Evaluation Certificate

Number **TC7056** revision 17
Project number: 1901179

Issued by	NMi Certin B.V.
In accordance with	– WELMEC guide 8.8 "General and Administrative Aspects of the Voluntary System of Modular Evaluation of Measuring instruments under the MID". – OIML R117-1: 2007 "Dynamic measuring systems for liquids other than water". – OIML R81: 1998 "Dynamic measuring devices and systems for cryogenic liquids"
Producer	Emerson Process Management Flow B.V. Neonstraat 1 6718 WX Ede The Netherlands
Measuring instrument	A **measurement sensor** (Coriolis sensor), intended to be used as a part of a measuring instrument.

Manufacturer	:	Micro Motion
Type	:	CMFxxxy; DS600 (see § 1.2 of the description for the meaning of xxxy)
Accuracy class	:	see § 1.2.1 of the description
Temperature range liquid	:	see § 1.2.1 of the description
Intended for the measurement of	:	See § 1.2.3 of the description

Further properties and test results are described in the annexes:
– Description TC7056 revision 17;
– Documentation folder TC7056-13.

Remarks

- The measurement sensor is approved for measuring mass, density and volume.
- This revision replaces the previous versions;
- The documentation folder replaces the previous documentation folder.

Issuing Authority

NMi Certin B.V.
3 November 2017

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1 General information on the measurement sensor

All properties of the measurement sensor, 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 guide 8.8.

The complete measuring instrument must be covered by an EC type-examination certificate or an EU-type examination certificate.

This Evaluation Certificate is valid for the Micro Motion sensors, as described in paragraph 1.2 of the description and may only be used in combination with the electronics/indication, as specified in Evaluation Certificate number TC7057 and Evaluation Certificate number TC8519.

1.1 Essential Parts

- Measurement sensor
  Essentially, the measurement sensor consists of a housing in which two parallel measuring tubes are mounted. On the measurement tubes, three coils are mounted: one drive-coil and two pick-off coils.
  Details of construction of the different sensor sizes can be found in the documentation numbers 7056/16-01 up till 7056/16-14.
- In- and outputs
  The measurement sensor is equipped with several in- and outputs:
  - Drive current input, for setting the measurement tubes in a vibrating motion;
  - Two Pick-off outputs, generating sinusoidal millivolt signals
  - One three-wire PT100 output, for the measurement of the measurement tube temperature.

1.2 Essential Characteristics

1.2.1 Applicability of the measurement sensor

	Oil and oil product, chemicals and potable liquids Accuracy Class 0,3; 0,5	Liquefied gases under pressure Accuracy Class 1,0	Cryogenic liquids, LNG Accuracy Class 1,5; 2,5	Density and volume measurement
Product temp. range [°C]	-40/+250 **(★)** CMF010: -10/+50	-40/+250**(★)**	-200/+50 **(★)**	-10/+150
DS600S	+	+	-	+
CMF010	+	-	-	-
CMFxxx except CMF010	+	+	+	+[1]
CMFHCx	+	+	+	+[1]

Note **(★)**: the product temperature can extended outside this range, but is limited to -200/+250 °C, under the conditions that extra accuracy tests are performed covering the extended temperature range, either on site or in a special calibration laboratory. If needed the meter is adjusted in respect to the calibration on water.

1.2.2 Additional characteristics of the measurement sensor

- Characteristics stated on page 1 of Evaluation Certificate TC7056

Sensor:	**CMF010 y)**	**CMF025 y)**	**CMF050 y)**	**CMF100 y)**
• Qmax [kg/min]	1,8	36	110	450
• Qmin [kg/min] Class 0.5; 1.0; 1.5 and 2.5	0,017 **(1)** 0,033 **(2)**	0,23	1,36	5,7
• Qmin [kg/min] Class 0.3	0,033 **(1)** 0,067 **(2)**	0,46	2,72	11,4
• MMQ sensor [kg]	0,05	0,5	5	10
• Maximum pressure [bar(g)]	125 **(3)** 225 **(4)** 413 **(2)**	103 **(3)** 190 **(4)**	103 **(3)** 185 **(4)**	100 **(3)** 170 **(4)**

Sensor:	**CMF200 y)**	**CMF300 y)**	**CMF350 y)**
• Qmax [kg/min]	1450	4500	4920
• Qmin [kg/min] Class 0.5; 1.0; 1.5 and 2.5	18	57	113 **(1; 2)** 226 **(6)**
• Qmin [kg/min] Class 0.3	36	114	226 **(1; 2)** 453 **(6)**
• MMQ sensor [kg]	20	200	500
• Maximum pressure [bar(g)]	108 **(3)** 190 **(4)**	119 **(3)** 185 **(4)**	102 **(3)** 155 **(2; 4)**

[1] With the exception of cryogenic measurements which are approved for mass only.

