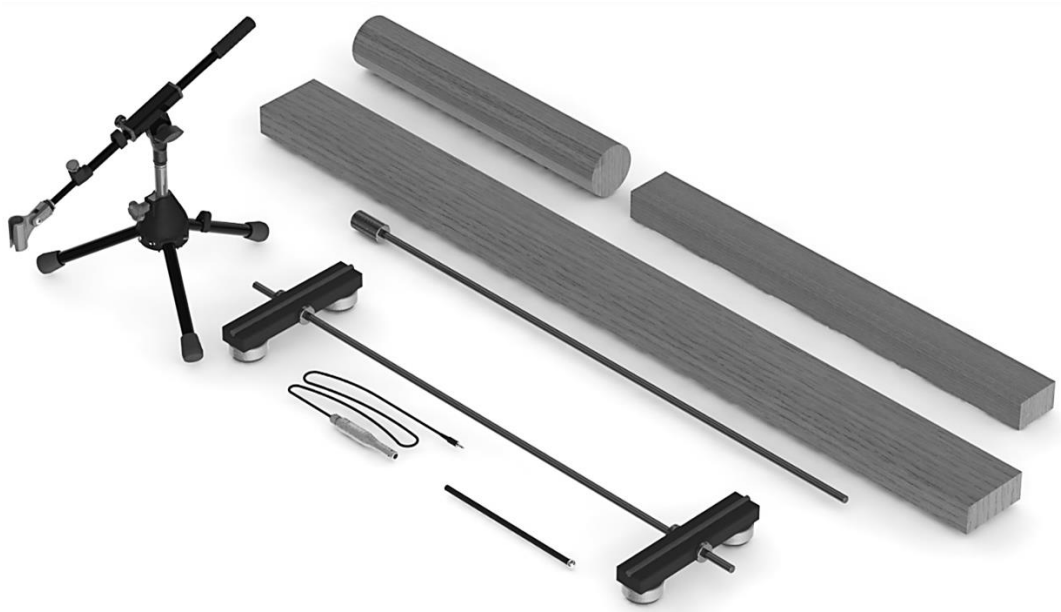




# ***Installation and Operation Manual***

**SA-AG**

**Adjustable support for large samples**



**ATCP Physical Engineering**

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# *Installation and Operation Manual*

SA-AG

Adjustable support for large samples

Manufactured by:

ATCP do Brasil – Alves Teodoro Cerâmicas Piezoelétricas do Brasil Ltda. ME.

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Brazilian Industry

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## 1. Introduction

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ATCP Physical Engineering equipment and products have been projected and manufactured to provide a long-lasting and top-rated performance. This Installation and Operation Manual contains all necessary information regarding the use and maintenance of this equipment.



***Carefully read this manual before using the equipment. Improper use may damage the product and compromise its performance.***

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## 2. Definitions

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***Impulse Excitation Technique:*** The Impulse Excitation Technique is a non-destructive test to determine the elastic moduli and the damping of materials using their resonance frequencies. This technique is described in the ASTM E1876 and correlated standards.

***Resonance Frequencies:*** Natural frequencies of vibration of a sample.

***Elastic Modulus:*** Elastic modulus is defined as the slope of the stress-strain curve at the elastic region, as described by Hooke's Law.

***Damping:*** Damping is the phenomenon by which mechanical energy is dissipated in dynamic systems. It is directly linked to the presence of defects and the microstructure of a material.

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## 3. Application and features

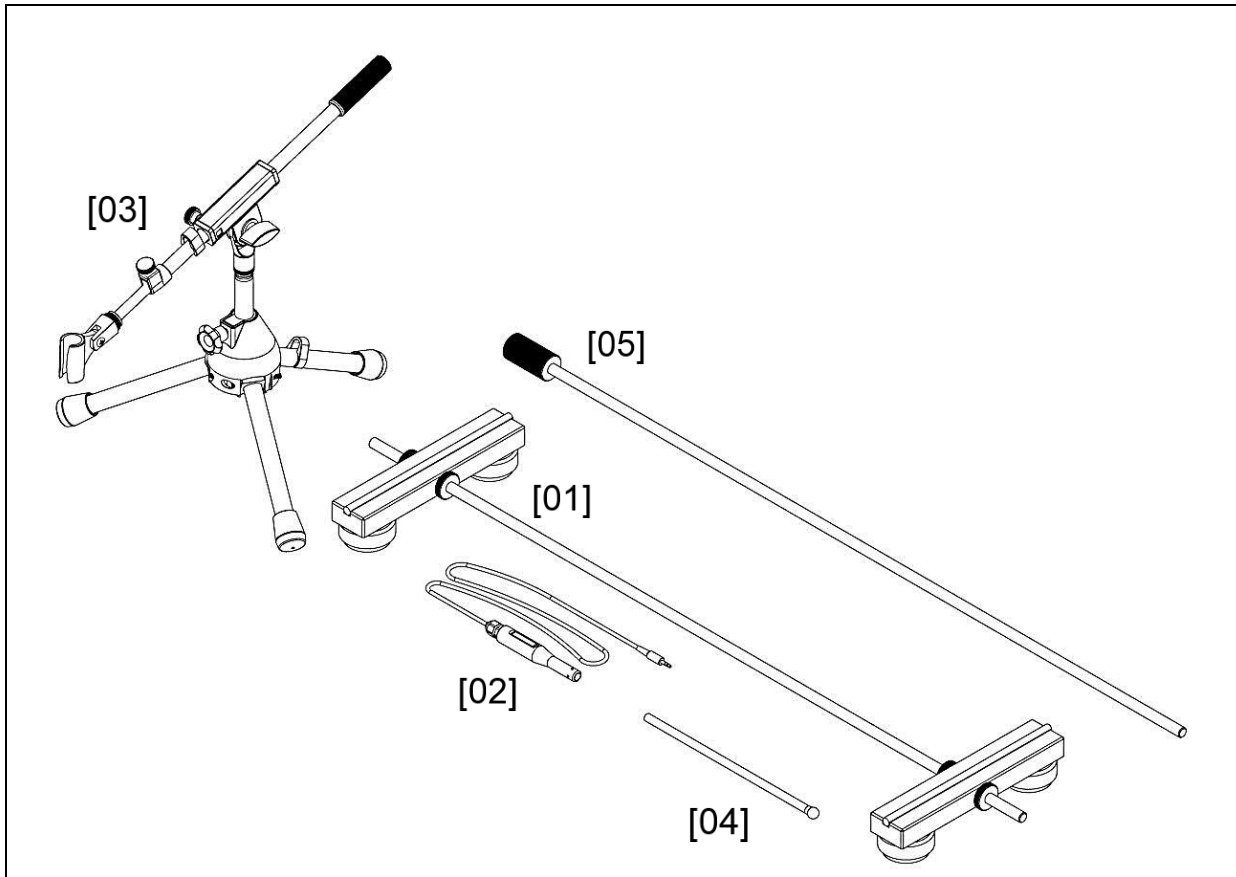
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SA-AG Support is an apparatus employed to hold and position samples to non-destructively measure Young's Modulus and damping coefficient of materials using the Impulse Excitation Technique, according to the ASTM E1876 and correlated standards. SA-AG Support was developed to be used alongside Sonelastic® Solutions.

