 TORUS	· Owner MULTIPATH ULTRASONIC METERS FE-111 / FE-121	Document No.	MEA-DS-001		
		Revision / Date	A · September 29, 2026		
		Issue purpose	Issued for Review		
MEASUREMENT · MULTIPATH ULTRASONIC METERS FE-111 / FE-121					
Rev.	Date	Revision description	Prepared	Reviewed	Approved
A	2026-09-29	Issued for Review			

NOTES

1. This sheet defines the two custody-transfer ultrasonic meters for quotation and purchase. It is read with  MEA-SPC-001, which sets the fabrication, calibration and test requirements.
2. Values marked typical are budgetary. The vendor shall confirm them with its proposal and final data (HOLD H-15).
3. Units are US customary. Pressures are gauge unless stated as absolute; standard volumes are at 14.73 psia and 60 °F.
4. Operating cases C1 to C7 are defined in  GEN-DB-001, Basis of Design, Section 6.

GENERAL

Table 1-1: General Data

Item	Value	Item	Value
Tags	FE-111 / FT-111 (run 1, MR-110); FE-121 / FT-121 (run 2, MR-120)	Quantity	2
Service	Custody-transfer natural gas measurement; one run duty, one standby, each 100 %	Location	Meter skid SK-110, outdoors under the canopy
Area classification	Class I, Division 2, Group D, T3 (API RP 500); electrical area classification drawing to confirm	Governing standard	AGA Report No. 9 (2022); API MPMS Chapter 21.1 interface
Specification	 MEA-SPC-001	Installation	 MEA-DWG-001;  MEA-CAL-001

PROCESS DATA

One run carries the full flow of each case. Meter conditions are taken from  MEA-CAL-001.

Table 1-2: Operating Cases, Pressure, Temperature and Density

Case	Flow (MMSCFD)	Pressure (psig)	Temperature (°F)	Z	ρ (lb/ft ³)
C1	120	1,137.0	44.2	0.7783	5.050
C2	90	1,042.7	69.6	0.8323	4.127
C3	10	999.9	60.0	0.8259	4.065
C4	120	1,087.0	119.4	0.8807	3.715
C5	120	887.0	59.2	0.8430	3.544
C6	120	1,137.0	44.2	0.7783	5.050
C7 (rich gas)	120	1,087.0	59.2	0.7750	5.023

Table 1-3: Operating Cases, Flow, Velocity and Speed of Sound

Case	Actual flow (acf/h)	Velocity (ft/s)	Speed of sound (ft/s)	Reynolds number
C1	48,408	27.0	1,227	1.21×10^7
C2	44,423	24.7	1,276	9.25×10^6
C3	5,012	2.8	1,258	1.05×10^6



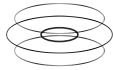
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Case	Actual flow (acf/h)	Velocity (ft/s)	Speed of sound (ft/s)	Reynolds number
C4	65,811	36.7	1,361	1.18 x 10 ⁷
C5	68,973	38.4	1,259	1.29 x 10 ⁷
C6	48,408	27.0	1,227	1.21 x 10 ⁷
C7 (rich gas)	51,912	28.9	1,185	1.27 x 10 ⁷

Table 1-4: Fluid and Design Conditions

Item	Requirement
Fluid	Dry sweet natural gas, compositions per  GEN-DB-001 Section 5.1
Base conditions	14.73 psia, 60 °F
Design pressure / temperature	1,440 psig / -20 to 150 °F
Speed of sound envelope (transducer selection)	1,130 to 1,461 ft/s
Water content	7 lb/MMscf maximum; no free liquids
Solids	Filtered to 1 micron upstream (V-101)

METER

Table 1-5: Meter Body and Performance

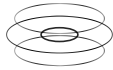
Item	Requirement
Size / rating / ends	NPS 10, ASME B16.5 Class 600 RF
Bore	9.562 in (NPS 10 Sch 80) ± 0.5 %
Paths	Minimum four chordal paths; eight-path (dual four-path) preferred
Face-to-face	30.0 in, typical, vendor to confirm (HOLD H-15)
$q_{min} / q_t / q_{max}$	1.5 / 5.0 / 100 ft/s = 2,693 / 8,976 / 179,526 acf/h, typical, vendor to confirm (HOLD H-15)
Performance after calibration	Residual ± 0.1 % from q_t to q_{max} , ± 0.2 % from q_{min} to q_t ; repeatability 0.1 %; zero-flow reading below 0.04 ft/s per path
Body material	Forged or cast carbon steel, impact tested at -20 °F (LF2 or equivalent)
Transducers	Titanium or 316 SS housings, removable under pressure or with isolation; spares per  MEA-SPC-001
Pressure taps	Body tap for PT-111 / PT-121 and a test tap, 1/2 in with root valves
Hydrostatic test	2,160 psig, 8 h

ELECTRONICS AND COMMUNICATIONS

Table 1-6: Electronics and Communications

Item	Requirement
Power	24 VDC from the station UPS ( GEN-DB-001 Section 9.8); 120 VAC only where stated; consumption 10 W, typical, vendor to confirm (HOLD H-15)
Enclosure	Explosion-proof or flameproof, NEMA 4X / IP66, suitable for the area classification
Outputs	Modbus RTU (RS-485) and Modbus TCP to FQI-110; two frequency outputs 0 to 5 kHz, phase shifted; one status output
Diagnostics	Per-path velocity, speed of sound, gain, signal-to-noise ratio and accepted pulses; turbulence, profile factor, symmetry, crossflow and swirl; status and alarms



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Item	Requirement		
Configuration log	Non-volatile configuration change log; sealable write-protect switch		
Time synchronization	From FQI-110		

CALIBRATION AND TESTING

Table 1-7: Calibration and Testing

Item	Requirement
Flow calibration	With its own meter tube and conditioner at an ISO/IEC 17025 laboratory with a calibration and measurement capability of 0.25 % (k = 2) or better; nine points from 2 to 80 ft/s ( MEA-SPC-001 Table 7.4); as-found and as-left
Zero-flow verification	At the laboratory and at site acceptance
Speed of sound check	Within 0.2 % of AGA Report No. 10 at the laboratory; in service alert at ± 0.25 %, alarm at ± 0.40 % ( MEA-CAL-003)
Factory acceptance and witness	 MEA-PRC-003; the receiving pipeline operator may witness (HOLD H-01)

VENDOR DATA

Table 1-8: Vendor Data Required

Item	Requirement
With proposal	Installation-effects test report with the offered conditioner; general arrangement with weight (1,500 to 2,500 lb per meter, typical, vendor to confirm (HOLD H-15))
After award	Electrical and loop drawings; diagnostic software; spare parts list
Before shipment	As-left configuration file; calibration certificates; manuals

OPEN ITEMS

Table 1-9: Open Items

HOLD	Item	Responsible party
H-15	All vendor-dependent values	Vendor
H-01	Witness rights and recalibration interval	Owner and receiving pipeline operator

The meter tube assembly (U1, conditioner, U2, meter and DS spool) is calibrated and shipped as one unit; see  MEA-DS-010.

