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APPROVAL REPORT

SGAES Gas Detection System
SGOES Gas Detector
UPES Control Unit for Gas Detector
FOR
HAZARDOUS (CLASSIFIED) LOCATIONS

Prepared for:

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Authorized by:
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SGAES Gas Detection System
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from

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I INTRODUCTION

1.1 Electronstandart-pribor requested an examination of the apparatus listed in Section 1.4 for compliance with the following standards as an explosionproof combustible gas detector system for use in Class I, Division 1, Groups B, C, and D; hazardous (classified) indoor/outdoor locations and IP66.

1.2 This Report may be freely reproduced only in its entirety and without modification.

1.3 Standards

Title	Class Number	Date
Electrical Equipment for Use in Hazardous (Classified) Locations, General Requirements	3600	November 1998
Electrical and Electronic Test, Measuring and Process Control Equipment	3810	2005
Performance Requirements for Combustible Gas Detectors	ANSI/ISA-12.13.01	2000
Combustible Gas Detectors	6310, 6320	January 2001
Degrees of Protection Provided by Enclosures (IP Code)	ANSI/IEC 60529 CSA-C22.2 No. 60529	2004 2005
Explosionproof Electrical Equipment – General Requirements	3615	2006
Bonding and Grounding of Electrical Equipment	CSA-C22.2 No. 0.4	1982
Threaded Conduit Entries	CSA-C22.2 No. 0.5	1982
Explosion-proof Enclosures for Use in Class I Hazardous Locations	CSA-C22.2 No. 30	1986 (2003)
Combustible Gas detection Instruments	CSA-C22.2 No. 152	June 2003

1.4 Listing: The following modifications to the product will appear in Section 10 of the Fire Protection Approval Guide and in the Canadian section of Section 10 of the Fire Protection Approval Guide, a publication of FM Approvals. The additions are underlines as follows:

COMBUSTIBLE GAS DETECTORS, Fixed

Stationary Single Channel 4-20mA Combustible Gas Detector. Stand Alone Sensor/Transmitter model SGOES. SGOES are Explosionproof for installation in Class I, Division 1, Groups B, C and D, T4 Ta = -40°C to +75°C Hazardous (Classified) Locations with an IP66 rating. SGOES monitors 0-100% LEL of either methane or propane. The SGOES provides an a 4-20mA output, RS-485 ModBus RTU digital output, 2 relays ("dry contacts") triggered upon exceeding software programmed levels, and a relay contact ("dry contact") which is triggered during a fault condition. The operating voltage range is 18-32 Vdc, with a maximum power consumption of 4.5W. This Approval covers use of the instruments when connected to FM Approvals stand alone combustible gas control unit and when calibration is performed using the gas to be monitored and when the higher of the alarm points is preset within 10% LEL of the calibration gas concentration.

Stationary one to sixteen Channel Control Unit for Combustible Gas Detector. Stand alone controller model UPES monitors FM Approved Combustible Gas Detectors which monitor 0-100% LEL gas-in-air atmospheres. Suitable for installation in ordinary (unclassified) locations. The unit contains a 2 line, 16 character display and 4 control pushbuttons. Each channel provides 2 channel status LEDs and 3 alarm status LEDs. UPES controllers' operating temperature range is -10°C to 45°C and operating voltage of 95-125VAC at 300W. Relay contacts ratings are 2A total at 110Vac. The apparatus complies with ANSI/ISA-12.13.01-2000 Performance Requirements for Combustible Gas Detectors. This Approval covers use of the instruments when connected to FM Approvals stand alone combustible gas Sensor/Transmitters and when calibration is performed using the gas to be monitored and when the higher of the alarm points is preset within 10% LEL of the calibration gas concentration.

Stationary Combustible gas detection System. The SGAES-TG Combustible gas detection System consists of an UPES Control Unit with up to 16 SGOES Gas Detectors. The Control Unit communicates to the Gas Detectors via a 4-20mA loop. The control unit provides a 4-20mA signal proportional to the gas detectors measuring range of gas of interest, High and Low Alarm indications and Trouble signals. The Detectors may be remotely connected up to 3600 ft away from the Control Unit. This Approval covers use of the system when calibration is performed using the gas to be monitored and when the higher of the alarm points is preset within 10% LEL of the calibration gas concentration. The operating voltage range is 18-32 Vdc, with a maximum power consumption of 4.5W for each SGOES Combustible Gas Detector. The UPES has an operating voltage of 95-125VAC at 300W.

