Installation Planning Guide EZDP-2126 Rev D

Assurance Monitoring System—Series 2

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1. About Cutsforth

Cutsforth specializes in developing innovative new technologies and services to support the power generation industry. Cutsforth's patented EASYchange® brush holder design, online truing service, InsightCM™ condition monitoring software, and patented shaft grounding and monitoring systems have been installed across the globe in generators of all sizes and in nearly every industry application, including nuclear, natural gas, coal, wind, and hydroelectric.

Cutsforth's knowledge and commitment to excellence drives our innovative solutions for the changing needs of the power industry. Whether it is a quick response to a critical situation or a new way of solving an old problem, our commitment to quality ensures that our customers receive best-in-class products and services—Cutsforth is the Power of Innovation.

Cutsforth, Inc. started back in 1991 as a small company focused primarily on making replacement brush holders for generators and exciters. Today, after 30+ years in business, Cutsforth's experience and innovative designs have brought its best-in-class excitation brush holder and shaft grounding replacements and collector ring services to some of the world's largest power companies.

1.1. Cutsforth Products

- EASYchange® Removable Brush Holders
- EASYchange® Brush Condition Monitoring
- Cutsforth Shaft Grounding Systems
- Rotor Flux Monitoring
- Electro-Magnetic Interference Monitoring
- InsightCM™ Condition Monitoring Software

1.2. Cutsforth Field Services

Cutsforth provides comprehensive product installations for all product offerings as well as on-site training after the installation. We work efficiently during your outage to ensure a smooth upgrade to our innovative solutions such as Product Installations, Online Collector Ring and Commutator Truing, Spiral Groove Restoration, and Consulting and Emergency Services.

1.3. Cutsforth Automation and Control Services

Cutsforth provides comprehensive Automation and Control services which include data historian integration, InsightCM™ integration, DCS logic, engineered drawings and much more. This further complements our turnkey monitoring system installations.

2. Legal Information

2.1. Limited Warranty

This document is provided 'as is' and is subject to being changed, without notice, in future editions. Cutsforth reviews this document carefully for technical accuracy; however, CUTSFORTH MAKES NO EXPRESS OR IMPLIED WARRANTY AS TO THE ACCURACY OF THE INFORMATION WITHIN THIS MANUAL AS IT RELATES TO SPECIFIC INSTALLATION. THE CUSTOMER IS RESPONSIBLE FOR VERIFYING INSTALLATION AND OPERATING CONDITIONS AT EACH INSTALLATION LOCATION AND FOR EACH GENERATOR TYPE. Cutsforth warrants that its hardware products will be free of defects in materials and workmanship that cause the product to fail to substantially conform to the applicable Cutsforth published specifications for one (1) year from the date of invoice.

For a period of ninety (90) days from the date of invoice, Cutsforth warrants that (i) its software products will perform substantially in accordance with the applicable documentation provided with the software, and (ii) the software media will be free from defects in materials and workmanship. If Cutsforth receives notice of a defect or non-conformance during the applicable warranty period, Cutsforth will, in its discretion: (i) repair or replace the affected product, or (ii) refund the fees paid for the affected product. Repaired or replaced hardware will be warranted for the remainder of the original warranty period or ninety (90) days, whichever is longer. If Cutsforth elects to repair or replace the product, Cutsforth may use new or refurbished parts or products that are equivalent to new in performance and reliability and are at least functionally equivalent to the original part or product. You must obtain an RMA number from Cutsforth before returning any product to Cutsforth. Cutsforth reserves the right to charge a fee for examining and testing hardware not covered by the Limited Warranty.

This Limited Warranty does not apply if the defect of the product resulted from improper or inadequate maintenance, installation, repair, or calibration performed by a party other than Cutsforth; unauthorized modification; improper environment; use of an improper hardware or software key; improper use or operation outside of the specification for the product; improper voltages; accident, abuse, or neglect; or a hazard such as lightning, flood, or other act of nature.

THE REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND THE CUSTOMER'S SOLE REMEDIES, AND SHALL APPLY EVEN IF SUCH REMEDIES FAIL OF THEIR ESSENTIAL PURPOSE.

WARNING REGARDING USE OF CUTSFORTH SHAFT MONITORING EQUIPMENT: CUSTOMER IS ULTIMATELY RESPONSIBLE FOR VERIFYING AND VALIDATING THE SUITABILITY AND RELIABILITY OF THE PRODUCTS WHENEVER THE PRODUCTS ARE INCORPORATED IN THEIR SYSTEM OR APPLICATION, INCLUDING THE APPROPRIATE DESIGN, PROCESS, AND SAFETY LEVEL OF SUCH SYSTEM OR APPLICATION. PRODUCTS ARE NOT DESIGNED, MANUFACTURED, OR TESTED FOR USE IN LIFE OR SAFETY CRITICAL SYSTEMS, OR ANY OTHER APPLICATION IN WHICH THE FAILURE OF THE PRODUCT OR SERVICE COULD LEAD TO DEATH, PERSONAL INJURY, SEVERE PROPERTY DAMAGE OR ENVIRONMENTAL HARM (COLLECTIVELY, "HIGH-RISK USES"). FURTHER, PRUDENT STEPS MUST BE TAKEN TO PROTECT AGAINST FAILURES, INCLUDING PROVIDING BACK-UP AND SHUT-DOWN MECHANISMS. CUTSFORTH EXPRESSLY DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY OF FITNESS OF THE PRODUCTS OR SERVICES FOR HIGH-RISK USES.

