



## DETAILED EQUIPMENT SPECIFICATION

### MRO-4 SERIES REVERSE OSMOSIS SYSTEMS

#### 1.0 SCOPE

- 1.1 Provide as indicated a factory assembled reverse osmosis (RO) system shipped for ease of installation and start up. The system shall be of an approved design as fabricated by a manufacturer regularly engaged in the production of water treatment equipment. All equipment and material shall be supplied per the specifications as intended for a complete and operational system.
- 1.2 Qualified manufacturers of water conditioning equipment shall be engaged in the manufacture of this type of equipment for a period of not less than (10) years. Acceptable manufacturers are Marlo, Inc. or engineer's approval equal.

#### 2.0 GENERAL DESCRIPTION

- 2.1 The system, in compliance with equipment specifications, is described as an \_\_\_\_\_
- 2.2 The system specifications are based on Marlo Model MRO-\_\_\_\_\_

#### 3.0 DESIGN DATA

##### 3.1 DESIGN PARAMETERS

Design System Flow \_\_\_\_\_ GPM (RO make-up rate)  
Design System Flow \_\_\_\_\_ GPM (Distribution)  
Daily Water Usage \_\_\_\_\_ Gallons / Day  
Daily Hours of Water Demand \_\_\_\_\_ Hours / Day  
Operating Temperature Range \_\_\_\_\_ °F  
Operating Pressure Range (System) \_\_\_\_\_ PSIG  
Electrical Requirements \_\_\_\_\_  
System Dimensions (LxWxH) \_\_\_\_\_  
Desired Storage Capacity \_\_\_\_\_ Gal.

##### 3.2 WATER ANALYSIS

**(insert accurate feed water quality report here)**

##### 3.3 DESIRED WATER QUALITY

**(insert final water quality parameters here)**

## **4.0 EQUIPMENT DESCRIPTION**

### **4.1 RO MEMBRANE ELEMENTS**

The RO elements shall be thin-film composite (TFC), 4" diameter x 40" long with an FRP overwrap, anti-telescoping device and u-cup brine seal. The design salt rejection shall be 98% based on 2000-PPM water and 225 PSIG at 77 degrees F.

### **4.2 RO ELEMENT HOUSINGS**

The RO element housings shall be constructed of fiberglass reinforced polyester (FRP) with PVC end caps. Stainless steel clamps hold the end caps in place. Each housing assembly is complete with one set of O-rings and O-ring lubricant.

### **4.3 HIGH PRESSURE PUMP AND MOTOR**

The pump shall be a vertical, multistage centrifugal type constructed of 304 stainless steel casing, shaft, impellers, inlet and discharge castings. All pump bearings shall be tungsten carbide and ceramic. The pump shall have a cast iron frame with flanged suction/discharge connections. A NEMA standard C-faced TEFC motor shall be mounted to an adapter supported on the pump-bearing frame. The motor shall be rated for 3500 RPM, 460 VAC, three-phase, 60 Hz. power supply.

### **4.4 ELECTRICAL CONTROL SYSTEM**

The control system shall consist of an electronic microprocessor controller and pre-wired motor starter panel factory assembled and tested. Enclosures shall be NEMA 4X rated and constructed of FRP. A pressure switch shall be provided to shut down the RO pump in a low pressure condition. A pump run-time indicator shall be provided. A pretreatment interlock indicator and control shall be provided to prevent RO operation when pretreatment equipment (such as the activated carbon filter) is off-line in the backwash or regeneration mode. An autoflush indicator and control shall be provided to flush RO concentrate from the machine at shutdown and/or pre-determined intervals.

### **4.5 INSTRUMENTATION**

Two (2) panel-mounted flowmeters, one product and one concentrate, shall be included. Panel-mounted pressure gauges for inlet, cartridge filter outlet, RO feed, RO concentrate, and RO product shall be 316 stainless steel and liquid filled. A panel-mounted conductivity monitor shall be provided to measure the RO product quality (in microsiemens/cm). The monitor shall have a digital display, alarm relays, and automatic temperature compensation. The conductivity probe shall be mounted in the RO product outlet line and pre-wired to the conductivity monitor.

