Div 1
I.S. HazardPRO Node
USERS MANUAL
(with I.S. Control Drawing)

HazardPRO™
Wireless Hazard Monitoring
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ELECTRO•SENSORS

Sensor Connectors
(Intrinsically Safe Circuits)

1 BEARING S/W
4 BEARING N/E
2 ALIGNMENT Belt In S/W
5 ALIGNMENT Belt In N/E
3 ALIGNMENT Belt Out S/W
6 ALIGNMENT Belt Out N/E
A AMBIENT S/W
B AMBIENT N/E
7 SPEED
8 CONTACT

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Symbols used in this document / Symboles utilisés dans le présent document

⚠️ Indicates CAUTION, risk of danger and precedes specific WARNING statements in this document. Obey all such warnings for safe use.

⚠️ Indique ATTENTION , risque de danger et précède mises en garde particulières dans ce document. Respectez tous ces avertissements pour une utilisation sûre .

Contents

Figures

1. Description

The battery-powered Div 1 I.S. HazardPRO Node is the sensor-input building block for HazardPRO Hazard Monitor Systems, providing intrinsically safe connector terminals for 10 HazardPRO (and compatible) sensors (8 temperature, 1 shaft speed, 1 switch contact) and an antenna (external antenna model only).

Nodes power their sensors, acquire their signals and transmit to the System Manager via wireless 802.15.4 network.

2 models: Div 1 I.S. HazardPRO Node (with internal antenna)   P/N   800-012007   (Fig. 1, 3, 4, 8)
           Div 1 I.S. HazardPRO Node (for external antenna)   P/N   800-012008   (Fig. 1, 3, 4, 8)

Fig. 2   HazardPRO system diagram
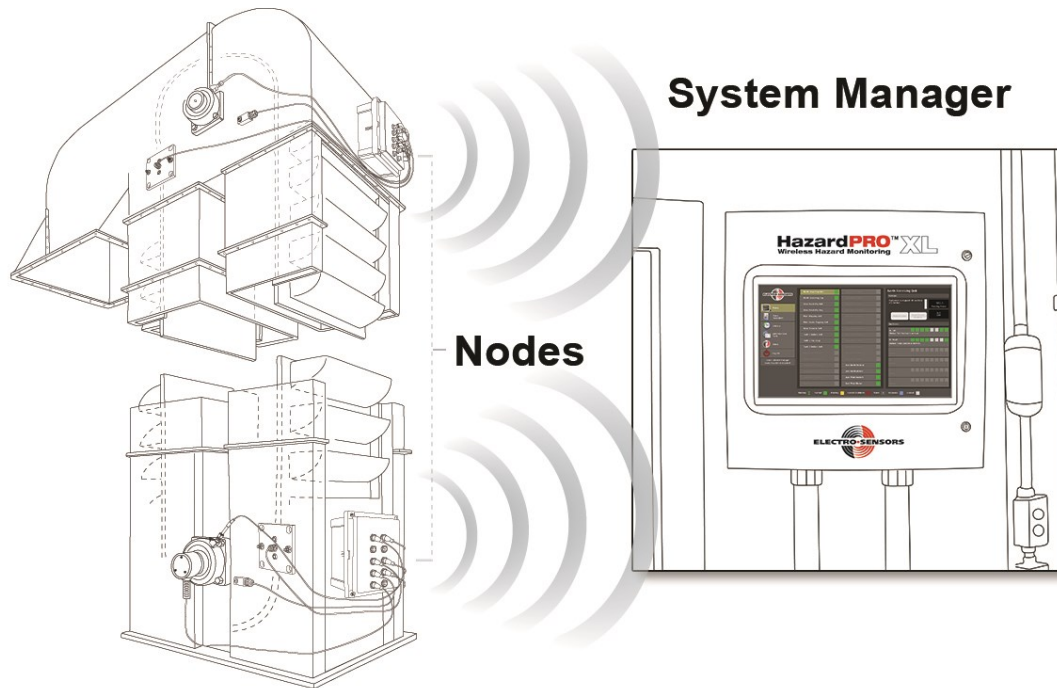
2. Model selection and installation planning

See the HazardPRO System Planning Guide 990-006400 for guidance:

2.1   Select the appropriate model for the operating location (Site Survey).
2.2   Determine the installation location and orientation for optimal wireless signal strength (Site Survey).
       Allow adequate space to view and access the calibration target (4.8, Fig. 4).

3. Pre-installation configuration

Requires a PC (or other device) running the Node Setup & Diagnostics (or other compatible) application and a Node RS232 Cable (9, Fig. 5). See the HazardPRO System Setup/Maintenance Guide 990-006500.

Do the following in a dry, clean location, away from explosive concentrations of dust:

⚠ WARNING – DO NOT OPEN THE ENCLOSURE WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.
⚠ AVERTISSEMENT - NE PAS OUVRIR LE COFFRET QUAND UN PRÉSENCE D'ATMOSPHÈRE EXPLOSIVE.

3.1   Loosen the 2 captive front-panel screws and open the enclosure door (Fig. 1, Fig 3).
3.2   Set the internal power switch to ON (GREEN STATUS LED should quickly turn ON, then OFF).
3.3   Connect the PC (or other device) to the node USER jack (Fig. 3) using a Node RS232 cable(9, Fig. 5), start the application and establish communications with the Node.
3.4   Configure wireless communications per 6.1.
3.5   Configure the temp measurement period and the temperature transmit thresholds per 6.2 and 6.3.
3.6   Configure and calibrate speed measurement and set the speed transmit thresholds per 6.4 → 6.6.
3.7   With all sensors bypassed, establish and verify wireless communications at the System Manager.
3.8   Close the enclosure door and tighten the captive front-panel screws until they stop.

⚠ WARNING – FAILURE TO CLOSE/TIGHTEN THE DOOR INVALIDATES CLASS II EXPLOSION PROTECTION.
⚠ AVERTISSEMENT - NE PAS SERRER NULLE LA PORTE PROTECTION CONTRE LES EXPLOSIONS CLASSE II.

4. Installation

Do the following:

4.1 Attach the mounting brackets to the node (Fig. 8, Fig. 9).

4.2 Position, orient and attach the pre-commissioned node for operation per 2.2.
Note: Allow adequate space under the node to view and access the calibration target (Fig. 4).

4.3 (If applicable,) position, orient and attach the external antenna for operation per 2.2 and connect the antenna cable to the node antenna connector (Fig. 8).

4.4 Establish and verify wireless communications with the System Manager.

4.5 Connect sensors to the node according to the connector labels (Fig 1).

4.6 Cap-off unconnected sensor connectors.

4.7 Verify sensor operation.

4.8 Calibrate the shaft speed per 6.5.

NOTE Do not allow dust or moisture to enter the node enclosure.
Keep the node insides clean, dry and the door CLOSED tight. Failure to do so will cause node/battery failure and void the warranty. Do not over-tighten the captive screws.
Do not drill, cut or in any way modify the node. Doing so will void the warranty.
Using the node in an unspecified manner may impair protection.

5. Battery replacement

See the HazardPRO System Setup/Maintenance Guide 990-006500 for information regarding discharged battery alerts and battery replacement.
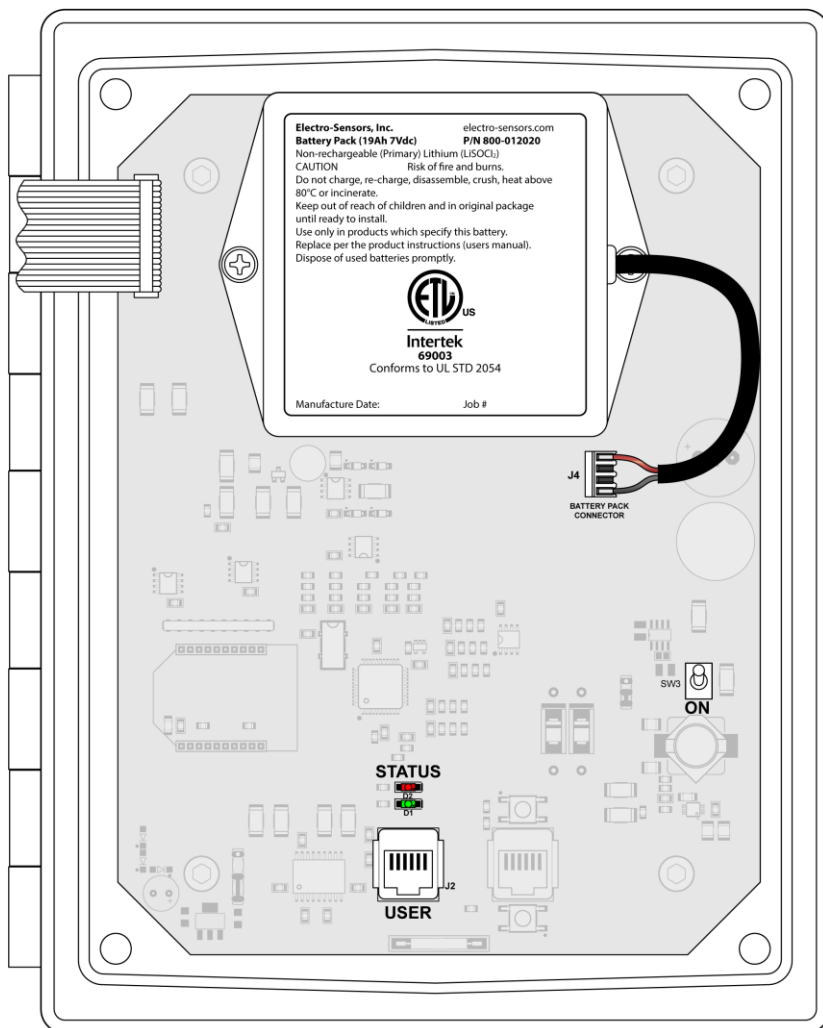
⚠ WARNING – DO NOT OPEN THE ENCLOSURE WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.

