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TEST LABORATORY
of CJSC SRC TECHNOPROGRESS
Accreditation certificate No. POCC RU.0001.21MЭ67

Approved by:

Deputy Head of the Test Laboratory
of CJSC SRC TECHNOPROGRESS
_____/ L.V. Polubotko
on June 1, 2015

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Seal: CJSC Scientific and Research Center TECHNOPROGRESS, MOSCOW city
Test Laboratory
No. POCC RU.0001.21MЭ67
FOR TEST REPORTS

REPORT No. 2869Ex
of Technical Documents Examination,
Design Check and Certification Tests

Name of product: Explosion-proof electric actuator TEC 2000, model 2GRG-5, serial No. 127109F02, Ex-marking 1Ex d IIB T4
Applicant: Scientific and Technical Center Techno-Standart Ltd.
Applicant's address: 24 Ryazansky avenue, block 2, 109428, Moscow
Manufacturer: Strongarm LLC
Manufacturer's address: 18A Melnichnaya str., 192019, Saint Petersburg

Moscow 2015

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- 1. Product:** Explosion-proof electric actuator TEC 2000, model 2GRG-5, serial No. 127109F02, Ex-marking 1Ex d IIB T4
Russian classification OKP code: 37 9110
HS Code: 8501 52 200 9
- 2. Manufacturer:** Strongarm LLC
Manufacturer's address: 18A Melnichnaya str., 192019, Saint Petersburg
- 3. Applicant:** Scientific and Technical Center Techno-Standart Ltd.
Applicant's address: 24 Ryazansky avenue, block 2, 109428, Moscow
- 4. Tests basis:** Tests application No. 23 dated 05/17/2015
- 5. Requirements:** GOST 30852.0-2002, GOST 30852.1-2002
- 6. Tests methods:** GOST 30852.0-2002, GOST 30852.1-2002
- 7. General provisions:** The tests were aimed at checking the product compliance with the requirements of GOST 30852.0-2002, GOST 30852.1-2002
- 8. Tests object:** Product tested: Explosion-proof electric actuator TEC 2000, model 2GRG-5, serial No. 127109F02, Ex-marking 1 Ex d IIB T4
- 9. Tests date, extent and location:** Tests started on: 05/17/2015
Tests ended on: 06/01/2015
The tests were performed at the Test Laboratory of CJSC Scientific and Research Center TECHNOPROGRESS to the full extent.
- 10. Tests conditions:** Environmental specifications:
 - air temperature: $(21 \pm 2)^\circ\text{C}$ above zero;
 - relative humidity: $(65 \pm 10)\%$;
 - atmospheric pressure: (99.3 ± 0.6) kPa.
- 11. Measuring tools:** The measuring tools are listed in Annex F.
The measuring tools used in the tests were provided with valid certificates (stamps) of compliance with the Measuring tools calibration procedure PR 50.2.006.
- 12.** This Report should be used together with GOST 30852.0-2002, GOST 30852.1-2002.

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13. Basic technical data

13.1 The electric actuator basic technical data are shown in Table 1.

Table 1

Parameter	Value
Ex-marking	1Ex d IIB T4
Exposure protection degree per GOST 14254-96	IP68
Twitching-off torque, N*m	343
Max. torque (jamming), N*m	510
Output shaft rotation speed, rpm	43
Operating temperature range, °C	from -60 to +70
Shaft rotation direction	Clockwise (top view) closing
Valve connection type	F14
Dimensions, mm	815x470 x256
Actuator weight, kg	73

