Standard Smart Cart Dynamics Systems

ME-5717, ME-5718, ME-5719

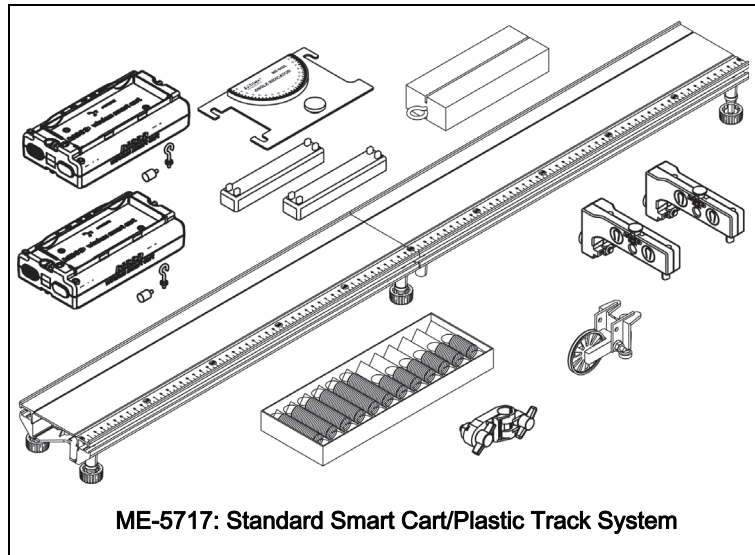| Standard Systems	Plastic Track	1.2 m Metal Track	2.2 m Metal Track
Smart Carts	ME-5717	ME-5718	ME-5719

Introduction

The Standard Smart Cart Dynamics Systems vary by the type of track and carts they include. They have in common that a variety of experiments and demonstrations can be done. You can also combine them with many other PASCO products—both traditional and computer-based—for an even greater range of uses.

This manual contains descriptions of the included equipment, complete instructions for eight experiments, and several additional experiment suggestions.
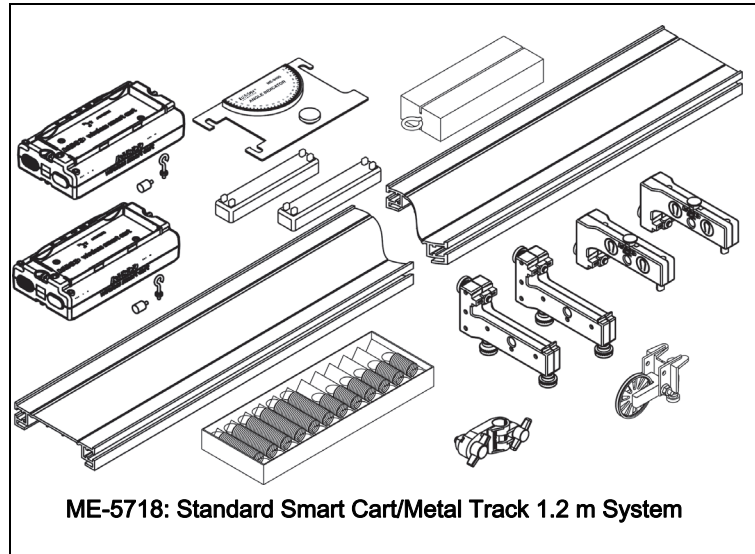
Included Equipment

ME-5717	Items
ME-6757A	2 Masses (250 g)
ME-1240	Smart Cart (Red)
ME-1241	Smart Card (Blue)
ME-6960	PAStrack
ME-8971	End Stops (set of 2)
ME-8999	Spring Kit
ME-9448B	Super Pulley with Clamp
ME-9495A	Angle Indicator
ME-9807	Friction Block
ME-9836	Pivot Clamp

ME-5717: Standard Smart Cart/Plastic Track System

ME-5718	Items
ME-6757A	2 Masses (250 g)
ME-1240	Smart Cart (Red)
ME-1241	Smart Card (Blue)
ME-8971	End Stops (set of 2)
ME-8972	Adjustable Feet (2)
ME-8999	Spring Kit
ME-9448B	Super Pulley with Clamp
ME-9493	Metal Track 1.2 m
ME-9495A	Angle Indicator
ME-9807	Friction Block
ME-9836	Pivot Clamp

