STP 5-21P2-SM-TG

Soldier's Manual and Trainer's Guide, MOS 21P, Prime Power Production Specialist, Skill Level 2

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Skill Level 2

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Preface

This Soldier training publication (STP) contains standardized training objectives (in the form of task summaries) to train and evaluate Soldiers on critical tasks that support unit missions during wartime. Trainers and leaders should actively plan for Soldiers holding this military occupational specialty (MOS) to have access to this publication.

This publication applies to the Active Army, the Army National Guard (ARNG)/Army National Guard of the United States (ARNGUS), and the U.S. Army Reserve (USAR) unless otherwise stated.

The proponent for this publication is the United States Army Training and Doctrine Command (TRADOC). Send comments and recommendations on Department of the Army (DA) Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commandant, United States Army Engineer School, ATTN: ATSE-DT, Individual Training Division, 320 MANSCEN Loop, Fort Leonard Wood, MO 65473-8929. Comments should be keyed to a specific page, paragraph, and line of text in which the change is recommended. Provide reasons for each comment to ensure understanding and complete evaluation.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

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Chapter 1

Introduction

1-1. General. This manual identifies the individual MOS training requirements for Soldiers. It is designed to be used by commanders, trainers, and Soldiers to plan, conduct, and evaluate individual training in units. This manual is the primary reference for supporting self-development, evaluating MOS proficiency, and training Soldiers. Commanders employ the following two primary methods to evaluate Soldier proficiency:

- **Commander's evaluation.** Commander's evaluations are local tests or assessments of Soldier performance of MOS-specific and common tasks critical to the unit mission. They may be conducted year-round.

- **Common task test (CTT).** CTTs are hands-on tests used to evaluate proficiency on common tasks. Alternate written tests are provided if equipment is not available for hands-on testing.

1-2. Integration of Individual and Collective Tasks. This manual should be used with STP 21-1-SMCT, STP 21-24-SMCT, Field Manual (FM) 7-0, FM 7-1, FM 25-4, FM 25-5, and any related Combined Arms Training Strategies (CATS) and drills to establish effective training plans and programs that integrate individual and collective tasks.

1-3. Task Summaries. Task summaries contain information necessary to conduct training and evaluate Soldier proficiency on tasks critical to the MOS. A separate task summary is provided for each critical task. These task summaries are, in effect, standardized training objectives which ensure that Soldiers do not have to relearn a task on reassignment to a new unit. The format for the task summaries included in this manual is as follows:

- **Task title.** The task title identifies the action to be performed.

- **Task number.** The 10-digit task number identifies each task or skill. Include this task number and title in any correspondence relating to the task.

- **Conditions.** Task conditions identify the equipment, tools, references, job aids, and supporting personnel that the Soldier needs to perform the task in wartime. This section identifies environmental conditions that could alter task performance (visibility, temperature, wind). This section also identifies specific cues or events (chemical attack, identification of a threat vehicle) that trigger task performance.

- **Standards.** Task standards describe how well and to what level a task must be performed under wartime conditions. Standards are typically described in terms of accuracy, completeness, and speed.

- **Training and evaluation.** This section may contain a training information outline, evaluation preparation, and/or evaluation guide. The training information outline includes detailed training information. The evaluation preparation subsection indicates the necessary modifications to task performance to train and evaluate a task that cannot be trained to the wartime standard under wartime conditions. The evaluation preparation may also include special training and evaluation preparation instructions to accommodate these modifications and any instruction that should be given to the Soldier before evaluation. The evaluation guide identifies the specific actions (known as performance measures) that the Soldier must do to successfully complete the task. These actions are listed in a pass/fail format for easy evaluation. Each evaluation guide contains a feedback statement that indicates the requirements for receiving a GO on the evaluation.

- **References.** This section identifies references that provide more detailed and thorough explanations of task performance requirements than those given in the task summary description.

1-4. Safety. Some task summaries include safety statements and notes. Safety statements (danger, warning, and caution notices) alert users to the possibility of death, personal injury, or equipment damage. Notes provide an explanation or hint relative to the performance measures.

1-5. Soldier's Responsibilities. Each Soldier is responsible for performing individual tasks that the first-line supervisor identifies based on the unit mission-essential task list (METL). The Soldier must perform each task to the standards listed in the Soldier's manual (SM). If a Soldier has a question about how to do a task or which tasks in this manual he must perform, it is his responsibility to ask the first-line supervisor for clarification. The first-line supervisor knows how to perform each task or can direct the Soldier to the appropriate training materials.

1-6. Noncommissioned Officer Self-Development and the Soldier's Manual. Self-development is one of the key components of the leader development program. It is a planned, progressive, and sequential program followed by leaders to enhance and sustain their military competency. It consists of individual study, research, professional reading, practice, and self-assessment. Under the self-development concept, the noncommissioned officer (NCO), as an Army professional, has the responsibility to remain current in all phases of the MOS. The SM is the primary source for the NCO to use in maintaining MOS proficiency.

1-7. Unit Learning Centers. Unit learning centers are valuable resources for planning self-development programs. They can help access enlisted career maps, training support products, and extension training materials.

1-8. Training Support.

a. This manual includes the following appendixes and information that provide additional training support information:

- **Appendix A, Metric Conversion Chart.** This appendix provides a metric measurement conversion chart.
- **Appendix B, Wire Gauge Size Conversions.** This appendix provides conversions for wire gauge sizes.
- **Glossary.** The glossary is a comprehensive list of acronyms, abbreviations, terms, definitions, and letter symbols used in this STP.
- **References.** This section contains two lists of references, required and related, that support the training of all tasks in this STP. Required references are listed in the conditions and are required for the Soldier to do the task. Related references are materials that provide more detailed information and a more thorough explanation of task performance.

b. The NCO trainer can use DA Form 5164-R (Hands-On Evaluation) to set up the leader book as described in FM 7-1. The use of this form may help preclude writing the Soldier tasks associated with the unit METL, and DA Form 5164-R can become a part of the leader book. The use of this form is optional, but highly encouraged. This evaluation allows you to maintain and track Soldier proficiency at the performance level. This form can be obtained electronically and may be reproduced locally. Follow these instructions when completing DA Form 5164-R:

- Enter the title and number of the task to be evaluated at the top of the form.
- Enter the number of each performance step from the evaluation guide in column A.
- Enter in column B each performance step from the evaluation guide that corresponds to the number in column A (abbreviate the information if necessary).
- Locally reproduce the partially completed form if more than one Soldier will be evaluated on the specific task or the same Soldier will be evaluated more than once.
- Enter the date, evaluator's name, and Soldier's name and unit before starting the evaluation.
- Enter a check in column c or column d for each performance step evaluated as appropriate.
- Check the status block GO or NO-GO.

NOTE TO THE TRAINING MANAGER: The training status of groups (teams, squads, platoons) can be maintained in key critical MOSs at any level by entering the level (1st platoon, 2d platoon, 3d platoon) in column headings. Simply have the trainers report the percentage of their Soldiers who have (GO) and have not (NO-GO) demonstrated proficiency on each task, and record this information for each level.

1-9. Enlisted Personnel Management System. The Enlisted Personnel Management System (EPMS) (Army Regulation [AR] 614-200) is the Army overall system to improve the professionalism of the enlisted force. It integrates policies relating to training, evaluation, classification, and promotion into an overall system. It provides the Soldier with a means to look to the future and see a realistic, clear, and viable career progression path from private (PVT) to sergeant major (SGM). However, the EPMS is useless if the Soldier does not understand and use it. Part of the trainer's job is to ensure that the Soldier understands and uses the EPMS. As an aid, Figure 1-1 (page 1-4) provides the trainer with a career management field (CMF) map for the Soldier. Along with information contained in AR 614-200, the Soldier can use the CMF map to develop goals early in his career and plan accordingly.

<table>
<tr><th>NCOES</th><th colspan="2">PLDC</th><th colspan="2">BNCOC</th><th colspan="2">ANCOC</th><th>USASMA</th></tr>
<tr><td>Civilian schools</td><td colspan="2">High school, GED diploma</td><td colspan="6">College</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2">1 year</td><td colspan="2">2 years</td><td>3 years</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="6">A goal: Troop assignments often preclude off-duty education.</td></tr>
<tr><td>Other schools</td><td colspan="8">Drill sergeant school
Recruiting school Battle staff course
1SG course</td></tr>
<tr><td>Encouraged assignments</td><td colspan="8">Retention, recruiter
Drill sergeant
Instructor
Operations/intelligence sergeant
Senior power plant operator
Prime power supervisor
CMF 21 staff assignments</td></tr>
<tr><td>Key leadership assignments</td><td>Technician</td><td colspan="2">Team leader</td><td>Squad leader/ section leader</td><td>Platoon/ section SGT</td><td>1SG</td><td>CSM</td></tr>
<tr><td>Grades</td><td>PVT, PFC, SPC, CPL</td><td colspan="2">SGT</td><td>SSG</td><td>SFC</td><td>1SG/ MSG</td><td>SGM/ CSM</td></tr>
<tr><td>Years of service</td><td>1–4</td><td colspan="2">3–8</td><td>6–14</td><td>10–18</td><td>16–22</td><td>20+</td></tr>
</table>

Figure 1-1. CMF Map

1-10. Skill Progression Chart. Similar or related education, training, and experience are grouped into CMFs. The career progression path for MOS 21P, CMF 21, prime power production specialist is shown in Table 1-1.

Table 1-1. Career Progression Sequence for Prime Power Production Specialist (CMF 21)

E9	21Z50 CSM
SL 5 (E8 and E9)	21X50 Power Station Sergeant
SL 4 (E7)	21P40 Prime Power Supervisor
SL 3 (E6)	21P30 Senior Power Plant Operator
SL 2 (E5)	21P20 Power Plant Operator
SL 1 (E1 through E4)	 NA

Chapter 2

Trainer's Guide

2-1. General. The trainer's guide (TG) identifies the essential components of a unit training plan for individual training. Units have different training needs and requirements based on differences in environment, location, equipment, dispersion, and similar factors. Therefore, the TG should be used as a guide for conducting unit training and not a rigid standard. It provides information necessary for planning training requirements for the MOS. The TG—

- Identifies subject areas in which Soldiers must be trained.
- Identifies individual tasks for each subject area.
- Specifies where Soldiers are initially trained on each task.
- Recommends how often to train each task to sustain proficiency.

2-2. MOS 21P2 Critical Tasks. This list identifies, by general subject areas, the critical tasks to be trained in an MOS and the type of training required (resident, integration, or sustainment).

- **Task number column.** This column lists the task numbers for all tasks included in the subject area.
- **Title column.** This column lists the task title for each task in the subject area.
- **Training location column.** This column identifies the training location where the task is first trained to STP standards. If the task is first trained to standard in the unit, the word "Unit" will be in this column. If the task is first trained to standard in the resident course, it will be identified by brevity code. Figure 2-1 contains a list of training locations and their corresponding brevity codes.

ASI/SD	Additional skill identifier/special duty
AIT	Advanced individual training
ANCOC	Advanced Noncommissioned Officer Course
BNCOC	Basic Noncommissioned Officer Course
UNIT	Trained in the unit

Figure 2-1. Training Locations

- **Sustainment training frequency column.** This column indicates the recommended frequency at which the tasks should be trained to ensure that Soldiers maintain task proficiency. Figure 2-2 identifies the frequency codes used in this column.

BA	Biannually
AN	Annually
SA	Semiannually
QT	Quarterly
MO	Monthly
BW	Biweekly
WK	Weekly

Figure 2-2. Sustainment Training Frequency Codes

- **Sustainment training skill level column.** This column lists the skill levels of the MOS for which Soldiers must receive sustainment training to ensure that they maintain proficiency to SM standards.

- **Subject area codes.** Tasks are grouped into numbered areas and are broken down by subject area/skill level. (See Figure 2-3.)

1	Overall 21P30 Tasks
2	Additional Skill Identifier Tasks
3	Power Line Distribution Tasks
4	Overall 21P40 Tasks

Figure 2-3. Subject Area Codes

2-3. Critical Tasks List. (See Table 2-1 for critical tasks for this STP.)

Table 2-1. MOS 21P2 Critical Tasks

Task Number	Title	Training Location	Sust Tng Freq	Sust Tng SL
Skill Level 2				
Subject Area 1. Overall 21P20 Tasks				
052-244-2101	Perform Generator Set Hourly Checks	AIT	AN	2
052-244-2102	Splice a Medium-Voltage Power Cable	AIT	AN	2
052-244-2103	Terminate a Medium-Voltage Power Cable	AIT	AN	2
052-244-2105	Rescue a Victim From a Nonaerial Electrical Conductor	AIT	AN	2
052-244-2106	Perform Preventive Maintenance on Safety Equipment	AIT	AN	2
052-244-2109	Perform Operator Preventive-Maintenance Checks and Services (PMCS) on Test, Measurement, and Diagnostic Equipment (TMDE)	AIT	AN	2
052-244-2111	Troubleshoot an Engine Failure to Stop	AIT	AN	2
052-244-2112	Perform Lockout and Tagout Procedures	AIT	AN	2-4
052-244-2114	Operate a Mobile Electric Power (MEP)-810A or B Generator	AIT	AN	2
052-244-2115	Operate a Mobile Electric Power (MEP)-012 or -208 Generator	AIT	AN	2
052-244-2116	Operate a Mobile Electric Power (MEP)-029 Generator	UNIT	AN	2
052-244-2117	Perform Preventive-Maintenance Checks and Services (PMCS) on a Mobile Electric Power (MEP)-810A or B Generator	AIT	AN	2
052-244-2118	Perform Preventive-Maintenance Checks and Services (PMCS) on a Mobile Electric Power (MEP)-012 or -208 Generator	AIT	AN	2
052-244-2121	Read an Electrical One-Line Diagram	AIT	AN	2
052-244-2123	Operate a Multiunit Power Plant	AIT	AN	2
052-244-2124	Install a Nonorganic Generator	UNIT	AN	2

Table 2-1. MOS 21P2 Critical Tasks (continued)

Task Number	Title	Training Location	Sust Tng Freq	Sust Tng SL
052-244-2125	Operate a Nonorganic Generator	UNIT	AN	2
052-244-2127	Identify the Hazards of a Power Generation and Distribution System	AIT	AN	2
052-244-2128	Troubleshoot a Direct-Current (DC) Voltage System	AIT	AN	2
052-244-2129	Troubleshoot an Alternating-Current (AC) Control Voltage Circuit	AIT	AN	2
052-244-2130	Perform a Load Assessment	AIT	AN	2
052-244-2131	Troubleshoot an Engine Failure to Crank	AIT	AN	2
052-244-2133	Troubleshoot an Engine Failure to Accelerate and/or Maintain a Rated Speed	AIT	AN	2
052-244-2135	Troubleshoot a Generator's Improper Voltage Output	AIT	AN	2
052-244-2136	Install Low-Voltage Organic Equipment	80 AIT	AN	2
052-244-2137	Record Maintenance and/or Operational Data	AIT	AN	2
052-244-2138	Install Low-Voltage Wiring	AIT	AN	2
052-244-2140	Improve Grounding Electrode Resistance	AIT	AN	2
052-244-2141	Repair a Low-Voltage Control Cable	AIT	AN	2
052-244-2142	Prepare a Power Plant for Movement	AIT	AN	2
052-244-2143	Perform Preventive-Maintenance Checks and Services (PMCS) on a Mobile Electric Power (MEP)-029 Generator	UNIT	AN	2
052-244-2144	Read a Schematic	AIT	AN	2
052-244-2145	Operate a Line Truck with Auxiliary Equipment	UNIT	AN	2
052-244-2146	Service a Nonorganic Prime Mover	UNIT	AN	2
052-244-2147	Troubleshoot a Nonorganic Prime Mover	UNIT	AN	2
052-244-2148	Perform Power Plant Battle Damage Assessment and Repair (BDAR)	AIT	AN	2
Subject Area 2. E5 Instrument Maintenance (Power Station) Tasks				
052-207-2100	Produce an Electronic Circuit	AIT	AN	2
052-207-2101	Perform Electronic Troubleshooting Procedures	AIT	AN	2
052-207-2106	Service a Timing Relay	AIT	AN	2
052-207-2113	Service a Current Boost Module	AIT	AN	2
052-207-2116	Service a Signal Transmission Circuit	AIT	AN	2
052-207-2118	Service an Induction Disk and/or Electromagnetic Relay	AIT	AN	2
052-207-2119	Service a Programmable Logic Controller (PLC)	AIT	AN	2
052-207-2120	Service Optoelectronic Equipment	AIT	AN	2
052-207-2121	Service a Solid-State Relay	AIT	AN	2
052-207-2123	Service a Digital Synchronizer and Load Controller (DSLC)	AIT	AN	2
052-207-2125	Service a Meter	AIT	AN	2
052-207-2126	Produce an Electronic Schematic	AIT	AN	2

Table 2-1. MOS 21P2 Critical Tasks (continued)

Task Number	Title	Training Location	Sust Tng Freq	Sust Tng SL
Subject Area 3. S2 Mechanical-Equipment Maintenance (Power Station) Tasks				
052-205-2032	Troubleshoot a Diesel Engine for a Misfiring Cylinder	AIT	AN	2
052-205-2034	Troubleshoot a Diesel Engine for Loss of Power	AIT	AN	2
052-205-2035	Troubleshoot a Diesel Engine for Unusual Smoking	AIT	AN	2
052-205-2100	Service a Diesel Engine Cylinder Head	AIT	AN	2
052-205-2104	Perform Electric Arc Welding	AIT	AN	2
052-205-2105	Perform Oxyfuel Cutting	AIT	AN	2
052-205-2109	Service a Piping System	AIT	AN	2
052-205-2110	Service a Diesel Engine Lube Oil System	AIT	AN	2
052-205-2111	Service a Diesel Engine Cooling System	AIT	AN	2
052-205-2113	Service an Engine Air Intake and/or Exhaust System	AIT	AN	2
052-205-2116	Troubleshoot the Cause of an Unexpected Shutdown of a Diesel Engine	AIT	AN	2
052-205-2118	Troubleshoot an Engine Failure to Start	AIT	AN	2
052-205-2119	Replace a Diesel Engine Piston Assembly	AIT	AN	2
052-205-2120	Service a Hydraulic System	AIT	AN	2
052-205-2123	Produce a Mechanical Drawing	AIT	AN	2
052-205-2124	Operate a Caterpillar™ Electronic Technician (ET) Tool	AIT	AN	2
052-205-2125	Service a Governor for Generating Equipment	AIT	AN	2
052-205-2126	Service an Internal Fuel System for a Diesel Engine	AIT	AN	2
052-205-2127	Service an External Fuel System for a Diesel Engine	AIT	AN	2
052-205-2128	Service a Diesel Engine Starting System	AIT	AN	2
052-205-2129	Troubleshoot a Diesel Engine Lube Oil System	AIT	AN	2
052-205-2130	Troubleshoot a Diesel Engine Cooling System	AIT	AN	2
052-205-2131	Troubleshoot a Diesel Engine Air Intake and/or Exhaust System	AIT	AN	2
052-205-2132	Repair a Diesel Engine Lube Oil System	AIT	AN	2
052-205-2133	Repair a Diesel Engine Cooling System	AIT	AN	2
052-205-2134	Repair an Engine Air Intake and/or Exhaust System	AIT	AN	2
Subject Area 4. S3 Electrical-Equipment Maintenance (Power Station) Tasks				
052-206-2100	Service a Low-Voltage Circuit Breaker	AIT	AN	2
052-206-2101	Install a Medium-Voltage, Nonaerial Air Switch	AIT	AN	2
052-206-2102	Service an Oil Switch	AIT	AN	2
052-206-2103	Service a Vacuum Switch	AIT	AN	2
052-206-2104	Service a System Ground	AIT	AN	2
052-206-2105	Service a Nonaerial Air Switch	AIT	AN	2
052-206-2108	Service an Electrical-Equipment Grounding System	AIT	AN	2
052-206-2114	Service a Power Transformer	AIT	AN	2
052-206-2115	Service a Distribution Transformer	AIT	AN	2

Table 2-1. MOS 21P2 Critical Tasks (continued)

Task Number	Title	Training Location	Sust Tng Freq	Sust Tng SL
052-206-2116	Service Bus Bars	AIT	AN	2
052-206-2122	Service a Switchgear Enclosure	AIT	AN	2
052-206-2123	Perform a Power Factor and Dissipation Factor Test	AIT	AN	2
052-206-2124	Service an Air-Magnetic Circuit Breaker	AIT	AN	2
052-206-2125	Service an Alternating-Current (AC) Generator Assembly	AIT	AN	2
052-206-2127	Service a Sulfur Hexafluoride (SF6) Circuit Breaker	AIT	AN	2
052-206-2133	Identify Electrical Faults Using an Infrared (IR) Camera	AIT	AN	2
052-206-2134	Service a Sulfur Hexafluoride (SF6) Switch	AIT	AN	2
052-206-2135	Service a Vacuum Circuit Breaker	AIT	AN	2
052-206-2136	Perform an Insulation Resistance Test	AIT	AN	2
Subject Area 5. U4 Power Line Distribution Tasks				
052-204-1108	Inspect Safety Equipment	ASI/SD	AN	2-4
052-204-1113	Prepare a Manhole for Safe Entry	ASI/SD	AN	2-4
052-204-1114	Rescue an Injured Victim From a Utility Pole	ASI/SD	AN	2-4
052-204-1115	Rescue an Injured Victim From a Manhole	ASI/SD	AN	2-4
052-204-1116	Rescue an Injured Victim From an Aerial-Bucket Truck	ASI/SD	AN	2-4
052-204-1117	Inspect Hot-Line Equipment	ASI/SD	AN	2-4
052-204-1118	Maintain Climbing and Rigging Equipment	ASI/SD	AN	2-4
052-204-1119	Perform Operator Preventive-Maintenance Checks and Services (PMCS) on a Line Truck With Auxiliary Equipment	ASI/SD	AN	2-4
052-204-1120	Install a Grounding Set	ASI/SD	AN	2-4
052-204-1121	Install High-Intensity Lights and Ballasts	ASI/SD	AN	2-4
052-204-1122	Install Distribution Equipment (De-energized)	ASI/SD	AN	2-4
052-204-1123	Secure Conductor to Insulator (De-energized)	ASI/SD	AN	2-4
052-204-1124	Climb a Utility Pole	ASI/SD	AN	2-4
052-204-1126	Perform a Crossarm Change Out	ASI/SD	AN	2-4
052-204-1127	Perform Groundman Duties	ASI/SD	AN	2-4
052-204-1128	Interpret an Electrical One-Line Diagram	ASI/SD	AN	2-4
052-204-1129	Splice a Medium-Voltage Power Cable	ASI/SD	AN	2-4
052-204-1130	Terminate a Medium-Voltage Power Cable	ASI/SD	AN	2-4
052-204-2207	Conduct a Safety Briefing	UNIT	AN	2-4
052-204-2208	Conduct a Safety Inspection	UNIT	AN	2-4
052-204-2211	Develop a Bill of Materials (BOM) List	UNIT	AN	2-4
052-204-2212	Energize an Electrical Distribution System	UNIT	AN	2-4
052-204-2213	Locate an Underground Cable and/or a Fault	UNIT	AN	2-4
052-204-2214	Perform Live-Line Testing	UNIT	AN	2-4
052-204-2216	Perform Maintenance on Electrical Distribution Equipment	UNIT	AN	2-4
052-204-2217	Manage a Power Line Crew	UNIT	AN	2-4

Table 2-1. MOS 21P2 Critical Tasks (continued)

Task Number	Title	Training Location	Sust Tng Freq	Sust Tng SL
052-204-2218	Supervise the Installation of Underground Cable	UNIT	AN	2-4
052-204-2219	Supervise the Loading and Unloading of Utility Poles	UNIT	AN	2-4
052-204-2220	Supervise the Mechanical Erection of a Utility Pole	UNIT	AN	2-4
Subject Area 6. S3 and E5 Combined Tasks				
052-264-2106	Service a Potential Transformer	AIT	AN	2
052-264-2107	Service a Current Transformer (CT)	AIT	AN	2
052-264-2108	Solder an Electrical or Electronic Component	AIT	AN	2
052-264-2109	Perform Advanced, Electrical Troubleshooting Procedures	AIT	AN	2
052-264-2110	Determine the Transformer Polarity	AIT	AN	2
052-264-2112	Service an Automatic Transfer Switch (ATS)	AIT	AN	2
052-264-2113	Service a Voltage Regulator	AIT	AN	2
052-264-2114	Service an Uninterruptible Power Supply (UPS)	UNIT	AN	2
Subject Area 7. S3 and S2 Combined Tasks				
052-264-2105	Service an Electronic Governor	AIT	AN	2
052-264-2115	Troubleshoot the Improper Operation of an Electrical Motor	AIT	AN	2
Subject Area 8. S2 and E5 Combined Tasks				
052-264-2104	Service an Auxiliary and/or an Instrumentation Sensing Device	AIT	AN	2

Chapter 3

MOS/Skill Level Tasks

Skill Level 2

Subject Area 1: Overall 21P20 Tasks

Perform Generator Set Hourly Checks
052-244-2101

Conditions: As a power plant operator in a tactical or nontactical environment during power plant operations, you are given an operating generator, technical manuals (TMs), manufacturer's literature, an hourly log sheet, a pen, a clipboard, a wiping cloth, personal protective equipment, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE OPERATION OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT OPEN THE HIGH-VOLTAGE CABINET DURING OPERATIONS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. DO NOT REACH HANDS AROUND THE INSTALLED EQUIPMENT GUARDS IN THE ENGINE COMPARTMENT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. ALWAYS WEAR EYE PROTECTION WHEN ENTERING THE GENERATOR ENGINE COMPARTMENT. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

2. BATTERY ELECTROLYTE CONTAINS SULFURIC ACID, WHICH CAN CAUSE SEVERE CHEMICAL BURNS. AVOID CONTACT WITH SKIN OR EYES. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Perform hourly checks on the generator set and keep a record of the results on an hourly log sheet.

Performance Steps
NOTES:

1. Generator readings are taken hourly to assess the operational condition of the generator and identify degradation trends before a fault occurs.

Performance Steps

2. Hourly checks applicable to specific equipment should be completed according to the manufacturer's guidelines.

1. Review danger, warning, and caution notices.
2. Record administrative data.
   a. Record the generator bumper or serial number.
   b. Record the name of the person taking hourly readings.
   c. Record the date and time of the readings.
3. Record instrument panel readings.
   a. Record the oil pressure.
   b. Record the oil temperature.
   c. Record the coolant temperature.
   d. Record engine hours.
   e. Record kilowatt hours.
   f. Record the fuel level.
   g. Record ampere meter readings on phases.
   h. Record voltage meter readings on phases.
   i. Record the exhaust temperature.
   j. Record the air filter differential pressure reading.
   k. Record the fuel filter differential pressure reading.
4. Record the engine oil level reading from the engine compartment (oil pan dipstick or sight glass).
5. Record the coolant level from the radiator sight glass.
6. Record the battery charger voltage and amperes.
7. Check the generator set for damage, excessive or discolored smoke, and unusual noise. Record unusual conditions in the "Remarks" section of the log sheet.
8. Record hydraulic system readings, such as the sight glass and the dipstick.
9. Record actions taken on DA Form 2404 or DA Form 5988-E.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform generator set hourly checks.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Recorded administrative data.	____	____
3. Recorded instrument panel readings.	____	____
4. Recorded the engine oil level reading from the engine compartment (oil pan dipstick or sight glass).	____	____
5. Recorded the coolant level from the radiator sight glass.	____	____
6. Recorded the battery charger voltage and amperes.	____	____
7. Checked the generator set for damage, excessive or discolored smoke, and unusual noise. Recorded unusual conditions in the "Remarks" section of the log	____	____

Performance Measures	GO	NO-GO
sheet.		
8. Recorded hydraulic system readings, such as the sight glass and the dipstick.	____	____
9. Recorded actions taken on DA Form 2404 or DA Form 5988-E.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Splice a Medium-Voltage Power Cable

052-244-2102

Conditions: As a power plant operator in a tactical or nontactical environment during an initial installation of cables where the power cables must be joined or a power cable is damaged beyond repair, you are given a splice kit with instructions, the tools specified in the instructions, an electrician's tool kit, a lockout and tagout kit, grounding equipment, a megohmmeter test set, a voltage detector, manufacturer's literature, and personal protective equipment (PPE).