14. Documents submitted for consideration

14.1 Supporting documents are listed in Table 2.

Table 2

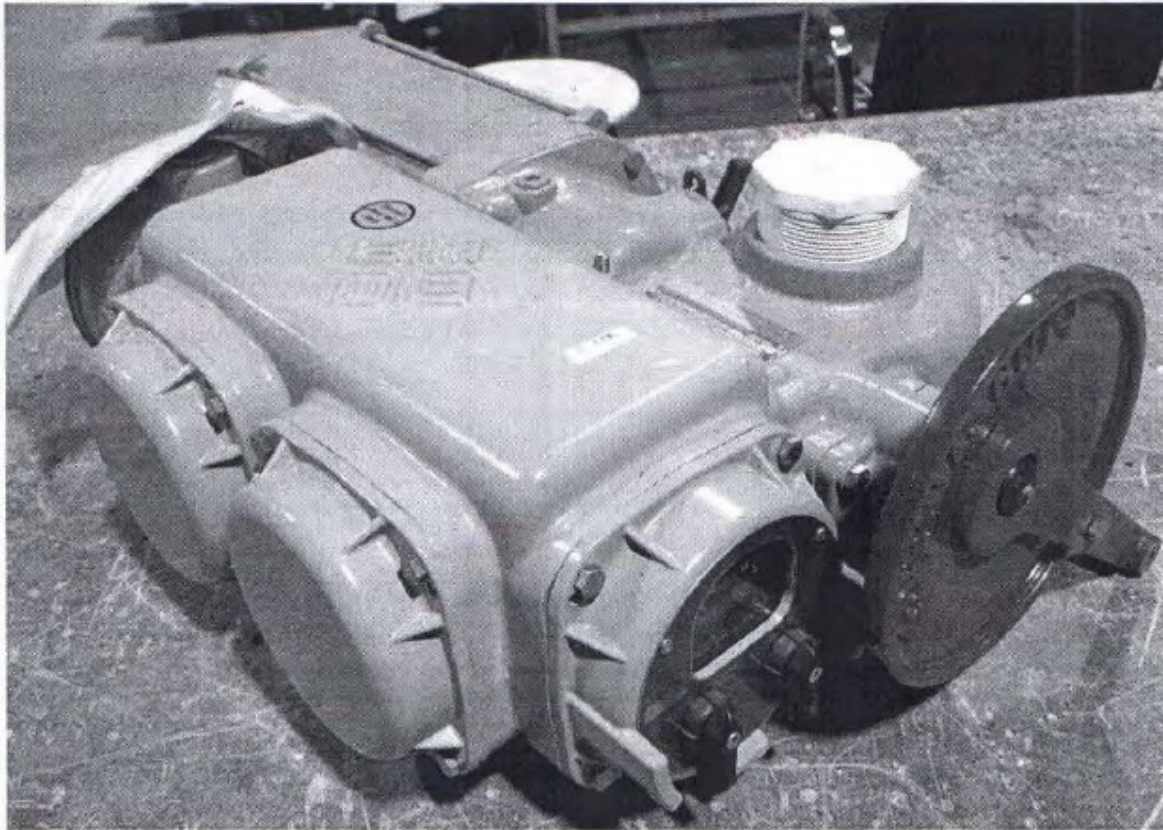
Document title	Document designation
Data sheet	Explosion-proof electric actuator TEC 2000 for industrial pipeline valve Serial number 127109F02
Installation, setup, operation and maintenance manual	Explosion-proof electric actuator TEC 2000 for industrial pipeline valve
Specifications	TU 379110-031-37719281-2015
Technical description	Electric actuator TEC 2000 for industrial pipeline valve
Assembly drawing	Number 84720
Explosion protection drawing	Number 84500

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16. Test object identification

Motor appearance, design and marking (see Annex E) complies with the documents and drawings submitted.
(Fig. 1)



*Fig. 1 Explosion-proof electric actuator TEC 2000, model 2GRG-5, serial No. 127109F02, Ex-marking
1Ex d IIB T4*

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Table 4. GOST 30852.0-2002 compliance checks and tests list