ME-5718: Standard Smart Cart/Metal Track 1.2 m System

ME-5719   Items

ME-6757A	2 Masses (250 g)
ME-1240	Smart Cart (Red)
ME-1241	Smart Card (Blue)
ME-8971	End Stops (set of 2)
ME-8972	Adjustable Feet (2)
ME-8999	Spring Kit
ME-9448B	Super Pulley with Clamp
ME-9495A	Angle Indicator
ME-9779	Metal Track 2.2 m
ME-9807	Friction Block
ME-9836	Pivot Clamp

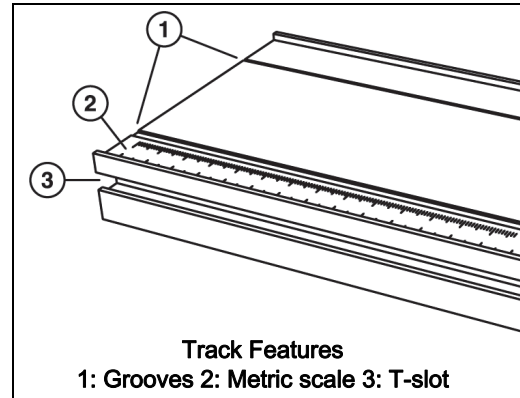**ME-5719: Standard Smart Cart/Metal Track 2.2 m System**

About the Equipment

Metal Track (1.2 m or 2.2 m) in ME-5718 and ME-5719

Metal Track   The aluminum track has two groves to guide the wheels of carts, a metric scale for measuring cart positions, and T-slots on both sides for attaching end stops, leveling feet and other accessories.
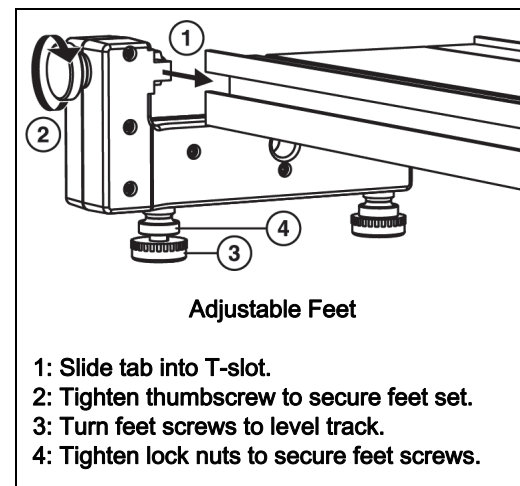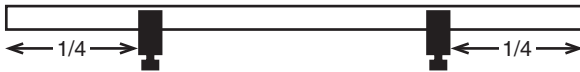
Tip: The track is designed to support the weight of carts and related apparatus. Excess weight will warp it. When you store the track, ensure that no heavy object will be placed on top of it.

Track Features
1: Grooves 2: Metric scale 3: T-slot
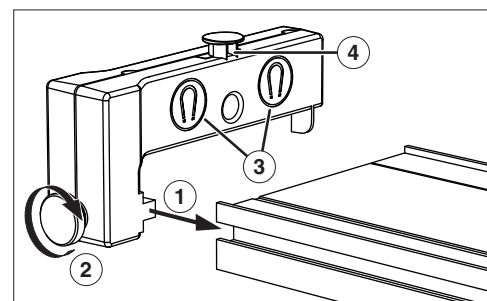
Adjustable Feet

Attach the feet to the track as illustrated. Turn the feet screws to level the track then tighten the lock nuts to secure them.

For maximum stability, position the feet about 1/4 of the track length from each end

Adjustable Feet

1: Slide tab into T-slot.
2: Tighten thumbscrew to secure feet set.
3: Turn feet screws to level track.
4: Tighten lock nuts to secure feet screws.

Adjustable End Stops

Attach the end stops to the track as illustrated. The end stops contain magnets to repel the magnetic bumper of a cart. A stud is provided as an attachment point for a spring.