DANGER: A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. THERE MUST BE NO MATERIALS (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE DEATH OR PERMANENT INJURY.

WARNING:

1. THE SPLICER'S TOOLS, HANDS, AND MATERIALS MUST BE KEPT CLEAN DURING THE CONSTRUCTION OF A SPLICE. FAILURE TO KEEP THE SPLICER'S TOOLS, HANDS, AND MATERIALS CLEAN MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. UTILIZE EVERY AVAILABLE RESOURCE TO PREVENT MOISTURE (DRIPPINGS, CONDENSATION, PERSPIRATION) FROM ENTERING THE JOINT INSULATION. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

NOTE: There are several different types of splicing kits available for use with medium-voltage power cables. Each kit contains specific instructions on how to make the splice. Always follow the manufacturer's procedures for the specific kit used.

Standards: Splice a medium-voltage power cable to ensure that the splice meets the rating of the original cable and does not cause an electrical hazard to personnel or equipment. Ensure that the cable is able to transmit the maximum electrical load without undue heating and is at the full mechanical strength of the conductors.

Performance Steps

1. Perform lockout and tagout procedures.

NOTES:

1. If the two cables do not have enough length to be spliced, an additional length of cable will be needed.

2. This task covers a 5- to 35-kilovolt, single-conductor, shielded power cable that is made of polyethylene, cross-linked polyethylene, butyl, or other rubberlike insulation with a polyvinyl-chloride (PVC) or neoprene jacket.

3. The insulation resistance value should exceed 80 percent of the cable's insulation rating.

2. Inspect the splice kit.
   a. Ensure that the correct splice kit for the cable is being used.
   b. Inventory the kit to ensure that all components/parts are present.

3. Prepare the cable, and splice it according to the manufacturer's literature.
   a. Measure and mark the cable.
   b. Inspect the cable for carbon particles, and remove any that are found.
   c. Inspect the cable jacket for nicks, and remove any that are found.

NOTE: Do not ring cut into the metallic shielding or the insulation when removing the jacket.

Performance Steps

4. Align cables so that the ends of the conductors conjoin squarely.
   a. Ensure that all cuts are made squarely and leave a smooth edge.
   b. Perform ring cuts, as needed, without damaging the other components/parts of the cable.
5. Remove the jacket using the distance indicated in the splice kit instructions.

NOTE: Make cuts square to the conductor.

6. Remove the metallic shield of the cable from the edge of the jacket using the distance indicated in the splice kit instructions.

NOTE: Do not ring-cut into the metallic shielding or the insulation when removing the jacket.

7. Remove the high-voltage insulation layer using the distance indicated in the splice kit instructions.
8. Remove the semiconductor from the edge of the metallic shield using the distance indicated in the splice kit instructions.
9. Apply the connector using the correct compression tool.
   a. Measure back the depth needed for the conductor to penetrate the connector plus the distance indicated in the splice kit.
   b. Clean the entire area of the splice with cable cleaning solvent.
   c. Remove sharp edges.
   d. Place two crimps on the connector, and rotate it approximately 90° between each crimp.
10. Clean surfaces with an approved solvent to remove carbon dust or residue.
11. Replace the high-voltage layer according to the manufacturer's literature.
12. Apply a semiconductive layer from the edge of the shielding tape to the edge of the opposing shield according to the manufacturer's literature.
13. Recreate a shield layer across the splice connector according to the manufacturer's literature.
14. Attach a ground to a shield according to the manufacturer's literature.
15. Leave the ground long enough to reach the grounding point.
16. Apply an outer jacket to the cable according to the manufacturer's literature to prevent moisture from entering the cable.
17. Test the splice to ensure that it meets the rating of the cable.
18. Close out lockout and tagout procedures by removing locking and tagging devices.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to splice a medium-voltage power cable.

Performance Measures	**GO**	**NO-GO**
1. Performed lockout and tagout procedures.	____	____
2. Inspected the splice kit.	____	____
3. Prepared the cable and spliced it according to the manufacturer's literature.	____	____
4. Aligned cables so that the ends of the conductors conjoined squarely.	____	____

Performance Measures	GO	NO-GO
5. Removed the jacket using the distance indicated in the splice kit instructions.	____	____
6. Removed the metallic shield of the cable from the edge of the jacket using the distance indicated in the splice kit instructions.	____	____
7. Removed the high-voltage insulation layer using the distance indicated in the splice kit instructions.	____	____
8. Removed the semiconductor from the edge of the metallic shield using the distance indicated in the splice kit instructions.	____	____
9. Applied the connector using the correct compression tool.	____	____
10. Cleaned surfaces with an approved solvent to remove carbon dust or residue.	____	____
11. Replaced the high-voltage layer according to the manufacturer's literature.	____	____
12. Applied a semiconductive layer from the edge of the shielding tape to the edge of the opposing shield according to the manufacturer's literature.	____	____
13. Recreated a shield layer across the splice connector according to the manufacturer's literature.	____	____
14. Attached a ground to a shield according to the manufacturer's literature.	____	____
15. Left the ground long enough to reach the grounding point.	____	____
16. Applied an outer jacket to the cable according to the manufacturer's literature to prevent moisture from entering the cable.	____	____
17. Tested the splice to ensure that it met the rating of the cable.	____	____
18. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	FM 5-412
	LCH
	NESC®
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Terminate a Medium-Voltage Power Cable

052-244-2103

Conditions: As a power plant operator in a tactical or nontactical environment during an initial installation of cables where the power cables must be terminated or when an existing power cable termination is damaged beyond repair, you are given an electrician's tool kit, a lockout and tagout kit, grounding equipment, a megohmmeter test set, a voltage detector, a termination kit with instructions, the tools specified in the termination kit instructions, manufacturer's literature, and personal protective equipment (PPE).

DANGER: 1. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE DETECTOR AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. USE EVERY RESOURCE TO PREVENT MOISTURE (DRIPPINGS, CONDENSATION, PERSPIRATION) FROM ENTERING THE JOINT INSULATION. FAILURE TO COMPLY MAY CAUSE INJURY OR EQUIPMENT DAMAGE.

2. THE SPLICER'S TOOLS, HANDS, AND TERMINATION MATERIAL MUST BE KEPT CLEAN DURING THE CONSTRUCTION OF A TERMINATION. FAILURE TO COMPLY MAY CAUSE INJURY OR EQUIPMENT DAMAGE.

Standards: Terminate a medium-voltage power cable to ensure that the termination meets the rating of the original cable and that it does not cause an electrical hazard to personnel or damage to equipment. The cable must be able to transmit the maximum electrical load without undue heating and must be at the full mechanical load strength of the conductors.

Performance Steps
NOTES:

1. There are several different types of termination kits available for use with a medium-voltage power cable. Each kit contains specific instructions on how to construct the termination. Always follow the manufacturer's instructions for the specific kit used.

2. This task covers a 5- to 35-kilovolt, single-conductor, shielded power cable that is made of polyethylene, cross-linked polyethylene, butyl, or other rubberlike insulation with a polyvinyl-chloride (PVC) or neoprene jacket.

3. The insulation resistance value should exceed 80 percent of the cable's insulation rating.

1. Perform lockout and tagout procedures.
2. Inspect the termination kit.
   a. Ensure that you use the correct termination kit for each cable.
   b. Inventory the kit to ensure that all components/parts are present.
3. Prepare the cable and termination as specified in the manufacturer's literature.
   a. Measure and mark the cable.
   b. Inspect the cable for carbon particles, and remove any that are found.
   c. Inspect the primary insulation of the cable for nicks, and remove any that are found.
   d. Cut the cable to the proper length.

Performance Steps

4. Remove the jacket using the distance indicated in the manufacturer's literature, and ensure that the length required for the lug is added to the measure-back distance.
5. Remove the shield using the distance indicated in the manufacturer's literature.
6. Remove the semiconductor using the distance indicated in the manufacturer's literature.
7. Remove the high-voltage insulation layer using the distance indicated in the manufacturer's literature.
8. Install the termination lug using the correct compression tool.
   a. Place two crimps on the lug, and rotate it approximately 90° between each crimp.
   b. Remove any sharp edges.
9. Clean all surfaces using an approved solvent to remove any carbon dust or residue.
10. Replace the high-voltage layer as specified in the manufacturer's literature.
11. Apply a semiconductive layer as specified in the manufacturer's literature.
12. Recreate a shield layer as specified in the manufacturer's literature.
13. Attach a ground as specified in the manufacturer's literature, leaving it long enough to reach the grounding point.
14. Apply a high-voltage insulation layer as specified in the manufacturer's literature.
15. Apply an outer jacket to prevent moisture from entering the power cable as specified in the manufacturer's literature.
16. Test the splice to ensure that it meets the rating of the cable.
17. Close out lockout and tagout procedures by removing locking and tagging devices.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to terminate a medium-voltage power cable.

Performance Measures	**GO**	**NO-GO**
1. Performed lockout and tagout procedures.	____	____
2. Inspected the termination kit.	____	____
3. Prepared the cable and termination as specified in the manufacturer's literature.	____	____
4. Removed the jacket using the distance indicated in the manufacturer's literature, and ensured that the length required for the lug was added to the measure-back distance.	____	____
5. Removed the shield using the distance indicated in the manufacturer's literature.	____	____
6. Removed the semiconductor using the distance indicated in the manufacturer's literature.	____	____
7. Removed the high-voltage insulation layer using the distance indicated in the manufacturer's literature.	____	____
8. Installed the termination lug using the correct compression tool.	____	____

Performance Measures	GO	NO-GO
9. Cleaned all surfaces using an approved solvent to remove any carbon dust or residue.	____	____
10. Replaced the high-voltage insulation layer as specified in the manufacturer's literature.	____	____
11. Applied a semiconductive layer as specified in the manufacturer's literature.	____	____
12. Recreated a shield layer as specified in the manufacturer's literature.	____	____
13. Attached a ground as specified in the manufacturer's literature, and left it long enough to reach the grounding point.	____	____
14. Applied a high-voltage insulation layer as specified in the manufacturer's literature.	____	____
15. Applied an outer jacket to prevent moisture from entering the power cable as specified in the manufacturer's literature.	____	____
16. Tested the splice to ensure that it met the rating of the cable.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	FM 5-412
	LCH
	NESC®
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Rescue a Victim From a Nonaerial Electrical Conductor

052-244-2105

Conditions: As a power plant operator in a tactical or nontactical environment, an incapacitated individual is in contact with a nonaerial, electrical conductor. You are given a variety of conductive and nonconductive implements found in the power plant area.

DANGER:

1. DO NOT TOUCH THE VICTIM OR CONDUCTOR WITH YOUR BARE HANDS. DO NOT USE IMPLEMENTS CONTAMINATED WITH FOREIGN MATTER (MUD, OIL, WATER). FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT ATTEMPT TO ADMINISTER FIRST AID OR INITIATE PHYSICAL CONTACT WITH AN ELECTRIC-SHOCK VICTIM BEFORE THE POWER IS SHUT OFF OR BEFORE THE VICTIM IS REMOVED FROM THE POWER SOURCE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Rescue a victim without causing harm to the rescuer or other personnel. Attempt to resuscitate the victim, and provide first aid measures as needed.

Performance Steps
NOTES:

1. For training purposes, simulate a situation where a victim is in contact with a power source. Position the victim and conductor so that the Soldier must decide whether to remove the power source from the victim or remove the victim from the power source. Provide a variety of conductive and nonconductive implements that the Soldier can select to rescue the victim.

2. Members of the power plant team should become familiar with the location of all electrical-circuit disconnect points, such as air switches and fuse cutouts. Knowing the locations of these devices will expedite shutting off the power in emergency situations.

3. Hot sticks and rubber gloves with leather gauntlets should be readily accessible to all personnel within the power plant for use in emergency situations.

1. Assess the situation, and take prompt action.
   a. Determine if it is a life-threatening situation.
   b. Evacuate the area if the potential for an explosion exists.
2. Disconnect or shut off the power if possible.

NOTE: The use of rubber gloves with leather gauntlets and a hot stick is the preferred method of manually opening air switches or disconnecting fuses.

3. Select a nonconductive or insulated implement (such as a hot stick, a wooden pole, or protective rubber gloves with leather gauntlets) to remove the conductor from the victim or remove the victim from the conductor.
4. Isolate the victim from the source of the electric shock by removing the conductor from the victim or removing the victim from the conductor.
5. Evaluate the victim.
6. Perform first aid treatment.
7. Contact emergency medical personnel.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed.

Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to rescue a victim from a nonaerial electrical conductor.

Performance Measures	GO	NO-GO
1. Assessed the situation, and took prompt action.	____	____
2. Disconnected or shut off the power if possible.	____	____
3. Selected a nonconductive or insulated implement (such as a hot stick, a wooden pole, or protective rubber gloves with leather gauntlets) to remove the conductor from the victim or remove the victim from the conductor.	____	____
4. Isolated the victim from the source of the electric shock by removing the conductor from the victim or removing the victim from the conductor.	____	____
5. Evaluated the victim.	____	____
6. Performed first aid treatment.	____	____
7. Contacted emergency medical personnel.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 4-25.11
	TB 385-4
	TM 5-315

Perform Preventive Maintenance on Safety Equipment

052-244-2106

Conditions: As a power plant operator in a tactical or nontactical environment during scheduled and unscheduled maintenance, you are given the manufacturer's literature, DA Form 2404, equipment technical manuals, cleaning materials, electrician tools, equipment specified in the manufacturer's maintenance instructions, and standing operating procedures.

DANGER: ALL SAFETY EQUIPMENT MUST BE MAINTAINED ACCORDING TO THE MANUFACTURER'S MAINTENANCE INSTRUCTIONS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Perform preventive maintenance on the safety equipment using the materials provided. Remove all unsafe equipment from the inventory.

Performance Steps
NOTE: All safety equipment will be inspected and maintained as specified in the equipment technical manual and the manufacturer's literature.

1. Inspect the hot sticks.
    a. Check for valid calibration stamps.
    b. Inspect for excessive wear to the wood or fiberglass.
2. Inspect the grounding sticks.
    a. Check for valid calibration stamps.
    b. Inspect for excessive wear to the wood or fiberglass.
    c. Check for good electrical connections to the grounding cables.
3. Inspect the ground clusters.
    a. Check for valid calibration stamps.
    b. Inspect for excessive wear.
    c. Inspect for obvious damage.
    d. Check for good electrical connections on interconnecting cables.
4. Maintain the rubber gloves.
    a. Check for valid calibration stamps.
    b. Perform user tests by rolling the gloves and feeling for air leaks.
    c. Ensure that the leather liners are serviceable and free of holes.
5. Maintain the rubber sleeves.
    a. Check for valid calibration stamps.
    b. Submit for scheduled electrical testing.
    c. Inspect for holes or cracking.
6. Maintain the rubber blankets and mats.
    a. Check for valid calibration stamps.
    b. Submit for scheduled testing.
    c. Inspect for holes or cracking.
7. Inspect the flash suits.
    a. Check for valid calibration stamps.
    b. Inspect for holes.
    c. Check for damage to the face shields.
8. Maintain the hard hats.
    a. Check for valid calibration stamps.
    b. Inspect for obvious damage.

Performance Steps

9. Inspect the safety glasses and face shields.
    a. Inspect for scratches.
    b. Inspect for structural damage.
10. Inspect the antislip floor mats.
    a. Check for tears.
    b. Inspect for excessive wear.
11. Maintain the petroleum spill kits.
    a. Check the inventory for correct stockage.
    b. Ensure that the kits are placed in the correct areas.
12. Maintain the lighted exit signs.
    a. Inspect for damage.
    b. Perform function tests.
13. Maintain the safety board.
    a. Ensure that the equipment is functional.
    b. Restock the first aid kit.
14. Inspect the fire extinguishers.
    a. Inspect for proper pressure.
    b. Check for obvious damage.
15. Inspect the eyewash stations.
    a. Perform function tests.
    b. Inspect for proper pressure.
16. Maintain the emergency lights.
    a. Perform function tests.
    b. Change the batteries and bulbs as necessary.
17. Maintain the smoke detectors.
    a. Perform a function test.
    b. Change the batteries as necessary.
18. Record actions taken on DA Form 2404.
19. Ensure that all cleaning material, electrician tools, and safety equipment are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed.

Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform preventive maintenance on safety equipment.

Performance Measures	**GO**	**NO-GO**
1. Inspected the hot sticks.	____	____
2. Inspected the grounding sticks.	____	____
3. Inspected the ground clusters.	____	____
4. Maintained the rubber gloves.	____	____
5. Maintained the rubber sleeves.	____	____

Performance Measures	GO	NO-GO
6. Maintained the rubber blankets and mats.	____	____
7. Inspected the flash suits.	____	____
8. Maintained the hard hats.	____	____
9. Inspected the safety glasses and face shields.	____	____
10. Inspected the antislip floor mats.	____	____
11. Maintained the petroleum spill kits.	____	____
12. Maintained the lighted exit signs.	____	____
13. Maintained the safety board.	____	____
14. Inspected the fire extinguishers.	____	____
15. Inspected the eyewash stations.	____	____
16. Maintained the emergency lights.	____	____
17. Maintained the smoke detectors.	____	____
18. Recorded actions taken on DA Form 2404.	____	____
19. Ensured that all cleaning material, electrician tools, and safety equipment were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	LCH
	NESC®

Perform Operator Preventive-Maintenance Checks and Services (PMCS) on Test, Measurement, and Diagnostic Equipment (TMDE)

052-244-2109

Conditions: As a power plant operator in a tactical or nontactical environment during scheduled or unscheduled maintenance of test equipment, you are given the manufacturer's literature, technical manuals, TB 43-180, cleaning materials, electrician tools, the equipment stated in the manufacturer's maintenance instructions, standing operating procedures, DA Form 2404 (Equipment Inspection and Maintenance Worksheet), DA Form 3758-R (Calibration and Repair Requirements Worksheet), DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and DA Label 80 (U.S. Army Calibrated Instrument).

DANGER: ALL TMDE MUST BE MAINTAINED ACCORDING TO MANUFACTURER SPECIFICATIONS. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE, PERMANENT INJURY, OR DEATH.

Standards: Perform PMCS on TMDE as indicated in the manufacturer's literature.

Performance Steps
NOTE: All TMDE, regardless of whether it is mentioned in this publication, will be inspected and maintained as specified in the technical manual, the manufacturer's literature, and TB 43-180.

1. Ensure that TMDE requiring calibration is listed in TB 43-180.
2. Complete DA Form 3758-R for the items requiring calibration that are not found in TB 43-180.
3. Ensure that a valid DA Label 80 is attached to TMDE requiring calibration.
4. Ensure that a valid DA Label 80 stamped with "Calibration Not Required" is attached to the test equipment not requiring calibration.
5. Place a valid DA Label 80 stamped with "Calibrate Before Use" on the TMDE that has not been calibrated.
6. Submit defective and delinquent equipment for calibration or repair.
7. Clean test equipment as necessary.
8. Perform PMCS on electrical, mechanical, and instrumentation TMDE.
9. Record actions taken on DA Form 2404 or DA Form 5988-E.
10. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform operator PMCS on TMDE.

Performance Measures	**GO**	**NO-GO**
1. Ensured that TMDE requiring calibration was listed in TB 43-180.	____	____
2. Completed DA Form 3758-R for the items requiring calibration that were not found in TB 43-180.	____	____
3. Ensured that a valid DA Label 80 was attached to TMDE requiring calibration.	____	____

Performance Measures	GO	NO-GO
4. Ensured that a valid DA Label 80 stamped with "Calibration Not Required" was attached to the test equipment not requiring calibration.	____	____
5. Placed a valid DA Label 80 stamped with "Calibrate Before Use" on the TMDE that had not been calibrated.	____	____
6. Submitted defective and delinquent equipment for calibration or repair.	____	____
7. Cleaned test equipment as necessary.	____	____
8. Performed PMCS on electrical, mechanical, and instrumentation TMDE.	____	____
9. Recorded actions taken on DA Form 2404 or DA Form 5988-E.	____	____
10. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	LCH
DA FORM 3758-R	
DA FORM 5988-E	
DA LABEL 80	
TB 43-180	

Troubleshoot an Engine Failure to Stop

052-244-2111

Conditions: As a power plant operator in a tactical or nontactical environment, you are given an engine that fails to stop, the technical manual for the engine, a general mechanic's tool box, a multimeter, a maintenance logbook, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE OPERATION AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND THE HAZARDS ASSOCIATED WITH IT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Troubleshoot an engine that fails to stop by identifying and verifying the cause of the engine failure. Correct the fault if possible.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review the maintenance logbook and historical data pertaining to the equipment.
4. Check the system emergency STOP button.
   a. Ensure that the button functions properly.
   b. Verify the proper voltage at the emergency STOP button.
5. Check the stop circuit.
   a. Inspect the stop circuit for loose connections.
   b. Check the stop circuit for defective wiring harnesses.
   c. Verify that the engine run relays de-energize.
   d. Check for improper system voltage.
   e. Check for unauthorized modifications.
6. Correct deficiencies if possible.
7. Record faults in the maintenance logbook.
8. Record actions taken on DA Form 2404 or DA Form 5988-E.
9. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot an engine failure to stop.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed the maintenance logbook and historical data pertaining to the equipment.	____	____
4. Checked the system emergency STOP button.	____	____
5. Checked the stop circuit.	____	____
6. Corrected deficiencies if possible.	____	____
7. Recorded faults in the maintenance logbook.	____	____
8. Recorded actions taken on DA Form 2404 or DA Form 5988-E.	____	____
9. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	
DA FORM 5988-E	

Perform Lockout and Tagout Procedures

052-244-2112

Conditions: As a power plant operator in a tactical or nontactical environment with a system that must be de-energized for troubleshooting or maintenance, you are given Occupational Safety and Health Administration (OSHA) Regulation 1910.147, TM 5-682, ER 385-1-31, Eng Form 1925 (Danger-Main Hold Card), ENG Form 1927-R (Safe Clearance Request), Eng Form 2198 (Operation Log), a lockout and tagout kit, a voltage detector, a two-way radio or telephone communication equipment, other appropriate TMs, and schematics or prints for the equipment to be locked out or tagged out.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE DETECTOR AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALL SYSTEMS ARE CONSIDERED ENERGIZED UNTIL THE ENERGY SOURCE IS REMOVED, LOCKED OUT (WHEN POSSIBLE), AND TAGGED OUT. WHEN ENERGY-ISOLATING DEVICES CANNOT BE PHYSICALLY LOCKED OUT, USE TAGOUT PROCEDURES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Perform lockout and tagout procedures according to OSHA regulations to ensure the safe isolation of energized circuits and mechanical hazards.

Performance Steps
NOTES:

1. Authorized personnel applying lockout and tagout devices are also responsible for ensuring the control of residual energy and for placing, tagging, and removing protective grounds.

2. Safe clearances must be used for electrical work performed on de-energized lines and for equipment operating over 600 volts.

1. Notify the project supervisor of the work areas requiring lockout and tagout procedures.
2. Initiate a safe clearance request.
   a. Fill out Eng Form 1927-R.
   b. Annotate the safe clearance in the power station operation log (Eng Form 2198).
3. Review the schematics and prints of the system.
   a. Identify all energy-isolating devices and disconnectors.
   b. Identify where the system can be isolated by—
      (1) Shutting down the system.
      (2) Isolating the system.
      (3) Blocking the system.
      (4) Securing the system.
4. Isolate systems operated by remote-controlled power sources.
5. Create a list of energy-isolating devices and disconnecting equipment to be locked and tagged.
   a. Identify the primary means of isolation.

Performance Steps

b. Identify the secondary means of isolation.

6. Review other work areas to identify possible exposure to sources of electrical and mechanical energy hazards.
7. Identify other energy sources in the immediate area to determine possible exposure to stored or residual energy.
8. Ensure that potentially hazardous stored or residual energy is relieved, discharged, or otherwise rendered safe.
9. Establish energy control methods to regulate other hazardous energy sources in the area.
10. Test each phase conductor or circuit part using a voltage detector to verify that it is de-energized.
    a. Check an energized circuit to ensure that the voltage detector is working.
    b. Check for the presence of voltage on the de-energized circuit.
    c. Check the energized circuit again to verify that the voltage detector is working properly.
11. Install lockout devices on the energy-isolating mechanisms and disconnectors so that they are maintained in an open or de-energized position.

NOTE: The person performing the work retains the keys to the lockout devices until the work is complete.

12. Attach Eng Form 1925 as a main hold card for the primary means of energy isolation.
    a. Ensure that the person installing the lockout device signs the lockout tag with the—
        (1) Printed name of the installer.
        (2) Date.
        (3) Time.
        (4) Clearance number.
    b. Ensure that the main hold card lists all locations of the auxiliary hold cards.
13. Attach Eng Form 1925 as an auxiliary hold card for the secondary means of energy isolation.
    a. Ensure that the person installing the lockout device signs the lockout tag with the—
        (1) Printed name of the installer.
        (2) Date.
        (3) Time.
        (4) Clearance number.
    b. Ensure that the auxiliary hold card number matches the numbered location of the main hold cards.
14. Attach Eng Form 1925 as a tagout device for the energy-isolating mechanisms and disconnectors that cannot be physically locked.
    a. Ensure that the person installing the lockout device signs the lockout tag with the—
        (1) Printed name of the installer.
        (2) Date.
        (3) Time.
        (4) Clearance number.
    b. Ensure that the lockout tag is placed directly over the operating controls of the energy-isolating mechanisms and disconnectors.

NOTE: The lockout tag should contain a brief statement that prohibits the unauthorized operation of energy-isolating devices and disconnectors and removal of the tag. It should warn against the hazards of the system being energized and include a legend that contains wording such as "Do Not Start," "Do Not Energize," "Do Not Open," "Do Not Close," and "Do Not Operate."

15. Perform an inspection with personnel in the work area and the project supervisor.
    a. Verify that the system has been successfully isolated and de-energized.
    b. Accomplish the inspection before working on the systems that have been locked out or tagged out.

Performance Steps

DANGER: VERIFICATION OF ISOLATION AND SYSTEM DE-ENERGIZING MUST BE ACCOMPLISHED BY ATTEMPTING TO OPERATE THE ENERGY-ISOLATING DEVICES AND DISCONNECTORS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

16. Test each phase conductor or circuit part with an adequately rated voltage detector to verify that they are de-energized.
    a. Check an energized circuit to ensure that the voltage detector is working properly.
    b. Check for the presence of voltage on the de-energized circuit.
    c. Check the energized circuit again to verify that the voltage detector is working properly.
17. Perform maintenance and service on the phase conductor or circuit part.
18. Request permission from the project supervisor to close out lockout and tagout procedures.
19. Perform an inspection with the personnel performing the work and the project supervisor to ensure that all affected personnel are notified when the lockout and tagout devices are ready for removal.

WARNING: BEFORE THE LOCKOUT OR TAGOUT DEVICES ARE REMOVED AND EQUIPMENT AND ELECTRIC CIRCUITS ARE REENERGIZED, APPROPRIATE TESTS AND VISUAL INSPECTIONS WILL BE CONDUCTED BY THE INSTALLER. THE INSTALLER WILL VERIFY THAT ALL TOOLS, MECHANICAL RESTRAINTS, ELECTRICAL JUMPERS, SHORTS, AND GROUNDS HAVE BEEN REMOVED. THE ENTIRE WORK AREA WILL BE INSPECTED AND NONESSENTIAL ITEMS WILL BE REMOVED FROM THE SYSTEM. FAILURE TO COMPLY MAY CAUSE INJURY OR EQUIPMENT DAMAGE.

20. Close out lockout and tagout procedures by removing locking and tagging devices.

NOTE: Ensure that each lockout and tagout device is removed by the installer or by a designated representative if the installer is unavailable.