Excerpts from GOST 30852.0-2002 (IEC 60079-1:1998) containing standardized technical requirements and tests	Sections and items No.	Evaluation and tests results	Requirements compliance statement
Temperatures			
Maximum surface temperature	Item 5.1	Maximum surface temperature does not exceed the declared temperature class T4. See Annex A	Compliant
Ambient temperature	Item 5.2	Ambient temperature operating range -60°C ... +70°C	Compliant
Surface and ignition temperature	Item 5.3	The requirement is not applicable	Not applicable
Requirements to all types of electrical equipment	Item 6	Explosion protection type "d" — explosion-proof shell	Compliant
Non-metallic shells and their parts	Item 7	Light-transmitting part is made of glass. The requirement is not applicable.	Not applicable
Shells made of light metals-containing materials	Item 8	Shell materials: steel 45, aluminum, ductile iron. Magnesium weight content is at most 7.5%. The requirement is met	Compliant
Fasteners	Item 9	The requirement is met	Compliant
Lockings	Item 10	The requirement is met	Compliant
Bushings	Item 11	No bushings. The requirement is not applicable	Not applicable
Sealant materials	Item 12	The requirement is met	Not applicable
Ex-components	Item 13	Ex-components are not used	Not applicable
Entries and connecting terminals	Item 14	Certified cable entries must be used	Compliant
Connection terminals for grounding and neutral protective conductors	Item 15	8 mm screws on the motor and actuator main gear housing are used for external grounding.	Compliant
Cable and pipe entries	Item 16	Certified cable entries must be used	Compliant
Additional requirements to rotating electrical machines	Item 17	The requirement is not applicable. Cooling fans are not used	Not applicable
Additional requirements to switching devices	Item 18	The requirement is not applicable	Not applicable
Additional requirements to safety fuses	Item 19	Safety fuses are not used	Not applicable
Additional requirements to connectors, thrust accumulators and thrust batteries	Item 20	Connectors, thrust accumulators and rechargeable batteries are not used	Not applicable
Lighting devices	Item 21	Lighting devices are not used	Not applicable
Additional requirements to head and hand-held lamps	Item 22	The requirement is not applicable	Not applicable
Checks and tests			

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Excerpts from GOST 30852.0-2002 (IEC 60079-1:1998) containing standardized technical requirements and tests	Sections and items No.	Evaluation and tests results	Requirements compliance statement
General provisions	23.1	The requirement is met	Compliant
Documents check	23.2	The documents contain a fairly complete and accurate description of all electrical equipment explosion protection aspects	Compliant
Prototype or specimen compliance with documents	23.3	The specimens comply with the submitted documents	Compliant
Tests			
General provisions	23.4.1	The models were tested in accordance with the requirements of GOST 30852.0-2002	Compliant
Mechanical tests			
Impact resistance test	23.4.3.1	The requirement is met. See Annex B	Compliant
Drop test	23.4.3.2	The electrical equipment is not hand-held. The requirement is not applicable	Not applicable
Necessary results	23.4.3.3	No damages to the electrical equipment explosion protection were revealed	Compliant
Material friction intrinsic safety check	23.4.3.4	The requirement is met	Compliant
Electrolyte spillage test of rechargeable batteries	23.4.3.5	Rechargeable batteries are not used	Not applicable
Checking the degree of protection provided by the shells	23.4.4	The requirement is met. See Annex C	Compliant
Bushings torque test	23.4.5	The requirement is not applicable	Not applicable
Thermal tests	23.4.6	The requirement is met. See Annex A	Compliant
Non-metallic shells or shell parts test	23.4.7	The requirement is met	Compliant
Test in explosive mixtures	23.4.8	Test per GOST 30852.1-2002. See Annex E	Compliant
Control checks and tests by the manufacturer	Item 24	The manufacturer performs hydraulic overpressure test at 1.0 MPa for 10 seconds	Compliant
Manufacturer's responsibility	Item 25	Ensured by the manufacturer	Compliant
Checks and tests of repaired and upgraded electrical equipment	Item 26	The requirement is not applicable	Not applicable
Marking	Item 27	The requirement is met. Marking plate layout is shown in Annex E	Compliant

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Table 5. GOST 30852.1-2002 compliance checks and tests list

Excerpts from GOST 30852.1-2002 (IEC 60079-1:1998) containing standardized technical requirements and tests	Sections and items No.	Evaluation and tests results	Requirements compliance statement
Explosion-proof joints			
General requirements	Item 5.1	The requirement is met. See Annex E	Compliant
Non-threaded joints	Item 5.2	The requirement is met. See Annex E	Compliant
Threaded joints	Item 5.3	The requirement is met. See Annex E	Compliant
Gaskets and O-rings	Item 5.4	The requirement is met	Compliant
Sealed joints	Item 5.5	The requirement is met. See Annex E	Compliant
Control thrust rods and shafts	Item 6	The requirement is met. See Annex E	Compliant
Shafts and bearing shields of rotating electrical machines	Item 7	Rolling bearings are used. The length of explosion-proof joint gap with the bearing shield is at least equal to the shaft diameter.	Compliant
Light-transmitting parts	Item 8	Light-transmitting part is made of glass.	Compliant
Ventilation, discharging and draining devices	Item 9	Ventilation, discharging and draining devices are not used.	Not applicable
Fasteners	Item 10	Thickness of the metal surrounding the hole for fixing bolts exceeds 3 mm. The requirement is met	Compliant
Shell mechanical strength	Item 11	Test per item 15 of GOST 30852.1-2002. See Annex B	Compliant
Wires and cables entry into the shell	Item 12	Certified cable entries must be used	Compliant
Marking	Item 13	The requirement is met. Marking plate layout is shown in Annex E	Compliant
Tests methods			
General provisions	Item 14	The requirement is met	Compliant
Shell check and test			
Shell compliance with this standard	Item 15.1	The requirement is met	Compliant
Checking explosion protection parameters with the help of standard measuring tools	Item 15.2	The requirement is met	Compliant
Determination of explosion pressure	Item 15.3	The requirement is met. See Annex D	Compliant
Explosion resistance test	Item 15.4	The requirement is met. See Annex D	Compliant
Shell explosion-proof test with spark discharge	Item 15.5	The requirement is met. See Annex D	Compliant
Metal grids and flame arresters-made shells test	Item 15.6	Metal grids and flame arresters are not used	Not applicable
Cable entries pressure leak and mechanical strength test	Item 15.7	Certified cable entries must be used	Not applicable

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Excerpts from GOST 30852.1-2002 (IEC 60079-1:1998) containing standardized technical requirements and tests	Sections and items No.	Evaluation and tests results	Requirements compliance statement
Shells test by the electrical equipment manufacturer	Item 16	The manufacturer performs hydraulic overpressure test at 1.0 MPa for 10 seconds	Compliant
Non-metallic explosion-proof shell and their parts	Annex A	The requirement is not applicable. Light-transmitting part area is less than 100 cm ² .	Not applicable
Testing metal grids-made shells of gas control sensors	Annex D	The requirement is not applicable	Not applicable

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Test engineer

 / D.V. Kharitonov

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*Annex A
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Thermal tests per GOST 30852.0-2002

The tests were performed according to the method provided in item 23.4.6.1 of GOST 30852.0-2002. The tests were performed under the harshest possible conditions with the most adverse deviation in supply voltage ranging from 90% to 110% of the electrical equipment rated voltage. The external surface temperature does not exceed 120°C. The test results meet the requirements of GOST 30852.0-2002 for the electrical equipment of Group II, temperature class T4 taking into account correction and maximum ambient temperature during the product operation.

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*Annex B
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Impact resistance test

The tests were performed using a striking pin per item 23.4.3.1 of GOST 30852.0-2002. Impact energy was chosen as shown in Table 4 of GOST 30852.0-2002. Since the electric actuator is made of steel, it was decided to test 1 specimen. The tests results are shown in Table B.1.

Table B.1

Impact place	Specimen temperature, °C	Impact energy, J	Load drop height, m	Result
Electrical compartment housing (top)	(20±5)	7	0.7	No damages affecting the protection type are observed at the impact place.
Electrical compartment housing (side)	(20±5)	7	0.7	No damages affecting the protection type are observed at the impact place.
Electrical compartment housing (rear)	(20±5)	7	0.7	No damages affecting the protection type are observed at the impact place.
Light-transmitting part	(20±5)	4	0.4	No damages affecting the protection type are observed at the impact place.
Motor compartment housing	(20±5)	7	0.7	No damages affecting the protection type are observed at the impact place.
Motor compartment cover	(20±5)	7	0.7	No damages affecting the protection type are observed at the impact place.

Tested by:
Test engineer

 / D.V. Kharitonov

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Annex C
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The results of the shell protection degree compliance tests
(IP code) per GOST 14254-96

Shell dust protection test

Table C.1

Verified characteristic digit	Test equipment	Dust consumption in the test chamber, kg/m ³	Test conditions, item number	Test results
The first 6	Vacuuming dust chamber	2.0	13.4, 13.6	Upon completion of the test no talc powder-like dust deposit was observed inside the housing

Shell hard object protection test

Table C.2

Verified characteristic digit	Test equipment	Test force	Test conditions, item number	Test results
The first 6	Test wire of 1.0 mm in diameter and 100 mm long	1 N ± 10%	12.2	Accessibility probe does not touch hazardous mechanical parts

Shell water protection test

Table C.3

Verified characteristic digit	Test equipment	Test duration	Test conditions, item number	Test results
The second 8	The tests were performed in the pressure chamber at 10.8 kPa, which corresponds to dive to a depth of 1.1 m	35 min	14.2.8	Upon completion of the test no moisture was observed inside the housing

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Annex D
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Explosion safety tests

Determination of explosion pressure

The tests per GOST 30852.1-2002, item 15.3, involve igniting explosive mixture inside the shell with a spark discharge at atmospheric pressure and ambient temperature, as well as measuring the pressure of the explosion with the explosion-proof gaps width not exceeding the tolerances specified in the technical documents. Electric actuator installation in the explosion chamber is shown in fig. D.1. The test results are shown in Table D.1

Table D.1

Shell, compartment name	Explosion pressure kPa; Ethylene (8 ± 0.5)%		
	Experiment 1	Experiment 2	Experiment 3
Motor compartment	432	433	427
Electrical compartment	662	651	624

Explosion resistance test

The explosion resistance test was performed using dynamic method per item 15.4 of GOST 30852.1-2002. 1.5-times explosion pressure specified in item 15.3.6 was taken as the test pressure. See the test results in Table D.2.

Table D.2

Shell, compartment name	Test pressure kPa	Test results
Motor compartment	649.5	No shell destruction or deformation
Electrical compartment	993	No shell destruction or deformation

Explosion-proof tests

The explosion-proof tests per GOST 30852.1-2002, item 15.5.1, subgroup IIB, hydrogen content of (37±1.0)%, were performed under normal pressure (not increased intentionally). A high-voltage spark plug was used to ignite the explosive mixture inside the shell.

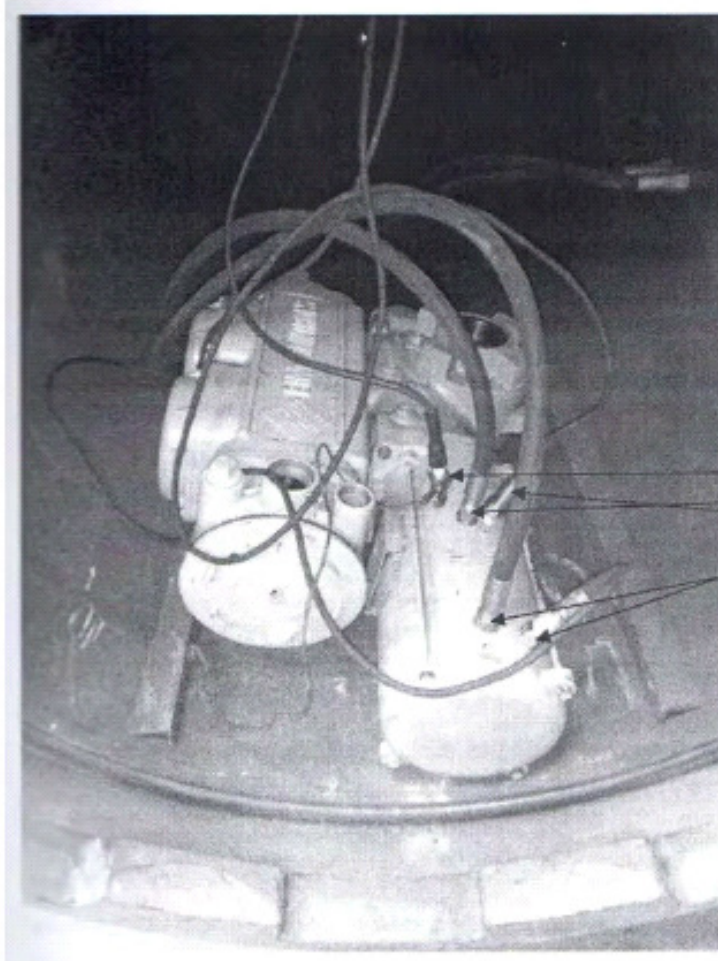
The tests were performed with the gap width in all explosion-proof joints conditioned by normal assembly in accordance with item 15.5.1.1, GOST 30852.1-2002. The tests results are shown in the Table D.3.