Adjustable End Stop

1: Slide tab into T-slot on side of track.
2: Tighten thumbscrew to secure end stop.
3: Magnets repel cart's magnetic bumper
4: Spring attachment stud

Plastic Track in ME-5717

PAStrack   The PAStrack consists of two sections that can be joined together with the included connector and split apart for storage. Together the two sections form a 1 m track. An extra connector is included, allowing any number of tracks to be joined together.

To assemble the track:

1. Slide a connector piece into the "50 cm" end of one track section. Push it hard until you hear it snap.

2. Slide the other track section onto the connector piece. Push it until it snaps.

3. Turn the track upside down and tighten the screws on the connector.
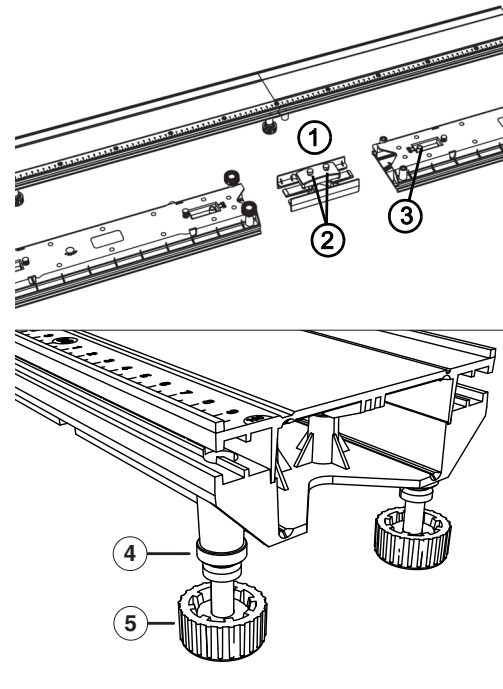
To level the track:

1. Set the track upright on a level surface.

2. Place a cart on the track to test it for level.

3. Adjust the feet to make the track straight and level.

4. Tighten the locknut of each foot.

To disassemble the track:

1. Loosen the connector screws.

2. Press and hold the release tabs on the bottom of the track.

3. Pull the track sections apart.

For more information, see the instruction sheet packaged with the track.
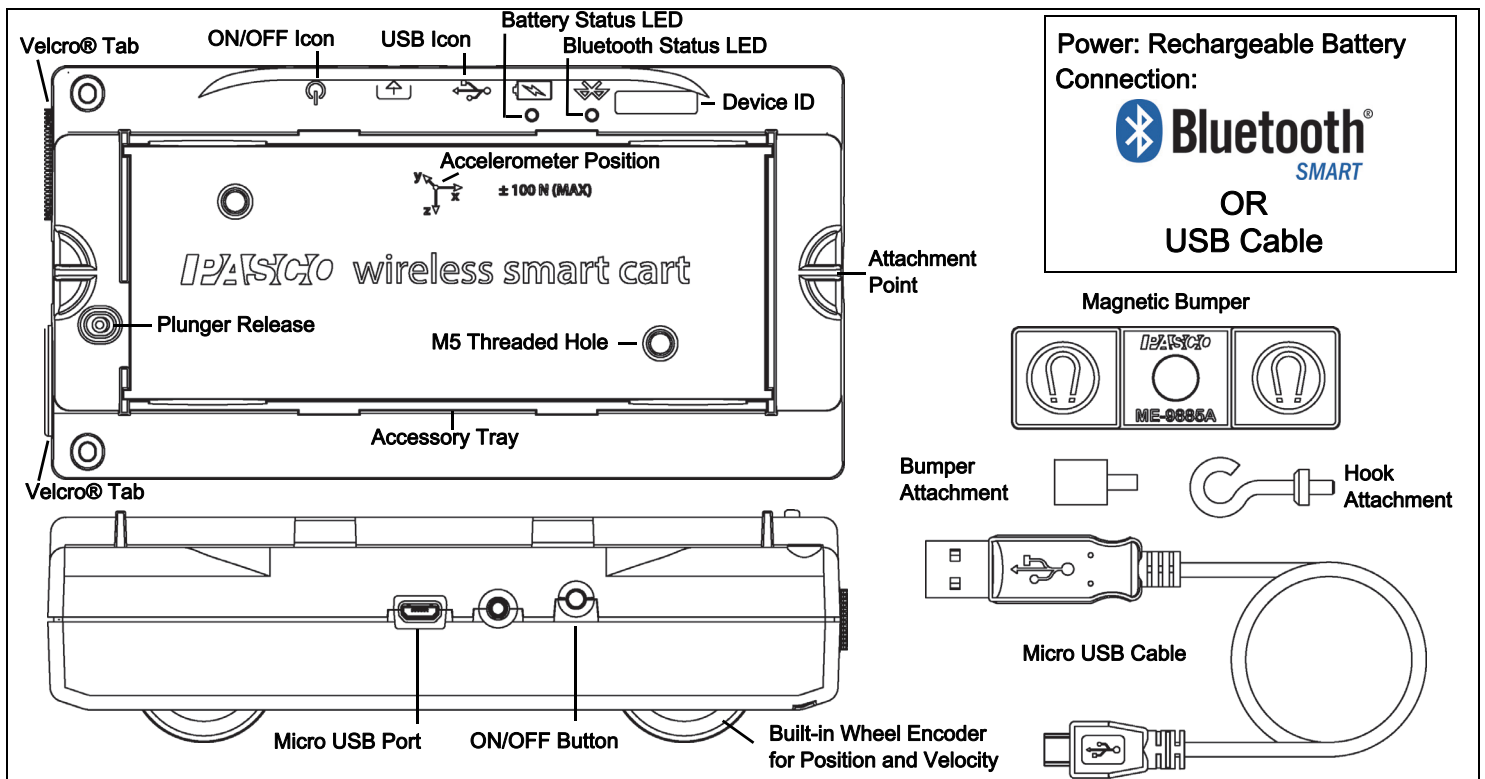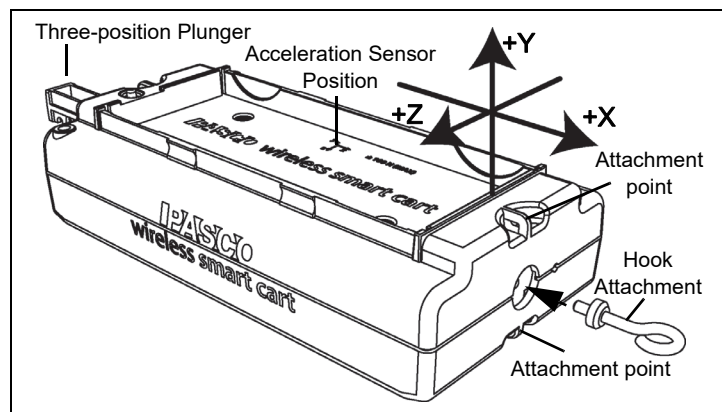
PAStrack Parts
1: Connector
2: Connector screws
3: Release tabs
4: Lock nut
5: Foot

Smart Carts in ME-5717, ME-5718, and ME-5719

The Wireless Smart Cart is a combination wireless and USB device that connects to a computer or tablet through Bluetooth® (version 4.2 or later), or to a computer or USB charger with a micro USB cable (included). The Smart Cart has a durable ABS body, a three-position plunger, and nearly frictionless wheels. It includes built-in sensors that measure force, position, velocity, and three degrees of freedom in acceleration. The Smart Cart also includes a gyroscope-type sensing element that can measure rotational motion. The Smart Cart can make its measurements on or off a dynamics track and transmit them wirelessly. For easy identification, the Smart Cart is available in red or blue..
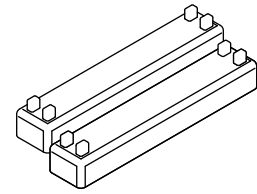
The accessory tray on the top of the Smart Cart can hold any of the accessories designed for a PASCO cart. The Smart Cart dimensions are the same as other PASCO carts and can be used with any PASCO track. The Smart Cart can be stacked with any PASCO cart and its mass is approximately 0.250 kilograms (about 250 grams). It has attachment points on the top and bottom of both ends, and Velcro® tabs for inelastic collisions on one end. The Magnetic Bumper, Bumper Attachment, and Hook Attachment fit into the threaded hole in the end of the Smart Cart opposite to the tabs. The built-in sensors measure force in the range between -100 newtons (N) and +100 N, acceleration in the range between -16g and +16g (g = ±9.8 m/s^2), and angular rotation rate up to ±245 degrees per second (dps). It measures force as a push or pull along its X axis and measures acceleration in three dimensions (X, Y, and Z). The PASCO Data Collection Software can also show the resultant acceleration. The encoder wheels on the Smart Cart measure motion to a maximum of 3.0 meters per second with a resolution of 0.2 millimeters (mm). The positive direction of motion is the same as the X-axis in the graphic that represents the acceleration sensor's position.

