

**Foucaults' Pendulum**  
**Model "Standard 16" Pendulum Tower Assembly**



*Academy Pendulum Sales*  
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# ***Foucault Pendulum***

## **Installation Manual**

The assembly of a pendulum kit at times requires working in high and precarious places while maneuvering heavy components into place. Please use proper precautions and equipment while undertaking this installation. If a scaffold is used to reach the platform of the pendulum it would be best if it can sit to one side. Create an area that is clear in the middle for the ball to swing. The ball will need to swing in all directions for testing.

Your pendulum kit should have arrived as four crates atop a pallet crate. That pallet is actually the fifth crate and contains the mounting plate. The heaviest of the crates contains the ball and end caps. This unit should be placed near the base of the display.

Your building should have been equipped with a 36" x 36" steel mount. It should have an 18" hole in the center, and 6- 1/2" threaded holes on a 13" radius. This mount should be level and centered over the display area.

### **Beginning the Setup**

- 1.** Remove the main mounting plate from its pallet crate and set it on top of the mount so that the six 2" holes expose the six threaded holes in the mount. Center this as best possible for now. Do not fasten at this time.
- 2.** Locate the magnet assembly and set it on top of the mounting plate with the safety ring (part # 19) extending through the large hole in the mounting plate. Rotate the magnet and align the six largest holes of the magnets mounting ring with the six threaded holes in the mounting plate. Roughly center these holes. Do not fasten at this time.
- 3.** Locate the tower block part # 5 (in the same crate as the magnet).  
Locate the tower legs (note the one leg has two 1/4" threaded holes on it), and position this leg on the mounting plate for best convenience of wiring the amplifier panel to the electrical junction box containing the wires from the control panel. Using the 1/2" x 1" bolts supplied bolt one end to the tower block and the other end to the mounting plate using the pre-threaded holes in the plate. **DO NOT TIGHTEN.** Assemble all of the tower legs to the block and the mounting plate.. When all of the tower legs are assembled tighten all the bolts evenly.

### **4. Centering the Mounting Plate**

You will need a plumb bob for this next step. Insert a fine piece of wire up through the pivot in the bottom of the tower block assy. Lower the plumb bob to the floor below to ensure you have enough string laid out. Using the wire pull a loop of the string up through the pivot and out the top far enough that it may be tied off. Pull the bob up and let it hang just off the ground. It will require that someone stay at the bottom and steady the bob for the next step.

Level and center the mounting plate keeping the six 2" holes aligned with the threaded holes in the platform. Use steel shims (not supplied) to level the mounting plate.

When leveling and centering are completed fasten the mounting plate using the six slotted clamps, square washers, and 1/2" x 2 1/2" bolts supplied. Place the T clamp across the 2" hole making sure it has a secure purchase on both sides of the hole on the mounting plate and tighten all six bolts.

### **5. Assembling the Cable Sleeve Assembly**

Locate the components that make up the cable sleeve assembly as shown on page 13. It consists of the following items: one cable sleeve part #15, two cable collets and clamp nuts part # 14, one armature assembly part #16, and one safety plate assembly part #18. The O-rings should already be installed.

Position the armature on the sleeve approximately 1/3 of the way down the shaft. Lock the four set screws firmly. **DO NOT OVER TIGHTEN.**

Slide the safety plate onto the other end of the sleeve until a distance of 3-3/16 inches separate the safety plate and the armature as shown in drawing of Cable Slide Assembly.

### **6. Installing the Cable**

Locate the cables supplied. Only one cable is used - the second is a spare.

With the collets removed apply a small amount of grease to the tapered portion of the collet. Install one of the collets onto the cable. Then insert the cable up from the bottom end of the cable sleeve (the safety plate end.). Install the collets on the sleeve but do not tighten them. Pull about three feet of cable through the top end of the sleeve.

Thread the cable up through the pivot in the bottom of the tower block until it projects out of the top of the height adjusting bolt part # 6. Remove the collet clamp part #6 and apply grease to the tapered end then feed the cable through. Reinstall the collet clamp and tighten it securely enough to hold the cable with approximately 6" of cable above the clamp.

Install one of the cable anchors part #9 on top of the collet and tighten the set screws.

Extend the long end of the cable through the center of the magnet and the safety ring and lower it to the floor. As the cable is lowered you will need to guide the cable sleeve into place in the center of the magnet until the safety plate comes to rest on the safety ring.

