

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 Edition 2007 (E) “Dynamic measuring systems for liquids other than water”.
 – OIML R81 Edition 1998(E) “Dynamic measuring devices and systems for cryogenic liquids”

Producer Emerson Process Management Flow B.V.
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Measuring instrument A **measurement sensor** (Coriolis sensor), intended to be used as a part of a measuring instrument.

Manufacturer : Micro Motion

Type : CMFxxxxy; DS600 (see paragraph 1.2 of the description for the meaning of xxxxy)

Minimum – maximum flow rate ($Q_{min} - Q_{max}$) : See paragraph 1.2 of the description

Minimum Measured Quantity : See paragraph 1.2 of the description

Accuracy class : 0.3; 0.5; 1.0; 1.5; 2.5

Environment classes : M3 / E3

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

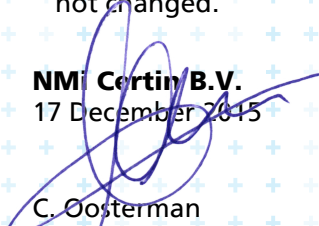
Temperature range liquid : See paragraph 1.2 of the description

Intended for the measurement of : Oil and oil products, alcohol, chemicals, potable liquids, liquefied gasses under pressure and cryogenic liquids. See paragraph 1.2 of the description for the approved density ranges.

Further properties are described in the annexes:
 – Description TC7056 revision 15;
 – Documentation folder TC7056-11.

Remarks – The measurement sensor is approved for measuring mass, density and volume.
 – An overview of performed tests is given in the Annex 1 belonging to this Evaluation certificate.
 – This revision replaces the previous versions. The documentation folder is not changed.

Issuing Authority **NMI Certin B.V.**
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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.

This Evaluation certificate is valid for the Micro Motion sensors, as described in paragraph 1.2 of the description and can 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, see the accompanying Documentation folder.
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.
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. Details of construction of the different sensor sizes can be found in the documentation folder appertaining to this Evaluation Certificate.
- 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.
 - 2 Pick-off outputs, generating sinusoidal millivolt signals.
 - One 3-wire Pt-100 output, for the measurement of measurement tube temperature.

1.2 Essential Characteristics

1.2.1 Flow characteristics

Apart from the characteristics stated on page 1 of this TC7056, the meter has the following characteristics:

Mass measurement

	Sensor type CMFxxx (xxx represents a number relating to the diameter of the sensor)						
	CMF010 y)	CMF025 y)	CMF050 y)	CMF100 y)	CMF200 y)	CMF300 y)	CMF350 y)
Q _{max} [kg/min] for all classes	1,8	36	110	450	1450	4500	4920
Q _{min} [kg/min], for accuracy class 0.5, 1.0, 1.5 and 2.5	0,017 (1) 0,033 (2)	0,23	1,36	5,7	18	57	113 (1+2) 226 (6)
Q _{min} [kg/min], for accuracy class 0.3	0,033 (1) 0,067 (2)	0,46	2,72	11,4	36	114	226 (1+2) 453 (6)
Maximum pressure [bar(g)]	125 (3) 225 (4) 413 (2)	103 (3) 190 (4)	103 (3) 185 (4)	100 (3) 170 (4)	108 (3) 190 (4)	119 (3) 185 (4)	102 (3) 155 (4+2)
Minimum Measured Quantity sensor [kg]	0,05	0,5	5	10	20	200	500
Diameter in- and outlet [mm]	2,5	6	12	25	50	80	90
Temperature range liquid [°C]	-10/+50	-200/+200	-200/+200	-200/+200	-200/+200	-200/+200	-200/+200

Mass measurement

	Sensor type					
	CMF400 y)	DS600 S	CMFHC3 y)	CMFHC2 y)	CMFHC4 y)	
Q _{max} [kg/min] for all classes	6800	10.800	22.000	12.600	30000	
Q _{min} [kg/min], for accuracy class 1.0, 1.5 and 2.5	680 (A) 340 (B) 340 (C)	570	1134	568	1700	
Q _{min} [kg/min], for accuracy class 0.5	680 (A) 340 (B) 850 (C)					
Minimum Q _{min} [kg/min], for accuracy class 0.3	680 (A) 680 (B) 1700 (C)	1140	2268	1136	3400	
Maximum pressure [bar(g)]	103 (3) 197 (4) 205 (2)	43	102 (3) 206 (5)	102 (3) 206 (5)	102 (3) 206 (5)	
Minimum Measured Quantity sensor [kg]	500	1000	1000	1000	1000	
Diameter in- and outlet [mm]	100	150	200	150	250	
Temperature range liquid [°C]	-200/+200	-200/+200	-200/+200	-200/+200	-200/+200	

Notes:

- y) Indicates the type of material the meter is build of.
- The sensor 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

- General notes to the table:

(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
- All sensor types can be used bi-directional.
- The product density lies between 300 kg/m³ and 2000 kg/m³.

Volume and density measurement

- The applicable values for Q_{max} , Q_{min} and MMQ in volume units 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.

Note: Meant are the minimum and maximum product density that can be expected for the actual product that is being measured and not the minimum and maximum product density as defined below under "Measuring volume and density".
- The CMF010 sensor is not approved for measuring density and volume.
- Measuring volume and density:
 - The temperature range of the liquid is limited from -10 °C to +50 °C.
 - The product density is limited between 400 kg/m³ and 2000 kg/m³.
- 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.

1.2.2 Pressure correction and Temperature correction

- 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 than 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 7056/13-01 for mass and for density and volume.
- Temperature correction

In the flow transmitter a temperature correction is applied depending on the connected sensor type. See the Documentation number 7056/14-01. 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).

- For CMFHC2,3 and 4 only: Individual determination of the flow sensor Flow Temperature coefficient FT by the manufacturer is mandatory when the process temperature is outside -100 °C and +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.

1.2.3

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. For all other products, the LD optimisation is described in document 7056/9-01.

1.3

Essential Shapes

- Inscriptions.
On the measurement sensor, clearly visible, at least the following is inscribed:
 - This Evaluation Certificate number: TC7056.
 - The sensor designation (type)
 - In case of the CMF400 sensor, the serial number.
- Seals
The measurement sensor is not sealed.

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Conditions for Conformity Assessment

- 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 an applicable 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.

- 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.

3 Test results

An overview of performed tests is given in the test reports:

- CVN/201269
- CVN-201999-01
- 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