APPROVAL REPORT

MODEL 600T
PRESSURE TRANSMITTER
FOR USE IN
HAZARDOUS LOCATIONS

Prepared for:

ABB Instrumentation Spa
Via Statale 113
Lenno (Co), I-22016

Project ID: 3012622
Class 3610, 3611, 3615
Date: December 10, 2001
I

INTRODUCTION

1.1 ABB Instrumentation Spa requested Approval of the apparatus listed in Section 1.5 to be in compliance with the applicable requirements of the following standards as explosionproof for Class I, Division 1, Groups A, B, C, and D and Dust-ignitionproof for Class II and III, Division 1, Groups E, F, G hazardous (classified) indoor/outdoor (Type 4X) locations; intrinsically safe (entity) for Class I, II, and III, Division 1, Groups A, B, C, D, E, F, and G hazardous (classified) indoor/outdoor (Type 4X) locations in accordance with drawing number 1H5-15-10067; nonincendive for Class I, Division 2, Groups A, B, C, and D; suitable for Class II, Division 2, Groups F and G; suitable for Class III, Division 2 with non-incendive field wiring circuits indoor/outdoor (Type 4X) hazardous (classified) locations.

1.2 This report supercedes Factory Mutual Research Approval Report 3006069 and any subsequent revision reports.

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

1.4 Standards

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1.5 Listing: The product will appear in the Approval Guide as follows

1.5.1 Model 6b1EefghijOlmnOp, Pressure Transmitter, Differential type

XP///1/ABCD; DIP/II,III/1/EFG/T6; Type 4X
IS///II,III/1/ABCDEFG/T3C Ta = 85°C; See Below; Entity: Type 4X
NI-ANI//I/2/ABCD; S/II,III/2/FG/T3C Ta = 85°C; See Below; Type 4X
ANI/I/2/ABCD

Entity Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0.013 μF, Li = 0.22 mH
Communication option P; Control Drawing 1H5-15-10067
Vmax = 15V, Imax = 208 mA, Pmax = 1.95 watts, Ci = 0, Li = 0
Communication option F; Control Drawing 1H5-15-10067
Vmax = 24V, Imax = 250 mA, Pmax = 1.2 watts, Ci = 0, Li = 0

Nonincendive Field Wiring Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0.013 μF, Li = 0.22 mH
Communication options P and F; Control Drawing 1H5-15-10067
Vmax = 32V, Imax = 400 mA, Ci = 0, Li = 0

b = Performance: 1, 2, 3, or 4
e = Measure type: D, E, H, G or A
f = Primary transducer upper range limit: A, B, P, C, N, D, T, E, G, F, W, U, M or Y
g = Isolating diaphragm material & Primary transducer fill fluid: 2, A, L, 3, B, N, 4, C, P, 5, 6, D, or R
i = Bolts & Gaskets: 1, 3, 4, 6, S, T, 7, A, or P
j = Mounting bracket: any alpha/numeric character
l = Communication: A, F, H, G, or P
m = Electrical certification: 8 (FM & CSA Approval)
n = Housing material: 1, A, 2, C, N, or H
o = Meter option: A, C, E, 1, 3, 5, 7, 8, 9, R, P, or W
p = Electrical options: 1, 3 or 5

1.5.2 Model 6b4EefghOjOlmnOp, Pressure Transmitter, Gauge type

XP///1/ABCD; DIP/II,III/1/EFG/T6; Type 4X
IS///II,III/1/ABCDEFG/T3C Ta = 85°C; See Below; Entity: Type 4X
NI-ANI//I/2/ABCD; S/II,III/2/FG/T3C Ta = 85°C; See Below; Type 4X
ANI/I/2/ABCD

Entity Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0.013 μF, Li = 0.22 mH
Communication option P; Control Drawing 1H5-15-10067
Vmax = 15V, Imax = 208 mA, Pmax = 1.95 watts, Ci = 0, Li = 0
Communication option F; Control Drawing 1H5-15-10067
Vmax = 24V, Imax = 250 mA, Pmax = 1.2 watts, Ci = 0, Li = 0

