Purchase Specification for Side Ported Housings

Dear Specifying Engineer friends,

In our endeavor for continuous improvement and innovation, we are pleased to announce the launch of the next generation side port pressure vessels - the OCTA Series. This new Series possesses a number of exciting new design features that translate to greater system design flexibility, lower cost of ownership/maintenance, and improved ease of operation.

As part of this exciting new design launch, we are issuing an updated version of the Side Ported Housing Purchase Specification document. We have incorporated the latest information from relevant industry certifying and regulatory bodies, more detailed design and operating parameters, and some specific information highlighting the features and benefits of the OCTA Series.

In an attempt to make this updated specification as simple to use as possible, we have divided it into four basic areas. For your convenience, the entire document and sections is available on CD to allow for cut-and-paste placement directly into your specification.

The four areas are as follows:
1) Basic Specification Requirements
2) ASME Code Stamp Applications
3) Items Commonly Requested by End Users
4) Features for Case by Case Consideration

Basic Specification

This Section includes only essential items that should be included in every basic specification.

Please note that they are included to help ensure that each supplier is indeed qualified and therefore, equal to the competition. Failure to include these items may encourage the use of lesser quality components that can in turn create problems for the end user. Please remember that if you do not include specific requirements such as outside surface finish or even vendor experience, you

might be forced to accept vessels that do not meet your or your customer's expectations.

ASME Code Applications

The Section on the ASME Code should be used in addition to the basic specification for vessel consistency and jurisdictional compliance. Our basic specification, above, requires as a minimum, that the design is qualified per ASME, Section X. An actual Code Stamp requires third party inspection throughout vessel fabrication as a means of ensuring that the integrity of a qualified design is not compromised while in production. Large projects commonly specify the Code to help ensure safe vessel operation (the prevention of catastrophic failure) and also to reduce the cost of plant insurance. While the Code cannot "guarantee" long vessel life, the actual cost of the ASME stamp is now low enough to make it a requirement well worth specifying for most of any system.

Items commonly requested by end users

In the past, most specifications were written to cover the initial purchase of equipment sometimes forgetting that the end user would need supplier support over the life of the products selected. With this being the case, end users have commonly come to us for help and support even though they may have purchased their housings elsewhere. This has led us to include a section that specifically identifies the items most commonly requested by end users, but sometimes ignored by specifying engineers.

Features for case by case consideration

Membrane housings are used in many different applications and configurations that sometimes will require additional features. While not every system will require these items, we have included them here so that you can select any that are appropriate for your system. We encourage you to add to this list and then inform us for future revisions to this sample specification.

PURCHASE SPECIFICATION (Side Ported Fiberglass RO/UF Pressure Vessels)

1. Basic Specification Requirements

1.1 Pressure vessels shall have a diameter and length designed specifically to contain a quantity of _____ standard eight-inch diameter by _____ inch long spiral-wound membrane elements. The feed and concentrate ports shall be located in the side-wall of the pressure vessel. Vessels with multiple ports per end for direct vessel to vessel connection are permitted to simplify system design, provide a smaller footprint and eliminate excessive manifolds.

1.2 The pressure vessel design must meet all the requirements of ASME Section X, entitled Fiber Reinforced Boilers and Pressure Vessels. The vessels do not have to be code stamped, but proof of Code compliance shall be demonstrated by submission of an ASME Design Report and the Prototype Qualification Form, duly approved by the Authorized Inspector for the vessel design and fabrication procedure proposed.

1.3 In order to demonstrate competency in the fabrication of pressure vessels used as membrane housings, the manufacturer shall have a minimum of ten years experience in the production of 8-inch membrane housings with a minimum of 250,000 such vessels in service.

1.4 Vessels shall have a maximum working pressure of not less than _____ psi at a temperature up to: 1. 150^{O}F(66^{O}C) for 1000/1200 psi vessels 2. 190^{O}F (88^{O}C) for vessels up to 600 psi. Minimum operating temperature shall be 20^{O}F (-7^{O}C.)

1.5 Vessels shall be complete with end closures, hardware and membrane element end adapters. Membrane elements and between-element inter-connectors are not furnished as part of this section.

1.6 In order to assure field serviceability, all seals, whether in the shell or head shall be visible so as to be directly accessible for replacement.

