BUILT TO SPEC' CHEMICAL FEED SYSTEMS

General Installation & Maintenance Guidelines

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MADDEN ENGINEERED PRODUCTS

Chemical Feed Systems

SECTION 1 — INTRODUCTION / SAFETY GUIDELINES / SYSTEM OVERVIEW

1.1 Introduction

This manual provides general instructions for the installation, startup, operation, troubleshooting, and maintenance of Madden chemical feed systems. **This document is NOT system specific.** It is intended as a broad overview for systems using positive displacement diaphragm metering pumps of any brand, including Madden JN, MF, and MH series pumps, as well as commonly used third-party pumps such as Milton Roy, Neptune, ProMinent, and others.

System-specific documentation — including pump manuals, mixer manuals, VFD manuals, relief valve instructions, GA drawings, P&IDs, and electrical diagrams — is supplied separately during the submittal review and approval process. These documents shall always be followed for detailed requirements.

1.2 Safety Guidelines

- Follow all facility safety procedures and refer to SDS sheets for every chemical used.
- Only trained and qualified personnel should install, operate, or service chemical feed systems.
- Always wear appropriate PPE including gloves, goggles, face shields, and chemical-resistant clothing.
- Isolate electrical power before servicing equipment when safe to do so.
- Do not breathe chemical vapors; refer to SDS for ventilation requirements
- Avoid placing hands near rotating mixer shafts.
- Do not modify equipment without written authorization from Madden.
- In any emergency scenario, follow site-specific emergency procedures and contact appropriate facility personnel.

⚠ This manual does NOT override specific pump manufacturer instructions, facility engineering standards, water treatment program recommendations, or jurisdictional authority requirements.

1.3 System Overview

A chemical feed system injects a controlled quantity of treatment chemical into a process stream. Positive displacement diaphragm metering pumps provide accurate, repeatable flow regardless of discharge pressure (within pump limits).

Typical components may include:

- Chemical storage tank (HDPE or stainless steel)
- Mixer or agitator
- Positive displacement diaphragm metering pump(s)
- Relief valve and backpressure valve
- Pulsation dampener
- Calibration column
- Suction strainer or foot valve
- Control panel, VFDs, alarms, and switches
- Suction and discharge piping or tubing assemblies

1.4 Receiving, Handling, Storage

Store indoors whenever possible. Recommended storage environment: dry, covered; protect capillaries and gauges; source freeze protection if stored below 32°F (0°C).

If outdoors: cover with a tarp and ensure paint coating is intact.

Handle with forklift or lifting equipment that is sized appropriately for the system weight. Lift from baseplate, vessel body, or lifting lugs only (if applicable). Do not lift by nozzles or ancillary equipment connections.

1.5 Operator Responsibility

Operators must understand basic operation, safe handling of chemical dosing systems, and valve logic.

Madden does not control field installation practices or treatment program strategy and therefore cannot assume responsibility for how the system is installed, operated, or integrated into the facility's process.

Final responsibility for safe piping, sizing, vent discharge routing, utility balancing, and boiler blowdown rate remains with:

- The installing contractor
- The boiler manufacturer
- The facility engineer
- The water treatment company

SECTION 2 — INSTALLATION, STARTUP, OPERATION, & MAINTENANCE

2.1 General Handling, Receiving, & Installation

- Inspect equipment upon delivery for visible damage
- Verify all components listed in the submittal packet are present
- Protect gauges, valves, piping/tubing during handling
- Install systems on a level, rigid foundation capable of supporting the operating weight.
- Anchor skids to prevent movement and vibration.
- Ensure the installation area is protected from weather unless outdoor-rated components are used.
- Ensure suction piping is as short and direct as possible. Vertical rises on the suction line should be avoided unless specifically required.
- Provide flooded suction for best pump performance; suction lift should be minimized when applicable.
- Avoid excessive pipe strain on pump connections; use unions or flexible connectors as needed.
- Pipe relief valves back to a safe location, typically the tank or suction line, depending on design.
- Electrical connections must be performed by qualified electricians following all applicable codes and OEM instructions. Ensure installation is in a clean, accessible location for future inspection

Adequate operator access to the chemical holding tanks, pump and mixer motors, control panel (if applicable), ancillary instrumentation, and system outlet, relief return, and drain line MUST be maintained.