For more information, download the PDF file of the reference guide for the Smart Cart on the PASCO web site.
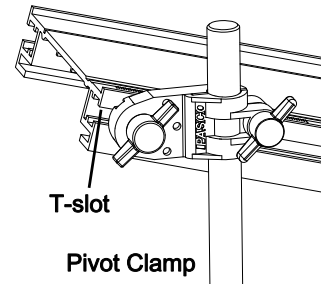
Cart Masses

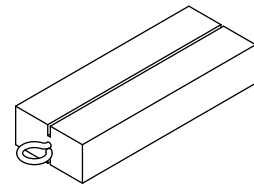These masses are designed to be placed on the upper tray of a cart.

Cart Masses

Pivot Clamp

Attach the pivot clamp to the T-slot of the track (as illustrated) to elevate one end of the track on a vertical rod.

T-slot

Pivot Clamp

Friction Block

The friction block has two different surfaces (wood and felt) and two different surface areas for studying friction. It includes an eye screw for attaching a string and slots on both broad surfaces for holding a picket fence (such as PASCO part ME-9804) or the included angle indicator.
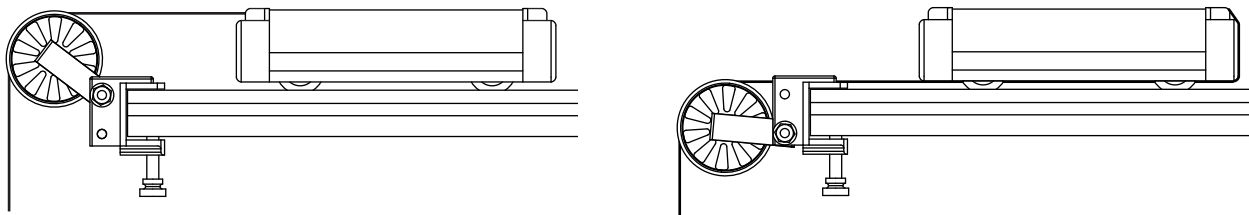
Friction Block

Super Pulley with Clamp

This low-friction, low-inertia pulley is designed for clamping onto the end of the track. Tie a string to the hole in the end of the cart an run it over the pulley. Adjust the height of the pulley to make the string parallel to the track.

The pulley can also be mounted in the lower position as illustrated. Tie the string to the opposite end of the cart and wrap it underneath the cart. In the lower position, the string can be run under an end stop, another cart, or a motion sensor.
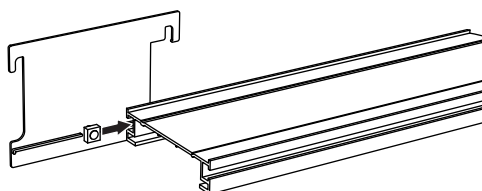
Super Pulley with string in normal position (left) and lower position (right)
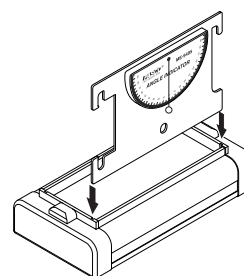
Angle Indicator

Attach the angle indicator to the track as illustrated, or remove the attachment screw and slip it into the slots of a cart or friction block. The hanging thread indicates the angle or incline.
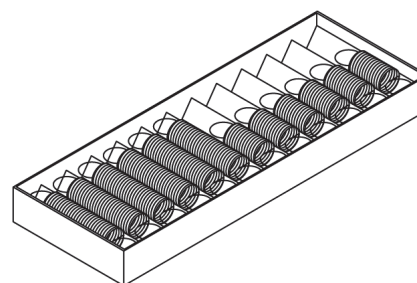
Angle Indicator on cart

Angle Indicator on track

Spring Kit

These twelve springs have spring constants of 3.4 N/m and 6.8 N/m. Each spring strength comes in two different lengths, approximately 3.5 cm and 5.7 cm, three of each type of spring.