Nonincendive Field Wiring Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0.013 μF, Li = 0.22 mH
Communication options P and F; Control Drawing 1H5-15-10067
Vmax = 32V, Imax = 400 mA, Ci = 0, Li = 0

b = Performance: 1, 2, or 3

e = Measure type: G or A

f = Primary transducer upper range limit: J, V, F, W, K, S, D, E, G, N, T, or U

g = Isolating diaphragm & transducer fill fluid: 2, A, L, 3, B, N, 5, D or R

h = Process connection: 1, 3, A, C, 2, 4, 5, 6, 7, 8, B, D, E, F, J, or K

j = Mounting bracket: any alpha/numeric character

l = Communication: A, F, H, G, or P

m = Electrical certification: 8 (FM & CSA Approval)

n = Housing material: 1, A, 2, C, N, or H

o = Meter option: A, C, E, 1, 3, 5, 7, 9, R, P, or W

p = Electrical options: 1, 3 or 5

1.5.3 Model 6b1ESfghijklmnop, Pressure Transmitter, Differential type with Remote Seals

XP/I/I/ABCD; DIP/I/III/1/EFGF/T6; Type 4X
IS/I,II,III/1/ABCDFG/T3C Ta = 85°C; See Below; Entity; Type 4X
NI-ANI/I/2/ABCD; S/I,II,III/2/FG/T3C Ta = 85°C; See Below; Type 4X
ANI/I/2/ABCD

Entity Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0.013 μF, Li = 0.22 mH
Communication option P; Control Drawing 1I5-15-10067
Vmax = 15V, Imax = 208 mA, Pmax = 1.95 watts, Ci = 0, Li = 0
Communication option P; Control Drawing 1H5-15-10067
Vmax = 24V, Imax = 250 mA, Pmax = 1.2 watts, Ci = 0, Li = 0

Nonincendive Field Wiring Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0.013 μF, Li = 0.22 mH
Communication options P and F; Control Drawing 1H5-15-10067
Vmax = 32V, Imax = 400 mA, Ci = 0, Li = 0

b = Performance: 1, 2 or 3

f = Primary transducer upper range limit: B, P, C, N, D, T, E, G, F, W, U, A, or M

i = Isolating diaphragm material & Primary transducer fill fluid: 2, A, L, 3, B, N, 4, 5, C, or D

h = High pressure side process interface: 5, J, H, Q, U, F, K, Y, R, S, B, 2, 3, 6, 7, A, C, D, or E


j = Bolts & Gaskets: 1, 3, 0.4, 6, L, S, T, R, 7, A, N, or P

k = Mounting bracket: any alpha/numeric character

l = Communication: A, F, H, G, or P

m = Electrical certification: 8 (FM & CSA Approval)

n = Housing material: 1, A, 2, C, N or H

o = Meter option: 1, 3, 5, 7, 8, A, C, E, 9, R, P, or W

p = Electrical options: 1, 3 or 5
1.5.4 Model 6b4ESfghijOlmnop, Pressure Transmitter, Gauge type with Remote Seal

XP/I/I/1/ABCD; DIP/I,I/III/I/EFG/T6; Type 4X
IS/I,I,II,III/I/ABCDEF/F/T3C Ta = 85°C; See Below; Entity: Type 4X
NI-ANI/I/2/ABCD; S/II,III/2/FG/T3C Ta = 85°C; See Below; Type 4X
ANI/I/2/ABCD

Entity Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0.013 μF, Li = 0.22 mH
Communication option P; Control Drawing 1H5-15-10067
Vmax = 15V, Imax = 208 mA, Pmax = 1.95 watts, Ci = 0, Li = 0
Communication option F; Control Drawing 1H5-15-10067
Vmax = 24V, Imax = 250 mA, Pmax = 1.2 watts, Ci = 0, Li = 0

Nonincendive Field Wiring Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0.013 μF, Li = 0.22 mH
Communication options P and F; Control Drawing 1H5-15-10067
Vmax = 32V, Imax = 400 mA, Ci = 0, Li = 0

1.5.5 Model 622EDfghijOlmnop, Pressure Transmitter, Differential type for High Static Pressure

XP/I/I/1/ABCD; DIP/I,I,III/I/EFG/T6; Type 4X
IS/I,I,II,III/I/ABCDEF/G/T3C Ta = 85°C; See Below; Entity: Type 4X
NI-ANI/I/2/ABCD; S/II,III/2/FG/T3C Ta = 85°C; See Below; Type 4X
ANI/I/2/ABCD

Entity Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0.013 μF, Li = 0.22 mH
Communication option P; Control Drawing 1H5-15-10067
Vmax = 15V, Imax = 208 mA, Pmax = 1.95 watts, Ci = 0, Li = 0
Communication option F; Control Drawing 1H5-15-10067
Vmax = 24V, Imax = 250 mA, Pmax = 1.2 watts, Ci = 0, Li = 0

