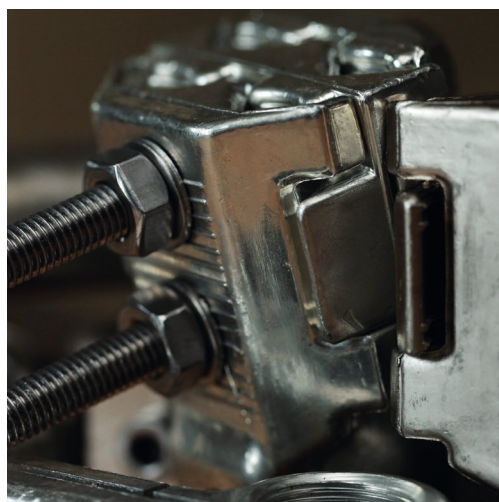


5 TRANSFORMER FITTINGS & ACCESSORIES

2024

1st EDITION



Bezpol



FOREWORD

The electrical connection to transformer is one of crucial points, demanding particular care, both for installation accuracy, and quality of materials used, while simultaneously these connections should provide:

- low level of losses on connections
- possibility of connecting cables, featuring round, sector single- and multi-wire cores, in broad range of cross-section areas,
- simple installation.

The damages, resulting from excessive increase of junction temperature (transformer termination - bushing screw, or damages in a form of burning out connection clamps) are the frequent causes of transformer failure. Substandard quality of transformer clamps used is usually the direct cause of above-mentioned phenomena. Electrical connections to transformer are performed by means of various clamp types. High reliability and cost-effectiveness of network operation are possible to achieve only when junctions of cables and leads will not constitute its weak points, and their reliability will be the same, as for the remaining components of the network. There are many engineering methods of making clamps.

The most important among them include: 1. Casting, 2. Forging

The clamps made of typical foundry brass are produced by casting method. The dispersion of the structure and mechanical properties of the casts depends on crystallization rate. Even though gravitational casts produced in gravity dies have many flaws, such as: gas holes, blow holes, slag streaks, contraction cavities, shrinkage porosities, coarseness, pits, external blisters. The above-mentioned flaws cause significant reduction of electrical and mechanical properties of produced clamps. In order to reduce casting defects, production of the clamps by means of pressure die-casting has been undertaken. Their quality is definitely higher than the quality of gravitational casts. However, even pressure die-casting does not eliminate creation of gas bubbles or slag intrusions.

Experience of users also indicates low bending strength of die-cast clamps. Coarse-grain crystallizing structure limits possibility of plastic deformations under external loads to the minimum. This is of key importance in case of busbar - clamp connection, featuring systematics of variable loads resulting from thermal stress. The frequent cause of cast clamps cracking, even during mounting, is casting stress. Considering the above observations, and making an effort to meet expectations of our customers, we have started works aimed at improving quality of transformer clamps manufactured by us. Significant quality improvement can only be achieved by changing production technology. We replaced the traditional casting technology with drop-forging of the clamps.

Therefore our clamps feature:

- beneficial, from the mechanical and electrical point of view, fibre arrangement,
- strengthening superficial layer,
- no blowholes presence,
- no shrinkage porosity and contraction cavities,
- good workability,
- high impact strength,
- excellent corrosion resistance,
- accuracy and repeatability of products, falling within 7-11 ISO class limits.

The technology used by us, provided that specific conditions are fulfilled, guarantees maintaining uniform structure and high material cleanness within whole volume of product, which prevents overheating clamps because of constrictions, while fibrous structure of drop forgings provides beneficial mechanical properties of the products. Even at significant excess of allowable load values, the clamps undergo plastic strain as a maximum, without change of cross-section and conduction effectiveness deterioration. The tests performed according to PN/91/E-06160/21 confirm rightness of adopted concept of transformer clamps manufacturing. The tests were intended for determining voltage drops, dissipated power and maximum temperature increase.

I=500A current was applied on the TOGA 1 2x240 mm² type clamp, during 3h period at T=20°C ambient temperature.

The results of the measurements were as follows:

- maximum voltage drop: $U=5\text{mV}$,
- maximum temperature of clamp reached 33°C,
- resistance 0.000014Ω,
- dissipated power amounted to 2.5W.

To summarize:

To significant degree we can owe such good results to our structural solution of the clamp and drop-forging method. Therefore we have a pleasure to hand over to you the catalogue of our products. We hope that their use will make your work easier. We kindly ask for your opinions and suggestions, which will help us to meet expectations of our customers.

We invite you to co-operation!

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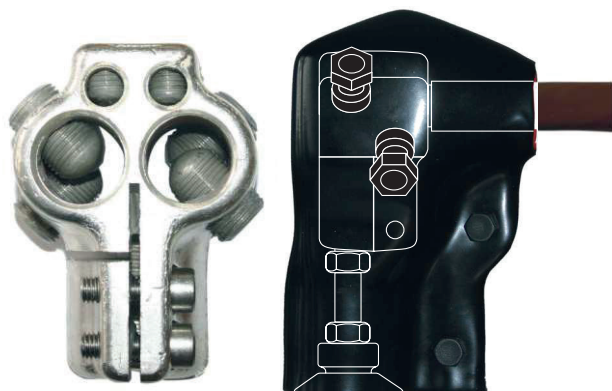
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1. TRANSFORMER CLAMPS

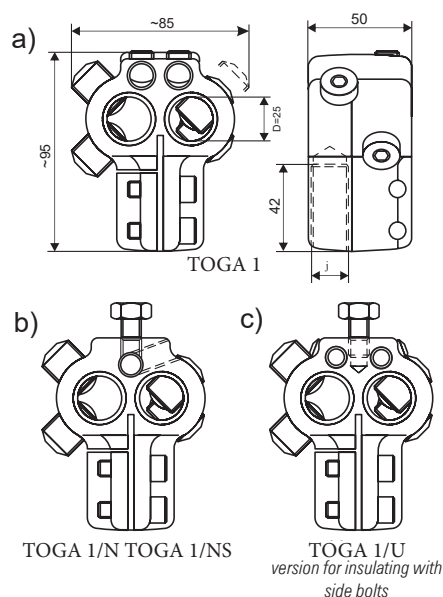


1.1. TOGA TYPE TRANSFORMER CLAMPS

1.1.1. TOGA 1 TYPE TRANSFORMER CLAMPS *



TOGA 1



Intended use:

Implementation of horizontal off-take from low voltage bushings of distribution transformers for threads within M12 up to M30x2 range.

Material:

Body : brass die-forging, tin galvanized.

Fastening bolts – stainless steel.

Set screws – tin galvanized brass.

Note:

1. The TOGA 1 type clamps are being sold in a set, comprising: three clamps in phase designs, one clamp without holes for auxiliary cables but with milled face, in order to facilitate connection of flat earthing wire – fig. b) TOGA 1/N.
2. We also offer special version of neutral TOGA 1/U type clamp fig. c), used when off-take with band iron is necessary, and connecting earthing leads of equipment mounted on transformer to the neutral clamp by means of special fixing holes.
3. A special front hole for earthing lead 2.5 to 50mm², fig. b)Toga 1/NS

Connectivity:

2 x 300 mm² RMC

Auxiliary leads (TOGA 1/NS): 1 x 2.5 to 50 mm²

Auxiliary leads (TOGA 1): 2 x 2.5 to 50 mm²

Possibility of connecting earthing wire terminal.

Technical parameters:

Overall dimensions as in fig. a).

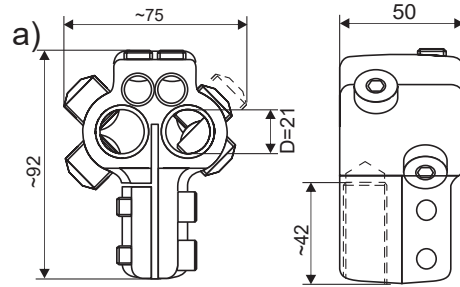
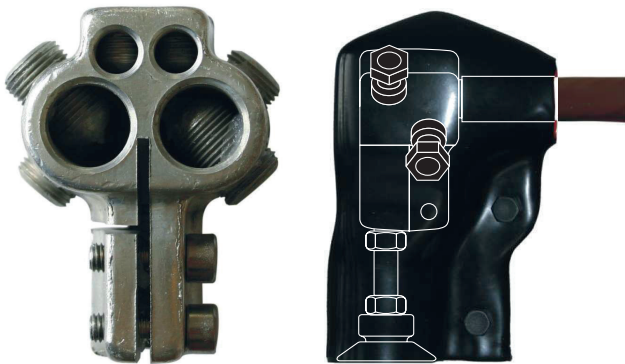
Selection according to the table below.

Catalogue no.	KTM	Type	Connecting	thread 1 max [A]	Output of transformer
BK 6100	1115-811-112-350	TOGA-1/M12	M 12	250	up to 160 kVA
BK 6101	1115-811-112-340	TOGA-1/M12/N	M 12	250	up to 160 kVA
BK 6102	1115-811-112-330	TOGA-1/M12/U	M 12	250	up to 160 kVA
BK 6103	1115-811-112-320	TOGA-1/M12/NS	M 12	250	up to 160 kVA
BK 6104	1115-811-116-350	TOGA-1/M16	M 16	400	up to 200 kVA
BK 6105	1115-811-116-340	TOGA-1/M16/N	M 16	400	up to 200 kVA
BK 6106	1115-811-116-330	TOGA-1/M16/U	M 16	400	up to 200 kVA
BK 6107	1115-811-116-320	TOGA-1/M16/NS	M 16	400	up to 200 kVA
BK 6108	1115-811-120-350	TOGA-1/M20	M 20	630	up to 250 kVA/400 kVA
BK 6109	1115-811-120-340	TOGA-1/M20/N	M 20	630	up to 250 kVA/400 kVA
BK 6110	1115-811-120-330	TOGA-1/M20/U	M 20	630	up to 250 kVA/400 kVA
BK 6111	1115-811-120-320	TOGA-1/M20/NS	M 20	630	up to 250 kVA/400 kVA
BK 6112	1115-811-130-350	TOGA-1/M30	M 30x2	1000	630 kVA
BK 6113	1115-811-130-340	TOGA-1/M30/N	M 30x2	1000	630 kVA
BK 6114	1115-811-130-330	TOGA-1/M30/U	M 30x2	1000	630 kVA
BK 6115	1115-811-130-320	TOGA-1/M30/NS	M 30x2	1000	630 kVA

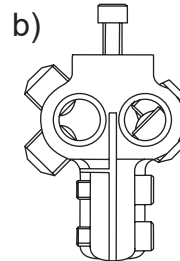
Designations of leads: RE – single wire round cores, SE – single wire sector cores, SM – multiwire sector cores,

RMC – consolidated, multiwire round cores * Patented product ** Technical features and dimensional range on page 23 of the catalogue

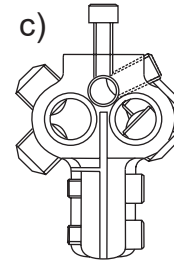
1.1.2. TOGA 2 TYPE TRANSFORMER CLAMPS *



TOGA 2



TOGA 2N



TOGA 2/NS

TOGA 2

Intended use:

Implementation of horizontal off-take from low voltage bushings of power transformers for threads within M12 up to M20 range.