SA-AG Support allows large rectangular and cylindrical bar samples to rest on the nodal lines of the fundamental flexural vibration mode. This support offers a practical system to regulate the gaps between the supporting blocks considering the length of each sample. SA-AG Support also allows tests based on torsional and longitudinal vibration modes for bars and cylinders.

#### 4. Configurations, parts, accessories and optional items

SA-AG Support is made up of two SUPPORTING BLOCKS that are linked together through a THREADED ROD, allowing an easy position adjustment. It also has an EXTENSION ROD to allow an expansion of the maximum distance between the SUPPORTING BLOCKS, adjusting the apparatus according to the size of the sample to be tested.



**Parts:**

- [01] - ADJUSTABLE SA-AG SUPPORT.
- [02] - CA-DP MICROPHONE.
- [03] - STURDY TRIPOD.

**Accessories:**

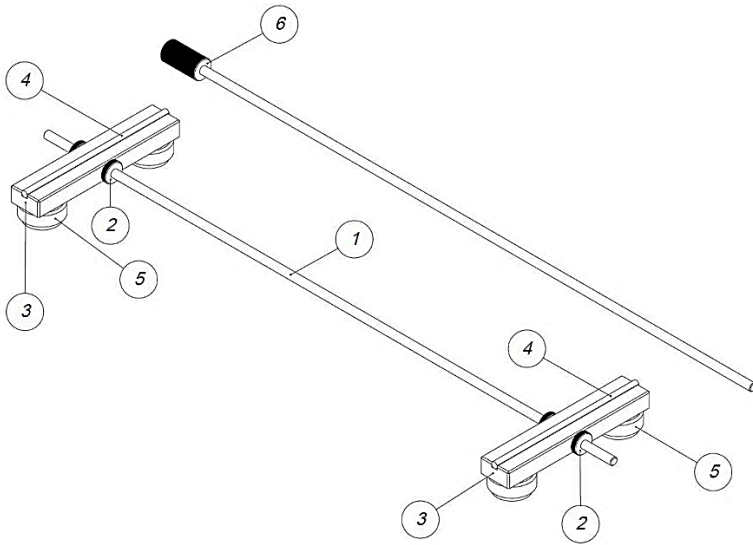
- [04] - MANUAL IMPULSE DEVICE OF MEDIUM IMPACT.
- [05] - EXTENSION ROD (01 UNIT).

**Optional items:**

- [05] - EXTENSION ROD (MAX. 01 UNIT).

