5° SMART UTILITY OPEN METER

Smart Meter, tra processi innovativi e sostenibilità economica

Aula Consiliare, Palazzo Isimbardi
via Vivaio 1, Milano

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SMART METERING & SMART NETWORKS: LE NUOVE FRONTIERE DELLE RETI

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Università della Campania «L. Vanvitelli» - ANIE
Smart Metering Group - ANIE *Gas Static Smart Meter*

Le tecnologie di misura statiche del gas (per applicazioni residenziali) sono 2:

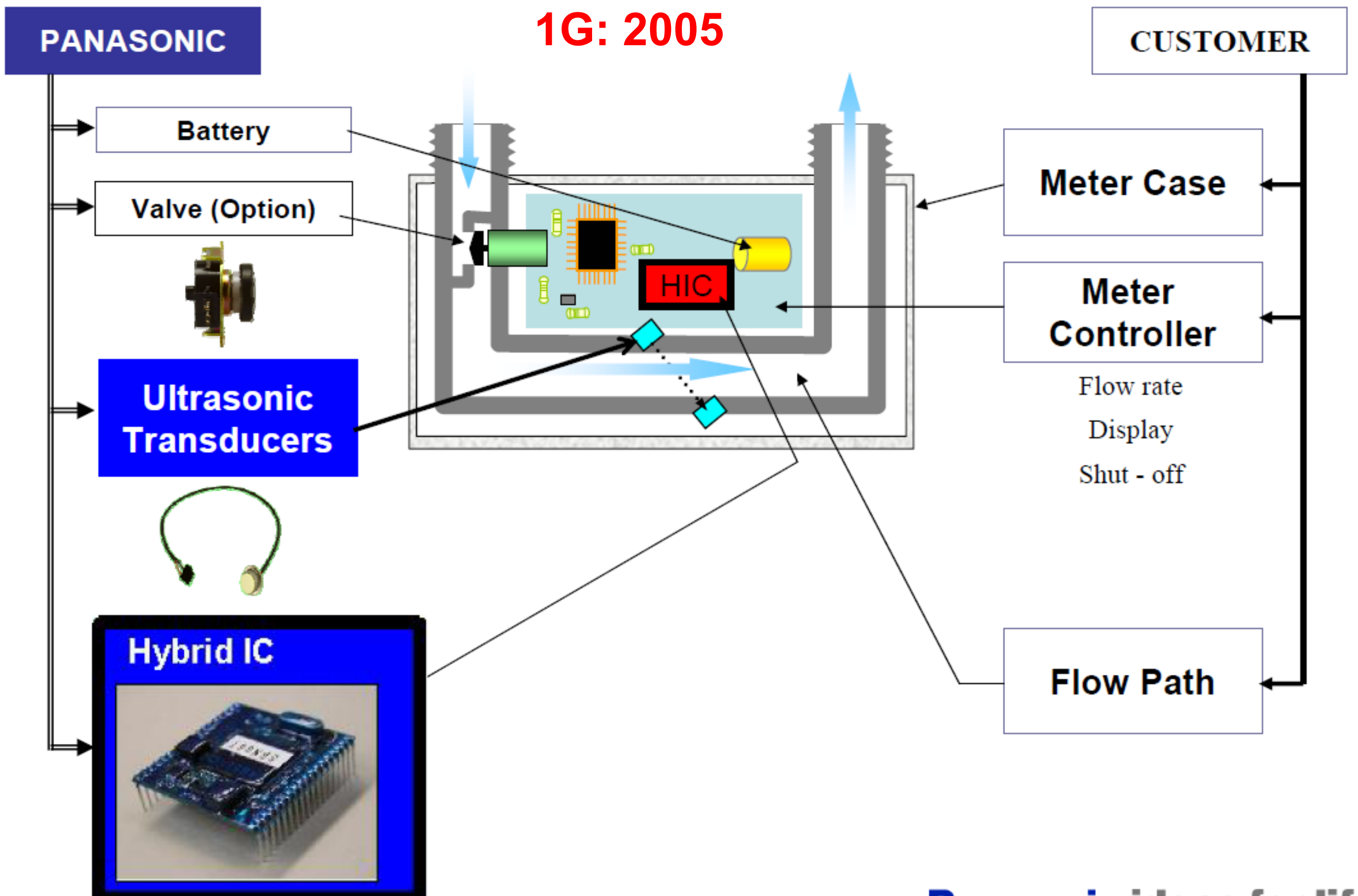
-I **misuratori ad ultrasuoni** (UltraSonic Meters)
-I **misuratori termo-massici** (Thermal Mass Meters)

Hanno avuto genesi e sviluppi sfalsati nel tempo:

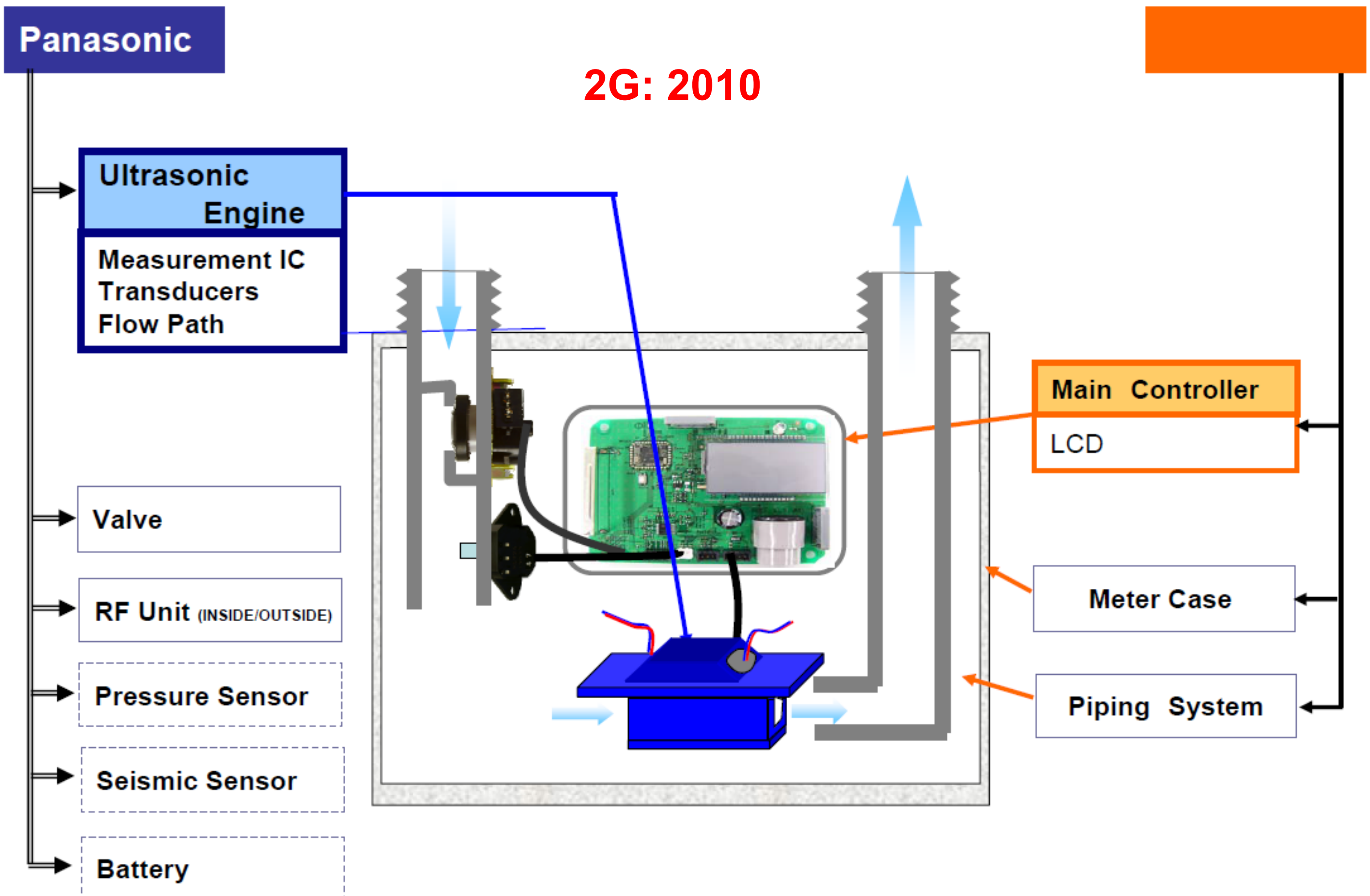
•I primi contatori gas statici apparsi sul mercato (installazione + messa in servizio) sono i **USM** già dal 2005 (Giappone). Nel corso degli anni hanno avuto varie versioni e realizzazioni migliorative. Oggi la tecnologia ad ultrasuoni mostra una buona maturità ed una notevole diffusione sul mercato mondiale.

•I misuratori **TMM** sono apparsi sul mercato nazioanale più tardi, dal 2008-2009. Anche i TMM hanno avuto successive release, nell'ottica del miglioramento continuo del prodotto.

Previous : Ultrasonic Devices



New : Ultrasonic Module



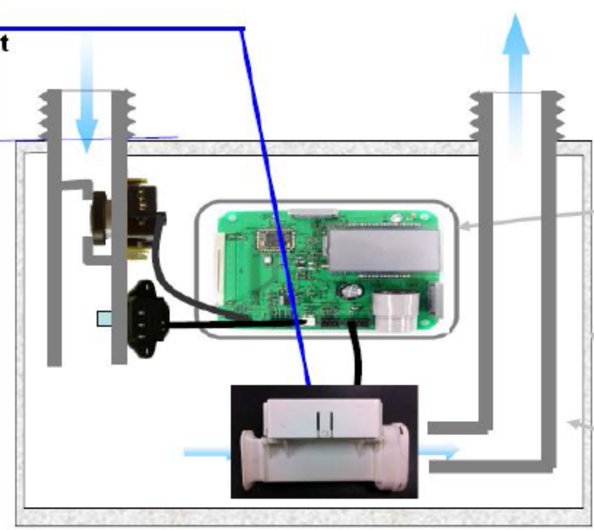
Panasonic ideas for life

NOW : Ultrasonic Module

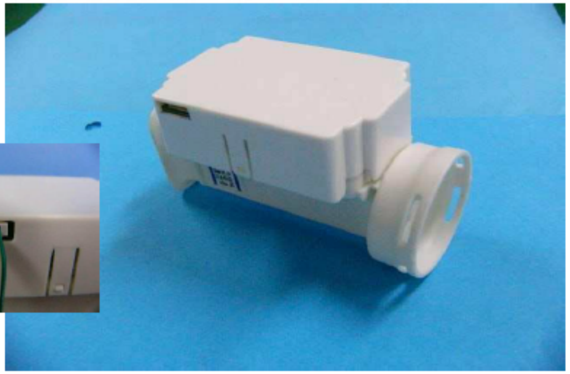
Panasonic

2 G (second generation): about 2010

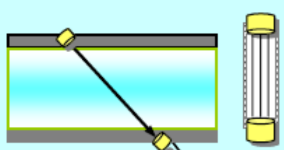
- **Ultrasonic Measurement Unit**
  - Measurement IC
  - Transducers
  - Flow Path
- Valve
- RF Unit (INSIDE/OUTSIDE)
- Pressure Sensor
- Seismic Sensor
- Battery



- Main Controller
- LCD
- Meter Case
- Piping System



Comparison to Previous Type

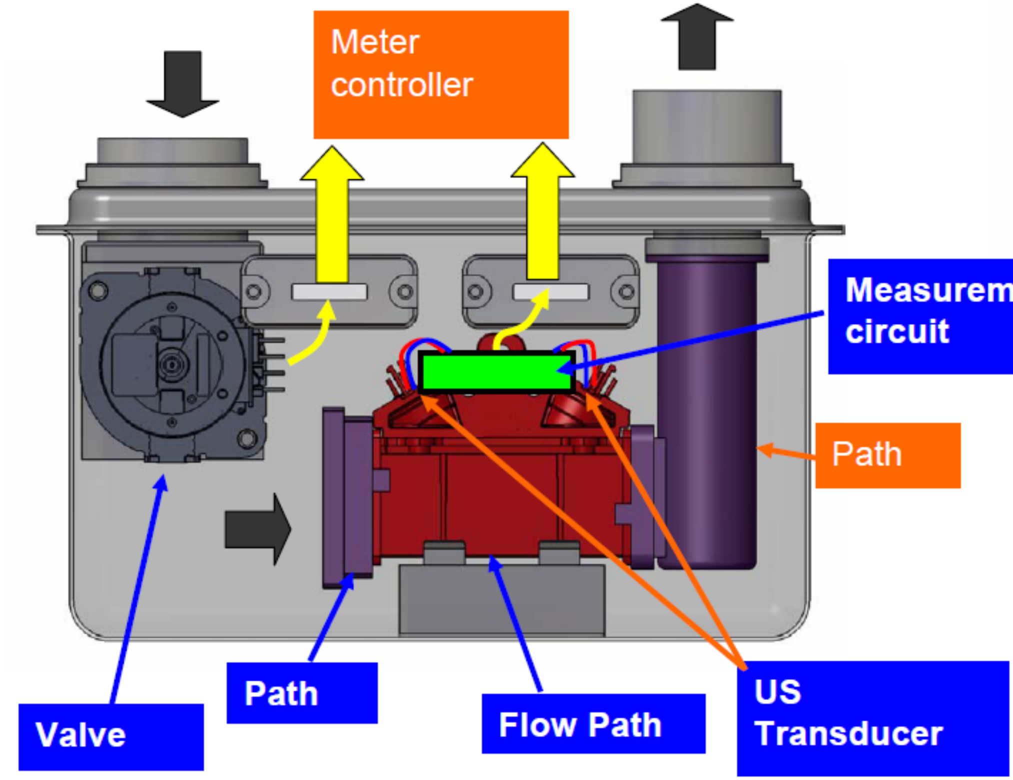
	Structure	Driven Voltage	Req. Battery Capacity
Previous	 W : 130mm H : 90mm D : 50mm	5 V	12Ah (10years)
		Driving Pulse optimization	Intermittent drive
New	 W : 80mm H : 70mm D : 40mm Smaller Size	3 V Less voltage	6Ah (10years) Less Battery

