

PLANNING GUIDE

Assurance Monitoring System

PART #: EZDP-2044



CUTSFORTH

THE POWER OF INNOVATION™

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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, 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 the 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 25+ 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](#)

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.

1.4. Cutsforth Electrical Contracting Services

In addition to our Field Service installation services, Cutsforth offers turn-key services including the electrical contractor scope of work as an additional service in select regions within the US. With this service offering, Cutsforth can greatly simplify the process of monitoring product installation from beginning to end.

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.

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2.3. Patents

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

3. Safety Information

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. 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.

3.2. 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.



WARNING

Cutsforth recommends that workers do not change Shaft Contact Assembly (SCA) meter ropes while the generator is energized and/or operational. It is recommended that meter ropes be inspected and if necessary, changed during outages when the generator has been secured. Since the SCA is generally installed in relatively close proximity to the collector/brush gear (energized equipment) and or other rotating hazards in this area of the generator, it may pose a risk to workers that may include but are not limited to the following:

- Risk of entanglement or rotational injury attempting to remove/insert a meter rope.
- Risk of electrical shock.
- Risk of creating a short circuit between energized parts and ground.

These conditions and limitations are to be carefully considered at the time of installation. It is recommended that procedures and policies be implemented by the end user so as to realize the full function of the monitoring system but avoid potential hazards. These conditions generally do not apply to the Shaft Grounding Assembly (SGA) equipment installation.

4. Installation Planning for the Cutsforth Assurance Monitoring System

This manual is a guide for planning the installation of the Cutsforth Shaft Grounding Assembly and the Assurance Monitoring System. Review the documentation for the original or OEM shaft grounding system for planning the removal of that system.



NOTE

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.

For more information on the Cutsforth Assurance Monitoring System, refer to the *Assurance Monitoring System Operations Manual—EZDP-2041*.

For more information on the Cutsforth Shaft Grounding System, refer to the *Shaft Grounding Assembly Operations Manual—EZDP-2035*.

5. Installation Strategies

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

5.1. Best Practices

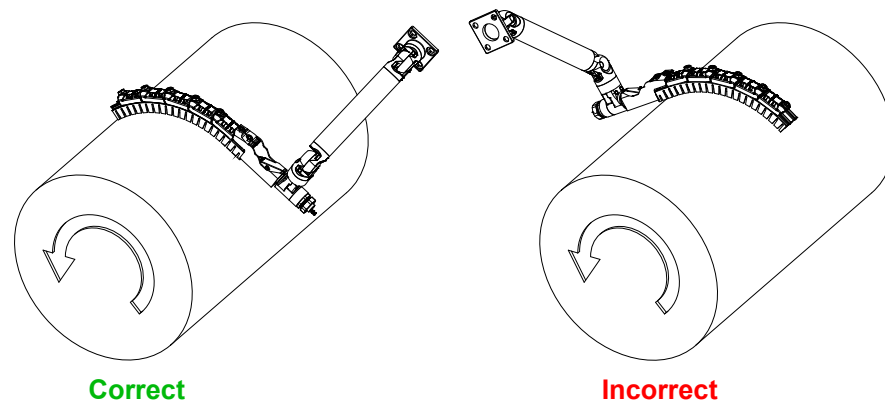
Please review the list of best practices for installation below to help ensure maximum effectiveness of your Cutsforth Shaft Grounding System:

- All Series 1 and Series 2 Shaft Grounding Assemblies (SGAs) shall be installed with a High Frequency Drain (HFD).
- Avoid sharp turns and bends in the grounding wire whenever possible. Bending the conductor can create induction back on the bent wire. While the HFD will aid in dissipating this inductance, it is best to make turns as gradual as possible.
- The grounding conductor shall be routed according to the shortest possible path. When the HFD is installed, it is allowable for the ground conductor to extend up to 47 ft (14 m) in total length when measured from the SGA grounding rope all the way to the finished grounding terminal on the unit case.
- The Assurance Monitoring System shall be mounted such that the segment of conductor between the SGA and the Assurance Monitoring System is no greater than 30 ft (9 m). If the signal lines between the SGA and the Assurance Monitoring System are longer than 30 ft (9m), the monitoring function begins to be diminished.

5.2. Positioning the Cutsforth Shaft Grounding Assembly

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 following illustration shows the correct orientation on the left.

Verify that there is adequate spacing on all dimensions of the SGA and/or SCA assemblies including the support arm and mounting point. Consider both the hot and cold operational conditions, and account for thermal expansion when installing in narrow clearance locations. Factors such as generator type may affect the clearances needed to account for thermal expansion.