⚠ AVERTISSEMENT - NE PAS OUVRIR LE COFFRET QUAND UN PRÉSENCE D'ATMOSPHÈRE EXPLOSIVE.

⚠ WARNING – Risk of fire. INSTALL Electro-Sensors Battery Pack (19Ah 7Vdc) P/N 800-012020 ONLY (Fig. 6).

⚠ AVERTISSEMENT - RISQUES D'INCENDIE. INSTALLER Electro-Sensors Battery Pack (19Ah 7Vdc) P/N 800-012020 SEULEMENT (Fig. 6).
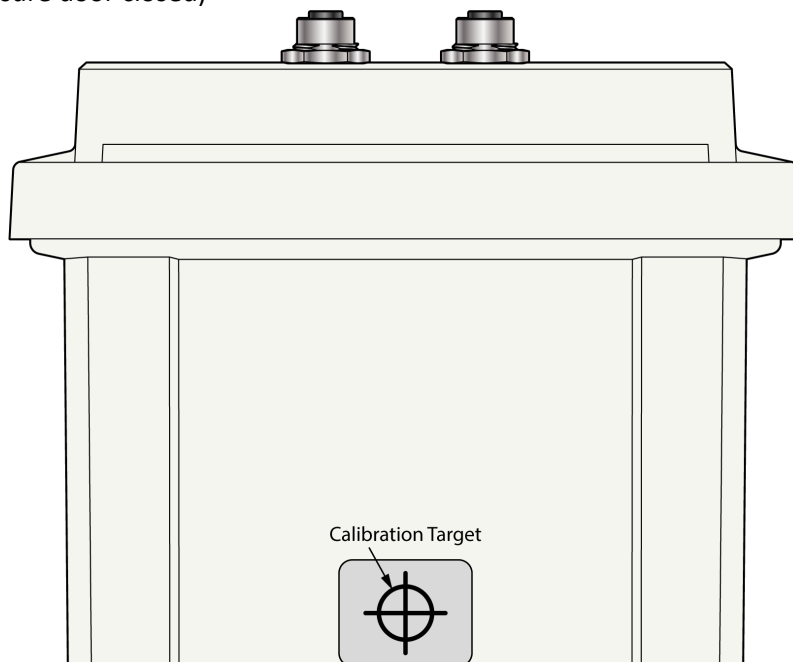
Do the following:

5.1 Loosen the 2 captive front-panel screws and open the enclosure door.

5.2 Set the internal power switch to OFF (Fig. 3).

5.3 Unplug the battery cable connector from the PCB battery pack connector header (Fig. 3).

5.4 While supporting the discharged battery, loosen and remove the battery screws and set them in a safe place.

5.5 Remove the discharged battery, taking care to not touch or damage pcb components.

5.6 Position the new battery within white battery pack border, insert the screws and engage them by hand.

5.7 Tighten the screws to firmly secure the battery. Do not over-tighten.

5.8 Orient and align the battery cable connector and plug it onto the PCB battery pack connector header as shown (Fig. 3).

5.9 Set the power switch to ON (GREEN STATUS LED should turn ON for less than 1S, then OFF)(7).

5.10 Close the enclosure door and tighten the captive front-panel screws until they stop. Do not over-tighten.

⚠ WARNING – FAILURE TO CLOSE/TIGHTEN THE DOOR INVALIDATES CLASS II EXPLOSION PROTECTION.

⚠ AVERTISSEMENT - NE PAS SERRER NULLE LA PORTE PROTECTION CONTRE LES EXPLOSIONS CLASSE II.

5.11 Dispose of the discharged battery promptly.

5.12 Establish and verify wireless communications with the System Manager.

5.13 Verify sensor operation.

NOTE Do not allow dust or moisture to enter the node enclosure.
Keep the node insides clean, dry and the door CLOSED tight. Failure to do so will cause node/battery failure and void the warranty. Do not over-tighten the captive screws.
Do not drill, cut or in any way modify the node. Doing so will void the warranty.
Using the node in an unspecified manner may impair protection.

Fig. 3   Internal view (enclosure door open)

Electro-Sensors, Inc.   electro-sensors.com
Battery Pack (19Ah 7Vdc)   P/N 800-012020
Non-rechargeable (Primary) Lithium (LiSOCl$_2$)
CAUTION   Risk of fire and burns.
Do not charge, re-charge, disassemble, crush, heat above
80°C or incinerate.
Keep out of reach of children and in original package
until ready to install.
Use only in products which specify this battery.
Replace per the product instructions (users manual).
Dispose of used batteries promptly.

ETL
US

Intertek
69003
Conforms to UL STD 2054

Manufacture Date: Job #

J4
**BATTERY PACK
CONNECTOR**

SW3
ON

STATUS
D1

USER
J2

Fig. 4   Bottom view (enclosure door closed)

Calibration Target

6. Parameters and configuration

The configuration parameters are non-volatile, writeable settings for configuring the node.
The diagnostic parameters are read-only and provide useful information.
All parameters are accessible using a PC (or other device) running the Node Setup & Diagnostics (or other compatible) app connected to the node USER jack (8.4, Fig. 3) with a Node RS232 cable (9, Fig. 5).

