

INSTYTUT NAFTY i GAZU

OIL AND GAS INSTITUTE

Testing Laboratories of Gas Grid, Utilities and Appliances

Accreditation Certificate No. AB 041 issued by Polish Centre of Accreditation
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AB 041

Arch. No.: GM-5100-429/08

Technical Report No. 9/GM/2008

from the Laboratory Tests on Diaphragm Gas Meters
6G4L and 6G6 ($V=2,2\text{dm}^3$)
APATOR METRIX S.A.

Z-ca Dyrektora INiG
ds. Gazownictwa

dr inż. Jacek Jaworski

Krakow, December 2008

COPY NO. 2 of 4

TESTING LABORATORY OF FLOW METROLOGY

Accredited for testing diaphragm gas meters and couplers for diaphragm gas meters

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Krakow
10.12.08

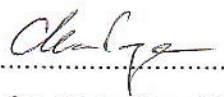
Technical Report No. 9/GM/2008

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Product name	Diaphragm gas meters
Identification mark (Type of Gas Meter)	6G4L and 6G6 ($V=2,2\text{dm}^3$)
Name of manufacturer	APATOR-METRIX S.A. Piaskowa 3 83-100 Tczew
Customer	APATOR-METRIX S.A. Piaskowa 3 83-100 Tczew
Internal order number	4366/GM

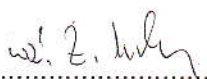
The test were carried by


.....
Jan Wojtala


.....
M. Sc. Eng. Paweł Kulaga

Responsible for technical legality of this Report:

Acting Head of the Flow Metrology Laboratory


.....
Ph. D Eng. Zbigniew Gacek

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The above Report regards only to the tested sample and is not technical opinion on the product
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1. SCOPE OF ORDER

The Report concerns the resistance tests of the diaphragm gas meters 6G4L and 6G6 ($V=2,2\text{dm}^3$) Apator Metrix S.A. to the magnetic field influence of the neodymium magnets, according to the detailed testing programme presented in the "Work schedule" - enclosure No. 1 for the contract No. 89/GM/2008. Neodymium magnets N50 type (size $\phi 70 \times 30$ mm, energy density $(BH)_{\max} = 374 \div 406 \text{ kJ/m}^3$) were used in the tests.

With regard to the same construction of the 6G4L and 6G6 ($V=2,2\text{dm}^3$) gas meters, 6G4L and 6G6 gas meters with nominal distance between centerlines of the connections equal 130 mm and 6G6 gas meter with nominal distance between centerlines of the connections equal 250 mm were chosen for the test.

2. DOCUMENTS REFERENCES FOR THE TESTS

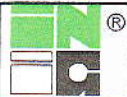
- 2.1. Act of 30th August 2002 concerning conformity assessment system (Polish Official Journal Dz. U. of 2002 No. 166, item 1360 with later amendments)
- 2.2. Measurement management systems - Requirements for measurement processes and measuring equipment PN-EN ISO 10012:2004
- 2.3. General Requirements for the Competence of Calibration and Testing Laboratories PN-EN ISO/IEC 17025:2005
- 2.4. PN-EN 1359:2004 Gas meters - Diaphragm gas meters
- 2.5. PN-EN 1359:2004/A1:2006 (U) Gas meters - Diaphragm gas meters
- 2.6. The contract No. 89/GM/2008 from 01.04.2008

3. PRODUCTS SELECTION

- 3.1. Selection type: choose by Customer
- 3.2. Type of supply: supply by Customer
- 3.3. Data of supply: 31.03.2008, 5.04.2008
- 3.4. Type of storage: according to PN-81/M-42009 art. 3.2.

4. TESTING CONDITIONS

- 4.1. Testing methods:
 - PN-EN 1359:2004 and PN-EN 1359:2004/A1:2006 (U) Gas meters – Diaphragm gas meters art. 6.2.2, 5.1.2a, 5.2.2.
 - Testing Procedures of the Flow Metrology Laboratory: PB GM-05, PB GM-01.
- 4.2. Environmental conditions in compliance with the Testing Procedures.
- 4.3. Accuracy of measurements in compliance with the Testing Procedures, which are confirmed by the Authentication Certificates and by the internal checking at the Flow Metrology Laboratory.
- 4.4. The Testing Reports and the Testing Results are kept at the Flow Metrology Laboratory.

