩ/m)	0.22	0.21	0.19	0.17	0.15	0.12	0.11	0.10	0.08	0.07
Reactance @ fault loop (mΩ/m)	0.10	0.10	0.10	0.10	0.06	0.05	0.04	0.03	0.02	0.02
Impedance @ fault loop (mΩ/m)	0.25	0.23	0.21	0.20	0.16	0.13	0.12	0.11	0.08	0.07
Joule losses at rated current (W/m)	224.8	187.3	155.2	205.5	244.9	233.1	388.0	506.0	540.5	784.4
Weight (kg/m)	11.7	12.4	13.5	14.8	16.2	24.7	27.0	31.5	47.0	51.0
Degree of protection	IP 55									

Voltage drop calculation @ rated current and distributed load (V/m/A *10 <sup>-6</sup> )	K parameter									
cos φ										
0.70	87.0	72.1	59.5	51.4	40.9	27.1	25.8	20.1	13.8	13.0
0.75	90.9	75.4	62.2	53.7	42.5	27.7	26.7	21.0	14.3	13.5
0.80	94.6	78.5	64.8	55.8	44.0	28.3	27.6	21.8	14.8	13.9
0.85	98.0	81.4	67.2	57.7	45.3	28.7	28.4	22.6	15.2	14.3
0.90	101.1	84.0	69.4	59.4	46.4	28.9	29.0	23.3	15.6	14.6
0.95	103.3	85.9	71.1	60.7	47.0	28.8	29.3	23.8	15.8	14.8
1.00	101.4	84.5	70.0	59.3	45.2	26.3	28.0	23.4	15.2	14.2

### Voltage drop calculation

$$\Delta v\% = b \cdot \frac{k \cdot I_b \cdot L}{V_n} \cdot 100$$

Where:

b = 1	for distributed load
b = 2	for load at the end of the line
K	k parameter
L	length of the line
I <sub>b</sub>	current of the line
V <sub>n</sub>	rated voltage of the line

# TECHNICAL DATA

## EXC (Sandwich Type Copper) BBT

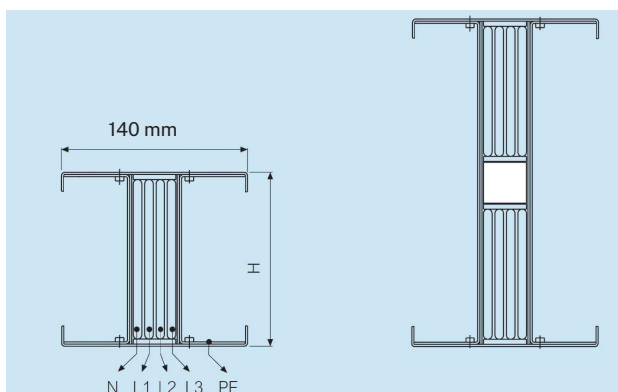


Fig: Single bar BBT

Fig: Double bar BBT



Technical Data									
Rated current (A)	800	1000	1250	1600	2000	2500	3200	4000	5000
Casing material	Pre-painted Steel Sheet RAL 9016								
Dimension lateral casing (mm)	85	85	85	130	160	200	266	326	406
Height of the bar	50	60	75	120	150	190	120	150	190
Overall dimensions (mm*mm)	140×85	140×85	140×85	140×130	140×160	140×200	140×266	140×326	140×406
Phase and neutral bar cross section (mm <sup>2</sup> )	300	360	450	720	900	1140	1440	1800	2280
Pe cross section (mm <sup>2</sup> Fe)	1026	1026	1026	1161	1251	1371	1569	1749	1989
Operating/insulation voltage (V)	1000								
Phase resistance @ 20° C (mΩ/m)	0.060	0.051	0.040	0.025	0.020	0.016	0.013	0.010	0.008
Phase resistance @ 50% load (mΩ/m)	0.062	0.053	0.042	0.026	0.017	0.017	0.013	0.011	0.000
Phase resistance @ thermal conditions (mΩ/m)	0.068	0.058	0.046	0.029	0.019	0.020	0.015	0.012	0.000
Phase reactance (mΩ/m)	0.017	0.017	0.016	0.015	0.014	0.010	0.006	0.006	0.005
Impedance @ 20° C (mΩ/m)	0.062	0.053	0.043	0.029	0.024	0.019	0.014	0.012	0.009
Impedance @ 50% load (mΩ/m)	0.064	0.058	0.045	0.030	0.022	0.020	0.015	0.012	0.005
Impedance @ thermal conditions (mΩ/m)	0.070	0.061	0.049	0.033	0.023	0.022	0.017	0.014	0.005
Resistance of protective conductor (mΩ/m)	0.121	0.121	0.121	0.108	0.092	0.083	0.072	0.062	0.057
Rated short-time current for three-phase fault (1s) - kA	40	45	50	55	60	80	100	100	120
Rated short-time current for phase-neutral fault (1s) - kA	40	45	50	55	60	80	100	100	120
Rated short-time current for phase-Pe fault (1s) - kA	24	26	30	33	36	48	60	60	72
Allowable peak current for three-phase fault (kA)	88	98	110	121	132	176	220	220	264
Allowable peak current for phase-N fault (kA)	88	98	110	121	132	176	220	220	264
Allowable peak current for phase-Pe fault (kA)	53	59	66	73	79	106	132	132	158