Nonincendive Field Wiring Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0.013 μF, Li = 0.22 mH
Communication options P and F; Control Drawing 1H5-15-10067
Vmax = 32V, Imax = 400 mA, Ci = 0, Li = 0

f = Primary transducer upper range limit: L, R, E or F
g = Isolating diaphragm material & Primary transducer fill fluid: 2 or 3
h = Process flange material: F, H, J, Q, R, or L
i = Bolts & Gaskets: 3, P, 1, R, F, or H
j = Mounting bracket: any alpha/numeric character
l = Communication: A, F, H, G, or P
m = Electrical certification: 8 (FM & CSA Approval)
n = Housing material: 1, A, 2, C, N, or H
o = Meter option: 1, 3, 5, 7, 8, A, C, E, 9, R, P, or W
p = Electrical options: 1, 3 or 5

1.5.6 Model 6b1EMfghijklmnop, Pressure Transmitter, Level type with Liquids Interface

XP/I/1/ABCD; DIP/II,III/1/EFG/ T6; Type 4X
IS/II,III/1/ABCDEFG/T3C Ta = 85°C; See Below; Entity; Type 4X
NI-ANI/I/2/ABCD; S/II,III/2/FG/T3C Ta = 85°C; See Below; Type 4X
ANI/I/2/ABCD

Entity Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 30V, Imax = 215 mA, Pmax = 1.62 watts, Ci = 0.013 μF, Li = 0.22 mH
Communication option P; Control Drawing 1H5-15-10067
Vmax = 15V, Imax = 208 mA, Pmax = 1.95 watts, Ci = 0, Li = 0
Communication option F; Control Drawing 1H5-15-10067
Vmax = 24V, Imax = 250 mA, Pmax = 1.2 watts, Ci = 0, Li = 0

Nonincendive Field Wiring Parameters:
Communication options A, H, or G; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0, Li = 0
Communication options A, H, or G with COMETER; Control Drawing 1H5-15-10064
Vmax = 42V, Imax = 250 mA, Ci = 0.013 μF, Li = 0.22 mH
Communication options P and F; Control Drawing 1H5-15-10067
Vmax = 32V, Imax = 400 mA, Ci = 0, Li = 0

b = Performance: 1 or 2
f = Primary transducer upper range limit: A, B, P, or M
g = Seal type: F or W
h = Process flange: 1, 2, 3, 4, 7, 8, A, C, J, K, L, M, Q, R, S, or T
i = Seal diaphragm and Fill fluid (High & Low pressure side): 2, A, 3 or B
j = Capillary length (Low pressure side): A, 1, B, 2, C, 3, D or 4
k = Bolts material: 0, L, N or R
l = Communication: A, F, H, G, or P
m = Electrical certification: 8 (FM & CSA Approval)
n = Housing material: 1, A, 2, C, N, or H
o = Meter option: 1, 3, 5, 7, A, C, E, 9, R, P, or W
p = Electrical options: 1, 3 or 5
II Description

2.1 The Model 600T series pressure transmitters are intended for the measurement of pressure and liquid levels. The Model 600T has four methods of transmitting the measured pressure data to the nonhazardous location, using HART protocol, Profibus, Foundation Fieldbus, or a standard 4-20 mA signal. The Model 600T also has an optional LCD display that can be integrally mounted (Not allowed with the Profibus and, Foundation Fieldbus versions).

2.2 The unencapsulated electronics is mounted in an explosion-proof/dust ignition-proof enclosure. The Model 600T enclosure has a tool secured access cover and has the ability for conduit connections.

2.3 The intrinsically safe analog and Hart versions operate on a supply of 30 Vdc. The intrinsically safe Profibus version operates on a supply of 15 Vdc. The intrinsically safe Foundation Fieldbus version operates on a supply of 24 Vdc. The explosion-proof, dust ignition-proof, and nonincendive versions operate on a supply of 10.5 to 42 Vdc.

2.4 The ambient operating temperature range of the Model 600T series is -40°C to 85°C.

III Examination and Tests

Representative samples of the Model 600T and its options were examined and tested by FMRC to determine acceptability as an explosion-proof, dust ignitionproof and intrinsically safe apparatus for use in the specified hazardous locations. The Model 600T was also examined for use in other specified hazardous locations. The examination was conducted under normal, one and two fault conditions with applicable factors and included circuit analysis, temperature measurements and component tests as well as a review of the manufacturer's documentation and the equipment'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.

3.1 Explosionproof Safety Evaluation

Suitability of the Model 600T transmitter as explosionproof for Class I, Division 1, Groups A, B, C, and D hazardous (classified) locations is based upon the Explosionproof Evaluation conducted under J.I. 3X1A3.AX. No further evaluation or testing is required.

3.2 Dust-Ignitionproof Evaluation

Suitability of the Model 600T transmitter as Dust-ignitionproof for Class II, Division 1, Groups E, F and G and Class III, Division 1 hazardous (classified) locations is based upon the Dust-ignitionproof Evaluation conducted under J.I. 3X1A3.AX. No further evaluation or testing is required.