**5. IDENTIFICATION OF THE TESTING SUBJECTS**

5.1. Manufacturer	Apator Metrix S.A.		
5.2. Type of Gas Meter:	6G4L	6G6	6G6
5.3. Approval mark and number:	D 03 7.122.58	PL 06 ZTE4	
5.4. Year of manufacture	2008	2008	2008
5.5. Serial Numbers:	024819	005779	006616
5.6. Characteristics:			
- maximum flow rate Q_{max} [m ³ /h]	6	10	10
- minimum flow rate Q_{min} [m ³ /h]	0,04	0,06	0,06
- maximum working pressure P_{max} [kPa]	50	50	50
- nominal value of the cyclic volume V [dm ³]	2,2	2,2	2,2
- nominal distance between centerlines of the connections [mm]	130	130	250

The gas meters delivered to tests were packed in foil bag and cardboard boxes. The gas meters have the permanency flow direction mark on the upper surface, in the form of an arrow. The inlets and outlets of the gas meters were protected against damage and contamination during transport

6. TESTING PROGRAMME

Detailed testing programme, requirements and method of testing are given in table 1.

Table 1. Testing programme

No.	Type of test	Requirements	Tests
1.	External leak tightness	art. 6.2.2.1 PN-EN 1359:2004	art. 6.2.2.2 PN-EN 1359:2004
2.	Initial errors of indication	art. 5.1.1a PN-EN 1359:2004 and PN-EN 1359:2004/A1:2006 (U)	art. 5.1.2a PN-EN 1359:2004 and PN-EN 1359:2004/A1:2006 (U)
3	Initial loss of pressure	art. 5.2.1. PN-EN 1359:2004 and PN-EN 1359:2004/A1:2006 (U)	art. 5.2.2 PN-EN 1359:2004
4.	Errors of indication and loss of pressure of gas meter with neodymium magnet put on the selected place/places on the gas meter casing	art. 16.1 PB GM-01 edit. 7:12.04.2007	art. 3.3 PB GM-01 edit. 7:12.04.2007
5.	Errors of indication and loss of pressure of gas meter after exposure to neodymium magnets	art. 16.1 PB GM-01 edit. 7:12.04.2007	art. 3.3 PB GM-01 edit. 7:12.04.2007

Start of testing:
31.03.2008

End of testing:
24.04.2008

Extended uncertainty type B (factor $k=2$ and $p=95\%$), while determining errors of indication of the diaphragm gas meter is not worse then:

- 0,35% in the range of tested flow rates from $0,1Q_{max}$ to Q_{max} and 0,5% at the flow rates Q_{min} and $3Q_{min}$ during test acc. to art. 2 of the testing programme.

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- 0,35% in the range of tested flow rates from $0,2Q_{\max}$ to $Q_{\max}$ and 0,7% at the flow rate $Q_{\min}$ - during test acc. to art. 4 of the testing programme.
- 0,22% in the range of tested flow rates from $Q_{\min}$ to $Q_{\max}$ during test acc. to art. 5 of the testing programme.

7. TESTS RESULTS EVALUATION CRITERION

- 7.1 Before determining initial errors of indication all the gas meter should keep external leak tight.
- 7.2 Initial errors of indication, without neodymium magnet (before any exposure to neodymium magnets), should be in the range of the "initial" permissible errors of indication given in the table 2. Initial average loss of pressure value should not exceed the "initial" values given in the table 3.
- 7.3 Errors of indication of the gas meters with the neodymium magnet should be within the range given in the "during durability test" column of the table 2. If the neodymium magnet put on the casing cause flow blocking through the gas meter, what not allow the illegal gas consumption, also the test results should be taken as positive.
- 7.4 Errors of indication of the gas meters after the exposure to neodymium magnets should be within the range given in the "during durability test" column of the table 2. Average loss of pressure value should not exceed "after durability test" value given in the table 3.
- 7.5 The final result can be positive only after positive result of the all gas meters in the all carried out tests, according to assumed test results evaluation criterion in the all tests.

