

APPROVAL REPORT

**MODEL SERIES 500
I/P TRANSDUCER
FOR
HAZARDOUS LOCATIONS**

Prepared For:

**CONTROLAIR, INCORPORATED
11 CALDWELL DRIVE
AMHERST, N. H. 03031**

**5Y6A8.AX
(3610, 3611)
DECEMBER 5, 1995**



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MODEL 500 SERIES I/P TRANSDUCER
FOR HAZARDOUS (CLASSIFIED) LOCATIONS
FROM
CONTROLAIR, INCORPORATED
11 CALDWELL DRIVE
AMHERST, N.H. 03031

INTRODUCTION

1.1 Controlair, Incorporated requested Approval of the apparatus listed in Section 1.2 to be in compliance with the applicable requirements of the following standards:

<u>Title</u>	<u>Class No.</u>	<u>Issue Date</u>
Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous (Classified) Locations	3610	October 1988
Note: Factors applied to energy rather than voltage or current.		
Electrical Equipment for Use in Class I, Division 2, Class II, Division 2 Class III, Divisions 1 and 2 Hazardous Locations	3611	April 1986
Electrical Equipment for Use In Hazardous (Classified) Locations General Requirements	3600	March 1989
Electrical and Electronic Test, Measuring, and Process Control Equipment	3810	March 1989

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1.2 The following was evaluated as intrinsically safe apparatus for Class I, II and III, Division 1, applicable Groups C, D, E, F and G in accordance with entity requirements and Controlair interconnection diagram No. 431-990-013, Rev. -; Nonincendive for Class I, Division 2, Groups A, B, C and D; suitable for Class II, Division 2, Group F and G, Suitable for Class III, Division 1 and 2 hazardous indoor locations and will appear in the Approval Guide as follows:

IS/I,II,III/1/CDEFG - 431-990-013 / - ; Entity
NI/I/2/ABCD;
S/II,/2/FG; S/III/1,2

Max. Entity Parameters

$V_{max} = 30 \text{ Vdc}$, $I_{max} = 65 \text{ mA}$, $C_i = 0 \text{ uF}$, $L_i = 35 \text{ mH}$

I/P Pressure Transducer. Model 500-Aa

a = Output range A,B,C,D,E,F,G or H

II DESCRIPTION

2.1 The 500-A Series I/P Transducer are process control devices which converts a 4 - 20 mAmp DC current input to a pressure flow output. The housing measures 4.5 x 2.2 x 2.2 inches (10.7 x 5.7 x 5.7 cm) with a threaded conduit opening for electrical input and two threaded openings for air in and out. The transducer utilizes a coil and magnet to convert the electrical signal to a mechanical pressure output control. The trimming resistors and associated components are mounted on a small printed circuit board inside the housing.

III EXAMINATION AND TESTS

3.1 Representative samples of the 500 series Transducers were examined and tested by Factory Mutual Research Corporation (FMRC) to determine their acceptability for use in the specified hazardous location. The examination included circuit analysis, component tests and temperature measurements, as well as a review of the manufacturer's documentation and the unit's physical construction. All were satisfactory and are summarized in the following sections. All data is on file at FMRC along with other documents and correspondence applicable to this program.

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3.2 Entity Concept - Under "Entity" requirements, the concept allows interconnection of intrinsically safe apparatus to associated apparatus, not specifically examined in such combination. The criteria for interconnection is that the voltage (Vmax) and current (Imax) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the voltage (Voc) or (It) and current (Isc) or (It) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (Ci) and inductance (Li) of the intrinsically safe apparatus, including interconnecting wiring, must be equal or less than the capacitance (Ca) and inductance (La) which can be safely connected to the associated apparatus. If these criteria are met than the combination may be connected.

3.3 Entity Evaluation - The maximum entity parameters for Class I, Division 1, Group C and D hazardous locations are as follows:

3.3.1 Capacitance Evaluation - The transducer contain no internal capacitors therefore the internal unprotected capacitance (Ci) is 0 uF. The maximum voltage (Vmax) as stated by the manufacturer which can safely be applied to the terminals is 30 Vdc.

$$V_{max} = 30 \text{ Vdc}$$

$$C_i = 0 \text{ uF}$$

3.3.2 Inductance Evaluation - The transducer contains a coil, 35 mH with 300 ohms resistance, therefore the unprotected inductance (Li) is 35 mH. Using curve B3 in FMRC Standard 3611, the maximum current (Imax) that can be safely applied to the input is 65 mAmps.

$$I_{max} = 65 \text{ mA}$$

$$L_i = 35 \text{ mH}$$

3.4 Intrinsic Safety Evaluation - The following tests verify that model series 500 Transducers are acceptable for use in a Class I, Division 1, Group C and D hazardous locations using the barriers specified on Controlair drawing 431-990-013.