Sensor:	CMF400 y)		
	(A)	**(B)**	**(C)**
• Qmax [kg/min]	6800		
• Qmin [kg/min], for Acc. Class 1.0; 1.5 and 2.5	680	340	340
• Qmin [kg/min] for Accuracy Class 0.5	680	340	850
• Qmin [kg/min] for Accuracy Class 0.3	680	680	1700
• MMQ sensor [kg]	500		
• Maximum pressure [bar(g)]	103 **(3)** 197 **(4)** 205 **(2)**		

Note:
The CMF400 did get a mechanical improvement, therefore the following distinction applies:
(A): Serial number up to 411000;
(B): Serial number from 411000 up to 14200000
(C): Serial number higher than 14200000

Sensor:	DS600 S
• Qmax [kg/min]	10800
• Qmin [kg/min] Class 0.5; 1.0; 1.5 and 2.5	570
• Qmin [kg/min] Class 0.3	1140
• MMQ sensor [kg]	1000
• Maximum pressure [bar(g)]	43

Sensor:	CMFHC2 y)	CMFHC3 y)	CMFHC4 y)
• Qmax [kg/min]	12600	22000	30000
• Qmin [kg/min]; Class 2.5	114	227	340
• Qmin [kg/min]; Class 1.5	227	453	680
• Qmin [kg/min]; Class 1.0	284	567	850
• Qmin [kg/min]; Class 0.5	568	1134	1700
• Qmin [kg/min]; Class 0.3	1136	2268	3400
• MMQ sensor [kg]	1000	1000	1000
• Maximum pressure [bar(g)]	102 **(3)** 206 **(5)**	102 **(3)** 206 **(5)**	102 **(3)** 206 **(5)**

Notes: y) indicates the type of material the meter is build of:
(1): y) = H, L or M;
(2): y) = P (high pressure version)
(3): y) = A, L or M;
(4): y) = B, C, E or H
(5): y) = Y;
(6): y) = A, B, C or E

1.2.3 Product range:
- Oil and oil products;
- Alcohol;
- Chemicals;
- Potable liquids;
- Liquefied gases under pressure;
- Cryogenic liquids;
- Supercritical ethylene with a density up to 450 kg/m^3.
- The product density lies between 300 kg/m^3 and 2000 kg/m^3 for mass measurement. The product density lies between 400 kg/m^3 and 2000 kg/m^3 for volume and density measurement.
- Maximum viscosity: 1242 mPa·s

1.2.4 Temperature range ambient: -40 °C / +55 °C, open location

1.2.5 Environment classes: M3 / E3

1.2.6 All sensor types can be used bi-directional.

1.2.7 Measuring principle
The drive coil, controlled by an external device, sets the measurement tubes in a vibrating motion. The pick-off coils generate signals representative for the frequency of motion of the measurement tubes.
The resonant frequency depends, among other things, on the density of the liquid in the measurement tubes.
The time difference between the signals from both pick-off coils depends on the mass flow of the liquid through the measurement tubes.
Processing of the measurement signals is performed by the same external device that controls the drive coil.

1.2.8 In case of volume measurement: the applicable values for Q_{max}, Q_{min} and MMQ are defined as:
- Q_{max} volume = Q_{max} mass / maximum product density;
- Q_{min} volume = Q_{min} mass / minimum product density;
- MMQ volume = MMQ mass / minimum product density
- Meant are the minimum and maximum product density that can be expected for the actual product that is being measured.

1.2.9 The measurement sensor with the electronics can be used as an associated measuring sensor for the measurement of the actual density and/or the reference density. The flow rate for this application goes from zero to the defined maximum flow rate of the sensor.

