



Field Inspection and Testing of Temporary Bonds and Grounds

Standard
Operating
Procedure

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1.0 Purpose

This SOP provides:

- A standard for the in-service inspection and testing of temporary portable bond and ground assemblies to certify or re-certify prior to use

2.0 Roles and Prerequisites

Role(s)	Quantity Required	Prerequisites
Competent Worker	1 or more	<ol style="list-style-type: none"> 1. Training on the proper inspection, testing and repair of Bond and Ground Leads 2. Review and understand the requirements of this SOP

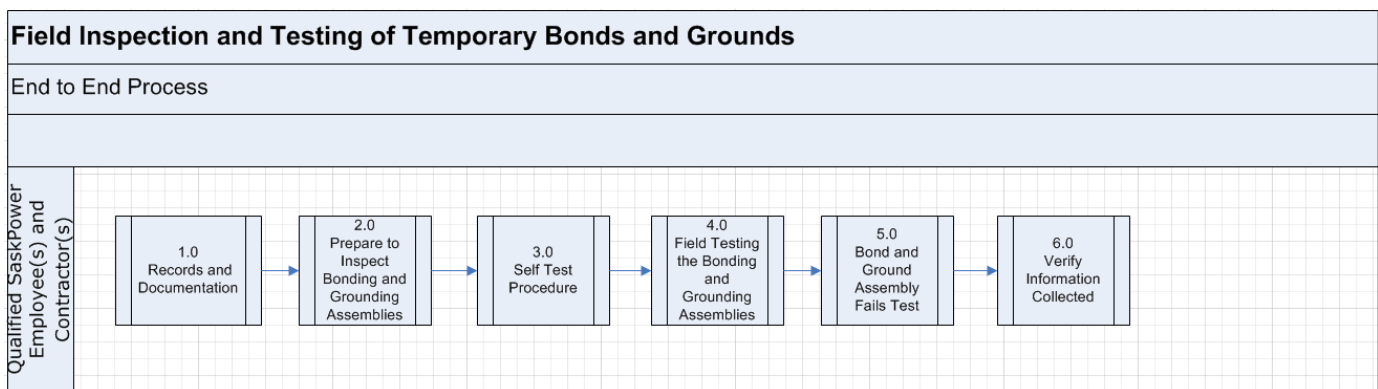
3.0 Tools and Equipment

Minimum Tools and Equipment Required:

- Chance Protective Grounding Set Tester
- Bonds and Grounds In-Service Inspection and Testing Sheet
- Tools required to perform the repairs on temporary bond and ground assemblies
- Graphite Lubricant
- Torque Wrench
- Isopropyl alcohol
- Wire Brush
- New ID tags

4.0 Procedure

High Level Flowchart



The Procedure

NOTE: The following requirements shall be met prior to the start of the procedure:

- Complete Hazard, Aspect and Risk Assessment (HARA)
- Applicable Personal Protective Equipment (PPE) is available and in good condition
- Consider Environmental Best Management Practices

1.0 Records and Documentation

1.1 Identification and Documentation Requirements

- *Locate the identification tag on the assembly to be tested*
- *Install an identification tag if there isn't one. Include the asset number, length of the assembly and the test expiry date*
- *If the existing identification tag is illegible/damaged, replace it and document the reason for the change*
- *Update ID tag with new expiry date*
- *Record bond or ground assembly identification number and associated information on the "Bonds and Grounds In-Service Inspection and Testing" sheet*
- *Ensure the information is accurate and complete. This information will be entered into SAP for future reference*

2.0 Prepare to Inspect Bonding and Grounding Assemblies

2.1 Steps to Inspect Bonding and Grounding Assemblies

2.1.1 Visual inspection

- *Visual inspection shall be made of all bonding or grounding assemblies prior to testing. If the following defects are evident, the bonding or grounding assemblies must be repaired if possible or rejected:*
 - *Cracked or broken ferrules and clamps,*
 - *Exposed broken strands,*
 - *Cut or badly mashed or flattened cable,*
 - *Extensively damaged cable-covering material,*
 - *Swollen cable jacket or soft spots, indicating internal corrosion,*
 - *Cable strands with a black deposit on them,*
 - *I.D. tag is missing or damaged and information is not legible,*
- *Bonding and grounding assemblies which are visually defective shall be removed from service and disposed of immediately. If the clamps appear to be in good shape, remove and keep for later use*

- Before the bonding or grounding assembly can be placed back in service, it must pass the inspection requirements and the electrical requirements

2.1.2 If the bonding or grounding assembly is known to have been exposed to short-circuit current (fault condition), it shall be removed from service permanently. If clamps appear to be in good shape, remove and keep for later use