5.3. Determining a Ground Conductor Termination Location

The goal when choosing a grounding location is to electrically bond the shaft to the unit case. 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 in order 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 Assurance Monitoring System Mounting Location

The Assurance Monitoring System has a temperature rating of 70°C (158°F). Avoid mounting the enclosure in areas that exceed this temperature. If possible, avoid mounting the monitoring system in a location that experiences direct sunlight for extended periods of time throughout the day.

The ground conductor must be routed through the Junction Box prior to terminating to the unit case. Therefore, it is a good idea to mount the Junction Box somewhere between the Shaft Grounding Assembly (SGA) and the unit case termination location. This helps eliminate extensive lengths in the ground conductor run. Routing to ground, the Junction Box should be installed between the SGA and the ground location to accommodate a short ground run.

The Assurance Monitoring System contains an interactive control panel and should be placed in a location that is safe and accessible for plant personnel. The monitoring system should be placed at an ergonomic height such that the center of the touchscreen is roughly at eye-level.

5.5. Mounting the Assurance Monitoring System

The Assurance Monitoring System is commonly mounted using a strut channel rail, as shown in the following figure. If preferred, the enclosure can also be bolted directly to other solid structures.



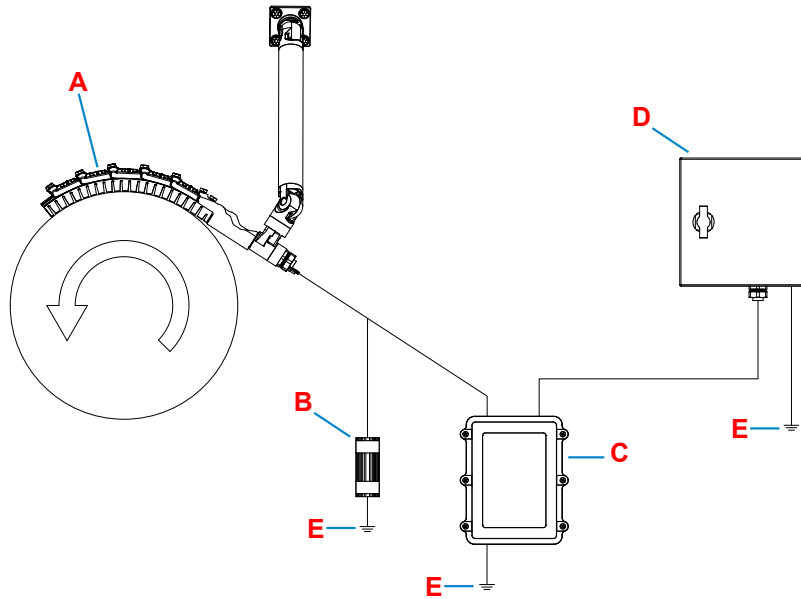
5.6. Shaft Voltage and Ground Current Values

The generator manufacturer is the best source of information regarding the values that you can expect to see on your generator. We suggest focusing on the data trends more than the specific voltage and current values. For example: Do the values change over time? Are the changes significant? How are the values changing?

6. Diagrams

6.1. Cabling Overview

The following figure shows the overview of the cable routing associated with the Shaft Grounding and Assurance Monitoring Systems.

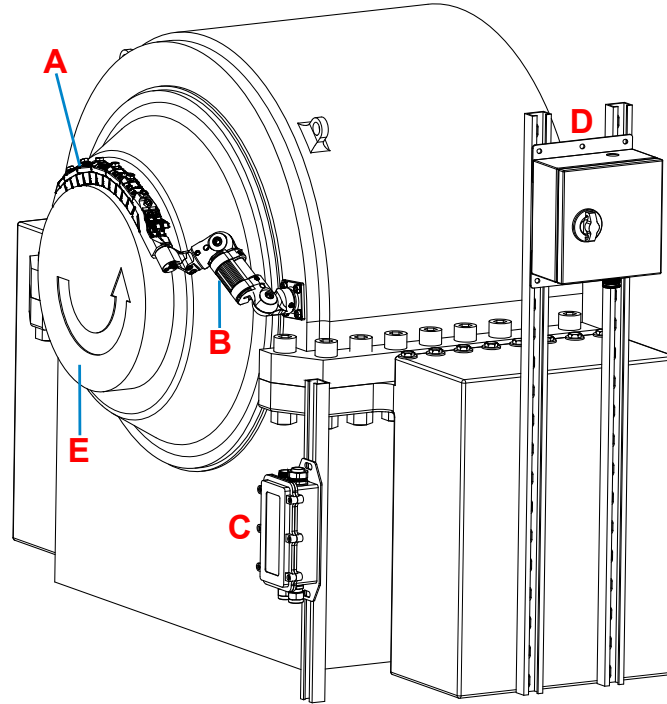


- A** - Shaft Grounding Assembly
- B** - HFD resistor heat sink
- C** - Junction box

- D** - Assurance Monitoring System
- E** - Unit case ground

6.2. Cutsforth Equipment Layout

The following figure represents a typical layout. Individual installations may vary.

