BOILER ROOM SAMPLE CONDITIONING PANELS

General Installation & Maintenance Guidelines

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Madden Engineered Products has prepared this document to provide clear, practical, system-level guidance for sampling system operation. This manual is intended to help operators and maintenance personnel:

- Understand how the overall system functions
- Recognize common installation and startup issues
- Identify potential operating problems before damage occurs
- Establish safe and reliable baseline operation

This document reflects Madden's experience designing, fabricating, and integrating complete sampling systems as a whole.

Individual ancillary equipment manufacturer's manuals govern internal limits, factory settings, and component-specific requirements and shall always be followed.

Failure to review and follow both this manual and the applicable OEM manuals may result in improper operation, reduced equipment life, or unsafe conditions.

SECTION 1 - INTRODUCTION / SAFETY GUIDELINES / SYSTEM OVERVIEW

1.1 Introduction

This manual provides general installation, startup, operation, and maintenance guidance for Madden Engineered Products preassembled sample cooler stations. Because Madden builds nearly all sample cooler panels to order, your specific station may vary in size, materials, number of coolers, and ancillary equipment from the configurations described here. Where differences exist, your project-specific General Arrangement (GA) drawing and Bill of Materials (BOM) take precedence over this document.

This manual does NOT override site-specific engineering standards, boiler manufacturer instructions, applicable codes, or water treatment program recommendations. Final responsibility for correct installation, operation, and integration of this equipment rests with the facility owner, installing contractor, and water treatment provider.

1.2 What is a Sample Conditioning Panel?

A Madden sample cooler station is a pre-piped, wall-mount or free-standing mechanical assembly that provides boiler room operators with the basic components needed to safely take an accurate water or steam-based grab sample. The station reduces sample temperature and pressure so that no flashing occurs during sample collection, protecting operators and preserving the accuracy of water quality measurements.

1.3 Typical Configurations

Madden stations are built around one or more of the following Type 2 (4" diameter) sample coolers as the core heat exchanger:

SC102 / SC102A	1.3 ft^2 — 316SS coil, ¼" OD, 0.035" wall — Rated 3,850 PSI coil / 300 PSI shell — Water/saturated steam, boiler drum, feedwater, condensate
SC105 / SC105A	1.9 ft^2 — 316SS coil, 3/8" OD, 0.035" wall — Rated 2,500 PSI coil / 300 PSI shell — Continuous liquid flow, higher duty cycle
SC106 / SC106A	3.8 ft^2 — 316SS coil, 3/8" OD, 0.035" wall — Rated 2,500 PSI coil / 300 PSI shell — Steam grab samples; desuperheating + condensation
SC107 / SC107A	3.8 ft^2 — 316SS coil, 3/8" OD, 0.065" wall — Rated 4,925 PSI coil / 300 PSI shell — High-pressure steam applications
SC108 / SC108A	1.9 ft^2 — 316SS coil, 3/8" OD, 0.065" wall — Rated 4,925 PSI coil / 300 PSI shell — High-pressure, compact duty
NOTE	Type 2 Sample Coolers are standard for turnkey panel systems. Type 1 sample coolers may also be used. See Madden Sample Cooler data sheet for full product line details.

Panels may be wall-mount (single-panel) or free-standing (bridge frame). Free-standing bridges include a structural C-channel frame bolted to the floor, with the back panel attached. Multi-cooler stations may serve water sampling, steam sampling, or a combination. Some stations include a stainless steel sink, shelf, storage cabinet, and/or countertop. Refer to your GA drawing for your specific configuration.