CUTSFORTH DOES NOT WARRANT, GUARANTEE, OR MAKE ANY REPRESENTATIONS REGARDING THE USE OF OR THE RESULTS OF THE USE OF THE PRODUCTS IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. CUTSFORTH DOES NOT WARRANT THAT THE OPERATION OF THE PRODUCTS WILL BE UNINTERRUPTED OR ERROR FREE. INCIDENTAL AND CONSEQUENTIAL DAMAGES, INCLUDING LOSS OF USE, ARE SPECIFICALLY EXCLUDED FROM THIS WARRANTY; THE MAXIMUM VALUE OF A WARRANTY CLAIM CANNOT EXCEED THE ORIGINAL VALUE OF THE ASSEMBLY OR COMPONENT.

2.2. Copyright

2.3. Patents

Please send patent information requests to patents@cutsforth.com.

3. Safety Information

3.1. Safety Information [English]

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

3.1.1. Safety Conventions

NOTE:

Additional information.

ELECTRICAL DANGER

Indicates an action or specific equipment area that can result in personal injury or death from an electrical hazard if proper precautions are not taken.

CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury or equipment damage.

WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

ROTATING PART CAUTION

Indicates possible injury from rotating parts.

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

3.1.2. General Safety Instructions

ELECTRICAL DANGER

Only qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid injury should work with Cutsforth products. Among the many considerations are the following:

- Avoid contact with energized circuits.
- Avoid contact with rotating parts.
- Never install any component that appears not to be functioning in a normal manner.
- Always ensure proper installation of the holder assembly and shaft grounding rope.

ELECTRICAL DANGER

Before working on the generator, de-energize, lock out, and tag out all power sources to the generator, shaft, and accessory devices. Electric shock and death may result due to failure to heed this warning.

ROTATING PART CAUTION

High-voltage and rotating parts can cause serious or fatal injury. Installation, operation, and maintenance of this product must be performed only by qualified personnel, in accordance with all applicable safety regulations and guidelines.

3.2. Consignes de Sécurité [Français]

Les informations qui suivent sont essentielles afin d'assurer la sécurité de l'utilisateur lors de l'installation et de l'opération de l'équipement. Assurez-vous de bien lire et de comprendre tous les avertissements et mises en garde qui suivent.

3.2.1. Conventions de Sécurité

NOTE:

Informations supplémentaires.

RISQUES DE CHOC ÉLECTRIQUE

Indique que l'action ou la partie de l'équipement concernée peut mener à des blessures par électrisation ou à la mort par électrocution si les précautions adéquates ne sont pas prises.

MISE EN GARDE

Indique la présence d'une situation dangereuse qui, si elle n'est pas évitée, pourrait mener à des blessures mineures à modérées ou à des dommages matériels.

AVERTISSEMENT

Indique la présence d'une situation dangereuse qui, si elle n'est pas évitée, pourrait mener à des blessures sévères ou à la mort.

MISE EN GARDE : PIÈCE ROTATIVE

Indique la présence de pièces d'équipement rotatives pouvant causer des blessures.

DANGER

Indique la présence d'une situation dangereuse qui, si elle n'est pas évitée, pourrait mener à des blessures sévères ou à la mort.

3.2.2. Consignes de Sécurité Générales

RISQUES DE CHOC ÉLECTRIQUE

L'utilisation des produits Cutsforth n'est recommandée qu'aux professionnels qualifiés qui savent comment reconnaître la présence de risques de choc électrique ainsi que les consignes de sécurité à suivre pour éviter les blessures liées à ces risques. Lesdites consignes de sécurité incluent, sans s'y limiter :

- Éviter tout contact avec des circuits alimentés;
- Éviter tout contact avec des pièces d'équipement rotatives;
- Ne jamais installer de composante ne paraissant pas fonctionner normalement;
- Toujours s'assurer que la structure de soutien et le câble de terre de l'arbre de la génératrice sont correctement installés.

RISQUES DE CHOC ÉLECTRIQUE

Avant de travailler sur la génératrice, désalimentez, cadenassez et étiquetez toutes les sources d'énergies liées à la génératrice, à l'arbre et aux appareils accessoires. L'opérateur s'expose à des risques de chocs électriques pouvant causer la mort s'il ne tient pas compte de cet avertissment.

MISE EN GARDE : PIÈCE ROTATIVE

Les pièces d'équipement rotatives et sous haute tension peuvent causer des blessures sévères ou fatales. L'installation, l'opération et la manutention de ce produit ne doivent être faites que par des professionnels qualifiés et en respectant toutes les règles et consignes de sécurité applicables.

4. Installation Planning for the Cutsforth Assurance Monitoring System—Series 2

This manual is a guide for planning the installation of the Cutsforth Assurance Monitoring System – Series 2. Review the documentation for the original or OEM shaft grounding system for planning the removal of that system.

