




Assembly instruction

# Metal Oxide Surge Arresters EXLIM



# Safety information

## Key to the signs

	This sign is a visual notice to avoid mistakes which can result in damage of the material and/or no function of the surge arrester. Read the text carefully and if you don't understand do not proceed.
	Serious material damage, severe personal injury and/or death can be the result of not following the information given at this sign. Read the text carefully and if you don't understand do not proceed.
	The bolt of the given size shall be tightened with a torque wrench to the specified value.

## Important information

The following instruction is valid for EXLIM R, Q, P and T surge arresters for vertical, upright mounting including non-catalogue arresters with the following additional suffix letters:



E = Non-standard electrical data

Serious material damage, severe personal injury and/or death can be the result of not following this instruction. Therefore, the personnel responsible for the installation of the equipment shall read and follow the instruction carefully.

Handling and maintenance of all the surge arresters described in this instruction must be done by personnel trained for this type of work.

## WARNING!



All work related to the surge arresters shall be made with disconnected and earthed conductors. Follow all regulations and rules stated by international and national safety regulations.

Normally, surge arresters operate at a high voltage. Therefore, they must be handled and installed by qualified personnel.

## Storage

In all cases and with consideration to specific local conditions, appropriate steps must be taken to ensure the equipment and packaging is stored in such a way as to protect it from damage or deterioration.

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# 1. Introduction

## 1.1 Sequence of assembly

The respective procedure in the tables below should be followed for safe and correct installation of the surge arresters

Order	Procedure	Section
1	Inspection upon arrival.	1.2
2	Lift out the arrester units from the case.	2
3	Fit the line terminal on the top cover.	3
4	Assemble the grading rings for the top unit.	4
5	Fit the top unit grading rings and top cover on the top unit.	6
6	Lift the top unit and assemble it with the second unit. Repeat the procedure until the arrester is completely assembled on the ground.	6
7	Fit the insulation base under the bottom unit if any along with the earth terminal or diagnostic indicator EXCOUNT II when provided.	7
8	Lift the arrester and secure it on the structure.	2, 7



Multi-unit arresters must be erected with their units in correct order, see section 5 on page 10.

The instruction must be followed in correct order to prevent problems during assembly. In the case where an arrester is not supplied with an insulating base and/or surge counter, the paragraphs dealing with these accessories may be disregarded.

## 1.2 Inspection upon arrival

Upon arrival it is important that the cases are inspected and the contents checked against the packing list which is attached to each case. Any shortage or damage should be reported immediately to the insurance and/or Hitachi Energy representative; latest within 30 days from the arrival of goods at site. Hitachi Energy cannot take responsibility for shortages or damages not reported within this time period.

If the contents are to be stored for a long period of time prior to installation they must be repacked and preferably stored dry and indoors. However, outdoor storage is acceptable for the arresters themselves.

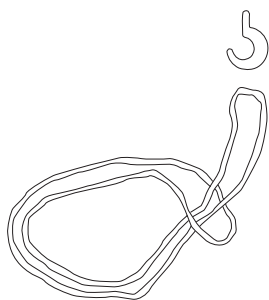
## 2. Lifting

### 2.1 Lifting the Surge arrester

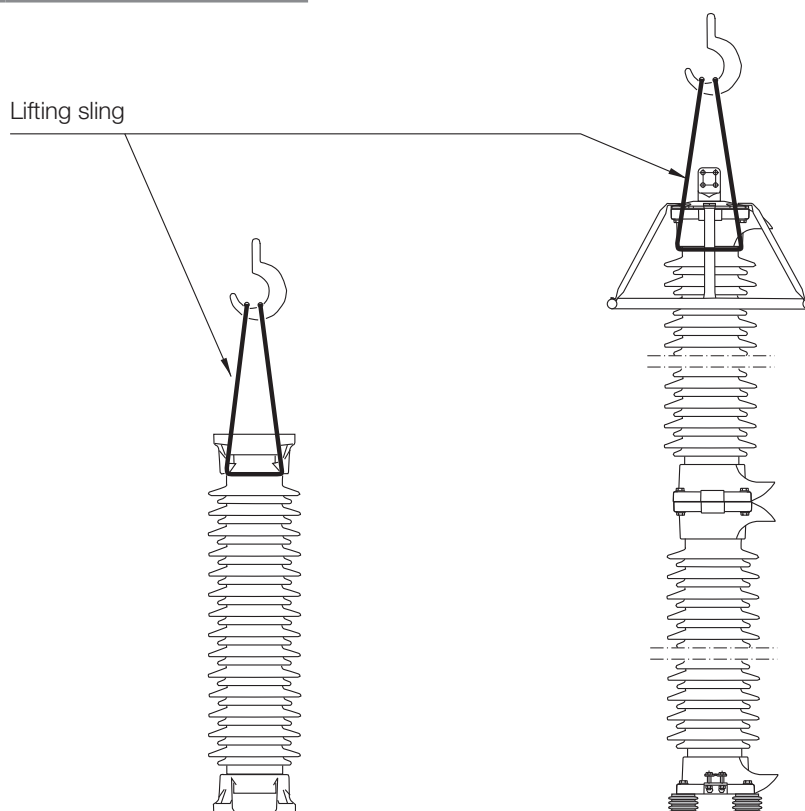
When lifting, two lifting slings must be used. Place the slings beneath the upper metal flange and around the neck of the porcelain insulator. See figure 2.1 to 2.3.

**Table 2.1**

	EXLIM R-C and Q-E	EXLIM Q-D and T-B
Typical weight of the smallest to the largest surge arrester.	40 - 210 kg	85 - 600 kg



**Figure 2.1**  
Sling arrangement  
(2x)



**Figure 2.2**  
Lifting a surge  
arrester unit

**Figure 2.3**  
Lifting of the complete  
assembled surge arrester  
onto the structure



Be careful so that the arrester units do not hit anything during lifting!

Keep the lifting slings in place until the completely assembled arrester is securely anchored to the structure.

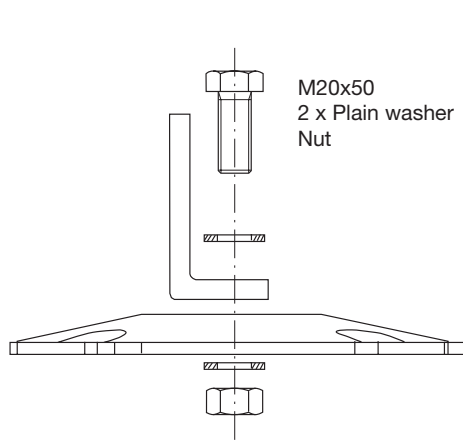
# 3. Line terminal

## 3.1 Fit the line terminal

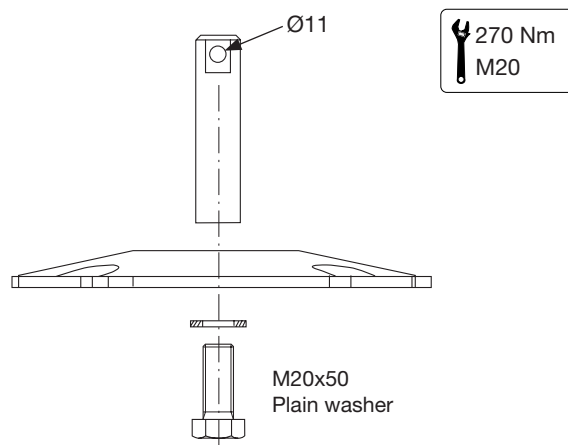
Fit the line terminal to the top cover according to figure 3.1 - 3.2. Recommended tightening torque is 270 Nm (M20).

### Line terminal with clamp:

When the line conductor is to be connected, put together the clamp according to section 8 on page 21.



**Figure 3.1**  
Assembly of  
1HSA410000-A, -B, -F, -G, -H, -J, -K



**Figure 3.2**  
Assembly of  
1HSA410000-C, -D, -E

## 4. Grading ring

### 4.1 Grading ring arrangement

When a grading ring is supplied, it must be fitted to the arrester. Otherwise the correct performance is not guaranteed. If the surge arrester has a grading ring, assemble the stays with the ring/rings according to the table 4.1.1 and the figures in the next side. The recommended tightening torque for M10 screws is 33 Nm.