1.4 Standard Ancillary Equipment

- Sample inlet shut-off ball valve(s) — Swagelok, 316SS, ¼" compression
- Cooling water inlet ball valve(s) — 316SS, ½" FNPT
- Sample flow metering valve — Swagelok, ¼" compression, Cv 0.03 (medium or high flow as specified)
- Pressure gauge — 316SS body, 2½" dial, 0–150, 0–300 PSI, 0-1,500 PSI (as specified)
- Temperature gauge — SS body, 3" dial, 0–240°F
- Pressure relief valve (PRV) — Swagelok poppet check valve, ¼" or ½", 150 PSI cracking pressure (included when any system piping has a shut off device on discharge of cold water or sampling line)

- Thermal shut-off valve (optional) — Closes at 135°F; opens at 125°F
- Cooling water globe valve (optional) — Used where precise CW flow control is needed
- Equipment and warning labels (as specified)

SECTION 2 – SAFETY GUIDELINES

2.1 Safety Guidelines

> ⚠ **NEVER open the sample valve without first confirming cooling water flow. Hot, pressurized boiler water or steam can flash to steam instantly, causing severe burns and inaccurate sample results.**

- Only trained and qualified personnel should install, operate, or service sample cooler stations.
- Always wear appropriate PPE — heat-resistant gloves, safety glasses, and face shield — when working near sample lines or taking samples.
- Confirm the sample outlet temperature is safe for handling (typically ≤ 120°F) before touching tubing or collecting a sample container.
- Do not exceed the pressure ratings of the sample cooler coil or shell side. Refer to your GA drawing and sample cooler data sheet for ratings.
- Close the sample valve first, then the cooling water valve. Never leave the sample valve open unattended.
- Do not modify, drill, weld, or repurpose any component of the station without written authorization from Madden.
- Route sample discharge to a safe location — sink drain or sample collection vessel. Never discharge to an open floor drain without confirming temperature compliance.
- If a thermal shut-off valve is installed, it will close automatically when sample outlet temperature reaches 135°F. Do not attempt to override or bypass this device.
- In any emergency, close the sample valve immediately and contact facility safety personnel.

SECTION 3 – RECEIVING, HANDLING & STORAGE

3.1 Receiving Inspection

- Inspect the station for shipping damage upon receipt. Check all gauges, valves, and tubing for damage or displacement.
- Verify all items listed on the packing list / BOM are present. Contact Madden before installation if any damage or shortage is found.
- Minor connection leaks after transit are normal — sample cooler bolts can be lightly snugged to reseal. Do not over-torque.

3.2 Storage

- Store indoors in a dry, covered environment whenever possible.
- If outdoor storage is required, cover with a tarp and ensure painted carbon steel panels remain protected from moisture.
- Protect gauges and compression fittings from impact during storage and handling.
- If storing below 32°F (0°C), ensure no water is trapped in the shell side or piping — drain fully to prevent freeze damage.

SECTION 4 - INSTALLATION

4.1 Wall-Mount Panels

Wall-mount stations consist of a carbon steel or stainless steel back panel, typically pre-bent with a 1" depth and 2" trim flange. Use the pre-drilled bolt holes to fasten the panel to a rigid structural wall or support member capable of carrying the system's operating weight. Refer to the GA for panel dimensions and bolt hole locations.

- Install in vertical orientation for optimal sample cooler performance.

- Ensure mounting surface is plumb and adequate for the panel weight plus operating loads.
- Maintain clear operator access to all valves, gauges, and the sample discharge / sink area.

4.2 Free-Standing Bridge Panels

Free-standing stations include a C-channel structural steel or stainless steel bridge frame. The frame arrives assembled to be lagged to the floor using the provided footpads.

- Anchor both footpads to the floor. Use anchor bolts appropriate for your floor construction.
- Level the frame before lagging. Shim footpads as needed.
- The back panel will arrive bolted to the bridge frame.
- Maintain minimum 18" clearance in front of the panel for operator access.

4.3 Incoming Sample Line Connection

- Sample inlet connection(s) are typically 1/4" Swagelok compression fittings. Use 1/4" OD x 0.035" wall 316SS tubing from the sample source to the station inlet ball valve (or site engineer approved alternative).
- For SC106/107/108 coolers with 3/8" OD coil: sample connections are typically 3/8" Swagelok compression fittings. Use 3/8" OD x 0.035" tube or 0.065” depending on system pressure requirements.
- Confirm that all field-supplied sample line materials (tubing, valves, fittings) are rated for the temperature and pressure of the sample medium. Refer to the sample cooler data sheet for coil pressure ratings.
- Steam sample lines must be capable of handling saturated or superheated steam conditions upstream of the cooler. Consult your engineering standards.
- Do not use copper tubing on steam sample lines or any coil-side connection — Madden stations use 316SS tubing throughout the sample flow path.