This manual does not cover all details or variations in equipment, nor does it consider every possible contingency for installation, operation, or maintenance. If you have questions or concerns that are not addressed in this manual, contact Cutsforth Engineering Support.

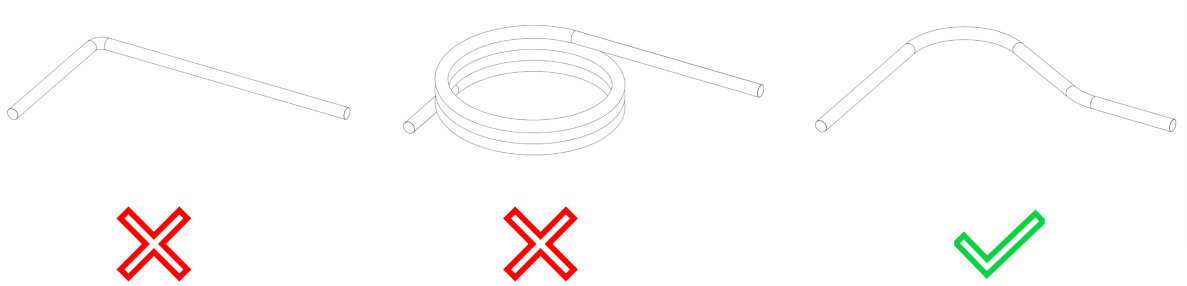
5. Installation Strategies

Determine the best component locations for your installation by applying the following strategies.

5.1. Cabling Requirements

Please review the list of best practices for installation below to help ensure maximum effectiveness of your Cutsforth Assurance Monitoring System:

- Avoid sharp bends and coils in the grounding wire whenever possible. Bending or coiling the conductor can create induction back on itself and reduce grounding effectiveness.



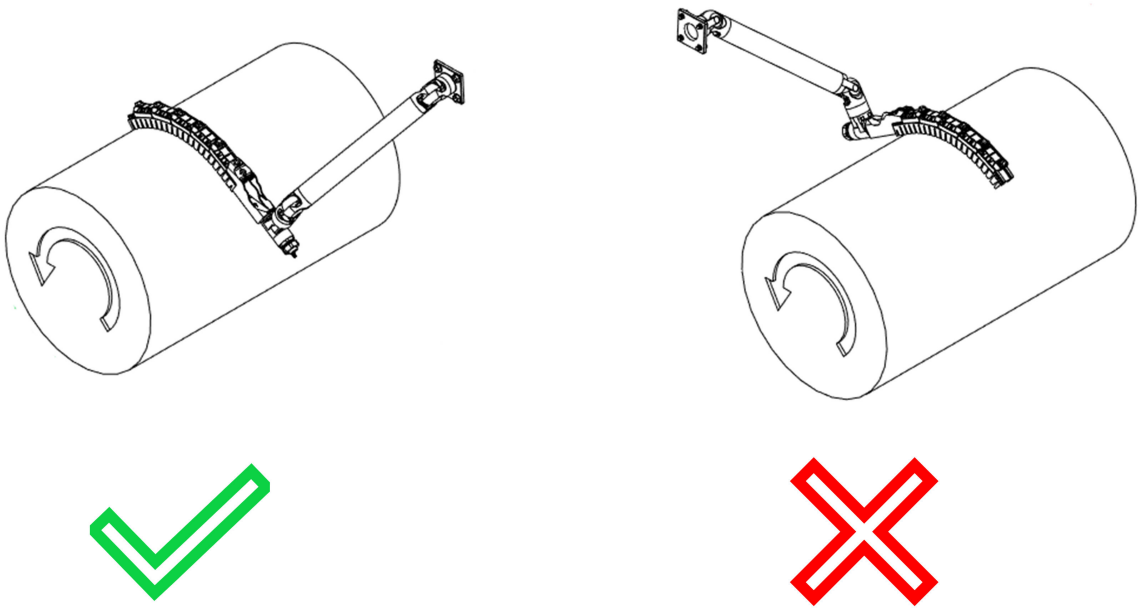
- The grounding conductor and signal cable shall be routed according to the shortest possible paths.
  - For Series 3 Shaft Grounding Assemblies (SGA):
    - The total ground conductor length from the SGA to the unit case's ground termination point shall not exceed 5 ft (1.5 m).
    - The total signal cable length from the SGA to the Cutsforth Monitoring System shall not exceed 30 ft (9 m). Deviations require sign-off by Cutsforth Engineering.

5.2. Positioning the Cutsforth Shaft Grounding Assembly

The Cutsforth Shaft Grounding Assembly has a maximum operating temperature of 150°C (302°F).

The Cutsforth Shaft Grounding Assembly is installed on the same portion of exposed shaft as the previous grounding equipment.

The Shaft Grounding Assembly must be installed on the "uphill" side of the shaft rotation. Installing on this side of the shaft ensures that the rope does not bunch up or bind up inside the rope guide. The configuration on the left in the following illustration shows the correct orientation.