21. Ensure that personnel are safely positioned or are removed from the area needing to be reenergized.
22. Complete and file all necessary forms.
    a. Complete Eng Form 1927-R.
    b. Annotate the completed work on Eng Form 2198.
    c. File the completed Eng Form 1927-R.
23. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform lockout and tagout procedures.

Performance Measures	**GO**	**NO-GO**
1. Notified the project supervisor of the work areas requiring lockout and tagout procedures.	____	____
2. Initiated a safe clearance request.	____	____
3. Reviewed the schematics and prints of the system.	____	____
4. Isolated systems operated by remote-controlled power sources.	____	____
5. Created a list of energy-isolating devices and disconnecting equipment to be locked and tagged.	____	____

Performance Measures	GO	NO-GO
6. Reviewed other work areas to identify possible exposure to sources of electrical and mechanical energy hazards.	____	____
7. Identified other energy sources in the immediate area to determine possible exposure to stored or residual energy.	____	____
8. Ensured that potentially hazardous stored or residual energy was relieved, discharged, or otherwise rendered safe.	____	____
9. Established energy control methods to regulate other hazardous energy sources in the area.	____	____
10. Tested each phase conductor and circuit part using a voltage detector to verify that it was de-energized.	____	____
11. Installed lockout devices on the energy-isolating mechanisms and disconnectors so that they were maintained in an open or de-energized position.	____	____
12. Attached Eng Form 1925 as a main hold card for the primary means of energy isolation.	____	____
13. Attached Eng Form 1925 as an auxiliary hold card for the secondary means of energy isolation.	____	____
14. Attached Eng Form 1925 as a tagout device for the energy-isolating mechanisms and disconnectors that could not be physically locked.	____	____
15. Performed an inspection with personnel in the work area and the project supervisor.	____	____
16. Tested each phase conductor or circuit part with an adequately rated voltage detector to verify that they were de-energized.	____	____
17. Performed maintenance and service on the phase conductor or circuit part.	____	____
18. Requested permission from the project supervisor to close out lockout and tagout procedures.	____	____
19. Performed an inspection with the personnel performing the work and the project supervisor to ensure that all affected personnel were notified when the lockout and tagout devices were ready for removal.	____	____
20. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
21. Ensured that personnel were safely positioned or were removed from the area needing to be reenergized.	____	____
22. Completed and filed all necessary forms.	____	____
23. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
ENG FORM 1925	EM 385-1-1
ENG FORM 1927-R	

References

Required	Related
ENG FORM 2198	
ER 385-1-31	
OSHA REG 1910.147	
TM 5-682	

Operate a Mobile Electric Power (MEP)-810A or B Generator

052-244-2114

Conditions: As a power plant operator in a tactical or nontactical environment after the completion of a power plant installation, you are given an MEP-810A or B generator, an operator's manual, the appropriate technical manuals, and the required accessories for initial start-up.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Operate an MEP-810A or B generator in manual and automatic mode according to TM guidelines to ensure that the system parameters are met without causing injury or equipment damage.

Performance Steps

1. Perform preoperational checks according to the TM.
2. Perform a preoperational run according to the TM.
3. Perform an operator remote terminal setup according to the TM.
4. Complete the switch arrangements.
5. Verify the lamp indicators.
6. Place the engine control switch in MANUAL mode.
7. Ensure that the generator starts and accelerates to the correct operating voltage and frequency.
8. Place the synchronous source switch at the master control panel in the G1 position.
9. Close the G1 breaker by cycling the breaker control switch to the CLOSE position.
10. Ensure that the breaker control switch closes.
11. Return the synchronous source switch to the OFF position.
12. Place the engineer control switch in the MANUAL position at G2.
13. Place the synchronous source switch at the master control panel in the G2 position.
14. Close the G2 breaker by cycling the breaker control switch to the CLOSE position when the two green, triangular, light-emitting diodes (LEDs) that show 12 o'clock on the synchroscope are energized.
15. Ensure that the breaker control switch closes.

Performance Steps

16. Return the synchronous source switch to the OFF position.
17. Close the required feeder tie breaker(s) from the local control panel and allow it run for 20 minutes through various load changes.
18. Shut down the generator according to the TM.
19. Perform a preoperational run according to the TM.
20. Perform an operator remote terminal setup according to the TM.
21. Ensure that Generator 1 automatically starts and accelerates to the correct operating voltage and frequency.
22. Ensure that Generator 1 automatically closes to the system bus.
23. Ensure that the tie breaker automatically closes.
24. Ensure that Generator 2 automatically starts and accelerates to the correct operating voltage and frequency.
25. Ensure that Generator 2 automatically parallels the system bus.
26. Shut down the generator according to the TM.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that all safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to operate an MEP-810A or B generator.

Performance Measures	**GO**	**NO-GO**
1. Performed preoperational checks according to the TM.	____	____
2. Performed a preoperational run according to the TM.	____	____
3. Performed an operator remote terminal setup according to the TM.	____	____
4. Completed the switch arrangements.	____	____
5. Verified the lamp indicators.	____	____
6. Placed the engine control switch in MANUAL mode.	____	____
7. Ensured that the generator started and accelerated to the correct operating voltage and frequency.	____	____
8. Placed the synchronous source switch at the master control panel in the G1 position.	____	____
9. Closed the G1 breaker by cycling the breaker control switch to the CLOSE position.	____	____
10. Ensured that the breaker control switch closed.	____	____
11. Returned the synchronous source switch to the OFF position.	____	____
12. Placed the engineer control switch in the MANUAL position at G2.	____	____

Performance Measures	GO	NO-GO
13. Placed the synchronous source switch at the master control panel in the G2 position.	____	____
14. Closed the G2 breaker by cycling the breaker control switch to the CLOSE position when the two green, triangular, LEDs showing 12 o'clock on the synchroscope were energized.	____	____
15. Ensured that the breaker control switch closed.	____	____
16. Returned the synchronous source switch to the OFF position.	____	____
17. Closed the required feeder tie breaker(s) from the local control panel and allowed it run for 20 minutes through various load changes.	____	____
18. Shut down the generator according to the TM.	____	____
19. Performed a preoperational run according to the TM.	____	____
20. Performed an operator remote terminal setup according to the TM.	____	____
21. Ensured that Generator 1 automatically started and accelerated to the correct operating voltage and frequency.	____	____
22. Ensured that Generator 1 automatically closed to the system bus.	____	____
23. Ensured that the tie breaker automatically closed.	____	____
24. Ensured that Generator 2 automatically started and accelerated to the correct operating voltage and frequency.	____	____
25. Ensured that Generator 2 automatically paralleled the system bus.	____	____
26. Shut down the generator according to the TM.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Operate a Mobile Electric Power (MEP)-012 or -208 Generator

052-244-2115

Conditions: As a power plant operator in a tactical or nontactical environment after a power plant has been fully installed and is operational, you are given an MEP-012 or -208 generator, TM 9-6115-604-12, other appropriate TMs, and personal protective equipment for a routine start-up and operation.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Operate the generating units according to the TMs to ensure that the system parameters are met without causing injury or equipment damage.

Performance Steps

1. Perform before-operation, preventive-maintenance checks and services (PMCS).
2. Place the 24-volt, direct-current (DC) control power circuit breaker in the ON position.
3. Place the maintenance lockout switch in the MANUAL position.
4. Place the operation selector switch in the MANUAL position.
5. Place the parallel switch in the appropriate position for the operating conditions, and ensure that the indicator light is illuminated.
6. Place the local remote switch in the LOCAL position.
7. Hold the prelube system switch in the ON position, and observe the lube oil pressure gauge for rising oil pressure. Release the switch when the pressure stabilizes (the pressure should stabilize within 2 minutes).
8. Place the master switch in the START position, and release it to the RUN position.

NOTE: The engine will automatically crank for 15 seconds, and then rest for 15 seconds, for a total of four crank cycles, until the engine starts.

9. Release the prelube system switch.
10. Adjust the frequency adjustment rheostat for a frequency meter reading of 50 or 60 hertz as applicable.
11. Place the GEN/BUS voltmeter switch in the GEN 3-1 position.
12. Adjust the voltage adjustment rheostat for an alternating-current (AC), kilovolt-ampere (KVA) reading of 4.16 KVA for a 60-hertz operation or 3.8 KVA for a 50-hertz operation.

Performance Steps

13. Verify that the AC KVA reading is the same at all three GEN/BUS settings.
14. Place the breaker control switch in the CLOSE position, and ensure that the indicator light is illuminated.
15. Monitor the engine and generator indicators to ensure that the operation continues through the various load changes.
16. Perform during-operation PMCS.
17. Conduct unit shutdown operations.
    a. Place the breaker control switch in the TRIP position.
    b. Allow the engine to operate for 5 minutes at no load.
    c. Place the master switch in the STOP position.
18. Perform after-operation PMCS.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to operate an MEP-012 or -208 generator.

Performance Measures	**GO**	**NO-GO**
1. Performed before-operation PMCS.	____	____
2. Placed the 24-volt, DC control power circuit breaker in the ON position.	____	____
3. Placed the maintenance lockout switch in the MANUAL position.	____	____
4. Placed the operation selector switch in the MANUAL position.	____	____
5. Placed the parallel switch in the appropriate position for the operating conditions, and ensured that the indicator light was illuminated.	____	____
6. Placed the local remote switch in the LOCAL position.	____	____
7. Held the prelube system switch in the ON position, and observed the lube oil pressure gauge for rising oil pressure. Released the switch when the pressure stabilized (the pressure should have stabilized within 2 minutes).	____	____
8. Placed the master switch in the START position, and released it to the RUN position.	____	____
9. Released the prelube system switch.	____	____
10. Adjusted the frequency adjustment rheostat for a frequency meter reading of 50 or 60 hertz as applicable.	____	____
11. Placed the GEN/BUS voltmeter switch in the GEN 3-1 position.	____	____
12. Adjusted the voltage adjustment rheostat for an AC, KVA reading of 4.16 for a 60-hertz operation or 3.8 KVA for a 50-hertz operation.	____	____
13. Verified that the AC KVA reading was the same at all three GEN/BUS settings.	____	____
14. Placed the breaker control switch in the CLOSE position, and ensured that the indicator light was illuminated.	____	____

Performance Measures	GO	NO-GO
15. Monitored the engine and generator indicators to ensure that the operation continued through the various load changes.	____	____
16. Performed during-operation PMCS.	____	____
17. Conducted unit shutdown operations.	____	____
18. Performed after-operation PMCS.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
TM 9-6115-604-12	

Operate a Mobile Electric Power (MEP)-029 Generator

052-244-2116

Conditions: As a power plant operator in a tactical or nontactical environment after an MEP-029 generator has been fully installed and is operational, you are given TM 5-6115-593-12 and personal protective equipment for a routine start-up and operation.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. ENSURE THAT NO TOOLS, PARTS, OR LOOSE ITEMS TOUCH THE ENGINE. FAILURE TO COMPLY MAY CAUSE INJURY.

2. SHUTTERS WILL RAPIDLY SNAP SHUT WITH CONSIDERABLE FORCE WHEN THE GENERATOR SET IS STOPPED. ENSURE THAT PERSONNEL ARE CLEAR OF THE SHUTTERS BEFORE STOPPING THE GENERATOR. FAILURE TO COMPLY MAY CAUSE INJURY.

3. IF THE ENGINE DOES NOT START IN 45 SECONDS, OVERCRANK PROTECTION WILL TERMINATE THE CRANKING CYCLE. RESET THE ENGINE AND ALLOW IT TO REST FOR 1 MINUTE BEFORE STARTING ANOTHER CRANK CYCLE. FAILURE TO COMPLY MAY CAUSE DAMAGE TO THE CRANK CIRCUIT.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Operate an MEP-029 generator according to TM 5-6115-593-12. Ensure that the system parameters are met without causing injury or equipment damage.

Performance Steps

1. Prepare the MEP-029 generator for start-up.
   a. Perform preventive-maintenance checks and services (PMCS) and prestart checks.
   b. Check the air box damper position, and reset it manually if required.
   c. Check the battery terminals, and ensure that the negative (-) is connected to a ground.
   d. Place the 24-volt, direct-current (DC) control circuit breaker on the generator panel to the ON position.
   e. Ensure that the maintenance switch on the alternating-current (AC)-DC control panel is in the OPERATION position.
   f. Check the fuel level and the side door shutter operation by placing the battle short switch on the generator panel to the ON position. Then switch the master switch on the engine panel to the START position.
   g. Return the master switch to the STOP position and the battle short switch to the

Performance Steps

OFF position.

h. Check the engine fault indicators and the annunciator by placing the annunciator test switch on the generator panel to the TEST position. If none of the lights are on after being tested, proceed with the next step. If a light comes on, correct the indicated fault before proceeding.
i. Check the voltage and frequency requirements of the load against the voltage and frequency connection of the generator set.
j. Place the AUTO/TRIP/MAN switch to the MAN position.

2. Start the MEP-029 generator.
   a. Ensure that the preheat system has operated at least 6 hours before starting. If the ambient temperature is below 40°F, operate the preheat system as follows:
      (1) Ensure that the jumper is connected between terminals 1 and 3 on Terminal Board 20.

NOTE: Terminal Board 20 is located in the AC-DC control box. The jumpers are needed only if the generator is permanently connected to the external power to permit battery operation.

      (2) Connect the 120- or 240-volt AC external power source to the external power receptacle on the external power box control panel.
      (3) Switch the external power breaker to the ON position.
      (4) Switch the preheat switch to the ON position.
   b. Toggle the master switch on the engine panel to the START position.
   c. Adjust the frequency and voltage to the desired values when the engine starts.
   d. Check the generator fault indicators by placing the annunciator test switch to the TEST position before closing the main circuit breaker.
      (1) Proceed with step 2e if no lights are on after being tested.
      (2) Correct the indicated fault before proceeding if a light comes on.
   e. Place the parallel/single unit operation switch to the SINGLE UNIT position.
   f. Place the AC power circuit breaker to the CLOSE position for about 2 or 3 seconds to close the main circuit breaker. Ensure that the closed indicator light comes on.

3. Operate the MEP-029 generator.
   a. Monitor the engine and generator indicators to ensure that the MEP-029 generator continues to operate through various load changes.
   b. Perform operational PMCS according to TM 5-6115-593-12, and record the operation and maintenance data.

4. Stop the MEP-029 generator.
   a. Place the AC power circuit breaker to the OPEN position for about 2 or 3 seconds. The AC power circuit breaker closed light should turn off.
   b. Place the master switch to the STOP position after allowing the engine to cool by operating it at "no load" for about 5 minutes.
   c. Remove the DC control power after the engine stops by setting the 24-volt DC control circuit breaker to the OFF position.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to operate an MEP-029 generator.

Performance Measures	**GO**	**NO-GO**
1. Prepared the MEP-029 generator for start-up.	____	____
2. Started the MEP-029 generator.	____	____
3. Operated the MEP-029 generator.	____	____

Performance Measures	GO	NO-GO
4. Stopped the MEP-029 generator.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
TM 5-6115-593-12	EM 385-1-1

Perform Preventive-Maintenance Checks and Services (PMCS) on a Mobile Electric Power (MEP)-810A or B Generator

052-244-2117

Conditions: As a power plant operator in a tactical or nontactical environment, you are given an MEP-810A or B generator, the operator's manual, technical manuals (TMs), DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), a pen, a clipboard, a general mechanic's tool box, a wiping cloth, and personal protective equipment.

DANGER:

1. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A POWER SOURCE, SUCH AS UTILITY POWER OR ANOTHER GENERATOR SET, IS CONNECTED TO THE LOAD TERMINALS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: AVOID CONTACT WITH BATTERY ELECTROLYTES; THEY CONTAIN SULFURIC ACID THAT CAN CAUSE SEVERE CHEMICAL BURNS. SKIN AND EYE PROTECTION IS REQUIRED. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Perform PMCS on an MEP-810A or B generator according to the TMs.

Performance Steps

1. Ensure that the parking brake is set by rotating the crank clockwise.
2. Ensure that wheels are properly chocked.
3. Open the petcock on the air tank to evacuate the air from the spring-set brakes.
4. Check the ground connection for tightness.
5. Ensure that the operator remote terminal and communication ports are properly connected.
6. Ensure that the feeder output cables are properly connected and that the concentric neutrals are grounded.
7. Ensure that the feeder output covers are secured.
8. Check parking stands for proper mounting and connection.
9. Ensure that the two 120-volt auxiliary duplex receptacles and the 60-amp, three-phase receptacle cables are securely connected and that the covers are properly installed.
10. Inspect the inside of the power unit (PU) by opening the side access door.
    a. Inspect the area for cleanliness, loose electrical connections, loose hardware, and leaks around the oil filter and oil lines.
    b. Check for heat damage and other abnormalities.
    c. Check high-voltage panels for security.
11. Ensure that battery chargers are plugged into the battery charger receptacle, circuit breakers are turned on, and chargers are working.
12. Inspect the air intake duct for obstructions or foreign objects.
13. Drain the crankcase vent reservoir into a proper container.

Performance Steps

14. Open the petcock of the primary fuel filter, and drain the water and sediment into a proper container.
15. Check oil levels.
16. Ensure that the fuel shutoff valve is in the OPEN position.
17. Remove splash guards.
18. Check fuel, hydraulic, and radiator fill tanks for leaks and damage.
19. Check fuel levels with the built-in dipstick, coolant levels through the coolant sight glass, and hydraulic-fluid levels through the hydraulic fluid sight glass.
20. Check the fuel transfer pump assembly for secure mounting and leaks.
    a. Place the fuel transfer mode switch in automatic mode (Position A).
    b. Place the fuel transfer pump power switch in the G1 position.
21. Check the condition of the batteries.
    a. Check for cleanliness and signs of damage.
    b. Check electrical connections for tightness and signs of corrosion.
22. Ensure that the battery isolation switch is in the OFF position.
23. Use a flashlight to check between the generators for leaks, loose hardware, and other potential problems.
24. Ensure that tie output cables are properly connected and that concentric neutrals are connected to the ground.
25. Ensure that the tie output cover is locked.
26. Check the PU equipment grounds for proper connection.
27. Ensure that the PU interconnect control cable is properly connected.
28. Inspect the exterior fuel system for proper connection, leaks, and fuel availability.
29. Open the three primary distribution center doors; and check for damage, loose connections, and foreign objects.
30. Position the selector switch in the proper mode based on location (50 or 60 hertz).
31. Secure side access doors.
32. Record actions taken on DA Form 2404 or DA Form 5988-E.
33. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform PMCS on an MEP-810A or B generator.

Performance Measures	**GO**	**NO-GO**
1. Ensured that the parking brake was set by rotating the crank clockwise.	____	____
2. Ensured that wheels were properly chocked.	____	____

Performance Measures	GO	NO-GO
3. Opened the petcock on the air tank to evacuate the air from the spring-set brakes.	____	____
4. Checked the ground connection for tightness.	____	____
5. Ensured that the operator remote terminal and communication ports were properly connected.	____	____
6. Ensured that the feeder output cables were properly connected and that the concentric neutrals were grounded.	____	____
7. Ensured that the feeder output covers were secured.	____	____
8. Checked parking stands for proper mounting and connection.	____	____
9. Ensured that the two 120-volt auxiliary duplex receptacles and the 60-amp, three-phase receptacle cables were securely connected and that the covers were properly installed.	____	____
10. Inspected the inside of the PU by opening the side access door.	____	____
11. Ensured that battery chargers were plugged into the battery charger receptacle, circuit breakers were turned on, and chargers were working.	____	____
12. Inspected the air intake duct for obstructions or foreign objects.	____	____
13. Drained the crankcase vent reservoir into a proper container.	____	____
14. Opened the petcock of the primary fuel filter, and drained the water and sediment into a proper container.	____	____
15. Checked oil levels.	____	____
16. Ensured that the fuel shutoff valve was in the OPEN position.	____	____
17. Removed splash guards.	____	____
18. Checked fuel, hydraulic, and radiator fill tanks for leaks and damage.	____	____
19. Checked fuel levels with the built-in dipstick, coolant levels through the coolant sight glass, and hydraulic-fluid levels through the hydraulic fluid sight glass.	____	____
20. Checked the fuel transfer pump assembly for secure mounting and leaks.	____	____
21. Checked the condition of the batteries.	____	____
22. Ensured that the battery isolation switch was in the OFF position.	____	____
23. Used a flashlight to check between the generators for leaks, loose hardware, and other potential problems.	____	____
24. Ensured that tie output cables were properly connected and that concentric neutrals were connected to the ground.	____	____
25. Ensured that the tie output cover was locked.	____	____
26. Checked the PU equipment grounds for proper connection.	____	____
27. Ensured that the PU interconnect control cable was properly connected.	____	____
28. Inspected the exterior fuel system for proper connection, leaks, and fuel availability.	____	____

Performance Measures	GO	NO-GO
29. Opened the three primary distribution center doors; and checked for damage, loose connections, and foreign objects.	____	____
30. Positioned the selector switch in the proper mode based on location (50 or 60 hertz).	____	____
31. Secured side access doors.	____	____
32. Recorded actions taken on DA Form 2404 or DA Form 5988-E.	____	____
33. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	
DA FORM 5988-E	

Perform Preventive-Maintenance Checks and Services (PMCS) on a Mobile Electric Power (MEP)-012 or -208 Generator

052-244-2118

Conditions: As a power plant operator in a tactical or nontactical environment, you are given an MEP-012 or -208 generator, TM 5-6115-456-15 or TM 9-6115-604-12, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), a pen, a clipboard, a general mechanic's tool box, a wiping cloth, and personal protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A POWER SOURCE, SUCH AS UTILITY POWER OR ANOTHER GENERATOR SET, IS CONNECTED TO LOAD TERMINALS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: AVOID CONTACT WITH BATTERY ELECTROLYTES; THEY CONTAIN SULFURIC ACID THAT MAY CAUSE SEVERE CHEMICAL BURNS. SKIN AND EYE PROTECTION IS REQUIRED. FAILURE TO COMPLY MAY CAUSE INJURY.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Perform PMCS on an MEP-012 or -208 generator according to the TM. Ensure that system parameters are met without causing injury or equipment damage.

Performance Steps

1. Review danger, warning, and caution notices.
2. Perform before-operation PMCS.
3. Perform preoperational checks, and start the generator.
4. Perform during-operation PMCS.
5. Perform after-operation PMCS.
6. Record actions taken on DA Form 2404 or DA Form 5988-E.
7. Perform operator level troubleshooting.
8. Correct on-the-spot deficiencies.
9. Report deficiencies to the plant supervisor.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform PMCS on an MEP-012 or -208 generator.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Performed before-operation PMCS.	____	____
3. Performed preoperational checks, and started the generator.	____	____
4. Performed during-operation PMCS.	____	____
5. Performed after-operation PMCS.	____	____
6. Recorded actions taken on DA Form 2404 or DA Form 5988-E.	____	____
7. Performed operator level troubleshooting.	____	____
8. Corrected on-the-spot deficiencies.	____	____
9. Reported deficiencies to the plant supervisor.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	
DA FORM 5988-E	
TM 9-6115-604-12	

Read an Electrical One-Line Diagram

052-244-2121

Conditions: You are a power plant operator in a tactical or nontactical environment where there is a fault in the system. Scheduled services are due, or an upgrade to the system is needed or proposed. You are given an electrical one-line diagram for an electrical system.

Standards: Read and interpret information from an electrical one-line diagram by identifying electrical flow and electrical symbols and their relationships.

Performance Steps

1. Identify the correct electrical one-line diagram for an electrical system.
2. Identify lines and symbols on the diagram.
3. Determine the function of the symbols on the one-line diagram and the relationships between the electrical devices.
4. Identify possible electrical paths depending on switchgear positioning.

Evaluation Preparation: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to read an electrical one-line diagram.

Performance Measures	GO	NO-GO
1. Identified the correct electrical one-line diagram for an electrical system.	____	____
2. Identified lines and symbols on the diagram.	____	____
3. Determined the function of the symbols on the one-line diagram and the relationships between the electrical devices.	____	____
4. Identified possible electrical paths depending on switchgear positioning.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	FM 5-412
	LCH
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Operate a Multiunit Power Plant

052-244-2123

Conditions: As a power plant operator in a tactical or nontactical environment after a multiunit power plant has been successfully installed and tested and preventive maintenance checks and services (PMCS) have been completed, you are given technical manuals (TMs), the standing operating procedure (SOP), an operator's logbook, and personal protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Operate the multiunit power plant according to the TMs to ensure that the system parameters are met without causing injury or equipment damage. Operate the power plant, in an isolated mode or parallel to a power grid, while balancing the load and maintaining system voltage, amperage, kilowatts, and power factor limitations.

Performance Steps

1. Perform preoperational PMCS.
2. Start the units, and conduct preoperation checks.
3. Adjust the frequency adjustment rheostat for a frequency meter reading of 50 or 60 hertz.
4. Adjust the voltage adjustment rheostat for an alternating-current (AC) reading of the desired value.
5. Perform isolated or parallel operations.
   a. Adjust the incoming frequency of the generator to the approximate frequency of the bus.
   b. Adjust the incoming voltage of the generator to the approximate voltage of the bus.
   c. Energize a synchronizing circuitry.
   d. Ensure that phase rotation is going slow in the fast direction.
   e. Adjust the incoming frequency of the generator to a frequency that is slightly higher than that of the bus.
   f. Adjust the incoming voltage of the generator to a voltage that is slightly higher than that of the bus.
   g. Close the circuit breaker at a synchronous moment to assume the load.
   h. De-energize the synchronizing circuit.
   i. Stabilize the incoming operating parameters of the generator or the plant as determined by the isolated or infinite grid.
   j. Maintain the frequency at a specified value in an isolated mode of operation for a non-810 series.
   k. Maintain the voltage at a specified value in an isolated mode of operation for a non-810 series.
   l. Maintain a proportional balance in kilowatt and kilovar loads.

Performance Steps

m. Bring the units online and off-line as determined by the load conditions.

6. Perform grid or parallel operations.
   a. Adjust the incoming frequency of the generator to the approximate frequency of the bus.
   b. Adjust the incoming voltage of the generator to the approximate voltage of the bus.
   c. Energize the synchronizing circuitry.
   d. Ensure that the phase rotation is going slow in the fast direction.
   e. Adjust the incoming frequency of the generator to a frequency that is slightly higher than that of the bus.
   f. Adjust the incoming voltage of the generator to a voltage that is slightly higher than that of the bus.
   g. Close the circuit breaker at a synchronous moment to assume the load.
   h. De-energize the synchronizing circuit.
   i. Stabilize the incoming operating parameters of the generator or the plant as determined by the isolated or infinite grid.
   j. Maintain the prescribed kilowatt and kilovar loads.
   k. Maintain a proportional balance in the kilowatt and kilovar loads.
   l. Bring the units online and-off line as directed by a supervisor or loading schedule.
7. Determine the proper number of generators required to handle the assessed load.
8. Operate the generators in different modes of operation.
   a. Operate the generator in automatic mode.
   b. Operate the generator in manual mode.
   c. Operate the generator in economize-on.
   d. Operate the generator in economize-off.
   e. Operate the generator in load-sharing.
9. Parallel the generators on and off the bus as directed by a shift supervisor or as needed.
10. Maintain the operator's logbook according to the SOP.
    a. Perform initial assessment of the power plant and individual generators.
    b. Make appropriate logbook entries when significant events happen.
11. Monitor engine and generator indicators to ensure continued operation through various load changes.
12. Maintain an hourly reading log, detailing the engine and electrical parameters of the equipment online and off-line.
13. Perform during-operation PMCS according to the TM.
14. Conduct unit shutdown operations.
15. Conduct postoperation PMCS according to the TM.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to operate a multiunit power plant.