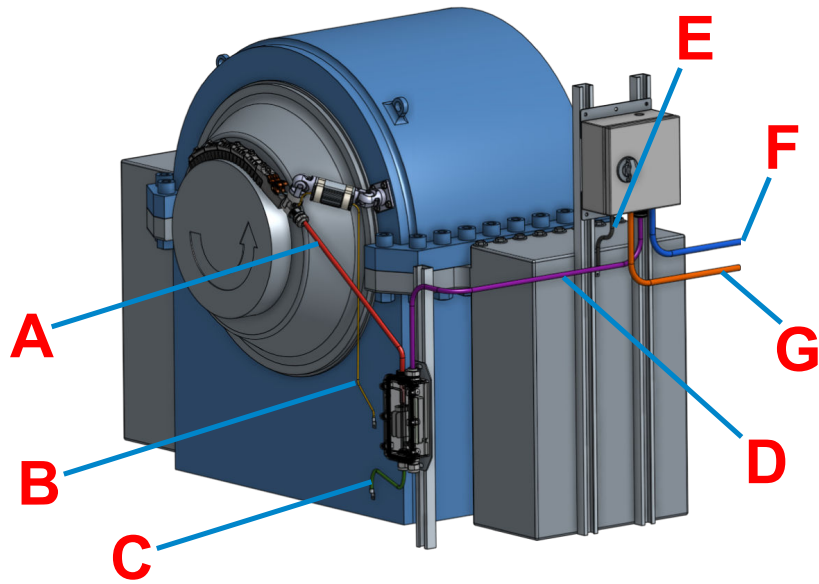


A - Shaft Grounding Assembly
B - HFD heat sink
C - Junction box

D - Assurance Monitoring System
E - Shaft rotation direction

6.3. Conduit Layout and Maximum Cable Lengths

Color on Diagram	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	1/2 in (1.27 cm)	27 ft (8.2 m)	3 conductors, shielded, 18 AWG, high temp	2 rope wear status, 1 shaft voltage,	Cutsforth	Plant Electrical Contractor
Purple	Junction box to assurance system	3/4 in (2 cm)	30 ft (9.1 m) (including Red run)	4 twisted pair, individually shielded, 18 AWG	Signal wires from junction box to assurance system	Cutsforth	Plant Electrical Contractor
Green	Junction box to unit case ground	N/A	47 ft (14.3 m) (including Red run)	8 AWG copper MTW green	Ground from junction box to unit case ground	Cutsforth	Plant Electrical Contractor
Black	Assurance to unit case ground	N/A	9 ft (2.7 m)	20 AWG coaxial RG58	Signal ground from assurance system to unit case ground	Cutsforth	Plant Electrical Contractor
Blue	Dedicated 120 V AC power to assurance system	3/4 in (2 cm)	N/A	AC: 85–264 V AC, 47–440 Hz, 10 W or DC: 20–32 V DC, 10W	Power for assurance system	Plant Electrical Contractor	Plant Electrical Contractor
Orange	Plant DCS drop to assurance system	1-1/4 in (3.17 cm)	N/A	4–20 mA DCS signal lines	Monitoring output to plant's DCS system	Plant Electrical Contractor	Plant Electrical Contractor
Yellow	High-Frequency Drain	N/A	4 ft 6 in (1 m 15 cm)	12 AWG, chemical-resistant wire	Drain ground wire for high-frequency voltage spikes	Cutsforth	Plant Electrical Contractor



A - Red: 1/2 in (1.27 cm) conduit from SGA to junction box

B - Yellow: 12 AWG from main ground conductor, through resistor, then to case ground

C - Green: 8 AWG from junction box to unit case ground

D - Purple: 3/4 in (2 cm) conduit from junction box to Assurance Monitoring System