2.2 Commissioning & Startup

Before startup:

- Verify pipe connections are tight and correctly oriented.
- Confirm electrical power supply and motor rotation (if applicable).
- Prime the suction line with chemical or water to reduce air accumulation.
- Ensure mixers are unobstructed and chemical levels are adequate.

Initial Startup:

- Start the pump at low stroke or low speed.
- Gradually increase to required output.

- Crack open a downstream fitting or loosen a discharge union temporarily (when safe) to help purge air from the pump head during initial prime.
- Observe discharge pressure, flow stability, and pump cycling.
- Verify that the relief valve is functional and not lifting during normal operation.
- Check for leaks and correct immediately.

2.3 Operation

- Operate pumps within their intended stroke or speed range for best accuracy.
- Maintain a flooded suction when possible to prevent air lock.
- Allow mixers to fully disperse chemicals before feeding downstream.
- Monitor discharge pressure and adjust backpressure valves as required.
- Inspect relief valve discharge periodically for unexpected flow (indicating overpressure or obstruction).

2.4 Maintenance

NOTE: The maintenance guidance below is general. For specific pump rebuild intervals, lubrication requirements, torque values, replacement part identification, and detailed procedures, always refer to the individual operator's manuals and OEM data sheets provided in your project submittal package.

- Inspect pumps weekly for leaks, unusual sounds, or changes in discharge pressure.
- Replace diaphragms and valve kits per OEM recommendations or when performance changes.
- Ensure suction strainers and foot valves remain clean and unobstructed.
- Diaphragms naturally 'creep' during early operation. Retorque pump head bolts lightly during the first weeks of runtime (refer to pump manual for torque values)
- Verify calibration column accuracy periodically.
- Keep common wear parts (diaphragms, valve kits) stocked based on the specific pump model.
- Maintain clean electrical enclosures and ensure proper ventilation.
- Document all maintenance activities in facility logs.

SECTION 3 — TROUBLESHOOTING

Issue / Symptom	Likely Cause(s)	Recommended Solution(s)
Pump Will Not Prime	• Air trapped in head • Suction line leak • Suction lift too high • Blocked foot valve or strainer • Incorrect valve orientation	• Verify flooded suction if possible • Tighten all suction fittings • Clean/replace foot valve screen • Refill suction line to remove air • Check valve orientation per pump manual
Pump Loses Prime During Operation	• Low tank level • Suction obstruction • Gas entrainment • Loose connections • Excessive suction lift	• Restore tank level • Check suction piping for debris • Eliminate air/gas source upstream • Tighten fittings • Reduce suction lift height
No Flow / Low Flow	• Worn diaphragm • Worn valve seats/balls • Obstructed suction/discharge • Incorrect stroke/speed setting	• Replace diaphragm • Replace valve kit • Remove obstruction • Set stroke/speed per calibration
Flow Pulsation / Instability	• Gas pockets in discharge line • Backpressure valve not set • Insufficient discharge pressure for stable flow	• Adjust backpressure valve • Install/verify pulsation dampener • Bleed trapped gas