Performance Measures	**GO**	**NO-GO**
1. Performed preoperational PMCS.	____	____
2. Started the units, and conducted preoperation checks.	____	____

Performance Measures	GO	NO-GO
3. Adjusted the frequency adjustment rheostat for a frequency meter reading of 50 or 60 hertz.	____	____
4. Adjusted the voltage adjustment rheostat for an AC reading of the desired value.	____	____
5. Performed isolated or parallel operations.	____	____
6. Performed grid or parallel operations.	____	____
7. Determined the proper number of generators required to handle the assessed load.	____	____
8. Operated the generators in different modes of operation.	____	____
9. Paralleled the generators on and off the bus as directed by a shift supervisor or as needed.	____	____
10. Maintained the operator's logbook according to the SOP.	____	____
11. Monitored engine and generator indicators to ensure continued operation through various load changes.	____	____
12. Maintained an hourly reading log, detailing the engine and electrical parameters of the equipment online and off-line.	____	____
13. Performed during-operation PMCS according to the TM.	____	____
14. Conducted unit shutdown operations.	____	____
15. Conducted postoperation PMCS according to the TM.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1 FM 3-34.480

Install a Nonorganic Generator

052-244-2124

Conditions: As a power plant operator in a tactical or nontactical environment with a mission to install a nonorganic generator that is properly sited and has fuel lines and electrical connections, you are given technical manuals, a general mechanic's tool box, a multimeter, ground rods, a slide hammer, cable rated for generator output with terminations, a high-voltage insulation tester, and personal protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. IT MAY BE POSSIBLE TO CONNECT INTO AN EXISTING GROUND GRID. AT THE TIME OF INSTALLING THE GROUND, THE GROUND RESISTANCE MUST BE MEASURED AND MUST NOT EXCEED 25 OHMS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. THE INSULATION TESTER PRODUCES HIGH VOLTAGE. DO NOT TOUCH THE CABLE BEING TESTED OR THE TEST LEADS. ALWAYS REMOVE POWER, AND THEN DISCHARGE AND GROUND THE CIRCUIT FOR TWICE THE AMOUNT OF TIME IT WAS TESTED BEFORE HANDLING IT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. DIESEL FUEL IS FLAMMABLE AND MODERATELY TOXIC TO THE EYES, SKIN, AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION ARE REQUIRED. AVOID REPEATED OR PROLONGED CONTACT WITH DIESEL FUEL, AND USE IT IN A WELL-VENTILATED AREA. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Install the generator to meet the load requirements so that the system parameters are met and the generator can be safely operated within its capacity.

Performance Steps

1. Ensure that the generator set meets the load requirements.
2. Prepare the engine.
   a. Conduct a thorough walk-around inspection, checking for obvious faults in the mechanical and electrical operating systems.
   b. Check the engine for leaks or damage.
   c. Check the coolant level, and add coolant if needed.
   d. Check the oil level, and add oil if needed.
   e. Ensure that air filters are present and serviceable.
3. Ground the generator unit.
   a. Determine the soil resistance.
   b. Emplace the appropriate number of ground rods based on the soil resistance.

Performance Steps

c. Make the connections.
d. Test the ground.

4. Attach fuel lines if necessary.
5. Test generator breakers to ensure proper operation.
6. Start the generator.
7. Perform a walk-around inspection to ensure that there are no major mechanical defects or malfunctions before proceeding to the next step.
8. Check the output voltage and frequency.
9. Stop the generator.
10. Prepare load cables.
    a. Test cables according to the manufacturer's standard.
    b. Connect load break elbows.
    c. Use a phase rotation meter to ensure primary phasing.
    d. Mark connections with colored tape to differentiate between phases.
    e. Trace cables from the generator to the load to ensure that cables are correctly marked and connected.
11. Energize the system.
    a. Start the generator.
    b. Check the voltage at the breaker with the breaker open.
    c. Close the breaker.
    d. Check the voltage at the load.
12. Make necessary changes to achieve the proper output voltage and frequency.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to install a nonorganic generator.

Performance Measures	**GO**	**NO-GO**
1. Ensured that the generator set met the load requirements.	____	____
2. Prepared the engine.	____	____
3. Grounded the generator unit.	____	____
4. Attached fuel lines if necessary.	____	____
5. Tested generator breakers to ensure proper operation.	____	____
6. Started the generator.	____	____
7. Performed a walk-around inspection to ensure that there were no major mechanical defects or malfunctions before proceeding to the next step.	____	____
8. Checked the output voltage and frequency.	____	____
9. Stopped the generator.	____	____

Performance Measures	GO	NO-GO
10. Prepared load cables.	____	____
11. Energized the system.	____	____
12. Made necessary changes to achieve the proper output voltage and frequency.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Operate a Nonorganic Generator

052-244-2125

Conditions: As a power plant operator in a tactical or nontactical environment after a nonorganic generator has been successfully installed, you are given the manufacturer's literature and personal protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT OPERATE THE GENERATOR UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Operate the generator according to the manufacturer's literature so that the system parameters are met without causing injury or equipment damage. Operate the generator within its voltage, amperage, kilowatt, and power factor limitations while maintaining the load.

Performance Steps

1. Perform before-operation checks.
2. Start the generator.
    a. Set a desired frequency.
    b. Set a desired voltage.
3. Perform one of the following operating procedures:
    a. Perform isolated operating procedures.
        (1) Ensure that there is no other generator online.
        (2) Close the circuit breaker, and assume the load.
        (3) Maintain the frequency and voltage.
        (4) Operate within the limits of the generator.
        (5) Open the circuit breaker.
    b. Perform parallel operating procedures.
        (1) Energize the synchronizing circuitry.
        (2) Ensure that the rotation is going slow in the fast direction.
        (3) Adjust the incoming frequency of the generator to a slightly higher frequency than that of the bus.
        (4) Adjust the incoming voltage of the generator to a slightly higher voltage than that of the bus.
        (5) Close the circuit breaker at a synchronous moment to assume the load.
        (6) De-energize the synchronizing circuit.
        (7) Maintain a proportional balance in kilowatt and kilovar loads.
        (8) Bring the unit online and off-line as determined by the load conditions or directed by a supervisor.
        (9) Remove the load, and open the circuit breaker.

Performance Steps

4. Perform during-operation checks according to the manufacturer's literature, and record operational and maintenance data.
5. Conduct unit shutdown operations.
6. Perform after-operation checks.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to operate a nonorganic generator.

Performance Measures	GO	NO-GO
1. Performed before-operation checks.	____	____
2. Started the generator.	____	____
3. Performed an isolated or parallel operating procedure.	____	____
4. Performed during-operation checks according to the manufacturer's literature, and recorded operational and maintenance data.	____	____
5. Conducted unit shutdown operations.	____	____
6. Performed after-operation checks.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	FM 3-34.480
DA FORM 5988-E	

Identify the Hazards of a Power Generation and Distribution System

052-244-2127

Conditions: As a power plant operator in a tactical or nontactical environment, you are given FM 5-19, National Fire Protection Association 70E, EM 385-1-1, TM 5-682, and material safety data sheets (MSDSs).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ALWAYS WEAR THE PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Identify hazards associated with a power generation and distribution system that allows individuals to make informed, conscious decisions about acceptable risk levels to reduce injury and equipment damage.

Performance Steps
NOTE: Each step contains examples of common hazards and is not intended to be an all-inclusive list.

1. Identify possible mechanical hazards.
    a. Consider noises.
    b. Consider high-temperature equipment.
    c. Consider compressed air.
    d. Consider pressurized liquids.
    e. Consider heavy objects.
    f. Consider grinding operations.
    g. Consider moving parts.
    h. Consider tools.
    i. Consider hazardous objects.
    j. Consider hydraulically operated equipment.
    k. Consider pneumatically operated equipment.
2. Identify possible electrical hazards.
    a. Check for loose wiring.
    b. Check for energized equipment.
    c. Check for capacitive charges.
    d. Check for ungrounded systems or equipment.
    e. Check ground resistance, and ensure that resistance is under 25 ohms.
3. Identify possible chemical hazards.
    a. Check for chemical solvents.
    b. Check welding operations.
    c. Check batteries.
    d. Check exhaust gases.
    e. Check for polychlorinated biphenyl (PCB).
    f. Check fuels.
    g. Check for hazardous waste.

Performance Steps

4. Identify possible fire hazards.
    a. Check generator equipment.
    b. Check electrical switchgears.
    c. Check petroleum, oil, and lubricant facilities.
    d. Check maintenance shops.
    e. Check ignitable substances.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that the task standards can be met.

Brief Soldier: Direct the Soldier to identify the hazards of a power generation and distribution system.

Performance Measures	**GO**	**NO-GO**
1. Identified possible mechanical hazards.	____	____
2. Identified possible electrical hazards.	____	____
3. Identified possible chemical hazards.	____	____
4. Identified possible fire hazards.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
EM 385-1-1	
FM 5-19	
NFPA 70E	
TM 5-682	

Troubleshoot a Direct-Current (DC) Voltage System

052-244-2128

Conditions: As a power plant operator in a tactical or nontactical environment while a DC voltage system is malfunctioning, you are given Ugly's™ Electrical Reference, a general mechanic's tool box, a maintenance logbook, and the manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND OPERATION OF ELECTRICAL POWER GENERATION EQUIPMENT, DC SYSTEMS, AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ALWAYS WEAR THE PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Troubleshoot a DC voltage system by identifying the cause(s) of the malfunction. Safely and accurately locate and correct the malfunction in the DC voltage system without causing injury or equipment damage.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review the maintenance logbook and historical data pertaining to equipment.
4. Isolate the system circuits that need troubleshooting.
5. Perform lockout and tagout procedures.
6. Identify the symptoms of the problem.
   a. Check for unusual sounds.
   b. Identify physical abnormalities.
   c. Check for unusual smells.
7. Review the references.
   a. Review technical manuals.
   b. Review the manufacturer's literature.
   c. Review electrical diagrams.
8. Locate the fault or problem.
   a. Determine which portion(s) of the circuit are working correctly. Eliminate circuits or portions of circuits that allow a look at a smaller, more isolated area.
   b. Verify that circuit components/parts function properly.
   c. Identify faulty components/parts.
9. Repair or replace defective components/parts when possible.
10. Verify that the fault was corrected.
11. Close out the lockout and tagout procedures by removing locking and tagging devices.
12. Put the system back into service.

Performance Steps

13. Ensure that the items listed in the conditions are properly cleaned and stored.
14. Ensure that deficiencies and troubleshooting procedures are recorded in the maintenance logbook.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a DC voltage system.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed the maintenance logbook and historical data pertaining to equipment.	____	____
4. Isolated the system circuits that needed troubleshooting.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Identified the symptoms of the problem.	____	____
7. Reviewed the references.	____	____
8. Located the fault or problem.	____	____
9. Repaired or replaced defective components/parts when possible.	____	____
10. Verified that the fault was corrected.	____	____
11. Closed out the lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Put the system back into service.	____	____
13. Ensured that items listed in the conditions were properly cleaned and stored.	____	____
14. Ensured that deficiencies and troubleshooting procedures were recorded in the maintenance logbook.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
UGLYS™	DA FORM 2404
	EM 385-1-1

Troubleshoot an Alternating-Current (AC) Control Voltage Circuit
052-244-2129

Conditions: As a power plant operator in a tactical or nontactical environment when an AC control voltage circuit malfunctions, you are given Ugly's™ Electrical Reference, a general mechanic's tool box, a maintenance logbook, and the manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT, AC SYSTEMS, AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ALWAYS WEAR THE PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Troubleshoot an AC control voltage circuit by safely and accurately identifying, locating, and correcting the malfunction in the circuit without causing injury or equipment damage.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review the maintenance logbook and historical data pertaining to the equipment.
4. Isolate the system circuits that need troubleshooting.
5. Perform lockout and tagout procedures.
6. Identify the symptoms of the problem.
    a. Check for unusual sounds.
    b. Identify physical abnormalities.
    c. Check for unusual smells.
7. Locate the fault or problem.
    a. Determine which portions of the circuit are working correctly. Eliminate circuits or portions of circuits to allow smaller, more isolated looks at the fault or problem.
    b. Verify that circuit components/parts function properly.
    c. Identify faulty components/parts.
8. Repair or replace defective components/parts when possible.
9. Verify that the fault was corrected.
10. Close out lockout and tagout procedures by removing locking and tagging devices.
11. Perform a functions check on the AC control voltage circuit.
12. Ensure that the items listed in the conditions are properly cleaned and stored.
13. Ensure that deficiencies and troubleshooting procedures are recorded in the maintenance logbook.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot an AC control voltage circuit.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed the maintenance logbook and historical data pertaining to the equipment.	____	____
4. Isolated the system circuits that needed troubleshooting.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Identified the symptoms of the problem.	____	____
7. Located the fault or problem.	____	____
8. Repaired or replaced defective components/parts when possible.	____	____
9. Verified that the fault was corrected.	____	____
10. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
11. Performed a functions check on the AC control voltage circuit.	____	____
12. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____
13. Ensured that deficiencies and troubleshooting procedures were recorded in the maintenance logbook.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
UGLYS™	DA FORM 2404
	EM 385-1-1

Perform a Load Assessment

052-244-2130

Conditions: As a power plant operator in a tactical or nontactical environment when data is needed for a distribution design, generator selection, disaster relief, or other electrical missions of a facility, you are given FM 5-424, the National Electrical Code (NEC) Handbook, Ugly's™ Electrical Reference, a calculator, DA Form 2702 (Bill of Materials), a multimeter, and access to the ENG LINK website.

NOTE: In some situations, Soldiers may not have access to the ENG LINK website. In these situations, Soldiers may have to rely on hard copies.

DANGER:

1. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A SOURCE OF POWER (SUCH AS UTILITY POWER OR ANOTHER GENERATOR SET) IS CONNECTED TO THE LOAD TERMINALS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALWAYS WEAR THE PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Perform a facility load assessment to obtain the estimated load. Determine DA Form 2702 information, the means of connection, and other mission-specific requirements.

Performance Steps
NOTE: Some performance steps will be omitted when conducting an emergency generation load assessment.

1. Establish a point of contact.
2. Determine the original use of the facility.
3. Determine the intended use of the facility.

NOTE: If conducting an emergency generation load assessment and not calculating a load for permanent or semipermanent usage, skip steps 4 through 14.

4. Extract data from specific sources.
   a. Extract data from electrical plans.
   b. Extract data from construction specifications.
   c. Extract data from equipment specifications.
   d. Extract data from on-site visual inspections.
5. Define the four critical load areas.
   a. Define the critical load areas in general lighting.
   b. Define the critical load areas in receptacle outlets.
   c. Receptacle outlets.
   d. Define the critical load areas in other major appliances or loads.
   e. Other major appliances or loads.
   f. Define the critical load areas in motor loads.
   g. Motor loads.
6. Determine the lighting load by obtaining values from blueprints, specifications, or direct visual inspection.
   NOTE: Lighting outlets shown on the drawings are listed in the specifications, along with their wattage ratings. Incandescent lighting rating represents the total wattage. Fluorescent

Performance Steps

lights are specified and the load per outlet is calculated by using one of the methods listed below.

a. Use the ampere rating of ballast directly for the most accurate method. It is referenced in the NEC Handbook.

EXAMPLE: When a building has 150 fluorescent light fixtures, each fixture consisting of two lamps (40 watts per lamp) with a single 120-volt ballast (rated at 1.1 ampere), the lighting load is calculated as follows:

FORMULA: 150 fixtures x 1.1 ampere per ballast = 165 amperes
165 amperes x 120 volts = 19,800 watts

b. Use the wattage of the lamps and increase the wattage by 20 percent to account for the ballast load that can be used when the ampere rating of the ballast is unknown. This method is referenced in FM 5-424.

EXAMPLE: When a building has 150 fluorescent light fixtures, each fixture consisting of two lamps (40 watts per lamp) with a single 120-volt ballast, the total lighting load is calculated as follows:

FORMULA: 2 lamps x 40 watts x 150 fixtures = 12,000 watts
12,000 watts x 1.2 (which is 120 percent) = 14,400 watts
14,400 watts/120 volts = 120 amperes

7. Determine the receptacle outlet load using one of the following methods:
   a. Calculate other outlets in the ceiling and walls, and compute the wattage drain at 1.5 amperes per outlet.
   b. Determine the total outlet load using the watts-per-square-foot method according to FM 5-424. (This includes lighting and general-purpose receptacles.)
      (1) Use the outside building dimensions to determine the total area in square feet.
      (2) Multiply the area by the standard watts-per-square-foot requirement, which is a constant based on the type of building. See FM 5-424.

      EXAMPLE: When a store is 200 feet by 200 feet, the total outlet load is calculated as follows:

      FORMULA: *200 feet x 200 feet = 40,000 square feet*
      40,000 square feet x 3 = 120 kilowatts

8. Use 5 amperes for each heavy-duty outlet or mogul-sized lamp holder to calculate the load.

9. Determine the load of major appliances and loads over 5 amperes each.
   a. Use the data plate wattage when available.
   b. Use the average wattage consumption data in FM 5-424 when the data plates are unavailable.
   c. Use the load conversion table in FM 5-424 when only partial data is available.

10. Determine the motor loads.
    a. Locate the motor data plate to determine the rated voltage, the full load amperes (FLA), the locked rotor amperes (LRA), and the rated horsepower.
    b. Determine the FLA (when not given) by referencing FM 5-424.
    c. Use the motor code letter to determine the LRA and the corresponding LRA values to each motor code by referencing the NEC Handbook.

NOTE: You must calculate in the extra wattage needed for starting electric motors. Depending on the type of motor, it may require from three to ten times its normal running watts for starting. As a rule of thumb, most motors require four times as much power to start as they do to run and the power load should be sized accordingly.

Performance Steps

11. Calculate the total load per building.
    a. Identify the connected load for each area.
    b. Add the totals together for the total connected load to the building.

12. Determine the maximum demand.
    a. Determine if the total possible power load may be connected at the same time.
        (1) Determine the demand or the amount of power that must be available on the power supply.
        (2) Determine if the total possible power load is equal to the demand load.
    b. Determine the maximum demand of the building (the set point at some arbitrary figure below the possible total connected load).

13. Calculate the demand factor.

NOTE: When specifications are not provided, refer to the standard loads for branch circuits and feeder and demand factors for feeders table in FM 5-424.

    a. Determine the demand factor percentage by taking a ratio of maximum demand to the total connected load in the building.
    b. Calculate the building loads by using the standard demand factors found in FM 5-424.

    EXAMPLE: Calculate the demand factor for a 90,000-square-foot warehouse using a factor of 0.25 watts per square foot, given a total connected load of 22,500 (90,000 x 0.25 = 22,500).

    FORMULA: *100 percent of the first 12,500 watts = 12,500 watts*
    50 percent of the remaining 10,000 watts = 5,000 watts
    12,500 + 5,000 = 17,500 watts
        (1) Expect the power demands on the system to increase in the future

14. Consider other factors on the load survey.
    a. The total load.
    b. Limit the load calculations to the identified critical loads.
    c. Special considerations.
    d. Allow for growth.
        (1) Expect the power demands on the system to increase in the future.
        (2) Allow for a growth of 50 percent of the initial load, depending on the type of load and the circumstances.
    e. A site map.
    f. Calculate power assessments using power factor ratings when possible.
    g. Consider the effects of harmonic loads where applicable.

NOTE: Steps 15 through 18 are for conducting an emergency generation load assessment only and should not be used to calculate a load for permanent or semipermanent usage.

15. Calculate the emergency generation load.
    a. Locate and identify the facility feeder transformer, and use it to determine the size of the power generation equipment needed to power the facility.
    b. Use the facility main circuit breaker (or other service disconnection means) to calculate the emergency power generation requirements if the facility transformer size cannot be determined or if it powers multiple facilities.

NOTE: If the main circuit breaker or service disconnect size cannot be determined, the incoming load cables from the feeder transformer or service disconnect can be used as the facility ampacity when calculating the estimated load.

16. Determine the location to connect emergency power generation equipment.

17. Determine the location to emplace emergency power generation equipment.

18. Determine DA Form 2702 information.

Performance Steps
NOTE: DA Form 2702 should include a minimum of the items listed below, plus any additional special items needed to connect the power generation equipment to the facility and properly ground any equipment such as fuel storage and power generation equipment.

a. Include load cables (size and length of each cable and total amount of runs required to power the facility).
b. Include equipment ground cables, ground rods, and connection devices such as split-bolt connectors.
c. Include other material needed to connect power generation equipment to the facility.

19. Complete the assessment data form by hard copy or on the ENG LINK Web site.
    a. Include the calculated load.
    b. Include DA Form 2702.
    c. Include special considerations.
    d. Include a site map.
    e. Include a strip map to the location.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that the task standards can be met.

Brief Soldier: Direct the Soldier to perform a load assessment.

Performance Measures	**GO**	**NO-GO**
1. Established a point of contact.	____	____
2. Determined the original use of the facility.	____	____
3. Determined the intended use of the facility.	____	____
4. Extracted data from specific sources.	____	____
5. Defined the four critical load areas.	____	____
6. Determined the lighting load by obtaining values from blueprints, specifications, or direct visual inspection.	____	____
7. Determined the receptacle outlet load.	____	____
8. Used 5 amperes for each heavy-duty outlet or mogul-sized lamp holder to calculate the load.	____	____
9. Determined the load of major appliances and loads over 5 amperes each.	____	____
10. Determined the motor loads.	____	____
11. Calculated the total load per building.	____	____
12. Determined the maximum demand.	____	____
13. Calculated the demand factor.	____	____
14. Considered other factors on the load survey.	____	____
15. Calculated the emergency generation load.	____	____
16. Determined the location to connect emergency power generation equipment.	____	____
17. Determined the location to emplace emergency power generation equipment.	____	____

Performance Measures	GO	NO-GO
18. Determined DA Form 2702 information.	____	____
19. Completed the assessment data form by hard copy or on the ENG LINK Web site.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
FM 5-424	NESC®
NEC® HANDBOOK	
UGLYS™	

Troubleshoot an Engine Failure to Crank

052-244-2131

Conditions: As a power plant operator in a tactical or nontactical environment when an engine fails to crank, you are given an engine, appropriate technical manuals, a maintenance logbook, a general mechanic's tool box, a multimeter, and a lockout and tagout kit.

DANGER:

1. ENSURE THAT THE PRIME MOVER IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE OPERATION AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE ALL RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Troubleshoot an engine that fails to crank by identifying the fault, testing the fault to verify that it is the cause of the malfunction, and annotating the cause of the malfunction and the corrective actions taken.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review the maintenance logbook and historical data pertaining to the equipment.
4. Ensure that the generator prime mover is locked out and tagged out.
5. Check the electrical system.
   a. Check the battery voltage.
   b. Check for loose terminals and harnesses.
   c. Check for corrosion.
   d. Check the starter.
6. Check the engine for seizure.
7. Lift the clearance for testing.
8. Test the suspected fault to determine if it is the cause of the malfunction.
9. Repair the fault if possible.
10. Close out the lockout and tagout procedures by removing locking and tagging devices.
11. Attempt to start the generator.
12. Record malfunctions and corrections made in the maintenance logbook.
13. Record actions taken on the maintenance logbook.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that the task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot an engine failure to crank.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed the maintenance logbook and historical data pertaining to the equipment.	____	____
4. Ensured that the generator prime mover was locked out and tagged out.	____	____
5. Checked the electrical system.	____	____
6. Checked the engine for seizure.	____	____
7. Lifted the clearance for testing.	____	____
8. Tested the suspected fault to determine if it was the cause of the malfunction.	____	____
9. Repaired the fault if possible.	____	____
10. Closed out the lockout and tagout procedures by removing locking and tagging devices.	____	____
11. Attempted to start the generator.	____	____
12. Recorded malfunctions and corrections made in the maintenance logbook.	____	____
13. Recorded actions taken on the maintenance logbook.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	DA FORM 2404

Troubleshoot an Engine Failure to Accelerate and/or Maintain a Rated Speed

052-244-2133

Conditions: As a power plant operator in a tactical or nontactical environment when an engine fails to accelerate or maintain a rated speed, you are given a generator engine, appropriate technical manuals, the manufacturer's literature, a maintenance logbook, a general mechanic's tool box, a multimeter, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE OPERATION AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. EXERCISE EXTREME CARE WHEN WORKING AROUND ROTATING ENGINE COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: DIESEL FUEL IS FLAMMABLE AND MODERATELY TOXIC. USE SKIN AND EYE PROTECTION WHEN CHECKING THE FUEL SYSTEM. FAILURE TO COMPLY MAY CAUSE INJURY.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Troubleshoot an engine that fails to accelerate or maintain a rated speed by identifying the fault and testing the fault to verify that it is the cause of the malfunction.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review the maintenance logbook and historical data pertaining to equipment.
4. Identify the location of the fault.
    a. Check the fuel system.
    b. Check the governor.
    c. Check the air system.
    d. Check the engine electrical components/parts.
5. Check the fuel system.
    a. Ensure that there is fuel in the system.
    b. Ensure that the fuel system is on.
    c. Check the fuel for contamination.
    d. Check fuel filters for restrictions.
    e. Check the fuel pump for proper operation.
    f. Check the fuel system for the presence of air.
    g. Check the injector flow.
6. Check the governor for proper operation.

Performance Steps

7. Check air filters for restrictions.
8. Check the engine electrical components/parts.
   a. Check the system for proper direct-current (DC) voltage control.
   b. Check relays for proper operation.
   c. Check speed sensors.
9. Test the engine to ensure that the suspected fault is the cause of the malfunction.
10. Repair the fault if possible.
11. Record actions taken on DA Form 2404 or DA Form 5988-E and the maintenance logbook.
12. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot an engine failure to accelerate and/or maintain a rated speed.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed the maintenance logbook and historical data pertaining to equipment.	____	____
4. Identified the location of the fault.	____	____
5. Checked the fuel system.	____	____
6. Checked the governor for proper operation.	____	____
7. Checked air filters for restrictions.	____	____
8. Checked the engine electrical components/parts.	____	____
9. Tested the engine to ensure that the suspected fault was the cause of the malfunction.	____	____
10. Repaired the fault if possible.	____	____
11. Recorded actions taken on DA Form 2404 or DA Form 5988-E and the maintenance logbook.	____	____
12. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	
DA FORM 5988-E	

Troubleshoot a Generator's Improper Voltage Output

052-244-2135

Conditions: As a power plant operator in a tactical or nontactical environment when the generator's output voltage is not within the correct parameters, you are given the corresponding technical manual or the manufacturer's literature, a maintenance logbook, electrical construction prints, wiring diagrams, and a general mechanic's tool box.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ELECTRICAL CIRCUITS, CONDUCTORS, COMPONENTS/PARTS, AND EQUIPMENT MUST BE CONSIDERED ELECTRICALLY ENERGIZED UNTIL THE ENERGY SOURCE IS REMOVED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY COULD RESULT IN ELECTROCUTION AND MAY CAUSE PERMANENT INJURY OR DEATH.

4. STATIC CHARGE MAY BE ON THE GENERATOR LINES WHEN THE GENERATOR SET IS SHUT DOWN. USING AN INSULATED ROD WITH A GROUNDED METAL TIP, DISCHARGE THE GENERATOR LEADS TO THE GROUND BEFORE WORKING ON THEM. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. ALWAYS WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Troubleshoot a generator's improper voltage output according to the corresponding technical manual or manufacturer's literature, ensuring that the problem is identified and corrected.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review the maintenance logbook and historical data pertaining to equipment.
4. Perform lockout and tagout procedures.
5. Isolate the system and system circuits that need troubleshooting.
6. Identify fault indicators.
    a. Check for failure to produce voltage.
    b. Check for low voltage.
    c. Check for high voltage.
    d. Check for fluctuating voltage.
    e. Check for slow load change recovery.
    f. Check for blown fuses.

