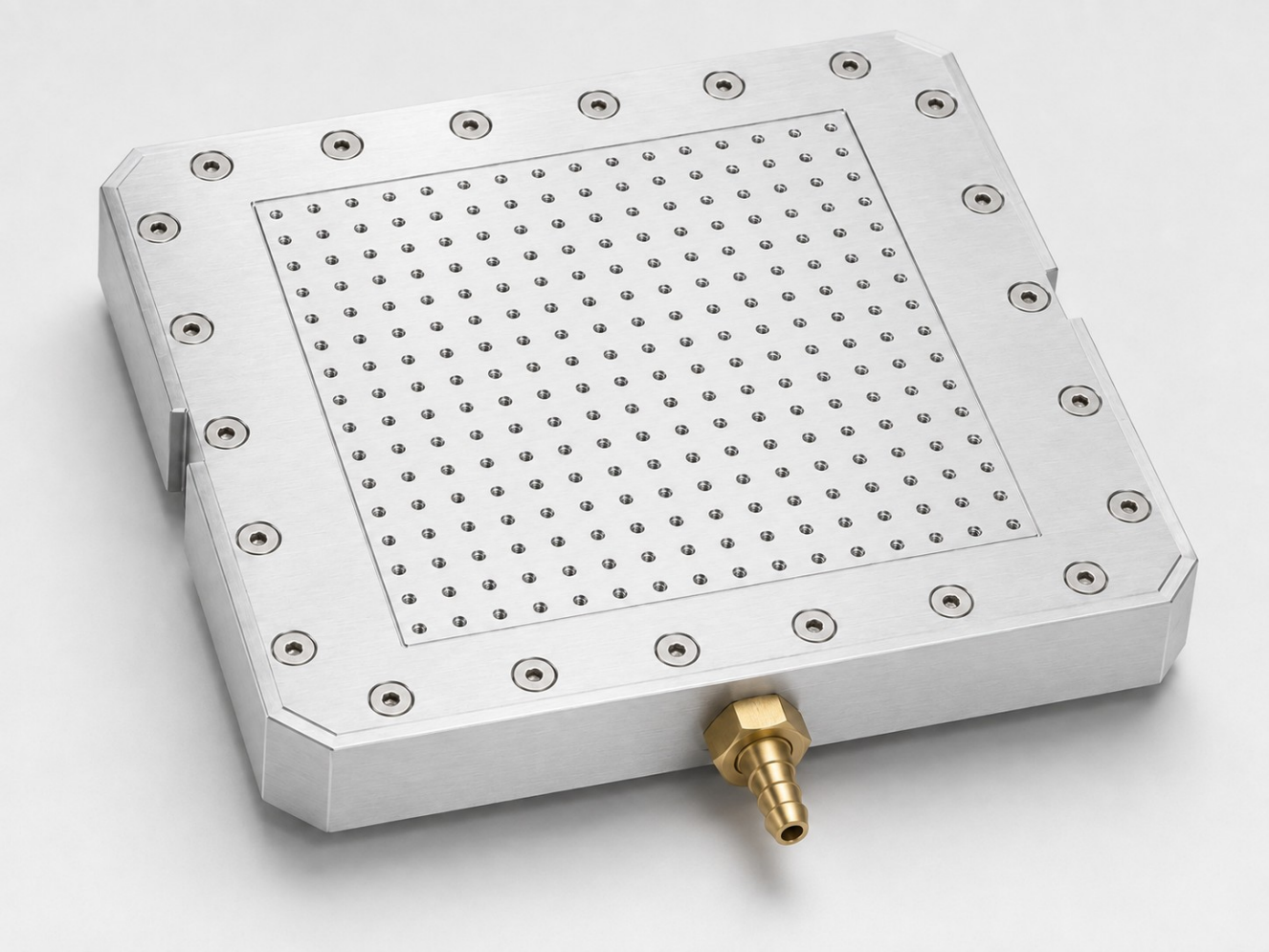
MODULAR

VACUUM WORK PLATE

User Manual



Standard bare-aluminum top plate shown.

