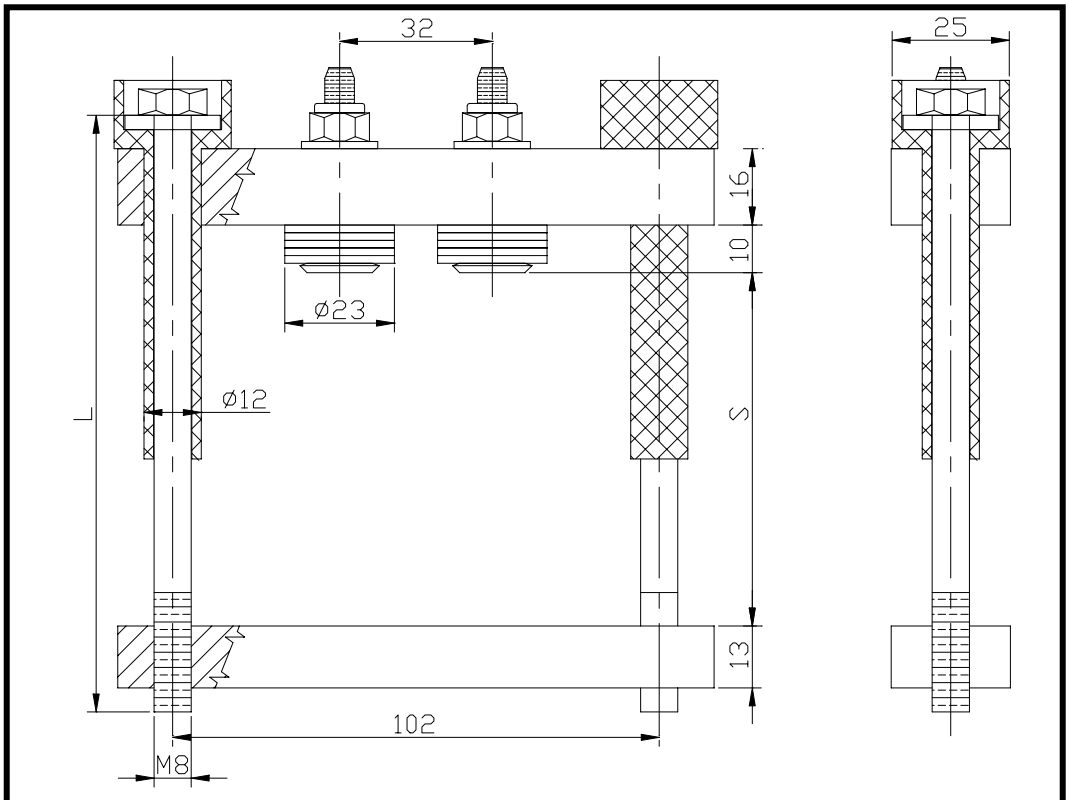
HOW TO CHOOSE THE RIGHT CLAMP FOR YOUR APPLICATION

ICT POWER COMPANY is one of the leading manufactures of precision clamping devices for various applications using semiconductors. Our line of clamp products complement the full line of semiconductor products we manufacture and support. For the purpose of this document we have categorized our standard (of the shelf) items; however we have the capability to manufacture replacements for any special or obsolete clamps.

WHAT IS A SEMICONDUCTOR CLAMP

A Semiconductor clamp is a pressure device utilized to provide and maintain proper pressure for proper operation of a variety of semiconductors. They are also used in conjunction with a variety of heat-sinks and bus-bars to provide adequate contact area for better electrical and thermal conductivity. To properly choose a clamp for a design there are several variables that must be considered. Table1 outline some of our most popular clamp series, categorized by device diameter and pressure ratings. For a full listing or your special clamp needs, please contact one of our engineering team members at ICT Power Company or email us at engineering@ictpower.com.



Above is an example of a C102 series of our clamps.
(Note that 102 in the series is derived from the bolt spacing)

CLAMP SELECTION PROCESS

To facilitate the understanding of clamp selection process, we will first review some of the terminologies and abbreviations used in this process. Once these terms are reviewed we will look at samples of tables and charts available in this guide and use them to select a clamp for a device.