Configuration parameters (writable)

Parameter	Factory default	Settable range	Notes
ChannelPrimary	Channel_A	Channel_A … Channel_D	Primary receiver channel
ChannelSecondary	Channel_D	Channel_A … Channel_D	Secondary receiver channel
Destination	0	0 - 99	Receiver or repeater ID (within PAN)
DualReceiverMode	True	True, False	Set True for 2 System Mgr. gateways
HeartbeatInterval	60S	30 – 60S	Heartbeat message transmit period
PanID	1	1 - 99	Network PAN ID
ID		1 - 96	Node ID (within PAN)
MagnetCount	1	1 – 4	Speed pulser target # magnets
PctChange0_80Dec	20%	5 – 35%	Speed < 80% cal: % decrease for xmit
PctChange0_80Inc	10%	5 – 35%	Speed < 80% cal: % increase for xmit
PctChange80_100	5%	5 – 8%	Speed ≥ 80% cal: % change for xmit
DeltaTemperatureTx	7°F	2 - 20°F	Temperature °F change for xmit
ReadInterval	12S	5 – 30S	Temperature, internal volts meas. period
ClearCalibration	False	(momentary)True, False	True un-calibrates speed

Diagnostic parameters (read-only)

Parameter	Factory default	Description
SerialNumber	<unique code>	Unique serial#
CompileDate	<n.a>	Node firmware date (factory use)
CompilerVersion	<n.a>	Node firmware tools info (factory use)
FileVersion	<n.a>	Firmware version I.D. (factory use)
SoftwareID	<n.a>	Node data structure I.D. (for wireless receiver)
Calibrated	False	Indicates if speed is calibrated (True, False)
Calibrated_RPM	0	Measured calibration RPM (if Calibrated = True)

6.1   Configuring wireless communications

PanID   Set to match the primary gateway Pan ID setting.
Destination   Set to match the receiver (gateway) or repeater ID setting.
ID   Set to a unique number (different from all nodes with the same PanID).
ChannelPrimary   Set to match the corresponding primary gateway channel setting.
HeartbeatInterval   (factory default setting is recommended)
                                 Sets the heartbeat data transmission (8.3, 8.3.2) period (in seconds).
                                 Lower settings increase the data transmit rate at the cost of proportionately increased battery power consumption.
DualReceiverMode   If a secondary gateway is used , set to True; if not, set to False.
ChannelSecondary   If a secondary gateway is used, set to match the corresponding secondary gateway channel setting.

6.2   Temperature measurement period

ReadInterval   (factory default setting is recommended)
                                 Sets the temperature measurement period (in seconds).
                                 All 8 temperature measurements are taken together, with ReadInterval seconds between each successive group. Setting ReadInterval lower makes the node more responsive (more frequent measurements) to temperature changes at the cost of marginally increased battery power consumption.

6.   Parameters and configuration (cont.)

6.3   Temperature change transmit threshold (factory default setting is recommended)
DeltaTemperatureTx   See 8.3.1 for an explanation of what DeltaTemperatureTx does and how it works.

6.4   Configuring shaft speed measurement
 MagnetCount   Set to the number of sensor pulser target magnets.

6.5   Calibrating shaft speed
Calibration measures the shaft speed, saves it in Calibrated_RPM, sets Calibrated = True and enables speed-change initiated data transmits (8.3.1).
There are two calibration methods:

6.5.1   Automatic calibration
If not calibrated (Calibrated = False), the node automatically calibrates to the first 16 consecutive unchanging speed measurements (10 RPM or more).

6.5.2   Manual calibration
Each node comes with a ½ inch permanent magnet for activating an internal calibration switch from outside the node. Store this magnet in a safe place, away from the node.
With the shaft turning at stable, normal operating speed (10 RPM or more), hold the magnet inside the Calibration Target (Fig. 4), against the node housing for at least 3 seconds, and then remove it.
The node calibrates to the next shaft speed measurement (8.1.2).

To enable automatic calibration, the node must first be un-calibrated (Calibrated_RPM = 0, Calibrated = False).
ClearCalibration   Set True to un-calibrate the node (Calibrated = False).
                                        The True setting is momentary (ClearCalibration immediately resets back to False).

6.6   Shaft speed transmit thresholds (factory default settings are recommended)
PctChange80_100   See 8.3.1 for an explanation of what this threshold does and how it works.
PctChange0_80Dec   See 8.3.1 for an explanation of what this threshold does and how it works.
PctChange0_80Inc   See 8.3.1 for an explanation of what this threshold does and how it works.

7.   Internal STATUS LEDs (Fig. 3)

Power-ON or RESET (internal switch, Fig. 3):

7.1   The D1(Green) LED turns ON and stays ON during the boot-up sequence (configuring the 802.15.4 radio).

7.2   If the boot-up sequence fails (e.g. a faulty or unplugged internal 802.15.4 radio), D1(Green) turns OFF after 10S, then D2(Red) flashes 3S ON / 3S OFF for 15S (indicating an error) then the boot sequence (7.1) repeats.