Material:

Body : brass die-forging, tin galvanized.
Fastening bolts – stainless steel.
Set screws – tin galvanized brass.

Note:

- The TOGA 2 type clamps are sold as a set that includes: three clamps in phase designs, one clamp without holes for auxiliary cables but with milled face, in order to facilitate connection of flat earthing wire – fig. b) TOGA 2/N.
- A special front hole for earthing lead 2.5 to 50 mm², fig. c) Toga 2/NS

Connectivity:

Main leads:
2 x 50 to 185 mm² RE, RM, SM, 2 x 240 mm² RMC
Auxiliary leads (TOGA 2/NS): 1 x 2,5 to 50 mm²
Auxiliary leads (TOGA 2): 2 x 2,5 to 50 mm²
Possibility of connecting earthing switch terminal.

Technical parameters:

Overall dimensions as in fig. a).
Selection according to the table below.

Catalogue no.	KTM	Type	Connecting		Output of transformer
BK 6130	1115-811-212-350	TOGA-2/M12	M 12	250	up to 160 kVA
BK 6131	1115-811-212-340	TOGA-2/M12/N	M 12	250	up to 160 kVA
BK 6132	1115-811-212-320	TOGA-2/M12/NS	M 12	250	up to 160 kVA
BK 6133	1115-811-216-350	TOGA-2/M16	M 16	400	up to 200kVA
BK 6134	1115-811-216-340	TOGA-2/M16/N	M 16	400	up to 200 kVA
BK 6135	1115-811-216-320	TOGA-2/M16/NS	M 16	400	up to 200 kVA
BK 6136	1115-811-220-350	TOGA-2/M20	M 20	630	up to 250 kVA/400 kVA
BK 6137	1115-811-220-340	TOGA-2/M20/N	M 20	630	up to 250 kVA/400 kVA
BK 6138	1115-811-220-320	TOGA-2/M20/NS	M 20	630	up to 250 kVA/400 kVA

Designations of leads: RE – single wire round cores, SE – single wire sector cores, SM – multiwire sector cores, RMC – consolidated, multiwire round cores

* Patented product ** Technical features and dimensional range on page 23 of the catalogue

1.1.3. TOGA 3 TYPE TRANSFORMER CLAMPS*



TOGA 3

Intended use:

Implementation of vertical off-take from low voltage bushings of power transformers for threads within M12 up to M30x2 range.

Material:

Body : brass die-forging, galvanized.

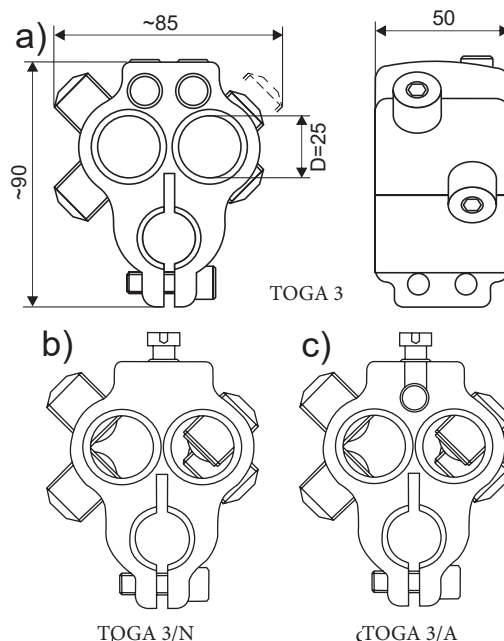
Fastening bolts – stainless steel.

Set screws – galvanized brass.

Note:

The TOGA 3 type clamps are sold as a set that includes:

three clamps in phase designs, one clamp (marked with N letter) without holes for auxiliary cables but with milled face in order to facilitate connection of flat earthing lead with single central hole for fastening auxiliary earthing lead – fig. c) TOGA 3/A – version for indoor stations.

**Connectivity:**

2 x 50 to 240 mm² RE, RM, SM,

2 x 300 mm² RMC

Auxiliary leads (TOGA 3/A): 1 x 2,5 to 50 mm²

Auxiliary leads (TOGA 3): 2 x 2,5 to 50 mm²

Possibility of connecting earthing switch terminal.

Technical parameters:

Overall dimensions as in fig. a).

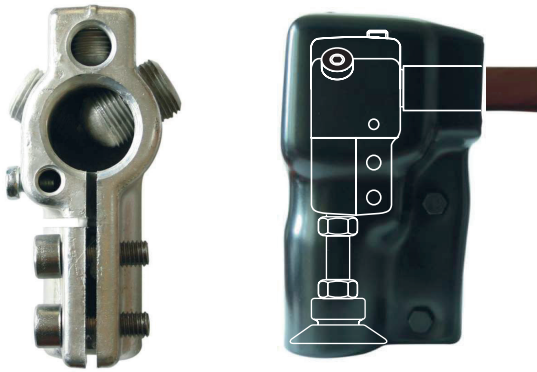
Selection according to the table below.

Catalogue no.	KTM	Type	Connecting	max [A]	Output of transformer
BK 6150	1115-811-312-350	TOGA-3/M12	M 12	250	up to 160 kVA
BK 6151	1115-811-312-340	TOGA-3/M12/N	M 12	250	up to 160 kVA
BK 6152	1115-811-312-310	TOGA-3/M12/A	M 12	250	up to 160 kVA
BK 6153	1115-811-316-350	TOGA-3/M16	M 16	400	up to 200 kVA
BK 6154	1115-811-316-340	TOGA-3/M16/N	M 16	400	up to 200 kVA
BK 6155	1115-811-316-310	TOGA-3/M16/A	M 16	400	up to 200 kVA
BK 6156	1115-811320-350	TOGA-3/M20	M 20	630	up to 250 kVA/400 kVA
BK 6157	1115-811-320-340	TOGA-3/M20/N	M 20	630	up to 250 kVA/400 kVA
BK 6158	1115-811-320-310	TOGA-3/M20/A	M 20	630	up to 250 kVA/400 kVA
BK 6159	1115-811-330-350	TOGA-3/M30	M 30 x2	1000	630 kVA
BK 6160	1115-811-330-340	TOGA-3/M30/N	M 30 x 2	1000	630 kVA
BK 6161	1115-811-330-310	TOGA-3/M30/A	M 30 x 2	1000	630 kVA

Designations of leads: RE – single wire round cores, SE – single wire sector cores, SM – multiwire sector cores, RMC – consolidated, multiwire round cores

* Patented product ** Technical features and dimensional range on page 23 of the catalogue

1.1.4. TOGA 4 TYPE TRANSFORMER CLAMPS*



TOGA 4

Intended use:

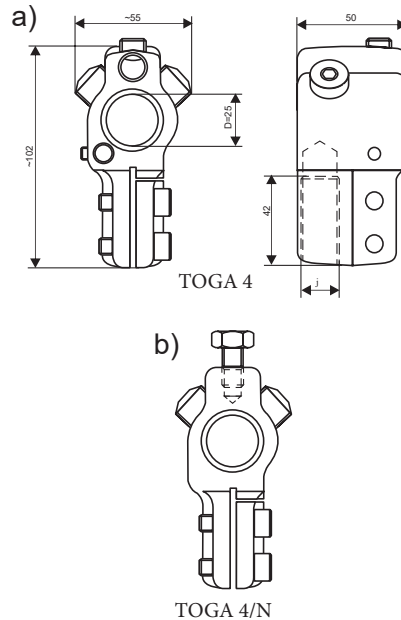
Implementation of horizontal off-take from low voltage bushings of distribution transformers for threads within M12 up to M20 range.

Material:

Body : brass die-forging, tin galvanized.
Fastening bolts – stainless steel.
Set screws – tin galvanized brass.

Note:

The TOGA 4 type clamps are being sold in set that includes: three clamps in phase design, one clamp (marked with N letter) without openings for auxiliary cables, but with milled face in order to facilitate connection of flat earthing lead – fig. b).



Connectivity:

Main leads: 1 x 50 to 240 mm² RE, RM, SM, 1 x 300 mm² RMC
Auxiliary leads: 1 x 2.5 to 50 mm² 1 x 2.5 to 25 mm²
Possibility of connecting earthing lead terminal.

Technical parameters:

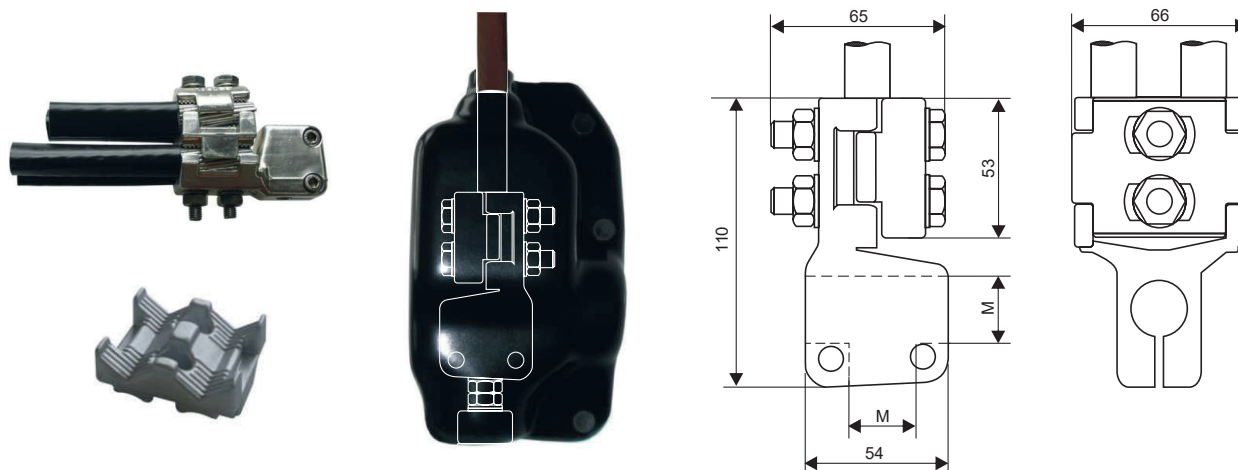
Overall dimensions as in fig. a).
Selection according to the table below.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6170	1115-811-412-350	TOGA-4/M12	M 12	250	up to 160 kVA
BK6171	1115-811-412-340	TOGA-4/M12/N	M 12	250	up to 160 kVA
BK6172	1115-811-416-350	TOGA-4/M16	M 16	400	up to 200 kVA
BK6173	1115-811-416-340	TOGA-4/M16/N	M 16	400	up to 200 kVA
BK6174	1115-811-420-350	TOGA-4/M20	M 20	630	up to 250 kVA/400 kVA
BK6175	1115-811-420-340	TOGA-4/M20/N	M 20	630	up to 250 kVA/400 kVA

Designations of leads: RE – single wire round cores, SE – single wire sector cores, SM – multiwire sector cores, RMC – consolidated, multiwire round cores

* Patented product ** Technical features and dimensional range on page 23 of the catalogue.

