Reliability and Compression Engineering

Purchase Specification: Filter Separators

Revision: 1.30
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1 INTRODUCTION

1.1 Scope

Filter separators shall be designed to remove entrained solids and liquids from a natural gas stream as specified herein. They are not primarily designed to handle constant or intermittent slugs of liquids.

This specification defines the Company requirements for materials and design, fabricating, coating, testing and shipping of filter separators.

The design, detailing, fabrication, supply, and delivery shall be in compliance with this *Specification*, attached datasheet, and any accompanying drawings.

Delivery shall be as specified in the contract documents for the filter separator. Shipping dates shall be coordinated with Company to meet the needs of the construction schedule.

1.2 Definitions

Within the body of this design standard, the following definitions shall apply:

- “Company” means Boardwalk Pipelines, LP, its subsidiaries and affiliates.
- “Company Representative” means a member of the design team that is designated to act on Company’s behalf for all matters relating to quality control, examination, witnessing, and acceptance of the Vendor’s work. This individual may be a Company employee or a non-employee representing Company (e.g., a third party inspection agency or a consultant hired by Company).
- “Vendor” means the filter separator supplier, its subcontractors and/or suppliers who will supply the filter separator in accordance with this *Specification*.

1.3 Codes and Standards

The codes and standards listed in the following tables are incorporated by reference. All equipment supplied under this Specification shall conform to the applicable requirements of each. In case of conflict between documents, contact Company Representative for resolution.

Codes and standards listed in the table below shall be the edition referenced in DOT/PHMSA regulations. Title 49 CFR, Part 192 and other codes and standards in the table below shall be the latest edition.

Table 1-1 Codes and Standards

Code/Standard	Title
49 CFR, Part 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
ASME Boiler & Pressure Vessel Code, Section VIII	Rules for Construction of Pressure Vessels
ASME Section IX	Welding, Brazing, and Fusing Qualifications
ASME B16.5	Pipe Flanges and Flanged Fittings
ASTM A435/A435M-90	Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
API RP521	Guide for Pressure Relieving and Depressurizing Systems
MSS SP-44	Steel Pipe Line Flanges

Additional Company specifications referenced in this Specification and listed in the table below shall be the latest edition.

Table 1-2 Additional Specifications

BWP Specification	Title
EC-PS-007	*Purchase Specification: Distributor-Supplied Fittings and Flanges*
OP-CC-GS-COAT-001	*General Coating Specifications of Above-Ground Pipeline Facilities*

1.4 Conflicts

Exceptions to this Specification shall be clearly indicated as such on the Bid and/or Purchase Order. It shall be Vendor's responsibility to obtain Company's written resolution of any conflict between this Specification and Purchase Order before proceeding with the work affected. Failure to clearly indicate exceptions to this Specification shall be interpreted as confirmation that Vendor complies fully with this Specification.

2 DESIGN REQUIREMENTS

2.1 The filter separator Vendor shall provide all material, labor and equipment (except that specifically designated as provided by Company) required to construct the filter separator in conformance with this *Specification* and referenced drawings.

2.2 Materials which fall under a category on Company Approved Manufacturer List (AML) shall be provided per the AML. Materials which do not fall under a category on the AML shall be manufactured in the USA. Any deviations to these requirements shall be approved by Company in writing.

2.3 The type of filter separator selected shall be based on the intended application and sized for the expected flow conditions. Multiple units may be used as necessary to meet particular design conditions or wide ranges of flow conditions.

2.4 Filter separators to be installed in cold climates shall be heat traced and insulated in the liquid holding areas, including the lower liquid level sump, the level gauges, level controllers, dump valves and drain lines to below frost depth. For extremely cold climates, the complete lower sump section shall be in an insulated enclosure with heat.

2.5 The design pressure of the vessel shall be a minimum of 107% of the MAOP of the associated piping system.

2.6 Unless otherwise specified, the design temperature of the vessel shall be -20 degrees F to 120 degrees F.

2.7 Overpressure protection (AGCO or equivalent) of the filter separator, with a minimum of thermal relief duty, shall be provided in conformance with ASME. The Company Project Manager shall determine if supplemental pressure relief duties are required (e.g., for fire relief requirements or blocked flow). Relief valve duty requirements and relief valve actual capacity calculations must be provided in the Documentation package from the Vendor.

