

# Budget Proposal



## Metering Equipment for CONPET fiscal metering

**Customer Name:** CONPET  
**Country:** Romania  
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## 1 EXECUTIVE SUMMARY

### 1.1 OVERVIEW

Endress+Hauser Instruments International AG is pleased to present this budget proposal for the design & supply of loose parts equipment for metering systems for the Petrobrazi Refinery Project in Romania.

Mass metering of hydrocarbon products is now a preferred principle for most hydrocarbon terminals. It completely removes all concerns over the significant changes in the product density that can affect volume based measurement systems.

Endress+Hauser pursue a policy of constant improvement, and we are able to offer the latest Promass type 84F for this critical application.

Our company has an enviable name for the supply of flow management solutions to the worldwide Oil & Gas industry. These class-leading Promass meters provide the 'best in class' foundation upon which all our systems are based. In addition our background in automation & project solutions ensures that they are **fully integrated** into your structure to operate **as systems**, and not just as individual instruments.

Endress+Hauser would provide a 'complete 1-stop solution'.

In effect this means the:

- System schematic design
- Instruments as flowmeter (Coriolis type), TT, PT, Flowcomputer
- High accuracy calibrated mass flow meters
- Compliance with appropriate standards for Coriolis metering of liquids
- Custody Transfer verification to MID-005 regulations (Modul B+F)
- FAT for the flowcomputer

This type of solution is a demonstration of the Endress+Hauser almost unique position; It is both a world-wide International company with engineering teams and production facilities on every continent, but it also benefits from the flexibility of a truly independent Swiss-family ownership. Few system builders have this strength to offer to its customers.

Please note that within this proposal the following abbreviations are used:

E+H for 'Endress and Hauser Instruments International AG'

## 2 PROJECT OBJECTIVES

### 2.1 PROJECT DESCRIPTION

The national oil transport company (CONPET) intends this year to invest in several fiscal metering skids at the Location Baicoi Centru and at the Petrobrazi Refinery.

### 2.2 CLIENT PROCESS DATA

Location	Density 15°C vacuum g/cm <sup>3</sup>	Viscosity range(cSt) 20°C	Operating pressure bar	Crude oil temperature	Flow m <sup>3</sup> /h (t/h)	Pipeline size	Cantitate /zi [t/zi]	Perioada de pompare	BiRotor size	BiRotor code
Baicoi Centru	0,8300 ÷ 0,8600	4,18 ÷ 50	1 ÷ 6	16	55 (47)	7" SR (6"5/8)	150	zilnic	3"	B061
Moreni	0,860 ÷ 0,905	13 ÷ 60	13 ÷ 28	13	52 ÷ 70 (46 ÷ 62)		750	zilnic	3"	B074
Madulari	0,7500 ÷ 0,7700	1,22 ÷ 1,4	8	36	110 (82)	10"	150	4x/sapt.	4"	B081
Varteju	0,8300 ÷ 0,8407	3 ÷ 6,10	23	42	60(50)	10"	30	2x/sapt.	3"	B071
Bucsan	0,8240 ÷ 0,8290	23,22 ÷ 28,71	8 ÷ 14	60	31 (25)	4"	50	4x/sapt.	3"	B061
Ochiuri	0,8900 ÷ 0,9050	30 ÷ 60	17	47	56(65)	6"	220	la 2 zile	3"	B061
Teis	0,8600 ÷ 0,8620	14 ÷ 18	24	36	63 (53)	6"	120	la 2 zile	3"	B071
Raca	0,910 ÷ 0,912	37 ÷ 51	22	48	19 (17)		3	lunar	3"	B064
Izvoru	0,8530 ÷ 0,8550	3,67 ÷ 6,11	11	36	33 (27)	6"	11	decadal	3"	B061
Padure II	0,8485 ÷ 0,8550	9,00 ÷ 11,00	3 ÷ 15	43	65	6"	290	zilnic	3"	B071
Slobozia	0,8400 ÷ 0,8450	7,00 ÷ 14,5	5 (max 30)	45 ÷ 50	32	4"	130	la 3 zile	3"	B064
Aricești	0,8444 ÷ 0,8550	14,25 at 30° C	8	48 ÷ 50	13	6"	90	la 6 zile	3"	B061
Saru	0,875 ÷ 0,880	17,95 ÷ 20,00	8 ÷ 10	40 ÷ 45	65	6"	600	la 2 zile	3"	B071
Oarja	0,8900 ÷ 0,8950	34,20 ÷ 42,57	8 ÷ 10	40 ÷ 46	62	6"	250	la 4 zile	3"	B071
Poeni	0,915 ÷ 0,920	70,00 ÷ 212,30	8 ÷ 10	44 ÷ 46	135		900	la 2 zile	4"	B081
Poeni (2)	0,890 ÷ 0,895	25,93 ÷ 40,69	8 ÷ 10	31 ÷ 40	135		250	la 4 zile	4"	B081
LACT Badesti	0,825 ÷ 0,830	5,81 ÷ 6,13	10	35 ÷ 40	55		190	zilnic	3"	B061
Boldesti	0,8385 ÷ 0,8485	8,55 ÷ 15,28	2 ÷ 5	40 ÷ 46	46 ÷ 60	8"	220	zilnic	3"	B071

Petrobrazi metering locations:

Location	Density 15°C vacuum g/cm <sup>3</sup>	Vascozitate min (20°C) / max(5°C)	Operating pressure bar	Crude oil temperature	Flow m <sup>3</sup> /h (t/h)	Pipeline size	Cantitate /zi [t/zi]	Perioada de pompare	BiRotor size	BiRotor code
Brazi 1	0,830 ÷ 0,905	10 / 150	2 ÷ 3	5 °C ÷ 35 °C	50 - 140	8"			4"	B081
Brazi 2	0,800 ÷ 0,930	10 / 150	2 ÷ 3	5 °C ÷ 35 °C	30 ÷ 250	10"			8"	B101
Brazi 3	0,800 ÷ 0,930	50 / 800	2 ÷ 3	5 °C ÷ 35 °C	50 ÷ 400	10"			10"	B111
Brazi 4	0,800 ÷ 0,920	10 / 100	2 ÷ 3	5 °C ÷ 35 °C	30 ÷ 70	8"			3"	B071
Brazi 5	0,835 ÷ 0,920	10 / 200	2 ÷ 3	5 °C ÷ 35 °C	30 ÷ 70	12"			3"	B071
Brazi 6	0,730 ÷ 0,960	50 / 800	2 ÷ 3	5 °C ÷ 35 °C	30 ÷ 250	12"			8"	B101
Brazi 7 Import	0,800 ÷ 0,960	75/150	2 ÷ 3	5 °C ÷ 35 °C	150 ÷ 800	24"			12"	TM
Brazi 8 Total	0,800 ÷ 0,960	50 / 800	2 ÷ 3	5 °C ÷ 35 °C	100 ÷ 800	12"			12"	B121

## 2.3 METER & STREAM SIZING

Based on the client flow information provided in 2.2 above we are proposing the most suitable Promass coriolis mass meters.

Caracteristici locatii de interes (Conform cu Caietul de sarcini):

Location	Viscosity range(cSt) 20°C	Operating pressure bar	Pressure drop of the meter in bar at max flow and max viscosity	Flow m3/h (t/h)	Meter size 1x100%
Baicoi Centru	4,18 ÷ 50	1 ÷ 6	0.19	55 (47)	3"
Moreni	13 ÷ 60	13 ÷ 28	0.41	52 ÷ 70 (46 ÷ 62)	3"
Madulari	1,22 ÷ 1,4	8	0.38	110 (82)	3"
Varteju	3 ÷ 6,10	23	0.17	60(50)	3"
Bucsan	19,51 ÷ 28,71	8 ÷ 14	0.08	31 (25)	3"
Ochiuri	30 ÷ 60	17	0.28	56(65)	3"
Teis	14 ÷ 18	24	0.24	63 (53)	3"
Raca	37 ÷ 51	22	0.04	19 (17)	3"
Izvoru	3,67 ÷ 6,11	11	0.05	33 (27)	3"
Padure II	9,69 ÷ 9,82	3 ÷ 15	0.22	65	3"
Slobozia	15,89 ÷ 16,67	5 (max 30)	0.07	32	3"
Aricesti	14,25 at 30° C	8	0.01	13	3"
Saru	34,84 ÷ 36,61	8 ÷ 10	0.31	65	3"
Oarja	34,84 ÷ 36,61	8 ÷ 10	0.28	62	3"
Poeni		8 ÷ 10	0.29	135	4"
Poeni (2)		8 ÷ 10	0.29	135	4"
ACT Badesti		10	0.16	55	3"
Boldesti	11,11 ÷ 25,65	2 ÷ 5	0.24	46 ÷ 60	3"

Petrobraz

Location	Vascozitate min (20°C) / max(5°C)	Operating pressure bar	Pressure drop of the meter in bar at max flow and max viscosity	Flow m3/h (t/h)	Meter size 1x100%
Brazi 1	10 / 150	2 ÷ 3	0.34	50 - 140	4"
Brazi 2	10 / 150	2 ÷ 3	0.28	30 ÷ 250	6"
Brazi 3	50 / 800	2 ÷ 3	0.28	50 ÷ 400	10"
Brazi 4	10 / 100	2 ÷ 3	0.25	30 ÷ 70	3"
Brazi 5	10 / 200	2 ÷ 3	0.25	30 ÷ 70	3"
Brazi 6	50 / 800	2 ÷ 3	0.43	30 ÷ 250	6"
Brazi 7 Import	75 / 150	2 ÷ 3	0.37	150 ÷ 800	12"
Brazi 8 Total	50 / 800	2 ÷ 3	0.7	100 ÷ 800	12"

## 2.4 GENERAL ARRANGEMENT OF SYSTEM

The metering system is of conventional design, with coriolis mass meters as the primary flow measurement sensor(s).

In order to meet the expected OIML accuracy class of 0.5 (pipeline 0.3) it will be mandatory to have single phase fluid without any air or solid content. This can be achieved by using air eliminator which we not included in this proposal. Air eliminators are certified up to a viscosity of 20 cSt only. After an evaluation of your application we can decide how to guarantee to measure a single phase fluid.

## 2.5 COMPERISON PD VERSUS CORIOLIS METER

### Coriolis Mass Meter or PD Positive Displacement Meter?

The mechanical PD meter with rotating vanes or gears has been the work-horse of the truck loading flow metering business – one leading manufacturer issued an original patent some 75 years ago in 1940, for an oilfield unit. The designs have not changed so much in that time! Most improvements have been in materials and in the addition of electronic transmitters and calculators which are attached to the basic rotating output.

The coriolis mass flow meter was first available for oilfield use around the middle of the 1980s, although industrial designs emerged some ten years earlier. Clearly, after 30 years of reliable use, mass metering is a mature and reliable oilfield technology.

### Disadvantages of PD Meters compared to Coriolis

A table of the disadvantages that owners find with typical PD meters:

They are Large	Heavy for their capacity	Must have upstream fine-mesh dirt filters
Always need inlet gas eliminators	Rotation consumes expensive spare parts	Consequently need regular maintenance
Require skilled repair labour	No electronic diagnostics	High spares requirement and cost = high OPEX
The internals are mechanically delicate	Rotors and bearings are prone to low frequency vibration damage	Require regular proving / calibration on-site
Susceptible to flow shock by gas and surges	Observed volume rate only	They are not smart instruments
Mechanical tolerances mean it has a limited temperature range	Mechanical tolerances mean it has a limited high pressure capability	Size & weight limits the range of materials available
Metering is uni-directional	Only a single installation orientation	Instrument is not 'secure' against tampering
Limited electric signal output (needs additional electronics)	Not suitable for gas	Large internal volume that must be drained
Unsuitable for cryogenic work	High downtime for repairs	

### Benefits of Coriolis

Without doubt the biggest benefit is the best in class accuracy of the mass meter. Let's take a 3"nb gasoline system as an example loading at 1200 lpm (72 m<sup>3</sup>/h) and fitted with a batch flow-computer & line temperature input. The coriolis meter delivers a basic mass or volume flow rate accuracy of 0.1% (0.05% premium accuracy available), but measures live fluid density at the same time. A typical PD meter only measures volume flow at around 0.25% accuracy.

We have simplified these results; but it means that for a typical use of 600,000 gallons per month and at a price of \$2 per gallon, the potential loss is 900 gallons or \$ 1,800 per month.

#### CAPEX & OPEX

Using the figures from the example above, we can see how long it takes for the coriolis savings to repay the initial CAPEX cost difference of a change from old fashioned PD to coriolis metering:

<b>CAPEX:</b>	<u>Coriolis</u>	PD meter
Basic cost meter + batch controller + temperature input	<b>\$ 20,000</b>	<b>\$ 16,000</b>
<b>OPEX:</b>		
1 year spares cost	None required	\$ 300 (2 x vane set) \$ 350 (unit = \$700 every 2 years)
1 year service labour	None required	\$ 300 (12h x \$25 p/h)
1 year re-proving charge	\$150 (annual for local authority)	\$ 600 (4 x \$150)
Annual cost	\$ 150	\$ 1,550
<b>OPEX Coriolis: Saving per month</b>	<b>\$ 1,800</b>	
<b>CAPEX repaid in 6 weeks !</b>		

#### The 'Hidden Benefit' of Coriolis

In addition to the advantages above, the new technology is a marketing & sales tool you can use to give confidence to your customers and reduce any disputes or wrongful claims. In the same way, it shows your suppliers that you are improving your accounting and security process to ensure 'zero-loss' for both input and output.

## 2.6 APPLICABLE STANDARDS AND SPECIFICATIONS

Our offer is based only upon E+H standard specifications, and that are expressly included in this proposal:

- Measuring Systems for Liquids other than Water, OIML R 117-1
- OIML D 11 General requirements for measuring instruments
- Direct Mass Flow Measuring Systems for Quantities of Liquids, OIML R 105
- Guide to the Expression of Uncertainty in Measurements OIML P 17
- EC Directive 2004/22/EC Measuring Instruments Directive (MID) MI-005
- PED 97/23/EC

### 3 ENDRESS+HAUSER TECHNICAL SOLUTION

#### 3.1 GENERAL DESCRIPTION

The metering streams shall be redundant (2x100%), our coriolis meters is designed to cover the complete flowrange (1x100%). The flowcomputer is able to read the signals from both metering streams and transmitters.

The piping, construction, installation, cabling and engineering of the metering skids is not in our scope of supply. We as E+H deliver the Transmitter per stream (pressure + temperature, coriolis meter, flocomputer and the verification service (MID-005 Modul B+F).

#### 3.2 AIR ELIMINATOR

Coriolis meter will detect presence of air and provide appropriate alarm, but the performances will be affected; the removal of the air is the an important topic to be considered to guarantee the best performances especially in custody transfer application.

##### Centrifugal gas separator type DV

EU Directives Compliance

PED (dir. 97/23/CE): compliant directive 97/23/CE, with risk category depending on the measured liquid

ATEX (dir. 94/9/CE): non electrical equipment, compliant directive 94/9/CE, suitable for installation in hazardous area II 2G, marking Ex II 2 G c T1 ... T6

##### Approval

Pattern evaluation report according to OIML R117 N. PTB-1.5-4033320

##### Working conditions

Max. Working pressure:	1,000 KPa max
Test pressure:	1,700 KPa
Working temperature:	[-25; +100] °C
Maximum flow rate:	depending on the model (see below)
Flanges:	ANSI 150 RF, size below

##### Materials

Body and flanges:	carbon steel
Air vent valve:	Aluminium
Sight glass	Tempered glass

TYPE	SIZE	MAX. FLOW RATE
DV80-01	3"	1,300 l/min
DV100-01	4"	2,000 l/min
DV100-02	4"	2,500 l/min
DV100-03	4"	3,000 l/min
DV150-01	6"	3,600 l/min
DV150-02	6"	5,000 l/min



The maximum allowed influence of gas/air is still 0.5%. If the value is higher you have to use a air eliminator. The allowed viscosity range is from 1mPas @20°C to 20mPas @20°C.

The requirements for use under this certificate are:

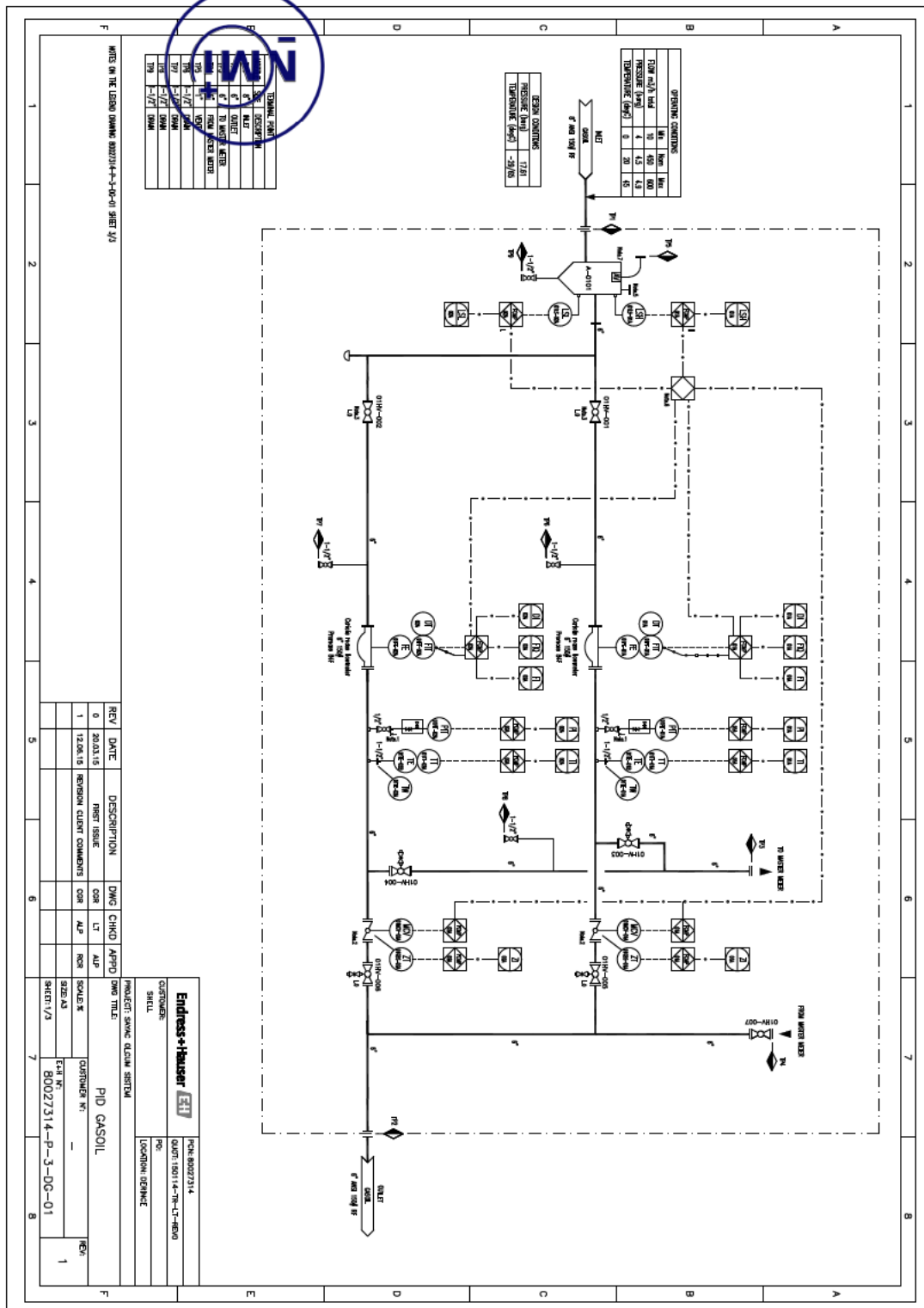
- Minimum inlet pressure of 1.5barg
- Minimum outlet backpressure of 0.5barg
- Vent line outlet with no (or insignificant) back pressure
- Viscosity range is from 1mPas @20°C to 20mPas @20°C
- The max flowrate doesn't exceed the design flowrate of the air eliminator
- An affixed Name Plate
- The counterweight (in the air vent inside the vessel) is calculated to the product density

As not all applications are in the allowed viscosity range, it is only possible to deliver the air eliminator for this locations if needed, viscosities at 20°C less than 20mPas.

Type DV80-01 connection size 3"	Location: Varteju, Teis, Izvoru, Slobozia, Saru, LACT Badesti, Boldesti, Brazi4 and Brazi 5
Type DV100-01 connection size 4"	Location: Madulari
Type DV100-02 connection size 4"	Location: Brazi 1
Type DV150-02 connection size 6"	Location: Brazi 2

### 3.3 PRELIMINARY PROPOSAL PID

We present underneath a **PRELIMINARY** P&ID (Piping and Instrument Diagram) for the metering skid in dual configuration. This is not our scope of supply.



### 3.4 SCOPE OF WORK AND DOCUMENTATION

Endress+Hauser will assign a project engineer for all aspects of the contract. The Project Manager will be the single contact point for the client, and will control the project on a day to day basis. Close contact and team work with the client will be assured to provide a seamless execution of the engineering and construction.

Endress+Hauser will carry out the following services for the project:

- Installation and design recommendations to custody transfer use
- FDS (Functional Design Specification) document
- Selection and specification of instruments and system components
- Electrical wiring documentation for the supplied instruments and computer
- Provision of all supporting documentation to show compliance with standards
- Calibration certification/documents for instruments
- Instruction and Operating Manuals for all instruments and system components in English language
- Site commissioning services (as below – but not site installation)
- Approval and metrological services in Romania of the applications
  - Loading and pipeline, B+F certification

### 3.5 CORIOLIS METER TECHNOLOGY

The benefits of Coriolis meters for metering of hydrocarbons are well known. Industrial mass meters have been in operation since the mid-1970s and are now considered a mature technology.

The Endress+Hauser Promass custody flow meters offer unrivalled accuracy and are robust units, far better suited to field applications than the rather delicate positive displacement (PD) meters they replace.



In this installation, the liquids are considered clean products. However Coriolis meters have a far greater tolerance to inclusions of solids, water and gases in the flow than do the older PD & Turbine meters. Indeed, this tolerance is a contributing factor to the excellent long term stability of mass meters, resulting in extended periods of normal operation between eventual re-calibrations.

Standard Promass meters are available with a reference accuracy of  $\pm 0.1\%$  of reading on both the mass and liquid volume flowrate measurements.