### **4.6 VALVES**

The pump throttle valve, concentrate throttle valve and recycle throttle valve shall be an in-line needle style, constructed of stainless steel and rated over 300 PSIG. The automatic inlet shutoff valve shall be a diaphragm type, solenoid actuated, normally closed, and constructed of glass-filled noryl thermoplastic. The inlet isolation valve, product and concentrate check valves and sample valves shall be PVC with EPDM seats and seals. There shall be a sample valve for cartridge filter outlet, concentrate and product lines. The machine shall be equipped with an automatic membrane flush valve in order to purge the RO membranes with fresh water when the machine shuts down as a means of reduces membrane scaling and fouling.

### **4.7 CARTRIDGE PRE-FILTER**

A cartridge filter housing shall be provided in the machine inlet line and constructed of polypropylene and include a built-in pressure relief or vent valve. The filter element shall be constructed of spun-wound polypropylene and rated at 5-micron nominal.

### **4.8 SKID AND FRAME ASSEMBLY**

The entire RO machine shall be built on a skid and frame constructed of structural carbon steel and completely electrically welded. The entire surface shall be sand-blasted and finish painted with a "Safety Blue" self-priming, high solids epoxy overcoat.

### **4.9 PIPING**

All low pressure piping (75 psig or less) shall be constructed of Sch 80 PVC. RO product tubing from each membrane housing shall be reinforced PVC. All control and pressure gauge tubing shall be constructed of polyethylene.

All high pressure piping (75 psig and higher) shall be constructed of 304 stainless steel. Threaded and compression high pressure fittings constructed of stainless steel or brass is acceptable. High pressure control and pressure gauge tubing shall be 1000 psig burst nylon.

#### 4.10 INSTRUCTIONS

A set of two (2) complete Installation, Operation and Maintenance manuals shall be provided in three-ring binder form. As-built general arrangement, process and instrument, and electrical drawings shall be included. All component data, manuals, calibration documents shall also be included. A recommended "on-hand" spare parts list shall be provided.

#### 4.11 WARRANTY

The manufacturer shall provide an 18-month materials and workmanship warranty from the date of equipment shipment. Membrane element warranty is per the selected RO element manufacturer standard warranty.

#### 4.12 FIELD-SERVICE

On-site startup or service shall be made available from the factory or the local manufacturers representative. Technical service phone support and spare parts must also be available from the manufacturers factory. Rates and prices to be clearly stated in the operation and maintenance manuals.

### 5.0 OPTIONAL EQUIPMENT (RO PRE-TREATMENT)

#### 5.1 MULTI-MEDIA FILTER

A single multi-media filter properly sized for the inlet flow rate of the RO machine shall be provided for suspended solids removal down to the order of 10-20 micron. Media tank to be constructed of fiberglass reinforced polyester (FRP) designed for 150 psig. A pre-piped internal backwash distributor and filtered water collector shall be provided. The filter media shall consist of a top layer of anthracite, middle layer of silica sand, and bottom layer of multi-grade garnet. The filter media shall be provided separately in one (1) cubic foot bags and installed at the job-site. The automatic backwash cycle shall be performed by a top mounted, piston operated control valve with a pre-sized drain line flow control orifice. The backwash cycle to be initiated by an adjustable seven (7) day electro-mechanical calendar timeclock. Basis of Design: Marlo MID Series

#### 5.2 ACTIVATED CARBON FILTER

A single activated carbon filter properly sized for the inlet flow rate of the RO machine shall be provided for the removal of chlorine and prevention of RO membrane damage. Media tank to be constructed of fiberglass reinforced polyester (FRP) designed for 150 psig. A pre-piped internal backwash distributor and filtered water collector shall be provided. The filter media shall consist of a 12 x 40 mesh, bituminous coal based activated carbon. The filter media shall be provided in one (1) cubic foot bags and installed at the job-site. The automatic backwash cycle shall be performed by a top mounted, piston operated control valve with a pre-sized drain line flow control orifice. The backwash cycle to be initiated by an adjustable seven (7) day electro-mechanical calendar timeclock. Basis of Design: Marlo ACA Series

#### 5.3 WATER SOFTENER

A twin alternating water softener properly sized for the inlet flow rate of the RO machine and incoming water hardness shall be provided to prevent the scaling of RO membrane elements. Resin tank to be constructed of fiberglass reinforced polyester (FRP) designed for 150 psig. A pre-piped internal backwash distributor and soft water collector shall be provided. Softening resin shall have an exchange capacity of 30,000 grains per cubic foot when regenerated with 15 lbs of salt. The brine tank shall be constructed of rotationally molded polyethylene with snug-fitting cover. A float operated, air-check brine valve shall be provided to automatically measure the correct amount of brine to the softener unit and re-fill with fresh water.