Document	Modular Vacuum Work Plate - User Manual
Revision	Final
Configuration	Modular base; standard passive, heated, or active PCB top plates

LAB USE This manual is intended for users of the modular vacuum workholding system. Plate-specific instructions may supplement this document.

1. Purpose and System Overview

The Modular Vacuum Work Plate is a laboratory workholding platform for securing components, substrates, assemblies, and custom fixtures using vacuum, mechanical mounting, or a combination of both. The system uses interchangeable top plates so the work surface can be adapted to different processes without replacing the vacuum base.

The standard top plate includes an 80 mm x 80 mm recessed hold-down region with M2.5 threaded mounting holes on a 5 mm pitch in both X and Y. The regular grid supports configurable stops, clamps, work holders, adapter plates, and other custom tooling.

Modular platform. Top plates may use different hole patterns, vacuum patterns, materials, fixtures, integrated heating, or active PCB electronics. Active PCB plates may incorporate control/monitoring circuitry, temperature control, zoning, sensing, and vacuum holes or vias. Always follow any plate-specific instructions supplied with the installed top plate.

2. Standard Top Plate - Quick Reference

Specification	Standard configuration
Recessed hold-down region	80 mm x 80 mm
Mounting thread	M2.5
Hole pitch	5 mm x 5 mm (X-Y)
Tap-drill diameter	Approx. 2.05 mm
Top plate	Interchangeable
Top-plate screws	M2.5 x 5 mm flat head, 18-8 SS (McMaster 92125A083)
Vacuum-hole plugs	M2.5 x 4 mm cup-tip set screw, 18-8 SS (McMaster 92015A095)
Top-plate vacuum seal	1/16 in gasket: silicone for non-heated plates; PTFE for heated plates
Vacuum connection	McMaster 5346K61: brass, 1/8 in hose ID x 1/8 NPTF male
Workholding	Vacuum, mechanical fixturing, or combined
Unused-hole sealing	Set screws, metal shim stock, or both
Heating	Available on compatible top plates
Active PCB top plate	Optional; may integrate control/monitoring, temperature control, zoning, sensing, and vacuum holes/vias
Main material shown	Bare machined aluminum

3. Main Components

Vacuum base: Provides the structural base and internal vacuum distribution path for the installed top plate.

Interchangeable top plate: Defines the active work surface and can be replaced with application-specific versions, including heated plates and active PCB plates.

Recessed hold-down region: The 80 mm x 80 mm central work area on the standard plate.

M2.5 vacuum / mounting grid: Threaded holes on a 5 mm X-Y pitch. The grid provides vacuum openings and can also accept compatible workholding hardware.

Top-plate fasteners: M2.5 x 5 mm 18-8 stainless steel flat-head screws (McMaster 92125A083) secure the interchangeable top plate to the base.

Vacuum-hole plugs: M2.5 x 4 mm 18-8 stainless steel cup-tip set screws (McMaster 92015A095) can close individual unused vacuum holes.

Perimeter vacuum gasket: A 1/16 in thick gasket seals the interchangeable top plate to the vacuum base. Use silicone with non-heated top plates and PTFE with heated top plates.

Vacuum connection: McMaster 5346K61 brass straight hose-barb adapter: 1/8 in hose ID barb with 1/8 NPTF male thread.

Active PCB top plate (optional): A PCB-based work surface may integrate control and monitoring electronics, temperature-control zones, sensors, and vacuum hold-down openings formed by through-holes or vias connected to the vacuum plenum.

4. Hardware Reference

Use	McMaster	Hardware	Hex drive
Attach top plate	92125A083	M2.5 x 0.45 mm x 5 mm, 90 deg flat head, 18-8 SS	1.5 mm
Plug vacuum hole	92015A095	M2.5 x 0.45 mm x 4 mm, cup-tip set screw, 18-8 SS	1.3 mm
Connect vacuum hose	5346K61	Brass straight adapter, 1/8 in hose ID barb x 1/8 NPTF male	7/16 in hex

4.1 Top-Plate Vacuum Gasket

The interchangeable top plate seals to the vacuum base with a 1/16 in thick perimeter gasket. The gasket sits in the recessed sealing region shown in Section 13 and must be clean, flat, and correctly positioned before the top plate is installed.

