Installing HazMon-In-A-Box™
Best Practices Manual

Document No. 11258
V0.0

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Revision Notes

First Release – October 18, 2010

Revision A – January 31, 2011

- Change the photograph and text for the CMC supplied bearing probe mounting fixture

Revision B – April 11, 2011

- Add more detailed sensor mounting drawings and location descriptions

Revision C – December 7, 2011

- Modify sensor install drawings for conveyors and legs
- Add worksheet and template appendices

Revision D – April 19, 2012

- Clarify bearing temperature sensor installation

Revision E – October 3, 2012

- Add commissioning checklist

Revision V0.0 – August 1, 2020

- Numerous updates and additions to text and images
- Add Plugged Chute Switch
- Add Grounding at the FIBs
- Add Punch-downs instruction and images
- Add Grounding the Bus Converters

1. Overview

HazMon-In-A-Box™ consists of complete kits for the installation of hazard monitoring products on grain processing and handling equipment. Kits are available for open belt and enclosed conveyors, legs/bucket elevators, drags and other machines. Each kit includes all the components required to complete the installation for a specific machine. Kit contents include:

- Sensors
- Field Interconnect Boxes
- Protective conduit and fittings, and gaskets
- Mounting hardware and brackets
- All required standard hardware

The only parts the contractor is required to supply are the strain relief glands, CAT5 cable for the sensor network, rigid conduit (dependent on CAT5), 4-wire shielded cable for the RS485 bus converter network, and any necessary beam clamps or straps for securing of boxes and cable.

This manual outlines the steps required to perform a successful installation of the CMC hazard monitoring system. The following manuals should be consulted for additional information:

WS2-HM - ***12035 WS2-HM Technical Manual***
EZS128 - ***EZSentinel128 Installation and Configuration Manual***
mBC083 - ***11755B03 mBC083 Technical Manual***
Field Interconnect Boxes - ***mTB006 (AdaptaNet) Technical Manual***
Vibration Sensor - ***mVM001 Technical Manual***
Shaft Rotation Sensor - ***mRS001 Technical Manual***
Temperature Sensors (various) - ***mTS01X Technical Manual***

Do not attempt to install a CMC hazard monitoring system until you read and understand this document and any other necessary system manuals (noted above).

Read and understand all safety notices and instructions and follow all site safety requirements. Proper lock out tag out procedures and all machinery warning notices must be followed when working on any part of a hazard monitoring system. All system installation and wiring must be in accordance with Local and National Electrical Codes and other applicable industry standards. Failure to read and understand these documents may result in damage to machinery, personal injury, or loss of life.

Contact CMC *BEFORE* commencing with any installation work if you have questions.

2. What are the required steps?

Follow these steps when planning and installing your system:

1. Identify the machines to be monitored.
2. Identify the points to be monitored on each machine (machine worksheets ***Appendix A*** are very helpful).
3. Order the required CMC equipment from the list of HazMon-In-A-Box™ Kits.
4. Review this manual and ***Basic Installer Training*** before attempting to install the system.
5. Install the sensors on the machines.
6. Mount the Field Interconnect Boxes.
7. Install the CAT5 network wiring between the Field Interconnect Boxes.
8. Install the Bus Converters.
9. Install the HMI/Control system.
10. Commission and validate the system.
11. Line drawing of the as-built network layout and all machine worksheets to be left onsite

Read and understand this manual and take the ***Basic Installer Training*** before attempting to install the CMC HazMon System.

CMC offers system commissioning and inspections along with annual system audits and user training as part of our ***RoadMap to HazMon Safety™*** program. Contact CMC for more information.

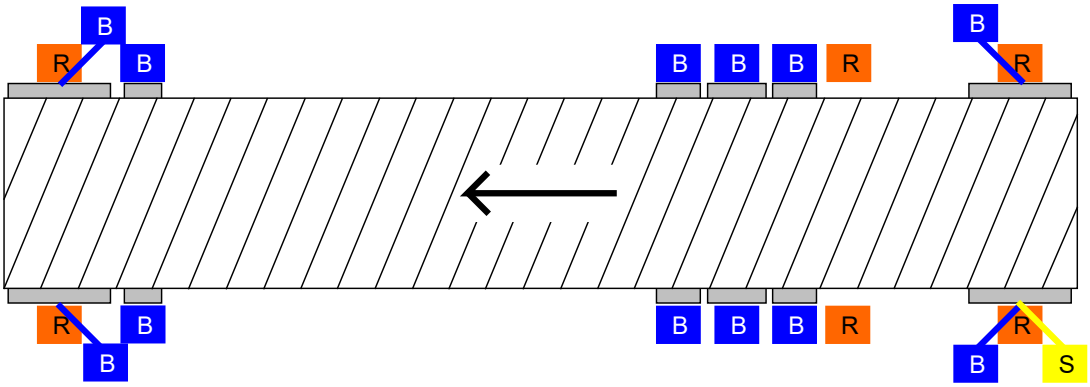
2.1 Identify the machines to be monitored

The first step is to perform an assessment of the facility to identify which machinery requires hazard monitoring. Generally, all moving conveying equipment, dust collector fans and other motorized equipment should be monitored. Large bearing, belt tracking and belt speed are typically monitored. Machine worksheets (located in ***Appendix A*** at the end of this manual) are very helpful and should be used during this process to record sensor locations, name the sensors and assist in planning the installation. Each of these worksheets identifies the possible monitoring locations for typical machinery types. Take the time to complete these worksheets for each machine in your facility. These worksheets will be used later in the installation process to identify which sensors have been installed at each machine location.

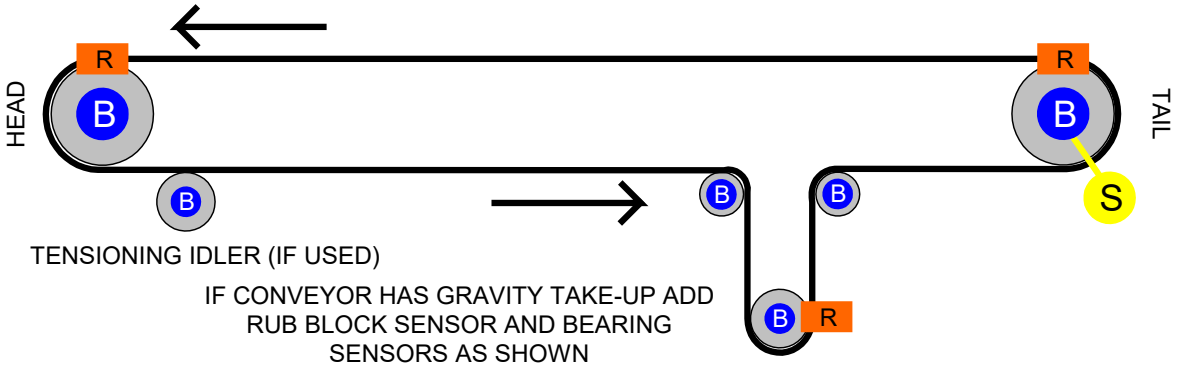
Many companies have comprehensive policies on what is required of a hazard monitoring system. Be certain to consult with your company's safety department to obtain company documentation that may assist you in identifying what devices and machinery need monitoring. The following table describes the industry standard minimum points to be monitored:

Equipment	Points to monitor	Optional points
Open Conveyor or Elevator Leg	Head pulley main bearings Tail pulley main bearings Head end belt tracking rub Tail end belt tracking rub blocks Speed sensor	Additional idler bearings Additional rub blocks for pulley shift
Gravity Take-Conveyor	Head pulley main bearings Tail pulley main bearings Head end belt tracking rub Tail end belt tracking rub blocks Gravity idler bearings Exit gravity idler rub blocks Speed sensor	Additional idler bearings Additional rub blocks for pulley shift
Enclosed Conveyor	Head pulley main bearings Tail pulley main bearings Head end belt tracking rub Tail end belt tracking rub blocks Speed sensor	Additional lug sensors for pulley shift
Drag Conveyor	Head pulley main bearings Tail pulley main bearings	Speed sensor
Fan	Motor main bearings Fan main bearings	Fan vibration
Motor Drives	Motor main bearings Drive main bearings	Drive vibration

Use the machinery illustrations below to identify the equipment and locations you are going to monitor. Not all operators monitor all the points described in the equipment shown below.