7.3   When the boot-up sequence successfully completes, D1(Green) turns OFF and the node transmits a special "ping" message to the system manager gateway(s).
If an acknowledge is received, the node immediately enters normal operation (7.4).
If no acknowledge is received, D2(Red) turns ON for 1S, then OFF and the node enters normal operation (7.4).

Normal operation:

7.4   D1(Green) quickly flashes ON-OFF during each data packet transmit (heartbeat or sensor initiated , 8.3).
If no acknowledge is received from the System Manager gateway(s), D2(Red) quickly flashes ON-OFF (8.3.3).

7.5   If the internal 802.15.4 radio becomes unresponsive to node commands to transmit, D2(Red) flashes 3S ON / 3S OFF for 15S (indicating an error), then the node attempts the boot-up sequence (7.1).

8.   Operation

8.1   Sensor measurements
    8.1.1   All temperature sensor temperatures are measured at a constant rate set by ReadInterval. Unused (no connected sensor) temperatures measure -50°F.
    8.1.2   Shaft speed is measured each time a pulser target magnet passes the shaft speed sensor. When unused (no connected sensor) the measured shaft speed is 0 RPM.
    8.1.3   The switch contact state (open/closed) is detected every 3S. When unused (no connected switch), the state is OPEN.

Measurement	Connector (Fig.1)	Meas. range, units	Notes
Bearing S/W	1 (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Alignment Belt In S/W	2 (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Alignment Belt Out S/W	3 (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Ambient S/W	A (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Bearing N/E	4 (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Alignment Belt In N/E	5 (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Alignment Belt Out N/E	6 (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Ambient N/E	B (temp. sensor)	-49 → 302°F	Unconnected (no sensor) measures -50°F
Speed	7 (speed sensor)	8 → 500 RPM	< 8RPM and unconnected measures 0 RPM
Contact	8 (switch)	Open, Closed	Unconnected (no switch) measures Open
Battery V	(internal)	0 → 15V	See 8.2
Temp. sens. power V (VBOOST)	(internal)	0 → 15V	See 8.2

8.2   Internal measurements
The battery volts and temperature sensor power volts (VBOOST) are measured every ReadInterval seconds.

8.3   Wireless data transmissions
The Node transmits data packets containing the most recent measurement, diagnostic (and other) data to the System Manager gateway(s). Each packet contains all data, regardless of which mechanism or sensor measurement initiates the transmission.

3 mechanisms initiate transmissions:
    8.3.1   Sensor measurements (measurement changes crossing pre-set thresholds)
When the shaft speed is less than 80% of Calibrated_RPM, a speed decrease of PctChange0_80Dec of Calibrated_RPM (or more) from the previous speed, or a speed increase of PctChange0_80Inc of Calibrated_RPM (or more) from the previous speed initiates a transmission.
When the shaft speed is at least 80% of Calibrated_RPM , a speed change of Pcthange80_100 of Calibrated_RPM (or more) from the previous speed initiates a transmission.
A temperature change of DeltaTemperatureTx (or more) from the previous temperature initiates a transmission.
A switch contact state change always initiates a transmission.
    8.3.2   Heartbeats
An internal timer initiates packet transmissions HeartbeatInterval seconds after the previous transmission.
Heartbeat transmissions always occur, independent of measurements and thresholds, ensuring a minimum data packet rate from the Node to the System Manager gateway(s).
    8.3.3   Re-tries
After transmitting a packet, the node listens for an acknowledgement from the System Manager gateway(s). If none is received, a re-try mechanism is invoked and (depending on the number of prior re-tries) a replacement packet may be transmitted.

8. **Operation** (cont.)

8.4   RS232 data port
The internal USER RJ12 jack (Fig. 3) is an RS232 port (DCE) connector for accessing configuration and diagnostics parameters (6). The communications protocol is proprietary, requiring a PC (or other device) running the Node Setup & Diagnostics (or other compatible) application.

Note: An RS232 data connection to a PC (or other device) increases node power demand which in turn lowers the Battery and Temp sensor power voltages for the duration of the connection.
These lower voltages don't otherwise affect node operation but are not representative of normal (wireless) operation and shouldn't necessarily be interpreted as indicating an exhausted (or nearly exhausted) battery. Both voltages return to their previous levels after the connection is terminated.

NOTE   Do not allow dust or moisture to enter the node enclosure.
Keep the node insides clean, dry and the door CLOSED tight. Failure to do so will cause node/battery failure and void the warranty. Do not over-tighten the captive screws.
Do not drill, cut or in any way modify the node. Doing so will void the warranty.