Top-plate type	Gasket material
Non-heated	1/16 in silicone
Heated	1/16 in PTFE

5. Typical Applications

- Precision manual assembly and alignment
- Microscope inspection and device handling
- Wire bonding and probing
- Soldering, rework, and small-part assembly
- Adhesive curing and temperature-controlled assembly
- Zoned thermal processing, sensing, and monitored workholding using an active PCB top plate
- Custom fixtures for substrates, packages, or small mechanical parts

6. Operating Instructions

6.1 Before Use

1. Confirm that the installed top plate is appropriate for the intended process.
2. Inspect the work surface, threaded holes, and vacuum interface for debris or damage.
3. Verify that the 1/16 in top-plate gasket is installed, clean, undamaged, and appropriate for the installed top plate: silicone for non-heated use or PTFE for heated use.
4. Verify that 1/8 in ID vacuum tubing is securely connected to the McMaster 5346K61 hose barb and is in good condition.
5. If a heated top plate is installed, verify that its heater, temperature sensor, controller, and wiring are correctly connected before use.
6. If an active PCB top plate is installed, verify all required power, control, monitoring, sensing, and communications connections according to the plate-specific instructions before use.
7. Install any stops, clamps, or custom fixtures before placing the workpiece when practical.

6.2 Install Fixtures and Position the Workpiece

Use the M2.5 grid to attach compatible stops, clamps, adapter plates, or custom work holders. The 5 mm X-Y pitch allows repeatable fixture placement across the standard work area.

Protect the threads. Start M2.5 screws by hand and avoid cross-threading or excessive tightening. Use screw lengths appropriate for the installed top plate and fixture.

Place the workpiece in the recessed work area and align it with the desired fixture or reference features. Mechanical fixturing may be used by itself or together with vacuum holding.

6.3 Seal Unused Vacuum Holes

The M2.5 grid communicates with the vacuum system. Vacuum performance is best when openings that are not needed beneath the workpiece are closed. Choose the sealing method that matches the amount of unused area.

Method	Best use	Procedure
M2.5 set screws	A few scattered unused holes	Install McMaster 92015A095 plugs only in holes that need individual closure. Thread them in until secure and at or below the work surface. Do not overtighten or drive them deeper than required.
Metal shim stock	Large unused sections	Lay clean, flat, nonporous metal shim stock over the unused portion of the grid. When vacuum is applied, the shim is drawn against the plate and closes many holes at once.
Combined method	Mixed or irregular setups	Use set screws near the active work area and shim stock over larger inactive regions to minimize setup time and leakage.

Shim-stock guidance. Use smooth metal shim stock that lies flat and is large enough to fully cover the selected unused openings. Aluminum, stainless steel, brass, or copper shim stock may be suitable. Keep sharp or curled edges away from the workpiece and tooling. For heated operation, use a shim material and thickness compatible with the process temperature.

6.4 Apply Vacuum

8. Connect the plate to the approved laboratory vacuum source.
9. Confirm that unused vacuum holes have been closed with set screws, metal shim stock, or a combination of both.
10. Leave only the openings required for the active workholding area exposed beneath the workpiece.
11. Apply vacuum and verify that the workpiece is drawn securely against the work surface.
12. Gently check for movement before beginning the operation. If the workpiece slides or rocks, remove vacuum and correct the setup.

Vacuum holding force depends on pressure differential, effective sealed area, and leakage. Closing large unused areas with shim stock is usually faster than installing many individual set screws and can substantially reduce leakage when only a small portion of the plate is being used.

6.5 During Use

- Periodically confirm that the workpiece and fixtures have not shifted.
- Avoid applying lateral loads that exceed the holding capability of the vacuum or installed fixtures.
- Prevent loose wire, metal chips, adhesive, solder debris, liquids, or other contamination from being drawn into the vacuum system.

6.6 Removing the Workpiece

13. Complete the operation and remove any process tooling from the work area.
14. Turn off or isolate the vacuum source.
15. Allow the pressure beneath the workpiece to equalize before lifting it.
16. If the plate was heated, allow the workpiece and plate to cool to a safe handling temperature unless the process specifically requires hot removal.
17. Remove the workpiece and clean the work surface as needed.