5.3. Determining a Ground Conductor Termination Location

The goal for selecting a grounding location is to electrically bond the shaft to the unit case. The unit case is defined by the lower half of the turbine case, generator case, or coupler case near the SGA to which the shaft can be grounded. Cutsforth suggests drilling and tapping into the lower half of the unit case to create a grounding location close to the Shaft Grounding Assembly. The location at which the ground wire will terminate should have all paint removed and should be free of all contaminants to create a smooth, conductive surface. Structural steel and station ground are examples of unacceptable grounding locations. It is important to note that it is not necessary for the ground conductor to be grounded to an existing generator grounding pad.

5.4. Identifying an Accessible and Safe Monitoring System Mounting Location

The Assurance Monitoring System has a minimum/maximum operating temperature range of –20°C (–4°F) to 65°C (149°F). Avoid mounting the enclosure in areas where the temperature falls outside this range on a regular basis. If possible, avoid mounting the monitoring system in a location that experiences direct sunlight for extended periods of time throughout the day.

The monitoring system should be installed in a location that does not complicate generator disassembly during outages.

The monitoring system should be accessible to personnel for data collection using the local display or monitoring system test points, as well as for servicing and troubleshooting, as needed.

The monitoring system should be mounted in a location that does not experience excessive vibration. Mounting directly to rotating equipment, such as a generator or other vibrating structures, is not recommended. All cabling should be strain-relieved near input connectors. Take care to not directionally bias cable connectors when applying strain relief.

5.5. Mounting the Assurance Monitoring System

The Assurance Monitoring System enclosure is commonly installed using strut channel provided by the electrical contractor. Cutsforth recommends the use of a floor-mounted strut channel structure, as it is typically less susceptible to excessive vibration. If a wall-mounted structure is necessary, Cutsforth recommends using vibration-isolation mounting. The example image below shows a suitable location.

5.6. Power Requirements:

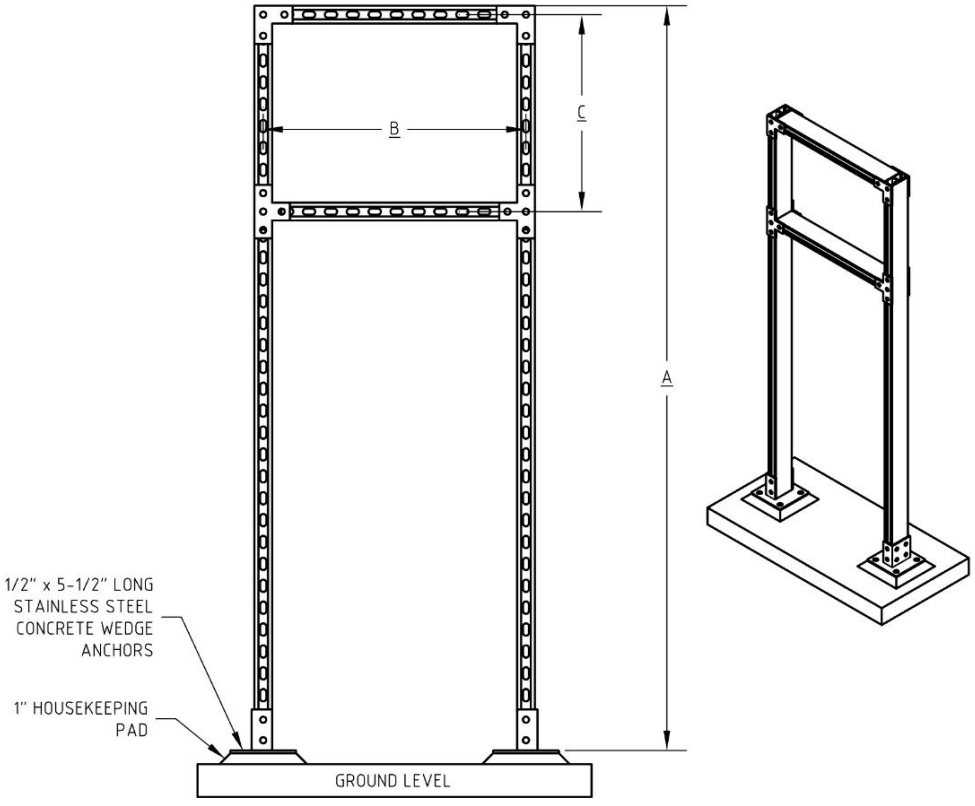
Power Requirement	Value
Voltage	85–264 VAC
Recommended breaker size	20 A
Recommended power cabling wire gauge	12 AWG
Actual operational current draw	~ 0.5 A at 120 VAC

5.7. Conduit and Strut Channel Recommendations

Component	Standard Recommendation	Recommendation for High-Corrosion Environments
Conduit type	Galvanized rigid metal conduit (RMC)	Rigid Aluminum Conduit (RAC)
Conduit fittings type	Malleable	Aluminum
Strut channel type	Hot dipped galvanized, back-to-back	316 Stainless steel
Mounting hardware	316 Stainless steel	316 Stainless steel
Liquid flexible metallic conduit	Type HCX	Type HCX

Cutsforth recommends that a duct seal be used to seal the inside of any conduit entering the Cutsforth monitoring system enclosure(s). The duct seal should be non-permanent in nature to accommodate future equipment or cable maintenance.