Performance Steps

7. Ensure that the voltage detector functions properly.
   a. Check an energized circuit to ensure that the voltage detector is working properly.
   b. Check for the presence of voltage on the de-energized circuit.
   c. Check the energized circuit again to verify that the voltage detector is working properly.
8. Test the voltage regulator for proper settings.
9. Ensure that the voltage regulator is receiving the proper amount of voltage from the power transformers and current transformers.
10. Ensure that the prime mover of the generator is operating at the proper revolutions per minute.
11. Test relays associated with the alternator.
12. Test the rotating rectifier.
13. Replace faulty components/parts.
14. Close out the lockout and tagout procedures by removing locking and tagging devices.
15. Test the system to ensure that faults are corrected.
16. Return the generator to operation.
17. Record actions taken on the maintenance logbook.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a generator's improper voltage output.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed the maintenance logbook and historical data pertaining to equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Isolated the system and system circuits that needed troubleshooting.	____	____
6. Identified fault indicators.	____	____
7. Ensured that the voltage detector functioned properly.	____	____
8. Tested the voltage regulator for proper settings.	____	____
9. Ensured that the voltage regulator was receiving the proper amount of voltage from the power transformers and current transformers.	____	____
10. Ensured that the prime mover of the generator was operating at the proper revolutions per minute.	____	____
11. Tested relays associated with the alternator.	____	____

Performance Measures	GO	NO-GO
12. Tested the rotating rectifier.	____	____
13. Replaced faulty components/parts.	____	____
14. Closed out the lockout and tagout procedures by removing locking and tagging devices.	____	____
15. Tested the system to ensure that faults were corrected.	____	____
16. Returned the generator to operation.	____	____
17. Recorded actions taken on the maintenance logbook.	____	____
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Install Low-Voltage Organic Equipment

052-244-2136

Conditions: As a power plant operator in a tactical or nontactical environment when tasked to provide low-voltage power, you are given a general mechanic's tool box, electronic tool kit, electrical construction prints, wiring diagrams, manufacturer's literature, and appropriate technical manuals.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A POWER SOURCE IS CONNECTED TO THE EQUIPMENT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE INJURY.

2. ENSURE THAT THE POWER IS REMOVED FROM THE PRIMARY POWER CABLES BEFORE TOUCHING THEM. FAILURE TO COMPLY MAY CAUSE INJURY

Standards: Install low-voltage organic equipment without causing injury or equipment damage, and ensure that the equipment is able to run and supply power to the connected equipment.

Performance Steps
NOTE: Installation should be conducted according to the manufacturer's literature when available.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Inventory equipment.
4. Position equipment.
   a. Review the site layout.
      (1) Verify that the ground is level.
      (2) Ensure that the site is not in a flood plan.
      (3) Verify that the proposed location is not a high-traffic zone.
   b. Place equipment with proper spacing and orientation according to the application specifications.
5. Perform preventive-maintenance checks and services (PMCS) on equipment.
6. Install ground rods.

WARNING: ENSURE THAT THE POWER IS REMOVED FROM THE PRIMARY POWER CABLES BEFORE TOUCHING THEM. FAILURE TO COMPLY MAY CAUSE IMMEDIATE INJURY.

7. Install load cables.
8. Close the main breaker.
9. Check the voltage to ensure that the output is correct for the load requirements.

Performance Steps

10. Energize the equipment.
11. Monitor the equipment to ensure proper operation.
12. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to install low-voltage organic equipment.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Inventoried equipment.	____	____
4. Positioned equipment.	____	____
5. Performed PMCS on equipment.	____	____
6. Installed ground rods.	____	____
7. Installed load cables.	____	____
8. Closed the main breaker.	____	____
9. Checked the voltage to ensure that the output was correct for the load requirements.	____	____
10. Energized the equipment.	____	____
11. Monitored the equipment to ensure proper operation.	____	____
12. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Record Maintenance and/or Operational Data

052-244-2137

Conditions: As a power plant operator in a tactical or nontactical environment where equipment is being operated and maintained, you are given a maintenance logbook, operational logbook, and corresponding technical manual.

Standards: Record the maintenance and operational data in maintenance and operational logbooks while equipment is being operated and maintained.

Performance Steps

1. Identify the type of work logged as maintenance or operational.
2. Record information in the maintenance logbook.
   a. Document hourly services.
   b. Document completed repairs.
   c. Document annual services.
   d. Document noticeable abnormalities.
   e. Document part replacements.
3. Record information in the operational logbook.
   a. Document current shift operator names.
   b. Document current cautions and clearances.
   c. Document the plant status during shift changes.
      (1) Log engine hours.
      (2) Log circuit breaker trips.
      (3) Log kilowatt hours.
      (4) Log bumper numbers of current online units.
      (5) Log plant loads.
   d. Document added fuel.
   e. Document added oil.
   f. Document breaker operations.
   g. Document generator startups and shutdowns.
   h. Document unusual plant occurrences.
   i. Document names of personnel on shift turnovers.
   j. Document times of shift turnovers.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to record maintenance and/or operational data.

Performance Measures	GO	NO-GO
1. Identified the type of work logged as maintenance or operational.	____	____
2. Recorded information in the maintenance logbook.	____	____
3. Recorded information in the operational logbook.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related

ASTM D1500
FM 3-34.480
NETA™

Install Low-Voltage Wiring

052-244-2138

Conditions: As a power plant operator in a tactical or nontactical environment in which low-voltage wiring is being installed, you are given the National Electrical Code (NEC) Handbook, manufacturers literature, a voltage detector, a multimeter, an electrician's tool kit, electrical construction prints, wiring diagrams, and a lockout and tagout kit.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE OPERATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT THE SYSTEM IS PROPERLY LOCKED OUT AND TAGGED OUT IF NECESSARY. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Install low-voltage wiring according to the NEC Handbook without causing injury or equipment damage.

Performance Steps
NOTE: Always operate in teams when working with electrical equipment or installing electrical circuits.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Create a wiring diagram or a schematic of the circuit to be installed.
4. Identify the equipment to be used.
   a. Ensure that tools are serviceable.
   b. Ensure that equipment is suitable for installation.
5. Perform lockout and tagout procedures.
6. Install the low-voltage wiring according to the NEC Handbook and the wiring diagram or schematic.
7. Inspect the work before energizing the circuit to ensure proper installation.
8. Close out the lockout and tagout procedures by removing locking and tagging devices.
9. Reenergize the circuit.
10. Test the circuit for the desired function.
11. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to install low-voltage wiring.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Created a wiring diagram or a schematic of the circuit to be installed.	____	____
4. Identified the equipment to be used.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Installed the low-voltage wiring according to the NEC Handbook and the wiring diagram or schematic.	____	____
7. Inspected the work before energizing the circuit to ensure proper installation.	____	____
8. Closed out the lockout and tagout procedures by removing locking and tagging devices.	____	____
9. Reenergized the circuit.	____	____
10. Tested the circuit for the desired function.	____	____
11. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
NEC® HANDBOOK	EM 385-1-1
	FM 3-34.480

Improve Grounding Electrode Resistance

052-244-2140

Conditions: As a power plant operator in a nontactical environment when ground resistance tests indicate that resistance does not meet the required parameters, you are given a ground rod assembly; a measuring tape; a hammer; a shovel; a ground resistance tester; applicable manufacturer's literature; and magnesium sulfate, bentonite clay, or rock salt.

DANGER: WHEN PERFORMING A GROUND RESISTANCE TEST, THE FAULT IN THE POWER SYSTEM MAY CAUSE A HIGH CURRENT FLOW INTO THE GROUND SYSTEM WHILE THE TEST IS IN PROGRESS. THIS MAY CAUSE UNEXPECTED, HIGH VOLTAGES AT THE CURRENT AND VOLTAGE PROBES. ALWAYS WEAR PROTECTIVE GLOVES WHILE HANDLING THE CONNECTIONS AT THE TERMINALS OF THE TEST SET, AND USE A RUBBER SAFETY MAT WHILE OPERATING THE TEST SET. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTES:

1. When using chemicals to reduce soil resistivity, users must follow Environmental Protection Agency (EPA) and local environmental regulations. Failure to comply may cause legal issues.

2. Factors that should be considered because they can change earth electrode requirements over a period of time include—

- **Expanding the facility size or incorporating different pieces of electrical equipment, which can render formerly suitable, low earth-resistance standards obsolete.**
- **Increasing the use of nonmetallic pipes and conduits, which can change the overall effectiveness of low-resistance ground connections.**
- **Decreasing the area water table, which can result in a drier, high earth resistance.**

Standards: Improve resistance of the ground system to meet required parameters. Review existing grounding methods and techniques, and determine which ones are best for improving ground resistance.

Performance Steps

1. Determine the soil condition.
   a. Assess the type of soil, and determine if it is—
      (1) Sandy.
      (2) Rocky.
      (3) Loam.
      (4) Gravel.
   b. Record the moisture level of the soil.

2. Assemble multiple rods to lengthen the earth electrode.
   a. Ensure that the connection is rigid.
   b. Ensure that the minimum diameter of the rod is at least 5/8 inch.

3. Align the electrode at an oblique angle that does not exceed 45° and drive the rod a minimum of 8 feet deep (in contact with the soil).

4. Perform a ground resistance test. If the resistance exceeds the required resistance levels, proceed to step 5, 7, and/or 8.

5. Place multiple rods.
   a. Space the rods further than the length of their immersion.
   b. Maintain at least 6 feet between each rod.

NOTE: The National Electrical Code (NEC) Handbook requires that supplemental rods be placed at least 6 feet apart, but notes that increasing the distance will improve the paralleling efficiency of

Performance Steps
the rods.

6. Perform a ground resistance test. If the resistance exceeds the required resistance levels, proceed to step 7.
7. Treat the soil with a chemical treatment.
   a. Administer magnesium sulfate (least corrosive).
   b. Administer rock salt (cheaper; does the job if applied in a trench).
   c. Administer bentonite clay (inexpensive, but requires large amounts of moisture).
8. Use chemical methods to reduce the soil resistivity.
   a. Apply the pipe technique. Fill a pipe that is 8 inches or larger in diameter and has a minimum length of 1/4 the ground rod length with a chemical, and drive it into the soil about 4 inches from the ground rod.
   b. Prepare a circular trench by digging around the ground rod, and fill it with about 40 to 90 pounds of chemical, which should last 2 to 3 years.
9. Perform a ground resistance test. If the resistance exceeds the required resistance levels, proceed to step 10.
10. Apply any combination of the above methods to achieve the required resistance levels.
11. Perform a ground resistance test. If the resistance exceeds the required resistance levels, repeat step 10.
12. Ensure that the testing equipment and tools are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to improve grounding electrode resistance.

Performance Measures	**GO**	**NO-GO**
1. Determined the soil condition.	____	____
2. Assembled multiple rods to lengthen the earth electrode.	____	____
3. Aligned the electrode at an oblique angle that did not exceed 45° and drove the rod a minimum of 8 feet deep (in contact with the soil).	____	____
4. Performed a ground resistance test. If the resistance exceeded the required resistance levels, proceeded to step 5, 7, and/or 8.	____	____
5. Placed multiple rods.	____	____
6. Performed a ground resistance test. If the resistance exceeded the required resistance levels, proceeded to step 7.	____	____
7. Treated the soil with a chemical treatment.	____	____
8. Used chemical methods to reduce the soil resistivity.	____	____
9. Performed a ground resistance test. If the resistance exceeded the required resistance levels, proceeded to step 10.	____	____
10. Applied any combination of the above methods to achieve the required resistance levels.	____	____

Performance Measures	GO	NO-GO
11. Performed a ground resistance test. If the resistance exceeded the required resistance levels, repeated step 10.	____	____
12. Ensured that the testing equipment and tools were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related
EM 385-1-1
IEEE GREEN BOOK™
LCH
NEC® HANDBOOK
NESC®

Repair a Low-Voltage Control Cable

052-244-2141

Conditions: As a power plant operator in a tactical or nontactical environment when a low-voltage control cable has failed, you are given a voltage detector, a voltmeter, a multimeter, an insulation-resistance test device, a lockout and tagout kit, a general mechanic's tool box, the manufacturer's literature, electrical construction prints, wiring diagrams, appropriate technical manuals, personal protective equipment, and other materials needed to repair cables.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE OPERATION AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT THE SYSTEM IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Repair a low-voltage control cable so that it carries the rated current or signal of the original cable and does not cause injury or equipment damage. Replace the cable if it cannot be repaired to meet these requirements.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Ensure that personal protective equipment has been properly tested and is fully operable.
   a. Test the cable for continuity.
   b. Perform an insulation-resistance test at no higher than 500 volts.

NOTE: Do not perform step 3b on the unshielded, twisted pair (UTP) cable.

4. Perform lockout and tagout procedures.
5. Prepare an "as found" wiring diagram to ensure the correct reinstallation of the cable.
6. Ensure that no voltage is present by using a voltage detector and voltmeter.
7. Disconnect the damaged cable from the equipment to perform repairs as necessary.
8. Repair the damaged cable using the splice, mechanical-type connector, or termination method.

NOTE: A damaged UTP cable should be replaced unless it is repairable at the ends.

9. Reinstall the cable using the as-found wiring diagram.
10. Test the cable.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Ensure that voltage is present by using a voltage detector and voltmeter.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to repair a low-voltage control cable.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Ensured that personal protective equipment was properly tested and was fully operable.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Prepared an "as found" wiring diagram to ensure the correct reinstallation of the cable.	____	____
6. Ensured that no voltage was present by using a voltage detector and voltmeter.	____	____
7. Disconnected the damaged cable from the equipment to perform repairs as necessary.	____	____
8. Repaired the damaged cable using the splice, mechanical-type connector, or termination method.	____	____
9. Reinstalled the cable using the as-found wiring diagram.	____	____
10. Tested the cable.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Ensured that voltage was present by using a voltage detector and voltmeter.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	NEC® HANDBOOK

Prepare a Power Plant for Movement

052-244-2142

Conditions: As a power plant operator in a tactical or nontactical environment when the power plant needs to be moved from one location to another, you are given a general mechanic's tool box, appropriate technical manuals, the manufacturer's literature, electrical construction prints, wiring diagrams, and an electrician's tool kit.

DANGER: REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. DO NOT PERFORM MAINTENANCE ON THE ENGINE EXHAUST SYSTEM WHILE THE SYSTEM IS HOT. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

2. EXERCISE EXTREME CAUTION WHEN INSPECTING OR DRAINING ENGINE FLUIDS; THEY MAY BE EXCESSIVELY HOT OR UNDER PRESSURE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

3. ALWAYS DISCONNECT BATTERIES BEFORE A GENERATOR IS MOVED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Prepare the power plant for movement. Pack the generator in the same manner that it was originally shipped, conforming to local laws and regulations without causing personal injury or equipment damage.

Performance Steps
NOTES:
1. This task requires subtasks specific to each generating unit. Each generating unit has its own danger, warning, and caution notices.
2. Because of the different generating units available, the various methods of transportation offered, and the numerous laws and regulations that govern each type of movement (including international and host country laws), these steps are only a guideline. Refer to the generating unit manuals, laws, and regulations that apply to each situation.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Contact unit movement personnel to arrange for shipment of the power plant.
4. Shut down the power plant.
5. Apply safe-clearance procedures to the power plant.
6. Isolate the power plant from exterior electrical connections.
7. Disconnect or remove batteries according to the shipping requirements.
8. Remove ground connections.
9. Drain fluids to the allowable levels according to the shipping requirements.
10. Prepare the generator accessories for movement.
    a. Identify the following accessories:
        (1) Identify the lifting, rigging, and positioning equipment.
        (2) Identify the operator remote terminal.

Performance Steps

(3) Identify the main circuit breakers.
(4) Identify the fire extinguishers.
b. Disconnect the accessories.
c. Store accessories.
d. Secure accessories in appropriate shipping locations.

11. Prepare the basic initial issue.
    a. Inventory the generator and accessories.
    b. Inspect the generator and accessories.
    c. Load the generator and accessories.
    d. Secure the generator and accessories.
12. Inspect the tools and rigging and lifting equipment for serviceability.
13. Install the lifting, rigging, and positioning equipment as necessary.
14. Supervise the loading of the generator onto the transport vehicle.
15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to prepare a power plant for movement.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Contacted unit movement personnel to arrange for shipment of the power plant.	____	____
4. Shut down the power plant.	____	____
5. Applied safe-clearance procedures to the power plant.	____	____
6. Isolated the power plant from exterior electrical connections.	____	____
7. Disconnected or removed batteries according to the shipping requirements.	____	____
8. Removed ground connections.	____	____
9. Drained fluids to the allowable levels according to the shipping requirements.	____	____
10. Prepared the generator accessories for movement.	____	____
11. Prepared the basic initial issue.	____	____
12. Inspected the tools and rigging and lifting equipment for serviceability.	____	____
13. Installed the lifting, rigging, and positioning equipment as necessary.	____	____
14. Supervised the loading of the generator onto the transport vehicle.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1

Perform Preventive-Maintenance Checks and Services (PMCS) on a Mobile Electric Power (MEP)-029 Generator

052-244-2143

Conditions: As a power plant operator in a tactical or nontactical environment, you are given an MEP-029 generator, TM 5-6115-593-12, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), a general mechanic's tool box, a wiping cloth, a maintenance logbook, and personal protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF LOW-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A POWER SOURCE, SUCH AS A UTILITY POWER OR ANOTHER GENERATOR SET, IS CONNECTED TO THE LOAD TERMINALS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. DO NOT OPERATE THE GENERATOR SET UNLESS IT HAS BEEN PROPERLY GROUNDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. AVOID CONTACT WITH BATTERY ELECTROLYTES; THEY CONTAIN SULFURIC ACID THAT CAN CAUSE SEVERE CHEMICAL BURNS. SKIN AND EYE PROTECTION IS REQUIRED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. DO NOT ATTEMPT TO SERVICE, ADJUST, CONNECT, OR RECONNECT WIRES OR CABLES UNTIL THE GENERATOR SET IS SHUT DOWN AND COMPLETELY DE-ENERGIZED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Perform PMCS on an MEP-029 generator according to TM 5-6115-593-12 without causing personal injury or equipment damage. Ensure that the system parameters are met.

Performance Steps
NOTE: Perform steps 1 through 7 before starting the MEP-029 generator. Perform checks in the order listed.

1. Inspect the battery compartment.
   a. Check the batteries for sufficient electrolyte levels.
   b. Ensure that the battery cables are securely tightened.
   c. Ensure that the battery cover plate is securely fastened.
2. Inspect the exhaust system.
   a. Check the mufflers for serviceability.
   b. Ensure that the rain caps move freely.
   c. Check the turbocharger assembly for leaks and damage.
3. Inspect the ground terminals for tight connections.
4. Inspect the controls and instruments on the engine panel.

Performance Steps

a. Inspect for damage and loose mounts.
b. Operate the press-to-test indicator to ensure that all fault indicators light up.
c. Ensure that the battery charger volts and amperes register in the green portion of the scale.
d. Inspect the fuel-level gauge for the proper fuel level.

5. Inspect the air cleaner to ensure that the service indicator is not red.

6. Inspect the radiator assembly.
   a. Relieve the pressure by loosening the radiator cap and waiting 2 minutes before removing the cap.
   b. Check the cooling system for leaks.
   c. Ensure that the coolant is visible in the sight glass, and add coolant if necessary.
   d. Check the radiator louvers for unrestricted operation.
   e. Check the fan belts for wear and proper tension.
   f. Check the radiator fins for damage or obstruction.

7. Inspect the fuel system.
   a. Check the fuel lines for leaks.

WARNING: WHEN HANDLING DIESEL FUEL, PROVIDE METAL-TO-METAL CONTACT BETWEEN THE CONTAINER AND THE FUEL TANK. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

   b. Check the valve location to ensure that it is in the OPEN position on the inside of the fuel filler neck cap.
   c. Add fuel if necessary.
   d. Drain the water and sediment from the filters.
   e. Inspect the filters.

8. Inspect the muffler and exhaust during MEP-029 generator operation.
   a. Check for leaks in the turbocharger and exhaust stack.
   b. Inspect the muffler for unusual smoking.

9. Inspect the engine panel controls and instruments during MEP-029 generator operation.
   a. Ensure that battery-charging volts and amperes register in the green portion of the scale.
   b. Ensure that the coolant temperature gauge is between 180° and 200°F.
   c. Ensure that the oil pressure gauge is between 30 and 55 pounds per square inch.

10. Inspect the generator panel during MEP-029 generator operation.
    a. Ensure that the voltmeter reads 120 phase to neutral and 208 phase to phase when in the United States. When not in the United States, ensure that the voltmeter reads 240 phase to neutral and 416 phase to phase.
    b. Ensure that the alternating-current (AC) ammeter does not exceed 100 percent.
    c. Ensure that the kilowatt meter does not exceed 100 percent.
    d. Ensure that the frequency meter reads 50 or 60 hertz.
    e. Ensure that the fault indicator lights are extinguished.

11. Add fuel as needed during MEP-029 generator operation.

12. Inspect the exhaust system after MEP-029 generator operation.
    a. Check the mufflers for serviceability.
    b. Ensure that the rain caps move freely.
    c. Check the turbocharger assembly for leaks and damage.

13. Inspect the fuel system after MEP-029 generator operation.

14. Record actions taken on DA Form 2404 or DA Form 5988-E and the maintenance logbook.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare

the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform PMCS on an MEP-029 Generator.

Performance Measures	GO	NO-GO
1. Inspected the battery compartment.	____	____
2. Inspected the exhaust system.	____	____
3. Inspected the ground terminals for tight connections.	____	____
4. Inspected the controls and instruments on the engine panel.	____	____
5. Inspected the air cleaner to ensure that the service indicator was not red.	____	____
6. Inspected the radiator assembly.	____	____
7. Inspected the fuel system.	____	____
8. Inspected the muffler and exhaust during MEP-029 generator operation.	____	____
9. Inspected the engine panel controls and instruments during MEP-029 generator operation.	____	____
10. Inspected the generator panel during MEP-029 generator operation.	____	____
11. Added fuel as needed during MEP-029 generator operation.	____	____
12. Inspected the exhaust system after MEP-029 generator operation.	____	____
13. Inspected the fuel system after MEP-029 generator operation.	____	____
14. Recorded actions taken on DA Form 2404 or DA Form 5988-E and the maintenance logbook.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	
TM 5-6115-593-12	

Read a Schematic

052-244-2144

Conditions: You are a power plant operator in a tactical or nontactical environment when there is a fault in a system. Scheduled services are due, or an upgrade to the system is needed or proposed. You are given equipment-specific schematics for an electrical application.

Standards: Read and interpret the schematic information to identify normal current flow and possible faulty circuit components/parts.

Performance Steps

1. Identify the proper schematic for the appropriate application.
2. Orient the schematic to the actual layout.
3. Identify the proper current flow through a circuit.
4. Identify the alternate current flows within the circuit.
   a. Identify the current flow within different switch positions.
   b. Identify the current flow within a faulty component.
      (1) Check for a blown fuse.
      (2) Check for shorts.
      (3) Check for opens.
      (4) Check for defective or burned components/parts.
5. Identify the circuit components/parts.
6. Identify the characteristics of the circuit components/parts.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to read a schematic.

Performance Measures	**GO**	**NO-GO**
1. Identified the proper schematic for the appropriate application.	____	____
2. Oriented the schematic to the actual layout.	____	____
3. Identified the proper current flow through a circuit.	____	____
4. Identified the alternate current flows within the circuit.	____	____
5. Identified the circuit components/parts.	____	____
6. Identified the characteristics of the circuit components/parts.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
	TM 5-811-1

Operate a Line Truck with Auxiliary Equipment

052-244-2145

Conditions: As a power plant operator in a tactical or nontactical environment when maintenance, repair, or new installation is needed for an overhead or underground electrical-distribution system, you are given a line truck with auxiliary equipment, the appropriate technical or service manual, ground guides, a safety harness, and personal protective equipment.

DANGER: NEVER LIFT OBJECTS WITHOUT TWO GROUND GUIDES (ONE TO ASSIST IN FINDING LOCATIONS OF ITEMS BEING LIFTED AND ANOTHER TO HELP ENSURE THAT THE OBJECT BEING LIFTED DOES NOT BEGIN TO SWAY OUT OF CONTROL). FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: BEFORE MOVING A BUCKET OR LINE TRUCK, YOU MUST PERFORM PREVENTIVE-MAINTENANCE CHECKS AND SERVICES. YOU MUST ALSO BE LICENSED ON THE EQUIPMENT OR BE ACCOMPANIED BY A LICENSED DRIVER IN THE VEHICLE CAB TO ENSURE THAT CORRECT OPERATING PROCEDURES ARE FOLLOWED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Operate a line truck with auxiliary equipment by using the primary and secondary controls to move the bucket, winch line, and auger to predetermined areas and by operating the auxiliary equipment according to the applicable technical or service manual.

Performance Steps

1. Prepare a line truck for operation.

NOTE: Consult the applicable technical or service manual for each bucket and line truck to obtain guidance on the correct operation of controls. Before using a bucket or line truck near energized lines, ground the truck chassis for safety.

   a. Position the truck.
      (1) Park the truck as close as possible to the location of the work being performed.
      (2) Perform the work on the uphill side of the truck if it is parked on a slope.
   b. Prepare the truck for operation.
      (1) Engage the emergency brake.
      (2) Engage the power take-off.
      (3) Transfer the controls from the truck to the machine.
      (4) Lower the outriggers.
      (5) Free the boom for movement.
      (6) Don the proper safety gear.

2. Operate the truck boom using the primary and secondary controls while paying close attention to the hand-and-arm signals of the ground guide.
   a. Raise the boom to a height of 30 feet.
   b. Rotate the boom to the left.
   c. Rotate the boom to the right.
   d. Lower the boom and place it back in the cradle.

3. Operate the line truck boom while paying close attention to the hand-and-arm signals of the ground guide.

WARNING: WHEN EXTENDING THE SECOND STAGE OF THE BOOM OR WHEN WINCHING UP, ENSURE THAT THE WINCH HOOK DOES NOT GET PULLED INTO THE WINCH LINE GUIDE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

   a. Raise the boom straight up, ensuring that it does not exceed an 80° angle above the horizontal position.
   b. Rotate the boom so that it is in line with the desired location of the winch hook.

Performance Steps

c. Extend the second stage of the boom so that the hook will fall within 1 foot of the desired area when the winch is lowered.
d. Lower the winch line.
e. Return the boom to its original state.

4. Operate the digger or auger on a line truck while paying close attention to the hand-and-arm signals of the ground guide.

WARNING: THE FOLLOWING PROCEDURES SHOULD BE FOLLOWED AS CLOSELY AS POSSIBLE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

a. Raise the boom 45° above the horizontal position.
b. Rotate the boom 90° to the side of the truck.
c. Verify that the second stage of the boom is fully retracted.
d. Place the two-speed digger button in the LOW-SPEED position.
e. Move the digger control slightly toward the DIG position and, as it rises, hold the auger release switch in the RELEASE position.
f. Move the digger control toward the clean position to slowly lower the auger.
g. Move the auger to the desired location, and dig a hole to a depth of 8 feet.
h. Return the auger and boom to their cradles.

5. Operate the auxiliary line truck equipment.
   a. Operate the capstan.
   b. Operate the take-up reel.
   c. Operate the hydraulic tools.

6. Secure the line truck with the auxiliary equipment.
   a. Secure the loose gear.
   b. Raise and store the outriggers.
   c. Secure the boom.
   d. Turn the truck and machine switch to the TRUCK position.
   e. Disengage the power take-off.
   f. Release the emergency brake before moving the truck.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to operate a line truck with auxiliary equipment.

Performance Measures	**GO**	**NO-GO**
1. Prepared a line truck for operation.	____	____
2. Operated the truck boom using the primary and secondary controls while paying close attention to the hand-and-arm signals of the ground guide.	____	____
3. Operated the line truck boom while paying close attention to the hand-and-arm signals of the ground guide.	____	____
4. Operated the digger or auger on a line truck while paying close attention to the hand-and-arm signals of the ground guide.	____	____
5. Operated the auxiliary line truck equipment.	____	____
6. Secured the line truck with the auxiliary equipment.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related

EM 385-1-1
LCH
TM 5-684
TM 5-811-1

Service a Nonorganic Prime Mover

052-244-2146

Conditions: As a power plant operator in a tactical or nontactical environment when a nonorganic prime mover has been identified for service or when symptoms indicate one or more system faults, you are given a prime mover, a lockout and tagout kit, grounding equipment, safety standing operating procedures, the appropriate technical manuals, construction prints, wiring diagrams, the manufacturer's literature or industry standards, a maintenance logbook, a general mechanic's tool box, a multimeter, and personal protective equipment (PPE).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. EXERCISE EXTREME CARE WHEN WORKING AROUND ROTATING ENGINE COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. ALWAYS WEAR THE PPE REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. ISOLATION VERIFICATION AND SYSTEM DE-ENERGIZING MUST BE ACCOMPLISHED BY ATTEMPTING TO OPERATE THE ENERGY-ISOLATING DEVICES AND DISCONNECTING MEANS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION:

1. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

2. EQUIPMENT WITH A CLASS III LEAK SHOULD NOT BE OPERATED AND MUST BE REPAIRED OR SENT FOR REPAIR IMMEDIATELY. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE.