1.5 Specifications - The manufacturer's specifications are as follow;

Range:	0-100% LEL
Operating Temperature:	-40°C to +75°C
Accuracy:	The greater of ±3 %LEL or 10 % of applied concentration for 0-100%LEL
Relative Humidity:	10 to 95% RH
Supply Voltage:	18-30 Vdc 4.5VA maximum
Step Response:	Rise to 90% of Full Scale within 30 Sec
Measurement Signal:	4-20mA

1.6 Instruction Manual - The instruction manual provided with each unit contains the following information:

a. Instrument specifications and operational limits.
b. Maintenance and calibration instructions.
c. Explanation of indicators, adjustments and initial start-up instructions.
d. A trouble shooting procedure and recommended replacement parts list.

II DESCRIPTION

2.1 **Product Description** - The SGOES operation is founded on differential absorption of electromagnetic radiation by hydrocarbon molecules and consists of measuring the change of IR radiation intensity after the IR radiation has passed the test gas medium. To decrease the influence of water vapour, optics pollution, and dust, the parameters of the optical elements can be changed and are used in the optical scheme with the absorption measurement at the operating and reference wavelengths.

The SGOES consists of optoelectronic and introductory cells, furnished in an explosion-proof casing. There are emission sources and radiation receivers, electronic scheme in the optoelectronic cell. From emission source IR radiation is got to space with analyzable mixed gas via transparent glass, after reflection from the mirror it returns via the same transparent glass into tight casing and get to photo sensor. From the outputs of the photo sensor's electric signals enter the electronic circuit where they are being amplified, processed, and converted to the unified electric signal within the current band of 4-20mA, which according to measurement gas concentration range 0-100% LEL.

The UPES is a 1 to 16 channel Control Unit for Combustible Gas Detectors intended to be installed in Ordinary Locations. It accepts the 4-20mA signals from 0-100% LEL Combustible Gas Detectors and provides power for up to 16 Combustible Gas Detectors.

2.2 **Construction** - The SGOES Gas Analyzer enclosure is a cylindrical shaped housing constructed of aluminum alloy. Both ends of the housing are closed by covers. The base cover is solid and contains the external grounding lug, wiring entry and mounting holes. The window cover contains one sapphire lens cemented in place and externally protected by a permanent guard/reflector assembly. The window cover also contains the mounting holes for the electronics. The base cover is provided with one ½ inch - 14 NPT conduit entry. O-rings are provided on the covers for environmental protection. The maximum free internal volume of the apparatus is approximately 374 cm^3. The flamepath joint construction of the SGOES Gas Analyzer enclosure is identical to that of the IPES Combination IR/UV Flame Detector previously Approved under FM Approvals project ID 3028847. The SGOES Gas Analyzer contains a different window assembly and has a smaller free internal volume.

III EXAMINATIONS AND TESTS - EXPLOSIONPROOF

3.1 Samples of the SGOES Gas Analyzer housing, representative of production, were examined, tested, and compared with the manufacturer's drawings by FM Approvals. All test data is on file at FM Approvals along with other documents and correspondence applicable to this program. All explosionproof testing and assessment was conducted at the FM Approvals facility, located in West Glocester, RI, USA.

3.1.1 **Note on Sample Preparation** - The electronics are mounted directly to the inside of the window cover. Three standoffs and three non-metallic washers are used. The non-metallic washers slightly

overlap the retaining ring on the window to provide supplemental mechanical retention. These standoffs and washers are not relied upon to secure the window during normal operation. Therefore, these standoffs and washers were removed from all samples for all tests.

3.1.2 Based on the similar housing construction of the SGOES Gas Analyzer and the IPES Combination IR/UV Flame Detector and the satisfactory testing conducted for the IPES Combination IR/UV Flame Detector housing under FM Approvals project ID 3028847 as explosionproof for Class I, Division 1, Groups B, C and D for US and Canada, it was determined that only the following examination and testing is required on the SGOES Gas Analyzer.

- Impact Test
- Thermal Shock Test
- Hydrostatic Overpressure Test
- Flame Propagation Tests (Cemented Window Joint)
- IP6X Dust Exclusion
- IPX6 Hosedown
- Chemical Compatibility of Window Assembly
- Flammability of Window Assembly

3.1.3 The following examination and testing conducted under FM Approvals project ID 3028847 was considered applicable to the SGOES Gas Analyzer.

- Explosion Reference Pressure Tests
- Flame Propagation Tests (Spigot Joints)
- Chemical Compatibility of Window Cement
- Artificial Aging of Window Cement

3.2 Flamepath Joint Analysis - The following details the critical flamepaths of the SGOES Gas Analyzer housing for Class I, Division 1, Groups B, C and D hazardous locations.