3.3 Intrinsic Safety Evaluation (Entity)

The following examination verifies the Model 600T as suitable for Class I, Division 1, Groups A, B, C, D, E, F, and G hazardous (classified) locations.

3.3.1 Entity

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 Vt) 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 the combination may be connected.
3.3.2 Intrinsic Safety Evaluation (Class I), Analog & Hart Communications
Suitability of the Model 600T transmitter with analog or Hart Communications as intrinsic safe for Class I, Division 1, Groups A, B, C, and D hazardous (classified) locations is based upon the Intrinsic Safety Evaluation conducted under J.I. 3004140. No further evaluation or testing is required.

3.3.3 Intrinsic Safety Evaluation (Class I), Profibus
The following examination verifies the Model 600T Profibus pressure transmitter as suitable for Class I, Division 1, Groups A, B, C, and D hazardous (classified) locations.

3.3.3.1 Determination of Vmax and Imax, Profibus
The maximum input voltage, Vmax, input terminal connections of the Model 600T Profibus pressure transmitter is specified on the installation drawing as 15V. The maximum input current, Imax, to the input terminal connections of the Model 600T Profibus pressure transmitter is specified on the installation drawing as 208 mA. The maximum power available to the Model 600T Profibus pressure transmitter is specified not exceed 1.95 watts.

3.3.3.2 Determination of Ci, Profibus
Analysis of the Model 600T Profibus pressure transmitter circuitry detailed no capacitance across the input terminal connections. Analysis determined that more than two faults would be needed to place additional capacitors, found within the circuit, in parallel with the input terminals. Therefore, the maximum unprotected capacitance, Ci, of the input terminal connections of the Model 600T Profibus pressure transmitter will be identified as 0 μF.

3.3.3.3 Determination of Li, Profibus
Analysis of the Model 600T Profibus pressure transmitter circuitry detailed no inductance at the input terminal connections. Analysis determined that more than two faults would be needed to place additional inductance, found within the circuit, at the input terminals. Therefore, based on the design of the circuit, the maximum unprotected inductance, Li, of the input terminal connections of the Model 600T Profibus pressure transmitter will be identified as 0 mH.

3.3.3.4 Input Entity Parameters, Profibus
Based upon the unprotected capacitance and inductance values stated above in Sections 3.3.3.2 and 3.3.3.3 and the maximum input voltage and input current values specified above in Section 3.3.3.1, the maximum entity parameters for the input terminal connections of the Model 600T Profibus pressure transmitter will be stated as follows:

\[ V_{\text{max}} = 15\text{V}, I_{\text{max}} = 208\ \text{mA}, P_{\text{max}} = 1.95\ \text{watts}, C_i = 0, L_i = 0 \]

3.3.3.5 Installation, Profibus
The Model 600T Profibus pressure transmitter is supplied power through intrinsically safe barriers. The field wiring between the power source and the input terminal connections of the Model 600T Profibus pressure transmitter is intrinsically safe when installed in accordance with the control drawing, ABB Instrumentation document number 1H5-15-10067, and the National Electrical Code (ANSI-NFPA 70) using FMRC Approved barriers with a barrier fault power not to exceed 1.95 watts.

3.3.3.6 Capacitive Ignition Analysis, Internal, Profibus
The Model 600T Profibus pressure transmitter circuit was examined to determine if there was any capacitance that could be discharged, under fault conditions, at a potential high enough to ignite a Group A/B hazardous atmosphere. Numerous capacitors located throughout the encapsulated circuit board were analyzed, singularly and in parallel. Analysis determined that the capacitance available would not ignite a Group A/B hazardous atmosphere under normal or fault conditions.
3.3.3.7 **Inductive Ignition Analysis, Internal, Profibus**

The Model 600T Profibus pressure transmitter circuit was examined to determine if there were any inductors that could be discharged of energy under normal or fault conditions. There are no inductors within the pressure transmitter that may be considered as "unprotected". Analysis determined that energies stored, under the reference circuit conditions, would be incapable of igniting a Group A/B hazardous atmosphere.

3.3.3.8 **Protective Components, Profibus**

Components critical to maintaining intrinsic safety of the Model 600T Profibus pressure transmitter were found to operate at less than two-thirds of rating under fault. Current limiting resistors were of film-type construction. Blocking and clamping diodes featured redundancy.

3.3.3.9 **Temperature Evaluation, Profibus**

Analysis revealed that the maximum power that could be dissipated by any one component under normal, one and two fault conditions was less than 1 watt. Based on the table FMRC Standard 3610 Table A9.4.3, Assessment for T4 Classification According to Component Size and Ambient Temperature, a temperature classification of T4 is allowed with a maximum ambient of 80°C. A temperature code of T4 is required on the label for an ambient of 80°C and a temperature code of T3C is required on the label for an ambient of 85°C.

3.3.3.10 **Creepage and Clearance Assessment, Profibus**

Distances that affect intrinsic safety meet the requirements in accordance with Table 6.1 of FMRC Standard 3610 at the applicable circuit voltages.

3.3.3.11 **Comparative Tracking Index, Profibus**

The CTI for the printed circuit board insulation materials are satisfactorily specified by the manufacturer to be a minimum of 100.

3.3.4 **Intrinsic Safety Evaluation (Class I), Foundation Fieldbus**

The following examination verifies the Model 600T Foundation Fieldbus pressure transmitter as suitable for Class I, Division 1, Groups A, B, C, and D hazardous (classified) locations.

3.3.4.1 **Determination of Vmax and Imax, Foundation Fieldbus**

The maximum input voltage, Vmax, input terminal connections of the Model 600T Foundation Fieldbus pressure transmitter is specified on the installation drawing as 24V. The maximum input current, Imax, to the input terminal connections of the Model 600T Foundation Fieldbus pressure transmitter is specified on the installation drawing as 250 mA. The maximum power available to the Model 600T Foundation Fieldbus pressure transmitter is specified not exceed 1.2 watts.

3.3.4.2 **Determination of Ci, Foundation Fieldbus**

Analysis of the Model 600T Foundation Fieldbus pressure transmitter circuitry detailed no capacitance across the input terminal connections. Analysis determined that more than two faults would be needed to place additional capacitors, found within the circuit, in parallel with the input terminals. Therefore, the maximum unprotected capacitance, Ci, of the input terminal connections of the Model 600T Foundation Fieldbus pressure transmitter will be identified as 0 μF.

3.3.4.3 **Determination of Li, Foundation Fieldbus**

Analysis of the Model 600T Foundation Fieldbus pressure transmitter circuitry detailed no inductance at the input terminal connections. Analysis determined that more than two faults would be needed to place additional inductance, found within the circuit, at the input terminals. Therefore, based on the design of the circuit, the maximum unprotected inductance, Li, of the input terminal connections of the Model 600T Foundation Fieldbus pressure transmitter will be identified as 0 mH.
3.3.4.4 Input Entity Parameters, Foundation Fieldbus

Based upon the unprotected capacitance and inductance values stated above in Sections 3.3.4.2 and 3.3.4.3 and the maximum input voltage and input current values specified above in Section 3.3.4.1, the maximum entity parameters for the input terminal connections of the Model 600T Foundation Fieldbus pressure transmitter will be stated as follows:

\[ V_{\text{max}} = 24\, \text{V}, \quad I_{\text{max}} = 250\, \text{mA}, \quad P_{\text{max}} = 1.2\, \text{watts}, \quad C_I = 0, \quad L_I = 0 \]

3.3.4.5 Installation, Foundation Fieldbus

The Model 600T Foundation Fieldbus pressure transmitter is supplied power through intrinsically safe barriers. The field wiring between the power source and the input terminal connections of the Model 600T Foundation Fieldbus pressure transmitter is intrinsically safe when installed in accordance with the control drawing, ABB Instrumentation document number 1H5-15-10067, and the National Electrical Code (ANSI-NFPA 70) using FMRC Approved barriers with a barrier fault power not to exceed 1.2 watts.

3.3.4.6 Capacitive Ignition Analysis, Internal, Foundation Fieldbus

The Model 600T Foundation Fieldbus pressure transmitter circuit was examined to determine if there was any capacitance that could be discharged, under fault conditions, at a potential high enough to ignite a Group A/B hazardous atmosphere. Numerous capacitors located throughout the encapsulated circuit board were analyzed, singularly and in parallel. Analysis determined that the capacitance available would not ignite a Group A/B hazardous atmosphere under normal or fault conditions.

3.3.4.7 Inductive Ignition Analysis, Internal, Foundation Fieldbus

The Model 600T Foundation Fieldbus pressure transmitter circuit was examined to determine if there were any inductors that could be discharged of energy under normal or fault conditions. There are no inductors within the pressure transmitter that may be considered as "unprotected". Analysis determined that energies stored, under the reference circuit conditions, would be incapable of igniting a Group A/B hazardous atmosphere.