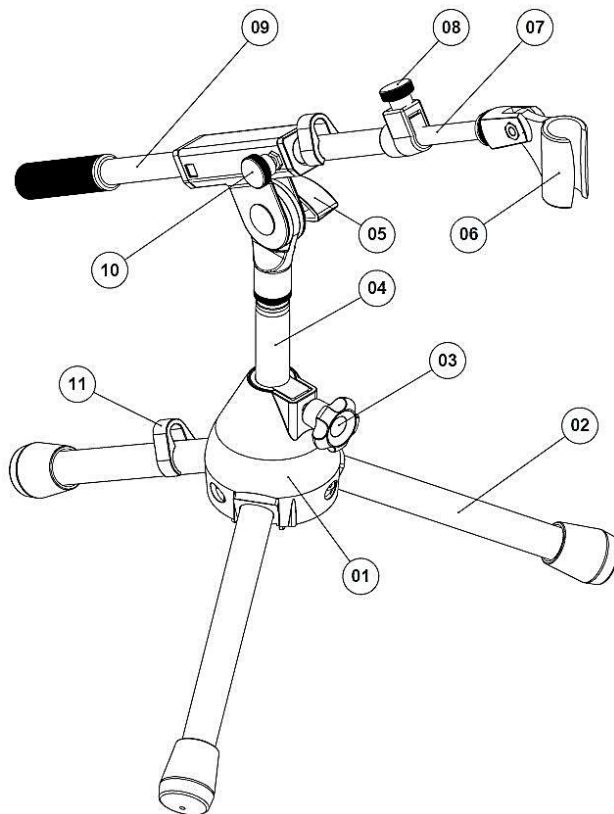
**5. Identifying the parts**

**SA-AG SUPPORT**

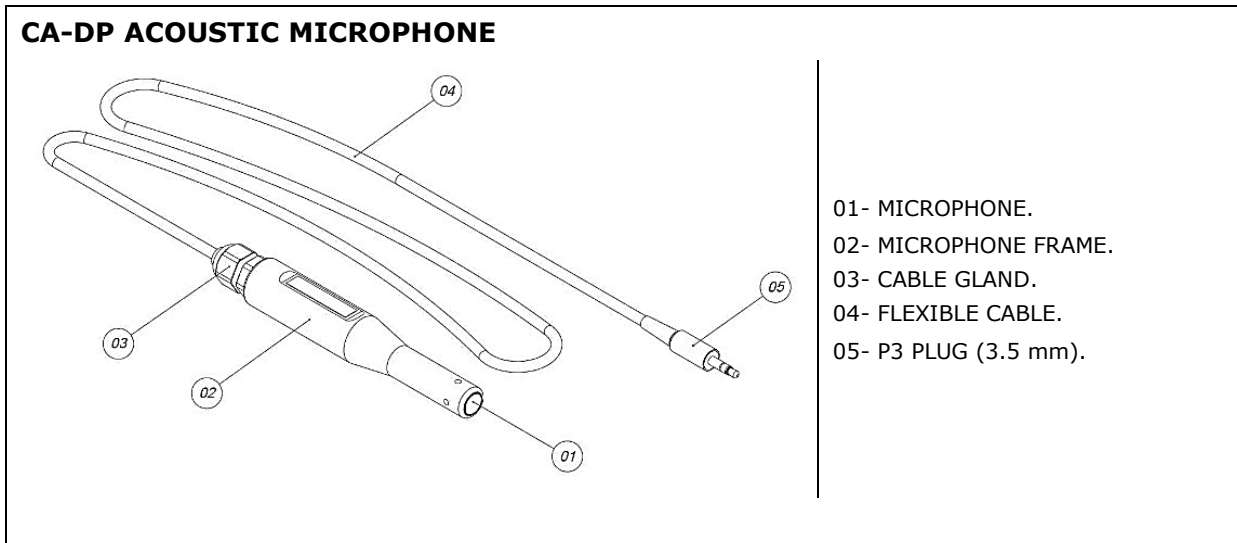


- 01- STAINLESS STEEL THREADED ROD.
- 02- FASTENING NUT OF THE SUPPORTING BLOCK.
- 03- SUPPORTING BLOCK.
- 04- SUPPORTING FRIEZE.
- 05- DAMPER FOOT.
- 06- EXTENSION ROD.

**STURDY TRIPOD**



- 01- FRAME.
- 02- ARTICULATED TRIPOD.
- 03- HANDLE FOR SECURING THE TUBE.
- 04- PILLAR.
- 05- HANDLE FOR THE TUBE ARTICULATION.
- 06- MICROPHONE CLIP.
- 07- INNER TUBE.
- 08- HANDLE FOR THE INNER TUBE ARTICULATION.
- 09- OUTER TUBE.
- 10- HANDLE FOR THE OUTER TUBE ARTICULATION.
- 11- CABLES ORGANIZER



**6. Specifications**

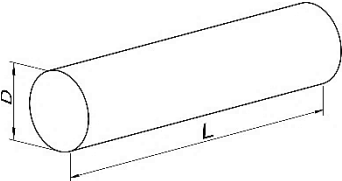
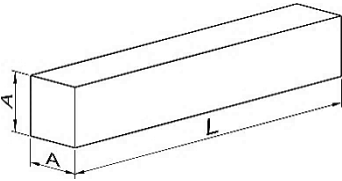
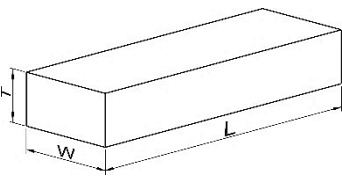
Maximum dimensions for rectangular samples (L x W x T) .....	5,300 x 200 x 200 mm
Minimum dimensions for rectangular samples (L x W x T) .....	120 x 20 x 20 mm
Maximum dimensions for cylindrical samples (L x D) .....	5,300 x 200 mm
Minimum dimensions for cylindrical samples (L x D) .....	120 x 30 mm
Maximum dimensions for the Standard Support (L x W x T).....	1,000 x 250 x 57 mm
Maximum dimensions for the extended support (L x W x T).....	3,000 x 250 x 57 mm
Maximum weight capacity.....	200 kg
Standard Support weight, without a sample.....	2.8 kg
Extended support weight, without a sample.....	5.2 Kg
Working temperature range .....	-5 to + 50 °C



## 7. Samples

### 7.1 Recommended proportions

There are minimum proportions that must be observed to avoid the coupling between samples vibration modes. In addition, proportions determine the pattern of frequency spectrum of acoustic response. Users are advised on standardizing the proportions to facilitate the correct identification of frequencies.

Geometry	Recommended proportions
 <p>Cylinder</p>	$\frac{L}{D} \geq 2$ <p>The ratio between length (L) and diameter (D) must be greater than or equal to 2.</p>
 <p>Square section bar</p>	$\frac{L}{A} \geq 3$ <p>The ratio between length (L) and edge (A) must be greater than or equal to 3.</p>
 <p>Rectangular section bar</p>	$\frac{L}{W} \geq 4$ <p>The ratio between length (L) and width (W) must be greater than or equal to 4.</p> $\frac{W}{T} \leq 8$ <p>The ratio between width (W) and thickness (T) must be less than or equal to 8.</p>

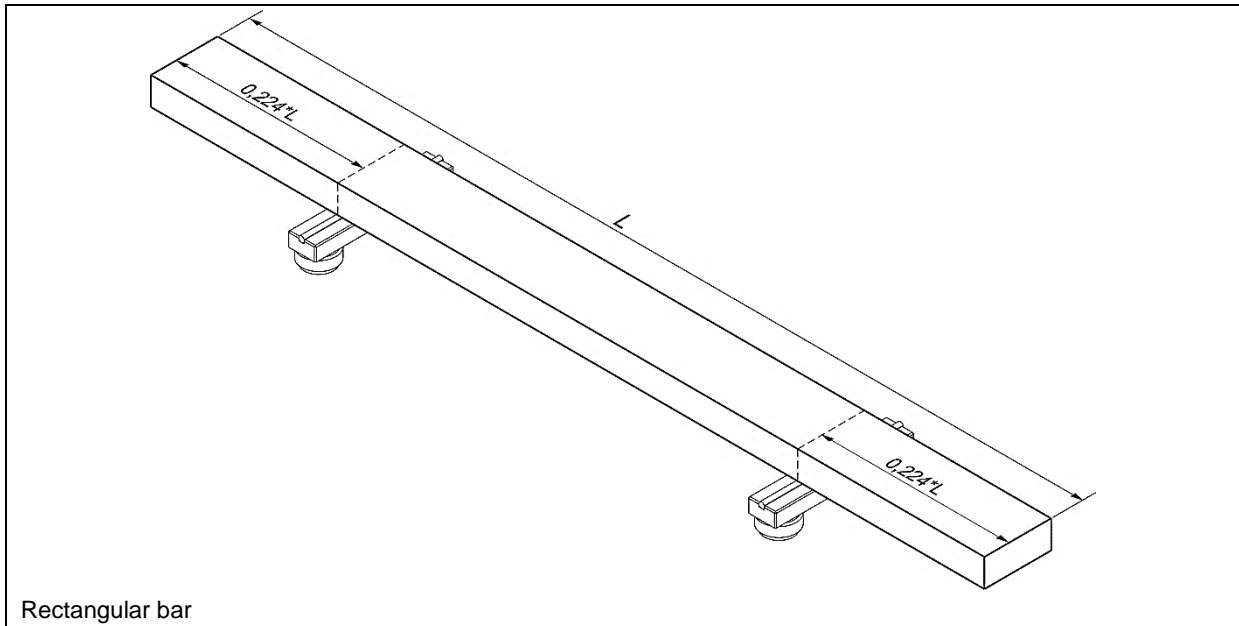
Important observations for preparing and finishing the samples:

- The recommended dimension tolerance is 2%;
- Faces should be flat and paralelle;
- Corners should not be rounded.

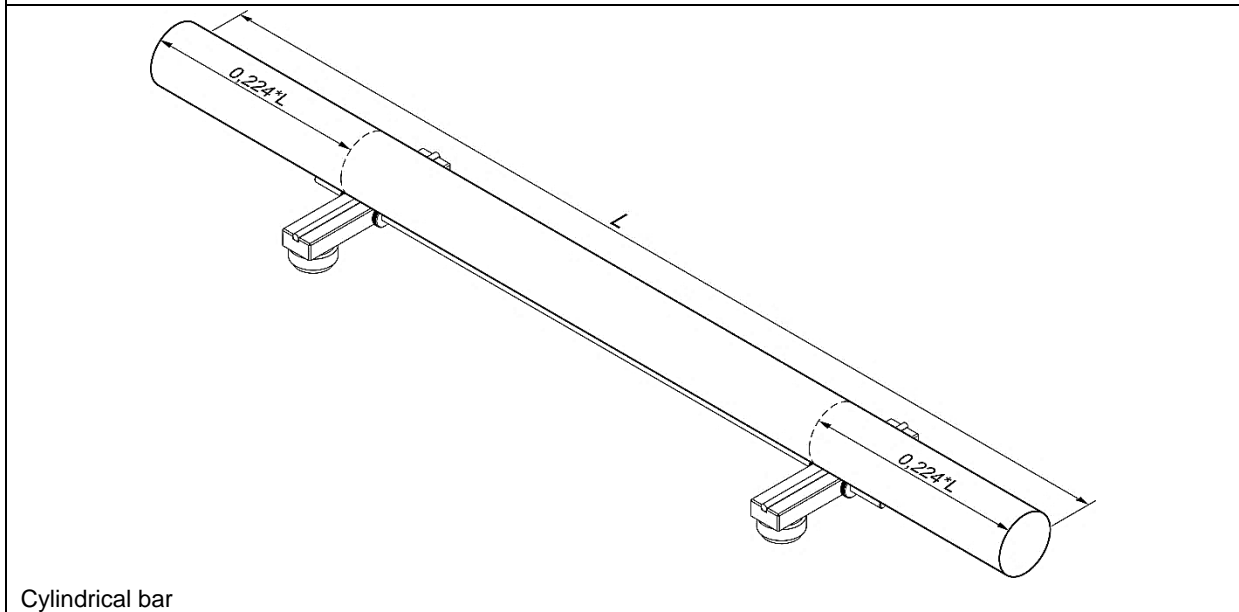
### 7.2 Placing the sample

The sample should be symmetrically supported and placed over the SUPPORTING BLOCKS, with these resting at a distance of 0.224 L from the sample ends (L is the length of the sample). For instance, if a sample's length (L) is 1,000 mm, the SUPPORTING BLOCKS should

be positioned at a distance of 224 mm from each end. The positions of  $0.224 L$  correspond to the nodal lines of the flexural vibration mode.



Rectangular bar



Cylindrical bar

The corresponding distance calculation of  $0.224 L$  is automatically generated and informed by Sonelastic® Software. Markings on the sample are generally done by using a pencil and a ruler or caliper ruler.

## 8. Installing the equipment

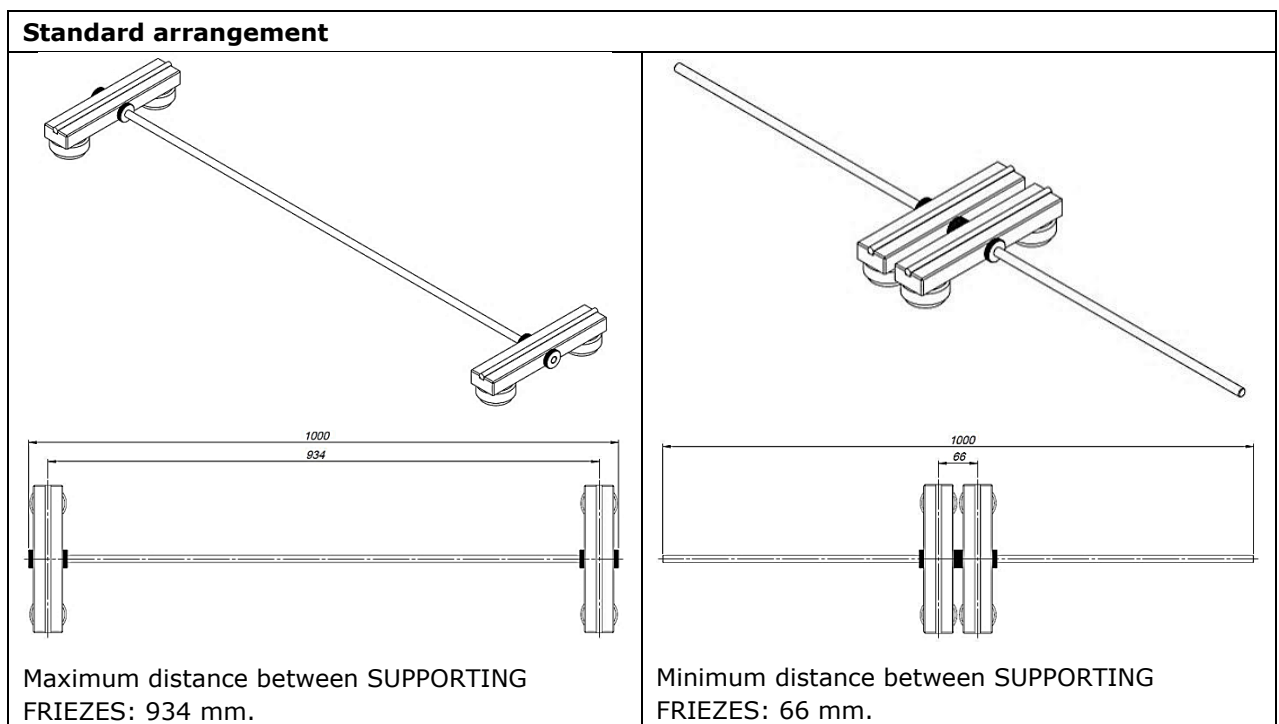
### 8.1 Requirements

- A flat space to place the support, with a free area big enough to match the size of the samples to be tested.
- The workbench must be flat and leveled with a free gap of at least 60 x 120 cm (depth and width). This gap should be enough to fit the computer and possible optional items that may be also used.
- A 127 or 220 VAC three-pin ground wired electrical mains plug. This pug is needed to feed the computer and other optional items that may be combined with the use of the SA-AG support.

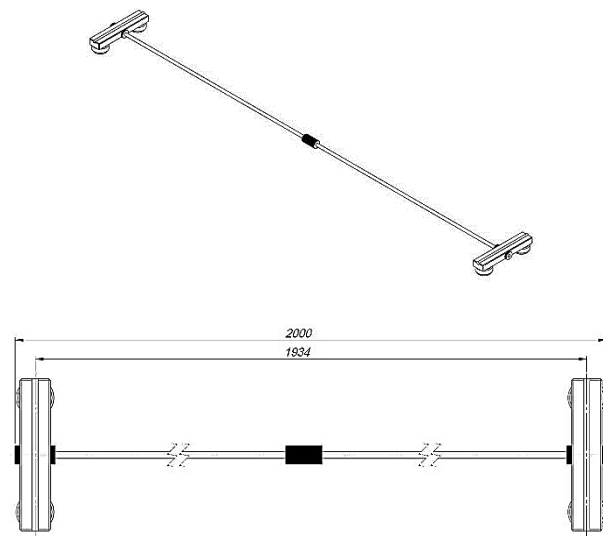
The equipment installation consists mainly of mounting and positioning the support over the surface, coupling the MICROPHONE to the STURDY TRIPOD and adjusting the gap between the SUPPORTING BLOCKS.

### 8.2 Typical arrangements

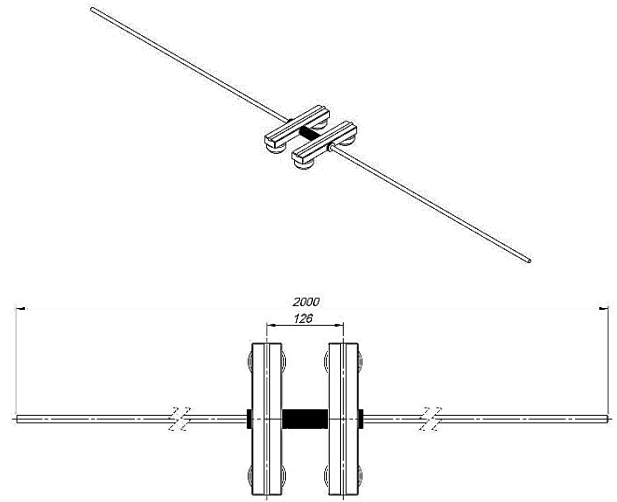
Typical SA-AG Support arrangements are presented next:



**Arrangement with an EXTENSION ROD**

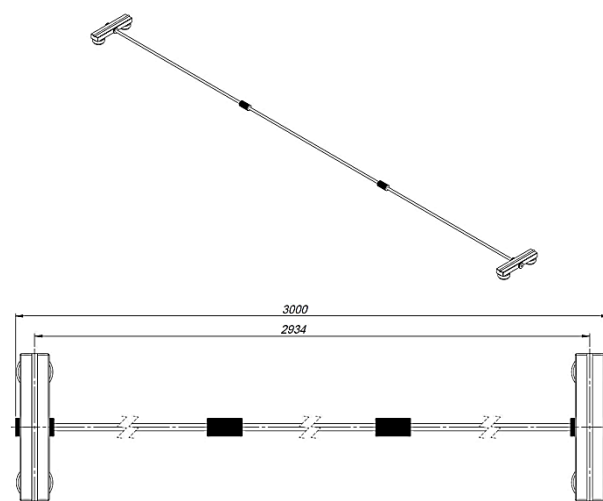


Maximum distance between the SUPPORTING FRIEZES: 1,934 mm.

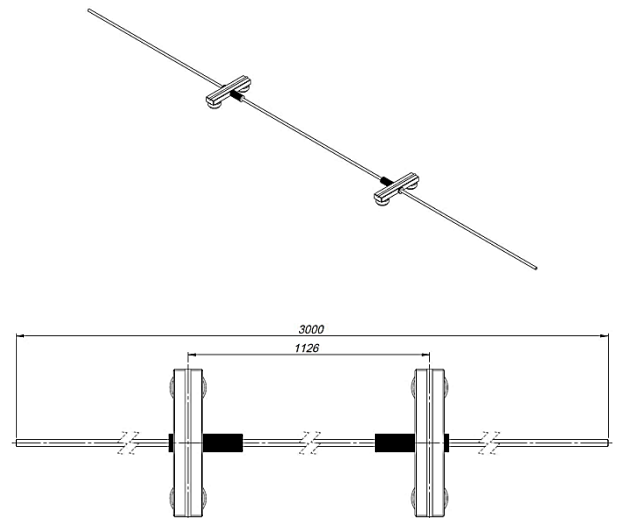


Minimum distance between the SUPPORTING FRIEZES: 126 mm.

**Arrangement with two EXTENSION RODS**



Maximum distance between the SUPPORTING FRIEZES: 2,934 mm.



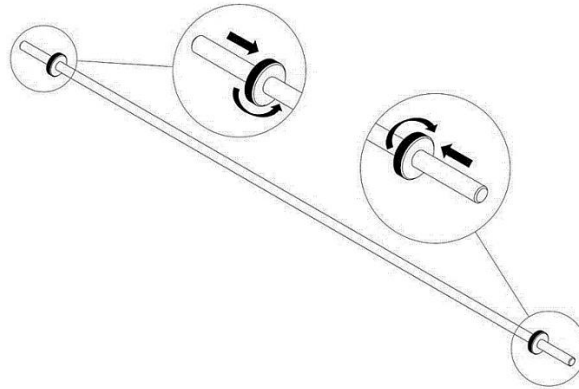
Minimum distance between the SUPPORTING FRIEZES: 1,126 mm.

**Notes:**

- The maximum and minimum lengths for which to detect the resonance frequencies will also depend on the elastic properties of the material a sample is made from. For instance, in the case of wood, it is recommended that the characterization should be carried out by employing the longitudinal mode because it presents the highest frequency.
- SA-AG Support comes partially disassembled to facilitate its transportation. To be able to use it, follow the assembling instructions in 8.3 – Setting up the Standard Support, whilst checking for descriptions in 5 – Identifying the parts.

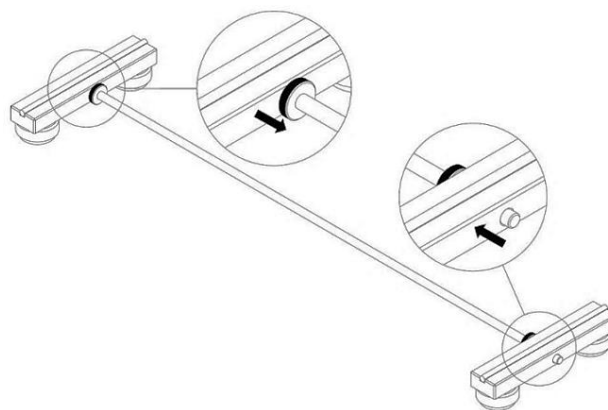
### 8.3 Setting up the Standard Support

*Step 01 -* Hold the THREADED ROD [01] and fit the SUPPORTING BLOCK FASTENING NUTS [02] on each end at a minimum distance of 60 mm from the tip, as pictured next:

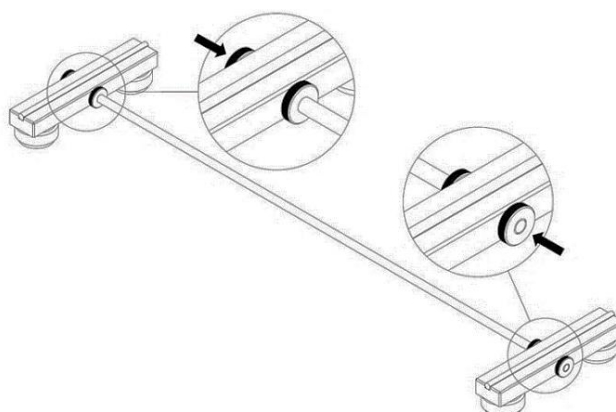


*Step 02 -* Fit the SUPPORTING BLOCKS [03] on each ROD end through the central holes, positioned on the sides of each block, until the blocks are touching the FASTENING NUTS [02], as pictured next:

*Observation:* to facilitate this step, rest the support on a hard and flat surface.



*Step 03 -* Finalize mounting the equipment by fitting the other two FASTENING NUTS on the end of each ROD, tightening them well to lock the SUPPORTING BLOCKS, as pictured next:

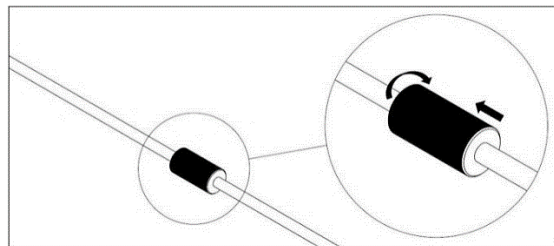


*Step 04* - To adjust (or change) the distance between the SUPPORTING BLOCKS, release the FASTENING NUTS, positioning them on the THREADED ROD together with the SUPPORTING BLOCKS until an ideal distance between the SUPPORTING FRIEZES [04] is achieved. After that, secure the SUPPORTING BLOCKS by tightening the FASTENING NUTS. The maximum and minimum distances between the SUPPORTING FRIEZES in each of the possible Support SA-AG mounting arrangements are presented in 8.2 – Typical arrangements.

**Note:** After positioning the SUPPORTING BLOCKS at ideal distances, ensure they are locked well using the FASTENING NUTS so the support is always sturdy enough to carry out the characterizations.

#### 8.4 Mounting of the EXTENSION ROD on the support

*Step 01* - If the support has already been assembled as previously described, remove the FASTENING NUTS and the SUPPORTING BLOCKS off one of the ends of the THREADED ROD, then couple the EXTENSION ROD [06] to it. For that, screw the EXTENSION ROD until the end, checking that it is totally locked and fastened, as pictured next:

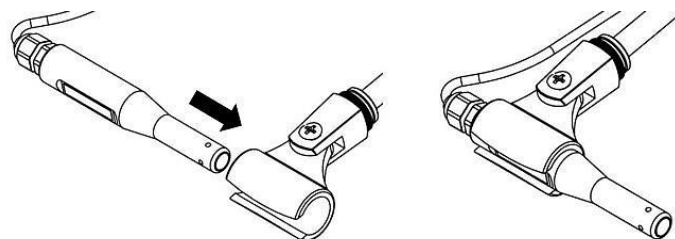


*Step 02* - After mounting the EXTENSION ROD, assemble the SUPPORTING BLOCK [03] and couple the respective FASTENING NUTS to the EXTENSION ROD ends, as described in *Step 01*.

**Note:** Depending on the length of the sample, SA-AG Support may be extended once again by using a second EXTENSION ROD (optional).

#### 8.5 Mounting the MICROPHONE for characterization

*Step 01* - Insert the CA-DP MICROPHONE in the STURDY TRIPOD microphone clip, as pictured below:



*Step 02* - Slide the MICROPHONE into the clip until the whole microphone frame is fully secured, then place its cable over the STURDY TRIPOD INNER TUBE.

*Step 03* - Connect the MICROPHONE to the computer's audio input.

---

## 9. Operating the support

---

After following the steps in 8 – *Equipment Installation*, your SA-AG Support will be ready for use.

### 9.1 Positioning the sample

To be able to carry out a fast and precise characterization of samples using SA-AG Support, read carefully the following steps:

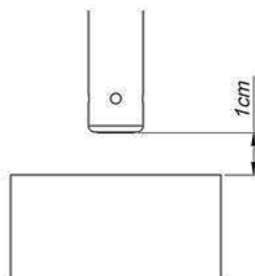
- Step 01* – Prepare the equipment according to the type of sample to be characterized and to the information in 8 – *Equipment Installation*;
- Step 02* – Using a measuring tape (or tapeline) and a pencil, trace precisely on the sides of the sample the ideal distances it should be supported by, according to its shape and dimensions indicated by the software;
- Step 03* – Shift the SUPPORTING BLOCKS, as described in 8.3 – *Setting up the Standard Support*, until the final distance between them is the same as the one pre-defined and marked on the sample.
- Step 05* – Carefully place the sample over the SUPPORTING FRIEZES, ensuring that the traced marks are precisely aligned with the FRIEZES below them.

After completing this sequence of steps, the sample should be correctly supported and positioned for the characterization.

**Note:** To measure the torsional mode, it is necessary to trace marks on the sample at a distance of  $0.32 L$ , as the ideal supporting points for acquisition and excitation modes. For more details, check 10 - *Acquisition and Excitation Modes*.

### 9.2 Positioning the MICROPHONE for acoustic signal acquisition



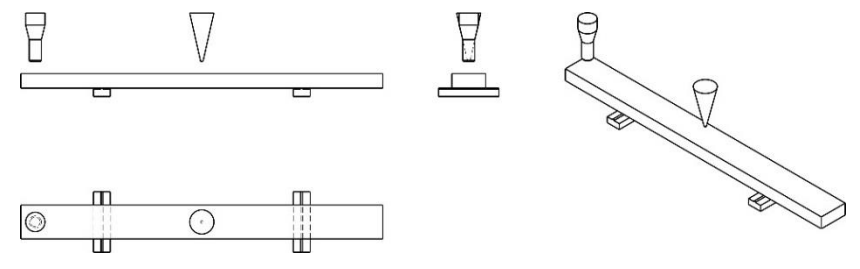
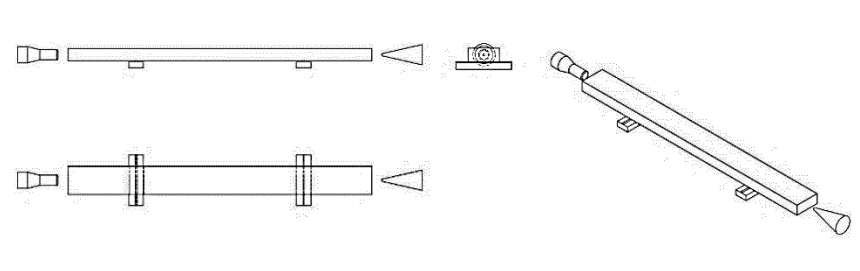
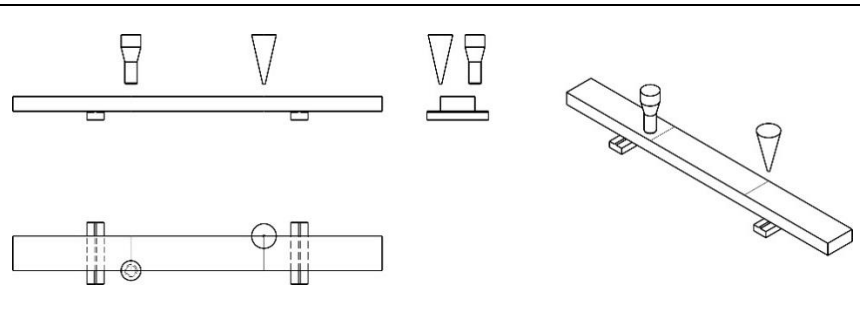
- Step 01* – Mount the MICROPHONE on the STURDY TRIPOD, as described in 8.5 – *Mounting the MICROPHONE for characterization*.
- Step 02* – Adjust the MICROPHONE distance so its face is approximately 1 cm away from the face of the sample. This distance is not critical for the results.