Table D.3

Shell, compartment name	Number of explosions	Explosion transfer
Motor compartment	5	No
Electrical compartment	5	No

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*Fig. D.1 Installation of the electric actuator TEC 2000
in the explosion chamber:*

1. Spark plug
2. Inlet connecting branch
3. Pressure sensors
4. Outlet connecting branch

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*Annex E
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Description of the product design and explosion protection means

The electric actuator TEC2000 is intended to remotely and locally operate shutoff and control pipeline multi-turn, part-turn and straight-type valves when they are used with auxiliary mechanisms.

The electric actuator includes the following structural elements:

- electric motor;
- main reduction gear consisting of a motor reduction gear and non-reversible worm gear;
- handwheel;
- actuator limiting device in the shut-off valve extreme positions (with switching elements);
- control box.

Electric actuator explosion protection is ensured with:

Enclosing electrical components in the explosion-proof shell capable of withstanding the pressure of an explosion inside it and preventing the explosion from entering into the surrounding explosive environment;

The word "Explosion" on the explosion protection means drawing denotes all explosion-proof joints and places where explosion-proof seals are adjacent to the shell parts. Explosion-proof joints parameters as well as other data and dimensions that ensure shell explosion-proof capability and its explosion resistance are provided and must be observed in the electric actuator operation and maintenance.

Electrostatic spark-proof capability is ensured by absence of plastic external parts on the shell.

Explosion-proof surfaces are protected from corrosion due to corrosion preventive compound. All bolts and nuts fixing the parts to the explosion-proof surfaces as well as live and grounding terminals are equipped with spring lock washers to prevent self-unfastening.

The temperature of the shell external surfaces in the most heated places does not exceed 120°C in normal actuator modes.

The shell strength is tested by the manufacturer. The strength of each explosion-proof shell is tested by applying pressure of 1.0 MPa for at least 10 seconds.

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Explosion-proof joints

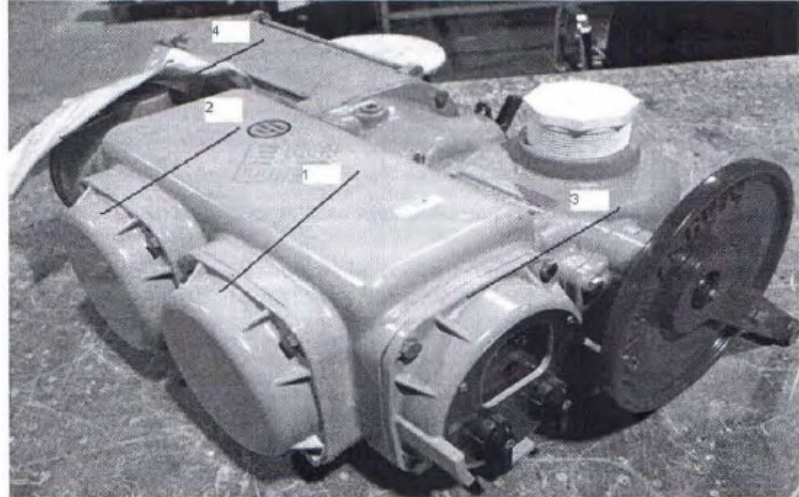


Fig. E.1 The figure schematically shows the places of explosion-proof joints (covers with the housing)

Explosion-proof joints are shown in Table E.1.