7. Changing the Interchangeable Top Plate

Different top plates may be installed to accommodate alternate workpiece geometries, dedicated fixtures, specialized vacuum patterns, or heating requirements.

18. Shut off and disconnect or isolate the vacuum source.
19. Disconnect heater, sensor, power, control, monitoring, communications, or other electrical connections if the installed top plate includes them.
20. Confirm that the plate is cool enough to handle.
21. Remove the M2.5 x 5 mm flat-head top-plate fasteners (McMaster 92125A083) using a 1.5 mm hex key.
22. Lift the top plate straight away from the base without damaging the mating surfaces or perimeter gasket.
23. Remove and inspect the 1/16 in gasket. Replace it if cut, torn, permanently deformed, contaminated, or otherwise unable to lie flat.
24. Clean the gasket recess and both mating surfaces. Install the correct gasket material: silicone for a non-heated top plate or PTFE for a heated top plate.
25. Position the replacement plate correctly, confirm the gasket remains flat and aligned, reinstall the M2.5 flat-head fasteners, and tighten them evenly in an alternating pattern using the approved assembly torque for that plate.
26. Reconnect any vacuum, power, heater, sensor, control, monitoring, and communications interfaces required by the replacement top plate, then perform a functional check before use.

Do not guess fastener torque. Because top-plate thickness, material, sealing method, and hardware may vary, use the assembly torque specified for the installed plate or local lab procedure.

8. Heated Top Plates

Compatible top plates may incorporate heating for processes such as hot-plate baking, adhesive curing, wire bonding, temperature-controlled assembly, and thermal testing. Heating capability is top-plate dependent; the base manual does not define a universal operating temperature. Heated top plates use the 1/16 in PTFE perimeter gasket rather than the standard silicone gasket.

- Use the heater controller and temperature sensor specified for the installed top plate.
- Do not exceed the temperature rating of the top plate, seals, vacuum tubing, fixtures, workpiece, or adjacent equipment.
- Route heater and sensor wiring so it cannot contact moving tools or create a snag hazard.
- Treat the top plate, perimeter fasteners, fixtures, and workpiece as hot until they have cooled.
- Verify that heating does not degrade the vacuum seal or cause the workpiece to shift during the process.

9. Active PCB Top Plates

An interchangeable top plate may be implemented as an active printed-circuit-board (PCB) assembly rather than a passive machined plate. This allows the work surface itself to incorporate application-specific electronics while retaining vacuum workholding through the modular base.

- Integrated control and monitoring circuitry for the workholding process
- Closed-loop or monitored temperature control using built-in heaters and temperature sensors
- Multiple independently controlled or monitored zones across the work surface
- Additional sensing or instrumentation located close to the workpiece
- Application-specific control, data acquisition, or interface circuitry

9.1 Vacuum Hold-Down Through the PCB

Vacuum hold-down can be retained on an active PCB top plate by using plated or non-plated through-holes, vias, or other designed openings that connect the top work surface to the vacuum plenum beneath the plate. The number, size, spacing, and location of these openings are specific to the PCB design and intended workpiece.

Plate-specific vacuum pattern. Only openings intentionally connected to the vacuum plenum should be treated as vacuum hold-down points. Do not assume that every PCB via or through-hole is part of the vacuum system.

9.2 Using an Active PCB Plate

- Follow the plate-specific electrical, thermal, vacuum, and software/control instructions supplied with the active PCB top plate.
- Verify that vacuum openings intended to hold the workpiece are unobstructed and aligned with the required work area.
- Use only the zones, sensors, heaters, and control functions intended for the installed plate and process.
- Before removing or changing an active PCB top plate, de-energize it and disconnect the required power, control, monitoring, sensing, and communications interfaces.

Conductive covers on active PCB plates. Metal shim stock is useful for covering large unused vacuum areas on passive metal top plates, but it can electrically short exposed pads, traces, components, or test points on an active PCB. Use metal shim stock on an active PCB only when the plate design specifically permits it and adequate electrical isolation is provided. Otherwise use the plate-specific vacuum-masking method.

An active PCB plate that incorporates heating should use the heated-plate sealing configuration, including the 1/16 in PTFE perimeter gasket, unless the plate-specific design specifies another compatible seal.

10. Safety

Vacuum workholding

Verify actual workpiece retention before beginning an operation. Do not rely on vacuum alone when loss of holding force could create a personnel hazard, damage equipment, or allow a workpiece to contact moving tooling.

Mechanical fixturing

Keep clamps, stops, screws, and custom fixtures clear of microscopes, probes, bonding heads, soldering tools, and other process equipment. Use appropriate screw lengths and protect the aluminum threads from cross-threading and over-tightening.

Heated operation

Use only temperature-rated fixtures, hoses, seals, and workpieces. Heated top plates use the 1/16 in PTFE perimeter gasket. Observe the limits specified for the installed heated top plate and its controller.

Active PCB operation

Treat an active PCB top plate as powered laboratory equipment. Follow its plate-specific electrical and control instructions, keep conductive objects away from exposed circuitry unless intended by the design, and de-energize the plate before removal or service. Verify that temperature-control zoning and sensing are operating as intended before relying on them for the process.

11. Cleaning and Maintenance

- Remove dust, metal chips, wire fragments, solder debris, adhesive residue, and other contamination after use.
- Keep the M2.5 grid clean so screws and vacuum-hole plugs start freely by hand.
- Inspect set-screw plugs for damage and remove them when they are no longer required. Do not leave loose plugs on the work surface.
- Clean metal shim stock before reuse and discard pieces that are sharply bent, curled, contaminated, or damaged.
- Do not intentionally draw liquids, uncured adhesive, or loose particulate into the vacuum passages.
- If vacuum performance decreases, inspect the workpiece seal, unused openings, tubing, the McMaster 5346K61 fitting, perimeter gasket, top-plate mating surfaces, and vacuum source.
- Inspect the 1/16 in perimeter gasket whenever a plate is changed. Replace gaskets that are cut, torn, permanently deformed, contaminated, or unable to lie flat.
- Inspect top-plate mating and sealing surfaces whenever a plate is changed. Do not install a plate over trapped debris.

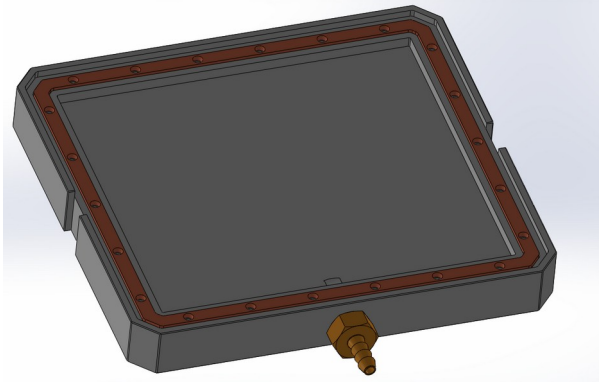
- For active PCB top plates, inspect connectors, wiring, components, vacuum holes/vias, and exposed circuitry for contamination or damage. Follow the plate-specific cleaning method and do not use cleaning practices that could damage electronics.
- Repair damaged threads or sealing surfaces before returning the system to service.

12. Storage

- Clean and dry the work surface before storage.
- Remove temporary fixtures when they may interfere with future users.
- Protect the mounting grid and mating surfaces from contamination and impact damage.
- Store interchangeable top plates so their working and sealing surfaces cannot be scratched.
- Store spare silicone and PTFE gaskets clean and flat so they are not creased or contaminated.
- Store active PCB top plates using appropriate ESD and physical protection for their electronics, connectors, work surface, and sealing surface.

13. Seal and Vacuum Connection Reference

The images below identify the perimeter gasket location and the specified vacuum hose fitting used on the base assembly.



