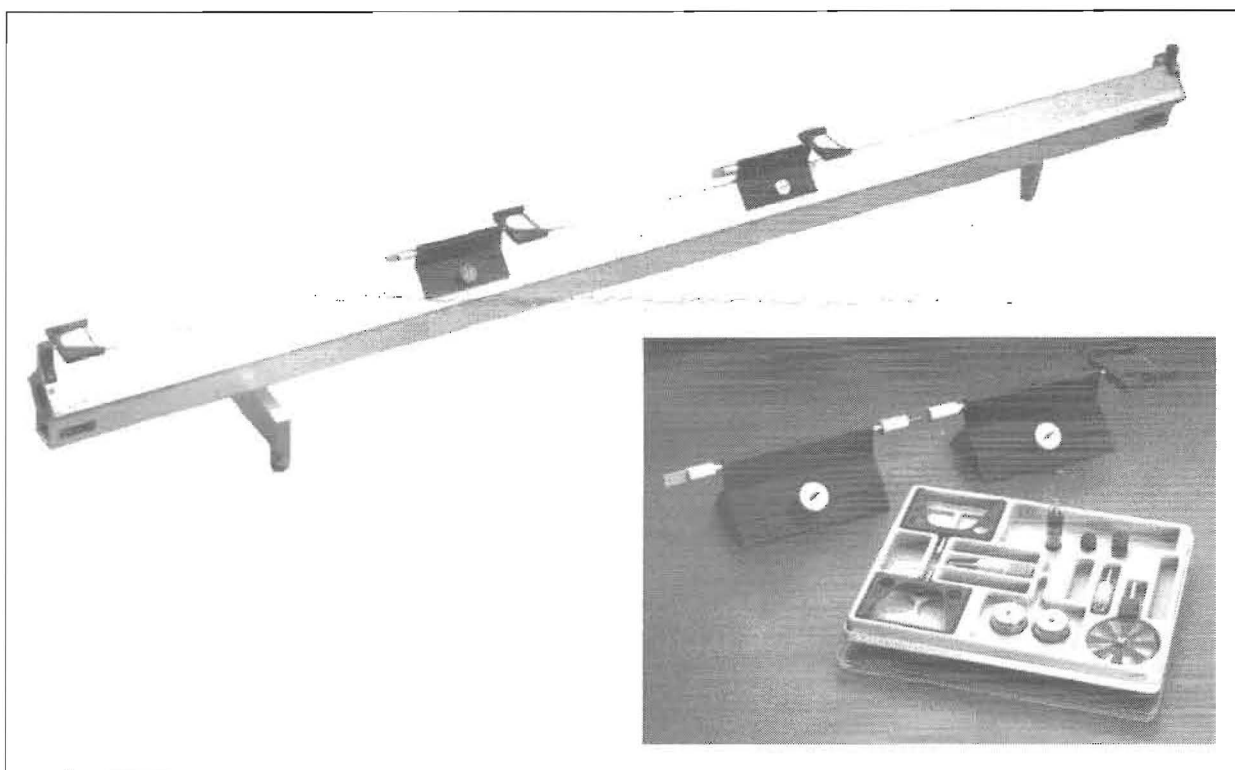


**Instruction Manual and
Experiment Guide for
the PASCO scientific
Model SF-9214**

012-02149B
9/91

Precision 2.0 Meter Air Track



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\$5.00

PASCO®
scientific

10101 Foothills Blvd. • Roseville, CA 95747-7100
Phone (916) 786-3800 • FAX (916) 786-8905 • www.pasco.com

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Copyright and Warranty

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Copyright Notice

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Limited Warranty

PASCO scientific warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer.

PASCO will repair or replace, at its option, any part of the product which is deemed to be defective in material or workmanship. This warranty does not cover damage to the product caused by abuse or improper use. Determination of whether a product failure is the result of a manufacturing defect or improper use by the customer shall be made solely by PASCO scientific. Responsibility for the return of equipment for warranty repair belongs to the customer. Equipment must be properly packed to prevent damage and shipped postage or freight prepaid. (Damage caused by improper packing of the equipment for return shipment will not be covered by the warranty.) Shipping costs for returning the equipment, after repair, will be paid by PASCO scientific.

Equipment Return

Should this product have to be returned to PASCO scientific, for whatever reason, notify PASCO scientific by letter or phone BEFORE returning the product. Upon notification, the return authorization and shipping instructions will be promptly issued.

NOTE: NO EQUIPMENT WILL BE ACCEPTED FOR RETURN WITHOUT AN AUTHORIZATION.

When returning equipment for repair, the units must be packed properly. Carriers will not accept responsibility for damage caused by improper packing. To be certain the unit will not be damaged in shipment, observe the following rules:

- ① The carton must be strong enough for the item shipped.
- ② Make certain there is at least two inches of packing material between any point on the apparatus and the inside walls of the carton.
- ③ Make certain that the packing material can not shift in the box, or become compressed, thus letting the instrument come in contact with the edge of the box.

Equipment

Introduction

The PASCO Model SF-9214 Air Track is 2.0 meters long with a guaranteed straightness to within .04 mm over its entire length. The track construction is a large square aluminum extrusion of 3 mm thick walls that are further strengthened by a supporting U-channel.

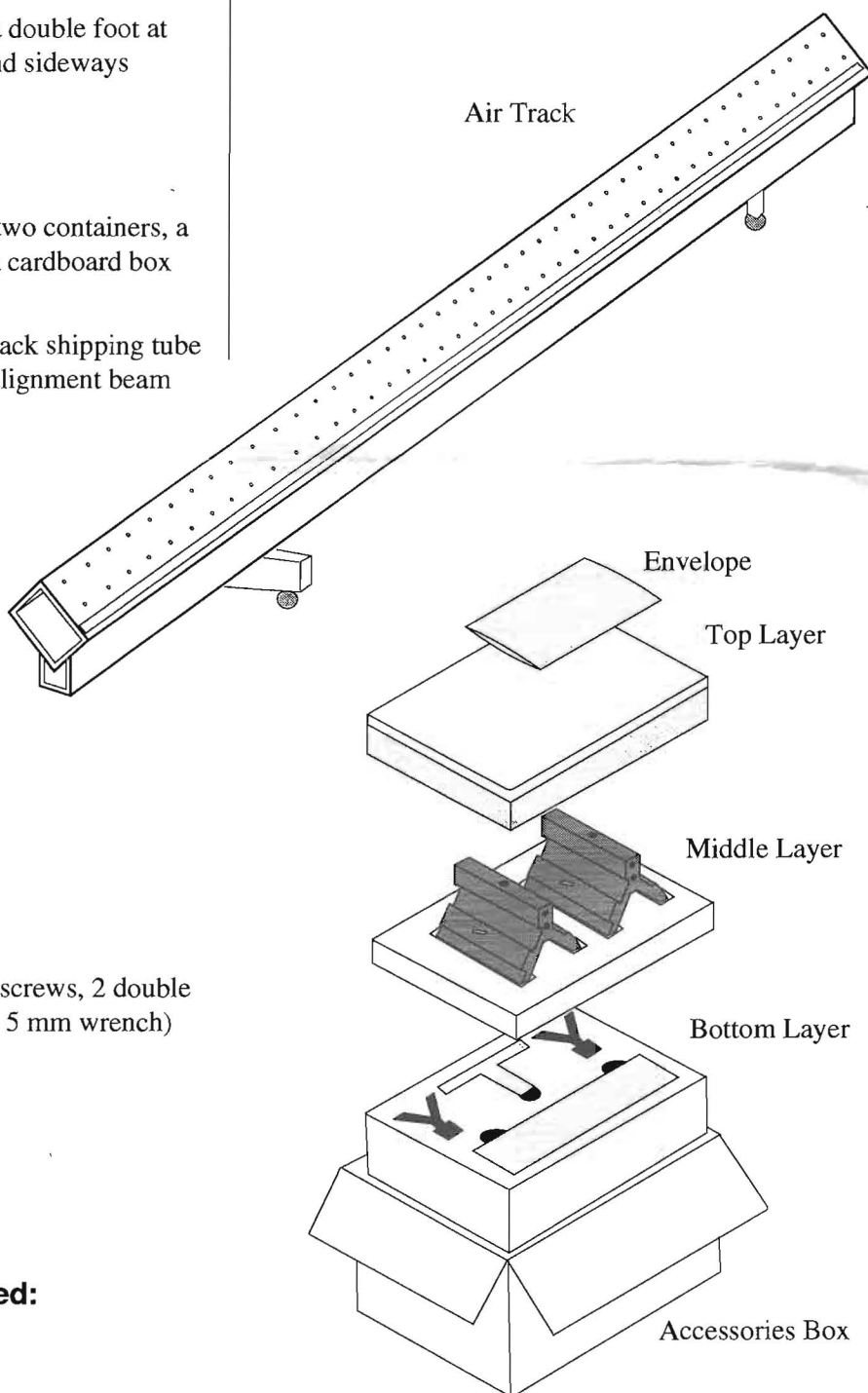
A single foot support at one end and a double foot at the other end allows for lengthwise and sideways leveling.