Table E.1

Joint	Joint type	Parameters
Cover 1 and electrical compartment joint	Cylindrical	Gap length ≥ 12.5 mm; Shell volume $> 2,000$ cm ³ ; Maximum gap width ≤ 0.15 mm; Roughness Ra < 6.3 μ m
Cover 2 and electrical compartment joint	Cylindrical	Gap length ≥ 12.5 mm; Shell volume $> 2,000$ cm ³ ; Maximum gap width ≤ 0.15 mm; Roughness Ra < 6.3 μ m
Cover 3 and electrical compartment joint	Cylindrical	Gap length ≥ 12.5 mm; Shell volume $> 2,000$ cm ³ ; Maximum gap width ≤ 0.15 mm; Roughness Ra < 6.3 μ m
Cover 4 and electrical compartment joint	Threaded	Number of complete intact solid threads ≥ 5 ; Thread axial length ≥ 8 mm Roughness Ra < 6.3 μ m
Light-transmitting part and cover 3 joint	Sealed	Length of the sealed joint ≥ 10 mm; Roughness Ra < 6.3 μ m
Control knob and cover 3 joint	Control thrust rods and shafts	Gap length ≥ 12.5 mm; Shell volume $> 2,000$ cm ³ ; Maximum gap width ≤ 0.2 mm; Roughness Ra < 6.3 μ m
Mode selector knob and cover 3 joint	Control thrust rods and shafts	Gap length ≥ 12.5 mm; Shell volume $> 2,000$ cm ³ ; Maximum gap width ≤ 0.2 mm; Roughness Ra < 6.3 μ m
Cable entries and the electrical compartment housing joint	Threaded	Number of complete intact solid threads ≥ 5 ; Thread axial length ≥ 8 mm Roughness Ra < 6.3 μ m

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Joint	Joint type	Parameters
Cover and motor compartment housing joint	Cylindrical	Gap length ≥ 25 mm; Shell volume $> 2,000$ cm ³ ; Maximum gap width ≤ 0.2 mm; Roughness Ra < 6.3 μ m
Shaft and bearing shield joint	Cylindrical	Gap length ≥ 40 mm; Shell volume $> 2,000$ cm ³ ; Maximum gap width ≤ 0.4 mm; Roughness Ra < 6.3 μ m