The softener regeneration shall be performed by a top-mounted, piston operated control valve with pre-sized flow controls and brine injector. An attached water meter shall monitor the volume of water processed and automatically initiate softener regeneration. An alternator controller shall be provided to permit only one vessel in service at any time. The second tank is to be in either regeneration or stand-by mode at any time. Basis of Design: Marlo MAT or MGT Series

**5.4 INLET WATER TEMPERING VALVE**

A thermostatic water tempering valve shall be provided to increase the RO inlet water temperature to 75-77°F and improve machine performance. The valve shall include a bronze body, swivel action check stops, removable cartridge/strainer, stainless steel internal piston, temperature regulator dial, hot/cold water inlet shutoff valves, and outlet bimetal thermometer. Basis of Design: Symmons Series #5

**5.5 SDI APPARATUS**

A Silt Density Index (SDI) apparatus shall be provided to measure the degree of suspended solids feeding the RO membranes. It consists of a pressure regulator pressure gauge, filter holder, 600 mL beaker, sample valve, tubing and 0.45 micron filter papers.

**5.6 WATER TEST KIT**

A comprehensive water quality testing kit shall be provided to field-measure total water hardness, total iron, free chlorine, and pH.

**6.0 OPTIONAL EQUIPMENT (RO POST-TREATMENT)**

**6.1 ATMOSPHERIC STORAGE TANK**

The free-standing RO product water storage tank shall be constructed of linear polyethylene in one piece, seamless construction and closed-top, flat bottom design. The tank shall have a top manway for convenient access. PVC bulkhead fittings shall be installed for high / low-level switches, RO permeate inlet, RO permeate discharge, and drain. A 0.2-micron tank vent filter shall be installed at the top head of the tank.

**6.2 STORAGE TANK LEVEL CONTROL**

An adjustable float switch assembly shall be provided for the product storage tank. Switches shall signal start and stop to the RO unit. A secondary adjustable float switch shall be provided for low tank level, and shall signal the shut-off of the repressurization pump.

**6.3 RO WATER RE-PRESSURIZATION PUMPS**

Two (2) close coupled, single-stage centrifugal pumps suitable for the distribution of RO water shall be provided. One pump is designed as a dedicated piped and wired spare. Wetted components shall be constructed of 316 stainless steel with NPT suction / discharge connections. Motors shall be ODP and rated for 3500 RPM, 460 VAC, three-phase, 60 Hz power supply. A NEMA-4X pump control panel constructed of fiberglass shall be provided with prewired motor starters, pump selector switch, pump run lights, low tank level alarm light, hand / off / auto switch, and pump run hour meters. Basis of Design: G&L NPE Series or approved equal.

**6.4 ULTRAVIOLET LIGHT**

An ultraviolet water disinfection light shall be provided for the effective destruction of water bacteria present in the storage tank and distribution line. The lamp wavelength shall be 254 nm with a 9,000 hour life. The pressure vessel shall be 316 stainless steel with NPT or flanged inlet / outlet connections. The UV lamp shall be housed in a heavy-duty quartz jacket. A NEMA-3R electrical control cabinet shall include an elapsed run time meter and ballast power indicator light. The ON / OFF control shall be wired through the pump control panel. Basis of Design: R-Can Sterilight Series

**6.5 POST-FILTER HOUSING**

Designed to trap contaminants down stream of the UV light. Filter housing shall be constructed of polypropylene or 316 stainless steel and include a built-in pressure relief valve. The filter element shall be spun-wound polypropylene and rated for 1.0 micron nominal.

## **7.0 SKID MOUNTED SYSTEM OPTION**

The RO machine, pre-treatment equipment, and post-treatment equipment (excluding the RO water storage tank) shall be provided completely mounted on a common skid and frame assembly constructed of welded structural carbon steel. All interconnecting piping and manual isolation/bypass valves between equipment shall be provided. Piping and valves are to be constructed of Sch 80 PVC. Electrical control panels and all interconnecting wiring are to be provided in a watertight flexible conduit. A single point electrical connection for three-phase and single-phase power shall be required.