### **7. Hanging the Ball Assembly**

Open the ball crate and remove the two end caps, and set them aside. Lift out the ball retainer crating. Two people will be needed to lift out the ball and its carrier. Use caution as this unit weights approximately 180lbs. Set this unit in a clear area where you will have room to work. In the crate where the tower legs were packed you will find the hinged ball cradle. This device looks a little like a port-a-potty.

The next step will require some padding. Use either a moving quilt or a stack of towels as a soft landing area for the ball to stand on.

Place the ball carrier with the threaded end of the ball over one edge of the padding. Lift one end of the carrier so as to stand the ball up on one of the threaded ends. Be sure the

end is on the padding so as not to damage the threads. While one person holds the ball on its end the other person can remove the ball carrier. Place the hinged ball cradle unit (with its legs folded under) up to and under the ball as far as you can. Roll the ball onto the seat and lift up the end so the legs may be folded down standing the unit upright. Place the ball and cradle in the center of the pit.

Examine the two ball end caps. Note the difference in the hole sizes at the pointed ends. The upper cap has the 1/8" hole while the lower cap has the 1/2" hole that holds the adjustable brass pin.

Push the cable (which should be hanging to the floor) through the upper ball cap (from the pointed end first, then through the ball. Thread the cap onto the ball. At the bottom of the ball place an anchor part #9 about one inch up on the cable and tighten the two set screws securely. Thread the lower ball cap onto the ball. Rotate the ball on it's cradle to an upright position.

From the top of the tower, loosen the collet securing the cable while leaving the anchor secured so the cable will not fall. Pull up on the anchor to remove all of the slack in the cable to the ball. Re-tighten the collet clamp part #8. Loosen the set screws in the anchor and position it against the collet. Re-tighten the set screws. Test the cable by pulling against it to see that the collet and anchors secure the cable solidly.

Lifting the ball cradle on one side fold the legs under and lower the cradle slowly allowing the ball to be supported by the cable. As the ball begins to become free it will begin to rotate. This is a normal process and will take several minutes to stabilize. Occasionally stop the ball's rotation so it does not over rotate too far. This will help speed up the installation.

## **8. Magnet Installation**

Secure the magnet to the mounting plate through the large holes in the magnet ring using six 1/2" x 1" bolts and the large washers supplied. Do not tighten at this time. In the 12 holes on either side of the mounting bolts on the magnet ring, install 12 -1/2" x 1" bolts. These bolts will be used to level the magnet on the mounting plate.

Locate the four magnet adjusting blocks part # 21 and the eight 1/4" x 1" bolts. Place these on the main plate at 90 degree intervals where the 1/4" threaded holes are located. Secure them in place with the head of the adjusting bolt towards the magnet. These units will be used to move the magnet during the centering procedures.

## **9. Critical Adjustments**

For the adjustments you will need a good level and either an inside caliper or a dial caliper.

Start with alignment of the cable sleeve and armature assembly. Loosen the collet clamp nuts part #14. Slide the cable sleeve up until the top of the armature is 1/4" below the

surface of the magnet. This will center the armature in the magnet housing. Move the armature to one side and see that only the O-rings touch the housing. There should be no metal to metal contact including the safety ring. Tighten the cable collet nuts to secure the sleeve to the cable.

The next step may require someone holding the ball steady in the center of the pit. Loosen the fastening bolts on the magnet ring. Using your dial caliper measure the distance between the top of the magnet case and the armature in all directions. Measure in the direction of the adjustment blocks. Center the magnet by using the magnet adjusting bolts to push the magnet into position. Make only a rough adjustment at this time.

Place a level on top of the magnet housing and begin the leveling process. Use the bolts on either side of the fastening bolts to level the magnet. Level the magnet in all directions.

Repeat the centering procedure and the leveling procedure until you have the best obtainable level and centering possible. A centering tolerance of +/- .020" is desirable. Tighten all hold down bolts on the magnet ring.

## **10. Setting the Ball Height**

There are three possible adjustments for changing the ball height. Your choice should be determined by the amount of adjustment needed.

**For adjustments of +/- 1/2"** use the brass pin in the bottom of the ball. Loosen the set screw and move the pin as required.

**For adjustments of 3-4"** use the adjusting bolt at the top of the tower block part #6. Loosen the lock nut part # 7, and raise or lower the height adjusting bolt part #6. When adjustments are made which move the cable it will require the cable sleeve to be re-adjusted. (see Critical Adjustments Section 9).

### **For major adjustments**

Measure the amount of adjustment required. Loosen the cable sleeve collet nuts and let the sleeve sit on the safety ring. Place the ball back into its cradle and allow the cable to loosen slowly.

**NOTE: to avoid losing the cable and having it drop to the floor, never have the cable anchor part # 9 and the cable clamp collet part # 8 loose at the same time.**

**To raise the ball:** Loosen the cable clamp collet, and pull the cable anchor up. Measure the desired adjustment distance between the anchor and the collet. Retighten the collet. Loosen the anchor and move it down to the collet and re tighten the set screws. If there is not enough slack in the cable to achieve the desired amount of adjustment, it

may be necessary to raise the ball cradle up on blocks high enough to acquire the needed slack. Once everything is tightened lower the ball from its cradle and repeat the spin setup.

**To lower the ball:** Install the ball onto the ball cradle and lift it slowly until the legs can set upright. Check to see that the cable collet clamp part #8 is tight. Loosen the set screws in the cable anchor. Slide the anchor upward on the cable until the desired amount of lowering can be measured between the cable collet and the anchor. Tighten the set screws on the anchor. Loosen the collet clamp and pull the cable downward until the anchor sits snug against the cable collet. Tighten the collet. Lower the ball slowly until it spins and repeat the ball spin setup. Once the ball has stabilized readjust the cable sleeve and armature assy.

### **11. Final Mechanical Adjustment of the Cable Sleeve**

Pull the cable sleeve and armature assembly all the way to one side. The O-rings on the armature and the safety plate hub should make contact with the machined surfaces of the magnet bore and the safety ring. Nothing else should touch. If any metallic sounds are heard or felt, a slight up or down adjustment of the cable may be necessary. Use the adjusting bolt part # 6 to raise or lower the armature until it is centered.

### **12. Setting up the Photo Beam Mounts**

There are four photo beam blocks (part # 12) in the set. They are all identical. The slot on these blocks is designed to fit on the safety ring. The photo beams will be installed under the safety ring. The brass knurled screw points down. Two Allen set screws secure the blocks to the safety ring. The blocks should be mounted in pairs and the pairs should be approximately 90 degrees from one another. The best way to align the pairs is with a ¼" diameter straight rod 16" long. Mount one block in place but do not tighten. With the ball standing at rest in the center of the pit, insert the rod through the photo beam block and center the end of the rod on the cable. Tighten the two set screws. Install a second block at 90 degrees to the first and center it on the cable. Tighten the set screws.

Using a heavy string or wire, tie the cable sleeve off center as far as possible. Install a third block directly across from the first block, and insert the rod through the first block all the way across to the third block. Align the third block with the rod and tighten the set screws. Install the fourth block the same as the third.

The photo beams may now be installed making sure that each pair of blocks contains one PT250 Photo transmitter, and one LR250 photo receiver. Dress the wires and tie them to the standoffs on the safety ring. Find the ½" hole on the magnet ring and run the wires up through the hole. They will be connected after the amplifier panel in the following steps.

### 13. Installing the Electronics

The control panel box may have been installed during the electrical roughin. If the control panel box was not preinstalled complete the following steps. Installation of the control panel may vary depending on whether the control panel is surface mounted or built into the wall. All electrical work should abide by NEC or applicable electrical codes. Connect the control panel to the conduits (specified in the architectural specifications.) Connect the wires to the terminal strip noting the color to numbers that you install. This will be the same at the amplifier end.

The amplifier panel box (the 6" deep box) is to be mounted onto the tower leg having two ¼" bolt holes on it. Remove the amplifier chassis to mount the box. From the junction box located near the tower containing the wires from the control panel, place a flexible conduit between the amplifier panel and the junction box. Reinstall the chassis and connect the wires to the terminal strip using the same color to number as used in the control panel. Install the cable clamp (supplied) in the knock out of the amplifier box and pull the photo beam wires through it into the box. Connect the photo beam wires observing that the color codes on the wires and the terminal strip ID. are matched. Locate the magnet hook up cable, and install it through the same fitting in the box as the photo beams. Hook the leads up to the terminal strip.

At the control panel install the power wires from the breaker to the AC terminals. Connect the ground to the supplied terminal.

### 14. Setting the Controls

A random setting for the time and amplitude controls can be made at #4 on the dial.

Turn on the power.  
No smoke? So far so good.

Hold the cable just above the pendulum ball and pull the ball to one side of the pit. Allow the ball to stabilize then release the ball slowly and allow the ball to swing free.

Turn on the meter and tone switches.

**Note:** each time the ball passes through the center of the pit the meter should react and a tone should be heard.

The meter reads the amount of power applied to the magnet, and the tone indicates when the magnet is powered.

Adjust the amplitude control until the meter reads between 250 and 300 milliamp.