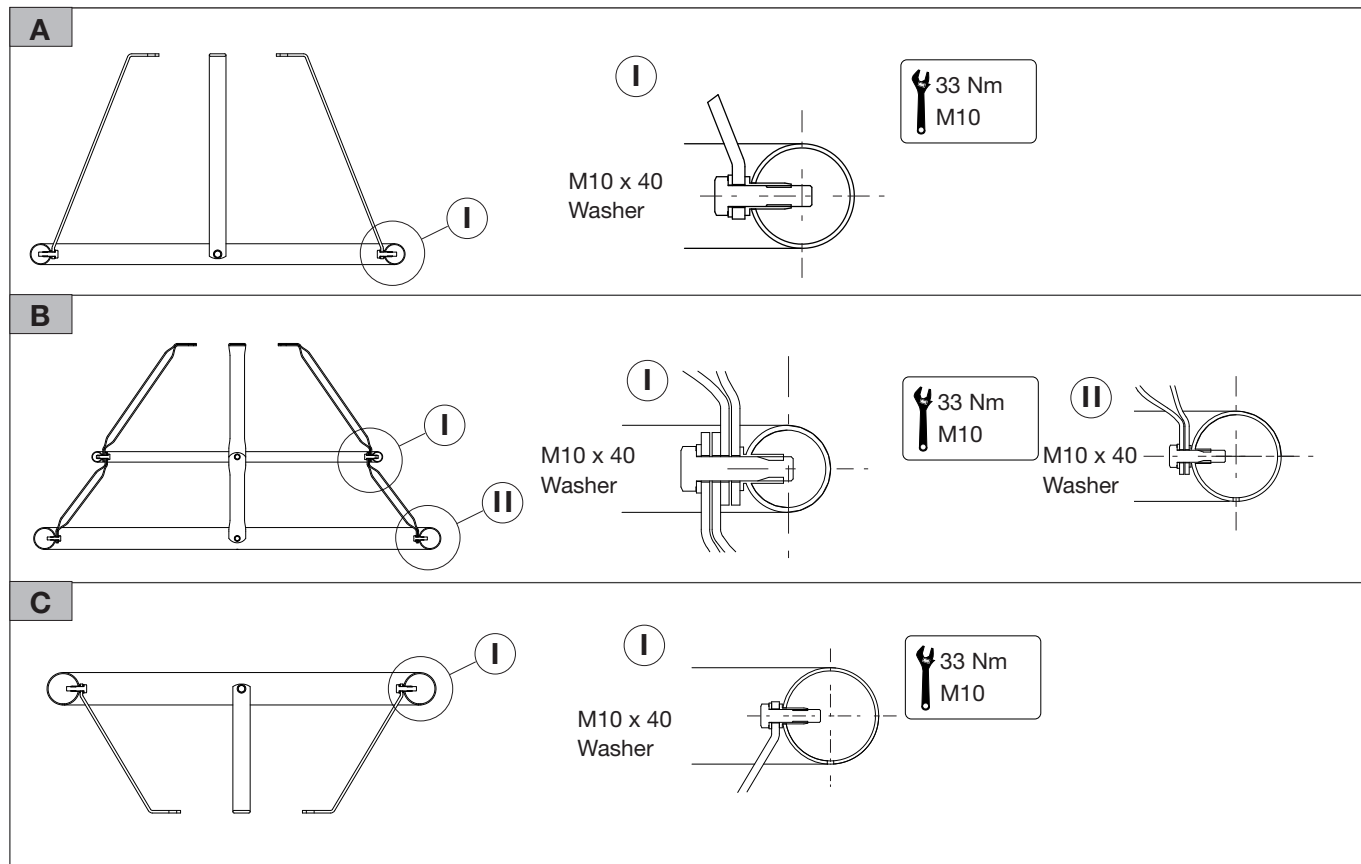
**Table 4.1.1 Grading ring arrangement.**

The letters in the table refer to the figures on next page.

Product type	Type Designation	See 4.2	Product type	Type Designation	See 4.2
<b>EXLIM R-C</b>	R090-CV123 — R096-CV123	A	<b>EXLIM P-G</b>	P132-GV170 — P150-GV170	A
	R108-CV145 — R144-CV145	A		P180-GH245 — P228-GH245	A
	R132-CH170 — R144-CH170	A		P180-GV245	B
	R132-CV170 — R168-CV170	A		P192-GV245 — P228-GV245	A
<b>EXLIM Q-E</b>	Q090-EV123 — Q096-EV123	A		Pxxx-GM300	A
	Q108-EV145 — Q120-EV145	A		P216-GH300	B
	Q132-EH170	A		P228-GH300 — P264-GH300	A
	Q132-EV170 — Q144-EV170	A		Pxxx-GV300	B
	Q180-EH245 — Q198-EH245	A		Pxxx-GV300	B
	Q210-EH245 — Q228-EH245	A		Pxxx-GM362	B
	Q180-EV245 — Q228-EV245	B		Pxxx-GH362	B
<b>EXLIM Q-D</b>	Q132-DH170	A		Pxxx-GV362	B
	Q132-DV170 — Q144-DV170	A		Pxxx-GM420	B
	Q162-DV170 — Q168-DV170	A		Pxxx-GH420	B
	Q180-DH245 — Q219-DH245	A		Pxxx-GV420	B
	Q228-DH245	A		Pxxx-GM550	B
	Q180-DV245 — Q198-DV245	B		P396-GH550 — P444-GH550	B, C
	Q210-DV245 — Q228-DV245	A	<b>EXLIM T-B</b>	T180-BH245 — T228-BH245	A
	Qxxx-DM300	A		T180-BV245 — T228-BV245	A
	Q216-DH300 — Q240-DH300	B		Txxx-BM300	A
	Q258-DH300 — Q264-DH300	A		T216-BH300 — T264-BH300	A
	Qxxx-DV300	B		Txxx-BV300	B
	Qxxx-DM362	B		Txxx-BM362	B
	Qxxx-DH362	B		Txxx-BH362	B
	Q258-DV362 — Q288-DV362	B		T258-BV362 — T288-BV362	B
	Qxxx-DM420	B		Txxx-BM420	B
	Qxxx-DH420	B		Txxx-BH420	B
	Q330-DV420 — Q420-DV420	B		T330-BV420 — T420-BV420	B
				T396-BM550 — T444-BM550	B, C
				Txxx-BH550	B, C

## 4.2 Grading ring assembly

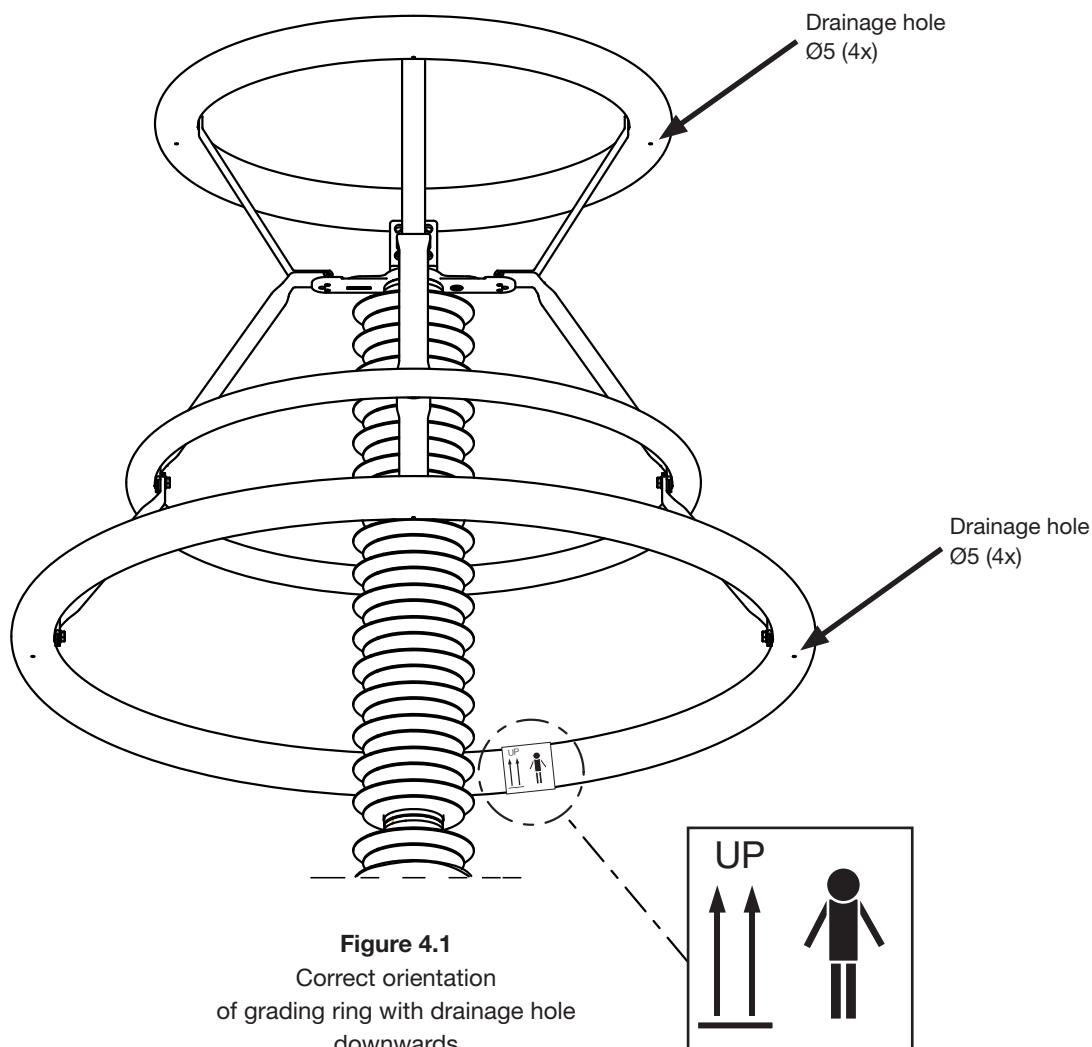
Assemble the grading ring according to the applicable arrester type designation in table 5.1.1. See also paragraph 4.3 on next page for orientation of grading ring with drainage holes.





