

APPROVAL REPORT

**TYPE TB82/ML82 AND TB84/ML84
PH AND CONDUCTIVITY 4-20 mA TRANSMITTERS AND ANALYZERS**

Prepared For:

**TBI-BAILEY CONTROLS
2175 LOCKHEED WAY
CARSON CITY, NV 89706**

**J.I. 3005229
(3611)
November 13, 1999**

Supersedes Report Dated: August 23, 1999

FACTORY MUTUAL



1151 Boston-Providence Turnpike
P.O. Box 9102
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3005229
(3611)

August 25, 1999

TYPE TB82/ML82 AND TB84/ML84
PH AND CONDUCTIVITY 4-20 mA TRANSMITTERS

from

TBI-BAILEY CONTROLS
2175 LOCKHEED WAY
CARSON CITY, NV 89706

I INTRODUCTION

1.1 TBI-Bailey Controls, has 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>No.</u>	<u>Issue Date</u>
Electrical Equipment for Use in Class I, Division 2 Class II, Division 2 and Class III, Division 1 and 2 Hazardous Locations	3611	April 1986
Electrical and Electronic Test Measuring, and Process Control Equipment	3810	March 1989
Electrical Equipment for Use in Hazardous (Classified) Locations General Requirements	3600	March 1989
Enclosures for Electrical	ANSI/NEMA 250	1991

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1.2 Listing - The following apparatus was evaluated as non-incendive for use in Class I, Division 2, applicable Groups A, B, C, and D; suitable for Class II, III, Division 2, Groups F and G hazardous indoor/outdoor (NEMA 4X) locations and will appear in the Approval Guide as follows:

aa84bb cdefghijk pH and Conductivity Transmitters

NI/I/2/ABCD/T5; S/II, III/2/FG/T5; Type 4X

- aa = TB for Advantage Series Transmitter
= ML for Multi Language Advantage Series Transmitter
- bb = Input
 - PH pH/ORP/PION
 - EC Four Electrode Conductivity
 - TE Two Electrode Conductivity
- c = Programming Options
 - 1 Basic; 2 Advanced
- d = Reserved for future use
- e = Reserved for future use
- f = Housing Type 0 Front Bezel
- g = Mounting Hardware
 - 0 None; 1 pipe; 2 Hinge; 3 Panel; 4 Wall
- h = Agency Approval
 - 1 Factory Mutual
- i = Identification Tag
 - 0 None; 1 Stainless Steel; 2 Mylar
- j = Language (ML version only)
 - 1 English; 2 German
- k = Keypad (ML version only)
 - 1 Tbl-Bailey; 2 Hartmann & Braun

II DESCRIPTION

2.1 The TB/ML84 Series transmitters are line powered analyzers which accept either a pH/ORP/PION sensor input (PH version), a two-electrode conductivity sensor input (TE version) or a four electrode conductivity sensor input (EC version) and provides two analog outputs proportional to the sensor input and three programmable relay outputs. These devices are similar in construction to the **82 Series transmitters Approved under J.I. 300671.

2.2 The construction of the **84 version is essentially the same as that of the **82 versions with the exception of a different power supply card which accepts a line powered input and has an interconnected relay board. A variation was also made to the securement of the front bezel window. All other aspects of the construction (e.g. enclosure, input board, μ P/Display board) remain the same

2.3 Revisions to the bezel assembly involve securing the window with a one-piece double-sided adhesive tape around the perimeter of the opening. The updated drawings are included in the Documentation File of this report.

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2.4 Other minor drawing updates have been included. Changes do not effect the previous evaluation of the **82 transmitters.

III EXAMINATION AND TESTS

3.1 General

Representative samples of the apparatus specified in Section 1.2, were examined and tested by Canadian Standards Association (CSA), under their File No. LR 53016-25, to determine acceptability for use in the specified hazardous locations. Examination and testing by CSA was conducted in accordance within the Factory Mutual Research Corporation (FMRC)/CSA Testing Agreement. CSA test results have been satisfactorily reviewed by FMRC and are attached to this report.

IV MARKING

Marking information was reviewed and found to meet standard requirements. Manufacturer's marking drawing E1924 is included as attachments to this Report.

V REMARKS

5.1 Installation shall be in accord with the manufacturer's instructions and the National Electrical Code (ANSI/NFPA 70).

5.2 Tampering and replacement with nonfactory components may adversely affect the safe use of the system.

VI FACILITIES AND PROCEDURES AUDIT

TBI-Bailey Controls, maintains design and manufacturing facilities in Carson City, NV; that is subject to follow-up audit inspections. The facilities and quality control procedures in place have been found satisfactory to manufacture product identical to that examined and tested as described herein.