Unpacking and Setup

The SF-9214 Air Track is shipped in two containers, a large tube (containing the track) and a cardboard box (containing the accessories).

Gently remove one end from the air track shipping tube and carefully pull the track, with the alignment beam attached, from the tube.

▶ **CAUTION:** Use care not to scratch or nick the upper surfaces of the track. (Those containing the airholes.) Any protrusion on this surface may impede the motion of the glider.



Equipment included:

- 2 m Air Track

Accessories:

Envelope:

- 2 (100 mm) Flags

Top Layer:

- 1 Accessory tray

Middle Layer:

- 2 Gliders
- Mounting hardware (2 single leg screws, 2 double leg screws, (1) 4 mm wrench, (1) 5 mm wrench)

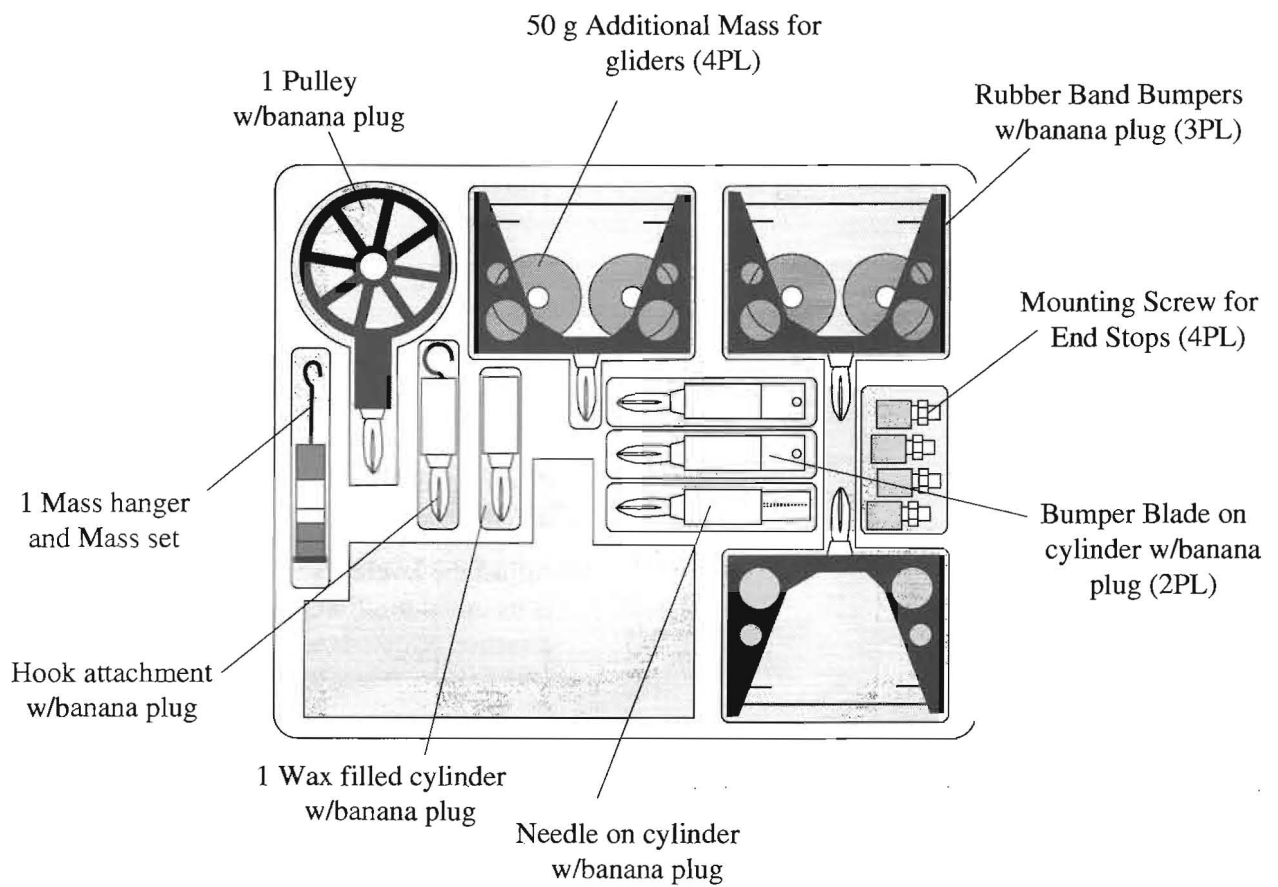
Bottom Layer:

- 1 Single leg
- 1 Double leg w/adjustable feet
- 2 End Stops

Additional Equipment Required:

- Air Supply (Model SF-9416)

The Accessory Tray



Equipment Setup

Assembling the Air Track

1. Use the screws and Allen wrenches provided and attach the single and double leveling foot to the Air Track U-channel as shown in Figure 2.

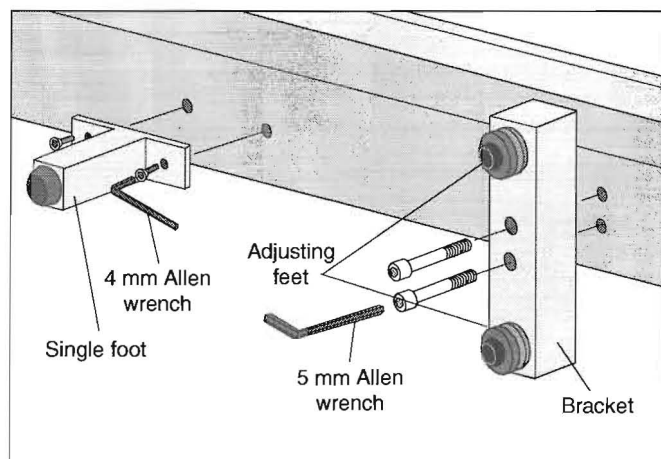


Figure 2 Attaching the Leveling Feet

2. Install one end stop at each end of the Air Track using the mounting screws included in the accessory tray.

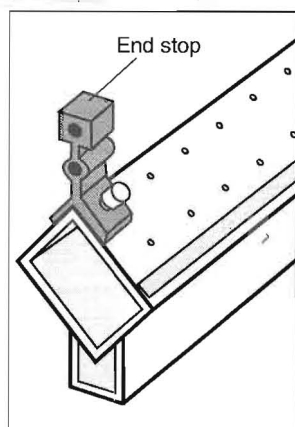


Figure 3 Installing End Stops

Leveling the Air Track

Place the Air Track on a stable, level table and rotate the two adjustable feet until the Air Track is as level as possible. A bubble level may be used to approximately level the track.

The final leveling, however, must be accomplished in the following manner:

- ① Connect the Air Track to the Air Supply and turn the Air Supply on.
- ② Place a glider in the middle of the track without initial velocity.
- ③ Adjust the leveling screws until the glider remains at its initial position, not accelerating in either direction.

➡ **NOTE:** The glider may oscillate slightly about its position. This movement is caused by air currents from the air holes in the track and should be considered normal.

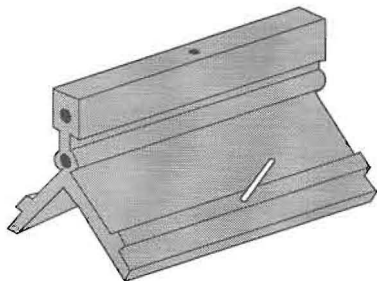
Adjusting the Air Supply

The Air Supply PASCO Model SF-9216 is connected to the Air Track by the air fitting on one end of the track. The output of the blower should be adjusted so that the glider just floats on the track. Excessive air pressure may cause the glider to wander on the track, even in the absence of an accelerating force.