9. **Accessories and related equipment**

HazardPRO Node Setup & Diagnostics   Windows application (for configuration)   P/N   800-012004

Fig. 5   **HazardPRO Node RS232 cable**   DB9(F) to RJ12, 25ft cable (for configuration)   P/N   800-012906
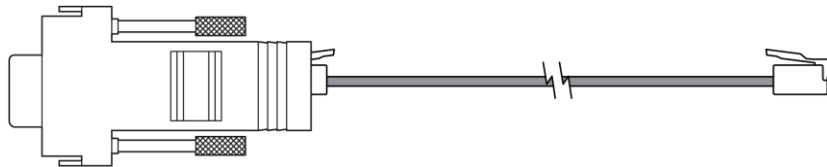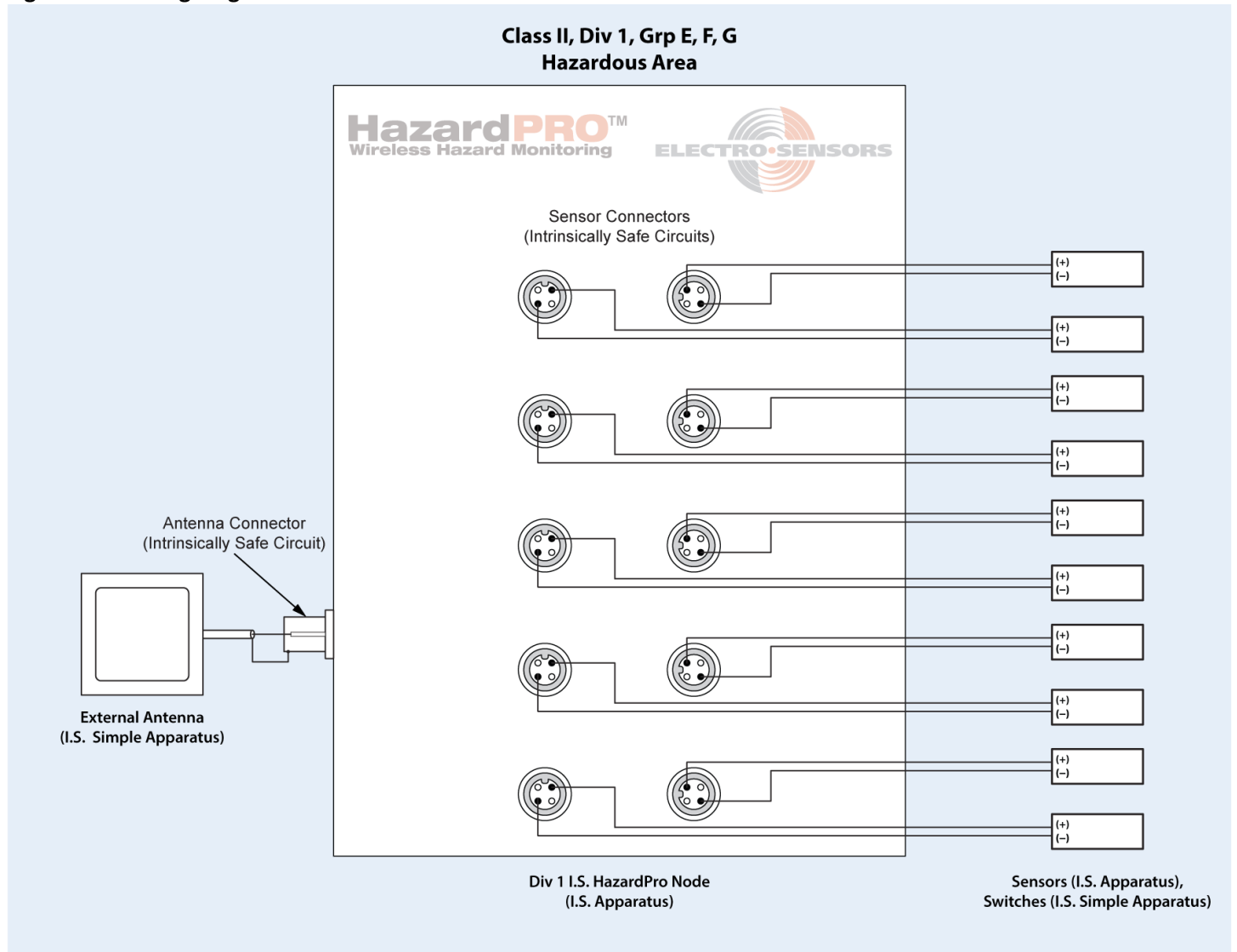

Fig. 6   **Battery Pack (19Ah 7Vdc)**   HazardPRO Node replacement battery   P/N   800-012020

Electro-Sensors, Inc.   electro-sensors.com
Battery Pack (19Ah 7Vdc)   **P/N 800-012020**
Non-rechargeable (Primary) Lithium (LiSOCl$_2$)
CAUTION   Risk of fire and burns.
Do not charge, re-charge, disassemble, crush, heat above 80°C or incinerate.
Keep out of reach of children and in original package until ready to install.
Use only in products which specify this battery.
Replace per the product instructions (users manual).
Dispose of used batteries promptly.