VII MANUFACTURER'S RESPONSIBILITIES

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

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VIII DOCUMENTATION FILE

<u>Document No.</u>	<u>Revision</u>	<u>Description</u>
E1924	A	FM Nameplate
E1911	A	Universal nameplate (TB84PH)
E1912	A	Universal nameplate (ML84PH)
E1913	A	Universal nameplate (TB84EC)
E1914	A	Universal nameplate (ML84EC)
E1915	A	Universal nameplate (TB84TE)
E1916	A	Universal nameplate (ML84TE)
PO856	A	Nonincendive Sensor Listing
E1921	A	TB84 Nomenclature
E1922	A	ML84 Nomenclature
E1900	A	TB/ML 84 Final Assembly
E1714	D	Front Bezel assembly
E1932	A	PCB Interconnect diagram (xx84PH)
E1930	A	PCB Interconnect diagram (xx84EC)
E1933	A	PCB Interconnect diagram (xx84TE)
E1708	D	PH Input board, schematic
E1727	D	PH Input board, assembly
E1723	E	uP/Display board, assembly
E1724	C	uP/Display board, layouts
SC-17-1005	1	Power Supply board schematic
SD-17-1078	1	Power Supply board assembly
SD-17-1079	1	Power Supply board assembly instructions
SD-17-1084	1	Power Supply board panelization drawing
PO831	A	Two-Electrode Conductivity sensor anatomy
PO655	C	Four-Electrode Conductivity sensor anatomy
E1705	D	uP/ Display Board, Schematic

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FMRC J.I. 3005229

IX CONCLUSION

The apparatus described in Section 1.2 meets Factory Mutual Research Corporation requirements. Approval is granted when the Approval Agreement is signed and received by Factory Mutual Research Corporation.

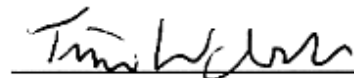
EXAMINATION AND TESTS BY: Ron Wildish, Canadian Standards Association

ORIGINAL DATA: Project Data Record 3005229
CSA Project No. LR 53016-25

ATTACHMENTS: CSA Test Report; File No. LR 53016-25
Manufacturer's Marking Drawing: E1924 rev. A

WRITTEN BY:

REVIEWED BY:



Timothy J. Walsh, Engineer
Instrumentation Section
Approvals Division



Peter T. Schimoeller, Project Engineer
Instrumentation Section
Approvals Division

**TYPE TB84/ML84
and Revised Construction
of
TYPE TB82/ML82
pH and CONDUCTIVITY 4-20 mA TRANSMITTERS
for
HAZARDOUS (CLASSIFIED) LOCATIONS**

Prepared For:

**TBI-BAILEY CONTROLS
2175 Lockheed Way
Carson City, NV 89706**

CSA FILE NO: LR 53016-25

FM J.I. Number: J.I. 3005229
(3611)

Prepared by: Ron Wildish
CSA Hazardous Location Product Team

Date: June 2, 1999

I INTRODUCTION

1.1 TBI-Bailey Controls 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>
Electrical Equipment for Use in Hazardous (Classified) Locations, General Requirements	FMRC 3600	March 1989
Electrical Equipment for Use in Class I, Div. 2, Class II, Div. 2 and Class III, Divisions 1 and 2 Hazardous Locations	FMRC 3611	April 1986
Electrical and Electronic Test, Measuring and Process Control Equipment	FMRC 3810	March 1989
Enclosures for Electrical Equipment (1000 V max)	NEMA Pub. 250	1991

1.2 The following equipment was examined as non-incendive for Class I, Division 2, Groups A,B,C and D; suitable for Class II, III, Division 2, Group F and G hazardous indoor/outdoor (NEMA 4X) locations.

aa84bb cdefghijk, where;

- aa = TB for Advantage Series Transmitter
 ML for Multi Language Advantage Series Transmitter
- bb = Input
 PH pH/ORP/PION
 EC Four Electrode Conductivity
 TE Two Electrode Conductivity
- c = Programming Options
 1 Basic; 2 Advanced
- d = Reserved
 for future use
- e = Reserved
 for future use
- f = Housing Type
 0 Front Bezel
- g = Mounting Hardware
 0 None; 1 Pipe; 2 Hinge; 3 Panel; 4 Wall
- h = Agency Approval
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II DESCRIPTION