DESCRIPTION OF TERMINOLOGIES USED

DEVICE DIAMETER – This is the diameter of the largest portion of a device. Some semiconductor devices are designed to have a lip that is larger than the actual device. This would have to be the diameter used in the clamp selection process. (See Fig.2)

DEVICE THICKNESS – This is the overall thickness of the device. Some semiconductor manufactures provide you with compressed and uncompressed thickness dimensions. This would be valuable in ensuring that in the clamp selection process we do not exceed the Maximum and the minimum clamping area dimensions ("Smax" and "Smin"). For more details on "Smax" and "Smin" please see the description note on *clamping area*. . (See Fig.2)

CLAMP PRESSURE OR FORCE – This is a pressure specified by the semiconductor manufacture for a specific device. This data is collected from the deice specifications provided by the manufacturer. Normally these specifications are expressed in KN (kilo Newton) or PSI (pounds per square inches).

CLAMPING AREA – Almost all of our clamp designs will have a table associated with it that establishes the maximum and minimum values for the area reserved for your assembly to be clamped. This area is identified as the "S" dimension, thereby having "Smax" and "Smin" Values.

CLAMP BOLT SPACING – This is determined by our design to accommodate several device packages sizes and pressure ranges. (ie: C070 clamp style indicates a 70mm bolt center spacing)

INSULATOR CUP – The insulator cups provide an electrical isolation between the two cooling mediums clamped together using steel bolts. Generally the isolation values are 4-7KV.

INSULATOR CUP LENGTH – The insulator cups are available at various standard lengths and can also be ordered for your specific needs. The tables describing our standard lengths can be found on the actual drawings for each specific clamp. Table 2 shows some of the standard cup lengths (dimension 'A') in these tables. The same tables will provide you with "S max" and "S min." values. (See Fig.1 & Table2)

DEVICE CLAMPING PRESSURE – This is a required pressure that the semiconductor manufacturer specifies that is required for the device to operate properly and to the given specification. Less that the required pressure can cause great decrease in cooling process and poor performance in current capability creating hot spots destroying the semiconductor chip. Too much pressure can physically damage the wafer chip and the contact surfaces of the device. The required pressure is normally expressed in KN (Kilo-Newton) or PSI (Pounds per Square Inch).

INSULATOR CUP LENGTH – Cup length is the length of insulator required to electrically isolate the cooling devices (i.e.: heat sinks, chill plates, etc) from one another. In certain clamp application the customer can specify the length.

OVERALL CLAMP HEIGHT – Items such as your existing device diameter and its potential future replacement size. The insulators cup lengths is another variable that must be determined to ensure no electrical failure due to arcing across the clamp bolts to the heat sink or the device itself. Another point that must be kept in mind is the issue of the actual clamp pressure to provide and maintain the proper pressure on the semiconductor device to operate properly. We take special care to include these main points and many other parameters when designing a new or a replacement clamp for your specific need.

WHAT WE NEED TO KNOW BEFORE SELECTING A CLAMP

Now that you are comfortable with the terminologies used we will use the following clamp selection process to select an appropriate clamp that would suite our design. The clamp selection process begins by knowing the *device* you intend to use and the *cooling process you intend to use* to maintain a proper temperature for the device. Many of the required information are obtained from the manufactures of the components used. ICT Power has provided website links to most of the semiconductor and heat sink manufactures.

There are three reasons for selecting a clamp.

1. **A direct replacement**. This type of selection is looking for a clamp replacement that requires no changes to your existing system.

For ***direct replacement,*** selection you need to know the following information about the existing clamp, before selecting a clamp. (See Fig.1, Fig.2 & Table 1)

1. Device diameter.
2. Device KN (pressure) rating.
3. Clamp bolt center spacing.
4. Clamp bolt thread type.
5. Clamp bolt length.
6. Clamping (“Smax” and “Smin”) area dimensions.
7. Clamp overall height.

2. **A replacement with modification.** This type of selection stems from changes is device diameter, device thickness, and new device pressure ratings. This type of selection can also stem from a redesign of and older system to improve overall system performance.

For ***replacement with modification*****,** You need to know the following information about your clamp and system. (See Fig.1, Fig.2 & Table 1)

1. Device diameter.
2. Device KN (pressure) rating.
3. Clamp bolt center spacing.
4. Clamp bolt thread type.
5. Clamp bolt length.
6. Clamping ("Smax" and "Smin") area dimensions.
7. Clamp overall height.

3. **A new design**. This is when you are selecting a clamp for an entirely new design. In this type of selection there are more options available since other parameters can slightly be modified before production. It also allows a selection for two or three different types of devices (diameters) to be used if the clamp bolt spacing is selected correctly.