ETL LISTED US

Intertek
69003
Conforms to UL STD 2054

Manufacture Date: Job #

## 10.	I.S. Control Drawing

**Fig. 7	I.S. wiring diagram**

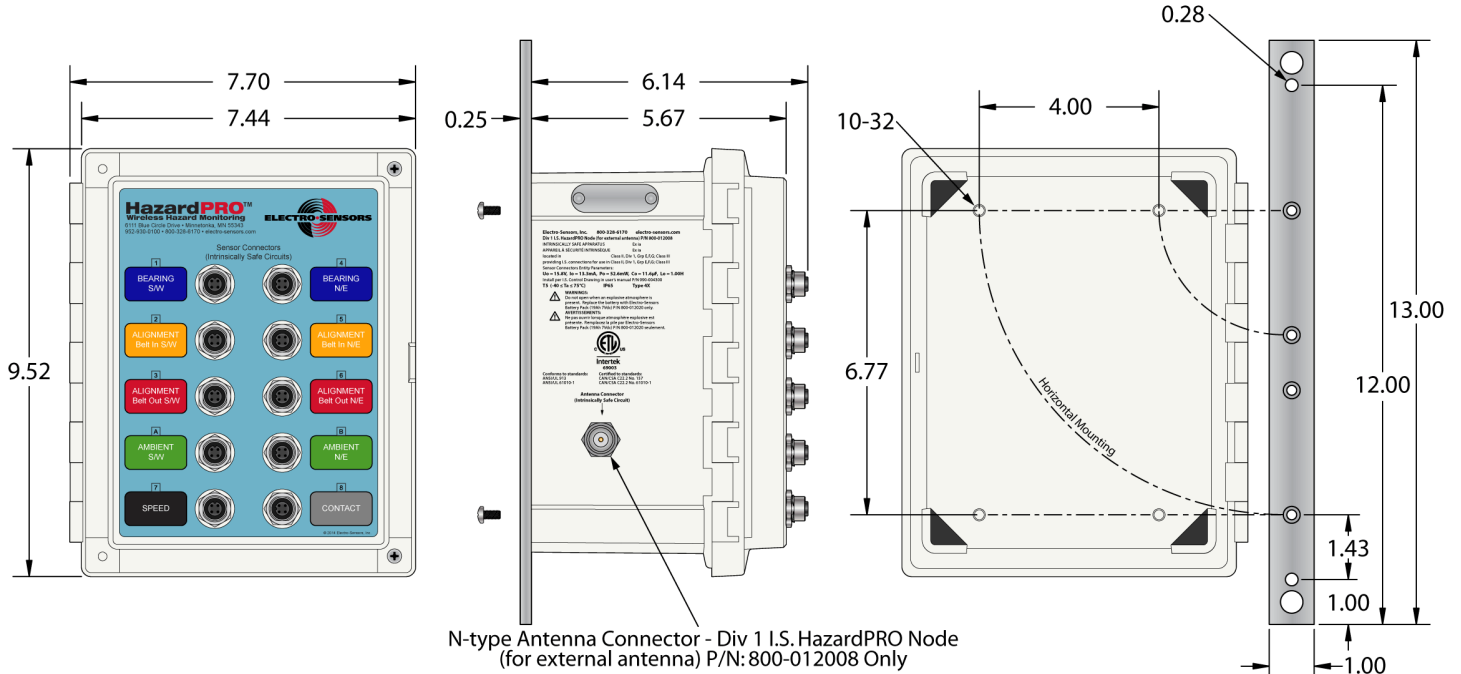Div 1 I.S. HazardPRO Node (for external antenna) shown

Sensors and switches shall satisfy the following:

Entity Parameters (sensor connector terminals)	Sensor or Switch	Div 1 I.S. HazardPRO Node	Notes
Uo = 15.8 Vdc	Ui >	Uo	
Io = 13.3 mA	Ii >	Io	
Po = 52.6 mW	Pi >	Po	If Pi unknown, use (Ui*Ii)/4
Co = 11.6 µF	Ci + Cc <	Co	Cc = (cable pF/ft) * length (ft)
Lo = 1.00 H	Li + Lc <	Lo	Lc = (cable µH/ft) * length (ft)

11. Specifications

Fig. 8   Enclosure and bracket dimensions

N-type Antenna Connector - Div 1 I.S. HazardPRO Node
(for external antenna) P/N: 800-012008 Only

Each node comes with 2 aluminum mounting brackets and 4 (10-32) screws to attach them to the Node.