5.7.1. Recommended Strut Rack Design

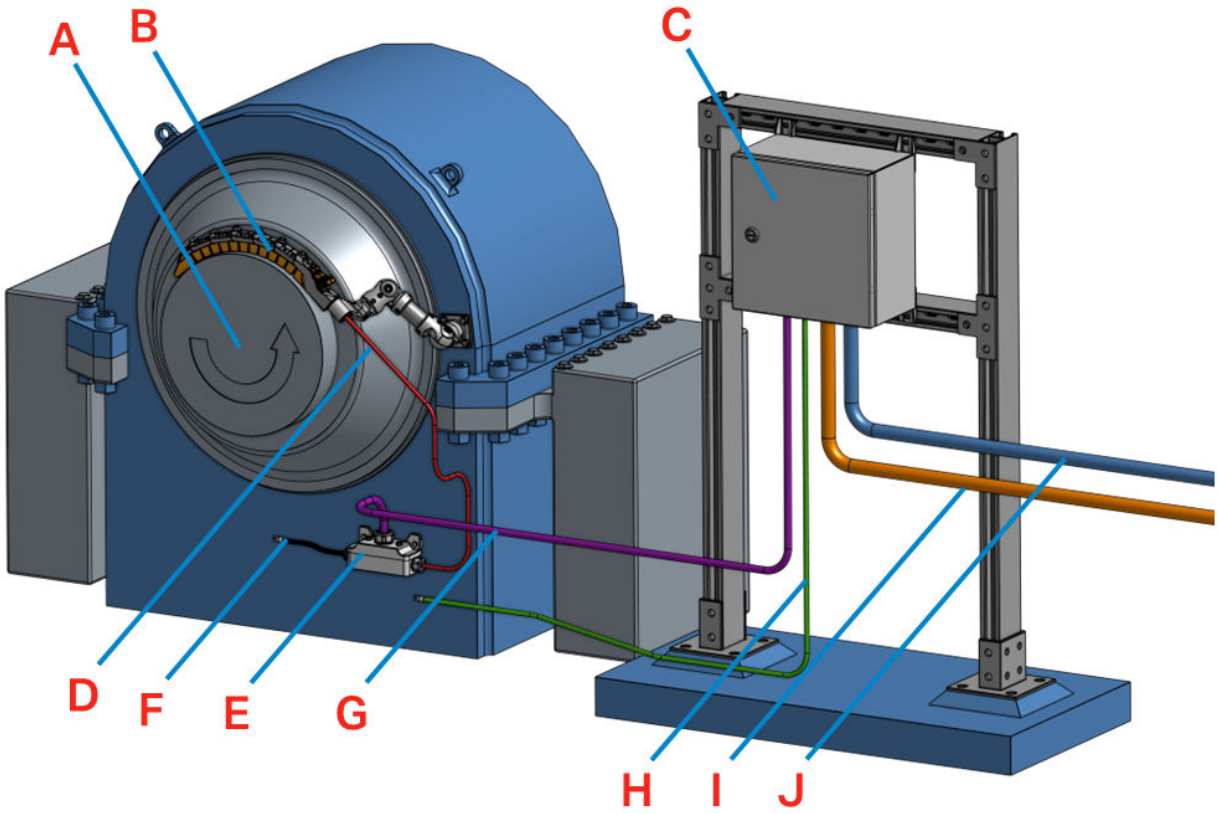


A (in (cm))	B (in (cm))	C (in (cm))
68 (173)	24 (61)	Refer to enclosure mounting feet dimensions

6. Diagrams

6.1. Conduit Layout

Color on Diagram (next page)	Conduit Run Description	Conduit Trade Size	Max Run Length	Wire Description	Purpose	Wire Supplied by	Conduit Supplied by
Red	Shaft grounding assembly to junction box	3/8 in (1 cm)	4 ft (1.2 m)	Twisted pair, individually shielded, high temp, 18 AWG + 8 AWG ground	Signals and ground from SGA to junction box	Cutsforth	Cutsforth
Black	Junction box to unit case ground	N/A	1 ft (0.3 m)	Single conductor, 8 AWG, high temp	Ground from junction box to unit case ground	Cutsforth	N/A
Purple	Junction box to monitoring system	1 in (2.5 cm)	27 ft (8.2 m)	Two high-voltage, CAT6a ethernet cables	Signals from junction box to monitoring system	Cutsforth	Plant electrical contractor
Green	Monitoring system to unit case ground	N/A	20 ft (6.1 m)	Single conductor, 12 AWG	Case ground connection for monitoring system enclosure	Cutsforth	N/A
Blue	Dedicated 120V AC power to monitoring system	3/4 in (2 cm)	N/A	AC 85–264 V AC, 47–440 Hz, 10 W 20 A circuit	AC power for monitoring system	Plant electrical contractor	Plant electrical contractor
Orange	Data output to control room	3/4 in (2 cm)	N/A	Dependent on data output type (Modbus TCP/IP, RTU, or [optional] 4-20mA)	Monitoring output to plant's control room	Plant electrical contractor	Plant electrical contractor