3.3.4.8 Protective Components, Foundation Fieldbus

Components critical to maintaining intrinsic safety of the Model 600T Foundation Fieldbus pressure transmitter were found to operate at less than two-thirds of rating under fault. Current limiting resistors were of film-type construction. Blocking and clamping diodes featured redundancy.

3.3.4.9 Temperature Evaluation, Foundation Fieldbus

Analysis revealed that the maximum power that could be dissipated by any one component under normal, one and two fault conditions was less than 1 watt. Based on the table FMRC Standard 3610 Table A9.4.3, Assessment for T4 Classification According to Component Size and Ambient Temperature, a temperature classification of T4 is allowed with a maximum ambient of 80°C. A temperature code of T4 is required on the label for an ambient of 80°C and a temperature code of T3C is required on the label for an ambient of 85°C.

3.3.4.10 Creepage and Clearance Assessment, Foundation Fieldbus

Distances that affect intrinsic safety meet the requirements in accordance with Table 6.1 of FMRC Standard 3610 at the applicable circuit voltages.

3.3.4.11 Comparative Tracking Index, Foundation Fieldbus

The CTI for the printed circuit board insulation materials are satisfactorily specified by the manufacturer to be a minimum of 100.
3.3.5 Intrinsic Safety Evaluation (Class II, III)
Acceptance for use in Class II and III, Division 1, Group E, F, and G hazardous locations is based upon acceptability for use in Class I, Division 1, Group C and D hazardous locations and the Dust-Ignitionproof evaluation for Class II, Division 1, Groups E, F, and G described above in the Section 3.2 and the temperature examination below.

3.3.5.1 Temperature Examination
The transmitters do not contain heat-producing components capable of elevating the external surface temperature above 165°C when referenced to the 85°C maximum ambient temperature rating. A temperature code marking is not required for Division 1, Class II and III installations.

3.4 Division 2 Evaluation (Class I)
The following examination verifies the Model 600T's suitability for Class I, Division 2, Groups A, B, C, and D hazardous (classified) locations.

3.4.1 Make/Break Evaluation
The pressure transmitter does contain user accessible make/break components. These are operator interface magnetic sensor switches located inside the tool secured enclosure and do not switch incendive levels.

3.4.2 Temperature Evaluation
The pressure transmitter circuitry was thermally analyzed at an operation of 32 Vdc. The pressure transmitter does not contain heat-producing components capable of elevating an internal surface temperature above 160°C when referenced to the 85°C maximum ambient temperature rating. A temperature code marking of T3C is required for Class I, Division 2 installation methods.

3.5 Nonincendive Field Wiring Evaluation (Division 2)
3.5.1 Nonincendive Field Wiring Evaluation, Analog & Hart Communications
Suitability of the Model 600T transmitter with analog or Hart Communications as suitable for nonincendive field wiring in Class I, Division 2, Groups A, B, C, and D hazardous (classified) locations is based upon the Nonincendive Field Wiring Evaluation conducted under J1. 3004140. No further evaluation or testing is required.

3.5.2 Nonincendive Field Wiring Evaluation, Profibus
The following examination verifies the Model 600T Profibus pressure transmitter as suitable for nonincendive field wiring in Class I, Division 2, Groups A, B, C, and D hazardous (classified) locations.

3.5.2.1 Determination of Vmax and Imax
The maximum input voltage, Vmax, to the Model 600T Profibus pressure transmitter is specified on the installation drawing as 32 Vdc. The maximum input current, Imax, to the pressure transmitter is specified on the installation drawing as 400 mA.

3.5.2.2 Determination of Ci, Profibus
Analysis of the Model 600T Profibus pressure transmitter circuitry determined that a fault would be needed to place additional capacitors, found within the circuit, in parallel with the input terminal connections. Therefore, the maximum unprotected capacitance, Ci of the Model 600T Profibus pressure transmitter's input will be identified as 0 µF.

3.5.2.3 Determination of Li, Profibus
Analysis of the Model 600T Profibus pressure transmitter circuitry determined that a fault would be needed to place additional inductance, found within the circuit, at the input terminal connections. Therefore, based on the design of the circuit, the maximum unprotected
inductance, Li of the Model 600T Profibus pressure transmitter’s input terminals will be identified as 0 mH.

3.5.2.4 Nonincendive Field Wiring Parameters, Profibus

Based upon the unprotected capacitance and inductance values stated above in Sections 3.5.2.2 and 3.5.2.3 and the maximum input voltage and input current values specified above in Section 3.5.2.1, the maximum nonincendive field wiring parameters will be stated as follows:

\[ V_{\text{max}} = 32 \text{V}, \quad I_{\text{max}} = 400 \text{mA}, \quad C_i = 0, \quad L_i = 0 \]

3.5.2.5 Installation Method, Profibus

The connections of the Model 600T Profibus pressure transmitter are non-incendive unless wire to an FMRC approved associated apparatus with non-incendive field wiring parameters (entity).