Table 2. Permissible errors of indication acc. to PN-EN 1359

Flow rate Q	Permissible errors limit E [%]	
	initial ¹⁾	during durability test
$Q_{\min} \leq Q < 0,1Q_{\max}$	$\pm 3,0$	-6,0; +3,0
$0,1Q_{\max} \leq Q \leq Q_{\max}$	$\pm 1,5$	$\pm 3,0$

¹⁾ - When the errors for flow rates between $0,1Q_{\max}$ (Q_l) and $Q_{\max}$ have the same sign, then shouldn't exceed 1%.

Table 3. Permissible loss of pressure acc. to PN-EN 1359

$Q_{\max}$ [m ³ /h]	Maximum permissible value of average loss of pressure [Pa]	
	initial	after durability test
from 1 to 10 inclusive	200	220

8. TESTS RESULTS

Test results are given in the table 4 ÷ 6. Base for preparation of tables presents Protocols from tests stored in Laboratory of Flow Metrology INiG in Krakow.

Before tests all the gas meters have been subjected to verification to external leak tightness (Protocols No. 35÷36/05/GM/08, 39/05/GM/08) with positive result..

NOTE: The symbols in the table 4 ÷ 6 signify:

E_0 – initial errors of indication (before exposure to neodymium magnets)
 E_1 - errors of indication with magnet on the gas meter casing in position 1,
 E_2 - errors of indication with magnet on the gas meter casing in position 2,
 E_3 - errors of indication with magnet on the gas meter casing in position 3,
 E_4 - errors of indication with magnet on the gas meter casing in position 4,
 E_5 - errors of indication with magnet on the gas meter casing in position 5,
 E_6 - errors of indication with magnet on the gas meter casing in position 6,
 E_7 - errors of indication with magnet on the gas meter casing in position 7,
 E_8 - errors of indication with magnet on the gas meter casing in position 8,
 E_9 - errors of indication with magnet on the gas meter casing in position 9,
 E_{10} - errors of indication after exposure to neodymium magnets

Δp_0 – initial loss of pressure (before exposure to neodymium magnets)
 Δp_1 - loss of pressure with magnet on the gas meter casing in position 1,
 Δp_2 - loss of pressure with magnet on the gas meter casing in position 2,
 Δp_3 - loss of pressure with magnet on the gas meter casing in position 3,
 Δp_4 - loss of pressure with magnet on the gas meter casing in position 4,
 Δp_5 - loss of pressure with magnet on the gas meter casing in position 5,
 Δp_6 - loss of pressure with magnet on the gas meter casing in position 6,
 Δp_7 - loss of pressure with magnet on the gas meter casing in position 7,
 Δp_8 - loss of pressure with magnet on the gas meter casing in position 8,
 Δp_9 - loss of pressure with magnet on the gas meter casing in position 9,
 Δp_{10} - loss of pressure after exposure to neodymium magnets.

Magnets positions on the gas meter casing are shown on the Fig. 1 ÷ Fig. 3.