4.4 Cooling Water Connection

- Cooling water inlet connections are typically 1/2" FNPT or 1/2" compression (see your GA). Cooling water outlet also 1/2".
- Cooling water supply should be 75°F or cooler for best performance. The sample cooler performance curves assume 5 GPM CW flow at 75°F. Lower flow or warmer water will reduce cooling capacity.
- Install an isolation valve on the CW supply line upstream of the station if not already provided. This allows the station to be serviced independently of the building CW supply.
- Ensure CW drain line is routed to a floor drain or building drain. Drain temperature from the CW side will be elevated during operation but is not a safety concern.

4.5 Sink Drain Connection (if equipped)

- Sink drain connections are 1-1/4" or 1-1/2" as noted on the GA. Connect to floor drain or building drain per local codes.
- Confirm that sample discharge temperatures into the sink will be within acceptable drain temperature limits for your facility.

4.6 Multi-Cooler Panels – Manifolded Cold Water Supply

On stations with multiple sample coolers, cooling water supply is typically manifolded from a single inlet and distributed to each cooler's shell side. CW return lines may be individually discharged or combined. Refer to your GA for the specific piping arrangement.

SECTION 5 – STARTUP PROCEDURE

> ⚠ **NEVER open the sample valve without first confirming cooling water flow. Hot, pressurized boiler water or steam can flash to steam instantly, causing severe burns and inaccurate sample results.**

Follow this sequence for initial startup and every subsequent sampling event:

- Confirm all connections are tight. Check that the sample inlet valve and metering valve are closed.
- Open the cooling water supply valve fully. Confirm flow by observing water at the CW outlet or drain.
- Slowly crack open the sample inlet ball valve — do not open fully on the first startup. Allow the cooler to pressurize gradually.
- Open the sample metering valve slowly and adjust to achieve adequate flow. Lower flow rates produce lower sample outlet temperatures. The standard metering valve Cv is 0.03 — it does not take much adjustment to significantly change flow.
- Check the pressure gauge. Confirm readings are within expected operating range for your sample source.
- Check the temperature gauge. Allow 2–3 minutes for the system to stabilize. Sample outlet should be ≤ 120°F for safe handling with bare hands; contact your water treatment provider for test equipment temperature requirements.
- Purge the sample line before collecting: allow at least *three full line volumes to pass through the station before grabbing a sample. This ensures a representative, fresh sample.
- For steam sample lines, flow should also be sufficient to establish turbulent flow through the full length of tubing between the sample source and the panel before a sample is collected — increase flow temporarily if the line run is *long, then return to normal operating rate before grabbing the sample.
    - *INCOMING SAMPLING LINE(S) LENGTH - Sample line runs on a typical single-cooler wall-mount station are usually 10 feet or less. On multi-cooler free-standing panels serving several boiler processes simultaneously, it is common for one or more sample lines to run 20 feet or longer — particularly for drum, feedwater, or condensate taps that are located across the boiler room from the panel. For those longer runs, three line volumes at normal metering rate may not be sufficient to fully flush stagnant or cooled sample from the line. Use the higher-flow purge described above before throttling back to collect the sample.
- Collect the sample. Close the sample metering valve and sample inlet valve when done. Close the CW valve last.

SECTION 6 – OPERATION

6.1 General Operating Guidance

Madden sample cooler stations are low-maintenance systems designed for reliable grab sampling and continuous flow monitoring. Normal day-to-day operation requires only valve sequencing (always CW first, sample second; close sample first, CW second) and periodic temperature and pressure checks.

6.2 Adjusting Sample Flow

The sample metering valve controls the sample flow rate through the coil. Flow rate is the primary variable that controls sample outlet temperature — lower flow = more cooling. Use the following general guidelines:

- For a grab sample, typical flow rates are 0.05–0.50 GPM depending on the cooler model and sample temperature.
- Increase CW flow (if a CW globe valve is installed) before increasing sample flow if additional cooling is needed.
- Do not attempt to operate above the rated coil pressure for your sample cooler model. The metering valve limits maximum sample flow but does not limit system pressure.

