PERSONAL IMPACTORS
MODEL 200

USER GUIDE

P/N 6011802, REVISION B
JULY 2019

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PERSONAL IMPACTOR
MODEL 200

USER GUIDE

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Manual History

The following is a manual history of the Personal Impactors Model 200 User Guide (P/N 6011802).

Revision	Date
A	June 2018
B	July 2019

Warranty

Part Number 6011802 / Revision B / July 2019

Address MSP, A Division of TSI / 5910 Rice Creek Parkway / Shoreview, MN 55126 / USA

E-mail Address answers@tsi.com

Limitation Of Warranty And Liability (effective April 2014)

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a. Hot-wire or hot-film sensors used with research anemometers, and certain other components when indicated in specifications, are warranted for 90 days from the date of shipment;

b. Pumps are warranted for hours of operation as set forth in product or operator’s manuals;

c. Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment;

d. Seller does not provide any warranty on finished goods manufactured by others or on any fuses, batteries or other consumable materials. Only the original manufacturer's warranty applies;

e. This warranty does not cover calibration requirements, and seller warrants only that the instrument or product is properly calibrated at the time of its manufacture. Instruments returned for calibration are not covered by this warranty;

f. This warranty is **VOID** if the instrument is opened by anyone other than a factory authorized service center with the one exception where requirements set forth in the manual allow an operator to replace consumables or perform recommended cleaning;

g. This warranty is **VOID** if the product has been misused, neglected, subjected to accidental or intentional damage, or is not properly installed, maintained, or cleaned according to the requirements of the manual. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller.

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Introduction

IMPORTANT

This User Guide contains important safety and operating instructions for the Model 200 Personal Impactor. Any use other than that intended by the manufacturer in this user guide is not proper use of the Model 200 Personal Impactor.

The Model 200 Personal Impactor is a single-stage impactor with an after-filter. The impactor stage removes particles larger than the cut size (either 2.5-µm or 10-µm aerodynamic diameter), and the smaller particles are collected on the after-filter. The particles on the impaction ring (those larger than the cut size) are normally discarded, and the particles collected on the after-filter are available for gravimetric and/or chemical composition analysis. The Personal Impactor obtains personal exposure data while the wearer goes about their normal activities. An appropriate personal sampling air pump worn by the user is necessary to provide the necessary air flow. See Appendix B for typical impactor pressure drops.

NOTE

Six versions of the Model 200 Impactors are available from TSI Incorporated. There are two impactor cut sizes, either 2.5 µm or 10 µm aerodynamic diameter, and each particle cut size can be achieved at three different flow rates: 2, 4, or 10 L/min. The specific cut size and flow rate for each impactor configuration are stamped inside the nozzle cap. Figure 1 below shows the six impactor versions. Each impactor version is manufactured in a different color to facilitate proper identification by the user.

Figure 1. Personal Impactor Configurations

Unpacking

Carefully remove the Model 200 Personal Impactor from its shipping box and visually inspect the impactor for any damage it may have suffered in transit. Please contact your shipping company if any damage is noted. The Model 200 Personal Impactor is shipped with this User Guide.

Principle of Operation

The operation of the Personal Impactor is based on the inertial separation of airborne particles using a conventional single-stage impactor. For more information on impactors, see Marple (2004). In this device the particle-laden air is accelerated through a number of identical nozzles, and the exiting jets impinge upon a porous metal ring. The large particles, because of their inertia, cross the air streamlines and impact on the ring, and the small particles are carried along the air streamlines and are collected on the after-filter.

Model 200 Personal Impactor Description

A schematic diagram of the Model 200 Personal Impactor is shown in Figure 2. The sampler consists of three basic parts: a nozzle cap, an impaction ring assembly, and a base. The impaction ring serves both as an impaction surface and as a clamping ring for the after-filter. The after-filter is supported by the filter support screen and the base.

The impactor stage has 5 or 10 nozzles, depending on the flow rate and cut size, located in a circle along the outer edge of the nozzle cap. Air passing through these nozzles impinges on the annular impaction surface. This annular disk of porous stainless steel is cemented onto the ring that clamps the after-filter to the base.

The clamping force is applied by attaching the nozzle cap, forcing the after-filter hold-down ring onto the outer edge of the filter. This force clamps the after-filter to the filter support screen and base to aid in forming a seal between the filter and the base.