ENSURE THE RUB BLOCK MOUNTING BRACKETS ARE STRONG ENOUGH TO WITHSTAND AN OFF TRACK BELT

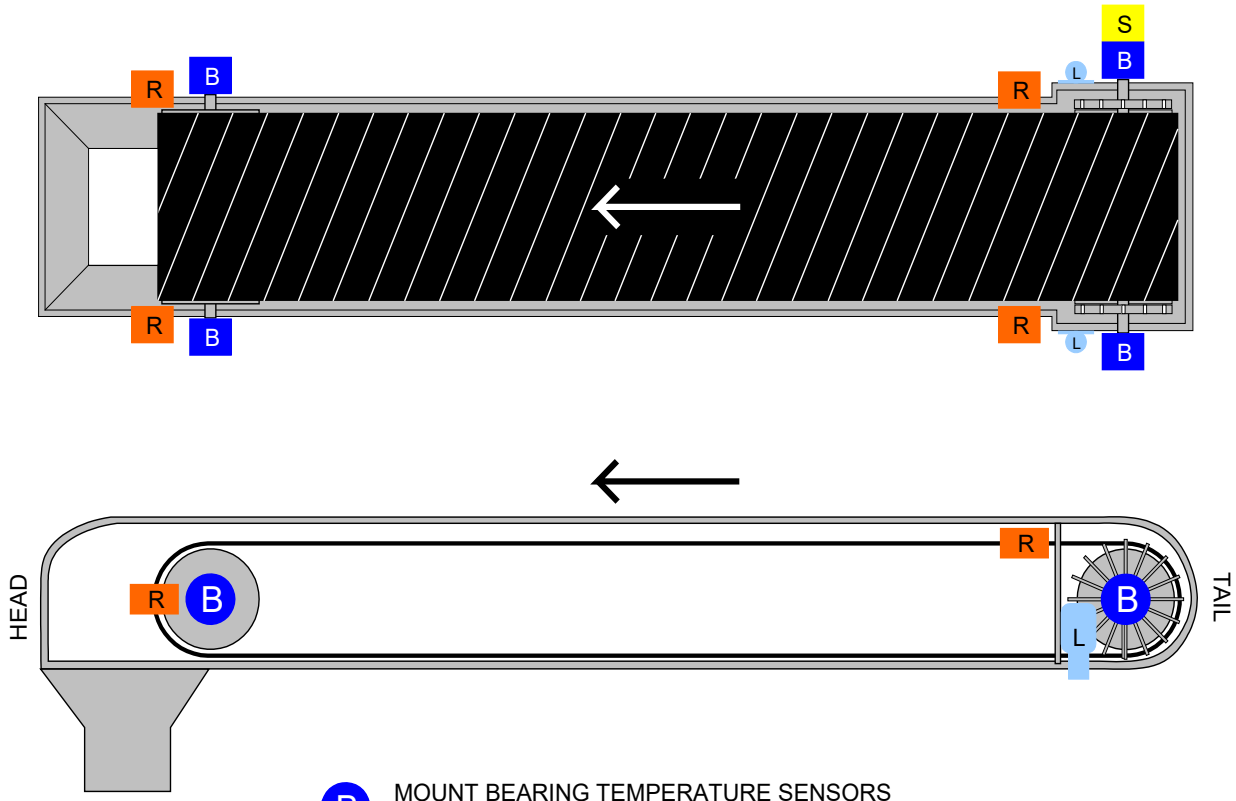


B — MOUNT BEARING TEMPERATURE SENSORS ON ALL LARGE BEARINGS AS SHOWN

R — MOUNT RUB BLOCKS AS SHOWN
THE RUB BLOCK SHOULD BE MOUNTED TO DETECT OFF TRACK BELTS AND MIS-LOCATED PULLEYS

S — MOUNT THE SPEED SENSOR TO THE TAIL PULLEY SHAFT

Typical Open Belt Conveyor



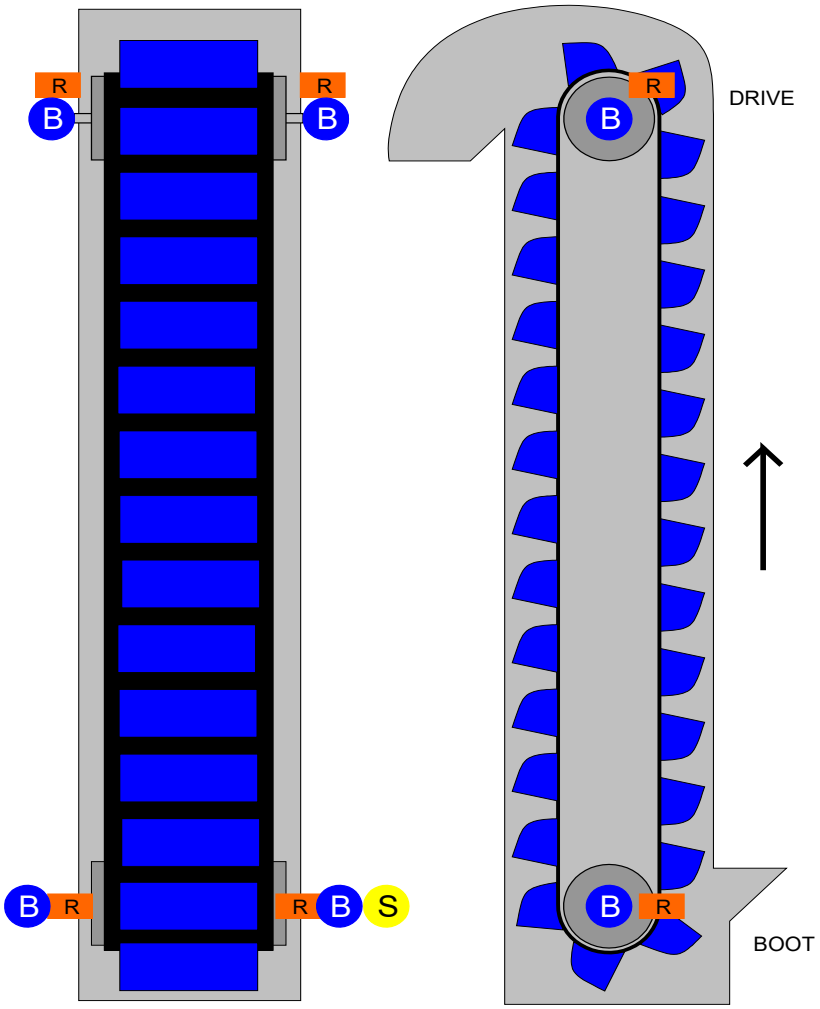
B MOUNT BEARING TEMPERATURE SENSORS ON ALL LARGE BEARINGS AS SHOWN

R MOUNT RUB BLOCKS AS SHOWN
THE RUB BLOCK SHOULD BE MOUNTED TO DETECT OFF TRACK BELTS AND MIS-LOCATED PULLEYS

L OPTIONAL LUG SENSORS TO DETECT PULLEY SIDE TRAVEL

S MOUNT THE SPEED SENSOR TO THE TAIL PULLEY SHAFT

Typical Fully Enclosed Belt Conveyor



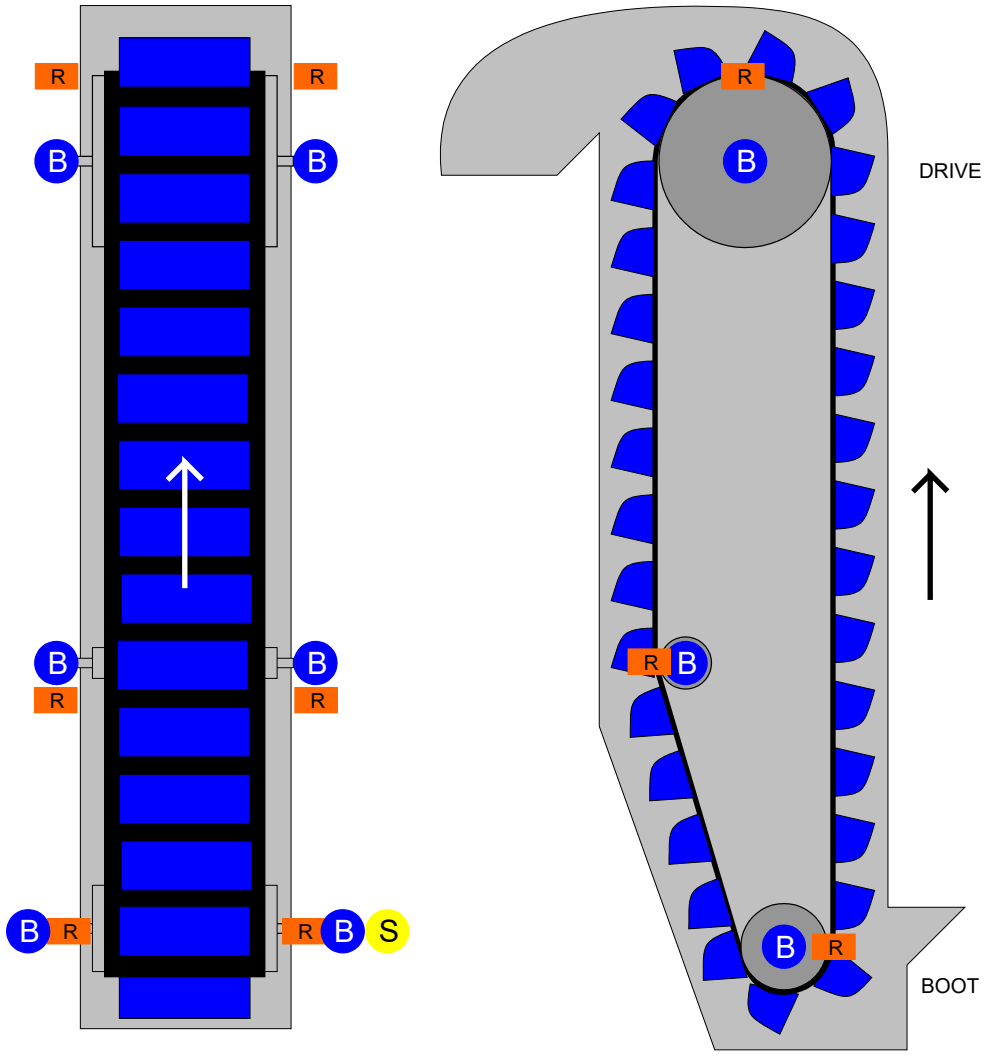
B MOUNT BEARING TEMPERATURE SENSORS ON ALL LARGE BEARINGS AS SHOWN

R MOUNT RUB BLOCKS AS SHOWN
THE RUB BLOCK SHOULD BE MOUNTED TO DETECT OFF TRACK BELTS AND MIS-LOCATED PULLEYS
RUB BLOCKS SHOULD BE DIRECTLY ACROSS FROM EACH OTHER

S MOUNT THE SPEED SENSOR TO THE TAIL PULLEY SHAFT

ON GRAVITY TAKE-UP SYSTEMS OR WHERE SIGNIFICANT ADJUSTMENT OF BELT TENSION IS POSSIBLE MOUNT ADDITIONAL RUB BLOCKS OR MOUNT THE RUB BLOCK SO IT CAN MOVE WITH THE TAKE-UP MECHANISM

Typical Bucket Elevator Leg



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Typical Bucket Elevator Leg with Knee Pulley

2.2 Order the HazMon-In-A-Box™ kits

The following is a list of the available HazMon-In-A-Box kits:

HMC001	Basic Conveyor or Bucket Elevator Kit
HMC004	Drag Conveyor with Speed Kit
HMC005	Drag Conveyor no Speed Kit
HMC006	Two Additional Rub Sensors Kit
HMC018	ATEX Bus Converter Kit
HMC008	Basic Conveyor or Bucket Elevator no Speed Kit
HMC009	Field Interconnect Box Kit
HMC010	Single Lug Sensor Kit
HMC011	Single Bearing Sensor Kit
HMC012	Single Speed Sensor Kit
12099	Single Plug Chute Sensor Kit
11353	HazMon Spare Parts Kit

The kits listed above provide all the parts (except those noted below) required to install hazard monitoring on specific types of machinery. Datasheets for each kit containing a list of all included contents can be obtained from our website cmciel.com.

The installer will need to provide some of the following supplies to complete the installation:

1. CAT5 cable to connect the Field Interconnect Boxes in the sensor network. There are many types of CAT5 cable available. **We recommend using direct burial CAT5 cable.**
2. RS485 cable for bus converter network.
3. Rigid conduit if not using direct burial CAT5 cable.
4. Strain relief cable glands and cable straps for the CAT5 cable.
5. Conduit straps to secure the liquid tight conduit.
6. Beam clamps (optional depending on mounting method for Field Interconnect Boxes).

2.3 Install the sensors

There are six basic sensor types that may need to be installed:

- Tube style bearing temperature sensors
- Lug style temperature sensors
- Rub block sensors
- Speed sensors
- Plug chute sensors
- Vibration sensors

The following best practices should be observed when installing all sensors:

1. Allow for access to properly install and service the sensor. This includes room for the conduit used to prevent damage to the sensor cables.
2. Use only the supplied liquid tight conduit, connectors, and gaskets to protect the sensor lead wire.
3. Protect each sensor's RJ11 connector jack and cable from foreign material or damage during the installation process.
4. Take care not to damage the sensor head, cable, or RJ11 connector jack when installing conduit or fittings.
5. Leave all the A & B branch switches in the ***OFF*** position after making connections. The switches will be turned on later, during the commissioning of the system.

2.3.1 Installing tube style stainless steel bearing temperature sensors

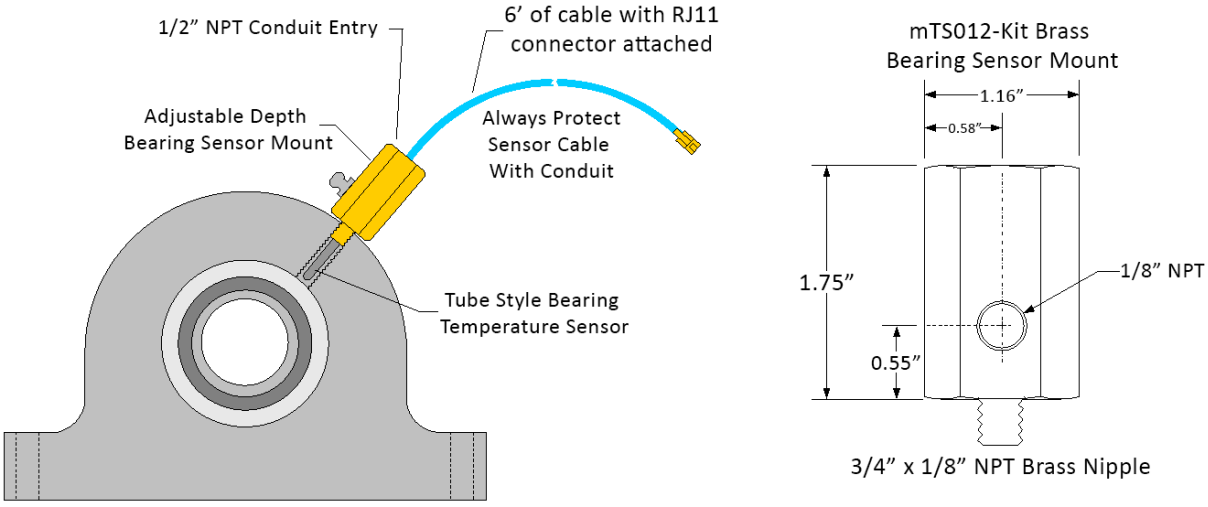
Tube style temperature sensors are available in a range of lengths, but all are ¼" in diameter. The standard length supplied in HazMon-In-A-Box Kits is 4" unless otherwise requested by the customer. In the kit, each sensor is provided with a brass bearing sensor mount fitting (mTS012-Kit) that threads into a standard ¼" zerk fitting opening in the bearing housing.

To install the sensor:

1. Protect the sensor's RJ11 connector jack using electrical tape during the installation process
2. Remove the existing zerk fitting and replace with the brass bearing sensor mount.
3. Re-install the zerk fitting into the side of the bearing sensor mount.
4. Remove the compression nut and collar from the top of the bearing sensor mount.
5. Slide the brass compression nut and collar onto the temperature sensor.
6. Insert the sensor into the bearing sensor mount until it touches the bearing race and withdraw the sensor 1/8".

7. Tighten the compression fitting taking care not to over tighten and damage the sensor.
8. Install the threaded end of the conduit fitting along with a gasket into the bearing sensor mount.
9. Install the supplied liquid tight conduit onto the other end of the fitting. The liquid tight conduit can be cut to length if necessary – but not so short as to prevent formation of an adequate drip loop.
10. Carefully slide the liquid tight conduit over the sensor cable and attach to the bearing sensor mount.
11. Secure the liquid tight conduit using standard conduit straps (not provided). The conduit will be attached to the field interconnect box in a later step.

The picture below illustrates how the bearing temperature probe and brass sensor mount is assembled with the factory supplied conduit fitting and gasket attached to the conduit.



It is important to protect the sensor cable where it exits the brass sensor mount and passes into the conduit system. If 90° or 135° angle fittings must be used (due to installation constraints) damage can be done to the sensor cable when the fitting is installed or adjusted.

The problem occurs when the sensor is installed on small bearings that limit the penetration of the probe into the bearing, leaving the stainless tube exposed, and too high in the brass fitting.

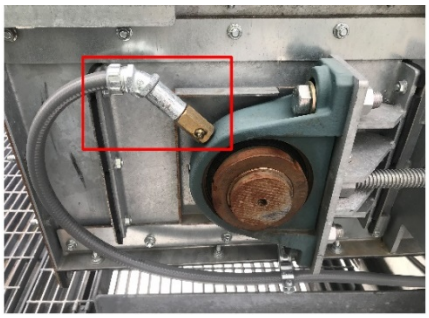
Rotating the angled fitting during installation breaks the cable jacket where it exits the stainless-steel tube.

To prevent this problem, install a close nipple and coupling to the end of the brass fitting as shown in the image below. Use only NPT threaded galvanized fittings. Standard electrical conduit fittings are not NPT thread and will leak if submersed in water. Use the shortest possible coupling that will provide clearance.

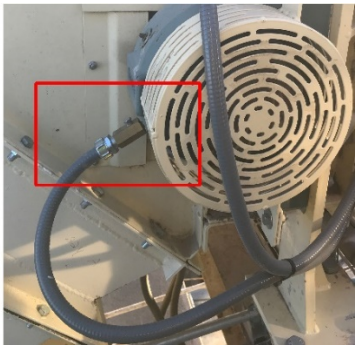
WARNING

Swivel fittings of any type should never be used when installing CMC sensors

Bearing sensor installed with close nipple and coupling to protect the sensor and cable when using an angled conduit fitting.



Bearing sensor installed with factory supplied conduit fitting.



2.3.2 Installing lug style temperature sensors

Lug style sensors can be used for monitoring bearing temperature or for surface/case temperature on enclosed conveyors, gearboxes, or any flat surface. The standard lug sensor is supplied with a 3/8” mounting hole in the lug.

To install the sensor:

1. Protect the sensor’s RJ11 connector jack using electrical tape during the installation process.
2. Install the sensor under the zerk fitting on a pillow block or a suitable mounting bolt. Do not bend or deform the sensor lug when securing the sensor.
3. Install the strain relief, coupling, and conduit fitting on one end of the supplied liquid tight conduit. The liquid tight conduit can be cut to length if required – but not so

short as to prevent formation of an adequate drip loop. Clamping of the conduit close to the sensor is required to reduce strain on the sensing head/lug.

4. Slide the liquid tight conduit over the sensor cable and tighten the strain relief on the barrel of the sensor body.
5. Secure the liquid tight conduit using standard conduit straps (not provided). The conduit will be attached to the field interconnect boxes in a later step.

The picture below illustrates how the lug style sensor is assembled with the factory supplied strain relief, coupling, and conduit fitting attached to the conduit.

Lug sensor installed with factory supplied strain relief, coupling, and conduit fitting.