Meter Structure Proposal

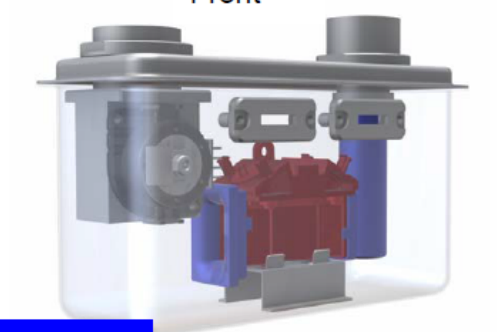
Internal structure

Panasonic

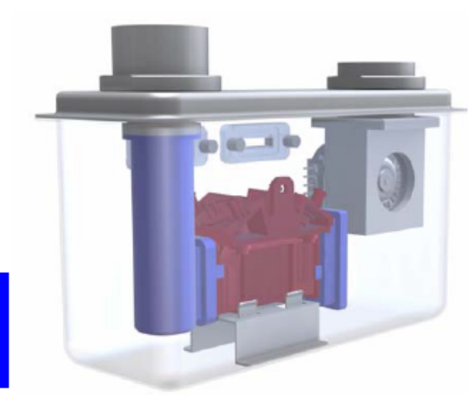
Meter manufacturer



Front



Rear



Key Feature of Measurement Unit

Shorter lead time and less development cost by the *Simple Module Product*

High Accuracy Measurement

Ability of resolution : 0.1L/h

Low Current Consumption

Current consumption : Typical 200mAh/year

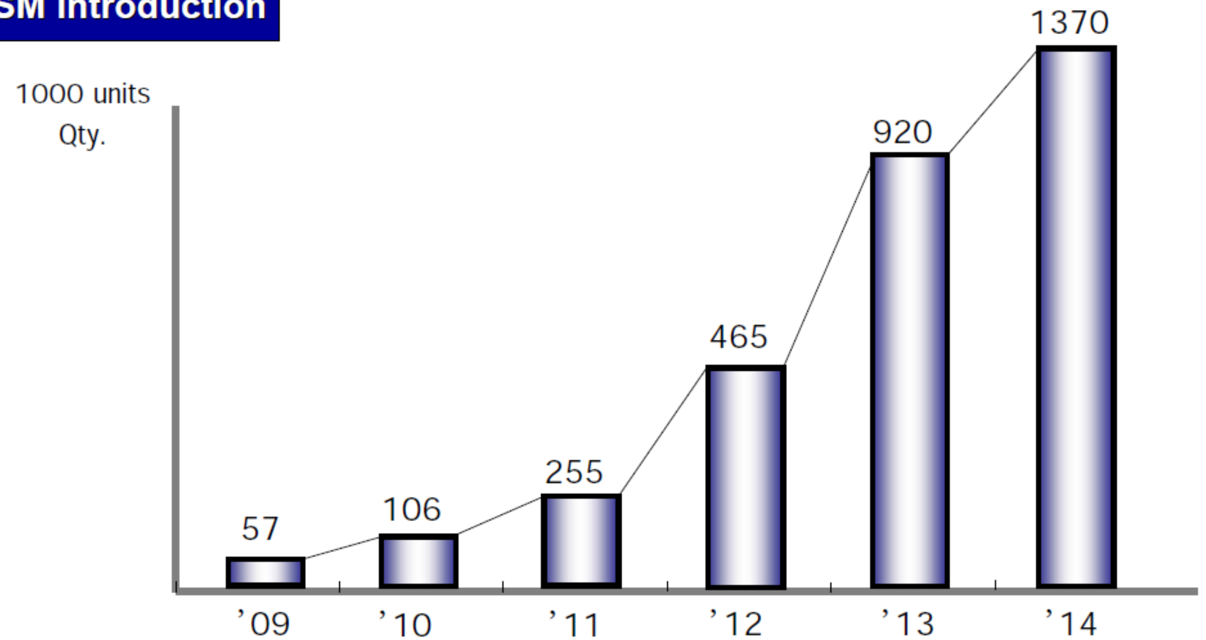
Compact Size Flow Path

Ultrasonic Gas Meter Roll Out in Japan

200K Ultrasonic Gas Meters have been Installed By Major Gas Utilities In JAPAN

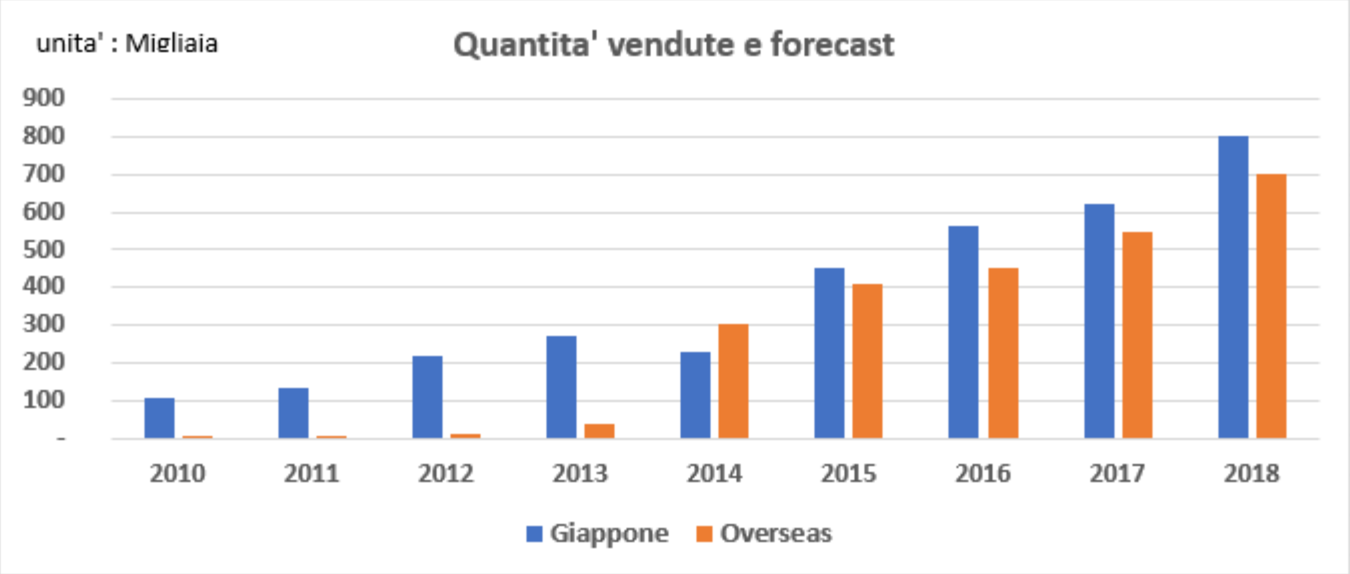
* As of APR 2011

USM introduction



Panasonic ideas for life

	2010	2011	2012	2013	2014	2015	2016	2017	2018	
Giappone	107	132	220	271	228	454	562	620	800	
Overseas	3	3	13	40	305	411	453	545	700	
Total	110	135	233	311	533	865	1.015	1.165	1.500	5.867



Test item and Past results in Japan market

1.Test Confirmation

Panasonic implemented below reliability test to ensure long-term reliability performance of ultrasonic sensor.(In fact it passed over 20 years equivalent or more)

(1) High temperature storage test
(2) Low temperature storage test (It is not accelerated test assuming a period)
(3) High temperature high humidity storage test
(4) Temperature and Humidity cycle test
(5) Heat shock test

2.Past results

It has been 11 years on 2016 since starting the field test with major gas manufacturer in Japan market on 2005.
Meter exchange is mandatory after 10 years passed in Japan. Some meters were back from the field and confirmed it was operated without problem for 10 years.

3.Data for reference