Adjust the time control knob so the magnet turns off when the ball reaches the end of its swing. (The tone will stop when the magnet turns off.) This control is used to stabilize the cable from wobbling at the top. Make minor adjustments to reach the smoothest operation in the cable. Allow some time between adjustments.

The amplitude control will cause the pendulum to increase or decrease its length of swing. Adjust the power until you have reached the desired amount of swing. **Keep in mind that the O-rings on the armature and safety hub must make a solid contact with the magnet and safety ring.** This is used to stabilize the orbit in the rotation of the swing. Allow about 20 minutes between adjustments on the amplitude control.

## **Trouble shooting possible problems**

1. No power.
2. No timing.
3. No meter reading.
4. Ball stops moving at one point of progression and dies.
5. Pendulum does not progress around the pit.

What to check for:

1. No power
  - A. Check the main breaker
  - B. Check the fuse located on the front of the control panel.
  - C. Check the wires to the AC connection.
2. No Timing:
  - A. Check for power off, or bad fuse
  - B. Check the sensitivity control on the module in the amplifier panel.
  - C. Lights on the module blink to indicate when photo beams are operating. If they are not showing triggering adjust the sensitivity control, and/or check your photo beam adjustment.
  - D. Possible defective CM5 module.
3. No meter reading.
  - A. Check meter switch is on.
  - B. Turn on audio switch and see if timing is occurring.
  - C. Check the magnet for continuity, and resistance. Magnet resistance should be approximately 100 Ohms. There should be no continuity to ground.
  - D. Check the bridge rectifier.
4. Ball stops during the day at the same point of progression in the pit.
  - A. Check photo beam alignment.
  - B. Check the sensitivity is turned up enough to keep the photo beams triggering.
  - C. Faulty photo beam or receiver.

NOTE: To check the photo beams, tie the cable to one side out of



the way. Cover one pair of beams and interrupt the other pair to see if they trigger the module. Reverse the process and check the other pair. The system should work on either pair with the opposite pair covered. If one pair is not triggering, see if turning up the sensitivity control will make it operate.

D. Check the clearance between the magnet and the armature. If the armature is not centered up and down it can cause interference (metal to metal contact). Adjust the cable up or down to correct.

E. If this is an older unit check for frayed cable at the pivot.

5. No progress or progression stops at one point

A. Check for armature to magnet interference. Adjust cable as needed

B. Check for leveling on the magnet

C. On old units check for O-ring damage on the armature or safety hub

D. Check for cable damage at the pivot

If assistance is needed contact;

(Emails preferred)

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## TOOL LIST

### *Tools needed for Installation:*

Combination wrenches 7/16" to 3/4"

3/8" drive socket set 7/16" to 3/4"

Screwdrivers: 1/8" to 1/4" blades (one each)

Phillips screwdriver #1 ( 1/4")

Allen wrench set .050 to 1/4"

12" channel lock pliers or 18" Crescent wrench or 14" pipe wrench

Wire cutters

Wire strippers to #12 wire

Soldering iron (small)

Level 12" machinist style or magnet

Plumb bob with adequate string for pendulum height

8" inside calipers with adjusting nut

Volt-ohm meter

1/4" diameter x 13" long straight rod

## PENDULUM PARTS LIST – Model “Standard 16”

Part No.	Item	Quantity
1	Mounting Plate	1
2	tower leg	6
3	magnet sub-plate	1
4	magnet case	1
5	tower block	1
6	cable adjust bolt	1
7	lock nut	1
8	collet clamp	1
9	anchor	2
10	cable (cut to length)	1
11	photo transmitter-PT 250	2
12	photo blocks	4
13	photo receiver	2
14	collet clamp assembly	2
15	cable sleeve	1
16	armature	1
17	O-ring AS331	2
18	safety plate and hub assembly	1
19	safety ring	1
20	extension tubes	6
21	magnet adj. Block	4
22	cap screw ¼ - 28 x 1”	8
23	cap screw ¼ - 28 x 1”	4
24	nut ½ N.F.	6
25	cap screw ½ - N.F. x 1”	18
26	cap screw 3/8 – N.F. x 3”	6
27	set screw ¼ - 20 x 3/8”	6
28	magnet core	1
29	cable pivot	1
30	pendulum ball	1
31a	ball end cap top	1
31b	ball end cap bottom	1
32	cable guide tube	1
33	cable guide supports	2
34	O-rings – AS314	3
35	T-clamps	6
36	Adjustable pin	1
Model 6A Electronics Include:		
	Electronic control panel	1
	Electronic logic panel	1