2.3.3 Installing rub sensors, rub blocks, and hinged access doors

The rub blocks come complete with a hinged mounting bracket that allows for easy access and inspection of the rub block without disassembly. Rub blocks should be positioned and installed to be the first point of contact for both the belt and pulley in the event of a misalignment.

To install the rub block, hinged mounting bracket, and rub sensor:

1. Cut a hole in the machine casing if it is an enclosed conveyor or bucket elevator leg. A template for the hole pattern provided in ***Appendix B*** of this manual
2. If working on an open belt conveyor with no machine casing, you will need to fabricate a metal plate to secure the mounting bracket.
3. Protect the sensor's RJ11 connector using electrical tape during the installation process.

4. Thread the rub sensor into the rub block and tighten the retaining nut. The sensor end should be flush with the exposed face of the rub block.
5. Attach the rub block to the hinged mounting bracket using the supplied hardware.
6. Attach the hinged mounting bracket to the conveyor or fabricated plate using the supplied hardware.
7. Install the liquid tight connector on one end of the supplied liquid tight conduit. The liquid tight conduit can be cut to length if required – but not so short as to prevent formation of an adequate drip loop.
8. Attach the threaded end of the liquid tight conduit connector to the rub block mounting bracket.
9. Secure the liquid tight conduit using standard conduit straps (not provided). The conduit will be attached to the field interconnect enclosures in a later step.
10. Should it be necessary to shim the rub block closer to the belt and pulley. CMC offers 1/8" thick shims sold in packs of (4) to address this issue.

The pictures below show a rub block mounted to a hinged bracket on an open belt conveyor and an enclosed elevator leg.

Brass rub sensor and rub block mounted to monitor both the belt and pulley for misalignment

Rub hinged access door, rub sensor, and rub block mounted on an elevator leg casing to monitor misalignment

Rub block mounting brackets are also available for Hi Roller enclosed conveyors and in stainless steel material for corrosive environments.

2.3.4 Installing shaft speed sensors

Shaft speed sensors can be installed using one of two different methods.

To install the sensor:

1. Install the speed sensor using the CMC magnet mount and stainless-steel protective shroud to mount the assembly on the end of the shaft.
2. Install the speed sensor by threading it directly onto the end of the shaft to be monitored. This requires a ½" x 13 threaded hole be drilled and tapped in the center of the machine's shaft. It is preferable to have this hole drilled and tapped at the factory by the OEM of the machine.
3. Regardless of the chosen installation method, speed sensors should always be mounted on the tail or **non-driven pulley shaft** of the conveyor, drag or bucket elevator.

Shaft speed sensor assembly mounted directly to an enclosed conveyor tail pulley shaft. Note the secured conduit and proper drip loop.

Shaft speed sensor assembly mounted to a tail pulley shaft using the magnet and protective shroud

2.3.5 Installing plug chute sensors

To install the sensor:

1. The plug chute sensor must be mounted vertically on the machine being monitored to ensure proper operation.

2. The diaphragm should face the material and the conduit opening should always be facing down.
3. Once the desired location has been selected, cut a 5” diameter hole in the machine casing and mount the switch in accordance with the above instructions using (4) suitable sheet metal screws (not supplied).
4. If the mounting surface on the machine is warped or uneven, a shim should be used to ensure proper contact between the switch and machine casing.
5. Use all provided conduit fittings and gaskets to ensure that moisture cannot enter through the conduit opening and damage the sensor.

The picture below illustrates the plug chute sensor assembled with the factory supplied conduit fitting attached to the conduit.

Plug chute sensor installed with factory supplied conduit fitting. Note that the sensor is installed with the conduit opening on the bottom.

Plug chute sensor dimensional drawing is available in ***Appendix C*** at the end of this manual.

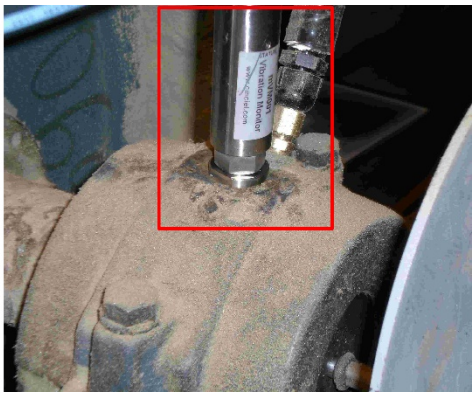
2.3.6 Installing vibration sensors

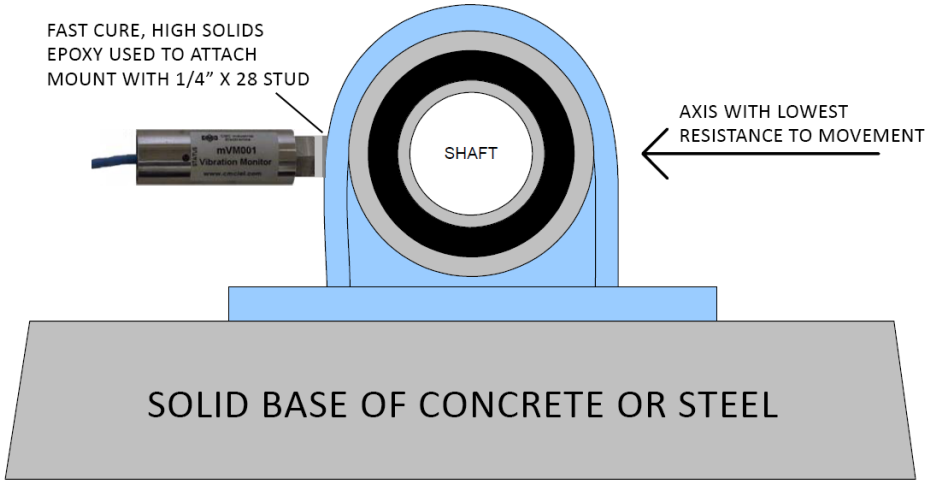
The vibration sensor measures movement through its vertical axis.

To install the sensor:

1. The sensor is mounted to a ¼” x 28 fine threaded stud.
2. The stud must not penetrate the sensor body by more than 0.4” and locknuts should be used on longer mounts.
3. The mount should be securely attached to the device being monitored.
4. An optional mounting stud that can be epoxied to the surface being monitored is available from CMC. Clean, dry, bare metal with a metal impregnated epoxy is best for making this joint.

Vibration sensor mounted to the top of a pillow block bearing.





2.4 Install the Field Interconnect Boxes (FIBs)

FIBs are part of the sensor bus network and are connected by CAT5 cable.

Some best practices to consider when selecting the best location for mounting FIBs:

- FIB should be able to be safely accessed for future maintenance and repairs
- FIB should be positioned to allow for proper installation of all sensor drip loops
- FIB should be positioned to allow for proper installation of CAT5 sensor bus cabling
- FIB should be positioned to avoid exposure to extreme weather conditions
- Mount the field interconnect box securely to the chosen mounting point using the supplied mounting bracket.
- The CAT5 cable layout to connect the field interconnect boxes should on any one sensor bus network should not exceed 1000 feet total.
- Avoid long runs of loose cable that could be damaged or allow moisture to enter the network.
- The CAT5 should be routed such that it always maintains at least 2 feet of separation from all high voltage cable runs.

2.4.1 Selecting the CAT5 sensor network bus cable

Once the sensors are installed on the machines and the field interconnect boxes have been mounted it is time to connect the field interconnect boxes to the CAT5 sensor bus cable creating the network. The CAT5 sensor bus network is Intrinsically Safe. Intrinsically Safe systems do not need to be installed in rigid conduit or raceways to meet the requirements of the electrical code.

There are three primary requirements for the installation of the CAT5 sensor bus cabling:

1. The cabling system **must** be protected from physical damage
2. The cabling system **must** be designed and installed to prevent the intrusion of water into the field interconnect boxes or any conduit runs.
3. The cabling **must** be completely separated from any cables that are not Intrinsically Safe such as any high voltage circuits and power cables that supply VFDs etc.

There are three primary types of cabling that can be used:

1. Armored or direct burial CAT5 cable (recommended)
2. CAT5 cable inside rigid conduit
3. Metal Clad (MMC or TECK) cables

CMC recommends the use of direct burial CAT5 cable (shown below) wherever possible.

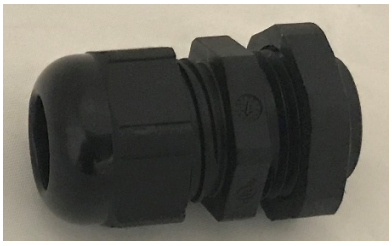
Direct burial cable CAT5 has several unique features making it the best cable with which to install the CMC HazMon system.

1. A silicone gel filled inner jacket that makes the cable impervious to moisture
2. A flexible but rugged inner jacket.
3. A continuous rigid copper shield that protects from external EMF and RFI interference and also provides a rat shield (the cable is marketed as rat proof).
4. The semi-rigid UV protected, cold weather rated outer jacket resists tears and scrapes and is stiff enough to allow for a reduced number of tie down points.
5. If enhanced physical protection is required, this cable can be run through conduit only in those areas where required.

The use of this cable with all proper strain relief fittings, cable straps, and installed in line with the best practices noted in this manual will make a robust, reliable, water-resistant installation. Properly installing the sensor bus network with direct burial CAT5 cable typically costs about 50% of the cost a rigid conduit system and ultimately will provide a more reliable system overall if done correctly.

If you use direct burial CAT5 cable observe the following:

1. Route the cable away from all other electrical circuits **(minimum 2 feet of separation)**.
2. Install the cable with proper use of clamps to secure it to machinery frames and other suitable support or brace points to prevent damage by machinery or workers.
3. No splices on the CAT5!
4. Use drip loops on all cables entering the field interconnect boxes
5. **NEVER** make any cable entries in the top of the field interconnect boxes
6. Use plastic strain relief fittings (example in picture below) at all wherever the CAT5 cable enters the field interconnect box.



WARNING

If CAT5 cable other than direct burial is selected and the cable is routed in a conduit system, the following best practices **must** be observed:

1. Route the conduit away from all other electrical circuits **(minimum 2 feet of separation)** and **NEVER** run other power cables in the same conduit.
2. A significant number of service issues with our installed systems are due to water ingress from the conduit system therefore drip loops should be installed at all entry points and drain vents at all junctions
3. Install sealing washers between all fitting and the enclosure and make sure they are watertight
4. Consider using silicone gel filled cable inside conduit runs.
5. Take care routing the conduit system to avoid low points and places where water can accumulate and freeze, severely damaging the cable and disrupting the network.
6. Absolutely no splices on the CAT5!
7. Be very careful when pulling the CAT5 through conduit to prevent damage to the conductors due to stretching or burrs and sharp edges on the conduit.
8. Make sure all joints exposed to weather are gasketed, tight, and sealed.

2.4.2 Drilling the field interconnect boxes

Each field interconnect box is shipped with a set of drilling templates for the sensor and bus cable holes. Save and use these templates to drill all required holes for the sensors **(side only)** and CAT5 sensor bus cables **(bottom only)**.

TECH TIP

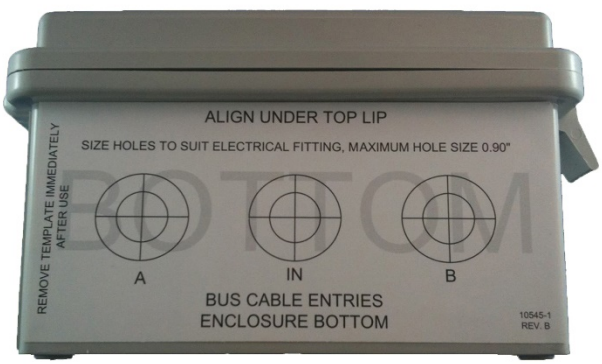
Use of these templates will ensure that all holes are drilled in the correct place and that fittings will not interfere with the internal components.

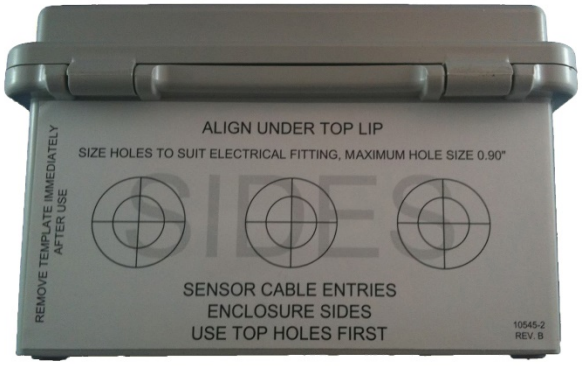
The illustration below shows where the sensors and network bus cables shall enter the field interconnect box:

WARNING

CAT5 sensor bus cables only enter on the bottom and sensor cables only enter on the sides of the field interconnect box – **NO EXCEPTIONS.**

The picture below shows a field interconnect box with the sensor bus and sensor cable labels attached.





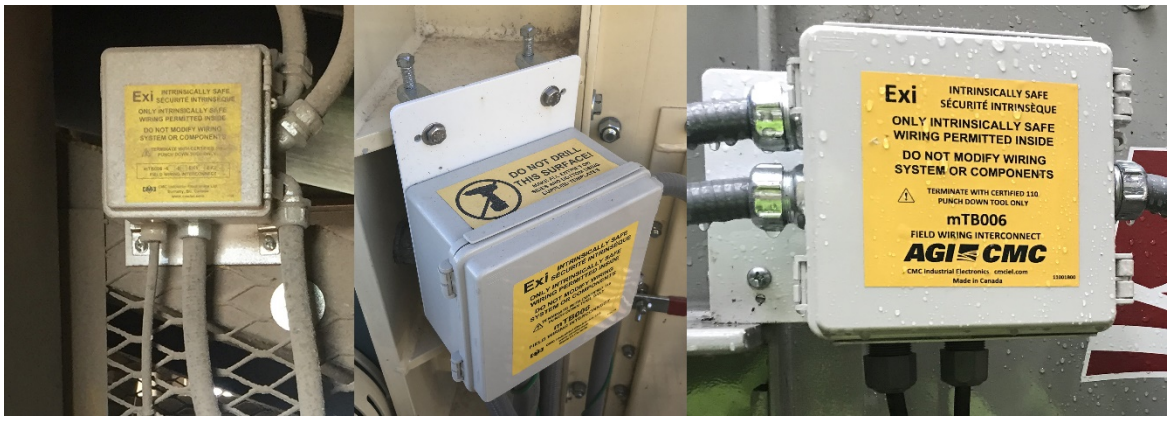
A stepped drill, as shown below, must be used to drill the holes in the field interconnect box. A standard large diameter drill can jam during drilling and damage or crack the enclosure. The factory supplied conduit fittings for the sensors have a ½" NPT thread and require a 7/8" hole to be drilled in the enclosure.