3.2.1 Covers to Housing: Spigot - The spigot joint between the covers and the housing has a minimum design length of 15 mm (0.6 inch) with a maximum design gap of 0.095 mm (0.004 inch). The design gap exceeds the maximum allowed gap of 0.08 mm (0.003 inch) for Group B equipment with an internal volume of 374 cm^3 for US Approval. This joint meets the required 9.5 mm minimum length and 0.1 mm maximum gap for Group B equipment with an internal volume of 374 cm^3 for Canadian Approval. During flame propagation testing successfully conducted under FM Approvals Project ID 3028847, the gap on the base cover was increased by 50% in excess of the design maximum gap to introduce the required safety factor for US Approval. The cylindrical portion of the joint was machined to achieve a gap of at least 0.14 mm (0.006 inch). This exceeds the 1.42 safety factor required for Canada for Group B equipment.

3.2.2 Window to Cover: Cemented - The sapphire glass window is cemented into the housing cover using Anles' Epoxi Exclusive epoxide resin with admitipe hardener. The cement material was tested in accordance with FM Standard 3600 and 3615 for non-metallic enclosure materials. Refer to FM Approvals Project ID 3028847 as well as Section 3.3.4 of this report. This joint has a minimum design length of 10 mm. This is satisfactory as it meets the minimum 10 mm requirement.

3.2.3 Threaded Entry - The base cover of the housing is provided with one ½ inch - 14 NPT entry with an axial thread length of 16.5 mm. The manufacturer specifies that all entries are gauged with a standard NPT-L1 plug gauge to ensure that all production models are within the specified +1/2 to +3-1/2 turns of the gauging notch. The manufacturer's specified gauging falls within the required

+1/2 to +3-1/2 turns of the gauging notch to provide a minimum of 5 full threads of engagement. This is satisfactory.

3.3 Explosionproof Examination and Tests - The following tests verify the suitability of the SGOES Gas Analyzer housing as explosionproof for Class I, Division 1, Groups B, C and D hazardous locations.

3.3.1 Impact Tests - Various areas of the SGOES Gas Analyzer housing samples were subjected to an impact from a 25 mm spherical steel tip at a 7.0 Joule magnitude. The impact was obtained by dropping a 1.0 kg weight from a height of 70.0 cm onto all sides of the samples. In addition, the window guard/reflector assemblies of the covers were subjected to the 7.0 Joule impact test. The design of the window guard prevents the impact tip from making contact with the sapphire lens of the enclosure. Results were satisfactory in that no damage occurred to the test samples that would impair their ability to pass the subsequent tests.

3.3.2 Thermal Shock - The external surface of the SGOES Gas Analyzer housing was heated to a temperature of at least 85°C and then subjected to a series of thermal shock tests. A cloth saturated with water at 10+/-5°C was applied to the light transmitting part. The test was repeated five times. No cracks or other failures that would affect the Type of Protection were observed. This is satisfactory.

3.3.3 Explosion Flame Propagation Test (Group B) - The cemented window joint of the SGOES Gas Analyzer housing was subjected to flame propagation testing. The o-rings were removed from the housing prior to testing. One series of ten tests and one series of five tests were performed on the sample at an elevated temperature of +85°C. The test gas used was hydrogen, representative of Group B. The first series was performed with gas concentrations ranging from 22.6% to 38.2% by volume in air while the second series was performed with a gas concentration of 24% volume in air. Ignition was initiated by a spark plug installed in the conduit entry of the housing. Ignition internal to the housing did not result in propagation to an identical external atmosphere surrounding the housing during any of these tests, nor was any visible permanent deformation of the housing observed. This is satisfactory.

3.3.4 Non-Metallic Enclosure Materials - The following tests verified the suitability of the cement materials used in the construction of the SGOES Gas Analyzer housing.

3.3.4.1 Chemical Compatibility Test - As a result of the chemical compatibility test conducted in FM Approvals Project ID 3028847, the cement samples subjected to acetone, methanol, and acetic acid experienced more than a 15% change in hardness with the sample subjected to acetone having the greatest percent change. One representative sample of the SGOES Gas Analyzer window cover with lens assembly cemented using Anles' Epoxi Exclusive epoxide resin with admitipe hardener was exposed to the vapors of acetone for 150 hours in a closed vessel containing 4 fluid ounces per quart volume. Following this exposure, the sample was subjected to a hydrostatic test at a pressure of 635 psi (4380 kPa). The test pressure was maintained for at least 10 seconds with no leakage occurring through the cemented joint. At the conclusion of the test, the sample was examined and there was no visible permanent deformation as a result of this test. This testing is considered to be satisfactory for the cement material to be used in this window cover design.