6.3 Pressure Relief Valve (if installed)

A Swagelok poppet check valve (PRV) is included when a discharge isolating valves or equipment are present on the panel sampling or cold water side piping. The PRV protects the shell side from overpressure if the CW supply valve is closed with sample still flowing through the coil. The shell-side rating is 300 PSI on all standard Madden sample coolers. The PRV cracks at 150 PSI. Do not block, bypass, or remove the PRV.

Installing contractors should terminate the PRV line into an existing flash tank in the boiler room, or another safe discharge area away from personnel.

6.4 Thermal Shut-Off Valve (if installed)

If your station includes a thermal shut-off valve (item IN203 or equivalent), it will automatically close the sample outlet when sample temperature exceeds 135°F (57°C), and reopen when temperature drops below 125°F (51°C). This protects operators and test equipment. If the thermal shut-off repeatedly closes during normal operation, reduce sample flow rate or increase CW flow — do not attempt to override or remove the valve.

6.5 Water (liquid) vs. Steam Service

Water service (typically SC102, SC105): The cooler receives liquid water already at or near saturation. Heat exchange is primarily sensible cooling. A 1.3 ft^2 coil is sufficient for most single-phase liquid grab samples at ≤ 0.5 GPM. Increase to 1.9 or 3.8 ft^2 for higher flow rates or sustained duty.

Steam service (typically SC106, SC107, SC108): Steam samples first undergo desuperheating and condensation before sensible cooling begins. A 3.8 ft^2 surface area is strongly recommended for any steam application. The larger surface area accounts for the significant heat load during the phase change. Allow additional stabilization time (3–5 minutes) before collecting a steam sample.

⚠ For steam sampling above 500 PSIG, a pressure letdown device must be installed downstream of the sample cooler and before any ancillary instrumentation on the sample line. Consult your engineering standards or contact the Madden factory for guidance on appropriate pressure reduction equipment.

6.6 Cooling Water Circuit Notes

If your station includes a cooling water outlet globe valve, always use it — not the inlet valve — to adjust CW flow. Throttling at the inlet reduces shell-side pressure and increases the risk of localized boiling on the coil surface, a condition called cavitation, which can fatigue and fracture the coil over time. If no CW outlet valve is present, keep the inlet valve fully open during all sampling operations. On panels used for continuous or steam service, a CW outlet globe valve is strongly recommended and should be specified at time of order if not already included.

As a general operating target, cooling water outlet temperature should not exceed 140°F (60°C). If the outlet temperature approaches this limit, increase CW flow by opening the outlet globe valve further, or reduce the sample flow rate. In continuous steam service, demineralized or softened cooling water is recommended to reduce scaling frequency on the shell side.

SECTION 7 – MAINTENCANCE & INSPECTION

Madden sample cooler stations are designed for long service life with minimal maintenance. The primary wear components are the sample cooler coil gaskets and the coil itself. All other components (Swagelok fittings, ball valves, gauges) are standard industrial items serviceable with replacement parts from industrial distributors.

7.1 Routine Inspection Schedule

Weekly	Check for leaks at all compression fittings, gauge ports, and valve connections. Inspect sample outlet discharge tube for discoloration or scaling.
Monthly	Verify pressure gauge reads correctly at known operating conditions. Check that temperature gauge capillary (if applicable) is undamaged.
Quarterly	Inspect CW drain line for restriction. Confirm thermal shut-off valve (if equipped) actuates freely — cycle the sample through it.
Annually	Disassemble sample cooler and inspect coil for scaling, pitting, or wall thinning (see Section 8). Inspect and replace shell gaskets as needed. Exercise all ball valves to confirm smooth operation.

7.2 Compression Fittings

Compression fittings are pre-swaged at the factory and should remain leak-free under normal use. If a minor leak develops after shipping or installation, it can typically be corrected by tightening the fitting nut 1/8 to 1/4 turn additional. Do not over-tighten. If a fitting continues to leak, replace the tubing and re-swage — do not attempt to re-use a previously swaged fitting on a new tube end.

7.3 Pressure and Temperature Gauges

Gauges are liquid-filled (standard on newer builds) or dry. If a gauge reads erratically, is damaged, or is clearly stuck, replace it. Gauges are standard 1/4" or 1/2" MNPT — replacements are readily available. Ensure replacement gauge range matches the original (typically 0–150, 0–300 PSI or 0-1,500 PSI for pressure gauges; 0–240°F for temperature gauges).

7.4 Shell Gasket (Type 2 Madden Coolers)

The shell-to-plate gasket (Madden P/N SC019A) should be inspected annually. Signs of fatigue include visible cracking, compression set, or weeping at the shell flange joint. Replace as needed. Light retightening of the four shell bolts (9/16" wrench) can reseal minor weeps without disassembly.

7.5 Coil Descaling

If reduced cooling performance is observed but the coil shows no visible pitting or wall loss, chemical descaling should be attempted before committing to coil replacement. For shell-side scale deposits, circulate a diluted inhibited sulfamic acid cleaning solution through the cooling water side of the shell. Follow the chemical supplier's instructions for concentration and contact time. After cleaning, flush the shell side thoroughly with clean water before returning to service. Descaling can restore a meaningful portion of heat transfer capacity and extend coil service life. If performance does not recover after descaling, or if physical damage is observed during disassembly, proceed with coil replacement per Section 8.

SECTION 8 – COIL REPLACEMENT

All Madden sample coolers are designed to be fully disassembled with standard hand tools. Coil replacement is the primary service procedure. Instructions below apply to the specific cooler type in your station.

8.1 Type 2 Cooler Coil Replacement

Tools required: 9/16" socket or open-end wrench (shell bolts); 11/16" open-end wrench (coil compression fittings); 3/4" socket or open-end wrench (bulkhead plate fittings)

- Remove the four 9/16" shell-to-plate bolts and nuts. Separate the shell from the top plate.
- Pull the top plate and coil assembly out of the shell. Secure the plate in a vise if available. Inspect the shell gasket (P/N SC019A) — replace if cracked or fatigued.
- Loosen the Swagelok compression fittings and remove the coil. Set coil aside.
- Loosen and remove the bulkhead fittings from the top plate. This allows the outer nuts to clear the plate's locking grooves. Replace the two bulkhead/coil fitting gaskets (P/N SC045B) while accessible.
- Reassemble in reverse order. Torque shell bolts snug-plus-quarter-turn. Do not over-torque.
- Before returning to service, run cooling water through the shell side only (sample valve closed) and confirm no leaks at the plate-to-shell joint or coil fittings.

8.2 Type 1 Cooler Coil Replacement (if applicable, not standard on panels)

Tools required: Strong vise (pipe vise preferred); large pipe wrench with cheater bar; 9/16" open-end wrench and socket; vise-grips

- Separate the threaded shell from the cap using a pipe wrench. Note: this joint is NPT-threaded and may require significant force. Extending the wrench leverage with a pipe cheater is often necessary.
- Remove the reverse-flow tube from the shell.
- Loosen Swagelok compression fittings and remove the coil. Do not remove the fittings entirely unless they also need replacement.
- If needed, replace the fittings screwed into the cap.
- Reassemble in reverse order. Use pipe thread sealant tape (PTFE) on all threaded connections — Madden recommends pipe dope in addition to PTFE tape for a reliable seal.

Contact the factory to order replacement coils, gaskets, or fittings. Have your sample cooler model number and coil material (copper or 316SS) ready when ordering.

SECTION 9 – TROUBLESHOOTING

Most sample cooler station issues trace to one of three root causes: insufficient cooling water flow, excessive sample flow rate, or a compromised coil/fitting. Check these first before assuming internal fault.