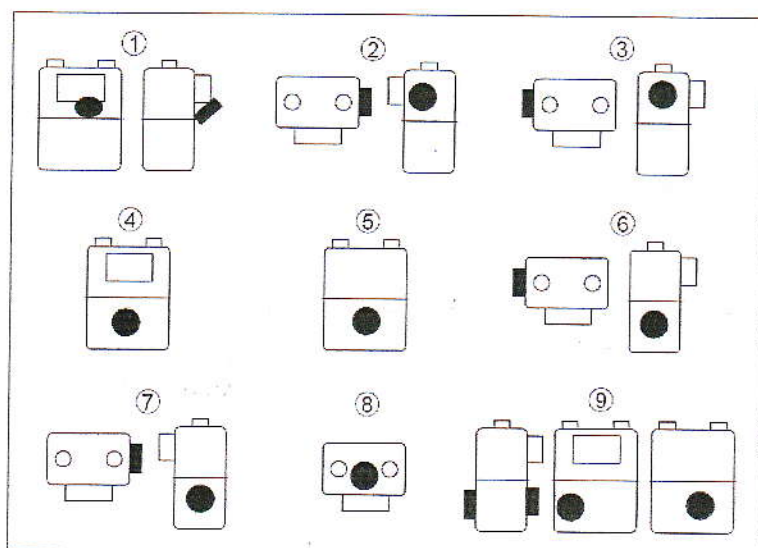


Fig. 1. Magnets positions on the gas meter casing 6G4L No. 024819

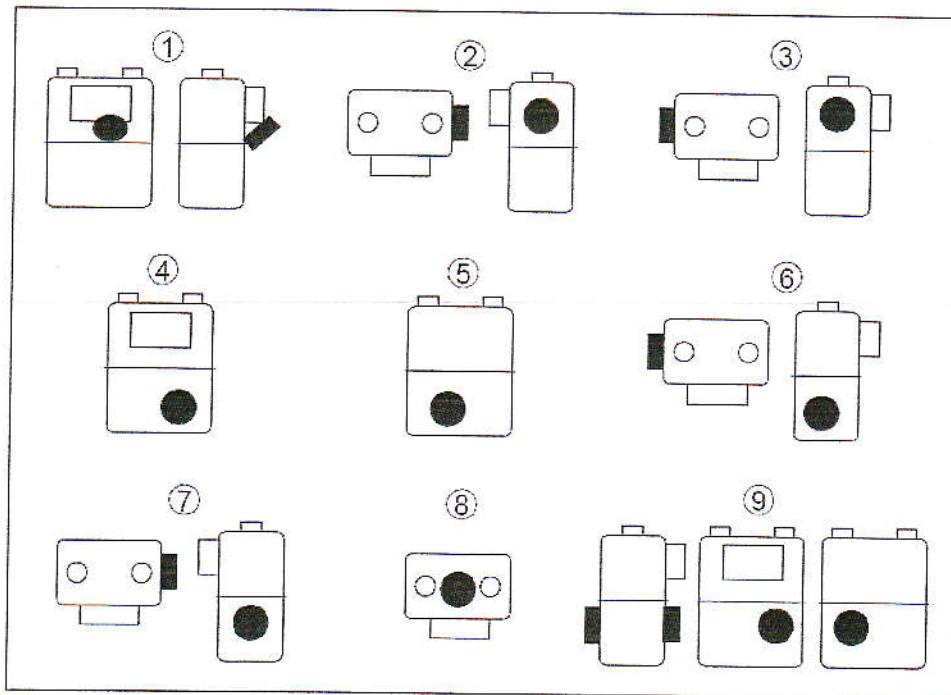


Fig. 2. Magnets positions on the gas meter casing 6G6 No. 005779

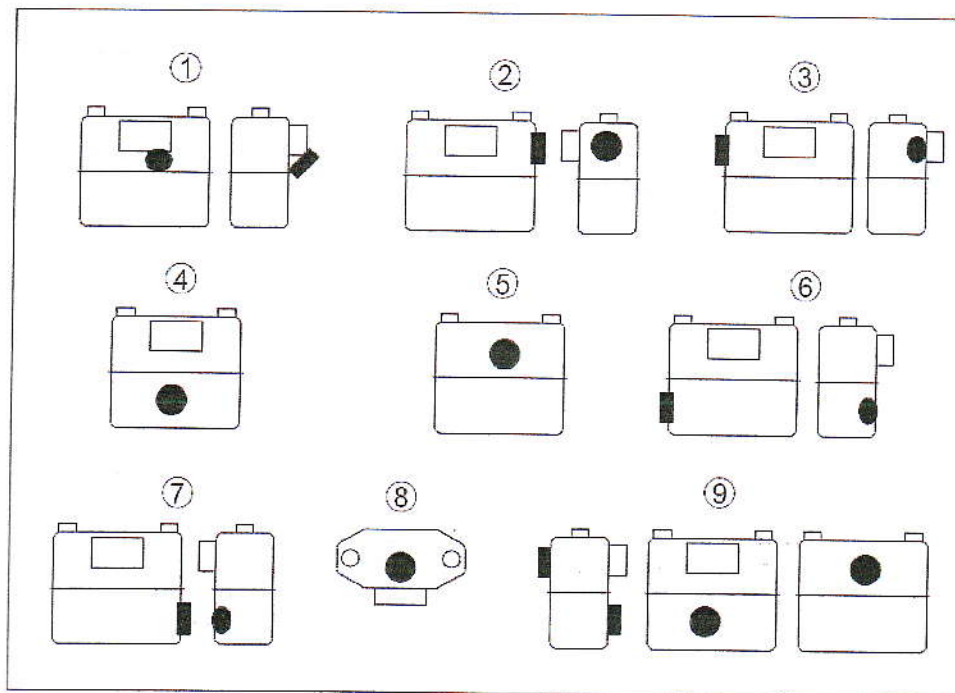


Fig. 3. Magnets positions on the gas meter casing 6G6 No. 006616

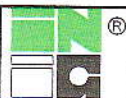


Table 4. Errors of indication and loss of pressure in the gas meter 6G4L No. 024819