P.3 High temperature storage test data　P.4 Low temperature storage test data 、P.5 High temperature high humidity storage test data P.6　Temperature and Humidity cycle test data、P.6 Heat shock test data

High temperature storage test

Test condition
After leaving in operatoing condition in high temperature atmosphere,
it is judged after 24 hours at normal temperature.
Condition：90±3℃　904h(Equivalent to 20 years)　1680h(Equivalent to 40 years)

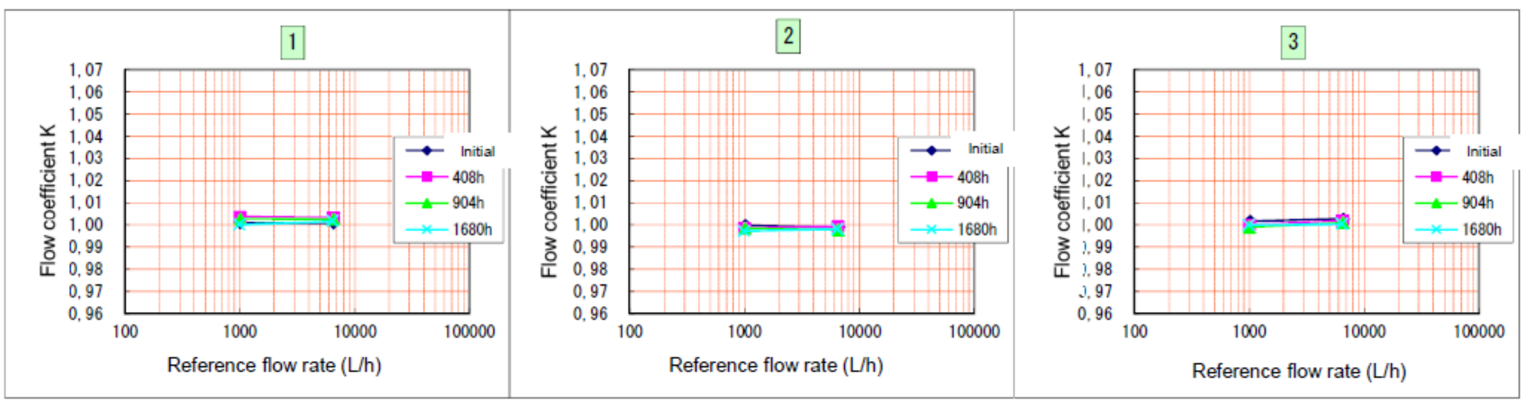
Standards
$Q_{min} \leqq Q < Q_t$: ±3%
$Q_t \leqq Q \leqq Q_{max}$: ±1.5%

Result : All within standard

Sample q'ty：3
Measure flow coefficient before and after the test

(Flow rate：L/h)

	1			2			3		
	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X
Initial	6566.818	1.000706		6627.476	0.998901		6614.904	1.002768	
	1014.959	1.000966		1024.563	0.999767		1022.354	1.00165	
408h (10 years)	6517.039	1.003346	-0.00264	6518.74	0.999347	-0.00045	6516.037	1.001783	0.000985
	1002.906	1.003689	-0.00272	1001.825	0.998507	0.00126	1002.567	0.999972	0.001678
904h (20 years)	6548.113	1.002657	-0.00195	6571.877	0.997833	0.001068	6540.648	1.000972	0.001796
	1010.746	1.002668	-0.0017	1010.488	0.998386	0.001381	1005.479	0.998976	0.002673
1680h (40 years)	6409.15	1.001712	-0.00101	6402.222	0.998056	0.000845	6407.911	1.000323	0.002445
	988.7602	1.000059	0.000907	990.3982	0.997139	0.002628	991.4052	0.999905	0.001744



* Accuracy = Flow coefficient – 1　　Accuracy: 0 = Flow coeffecient: 1

Low temperature storage test

Test condition
After leaving in operating condition in low temperature atmosphere, it is judged after 24 hours at normal temperature.
Condition：-30℃ 240h 521h
(It is implemented in company standards because low temperature is not an accelerated test assuming long term)