2.2 Preparing Bonding and Grounding Assemblies for test

- Thoroughly clean the jaws of the clamps with a stiff wire brush
- All the clamps in the set must have the screw and spring jaws operating smoothly. Lubricate them with graphite if required
- All physical connections should be checked for tightness with specified torque values. Nut of the eyelet clamp terminal is tightened as per the manufacturers recommendations



Figure #1 Proper alignment of strain relief clamp

- Inspect the strain relief clamp and ensure it is providing proper strain relief (see Figure #1 above)



Figure #2 Proper alignment of ferrule assembly

- Ferrule Assembly: Un-threaded: Apply anti-oxidant grease to the contact area. The chamfered surface of the clamp and the matching feature on the ferrule are part of the fault current path. It is therefore important that

these two surfaces be firmly engaged when the ground set is assembled. (see Figure #2 above)

- *Tighten eye terminal as per the manufacturers recommendations using a torque wrench*

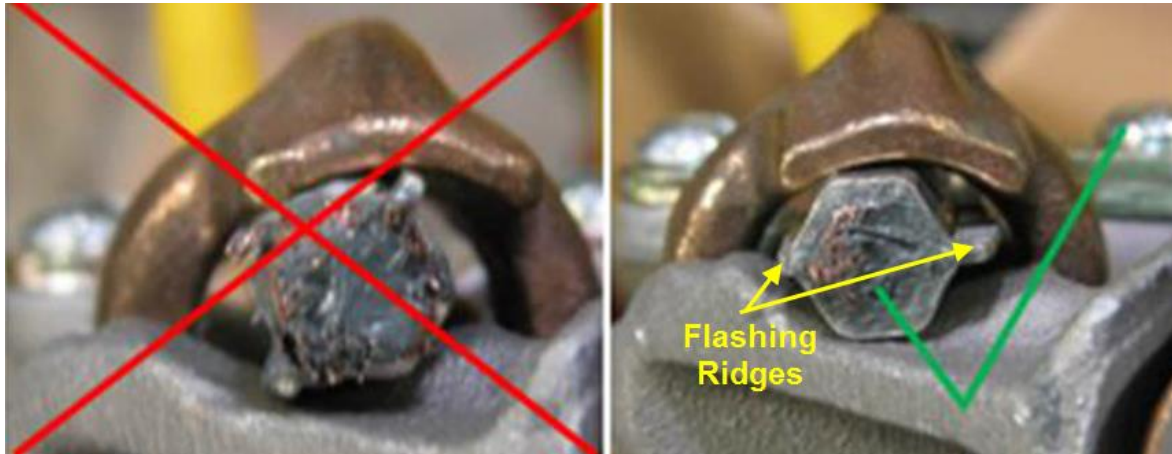


Figure #3 Proper alignment of flashing ridges

- *Ensure older style Hastings ferrules are installed with the flashing ridges horizontally oriented to create the best possible current path (see Figure #3 above)*



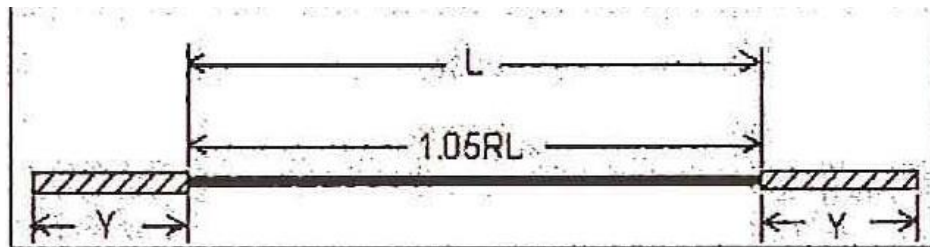
Figure #4 Proper clamp installation

- *Threaded (Chance and Salisbury): Thread ferrule into clamp as far as possible, then tighten locknut as per manufacturers recommendation using a torque wrench. Completed Chance clamp should be as shown in the Figure #4 above*

- *Tighten all strain relief screws until they are snug. Note: Ensure strain relief screws are tightened after ferrule/eye nut. If these are tightened before the ferrule/eye nut, it can cause the ferrule to lift and cause a poor connection*

2.3 Measuring Bonding and Grounding Assemblies

- *Identify the cable gauge (ie: #2AWG) and make a precise measurement of the cable length. See Fig. 5*
- *Document the measurement on the "Bonds and Grounds In-Service Inspection and Testing" sheet*



Figure#5: 'L' is cable length expressed in feet (ferrule to ferrule measurement to the nearest inch, not including shrouded portion of some ferrules which cover the cable insulation)