# TECHNICAL DATA

## EXC (Sandwich Type Copper) BBT

Allowable specific energy (A <sup>2</sup> s)*10 <sup>6</sup> for three-phase fault	1600	2000	2500	3025	3600	6400	10000	10000	14400
Allowable specific energy (A <sup>2</sup> s)*10 <sup>6</sup> for single-phase fault	1600	2000	2500	3025	3600	6400	10000	10000	14400
Resistance @ fault loop (mΩ/m)	0.18	0.17	0.16	0.13	0.11	0.10	0.08	0.07	0.06
Reactance @ fault loop (mΩ/m)	0.10	0.10	0.10	0.06	0.05	0.04	0.03	0.02	0.02
Impedance @ fault loop (mΩ/m)	0.21	0.20	0.19	0.15	0.12	0.11	0.09	0.07	0.07
Joule losses at rated current (W/m)	130.9	135.0	138.7	137.8	144.9	241.2	289.2	379.1	0.0
Weight (kg/m)	26.5	30.0	35.3	53.1	64.6	80.4	100.5	123.8	155.2
Degree of protection	IP 55								

Voltage drop calculation @ rated current and distributed load (V/m/A *10 <sup>-6</sup> )	K parameter								
cos φ									
0.70	51.9	45.8	37.9	27.1	20.1	18.4	13.1	11.2	3.1
0.75	54.0	47.5	39.2	27.7	20.3	18.8	13.5	11.5	2.9
0.80	56.1	49.1	40.3	28.2	20.3	19.1	13.8	11.7	2.6
0.85	57.9	50.4	41.3	28.5	20.3	19.4	14.1	11.8	2.3
0.90	59.6	51.6	42.1	28.6	20.0	19.4	14.3	11.9	1.9
0.95	60.7	52.5	42.4	28.2	19.3	19.2	14.3	11.8	1.4
1.00	59.1	50.6	40.0	25.4	16.3	17.4	13.4	10.7	0.0

### Voltage drop calculation

$$\Delta v\% = b \cdot \frac{k \cdot I_b \cdot L}{V_n} \cdot 100$$

Where:

b = 1	for distributed load
b = 2	for load at the end of the line
K	k parameter
L	length of the line
I <sub>b</sub>	current of the line
V <sub>n</sub>	rated voltage of the line

# MEASUREMENT OF SPECIAL ELEMENT LENGTHS

## Measurement of straight elements (EX BBT)

The exact length (L) of a piece can be determined by measuring the distance (Q) between the collars of the elements (as shown in fig-4) and then subtracting 220 mm from the dimension that has been taken.

Length of element,  $L = Q - 220 \text{ mm}$

Example:

Dimension measured,  $Q = 2520 \text{ mm}$

Order an element of length,  $L = (2520 - 220)$   
 $= 2300 \text{ mm}$

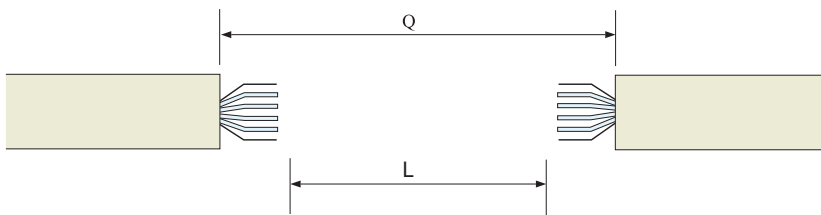


Fig-4

## Measurement of the size for the ordering of an elbow (EX BBT)

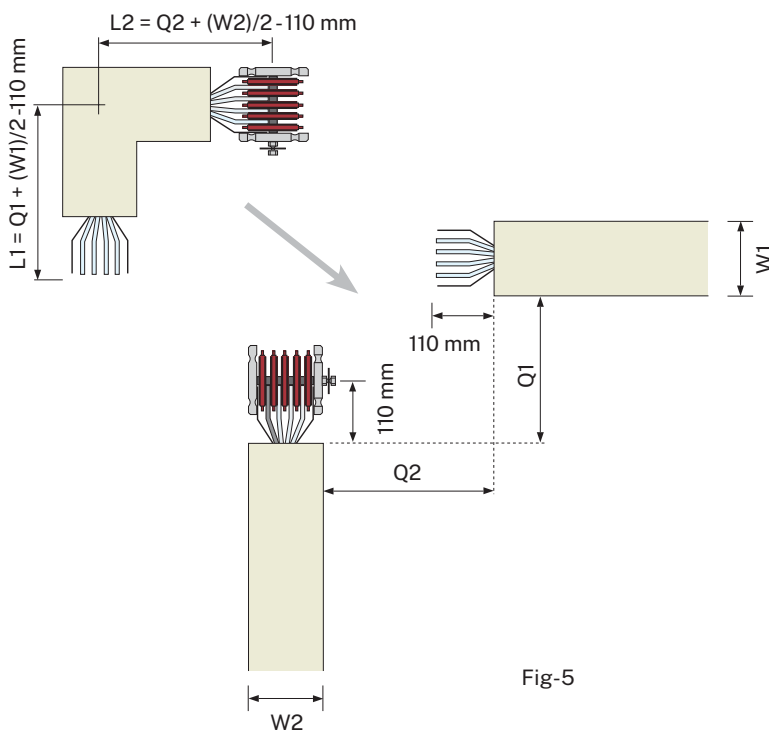


Fig-5

### Dihedral elbow

The exact length of the dihedral elbow needed to be ordered can be determined by measuring  $Q1$  and  $Q2$  (as shown in fig-5) and using following formula.

For Dihedral Elbow,  $W1=W2=140$

Dimension of the element to be ordered:

$L1 = Q1 + 70 - 110 \text{ mm}$

$L2 = Q2 + 70 - 110 \text{ mm}$

### Flat elbow

The exact length of the flat elbow needed to be ordered can be determined by measuring  $Q1$  and  $Q2$  (as shown in fig-5) and using following formula.

For Flat Elbow,  $W1$  &  $W2$  vary with current rating of the BBT.

Dimension of the element to be ordered:

$L1 = Q1 + (W1)/2 - 110 \text{ mm}$

$L2 = Q2 + (W2)/2 - 110 \text{ mm}$

# MEASUREMENT OF SPECIAL ELEMENT LENGTHS

## Measurement of straight elements (AX BBT)

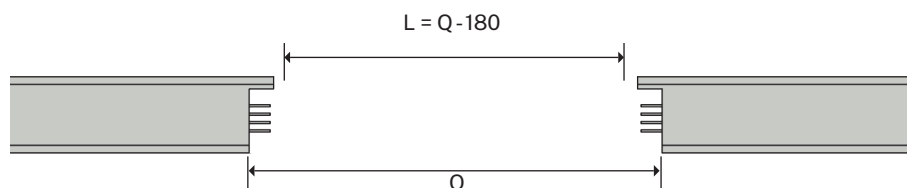


Fig-6

The exact length (L) of a piece can be determined by measuring the distance (Q) between the collars of the elements (as shown in fig-6) and then subtracting 180 mm from the dimension that has been taken.

Length of element,  $L = Q - 180 \text{ mm}$

Example:

Dimension measured,  $Q = 1880 \text{ mm}$

Order an element of length,  $L = (1880 - 180)$   
 $= 1700 \text{ mm}$

## Measurement of the size for the ordering of an elbow (AX BBT)

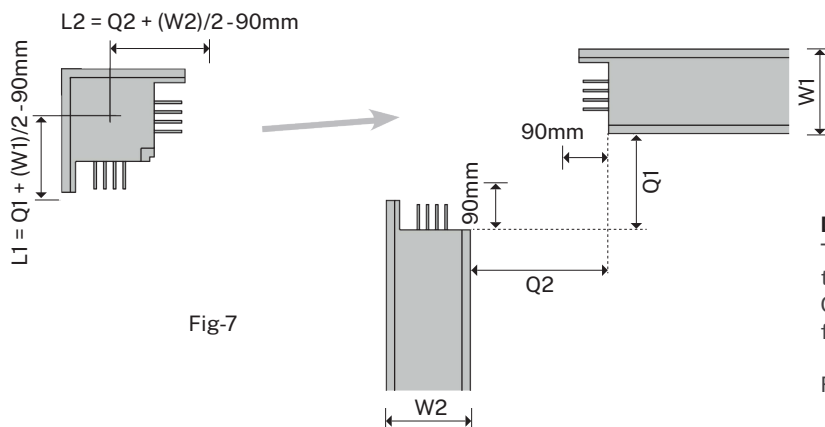


Fig-7

### Dihedral elbow

The exact length of the dihedral elbow needed to be ordered can be determined by measuring Q1 and Q2 (as shown in fig-7) and using following formula.