For ***new design*****,** You need to consider not only the selection items for the previous two types of selection criteria, you also need to consider allowing room for future system expansions or to facilitate servicing of the equipment. (See Fig.1, Fig.2 & Table 1)

1. Device diameter.
2. Device KN (pressure) rating.
3. Clamp bolt center spacing.
4. Clamp bolt thread type.
5. Clamp bolt length.
6. Clamping ("Smax" and "Smin") area dimensions.
7. Clamp overall height.
8. Does your design require a bottom bar for tightening of the clamp, if so will it be accessible for device replacement.

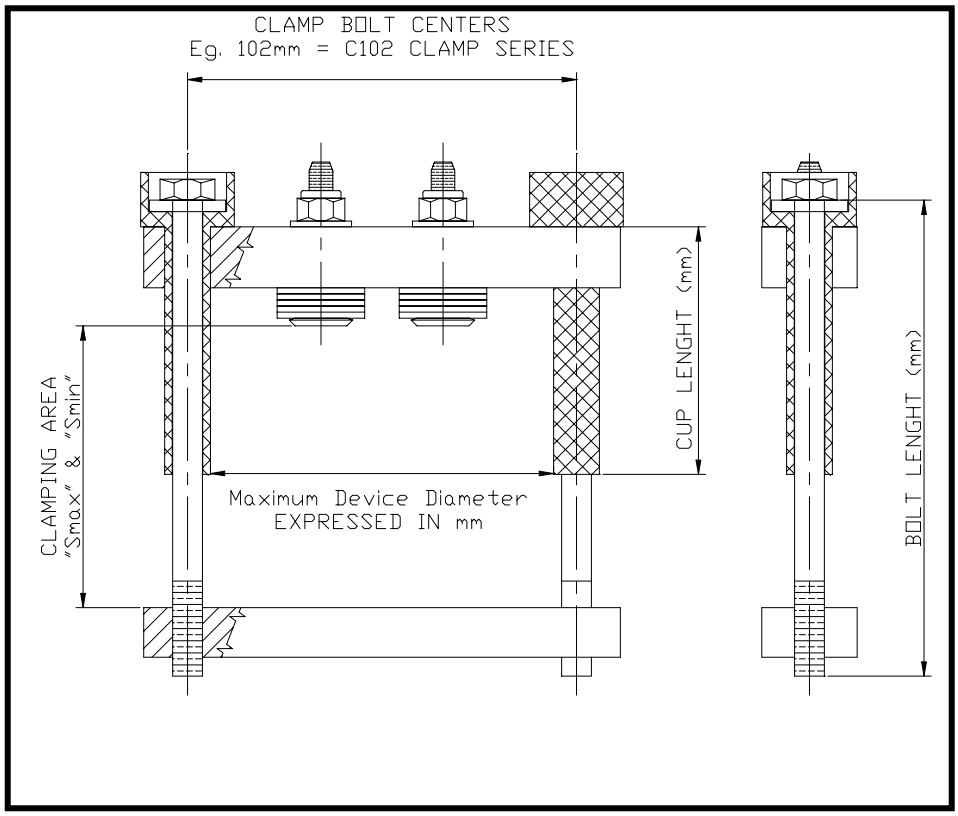


Fig.1

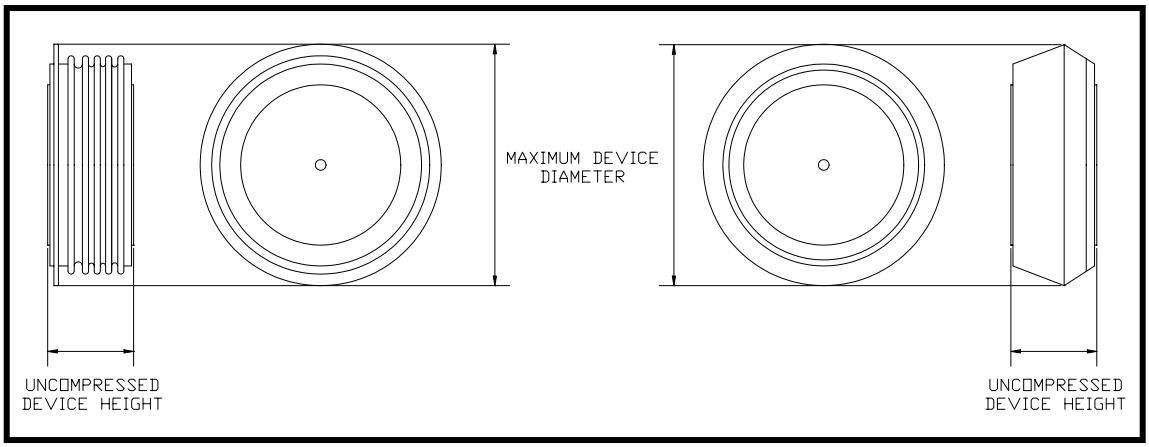


Fig. 2

You can find our most popular clamps listed below. Table1 lists these clamps by Bolt center spacing and compares them to the maximum device diameter that can be used with these clamps. Table 1 will also provide a list of the clamp rating available.

DEVICE DIAMETER (Millimeters)	CLAMP STYLE (Series)	CLAMP PRESSURE Rated in KN (Kilo Newton)											
54	C070	2	5	8	10	12							
74	C090				10	12	15	18	22				
86	C102							18	22	25	30		
102	C118								22	25	30	35	
120	C140										30	35	42
For other clamp sizes and pressure ratings contact ICT Power Company													

Table 1

Each clamp series are further divided into five different configurations Fig. 4, to meet a variety of designs and requirements.

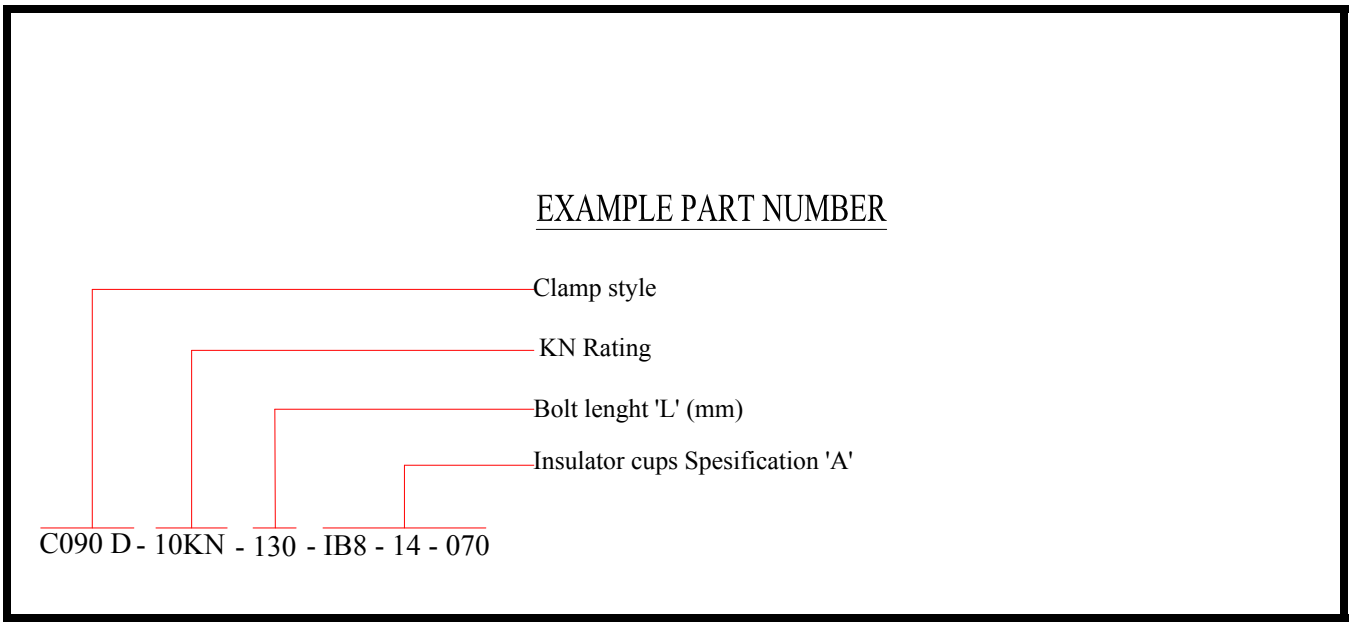


Fig. 3

CLAMP CONFIGURATION TYPES

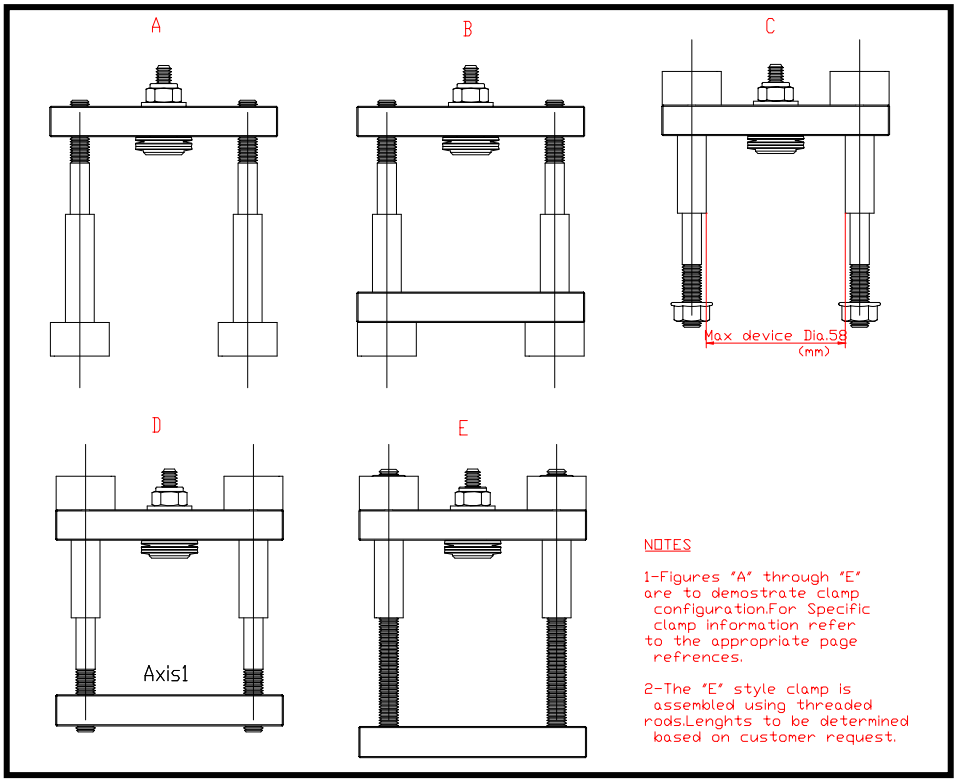
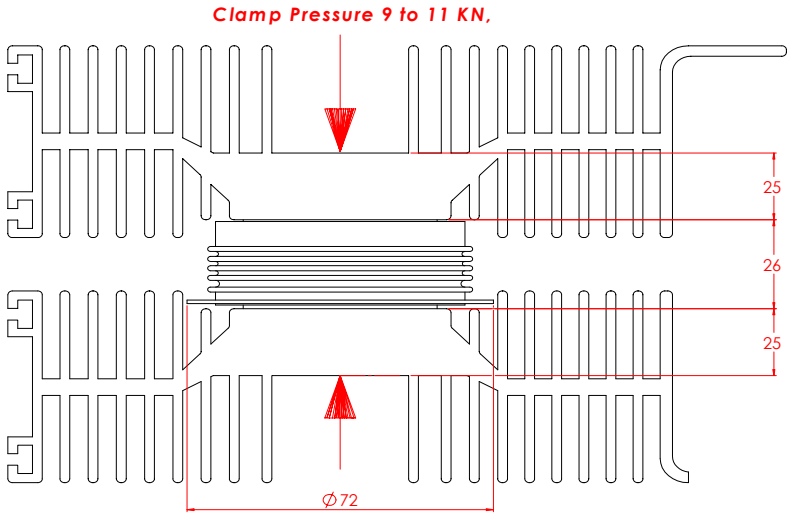


Fig. 4

CLAMP SELECTION EXAMPLE

In this example we will consider a clamp replacement for existing equipment with the following specifications published by the device manufacturer and the heat sink manufacture.

1. Device diameter 72 millimeters
2. Device thickness 26 millimeters
3. Required device clamping pressure of 9 to 11 KN
4. Heat-sink clamping area thickness 25 millimeters
5. Device requires double sided cooling



HOW TO BEGIN TO SELECT THE PART NUMBER SELECTION

1. First, we need to look at device diameter and determined the required clamps bolt spacing. Looking at Table 1 and Fig.2 we can note that the smallest clamp spacing we can use is the **C090** series. This clamp will allow for our device diameter of up to 75mm.

2. Since we are double side cooling the device, we require two heat sinks with the device in between. Our choices of clamp configuration (Fig.4) depend on the equipment design, the direction of clamp use and the overall clamp height. For the purpose of this example we will use a "D" series clamp. The "D" configuration will provide us with clamping bars on both side of the device. The part number **C090** is now extended to become **C090D-**.