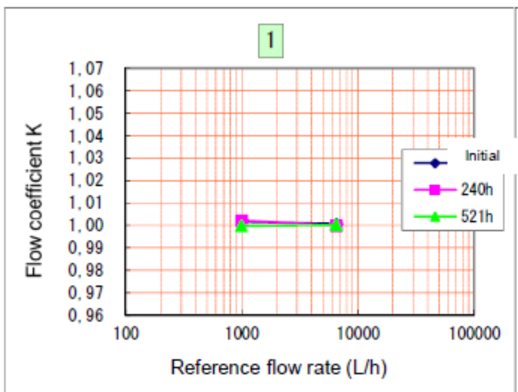
Standards
Qmin≦Q＜Qt : ±3%
Qt≦Q≦Qmax : ±1.5%

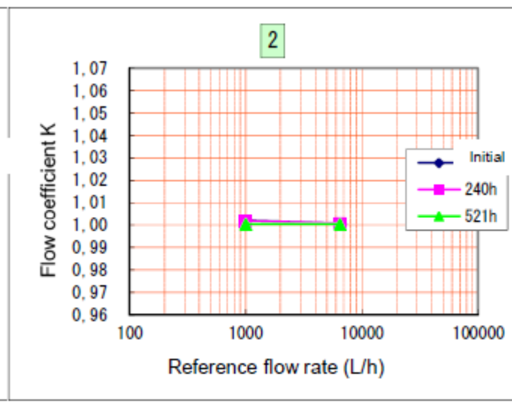
Results：All within standard

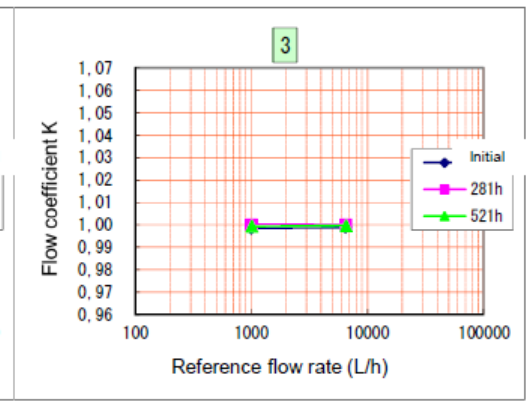
Sample q'ty：3
Measure flow coefficient before and after the test。

(Flow rate：L/h)

	1			2			3		
	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X
I nitial	6568.852	1.000565		6568.097	1.000646		6526.447	0.998903	
	1015.233	1.00152		1014.904	1.002063		1008.417	0.998563	
240h	6468.916	0.999786	0.000779	6477.321	1.00084	-0.00019	6482.203	1.000116	-0.00121
	993.024	1.002287	-0.00077	995.2219	1.001793	0.000271	999.1555	1.000163	-0.0016
521h	6490.75	1.000258	0.000307	6492.66	1.000336	0.000311	6575.312	0.999741	-0.00084
	998.5125	0.99986	0.00166	998.7761	1.000336	0.001728	1012.634	0.999282	-0.00072







* Accuracy = Flow coefficient – 1 Accuracy: 0 = Flow coeffecient: 1

High temperature high humidity storage test

Test condition
After leaving in operating condition in High temperature and High humidity atmosphere, it is judged after 24 hours at normal temperature.
Condition：70±3℃ 90～95% 480h(Equivalent to 20 years)
960h(Equivalent to 40years)

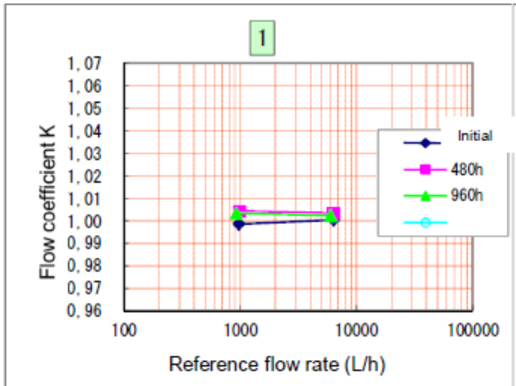
Standards
Qmin≦Q＜Qt : ±3%
Qt≦Q≦Qmax : ±1.5%

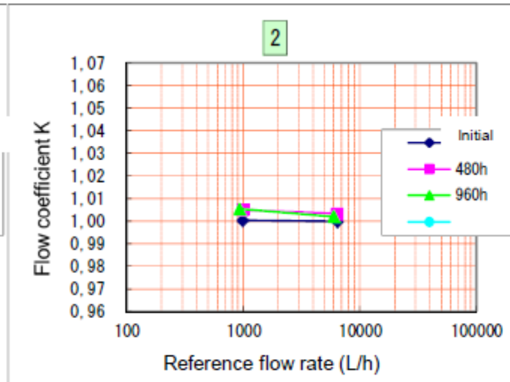
Results： All within standards

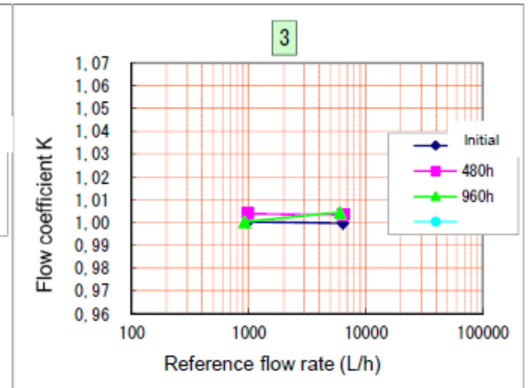
Sample q'ty ：3
Measure flow coefficient before and after the test

(Flow rate：L/h)

	1			2			3		
	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X
Initial	6391	1.00042		6399	0.99978		6399	0.99965	
	983	0.99853		984	1.00028		986	1.00027	
480h (20 years)	6371.524	1.003282	-0.00286	6368.915	1.00329	-0.00351	6369.739	1.003411	-0.00376
	984.9841	1.004248	-0.00572	984.6661	1.005049	-0.00477	985.4564	1.003775	-0.00351
960h (40 years)	6001.383	1.002224	-0.0018	5997.219	1.002028	-0.00225	6009.044	1.004362	-0.00471
	929.2561	1.003271	-0.00474	928.6311	1.005367	-0.00509	926.3828	1.000215	5.53E-05







* Accuracy = Flow coefficient – 1 Accuracy: 0 = Flow coeffecient: 1

Temperature and Humidity cycle test

Test condition
After implement desinated cycle of temperature and humidity cycle test on JIS C 60068-2-38 (Previous JIS C 0028), it is judged after 12~24 hours at normal temperature.
Condition : 20 cycle (Equivalent to 20 years) 40 cycle (Equivalent to 40 years)