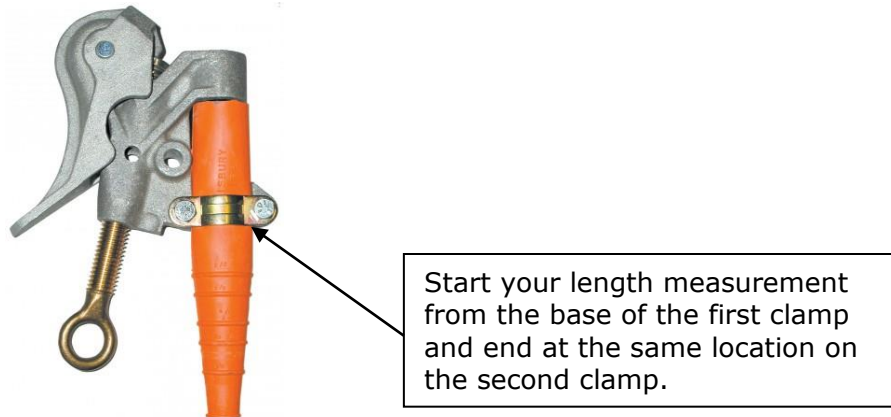


Figure #6 Location of where length measurement should start

3.0 Self Test Procedure

3.1 Steps to Self-Test the Protective Ground Tester

- **NOTE:** *Perform the following Self Test Procedure before beginning for the day to verify the operation of the test set. The operation of the Protective Ground Set Tester can be verified using the Self Test Cable included with the tester. Configure the test set as shown in Figures #8 & #9 below*
- *Place the tester on a table of convenient height and plug it into an AC outlet, 110 or 220 VAC*

- *Thread the attachment studs into fixed connection inputs*
- *Clean, then securely connect the Self Test Cable to the attachment studs*
- *Turn on the unit. The power switch will illuminate when the power is on*
- *Place the 'INPUT SELECT' switch in the 'FIXED' position*
- *Place the 'CONTINUOUS TEST' switch in the 'OFF' position*
- *Press the 'SINGLE TEST' switch*
- *The display will show the measured resistance of the Self Test Cable on line 2 of the display. The resistance measured should be between 3.0 and 7.5 mΩ**. If the measured resistance is outside these values, retighten the ball studs and check to make sure that the Self Test Cable has good electrical connections*
- *After retest, if the measured resistance is still not between 3.0 and 7.5 mΩ**, discontinue use of the tester. The Self Test Cable is not designed with tight tolerances for accuracy testing*
- *Note that the thresholds and pass/fail LEDs will function during the self test but do not pertain to the self test*

****mΩ (milliohm) = 0.001 ohm**



Figure #7 Chance Protective Ground Set Tester Self Test Setup

3.2 Test Set Up

- Figure #7 shows the test setup required to test a protective bond/ground set. The protective bond/ground set being tested must always be connected between the fixed connection regardless of the mode of testing. The bond/ground set carries the test current from one fixed input to the other during testing. Without the bond/ground set, the resulting open circuit prevents the resistance measurement. If the ground set is left unconnected and the 'INPUT SELECT' is in the 'FIXED' position, the display will read 'OVER RANGE' after a test. If the bond/ground set is left unconnected and the 'INPUT SELECT' is in the 'PROBE' position, the display will be erratic. The erratic display is unpredictable and does not indicate resistance



Optional Straight Stud Terminal T4033159 for testing grounded-parking-stand temporary grounding sets.

Figures #8 & #9 Test set up with bond and ground assemblies

4.0 Field Testing the Bonding and Grounding Assemblies

4.1 Steps to Perform the test for each assembly

- With the testing unit switched "off", securely connect the bonding/grounding assembly to be tested to the attachment studs. A low resistance connection must be maintained while testing the ground set. (Figures #8 & #9 above shows a typical test setup)
- Turn on the unit. The power switch will illuminate when the power is on
- Use the 'CABLE SIZE' switch to select the cable size being tested. The cable size is displayed at the end of the first line of the display
- Place the 'INPUT SELECT' in the 'FIXED' position
- Place the 'CONTINUOUS TEST' switch in the 'OFF' position