## 4.3 Grading rings with drainage holes

Assemble the grading ring according to the applicable arrester type designation in table 4.3.1.



**NOTE!** Surge arrester with grading ring arrangement B and C: drainage hole must always be oriented downwards.

**Table 4.3.1**

The letters refer to the figures on page 8.

Grading ring arrangement	View	Drainage hole	View	Drainage hole
B	①	-	②	x
C	①	x	②	-

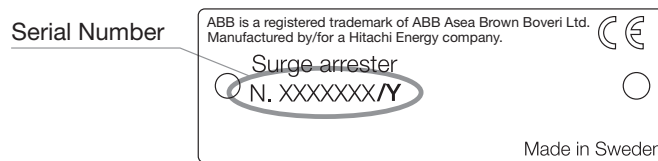
# 5. Relative position of arrester units

## 5.1 Rating plate



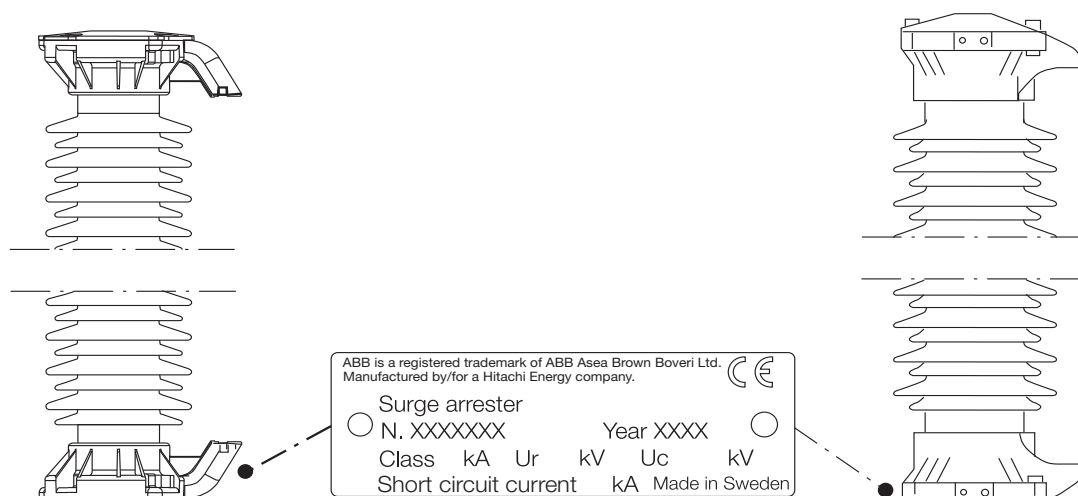
Multi-unit arresters must be erected with their units in the correct order. All units in one arrester have the same serial number with a consecutive suffix number to identify their position, i.e. top unit = N. XXXXXXXX/1, next unit = N. XXXXXXXX/2, etc.

N. XXXXXXXX is the serial number (according to section 5.2, 5.3, 5.4 and 5.5 on next pages).



**Figure 5.1**  
Rating plate

## 5.2 Single-unit arrester



**EXLIM R-C and Q-E**

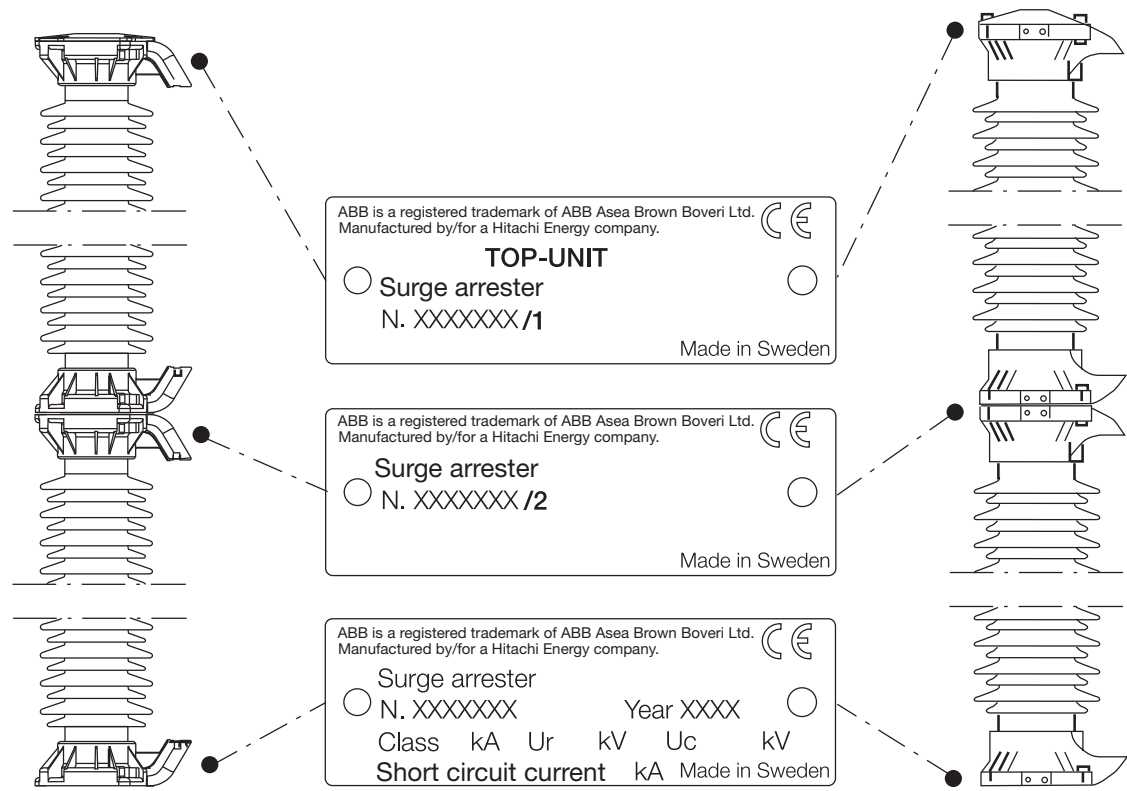
**EXLIM P-G and T-B**

EXLIM R-C	EXLIM Q-E	EXLIM Q-D	EXLIM P-G	EXLIM T-B
Rxxx-CV036	Qxxx-EV036	Qxxx-DH170	Pxxx-GV036	Txxx-BN245
Rxxx-CV052	Qxxx-EV052		Pxxx-GH052	
Rxxx-CN052	Qxxx-EN052		Pxxx-GV052	
Rxxx-CM072	Qxxx-EV072		Pxxx-GV072	
Rxxx-CV072	Qxxx-EN072		Pxxx-GV100	
Rxxx-CN072	Qxxx-EH100		Pxxx-GH123	
Rxxx-CH100	Qxxx-EV100		Pxxx-GV123	
Rxxx-CN100	Qxxx-EN100		Pxxx-GN123	
Rxxx-CM123	Qxxx-EM123		Pxxx-GM145	
Rxxx-CH123	Qxxx-EH123		Pxxx-GH145	
Rxxx-CN123	Qxxx-EN123		Pxxx-GN145	
Rxxx-CH145	Qxxx-EH145		Pxxx-GH170	
Rxxx-CN145	Qxxx-EN145		Pxxx-GN170	
Rxxx-CM170	Qxxx-EM170		Pxxx-GN245	
Rxxx-CN170	Qxxx-EN170			
	Qxxx-EN245			

For assembly of grading rings and top units, please refer to section 6.1 on page 15.

For assembly of grading rings and top units, please refer to section 6.2 on page 16.

5.3 Two-unit arrester



EXLIM R-C and Q-E

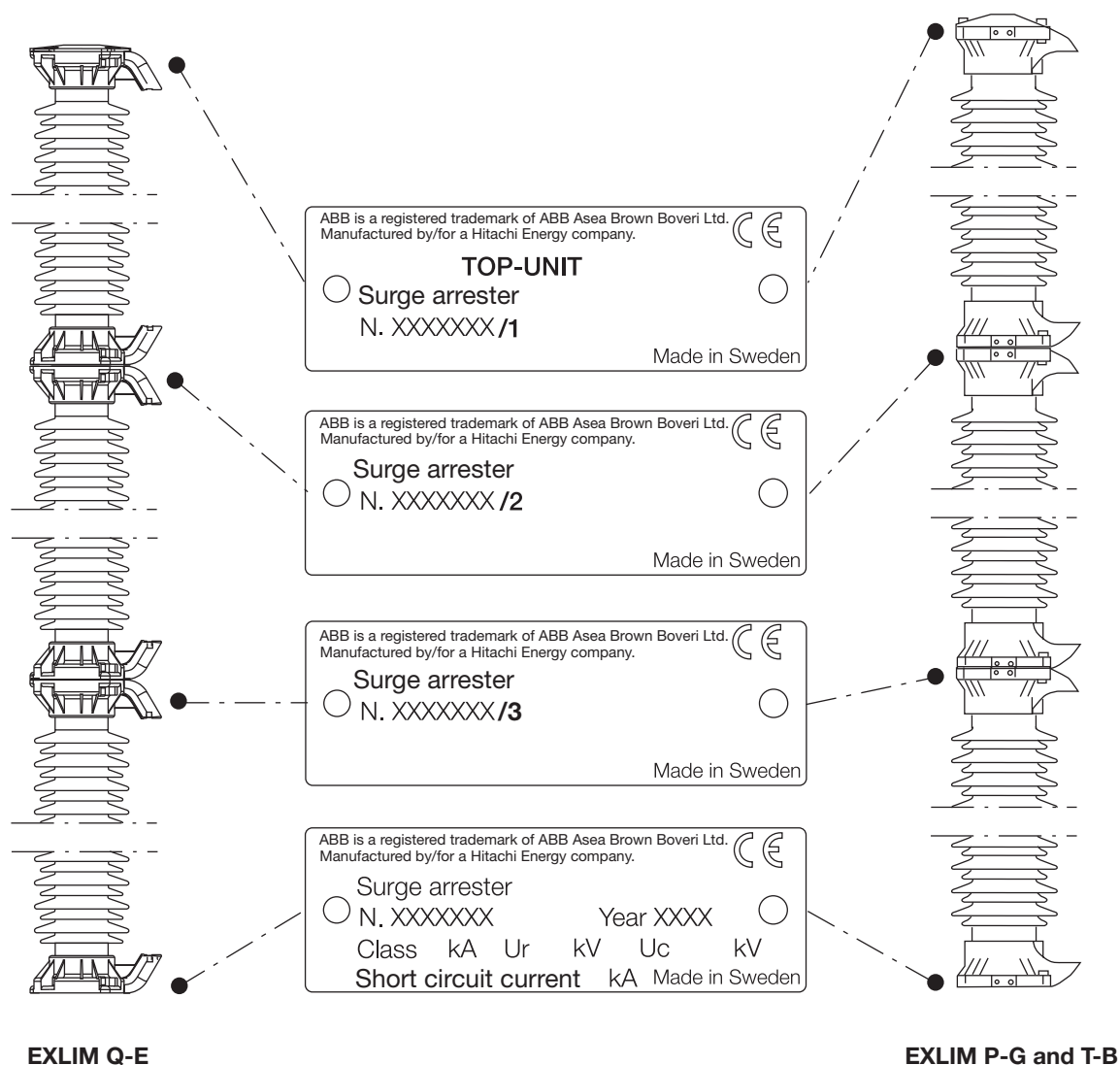
EXLIM P-G and T-B

EXLIM R-C	EXLIM Q-E	EXLIM Q-D	EXLIM P-G	EXLIM T-B
Rxxx-CV123	Qxxx-EV123	Qxxx-DV170	Pxxx-GV145	Txxx-BH245
Rxxx-CV145	Qxxx-EV145	Qxxx-DH245	Pxxx-GV170	Txxx-BV245
Rxxx-CH170	Qxxx-EH170	Qxxx-DV245	Pxxx-GH245	Txxx-BM300
Rxxx-CV170	Qxxx-EV170	Qxxx-DM300	Pxxx-GV245	Txxx-BH300
	Qxxx-EH245	Qxxx-DH300	Pxxx-GM300	Txxx-BM362
		Qxxx-DM362	Pxxx-GH300	Txxx-BM420
		Qxxx-DM420	Pxxx-GM362	
			Pxxx-GM420	

For assembly of grading rings and top units, please refer to section 6.1 on page 15.

For assembly of grading rings and top units, please refer to section 6.2 on page 16.

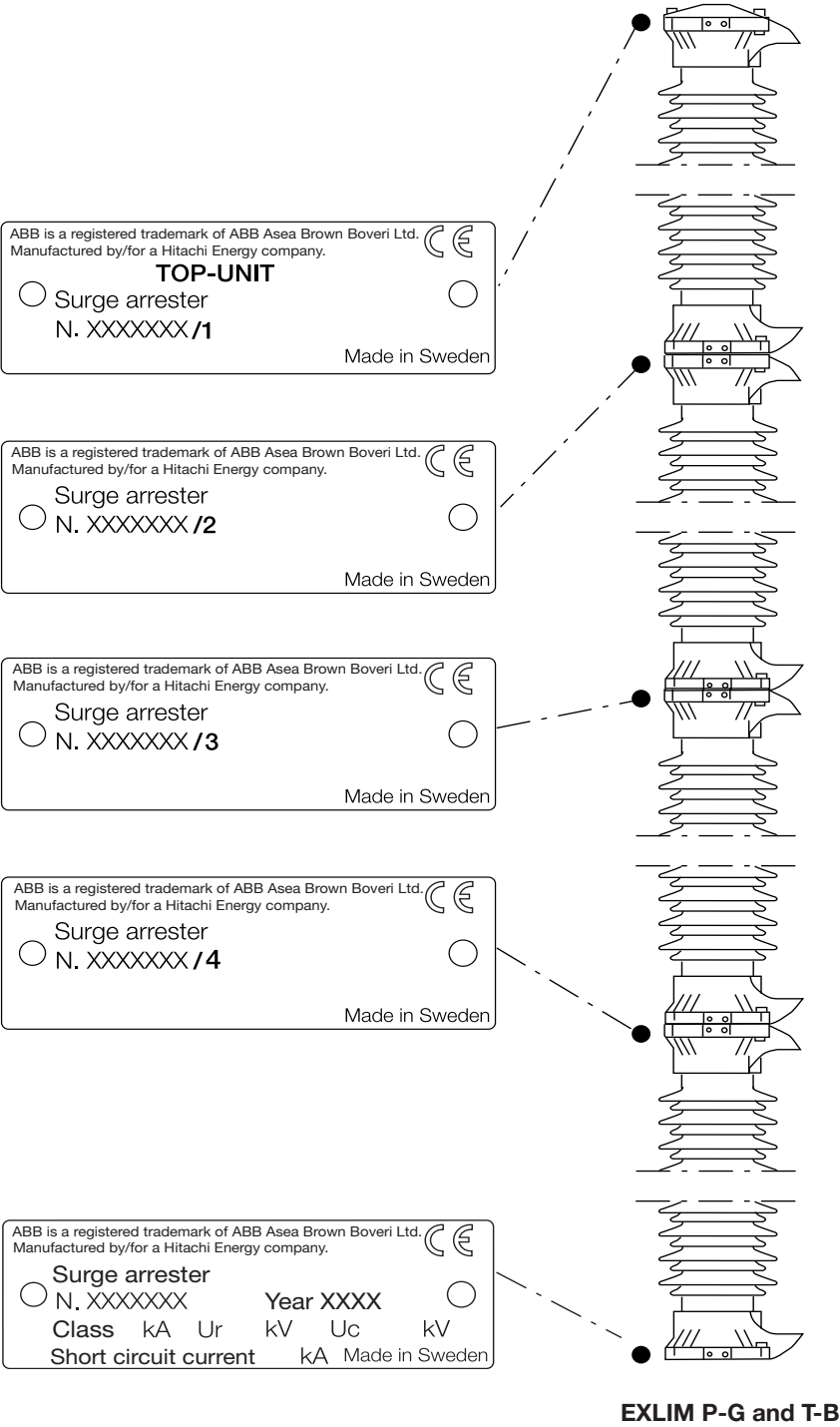
## 5.4 Three-unit arrester



EXLIM R-C	EXLIM Q-E	EXLIM Q-D	EXLIM P-G	EXLIM T-B
Not available as three-unit arrester	Qxxx-EV245	Qxxx-DV300	Pxxx-GV300	Txxx-BV300
		Qxxx-DH362	Pxxx-GH362	Txxx-BH362
		Qxxx-DV362	Pxxx-GV362	Txxx-BV362
		Qxxx-DH420	Pxxx-GH420	Txxx-BH420
		Qxxx-DV420	Pxxx-GV420	Txxx-BV420
			Pxxx-GM550	Txxx-BM550
For assembly of grading rings and top units, please refer to section 6.1 on page 15.		For assembly of grading rings and top units, please refer to section 6.2 on page 16.		



5.5
Four-unit arrester



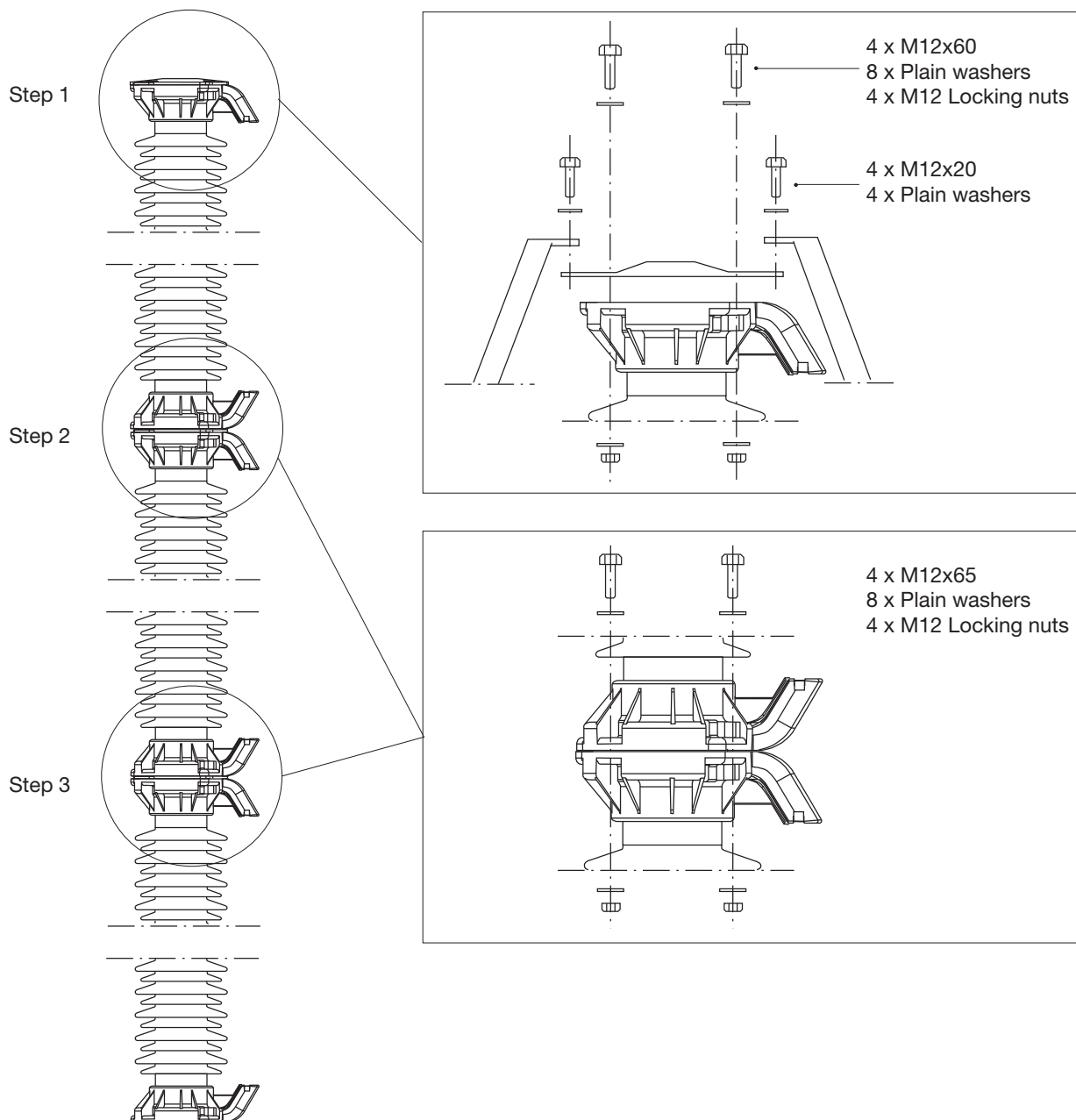
EXLIM R-C	EXLIM Q-E	EXLIM Q-D	EXLIM P-G	EXLIM T-B
Not available as four-unit arrester	Not available as four-unit arrester	Not available as four-unit arrester	Pxxx-GH550	Txxx-BH550

For assembly of grading rings and top units, please refer to section 6.2 on page 16.

# 6. Assembly of units and grading rings

## 6.1 Assembly of EXLIM R-C and Q-E

Recommended tightening torque for M12 bolts is 84 Nm

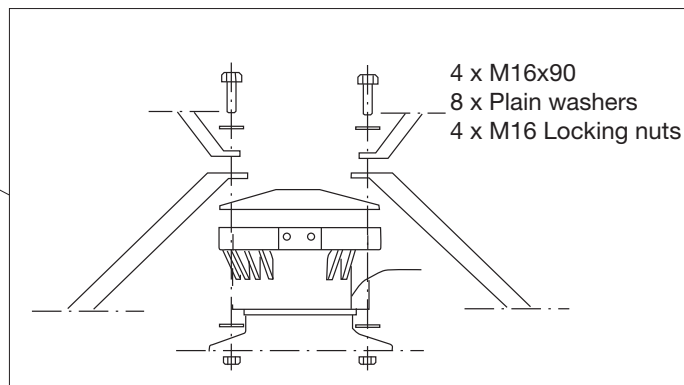
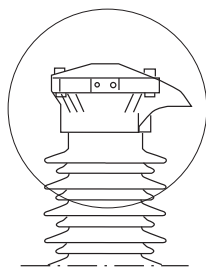


## 6.2 Assembly of EXLIM Q-D, P-G and T-B

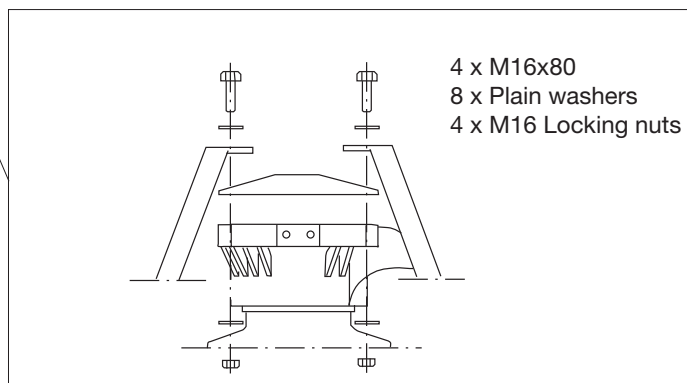
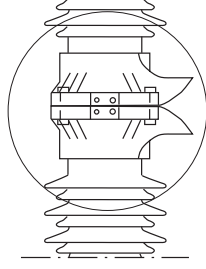
Recommended tightening torque for M16 bolts is 183 Nm



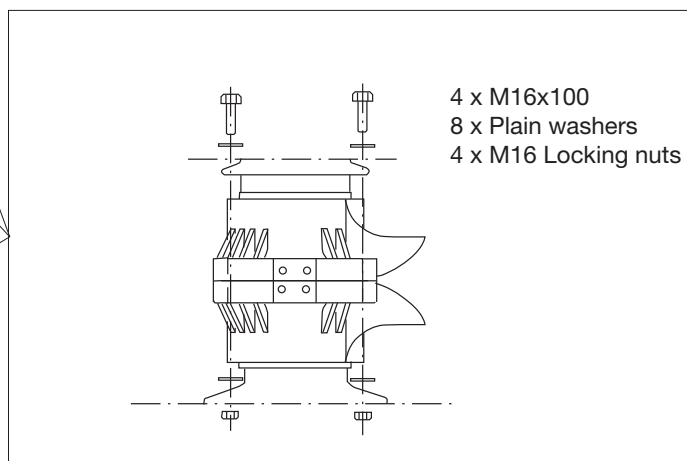
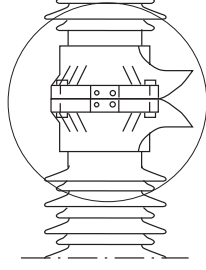
Step 1



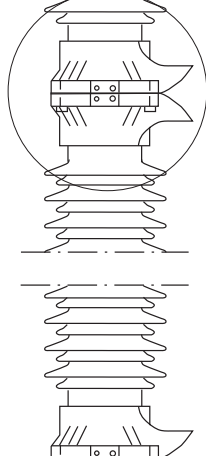
Step 2



Step 3



Step 4



# 7. Installation on structure

## 7.1 Installation on structure without insulating base

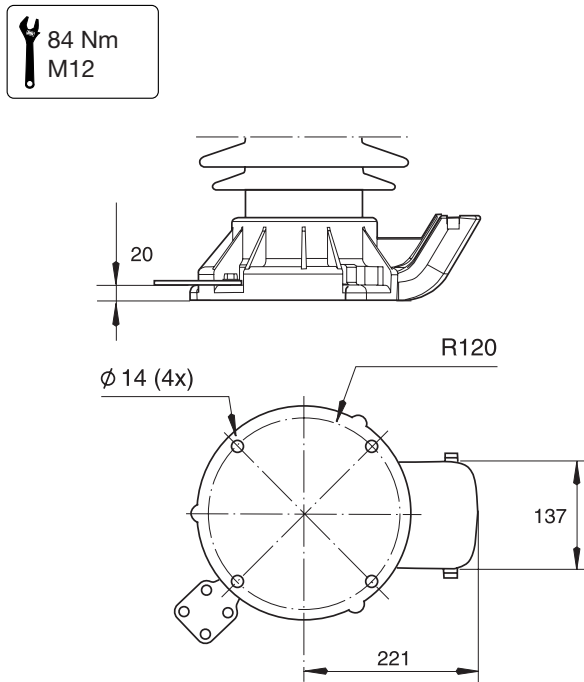
This section covers installation of surge arrester on a structure without insulating base. For installation on a structure with insulating base see section 7.2 and 7.3. Ensure that the distance between the drilling holes in the structure are according to the corresponding figure below.



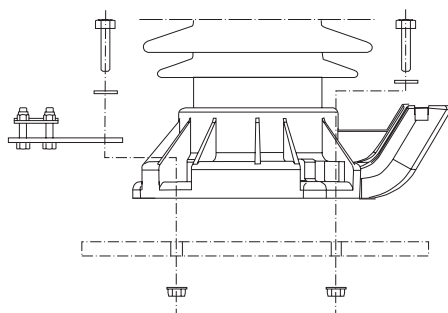
Note the lifting instructions in section 2 before undertaking installation. Anchoring bolts and nuts are **not** provided with the arrester.

Fit the arrester to the structure and the earth terminal to the bottom flange according to figures below.

### EXLIM R-C and Q-E

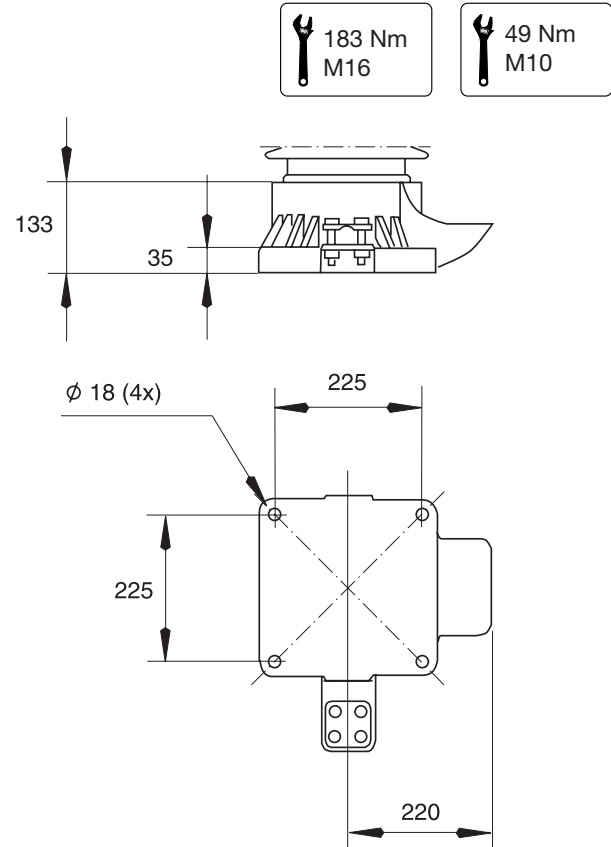


**Fig. 7.1.1**  
Drilling plan

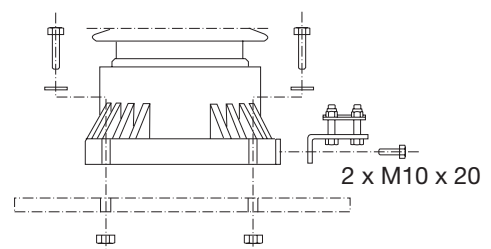


**Fig. 7.1.2**  
Assembly of earth terminal and installation  
on structure

### EXLIM Q-D, P-G and T-B



**Fig. 7.1.3**  
Drilling plan



**Fig. 7.1.4**  
Assembly of earth terminal and installation  
on structure

## 7.2 Installation on structure with insulating base

### EXLIM R-C and Q-E

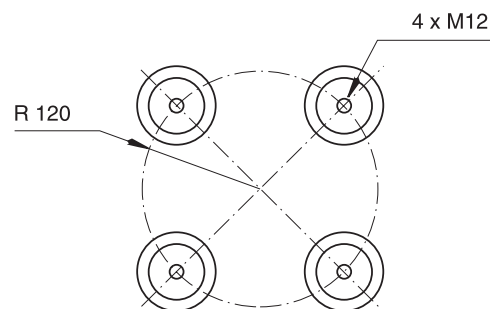
This instruction covers insulating base 1HSA430000-A and -B. 1HSA430000-B is identical with -A apart from the bolts used being of UNC-type. If you have purchased -B, please use the bolts size indicated in brackets.

In the case where another insulating base is to be fitted, the installation instructions included with the delivery shall be followed.

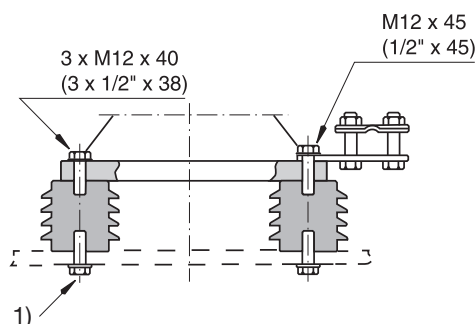
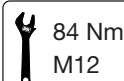
Ensure that the distance between the drilling holes in the structure are according to the corresponding figure 7.2.1.

Fit the insulating base and earth terminal to the bottom flange of the bottom unit. Anchoring bolts and nuts are not provided with the arrester.

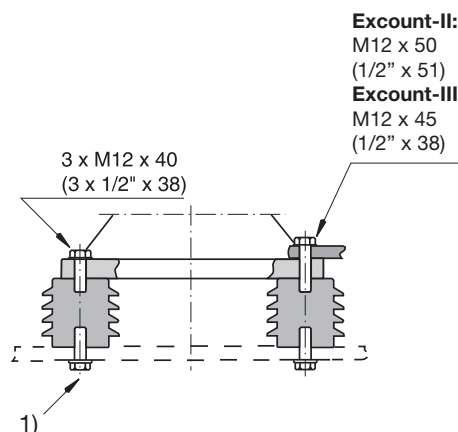
The bolt M12x45 (1/2"x45) is only used to fix the earth terminal or field probe for EXCOUNT-III. If diagnostic indicator EXCOUNT-II is to be mounted on the flange, the longer bolt M12x50 (1/2" x 51) shall be used instead. In this case the M12x45 (1/2"x45) bolt is not required and can be discarded.



**Fig. 7.2.1**  
Drilling plan



**Fig. 7.2.2**  
With earth terminal and/or Surge counter  
EXCOUNT-C and EXCOUNT-I



**Fig. 7.2.3**  
With diagnostic indicator  
EXCOUNT-II or field probe to Online Surge  
Arresters monitor EXCOUNT-III

#### 1) Requirements on M12 (1/2") bolts for installation to structure:

These bolts are not supplied with the arrester.

Recommended tightening torque: Acc. to strength class. max. 120 Nm.

Strength class: 8.8 or higher

Material: Hot dip galvanized steel or waxed stainless steel.

Required threaded grip length: 15 to 20 mm.

A washer shall be placed under the bolts head.



## 7.3 Installation on structure with insulating base

### EXLIM Q-D, P-G and T-B

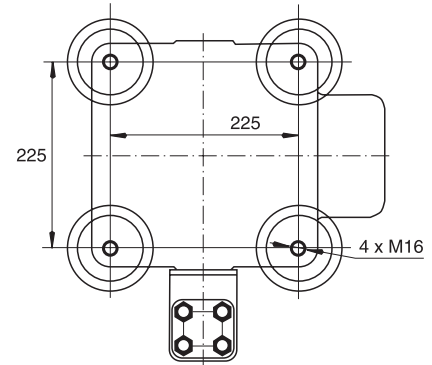
This instruction covers insulating base 1HSA430000-C and -D. 1HSA430000-D is identical with -C apart from the bolts used being of UNC-type. If you have purchased -D, please use the bolts size indicated in brackets.

In the case where another insulating base is to be fitted, the installation instructions included with the delivery shall be followed.

Ensure that the distance between the drilling holes in the structure are according to the corresponding figure 7.3.1.