- 2.1 The TB/ML84 Series transmitters are line powered analyzers which accept either a pH/ORP/PION sensor input (PH version), a two-electrode conductivity sensor input (TE version) or a four electrode conductivity sensor input (EC version) and provides two analog outputs proportional to the sensor input and three programmable relay outputs. These devices are similar in construction to the **82 Series transmitters approved in reports J.I. 300671.
- 2.2 The construction of the **84 version is essentially the same as that of the **82 versions with the exception of a different power supply card which accepts a line powered input and has an interconnected relay board. A variation was also made to the securement of the front bezel window. All other aspects of the construction (e.g. enclosure, input board, uP/Display board) remain the same.
- 2.3 Revisions to the bezel assembly involve securing the window with a one-piece double-sided adhesive tape around the perimeter of the opening. The updated drawings are included in the Documentation File of this report.
- 2.4 Other minor drawing updates have been included. Changes do not effect the previous evaluation of the **82 transmitters.

III EXAMINATION AND TESTS

- 3.1 Representative samples of the xx84 transmitters were examined and tested by CSA to determine their acceptability for use for the hazardous locations specified. The CSA examination consisted of circuit analysis, component tests, thermal analysis and tests, dielectric strength tests and a review of the manufacturer's documentation and the units physical construction. All were satisfactory and are summarized in the following sections. Appendix A contains the actual test data and evaluation notes.
- 3.2 Nonincendive Examination - Nonincendive equipment acceptability is based on the inability of the transmitters to release sufficient electrical or thermal energy under normal operating conditions to cause ignition of specific hazardous atmospheres.
 - 3.2.1 Power Supply Board - The power supply board circuitry does not contain any switches, relays or potentiometers. Fuse F101 is soldered directly to the pcb and is not accessible during normal operation. Connector J3 is mechanically secured and therefore the pull test was waived. TB1 and TB2, which connect to the feedthroughs to the terminal compartment, are mechanically secured by the display cover screws. A warning has been added to the markings to specify that power must be switched off or the area known to be nonhazardous prior to disconnecting the the equipment or opening the display cover. The input power rating is 110-240 VAC, 50/60 Hz, 17 VA and is specified on the Universal Nameplate.

The interconnected relay board contains relays, switches and fuses; but no potentiometers. Relays K301, K302 and K303 are manufactured by Potter & Brumfield, Type T75S5D112 and have previously been evaluated as sealed devices (Oven Aging and Solvent Vapor Exposure tests followed by an Air Leakage test) and determined suitable for Class I, Division 2 locations in Approval Report J.I. 0B5A4.AX. Fuses F301, F302 and F303 are soldered directly to the pcb and are not accessible during normal operation. Switches S301, S302 and S303 are used to set up the relay contacts as either normally open or normally closed. These switches can only be operated while the module is removed from the enclosure and therefore unpowered during this procedure.

- 3.2.2 Input Boards and uP/Display Board and Sensors - These components were previously evaluated as nonincendive with the **82 Series transmitters. The Power Supply board outputs to these circuits are the same and therefore, no further evaluation was considered necessary.
- 3.2.3 Temperature Test - Temperature tests were conducted on a sample transmitter in a 23°C ambient. The unit was powered with a suitable supply at 275 VAC, 50 Hz (determined by rating test to yield worst case power). The maximum measured surface temperature was 77°C on Q203. Corrected to 40°C, the resultant maximum temperature is less than 100°C.
- 3.2.4 Division 2 Installation Method - The transmitters are to be installed in accordance with the National Electrical Code (NEC) Division 2 wiring methods.
- 3.3 Class II and Class III Evaluation - The enclosure was previously evaluated in Approval report J.I. 300671. The Impact test was repeated on the display window to evaluate the alternative securement means.
- 3.3.1 Impact Tests - A representative sample was subjected to an impact from a 25 mm spherical steel tip at a 2.7 Joules magnitude. The impact was obtained by dropping a 4 lb (1.8kg) weight from a height of 6 inches (150mm) onto the display window. There was no damage to the enclosure or degradation of the joints that prevent dust from entering the enclosure.
- 3.4 NEMA Type 4X Evaluation - The enclosure was previously evaluated in Approval report J.I. 300671.
- 3.5 Protection from Electrical Shock Tests - The following tests verify the protection afforded by the **84 transmitters against electrical shock. The device is classified as Overvoltage Category II with a Pollution Degree 3. The terminal block material has a CTI value greater than 175 (Material Group III).
- 3.5.1 Dielectric Strength Test - The insulation of all power and relay contact circuits of the transmitter were tested at 1350 VAC. During the tests, the potential was held between the terminals and the protective ground, and between each set of terminals for one minute without arcing or dielectric breakdown of the insulation occurring. A test voltage of 500 VAC was also applied between the sensor terminals and the protective ground for one minute without arcing or dielectric breakdown of the insulation occurring. This is satisfactory.
- 3.5.2 Protective Grounding - A dedicated slotted screw with star washer and wire retainer is located adjacent to the field wiring terminal for use as the protective ground. The terminal is marked with Symbol 6 of Table I per ISA-S82.01, Section 5.1.6, b). The screw is threaded directly into the enclosure body. All accessible conductive parts of the transmitter that could otherwise become energized in the event of a fault are bonded to this point with a resistance of less than 0.1 ohms.
- 3.5.3 Protection from Accessible Hazardous Live Parts - There are no hazardous live parts accessible on the transmitter with tool-removable covers installed, when tested with the IEC rigid and articulated finger probes.
- 3.5.4 Spacings of Field Wiring Terminals - The creepage and clearance between each of the line, relay and sensor connection terminals and between those terminals and the enclosure exceeds the 6.3 mm required for field wiring terminals. This is satisfactory.
- 3.5.5 Protection Against Mechanical Hazards - Testing for protection against mechanical hazards was waived as the transmitters; 1) have no moving parts; 2) are for fixed installation; 3) have no provisions for lifting or carrying; and 4) have no parts likely to be expelled.