Excessive Noise or Vibration	• Air binding • Cavitation • Diaphragm wear • Pump misalignment • Mounting bolts loose	• Remove air from pump head • Reduce suction lift; ensure NPSA • Replace diaphragm • Check and tighten mounting hardware
Pump Overpressure / Relief Valve Lifting	• Blocked discharge • Closed valve downstream • Frozen pipeline • Relief valve stuck or mis-set	• Inspect discharge path • Confirm valves are open • Thaw and insulate exposed piping • Verify relief valve setting/condition
Chemical Leaks	• Loose fittings • Cracked piping • Worn diaphragm • Damaged O-rings/gaskets	• Tighten fittings • Replace damaged piping • Install new diaphragm • Replace gasket/O-ring set
Inaccurate Feed Rate	• Calibration drift • Viscosity changes • Worn pump components • Blocked calibration column	• Recalibrate pump • Verify chemical temperature/viscosity • Inspect and rebuild pump head • Clean calibration column
Pump Will Not Reach Expected Pressure	• Worn valves or diaphragm • Air entrainment • Relief valve lifting prematurely	• Replace valve assemblies • Eliminate air upstream • Check PRV setting
Suction Line Air Intrusion	• Cracked tubing • Loose joints • Worn foot valve • Porous hose or fittings	• Replace damaged suction components • Tighten all joints • Replace foot valve
Foot Valve or Strainer Issues	• High debris loading • Chemical precipitation • Screen plugging	• Clean or replace foot valve assembly • Evaluate upstream filtration
Diaphragm Failure Symptoms	• Loss of flow • No discharge pressure	• Replace diaphragm immediately • Inspect pump for secondary damage
VFD / Electrical Problems	• Incorrect settings • Low voltage • Wiring errors • Fault codes present	• Refer to OEM manual for VFD • Confirm rated supply voltage • Reset drive if appropriate • Correct wiring per diagram
Mixer Not Operating Properly	• Motor fault • Bent shaft / loose propeller • Worn bearings • Electrical failure	• Inspect motor and wiring • Verify alignment and connection • Replace bearings/shaft as needed
Alarms or Level Switch Issues	• Improper setpoint • Faulty float switch • Wiring/connection problems	• Adjust setpoint • Test and replace float switch • Resolve wiring issues

SECTION 4 — WARRANTY / LEGAL RESPONSIBILITIES

4.1 General Responsibility Assignment

Madden Engineered Products manufactures engineered chemical feed system equipment. The performance, lifecycle, and operating behavior of this equipment is strongly influenced by the environment in which it is installed, including but not limited to: water treatment program, operator technique, DCS/PLC control design, field piping method, outside pipe routing, and facility utility balance.

Therefore:

- The owner / facility is responsible for ensuring the system is installed correctly and operated under normal industrial conditions. Owner shall ensure compliance with local environmental regulations.
- The installer / piping contractor is responsible for correct piping practices, valve selection, vent routing, support, and service access.
- The local water treatment / chemical supply vendor is responsible for determining the correct chemical dosing rate.
- The water treatment provider is responsible for correct chemical control, conductivity strategy, scaling / corrosion mitigation, and general treatment philosophy.

Madden provides mechanical equipment. Madden cannot assume operational control or data-driven decision responsibilities for the user's chemical treatment process.

Improper field modifications (including unapproved ancillary equipment, valve substitutions, system piping changes, gauge or probe modifications, or drilling / welding) void warranty.

4.2 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:

- within 18 months from date of shipment, or
- within 12 months from the date the equipment is first placed in use

These terms apply only to Madden equipment manufactured at our Elkhart, Indiana facility.

Ancillary purchased components from outside suppliers are covered only by those manufacturer's original warranty terms (see "Goods of Other Manufacturers" below).

Madden assumes no responsibility for:

- Performance under conditions materially different than normally tested
- Damage due to abrasion, erosion, corrosion, scaling, abnormal thermal cycling, or foreign debris
- Damage caused by oversized or pulsed blowdown events outside normal surface blowdown range
- Any labor cost, field removal, installation, rigging, or troubleshooting cost
- Any freight beyond the original domestic destination
- Any substitution of non-Madden parts or unauthorized modification

The Seller shall not be liable for any cost, loss, or consequential damages beyond the price of goods sold.

Goods of Other Manufacturers: Components sourced outside Madden are not warranted by Madden directly. Madden will make good faith effort to assist Buyer in securing remedies available from the component OEM.

This warranty is in lieu of all other warranties expressed or implied, including merchantability or fitness for a particular purpose.

SECTION 5 — APPENDICES

Reminder, for any chemical feed system order, Madden provides system specific literature for review and approval before fabrication. Contact our factory or your company's purchaser / project manager / or in-house engineer for most of these details.

- Appendix A — System P&ID (Provided Separately During Submittal Review)
- Appendix B — General Arrangement Drawings (Provided Separately During Submittal Review)
- Appendix C — Specific Component Operator's Manuals (Provided Separately During Submittal Review)
- Appendix D — Electrical Drawings (Provided Separately During Submittal Review)
- Appendix E — Factory Testing Data (Provided Separately After Fabrication)