Marking

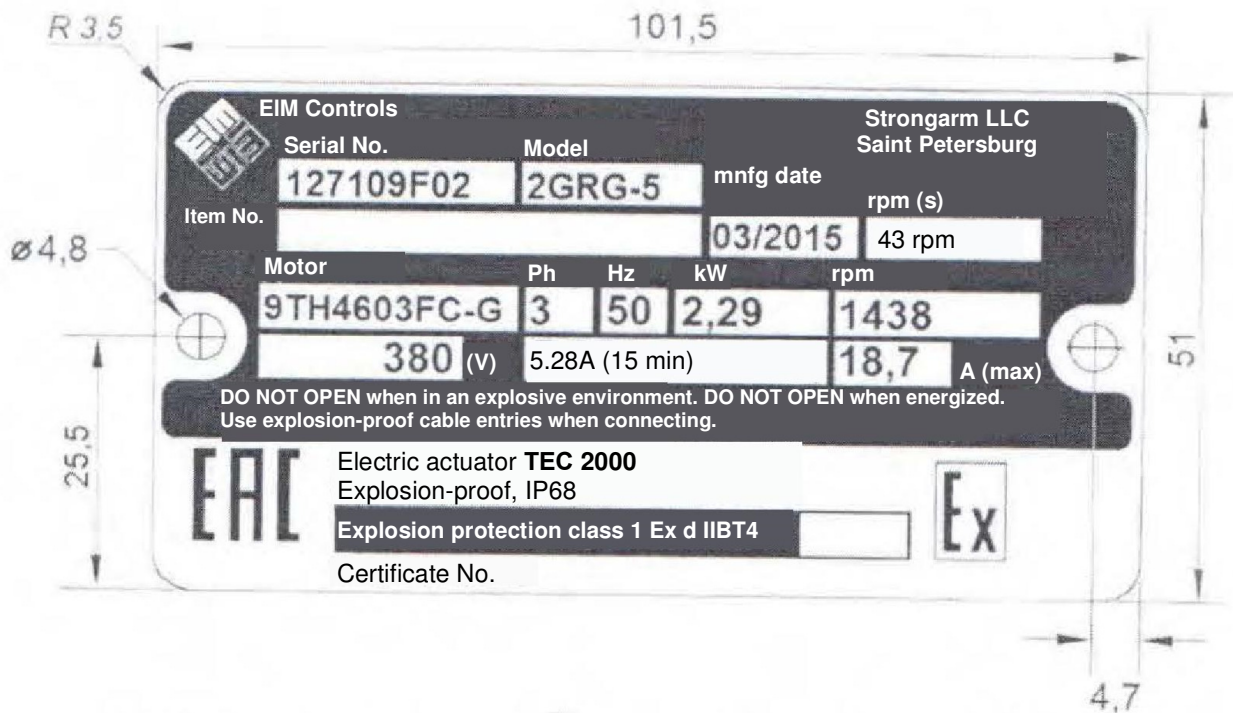


Fig. E. 1 Layout of the electric actuator TEC 2000 marking plate

Described by:
Test engineer

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Annex F
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List of the measuring tools used in the product specimen testing

Name of the measuring tools and test equipment, measurement limit, error category	Serial number	Next check (certification) date
<p>Thermohygrometer VIT 2 Temperature Measuring range: +15... +40°C Error: ± 0.1°C, Humidity Measuring range: +20... 90% RH Error: 0.1% RH</p>	17	06/01/2016
<p>Visual measurement kit VIK-1 Kit components: 1. Measuring tape 5 m, ± 0.5 mm 2. Metal ruler 30 cm, ± 0.5 mm 3. Caliper with depth gauge 4. ShTs 1-150-0.05; err.cat. ± 0.05 mm 5. Setsquare UP 160x100 6. Radius gauges kit No. 2 7. Radius gauges kit No. 3 8. Probes kit No.2 9. Probes kit No.3 10. All-purpose welder's gauge UShS-3 11. Weld seam legs gauge UShS-2 12. Measuring magnifier LI-3-10x, 2 cm ± 0.05 mm</p>	- - - No. 08068556 No. 200803647 - - - - - -	12/15/2015
<p>Meteorological Barometer-Aneroid BAMB-1 Measurement range: 80... 106 kPa Error: main: ± 0.2 kPa additional: ± 0.5 kPa</p>	292	10/01/2015
<p>Dust chamber KTP-800 Volume: 800 cm³ Flow rate: 0... 16 m/s Maximum concentration g/m³ at least: 2</p>	273	04/10/2016
<p>Measuring voltage converter E14-140-M-D DC voltage measuring range (positive or negative polarity) from 0.0001 to 10 V. Analog-to-digital converter frequency from 20 to 400 kHz Limits of permissible basic reduced error in voltage resupply ± 0.3</p>	1D157633	06/13/2015
<p>Roughness meter TR 100 Measuring range: Ra: 0.05... 10.0 μm Rz: 0.1 ...50 μm Error: ±15%</p>	27722340	06/01/2015
<p>Caliper ShTsTs-1 Measurement range: 0...200 mm Error: 0.01 mm</p>	G55241	10/08/2015
<p>Thermometer CENTER 304 Measuring range: -200... 1,370°C Resolution: 0.1°C Error: ±0.3°C</p>	090706292	06/04/2015
<p>Absolute pressure converter PAA-23SY Measuring range -1...50 bar. Error 0.5%</p>	215578	06/29/2016
<p>Voltmeter GDM-8245 Voltage range: 10 μV... 1,200 V Current range: 10 nA ... 20 A Error: ± 0.02%</p>	GCN861322	01/13/2016

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Name of the measuring tools and test equipment, measurement limit, error category	Serial number	Next check (certification) date
Laboratory autotransformer TSGC2-15KVA 3 phases Adjustable voltage 0 ... 420 V. Maximum current 20 A	no number	Not required
Compressor SV4/F-500.AV850/16 Operating pressure: 1.6 MPa Capacity: 850 l/min	105/13824	No check required
Drop-weight test installation UU-01	ИО 21	12/03/2015

Report made by:
Test engineer

 / D.V. Kharitonov