3.3.4.2 Flammability Test - One representative sample of the SGOES Gas Analyzer window cover with lens assembly was subjected to a flammability test. The purpose of this test was to verify that the cement material in its final assembly could maintain the cement joint construction. The sample was subjected to 5, 15 second applications of a Bunsen burner flame angled at 20 degrees from the

vertical. The overall height of the flame was 5 inches (12.5 cm) with an inner blue flame cone 1 ½ inches (3.8 cm) high. The flame was applied from the inner blue flame cone to the test sample for 15 seconds, removed for 15 seconds, for a total of 5 applications. The test sample did not burn through or sustain combustion for more than one minute after the fifth application of the flame. The test was repeated on the opposite side of the lens assembly. Following the test, the sample was subjected to a hydrostatic test at a pressure of 635 psi (4380 kPa). The test pressure was maintained for at least 10 seconds. At the conclusion of the test, the sample was examined and there was no visible permanent deformation as a result of this test. This is satisfactory.

3.4 **Surface Temperature Test** – The surface temperature test showed a surface temperature of 26°C in a 22°C ambient. This temperature rise of 4°C plus 5°C uncertainty, linearly adjusted to the 75°C ambient results in a maximum temperature of 84°C. The customer has elected to mark the product with a T4 rating. This is acceptable.

IV EXAMINATIONS AND TESTS - ENVIRONMENTAL

4.1 **Environmental Tests** - The following tests verified the IP66 rating for the SGOES Gas Analyzer housing.

4.1.1 **Dust Exclusion Test (IP6X)** - An SGOES Gas Analyzer housing sample was suspended in a circulating dust atmosphere of 200 mesh talc. The sample was connected to a vacuum pump adjusted to draw a vacuum of 20 mBar on the sample. The test lasted a total of 8 hours. At the conclusion of the test, the sample was removed from the test chamber, excess dust was removed from the surface and opened. Results are satisfactory as the enclosure was found to have excluded the entry of dust.

4.1.2 **IPX6 Water Hosedown Test** - The complete sample was subjected to a stream of water from a hose with a ½ inch (12.5mm) nozzle that delivers at least 26.4 gallons (100 liters) per minute. The stream of water was directed at the sample from all sides from a distance of 8.2 to 9.8 feet (2.5 to 3.0 meters) for 3 minutes. At the conclusion of the test, the enclosure was opened and inspected. The sample had excluded the entry of water. This is satisfactory.

V EXAMINATIONS AND TESTS – PERFORMANCE

5.1 **Performance Testing** – Representative samples of the SGOES and UPES were examined by FM Approvals to determine the operational acceptability. The examination included gas detection performance tests, circuit analysis, component and temperature measurements, as well as a review of the manufacturer's documentation and the unit's physical construction. Combustible gas detection performance tests were conducted at FM approvals in Norwood. The test results are summarized in the following sections.

5.1.1 **Operation Evaluation** - All tests were performed at an ambient temperature, 20 to 30°C, having a relative humidity in the range of 30-70% RH, unless otherwise specified. Temperature measurements were recorded after three successive observations taken at 5 minute intervals indicating no changes. Room air circulation was relatively still, not more than 1 m/sec, unless otherwise indicated. Methane and propane were used as representative combustible gas. The instruments' display and the 4-20mA loop current were recorded during tests. The 4-20mA measurements were converted to %LEL concentrations using the following formula:

Measurement (LEL) = [(Imeasured - 4)/16] x 100, where Imeasured is the measured 4-20mA current.

5.1.2 **Trouble Signals** – The SGOES can indicate trouble signals which correspond to a specific mA signal that include loss of optical signal, opening and shorting of the field wiring, down scale reading equivalent to 10% below nominal value and over range conditions.

5.1.3 **Control and Adjustments** – The adjustment and calibration of the SGOES is made at the controller. The calibration and zeroing does not require the user to open the explosionproof enclosure.

5.1.4 **Instruction Manual** - The instruction manual provided with each unit contains the following information:

a. Instrument specifications and operational limits.
b. Maintenance and calibration instructions.
c. Explanation of indicators, adjustments and initial start-up instructions.
d. A trouble shooting procedure and recommended replacement parts list.
e. A list of specifications for: maximum and minimum storage limits of all parts of the instrument, accuracy, response, response times, loop and line resistances and voltage ranges.

5.1.5 **Unpowered Preconditioning Storage** - A sample SGOES Combustible Gas Detector, used in subsequent tests, was exposed to the storage temperatures specified, as follows:

a. -55°C for 24 hours
b. Ambient temperature for 24 hours
c. +85°C for 24 hours
d. Ambient temperature for 24 hours

5.1.6 **Vibration** – The SGOES was vibrated while powered, vertically with a frequency range of 10 to 30 Hz at a total excursion of 1.0mm for one hour in each of three mutually perpendicular axes. During and after the test, there was no loss of function and no false indications of malfunctions. There was no visible damage to the instrument or any hidden damage which would manifest itself in loss of function and no loose components which could cause an electrical hazard. The instrument's measurement indications at the conclusion of the tests were satisfactory since they were within the required +5% of full scale gas concentration.

5.1.7 **Initial Calibration** - The SGOES was calibrated in accordance with the manufacturer's instruction manual using the suggested methods. An accuracy test, with satisfactory results, was performed with a representative sample of the manufacturer's combustible gas calibration delivery system with 50%LEL methane gas cylinder. The SGOES was calibrated in accordance with the manufacturer's instruction manual. Calibration was satisfactory with the calibration apparatus.

5.1.8 **Accuracy** - Subsequent to calibration, accuracy testing was performed on the SGOES. Gas concentrations of 7 - 13%, 22 - 28%, 45 - 55%, 67.5 – 82.5% and 90 - 110% LEL were applied to the SGOES. The gas was applied in a manner to simulate the instrument's actual diffusion method of monitoring. In all cases, the instrument's measurement indications were satisfactory since they were within ±3% of full-scale gas concentration or ±10% of applied gas concentration, whichever is greater. This is satisfactory as it is equal to the maximum allowable deviation ±3% of full-scale gas concentration or ±10% of applied gas concentration, whichever is greater.

5.1.9 **Trouble Signals** - A stationary or transportable gas detection apparatus shall provide for a signal transfer or contact transfer to produce a trouble signal if any of the following conditions occur:

a) **Apparatus power failure** – The system was aligned and calibrated. Power to the Transmitter was removed. The receiver indicated a fault condition. As all communication is received from the transmitter, the evaluation for the transmitter was waived. This is satisfactory.

b) **Down scale indication (below zero)** – The SGOES was zeroed with 0.4 LEL•m within the beam path. The gas cell was then removed. The under range fault (Zero Drift) was detected. This is satisfactory as the under range fault was identified at the allowable concentration of 10% of full scale.

5.1.10 Step Change Response - The sensor/transmitter was subjected to step change response tests. Response times were verified by suddenly exposing the sensor/transmitter to a gas concentration of 100% LEL and a flow rate not greater than 1 m/sec. The sensor/transmitter indications increased to 50% LEL within 1.9 seconds, 60% LEL within 10.5 seconds and 90 %LEL within 14.5 seconds. This is satisfactory as it exceeds minimum required step change responses of 50% of the applied concentration within 10 seconds, 60% of the applied concentration within 12 seconds and 90% of the applied concentration within 30 seconds.

5.1.11 Temperature - The sensor was exposed to the initial calibration gas concentration with all parts of the system at ambient conditions. The controller was then exposed to the initial calibration gas concentration while at the low operating temperatures of -40°C, -25°C and then at the high temperature of +75°C. The instrument's measurement indications did not vary by more than ±5% LEL at -40°C and +75°C from that observed at ambient conditions. This is satisfactory as it is less than the maximum allowable deviation of ± 5%LEL.

5.1.12 Humidity Variation - After calibrating the sensor/transmitter with the initial calibration concentration of 50% LEL at 50%RH, the same calibration concentration and humidity was then applied for approximately two hours. The sensor/transmitter was then exposed to the initial calibration concentration at 90% RH for two hours and then at10% RH for two hours. The instrument's measurement indications were satisfactory since they did not vary from that observed during the 50% RH exposure by more than ±5% of full scale concentration, which is less than the maximum allowable deviation of ±5% of the full scale concentration.

5.1.13 Air Velocity Variation - The sensor/transmitter was calibrated while exposed to the static mixture of the calibration concentration. The instrument was then exposed to the same mixture in motion so as to impinge on the gas detection sensor at a velocity of 6±0.5 m/sec. The instrument's measurement indications while subjected to the mixture in motion were satisfactory since they did not vary from that observed during exposure to the static mixture by more than ±2% of the full scale concentration in any orientation of the sensor with respect to the air motion.

5.1.14 Supply Voltage Variation – The sensor/transmitter was exposed to calibration gas and then the supply voltage was decreased to the minimum extremem voltage and then increased to the maximum extreme voltage. The variation in the meter reading did not change by more than 1%. This result meets the requirement of 2% full scale concentration.

5.1.15 Electromagnetic Interference (EMI) - The sensor/transmitter was subjected to EMI frequencies in the range of 150 to 170MHz and 450 to 470 MHz from frequency modulated portable radios with power outputs of 5 Watts. The distance from the radio to the gas detection system was 1.0m at any orientation. The instruments did not produce measurement changes greater than ±4% LEL or result in any instrument malfunctions. Test results were satisfactory.

5.1.16 Under-Range Condition – The sensor transmitter was zeroed with 10%LEL applied to sensor and calibrated to 50 %LEL. The gas concentration was then lowered until the under range fault was

detected. The under range fault was detected at a concentration of 10% LEL resulting in a fault at 5%LEL below zero. This is satisfactory as the under range fault was identified at 5%LEL below zero which is higher than the minimum allowable concentration of 10%LEL below zero

5.1.17 Flooding with Undiluted Gas - The sensor was subjected to a step change in gas concentrations from 0% (clean air) to 100% gas volume by volume. The instruments measurement was satisfactory since it indicated a concentration of 80% LEL and the alarm activated within 7 seconds after sudden exposure to the 100% gas volume by volume. The results were satisfactory as the SGOES produced an output indication corresponding to a concentration of at least 60% of the lower flammable limit or to full-scale concentration, whichever is lower, within 10 s of exposure to the 100% gas-by volume.

5.1.18 Long Term Stability – The SGOES was consecutively subjected to the following sets of conditions for the periods stated below.

a. Clean air at ambient temperature and humidity for six continuous days.
b. At the beginning of the seventh day, the gas-sensing element was exposed to the initial calibration gas mixture for a period of 24 h. Within 5 minutes after start of the test, the indicated concentration was noted and did not deviate from the actual calibration gas concentration by more than ±10% of full scale for the remainder of the 24 h.
c. Steps a and b were repeated for a total of four consecutive times (total of 28 days). Just prior to the end of the 14th and 28th days, while the gas-sensing element was still exposed to the initial calibration gas mixture, the indicated concentration was noted and did not deviate from the actual calibration gas concentration by more than ±10% of full scale.
d. Upon completion of the 28th day the gas-sensing element was exposed to clean air at ambient temperature and humidity for 24 h. At the end of this period, the gas-sensing element was exposed to the initial calibration gas mixture, and the indicated concentration was noted after 5 min and did not deviate from the actual gas concentration by more than ±10% of full scale. The sensor was then exposed to a gas concentration of 90% by volume for eight hours.
e. Immediately after completing d, the accuracy test procedure in Section 0, except that the maximum allowable deviation did not vary from the known test gas concentration by more than the maximum allowed tolerance of ±4% full-scale gas concentration or 10% of the applied gas concentration, whichever was greater.

VI MARKING

The following information appears on the apparatus identified in Section 1.4 and meets Standard requirements:

Manufacturer's name and manufacturing location.
Type number and date code
Maximum input and output ratings
Maximum ambient temperature
The FM Approval Mark
Hazardous Location Ratings
CAUTION: DO NOT OPEN WHEN AN EXPLOSIVE GAS ATMOSPHERE IS PRESENT. KEEP COVER TIGHT WHILE CIRCUITS ARE LIVE. READ AND UNDERSTAND INSTRUCTION MANUAL BEFORE OPERATING OR SERVICING.

VII REMARKS

7.1 Installations shall comply with the relevant requirements of the latest edition of the National Electrical Code (ANSI/NFPA 70).

7.2 Installations shall comply with the latest edition the manufacturer's instruction manual.

7.3 This report verifies the subject gas monitoring equipment operates as specified and provides an electronic signal indicative of the sampled methane-in-air gas concentrations. This report does not include or imply Approval of apparatus to which the subject instruments may be connected and which processes the electronic signal for eventual use. In order to maintain the Approval of the system, the control instrument, to which the subject instrument is connected, shall be FM Approved to process the specified electronic signal and provide the appropriate indication.

7.4 On 100% of production, the manufacturer shall inspect the protective grounding system in the sensor/transmitter enclosure.

7.5 Repair of equipment shall only occur at facilities audited by FM Approvals.

7.6 The product(s) discussed in this report were certified by FM Approvals under a Type 3 Certification System as identified in ISO Guide 67

VIII FACILITIES AND PROCEDURES AUDIT

The design and manufacturing site in St. Petersburg, Russia is subject to follow-up audit inspections. The facilities and quality control procedures in place have been found to be satisfactory to manufacture product identical to that examined and tested as described in this report.

IX MANUFACTURERS RESPONSIBILITIES

Documentation considered critical to this Approval is on file at FM Approvals and listed in the Documentation File, Section VIII of this report. No changes of any nature shall be implemented unless notice of the proposed change has been given and written authorization obtained from FM Approvals. The Approved Product Revision Report, Form 797, shall be forwarded to FM Approvals as notice of proposed changes.

X DOCUMENTATION

The following drawings describe the SGAES-TG Gas detection system and are filed under Project 3029728

Drawing No	Drawing Title	Revision
GSKF.301314.002 AD	Base of Enclosure Assembly Drawing	23.03.05
GSKF.301265.003 AD	Cover of Enclosure Assembly Drawing	23.03.05
GSKF.413311.002 AD	Gas Analyzer SGOES Assembly Drawing	23.03.05
GSKF.413311.002 OM	Gas Analyzer SGOES Operating Manual	2007.05.24
GSKF.713538.006	Enclosure for SGOES	23.03.05
GSKF.711111.009	Optical Protection Sapphire Glass OMLDY Enclosure	23.03.05
GSKF.754312.024	Marking Plate	23.03.05
GSKF.754342 018	Plate	13.08.03
GSKF.426211.033	Threshold device UPES-40	21.09.05
GSKF.426211.033 SB	Threshold device UPES-40 Assembly Drawing	21.09.05
GSKF.426211.033 E6	Threshold device UPES-40 General Electric Schematic	21.09.05
GSKF.411218.004 PE3	Power Supply 24V List	21.09.05
GSKF.411218.004 SB	Measuring two channel unit assembly drawing	21.09.05
GSKF.411131.001 SB	Converter current-voltage assembly drawing	21.09.05
GSKF.411131.001 E3	Converter current-voltage electrical scheme	21.09.05
GSKF.411218.005 SB	Board assembly drawing	21.09.05
GSKF.411218.004 E3	Measuring two-channel unit electrical schematic	21.09.05
GSKF.411618.001 SB	Interconnect board assembly drawing	21.09.05
GSKF.411618.001 E3	Interconnect board electrical schematic	21.09.05
GSKF.411618.001 PE3	Interconnect board List	21.09.05
GSKF.425621.005 SB	CPU assembly drawing	21.09.05
GSKF.425621.005 E3	CPU electrical schematic	21.09.05
GSKF.425621.005 PE3	CPU List	21.09.05
GSKF.435111.001 SB	Supply board assembly drawing	21.09.05
GSKF.436231.001 SB	Supply unit assembly drawing	21.09.05
GSKF.436231.001 E3	Supply unit electrical drawing	21.09.05
GSKF.436231.001 PE3	Supply unit List	21.09.05
GSKF.413311.002	Gas Analyzer SGOES	23.03.05
GSKF.413311.002 E6	Gas Analyzer SGOES general electric diagram	23.03.05
GSKF.426476.003 E3	Interconnect board electrical scheme	23.03.05
GSKF.423142.004 E3	Relay board electrical scheme	23.03.05
GSKF.411619.010 E3	Signal board electrical scheme	23.03.05
GSKF.426469.001 E3	Controller Card electrical scheme	23.03.05
GSKF.741124.003	Panel label	21.09.05
GSKF.754312.024	SGOES label	15.10.07
GSKF.413311.002 OM	SGOES Operating Manual	2007.05.04
GSKF.411711.002 OM	SGAES-TG Operating Manual	

XI CONCLUSION

The apparatus described in 1.4 meets FM Approvals requirements. Since a duly signed Master Agreement is on file for this manufacturer, Approval is effective the date of this report.

EXAMINATION AND TESTING BY: Patrick Byrne, Patrick Shaver, Marlon Mitchell

PROJECT DATA RECORD: 3029728

ATTACHMENTS: Operating Manual: GSKF.413311.002 OM, GSKF.411711.002 OM
Label drawings: GSKF.754312.024, GSKF.741124.003

REPORT BY:
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Engineer
Hazardous Locations

REPORT REVIEWED BY:
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REPORT BY:
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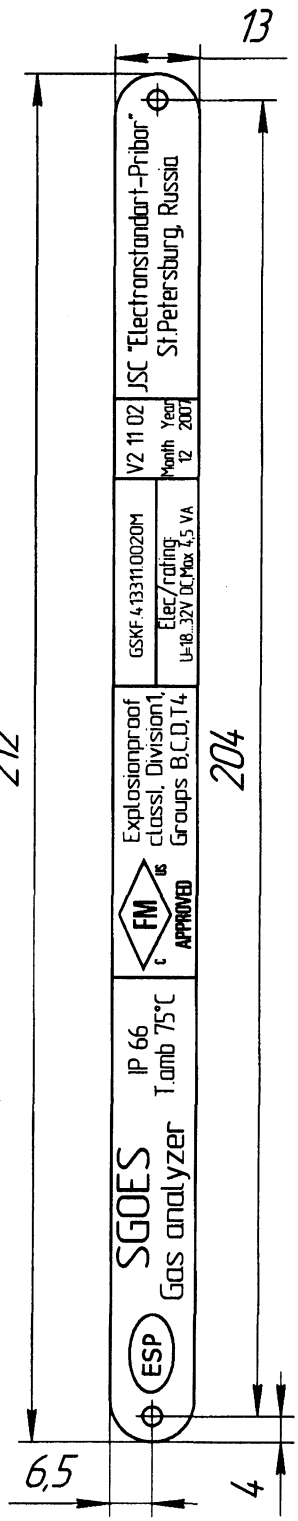
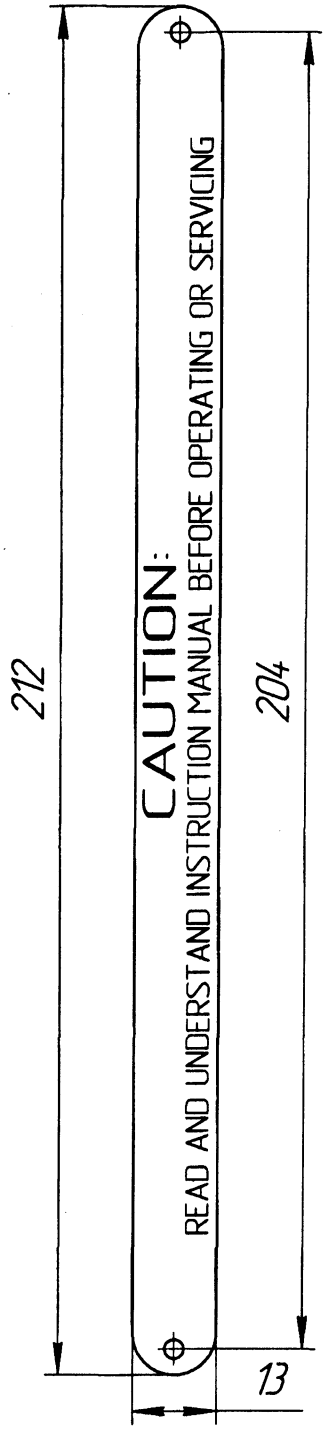
Pic.1



Pic.2



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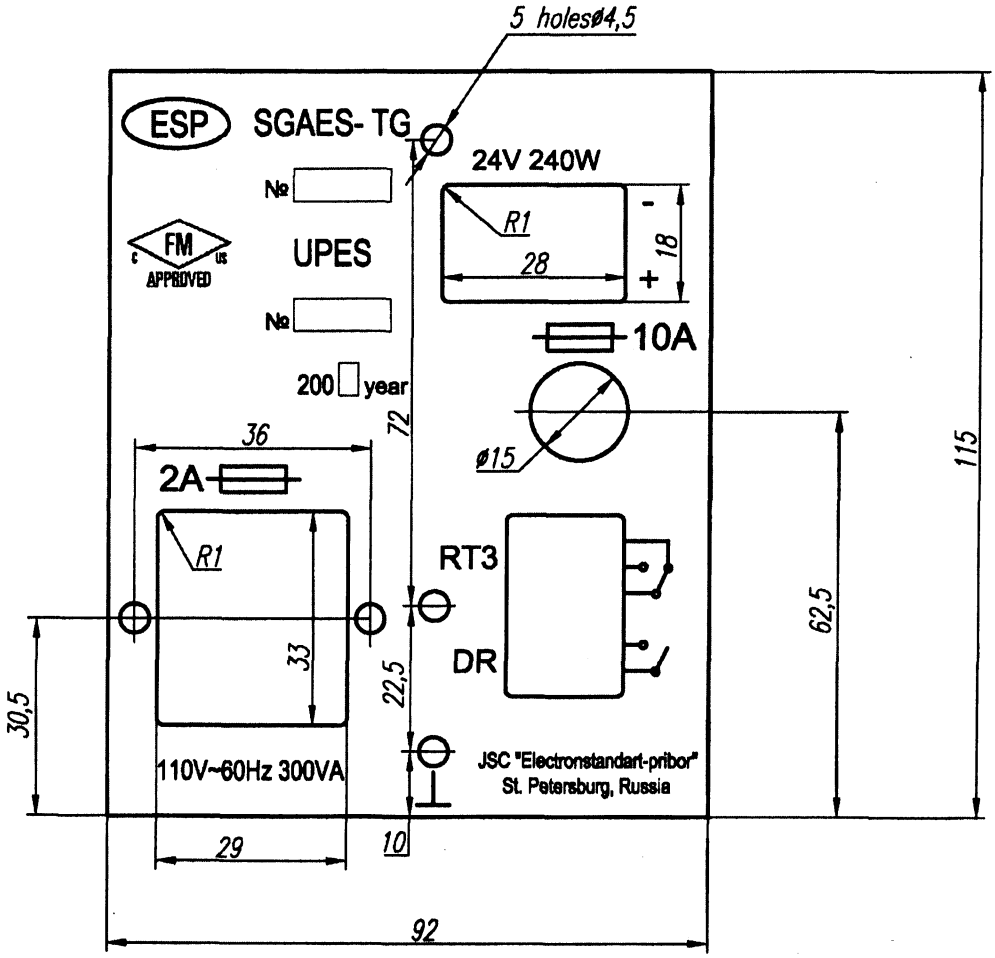
GSKF.754312.024

Sheet 3

GSKF.741124.003



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Developed by		Boldyreva		21.09.05		
Checked by		Didenko		21.09.05		Sheet 1 Sheets 1
Subject leader						ESP JSC"Electronstandart-pribor" ST.Peterburg, Russia
N.inspector						
Approved by						