Fig. 9   Bracket configurations
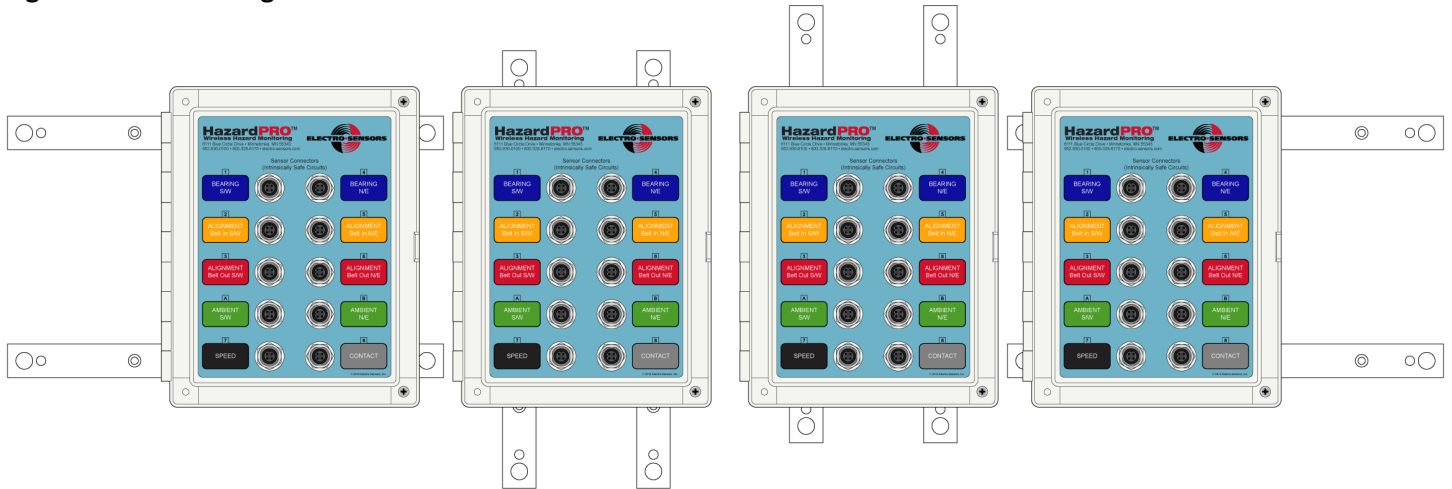
Several bracket configuration possibilities aid attaching the node to structures.

Weight	3.85 Lb (1.75kg)	Node only
	4.50 Lb (2.04 kg)	Node + brackets + screws
Enclosure material	Polycarbonate	
NOTE:	Keep the node insides clean, dry and the enclosure door CLOSED tight. Failure to do so will cause node/battery failure and void the warranty. Do not over-tighten the captive screws. Do not drill, cut or in any way modify the node. Doing so will void the warranty.	
Operating temp	-40 → +75°C	Ambient

11.   Specifications (cont.)

Measurement

Temperature range	-49 → 302 °F	(-45 →150°C)	1µA/K (I = 273.2µA + 1µA/°C) sensor
Error (max)	+4/-5°F	(+2.2/-2.8°C)	Full scale
Shaft speed range	8 → 500 RPM		1 contact Open-Close/rev sensor
Error (max)	±0.5RPM ± speed*(1 - 60/(60 + 0.002*speed))RPM		speed is actual shaft speed in RPM
Battery, VBOOST range	0 → 15.0V		
Error (max)	±0.1V		Full scale

Battery service life   5 years   Replace battery after 5 years service
Replace with Electro-Sensors Battery Pack (19Ah 7Vdc) P/N 800-012020 only (5, 9, Fig. 6) per the instructions (5. Battery replacement). Keep the node insides clean, dry and the door CLOSED tight (do not over tighten). Failure to do so will cause failure and void the warranty.

Radio (internal)   63mW, 2.4GHz, 802.15.4
Antenna connector   N-type female, 50Ω Div 1 I.S. HazardPRO Node (for ext. antenna) P/N 800-012008 only (Fig. 8)

Sensor connectors   M12 female, 4-terminal (Fig. 1, Fig. 7, Fig. 10)

Connector	Label	Sensor circuit	Compatible sensors
1	Bearing S/W	2-wire analog current	HazardPRO Temperature
2	Align Belt In S/W	(1µA/K, 423.2µA full scale)	HazardPRO Temperature
3	Align Belt Out S/W		HazardPRO Temperature
A	Ambient S/W		HazardPRO Temperature
4	Bearing N/E		HazardPRO Temperature
5	Align Belt In N/E		HazardPRO Temperature
6	Align Belt Out N/E		HazardPRO Temperature
B	Ambient N/E		HazardPRO Temperature
7	Speed	2-wire switch contact (Open	HazardPRO shaft speed
8	Contact	≤ 125µA, Closed ≥ 750µA)	Any mechanical switch

Fig. 10   **Sensor connector terminals**
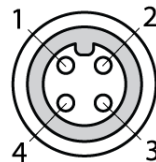
Terminal	Function	Electrical	
		Connectors 1-6, A, B	Connectors 7,8
1	unconnected		
2	(+) Power Out	Vmax ≈ 14Vdc, Ro = 2kΩ	Vmax ≈ 7.0Vdc, Ro = 1kΩ
3	unconnected		
4	(-) Signal In	Ri = 6.9kΩ	Ri = 4.9kΩ

Signal common is not accessible at the sensor connector.

Connector max torque   0.5 ft*lb (0.7 N*m)   Sensor and antenna
DO NOT OVER-TIGHTEN sensor or antenna cables.   Doing so will void the warranty.

Approvals/ratings   Intrinsically Safe (I.S.) apparatus located in   Class II, Div 1, Grp E, F, G; Class III,
providing intrinsically safe (I.S.) connections for use in   Class II, Div 1, Grp E, F, G; Class III.
Install per   I.S. Control Drawing (10).
T5   -40°C ≤ Ta ≤ 75°C   IP65,   Type 4X