TECH TIP

Use of a stepped drill not only ensures the correct hole size, but also no damage to the field interconnect box.

2.4.3 Mounting the field interconnect boxes

When supplied in a HazMon-In-A-Box™ kit every Field Interconnect Box comes with a complete set of mounting hardware. The field interconnect boxes mount to a metal bracket that is in turn mounted to a stable location on the machine. The pictures below show the field interconnect box mounted on a variety of machines in the field, indoors and out.



The enclosure can be mounted in any orientation on the bracket allowing for the bracket to mount either vertically or horizontally. Use the supplied stainless-steel hardware to mount the enclosure to the bracket and the bracket to the machine.

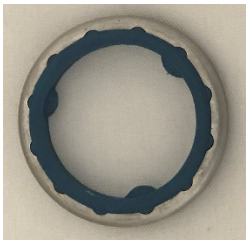
WARNING

NEVER mount a field interconnect box on a vibrating machine such as a shaker or screener.

If the field interconnect box has to be mounted on a moving component such as gravity take up system, ensure that the cable or conduit used to connect the field interconnect box to the network can withstand flexing at the full range of operating temperatures. Liquid tight conduit is available that can flex continuously at temperatures as low a -40°C. Standard liquid tight conduit, both metallic and plastic, becomes somewhat brittle at 0°C (32°F) and extremely brittle by -20°C (-5°F).

Important points to remember when installing a field interconnect box.

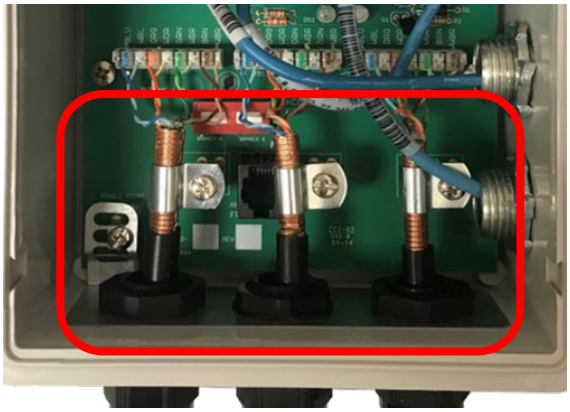
1. In the first field interconnect box, the bus converter always enters using the bottom center hole using the factory supplied metallic liquid tight conduit.
2. The sensor bus is wired using only CAT5 cable and always enters the bottom using gasketed plastic strain relief fittings (not supplied).
3. The sensor cables enter only on the sides using the factory supplied conduit fittings, gaskets, and non-metallic liquid tight conduit for protection.
4. Use sealing gaskets on all fittings (conduit or strain relief) an example of a conduit fitting with a sealing gasket is shown below.



2.4.4 Grounding the CAT5 sensor network at the Field Interconnect Box

TECH TIP

Properly installed grounding is key to a successful and safe installation!



Grounding of the CAT5 sensor network at each FIB can be done 1 of 2 recommended ways.

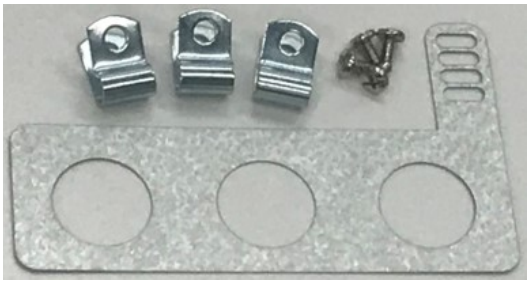
The first, and preferred method, is when utilizing direct burial shielded CAT5 cabling grounded to each field interconnect box using the grounding clamps provided. When using this method, the supplied grounding plate is only needed in the first FIB connected to Bus Converter.

The second method is when utilizing a non-shielded CAT5 cable and carrying the ground throughout the Intrinsically Safe portion of the network using metallic conduit throughout.

WARNING

With the second method all conduit **must** be metallic, and the factory supplied metal grounding plates **must** be used in **all** field interconnect boxes.

Every FIB is shipped with a grounding plate, clamps/straps and machine screws (shown below).



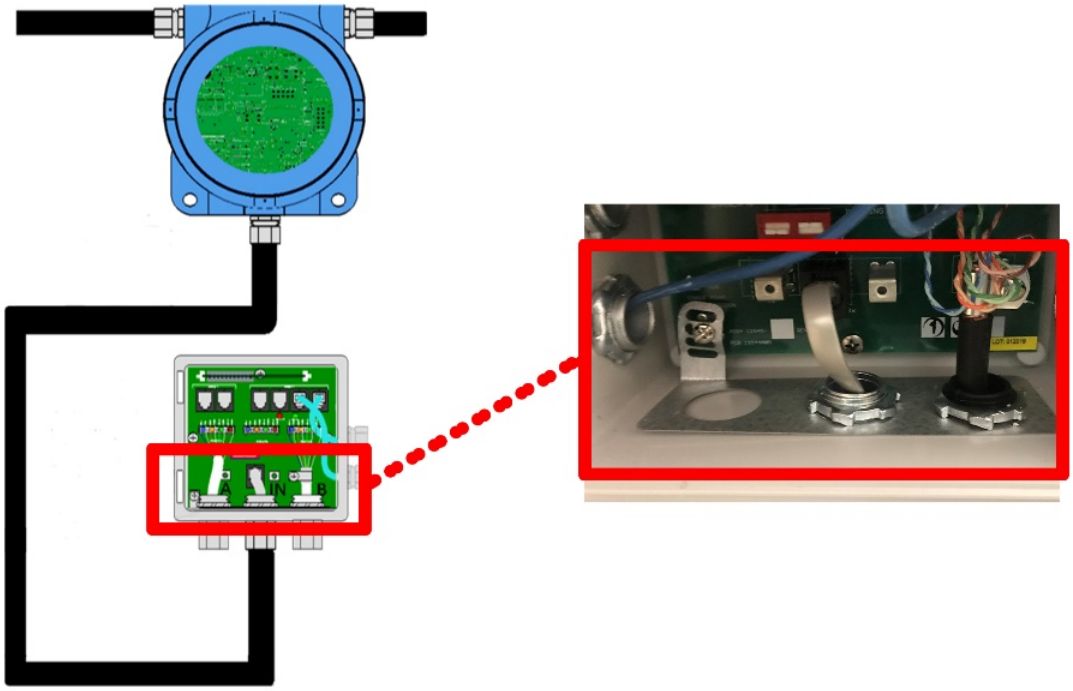
TECH TIP

DO NOT DISCARD any of the factory supplied grounding parts until you have determined which method will be used for grounding the sensor network.

The first FIB installed after the bus converter is shown in the graphic below:

WARNING

The first FIB after the bus converter in **EVERY** network **MUST** have the grounding plate installed regardless of the method used for grounding the entire sensor network. See the graphic below.



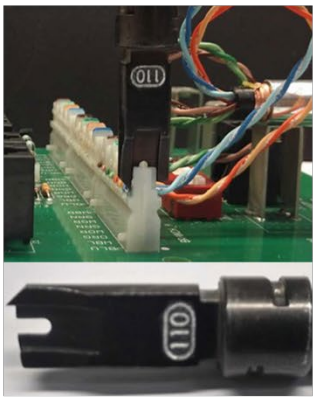
2.4.5 Punch-downs

Punch-downs must be done carefully and properly using the correct tool. Failure to do so can cause network outages and alarms. Do not try to perform punch-downs using anything other than a 110-style punch-down tool! See below for an image of a suitable punch-down tool.

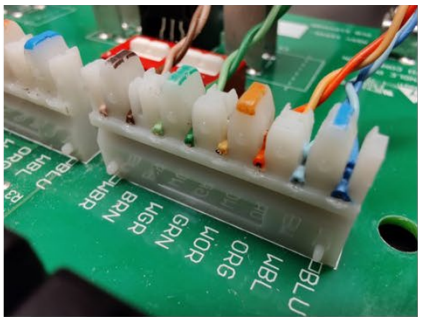
TECH TIP

Properly installed punch-downs are key to a successful installation. When using gel filled CAT5 be sure to clean all the gel off the wires before making the punch-downs.

Leave a service loop with ample slack for future maintenance and repairs, and carefully follow the color code printed above the connector.



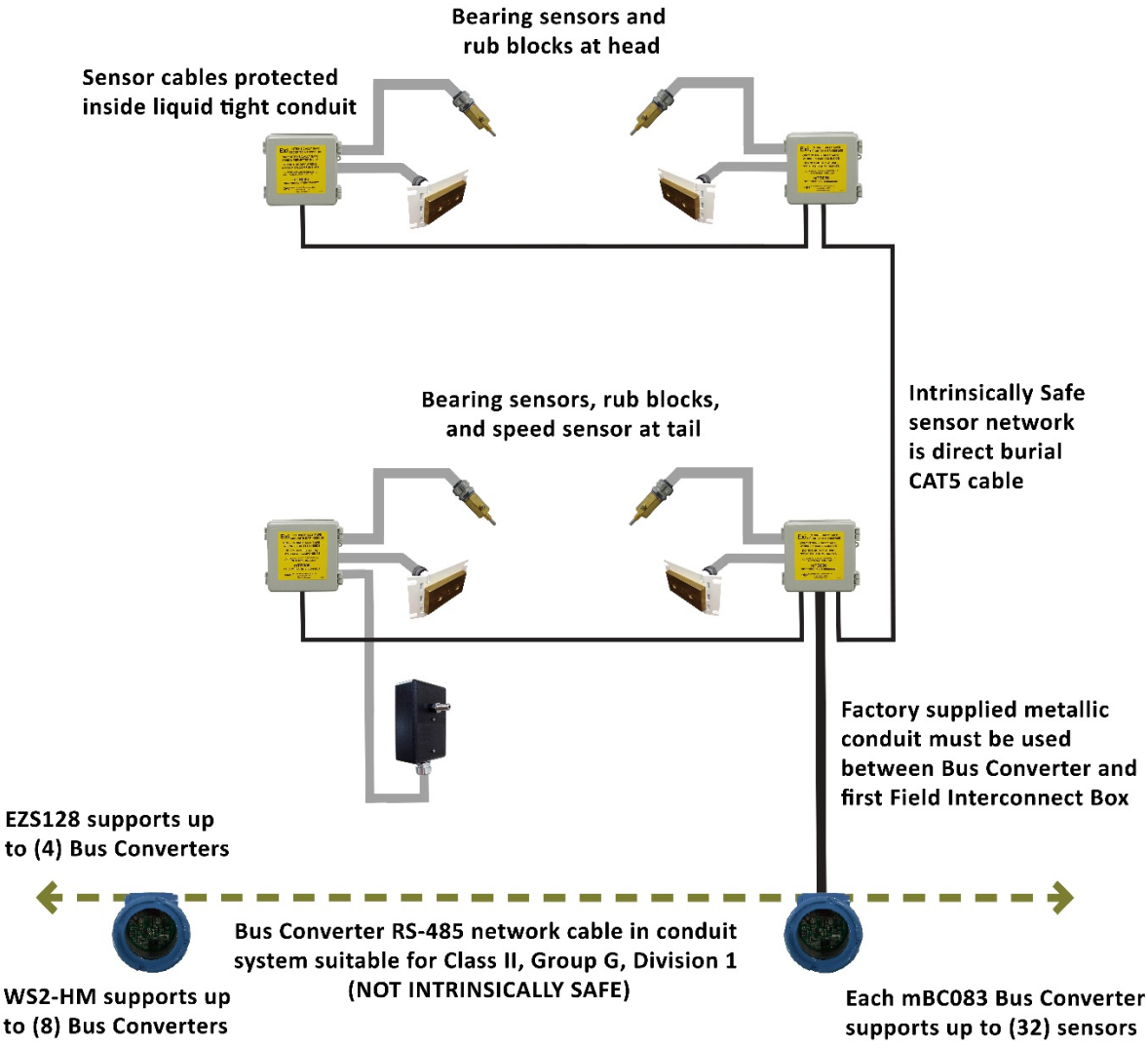
Before using the tool, check the punch-down bit orientation. Orient the tool so that the cutting edge will trim excess wire when the connection is made. When making the connection, exert force smoothly until the tool "pops" and the wire is trimmed without unnecessary force.