1.7 Pressure vessels shall be CodeLine, or equal, as proven by the OEM prior to bid submission.

1.8 Pressure vessels shall be designed for ease of use and fail-safe operation. The vessels shall include the following:

1.8.1 In order to provide superior long-term strength, the locking ring groove shall be integrally filament wound in to the I. D. of the vessel. Cutting or grinding of fibers to form the locking ring groove is not acceptable, as this may weaken the shell and directly affect the safety and service life of the vessel.

1.8.2 The shell bore shall be fabricated from a resin-rich epoxy barrier, that has been cured from the inside diameter outward to allow for superior corrosion resistance and minimal extractable. Winding over plastic pipe is not acceptable under any circumstances.

1.8.3 The shell of the vessel shall be fabricated of filament-wound fiberglass reinforced plastic (FWFRP) using continuous glass roving, impregnated with an elevated temperature cure epoxy resin system to provide superior dimensional stability and long term service life. The use of single monomer resin is strictly prohibited.

1.8.4 Each shell inside diameter shall be free of pits or voids that may promote bacteria growth or corrosive attack of the resin-rich barrier and shall conform to ASME Section X, Appendix 6. The bore diameter shall be a mirror-like, smooth surface and meet the following measurement throughout the membrane interface area:

Nominal 8-inch diameter	:	7.945" – 7.955"
Surface Finish of the Bore	:	Max 4 RA

1.8.5 Each shell shall have a smooth exterior surface that has been coated with a two-part polyurethane enamel for superior gloss retention, abrasion resistance and to block light that may promote biological growth. The maximum transmittance of UV rays of wavelength range of 380 nm to 820 nm should be less than 0.01%. The paint should have minimum 80% gloss retention after 2000 hours of QUV exposure. Each end-bell shall be free of any grinding or sanding marks. The length of the shell between the bells shall be perfectly straight and smooth, and without any lumpiness that may indicate filament-winding inconsistency that could affect performance.

1.8.6 The shell shall be fail-safe to prevent catastrophic failure while in service. The wall of the shell shall fail in weep mode at a nominal value of not less than four times the design pressure to ensure safe operation over a long service life. This failure shall not occur around the side ports. The shell of the vessel shall fail at a nominal value of not less than six times design pressure to prevent the possibility of catastrophic failure while in service. The failures should meet the requirements as specified by ASME Code, Section X, RT 223.

1.8.7 The head should be constructed of Aluminum / Steel bearing plates to meet ASME requirements and the sealing plate coming in contact with fluid should be constructed using high grade, NSF listed glass filled engineering thermoplastic.

1.8.8 The head should have a positive stop to prevent possible suction due to vacuum created during operation of the system. The positive stop helps reduce the possibility of permeate port seal roll-over and related loss of permeate quality.

1.8.9 Permeate port should have opening from both feed and concentrate end to facilitate the probing/sampling of permeate. Mechanical shim devices with corrosive materials should be avoided.

1.8.10 The head seal should be in the groove provided on the head / sealing plate to prevent dislocation during the installation/operation inside the vessel.

1.8.11 The internal operating pressure of permeate port should be 125 psi.

1.8.12 The seal between the adapter and the permeate port should be provided in the external groove of the adapter, allowing easy access to the seal and to prevent the seal from rolling off during installation/operation.

1.8.13 The primary means for head retention shall be a single piece retaining mechanism that provides ASME-required redundancy and is constructed for ease of use and long term reliability.

1.8.14 All metallic parts should comply with the requirements of Section VIII Div 1 per RM-211 of ASME Section X. The retaining mechanism, being metallic pressure part, shall comply with the requirements of UG –11(b) of Section VIII Div 1.

1.8.15 All metallic pressure parts in the vessels shall be made of materials permitted under Section VIII Div 1 and shall be suitable for the design conditions specified for the completed vessel in accordance with the rules of this division.

1.8.16 Each head shall contain integral secondary interlock that requires a simple, yet specific sequence of events to remove the end closure.

1.8.17 The feed/concentrate side port should be mechanically connected to the vessel shell by means of threads provided on the port and the shell of the vessel. Separate retaining rings or securing nuts should not be used for retention.

1.8.18 The sealing surfaces for the side port should be integrally formed, flat and resin-rich. This should not be created by cutting the laminate, thereby disturbing the continuity of the fiberglass reinforcement.