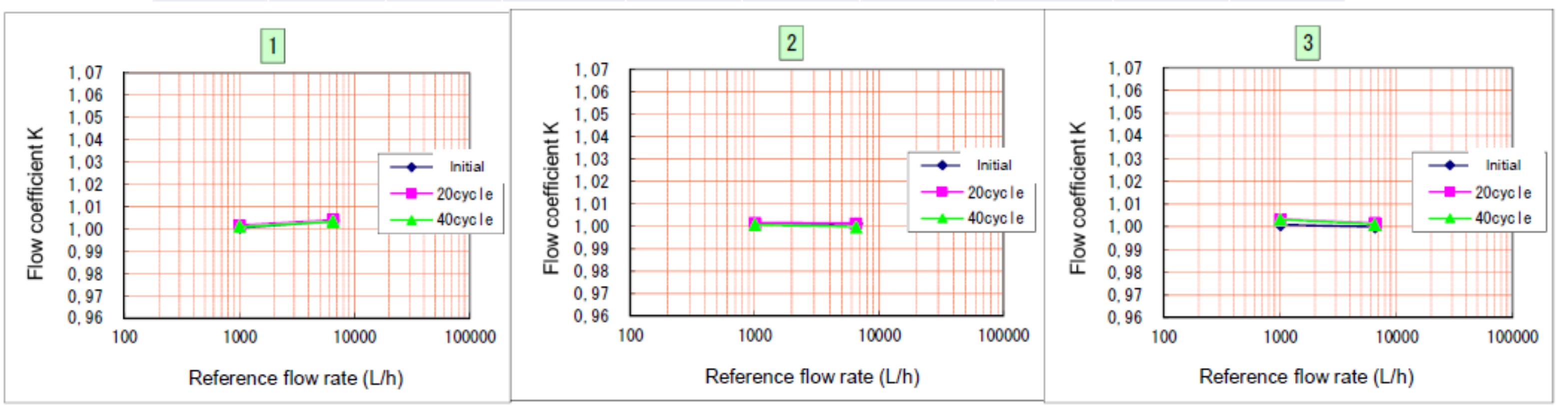
Standards
Qmin≦Q＜Qt : ±3%
Qt≦Q≦Qmax : ±1.5%

Results : All within standards

Sample q'ty : 3
Measure flow coefficient before and after the test

(Flow rate: L/h)

	1			2			3		
	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X
Initial	6582.706	1.003535		6599.239	1.001165		6553.244	0.99993	
	1015.299	1.000469		1019.66	1.000955		1011.326	1.000789	
20cycle (20 years)	6514.94	1.003943	-0.041%	6522.44	1.001264	-0.010%	6521.336	1.001655	-0.172%
	1002.197	1.0016	-0.113%	1002.603	1.001555	-0.060%	1001.694	1.003358	-0.257%
40cycle (40 years)	6531.402	1.003288	0.025%	6538.146	0.999709	0.146%	6533.72	1.001003	-0.107%
	1003.447	1.00093	-0.046%	1005.433	1.000728	0.023%	1005.071	1.003201	-0.241%



* Accuracy = Flow coefficient – 1   Accuracy: 0 = Flow coeffecient: 1

Heat shock test

Test condition
After leaving in heat shock stress, it is judged after 24 hours at normal temperature.
Condition :-40℃・30分⇔80℃・30分
840cycle (Equivalent to 20 years) 1680cycle (Equivalent to 40 years)
1080cycle (Equivalent to 27 years)

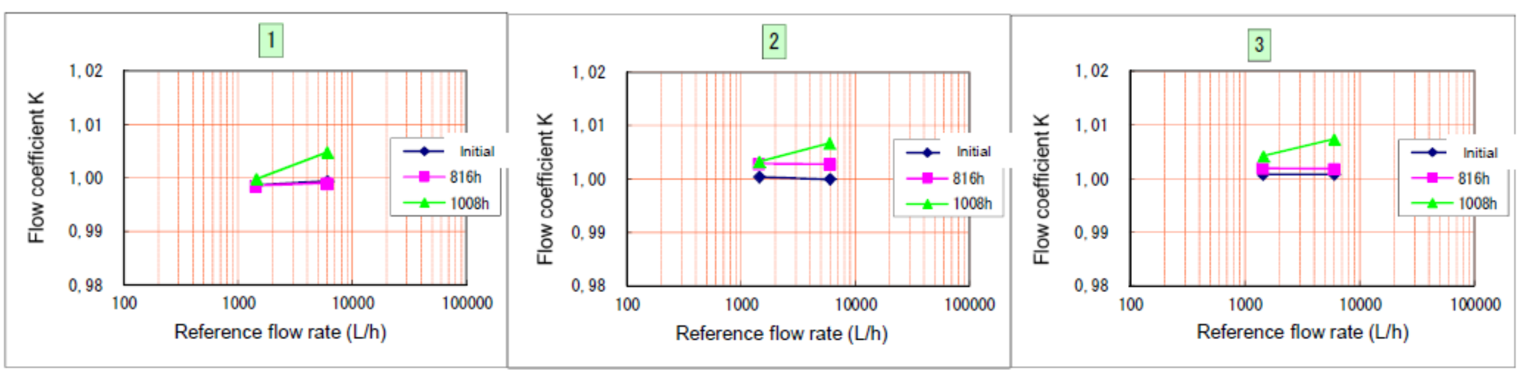
Standards
Qmin≦Q＜Qt : ±3%
Qt≦Q≦Qmax : ±1.5%

Results : All within standards

Sample q'ty :3
Measure flow coefficient before and after the test

(Flow rate:L/h)

	1			2			3		
	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X	Reference flow rate	Flow coefficient	Initial-X
Initial	6014.511	0.999399		6013.535	0.999958		6002.168	1.00077	
	1440.815	0.998669		1439.17	1.000388		1438.63	1.00077	
840cycle (20 years)	5947.912	0.999016	0.000383	5936.663	1.002788	-0.00283	5927.186	1.001789	-0.00102
	1417.692	0.998516	0.000153	1413.876	1.002861	-0.00247	1413.18	1.001932	-0.00116
1008cycle (27 years)	5987.42	1.004781	-0.54%	5983.16	1.006694	-0.67%	5966.16	1.007344	-0.66%
	1448.82	0.999823	-0.12%	1445.41	1.003244	-0.29%	1442.02	1.004203	-0.34%



* Accuracy = Flow coefficient – 1 Accuracy: 0 = Flow coeffecient: 1

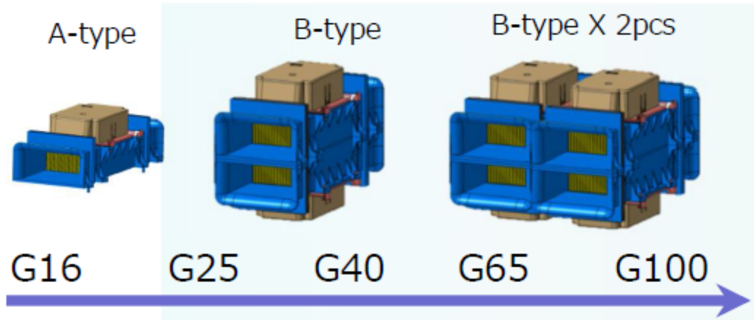
Ultrasonic Module for Commercial & Industrial Meters

■UMU

<Details>
- Size : 59 x 132 x 45
  (UMU : 40×83×50.4)

※General-purpose product

UMU for high flow gas meters can be achieved up to a large meters, with combination of modules.



m³/h

	Qmin	Qmax
G6	0.06	10
G10	0.10	16
G16	0.16	25
G25	0.25	40
G40	0.40	65
G65	0.65	100
G100	1.0	160

Current Specification

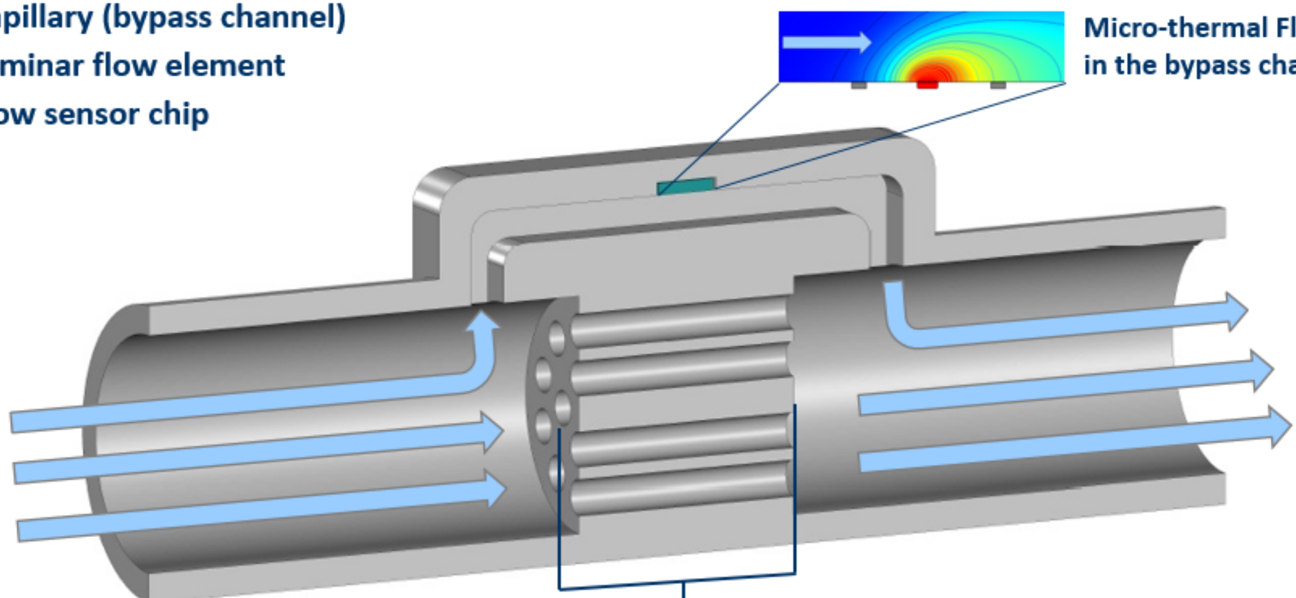
ITEM	A-TYPE	RESIDENTIAL-TYPE
Gas	Air 、 CH4	Air , CH4
Qmin / Qmax	G16 160 / 25,000 L/h	G4 40 / 6,000 L/h
Measurment Range	0～30,000 L/h(1.2Qmax)	0～7,200 L/h(1.2 Qmax)
Performance	Qmin～1/10 Qmax ： ±3% 1/10 Qmax～Qmax ： ±1.5%	Qmin～1/10 Qmax ： ±3% 1/10 Qmax～Qmax ： ±1.5%
Pressure Loss	200 Pa以下 (at 25℃、Air、 Qmax)	200 Pa以下 (at 25℃、Air、 Qmax)
Minimum Output Data	0.01 [L/h]	0.01 [L/h]

Panasonic

Operating measurement principle of a Capillary Type Thermal Mass Flow Meter

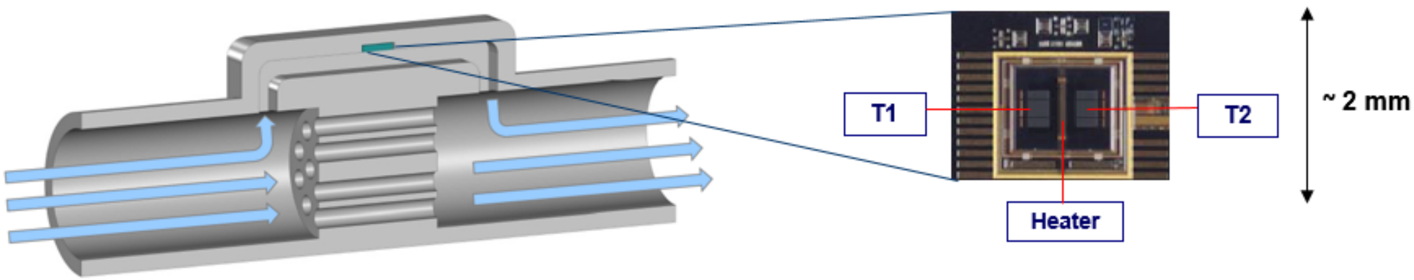
Schema

- Main body
- Capillary (bypass channel)
- Laminar flow element
- Flow sensor chip



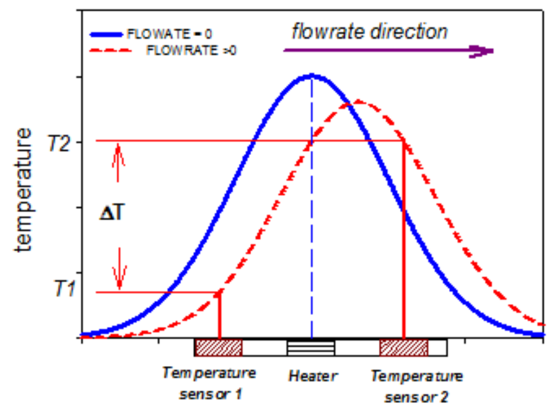
Operating measurement principle of a Capillary Type Thermal Mass Flow Meter