3.6 Mechanical Resistance to Shock, Vibration, and Impact

3.6.1 Rigidity Test - With the transmitter rigidly mounted, a force of at least 30 N was applied to the enclosures via a hard hemispherical rod of 12 mm diameter. No damage or distortion of the enclosure occurred. This is satisfactory.

3.6.2 Impact Test - The 0.5 J impact test was waived on the transmitter as the 2.7 J impact tests, as reported in paragraph 3.3.1 with satisfactory results, is a more severe test.

3.6.3 Vibration Tests - These tests were waived as they are not required per ANSI/ISA S82.01-1994. The US National Deviations take exception to the vibration test required in IEC 1010-1.

3.6.4 Drop Tests - These tests were not applicable as the transmitters are neither hand-held nor bench-top equipment.

3.7 Equipment Temperature Limits and Protection Against the Spread of Fire

3.7.1 Temperature Tests - These tests were waived as the Nonincendive temperature test, as reported in paragraph 3.2.3 was considered representative.

3.7.2 Field Wiring Compartment - Equipment is not marked for use in ambients higher than 40C and there was no temperature rise on the terminals in the terminal compartment.

3.7.3 Overcurrent Protection - Overcurrent protection is not required for this permanently connected equipment.

3.8 Resistance to Heat

3.8.1 Integrity of Clearances and Creepage Distances - The temperature rise of the transmitter under normal conditions will not compromise the integrity of the spacings.

3.8.2 Resistance to Heat of Non-Metallic Enclosures - Evaluation waived as the enclosures are metallic.

3.8.3 Resistance to Heat of Insulating Materials - The temperature ratings of the insulating materials employed are adequate for the applications.

3.9 Resistance to Moisture and Liquids - No additional testing was required as the transmitters comply with Enclosure Type 4X requirements as detailed in section 3.4.

3.10 Protection Against Radiation, Including Laser Sources, and Against Sonic and Ultrasonic Pressure - Testing was waived as these transmitters have no internal sources of these types of energy.

3.11 Protection Against Liberated Gases, Explosion, and Implosion - The transmitters are not a source of liberated gases and do not contain components likely to implode and cause injury.

3.12 Components - The transmitter does not use any motors, overtemperature protection devices, or mains connected devices.

3.13 Protection by Interlocks - The transmitter does not use any interlocks.

IV MARKING

Marking was examined and found to meet standard requirements. Manufacturer's marking drawing E1914 is included in the Documentation File.

V DOCUMENTATION FILE

<u>Document No.</u>	<u>Revision or Issue Date</u>	<u>Title</u>
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PO655	C	Four-Electrode Conductivity sensor anatomy




Canadian Standards Association

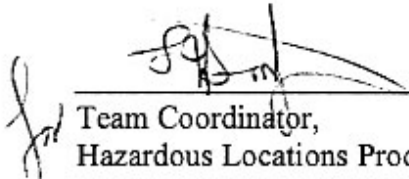
File LR 53016-25

FMRC Job Identification J.I. 3005229

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Hazardous Locations Product Group



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