For connections not made to a FMRC approved associated apparatus with non-incendive field wiring parameters, it is required that installation be in accordance with the National Electrical Code (ANSI-NFPA 70) Division 2 hazardous (classified) location wiring techniques.

For connections made to a FMRC approved associated apparatus with non-incendive field wiring parameters, it is required that installation be in accordance with the control drawing (ABB Instrumentation document number 1H5-15-10067) and the National Electrical Code (ANSI-NFPA 70) Division 2 hazardous (classified) location non-incendive wiring techniques.

3.5.3 Nonincendive Field Wiring Evaluation, Foundation Fieldbus

The following examination verifies the Model 600T Foundation Fieldbus pressure transmitter as suitable for nonincendive field wiring in Class I, Division 2, Groups A, B, C, and D hazardous (classified) locations.

3.5.3.1 Determination of Vmax and Imax, Foundation Fieldbus

The maximum input voltage, \( V_{\text{max}} \), to the Model 600T Foundation Fieldbus pressure transmitter is specified on the installation drawing as 32 Vdc. The maximum input current, \( I_{\text{max}} \), to the pressure transmitter is specified on the installation drawing as 400 mA.

3.5.3.2 Determination of Ci, Foundation Fieldbus

Analysis of the Model 600T Foundation Fieldbus pressure transmitter circuitry determined that a fault would be needed to place additional capacitors, found within the circuit, in parallel with the input terminal connections. Therefore, the maximum unprotected capacitance, \( C_i \), of the Model 600T Foundation Fieldbus pressure transmitter’s input will be identified as 0 \( \mu \)F.

3.5.3.3 Determination of Li, Foundation Fieldbus

Analysis of the Model 600T Foundation Fieldbus pressure transmitter circuitry determined that a fault would be needed to place additional inductance, found within the circuit, at the input terminal connections. Therefore, based on the design of the circuit, the maximum unprotected inductance, \( L_i \), of the Model 600T Foundation Fieldbus pressure transmitter’s input terminals will be identified as 0 mH.

3.5.3.4 Nonincendive Field Wiring Parameters

Based upon the unprotected capacitance and inductance values stated above in Sections 3.5.3.2 and 3.5.3.3 and the maximum input voltage and input current values specified above in Section 3.5.3.1, the maximum nonincendive field wiring parameters will be stated as follows:

\[ V_{\text{max}} = 32 \text{V}, \quad I_{\text{max}} = 400 \text{mA}, \quad C_i = 0, \quad L_i = 0 \]
3.5.3.5 Installation Method, Foundation Fieldbus

The connections of the Model 600T Foundation Fieldbus pressure transmitter are incendive unless wire to an FMRC approved associated apparatus with non-incendive field wiring parameters (entity).

For connections not made to a FMRC approved associated apparatus with non-incendive field wiring parameters, it is required that installation be in accordance with the National Electrical Code (ANSI-NFPA 70) Division 2 hazardous (classified) location wiring techniques.

For connections made to a FMRC approved associated apparatus with non-incendive field wiring parameters, it is required that installation be in accordance with the control drawing (ABB Instrumentation document number 1H5-15-10067) and the National Electrical Code (ANSI-NFPA 70) Division 2 hazardous (classified) location non-incendive wiring techniques.

3.6 Division 2 Examination (Class II and III)

Acceptance of the Pressure Transmitter for use in Class II and III, Division 2, Groups F and G hazardous locations is based upon the Dust-Ignitionproof evaluation for Class II, Division 1, Groups E, F, and G described above in the Section 3.2 and the temperature examination below.

3.6.1 Temperature Examination

The transmitters operating at the maximum input parameters do not contain heat-producing components capable of elevating the external surface temperature above 165°C when referenced to the 85°C maximum ambient temperature rating. A temperature code marking is not required for Division 2, Class II and III installations.

3.7 Electrical Utilization Examination

Electrical utilization equipment acceptability is based on the ability of the equipment to minimize the risk of electrical shock, injury and fire. The following verifies that the Pressure Transmitter was found to meet the requirements of FMRC Standard Class number 3810.

3.7.1 Electrical Utilization Examination

The following examination verifies the Model 600T the ability of the equipment to minimize the risk of electrical shock, injury and fire.

3.7.1.1 Accessibility

The Pressure Transmitter contains a tool removable cover that prevents the operator from coming in contact with energized circuitry within the instrument.