Meter:	84F
Process connection:	ANSI 150 & 300#
Electrical connection:	2 x M20 x 1.5mm
Reference condition	
Accuracy mass flow:	±0.1% of reading standard accuracy on factory water calibration
Density accuracy:	up to 0.0005g/cc, traceable ISO/IEC17025 of reading - premium field calibration
Repeatability:	±0.05% for mass
Local indication:	Display
Pressure rating:	cl.150
Temp. range:	Process fluid: -50...+200 °C
(Inst. Max)	Ambient: -40...+60 °C (harsh environment version)
<b>Note:</b> At ambient temperatures below -20 °C the readability of the display may be impaired.	
Hazardous approval:	ATEX II 1/2GD+ IECEx Z0/1,21 Ex dia IIA Z= Zone
Environmental:	IP67
Materials :	wetted : 316L, 904L ss
	Meter Casing : 304L ss
Trans. enclosure:	copper free aluminium, epoxy powder coated
Certification:	process wetted pressure retaining parts: ss material certificate
Outputs: remote:	Frequency pulse – twin phase shifted streams, relay, or Modbus RS485, 4-20mA
Local:	LCD display touch control
Status:	a single 'grouped' alarm status output is sent to the panel for indication of mass meter fault
Power Supply:	85-260 VAC
Consumption:	AC: <15 VA (including sensor)
Switch-on current:	Max. 3 A (<5 ms) at 260 V AC

Reference operating conditions for accuracy statements above:


- Error limits following ISO/DIS 11631
- Water, typically +20 to +30 °C (+68 to +86 °F); 2 to 4 bar (30 to 60 psi)
- Data according to calibration protocol ± 5 °C (± 9 °F) and ± 2 bar (± 30 psi)
- Accuracy based on accredited calibration rigs according to ISO 17025

### 3.6 PRESSURE TRANSMITTERS

The pressure transmitter PMP71 is proposed for this system, providing high accuracy performance. The unit is a digital transmitter with piezo-resistive sensor and welded metallic membrane. It is a modular transmitter with long term stability and enhanced safety via self diagnostic functions.

It may be used for process pressure monitoring up to SIL3

Reference accuracy:	High reference accuracy: 0.075%, as TD 1:1	
Long term stability:	0,05% of URL/year	
Temp. range:	Process fluid:	-40...+250°C
	Ambient:	-40...+85 °C
Materials :	wetted :	316L
	Trans. enclosure:	copper free aluminium, epoxy powder coated
Process connection:	size to the application	





### 3.7 TEMPERATURE TRANSMITTER

The temperature assembly TR 66 is proposed for this system with a high precision RTD sensor insert, mounted in a process thermowell.

Insert:	Pt100ohm/0°C, 2/3/4 wire RTD		
Certification:	EN 50014/18/20 ATEX or USA standard equivalent		
Electrical protection:	Eex ia, IIC T6 or USA standard equivalent		
Electrical connection:	M20		
Accuracy class:	1/3 DIN B		
Output:	4-20mA		
Environmental:	IP66		
Materials:	wetted:	316 thermowell	
	Trans. enclosure:	Stainless steel	
Thermowell design:	shape		
Flange connection:	1 ½" ANSI 150#		

## 4 FLOW CONTROL SYSTEM

### Flow-X series flow computers

The Flow-X series of flow computers offer a sophisticated concept in which advanced measurement technology and fast digital signal processing are combined with state-of-the-art processing power, versatile data communication and high capacity storage, resulting in the ideal platform for even the most demanding flow measurement applications.



It is designed for reliability in high-end custody gas and liquid applications, and includes all relevant API, AGA, ISO, IP and many other measurement standards, in a versatile, familiar, intuitive and free configurable software environment. The Flow-X series are based on powerful single stream modules which are combined in a number of different casings, for different application types.

A Flow-X/M stream module comprises an impressive number of inputs, outputs, communication interfaces and other hardware for real-time digital and analogue signal processing for one metering stream, with cycle times up to 250ms. The flow computer is approved in accordance with Measuring Instruments Directive MID, Annex MI-002 and Annex MI-005, including all EMC, ESD, surge, software, accuracy and many other tests.

### Flow Computer Display Options

The FlowX is available in two display options – here we have included for the behind-panel version. This has all the features described, but visual access is through the HMI of the supervisory.

If the OPTION of a front panel mounted unit is required, this is available but requires a larger control panel, and is of course more expensive. We would be pleased to discuss the benefits with the engineering team.



### Approvals

Directive/Standard	Description of Standard, Directive, or Test procedure
CE	Marking as per Conformité Européene, Directive 93/68/EEC. Declaration of conformity.
MID	Measuring Instruments Directive MID, Annex MI-002 and Annex MI-005.
EN 12405-1	European Standard for Gas meters and Gas-volume electronic conversion devices; part of MID.
OIML R117-1	Organisation Internationale de Metrologie Legale, Dynamic measuring systems for liquids other than water standard, Edition 2007; part of MID.
WELMEC 7.2	Software Guide - Measuring Instruments Directive 2004/22/EC; included in MID.
EN 61326-1997	Electromagnetic Compliance specification for Industrial locations; included in MID.
EN 55011	Electromagnetic Compliance specification; included in MID.

### Project Application Description

The system comprises the XS1 flow computer for safe area installation. All the transmitters of each stream can be connected to one flow module. In the case of dual configuration 2 off XS1 modules will be supplied.



### Flow Meter (dual) pulse type inputs

Analogue inputs (12 of which can be alternatively configured for Hart inputs)

Direct 4-wire RTD inputs

Analogue outputs

Digital I/O

RS232/485 serial ports

Ethernet ports

This provides sufficient I/O for either individual use of analogue inputs or the use of serial data transmission from the NOC installed on the skid. Therefore, the choice for minimum field cabling (Serial data transmission), individual transmitter loops or a mixture of the two, has no impact for Flow-X. The software system architecture requires one X/M module per meter run irrespective of the I/O actually used.

Each meter run or master meter computer shall receive the following

- Mass flow measurement data from the coriolis meter. Input signal may be pulse, Hart or via serial data.
- Temperature input from the meter stream for the determination of CTL-correction. Input signal may be via analogue 4-20mA, direct 4-wire RTD, Hart or via serial data.

- Pressure input from pressure transmitter for the determination the CPL . Input signal may be via analogue 4-20mA, Hart or via serial data
- The density data can allow the flow computer to calculate and totalise gross observed volume, alongside the mass meter transmitter.
- Mass flow rate and cumulative total is the main reported parameter
- Gross observed volume, gross standard volume, and mass totals and flow rates will also be calculated and displayed in metric units. Imperial units are available if stated at time of order.
- Master metering or proving, is initiated by the operator. The computer then automatically carries out the proving sequence.

Station Communication with the client's own SCADA/DCS can be via Modbus RS232/485 or Ethernet to provide all process and totalisation data in the flow computers. This would include gross standard volumetric flow rate, net volumetric flow rate, mass flow rate, pressure, temperature, density, gross total daily volume, net total daily volume, daily average density, daily average temperature and common alarms. Data passed to the SCADA/DCS is completely configurable by the user to suite the host protocol, data type, etc.

Alarms and events logs associated with both process and system operation are generated in the unit.

Reports including daily report, batch/periodic report, alarm/event report, audit trail and system configuration report are available. These are completely configurable by the user for content, time period or event trigger.

Station computer totalisers shall have ten significant digits. This plus the correct selection of the appropriate engineering units would limit totaliser roll over to once per year at maximum flow.

Storage capacity in each X/M module is 512MB. Additionally the Station X/P module has an additional 512MB. Therefore total user available storage capacity exceed 2GB for the archive of reports and data.

Resolution on the visual display shall be sufficient to verify the requirements for calculation uncertainty. Manually entered parameters will be displayed without rounding or truncation of digits.

Protection for all computer software e.g applications and parameters is assured by secure and registered time and date labels for audit purposes. The flow computer is configurable by downloading of the application and parameters from a PC or Laptop computer, using our dedicated configuration software FlowXpress. Additionally, all flow-X computers have a web server facility that allows remote or local viewing of the configured software using a conventional web browser such as Microsoft explorer.

Self-diagnostics are built into the station and meter run computers.

Physical security of the flow computer configuration is protected by secure user log-in security that can be set for various individual users access levels . Additionally, each meter run and the Station can be secured by a tamper evident wire seal.

Algorithms and fixed parameters used in computation are protected by a layered security system such that they can only be zeroed or altered by authorized, named personal. Any change in algorithm and or parameters is recorded and stored with identification of the initiator, time and date, as well as the Previous and New values of the altered parameters. This is recorded in the event log.

Time interval responding to changes in the flow computers input signals, the subsequent calculation and update of internal registers is 0.25 seconds.

Alarm groups: The system can provide following alarm groups:

- a. Hardware alarms (Transmitter and communication failures)
- b. Process alarms (Limit and deviation alarms)
- c. System alarms (Calculation errors)

#### Additional Features

- In each module there are two user-configurable RS232/RS485 interfaces available for connection to external devices, such as an ultrasonic meter, serial printer, gas chromatograph, DCS etc.
- There are two independent and versatile TCP/IP RJ45 ports available for connections to external systems, e.g. SCADA, HMI or DCS. With these dual Ethernet ports, support is available for fully dual redundant operation. Communication protocols are fully user-definable. Supported protocols for the Ethernet devices are Modbus/TCP (server as well as client), and HTTP for web-client applications.
- Each flow module is equipped with 512 MB memory for long-term permanent storage of data, logged information and stored reports.
- Multi-lingual interface: The Flow-X/P flow computer is truly multi-lingual by design, enabling on-the-fly changeover to the requested language on the touch-screen by the operator. Typical languages include Cyrillic, Arabic, Mandarin, and more.
- Data valid input (for metrological approval)
- API MPMS 11.1: 1980 (API-2540), API MPMS 11.2, API MPMS 11.1:2004, GPA-TP15, GPA-TP25 / TP27.
- Cross-module I/O sharing.
- Built-in support for compact provers
- PID control with cascading feature; Valve control.
- Meter run switching
- Master meter proving.

#### 4.1 FLOW-XPRESS CONFIGURATION SOFTWARE

All Flow-X series of flow computers are configured with the Flow-Xpress™ software. This allows Flow-X modules to be configured from a laptop or computer simply via the Ethernet interface. Configurations can be uploaded or downloaded to or from the flow computer.





Software configuration with step-by-step flow computer configuration is made using an Explorer-like tree. See the Flow-Xpress screen at the left.

At this basic level simple check-boxes and straightforward data-entry fields are offered to the user. After all

applicable choices/selections have been made the flow computer configuration can be downloaded to the connected flow computer with a single mouse-click. Each flow computer is provided with various, ready-to-run & metrology approved templates for oil and gas applications, allowing a user to further adapt the required application for his or her needs.

#### 4.2 INTEGRATION WITH CLIENT'S OWN SYSTEMS

We understand that the client's own computer system will be used to control and record information from this new system. Endress+Hauser will commit to assist in all reasonable manner, to integrate this system to this unit. The task is expected to be straightforward, as in principle such system are 'standard'. It is expected that the support will consist of suitable parts of the FDS for the Endress+Hauser supply, and final testing/configuration during the Endress+Hauser engineer site visits, as already detailed in this offer.