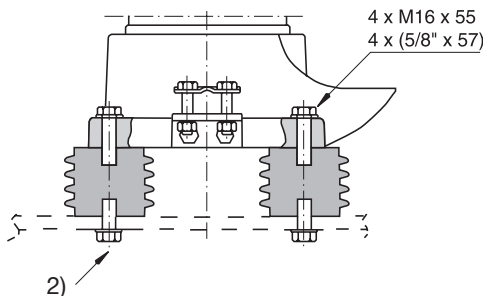
Fit the insulating base and earth terminal to the bottom flange of the bottom unit. Anchoring bolts and nuts are not provided with the arrester.

The bolt M16x65 (5/8"x64) is only used for connecting in the diagnostic indicator EXCOUNT-II. If EXCOUNT-II is not to be mounted, the shorter bolt M16x55 (5/8"x57) shall be used instead. In this case the M16x65 (5/8"x64) bolt is not required and can be discarded.

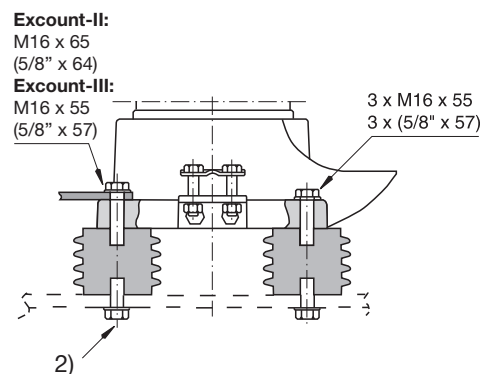


**Fig. 7.3.1**  
Drilling plan

183 Nm  
M16



**Fig. 7.3.2**  
With earth terminal and/or  
Surge counter EXCOUNT-C  
and EXCOUNT-I



**Fig. 7.3.3**  
With diagnostic indicator  
EXCOUNT-II or field probe to Online Surge  
Arresters monitor EXCOUNT-III

#### 2) Requirements on M16 (5/8") bolts for installation to structure:

These bolts are not supplied with the arrester.

Recommended tightening torque: Acc. to strength class. max 240 Nm.

Strength class: 8.8 or higher

Material: Hot dip galvanized steel or waxed stainless steel.

Required threaded grip length: 15 to 20 mm.

A washer shall be placed under the bolts head.

## 8. Connection of conductors

### 8.1 Mechanical load of the surge arrester

Surge arresters are dimensioned for use at an operating voltage that is equal to or lower than the continuous operating voltage  $U_c$  (as per IEC) or MCOV (as per ANSI), as is shown on the rating plate.

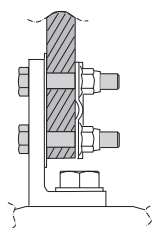
Surge arresters are dimensioned to withstand bending moments according to table 8.1. To obtain the best protection performance, the arresters must be connected with as short connectors as possible to both line and earth. However the mechanical aspects must be taken into consideration. Connectable diameter for terminals with clamps is 8-34 mm.

**Table 8.1**

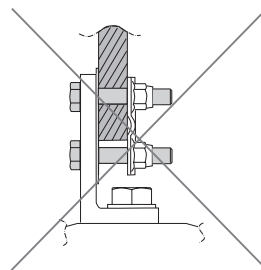
Service loading	EXLIM R-C and EXLIM Q-E	EXLIM P-G and EXLIM T-B
Specified long-term load (SLL)	3000 Nm	7200 Nm
Specified short-term load (SSL)	7500 Nm	18000 Nm
Definitions as per IEC 60099-4		

### 8.2 Connection of the conductor

Connection of the conductor must be done correctly. For vertical mounting the conductor must be fixed edge to edge with the clamp.



**Figure 8.2.1**  
Correct  
installation



**Figure 8.2.2**  
Warning!  
Faulty connection

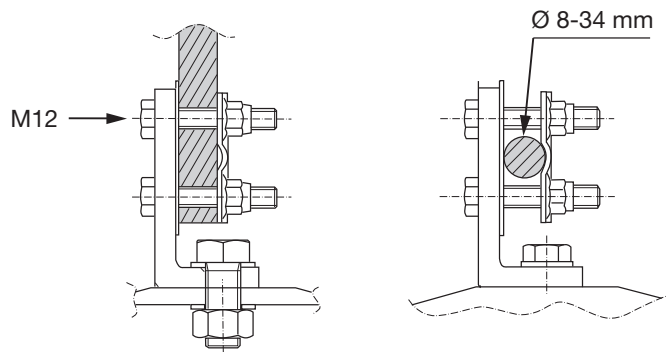
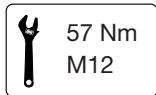


#### **Compatible conductor material**

All earth terminals are compatible with both copper and aluminium conductors, as are all line terminals except 1HSA410000-A, -C and -H which cannot be combined with copper conductors. In these cases use stainless steel washers between the aluminium terminal and the copper conductor

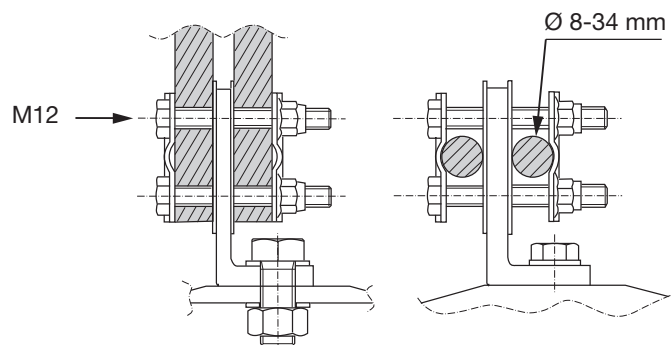
### 8.3 Connection of the conductor to line terminal

Connect the line conductor to the line terminal in such way that the permissible static loading together with steady wind load does not exceed the maximum value according to table 8.1.



**Fig 8.3.1**

Connection of single line conductor  
can be done from top or side

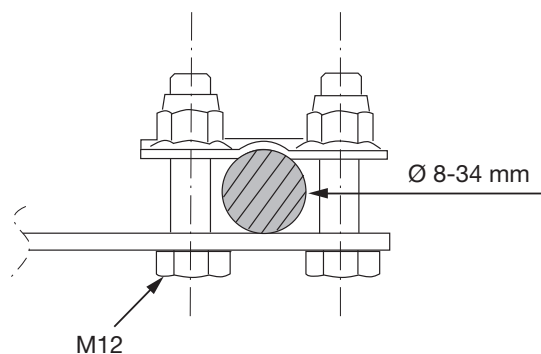


**Fig 8.3.2**

Connection of double line conductor  
can be done from top or side

## 8.4 Connection of the conductor to the earth terminal

The earth conductor cross section shall be chosen in accordance with local regulations and earth fault current requirements. For assembly of earth terminal to flange, see figure 7.1.2 and 7.1.4 on page 17. For assembly of clamp see figure 8.4.



**Figure 8.4**  
Earth terminal

## 8.5 Installation of surge counter

For installation of surge arrester monitor EXCOUNT-II and EXCOUNT-III, see section 7.2 on pages 18/19 together with the separate assembly instruction included with the delivery.

For installation of a surge counter EXCOUNT-C, EXCOUNT-I or surge counter from another manufacturer, ensure that:

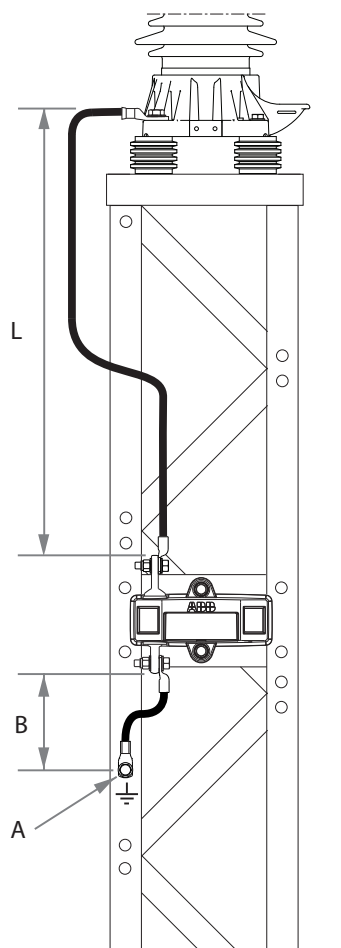
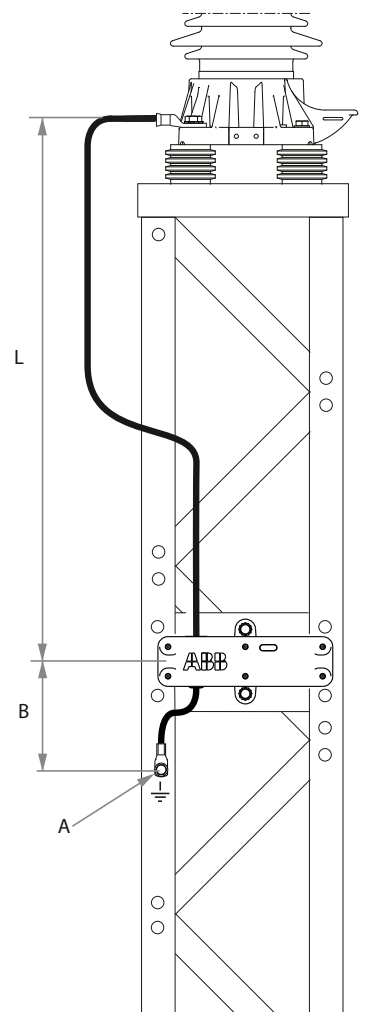
- The arrester is insulated from the structure by an insulating base with a LIWV of at least 15 kV or equal to that of the conductor between the surge arrester and the surge counter (see below), whichever is the greater.
- The length of the conductor between the arrester and the surge counter is to be minimum 0.5 m when a clip-on CT is to be used for control measurements of leakage current. The maximum length shall not exceed 3 m in the case of the insulating base and conductor having a LIWV of 15 kV. Longer lengths up to 10 m could be used with an insulating base having suitably higher LIWV, see table 8.5. The insulated base and conductor shall then be insulated for  $5 \times L$  kV (LIWV), where L is the conductor length in meters. Preferably, the total length between arrester earth terminal and grounding point (L+B in figure 8.5.1 and 8.5.2) should be considered in fulfilling the same requirement to avoid a flashover by the LIWV as described above being exceeded. Note that connection leads should always be kept as short as possible as longer leads result in a disadvantage from a protection point of view since inductance is added in series with the arrester.
- **Specifics for EXCOUNT-I**  
The conductor from the earth terminal of the counter to connection with the grounded support stand (point A in figure 8.5.1) on to which the counter is attached (or similar support) shall not exceed 0,5 m. For example, length B as shown in figure 8.5.1. The earth conductor may be extended from the connection point at the support to any "earth point" if the support itself, due to local requirements, is not considered as sufficiently grounded. However a flashover of the arrester base may occur if the length (L+B in figure 8.5.1) exceeds the value in table 8.5 and the counter may be damaged if the length B exceeds 0.5 m.
- **Specifics for EXCOUNT-C**  
Since the earth conductor is normally a single continuous piece, the total length from the earth terminal of the arrester to the grounding point (length L+B in figure 8.5.2) shall be the defining criteria for maximum length and minimum LIWV as described above. The length (B in figure 8.5.2) from the counter to earth or an intermediate grounding point shall not exceed 3m. The earth conductor may be extended from an intermediate connection point (A in figure 8.5.2) at the support to any "earth point" if the support itself, due to local requirements, is not considered as sufficiently grounded. In the event an intermediate connection is used between the arrester and counter, eg optional conductor kit 1HSA448427-A, then the same criteria as for EXCOUNT-I shall otherwise apply, except that the length B may be up to 3 m.
- The surge counter is to be installed according to the included assembly instruction.



**Table 8.5**

Standard Hitachi Energy Insulated base	Maximum length L *)
1HSA430 000-A, -B	10 m
1HSA430 000-C, -D	10 m
1HSA430 000-H, -J	10 m
1HSA430 000-P, -V	3 m

\*) On the condition the connecting conductor has at least  $LIWV = 5 \times L$  kV

**Figure 8.5.1****Figure 8.5.2**

# 9. Maintenance

## 9.1 Maintenance and checking

A properly chosen and installed EXLIM surge arrester is maintenance free during its lifetime, when operating under normal operating conditions. A properly chosen arrester means that both its electrical capability as well as its mechanical design correspond to the service conditions of the actual network.

### Cleaning

Cleaning is normally not necessary. However, under conditions of heavy marine or industrial pollution, where thick layers of pollutants are built up on the insulators, periodical cleaning of the surge arrester may be advantageous. Live washing is permitted. However, observe the following in addition to normal precautions for live washing.

- Arrester insulators usually have shorter flash-over distances than other insulators for the same system voltage, which means higher risk for external flash-over during washing.
- Arresters with series-connected units, must have all units spray-washed simultaneously, in order to avoid overheating of any unit.

### General

Should a routine check be desired, the only reliable method is to measure the resistive component of the leakage current periodically. For this purpose, use of Hitachi Energy Leakage Current Monitor, LCM, together with Hitachi Energys clip-on current meter or Hitachi Energy diagnostic indicator EXCOUNT-II is recommended. For description of the LCM/ EXCOUNT-II and measurement procedures, please refer to relevant catalogues.

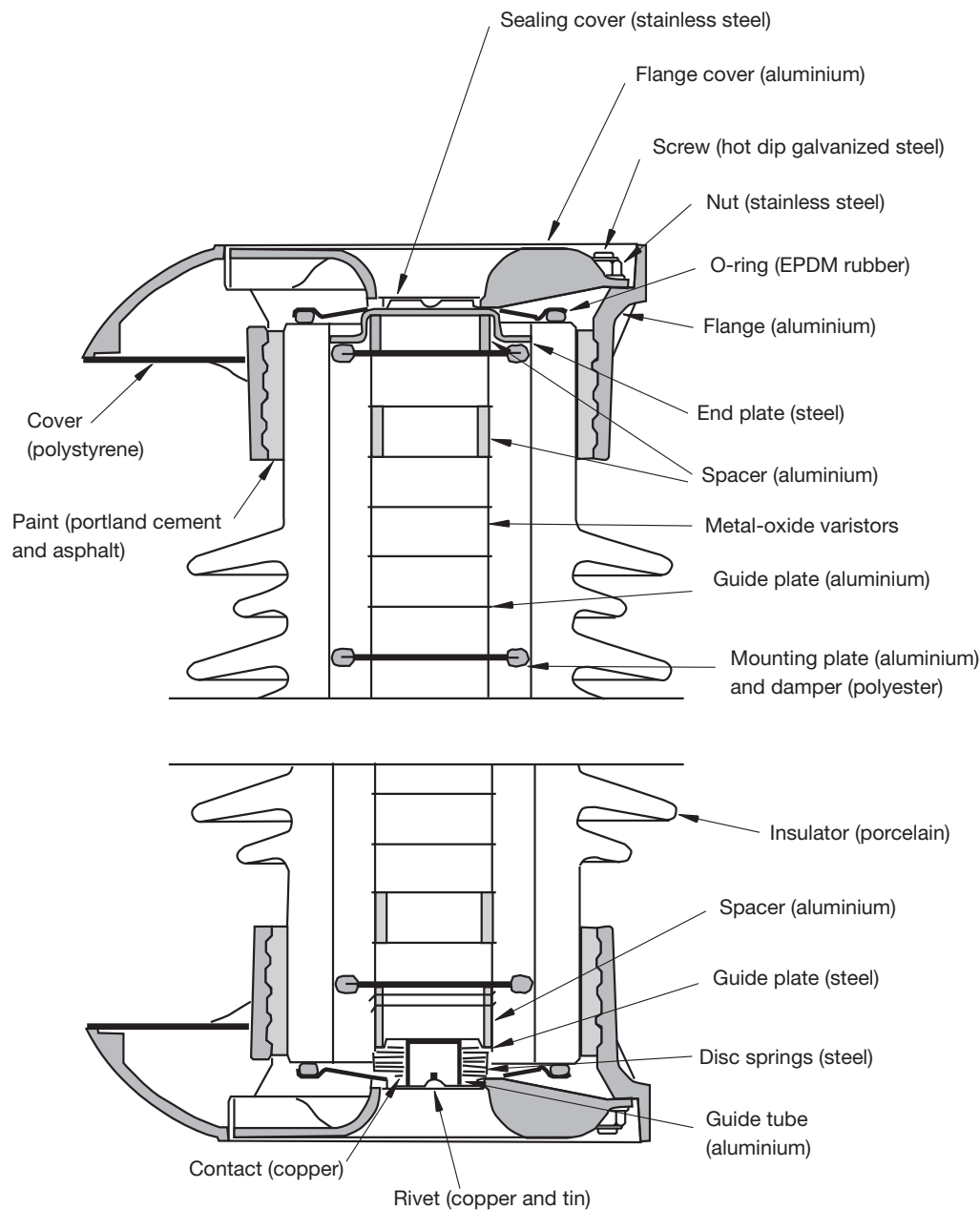
### Indications of arrester failure due to overstress

A red plastic cover covers each venting duct of the arrester. Check that these covers are in position before installation. In the event of an arrester failure due to overstress, one of the indications may be the blowing of these covers. Other indications may be soot marks around the venting ducts.

# 10. Disposal

## 10.1 Disposal of the surge arrester

When the surge arrester is taken out of service due to age or in case of an arrester failure due to overstress, its components shall be taken care of according to local regulations. The composition of the arrester and its components is shown in the figure below





**Additional information**

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**Hitachi Energy Sweden AB**

High Voltage Products

Surge Arresters

771 80 Ludvika

Phone: +46 (0)240 78 20 00

[www.hitachienergy.com/surge-arresters](http://www.hitachienergy.com/surge-arresters)