2.8 Coating shall be in conformance with Company General Coating Specifications of Above-Ground Pipeline Facilities – OP-CC-GC-COAT-001.

2.9 The detailed filter separator design shall be the total responsibility of the filter separator Vendor.

2.10 The filter separator shall be designed and guaranteed to remove 99.9% of all entrained solids 0.3 microns and larger at all flow conditions. The maximum allowable volume of all solids entrained in the gas stream shall be provided by the vendor for their designed filter separator. Solid particles include but are not limited to organic dirt, salt, sand, carbon dust, pipe scale, iron and ferrous oxide.

2.11 The filter separator shall be designed and guaranteed to remove 99.9% of all liquids 1 microns and larger at all flow conditions. The vendor shall supply the max quantity of liquids that can be entrained in the gas stream and still meet the standards above. Liquids include but are not limited to water, compressor oil, glycol, and hydrocarbon condensates with a Specific Gravity of 0.6 - 1.3 and an absolute viscosity of 0.56 – 72cP.

2.12 The filter separator shall not exceed a pressure drop of 2.0 psi with clean wet elements measured between the inlet and outlet flanges of the vessel at specified maximum flow capacity, minimum operating pressure and maximum operating temperature. Performance guarantee shall be the sole responsibility of the Vendor and shall be for the complete unit, inclusive of vessel, internals, filter elements and sealing of the elements to prevent any bypass.

2.13 Filter separator must be of new construction and of a proven design capable of field performance verification at specified operating conditions without vessel shutdown or removal from service. One-inch or larger connections (as recommended by Vendor) shall be installed for inlet and outlet test ports.

2.14 Filter separators up through 60 inches in diameter shall be designed with a full end opening closure for access to the filter elements. Filter separators having a diameter greater than 60 inches may have a reduced opening not less than 60 inches in diameter. The access opening shall be of a size and arrangement to allow for replacing the filter elements without physical entry into the vessel. The closure shall be equipped with davit or hinge and pressure alert device.

2.15 The liquid sump of the filter separator shall be divided into sections for each stage to preclude any bypassing of gas around the first stage filter elements.

2.16 Inlet flow shall not impinge directly on the filter elements. Elements shall be internally supported to the element support plate and positively supported at the closure end by a removable assembly. Filter case shall be designed to ensure positively sealing filter elements when installed (to prevent bypass). Vendor shall specify method of internal support and positive sealing of elements.

2.17 The elements shall withstand a minimum of 35 psi differential pressure before collapse. Vendor shall state in its documentation the recommended maximum differential pressure for element replacement.

2.18 Filter separators shall be equipped with the following instrumentation:

- Differential Pressure Transmitter (Rosemount w/LCD display or equivalent)
- Level Gage, each stage (Penberthy or equivalent)
- Low, High, and High-High Level switch, each stage (Penberthy or equivalent). A liquid level transmitter may be requested in lieu of the switches (Magtech LTM or equivalent).
- Level Controller, each stage (Fisher or equivalent)
- 4” diameter level bridles to hold all level instruments
- Automatic Dump Valves, each stage (Fisher or equivalent)

All instrumentation shall include the necessary piping, fittings and valves to assemble to the filter separator vessel. All instrument assemblies shall be tested and fitted to the vessel prior to shipment. Piping larger than one inch (1”) shall be welded.

All tubing shall be seamless 316 or 316L SS. Stainless steel trim shall be used for all wetted parts.

Filter-Separator instrumentation shall be specified in the vessel data sheet.

2.19 Liquid sumps shall be equipped with full sized openings on both ends with closures or blind flanges with davits.

3 FABRICATION REQUIREMENTS

3.1 All internal welds shall be full penetration. Any components where full penetration welding is not possible shall be identified on drawings submitted with proposal.

3.2 Longitudinal welds shall be double butt weld type.

3.3 All girth welds shall be full penetration butt welds.

3.4 Radial offset (misalignment) of plate edges at the weld seam shall not be greater than 1/16”.

3.5 Remaining wall under a grind shall be at least 92% on nominal wall (cannot go below minimum required wall thickness).

3.6 No welding, weld repairs, nor small fillet welds are permitted after any stress relieving of the vessel.

3.7 Weld splatter is not allowed on the surface. All arc strikes shall be repaired using Company approved methods. Company may reject any assemblies it deems to have excessive arc strikes.