E [%] Δp [Pa]	Flow rates Q							Protocol No. and compliance confirmation
	$Q_{\min}$	$3Q_{\min}$	$0,1Q_{\max}$	$0,2Q_{\max}$	$0,4Q_{\max}$	$0,7Q_{\max}$	$Q_{\max}$	
E_0	0,20	0,20	0,35	0,29	0,59	0,30	-0,16	20/01a/GM/08 in compliance
E_1	0,13	----	----	0,47	----	----	-0,15	
E_2	1,06	----	----	0,40	----	----	-0,22	
E_3	-0,34	----	----	0,26	----	----	-0,37	
E_4	-0,20	----	----	0,31	----	----	-0,47	
E_5	0,79	----	----	0,35	----	----	-0,38	
E_6	0,68	----	----	0,37	----	----	-0,39	
E_7	0,40	----	----	0,21	----	----	-0,21	
E_8	1,49	----	----	1,11	----	----	1,55	
E_9	-0,80	----	----	-0,27	----	----	-0,33	
E_{10}	0,08	----	----	0,34	----	----	-0,19	
Δp_0	18,9	19,8	20,1	27,2	37,9	65,5	108,2	20/01a/GM/08 in compliance
Δp_1	21,9	----	----	27,2	----	----	110,4	20/01a/GM/08 -----
Δp_2	22,4	----	----	27,0	----	----	113,8	
Δp_3	21,3	----	----	26,7	----	----	111,2	
Δp_4	21,0	----	----	26,3	----	----	111,2	
Δp_5	22,1	----	----	26,3	----	----	109,7	
Δp_6	22,6	----	----	26,5	----	----	108,7	
Δp_7	21,4	----	----	26,8	----	----	109,1	
Δp_8	84,4	----	----	30,2	----	----	125,1	
Δp_9	21,7	----	----	26,4	----	----	109,4	
Δp_{10}	20,5	----	----	26,8	----	----	104,6	20/01a/GM/08 in compliance

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Table 5. Errors of indication and loss of pressure in the gas meter 6G6 No. 005779

E [%] Δp [Pa]	Flow rates Q							Protocol No. and compliance confirmation
	$Q_{\min}$	$3Q_{\min}$	$0,1Q_{\max}$	$0,2Q_{\max}$	$0,4Q_{\max}$	$0,7Q_{\max}$	$Q_{\max}$	
E_0	0,03	0,19	0,46	0,45	0,21	-0,26	-0,53	24/01a/GM/08 in compliance
E_1	0,58	----	----	0,76	----	----	-0,43	
E_2	-0,12	----	----	0,42	----	----	-0,55	
E_3	0,62	----	----	0,52	----	----	-0,50	
E_4	0,68	----	----	0,56	----	----	-0,47	
E_5	0,83	----	----	0,65	----	----	-0,61	
E_6	-0,85	----	----	0,81	----	----	-0,14	
E_7	0,51	----	----	0,66	----	----	-0,35	
E_8	-2,01	----	----	0,86	----	----	-0,32	
E_9	-0,04	----	----	0,57	----	----	-0,50	
E_{10}	0,37	----	----	0,52	----	----	-0,53	
Δp_0	20,3	20,8	25,3	31,4	52,8	110,3	195,3	24/01a/GM/08 in compliance
Δp_1	23,0	----	----	32,5	----	----	188,2	24/01a/GM/08 -----
Δp_2	24,0	----	----	33,0	----	----	179,3	
Δp_3	23,2	----	----	33,1	----	----	185,9	
Δp_4	22,0	----	----	31,7	----	----	190,7	
Δp_5	22,0	----	----	17,1	----	----	191,1	
Δp_6	23,0	----	----	37,2	----	----	189,2	
Δp_7	22,2	----	----	32,2	----	----	192,3	
Δp_8	51,9	----	----	42,7	----	----	195,3	
Δp_9	22,8	----	----	32,6	----	----	191,1	
Δp_{10}	26,0	----	----	30,8	----	----	189,2	24/01a/GM/08 in compliance