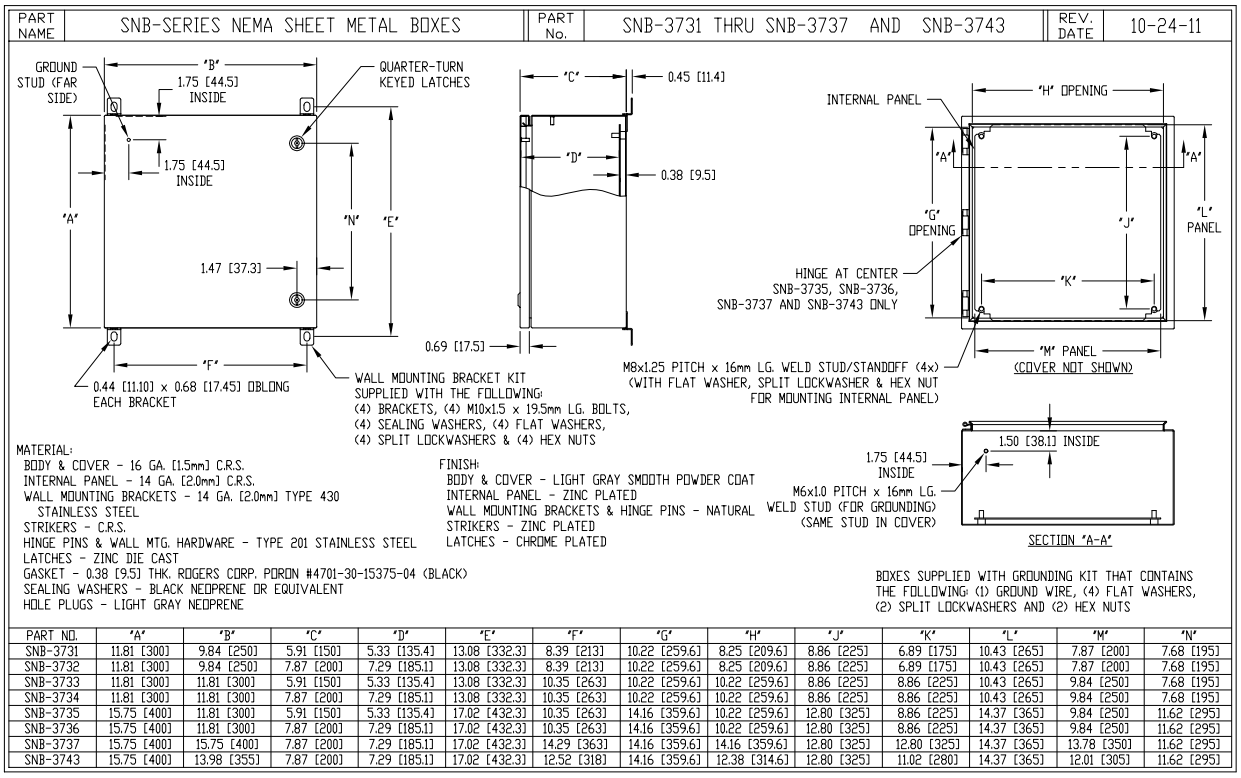


Part	Name
A	Shaft Rotation Direction
B	Shaft Grounding Assembly
C	Cutsforth Assurance Monitoring System
D	(Red) Signal and Ground Cable from SGA to Junction Box
E	Junction Box
F	(Black) 8 AWG from Junction Box to Unit Case Ground
G	(Purple) 3/4 in (2 cm) Conduit from Junction Box to Monitoring System
H	(Green) 12 AWG from Monitoring System Enclosure to Unit Case Ground
I	(Orange) 3/4 in (2 cm) Conduit for Data Output to Control Room
J	(Blue) 3/4 in (2 cm) Conduit for Plant Power Input

6.2. Monitoring System Enclosure

6.2.1. Painted Steel Enclosure

Catalog Number	A	B	C	Steel Type	Door/Body Gauge	Latch Qty
SNB-3734	11.81 in (300 mm)	11.81 in (300 mm)	7.87 in (200 mm)	Painted Steel, Cold Rolled	16	1