The sensor is a silicon CMOS (complementary metal-oxide semiconductor) chip:



In a micro-thermal mass flow sensor, the temperature difference between two temperature sensors placed symmetrically upstream and downstream of the micro is proportional to the mass flow rate:

$$Q_{el} = RI^2 = Q_{th} = \frac{dm}{dt} \cdot c_p \cdot \Delta T = \frac{dV}{dt} \cdot \rho \cdot c_p \cdot \Delta T$$



- Q_{el} is the heat power produced by the micro heater [W]
- Q_{th} is the heat power transferred to the gas flow [W]
- ***R*** is electrical resistance [Ω]
- ***I*** is current intensity [A]
- ***ΔT*** = T2 – T1 is the net difference in gas temperature [K]
- ρ is density of the gas at base conditions of temperature and pressure [kg/m^3]
- c_p is specific heat of the gas at constant pressure [J/(kg K)]
- ***dm/dt*** is the mass flow rate in the capillary bypass [kg/s]
- ***dV/dt*** is the volume flow rate at base conditions of temperature and pressure

MeteRSit

A new International Standard for thermal mass based gas meters

- The Italian standard UNI 11625:2016 is the first standard for Gas Meters based on thermal mass flow sensors (Published in Februrary 2016).
- UNI, the Italian Standardization Body, has proposed 11625 standard to CEN (European Normative Commitee) as base document for drawing up a European (EN) standard.
- CEN (TC 237) has approved this new work item, creating a new dedicated working group (WG10). Project has officially started in June, 2017.

Hints about UNI 11625 and the forthcoming European standard (EN):

- The new standard about “gas meters with a CTMF measuring element” bases mainly on the existing following papers, alongside MID:

1. EN14236:2007
2. EN1359
3. ISO 14511:2001 (Measurement of fluid flow in closed conduits — Thermal mass flow meters)
4. BS EN 437_2003+A1:2009
5. OIML R 137-1&2, Edition 2012 (E)
6. WELMEC 11: Proposal on Application of Article 2.2 of MI-002 of the MID

Tappe di normazione (scegli quelle più significative, a tuo gusto)

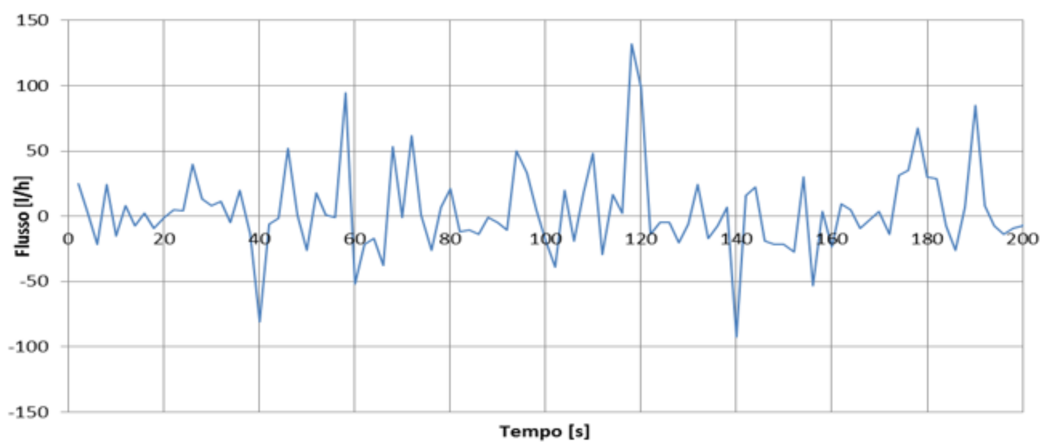
- 6 Settembre 2012 la Commissione Tecnica di Coordinamento del CIG delibera l'avvio dell'attività di produzione di un progetto di norma sui contatori termomassici, recepita nei mesi successivi anche dall'UNI.
- 22 febbraio 2013 - Inizio lavori in CIG
- 21 ottobre 2015 - Invio in inchiesta pubblica
- **19 febbraio 2016 - Pubblicazione UNI 11625 "Contatori di gas - Contatori di gas con elemento di misura massico-termico a circuito capillare**
- **8 agosto 2016 - Richiesta di new work item al CEN TC237**
- 11 ottobre 2016 - 12 paesi (su 21) votano a favore della richiesta dell'UNI, 6 paesi parteciperanno attivamente ai lavori (Belgio, Francia, Italia, Germania, Svizzera, Regno Unito)
- 9 novembre 2016 - CEN decide di creare un nuovo WG per seguire il progetto di norma EN
- **21 marzo 2017 - WG10 creato**
- 28-29 giugno 2017 Prima riunione del TC237 WG10 a Milano (UNI)
- 18-19 ottobre 2017 Seconda riunione del TC237 WG10 a Parigi (GRDF)
- 14-15 novembre 2017 Terza riunione del TC237 WG10 a Milano (UNI)

→ **La bozza di norma europea dovrebbe essere completata entro il Q1 2018.**

Backflows in networks

Backflows in low pressure networks: old issue, renewed interest.

- Measurement technologies, based on **instantaneous flow rate reading**, have led to a better understanding of noise effects in the gas distribution network, such effects have finally become detectable and measurable.



- For this reason the Italian standard for thermal mass gas meters prescribes that gas volumes resulting from noise in the network, rather than from actual consumption, shall be detected and disregarded.

- The same requirement has been presented by UNI/CIG to CEN for being added to the other gas meter standards.

Backflows in networks

CONCLUSIONS

- Italy has had confirmed (by means of field test) that pressure variation ("noise") in the distribution network may lead to actual flow rates even in closed pipework (no gas consumption), when no pressure / flow regulator is fitted. Therefore the meter shall be capable of detecting and filtering off gas volumes arising from pressure / temperature variation in the network.

- Italian Gas Committee and UNI has agreed in setting out new requirements in gas meter standards, aimed to prevent gas meters to integrate gas volumes arising from "back and forth" flows, also known as "network breathing" ("il respiro della rete").

- New requirements were laid down in the Italian standard for thermal mass gas meters, and presented to CEN for being added to any other gas meter standard.

- Test set-up and requirements will be discussed in next meeting of TC237 / WG10 (Thermal mass gas meters), and in particular compliance of requirements with actual field date will be checked. Results will be then shared among TC237 groups (and Welmec).

Grazie mille per l'attenzione

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