The Air Supply will slightly heat the Air Track, causing it to expand. The adjustment beam under the track has been set such that the track will be straight to $\pm .04$ mm when warm, or after 5 minutes of operation with the Air Supply.

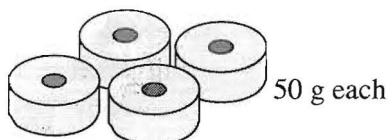
Accessories

Glider



The black anodized aluminum glider has a mass of $180 \text{ g} \pm 1 \text{ g}$ and a length of $129 \text{ mm} \pm 1 \text{ mm}$. To increase the mass of the glider simply place the supplied masses on the steel pins protruding from each side of the glider.

Additional Masses



► **NOTE:** Masses must always be added symmetrically (the same number on each side), or the glider will not function properly.

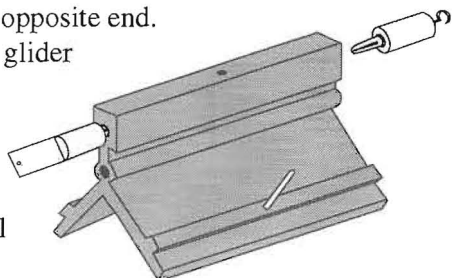
Glider accessories, such as the rubber band bumpers, are mounted in one of the holes located at each end of the glider.

► **NOTE:** In most cases the accessories should be mounted in the lower hole, so as not to interfere with any photogate operation.

These accessories will increase the mass of the glider and must be taken into account in all calculations.

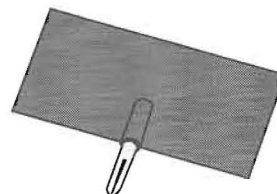
► **IMPORTANT:** If an accessory (such as the bumper plate) is placed on one end of the glider, then an accessory of equal mass (such as a bumper or the bumper plate) should be placed at the opposite end.

This way the glider will remain level on the Air Track and will not tend to propel itself in one direction.



Flags

When using photogates to measure the velocity of the glider, insert the 100 mm flags in the top surface of each glider to interrupt the photogate beam.

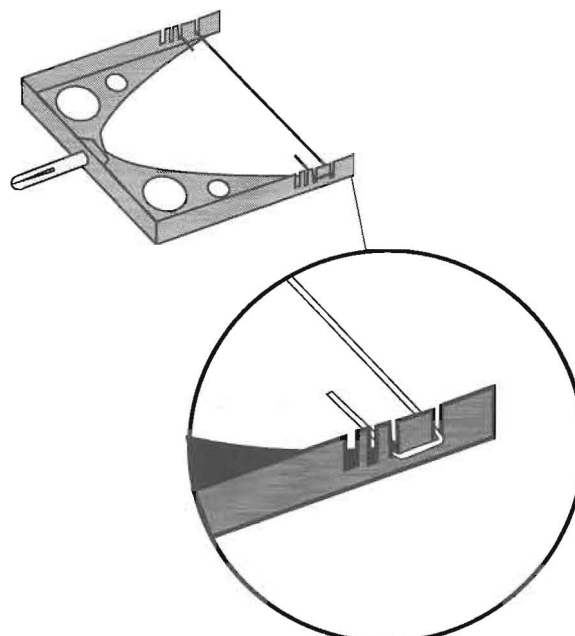


The glider itself may also be used as a "flag". If a flag of different length is required, simply cut a piece of thin cardboard or aluminum to the desired length and tape it to the top of the glider.

► **NOTE:** The following accessories mount to the Air Track End Stop or the Glider via standard 4 mm plugs. Except for the Pulley, each accessory weighs approximately 10 grams. Always load a glider symmetrically, one accessory on each end

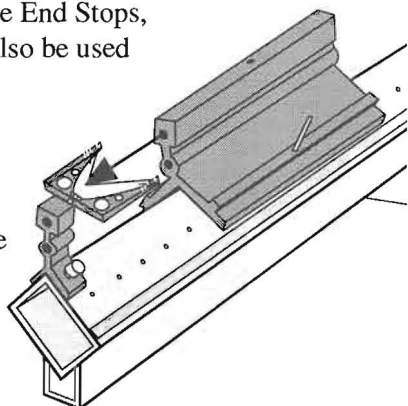
Rubber Band Bumpers

These bumpers provide a soft collision, eliminating any vibration of the glider as it collides with another glider or an end stop.