For Dihedral Elbow,  $W1=W2=200$

Dimension of the element to be ordered:

$L1 = Q1 + 100 - 90 \text{ mm}$

$L2 = Q2 + 100 - 90 \text{ mm}$

### Flat elbow

The exact length of the flat elbow needed to be ordered can be determined by measuring Q1 and Q2 (as shown in fig-8) and using following formula.

For Flat Elbow, W1 & W2 vary with current rating of the BBT.

Dimension of the element to be ordered:

$L1 = Q1 + (W1)/2 - 90 \text{ mm}$

$L2 = Q2 + (W2)/2 - 90 \text{ mm}$

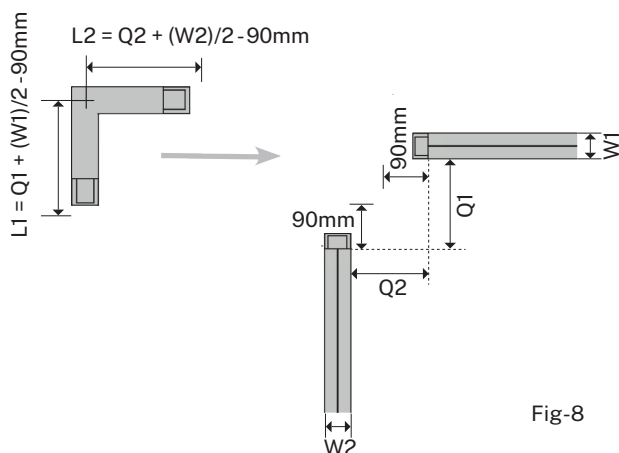
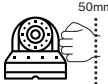

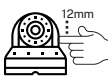

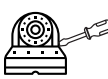












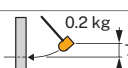


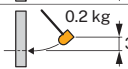
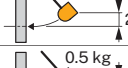
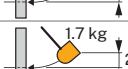
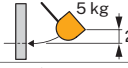
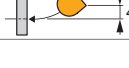


Fig-8

# PROTECTION CLASSIFICATIONS

**Protection against solid bodies and liquids : Index of protection - IP xx**  
Degree of protection of enclosures of electrical equipment in accordance with standards IEC 60529, BS EN 60529 Up to 1000 V

Ingress Protection Chart		
	Solids	Water
1	 Protected against a solid object greater than 50mm, such as a hand.	1  Protected against vertically falling drops of water. Limited ingress permitted.
2	 Protected against a solid object greater than 12.5mm, such as a finger.	2  Protected against vertically falling drops of water with enclosure tilted up to 15 degrees from the vertical. Limited ingress permitted.
3	 Protected against a solid object greater than 2.5mm, such as a screwdriver.	3  Protected against sprays of water up to 60 degrees from the vertical. Limited ingress permitted for three minutes.
4	 Protected against a solid object greater than 1mm, such as a wire.	4  Protected against water splashed from all directions. Limited ingress permitted.
5	 Dust protected. Limited ingress of dust permitted. Will not interfere with operation of the equipment. Two to eight hours.	5  Water from heavy seas or water projected in powerful jets shall not enter the enclosure in harmful quantities.
6	 Dust tight. No ingress of dust. Two to eight hours.	6  Protected against jets of water. Limited ingress permitted.
<b>Rating Example:</b>  <b>IP55</b> <b>INGRESS PROTECTION</b>		
		7  Protection against the effects of immersion in water between 15cm and 1m for 30 minutes.
		8  Protection against the effects of immersion in water under pressure for long periods.

**Protection against mechanical impact : Index of protection - IK**  
According to standards IEC 62262 and BS EN 62262

IK	Tests	Impact energy (in Joules)
IK 00		0
IK 01	 0.2 kg 75 mm	0.15
IK 02	 0.2 kg 100 mm	0.2
IK 03	 0.2 kg 175 mm	0.35
IK 04	 0.2 kg 250 mm	0.5
IK 05	 0.2 kg 350 mm	0.7
IK 06	 0.5 kg 200 mm	1
IK 07	 0.5 kg 400 mm	2
IK 08	 1.7 kg 295 mm	5
IK 09	 5 kg 200 mm	10
IK 10	 5 kg 400 mm	20



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