3. Next, we will determine the clamp pressure. From Table 1we can determine that the 10KN clamp would be in the mid range of the device requirements (device manufacture has specified a clamping force of 9-11 KN). The part number would extend to **C090D-10KN-**.

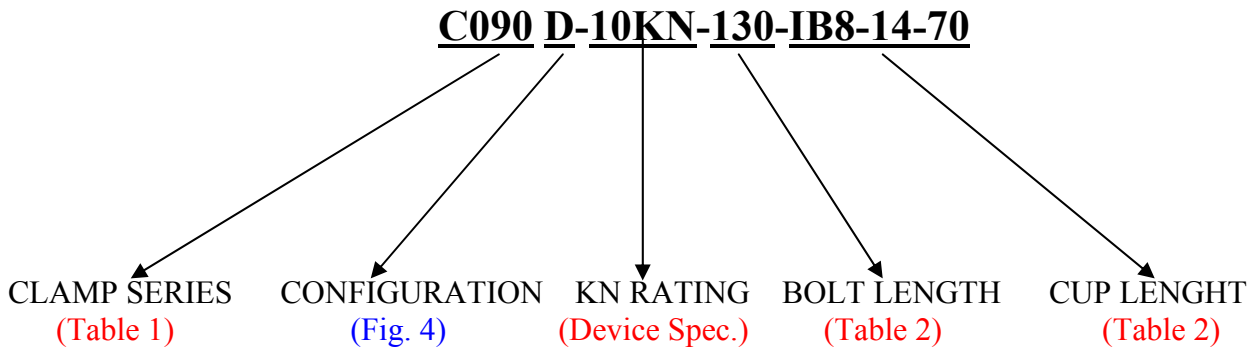
4. Next, we need to identify the clamping area required (the **"S"** dimension). We can identify the required space by adding one device thickness and two heat sink thick nesses (for double sided cooling). The required clamping space would calculate to be 76 millimeters (26 + 25 + 25). This falls between the "Smax" and "Smin"of 80 and 71 millimeters identified for a 130mm bolt (Table 2). The part number to **CO90D-10KN-130-**.

L	S max	S min	A
100	50	41	55
110	60	51	55
120	70	61	55
130	80	71	70
140	90	81	70

Table 2

5. The last item is to select the cup length that is supplied with the clamps. The IB8-14 in the style of the clamp and the length is the "A" dimension. In most cases, this cup length is selected to ensure that the cup extends past the half waypoint on the selected *clamping area*. The cup length that is supplied with this bolt length is the 70 millimeters. This would complete the part number as **C090 D-10KN-130-IB8-14-70**.

A review of this part number reveals that it is a clamp with the following specifications.



GENERAL MOUNTING INSTRUCTIONS FOR CLAMPS

These two types of clamps have a preloaded cup shaped springs system, which guarantees the pex-Dendicularity of the clamping force even without ball joints. The release of washer on the loader bar indicates the achievement of the right force. In order to achieve the proper mounting force and proper contact area, it is recommended that the following procedures to be followed in the absence of a manufacture that may supercede this procedure.

1) The two contact surfaces of semiconductor should be covered with a tin coating of an approved joint compound and then the possible surplus should be removed.

2) Locate the semiconductor on one of the two heat sinks centrally by using the provided pin after having checked the polarity. Then the semiconductor should be rotated to spread the compound.

3) Position the second heat sinks on the semiconductor and locate it centrally by using a second pin. Then slightly rotate the heat sink to spread the compound.

4) Mount the clamp on the heat sinks by tightening alternatively the bolts with a wrench up to the contact with the metal washer of the insulator. CHECKING FOR PARALLEL ALIGNMENT OF HEATSINKS SEMICONDUCTOR.

5) Tighten alternately both bolts each time about 1/6 turn until the indicating washer turns free, then tighten both bolts once more about 1/10 turn.

TECHNICAL CHARACTERISTICS

The bars of clamps type C70, C90, C102, C118 and C140 are made of high resistance steel.

The cup shaped springs is made of 1075 steel. Upon request they can be made of stainless steel.

The screws and bolts are made of steel class 8.8 (GR8) or as necessary.

The insulators are made of polyamide 6.6 with 50% glass fiber added.

All metal parts are galvanicaly treated in order to be corrosion proof.