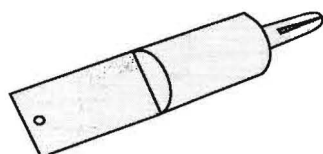
When mounted on the End Stops, these bumpers may also be used as glider launchers:

- Pull the glider back until it touches the nut on the end of the bumper.
- Release the glider.
- Change the impulse imparted to the glider by moving the rubber band to a different groove in the bumper.



Bumper Plate

This plate mounts on the end of the glider and is designed to collide with the rubber band bumper.

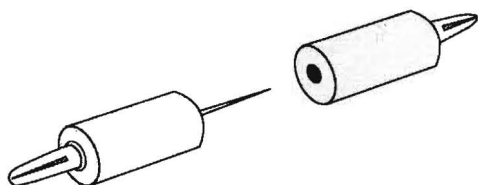


Wax Tube and Needle

The wax tube is mounted on the end of a glider for an inelastic collision. After a number of collisions the wax should be pressed into the tube to maintain adequate adhesion with the needle.

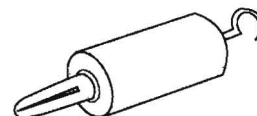
The needle is mounted on the end of the second glider. It needs to be positioned so the needle will stick into the wax tube of the other glider once the two gliders collide, causing the gliders to stick together.

➡ **NOTE:** The needle is covered by a small cork for protection. When the needle is stored in the accessory tray, replace the cork on the needle.



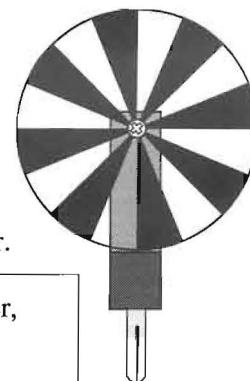
Hook

The hook may be mounted to the end or top of the glider. It is used to attach a string to the glider.

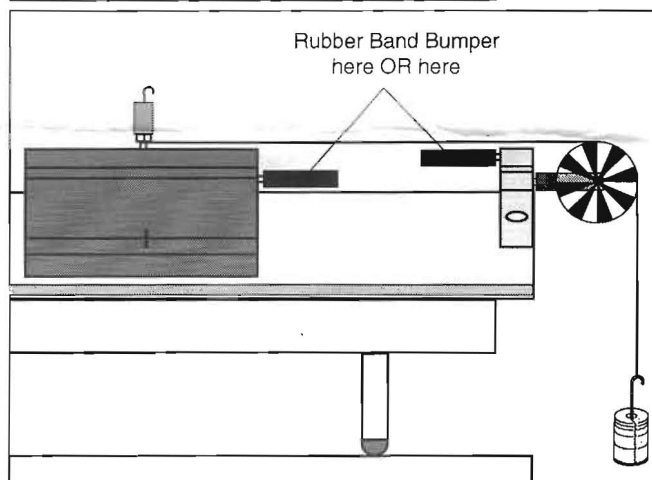


Pulley

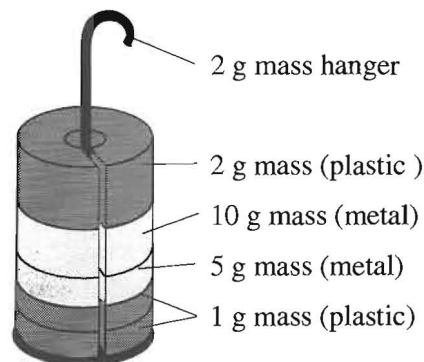
The pulley is mounted in the bottom hole of the end stop, opposite the air input. A string attached to the glider, passed over the pulley and attached to a hanging mass on the other end can be used to accelerate the glider.



➡ **NOTE:** To protect the glider, do not let it hit the End Stop.



Air Track Mass/Hanger Set



Maintenance

Air Track

The only maintenance required is to keep the Air Track surface clean and free of scratches or nicks. When the unit is stored make sure that nothing can damage the Air Track surface. If the track becomes nicked, such that a protrusion on the surface hinders the free motion of the glider, gently file or sand down the protrusion.

The PASCO Air Track is factory aligned so the deviation from linearity is less than ± 0.04 mm. The construction of the unit is designed that the track should remain within these specifications for many years. However, through excessive stress on the track it is possible that it may get out of alignment. This condition produces an uneven velocity of the glider as it travels along the track. The glider will speed up and slow down as it traverses the slight curves in the track.

Should uneven motion of the glider make use of the product objectionable, the Air Track should then be realigned. This procedure requires a special test tool and we recommend that the unit be returned to PASCO for adjustment. Please contact PASCO scientific for information on returning your Air Track for alignment.

Glider

Glider must be handled with care to maintain a friction-free motion the Air Track. If any scratches or nicks develop on those surfaces that float on the track they must be removed with a file or sandpaper. If the glider is dropped or bent out of alignment, it must be straightened so its profile matches that of the Air Track. If the angle between the two sides of the glider is too small the glider will stick to the track. If the angle is too large the glider will wobble as it moves on the track.

Rubber Band Bumper

The rubber bands may deteriorate with time. They may be replaced with any elastic band that produces the desired launch and "bounce" characteristics.

➔ **NOTE:** To extend the life of the rubber bands, remove them from the rubber band bumpers when not in use. Also, excessive handling of the rubber bands may remove the protective powder used to coat the rubber.

Experiments

The specifics of the experiments performed on the Air Track are a function of the timing system used. Therefore, the experiments are included with the various timing systems available from PASCO.

Please reference the manuals provided with the following PASCO products:

- ME-9218 Air Track and Self-contained Photogate System
- ME-9394 Air Track and Computer Photogate System (Apple II)
- ME-9363A Air Track and Computer Photogate System (IBM PC and compatible)
- ME-9336 Air Track and Computer Sonic Ranger System (Apple II)
- ME-9391 Air Track and Computer Sonic Ranger System (IBM PC and compatible)
- ME-9226 Air Track and Spark Timer System
- ME-9206A Photogate Timer
- ME-9215A Photogate Timer with Memory
- PI-8025 Counter/Timer/Frequency Meter
- SF-9297 Coupled Harmonic Oscillators

Replacement Parts

Air Track Accessories (included):

Description	Part No.
Mass/hanger set	655-001
Bumper with holder	655-002
Bumper blade	655-003
Needle	655-004
Wax tube	655-005
Glider hook	655-006
Glider	655-007
Additional glider mass	655-008
Pulley	655-009
100 mm Flag	655-011
End stop, fixed	655-014
Accessory Kit (in molded case)	SF-9295

Accessories available (not included):

Description	Part No.
End stop, adjustable	655-010
25 mm Flag	655-012
U-shaped flag	655-013
2 m Hose	SF-9298

Recommended Equipment

Model SF-9216 Air Supply –

A variable speed air supply suitable to power one or two Model SF-9214 Air Tracks.

Model SF-9217 T-Adaptor and Hose –

Permits operating **two** Air Tracks from **one** air supply.

Model SF-9224 Additional Glider Kit –

This kit includes one glider with two additional 50 g masses, a bumper plate and a rubber band bumper.

ME-9239 Riser Block Kit –

This set of four aluminum riser blocks (.25 to 2 cm thickness) tilt the Air Track to **precise and repeatable** angles.

Model SF-9296 Electric Launcher –

This launcher, designed for use only with the PASCO Air Track, launches the glider repeatedly with the same impulse and velocity.

➡ **Note:** Requires a power supply. Refer to the PASCO catalog.

SF-9297 Coupled Harmonic Oscillators –

The kit includes three gliders, six 50 g masses, springs and connecting plugs, allowing experiments with up to five gliders in coupled harmonic motion.

ME-9356 Force Transducer to Air Track Mounting Kit –

Mounting the PASCO Force Transducer to the Air Track enables measuring the impulse in an air track collision.

ME-9206A Basic Photogate Timer –

A self-contained timer with resolution to 1.0 mS and 1% accuracy

ME-9215A Photogate Timer with Memory –

A self-contained timer with resolution to .1 mS, 1% accuracy and a memory feature for taking collision measurements.

ME-9204A Accessory Photogate –

Plugs into any PASCO Photogate Timer or Counter/Timer for taking "pulse" or timing measurements over longer distances.

PI-8025 Counter/Timer/Frequency Meter –

The capability of operating as two independent timers with memory, provides a total of four measurements in a single experiment.