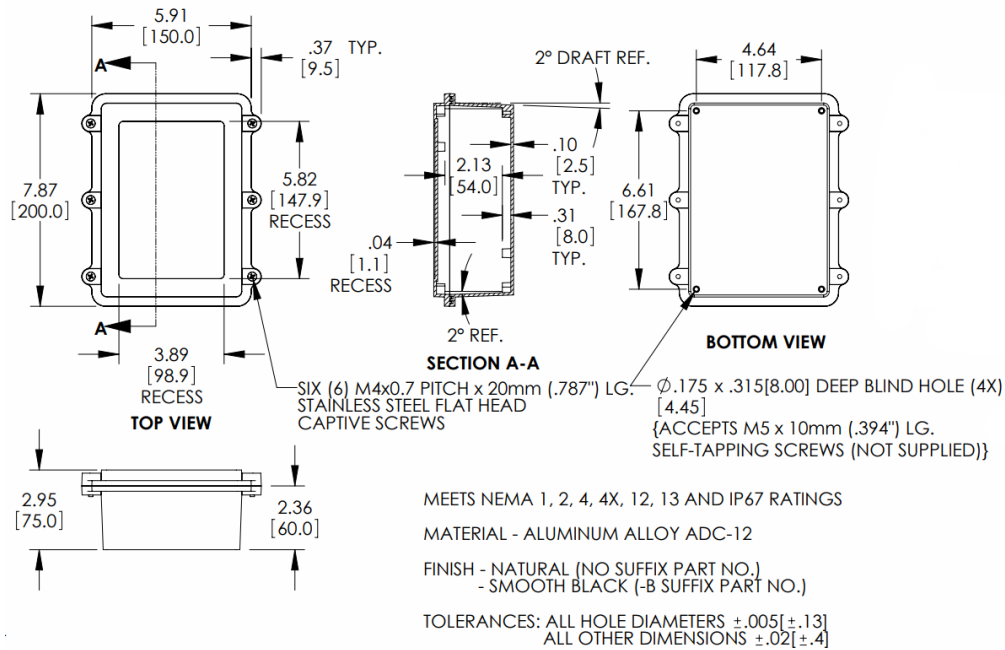
E - Black: 20 AWG coaxial RG58 to unit case ground

F - Blue: 3/4 in (2 cm) conduit for plant power input

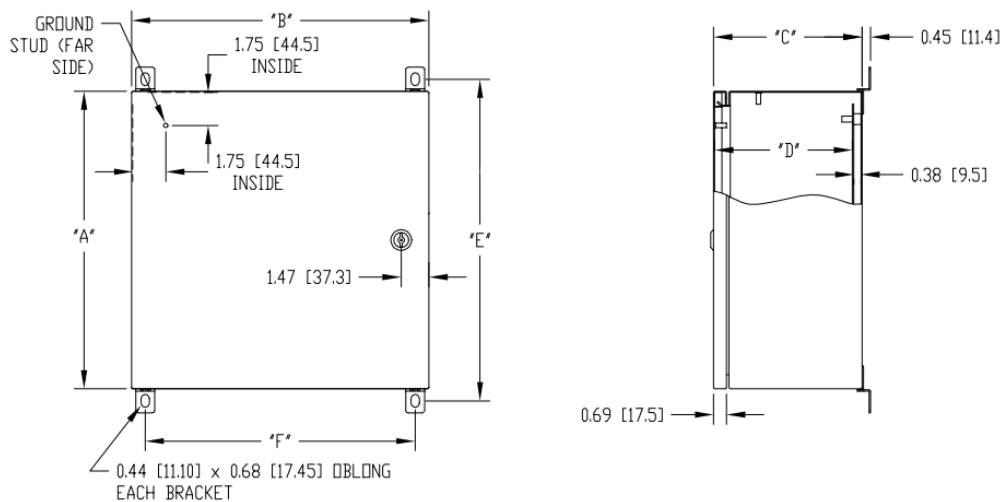
G - Orange: 1-1/4 in (3.17 cm) conduit for 4–20 mA lines

6.4. NEMA 4X Enclosure Specifications

6.4.1. Junction Box



6.4.2. Assurance Monitoring System



Catalog Number	A (in/cm)	B (in/cm)	C (in/cm)	D (in/cm)	E (in/cm)	F (in/cm)
SNB-3740	9.84/24.99	9.84/24.99	5.91/15.01	5.33/13.54	11.12/28.24	8.39/21.31

7. Responsibilities

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

7.1. 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.		✓

7.2. 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
Mount assurance enclosure(s) with supporting strut channel rails and install required conduit.		✓
LOTO the following components: Main excitation system, ground detection system, and turning gear.		✓
Provide 120 V GFI protected power for general use during installation.		✓
Provide adequate working access to installation site including scaffolding.		✓
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.		✓