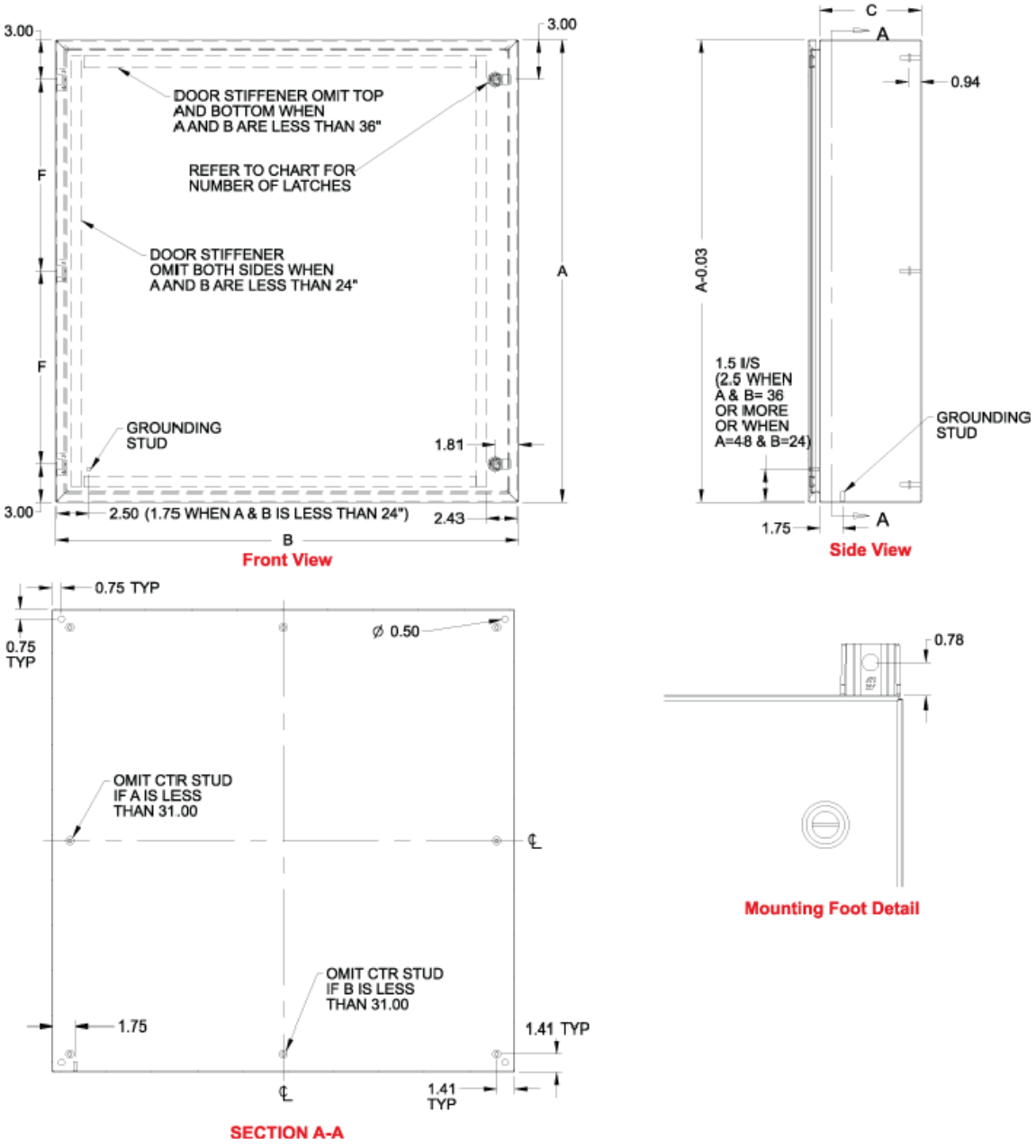
PART NO.	'A'	'B'	'C'	'D'	'E'	'F'	'G'	'H'	'J'	'K'	'L'	'M'	'N'
SNB-3731	11.81 [300]	9.84 [250]	5.91 [150]	5.33 [135.4]	13.08 [332.3]	8.39 [213]	10.22 [259.6]	8.25 [209.6]	8.86 [225]	6.89 [175]	10.43 [265]	7.87 [200]	7.68 [195]
SNB-3732	11.81 [300]	9.84 [250]	7.87 [200]	7.29 [185.1]	13.08 [332.3]	8.39 [213]	10.22 [259.6]	8.25 [209.6]	8.86 [225]	6.89 [175]	10.43 [265]	7.87 [200]	7.68 [195]
SNB-3733	11.81 [300]	11.81 [300]	5.91 [150]	5.33 [135.4]	13.08 [332.3]	10.35 [263]	10.22 [259.6]	10.22 [259.6]	8.86 [225]	8.86 [225]	10.43 [265]	9.84 [250]	7.68 [195]
SNB-3734	11.81 [300]	11.81 [300]	7.87 [200]	7.29 [185.1]	13.08 [332.3]	10.35 [263]	10.22 [259.6]	10.22 [259.6]	8.86 [225]	8.86 [225]	10.43 [265]	9.84 [250]	7.68 [195]
SNB-3735	15.75 [400]	11.81 [300]	5.91 [150]	5.33 [135.4]	17.02 [432.3]	10.35 [263]	14.16 [359.6]	10.22 [259.6]	12.80 [325]	8.86 [225]	14.37 [365]	9.84 [250]	11.62 [295]
SNB-3736	15.75 [400]	11.81 [300]	7.87 [200]	7.29 [185.1]	17.02 [432.3]	10.35 [263]	14.16 [359.6]	10.22 [259.6]	12.80 [325]	8.86 [225]	14.37 [365]	9.84 [250]	11.62 [295]
SNB-3737	15.75 [400]	15.75 [400]	7.87 [200]	7.29 [185.1]	17.02 [432.3]	14.29 [363]	14.16 [359.6]	14.16 [359.6]	12.80 [325]	12.80 [325]	14.37 [365]	13.78 [350]	11.62 [295]
SNB-3743	15.75 [400]	13.98 [355]	7.87 [200]	7.29 [185.1]	17.02 [432.3]	12.52 [318]	14.16 [359.6]	12.38 [314.6]	12.80 [325]	11.02 [280]	14.37 [365]	12.01 [305]	11.62 [295]

