

# OPERATING INSTRUCTIONS

## Precision 1.5-Meter Air Track No. 74880-05

### 1. Introduction

We have designed and packaged our air track so students can perform a variety of precise kinematics experiments in the classroom. The 1.5-meter linear air track is made of extruded aluminum, anodized for protection against chemical spills and scratches. It has a sturdy cross-section so it won't be deflected by normal loading, and a full-length scale for measuring the exact positions of gliders and photogates.

The air track and its accessories are excellent tools for studying the mechanics of one-dimensional motion. Students can connect an air source (74873-02) directly to the track to supply the large volume of low-pressure air required for smooth glider motion. For your convenience, we have also included Professor Harold J. Metcalf's Air Track Physics: A First Semester Guide, which covers advanced laboratory experiments in practice and in theory.

Using the included gliders, students will investigate average and instantaneous velocity and acceleration, magnetic forces, and forced, damped harmonic oscillation. By performing a variety of elastic and inelastic collision experiments, they will learn about the conservation of momentum and kinetic energy.

### 2. Description

A complete description of the 1.5m air track appears below. To avoid confusion, we've loosely attached the hardware used for assembling the air track such as screws, nuts, and washers, in the correct positions on the track.

This 1.67m-long extruded aluminum track has a working distance of 1.5m. The aluminum is anodized for protection from harsh chemicals and scratches that can damage the track and affect experimental results. The track's cross-section is an isosceles triangle with the right angle at its apex, which prevents track deflection due to loading. The cross-section walls are 0.3cm thick; the base width is 9.4cm.

The track has an attached 1.5m metric tape measure. Two rows of air holes stretch across the length of the track. The air holes have .09cm diameters and are spaced at 2.4cm intervals. The track has an air hose inlet at one end for connecting an air source.

The 3-point support set for leveling the track on a flat surface consists of a crossfoot and an adjustable foot shipped assembled with one  $\frac{1}{4}$ -20 x  $1\frac{1}{2}$ " nylon thumbscrew and one  $\frac{1}{4}$ -20 wing (butterfly) nut. Also included are six #10-24 x  $\frac{1}{2}$ " machine screws, eight #10 flat washers, four  $\frac{1}{4}$ -20 x  $\frac{1}{4}$ " machine screws, 2 ceramic magnets, and three 25mm springs.

The air track's endstops have removable bumpers made of spring steel for low energy absorption in collisions. One endstop has a glider-launcher consisting of two rows of metal prongs which hold a

rubberband (see Fig. 1). The second endstop has an air bearing pulley; the pulley string is included.

### Fig. 1

The 3 included gliders have angled legs that fit onto the air track. The gold glider has a mass of 150g, and the two red gliders each have a mass of 300g. The gliders are made of anodized aluminum and have extruded grooves for attaching accessories.

The removable glider bumpers are made of spring steel for low energy absorption in collisions. The small holes at the top ends of each glider are for attaching the included springs or string. Additional uses for the glider grooves are described in Harold J. Metcalf's *Air Track Physics: A First Semester Guide*.

### 3. Setup and Operation

Detailed instructions for assembling the air track appear below. Consult Metcalf's *Air Track Physics* for specific information about performing a variety of educational experiments.

Place the 1.5-Meter Precision Air Track on a flat surface with the metric tape facing down. The required screws are already loosely screwed into the correct positions on the track. To assemble the track, simply remove the screws, attach the parts, and then tighten the screws according to the following instructions:

Using the #10-24 x  $\frac{1}{2}$ " screws and the #10 flat washers, attach the adjustable foot to the bottom end of the track having the air hose inlet. Align the adjustable foot so the channel faces toward the center of the track. Do not lock the wing nut yet. Attach the crossfoot to the opposite end of the track using the two #10-24 x  $\frac{1}{2}$ " screws and two of the #10 flat washers.

Set the air track down on its new 3-point support. Using two  $\frac{1}{4}$ -20 x  $\frac{1}{4}$ " machine screws, attach the endstop with the rubberband glider-launcher to the end of the track with the air hose inlet. To avoid stripping the threads inside the holes, do not use excessive force when tightening the machine screws.

Use the two remaining  $\frac{1}{4}$ -20 x  $\frac{1}{4}$ " machine screws to attach the endstop with the air bearing pulley to the opposite end of the track. Be sure the bumper spring faces toward the track. To assemble

the rubberband glider-launcher, slip a wide rubberband over two opposite prongs.

Connect one end of the 2m air hose to the air source nozzle, and the second end to the air track inlet. To avoid damaging the air source nozzle, do not use excessive force when attaching the hose. If the new plastic fittings on the ends of the hose are too rigid to slide over the nozzle and the inlet, heat the plastic fittings in hot water (60°C) for several minutes. Be sure the fittings are dry before attaching them to the source nozzle and the air track inlet. Plug the air source into an AC wall outlet.

**WARNING!** To avoid a painful electric shock and equipment damage, only operate the air source at or below the rated voltage (120 volts). Do not operate the air source near containers of flammable solvents, dry chemicals, cleaners, or varnishes. These substances emit fumes that can ignite from motor sparks and cause a fire.

Place a red 300g glider on the track and turn on the air source. Normally, the glider slowly drifts to one end of the track, indicating that the track is not perfectly horizontal. To level the track, loosen the wing nut on the adjustable foot and twist the thumbscrew until the glider is motionless near the middle of the track. Tighten the wing nut. Be sure to turn off the air source before connecting additional air track accessories.

Sometimes accidents alter the 90° angle between a glider's legs. When this occurs, contact friction between the glider and the track prevents the glider from floating. This angle is too large if the glider rests on the center groove of the legs. To decrease the angle, place the glider on its side on a flat surface. Gently tap the upright leg with a rubber mallet. Turn the glider over and tap the opposite leg.

Check the new angle with a machinist's square or a drafting triangle, drawing the square over the interior surface. The angle should be 90°. The angle is too small if the glider rests on the ends of its legs on the track. To increase the angle, place the glider upright on a flat surface. Tap the top of the glider firmly with a rubber mallet. Check the angle using the same method.

#### **4. Maintenance**

The Precision 1.5-Meter Air Track requires no special maintenance. If you experience any problems with this apparatus or need more information about operating it, contact Central Scientific Company. Please do not return any equipment until we have sent you written authorization.

#### **5. Accessories**

<u>Description</u>	<u>Catalog No.</u>
Air Source	74873-02

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