1.1.5. TOGA 5* AND TOGA 6* TYPE TRANSFORMER CLAMPS



TOGA 5 and TOGA 6

Intended use:

An universal implementation of horizontal or vertical off-take from low-voltage bushings of power distribution transformers, TOGA 5 type for threads within M12 up to M20 range and TOGA 6 type for M30x2 thread. The clamps are equipped with frictional – elastic lock with two fastening holes, which are intersecting each other at right angle. The enable mounting of the clamp as required, in vertical or horizontal position.

Material:

Body – tinned brass die-forging.
Set screws – stainless steel.

Connectivity:

2 x 70 up to 240 mm² RE, RM, SM, while use of doubling divider enables 4 x 240 mm² off-take – with divider – RE, RM, SM, RMC

Note:

The TOGA 5 clamp enables connection of band iron and LV surge arresters on extension arm made of hot-galvanized steel sheet.

Technical parameters:

Overall dimension as in figure.
Selection according to the table below.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6185	1115-811-512-350	TOGA-5/M12	M 12	250	up to 160 kVA
BK6186	1115-811-516-350	TOGA-5/M16	M 16	400	up to 200 kVA
BK6187	1115-811-520-350	TOGA-5/M20	M 20	630	up to 250 kVA/400
BK6188	1115-811-530-350	TOGA-6/M30x2	M 30 x 2	1000	up to 630 kVA
BK6189	1115-811-520-070	TOGA-5/M20 z przekładką	M 20	630	250-400 kVA
BK6190	1115-811-530-070	TOGA-6/M30x2 z przekładką	M 30 x 2	1000	up to 630 kVA

Designations of leads: RE – single wire round cores, SE – single wire sector cores, SM – multiwire sector cores, RMC – consolidated, multiwire round cores

* Patented product ** Technical features and dimensional range on page 23 of the catalogue

1.1.6. TOGA 7 TYPE TRANSFORMER CLAMPS

TOGA 7

Intended use:

Implementation of horizontal off-take from low voltage bushings of power distribution transformers for TOGA 7 within M12 up to M20 thread range.

The clamps are equipped with frictional - elastic lock, for mounting on bushing screw at transformer.

Material:

Body – tinned brass die-forging.
Set screws – stainless steel.

Connectivity:

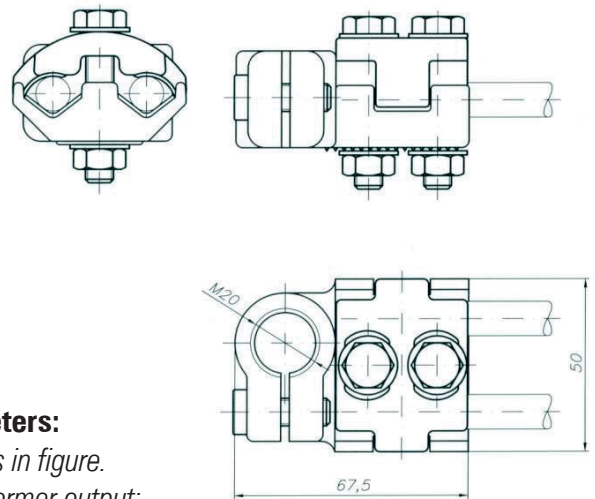
2 x 30 do 150 mm² RE, RM, SM, RMC

Technical parameters:

Overall dimension as in figure.

I max - 630A Transformer output:

- for M12 fastening thread – up to 160 kVA,
- for M16 fastening thread – up to 200 kVA,
- for M20 fastening thread – 250-400 kVA,

**Note:**

The TOGA 7 clamp enables connection of band iron and LV surge arresters on extension arm made of hot-galvanized steel sheet.

1.1.7. TOGA 8 TYPE TRANSFORMER CLAMPS

TOGA 8

Intended use:

An universal implementation of vertical off-take with four main leads from low voltage bushing of power distribution transformers with threads (M33x2, M42x3, M48x3).

The clamps are fastened on a bushing by means of frictional - elastic lock.

Material:

Body – tinned brass die-forging.
Set screws – stainless steel.

Connectivity:

4 x 70 do 300 mm² RE, RM, SM, RMC

Technical parameters:

Overall dimension as in figure.

I max - 2000A Transformer output:

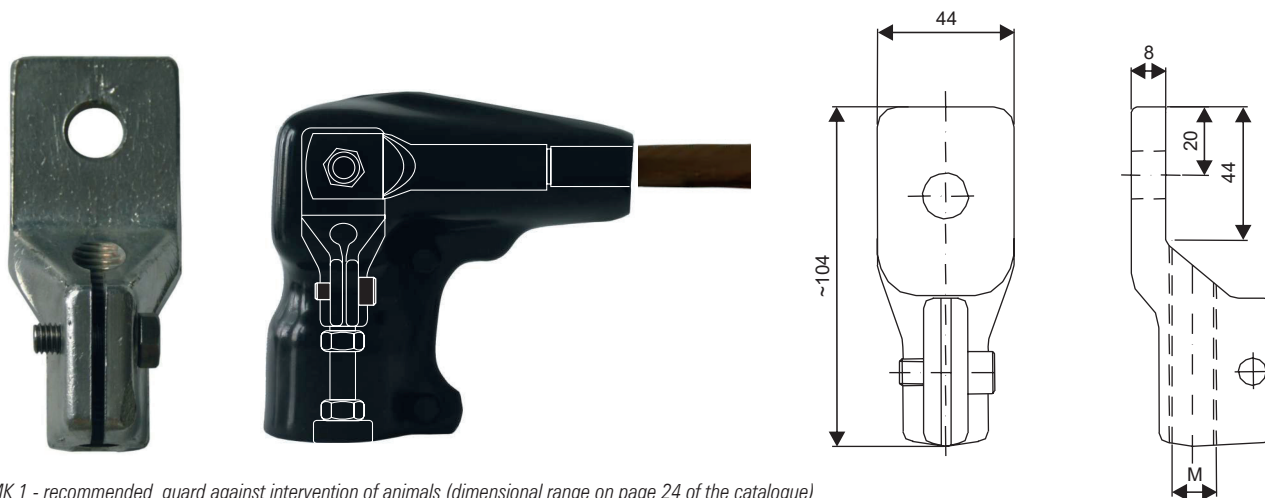
- for M 33x2 fastening thread – up to 1000 kVA,
- for M 42x3 fastening thread – up to 1000 kVA,
- for M 48x3 fastening thread – up to 1000 kVA,



Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK 6194	1115-811-830-350	TOGA 8/M30x2	M30x2	1000A	up to 1000 kVA
BK 6195	1115-811-830-340	TOGA 8/M30x2/N	M30x2	1000A	up to 1000 kVA
BK 6196	1115-811-842-350	TOGA 8/M42x3	M42x3	2000A	up to 1000 kVA
BK 6197	1115-811-842-340	TOGA 8/M42x3/N	M42x3	2000A	up to 1000 kVA
BK 6198	1115-811-848-350	TOGA 8/M48x3	M48x3	3150A	up to 1000 kVA
BK 6199	1115-811-848-340	TOGA 8/M48x3/N	M48x3	3150A	up to 1000 kVA

1.2. MK TYPE DROP-FORGED TRANSFORMER CLAMPS FOR BUSBAR CONNECTIONS

1.2.1. MK 1 TYPE DROP-FORGED TRANSFORMER CLAMP FOR BUSBAR CONNECTIONS



OZ MK 1 - recommended guard against intervention of animals (dimensional range on page 24 of the catalogue)

MK 1

Intended use:

Implementation of 40 mm wide busbar connections on low voltage side of transformer stations.

Material:

Body – tinned brass die-forging.
Set screw – stainless steel.

Connectivity:

The clamp screwed on connecting screw of transformer bushing (M12 and M16, set and locked with one M8 bolt).

The clamps are produced for:

M12 – nominal current $I=250A$ for transformer outputs up to 160 kVA
M16 – nominal current $I=400A$ for transformer outputs up to 200 kVA

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6200	1115-810-112-000	MK 1/12	M 12	250	up to 160 kVA
BK6201	1115-810-116-000	MK 1/16	M 16	400	up to 200 kVA

1.2.2. MK 1A TYPE DROP-FORGED TRANSFORMER CLAMP FOR BUSBAR CONNECTIONS 12

MK 1A

Intended use:

Implementation of 40 mm wide busbar connections on low voltage side of transformer stations.

The clamps are produced for:

M12 – nominal current $I=250\text{ A}$ for transformer output up to 160 kVA

M16 – nominal current $I=400\text{ A}$ for transformer output up to 200 kVA

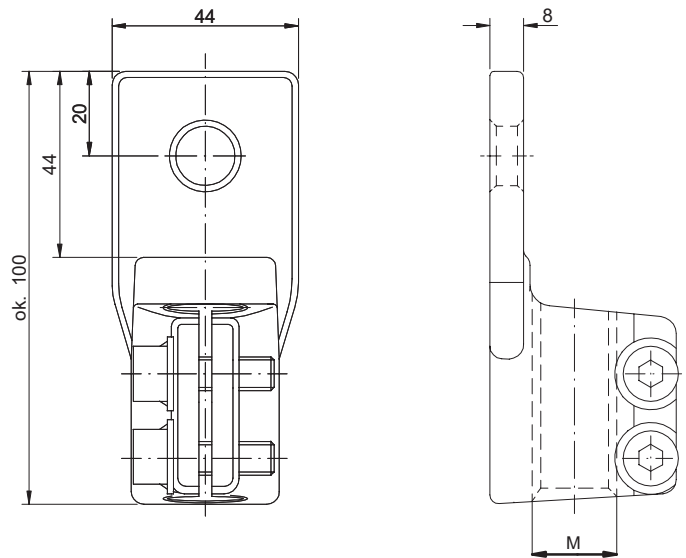
M20 – nominal current $I=630\text{ A}$ for transformer output up to 400 kVA

Material:

Body – brass die-forging with possibility of tinning.
Set screws – stainless steel.

Connectivity:

The clamp is screwed on transformer screw of transformer bushing (M12, M16 and M20), tightened and locked with two M8 bolts.

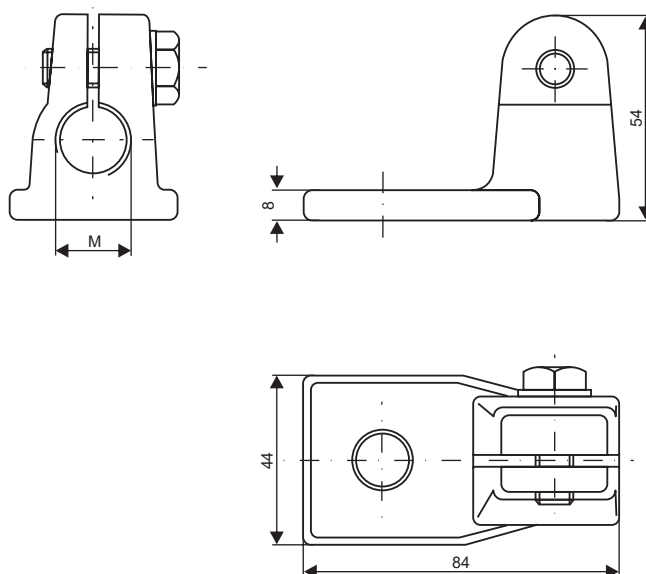


Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6210	1115-810-001-012	MK 1A/12	M 12	250	up to 160 kVA
BK6211	1115-810-001-016	MK 1A/16	M 16	400	up to 200 kVA
BK6212	1115-810-001-020	MK 1A/20	M 20	630	up to 250/400 kVA

1.2.3. MK 1B TYPE DROP-FORGED TRANSFORMER CLAMP FOR BUSBAR CONNECTIONS 12



MK 1B

**Intended use:**

Implementation of up to 40 mm wide busbar connections on low voltage side of transformer stations

The clamps are produced for:

M12 – nominal current $I=250A$ for transformer output up to 160 kVA

M16 – nominal current $I=400A$ for transformer output up to 200 kVA

M20 – nominal current $I=630A$ for transformer output up to 400 kVA

Material:

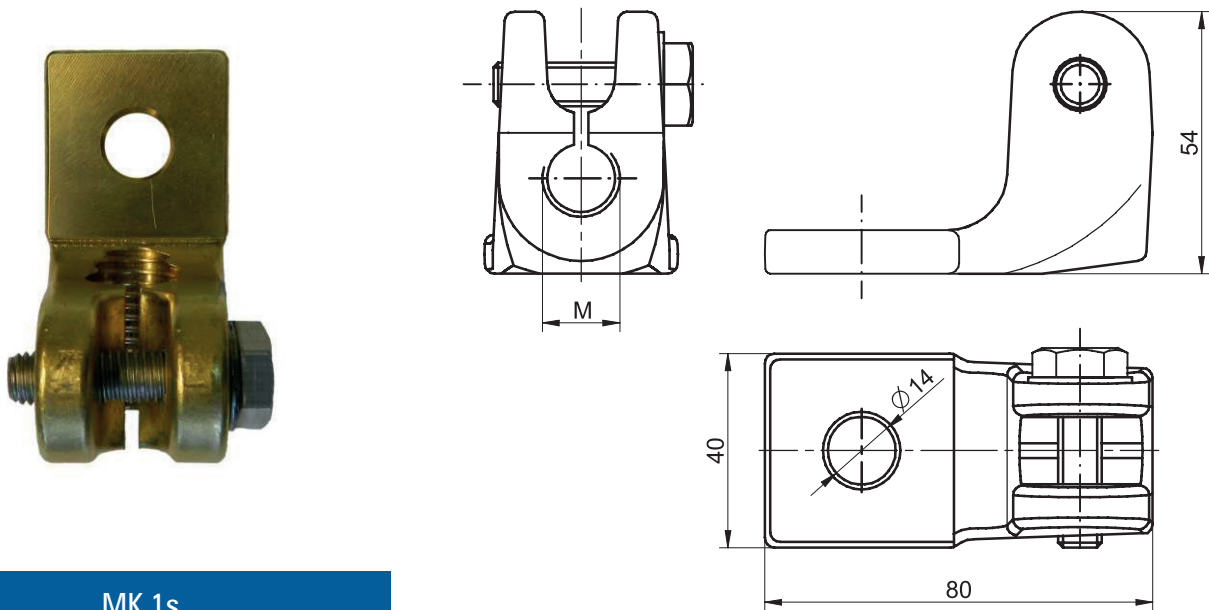
Body – brass die-forging with possibility of tinning.
Set screws – stainless steel.

Connectivity:

The clamp is screwed on transformer screw of transformer bushing (M12, M16 and M20), tightened and locked with one M10 bolt.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6215	1115-810-001-120	MK 1B/12	M 12	250	up to 160 kVA
BK6216	1115-810-001-160	MK 1B/16	M 16	400	up to 200 kVA
BK6217	1115-810-001-200	MK 1B/20	M 20	630	up to 250/400 kVA

1.2.4. DROP-FORGED TRANSFORMER CLAMP FOR MK 1s TYPE BUSBAR CONNECTIONS



MK 1s

Intended use:

Implementation of 40 mm wide busbar connections on low voltage side of transformer stations.

The clamps are produced for:

The clamps are produced for:

M12 – nominal current $I=250A$ for transformer output up to 160 kVA

M16 – nominal current $I=400A$ for transformer output up to 200 kVA

M20 – nominal current $I=630A$ for transformer output up to 400 kVA

Material:

Die-forged brass

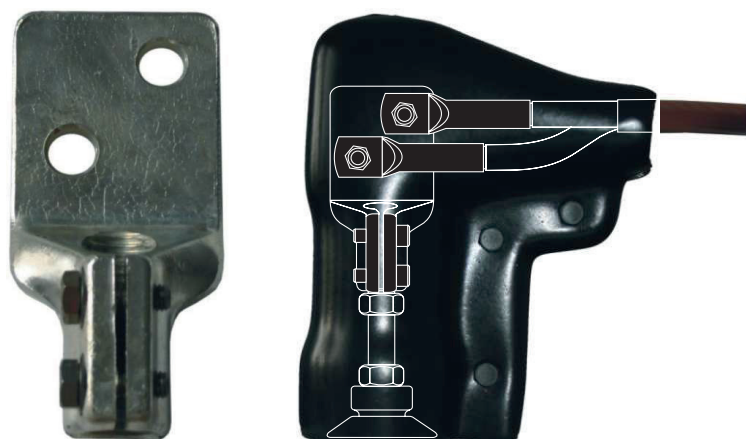
The product is available in as forged or tinned versions.
Set screw – stainless steel

Connectivity:

The clamp is screwed on transformer screw of transformer bushing (M12 up to M20), tightened and locked with one M8 bolt.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6205	1115-810-112-100	MK 1s/12	M 12	250	160 kVA
BK6206	1115-810-116-100	MK 1s/16	M 16	400	200 kVA
BK6207	1115-810-120-100	MK 1s/20	M 20	630	400 kVA

1.2.5. MK 2 TYPE DROP-FORGED TRANSFORMER CLAMP FOR BUSBAR CONNECTIONS



MK 2

Intended use:

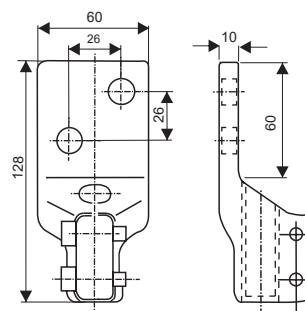
Implementation of 40 mm wide busbar connections on low voltage side of transformer stations.

The clamps are produced for:

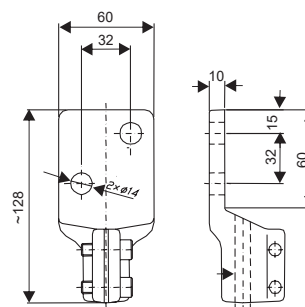
M12 – nominal current $I=250A$ for transformer outputs up to 160 kVA

M16 – nominal current $I=400A$ for transformer outputs up to 200 kVA

M20 – nominal current $I=630A$ for transformer outputs up to 400 kVA



Drilling out of the clamp acc. to DIN4253269



Drilling out of the clamp acc. to BN-76/3071-72

Material:

Die-forged brass

The product is available in as forged or tinned versions.

Set screw – stainless steel

Connectivity:

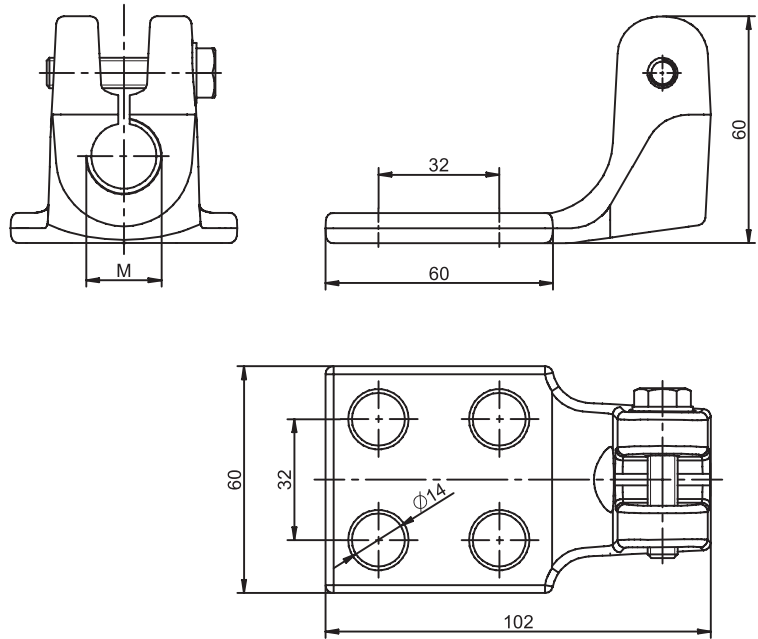
The clamp is screwed on transformer connecting screw of transformer bushing (M12 up to M20), tightened and locked with one M8 bolt.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6220	1115-810-212-000	MK 2/12	M 12	250	up to 160 kVA
BK6221	1115-810-216-000	MK 2/16	M 16	400	up to 200 kVA
BK6222	1115-810-220-000	MK 2/20	M 20	630	up to 250/400 kV

1.2.6. DROP-FORGED TRANSFORMER CLAMP FOR MK 2s TYPE BUSBAR CONNECTIONS



MK 2s

**Intended use:**

Implementation of 60 mm wide busbar connections on low voltage side of transformer stations.

The clamps are produced for:

M12 – nominal current $I=250\text{ A}$ for transformer outputs up to 160 kVA

M16 – nominal current $I=400\text{ A}$ for transformer outputs up to 200 kVA

M20 – nominal current $I=630\text{ A}$ for transformer outputs up to 400 kVA

Material:

Die-forged brass

The product is available in as forged or tinned versions.

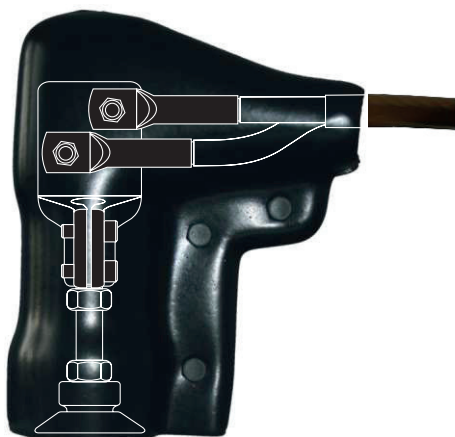
Set screw – stainless steel

Connectivity:

The clamp is screwed on transformer screw of transformer bushing (M12 up to M20), tightened and locked with one M8 bolt.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6223/12	1115-810-212-100	MK 2s/12	M 12	250	160 kVA
BK6223/16	1115-810-216-100	MK 2s/16	M 16	400	200 kVA
BK6223/20	1115-810-220-100	MK 2s/20	M 20	630	400 kVA

1.2.7. MK 3 TYPE DROP-FORGED TRANSFORMER CLAMP FOR BUSBAR CONNECTIONS



OZ MK 1 - recommended guard against intervention of animals (dimensional range on page 24 of the catalogue)

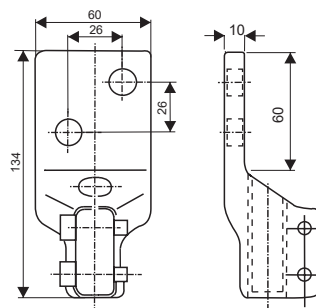
MK 3

Intended use:

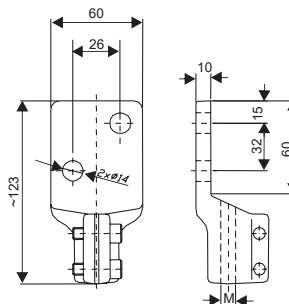
Implementation of 60 mm wide busbar connections on low voltage side of transformer stations.

The clamps are produced for:

M20 – nominal current $I=630\text{ A}$ for transformer outputs up to 400 kVA
M30x2 – nominal current $I=1000\text{ A}$ for transformer outputs up to 630 kVA



Drilling out of the clamp acc. to DIN 4253269



Drilling out of the clamp acc. to BN-76/3071-72

Material:

Die-forged brass

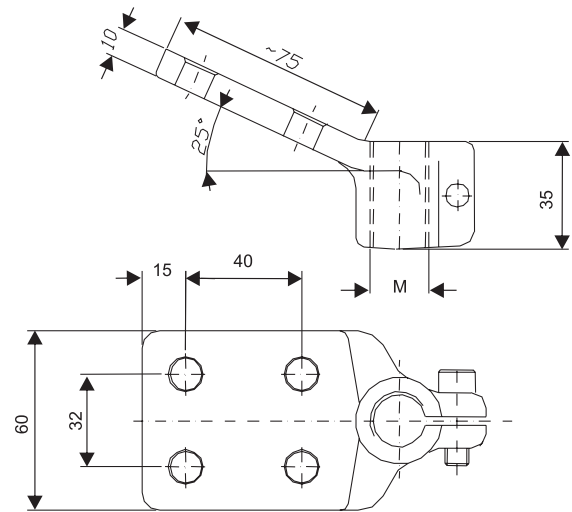
The product is available in as forged or tinned versions.
Set screw – stainless steel

Connectivity:

The clamp is screwed on transformer screw of transformer bushing (M12, M16, M20 and M30x2), tightened and locked with two M8 bolts.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6225	1115-810-312-000	MK 3/12	M 12	250	160 kVA
BK6226	1115-810-316-000	MK 3/16	M 16	400	250 kVA
BK6227	1115-810-320-000	MK 3/20	M 20	630	400 kVA
BK6228	1115-810-330-000	MK 3/30x2	M 30 x 2	1000	630 kVA

1.2.8. MK 4 TYPE DROP-FORGED TRANSFORMER CLAMP FOR BUSBAR CONNECTIONS



Possibility of connecting buses at 25° angle.

MK 4

Intended use:

Implementation of 60 mm wide busbar connections on low voltage side of transformer stations.

The clamps are produced for:

M12 – nominal current $I=250A$ for transformer outputs up to 160 kVA

M16 – nominal current $I=400A$ for transformer outputs up to 200 kVA

M20 – nominal current $I=630A$ for transformer outputs 250 - 400 kVA

Possibility of connecting buses at 25° angle.

Material:

Die - forged brass

The product is available in as forged or tinned versions.

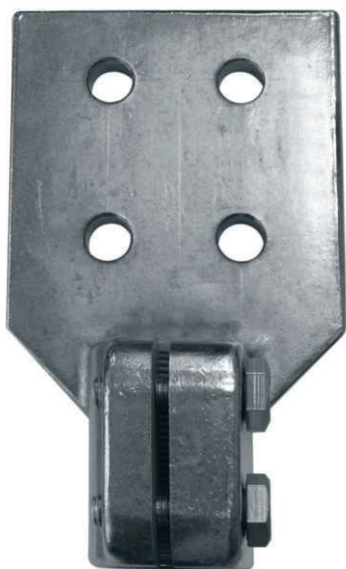
Set screw – stainless steel

Connectivity:

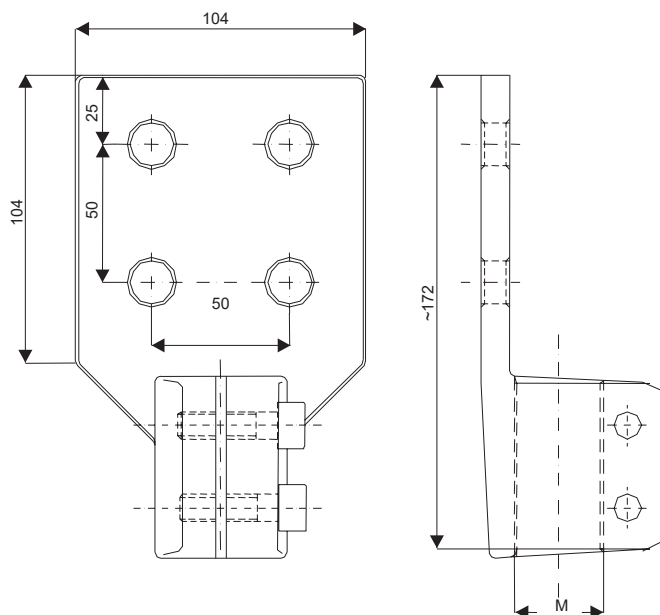
The clamp is screwed on transformer screw of transformer bushing (M12, M16 and M20), tightened and locked with one M8 bolt.

Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6230	1115-810-412-000	MK 4/12	M 12	250	up to 160 kVA
BK6231	1115-810-416-000	MK4/16	M 16	400	up to 200 kVA
BK6232	1115-810-420-000	MK 4/20	M 20	630	up to 250/400 kVA

1.2.9. MK 5 TYPE DROP-FORGED TRANSFORMER CLAMP FOR BUSBAR CONNECTIONS



MK 5

**Intended use:**

Implementation of 100 mm wide busbar connections on low voltage side of transformer stations.

The clamps are produced for:

M20 – nominal current $I=630\text{ A}$ for transformer outputs up to 400 kVA

M30x2 – nominal current $I=1000\text{ A}$ for transformer outputs up to 630 kVA

Material:

Die-forged brass

The product is available in as forged or tinned versions.
Set screw – stainless steel

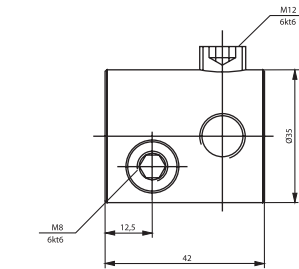
Connectivity:

The clamp is screwed on transformer screw of transformer bushing (M20 and M30x2), tightened and locked with two M10 bolts.

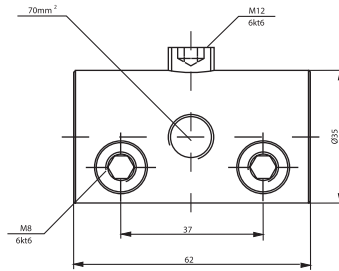
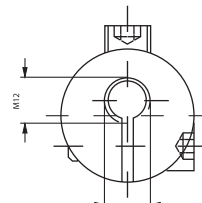
Catalogue no.	KTM	Type	Connecting thread	max [A]	Output of transformer
BK6237	1115-810-530-000	MK 5/30x2	M 30x2	1000	630 kVA
BK6238	1115-810-520-000	MK 5/20	M 20	630	400 kVA

1.3. ZGU and ZGU OP TYPE CLAMPS

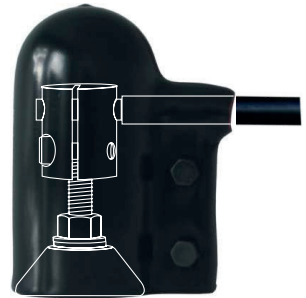
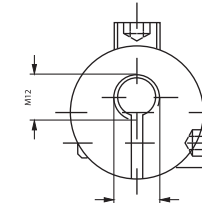
OZ ZGU OP and ZGU - recommended guard against intervention of animals (see the dimensional range on page 25 of the catalogue)



ZGU



ZGU OP



ZGU and ZGU OP

Intended use:

ZGU version

- connection of upper winding voltage of MV/LV distribution transformer

ZGU OP version

- connection of upper winding voltage of MV/LV distribution transformer with simultaneous installation of MVsurge arresters on the insulator bushing screw.

Material:

Tin galvanized brass

Set screws – stainless steel

**On customer demand ZGU-AL, ZGU OP – AL version*

Advantages:

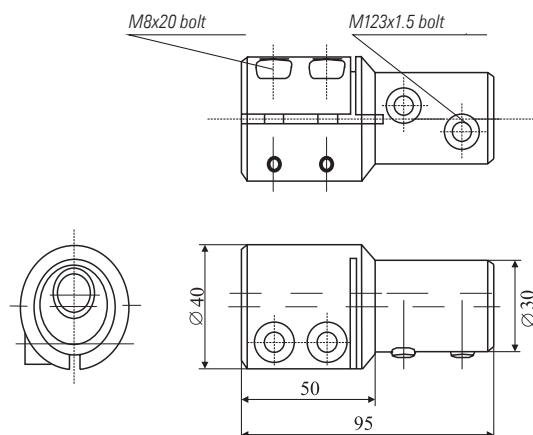
excellent electrical properties, compact design, possibility of single-wrench handling, possibility of connecting upper winding voltage of MV/LV distribution transformer without using additional elements, as cable terminals for example, in ZGU OP version – possibility of MV surge arrester installation directly on insulator screw, application of frictional – elastic lock enables precise and firm screwing the clamp onto bushing screws in loose position, and then fixing it by means of set screws, which eliminates possibility of creating any torsional forces transmitted by the screw onto internal elements of distribution transformer, ease of installation.

Note:

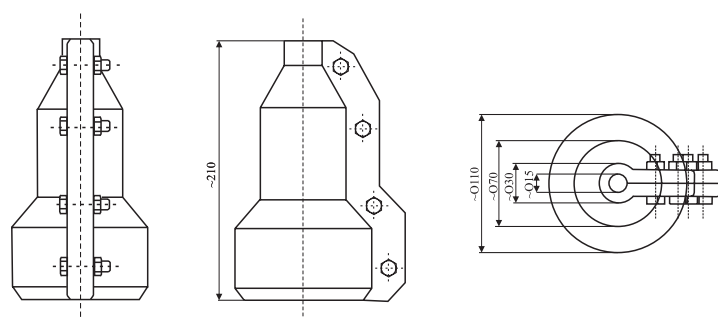
We offer a set of guards for the clamps, enabling their separation, hence protection against damages resulting from intervention of birds and other animals.

Catalogue no.	KTM	Type	Connecting thread	Cross-section of wire	Thread of surge arrester fastening
BK6244	1115-810-151-002	ZGU - brass	M 12	70 mm ²	-
BK6243	1115-810-152-002	ZGU OP - brass	M 12	70 mm ²	M 12

1.4. ZIP 40/95 TYPE CLAMPS



ZIP 40/95 TYPE CLAMP



OZ ZIP type guard

BK6242, BK7009

Intended use:

Connecting leads of up to 70 mm² cross-section to screws of bushing insulators with threads M12 up to M20.

Material:

Tin galvanized brass

Advantages:

Excellent electrical properties, compact design, possibility of single-wrench handling, possibility of implementing leads to a screw of bushing insulator without using additional elements, as cable terminals for example, application of frictional – elastic lock enables precise and firm screwing the clamp onto bushing screw in loose position, and then fixing it by means of set screws, which eliminates possibility of creating any torsional forces transmitted by the screw onto internal elements of the system, ease of installation.

Note:

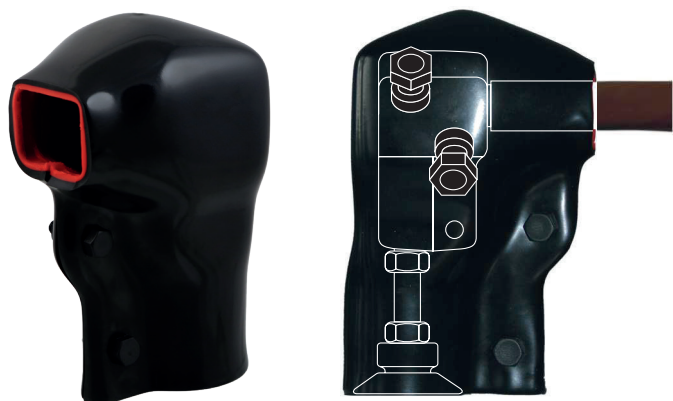
We offer a set of guards for the clamps, enabling their separation, hence protection against damages resulting from intervention of birds and other animals.

Catalogue no.	KTM	Type	Connecting thread	Cross-section of wire	Outer diameter of insulator
BK6242	1115-810-040-095	ZIP 40/95/M12	M12	70 mm ²	-
BK6242/1	1115-811-040-095	ZIP 40/95/M16	M16	70 mm ²	-
BK6242/2	1115-812-040-095	ZIP 40/95/M20	M20	70 mm ²	-
BK7009	1362-112-040-095	OZ ZIP	M12 - M20	70 mm ²	95 mm

2. INSULATION GUARDS



2.1. OZT TYPE COVERS OF LOW VOLTAGE CLAMPS



OZT GUARDS

Construction:

2 PVC layers having 3-6 mm thickness in total, applied by means of plastisol gelation. Top layer
 – black (UV resistant) Internal layer
 – red (signalling) The shape - depending on clamps used (as in the drawings).

Intended use:

Protection of low voltage transformer clamps against effects of short – circuits resulting from intervention of animals, implemented by full guarding live elements. Fastening by means of PE screws.

Selection rules:

1. Depending on type of clamp used,
2. Depending on low voltage transformer bushing insulator outer diameter: Ø50, Ø70, Ø90.

Note:

Each guard offered by us is available in a version tested for electrical break-down, depicted by the letter „B” added to name.

Technical properties:

Resistance to insulation break-down: 7000 V/mm Specific through resistance at temp.:

20°C - 3x10 W cm 70°C - 3x10 W cm

Tensile strength: >10MPa Elongation: 23% for negative temperature range, for tests according to PN-73/E-29200.

Catalogue no.	KTM	Cover type	Type of clamp being guarded	Thread of bushing	Outer diameter of insulator
BK7100	1362-112-150-000	OZT - 1/50	TOGA 1	M 12 or M 16	50mm
BK7101	1362-112-150-001	OZT - 1/50 B	TOGA 1	M 12 or M 16	50mm
BK7102	1362-112-170-000	OZT - 1/70	TOGA 1	M 16 or M 20	70mm
BK7103	1362-112-170-001	OZT - 1/70 B	TOGA 1	M 16 or M 20	70mm
BK7104	1362-112-190-000	OZT - 1/90	TOGA 1	M 30 x 2	90mm
BK7105	1362-112-190-001	OZT - 1/90 B	TOGA 1	M 30 x 2	90mm
BK7106	1362-112-250-000	OZT - 2/50	TOGA 2	M 12 or M 16	50mm
BK7107	1362-112-250-001	OZT - 2/50 B	TOGA 2	M 12 or M 16	50mm
BK7108	1362-112-270-000	OZT - 2/70	TOGA 2	M 16 or M 20	70mm
BK7109	1362-112-270-001	OZT - 2/70 B	TOGA 2	M 16 or M 20	70mm
BK7110	1362-112-350-000	OZT - 3/50	TOGA 3	M 12 or M 16	50mm
BK7111	1362-112-350-001	OZT - 3/50 B	TOGA 3	M 12 or M 16	50mm
BK7112	1362-112-370-000	OZT - 3/70	TOGA 3	M 16 or M 20	70mm
BK7113	1362-112-370-001	OZT - 3/70 B	TOGA 3	M 16 or M 20	70mm
BK7114	1362-112-390-000	OZT - 3/90	TOGA 3	M 30 x 2	90mm
BK7115	1362-112-390-001	OZT - 3/90 B	TOGA 3	M 30 x 2	90mm
BK7116	1362-112-450-000	OZT - 4/50	TOGA 4	M 12 or M 16	50mm
BK7117	1362-112-450-001	OZT - 4/50 B	TOGA 4	M 12 or M 16	50mm
BK7118	1362-112-470-000	OZT - 4/70	TOGA 4	M 30 x 2	70mm
BK7119	1362-112-470-001	OZT - 4/70 B	TOGA 4	M 30 x 2	70mm
BK7120	1362-112-550-000	OZT - 5/50	TOGA 5	M 12 or M 16	50mm
BK7121	1362-112-550-001	OZT - 5/50 B	TOGA 5	M 12 or M 16	50mm
BK7122	1362-112-570-000	OZT - 5/70	TOGA 5	M 16 or M 20	70mm
BK7123	1362-112-570-001	OZT - 5/70 B	TOGA 5	M 16 or M 20	70mm
BK7124	1362-112-670-000	OZT - 6/70	TOGA 6	M 16 or M 20	70mm
BK7125	1362-112-670-001	OZT - 6/70 B	TOGA 6	M 16 or M 20	70mm
BK7126	1362-112-690-000	OZT - 6/90	TOGA 6	M 30 x 2	90mm
BK7127	1362-112-551-000	OZT - 5/50 z przekładką	TOGA 5	M 16 or M 20	50mm
BK7128	1362-112-571-000	OZT - 5/70 z przekładką	TOGA 5	M 16 or M 20	70mm
BK7200	1362-112-690-001	OZT - 6/90 B	TOGA 6	M 30 x 2	90mm
BK7129	1362-112-890-000	OZT - 8/90	TOGA 8	M 33 x 2 or M 48x3	90mm

2.2. OZ MK TYPE GUARDS OF LOW VOLTAGE CLAMPS



OZ MK TYPE GUARDS

Construction:

2 PVC layers having 3-6 mm thickness in total, applied by means of plastisol gelation. Top layer – black (UV resistant) Internal layer – red (signalling) The shape – depending on clamps used (as in the drawings).

Intended use:

Protection of low voltage transformer clamps against effects of short – circuits resulting from intervention of animals, implemented by full guarding of live elements. Fastening by means of PE screws.

Ordering example:

OZ - 4 Ø70 B
 ↓ ↓ ↓ tested against break-down
 ↓ ↓ diameter of transformer bushing insulator
 ↓ clamp type
 ↓ guard type

OZ MK5 TYPE GUARD

Selection rules:

1. Depending on type of clamp used,
2. Depending on low voltage transformer bushing insulator outer diameter: Ø50, Ø70, Ø90.

Note:

Each guard offered by us is available in a version tested for electrical break-down, depicted by the letter „B” added to name.

Technical properties:

Resistance to insulation break-down: 7000 V/mm
 Specific through resistance at temp.:
 20°C – 3x10 W cm 70°C – 3x10 W cm
 Tensile strength: >10MPa Elongation: 23% for negative temperature range, for tests according to PN-73/E-29200.