NOTES:

1. All equipment is not the same and may function differently depending on the make, model, or manufacturer. The troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. Conduct tests should be conducted according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

3. Repair or replace defective components/parts before use.

Standards: Service a nonorganic prime mover by inspecting, testing, cleaning, repairing, or replacing system components/parts.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the appropriate technical manuals, construction prints, wiring diagrams, manufacturer's literature or industry standards, maintenance logbook, and historical data pertaining to the equipment.
3. Ensure that the PPE has been correctly tested and is fully operable.
4. Inspect the tools and testing equipment for serviceability.
5. Determine which systems are due for service.

NOTE: This list is meant to be a guideline and is not all-inclusive.

   a. Check the intake system.
   b. Check the exhaust system.
   c. Check the lubrication system.
   d. Check the cooling system.
   e. Check the governor/speed control system.
   f. Check the hydraulic system.
   g. Check the pneumatic system.
   h. Check the alternating-current (AC) control system.
   i. Check the direct-current (DC) control system.

6. Perform lockout and tagout procedures.
7. Inspect, test, clean, repair, or replace system components/parts according to the manufacturer's literature.
8. Perform a functions check on serviced systems.
9. Close out lockout and tagout procedures by removing all locking and tagging devices.
10. Put the system back into service.
11. Record faults and repairs in the maintenance logbook.
12. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a nonorganic prime mover.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the appropriate technical manuals, construction prints, wiring diagrams, manufacturer's literature or industry standards, maintenance logbook, and historical data pertaining to the equipment.	____	____
3. Ensured that the PPE was correctly tested and was fully operable.	____	____
4. Inspected the tools and testing equipment for serviceability.	____	____
5. Determined which systems were due for service.	____	____
6. Performed lockout and tagout procedures.	____	____
7. Inspected, tested, cleaned, repaired, or replaced system components/parts	____	____

Performance Measures	GO	NO-GO
according to the manufacturer's literature.		
8. Performed a functions check on serviced systems.	____	____
9. Closed out lockout and tagout procedures by removing all locking and tagging devices.	____	____
10. Put the system back into service.	____	____
11. Recorded faults and repairs in the maintenance logbook.	____	____
12. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	LCH
	TM 5-682
	TM 5-684
	TM 5-811-1
	TM 5-811-3

Troubleshoot a Nonorganic Prime Mover

052-244-2147

Conditions: As a power plant operator in a tactical or nontactical environment when a nonorganic prime mover fails to maintain the normal operating speed, you are given a prime mover, a lockout and tagout kit, grounding equipment, safety standing operating procedures, the appropriate technical manuals, construction prints, wiring diagrams, the applicable manufacturer's literature or industry standards, a maintenance logbook, a general mechanic's tool box, a multimeter, and personal protective equipment (PPE).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. EXERCISE EXTREME CARE WHEN WORKING AROUND ROTATING ENGINE COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. ALWAYS WEAR THE PPE REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. ISOLATION VERIFICATION AND SYSTEM DE-ENERGIZING MUST BE ACCOMPLISHED BY ATTEMPTING TO OPERATE THE ENERGY-ISOLATING DEVICES AND DISCONNECTING MEANS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION:

1. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

2. EQUIPMENT WITH A CLASS III LEAK SHOULD NOT BE OPERATED AND MUST BE REPAIRED OR SENT FOR REPAIR IMMEDIATELY. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE.

NOTES:

1. All equipment is not the same and may function differently depending on the make, model, or manufacturer. The troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. Defective equipment should be repaired or replaced immediately and before use.

3. Conduct tests according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

Standards: Troubleshoot a nonorganic prime mover that fails to maintain the normal operating speed. Identify the fault, and test the fault to verify that it is the cause of the malfunction.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the appropriate technical manuals, construction prints, wiring diagrams, manufacturer's literature or industry standards, maintenance logbook, and historical data pertaining to the equipment.
3. Ensure that the PPE has been correctly tested and is fully operable.
4. Inspect the tools and testing equipment for serviceability.
5. Determine which systems are critical to the operation.

NOTE: This list is meant to be a guideline and is not all-inclusive.

   a. Check the intake system.
   b. Check the exhaust system.
   c. Check the lubrication system.
   d. Check the cooling system.
   e. Check the governor/speed control system.
   f. Check the hydraulic system.
   g. Check the pneumatic system.
   h. Check the alternating-current (AC) control system.
   i. Check the direct-current (DC) control system.

6. Identify the fault locations by checking the fault indicator panel or each critical system for obvious malfunctions.

NOTE: This list is meant to be a guideline and is not all-inclusive. Check for the most obvious and easily corrected problems first.

   a. Identify incorrectly positioned control switches.
   b. Identify lighted control panel warnings.
   c. Identify improper meter readings.
   d. Identify tripped circuit breakers and reset buttons and blown fuses.
   e. Identify fluid leaks.
   f. Identify loose or burnt wiring.
   g. Identify excessively worn components/parts.
   h. Identify burnt components/parts by sight and smell.
   i. Identify out-of-tolerance service requirements.
   j. Identify low fluid levels.
   k. Identify the restricted flows of fluids and gases.

7. Isolate the system in which the fault was found.
8. Conduct further testing to identify defective components/parts if necessary.
9. Perform lockout and tagout procedures.
10. Repair or replace defective components/parts when possible.
11. Perform a functions check on the affected system.
12. Close out lockout and tagout procedures by removing all locking and tagging devices.
13. Put the system back into service.
14. Record faults and repairs in the maintenance logbook.
15. Ensure that the PPE, testing equipment, and tools are correctly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a nonorganic prime mover.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the appropriate technical manuals, construction prints, wiring diagrams, manufacturer's literature or industry standards, maintenance logbook, and historical data pertaining to the equipment.	____	____
3. Ensured that the PPE was correctly tested and was fully operable.	____	____
4. Inspected the tools and testing equipment for serviceability.	____	____
5. Determined which systems were critical to the operation.	____	____
6. Identified the fault locations by checking the fault indicator panel or each critical system for obvious malfunctions.	____	____
7. Isolated the system in which the fault was found.	____	____
8. Conducted further testing to identify defective components/parts if necessary.	____	____
9. Performed lockout and tagout procedures.	____	____
10. Repaired or replaced defective components/parts when possible.	____	____
11. Performed a functions check on the affected system.	____	____
12. Closed out lockout and tagout procedures by removing all locking and tagging devices.	____	____
13. Put the system back into service.	____	____
14. Recorded faults and repairs in the maintenance logbook.	____	____
15. Ensured that the PPE, testing equipment, and tools were correctly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 5-424
	LCH
	TM 5-682
	TM 5-684
	TM 5-811-1
	TM 5-811-3

Perform Power Plant Battle Damage Assessment and Repair (BDAR)

052-244-2148

Conditions: As a power plant operator in a tactical or nontactical environment after a power plant has been damaged, you are given one-line diagrams, electrical construction prints, the applicable BDAR repair kit, appropriate technical manuals, wiring diagrams, DA Form 2404 or DA Form 5988-E, the manufacturer's literature with schematics, a multimeter, maintenance logbooks, a general mechanic's tool box, a lockout and tagout kit, and personal protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND OPERATION OF ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ALWAYS WEAR THE PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: All power plant equipment is not the same and may function differently depending on the make, model, or manufacturer. The troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

Standards: Perform power plant BDAR by identifying the cause(s) of the damage and completing the BDAR without causing personal injury or equipment damage. Initiate the additional actions required as a result of the inspection.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Perform an equipment inspection.
    a. Locate the damaged components/parts.
    b. Test the salvageable components/parts to ensure serviceability.
6. Determine the extent of the equipment damage.
    a. Determine if the damage is minor enough to repair on the spot.
    b. Determine if the damage warrants equipment recovery at a maintenance facility (if possible).
    c. Determine if the damage warrants abandonment or destruction of the equipment in place.
7. Perform expedient repairs.
    a. Use substitute components/parts if required.
    b. Use BDAR procedures to rapidly repair damages.
    c. Use field-expedient materials to make repairs if required
    d. Use field-expedient POL if required.
8. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.

Performance Steps

9. Notify the change of command of destruction procedures if required.
10. Prepare the equipment for destruction if required according to the BDAR manual.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Perform a functions check on the repaired equipment.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform power plant BDAR.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Performed an equipment inspection.	____	____
6. Determined the extent of the equipment damage.	____	____
7. Performed expedient repairs.	____	____
8. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
9. Notified the change of command of destruction procedures if required.	____	____
10. Prepared equipment for destruction if required according to the BDAR manual.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Performed a functions check on the repaired equipment.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	5180-02-502-9507
DA FORM 5988-E	EM 385-1-1
	FM 3-34.480
	FM 4-30.31
	TM 5-811-1
	UGLYS™

Subject Area 2: E5 Instrument Maintenance (Power Station) Tasks

Produce an Electronic Circuit

052-207-2100

Conditions: As a power station instrument technician in a tactical or nontactical environment, you are given safety standing operating procedures (SOPs), an empty circuit board, the required electronic components, a soldering iron, a solder and rosin flux, a multimeter, an oscilloscope with manual, an electronic tool kit, TM 5-704, electrical schematics, and the applicable manufacturer's literature with schematics.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. THE SOLDERING IRON IS VERY HOT DURING OPERATION. USE CAUTION TO AVOID SETTING FIRE TO YOURSELF OR THE WORKPLACE. FAILURE TO COMPLY MAY RESULT IN PERMANENT INJURY OR DEATH.

NOTE: Keep the work area neat and organized. Keep the meter and equipment stable. Failure to comply may lead to unreliable test readings.

Standards: Produce a functional electronic circuit.

Performance Steps

1. Identify circuit components correctly.
2. Inspect components for damage and serviceability.
3. Install components in the circuit board as specified in schematics.
   a. Insert each component individually into its proper position.
   b. Ensure that polarity-sensitive components are properly oriented.
   c. Place the heat sink clips on temperature-sensitive components.
   d. Solder the component in place (using the proper technique) to ensure that there is a good electrical connection.
4. Inspect the final product for flaws or damage.
5. Test the circuit for proper operation.
6. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to produce an electronic circuit.

Performance Measures	**GO**	**NO-GO**
1. Identified circuit components correctly.	____	____
2. Inspected components for damage and serviceability.	____	____

Performance Measures	GO	NO-GO
3. Installed components in the circuit board as specified in schematics.	____	____
4. Inspected the final product for flaws or damage.	____	____
5. Tested the circuit for proper operation.	____	____
6. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
TM 5-704	TC 9-60

Perform Electronic Troubleshooting Procedures

052-207-2101

Conditions: As a power station instrument technician in a tactical or nontactical environment during scheduled maintenance or when a control system with electronic circuits requires troubleshooting, you are given safety standing operating procedures (SOPs), a lockout and tagout kit, a multimeter, an oscilloscope, an electronic tool kit, appropriate technical manuals, the applicable manufacturer's literature with schematics, maintenance logbooks, and wiring diagrams.

DANGER:

1. SOME TROUBLESHOOTING TASKS ARE NORMALLY PERFORMED WITH THE SUSPECTED EQUIPMENT ENERGIZED AND IN OPERATION. FAILURE TO OBSERVE SAFETY MEASURES MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Perform electronic troubleshooting procedures using systematic procedures. Safely troubleshoot the electronic or control circuit, and identify the cause of system malfunction.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics, electrical construction prints, and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Check for obvious malfunctions.
    a. De-energize the inoperative system.
    b. Test the system for voltage presence.
        (1) Proceed to step 4b(2)(c) if there is no voltage present.
        (2) Stop if there is voltage present, and perform the following checks until voltage is no longer present:
            (a) Check schematics for proper circuit identification.
            (b) Check for back-fed circuits.
            (c) Check for the proper use of safe-clearance procedures.
    c. Visually inspect for obvious damage.
    d. Check fuses.
    e. Ensure that control switches are positioned correctly.
    f. Check for indications of burning wires or components via sight and smell.
    g. Check for wire continuity in the involved circuit.
5. Ensure that the power is on.
    a. Energize the system if there is no obvious malfunction.
    b. Check for a complete operation cycle.
    c. Listen for unusual operating sounds.

DANGER: DE-ENERGIZE IMMEDIATELY AT THE FIRST SIGN OF AN ELECTRICAL SHORT OR SMOKE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE INJURY AND SEVERE DAMAGE TO EQUIPMENT.

    d. Check the system by sectionalizing the circuit if the fault cannot be identified.

6. Sectionalize the circuit.
    a. Study schematics and wiring diagrams.
    b. Take measurements at each end of the circuit.

Performance Steps

c. Begin sectionalizing the circuit if the desired values are not obtained.
   (1) Identify the point where the circuit can be approximately sectionalized in half to determine if the circuit is working up to that point.
   (2) Divide the circuit closest to the output voltage approximately in half again if the values obtained indicate that the circuit is working up to that point.
   (3) Divide the circuit closest to the power source approximately in half again if the values obtained indicate that the circuit is not working up to that point.
d. Continue sectionalizing the circuit until the component that is causing the fault is identified.
e. Perform a circuit trace and component test if the fault cannot be located.

7. Perform a circuit trace if needed.
   a. De-energize the inoperative circuit.
   b. Test the circuit for voltage.
      (1) Proceed to step 7c if there is no voltage present.
      (2) Stop if there is voltage present, and perform the following checks until voltage is no longer present:
         (a) Check schematics for proper circuit identification.
         (b) Check for back-fed circuits.
         (c) Check for the proper use of safe-clearance procedures.
   c. Trace the circuit using schematics and wiring diagrams.
   d. Test each wire for continuity and secure the electrical connection.
   e. Isolate each component and test for proper electrical parameters.
   f. Test switches for proper operation.
   g. Test relays for proper contact transfer when the coil is energized.
   h. Test resistors for rated values.

8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform electronic troubleshooting procedures.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Checked for obvious malfunctions.	____	____
5. Ensured that the power was on.	____	____
6. Sectionalized the circuit.	____	____
7. Performed a circuit trace if needed.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Service a Timing Relay

052-207-2106

Conditions: As a power station instrument technician in a tactical or nontactical environment during scheduled maintenance or if a timing relay is suspected of being defective, you are given safety standing operating procedures (SOPs), a lockout and tagout kit, a multimeter, a relay test set and manual, an electronic tool kit, maintenance logbooks, wiring diagrams, and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE RELAY IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO THE ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT CURRENT TRANSFORMERS ARE DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING THE METER. IF ENERGIZED, AN OPEN CURRENT TRANSFORMER CIRCUIT WILL PRODUCE VERY HIGH VOLTAGES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING THE RELAY ARE DE-ENERGIZED BEFORE SERVICING THE METER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH AND EQUIPMENT DAMAGE.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: Keep the work area neat and organized. Keep the meter and equipment stable. Failure to comply may lead to unreliable test readings.

Standards: Service the timing-relay circuit safely by testing and calibrating it, and then reinstalling or replacing the relay. Calibrate and reinstall or replace the relay based on test results.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify which circuit needs to be tested using schematics.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage presence.
   a. Proceed to step 7 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check the schematics for proper identification of the circuit.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.
7. Remove the timing relay from the base according to the manufacturer's literature.
8. Identify relay contacts.
   a. Identify the main coil.
   b. Identify the normally open.

Performance Steps

c. Identify the normally closed.

9. Determine time delay types.
   a. Determine the pickup time delay (proceed to step 10).
   b. Determine the dropout time delay (proceed to step 11, skip step 10).
10. Test the relay for proper pickup time delay.
   a. Apply the voltage or current to the main coil according the manufacturer's literature.
   b. Determine the time between voltage or current application and contact transfer.
   c. Remove the voltage or current from the main coil according to the manufacturer's literature.
   d. Ensure that auxiliary contacts transfer immediately.
11. Test the relay for the proper dropout time delay.
   a. Apply voltage or current to the main coil according to the manufacturer's literature.
   b. Ensure that auxiliary contacts transfer.
   c. Remove the voltage or current from the main coil according to the manufacturer's literature.
   d. Determine the time between voltage or current removal and contact transfer.
12. Compare test results with the manufacturer's specifications, and take appropriate action.
13. Calibrate, reinstall, or replace the timing relay.
14. Test the circuit for voltage presence.
   a. Proceed to step 15 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check the electrical schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.
15. Tag the timing-relay with the appropriate calibration sticker (to include the name and testing date).
16. Reinstall the timing relay.
17. Close out lockout and tagout procedures by removing locking and tagging devices.
18. Energize the circuit, and check for proper timing-relay operation.
19. Keep a record of results and actions taken.
20. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a timing relay.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified which circuit needed to be tested using schematics.	____	____
5. Performed lockout and tagout procedures.	____	____

Performance Measures	GO	NO-GO
6. Tested the circuit for voltage presence.	____	____
7. Removed the timing relay from the base according to the manufacturer's literature.	____	____
8. Identified relay contacts.	____	____
9. Determined time delay types.	____	____
10. Tested the relay for proper pickup time delay.	____	____
11. Tested the relay for proper dropout time delay.	____	____
12. Compared test results with the manufacturer's specifications and took appropriate action.	____	____
13. Calibrated, reinstalled, or replaced the timing-relay.	____	____
14. Tested the circuit for voltage presence.	____	____
15. Tagged the timing-relay with the appropriate calibration sticker (to include the name and testing date).	____	____
16. Reinstalled the timing relay.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
18. Energized the circuit and checked for proper timing-relay operation.	____	____
19. Kept a record of results and actions taken.	____	____
20. Ensured that the items listed in the conditions statement properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	DA FORM 2404

Service a Current Boost Module

052-207-2113

Conditions: As a power station instrument technician in a tactical or nontactical environment during scheduled maintenance or if the current boost module is suspected of being defective, you are given safety standing operating procedures (SOPs), a lockout and tagout kit, a multimeter, an alternating-current (AC) power supply, an electronic tool kit, wiring diagrams, maintenance logbooks, and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE MODULE IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO THE ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT CURRENT TRANSFORMERS SUPPLYING CURRENT TO THE MODULE ARE DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING THE MODULE. IF ENERGIZED, AN OPEN-CURRENT TRANSFORMER CIRCUIT WILL PRODUCE VERY HIGH VOLTAGES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING THE MODULE ARE DE-ENERGIZED BEFORE SERVICING THE METER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH AND EQUIPMENT DAMAGE.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: KEEP THE WORK AREA NEAT AND ORGANIZED. KEEP THE METER AND EQUIPMENT STABLE WHILE PERFORMING THIS TASK. FAILURE TO COMPLY MAY LEAD TO UNRELIABLE TEST READINGS.

Standards: Service the current boost module by safely testing and calibrating it according to the manufacturer's literature. Reinstall or replace the module based on the test results.

Performance Steps

NOTE: The low-voltage side of the potential transformer that supplies voltage to the module may be fuse-protected. To further isolate the circuit electrically and as an additional safety measure, this fuse may be removed. Check the schematics for verification.

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify the circuit connected to the current boost module by using the schematics.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage presence.
   a. Proceed to step 7 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check the electrical schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.

Performance Steps

7. Remove the current boost module, and tag the leads.
8. Inspect the current boost module for damage.
9. Test the current boost module according to the manufacturer's literature.
10. Compare the results with the manufacturer's specifications, and take appropriate action.
11. Calibrate or replace the current boost module.
12. Test the circuit for voltage presence.
    a. Proceed to step 13 if there is no voltage present.
    b. Stop If there is voltage present, and perform the following steps until voltage is no longer present:
       (1) Check the schematics for proper circuit identification.
       (2) Check for back-fed circuits
       (3) Check for the proper use of safe-clearance procedures.
13. Tag the current boost module with the appropriate calibration sticker (including the name and testing date).
14. Reinstall the current boost module.
    a. Attach tagged leads.
    b. Verify connections.
15. Close out lockout and tagout procedures by removing locking and tagging devices.
16. Energize the circuit, and ensure that it is operating properly.
17. Keep a record of results and actions taken.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a current boost module.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified the circuit connected to the current boost module by using the schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage presence.	____	____
7. Removed the current boost module and tagged the leads.	____	____
8. Inspected the current boost module for damage.	____	____
9. Tested the current boost module according to the manufacturer's literature.	____	____

Performance Measures	GO	NO-GO
10. Compared the results with the manufacturer's specifications and took appropriate action.	____	____
11. Calibrated or replaced the current boost module.	____	____
12. Tested the circuit for voltage presence.	____	____
13. Tagged the current boost module with the appropriate calibration sticker (including the name and testing date).	____	____
14. Reinstalled the current boost module.	____	____
15. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
16. Energized the circuit and ensured that it was operating properly.	____	____
17. Kept a record of results and actions taken.	____	____
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Service a Signal Transmission Circuit

052-207-2116

Conditions: As a power station instrument technician in a tactical or nontactical environment when an unshielded, twisted pair (UTP) communication cable is in need of repair or replacement, you are given a UTP cable reel (at least Category 5 quality), RJ-45 connectors, a modular-plug crimp tool, an electronic tool kit, wiring diagrams, and the applicable manufacturer's literature with schematics.

Standards: Service a signal transmission circuit by repairing or replacing a damaged connector based on cable inspection.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Inspect the cable for serviceability.
    a. Examine the RJ-45 connectors for proper crimps and solid connections.
    b. Perform a visual inspection of the entire length of the cable.
    c. Replace the cable if it is damaged anywhere other than the ends near the connectors.
    d. Test each conductor for continuity.
    e. Test each conductor for isolation from other conductors.
4. Repair the cable as needed.
    a. Determine if the cable is a crossover cable or a straight-through cable.

NOTE: Straight-through cables have identical ends (End A). Crossover cables have one end that is identical to a straight-through cable (End A) and the other end has the green and orange pairs switched (End B). When other colors are present or in a different order, ensure that Pins 2 and 6 are opposite.

    b. Cut off the old connector.
    c. Strip the outer jacket back about 1 inch.
    d. Lay out the conductors.
        (1) Lay out the straight-through and crossover cable pin configuration for End A in the following order:
            (a) White-striped green.
            (b) Green.
            (c) White-striped orange.
            (d) Blue.
            (e) White-striped blue.
            (f) Orange.
            (g) White-striped brown.
            (h) Brown.
        (2) Lay out the crossover cable pin configuration for End B in the following order:
            (a) White-striped orange.
            (b) Orange.
            (c) White-striped green.
            (d) Blue.
            (e) White-striped blue.
            (f) Green.
            (g) White-striped brown.
            (h) Brown.
    e. Cut back the conductors to within 1/2 inch of the outer jacket.
    f. Crimp the new connector end.
5. Reconnect the cable.

Performance Steps

6. Test the system.
7. Bury the cable if required.
8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a signal transmission circuit.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Inspected the cable for serviceability.	____	____
4. Repaired the cable as needed.	____	____
5. Reconnected the cable.	____	____
6. Tested the system.	____	____
7. Buried the cable if required.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Service an Induction Disk and/or Electromagnetic Relay

052-207-2118

Conditions: As a power station instrument technician in a tactical or nontactical environment during routine scheduled maintenance or when the relay device suspected of being defective, you are given an SR-90 or Pulsar® relay test set with instruction manual, a Westinghouse® type or General Electric (GE)® type relay test block, an EPS-1000 electronic phase shifter with instruction manual, an instruction booklet for the specific relay being serviced, an electronic tool kit, a burnishing tool, a calculator, wiring diagrams, maintenance logbooks, and the applicable manufacturer's literature with schematics.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. TERMINALS INSIDE THE SWITCHGEAR COMPARTMENT WILL REMAIN ENERGIZED AFTER REMOVING THE RELAY FROM SERVICE. CONTACT WITH THE EXPOSED CONNECTION MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. NOT ALL RELAYS ARE THE DRAW-OUT TYPE; ALWAYS REFER TO THE MANUFACTURER'S LITERATURE TO ENSURE THAT CURRENT TRANSFORMER CONTACTS ARE SHORTED BEFORE REMOVING THE RELAY FROM SERVICE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY AND SEVERE DAMAGE TO EQUIPMENT.

2. EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE RELAY DEVICE FROM SERVICE. DO NOT CAUSE THE CIRCUIT THAT THE RELAY IS PROTECTING TO TRIP. FAILURE TO COMPLY MAY CAUSE DAMAGE TO EQUIPMENT.

NOTE: Keep the work area neat and organized. Keep the meter and equipment stable while performing this task. Failure to comply may lead to unreliable test readings.

Standards: Service the relay device in question by testing it to determine if it meets the manufacturer's specifications. Perform any necessary adjustments to bring the relay to serviceable condition when possible. Replace the relay when it cannot be returned to the manufacturer's specifications.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Review the relay instruction booklet.
5. Record the relay information.
    a. Record the location.
    b. Record the circuit identification.
    c. Record the date.
    d. Record the temperature.
    e. Record the relay nameplate data.
    f. Record one as-found relay settings.

NOTE: Use extreme caution when removing the relay from the circuit. Do not trip the circuit off-line.

Performance Steps

6. Remove the relay from service.
    a. Remove GE type relays by removing the connection block smoothly.
    b. Remove Westinghouse type relays by first releasing the red lever to disarm the trip circuit and then releasing the black levers.

7. Inspect the relay for damage.
    a. Inspect for signs of overheating.
    b. Inspect for loose connections.
    c. Inspect for debris.
    d. Inspect the disk travel for smooth operation.

8. Clean the relay with a soft brush or noncompressed air.
    a. Clean relay contacts with a burnishing tool.
    b. Clean the magnet with a magnet-cleaning tool.

CAUTION: WHILE CLEANING THE RELAY, DO NOT USE SOLVENTS OR ABRASIVE MATERIAL, AND AVOID TOUCHING THE INDUCTION DISK WITH YOUR FINGERS. FAILURE TO COMPLY MAY REDUCE THE LIFE OF THE RELAY.

9. Set up the relay test set according to the instruction manual.

NOTE: To ensure accurate relay testing, place the device being tested on a level surface.

10. Perform an insulation resistance test on the relay, testing from the output connection to the relay case ground by using the insulation resistance output on the relay test set.

11. Perform a zero check on the time dial, ensuring that relay contacts only make contact when the time dial reads zero; and make necessary adjustments if this does not occur.

12. Perform a pickup test according to the manufacturer's literature.

13. Perform a time curve verification test on the as-found time dial setting.
    a. Determine if the pickup is as specified in the manufacturer's literature.
    b. Select three test currents that fall along the knee of the curve for the particular relay being tested.
    c. Perform a test at each current to verify the curve.
    d. Verify that the relay performs within the manufacturer's specifications, and make necessary adjustments to meet these specifications.

CAUTION: THE APPLIED TEST CURRENTS SHOULD ONLY BE APPLIED MOMENTARILY. FAILURE TO COMPLY MAY CAUSE EXCESSIVE HEATING OF THE MAIN COIL.

NOTE: Ensure that the relay disk has returned to a rested position before performing each consecutive test. Perform each test at least twice for each current to verify the results.

14. Test the direct-current (DC) target, and seal-in the unit according to the relay instruction booklet.

15. Ensure that the trip circuit remains energized after removing the fault current from the main coil.

16. Make adjustments based on the test results.

17. Perform a pickup test of the instantaneous unit according to the manufacturer's literature.

CAUTION: HIGH AMOUNTS OF FAULT CURRENT ARE REQUIRED TO PERFORM THIS TEST. THE APPLIED TEST CURRENT SHOULD ONLY BE ALLOWED TO TRAVEL THROUGH THE INSTANTANEOUS UNIT COIL AND NOT THROUGH THE MAIN COIL. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE.