1.2.10 Pressure correction
A) Depending on the sensor characteristics, a dynamic pressure correction by means of MID compliant pressure transmitter is required when the pressure variation in the final application has an effect of more than 1/5 of the Maximum Permissible Error (MPE) for that application.
B) When the sensor is calibrated at another average pressure then the average pressure in the final application (e.g. water calibration at low pressure), the corresponding pressure effect due to the pressure difference has to be considered.
When the pressure effect is more than 1/5 of the MPE, then a pressure correction is required, either static (configured in electronics) or dynamic (MID compliant pressure transmitter).
The pressure coefficient values for the different sensors and the pressure values at which the correction has to take place for the different accuracy classes are mentioned in the documentation number 7056/17-01 for mass and for density and volume.

1.2.11 Temperature correction
In the flow transmitter a temperature correction is applied depending on the connected sensor type. See the Documentation number 7056/16-16.
Temperature correction for the sensor behaviour due to process temperature variations takes automatically place by default, based on the integral temperature sensor and the configured temperature coefficients in the electronics.
- The temperature dependency on mass flow is called mass Flow Temperature coefficient FT (in % per 100 °C).
- The temperature dependency on density is called mass Density Temperature coefficient DT (in % per 100 °C).
- Individual determination of the flow sensor Flow Temperature coefficient FT and the Density Temperature coefficient DT by the manufacturer is mandatory for %alcohol applications.
- Individual determination of the Density Temperature coefficient DT by the manufacturer is mandatory for temperatures higher than 100 °C.

1.2.12 LD Optimisation
Because the manufacturer has shown that factory calibration on water is representative for all liquids, the LD optimisation must be enabled for the sensors CMF350; CMF400; DS600; CMFHC2; CMFHC3 and CMFHC4 for the measurement of liquid hydrocarbons.
The LD optimisation is described in document 7057/26-017.

1.3 Essential Shapes

1.3.1 Inscriptions.
On the nameplate of the measurement sensor, clearly visible, at least the following is inscribed:
- This Evaluation Certificate number: **TC7056**.
- Manufacturers name and/or trademark
- The sensor designation (type)
- Serial number and year of manufacture

1.3.2 Seals.
If present, the junction box with the 9-wire connection to the (remote) Core Processor is sealed against opening. This accounts for configurations 2 and 3 as mentioned in TC7057 and for configurations 2 and 4 as mentioned in TC8519.

1.4 Non-essential shapes

- The appearance of the data plate.

2 Conditions for Conformity Assessment

- The use of this Evaluation Certificate is limited to:
  Other parties may use this Evaluation Certificate only with the written permission of Emerson Process Management Flow B.V., Neonstraat 1, 6718 WX Ede, the Netherlands.
- Verification procedure
  For the initial verification the NMi procedure C-SP-HW-280 can be applied with the title 'Procedure C-SP-HW-280 for the MID conformity assessment for the Micro Motion Flow meter when used for custody transfer in gas applications (annex MI-002) and liquid applications (annex MI-005)'.

  The initial verification can be based on:
  - a water calibration, which includes:
    - a zero mass flow setting at the water calibration facility
    - a mass flow test
    - if applicable a density test
  - In the field:
    - a zero mass flow setting, if needed
    - a zero mass flow verification
    - if applicable a density test

  Note: a zero mass flow verification and, if applicable, a density verification can also be used for subsequent verifications.

  If the measurement sensor is used bi-directional, the verification in one direction is sufficient.

  This procedure is justified because of the fact that tests have proven that the mass accuracy on water is representative for mass accuracy on other liquids.

3 Test Reports

An overview of the performed tests is given in the reports:
- CVN/201269;
- CVN-207999-01;
- CVN-410178-01;
- CVN-410178-02;
- CVN-410178-03;
- CVN-410178-04;
- CVN-607580-01;
- C-SP/603876;
- 92-EIB-RPT-015, issued by TNO;
- CPC-802620-1;
- CPC-9200041-1;
- CPC-9200087-1;
- NMi-10200543-2;
- NMi-11200345-2;
- NMi-1901179-01.

A report can be a test report, an evaluation report, a type evaluation report and/or a pattern evaluation report.