3.8 All process connections two inch (2”) and larger shall have ANSI rated weld-neck flanges.

3.9 Vessel connections of less than 2” shall be ASTM A105 3000 forged steel full depth couplings. Half couplings shall not be used.

3.10 All flange bolts and nuts shall be Cadmium plated ASTM A193 Grade B, A194 Grade H2 respectively. All permanently installed flange bolts and nuts shall be painted.

3.11 All anchor bolt holes and customer connections shall be located at a tolerance of +/- 1/16”, non-cumulative.

3.12 Inlet and outlet flange faces shall be parallel (or perpendicular, as appropriate for the design) to each other within 1/8” measured across the flange face.

3.13 All flange gaskets shall be spiral wound stainless steel with solid inner rings.

3.14 All internal components shall be attached to vessel wall by 5/8" minimum thick steel wear pads. Wear pads shall tightly conform to vessel shell contours. Wear pads shall attach to vessel wall by a continuous fillet weld. This fillet weld shall be continuous along both sides of the wear plate and shall be stronger than the full penetration weld between internal components and wear plate. lnternal shell connections shall have an external wear plate.

3.15 Vessel baseplate(s) shall be perpendicular (or parallel, as appropriate for the design) to inlet and outlet flange faces within 1/8” measured across the flange face.

3.16 The separator shall have lifting lugs to facilitate installation.

3.17 The equipment shall have an adequate number of jacking bolts to support the equipment during installation. Jacking bolts shall have fine threads and be manufactured by drilling baseplate and welding nuts over these holes on the bottom side of the baseplate.

3.18 The equipment shall be identified with a stainless steel tag located in an area that will be easily accessible after the equipment has been installed on site. Each tag shall include the following information, as a minimum: manufacturer's name; model number; serial number; codes, and standards utilized in construction; customer's purchase order number; equipment weight; year of construction; and equipment ratings (flow, temperature and pressure). A copy of the proposed tag shall be required as part of the approval documents.

3.19 Perforated distribution plate shall be 3/4" thick minimum. The outer 2 inches around plate circumference shall be without perforations. Plate shall be beveled to allow full penetration welding around plate circumference.

3.20 Mist extractor vanes shall be 18 gauge. Mist extractor vanes shall be tied together by six (6) tie rods minimum.

3.21 Vane traps shall be 20 gauge. Vane cover plates shall be 5/8” thick minimum.

4 INSPECTION AND TESTING

4.1 Inspection and testing is to be performed in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1.

4.2 The vessel shall be code stamped and registered with the National Board.

4.3 Hydrostatic testing (see §192 Subpart J) shall be tested to at least 1.5 times the MAOP. Vendor shall hydro-test all pressure containing components for 8 hours continuous. The hydro-test shall be recorded using calibrated and certified dead-weight, pressure and temperature recorders.

4.4 Vendor is responsible for overall quality control. Vendor shall provide the Company with its Quality Assurance/Quality Control (QA/QC) procedures for Company review and approval. The QA/QC procedures shall include welding procedures, welder qualifications, and NDT procedures.

4.5 Company reserves the right to inspect all work at any time during fabrication, painting or testing operations to be assured that materials and workmanship are in accordance with these specifications. Company shall assign a third party inspector to monitor the fabrication of the vessel. The inspector shall be granted unlimited reasonable access to the Vendor's facility to review and inspect project materials, assemblies and documentation.

4.6 Vendor shall provide Material Test Reports (MTRs) for all pressure containing materials before they are placed into fabrication. Company has the right to reject any material that it deems does meet the material requirements or is of questionable quality or origin.

4.7 100% of all seam and butt welds shall be X-rayed. 100% of all fillet welds shall be magnetic particle tested. Vendor shall make all X-ray film and reader sheets available to the Company Inspector.