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- Press the 'SINGLE TEST' switch
- The display will show the measured resistance between fixed connections on line 2 of the display in mΩ. ** mΩ (milli ohm) = 0.001 ohm
- Compare the measured resistance of the bond or ground assembly to the corresponding resistance found in **Table #1** below. If the measured value is greater than the value in the table then the assembly has failed the test
- **NOTE: INITIAL TESTING OF BOND AND GROUND ASSEMBLIES WILL LIKELY REVEAL A HIGHER NUMBER OF FAILURES**
- **THE CHANCE TESTER #C403-3220 DEFAULTS TO THE 1/0 CABLE SIZE AFTER EACH TEST. THE PROPER CABLE SIZE MUST BE SELECTED EACH TIME A TEST IS DONE**
- **Example #1:** Bond jumper is 1/0 cable and measured to be 14 feet long. Temperature is 5°C. Measured resistance is found to be 1.651. See Table #1. This is a passing value
- **Example #2:** Ground assembly is 2/0 cable and measured to be 25 feet long. Temperature is 20°C. Measured resistance is found to be 2.406. See Table #1. This is a fail value

Table #1 Pass/Fail Resistance Values for Copper Grounding Jumper Assemblies												
R _{max} Limits - DC Resistance, mΩ												
Cable Length ft.	#2 Cable			1/0 Cable			2/0 Cable			4/0 Cable		
	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)
1	0.474	0.484	0.494	0.417	0.423	0.429	0.397	0.402	0.407	0.368	0.371	0.374
2	0.629	0.648	0.668	0.514	0.526	0.538	0.474	0.484	0.493	0.417	0.423	0.429
3	0.783	0.812	0.841	0.611	0.630	0.648	0.551	0.565	0.580	0.465	0.474	0.483
4	0.938	0.976	1.015	0.708	0.733	0.757	0.628	0.647	0.667	0.514	0.526	0.538
5	1.092	1.141	1.189	0.805	0.836	0.866	0.705	0.729	0.753	0.562	0.577	0.582
6	1.247	1.305	1.363	0.902	0.939	0.975	0.782	0.811	0.840	0.610	0.629	0.647
7	1.401	1.469	1.536	0.999	1.043	1.084	0.859	0.893	0.926	0.659	0.680	0.701
8	1.556	1.633	1.710	1.096	1.146	1.194	0.936	0.974	1.013	0.707	0.732	0.756
9	1.710	1.797	1.884	1.193	1.249	1.303	1.013	1.056	1.100	0.756	0.783	0.810
10	1.865	1.961	2.058	1.290	1.352	1.412	1.090	1.138	1.186	0.804	0.835	0.865
11	2.019	2.125	2.232	1.387	1.455	1.521	1.167	1.220	1.273	0.852	0.886	0.919
12	2.173	2.289	2.405	1.484	1.559	1.630	1.244	1.302	1.360	0.901	0.937	0.974
13	2.328	2.453	2.579	1.581	1.662	1.740	1.321	1.383	1.446	0.949	0.989	1.028
14	2.482	2.618	2.753	1.678	1.765	1.849	1.398	1.465	1.533	0.998	1.040	1.083
15	2.637	2.782	2.927	1.775	1.868	1.958	1.474	1.547	1.619	1.046	1.092	1.137
16	2.791	2.946	3.100	1.872	1.971	2.067	1.551	1.629	1.706	1.094	1.143	1.192
17	2.946	3.100	3.274	1.969	2.075	2.176	1.628	1.711	1.793	1.143	1.195	1.246
18	3.100	3.274	3.448	2.066	2.178	2.286	1.705	1.792	1.879	1.191	1.246	1.301
19	3.255	3.438	3.622	2.163	2.281	2.395	1.782	1.874	1.966	1.240	1.298	1.355
20	3.409	3.602	3.796	2.260	2.384	2.504	1.859	1.956	2.053	1.288	1.349	1.410
25	4.181	4.423	4.664	2.746	2.900	3.050	2.244	2.365	2.486	1.530	1.606	1.682
30	4.954	5.234	5.533	3.231	3.416	3.596	2.629	2.774	2.919	1.772	1.864	1.955
35	5.726	6.064	6.402	3.716	3.933	4.142	3.014	3.183	3.352	2.014	2.121	2.227
40	6.498	6.885	7.0271	4.201	4.449	4.688	3.399	3.592	3.785	2.256	2.378	2.500
45	7.270	7.705	8.140	4.686	4.965	5.234	3.783	4.001	4.218	2.498	2.635	2.772
50	8.043	8.526	9.009	5.171	5.481	5.780	4.168	4.410	4.651	2.740	2.893	3.045