### 5 MID CERTIFICATION

The EU Measuring Instruments Directive (MID: 2004/22/EC) sets out requirements for all new hydrocarbon liquid and most hydrocarbon gas, metering systems. In terms of accuracy, these are generally no more onerous than the existing regulations, but the MID does require a design and performance survey of the complete system.

As is appropriate for this type of system, the accuracy class of OIML R-117-1 will be class **0.5** for the liquid applications, 0.3 in case of pipeline measurements.

To ensure that this solution meets the full requirements of the client and the authorities, the design will be reviewed by an EC Notified MID certifying body.

In this case E+H will work with 'NMI Certin B.V. Netherland to obtain the necessary certification under their notifying body number 0122 and Annex MI-005 'Measuring Instruments for Liquids Other than Water'. An 'Examination Report' will be produced during the design and build phase of the system from documents prepared by E+H according to Article 10 of the MID. These will be supplied to NMI along with existing CE approvals & other certificates for the significant parts of the metering system.

The notifying body will attend the verification on site, and will review the certification and results.

Upon successful verification of the complete system on site, a 'Certificate of Conformity Unit Verification' will be issued by the authority according to Annex B+F of the directive, and their sign and number will be applied to the nameplate of the certified equipment.

All of these tasks will be paid for, managed and documented by E+H.

The client must supply all the normal necessary facilities for the tests to occur: this means adequate access, safety provisions, a desk in an office with messing facilities for the notifying officer etc.

## 5.1 SYSTEM VERIFICATION & SUBSEQUENT RE-CALIBRATIONS

The initial system verification is essentially a witness of the installation of the skids and approval of following the guidelines, under the witness of the notifying body. This verification is necessary to demonstrate the error-free working of the total system and to demonstrate that the accuracy & repeatability are within the limits.

For an official approved verification a flow test is not necessary. This is based on an official document from the notified body NMI which stated on practical tests that our coriolis meters shows the same accuracy and behaviour on oil compared with water calibrations. The physical effects and influences from specific products were eliminated. The verification need a fully filled product line with the measured liquid for the zero setting procedure.

**Note: We as Endress+Hauser are able do an initial verification without any flow test on site.**

## 6 EXCLUSIONS & QUALIFICATIONS

### 6.1 EXCLUSIONS&DEVIATONS

Not yet at this stage

## 7 COMMERCIAL TERMS OF PROJECT

### 7.1 BUDGET PROJECT PRICE

We are pleased to offer the scope of work as described above, and in summary

- The metering stream (loose parts equipment) consist of a coriolis meter, pressure transmitter , temperature transmitter and a flow computer for one stream. For a dual configuration it shall be multiplied by two.
- The verification service is calculated per day and includes the on site verification, document handling and certification of a notified body together with a service technician of E+H. (accommodation and traveling costs are not included).

- The costs for a single loose parts 3" stream:

▪ Coriolis:	12.876 EUR
▪ Pressure Transmitter:	1.224 EUR
▪ Temperatur Transmitter:	776 EUR
▪ Flowcomputer:	6.251 EUR
Set price for 2x100%	
▪ Project services, commissioning and configuration:	3.062 EUR
▪ Modul B+F verification:	4.334 EUR

- The costs for a single loose parts 4" stream:

▪ Coriolis:	21.576 EUR
▪ Pressure Transmitter:	1.224 EUR
▪ Temperatur Transmitter:	776 EUR
▪ Flowcomputer:	6.251 EUR
Set price for 2x100%	
▪ Project services, commissioning and configuration:	3.062 EUR
▪ Modul B+F verification:	4.334 EUR

- The costs for a single loose parts 6" stream:
  - Coriolis: 30.656 EUR
  - Pressure Transmitter: 1.224 EUR
  - Temperatur Transmitter: 776 EUR
  - Flowcomputer: 6.251 EUR
  - Set price for 2x100%
  - Project services, commissioning and configuration: 3.062 EUR
  - Modul B+F verification: 4.334 EUR
  
- The costs for a single loose parts 10" stream:
  - Coriolis: 55.492 EUR
  - Pressure Transmitter: 1.224 EUR
  - Temperatur Transmitter: 776 EUR
  - Flowcomputer: 6.251 EUR
  - Set price for 2x100%
  - Project services, commissioning and configuration: 3.062 EUR
  - Modul B+F verification: 4.334 EUR
  
- The costs for a single loose parts 12" stream:
  - Coriolis: 118.069 EUR
  - Pressure Transmitter: 1.224 EUR
  - Temperatur Transmitter: 776 EUR
  - Flowcomputer: 6.251 EUR
  - Set price for 2x100%
  - Project services, commissioning and configuration: 3.062 EUR
  - Modul B+F verification: 4.334 EUR

This proposal could have a maximum value in a dual configuration (2\*100%) of the metering streams and a verification service (one day per application) of: 2.137.632 EUR for all of the 26 locations together.

The prices are based on the total 26 applications as one order.

## 7.2 OPTIONS

As indicated in chapter 3.2 the air eliminator can be used as an optional device for some of the applications. The prices are indicated per each device, one device will be enough even for the dual configuration:

DV80-01 connection size 3"	Location: Varteju, Teis, Izvoru, Slobozia, Saru, LACT Badesti, Boldesti, Brazi4 and Brazi 5
DV100-01 connection size 4"	Location: Madulari
DV100-02 connection size 4"	Location: Brazi 1
DV150-02 connection size 6"	Location: Brazi 2
DV80-01:	7.411 EUR
DV100-01:	10.150 EUR
DV100-02:	11.100 EUR
DV150-02:	13.682 EUR

## 7.3 TERMS OF PAYMENT

We propose:

- 30% of contract value upon purchase order
- 40% of contract value upon start of production
- 25% upon despatch from manufacturing works
- 5% after commissioning

Monies to be received by confirmed and irrevocable letter of credit preferably.

Contractual point & terms of delivery: FCA Germany (Weil am Rhein) according to INCOTERMS 2010

## 7.4 PAYMENTS

Buyer will pay seller within thirty (30) days of receipt by buyer of a properly prepared and adequately supported invoice. Where payment is made by electronic funds transfer, payment is considered to have been made as soon as the due payment has been transferred from buyer to seller account.

## **7.5 BONDS & PENALTIES CANCELLATION CHARGES**

No bonds supplied by E+H nor any penalties against E+H are envisioned or included in this contract.

Cancellation charges:

- 10% at PO
- 30% presentation of basic engineering
- 35% approval of basic engineering
- 60% start of production
- 95% FAT against inspection release note
- 98% materials ready to ship
- 100% commissioning and SAT

## **7.6 VALIDITY OF BID**

This proposal is for budget evaluation only.

## **7.7 TERMS & CONDITIONS OF CONTRACT**

Standard E+H conditions

## **7.8 DELIVERY & PROJECT (MANUFACTURING) SCHEDULE**

Following the clear approval 'proceed with build', we estimate the manufacture will take **16** calendar weeks. Partial delivery will be preferred.

### **FAT**

FAT (factory acceptance test) procedures may or may not be additional to the manufacturing period described above, depending upon the finalised contract agreement. If the customer decide to do this this can be arranged and is included in the costing.

### **Packing & Protection (conservation)**

An appropriate project packing & protection (conservation) specification will be created and the time for this may be additional to the manufacturing period described above, depending upon the finalised contract agreement.

### **Shipping & Delivery Acceptance**

All shipping & delivery acceptance arrangements shall be project specific, and the time for this is normally additional to the manufacturing period described above, depending upon the finalised contract agreement.

### **Installation, Commissioning, SAT**

Installation, Commissioning & SAT (site acceptance test) durations are normally additional to the manufacturing period described above, but depend upon the finalised contract agreement.

**Definitions for the above:**

**‘Contract Value’:**

for the purpose of this contract means the total value of all goods and services ordered for the project from the seller at the time of invoicing.

**‘acceptance of purchase order’:**

for the purpose of this contract means from the submission to the buyer in writing (letter and/or email) of an acceptance of the purchase order in principle and in general, with intention to proceed, and notwithstanding that some specific conditions and matters may still be outstanding and pending an agreement between the parties. The acceptance must be sent to the buyer within 5 calendar days of formal receipt by seller.

**‘upon start of production’:**

for the purpose of this contract means from the notification to buyer in writing (letter and/or email) that specific engineering, procurement and production tasks have commenced along with the package of ‘preliminary critical documents’ and unpriced copies of the sub-vendor purchase orders for critical components.

**‘preliminary critical documents’:**

for the purpose of this contract means a package of documents comprising:

- preliminary issue of: PID, GA, ITP/QCP, project (manufacturing) schedule, functional design specification (index only)

**‘critical components’:**

for the purpose of this contract means:

- DB&B isolation valves and flow control valves on the main process stream pipe line, 4"nb and above
- pressure vessels (eg: air eliminators) on the main process stream pipe line
- coriolis mass flow meters on the main process stream pipe line
- computer control & metering panel or flow computers and supervisory computer

**‘items shipped including partial shipments’:**

for the purpose of this contract means from the the submission to the buyer (hard copy and/or electronic) of the goods ‘release note’ and/or proof of shipment (eg: in the case of sea freight the bill of lading) and the appropriate packing documents – all as agreed in the finalised contract agreement for the supply of these goods. ‘Partial shipments’ are allowed.

**‘release note’:**

for the purpose of this contract means the buyer’s document recording that the goods are now released from the care of the seller and are ready for shipping. ‘Partial shipments’ are also permitted to be released. In the case that the goods are made ready for release by the seller, and should such release be delayed by the buyer or his agents and representatives for his convenience or for reasons outside of the control or responsibility of the seller, then only for the purposes of releasing any associated milestone or stage payment the release shall be considered to have been approved.

**‘final documentation’:**

for the purpose of this contract means from the the submission to the buyer (hard copy and/or electronic) of the agreed package of ‘final documentation’ supported by proof of delivery (eg: in the case of hard copy DHL tracking receipt).

**7.9 WARRANTY**

Standard E+H conditions

**7.10 STORAGE OF COMPLETED GOODS**

The buyer shall take delivery of the goods on the date agreed in the contract unless otherwise agreed in writing by the seller. If the agreed delivery or collection or acceptance is delayed by no fault of the seller, then the goods shall be deemed to be in storage, and the buyer shall be liable to pay storage charges. The first three weeks of storage charges are waived. Each additional full or part week of storage is charged at a rate of 125 Euros per week or 0.125 % of the total contract value per week, whichever is the greater. Any agreement by the seller to store the goods shall not delay nor in any way affect the Buyer’s duty and responsibility to pay for the goods as previously agreed. Any late delivery penalty or liquidated damages clause in the buyer’s terms and conditions, is automatically terminated at the moment the goods are put into storage.

For long periods of storage at the Buyer’s site following his acceptance of the goods, all removed or loose instrumentation and equipment must be stored indoors. To ensure the effectiveness of storage/preservation procedures, regular maintenance/inspection checks are required to be carried out by Endress+Hauser authorised operators at the Buyer’s cost. To retain full warranty cover by Endress & Hauser, a planned inspection/maintenance program should be agreed with the buyer at time of equipment delivery.

**7.11 SOLUTION**

Endress+Hauser have selected the best solution, products and services for this project based upon the information received at the time of bidding.

We hope that the above meets with your full approval and look forward to receiving your earliest confirmation for this important contract.

## 8 SIGNATURES

**Tobias Linsner**

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Visits us:

<http://www.endress.com/en/Endress-Hauser-group/industry-automation-expertise/industry-oil-gas>