4.8 Prior to rolling, all shell plate shall be ultrasonically tested per ASTM A435.

4.9 Vendor shall provide a fabrication schedule and Inspection and Test Plan for Company's review and approval. Notification is to be given to Company for the milestones listed below. Company shall have the right to inspect the vessel/unit after each milestone. A minimum of 72 hour notice is required**.**

- After all forming operations and prior to assembly
- After installation of baffles or other internal components and before installation of heads
- After stress relieving; prior to hydrostatic testing

- For Hydrostatic Testing
- After Painting
- Prior to shipment

5 DOCUMENTATION AND DRAWINGS

5.1 Vendor shall submit general outline drawings for approval with their proposal. Included shall be a detailed BOM outlining the material specs and thicknesses for each major component. The estimated weight without filters shall be provided. Upon receipt of approval, Vendor shall forward corrected and certified fabrication drawings and shop detail drawings to Company.

5.2 Vendor shall submit separate performance and sizing calculations as part of their proposal. This shall include performance charts showing the full range of flows and pressures that the unit can meet the specified efficiencies.

5.3 Vendor shall submit code calculations, welding procedures, material data, and other documents to Company prior to fabrication.

5.4 Vendor drawing package shall include a listing of all loose shipped items which shall clearly denote installation responsibility.

5.5 Vendor shall submit an electronic copy and three (3) hardcopy full sets of both the Equipment Data Book and Operation and Maintenance Manuals upon shipment of the equipment.

5.6 Vendor shall submit a warranty statement for the vessel with the quote.

5.7 Vendor shall provide detailed installation requirements including, but not limited to, all nozzle location, overall dimensions, anchor bolt locations, mounting pad locations, maximum allowable flange forces and moments and related calculations

6 SHIPPING

6.1 All equipment and materials supplied shall be prepared and packaged in a manner so as to provide for weather protection while in transit. All openings in the equipment shall be suitably protected to prevent the possible entry of water and other foreign material. All equipment shall be braced adequately to prevent damage during shipment.

6.2 Any loose material and parts shall be contained in separated boxes, crates, or cartons, and adequately protected against damage.

6.3 A packing slip in a weatherproof envelope shall be attached to each container. Each container (package, box, and carton) shall be stamped with purchase order number. Each container package shall be numerically identified, such as 1 of ___, 2 of ___, and so forth.

6.4 A complete set of Certified Drawings shall be attached to the equipment in a weatherproof envelope. This will count as one of the three copies requested in section 5.

7 DOCUMENT CONTROL

As part of the Company's Management of Change procedure, this section provides information about updates to this document.

Revisions to this document are recorded in the following table. Minor revisions (new formatting, title changes, minor updates, etc.) are indicated by a fractional increase. Major revisions (new critical information, significant re-arrangement of information, etc.) are indicated by a whole number increase.

Table 7-1: Document History Log

Version	Effective Date	Description
1.00	09/01/2016	New Specification replacing EC-PS-017
1.10	11/02/2018	Add ITP – Filter Separator per CR 2018-10-10b
1.20	01/01/2020	Updated Company logo and Company name, removed references to Gulf Crossing per CR 2019-12-11
1.30	10/09/2020	Updated document per CR 2020-08-13a

Attachment A - Specification Sheet

Location: _____

Identification Tag _____ Requisition No: _____

Project: _____ Project No. _____

Prepared By: _____ Approved By: _____

Date:_____ Revision:_____ Revised Date: _____

Gas Design Conditions:

Flow: Normal _____ MMSCFD @ _____ psig & _____ ° F

Min/Max _____ / _____ MMSCFD

Pressure: Temperature:

Min/Max _____ / _____ psig Min/Max _____ / _____ ° F

☐ Insulate and heat trace the lower liquid level sump, the level gauges, level controllers, dump valves and drain lines to below frost depth

☐ The complete lower sump section shall be in an insulated enclosure with heat and drain lines insulated and heat traced to below frost depth

Gas Analysis (Mole %) (Fill in parameters below or attach analysis to this specification)**:**

BTU	
Specific Gravity	.58-62
Gas Analysis (Mole %)	
C1 Methane	
C2 Ethane	
C3 Propane	
IC4 Iso-Butane	
NC4 Normal Butane	
IC5 Iso-Pentane	
NC5 Normal Pentane	
C6 Hexane	
CO2 Carbon Dioxide	
N2 Nitrogen	
H2O Water	

Vendor Furnished Information:

Total Liquid Storage Capacity (gal.) _____

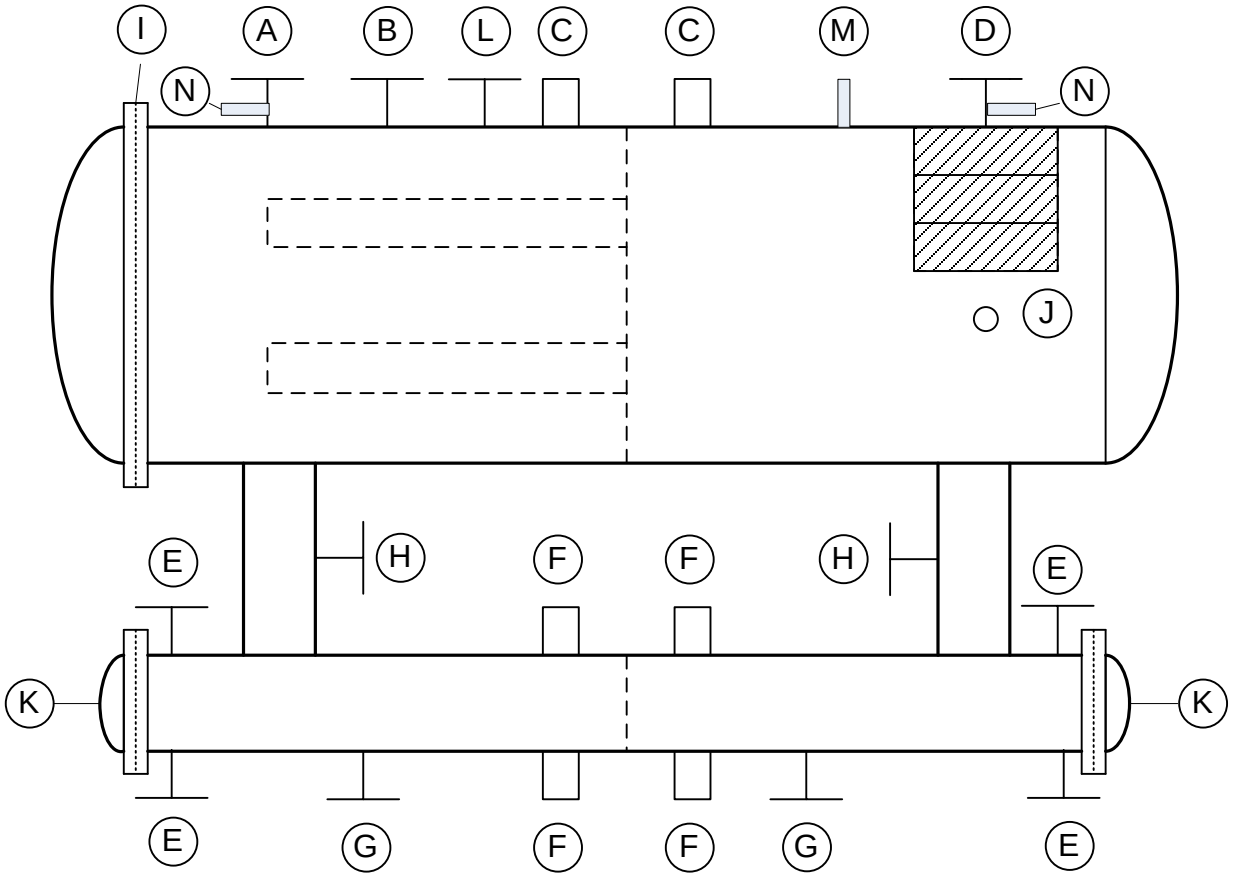
Total Solid Capacity (Cu-Ft. or Lbs.) _____

Design Pressure (MAWP) _____psig
Design Temperature Min _____° F to Max _____° F
Corrosion Allowances: Vessel: _____inches, Internals: _____ inches
Support Earthquake Zone: ____ or ☐NA

Horizontal Separator Openings

(To be completed by vendor unless specified. See also Vessel Diagram)

Mark	Service	No.	Size	Rating	Type	Nozzle Projection
A	Inlet					
B	Relief Valve					
C	Pressure Differential					
D	Outlet					
E	Level Control Bridle					
F	Level Gauge					
G	Liquid Drain					
H	Bridle, Level, Sensor					
I	Filter Access/Closure					
J						
K	Sump					
L	Blowdown/Vent					
M	Pressure Gauge					
N	Test Connections	2	1”	6000#		
O						
P						
Q						
R						



Vessel Diagram