Specifications:

- UL 508A Listed: Type 1, 2, 4, 4X, 12, and 13
- UL File Number: E194432-20071011
- Meets NEMA 1, 2, 4, 4X, 12, 13 Requirements
- Meets IP66 Requirements
- 16 Gauge Cold Rolled Steel
- Light Gray Smooth Powder Coat
- Product Weight: 20 lb (9.1 kg)

6.2.2. Stainless Steel Enclosure

Catalog Number	A	B	C	Steel Type	Door/Body Gauge	Latch Qty
EN4SD12126S16	12.0 in (305 mm)	12.0 in (305 mm)	6.00 in (152 mm)	316 Stainless	16	1



Specifications:

▪ UL 508A Type 3R, 4, 4X, 12	▪ Meets NEMA 3R, 4, 4X, 12, 13 Requirements
▪ UL File: E65234	▪ Meets IP 66 Requirements
▪ CSA Type 3R, 4, 4X, 12	▪ 16 Gauge Stainless Steel
▪ CSA Cert: LR21001	▪ Product Weight: 20 lb (9.1 kg)

7. Integration and Infrastructure

The Cutsforth Assurance Monitoring System has multiple data output options for integration into the plant's DCS and/or historian, as listed below.

- Modbus Output
  - RTU over RS485
  - TCP/IP
- 4–20 mA Outputs
  - Optional add-on. Not included in standard offering.

For details on how to program the Assurance Monitoring System's data outputs, please refer to the system's operations manual.

8. Responsibilities

The following tables summarize the responsibilities of Cutsforth and the Plant during the three project phases.

8.1. Planning Phase

Task	Cutsforth	Plant
Review this planning guide and share it with key plant personnel involved in the project.		✔
Determine enclosure mounting position and conduit routes customized to the generator and ensure that they are within system guidelines.		✔
Select an electrical contractor and coordinate.		✔

8.2. Preparation for Service Phase

NOTE:

The responsibilities listed in the following table are critical to technician safety and proper installation of the Cutsforth equipment. Failure to comply may result in significant delays and additional charges.

Task	Cutsforth	Plant
Determine enclosure mounting position, customize conduit routes to generator, and ensure it is within system requirements.		✔
Mount monitoring system enclosure with supporting strut channel, punch conduit holes in enclosure, and install required conduit, complete with conductors installed.		✔
LOTO the following components: Main excitation system, ground detection system, and turning gear. LOTO needs to be in place prior to arrival of Cutsforth technicians.		✔
Provide 120V, GFI-protected power.		✔
Provide adequate working access to installation site including scaffolding. Scaffolding must be erected prior to arrival of Cutsforth technicians.		✔
Ensure that the shaft is off turning gear and stationary.		✔
Ensure that the shaft is fully coupled for installation .		✔
Ensure that the bearing caps immediately adjacent to the shaft grounding area are in place.		✔

8.3. Cutsforth Service Phase— Cutsforth Technicians Onsite

Task	Cutsforth	Plant
Provide shaft growth value at grounding location to Cutsforth technician.		✔
Indicate shaft rotation direction to Cutsforth technician.		✔
Install Cutsforth shaft assembly.	✔	
Run wiring in plant-completed conduit raceways.	✔	
Identify main grounding termination point on the unit case.	✔	
Make system wiring terminations.	✔	
Make grounding termination to unit case.	✔	
Perform system testing and commissioning.	✔	
Provide control room/IT support for testing data outputs of monitoring system.	✔	✔

9. Glossary

Assurance Monitoring System	A Cutsforth product which monitors shaft voltages and shaft currents to provide real-time data locally and data outputs for integration into a DCS or historian.
attenuation	The reduction of the amplitude of a signal due to excessive cable length.
AWG	American Wire Gauge
ground conductor	8 AWG, green ground conductor that carries the shaft current to the unit case ground location.
ground current	The electrical current between the shaft and the unit case ground through the ground conductor.
ground rope	The left rope in the Shaft Grounding Assembly, which provides the primary path to unit case ground through the 8AWG ground conductor.
impedance	The resistance to change in the current of a circuit.
LOTO	Lockout/Tagout
meter rope	The right rope in the Shaft Grounding Assembly which provides a shaft contact point at which shaft voltage readings are taken.
Shaft Grounding Assembly (SGA)	A Cutsforth product designed to provide a best-in-class ground connection, as well as a shaft contact point at which shaft voltage can be measured.
shaft voltage	The voltage potential between the shaft and the unit case ground as measured by the metering rope.
signal cable	Shielded cable that carries the voltage signals from the SGA and the SCA to the monitoring system.
unit	The equipment monitored by the Cutsforth monitoring system.
unit case ground	The lower half of the turbine case, generator case, or coupler case near the Shaft Grounding Assembly to which the shaft can be grounded.