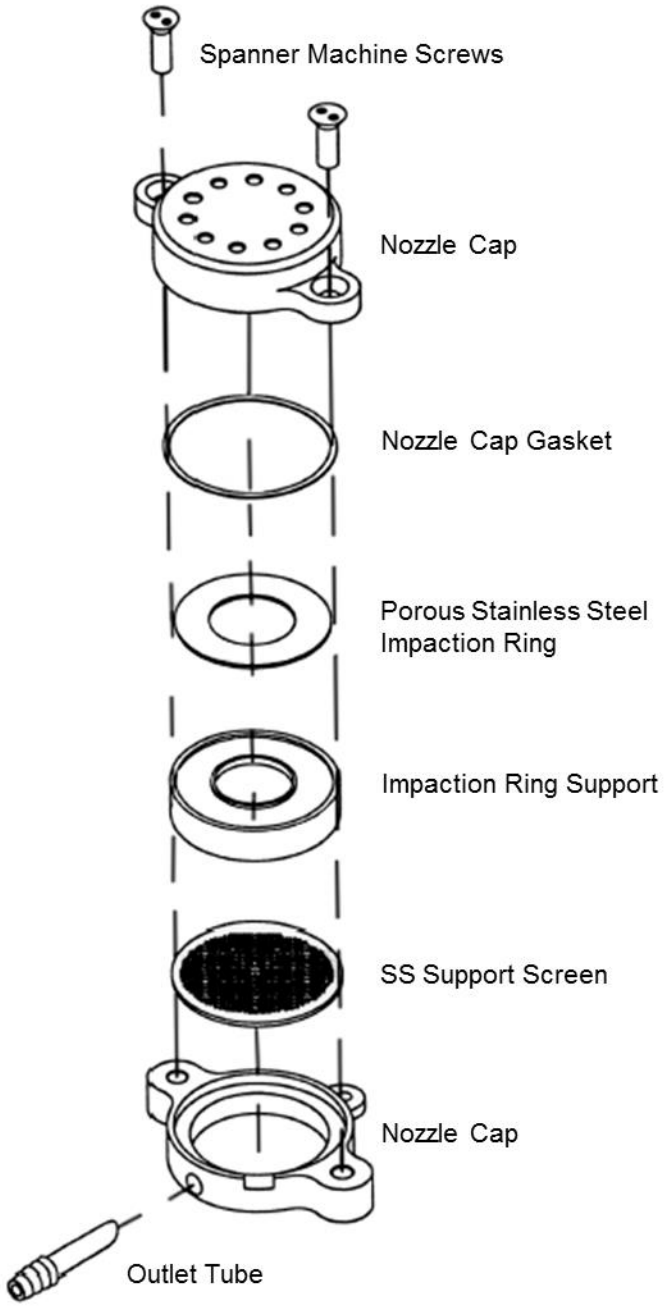

Figure 2. Schematic Diagram of Personal Impactor. Phillips flat head screws are normally used instead of the spanner screws

Figure 3. Model 200 Personal Impactor in Clamping Device

Figure 4. Assembled Model 200 Personal Impactor

Operation

Disassembly Procedure

The Model 200 Personal Impactor is disassembled by removing the two screws holding the nozzle cap to the base. Optional spanner screws (flat head with two holes) and matching screw driver could be used for applications where there is a risk of the wearer opening the sampler. After the screws are removed, the nozzle cap is lifted straight up and clear of the impaction ring assembly. Next, the impaction ring assembly is removed exposing the after-filter.

Coating the Impaction Plate

To keep the particles from bouncing off the impaction ring, light mineral oil should be applied to this surface.

For most sampling applications, saturating the porous metal with a light mineral oil is best. As the particles strike the ring, the oil will wick up through the deposit and continually provide a fresh surface for new particles to strike. The oil can be applied to the ring with an eye dropper by placing the drops evenly about the disk. Fourteen drops is about the maximum that the plate will hold. When it takes 5 to 10 seconds for a drop to disappear into the ring, the ring is saturated, and no more oil should be added. Excess oil can be removed from the ring by touching a

tissue to the porous surface. If oil drips from the ring when it is held vertically, too much has been applied.

After each use, the particles on the impaction ring should be removed by scraping the surface with a knife or razor blade and, periodically, more oil should be added. An alternate technique is to remove all the oil and re-coat the ring after each run. Oil can be removed from the ring by placing it in a soap solution or in a solvent such as cyclohexane, and then rinsing and drying completely.

If the particles are very coarse, such as sand, they may still bounce from the oiled ring. In this case a thin layer of grease (i.e., heavy-duty silicon grease) should be spread on the surface of the impaction ring. This grease will have to be removed and replaced between runs.

Assembly Procedure

To assemble the impactor, a filter support screen and a 37-mm filter are placed in the base, and the impaction ring assembly is set on top of the filter. Next, the nozzle cap is placed over the impaction ring assembly, and the nozzle cap is attached to the base with two 8-32 x 1/2” flat-head screws. When tightening the screws care must be taken to ensure that the same torque is applied to both screws.

Another way of assembling the Model 200 Personal Impactor is with the impactor Clamping Device shown in Figure 3. This device ensures that the nozzle cap is clamped parallel to the base and that the correct clamping force is applied to the after-filter. The handle of the clamping device is turned until the clutch in the handle slips. The screws are tightened, and the sampler is now completely assembled (Figure 4) and can be removed from the clamping device.

Operating Procedure

First, disassemble the Personal Impactor, as described above, and clean the parts. The nozzle cap can be cleaned by rinsing it with isopropyl alcohol. After the parts are cleaned, the filter support screen and filter are placed in the base and assembled as described above.

NOTE

The porous metal impaction ring needs to be coated as described in Coating the Impaction Plate to eliminate particle bounce.