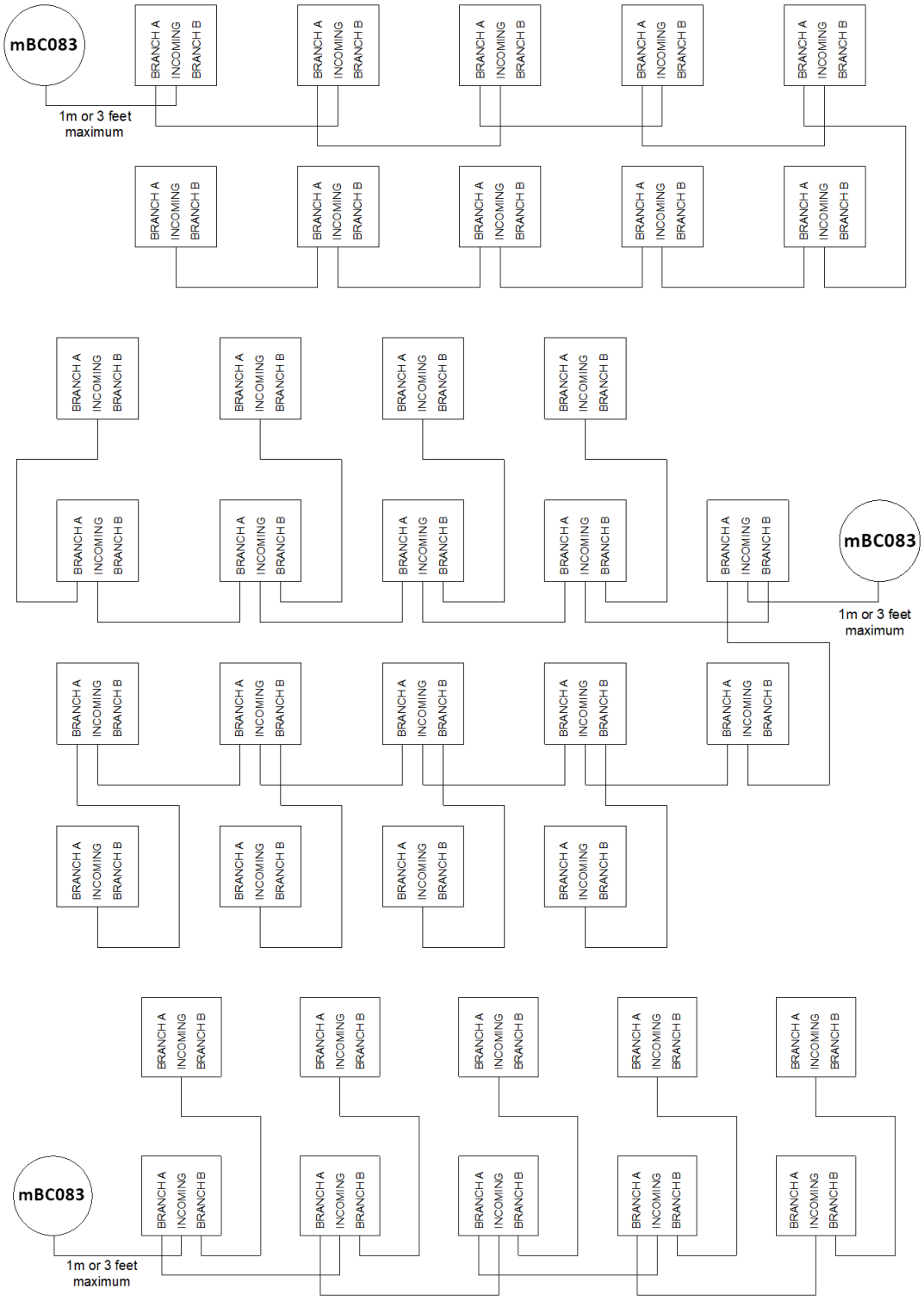
The finished connections should have the wires evenly seated in the grooves of the connector. Excess wire must be trimmed neatly, do not leave "stingers" hanging out of the connection

2.4.6 Typical FIB installation and network topologies

The illustration below details a typical installation with (4) FIBs on a bucket elevator:



Field interconnect boxes have 6 jacks for sensors and 3 punch down terminals for the CAT5 sensor bus network. The punch-down terminals are labeled ***Incoming***, ***Branch A*** and ***Branch B***. The first field interconnect box in the sensor network that is connected to the bus converter will have no connection on the ***Incoming*** punch down terminals. The bus converter plugs into the field interconnect box using the same connector as the sensors. As a good practice use the ***Branch A*** punch-down terminal first when extending the network. The ***Branch A*** terminal of one box connects to the ***Incoming*** terminal of the next box. Below are examples of some typical network topologies.



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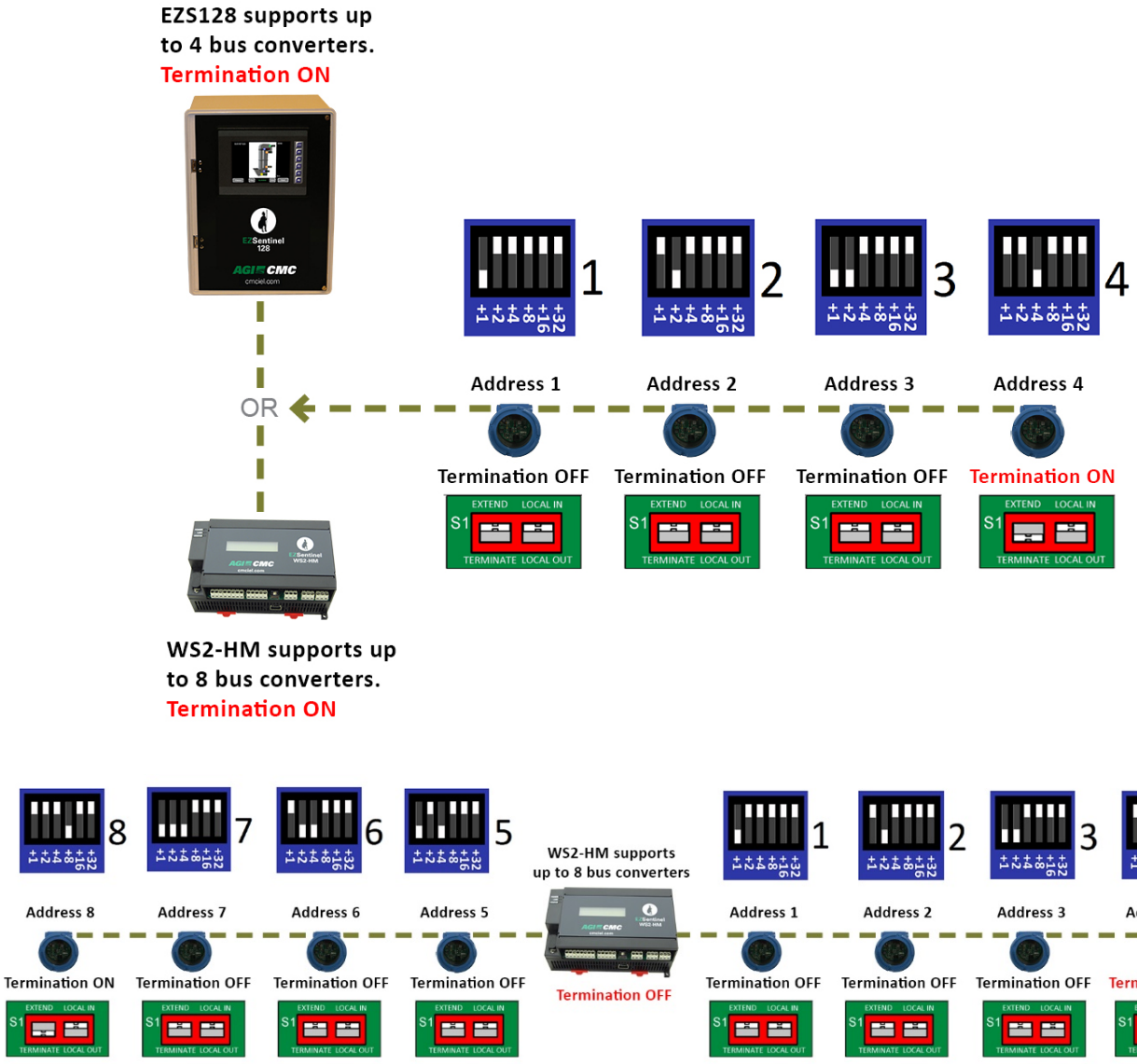
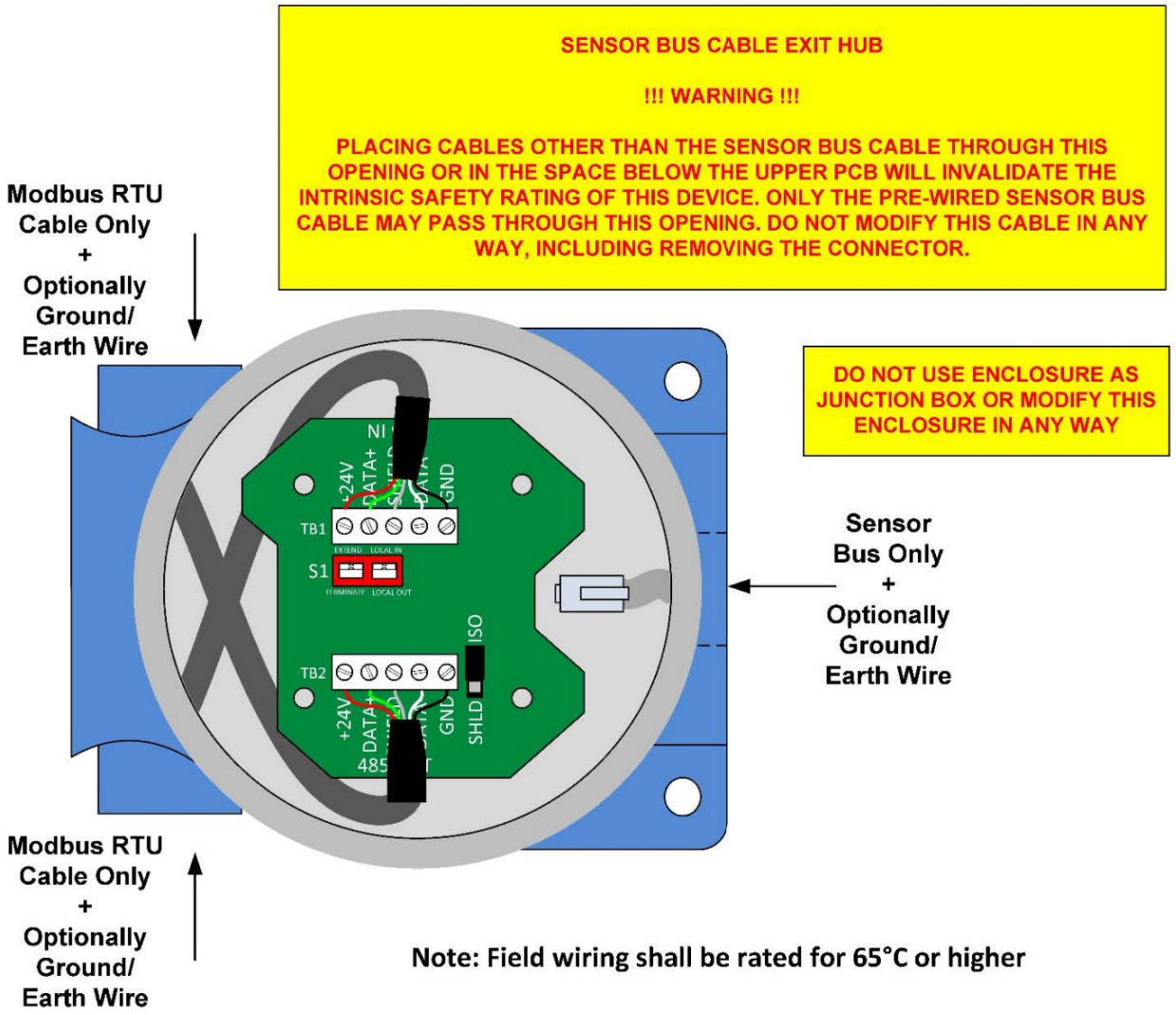
2.5 Install the Bus Converters

Bus converters are responsible for communications on the CAT5 sensor network. In addition, bus converters provide the ***Intrinsic Safety*** barrier for the network. The bus converter communicates with the EZS128 or web server (WS2-HM or WS1) using Modbus RS485 communications. Bus converters connect to the host over a four-conductor (or 2 pair) shielded cable. The size of the cable is determined by the distance between the host and the bus converters (a cable calculator is available from CMC). Unlike the CAT5 sensor network, the Modbus RS485 network **must** have a linear topology and cannot have branches or tees. The network is terminated at each end. Two examples of valid Modbus RS485 networks are shown below:



Follow the installation detail below exactly when installing the bus converter. No other cables shall enter or exit the bus converter through the conduit opening designated for the sensor bus network and ground wire.

mBC083 FIELD WIRING ENTRIES - CONTROLLED DRAWING



2.5.1 Grounding the Bus Converters

WARNING

An earth ground must be installed for each bus converter and shall be continuous #12-10 AWG from the bonding point.

The preferred method is to attach the Earth ground wire to the ground lug established inside enclosure using #6-32 screw and #6 star-lock washer provided.

The alternative method is to attach the Earth Ground wire to the existing ground lug situated outside the enclosure using the existing screw and #8 star-lock washer.

For complete instructions on installing and grounding the mBC083 bus converter, refer to the mBC083 Bus Converter manual available from CMC or at cmciel.com.

2.6 HazMon System – key information and metrics

Follow these best practices when working with and laying out the HazMon System network:

1. Bus converters should **Never** have the cover removed without first shutting off the power to the RS485 network.
2. Bus converters can be installed anywhere on the linear RS485 network and do not have to be at the end.
3. The maximum total length of the RS485 bus converter network is 1640 feet.
4. Each bus converter can support up to (32) sensors. As a rule of thumb, for network planning and expansion purposes, we recommend not exceeding (28) sensors.
5. WS2-HM supports up to (8) bus converters – 256 sensors max
6. EZS128 supports up to (4) bus converters – 128 sensors max
7. The number of field interconnect boxes that can be on a sensor bus network should be driven by application needs and sensible network design and layout practices.
8. Keep CAT5 branches and tees as short as possible, ideally, they are used to pick up sensors on the other side of a machine such as a conveyor or bucket elevator leg.
9. The maximum total length of the CAT5 sensor bus network is 1000 feet.
10. To facilitate a balanced sensor bus network layout, the first sensors should ideally be installed within 150 feet of the bus converter.
11. **Do not run** the CAT5 sensor network cable next to high electrical noise sources such as VFD controlled motor cables or high energy discharge lighting. At least 2 feet of separation is required.
12. **Never** install CAT5 sensor network cabling in a conduit or raceway with any other cables not rated intrinsically safe. Low voltage analog or digital control signals are not rated intrinsically safe unless installed with safety barriers. The CAT5 sensor network must never be installed in the same conduit or raceway as the data cable serving the bus converters.
13. **Read and understand** all grounding instructions for the bus converters and sensor bus network. Proper grounding is key to a successful installation.
14. **Do not discard** any of the factory supplied grounding plates, clamps, machine screws, or templates that come with the bus converters and field interconnect boxes. You will need some or all of them at some point in the installation process in order to follow our best practices.

2.7 Install the controller: EZSentinel128 or WS2-HM

Controllers are not rated for installation in a hazardous area and should always be mounted in a secure, protected location, preferably indoors. They are typically installed in MCC rooms, electrical panels or other non-hazardous locations that are not exposed to the elements.

EZS128 – The EZS128 housing should be installed using the four supplied mounting brackets and screws. The unit should be mounted to a flat surface with at least 6” of clearance around all sides of the enclosure to allow for maintenance access. All cable entries should be made to the bottom of the enclosure.

WS2-HM – Should be mounted using 35mm DIN rail and installed with the factory supplied SELV power supply. At least 6” of clearance should be provided around all sides of the enclosure to allow for ventilation and maintenance

For complete details on the installation and configuration of the EZS128 or WS2-HM controllers refer to their respective product manuals available from CMC or at cmciel.com.

2.8 Commissioning the System

If the project uses an EZSentinel128 controller refer to the ***Commissioning*** section of the EZSentinel128 Installation and Configuration Manual for information on commissioning the project

If the project uses a WS2-HM controller and an integrator supplied HMI and alarm system refer to the documentation supplied by the integrator.

A detailed commissioning checklist is provided in ***Appendix D*** of this manual. This checklist should be completed by the installer and facility operator and be maintained as a permanent record of the commissioning of the system.

3. Appendix A – Machine Worksheets

Worksheets are available for:

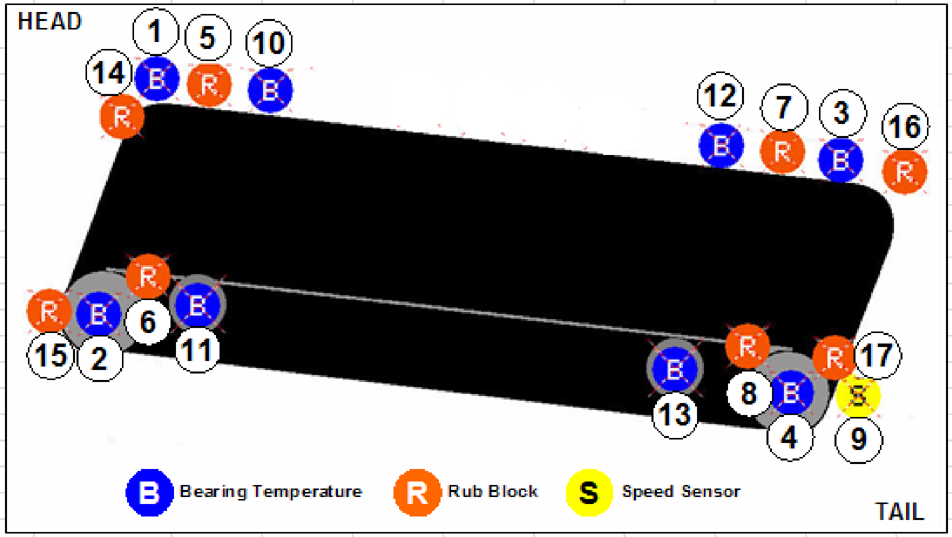
- Conveyors
- Legs / Bucket Elevators
- Drags
- Motor Drives
- Fans
- Gravity Take Up Conveyors

The worksheets should be completed in the following order:

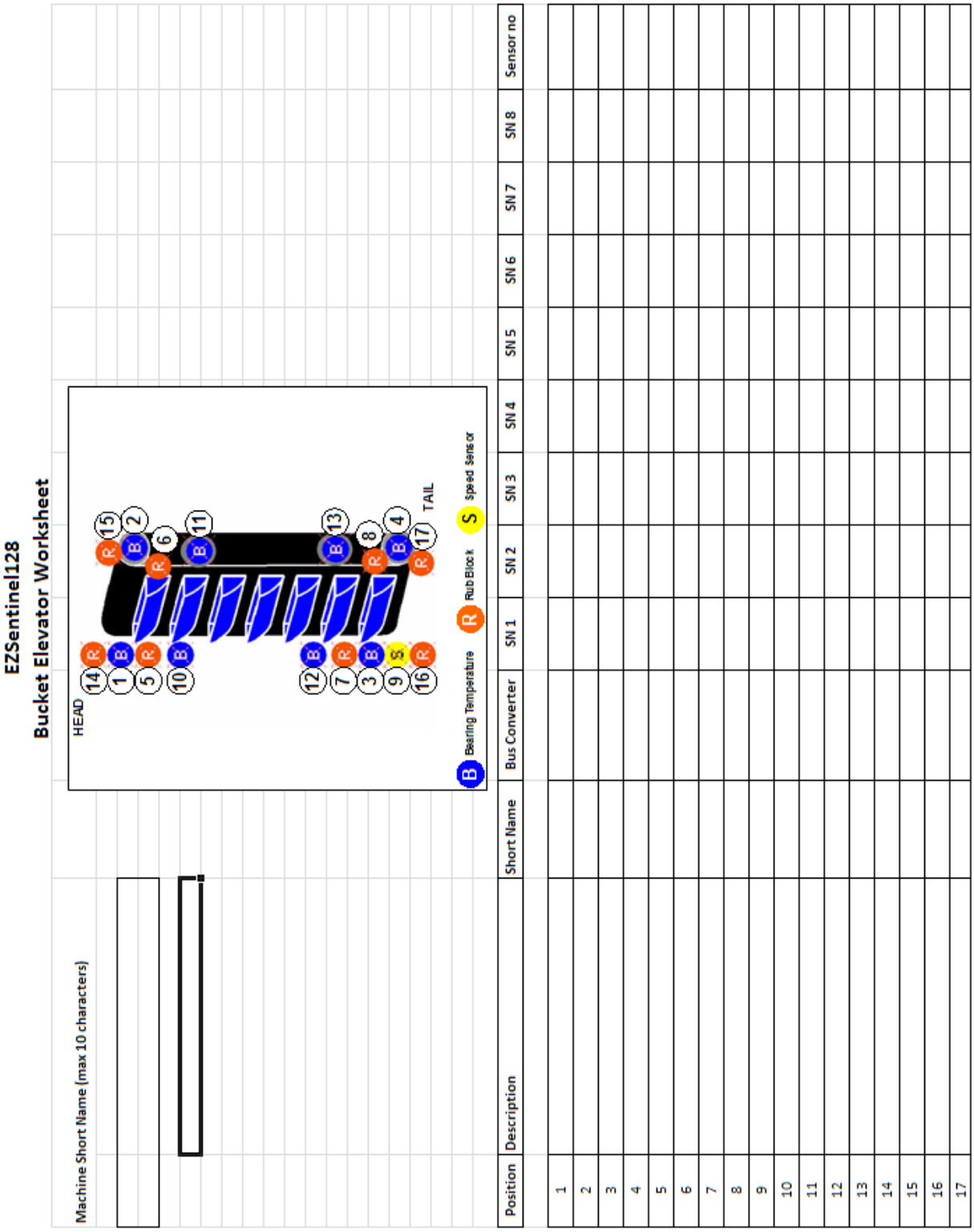
1. Enter the machine name, and sensor descriptions before beginning installation
2. Enter the serial numbers as the sensors are being installed
3. Enter the bus converter numbers as the field sensor networks are completed

EZSentinel128
Conveyor Worksheet

Machine Short Name (max 10 characters)



Position	Description	Short Name	Bus Converter	SN 1	SN 2	SN 3	SN 4	SN 5	SN 6	SN 7	SN 8	Sensor no
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												



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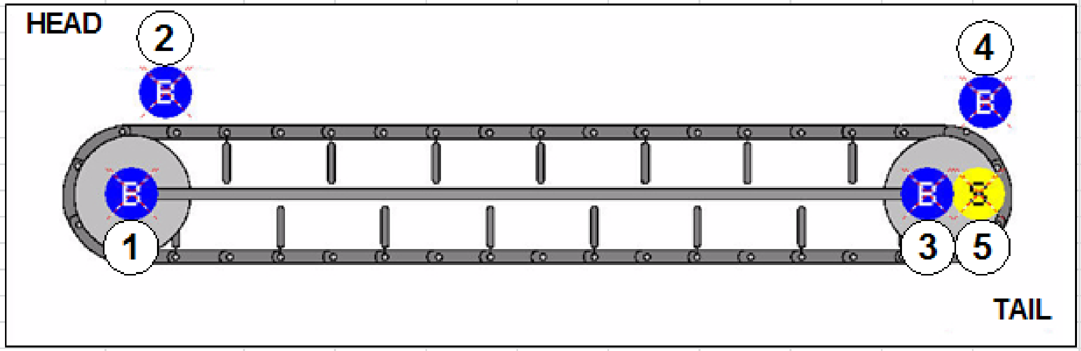
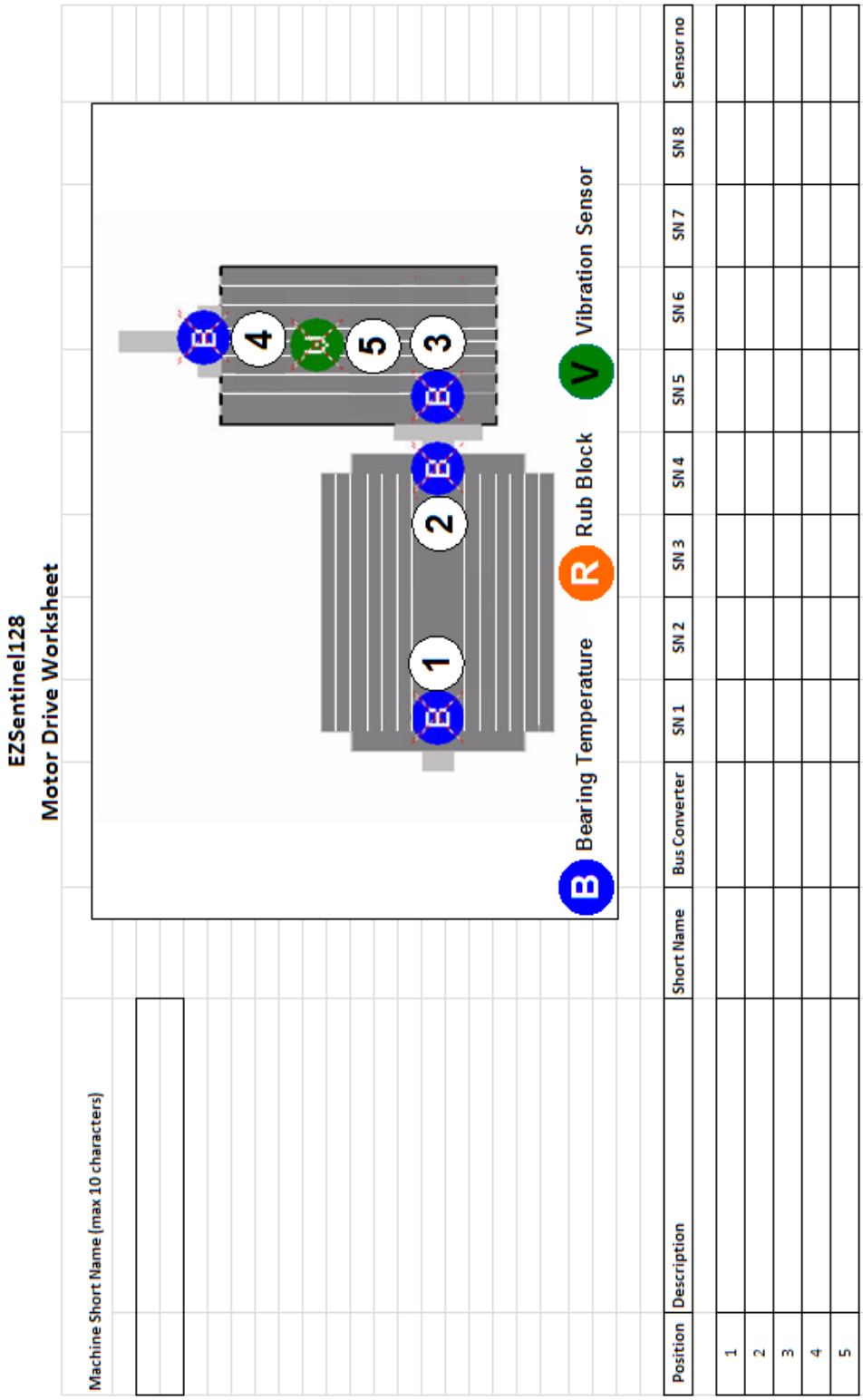
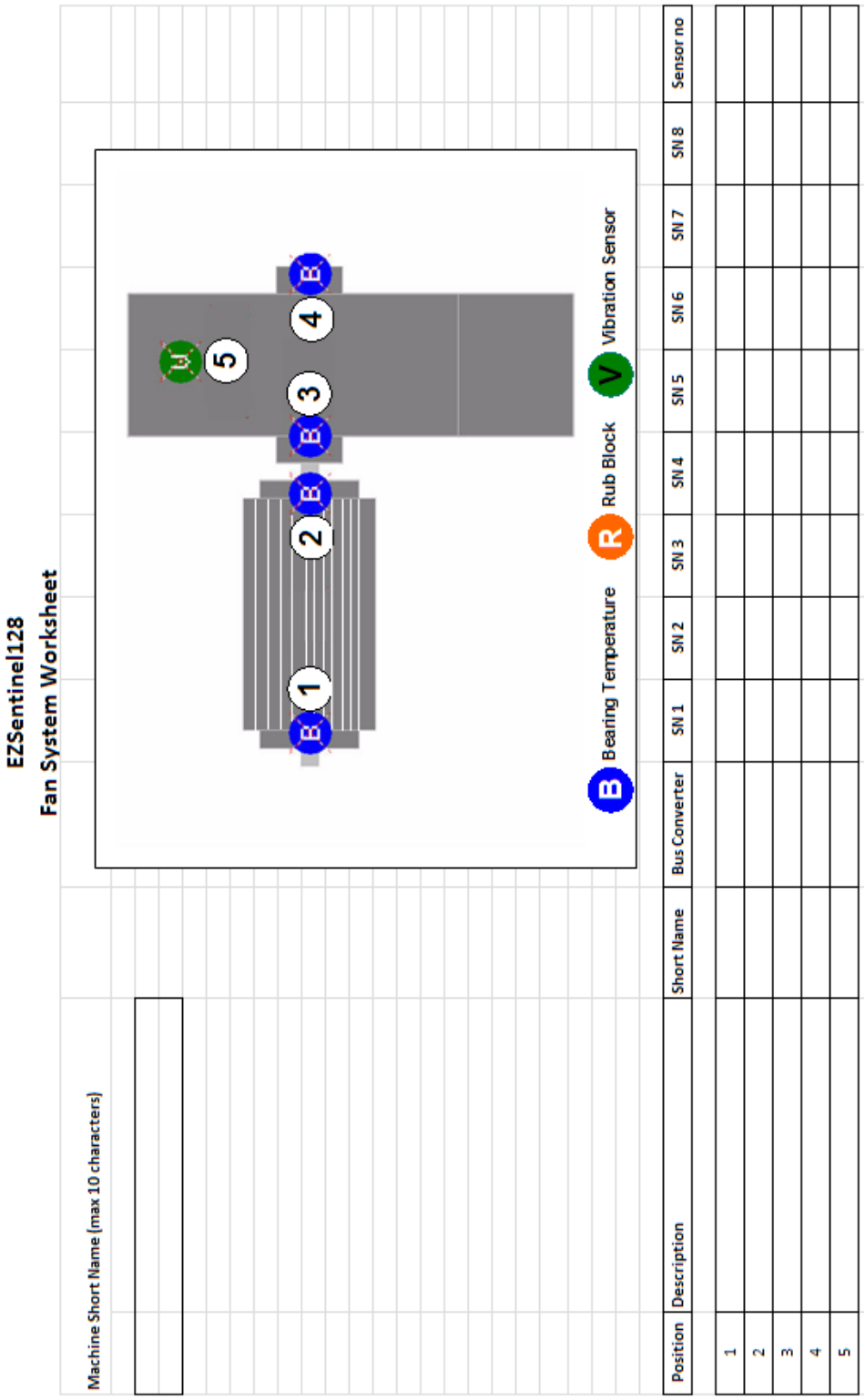
EZSentinel128
Drag Conveyor Worksheet

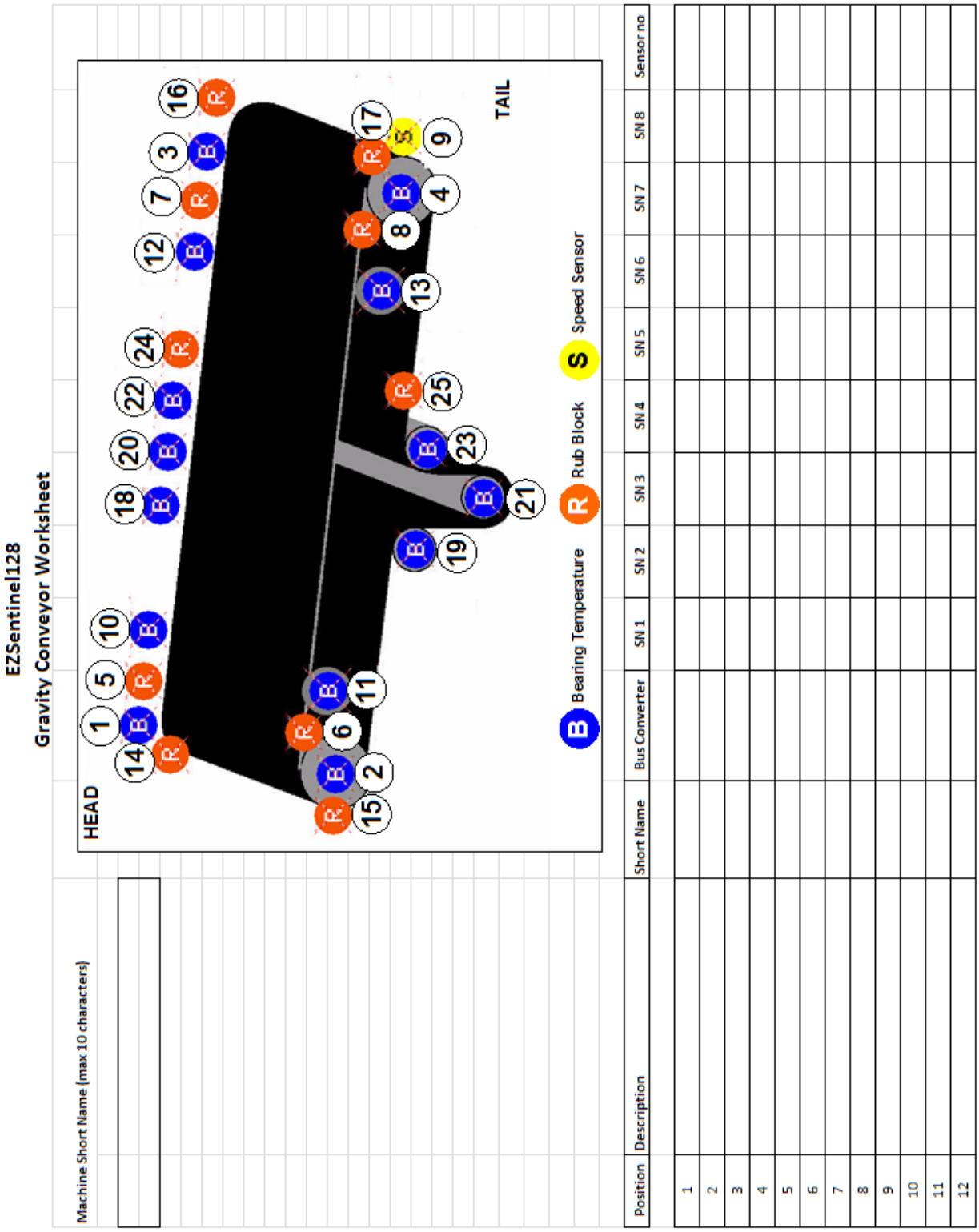
Machine Short Name (max 10 characters)



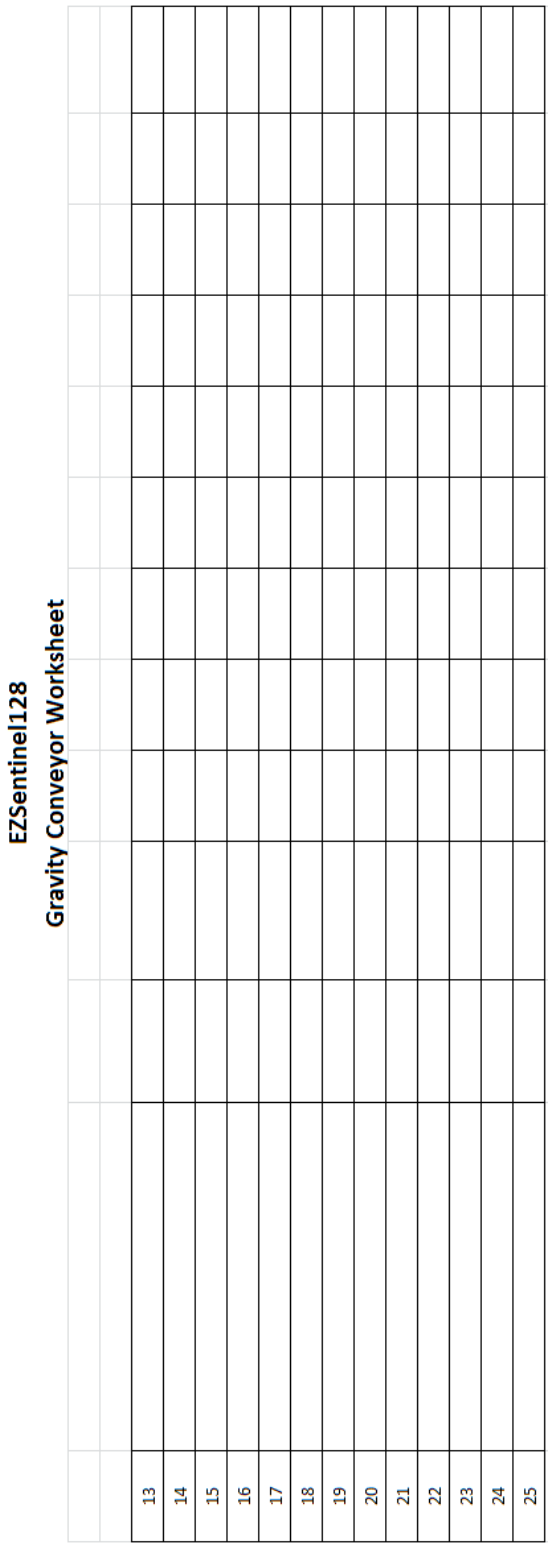
Position	Description	Short Name	Bus Converter	SN 1	SN 2	SN 3	SN 4	SN 5	SN 6	SN 7	SN 8	Sensor no
1												
2												
3												
4												
5												


EZSentinel128
Motor Drive Worksheet
Machine Short Name (max 10 characters)
B Bearing Temperature
R Rub Block
V Vibration Sensor
B 1
B 2
B 3
B 4
B 5
Position
Description
Short Name
Bus Converter
SN 1
SN 2
SN 3
SN 4
SN 5
SN 6
SN 7
SN 8
Sensor no
1
2
3
4
5


EZSentinel128
Fan System Worksheet
Machine Short Name (max 10 characters)
B Bearing Temperature
R Rub Block
V Vibration Sensor
B 1
B 2
B 3
B 4
5
Position
Description
Short Name
Bus Converter
SN 1
SN 2
SN 3
SN 4
SN 5
SN 6
SN 7
SN 8
Sensor no
1
2
3
4
5



Position	Description	Short Name	Bus Converter	SN 1	SN 2	SN 3	SN 4	SN 5	SN 6	SN 7	SN 8	Sensor no
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												


EZSentinel128
Gravity Conveyor Worksheet
13
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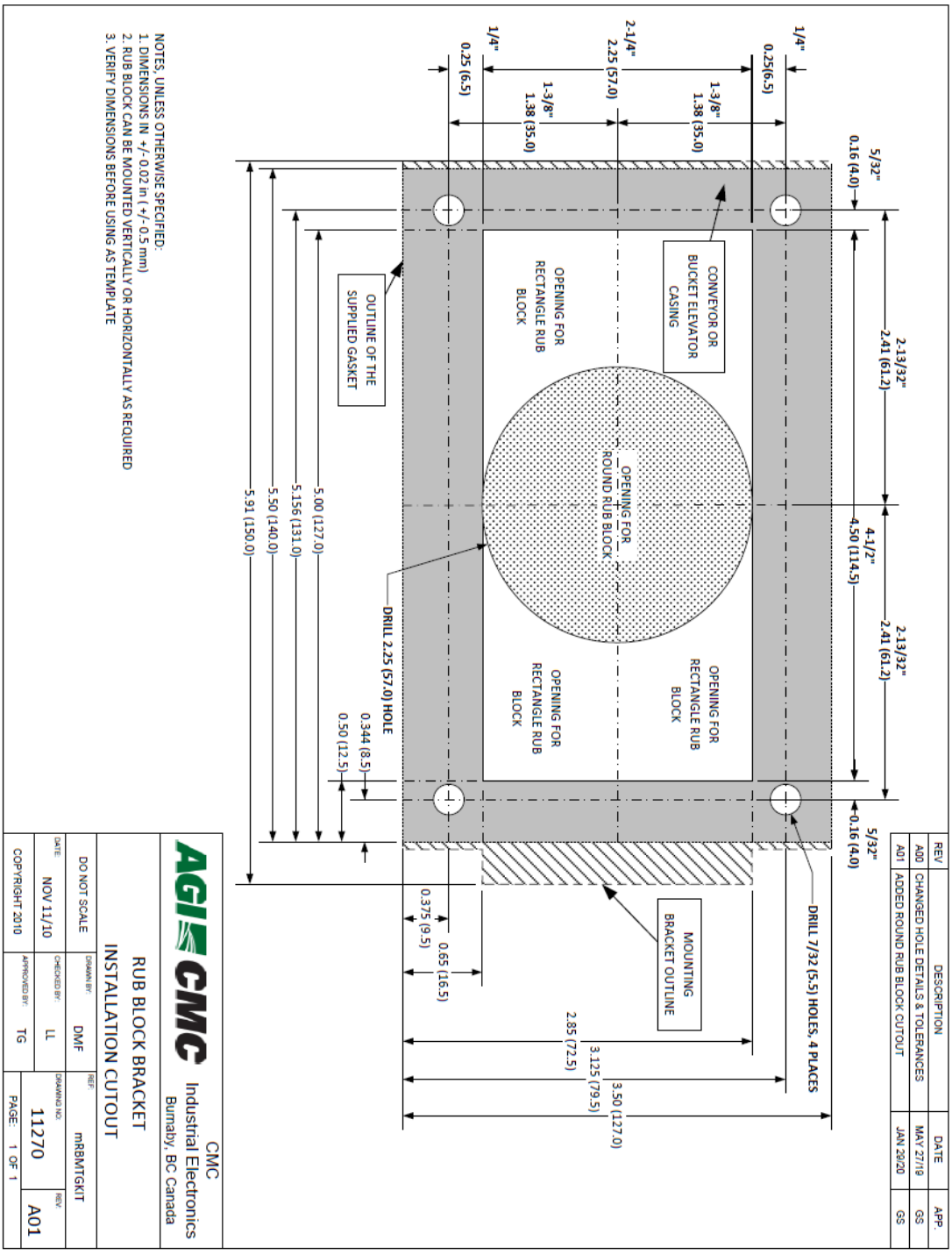
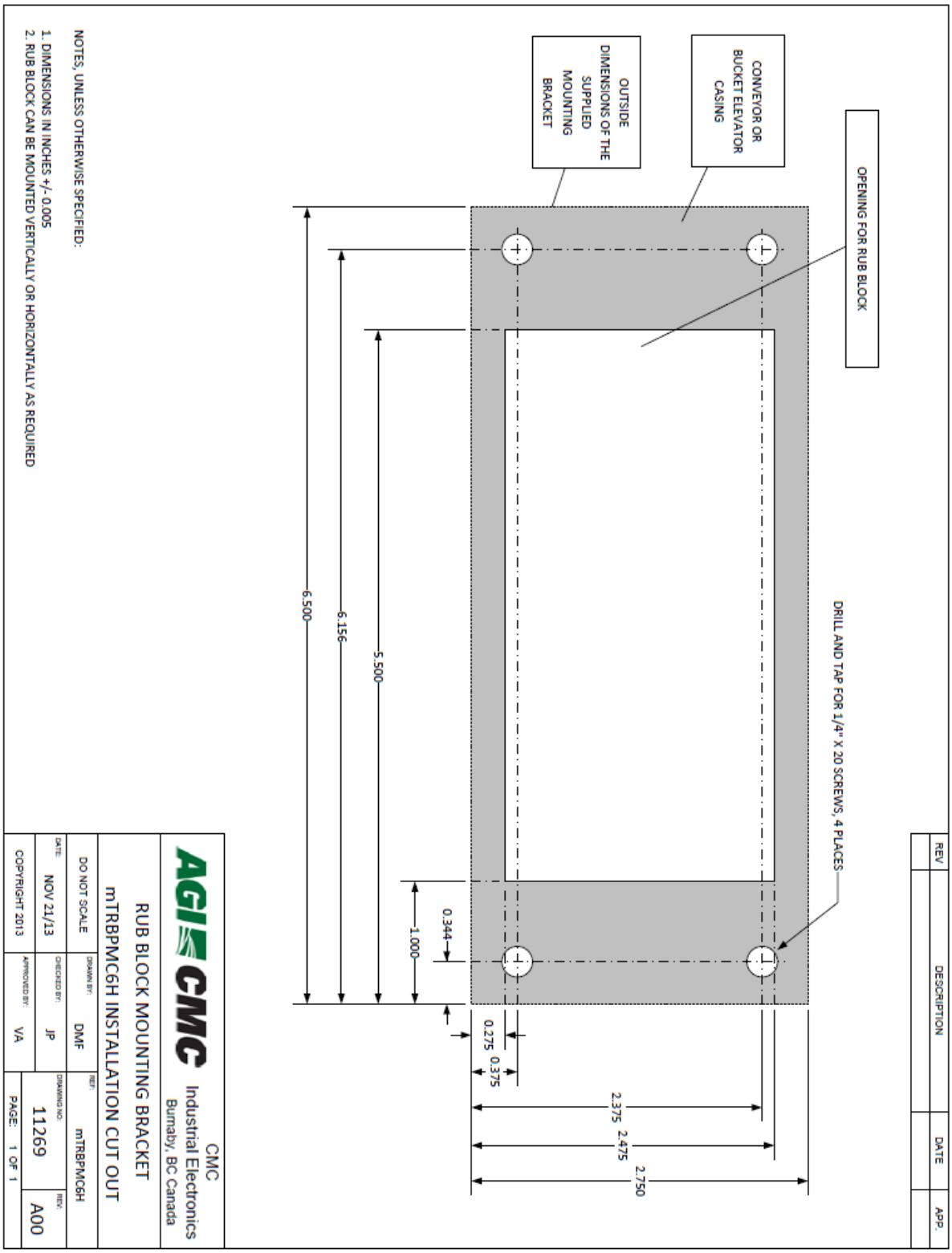
24
25

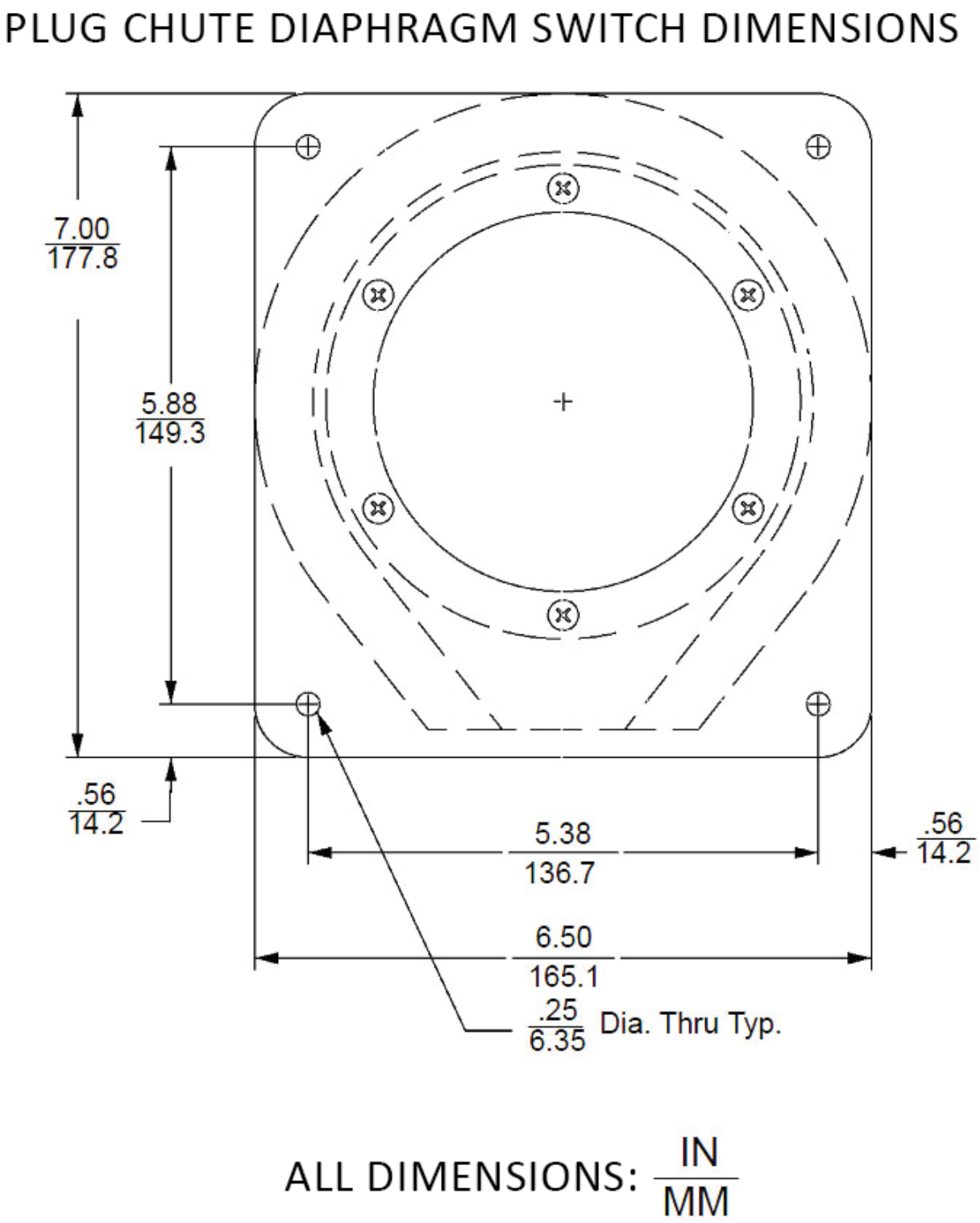
4. Appendix B – Rub Block Cut Out Template – Standard



Appendix B – Rub Block Cut Out Template – Hi Roller



Appendix C – Diaphragm Switch (plug chute) dimensional drawing



5. Appendix D – Commissioning Checklist

This checklist should be reviewed by the installer prior to commencing the project. Upon completion, the installer and facility owner should complete the checklist.

To be completed before power is applied to the system

Sensor Network and Wiring

- ☐ All field interconnect boxes have been mounted in accessible locations and are securely affixed
- ☐ No holes have been drilled in the top of any field interconnect box
- ☐ Only the sides of the field interconnect box have been used for sensor connections
- ☐ Only the bottom of the field interconnect box has been used for box to box connections
- ☐ If direct burial CAT5 cable is used, it is well strapped to prevent accidental damage during maintenance
- ☐ If metallic conduit is used for the CAT5 cables and the metallic conduit system is directly attached to the field interconnect box, ensure the metal grounding plate has been installed in the bottom of every box
- ☐ The CAT5 sensor network is fully divided from all other wiring and does not share any conduits or raceways with any other wiring such as the bus converter RS485 wiring system
- ☐ If direct burial cable is used, verify the shields of the direct burial cable are clamped to the grounding lugs provided in the field interconnect boxes
- ☐ All cable or conduit entries to the field interconnect box are tight and sealing gaskets have been used on all connectors to prevent water ingress
- ☐ Sensor liquid tight conduit has adequate drip loops and is strapped down to prevent accidental damage during maintenance
- ☐ Sensor conduit fittings are tight to prevent water ingress
- ☐ Bearing probes are adjusted 1/8” above the bearing race
- ☐ Rub block sensors are installed and have been inspected to ensure all possible off-track belt **and** pulley events are sensed
- ☐ Rub block brackets are installed using wing nuts and locked screws to allow for inspections
- ☐ Speed sensors are center-mounted to the machine shaft – either directly threaded or mounted using the magnet mount and protective shroud
- ☐ Speed sensor liquid tight conduit is fixed to the machine a minimum 2’ from the sensor to prevent damage during maintenance
- ☐ All punch-down connections were made using the proper tool and have been double checked for connection and accuracy
- ☐ All A and B branch disconnect switches in the field interconnect boxes are ***OFF***

- ☐ All sensors are installed but not plugged into the RJ11 jacks in the field interconnect boxes
- ☐ All machinery worksheets are complete, and all serial numbers have been recorded

Bus Converter Wiring

- ☐ Bus converters have been mounted in accessible locations and are securely affixed
- ☐ All bus converter RS485 network cabling is installed in a suitable raceway or conduit system for Class II, Group G, Division 1 or 2 as required for the facility
- ☐ The network is installed in its own raceway or conduit or if installed with other low voltage (24VDC or lower) cables those cables are verified not to cause interference with the RS485 network
- ☐ The correct conduit entries are used for the RS485 and sensor network cables as shown in the ***mBC083 Manual***
- ☐ All conduit connections are tight to prevent water ingress
- ☐ All bus converter connections to field interconnect boxes use factory supplied metallic conduit and connectors
- ☐ All connectors from bus converters to field interconnect boxes have sealing gaskets
- ☐ The field interconnect box where the bus converter connects has the metal grounding plate installed in the bottom and the ground screw installed connecting the plate to the circuit board
- ☐ The RS485 cable is correctly sized using the CMC cable sizing utility for the length of cable used
- ☐ The RS485 wiring is installed as shown in the ***mBC083 Manual*** and the connections double checked
- ☐ The RS485 network is connected at the EZS128 or WS2-HM Webserver, and that the connections are as described in the Installation and Technical Manuals
- ☐ The address and network termination switches for each bus converter and the HMI are set as shown in the ***mBC083 Manual***

To be completed after power is applied to the system

Bus Converter Network

- ☐ Configure the EZS128 or WS2-HM as described in their respective Technical Manuals and ensure the maximum number of bus converters has not been exceeded for each controller type: EZS128 (4) mBC083, WS2-HM (8) mBC083.
- ☐ Starting at the first bus converter on the network, verify that both the red and green LEDs are flashing on the bus converters.

- ☐ If the red or green LED is not flashing, remove power and verify the wiring for the bus converter network and the address switch and termination settings on the HMI and bus converters.

Sensor bus network

- ☐ Starting with the first field interconnect box after the bus converter connect, verify that both the red and green LEDs inside the field interconnect box are on.
- ☐ If sensors are present in this box, connect the sensors one at a time and verify the LEDs remain on.
- ☐ Turn on the Branch A disconnect and verify the red and green LEDs remain on
- ☐ If one or more of the LEDs go off, verify the CAT5 wiring between the field interconnect boxes
- ☐ Move to the field interconnect on Branch A and repeat ensuring that the red and green LEDs remain on after each operation
- ☐ Repeat the procedure until all sensors have been connected and all branches in use are verified

To be completed after system configuration

Verifying sensor location on the HMI

Full details on the HMI configuration are provided in the Technical Manuals for the EZS128 and the WS2-HM. For each sensor, the following minimum verification should be completed

- ☐ For temperature sensors locate the sensor value on the HMI display
- ☐ The sensor should be displaying ambient temperature
- ☐ Use the EZTest handheld tester to emulate each sensor to verify that the HMI value changes exactly as is driven by the tester
- ☐ If the temperature value is displayed in multiple locations on the HMI ensure all of the locations are linked to the correct sensor
- ☐ For speed sensors use a handheld tachometer to verify the speed displayed on the HMI is the same as the shaft speed for the machine being monitored
- ☐ Stop and start the machine while observing the display to ensure the speed sensor is linked to the correct speed display
- ☐ Repeat the above test for all sensors on the system

Alarm Test

This section only applies to the EZS128. For WS2-HM systems, the systems integrator should have designed a test procedure for the alarming system supplied. The integrator's test procedure should provide at minimum the functionality described in this section.
Note: the machine under test must be running when these tests are performed if direct machinery control is configured on the EZS128.

- For each sensor, using the "Alarm Test" function on the EZS128, force a **warning** condition by using the EZTest handheld tool to set the sensor value at or above the warning setpoint for temperature sensors or at or below the low speed warning setpoint for speed sensors
- The correct alarm annunciator should be indicated on the alarm test screen and the horn should sound
- For each sensor, using the "Alarm Test" function on the EZS128, force an **alarm** condition by using the EZTest handheld tool to set the sensor value at or above the alarm setpoint for temperature sensors or at or below the low speed alarm setpoint for speed sensors
- The correct alarm annunciator should be indicated on the alarm test screen. **Note**: the warning indicator will also be set) and the horn should sound
- In addition to the horn sounding, if configured, the machine and all machines interlocked to the primary machine controlled by the **EZS128 must stop**
- This test is repeated for each sensor installed on the system

We the undersigned agree that the above basic commissioning requirements have been met. We also agree that the responsibility for safe operation of the facility rests solely with the facility operator. Hazard monitoring systems require frequent inspection and verification. It is the facility operator's sole responsibility to ensure the monitoring system is fully operational and regularly inspected.

_____ _____

Installer Signature **Facility Operator Signature**

_____ _____

Print Installer Name **Print Facility Operator Name**

_____

Company

_____

Site name

_____

Address

_____

City

_____

State/Province, Postal code

_____

Date