18. Return relay settings to the correct parameters.

19. Tag the relay with the appropriate calibration sticker (including the name and testing date).

Performance Steps

20. Ensure that flags are reset.
21. Replace the window cover, and clean and inspect the seal for serviceability.
22. Return the relay to service.
    a. Replace the relay inside the case.
    b. Reconnect GE type relays by slowly sliding the connecting block back in.
    c. Reconnect Westinghouse type relays by first returning the black connecting levers and then the red lever.
23. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an induction disk and/or electromagnetic relay.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Reviewed the relay instruction booklet.	____	____
5. Recorded the relay information.	____	____
6. Removed the relay from service.	____	____
7. Inspected the relay for damage.	____	____
8. Cleaned the relay with a soft brush or noncompressed air.	____	____
9. Set up the relay test set according to the instruction manual.	____	____
10. Performed an insulation resistance test on the relay, testing from the output connection to the relay case ground by using the insulation resistance output on the relay test set.	____	____
11. Performed a zero check on the time dial, ensuring that the relay contacts only made contact when the time dial read zero and made necessary adjustments when this did not occur.	____	____
12. Performed a pickup test according to the manufacturer's literature.	____	____
13. Performed a time curve verification test on the as-found time dial setting.	____	____
14. Tested the DC target and sealed in the unit according to the relay instruction booklet.	____	____
15. Ensured that the trip circuit remained energized after removing the fault current from the main coil.	____	____
16. Made adjustments based on the test results.	____	____
17. Performed a pickup test of the instantaneous unit according to the manufacturer's	____	____

Performance Measures	GO	NO-GO
literature.		
18. Returned relay settings to the correct parameters.	____	____
19. Tagged the relay with the appropriate calibration sticker (including the name and testing date).	____	____
20. Ensured that flags were reset.	____	____
21. Replaced the window cover and cleaned and inspected the seal for serviceability.	____	____
22. Returned the relay to service.	____	____
23. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Service a Programmable Logic Controller (PLC)

052-207-2119

Conditions: As a power station instrument technician in a tactical or nontactical environment during scheduled maintenance or if a PLC is suspected of being defective, you are given a lockout and tagout kit, a multimeter, a power supply, an oscilloscope, an electronic tool kit, wiring diagrams, maintenance logbooks, and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE CONTROLLER IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT CURRENT TRANSFORMERS SUPPLYING CURRENT TO THE CONTROLLER ARE DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING THE CONTROLLER. IF ENERGIZED, AN OPEN-CURRENT TRANSFORMER CIRCUIT WILL PRODUCE VERY HIGH VOLTAGES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING THE CONTROLLER ARE DE-ENERGIZED BEFORE SERVICING THE CONTROLLER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH AND EQUIPMENT DAMAGE.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: Keep the work area neat and organized. Keep the controller and equipment stable while performing this task. Failure to comply may lead to unreliable test readings.

Standards: Service a PLC by safely testing it as specified in the manufacturer's literature. Reinstall or replace the controller based on the test results.

Performance Steps

NOTE: The low-voltage side of the potential transformer that supplies voltage to the controller may be fuse-protected. To further isolate the circuit (electrically), and as an additional safety measure, this fuse may be removed. Check the schematics for verification.

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify the circuit connected to the PLC by using the schematics.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage presence.
   a. Proceed to step 7 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check the schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.
7. Remove the controller, and tag the leads.
8. Inspect the controller for damage.

Performance Steps

9. Test the controller according to the manufacturer's literature.
10. Compare the results with the manufacturer's specifications, and take appropriate action.
11. Reinstall or replace the controller.
12. Test the circuit for voltage presence.
    a. If there is no voltage present, proceed to step 13.
    b. If there is voltage present, stop and perform the following checks until voltage is no longer present:
       (1) Check schematics for proper circuit identification.
       (2) Check for back-fed circuits.
       (3) Check for the proper installation of safe-clearance procedures.
       (4) Check for violations of safe-clearance procedures.
13. Tag the controller with the appropriate calibration sticker (including the name and testing date).
14. Reinstall the controller.
    a. Attach tagged leads.
    b. Verify connections.
15. Close out lockout and tagout procedures by removing locking and tagging devices.
16. Energize the circuit, and ensure that it is operating properly.
17. Keep a record of results and actions taken.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a PLC.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified the circuit connected to the PLC by using the schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage presence.	____	____
7. Removed the controller and tagged the leads.	____	____
8. Inspected the controller for damage.	____	____
9. Tested the controller according to the manufacturer's literature.	____	____
10. Compared the results with the manufacturer's specifications and took appropriate action.	____	____
11. Reinstalled or replaced the controller.	____	____

Performance Measures	GO	NO-GO
12. Tested the circuit for voltage presence.	____	____
13. Tagged the controller with the appropriate calibration sticker (including the name and testing date).	____	____
14. Reinstalled the controller.	____	____
15. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
16. Energized the circuit and ensured that it was operating properly.	____	____
17. Kept a record of results and actions taken.	____	____
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Service Optoelectronic Equipment

052-207-2120

Conditions: As a power station instrument technician in a tactical or nontactical environment during scheduled maintenance or if optoelectronic equipment is suspected of being defective, you are given a lockout and tagout kit, a multimeter, a power supply, an oscilloscope, an electronic tool kit, wiring diagrams, maintenance logbooks, and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE EQUIPMENT IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT CURRENT TRANSFORMERS SUPPLYING CURRENT TO EQUIPMENT ARE DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING EQUIPMENT. IF ENERGIZED, AN OPEN-CURRENT TRANSFORMER CIRCUIT WILL PRODUCE VERY HIGH VOLTAGES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING EQUIPMENT ARE DE-ENERGIZED BEFORE SERVICING THE EQUIPMENT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH AND EQUIPMENT DAMAGE.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: Keep the work area neat and organized. Keep equipment stable while performing this task. Failure to comply may lead to unreliable test readings.

Standards: Service the optoelectronic equipment by safely testing it as specified in the manufacturer's literature. Reinstall or replace the controller based on test results.

Performance Steps
NOTE: The low-voltage side of the potential transformer that supplies voltage to the equipment may be fuse-protected. To further isolate the circuit electrically and as an additional safety measure, this fuse may be removed. Check the schematics for verification.

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify the circuit connected to the optoelectronic equipment by using the schematics.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage presence.
   a. Proceed to step 7 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check the schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.
7. Remove the equipment, and tag the leads.
8. Inspect the equipment for damage.

Performance Steps

9. Test the equipment according to the manufacturer's literature.
10. Compare the results with the manufacturer's specifications, and take appropriate action.
11. Reinstall or replace the equipment.
12. Test the circuit for voltage presence.
    a. Proceed to step 13 if there is no voltage present.
    b. Stop if there is voltage present, and perform the following checks until the voltage is no longer present:
       (1) Check the schematics for proper circuit identification.
       (2) Check for back-fed circuits.
       (3) Check for the proper use of safe-clearance procedures.
13. Tag the equipment with the appropriate calibration sticker (including the name and testing date).
14. Reinstall the equipment.
    a. Attach tagged leads.
    b. Verify connections.
15. Close out lockout and tagout procedures by removing locking and tagging devices.
16. Energize the circuit, and ensure that it is operating properly.
17. Keep a record of results and actions taken.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service optoelectronic equipment.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified the circuit connected to the optoelectronic equipment by using the schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage presence.	____	____
7. Removed the equipment and tagged the leads.	____	____
8. Inspected the equipment for damage.	____	____
9. Tested the equipment according to the manufacturer's literature.	____	____
10. Compared the results with the manufacturer's specifications and took appropriate action.	____	____
11. Reinstalled or replaced the equipment.	____	____

Performance Measures	GO	NO-GO
12. Tested the circuit for voltage presence.	____	____
13. Tagged the equipment with the appropriate calibration sticker (including the name and testing date).	____	____
14. Reinstalled the equipment.	____	____
15. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
16. Energized the circuit and ensured that it was operating properly.	____	____
17. Kept a record of results and actions taken.	____	____
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	TM 5-6115-593-12 TM 5-6115-593-34

Service a Solid-State Relay

052-207-2121

Conditions: As a power station instrument technician in a tactical or nontactical environment during scheduled maintenance or if the relay is suspected of being defective, you are given a lockout and tagout kit, a multimeter, a relay test set with manual, an electronic tool kit, wiring diagrams, maintenance logbooks, and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE RELAY IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT CURRENT TRANSFORMERS SUPPLYING CURRENT TO THE RELAY ARE DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING THE RELAY. IF ENERGIZED, AN OPEN-CURRENT TRANSFORMER CIRCUIT WILL PRODUCE VERY HIGH VOLTAGES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING THE RELAY ARE DE-ENERGIZED BEFORE SERVICING THE METER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH AND EQUIPMENT DAMAGE.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: Keep the work area neat and organized. Keep the relay stable while performing this task. Failure to comply may lead to unreliable test readings.

Standards: Service a solid-state relay by testing and calibrating it and then installing or replacing the relay. Test the relay as specified in the manufacturer's literature, and keep a record of the results. Reinstall or replace the relay based on the test results.

Performance Steps

NOTE: The low-voltage side of the potential transformer that supplies voltage to the relay may be fuse-protected. To further isolate the circuit electrically and as an additional safety measure, this fuse may be removed. Check the schematics for verification.

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify the circuit connected to the relay by using the schematics.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage presence.
   a. Proceed to step 7 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check the schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.
7. Remove the relay, and tag the leads.

Performance Steps

8. Test the relay according to the manufacturer's literature.
9. Compare the results with the manufacturer's specifications, and take appropriate action.
10. Calibrate, reinstall, or replace the relay.
11. Test the circuit for voltage presence.
    a. Proceed to step 12 if there is no voltage present.
    b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
       (1) Check the schematics for proper circuit identification.
       (2) Check for back-fed circuits.
       (3) Check for the proper use of safe-clearance procedures.
12. Reinstall the relay.
    a. Attach tagged leads.
    b. Verify connections.
13. Close out lockout and tagout procedures by removing locking and tagging devices.
14. Energize the circuit, and ensure that it is operating properly.
15. Keep a record of results and actions taken.
16. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a solid-state relay.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified the circuit connected to the relay by using the schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage presence.	____	____
7. Removed the relay and tagged the leads.	____	____
8. Tested the relay according to the manufacturer's literature.	____	____
9. Compared the results with the manufacturer's specifications and took appropriate action.	____	____
10. Calibrated, reinstalled, or replaced the relay.	____	____
11. Tested the circuit for voltage presence.	____	____
12. Reinstalled the relay.	____	____
13. Closed out lockout and tagout procedures by removing locking and tagging	____	____

Performance Measures	GO	NO-GO
devices.		
14. Energized the circuit and ensured that it was operating properly.	____	____
15. Kept a record of results and actions taken.	____	____
16. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Service a Digital Synchronizer and Load Controller (DSLC)

052-207-2123

Conditions: As a power station instrument technician in a tactical or nontactical environment during scheduled maintenance or if the DSLC is suspected of being defective, you are given a lockout and tagout kit, a multimeter, wiring diagrams, a relay test set with manual, an oscilloscope, a handheld DSLC programmer, an electronic tool kit, a DSLC operations and calibration manual, wiring diagrams, maintenance logbooks, and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE CONTROLLER IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT CURRENT TRANSFORMERS SUPPLYING CURRENT TO THE CONTROLLER ARE DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING THE CONTROLLER. IF ENERGIZED, AN OPEN-CURRENT TRANSFORMER CIRCUIT WILL PRODUCE VERY HIGH VOLTAGES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING THE CONTROLLER ARE DE-ENERGIZED BEFORE SERVICING THE CONTROLLER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH AND EQUIPMENT DAMAGE.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: KEEP THE WORK AREA NEAT AND ORGANIZED. KEEP THE CONTROLLER STABLE WHILE PERFORMING THIS TASK. FAILURE TO COMPLY MAY LEAD TO UNRELIABLE TEST READINGS.

Standards: Service a DSLC by safely testing it as specified in the manufacturer's literature. Reinstall or replace the controller based on the test results.

Performance Steps

NOTE: The low-voltage side of the potential transformer that supplies voltage to the controller may be fuse-protected. To further isolate the circuit electrically and as an additional safety measure, this fuse may be removed. Check the schematics for verification.

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify the circuit connected to the DSLC by using the schematics.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage presence.
   a. Proceed to step 7 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check the schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.

Performance Steps

7. Remove the controller, and tag the leads.
8. Inspect the controller for damage.
9. Connect the handheld programming device to the diagnostic and service port.
10. Perform testing and calibration according to the DSLC operations and calibration manual.
11. Compare the results with the manufacturer's specifications, and take appropriate action.
    a. Reinstall the controller.
    b. Reprogram the controller.
    c. Replace the controller.
12. Test the circuit for voltage presence.
    a. Proceed to step 13 if there is no voltage present.
    b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
       (1) Check the schematics for proper circuit identification.
       (2) Check for back-fed circuits.
       (3) Check for the proper use of safe-clearance procedures.
13. Tag the controller with the appropriate calibration sticker (including the name and testing date).
14. Reinstall the controller.
    a. Attach tagged leads.
    b. Verify connections using the schematics.
15. Close out lockout and tagout procedures by removing locking and tagging devices.
16. Energize the circuit, and ensure that it is operating properly.
17. Keep a record of results and actions taken.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a DSLC.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified the circuit connected to the DSLC by using the schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage presence.	____	____
7. Removed the controller and tagged the leads.	____	____
8. Inspected the controller for damage.	____	____

Performance Measures	GO	NO-GO
9. Connected the handheld programming device to the diagnostic and service port.	____	____
10. Performed testing and calibration according to the DSLC operations and calibration manual.	____	____
11. Compared the results with the manufacturer's specifications and took appropriate action.	____	____
12. Tested the circuit for voltage presence.	____	____
13. Tagged the controller with the appropriate calibration sticker (including the name and testing date).	____	____
14. Reinstalled the controller.	____	____
15. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
16. Energized the circuit and ensured that it was operating properly.	____	____
17. Kept a record of results and actions taken.	____	____
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	TM 5-6115-593-12 TM 5-6115-593-34

Service a Meter

052-207-2125

Conditions: As a power plant instrument technician in a tactical or nontactical environment during scheduled maintenance or if a meter is suspected of being defective, you are given safety standing operating procedures (SOPs); a lockout and tagout kit; a multimeter; a relay test set with three-phase voltage, current capability, and manual; a variable frequency generator; an oscilloscope or digital equivalent; an electronic tool kit; appropriate equipment technical manuals and schematics; wiring diagrams; maintenance logbooks; and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE METER IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT CURRENT TRANSFORMERS ARE DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING THE METER. IF ENERGIZED, AN OPEN-CURRENT TRANSFORMER CIRCUIT WILL PRODUCE VERY HIGH VOLTAGES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING MODULES OR METERS ARE DE-ENERGIZED BEFORE SERVICING THE METER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH AND EQUIPMENT DAMAGE.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: Keep the work area neat and organized. Keep the meter and equipment stable while performing this task. Failure to comply may lead to unreliable test readings.

Standards: Service the meter safely. Test and calibrate the meter, and then reinstall or replace it. Test the meter according to the manufacturer's literature. Reinstall or replace the meter based on the test results.

Performance Steps
NOTES:

1. Some meters are usually tested with the associated transducer. The meter and transducer may come as a matched set and should be tested and replaced accordingly. Refer to the manufacturer's literature and equipment technical manuals for further information. For the purpose of this task, references to the meter include the transducer unless otherwise specified.

2. The low-voltage side of the potential transformer that supplies voltage to the module may be fuse-protected. To further isolate the circuit electrically and as an additional safety measure, this fuse may be removed. Check the appropriate schematics for verification.

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature with schematics and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify which circuit needs to be tested by using the appropriate schematics.
5. Perform lockout and tagout procedures.

Performance Steps

6. Test the circuit for voltage presence.
   a. Proceed to step 7 if there is no voltage present.
   b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
      (1) Check appropriate schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper use of safe-clearance procedures.
7. Remove the meter, and tag attached leads.
8. Inspect the meter for physical damage.
9. Test the meter according to the manufacturer's literature.
10. Compare the results with the manufacturer's specifications, and take appropriate action by calibrating or replacing the meter.
11. Test the circuit for voltage presence.
    a. Proceed to step 12 if there is no voltage present.
    b. Stop if there is voltage present, and perform the following checks until voltage is no longer present:
       (1) Check appropriate schematics for proper circuit identification.
       (2) Check for back-fed circuits.
       (3) Check for the proper use of safe-clearance procedures.
12. Tag the equipment with the appropriate calibration sticker (including the name and testing date).
13. Reinstall the meter.
    a. Attach tagged leads.
    b. Verify connections.
14. Close out lockout and tagout procedures by removing locking and tagging devices.
15. Energize the circuit, and check for proper meter operation.
16. Keep a record of results and actions taken.
17. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a meter.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature with schematics and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified which circuit needed to be tested using the appropriate schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage presence.	____	____

Performance Measures	GO	NO-GO
7. Removed the meter and tagged attached leads.	____	____
8. Inspected the meter for physical damage.	____	____
9. Tested the meter according to the manufacturer's literature.	____	____
10. Compared the results with the manufacturer's specifications and took appropriate action by calibrating or replacing the meter.	____	____
11. Tested the circuit for voltage presence.	____	____
12. Tagged the equipment with the appropriate calibration sticker (including the name and testing date).	____	____
13. Reinstalled the meter.	____	____
14. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
15. Energized the circuit and checked for proper meter operation.	____	____
16. Kept a record of results and actions taken.	____	____
17. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

Produce an Electronic Schematic

052-207-2126

Conditions: As a power station instrument technician in a tactical or nontactical environment tasked to produce an electronic schematic for an electronic system, you are given an electronic system.

Standards: Produce an electronic schematic that accurately depicts an electronic system.

Performance Steps

1. Determine which electronic system needs the electronic schematic.
2. Identify electronic components and protective devices within the electronic system.
3. Identify the correct electronic symbols for the components and protective devices for the electronic schematic.
4. Illustrate the electronic schematic.
   a. Organize the correct sequence of the electrical- and protective-device symbols.
   b. Determine the current path.
   c. Label the current path, amperage, voltage, and components.
5. Perform a complete system trace using the created electronic schematic to check for accuracy.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to produce an electronic schematic.

Performance Measures	GO	NO-GO
1. Determined which electronic system needed the electronic schematic.	____	____
2. Identified electronic components and protective devices within the electronic system.	____	____
3. Identified the correct electronic symbols for the components and protective devices for the electronic schematic.	____	____
4. Illustrated the electronic schematic.	____	____
5. Performed a complete system trace using the created electronic schematic to check for accuracy.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related
FM 55-509-1
INTRO CIRCUIT ANALYSIS
TM 5-811-1
TM 5-811-3

Subject Area 3: S2 Mechanical-Equipment Maintenance (Power Station) Tasks

Troubleshoot a Diesel Engine for a Misfiring Cylinder

052-205-2032

Conditions: As a power station mechanic in a tactical or nontactical environment when a diesel engine loses power, you are given a general mechanic's tool box, appropriate special tools, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER: REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Troubleshoot a diesel engine for a misfiring cylinder by identifying which cylinder is misfiring. Test the engine to verify what caused the malfunction, annotate the problem in the maintenance logbook, and annotate any uncorrectable malfunctions on DA Form 2404 or DA Form 5988-E.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment.
2. Identify the misfiring cylinder.
3. Determine what caused the malfunction.

NOTE: This list is meant to be a guideline and is not all-inclusive. Check for the most obvious and easily corrected problems first.

   a. Check for contaminated fuel at the misfiring cylinder or injector.
   b. Check for air restriction at the cylinder air inlet.
   c. Check for low compression on the misfiring cylinder.
   d. Check for incorrect injector timing.
   e. Check for low fuel or oil pressure at the misfiring cylinder.
   f. Check for incorrect exhaust valve adjustment and timing.
   g. Check for incorrect power assembly components.
   h. Check for a damaged power pack.

4. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
5. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a diesel engine for a misfiring cylinder.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
2. Identified the misfiring cylinder.	____	____
3. Determined what caused the malfunction.	____	____

Performance Measures	GO	NO-GO
4. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
5. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	TM 9-6115-604-12
DA FORM 5988-E	

Troubleshoot a Diesel Engine for Loss of Power

052-205-2034

Conditions: As a power station mechanic in a tactical or nontactical environment when a diesel engine cannot reach or maintain the desired revolutions per minute, you are given a lockout and tagout kit, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), a general mechanic's tool box, and the applicable manufacturer's literature.

DANGER:

1. ENSURE THAT BATTERIES ARE DISCONNECTED BEFORE SERVICING. APPLY SAFE CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY OR DEATH.

2. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

2. WHEN DISCONNECTING BATTERY CABLES, ALWAYS DISCONNECT THE NEGATIVE TERMINAL FIRST. WHEN RECONNECTING, CONNECT THE POSITIVE TERMINAL FIRST. FAILURE TO COMPLY MAY RESULT IN SPARKING AND CONSEQUENT BATTERY EXPLOSION AND MAY CAUSE IMMEDIATE INJURY OR EQUIPMENT DAMAGE.

3. DO NOT PERFORM MAINTENANCE ON THE ENGINE EXHAUST SYSTEM WHILE THE SYSTEM IS HOT. SERIOUS BURNS CAN RESULT. FAILURE TO COMPLY MAY CAUSE IMMEDIATE INJURY OR EQUIPMENT DAMAGE.

CAUTION: REPLACE FILTER ELEMENTS IN PAIRS TO PREVENT THE DETERIORATION OF REPLACEMENT PARTS. REPEATED FAILURE TO FOLLOW THE CORRECT PROCEDURES MAY CAUSE EQUIPMENT DAMAGE.

Standards: Troubleshoot a diesel engine for loss of power by identifying what caused the loss of power. Test the engine to verify what caused the malfunction, annotate the problem in the maintenance logbook.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment.
2. Determine what caused the malfunction.
   a. Check for fuel flow restriction.
   b. Check for high fuel temperature.
   c. Check for air in the fuel system.
   d. Check for a plugged fuel filter.
   e. Check for the incorrect fuel grade or poor-quality fuel.
   f. Check for incorrect timing.
   g. Check for positive crankcase pressure.
   h. Check for a faulty injector.

Performance Steps

i. Check for a high lubricating-oil level.
j. Determine if the engine is operating above the recommended altitude.
k. Check for engine overload.
l. Check the turbocharger operation.
m. Check for airflow restriction.

3. De-energize the circuit before applying safe-clearance procedures.
4. Perform lockout and tagout procedures.
5. Identify the malfunction.
6. Repair or replace defective components/parts when possible.

NOTE: If adverse environmental conditions prevent fault correction, refer to direct support for further repair.

7. Close out lockout and tagout procedures by removing locking and tagging devices.
8. Energize the circuit, and ensure that it is operating properly.
9. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
10. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a diesel engine for loss of power.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
2. Determined what caused the malfunction.	____	____
3. De-energized the circuit before applying safe-clearance procedures.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Identified the malfunction.	____	____
6. Repaired or replaced defective components/parts when possible.	____	____
7. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
8. Energized the circuit and ensured that it was operating properly.	____	____
9. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
10. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	TM 5-6115-456-34P
DA FORM 5988-E	TM 5-6115-593-12
	TM 5-6115-593-34
	TM 9-6115-604-12

Troubleshoot a Diesel Engine for Unusual Smoking

052-205-2035

Conditions: As a power station mechanic in a tactical or nontactical environment when unusual smoke is coming from the exhaust stack of a diesel engine, you are given the applicable manufacturer's literature, maintenance logbooks, a general mechanic's tool box, special manufacturer's tools, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER: REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Troubleshoot a diesel engine with unusual smoke coming from the exhaust stack. Test the engine to verify the cause of the smoke, and annotate the problem according to applicable manufacturer's literature.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment.
2. Identify the smoke color to determine the cause of the malfunction.
    a. Identify white or blue smoke, and determine that it indicates—

NOTE: White or blue smoke can indicate one or more of the following.

    (1) Incorrect fuel grade.
    (2) Incorrect oil grade.
    (3) Too much oil in the sump.

NOTE: Ensure that the fuel and oil grades are correct for extreme environmental conditions if applicable.

    b. Identify black smoke, and determine that it indicates—

NOTE: Black smoke can indicate one or more of the following.

    (1) Air restriction in the air filter or combustion chamber.
    (2) Faulty cylinder head or gasket.
    (3) Turbocharger malfunction.
    (4) Governor malfunction.
    (5) Crankcase breather restriction.
    (6) Fuel injector malfunction.
    (7) Incorrect valve timing.
    (8) Worn camshaft or bushings.

3. Repair or replace defective components when possible.
4. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
5. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a diesel engine for unusual smoking.

Performance Measures	GO	NO-GO
1. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
2. Identified the smoke color to determine the cause of the malfunction.	____	____
3. Repaired or replaced defective components when possible.	____	____
4. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
5. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	TM 9-6115-604-12
DA FORM 5988-E	

Service a Diesel Engine Cylinder Head

052-205-2100

Conditions: As a power station mechanic in a nontactical environment when a diesel engine cylinder head has been identified for service or symptoms of cylinder head faults occur, you are given a lockout and tagout kit, a general mechanic's tool box, torque wrenches, special tools, applicable technical manuals (TMs), the applicable manufacturer's literature, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. WHEN DISCONNECTING BATTERY CABLES, ALWAYS DISCONNECT THE NEGATIVE TERMINAL FIRST. WHEN RECONNECTING, CONNECT THE POSITIVE TERMINAL FIRST. FAILURE TO COMPLY MAY RESULT IN SPARKING OR BATTERY EXPLOSION AND MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. ENGINE SYSTEMS SHOULD BE ALLOWED TO COOL COMPLETELY BEFORE ATTEMPTING TO SERVICE THE INTERNAL COMPONENTS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY AND EQUIPMENT DAMAGE.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Service the cylinder head of a diesel engine by inspecting and replacing or repairing defective components/parts.

Performance Steps

1. Review maintenance logbooks and historical data for the equipment to verify that the diesel engine cylinder head needs to be serviced.
2. Perform lockout and tagout procedures.

NOTE: The following inspections and checks are guidelines and may be done in any order. If defective components/parts are found, replace, repair, or clean them as necessary.

3. Visually inspect the exterior of the cylinder head for obvious faults.
   a. Check for a cracked head.
   b. Check for loose or missing head bolts.
   c. Check for a bad gasket or seal.
   d. Check for a broken valve train.
   e. Check for a bent valve.
   f. Check for a broken rocker assembly.
4. Remove the cylinder head according to the manufacturer's literature.

WARNING: SPECIAL CARE SHOULD BE GIVEN WHEN REMOVING THE CYLINDER HEAD BECAUSE IT IS VERY HEAVY. SPECIAL LIFTING DEVICES OR, AT A MINIMUM, TWO PEOPLE

Performance Steps
SHOULD BE RESPONSIBLE FOR REMOVING THE CYLINDER HEAD. WHEN THE CYLINDER HEAD IS REMOVED, DO NOT PLACE IT FACE DOWN. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

5. Clean the cylinder head.
6. Inspect the cylinder head by measuring and inspecting it according to the manufacturer's literature.
7. Repair or replace the cylinder head, depending on the test results.
8. Reinstall the cylinder head according to the manufacturer's literature.
9. Refer to the manufacturer's literature for proper torque specifications and the correct torque sequence.
10. Close out lockout and tagout procedures by removing locking and tagging devices.
11. Start the unit, and observe it for proper operation.
12. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a diesel engine cylinder head.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data for the equipment to verify that the diesel engine cylinder head needed to be serviced.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Visually inspected the exterior of the cylinder head for obvious faults.	____	____
4. Removed the cylinder head according to the manufacturer's literature.	____	____
5. Cleaned the cylinder head.	____	____
6. Inspected the cylinder head by measuring and inspecting it according to the manufacturer's literature.	____	____
7. Repaired or replaced the cylinder head, depending on the test results.	____	____
8. Reinstalled the cylinder head according to the manufacturer's literature.	____	____
9. Referred to the manufacturer's literature for proper torque specifications and the correct torque sequence.	____	____
10. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
11. Started the unit and observed it for proper operation.	____	____
12. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	
DA FORM 5988-E	

Perform Electric Arc Welding

052-205-2104

Conditions: As a power station mechanic in a nontactical environment when a piece of metal must be welded and it is determined that electric arc welding is the best available method, you are given the appropriate technical manuals (TMs), a shielded metal arc welding (SMAW) machine, the applicable welding electrodes, an arc welder's 9 Lens shade helmet, leather gloves, a welder's leather cape and bib, a chipping hammer, a wire brush, work gloves, safety glasses, hearing protection, and a fire extinguisher.