Spare Parts

You can order any of the major components of the system using the part numbers listed in the tables for Included Equipment. For an assortment of thumbscrews, square nuts, and other small parts, order the IDS Spares Kit (ME-9823)

For help identifying a part, contact PASCO Technical Support.

Connecting the Smart Cart to Software

PASCO Capstone Software or SPARKvue

PASCO Capstone Software is best for Windows or Mac in Physics and Engineering laboratories. The site license allows students to use it at home.

Use SPARKvue if you are on a mobile platform: iOS, Android, or Chrome.

SPARKvue

See the SPARKvue Help for information about setting up the software:

• In SPARKvue, select the HELP button in any screen, such as the Home Screen.

Connecting the Wireless Smart Cart to a Tablet or a Computer via Bluetooth

• For SPARKvue, select the Bluetooth icon to open the Wireless Devices list. In the Wireless Devices list, the devices are ordered by proximity to the tablet or computer. Select the Smart Cart that

matches the XXX-XXX number found on the Smart Cart. Select Done. A list of measurements appears under the Smart Cart in the Home Screen.

Connecting the Wireless Smart Cart to a Computer with the Micro USB Cable

• Connect the micro end of the included Micro USB Cable into the micro USB port on the end of the Smart Cart. Connect the other end of the Micro USB Cable to a USB port on the computer, or into a powered USB hub connected to the computer.

Zero (Tare) the Smart Cart

At the beginning of an experiment, the measurement from the built-in force and acceleration sensors may not be zero when the force or acceleration is actually zero. This is a normal behavior that is corrected when you zero (or tare) the sensor using the PASCO Data Collection Software.

Collect Data

• In the SPARKvue Home Screen, select a measurement from the list under the sensor's name. A graph of the measurement versus time opens.

• In SPARKvue, select the Start button to begin collecting data.

PASCO Capstone

See the PASCO Capstone Help for information about setting up the software:

• In PASCO Capstone, select PASCO Capstone Help from the Help menu, or press F1.

Connecting the Wireless Smart Cart to a Tablet or a Computer via Bluetooth

• For PASCO Capstone, select Hardware Setup in the Tools palette. The devices in the list are ordered by proximity to the tablet or computer. Select the Smart Cart with the address that matches the XXX-XXX Device ID number on the Smart Cart.

Connecting the Wireless Smart Cart to a Computer with the Micro USB Cable

• Connect the micro end of the included Micro USB Cable into the micro USB port on the side of the Smart Cart. Connect the other end of the Micro USB Cable to a USB port on the computer, or into a powered USB hub connected to the computer.

Zero (Tare) the Force Sensor

• At the beginning of an experiment, the measurement from the built-in force and acceleration sensors may not be zero when the force or acceleration is actually zero. This is a normal behavior that is corrected when you zero (or tare) the sensor using the PASCO Data Collection Software.

Collect Data

• In PASCO Capstone, select a display in the main window or from the Display palette. In the display, use the <Select Measurement> menu to pick a measurement to be shown.

• Select Record to begin collecting data.

Accessories Available Separately

Many additional accessories are available for dynamics systems, such as the Fan Accessory, Visual Accelerometer, and Magnetic Damping Accessory. See www.pasco.com for more information.

Downloadable Experiments

The following experiments can be downloaded at www.pasco.com/smart cart..

1. Average Speed & Velocity

2. Conservation of Energy

3. Conservation of Momentum

4. Graphical Analysis Motion

5. Momentum & Explosions

6. Momentum & Impulse

7. Speed & Velocity Graphs

8. **Work & Kinetic Energy**

Technical Support

For assistance with any PASCO product, contact PASCO at:

Address: PASCO scientific
          10101 Foothills Blvd.
          Roseville, CA 95747-7100

Phone: 916-462-8384 (worldwide)
          800-772-8700 (U.S.)

Web: www.pasco.com

Email: support@pasco.com