1.8.19 Seal should get required compression by tightening the port to specified torque level (120 Nm).

1.8.20 Each side-ported feed/concentrate port shall incorporate a flush-face elastomeric seal that seals directly to the inside diameter of the vessel shell so that edge laminate surfaces are not exposed and dead space is eliminated.

1.8.21 Each side-ported feed/concentrate port shall be constructed of high-grade stainless steel and shall be designed to interface with a (1 ½", 2.0", 2 ½" or 3.0") flexible grooved coupling.

1.8.22 The materials used in the construction of the pressure vessel shall be of sufficient strength and corrosion resistance for the operating conditions. These materials shall have the following characteristics:

1.8.22.1 All wetted components in continuous contact with the pressured process water shall be made from Engineering Plastics or metals that are known to have long-term resistance to corrosion in the service intended.

1.8.22.2 All other materials of construction shall be of appropriate strength and corrosion resistance for the operating conditions. The use of an UN-anodized aluminum is strictly prohibited.

1.8.22.3 The materials of construction for each component part of the vessel shall be clearly and fully specified on the Engineering Drawing.

2. ASME CODE STAMP APPLICATIONS

2.1 Vessels shall be designed, constructed, third party inspected and code-stamped in accordance with the latest edition of the ASME Boiler and Pressure Vessel Code - Section X, Fiber-Reinforced Plastic Pressure Vessels (Code). The requirements include, but are not limited to, the following:

2.1.1 Manufacturer shall be qualified to produce Code Certifiable Pressure Vessels per Section X of the Code as verified by possession of a current Certificate of Authorization issued by the ASME.

2.1.2 Vessels shall be built to a design that has been qualified for manufacture through ASME Design and Procedure Qualification Tests. The tests include destructive pressure tests of prototype vessels. To qualify, a prototype must not burst at less than six times **(6X)** its rated pressure after being pressure cycled **100,000** times.

2.1.3 Vessels shall be manufactured so as to duplicate the qualified design through compliance with the ASME approved Procedure Specification written for the prototype. Proof of conformance is established through the workings of the ASME approved Quality Control System.

2.1.4 Vessels shall be tested to assure conformance with the qualified design through ASME Quality Control and Production Tests. Each vessel undergoes ASME Production Tests, which include a Hydrostatic Leakage Test at a pressure of **1.3** times the rated pressure.

2.1.5 A third party ASME Authorized Inspector shall inspect vessels at stages during fabrication in order to assure conformance with the qualified design.

2.2 The materials shall be approved for use in pressure vessel construction by the standards of the ASME Boiler and Pressure Vessel Code. Such materials shall meet the following criteria:

2.2.1 Materials shall be certified by the manufacturer to meet Code standards where applicable and shall be lot traceable. Materials of construction shall be lot traceable to the vessel serial number.

3. END USER COMMONLY REQUESTED ITEMS

3.1 The manufacturer shall provide instructions on installation, operation and maintenance and proper application of the vessels as well as a vessel drawing. One set of this documentation shall be provided with the bid and 3 sets with the order. The documents provided shall include the following:

3.1.1 Operation and Maintenance Instructions - step by step instructions for opening and closing the vessel along with precautions and recommended maintenance procedures. These instructions shall be written to inform a general mechanic unfamiliar with RO vessels.

3.1.2 Installation Instructions - detailed instructions for handling, mounting and connecting the vessel.

3.1.3 Application Guide - general guidelines to assist the RO system engineer to apply vessels correctly to the specific requirements.

3.1.4 Engineering Drawing - detailed drawings that specify all parameters necessary to incorporate the vessel component into the RO system, including dimensions, weights and materials of construction.

4. **FEATURES FOR CASE BY CASE CONSIDERATION**

4.1 The adapters furnished shall be appropriate for the brand of membrane element specified. In addition, the vessel shall be designed to allow other makes of membrane elements to be easily accommodated by changing the adapters.

4.2 Vessels shall be designed to allow membrane elements be connected to the permeate port at both ends of the vessel in order that permeate can be taken from either or both ends.

4.3 Each permeate port shall be designed with an anti-rotation mechanism so that piping may be easily tightened.

4.4 The head shall be designed to minimize both the distance and force required for installation and removal.

4.5 Tool for assistance in removing the head from the vessel should be available as an option.