5.0 Bond or Ground Assembly Fails Test

5.1 Steps to follow if the Bond or Ground Assembly Fails the Test

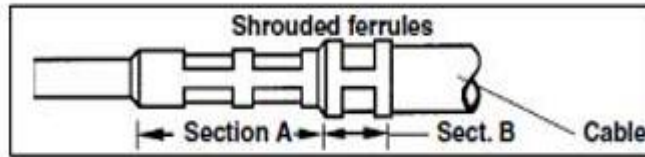
- *Note: For the measurements that indicate a failure, additional cleaning and tightening of the assembly may restore its electrical integrity*
- *Disassemble the bonding or grounding jumper assembly and thoroughly clean the ferrule and clamp interface with isopropyl alcohol and a stiff wire brush*
- *Inspect all components during the disassembly and reassembly process*
- *Reassemble the bonding or grounding jumper. All physical connections should be checked for tightness with specified torque values*
- *Re-test the temporary bond or ground assembly*
- *If the assembly fails the test again, remove the clamps and cut off the old ferrules. Replace the ferrules with the appropriate new ferrules as per the manufacturer's instructions. Reassemble the bond or ground assembly and re-test. The expected resistance will have to be recalculated due to the assembly being now shorter than previously*

Shrouded plain copper ferrules (Chance Catalog)

1 unit each, not installed Catalog No.	Burndy Die No. † or equivalent		Cable Size, AWG
	Sect. A	Sect. B	
C6002630	U165	U166	#2
C6002631	U165	U168	1/0
C6002632	U165	U-L	2/0
C6002633	U166	U-L	4/0

Shrouded threaded copper ferrules (Chance Catalog)

1 unit each, not installed Catalog No.	Burndy Die No. † or equivalent		Cable Size, AWG
	Sect. A	Sect. B	
C6002622	U165	U166	#2
C6002623	U165	U168	1/0
C6002624	U165	U-L	2/0
C6002625	U166	U-L	4/0



- *Bonding or grounding jumper assemblies that fail this second electrical test after additional maintenance or repairs are performed, shall be removed from service and disposed of immediately. If the clamps appear to be in good shape, remove them for later use*

6.0 Verify Information Collected

6.1 Information to Review

- *Verify that all required information is collected on the "Bonds and Grounds In-Service Inspection and Testing" sheet*
 - *Asset Tag*
 - *Test Date*
 - *Length*
 - *Recorded Resistance*
 - *Pass/Fail*
 - *If assembly failed, ensure to document the reason*
 - *Submit sheets to Business Support - Safety for upload to Corporate Database (permanent storage solution to be determined)*

5.0 Components

The following is a list of components for this SOP which can be accessed through the SOP System:

Component Name	Component Type	Component Description	Location of Component
Field Inspection and Testing of Temporary Bonds and Grounds Flowchart	Flowchart	A high level and mid-level flowchart to use for this procedure	SOP Online - SOP Bundle: Field Inspection and Testing of Temporary Bonds and Grounds
Bonds and Grounds In-Service Inspection and Testing" sheet - Job Aid	Job Aid	A job aid for the worker to document all pertinent information for each test completed	SOP Online - SOP Bundle: Field Inspection and Testing of Temporary Bonds and Grounds
Chance Protective Grounding Tester Instructions Manual - Job Aid	Job Aid	Manufacturer's Operators manual for reference	SOP Online - SOP Bundle: Field Inspection and Testing of Temporary Bonds and Grounds
Chance Ferrule Crimping Instructions	Job Aid	A job aid for when the worker is installing new ferrules	SOP Online - SOP Bundle: Field Inspection and Testing of Temporary Bonds and Grounds



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6.0 Acronyms, Definitions and Symbols

Acronyms and Abbreviations

PPE - Personal Protective Equipment

HARA - Hazard/Aspect and Risk Assessment

Definitions

N/A

Symbols

Ω - Electrical Symbol for the Ohmic value

7.0 Policies and Regulatory Requirements

This SOP is a result of the following regulations, policies, industry standards, and corporate directives and standards:

Regulatory Requirement(s)

- N/A

Policies

- Hazard/Aspect and Risk Assessment Policy
- Personal Protective Equipment Policy

Standards

- Hazard/Aspect and Risk Assessment Standard
- Deviation from Safe Work Procedure Standard
- Personal Protective Equipment Standard

Other

- Safety and Environment Rulebook
- Environmental Best Management Practices

8.0 References

References

CAN/ULC 61230: Live Working- Portable Equipment for Grounding (Earthing) and Bonding

ASTM F855: Standard Specifications for Temporary Protective Grounds to be used on De-Energized Electric Power Lines and Equipment

ASTM F2249: Standard Specifications for In-Service Test Methods for Temporary Grounding Jumper Assemblies Used on De-Energized Electric Power Lines and Equipment

Chance Protective Grounding Set Tester Instructions: Catalog No. C403-3220