3.4.1 The FMRC Approved zener barriers, listed below, are used in series with all ungrounded signals from the nonhazardous area to the I/P controller. They are located in the nonhazardous area and restrict the voltage and current that can be applied to the transducer. No additional testing of the barriers is required.

<u>Barrier</u>	<u>Normal</u>	<u>One Fault</u>
MTL 4045	26.9 V at 89 mA	28.0 V at 93 mA
MTL 728	26.8 V at 89 mA	28.1 V at 93 mA
MTL 787S (each channel)	26.0 V at 86 mA	28.5 V at 93 mA
STAHL 9001/01-280-100-10	26.0 V at 95 mA	28.0 V at 100 mA
STAHL 9002/13-280-110-00	26.6 V at 104 mA	28.0 V at 109 mA

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3.4.2 Ignition test were conducted to verify the inability of the coil to cause ignition of a Group C test gas. The normal output of the Stahl Model 9002/13-280-110-00 barrier was used and one fault applied in the coil circuit with a 1.225 factor on loop current. The results were satisfactory in that no ignition occurred.

3.4.3 Creepage and Clearance Evaluation - Analysis revealed that the components which affect intrinsic safety meet the minimum requirement of 0.7 mm (0.028 in.) creepage and clearance for a coated printed circuit board that operates below 30 Vdc.

3.4.4 Temperature Evaluation - Analysis revealed that all components contained within the assembly with the exception of the coil, do not have a surface area greater than 10 cm² and are not subjected to a power greater than 1.2 W. Utilizing table A9.4.3 of FMRC Class Standard 3610 a temperature code of T4 applied to the label is satisfactory. The maximum temperature rise measured on the coil was less than 25 C° (77 F°), a T4 code is also satisfactory for this temperature.

3.4.5 Comparative Tracking Index (CTI) - The CTI of the printed circuit board laminate has a rating of 90 which meets the minimum of 90 required. This is satisfactory.

3.5 Nonincendive Evaluation - Nonincendive equipment acceptability is based on the inability of the device to release sufficient electrical or thermal energy under normal operating conditions to cause ignition of the specific hazardous atmospheres. Normal voltage and current input to the transmitter is specified by Controlair to be 30 Volts and 20 mAmps. The following tests verify the suitability of Model 500 I/P Transducer in Class I, Division 2 Group A, B, C and D hazardous locations.

3.5.1 Make/Break Evaluation - Analysis revealed that the 500 series transducers contain two accessible adjustment components, the span and zero adjustments. The zero is a mechanical adjustment and there is no interruption of the electrical circuit when operated. The span adjustment is a 1 Kohm potentiometer. The energy levels present on the wiper are incapable of causing ignition of a Group A/B test gas when compared to figure B1 of FMRC Class Standard 3611.

3.5.2 Temperature Tests - The temperature testing conducted in section 3.4.4 under fault conditions are more severe than the Division 2 normal conditions. Therefore the T4 Temperature marking is satisfactory.

3.5.3 Division 2 Installation Method - The manufacturer has specified on control drawing 431-990-013 that the transducers are to be installed in accordance with the National Electrical Code (NEC) Division 2 wiring methods. Barriers are not required.

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3.6 Class II Division 2 and Class III, Division 1 and 2 Evaluation - The following analysis verified the suitability of the Model 500 Transducer for Class II, Division 1, Groups F and G and Class III, Division 1 and 2, hazardous locations.

3.6.1 The transducer was examined assuming that dust could enter the enclosure and short out any or all electrical components. This was satisfactory for the ignition tests for Class I, Division 1, Group C as the transducer was tested with all components connected in the most unfavorable conditions.

3.6.2 The maximum surface temperature of any component was examined in section 3.4.4 with no component exceeding 165°C (329°F). This is satisfactory.

3.7 Protection From Electrical Shock - The series 500 Transducer enclosure were examined to ensure the units offer protection against electrical shock, injury or fire.

3.7.1 Protection from Accessible Live Parts - The transducers contain a tool removable cover which prevents the operator from coming in contact with energized circuitry.

3.7.2 Protective Ground - The transducer has a 10-32 screw for connection of a ground wire. All points of the transducer are mechanically connected with a resistance of less than 0.1 ohm, which is satisfactory.

3.7.3 Dielectric Voltage Withstand Test - A sample of series 500 transducers were subjected to a test potential of 707 Vdc which was applied between the input circuits connected together and ground. The results were satisfactory in that there was no breakdown when the voltage was applied for one minute.

3.7.4 Flammability Rating - The printed circuit boards have a flammability rating of 94V-0, which is satisfactory.

3.7.5 Process Pressure Assessment - Process pressure testing was not required. The maximum working pressure is below 300 psi (2067kPa).

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IV MARKING

4.1 Marking meets the standard requirements as stated below

Manufacturer's name, address, model number and date code

The statement: "Int. Safe Cl. I, II, III Div. 1, Gp C, D, E, F, G; Nonincendive Cl. I Div. 2, Gp A, B, C, D; Suitable Cl. II, Div. 2, Gp. F, G and Suitable for Cl. III Div. 1 & 2; per drawing 431-990-013

The Factory Mutual Research Corporation mark of Approval

V REMARKS

5.1 Manufacturer's instructions supplied with the protective assemblies as well as the system installation instructions and the National Electric Code (ANSI/NFPA 70) and ANSI/ISA RP12.6 must be followed when installing this equipment.

5.2 Control room equipment connected to associated apparatus should not use or generate more than the maximum voltage specified for the barrier.

5.3 Tampering or replacement with nonfactory components may adversely affect the safe use of the system.

5.4 The resistance between the shunt diode barrier ground and earth ground must be less than 1.0 ohm.

VI FACILITIES AND PROCEDURES AUDIT

The manufacturing site at Amherst N. H. was examined (first audit) with regard to facilities and quality control procedures and results were satisfactory in that the level of performance which produced the item which was tested was maintained.

VII MANUFACTURERS RESPONSIBILITIES

7.1 The documentation listed in Section VIII is applicable to this Approval and is on file at FMRC. No changes of any nature shall be made unless notice of the proposed change has been given and written authorization obtained from FMRC. The Approved Product - Revision Report, FMRC Form 797 shall be forwarded to FMRC as notice of proposed changes.

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7.2 The manufacturer shall supply the end user a copy of control drawing.

7.3 On 100% of production, the manufacturer shall conduct routine dielectric tests. The Transducers shall withstand for one minute, with no insulation breakdown, the application of 500 Vrms or 707 Vdc between the power input terminals connected together and the protective ground. Alternately, tests potentials of 860 Vrms or 1216 Vdc may be applied for at least one second.

VIII DOCUMENTATION

The following documentation is applicable to this Approval and is on file at Factory Mutual Research Corporation.

<u>Drawing Number</u>	<u>Revision</u>	<u>Title</u>
431-990-013	-	Interconnection Diagram
446-732-187	1	Label I.S. 500X Transducer
446-732-188	1	Label I.S. 500X Transducer
446-732-189	1	Label I.S. 500X Transducer
446-732-190	1	Label I.S. 500X Transducer
446-732-191	1	Label I.S. 500X Transducer
446-732-192	1	Label I.S. 500X Transducer
8001916	-	Schematic
8001910	-	Artwork
446-799-001	-	P.C. Board Assembly
463-772-001	-	Coil Specs
448-534-003	-	Magnet Ass'y

IX CONCLUSION

The apparatus described in Section 1.2 meet FMRC requirements. Approval is effective when the Approval Agreement is signed and received by FMRC.

EXAMINATION AND TESTS BY:

Robert T Burke

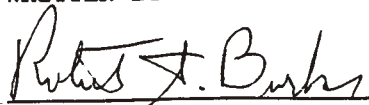
ATTACHMENTS

Mfg's Control Drawing 431-990-013

ORIGINAL TEST DATA:

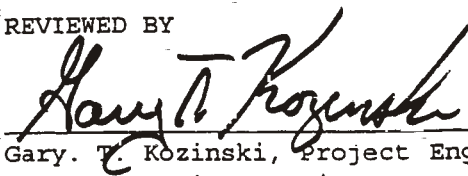
Project Data Record J.I 5Y6A8.AX

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