3.7.1.2 Field Terminals Spacing

Measurements verified that the field wiring terminal spacing meets the minimum creepage and clearance requirements.

3.7.1.2.1 Field Terminals Marking

Markings satisfactorily identify field wire terminals within the Pressure Transmitter assembly.

3.7.1.3 Protective Ground

There is a protective grounding terminal is in the wiring compartment and there is also an external protective grounding terminal. All accessible parts of the enclosure that could become energized in the event of a fault are bonded to the ground with a resistance of less than 0.1 ohm.

3.7.1.4 Temperature Assessment

Analysis determined that the circuitry contains no heat generating components which are capable of raising the surface temperature of the components parts that can be touched above 100°C; cautionary marking on the label is not required.
3.7.1.5 Dielectric Voltage Withstand Test
Acceptance is based on the previous evaluation conducted in JI 3X1A3.AX. No further evaluation or testing is required.

3.8 Environmental Protection
Suitability of the Model 600T transmitter as Type 4X is based upon the environmental evaluation conducted under J.I. 3X1A3.AX. No further evaluation or testing is required.

IV MARKING
The following information appears on the apparatus identified in 1.5 and meets Standard requirements:

- Manufacturer’s name and manufacturing location.
- Type number
- Maximum input and output ratings
- Maximum ambient temperature
- Control Drawing Reference
- The Factory Mutual Research mark of Approval

V REMARKS
5.1 Installations shall comply with the relevant requirements of the latest edition of the National Electrical Code (ANSI/NFPA 70)

5.2 Installations shall comply with the latest edition the manufacturer’s instruction manual.

5.3 See ANSI/ISA RP12.6, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations for guidance on the installation of intrinsically safe apparatus and systems.

5.4 Control room equipment connected to intrinsically safe associated apparatus should not use or generate more than 250 V rms or DC.

VI FACILITIES AND PROCEDURES AUDIT
The manufacturing sites at ABB Instrumentation at 22016 Lenno, (CO) Italy, ABB Instrumentation at Warminster, PA, and ABB Kent-Taylor at Birla, India are 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.

VII MANUFACTURERS RESPONSIBILITIES
7.1 Documentation considered critical to this Approval is on file at Factory Mutual Research 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 Factory Mutual Research. The Approved Product Revision Report, Form 797, shall be forwarded to Factory Mutual Research as notice of proposed changes.

7.2 The manufacturer shall make available to users of the subject equipment installation drawing 1H5-15-10067. The manufacturer shall make additional copies available upon request.

7.3 On 100% of production, the manufacturer shall conduct routine dielectric tests. Pressure Transmitter shall withstand for one minute, with no insulation breakdown, the application of 500 Vrms, 45 to 60 Hz., or 707 Vdc between supply power connections and the protective ground terminal. Alternatively, test potentials of 600 Vrms, 45 to 60 Hz., or 848 Vdc may be applied for at least one second.
WARNING: The dielectric test required may present a hazard of injury to personnel and/or property and should only be performed under controlled conditions, and by persons knowledgeable of the potential hazards of such testing to minimize the likelihood of shock and/or fire.

VIII DOCUMENTATION FILE

The following documentation is applicable to this equipment and has been added to the existing documentation files at Factory Mutual Research under J.I. # 3004140, 3002694, and 3X1A3.AX. 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. The Approved Product - Revision Report, Factory Mutual Research From 797, shall be forwarded to Factory Mutual Research as notice of proposed changes.

The following drawings describe the Model 600T Pressure Transmitter and are filed under J.I. 3003067 an 3006069

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<th>Document No.</th>
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<td>1H5-15-10067</td>
<td>11-15-2000</td>
<td>Control Drawing</td>
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<tr>
<td>AN 0600</td>
<td>01</td>
<td>Foundation Fieldbus/Profibus: board &quot;µP&quot;</td>
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<td>1H5-15-01730</td>
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<td>Label Drawing</td>
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IX CONCLUSION

The apparatus described in Section 1.5 meets FMRC requirements. Approval is granted when the Approval Agreement is signed and received by FMRC.

EXAMINATION AND TESTS BY: S. Sylvia

PROJECT DATA RECORD: PDR 3012622

ORIGINAL TEST DATA: PDR 3012622, 3003067, 3004140, 3002694, and 3X1A3.AX

ATTACHMENTS: Control Drawing 1H5-15-10067, Label Drawing 1H5-15-01730 issue 11-15-200

REPORT BY: Stephen A. Sylvia, Engineer  
Electrical Section  
Approvals Division

REPORT REVIEWED BY: R. Menot, Project Engineer  
Electrical Section  
Approvals Division