Symptom	Likely Cause(s)	Corrective Action
Sample outlet temperature too high (>120°F)	Sample flow rate too high; CW flow too low or too warm; coil scaled	Reduce sample flow at metering valve; confirm full CW flow; inspect coil for scale
Sample outlet temperature too high — thermal shut-off repeatedly closing	Same as above; thermal shut-off operating correctly	Reduce sample flow rate; increase CW flow if globe valve installed; do not bypass thermal shut-off
No sample flow / metering valve won't pass flow	Sample inlet valve closed; line plugged; coil plugged with scale or debris	Confirm inlet valve is open; flush or clean coil; replace coil if needed
Pressure gauge reads unexpectedly high	Metering valve closed too far while sample inlet is open; line restriction downstream	Open metering valve slightly; confirm sample discharge path is clear
Leak at shell-to-plate joint	Shell bolts loose; shell gasket fatigued or failed	Snug shell bolts (9/16" wrench); inspect and replace gasket if needed (P/N SC019A)
Leak at Swagelok compression fitting	Fitting backed off during shipping; fitting not properly made up	Tighten fitting nut 1/8–1/4 turn. If leak persists, replace tubing and re-make fitting
Leak at coil bulkhead fitting (Type 2)	Bulkhead fitting gasket worn; fitting loose	Tighten bulkhead fitting; replace P/N SC045B gaskets if needed
Sample quality poor / test results inconsistent	Sample line not purged before collection; sample flashing in discharge	Purge 3 full line volumes before collection; confirm sample outlet temp < saturation temp at sample pressure
Pressure relief valve (PRV) discharging	CW globe valve is closed while sample is flowing, pressurizing shell side above 150 PSI	Open CW globe valve; confirm PRV discharge path is unobstructed — do not plug or cap PRV discharge
Reduced cooling performance over time	Scale buildup on coil interior or exterior; CW supply temperature increased seasonally	Inspect and clean coil; consider coil replacement if scaling is severe

If the issue cannot be resolved with the guidance above, contact Madden at (574) 295-4292 or info@maddenep.com. Have your station model number (from the GA drawing or panel label), sample cooler model numbers, and a description of the operating conditions ready.

SECTION 10 – SERVICE & SUPPORT / WARRANTY

For technical assistance, spare parts, or service inquiries:

Phone	(574) 295-4292 (8:00 AM – 4:30 PM EST, Monday–Friday)
Email	info@maddenep.com or sales@maddenep.com
Website	www.maddenep.com
Address	1317 Princeton Blvd., Elkhart, IN 46516
When contacting	Please have your GA drawing number, sample cooler model numbers, and a description of the operating conditions or issue available.

10.1 Warranty Terms

Except where a different express warranty has been issued in writing for a specific product or project, no warranty of any kind, express or implied, is extended by Madden Engineered Products (Seller) to any party other than the direct purchasing Buyer.

To direct Buyers only, Madden warrants that it will either (at Seller's option): furnish replacement parts freight allowed to the initial domestic destination, OR repair the component — for any item manufactured by Madden which is proven to Madden's satisfaction to be defective in material or workmanship under normal use and service: (i) within 18 months from date of shipment, or (ii) within 12 months from the date the equipment is first placed in use.

These terms apply only to Madden equipment manufactured at the Elkhart, Indiana facility. Ancillary purchased components from outside suppliers (gauges, Swagelok valves, fittings, etc.) are covered only by those manufacturers' original warranty terms. Madden will make a good faith effort to assist Buyer in securing remedies from the component OEM.

Madden assumes no responsibility for: performance under conditions materially different than normally tested; damage due to abrasion, erosion, corrosion, scaling, or abnormal thermal cycling; any labor cost, field removal, installation, rigging, or troubleshooting cost; any freight beyond the original domestic destination; or any substitution of non-Madden parts or unauthorized modification.

Improper field modifications — including unapproved valve substitutions, system piping changes, gauge or probe modifications, or drilling/welding on Madden components — void warranty. The Seller shall not be liable for any cost, loss, or consequential damages beyond the price of goods sold.

This warranty is in lieu of all other warranties expressed or implied, including merchantability or fitness for a particular purpose. For complete terms, refer to Madden's Standard Conditions of Sale document provided with your order.