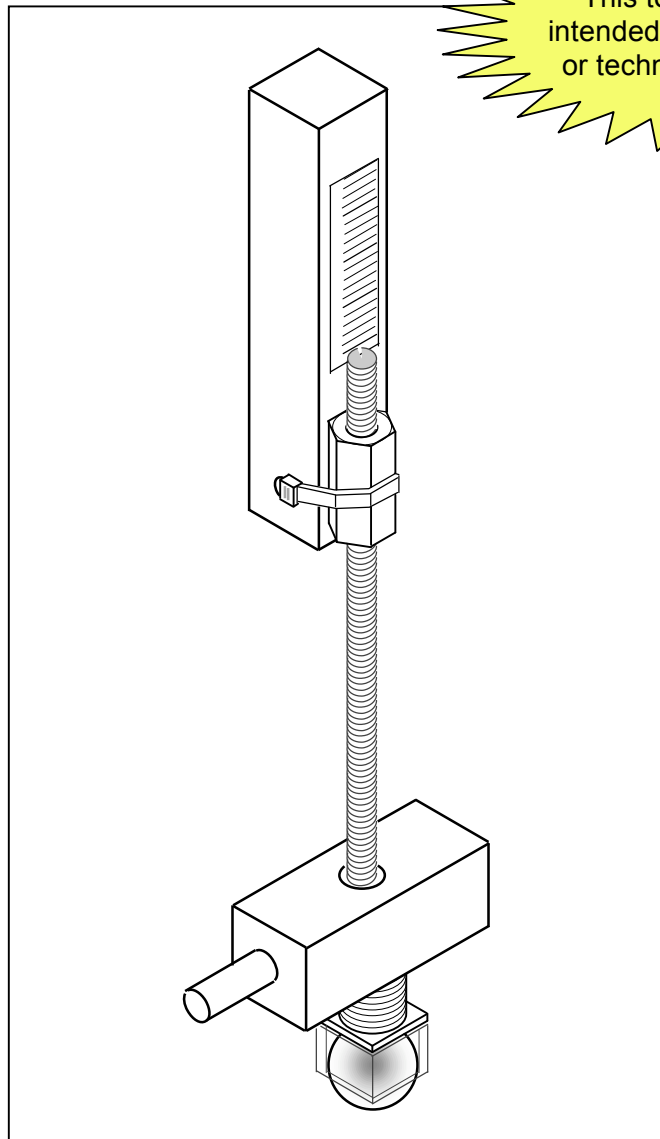




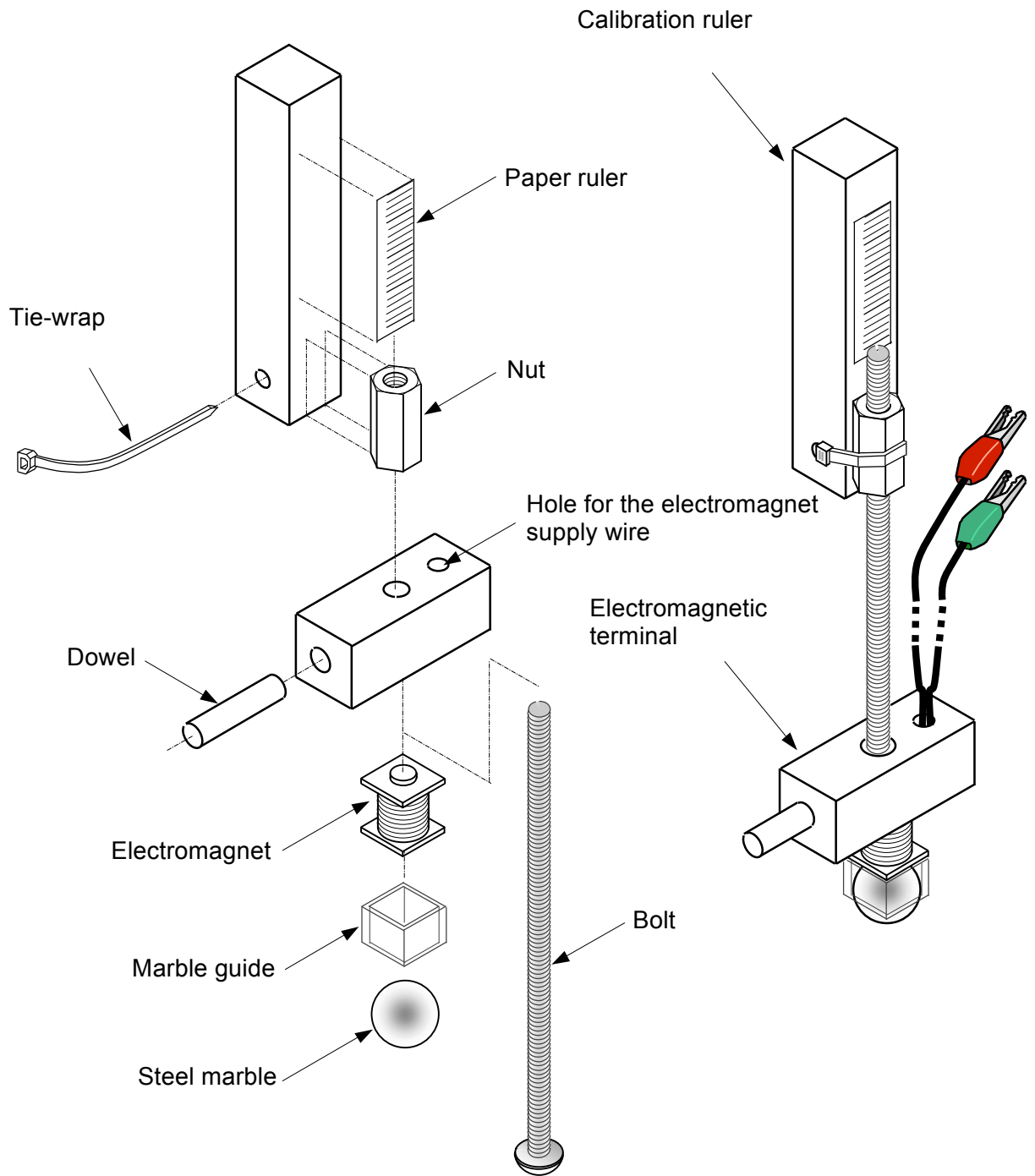
## **TECHNICAL FILE FOR THE CALIBRATION SET**

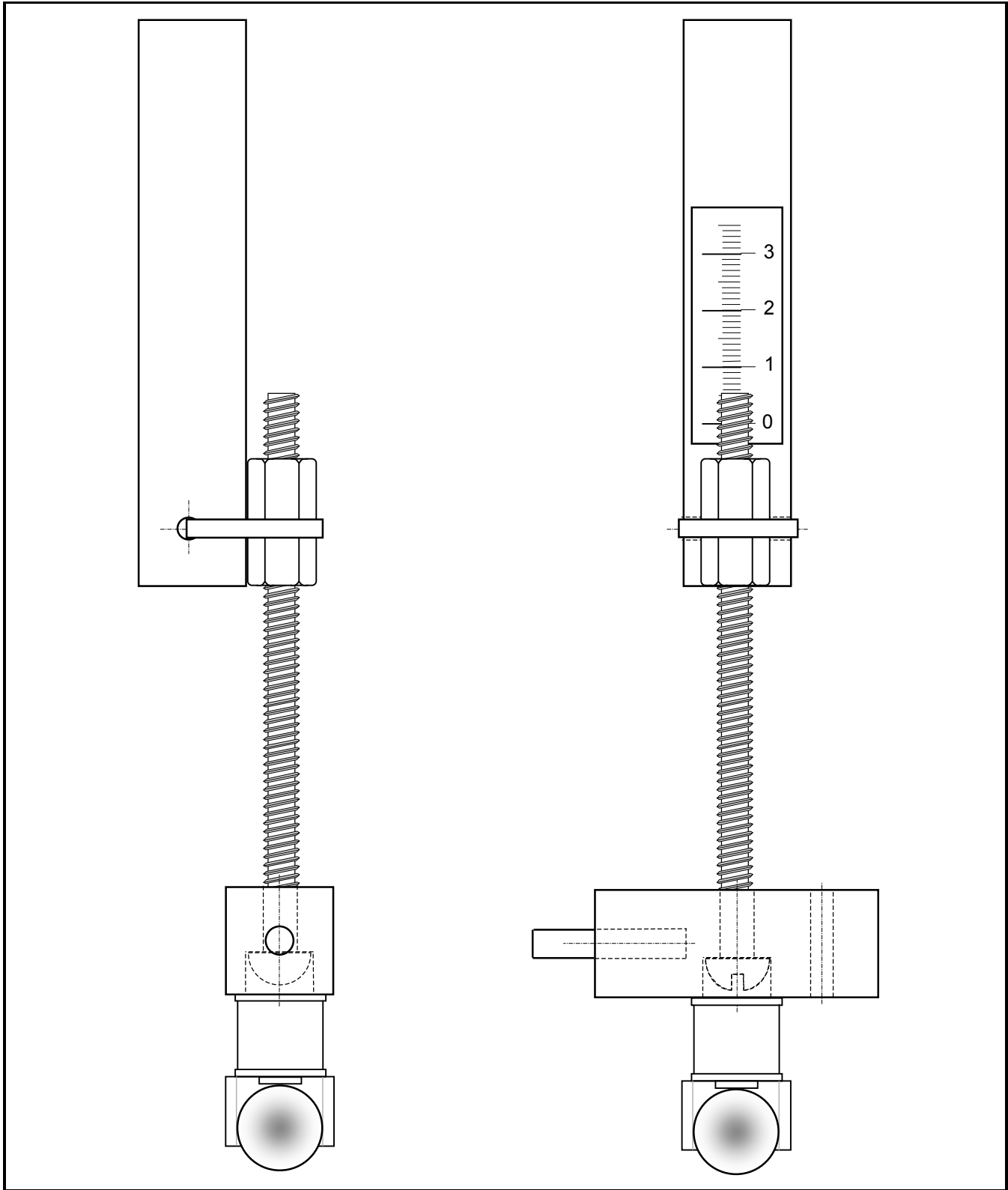
This technical file is  
intended for the teaching  
or technical personnel.

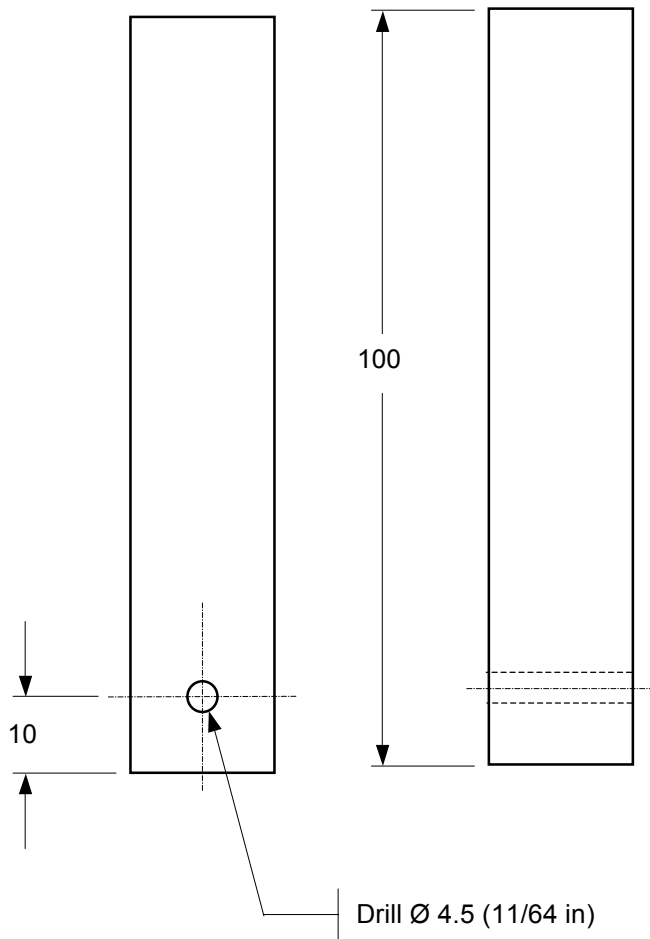


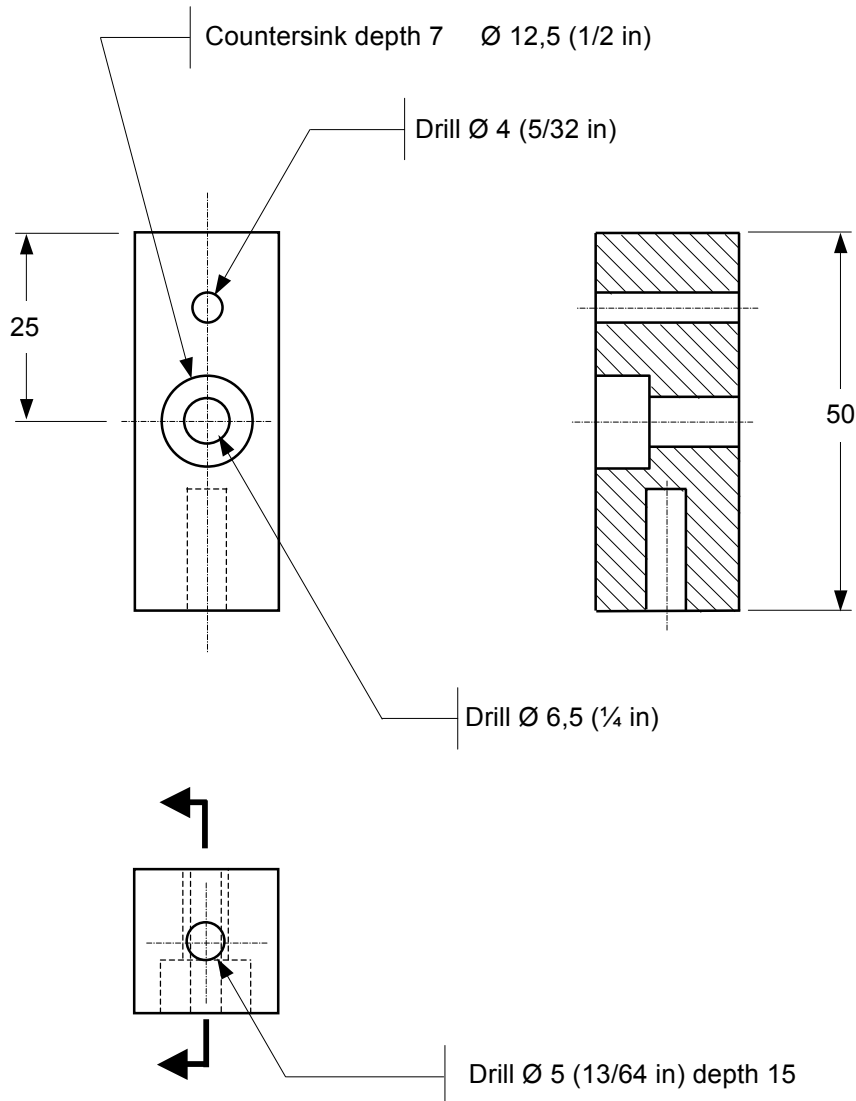
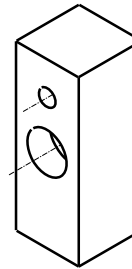
**AEOLUS' CHARIOT (Simplified LES)**

January 2012









## FABRICATION AND ASSEMBLY RANGE

ELEMENT: CALIBRATION SET

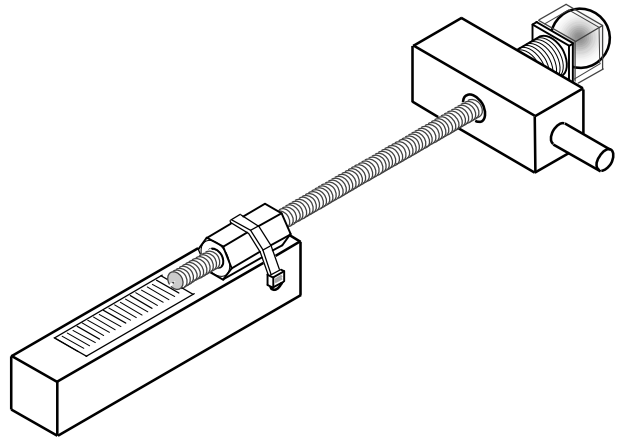
SET: "AEOLUS' CHARIOT" LES

RANGE: 3

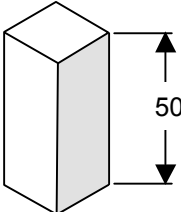
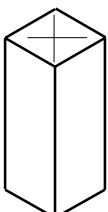
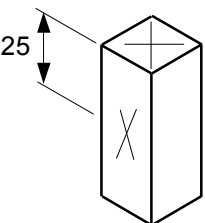
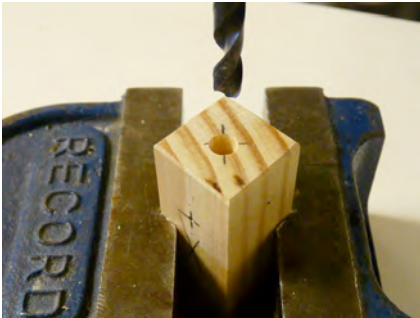
SHEET: 1 of 6

NUMBER: 1





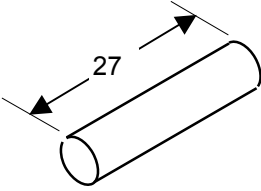
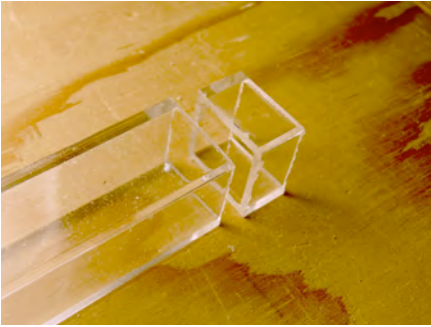
MATERIALS: Various



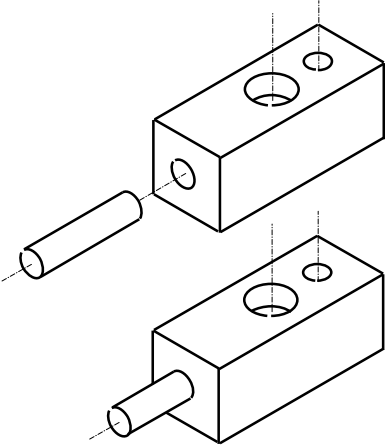
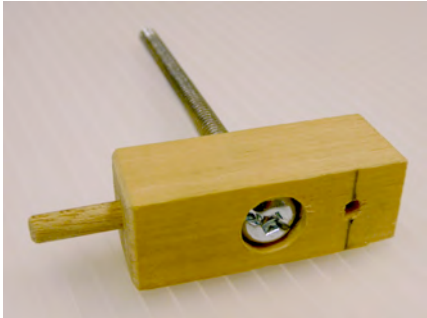
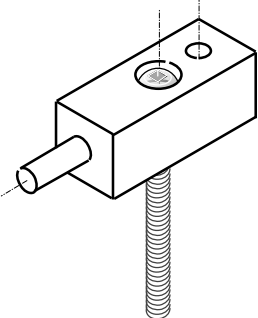
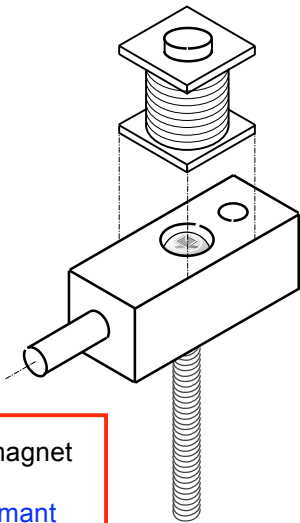
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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10	<p align="center"><b>FABRICATION OF THE ELECTROMAGNETIC TERMINAL</b></p>		
11	<p>In a 19 mm x 19 mm (3/4 x 3/4) pine moulding, cut a 50 mm length.</p>		<ul style="list-style-type: none"> <li>- Pencil</li> <li>- Ruler</li> <li>- Mitre box</li> <li>- Hand saw</li> </ul>
12	<p>Mark and point the center of the end of the part.</p>		<ul style="list-style-type: none"> <li>- Pencil</li> <li>- Ruler</li> <li>- Punch</li> <li>- Hammer</li> <li>- <b>Drawing n° 7</b></li> </ul>
13	<p>Mark and point the center of the center of one side of the part. This point will be used to affix the electromagnet and the calibration screw.</p> <p>Punch the holes.</p>		<ul style="list-style-type: none"> <li>- Pencil</li> <li>- Ruler</li> <li>- Punch</li> <li>- Hammer</li> <li>- <b>Drawing n° 7</b></li> </ul>
14	<p>Holding the part in a vise, drill the 5 mm (13/64") diameter hole to a depth of 15 mm.</p> <p>This hole will be used to insert a dowel.</p>		<ul style="list-style-type: none"> <li>- Drill vise</li> <li>- Drill</li> <li>- 5 mm (13/64") Ø bit</li> </ul>

N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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15	<p>Holding the part in a vise, drill the 12.5 mm (1/2") diameter hole to a depth of 7 mm. (A flat bit would be preferable).</p> <p>This hole is a countersink used to fit the head of the calibration screw.</p>		<ul style="list-style-type: none"> <li>- Drill vise</li> <li>- Drill</li> <li>- 12.5 mm (1/2") Ø bit</li> </ul> 
16	<p>Holding the part in a vise, drill a second hole, diameter 6.5 mm (1/4") at the center of the first one, going right through.</p>		<ul style="list-style-type: none"> <li>- Drill vise</li> <li>- Drill</li> <li>- 6.5 mm (1/4") Ø bit</li> </ul>
17	<p>Drill a 4 mm (5/32") on the opposite side of the dowel (between the countersink and the top of the terminal).</p> <p>The location of this hole is determined by the diameter of the electromagnet chosen and will be used to thread the electrical wire through.</p>		<ul style="list-style-type: none"> <li>- Drill vise</li> <li>- Drill</li> <li>- 4 mm (5/32") Ø bit</li> </ul>
18	<p>Cut a 27 mm length in a 3/16" diameter dowel. Chamfer the edges using sandpaper.</p>		<ul style="list-style-type: none"> <li>- Pencil</li> <li>- Ruler</li> <li>- Mitre box</li> <li>- Hand saw</li> <li>- Sandpaper</li> </ul>
19	<p>In a square acrylic extruded tube (or a 16 mm Ø cylindrical tube), cut a 10 mm section.</p> <p><b>Note:</b> Use a saw for metals, the cut will be cleaner.</p> <p>The square tube must have a 5/8" interior dimension to guide the steel marble (15 mm Ø) without slowing it.</p>		<ul style="list-style-type: none"> <li>- Pencil</li> <li>- Ruler</li> <li>- Mitre box</li> <li>- Metals saw</li> </ul>

N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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20	<p align="center"><b>ASSEMBLY OF THE ELECTROMAGNETIC TERMINAL</b></p>		
21	<p>Insert the dowel into the terminal and use a drop of glue as needed.</p>		<ul style="list-style-type: none"> <li>- Hammer</li> <li>- Carpenter's glue (as needed)</li> </ul>
22	<p>Insert the ¼ - 20 - 4 in. bolt in the ¼ in. hole. The head of the screw must be completely sunk into the 12 mm (15/32 in) chamber.</p> <p><b>Note:</b> The head of the bolt should turn freely in its chamber.</p>		
23	<p>Glue the 6 volt (or 9 volt) electromagnet onto the chamber, aligning the core of the electromagnet with the 4 in. bolt.</p> <p>The glue should be placed on the outer edge of the electromagnet. After gluing, the bolt should be free in rotation.</p>		<ul style="list-style-type: none"> <li>- Hot glue gun</li> </ul>
<p>The following video shows you how to recover the electromagnet form two models of 6 volt relays.  <a href="http://www2.cslaval.qc.ca/star/Recuperation-d-un-electroaimant">http://www2.cslaval.qc.ca/star/Recuperation-d-un-electroaimant</a></p>			



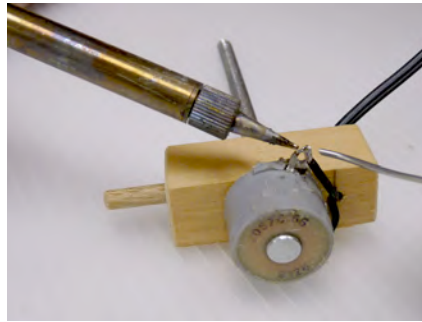
FABRICATION AND ASSEMBLY RANGE OF THE CALIBRATION SET

SHEET: 4 of 6

N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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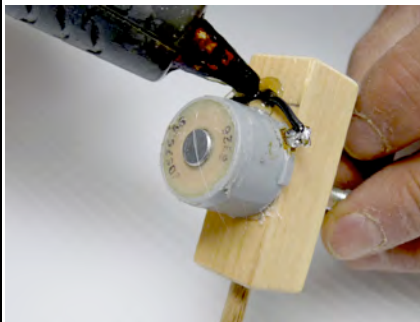
24 Insert 45 cm of speaker wire (2 conductors, flexible, AWG 22) in the hole and solder the two ends to the electromagnet terminal.

**Note:** With some electromagnets, it may be necessary to gently scrape the ends of the electromagnet wire to remove the resin.



- Soldering iron
- Flux (solder)
- Sandpaper

25 Remove the excess wire by the hole and apply hot glue on the solders and in the hole to solidify everything.



- Hot glue gun

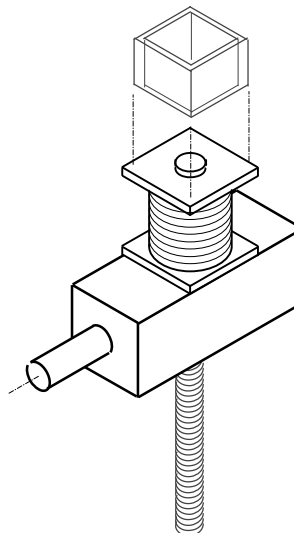
26 Insert the insulating sleeves from alligator clips onto the speaker wire.

Solder the two alligator clips to the other end of the wire. Cover the solder with the insulating sleeves.



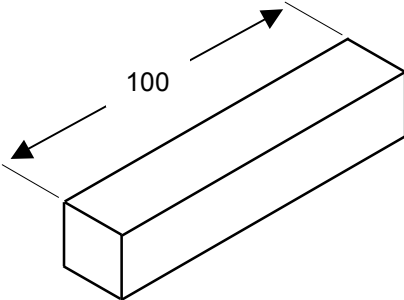
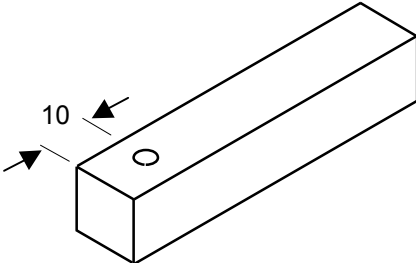
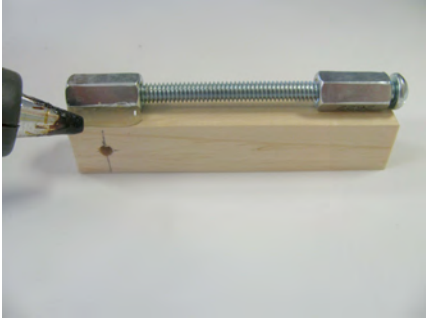
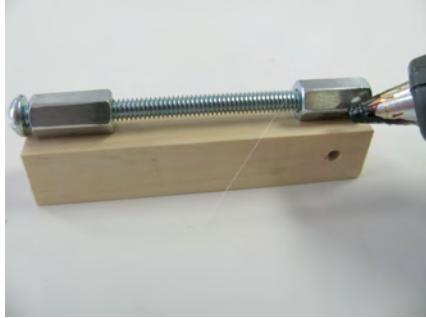

- Soldering iron
- Flux (solder)
- Needle nosed pliers

27 Glue the 10 mm. section of square acrylic extruded tubing onto the end of the electromagnet.



- Hot glue gun

FABRICATION AND ASSEMBLY RANGE OF THE CALIBRATION SET			SHEET: 5 of 6
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS

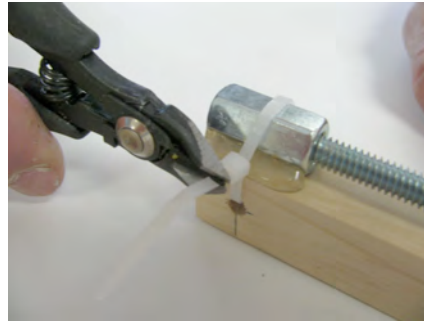
30	<b>FABRICATION AND ASSEMBLY OF THE CALIBRATION RULER</b>		
31	Cut a 100 mm length in a 19 mm X 19 mm (3/4 x 3/4) piece of pine moulding.		<ul style="list-style-type: none"> <li>- Pencil</li> <li>- Ruler</li> <li>- Mitre box</li> <li>- Hand saw</li> </ul>
32	<p>Holding the part in a vise, drill the 4.5 mm (11/64 in.) diameter hole.</p> <p>This hole will be used to insert a tie-wrap.</p>		<ul style="list-style-type: none"> <li>- Drill vise</li> <li>- Drill</li> <li>- 4.5 mm (11/64 in.) Ø bit</li> <li>- <b>Drawing n° 6</b></li> </ul>
33	<p>Insert an extension nut at each end of a 1/4 - 20, 4 in. bolt (these two nuts should make aligning the set easier).</p> <p>Place the bolt-nut set perfectly aligned and centered on the pine block.</p> <p>Glue the nut facing the hole.</p>		<ul style="list-style-type: none"> <li>- Hot glue gun</li> </ul>
34	Turn the pine block around and glue the other extension nut (the one facing the hole).		<ul style="list-style-type: none"> <li>- Hot glue gun</li> </ul>
35	<p>Add a tie-wrap around the extension nut in order to strengthen the linkage.</p> <p>Tighten the wrap with needle nosed pliers.</p>		<ul style="list-style-type: none"> <li>- Tie-wrap</li> <li>- Needle nosed pliers</li> </ul>

**FABRICATION AND ASSEMBLY RANGE OF THE CALIBRATION SET**

SHEET: 6 of 6

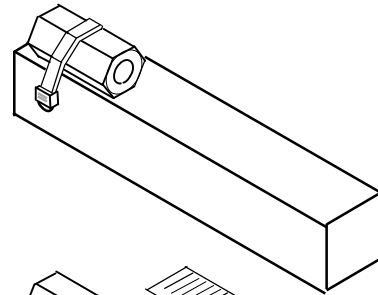
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL, TOOLS
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36 Cut the excess of the tie-wrap with a pair of wire cutters.

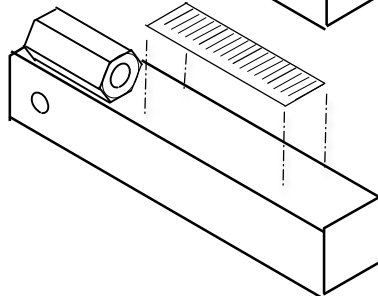


- Wire cutters

37 Remove the additional nut and bolt.

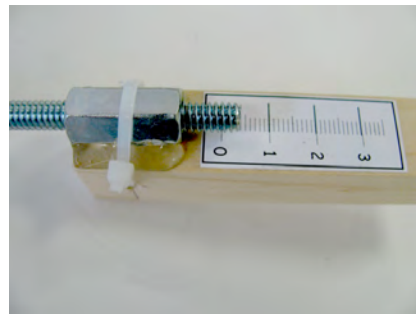


38 Glue the measurement ruler as close as possible to the extension nut (the zero of the ruler should be on the side of the nut).

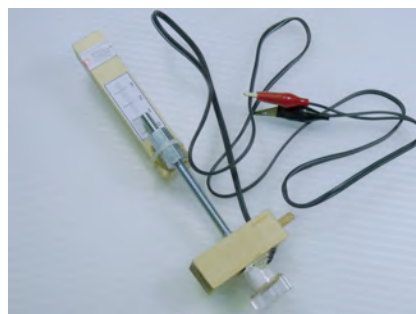


- Paper glue  
- Paper ruler (see annex 1)

Insert the 1/4 - 20, 4 in. bolt from the electromagnetic terminal into the nut of the calibration ruler.

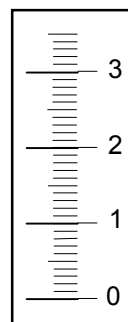
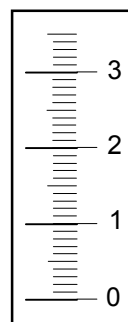
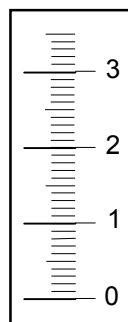
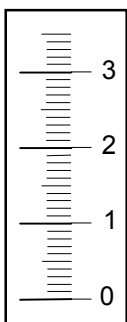
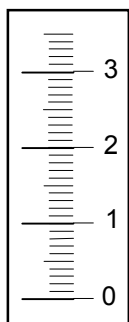
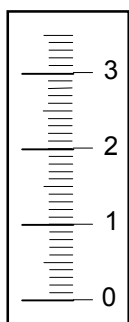
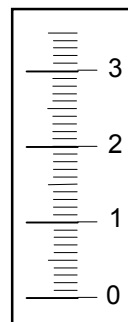
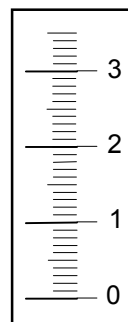
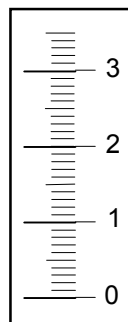
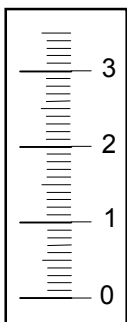
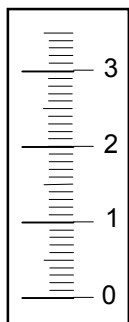
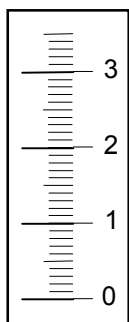
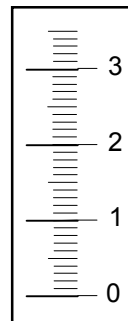
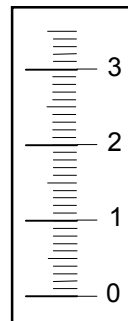
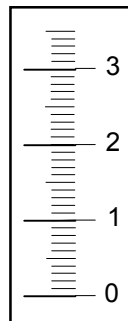
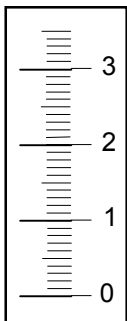
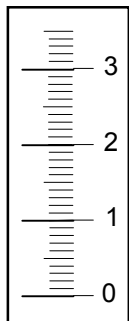
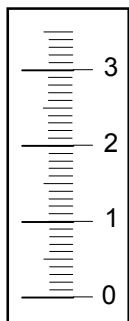


Your calibration set is ready for the experiment.



# ANNEX 1

**Ensure that this ruler is to scale after printing.**  
When printing with "Acrobat Reader", it is important not to choose the "Page scaling" option in the "Print" menu.



Rulers for calibration