Catalogue no.	KTM	Guard type	Type of clamp being guarded	Thread of bushing	Outer diameter of insulator
BK7201	1362-112-100-050	OZ MK 1/50	MK 1/50	M 12 or M 16	50mm
BK7202	1362-112-200-050	OZ MK 2/50	MK 2/50	M 12 or M 16	50mm
BK7203	1362-112-200-070	OZ MK 2/70	MK 2/70	M 12 or M 20	70mm
BK7205	1362-112-300-090	OZ MK 3/90	MK 3/90	M 30x2	90mm

Catalogue no.	KTM	Guard type	Type of clamp being guarded	Thread of bushing	Outer diameter of insulator
BK7207	1362-112-500-090	OZ MK 5/90	MK 5/90	M 30x2	90mm
BK7208	1362-112-500-070	OZ MK 5/70	MK 5/70	M 20	70mm

2.3. OZ ZGU OP AND OZ ZGU TYPE GUARDS



Fig. 1 OZ ZGU OP -BK 7008

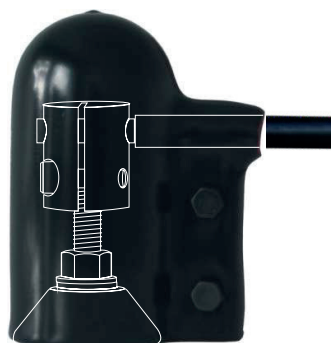


Fig. 2 OZ ZGU-BK 7007

OZ ZGU TYPE GUARDS

Construction:

2 PVC layers having 3-6 mm thickness in total, applied by means of plastisol gelation. Top layer – black (UV resistant) Internal layer – red (signalling) The shape – depending on clamps used (as in the drawings).

Intended use:

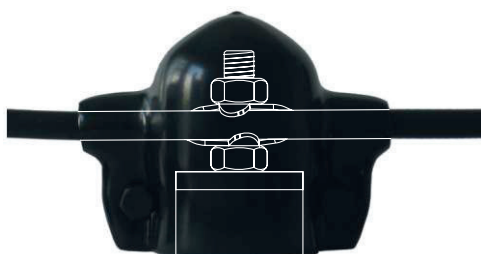
Protection of medium voltage screw clamps against short circuits caused by intervention of birds and other animals. Fig. 1 – for connections with armament version with MV surge arresters installed directly on transformer bushing screw; BK 7008 Fig. 2 – for armament version with surge arresters installed on transformer tube or in location other than point 1; BK 7007

Technical properties:

7000 V/mm break-down resistance Specific through resistance at temp.:
 20 °C – 3x10¹¹ Ωcm 70 °C 3x10⁸ Ωcm
 Tensile strength over 10 MPa Elongations 23% within negative temperature range, according to PN-73/E29200.

Catalogue no.	KTM	Type	Max. cross-section of wire	Thread of bushing
BK7007	1362-112-000-001	OZ ZGU	70 mm ²	M12
BK7008	1362-112-000-002	OZ ZGU OP	70 mm ²	M12

2.4 OSOP TYPE GUARD OF MEDIUM VOLTAGE SURGE ARRESTER (SBK)



OSOP TYPE GUARD

Construction:

Material as in case of transformer clamp guards.

Technical properties:

Analogous as in case of transformer clamp guards.

Intended use:

Protection of medium voltage surge arresters current clamp against effects of short circuits caused by intervention of animals (SBK surge arresters of TRIDELTA company make are preferred). Fastening by means of PE screws.

Catalogue no.	KTM	Type
BK 7003	1362-112-110-050	OSOP

2.5. OIP-2, OIP-3 TYPE COVER - ANTI-BIRD INSULATOR AND OIN TYPE COVER OF SPARK GAP



OIP 2

Construction:

Made of thermoplastic material, self-extinguishing, resistant to UV radiation and environmental factors. The shape of lower part provides for precise seating on insulator shed. Fastening band positioned below fastening line on the shed. There is an perforation over fastening line, ensuring mounting of the device solely in proper position, i.e. on the first, upper insulator shed. This prevents from installation errors and shortening of leakage path.

There are 4 slits made in wall in orthogonal planes, enabling off-take of leads.

The OIP 2I and OIP 3I version additionally equipped with the OIN type guard of spark gap upper part



OIN

Intended use:

Protection of medium voltage distribution transformers bushing insulators of electrical connections against short-circuiting risk by birds and penetration of foreign bodies.

Advantages:

made of material featuring self-extinguishing properties, firm seating of device on the insulator, simple installation, protection against wrong installation, compact structure, resistance to outdoor conditions, high mechanical strength.

Specifications:

Outer diameter range for insulators:

OIP 2 – 120 to 170 mm OIP 3 – above 170 mm

OIN – universal guard – adapted to all types of spark gaps and both guard types used. Total height: 260 mm.

Utilisation temperature range: -40°C to +70°C.

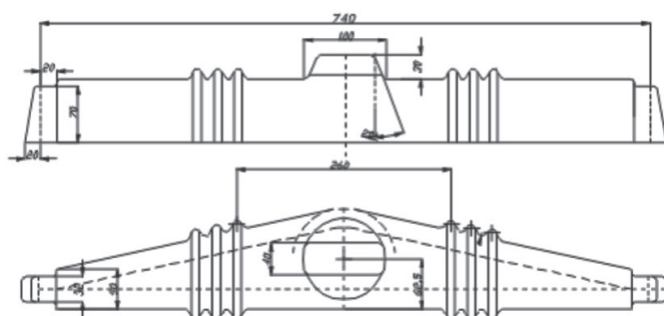
Catalogue no.	KTM	Type	Intended use	Outer diameter of insulator
BK7004	1362-112-002-000	OIP 2	Osłona izolatorów SN	120 - 170
BK7005	1362-112-003-000	OIP 3	Osłona izolatorów SN	Above 170
BK7006	1362-112-185-070	OIN	Osłona iskiernika	-

Caution! Application of guard against birds absolutely requires improvement of overvoltage protection, by means of modern surge arresters utilisation and optimization of the protection for installation place. With proper overvoltage protection, spark gap can be dismounted from bushing insulators without risk. When using guards against birds without improvement of overvoltage protection, possibility of flashover and ignition of guards exists, which results in bushing insulator destruction.

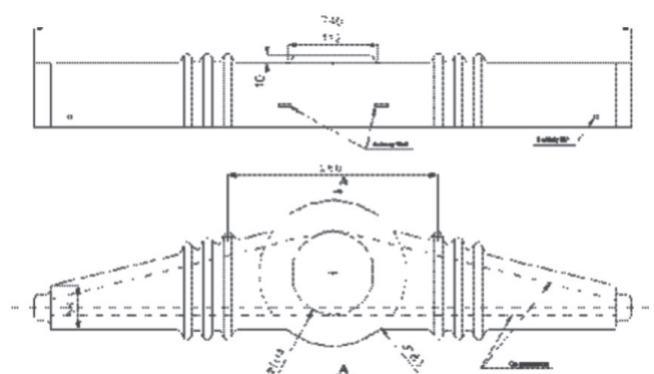
2.6. GUARDS OF LINE POST INSULATORS



BK 7001



BK 7002



Material:

PCV with additives increasing resistance to UV radiation, and formed with vacuum thermoforming technology.

Installation:

The body of the guard is seated on the first shed of insulator in such manner, so that it guards both passage of the lead through the insulator, and the leads section upstream and downstream the insulator, subsequently fastened by means of self-tightening bands.

Intended use:

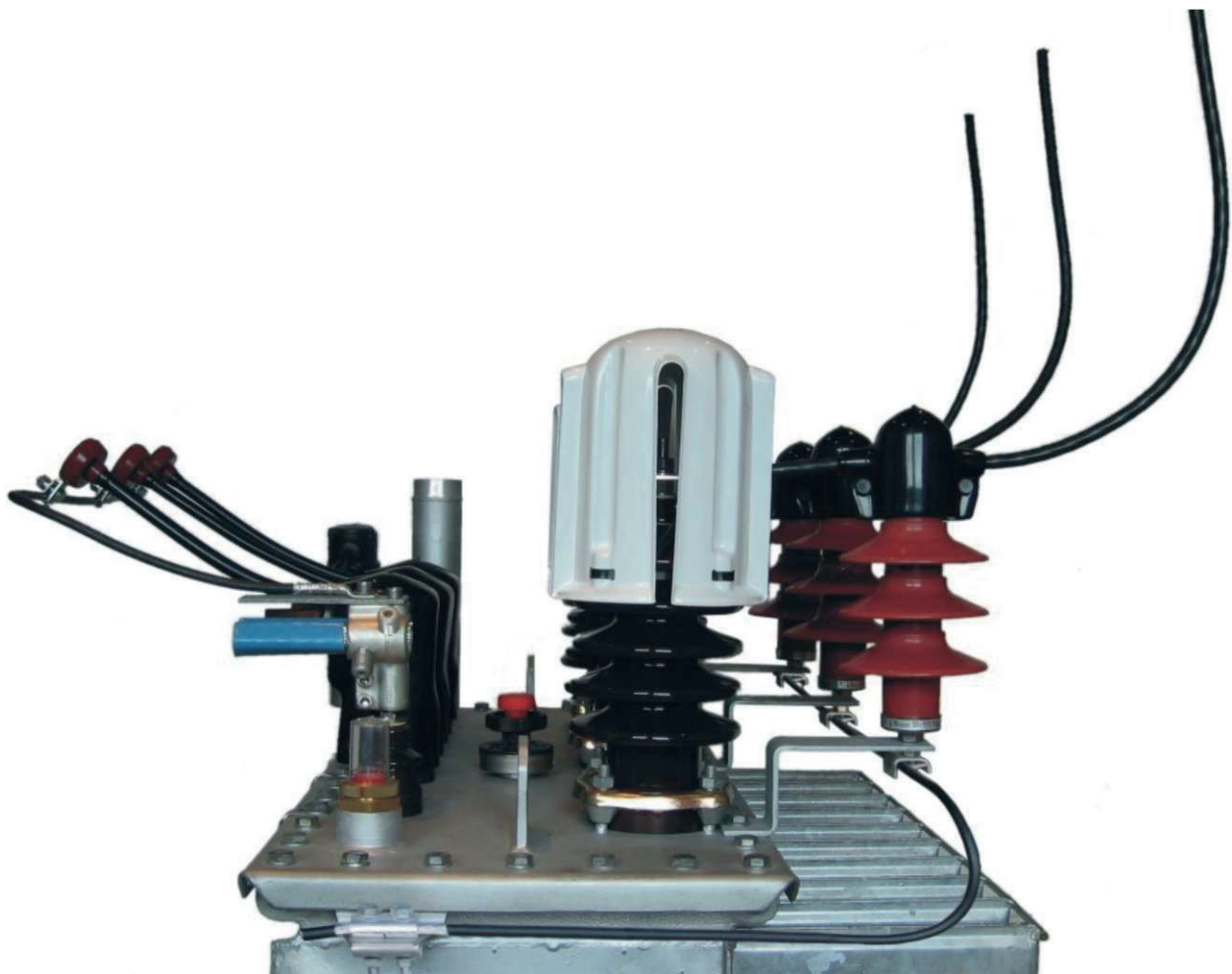
Protection of connections on high and medium voltage line post insulators against consequences of earth faults and phase-to-phase faults, caused by intervention of birds.