Perimeter vacuum gasket

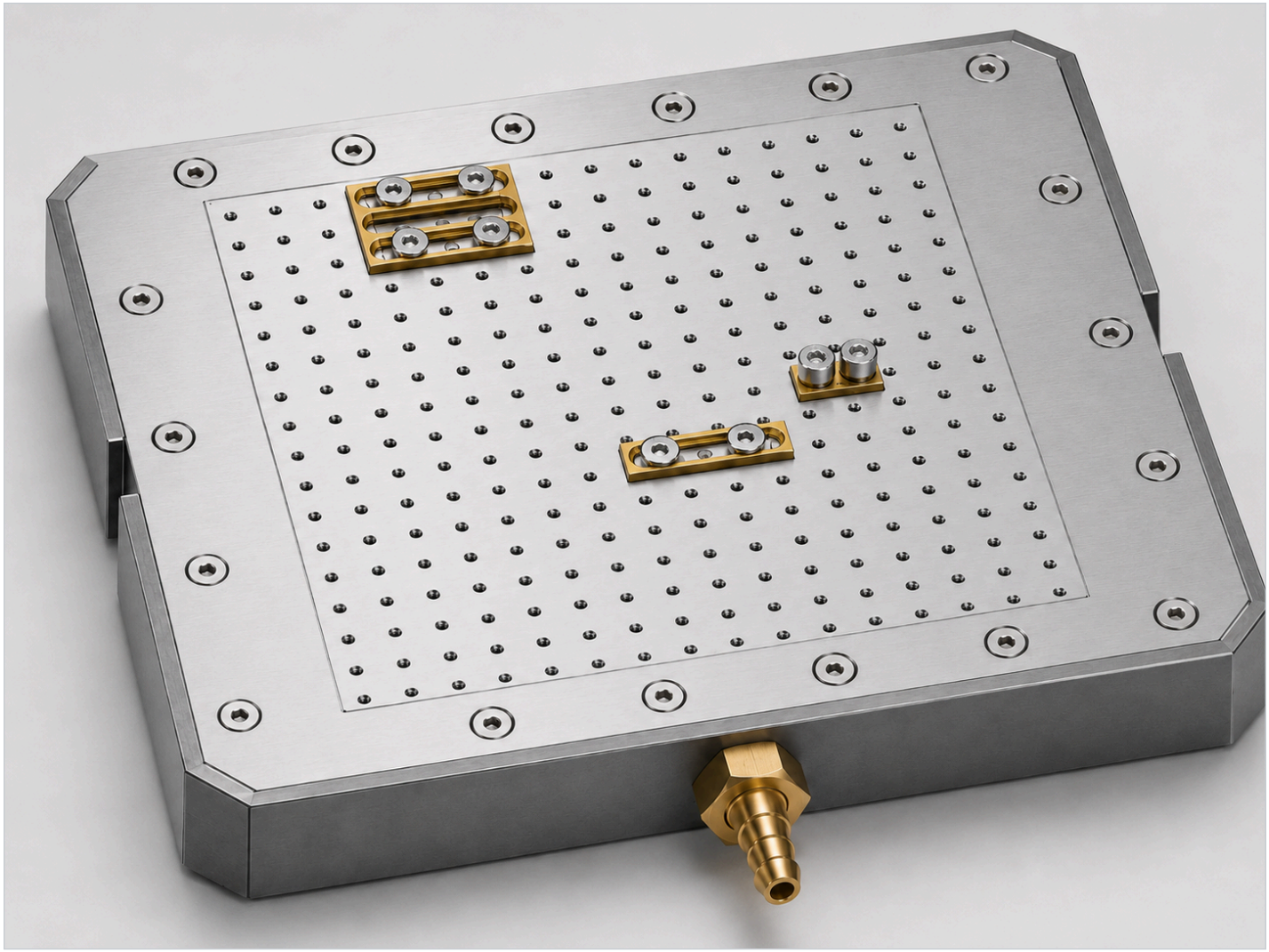
The highlighted sealing ring is 1/16 in thick. Use silicone for non-heated plates and PTFE for heated plates.

Vacuum hose fitting - McMaster 5346K61

Brass straight adapter for 1/8 in ID hose with 1/8 NPTF male thread. The fitting installs in the side of the vacuum base.