7.3. Cutsforth Service Phase – Cutsforth Technicians On-site

Task	Cutsforth	Plant
Provide shaft growth value at grounding location to Cutsforth technician.		✓
Indicate shaft rotation direction to Cutsforth technician.		✓
Install Cutsforth shaft assembly.	✓	
Provide welding for support arm.		✓
Install junction box.	✓	
Run wiring in plant-completed conduit raceways.	✓	
Make system wiring terminations, not including grounding termination to generator case.	✓	
Identify main grounding termination point on the unit case.	✓	
Provide electrical support to assist in making ground terminations.	✓	✓
Perform system testing and commissioning.	✓	
If connecting to DCS, provide control room support for testing 4–20 mA outputs.	✓	✓

8. Welding Instructions



These instructions only apply to Series 1 and Series 2 Shaft Grounding Assemblies. The Series 3 Shaft Grounding Assemblies do not require welding.

The attachment arm is made of 300 series stainless steel. TIG welding is the preferred welding method. If a weld filler is needed, AWS E/ER 308, 308L, or 347 are acceptable.



NOTE

The customer must provide a qualified welder to perform support arm welding.

To weld the attachment arm

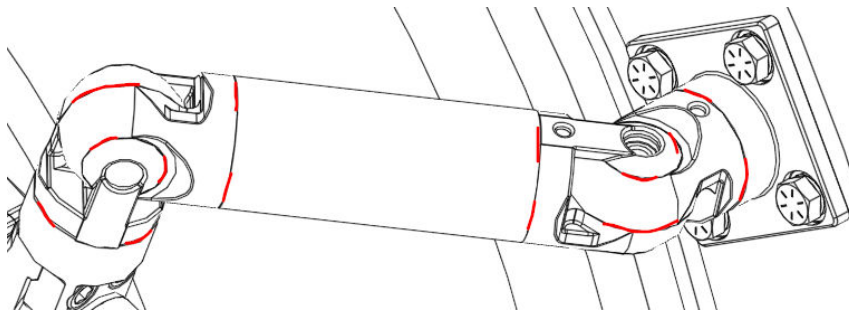
1. Begin by tack or stitch welding at the marks. The goal is a “stitch” or “fuse” weld. No additional welding material needs to be added at this time. The arm joints simply need to be locked in place by the tacks.



CAUTION

If the tacking step is overlooked and the welder commences to weld the seam, the attachment arm positioning will be compromised, resulting in a distorted arm, which is unusable and must be replaced.

2. After tack welding, proceed to weld all of the seams as indicated with the red lines shown in the illustration below. Weld both ends and follow accepted welding practices to minimize distortions that would compromise proper alignments.



3. Return the fully welded arm to the Cutsforth technician for final assembly on the generator.

9. Glossary

Assurance Monitoring System	A Cutsforth product that connects to Cutsforth's Shaft Grounding Assembly to provide shaft voltage and ground current readings on a touchscreen display. It can also be connected to plant DCS systems for real-time data in the control room.
attenuation	The reduction of the amplitude of a signal due to excessive cable length.
AWG	American Wire Gauge
DC	Direct Current
DCS	Distributed Control System
FEP	Fluorinated Ethylene Propylene (high-temperature cable jacket material)
ground conductor	An 8 AWG ground conductor that runs from the Shaft Grounding Assembly to the junction box, then to unit case ground.
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 8 AWG ground conductor.
High-Frequency Drain (HFD)	A 12 AWG conductor that splits off from the meter rope, runs through a low-inductance resistor, and then connects to unit case ground in less than 4 ft 6 in (1 m 15 cm). The HFD ensures that high frequency voltage spikes are grounded properly.
impedance	The resistance to change in the current of a circuit.
junction box	An enclosure that contains the current-sensing equipment and is placed between the Shaft Grounding Assembly and the grounding location.
LOTO	Lock-out, tag-out
meter rope	The right rope in the shaft grounding assembly, which provides a shaft contact point at which shaft voltage readings are taken. It

also provides a secondary path to unit case ground through the High-Frequency Drain.

RMS

rope refresh kit

A rope assembly that can be used as a ground rope or a meter rope.

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

A shielded, twisted-pair cable that carries voltage signals from the Shaft Grounding Assembly to the junction box and the Assurance Monitoring System.

TC/TC-ER

Ratings that describe the crush and impact requirements for cable types. For more information, see *Type TC vs. Type TC-ER Cable* at <http://www.ecmweb.com/nec/type-tc-vs-type-tc-er-cable>.

unit

The equipment being 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.

zero-to-peak

A measurement of a signal determined by the maximum absolute value amplitude of the signal over a given time frame.