Advantages:

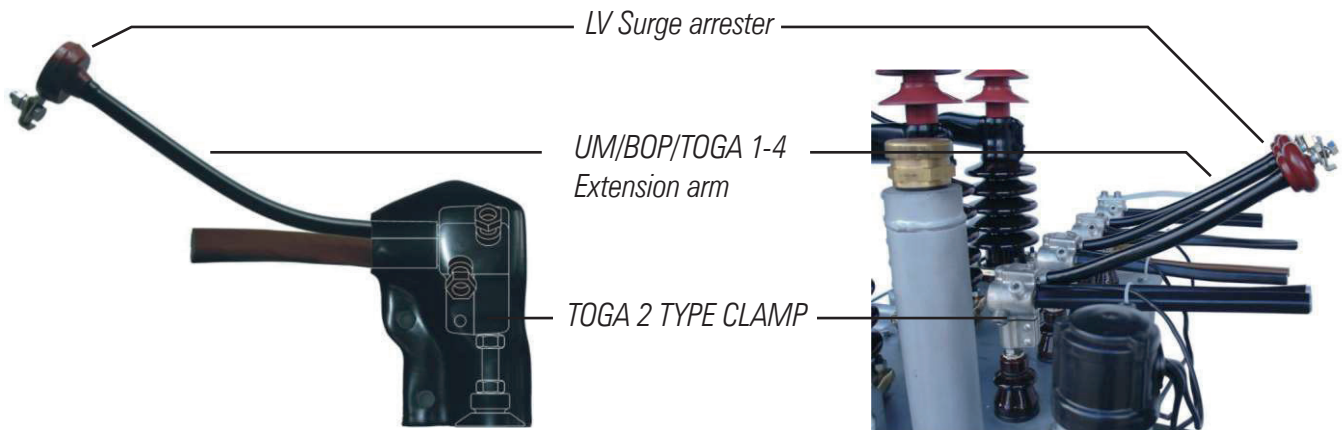
Simple installation, firm seating on the insulator (fastening band located below fastening line on the shed), resistance to UV radiation and temperature changes.

Catalogue no.	KTM	Type	Weight of guard	Insulator type
BK 7001	1362-112-125-078	OIW.LWP	0,4 kg	LWP 8/24 LWP 12,5/24
BK 7002	1369-900-175-074	St 20	0,5 kg	St 20

3. BRACKETS AND ADDITIONAL EQUIPMENT



3.1. UM/BOP/TOGA 1-4 TYPE EXTENSION ARM OF LOW SURGE ARRESTER



UM/BOP/TOGA

Advantages:

Possibility of mounting LV surge arresters without additional supporting structures directly on LV clamp, bringing the arrester outside the transformer tank which prevents sparking on the tank in case of surge arrester damage by falling live elements, complete isolation of fastening element, preventing earth fault resulting in effect of animal intervention, resistance of insulation to UV radiation and temperature changes.

Material:

Pipe covered with insulating PVC layer.

Intended use:

Rigid fastening of LV surge arresters in openings of auxiliary clamps of TOGA type with bringing them outside the transformer tank.

Catalogue No.: 1115-810-000-003

3.2. UM/SBK TYPE EXTENSION ARM OF MEDIUM VOLTAGE SURGE ARRESTER



UM/SBK

Material:

Hot galvanized steel

Intended use:

Rigid fastening of MV surge arrester directly on transformer tank.

Catalogue No.: 1131-629-005-004



3.3. UM/BOP/TOGA 5 TYPE EXTENSION ARM FOR BOP SURGE ARRESTER



UM/BOP/TOGA5

Intended use:

The handle for fastening surge arrester serves connecting the BOP-R type LV arrester to TOGA 5 clamp.

Catalogue No.: 1115-810-000-001

Construction:

Part of the holder protruding from TOGA guard is covered with PCV coat, providing insulation. The body is made of steel flat bar and hot galvanized.

3.4. UM/K TYPE CAPACITOR BRACKET



UM/K

Material:

Hot galvanized steel

Catalogue No.: 1131-629-005-002

Intended use:

Part of the holder protruding from TOGA guard is covered with PCV coat, providing insulation. The body is made of steel flat bar and hot galvanized.

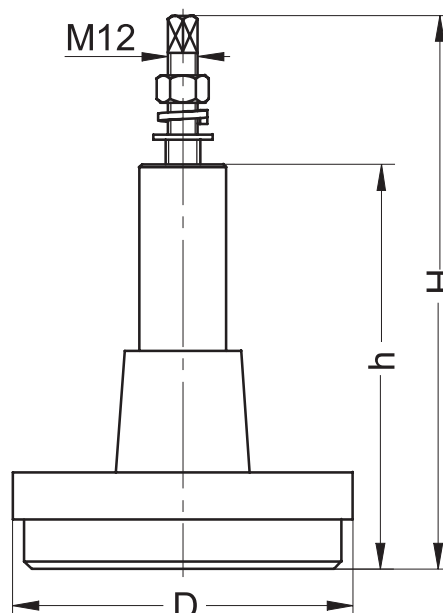
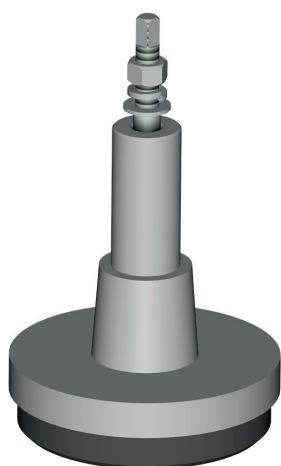
3.5. VIBRATION INSULATION PADS FOR TRANSFORMERS

Vibration insulators are elastic rubber-metal elements, serving attenuation of vibrations within range of values characteristic to composition of attenuating mixture. Their task is to eliminate noise, resulting from mechanical vibrations created during operation of transformer. They provide excellent attenuation of vibrations within range of values characteristic for working transformer, hence significant limitation of noise level.

3.5.1. WOT TYPE VIBRATION INSULATOR PADS

Construction:

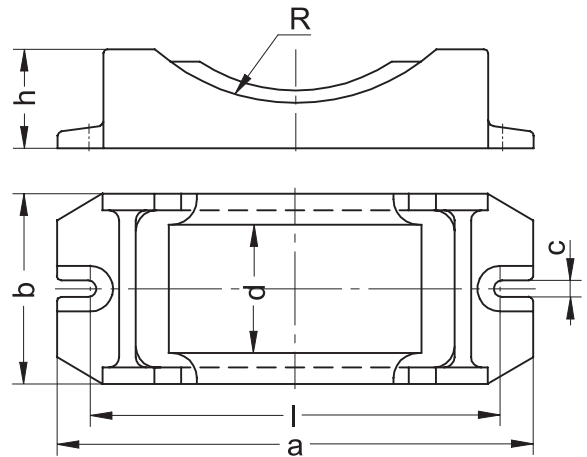
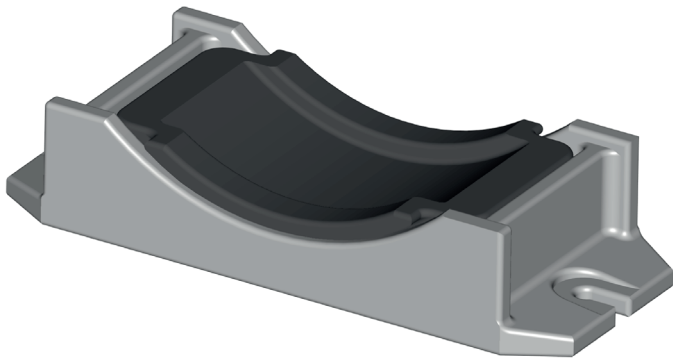
The fastening part of vibration insulator is constructed from a foot cooperating with damping element, ended with cylinder, in which internally threaded sleeve is located with a bolt screwed through it. They simultaneously constitute: retaining element (the transformer is supported on the sleeve, which transfers mechanical influences on the foot by the bolt) and levelling arrangement (screwing the bolt in results in sleeve motion in vertical axis of vibration insulator, which in turn enables precise levelling of the equipment). All metallic elements of vibration insulator are hot galvanized.



WOT

Catalogue no.	KTM	Type	D	h (sleeve outreach)	H	Nominal load [kN]	Rigidity in vertical direction
BK8309	1373-163-138-192	WOT	138	hmin 155 hmax 170	192	16	1200 kN/m

3.5.2. WPK TYPE VIBRATION INSULATOR PADS



WPK

Selection rules:

1. Diameter of transformer wheels
 - up to 120 mm – WPK 1,
 - over 120 mm – WPK 2,
2. Nominal load for 1 support (up to 9 kN and 9-12 kN).

Ordering example:

WPK-1/12 – underwheel vibration insulator type 1, that is diameter of wheels up to 120mm. With insert of nominal load up to 12 kN.

Construction:

Aluminum body, dampening insert made of material featuring high dampening properties.

Intended use:

Seating of carriage type transformers.

Method of mounting:

Vibration insulators are located on substrate such, that transverse symmetry axes of equipment would align with rotation axes of transformer wheels, that is at distances confirming to the wheelbase, and then transformer is positioned on them by lifting it with jacks or rolling it in with use of run in wedges. It is recommended to fasten the vibration insulator to substrate by means of bolts.

Specification of WPK 1 and 2 vibration insulators

Nominal load 12 kN

Rigidity in vertical direction	1000 kN
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Temperature range for normal mechanical properties -20 °C ÷ 160 °C

Nominal load 9 kN

Rigidity in vertical direction	800 kN
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Temperature range for normal mechanical properties -20 °C ÷ 160 °C

Catalogue no.	KTM	Type	a	b	c	d	l	h	R	Nominal load [kN]
BK8312	1373-163-060-170	WPK 1/9	196	92	9	63	170	48	60	9
BK8310	1373-163-100-205	WPK 2/9	230	92	9	63	200	48	100	9
BK8313	1373-163-061-170	WPK 1/12	196	92	9	63	170	48	60	12
BK8311	1373-163-101-205	WPK 2/12	230	92	9	63	200	48	100	12

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