After assembly is completed, the vacuum source (personal sampling pump) is attached to the impactor outlet, drawing either 2.0, 4.0 or 10 L/min through the Model 200 Personal Impactor. An impactor calibration cap (sold separately by TSI Incorporated as an accessory) can be used to measure the flow rate at the inlet of the Model 200 PEM. See Appendix A for the proper use of the impactor Calibration Cap and Appendix B for typical impactor pressure drops.

NOTE
The inlet flow rate to the Model 200 Personal Impactor must be measured and controlled to within ±5% of the specified flow rate. The specified cut size for the Model 200 Personal Impactor is valid as long as the required flow rate is maintained by the sampling pump throughout the complete sampling period.

The total sampling time depends on the flow rate of the specific impactor and on the particle concentration at the selected sampling location. A typical sampling time is 8 hours to determine the 8-hr average concentration at a work-place environment.

Specifications

Sampling flow rate.....	2.0 L/min, 4.0 L/min, or 10.0 L/min
Cut-point aerodynamic diameter....	2.5 μm or 10 μm
Filter diameter	37 mm
Dimension (L x W x H)	60 x 65 x 22 mm (2.3 in. x 2.5 in. x 0.9 in.)
Weight	48 g (1.7 oz.)

Spare Parts and Accessories List

All replacement parts must be factory approved. Call the manufacturer for details (see Technical Contacts).

Description	TSI P/N	Qty
Kit of nozzle cap gaskets (5)	0200-82-0001	1
SS Screen Filter Support, 37 mm	0200-81-0017	1
Screws, 8-3 2x ½” FH 2)	9999-89-0110	1
Calibration, Cap Assembly with Tap	0200-01-5000	1
Calibration, Cap Assembly w/o Tap	0200-01-5001	1
Clamping Fixture Assembly	0200-98-0038	1
Glass Fiber Filters, 37 mm	0135-01-5203	500

Technical Contacts

- If you have any difficulty installing the instrument, or if you have technical or application questions about this system, contact an applications engineer at one of the locations listed below.
- If the Model 200 Personal Impactor does not operate properly, or if you are returning it for service, visit our website at http://rma.tsi.com or contact TSI at:

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500 Cardigan Road
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Customer Service will need the following information:

- The instrument model number
- The instrument serial number
- A purchase order number (unless under warranty)
- A billing address
- A shipping address

Use the original packing material to return the instrument to TSI. If you no longer have the original packing material, seal off any ports to prevent debris from entering the instrument and ensure that the display and the connectors on the instrument front and back panels are protected. This instrument is very fragile and must be packed in a manner appropriate for a precision instrument.

References

1) Marple, V.A. "History of Impactors-The First 110 Years". *Aerosol Science and Technology*, **38:**247-292, 2004.

2) Marple, V. A., “PEM Development, Fabrication, Evaluation and Calibration”, *Final Report submitted to Research Triangle Institute*, July 1989.

Appendix A: Impactor Flow Calibration Instructions

A correct flow calibration of the impactor requires a special attachment known as the Flow Calibration Cap (Figure 5). The impactor flow calibration cap is intended to provide for a single inlet to the impactor sampler to which a flowmeter can be attached. The calibration cap is used by pressing the cap onto the nozzle cap of the impactor. A flowmeter is attached to the ½-inch diameter inlet tube on top of the calibration cap. The barbed fitting on the side of the cap is for the purpose of attaching a pressure gauge. Measuring the pressure between the flowmeter and the impactor is only necessary if there is a large pressure drop across the flowmeter. If the flowmeter has a low-pressure drop, such as a mass flowmeter, bubble flowmeter, or a laminar flow element meter, the pressure at the calibration cap does not need to be measured, and the pressure tap can be closed off with a rubber cap.

The steps in using the impactor Flow Calibration Cap are:

1. Connect a flowmeter to the inlet of the flow calibration cap.
2. Turn on pump connected to the impactor.
3. Place the calibration cap on the impactor (be sure O-ring is properly seated in the O-ring groove inside the calibration cap).
4. Check impactor flow rate with a flowmeter connected to the flow calibration cap.

Figure 5. Flow Calibration Cap

Appendix B: Typical Model 200 Personal Impactor Pressure Drops

The table below shows the typical pressure drop that is characteristic for each type of impactor when it is used with a 37-mm glass fiber filter (e.g. Gelman Type A/E).

PEM Description	Cut Point (μm)	Flow Rate (L/min)	# of Nozzles	Nozzle Diameter (in)	Nozzle ΔP (in wg)	Filter ΔP (in wg)	Total ΔP (in wg)
PEM 2-10	10	2.0	5	0.1200	0.003	1.37	1.37
PEM 4-10	10	4.0	10	0.1200	0.003	2.73	2.73
PEM 10-10	10	10.0	10	0.1520	0.008	6.83	6.84
PEM 2-2.5	2.5	2.0	5	0.0430	0.190	1.37	1.56
PEM 4-2.5	2.5	4.0	10	0.0430	0.190	2.73	2.92
PEM 10-2.5	2.5	10.0	10	0.0670	0.201	6.83	7.03

Filter pressure drop assumes typical 37 mm glass fiber filter

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