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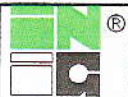
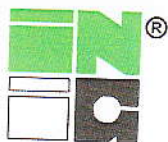


Table 6. Errors of indication and loss of pressure in the gas meter 6G6 No. 006616

E [%] Δp [Pa]	Flow rates Q							Protocol No. and compliance confirmation
	$Q_{\min}$	$3Q_{\min}$	$0,1Q_{\max}$	$0,2Q_{\max}$	$0,4Q_{\max}$	$0,7Q_{\max}$	$Q_{\max}$	
E_0	0,48	0,54	0,71	0,71	0,03	-0,31	-1,19	23/01a/GM/08 in compliance
E_1	1,29	----	----	0,82	----	----	-0,82	
E_2	-0,92	----	----	0,95	----	----	-0,86	
E_3	0,82	----	----	1,18	----	----	-0,62	
E_4	0,59	----	----	0,98	----	----	-0,86	
E_5	0,02	----	----	0,96	----	----	-0,77	
E_6	0,13	----	----	1,00	----	----	-0,75	
E_7	0,93	----	----	1,16	----	----	-0,75	
E_8	1,72	----	----	2,34	----	----	0,77	
E_9	-0,80	----	----	1,07	----	----	-0,70	
E_{10}	0,83	----	----	0,77	----	----	-0,83	
Δp_0	26,4	26,3	31,1	35,3	61,1	122,8	198,8	23/01a/GM/08 in compliance
Δp_1	25,7	----	----	35,9	----	----	222,1	23/01a/GM/08 -----
Δp_2	25,3	----	----	35,6	----	----	218,5	
Δp_3	25,4	----	----	36,0	----	----	213,1	
Δp_4	25,0	----	----	36,0	----	----	214,9	
Δp_5	27,8	----	----	35,2	----	----	216,1	
Δp_6	25,1	----	----	34,4	----	----	219,2	
Δp_7	23,5	----	----	34,4	----	----	215,1	
Δp_8	74,7	----	----	40,0	----	----	225,9	
Δp_9	30,7	----	----	35,5	----	----	213,9	
Δp_{10}	21,7	----	----	34,0	----	----	213,4	23/01a/GM/08 in compliance

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The Oil and Gas Institute in Krakow, based on the tests results, documentation analysis and Manufacturer Declaration, confirms that the product:

Product name: **Diaphragm gas meter**

Approval mark: **CD 03
7.122.58**

Identification mark: **6G4L**

Nominal cyclic volume: **2,2 dm³**

Nominal distance between
centerlines of the connections: **130 mm, 250 mm**

Manufacturer: **Apator-Metrix S.A.
Piaskowa 3
83-110 Tczew**

fulfils the requirements listed in the PB GM-01 edition 7:12.04.2007, Testing of the Diaphragm Gas Meters Metrological Characteristics, art. 16.1, in the scope of the resistance to the magnetic field influence of the N50 type neodymium magnets (size $\phi 70 \times 30$, energy density $(BH)_{max} = 374 \div 406 \text{ kJ/m}^3$).

The requirements and the test results are presented in tables 1 ÷ 6 of the Report No. 9/GM/2008.

Presented test results solely regard the product tested.

Acting Head of the Laboratory of Flow Metrology

mgr inż. Z. Gacek
Ph. D Eng. Zbigniew Gacek



General Director of the Institute

Z-ca Dyrektora INiG
ds. Gazownictwa

dr inż. Jacek Jaworski



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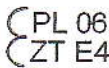
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The Oil and Gas Institute in Krakow, based on the tests results, documentation analysis and Manufacturer Declaration, confirms that the product:

Product name: **Diaphragm gas meter**

Approval mark 

Identification mark: **6G6**

Nominal cyclic volume: **2,2 dm³**

Nominal distance between
centerlines of the connections: **130 mm, 250 mm**

Manufacturer: **Apator-Metrix S.A.
Piaskowa 3
83-110 Tczew**

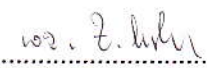
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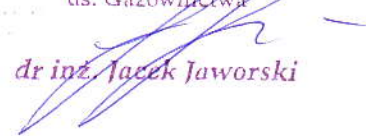
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