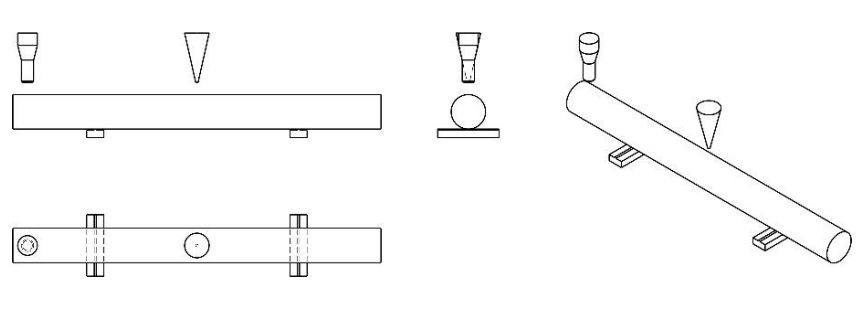
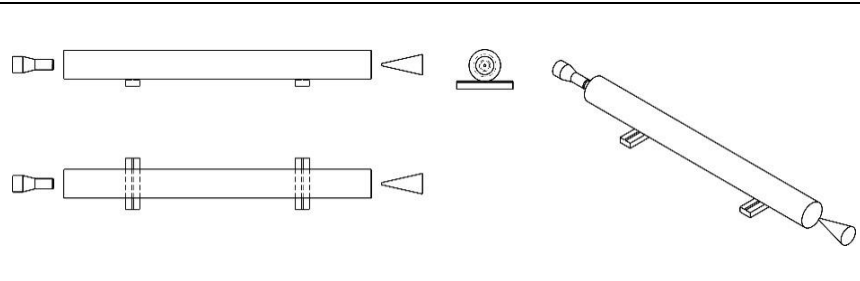
- Step 03* – Position the CA-DP MICROPHONE according to 10 - *Acquisition and excitation modes*. After positioning the MICROPHONE, start the characterization process using the MANUAL IMPULSE DEVICE OF MEDIUM IMPACT.

**10. Acquisition and excitation modes**

The table below describes in detail the most practical positions of the MICROPHONE and IMPULSE DEVICE (of medium impact) for characterizing rectangular samples, using flexural, torsional and longitudinal vibration modes.

Impulse:  Acoustic sensor: 	
<p><b>Flexural Mode for bars</b>  <i>Excitation at the center and acquisition at the end of the sample, both from above and width-centered.</i>  <i>Supports positioned at 0.224L.</i></p>	
<p><b>Longitudinal Mode for bars</b>  <i>Top-centered excitation and signal acquisition from opposite sides of the sample.</i>  <i>Supports positioned at 0.224L.</i></p>	
<p><b>Flexural + Torsional Modes</b>  <i>Excitation and signal acquisition from above, positioned at 0.32L from opposed edges.</i>  <i>Supports positioned at 0.224L.</i></p>	

The next table provides detailed information on the most practical forms for characterizing cylindrical samples using flexural and longitudinal modes.

<p><b>Flexural Mode for cylinders</b>  <i>Excitation at the center and acquisition at the end of the sample, both from above and width-centered.</i>  <i>Supports positioned at 0.224L.</i></p>	
<p><b>Longitudinal Mode for cylinders</b>  <i>Top-centered excitation and signal acquisition from opposite sides of the sample.</i>  <i>Supports positioned at 0.224L.</i></p>	



**Note:** Considering the typical arrangements presented, the optimum support form for the flexural mode is also proposed for torsional and longitudinal modes. Nodal lines and the optimum support for these vibration modes, however, do not match the ones for the flexural mode. The longitudinal mode, for example, is not sensitive to the supporting positions (when faces are free) and the sensitivity of the torsional mode is less than 1%. As a result, it is possible to use the flexural mode boundary conditions to characterize the longitudinal and torsional modes efficiently, without compromising the results.

### 11. Warnings and equipment transportation

- ▲ Reading all the information contained in this Installation and Operation Manual is compulsory for the correct use of the equipment;
- ▲ The electricity network where the optional items and accessories will be connected for use must have a functional ground system;
- ▲ Do not use this equipment for other purposes apart from the ones specified by this Manual;
- ▲ The non-compliance with the instructions provided by this manual in what regards the use of this equipment may reduce or invalidate warranty time.

Equipment Transportation:

- Transport the equipment with care;
- Avoid impacts and falls when transporting the equipment;
- Do not transport the equipment under the rain, even when wrapped in its original packaging.

### 12. Maintenance and troubleshooting

- Depending on the material of the sample, there may be a detachment of residues during handling. To avoid hazards and possible damages to the equipment, clean frequently using a slightly damp cloth.
- To maintain the equipment in a good working order and extend its life, keep all accessories and optional items clean.

Problem	Possible cause	Troubleshooting
The support wobbles when mounted over a surface.	The surface may not be completely flat or may present some irregularities.	Find a flatter area around the place where the support should be mounted.
The sample cannot be properly positioned under the MICROPHONE.	The sample dimensions do not comply with the specifications.	Check specific dimensions limits in 8 – Specifications.

### 13. Symbology



Attention! Risk of danger.

---

#### **14. Technical support and warranty**

If the equipment presents any abnormality, check first if the problem is linked to any of the ones listed in *18 – Maintenance and Troubleshooting*. If the problem still cannot be fixed, contact ATCP.

ATCP Physical Engineering offers a 12-month warranty with this equipment, starting from the date of purchase. It covers manufacturing defects or materials defects, but some factors may cause the invalidation of warranty:

- 1 – The non-compliance with the recommended care regarding the installation and operation of this equipment, as describe herein;
- 2 – Accidents, falls, inadequate installation or any other damage cause by incorrect use or action of natural agents;
- 3 – Violation, repair or any other modification or alteration done in the equipment or parts of the equipment carried out by non-authorized agents (non-authorized by ATCP Physical Engineering).

After the 12 months of warranty, parts, expenses and services shall be charged.

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#### **15. Statement of Responsibility**

ATCP Physical Engineering takes total technical and legal responsibility over the *SA-AG Adjustable Support for Large Samples* and it guarantees that all information here provided are true.