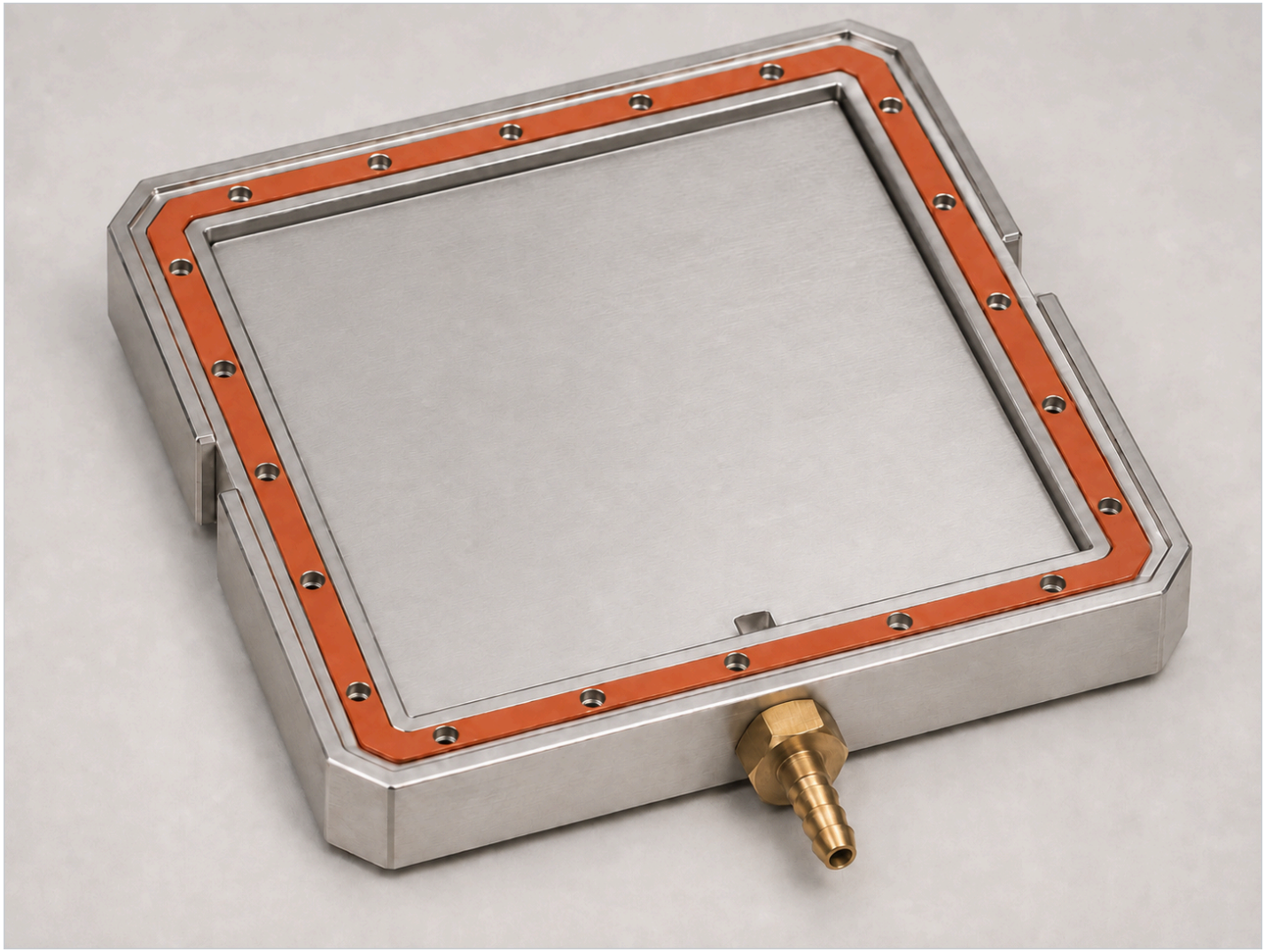
14. Reference Images

Standard Top Plate - Example Workholding Configuration



Reference view of the standard 80 mm x 80 mm workholding region with example mechanical fixtures installed. The top plate mounting screws are shown installed flush with the plate surface, and the brass vacuum hose fitting is visible at the front of the assembly.

Vacuum Base, Perimeter Gasket, and Vacuum Chamber



Reference view of the vacuum base with the interchangeable top plate removed. The orange perimeter gasket provides the vacuum seal, the top-plate attachment locations are shown as threaded holes, and the central vacuum chamber is approximately 3 mm deep. The brass vacuum hose fitting is shown at the front of the base.