DANGER:

1. EXTREME CAUTION SHOULD BE EXERCISED WHEN USING WELDING EQUIPMENT. INJURY CAN RESULT FROM FIRE, EXPLOSION, OR HARMFUL AGENTS GENERATED BY WELDING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE FLAMMABLE MATERIALS, SUCH AS BUTANE CIGARETTE LIGHTERS, FROM THE CUTTING AREA AND THE WELDER'S POCKETS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. PROTECTIVE GUARDS, COVERS, AND INSULATORS MUST BE MAINTAINED IN THEIR PROPER POSITIONS AND CONDITION. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. IF THE WELDER MUST LEAN, SIT, OR KNEEL ON THE WORKTABLE DURING THE WELDING PROCESS, A NONCONDUCTIVE, FIRE-RESISTANT INSULATING PAD SHOULD BE USED BETWEEN THE WELDER AND THE MATERIAL. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. ENSURE THAT WELDING OCCURS IN AN ADEQUATELY VENTILATED AREA. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: WELDING BY PRIME POWER MECHANICS IS INTENDED TO SUPPORT NONCRITICAL WELDS USED IN THE INSTALLATION AND MAINTENANCE OF PRIME POWER GENERATION EQUIPMENT. WELDING OF CRITICAL WELDS USED TO LIFT EQUIPMENT SHOULD BE DEFERRED TO PROFESSIONAL WELDERS POSSESSING THE SPECIAL EQUIPMENT AND QUALIFICATIONS TO PERFORM, TEST, AND CERTIFY THOSE WELDS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE INJURY TO PERSONNEL AND EQUIPMENT DAMAGE.

Standards: Perform electric arc welding in a manner that will safely fuse the metal together to provide enough strength to match or exceed the original tensile strength of the base metal or original configuration.

Performance Steps
NOTE: This task is to be performed with SMAW equipment, not metal inert gas (MIG) or tungsten inert gas (TIG) welding equipment.

1. Identify the characteristics of ferrous components and materials.
2. Prepare the welding area and the items to be welded.
   a. Inspect the welding area for readily combustible material, and clear the area of combustible material.
   b. Position the material or item to be welded in a safe location.
      (1) Ensure that no material is placed directly on concrete or asphalt floors or near flammable materials.
      (2) Ensure that only the items to be welded receive the arc.
      (3) Ensure that sparks and other hot items are diverted away from potential hazards.

Performance Steps

3. Inspect the welding machine to ensure that protective guards, covers, and insulators are in the proper position and in good material condition.
4. Select the proper welding electrode type and size.
   a. Consider the nature of the base metal.
   b. Consider the position to be welded.
   c. Consider the type of welding machine available.
5. Select the proper current (alternating-current [AC] or direct-current [DC]) and the proper current polarity (DC negative electrode or DC positive electrode).
   a. Consider the nature of the base metal.
   b. Consider the position to be welded.
   c. Consider the type of welding machine available.
6. Determine the approximate welding amperage required.
   a. Consider the nature of the base metal.
   b. Consider the position to be welded.
   c. Consider the type and size of the electrodes.
7. Energize the welding machine, and adjust the amperage.
   a. Perform a test weld on a metal similar to the metal being welded.
   b. Adjust the welding amperage to produce suitable weld beads.
8. Perform one or more SMAW weld types, depending on the items to be welded.
   a. Perform butt welds.
   b. Perform inside corner welds.
   c. Perform outside corner welds in flat.
   d. Perform out-of-position orientation welds.
9. Inspect the weld for proper penetration.
10. Shut down and properly store the welding equipment.
    a. Shut off the power switch to the welding machine.
    b. De-energize the breaker to the welder if present.
    c. Coil electrode cables, and store them in a secure location to prevent damage.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform electric arc welding.

Performance Measures	**GO**	**NO-GO**
1. Identified the characteristics of ferrous components and materials.	____	____
2. Prepared the welding area and the items to be welded.	____	____
3. Inspected the welding machine to ensure that protective guards, covers, and insulators were in the proper position and good material condition.	____	____
4. Selected the proper welding electrode type and size.	____	____
5. Selected the proper current (AC or DC) and the proper current polarity (DC negative electrode or DC positive electrode).	____	____
6. Determined the approximate welding amperage required.	____	____

Performance Measures	GO	NO-GO
7. Energized the welding machine and adjusted the amperage.	____	____
8. Performed one or more SMAW weld types, depending on the items to be welded.	____	____
9. Inspected the weld for proper penetration.	____	____
10. Shut down and properly stored the welding equipment.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	TC 9-510

Perform Oxyfuel Cutting

052-205-2105

Conditions: As a power station mechanic in a nontactical environment when the oxyfuel cutting method must be used, you are given the applicable manufacturer's literature, an oxyacetylene welding set with hoses, acetylene and oxygen cylinders, regulators with pressure gauges, an oxyacetylene cutting torch, an applicable cutting tip sized to the metal being cut, a soapstone marker pencil, a spark igniter, a welder's wrench, Shade 5 lens welding goggles, work gloves, safety glasses, a fire extinguisher, manufacturers literature, and an item to be cut.

DANGER:

1. EXTREME CAUTION SHOULD BE EXERCISED WHEN USING ANY TYPE OF CUTTING EQUIPMENT. INJURY CAN RESULT FROM FIRE, EXPLOSION, OR HARMFUL AGENTS GENERATED BY THE CUTTING PROCESS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE FLAMMABLE MATERIALS, SUCH AS BUTANE CIGARETTE LIGHTERS, FROM THE CUTTING AREA AND THE WELDER'S POCKETS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT THE ACETYLENE OPERATING PRESSURE NEVER EXCEEDS 7 POUNDS PER SQUARE INCH. ACETYLENE IS A POTENTIALLY UNSTABLE GAS AT ELEVATED PRESSURES. ACETYLENE ABOVE 15 POUNDS PER SQUARE INCH CAN CHEMICALLY BREAK DOWN AND EXPLODE IF SUBJECTED TO HEAT OR SHOCK. ACETYLENE ABOVE 29.4 POUNDS PER SQUARE INCH WILL SPONTANEOUSLY COMBUST WITHOUT OUTSIDE FORCE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. ENSURE THAT THERE ARE NO FAULTY REGULATORS. FAULTY REGULATORS MAY ALLOW ACETYLENE TO BE PRESSURIZED ABOVE ITS UNSTABLE POINT AND DETONATE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. ENSURE THAT CUTTING OCCURS IN AN ADEQUATELY VENTILATED AREA. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

6. USE EXTREME CAUTION WHEN HANDLING COMPRESSED GASES. ACCIDENTAL REMOVAL OF THE REGULATOR COULD TURN THE TANK INTO A POTENTIALLY LETHAL PROJECTILE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. DO NOT CUT DIRECTLY ON CONCRETE OR ASPHALT. CONCRETE WILL POP AND SPALL AND ASPHALT WILL IGNITE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. CUTTING PRESSURES ARE SPECIFIC TO TIP SIZE AND VARY GREATLY. IMPROPER GAS PRESSURES WILL GREATLY AND ADVERSELY AFFECT THE ABILITY OF THE EQUIPMENT TO CUT AND THE QUALITY OF THE CUT MADE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

3. THE ACETYLENE TANK VALVE SHOULD ONLY BE OPENED APPROXIMATELY ONE-QUARTER TO ONE-HALF TURN TO ALLOW THE TANK TO BE SHUT OFF RAPIDLY IF A MALFUNCTION OCCURS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Use the materials provided, and safely cut the metal into the shape required. Ensure that the cut penetrates through the metal and is smooth enough to prevent the need for excessive grinding.

Performance Steps

1. Prepare the cutting area and the material to be cut.
    a. Inspect and clear the cutting area of any readily combustible material.
    b. Position the material to be cut in a safe location.
    c. Draw the pattern to be cut on the material.

2. Inspect oxyacetylene equipment.
    a. Inspect the welding equipment to ensure that there are no obvious deficiencies.
    b. Ensure that tanks are secured by a retaining chain.
    c. Verify that nonreturn valves are installed.

NOTE: Nonreturn valves must be installed at the torch handle and hoses connection. Optional nonreturn valves may be connected on the hoses and regulator connections.

    d. Back out both oxygen and acetylene pressure setscrews counterclockwise until no resistance is felt.

DANGER: FAILURE TO BACK OUT THE OXYGEN AND ACETYLENE PRESSURE SETSCREWS MAY CAUSE THE ACETYLENE TO BE PRESSURIZED BEYOND ITS STABILITY POINT OF 15 POUNDS PER SQUARE INCH AND DETONATE UPON OPENING THE TANK MAIN SUPPLY VALVES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

    e. Determine the cutting tip size, as needed, for the brand of cutting torch being used and based on the thickness of the steel being cut, and determine the required cutting pressures for acetylene and oxygen.

WARNING: AN ACETYLENE REGULATOR IS DEFECTIVE IF IT SHOWS SIGNS OF CREEPING OR A STEADY RISE IN PRESSURE ON THE PRESSURE GAUGE. A SINGLE MOMENTARY RISE IN PRESSURE UP TO 1 POUND PER SQUARE INCH IS ACCEPTABLE WHEN SHUTTING THE FLOW OF THE GAS AT THE TORCH. A CREEPING ACETYLENE GAUGE WILL ALLOW THE ACETYLENE PRESSURE TO RISE TO A LEVEL THAT WILL CAUSE SPONTANEOUS DETONATION OF THE ACETYLENE IN THE HOSE AND REGULATOR. FAILURE TO COMPLY MAY RESULT IN IMMEDIATE PERSONAL INJURY AND EQUIPMENT DAMAGE.

3. Prepare the torch for lighting.
    a. Open the torch oxygen valve on the cutting torch.

NOTE: On combination welding and cutting-torch assemblies that are screwed together in the middle, two oxygen valves will be present. Open both valves.

DANGER: WHILE OPENING THE TANK SUPPLY VALVES ON THE REGULATOR, PERSONNEL SHOULD STAND TO THE SIDE OF THE REGULATOR FACE. FAULTY REGULATORS MAY DETONATE INTERNALLY, PROJECTING THE REGULATOR FACE OUTWARD. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

    b. Standing to the side of the oxygen regulator, slowly open the oxygen tank valve about one-quarter to one-half turn until the dial on the high-pressure gauge moves, indicating tank pressure.
        (1) Monitor the high- and low-pressure regulator for signs of malfunction.
        (2) Open the oxygen supply valve fully if there are no signs of problems.

NOTE: Fully opening the oxygen valve will cause it to back-seat against a stem seal in order to prevent valve stem pressure leaks while in operation.

    c. Adjust the oxygen regulator working pressure, as necessary, for cutting.

NOTES:

1. See the manufacturer's literature to determine the proper pressure for the cutting torch tip size being used. The size is indicated on the side of the cutting tip.

2. Oxygen gas will flow out of the torch tip while the working pressure is being adjusted. The open flow will allow proper adjustment in the flowing condition and purge the oxygen hose to obtain a

Performance Steps
pure supply to the torch.

d. Close both torch oxygen valves after 10 seconds of gas flow.
e. Open the torch acetylene valve.
f. Stand to the side of the regulator, and slowly open the tank valve about one-quarter to one-half turn until the dial on the high-pressure gauge moves, indicating tank pressure.

WARNING: THE ACETYLENE SHOULD ONLY BE OPENED ABOUT ONE-QUARTER TO ONE-HALF TURN TO ALLOW THE TANK TO BE SHUT OFF RAPIDLY IN THE EVENT OF A MALFUNCTION. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY AND EQUIPMENT DAMAGE.

g. Adjust the acetylene regulator working pressure, as necessary, for cutting.

NOTES:

1. Acetylene gas will flow out of the torch tip while the working pressure is being adjusted. The open flow will allow proper adjustment in the flowing condition and purge the acetylene hose to obtain a pure supply to the torch.

2. Refer to the manufacturer's literature to determine the appropriate pressure for the cutting torch tip size being used. The tip size is indicated on the side of the cutting tip.

h. Shut off the torch acetylene valve after 10 seconds of gas flow.
i. Monitor the low-pressure regulator gauge for any sign of a malfunction.

4. Light and adjust the torch flame.
   a. Open fully the oxygen valve that is nearest to the hose connection.
   b. Open only the acetylene torch valve, and light the torch with the spark lighter. Quickly cut in oxygen to reduce soot.
   c. Progressively add acetylene and oxygen until the acetylene valve no longer increases flame size.
   d. Make a final torch adjustment using the oxygen valve nearest to the cutting tip to adjust the preheat flame, and adjust the oxygen flow to remove the blue feather flame, leaving only the small blue tips of the flame at the torch tip.
   e. Depress the oxygen lever to ensure that the oxygen lance flow does not disrupt the preheat flame.

5. Cut the material using the correct cutting techniques.

6. Shut down and properly store the cutting equipment.
   a. Close the torch oxygen valve first, and then close the torch acetylene valve.
   b. Shut off tank supply valves.
   c. Bleed the oxygen from the hose by opening both oxygen torch valves and then closing both oxygen torch valves.
   d. Bleed the acetylene from the hose by opening the torch acetylene valve and then closing the acetylene valve.
   e. Back out the oxygen and acetylene regulator pressure setscrews counterclockwise until no resistance is felt.
   f. Place the torch in a secure location to prevent damage.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform oxyfuel cutting.

Performance Measures	GO	NO-GO
1. Prepared the cutting area and the material to be cut.	____	____
2. Inspected oxyacetylene equipment.	____	____
3. Prepared the torch for lighting.	____	____
4. Lit and adjusted the torch flame.	____	____
5. Cut the material using the correct cutting techniques.	____	____
6. Shut down and properly stored the cutting equipment.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	TC 9-510

Service a Piping System

052-205-2109

Conditions: As a power station mechanic in a nontactical environment when maintenance on general piping systems is required, you are given TM 5-551K, the applicable equipment-specific TMs, a general mechanic's tool box, specialized piping system maintenance and repair tools, maintenance logbooks, DA Form 2404 (Equipment Maintenance and Inspection Worksheet) or DA Form 5988-E (Equipment Maintenance Inspection Worksheet), and a lockout and tagout kit.

DANGER:

1. ENSURE THAT THE SECTION OF THE PIPING SYSTEM BEING SERVICED IS PROPERLY ISOLATED, LOCKED OUT, TAGGED OUT, DEPRESSURIZED, AND DRAINED BEFORE BEGINNING MAINTENANCE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT ELECTRICAL POWER TO THE PUMPING UNIT IS DE-ENERGIZED, LOCKED OUT, AND TAGGED OUT BEFORE SERVICING THE CONTROLLER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: ENSURE THAT THE VALVE IS IN THE OPEN POSITION WITH THE VALVE SEALING FACE BACKED OFF ITS SEAT BEFORE TIGHTENING THE VALVE. DAMAGE TO THE VALVE WILL RESULT IF THE BONNET IS TIGHTENED WITH THE VALVE SEATED IN THE CLOSED POSITION.

Standards: Service a piping system to ensure that fluid distribution systems operate within established standards.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the piping system needs to be serviced.
2. Ensure that service tools and parts are on hand before servicing the system.
   a. Ensure that the appropriate TMs are on hand.
   b. Ensure that a general mechanic's tool box is on hand.
   c. Ensure that specialized piping system maintenance and repair tools are on hand.
   d. Ensure that the replacement fluids needed to put the system back into service when maintenance is complete are on hand.
3. Perform safety requirements before servicing or repairing the piping system.
   a. Shut down the section to be serviced or repaired from the rest of the system.
   b. Isolate the section to be serviced or repaired from the rest of the system.
   c. Perform lockout and tagout procedures.
   d. Depressurize and drain the affected portion of the system.
4. Inspect pump or compressor drive mechanisms for signs of loose mounting bolts, deteriorated couplings, loose fittings, and leakage.
5. Inspect drive belts between the motor and pump or compressor for dry rotting, cracking, and glazing.
6. Inspect the motor and pump or compressor sheave alignment using a straightedge along the outside edge of the sheave to ensure that the motor and pump or compressor have not slipped out of alignment.
7. Inspect the belt tension by deflecting the belt one belt thickness for every 48 inches of unsupported length, using your thumb to apply moderate pressure.
8. Replace belt sets, if necessary, as a complete set.

Performance Steps

9. Inspect compressor lubrication fluid levels.
10. Observe several pumping-mechanism cycles of operation.
    a. Ensure that the unit starts properly and comes up to speed, indicating that the unloaders are working properly.
    b. Ensure that the pumping mechanism is capable of bringing the system to its designed working pressure within the time parameters.
    c. Ensure that the system shuts down properly, with the unloaders properly depressurizing the pump or compressor.
    d. Ensure that the pumping mechanism cycles on and off at the pressures specified in the appropriate TM.
    e. Check the cycle time between the end of one cycle and the beginning of the next on the system with no usage demands, which will establish if there are internal or external leaks that need to be corrected.
11. Check the piping system for leaks by pressurizing the system to its full working pressure, and perform a full system trace.
    a. Remove vault covers or piping protectors to gain visual access to the portions of the aboveground piping.
    b. Closely inspect connections.
    c. Closely inspect valves.
        (1) Cycle each valve fully opened and closed.
        (2) Adjust the stem packing to produce moderate resistance while turning it to ensure leak tightness around the stem.
        (3) Tighten valve bonnets if any leakage is indicated on the valve body.

WARNING: ENSURE THAT THE VALVE IS IN THE OPEN POSITION WITH THE VALVE SEALING FACE BACKED OFF ITS SEAT BEFORE TIGHTENING THE VALVE. DAMAGE TO THE VALVE WILL RESULT IF THE BONNET IS TIGHTENED WITH THE VALVE SEATED IN THE CLOSED POSITION.

12. Drain condensation from the volume tanks and in-line water separators on compressed air systems.
13. Verify that automated condensation drain systems are clean and working as designed.
14. Replace inoperative drain systems.
15. Clean filters and strainers on the incoming sides of pumps or compressors.
16. Replace filters that cannot be cleaned.
17. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a piping system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the piping system needed to be serviced.	____	____
2. Ensured that service tools and parts were on hand before servicing the system.	____	____
3. Performed safety requirements before servicing or repairing the piping system.	____	____

Performance Measures	GO	NO-GO
4. Inspected pump or compressor drive mechanisms for signs of loose mounting bolts, deteriorated couplings, loose fittings, and leakage.	____	____
5. Inspected drive belts between the motor and pump or compressor for dry rotting, cracking, and glazing.	____	____
6. Inspected the motor and pump or compressor sheave alignment using a straightedge along the outside edge of the sheave to ensure that the motor and pump or compressor had not slipped out of alignment.	____	____
7. Inspected the belt tension by deflecting the belt one belt thickness for every 48 inches of unsupported length, using your thumb to apply moderate pressure.	____	____
8. Replaced belt sets, if necessary, as a complete set.	____	____
9. Inspected compressor lubrication fluid levels.	____	____
10. Observed several pumping-mechanism cycles of operation.	____	____
11. Checked the piping system for leaks by pressurizing the system to its full working pressure and performed a full system trace.	____	____
12. Drained condensation from the volume tanks and in-line water separators on compressed air systems.	____	____
13. Verified that automated condensation drain systems were clean and working as designed.	____	____
14. Replaced inoperative drain systems.	____	____
15. Cleaned filters and strainers on the incoming sides of pumps or compressors.	____	____
16. Replaced the filters that could not be cleaned.	____	____
17. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	FM 3-34.471
TM 5-551K	

Service a Diesel Engine Lube Oil System

052-205-2110

Conditions: As a power station mechanic in a nontactical environment when a diesel engine lube oil system has been identified for service or symptoms of lube oil system faults occur, you are given a lockout and tagout kit, a general mechanic's tool box, a filter wrench, the applicable technical manuals (TMs), the applicable manufacturer's literature, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. WHEN DISCONNECTING BATTERY CABLES, ALWAYS DISCONNECT THE NEGATIVE TERMINAL FIRST. WHEN RECONNECTING, CONNECT THE POSITIVE TERMINAL FIRST. FAILURE TO COMPLY MAY RESULT IN SPARKING OR BATTERY EXPLOSION AND MAY CAUSE IMMEDIATE PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT.

2. ENGINE OIL GETS VERY HOT DURING OPERATION. DO NOT REMOVE ANY OIL OR LUBE OIL COMPONENTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

Standards: Service a diesel engine lube oil system by inspecting and replacing or repairing the defective components/parts.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the diesel engine lube oil system needs to be serviced.
2. Perform lockout and tagout procedures.

NOTE: The following inspections and checks are guidelines and may be done in any order. If defective components/parts are found, replace or repair them as necessary.

3. Inspect the oil level.
4. Check oil viscosity and color.

NOTE: If oil contamination is suspected and a Joint Oil Analysis Program (JOAP) is not readily available, change the oil and filters. It is preferred that a JOAP be conducted before putting the unit back into operation to ensure the worthiness of the oil.

5. Check oil filters and filter housings.
6. Check the filter bypass and differential bypasses.
7. Check oil lines and oil rifles if needed.
8. Check the oil sump or oil pan seal for cleanliness and leaks.
9. Ensure that the oil pump is secure, inlet screen is clear, gear teeth are in good condition, and backlash is within tolerance.
10. Close out lockout and tagout procedures by removing locking and tagging devices.
11. Start the unit, and observe it for proper operation.
12. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a diesel engine lube oil system.

Performance Measures	GO	NO-GO
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the diesel engine lube oil system needed to be serviced.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Inspected the oil level.	____	____
4. Checked oil viscosity and color.	____	____
5. Checked oil filters and filter housings.	____	____
6. Checked the filter bypass and differential bypasses.	____	____
7. Checked oil lines and oil rifles if needed.	____	____
8. Checked the oil sump or oil pan seal for cleanliness and leaks.	____	____
9. Ensured that the oil pump was secure, inlet screen was clear, gear teeth were in good condition, and backlash was within tolerance.	____	____
10. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
11. Started the unit and observed it for proper operation.	____	____
12. Recorded actions taken on DA Form 2404 and DA Form 5988-E and maintenance logbooks.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	
DA FORM 5988-E	

Service a Diesel Engine Cooling System

052-205-2111

Conditions: As a power station mechanic in a nontactical environment when a diesel engine cooling system shows symptoms of faults, you are given a hydrometer, a filter wrench, a lockout and tagout kit, a general mechanic's tool box, the applicable technical manuals (TMs), the applicable manufacturer's literature, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. ENSURE THAT THE EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. WHEN DISCONNECTING BATTERY CABLES, ALWAYS DISCONNECT THE NEGATIVE TERMINAL FIRST. WHEN RECONNECTING, CONNECT THE POSITIVE TERMINAL FIRST. FAILURE TO COMPLY MAY RESULT IN SPARKING AND CONSEQUENT BATTERY EXPLOSION AND MAY CAUSE IMMEDIATE PERSONAL INJURY OR DAMAGE TO EQUIPMENT.

2. THE RADIATOR GETS VERY HOT DURING OPERATION. DO NOT REMOVE THE RADIATOR CAP UNTIL THE RADIATOR HAS REACHED A POINT WHERE THERE IS NO STEAM PRESSURE BUILDUP. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION: REPLACE FILTER ELEMENTS IN PAIRS TO PREVENT DETERIORATION OF REPLACEMENT PARTS. REPEATED FAILURE TO FOLLOW THE CORRECT PROCEDURES MAY CAUSE EQUIPMENT DAMAGE.

Standards: Service a diesel engine cooling system by inspecting and replacing or repairing the defective components/parts.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the diesel engine cooling system needs to be serviced.
2. Perform lockout and tagout procedures.

NOTE: The following inspections and checks are guidelines and may be done in any order. If defective components/parts are found, replace or repair them as necessary.

3. Inspect the water pump.
   a. Check for secure installation.
   b. Check for obvious damage.
   c. Check for signs of leakage.
   d. Check the weep hole for leaks.
4. Inspect the radiator cap for signs of rust, a degraded seal, and leaks.

NOTE: There are no coolant filters on a mobile electric power (MEP)-810A, MEP-810B, or MEP-36A generator.

5. Inspect the coolant filter for damage, leaks, and a secure mounting.
6. Inspect radiator pipes, hoses, and clamps for security, signs of rust, and other signs of leakage.

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7. Inspect the sight gauge for damage, leaks, and a secure mounting.
8. Inspect radiator fans.
9. Inspect the fan belt for tension and signs of excessive wear (glazing, dry rotting, fraying).
10. Inspect the radiator.
    a. Check for leaks or damage.
    b. Use a strong light to examine the core from the front and back side of the radiator.

NOTE: If damage is found to the radiator core, refer it to the next higher maintenance level.

11. Check the coolant for the proper antifreeze level, and add coolant or additives as needed.

NOTE: Different units and units at different locations require different types of coolant or different mixes of coolant. Refer to the appropriate TM for the correct type of coolant.

12. Close out lockout and tagout procedures by removing locking and tagging devices.
13. Start the unit, and observe it for proper operation.
14. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a diesel engine cooling system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the diesel engine cooling system needed to be serviced.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Inspected the water pump.	____	____
4. Inspected the radiator cap for signs of rust, a degraded seal, and leaks.	____	____
5. Inspected the coolant filter for damage, leaks, and a secure mounting.	____	____
6. Inspected radiator pipes, hoses, and clamps for security, signs of rust, and other signs of leakage.	____	____
7. Inspected the sight gauge for damage, leaks, and a secure mounting.	____	____
8. Inspected radiator fans.	____	____
9. Inspected the fan belt for tension and signs of excessive wear (glazing, dry rotting, fraying).	____	____
10. Inspected the radiator.	____	____
11. Checked the coolant for the proper antifreeze level and added coolant or additives as needed.	____	____
12. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____

Performance Measures	GO	NO-GO
13. Started the unit and observed it for proper operation.	____	____
14. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	TM 9-6115-604-12
DA FORM 5988-E	

Service an Engine Air Intake and/or Exhaust System

052-205-2113

Conditions: As a power station mechanic in a tactical or nontactical environment when a engine air intake and/or exhaust system is identified for service or symptoms of air intake and/or exhaust system faults occur, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable technical manuals (TMs), the applicable manufacturer's literature, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. WHEN DISCONNECTING BATTERY CABLES, ALWAYS DISCONNECT THE NEGATIVE TERMINAL FIRST. WHEN RECONNECTING, CONNECT THE POSITIVE TERMINAL FIRST. FAILURE TO COMPLY MAY RESULT IN SPARKING OR BATTERY EXPLOSION AND MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. THE ENGINE EXHAUST SYSTEM CAN REACH TEMPERATURES ABOVE 2,000°F. DO NOT REMOVE EXHAUST SYSTEM COMPONENTS/PARTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Service an engine air intake system and/or exhaust system by inspecting and replacing or repairing faulty components/parts.

Performance Steps
NOTE: The following inspections and checks are guidelines and may be done in any order. Replace, repair, or clean defective components/parts as necessary.

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the air intake and/or exhaust system needs to be serviced.
2. Perform lockout and tagout procedures.
3. Inspect air filters.
   a. Clean oil bath filters with solvent, and ensure that the solvent is completely removed before putting the filter back into service.
   b. Use compressed air to clean paper filters from the inside out.

WARNING: WHEN CLEANING THE FILTERS WITH AN AIR COMPRESSOR, WEAR EYE PROTECTION AND DO NOT EXCEED MORE THAN 15 POUNDS PER SQUARE INCH. FAILURE TO COMPLY MAY CAUSE THE AIR FILTER ELEMENT TO BE DAMAGED.

   c. Clean cotton filters according to the manufacturer's literature.
4. Inspect the air filter housing.
5. Inspect air restriction indicators.
6. Ensure that air intake mechanisms are clean and serviceable.
   a. Check the cyclonic air intake.

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b. Check dust boots.
c. