Evaluation Certificate

Number **TC13096** revision 0
Project number 3993171

Issued by: NMi Certin B.V.

In accordance with:
- WELMEC 8.8, 2017: Guide on the General and Administrative Aspects of the Voluntary System of Modular Evaluation of Measuring instruments
- WELMEC 7.2, 2015: Software Guide
- WELMEC 7.2, 2023: Software Guide
- OIML R117-1, 2007: Dynamic measuring systems for liquids other than water
- OIML R117, 2019: Dynamic measuring systems for liquids other than water

Producer:
Endress+Hauser SICK GmbH+Co. KG
Bergener Ring 27
D-01458 Ottendorf-Okrilla
Germany

Part: An **electronic calculating and indicating device** intended to be used as a part of a dynamic measuring systems for liquids other than water.

Producer mark or name	:	Endress+Hauser
Type designation	:	Flow-X/C
Accuracy class	:	0.3

Further properties and test results are described in the annexes:
- Description TC13096 revision 0.
- Documentation folder TC13096-1.

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Certification Board

NMi Certin B.V.
Thijsseweg 11
2629 JA Delft
The Netherlands
T +31 88 636 2332
certin@nmi.nl
www.nmi.nl

1 General information on the electronic calculating and indicating device

All properties of the electronic calculating and indicating device, whether mentioned or not, shall not be in conflict with the legislation.

This Evaluation Certificate is the positive result of the applied voluntary, modular approach, for a component of a measuring instrument, as described in WELMEC 8.8, 2017.

The complete measuring instrument must be covered by relevant metrological certification that is valid in the country where the instrument is put into use.

One Flow-X/C flow module can be used for one or two meters with dual pulse input per stream.

Example of the Flow-X/C

1.1 Essential parts

The electronic calculating and indicating device can be composed of the following parts:

1.1.1 Hardware-components

Description	Part number	Documentation	Ambient temperature range
Digital board	xx-211-006	13096/0-01; -02	+5 °C / +55 °C
	xx-211-007	13096/0-03, -04	-25 °C / +55 °C
	xx-211-008	13096/0-05, 13096/0-06	
Analog board	xx-212-004 xx-212-003	13096/0-03, -04	+5 °C / +55 °C
	xx-212-005	13096/0-09, -10	-25 °C / +55 °C
	xx-212-006	13096/0-11, -12, 13096/0-13	
Power board	xx-213-003	13096/0-14, -15	+5 °C / +55 °C
	xx-213-004	13096/0-16, -17	-25 °C / +55 °C
Backplane panel	xx-216-003	13096/0-18, -19	-25 °C / +55 °C
Connector panel	xx-218-004	13096/0-20, -21	+5 °C / +55 °C
	xx-218-005	13096/0-22, 13096/0-23	-25 °C / +55 °C
Display interconnection board	xx-219-004	13096/0-24, -25	+5 °C / +55 °C
	xx-219-005	13096/0-26, -27	-25 °C / +55 °C
7" touch screen display drawing	TST070WSBE	13096/0-28, 13096/0-29	-25 °C / +55 °C

Remark: xx can be any set of characters

1.2 Essential characteristics

1.2.1 Temperature range ambient:
- -25 °C to +55 °C
- Humidity class H1: non-condensing temperature controlled enclosed location

1.2.2 Environment classes:
- M1 / E1

1.2.3 Software specification (refer to WELMEC guide 7.2)
- Software type P.
- Risk Class C.
- Extension L, T, S and I5 are applicable, while extensions O and D are not applicable.

The validated software versions and checksums are:

Software part	Software and identifiers		Remarks
Firmware [1]	Software checksum acts as software version indication	2F494636	Core calculation, reporting and communication engine
		11143FE8	
		1AAD4807	
	1.9.0.7041	47E8CD2F	
	2.1.1.9285	712C1E6B	
	2.1.2.10217	0B29E8A2	
	2.1.3.10452	0B29E8A2	
	2.1.4.12541	0B29E8A2	
	3.0.0.10988	A9B2B7D9	
	3.1.1.12149	13D0B0C5	
	3.1.3.12952	13D0B0C5	
	3.2.0.13638	2555BE9D	
	3.2.1.13738	2555BE9D	
	3.2.3.14630	2555BE9D	
	3.2.4.14771	2555BE9D	
	3.2.6.16452	37B727D5	
	3.2.8.17090	37B727D5	
	3.3.x.yyyyy	69D96585	

Software part	Software and identifiers		Remarks
Add-on Programs	1.1.2.7027	Label: Jun 13, 2016 18:04:09	Boot loader and other auxiliary programs
	2.0.0.8200	Label: Aug 4, 2017 15:38:44	
	2.3.0.11844	Label: Oct 07, 2019 16:24:57	
	2.4.0.12900	Label: Apr 14, 2020 13:03:41	

Software part	Software and identifiers		Remarks
Operating system	1.1	Release_20160425	Real-time operating system
	1.1	Release_20180327	
	1.1	Release_20190625	
	2.0	3175	
	2.0	3186	
	2.0	3423	
	2.0	3753	
	2.0	4121	
	2.0	4616	
	2.0	4707	
	2.0	4768	
	2.0	4823	

Software part	Software and identifiers		Remarks
FPGA	0879.914A.E820.BBF1	20D4.7372.2349.0DFB	
	0879.914A.E820.BBF1	6B1A.43BD.C7C8.F1D5	
	0000.0000.9367.6641	0000.0000.707E.0117	
	0000.0000.4486.EE18	0000.0000.5AF4.9B91	
	0000.0000.4486.EE18	0000.0000.354A.32F1	
	0000.0000.2244.331C	0000.0000.00E4.231B	
	0000.0000.2244.331C	0000.0000.8F26.C78C	
	0000.0000.2244.331C	0000.0000.BE45.0762	
	0000.0000.2244.331C	0000.0000.38D2.DDE6	

Software part	Software and identifiers		Remarks
Liquid application [1]	2.1.0.x	E21B13310	-
	2.2.0.x	D5CF6C993	
	2.3.0.x	E48FE7BA4	
	2.3.1.x	E629A5DAF	
	3.0.0.x	12B497603A	
	3.0.0.x	1C190AD587	
	3.1.0.x	11B78C6249	
	3.1.0.x	1D7F5633C8	
	3.1.0.x	30663BE481	
	5.0.0.x	128D4AADEC, 187280E671	
	5.1.1.x	14A5AE80DF, 1AD7ED0A6B	
	105.2.0.x	CD9ECC887 196C1204D9 2C3A83853E	
	106.0.0.x	F82B574A6 1A3EEA2607 2E422534C2	

[1] Where 'x' and if applicable 'y' is related to metrologically non relevant part of the software and could be any number.
Remarks:
The software version number and appertaining information can be inspected on the local display by selecting display 'Metrological', 'Software version'.

1.2.4 Legal software functions

1.2.4.1 Monitoring and protection of volume and / or mass impulse input from meters, from analog temperature inputs, from analog pressure, from analog density input and from digital inputs, for instance from HART devices.

1.2.4.2 Meter factor curve is available for a maximum of 16 different products. Each meter factor curve is coupled to a product. Selecting a product automatically selects the appertaining meter factor curve.

1.2.4.3 Registering of volume(s), mass and other measured values and parameters.
For each run and for both forward and reverse flow direction the calculating and indication device supports the following totalizers.
- cumulative accountable indicated (volume or mass depending on the meter type);
- cumulative accountable gross volume;
- cumulative accountable gross standard volume;

- cumulative accountable net standard volume;
- cumulative accountable mass.

1.2.4.4 The calculating and indicating device may be equipped with an application that allows connection of two temperature transmitters per stream, for calculating and presenting the average value of the two measured temperature values.
In case the deviation between the temperature transmitters is larger than a preset value, the following options are available:
- The temperature indications of both transmitters are still used;
- The indication of temperature transmitter A is used;
- The indication of temperature transmitter B is used.
- The deviation is considered as a transmitter failure; depending of the fallback typesetting the calculating and indicating device either shows the last good value or the keypad value or the fallback value.

The checks on that temperature transmitter value (not out of service, not defective, etc.) apply.
One of the transmitters can be manually taken out of service for calibration purposes. In that case the measured temperature of the other transmitter is used.

1.2.4.5 The calculating and indicating device may be equipped with an application that allows connection of two pressure transmitters per stream, for calculating and presenting the average value of the two measured pressure values.
In case the deviation between the pressure transmitters is larger than a preset value, the following options are available:
- The pressure indications of both transmitters are still used;
- The indication of pressure transmitter A is used;
- The indication of pressure transmitter B is used;
- The deviation is considered as a transmitter failure; depending on the fallback typesetting the calculating and indicating device either shows the last good value or the keypad value or the fallback value.

The checks on that pressure transmitter value (not out of service, not defective, etc.) apply.
One of the transmitters can be manually taken out of service for calibration purposes. In that case, the measured pressure of the other transmitter is used.

1.2.4.6 In case no product density temperature transmitter is configured the measured product temperature at the meter is used as the product density temperature.
The meter density is assumed to be equal to the measured density.

1.2.4.7 In case no product density pressure transmitter is configured the measured product pressure at the meter is used as the product density pressure.
The meter density is assumed to be equal to the measured density.

1.2.4.8 Option to use pressure and temperature from a smart meter as meter pressure and
Option to disable totalizers of one meter when two meters are in serial configuration.

1.2.4.9 The Weights and Measures part of the program that contains the test routines for memory, transmissions and calculation.

1.2.5 Conversions

The Flow X series can perform conversion calculations according to the following methods:

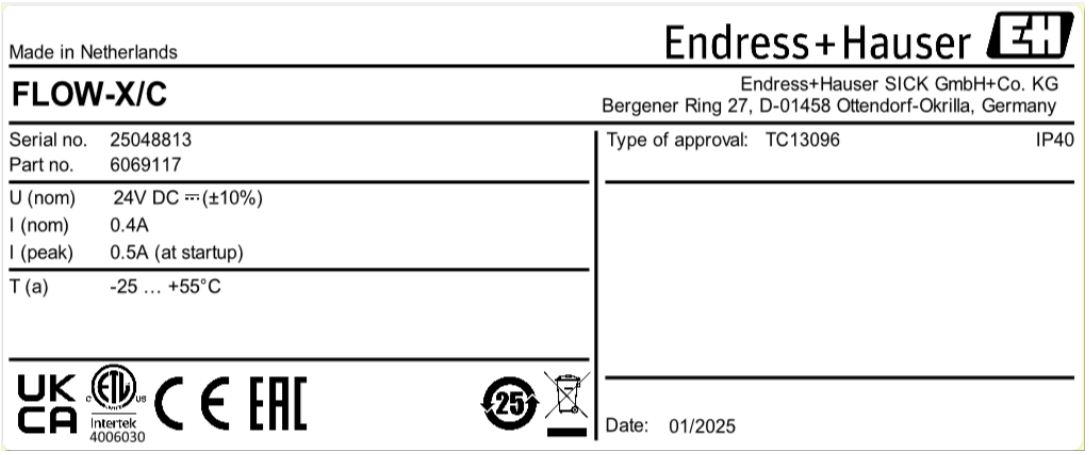
- API Manual of Petroleum Measurements Standards API-2540, Chapter 11.1; 1980 tables (ASTM D1250-80) tables 53A and/or 54A (crude oil), 53B and/or 54B (refined petroleum products), table 54C, table 53D and/or 54D (lube oils);
- API Manual of Petroleum Measurements Standards API MPMS, Chapter 11.1; 2004 tables (ASTM D1250-04) tables 53A and/or 54A (crude oil), 53B and/or 54B (refined petroleum products), table 54C, table 53D and/or 54D (lube oils);
- GPA-27 table 53E and/or 54E (light products);
- API MPMS 11.2.1M and 11.2.2M (pressure correction);
- OIML R22 (Alcohol, ethanol);
- ISO6578-2017 LNG density calculation using Klosek-McKinley formula.

1.3 Essential shapes

1.3.1 Inscriptions

On the electronic calculating and indicating device, clearly visible, at least the following is inscribed:

- Evaluation Certificate number **TC13096**).
- Name or trademark of the producer.
- Part number.
- Serial number.



Example of name plate for Flow-X/C

The markings must be clearly visible without removing any covers.

1.3.2 For non-interruptible applications, an external uninterruptible power supply must be used.

1.3.3 Ethernet cable if connected to the instrument should be less than 10 meters long.

1.4 Conditional characteristics

1.4.1 One additional serial RS232 port.

1.4.2 2 Ethernet interfaces.

1.4.3 External power supply voltage: 24 Vdc +/- 10%. For use in uninterruptible measurement systems the output of this power supply must be undisturbed during input power dips of 10 ms to 0% of the nominal voltage, of 100 ms to 40% of the nominal voltage and of 10 s to 85% of the nominal voltage. This can be achieved by using an uninterruptible power supply.

1.4.4 Parameter settings

The below mentioned parameters shall be set to the belonging values and in the secure mode “read only”.
For the programming of the parameters see 13096/0-30.

Menu	Parameter	Value
Common settings		
Configuration, Overall setup, Common settings	Atmospheric pressure	1)
	Base pressure	1)
	Density of water	1)
	Disable totals if meter is inactive	No
	MID compliance	Enabled
	Calculation out of range alarms	Enabled
Meter ticket		
Configuration, Overall setup, Meter ticket	'API 12.2.2 Measurement Tickets' compliance	1)
	API rounding	1)
	Calculation extrapolation allowed	1)
Metrological		
Configuration, Metrological	Minimum accountable batch size (volume)	1)
	Minimum accountable batch size (mass)	1)
	Minimum accountable flow rate	1)
	Maximum accountable flow rate	1)
	Minimum accountable temperature	1)
	Maximum accountable temperature	1)
	Minimum accountable pressure	1)
	Maximum accountable pressure	1)
	Equilibrium pressure accountable limit	1)

Menu	Parameter	Value
	Minimum accountable standard density	1)
	Maximum accountable standard density	1)
	Accountable alarm neutralization enabled	1) 3)
	Accountable alarm neutralization quantity	1) 3)
	Accountable alarm neutralization reset quantity	1) 3)
Products		
Configuration, Products (for each individual product; max. 16)	Name	1)
	Density conversion method	1)
	Standard density override value	1)
	Standard density override unit type	1)
	Densitometer correction factor	1)
	Equilibrium pressure method	1)
	Equilibrium pressure override	1)
	TP15 P100 correlation	1)
	Vapor pressure at 100F	1)
	Equilibrium pressure coefficients A, B, C	1)
	Compressibility F override enabled	1)
	Compressibility F override value	1)
Run setup		
Configuration, Run, Run setup	Meter device type	1)
	Observed density input type	1)
	Density temperature input type	1)
	Density pressure input type	1)
	Standard density input type	1)

Menu	Parameter	Value
	Single or dual meter temperature transmitter(s)	1)
	Single or dual meter pressure transmitter(s)	1)
Pulse input		
Configuration, Run, Flow meter, Pulse input (if applicable)	Type of pulse input (single or dual pulse)	1)
	Pulse input quantity type	1)
	Dual pulse fidelity level	1)
	Meter active threshold frequency	1)
Smart meter		
Configuration, Run, Flow meter, Smart meter (if applicable)	Smart meter input type	1)
	Smart meter internal device number	1)
	Use flow rate or total	1)
	Pulse is primary	1)
	Fallback to secondary flow signal	1)
	Meter active threshold flow rate	1)
Meter K-factor		
Configuration, Run, Flow meter, Meter K-factor (if applicable)	K-factor curve enabled	1)
	Curve extrapolation allowed	1)
	Fwd nominal K-factor	1)
	Rev nominal K-factor	1)
	Fwd K-factor curve (max. 12 points)	1)
	Rev K-factor curve (max. 12 points)	1)
Meter factor		
Configuration, Run, Flow meter, Meter factor	Type of input value (meter factor or meter error)	1)
	Meter factor / error curve enabled	1)

Menu	Parameter	Value
	Curve extrapolation allowed	1)
for each product (max. 16 products):	Fwd MF / error	1)
	Rev MF / error	1)
	Fwd meter factor curve (max. 12 points)	1)
	Rev meter factor / error curve (max. 12 points)	1)
Data valid input		
Configuration, Run, Flow meter, Data valid input	Data valid input type	1)
	Data valid digital input module	1)
	Data valid digital input channel	1)
Meter body correction		
Configuration, Run, Flow meter, Meter body correction (if applicable)	Meter body correction enabled	1)
	Body corr reference temperature	1)
	Body corr reference pressure	1)
	Cubical temperature expansion coefficient	1)
	Cubical pressure expansion coefficient	1)
Viscosity correction		
Configuration, Run, Flow meter, Viscosity correction (if applicable)	Viscosity correction enabled	1)
	Viscosity correction type	1)
	Coefficients for the applicable viscosity correction calculation method	1)
Temperature		
Configuration, Run / Station, Temperature (for each individual temperature transmitter)	Temperature input type	1)
	Analog / PT100 input module	1)
	Analog / PT100 input channel	1)
	HART internal device number	1)
	HART variable	1)

Menu	Parameter	Value
	HART to analog fallback	1)
	Fallback type	1)
	Fallback value	1)
	Dual transmitter mode	1)
	Dual transmitter deviation limit	1)
	Dual transmitter deviation fallback mode	1)
Pressure		
Configuration, Run / Station, Pressure (for each individual pressure transmitter)	Pressure input type	1)
	Pressure input units (gauge or absolute)	1)
	Analog input module	1)
	Analog input channel	1)
	HART internal device number	1)
	HART variable	1)
	HART to analog fallback	1)
	Fallback type	1)
	Fallback value	1)
	Dual transmitter mode	1)
	Dual transmitter deviation limit	1)
	Dual transmitter deviation fallback mode	1)
Observed density		
Configuration, Run / Station, Density, Observed density (if applicable)	Observed density input type	1)
	Observed density input unit type	1)
	Analog input module	1)
	Analog input channel	1)
	HART internal device number	1)
	HART variable	1)

Menu	Parameter	Value
	HART to analog fallback	1)
	Fallback type	1)
	Fallback value	1)
	High fail limit	1)
	Low fail limit	1)
	Failure delay	Default: 0 sec.
Standard density		
Configuration, Run / Station, Density, Standard density	Standard density input type	1)
	Standard density input unit type	1)
	Analog input module	1)
	Analog input channel	1)
	HART internal device number	1)
	HART variable	1)
	HART to analog fallback	1)
	Fallback type	1)
	Fallback value	1)
	High fail limit	1)
	Low fail limit	1)
Densitometer setup		
Configuration, Run / Station, Density, Densitometer setup (if applicable; for each individual densitometer)	Densitometer type	1)
	Time period input module	1)
	Time period input number	1)
	Time period averaging	Default: disabled
	Use product density correction factor	1)
	Densitometer nominal DCF	1)

Densitometer constants		
Configuration, Run / Station, Density, Densitometer constants (if applicable; for each individual densitometer)	Densitometer constants as given on the appertaining calibration certificate (Solartron / Sarasota / UGC / Anton Paar)	1)
BS&W		
Configuration, Run / Station, BS&W (if applicable)	BS&W input type	1)
	Analog input module	1)
	Analog input channel	1)
	HART internal device number	1)
	HART variable	1)
	HART to analog fallback	1)
	Fallback type	1)
	Fallback value	1)
Viscosity		
Configuration, Run / Station, Viscosity (if applicable)	Viscosity input type	1)
	Analog input module	1)
	Analog input channel	1)
	HART internal device number	1)
	HART variable	1)
	HART to analog fallback	1)
	Fallback type	1)
	Fallback value	1)
Analog inputs		
IO, Module, Configuration, Analog inputs (for each individual analog input)	Input type	1)
	Averaging method	1)
	Full scale	1)
	Zero scale	1)

	Unit type	1) 2)
	Unit	1) 2)
	High fail limit	1)
	Low fail limit	1)
PT100 inputs		
IO, Module, Configuration, PT100 inputs (for each individual PT100 input)	Input type	1)
	High fail limit	1)
	Low fail limit	1)
Pulse input		
IO, Module, Configuration, Pulse input	Pulse input A channel	1)
	Pulse input B channel	1)
	Dual pulse fidelity level	1)
	Fall back to secondary pulse	1)
	Error pulses limit	1)
	Good pulses reset limit	1)
	Error rate limit	1)
	Dual pulse fidelity threshold	1)
Time period inputs		
IO, Module, Configuration, Time period inputs (for each individual time period input)	Time period input channel	1)
Calibration		
IO, Module, Calibration, Analog inputs	Selected analog input	None
	Freeze all analog and PT100 inputs	Disabled
IO, Module, Calibration, PT100 inputs	Selected PT100 input	None
	Freeze all analog and PT100 inputs	Disabled
	HART freeze mode	Off

Calibration, HART inputs	HART value offsets	Correct values
Forces		
IO, Module, Force IO, Analog inputs (for each individual analog input)	Force mode	Disabled
IO, Module, Force IO, PT100 inputs (for each individual PT100 input)	Force mode	Disabled
IO, Module, Force IO, Digital IO (for each individual digital IO)	Force mode	Normal
IO, Module, Force IO, Pulse input	Force mode	Disabled
IO, Module, Force IO, Time period inputs (for each individual time period input)	Force mode	Disabled
Communication, HART transmitters (for each individual HART transmitter)	Force mode	Disabled
Communication, flow meter	Force mode	Disabled
Maintenance mode		
Maintenance mode	Maintenance mode	Disabled

1) These values should be specified and motivated by the producer or the owner of the calculating and indicating device. Prior to Weights & Measures verification, a list with the parameter settings and a motivation of these setting should be present at the flow computer location.
2) Applicable from firmware revision 5.0.0.x.

3) Neutralization

Neutralization enable / disable	If neutralization is enabled, flow range, temperature range, pressure range and standard density range accountable alarms are delayed until a neutralization quantity is reached. If neutralization is enabled, each time an accountable defect appears a neutralization counter (indicated volume or mass depending on meter quantity type) is started. The accountable totalizers are running, until the counter reaches the neutralization quantity, the accountable alarm is set, and the non-accountable totalizers start running. When there is no more pending defect, the non-accountable totalizers stop running and the accountable totalizers start running again. The neutralization counter is reset after the neutralization reset quantity is reached without any accountable alarm.
Neutralization counter	Setting depends on the minimum measured quantity of the liquid measuring installation.

1.5 Non-essential characteristics

1.5.1 Output lines (only for version 2 products).
- Impulse outputs
- 4 to 20 mA output

1.5.2 Totalizer information
Additional to the totalizers that are specified in paragraph 1.2.3.3, the following totalizers are available; these totalizers are not intended for use as Weights & Measures data.

For the station:
- cumulative accountable gross volume
- cumulative accountable gross standard volume
- cumulative accountable net standard volume
- cumulative accountable mass

Furthermore, for station, run 1, run 2, run 3 and run 4, and for both forward and reverse flow direction the calculation and indication device supports the following totalizers:
- cumulative non-accountable indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- cumulative non-accountable gross volume
- cumulative non-accountable gross standard volume
- cumulative non-accountable net standard volume
- cumulative non-accountable mass
- cumulative indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- cumulative gross volume
- cumulative gross standard volume
- cumulative net standard volume
- cumulative mass
- cumulative number of impulses (does not apply to station totalizers)
- cumulative number of error impulses (does not apply to station totalizers)
- current [xxx] indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- current [xxx] gross volume

- current [xxx] gross standard volume
- current [xxx] net standard volume
- current [xxx] mass
- current [xxx] number of impulses (does not apply to station totalizers)
- current [xxx] number of error impulses (does not apply to station totalizers)
- current [xxx] accountable indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- current [xxx] accountable gross volume
- current [xxx] accountable gross standard volume
- current [xxx] accountable net standard volume
- current [xxx] accountable mass
- current [xxx] non-accountable indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- current [xxx] non-accountable gross volume
- current [xxx] non-accountable gross standard volume
- current [xxx] non-accountable net standard volume
- current [xxx] non-accountable mass
- previous [xxx] indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- previous [xxx] gross volume
- previous [xxx] gross standard volume
- previous [xxx] net standard volume
- previous [xxx] mass
- previous [xxx] number of impulses (does not apply to station totalizers)
- previous [xxx] number of error impulses (does not apply to station totalizers)
- previous [xxx] accountable indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- previous [xxx] accountable gross volume
- previous [xxx] accountable gross standard volume
- previous [xxx] accountable net standard volume
- previous [xxx] accountable mass
- previous [xxx] non-accountable indicated (volume or mass depending on the meter type; does not apply to station totalizers)
- previous [xxx] non-accountable gross volume
- previous [xxx] non-accountable gross standard volume
- previous [xxx] non-accountable net standard volume
- previous [xxx] non-accountable mass

With [xxx] either ‘batch’, ‘batch open’, ‘hour’, ‘hour open’, ‘day’, ‘day open’, ‘period A’, ‘period A open’, ‘period B’ or ‘period B open’

“Current” totalizers register during the batch or during the applicable time period. At the start of the batch or applicable time period, the respective “current” totalizer values are zero.

“Previous” totalizers show the totals of the previous batch or previous applicable time period.
Totalizers indicated with the word “open” show the value of the cumulative totalizers at the start of the batch or applicable time period.

Finally cumulative and current batch open gross volume totalizers per product are available for run 1, run 2, run 3, run 4 and station.

2 Seals

The Flow-X/C must be locked and sealed. Enabling the tamper switch locks the flow computer.
A locked Flow-X/C must be sealed by use of a seal wire through the enabled tampered switch.

If the Flow-X/C is unlocked by disabling the tamper switch and the MID compliance is enabled an alarm is raised.

3 Conditions for conformity assessment

- The electronic calculating and indicating device must be constructed in accordance with this Evaluation Certificate and the appertaining documentation.
- Other parties may use this Evaluation Certificate only with the written permission of the producer.

4 Reports

An overview of the performed tests is given in Evaluation Report ER13096 revision 0 issued together with this Evaluation Certificate.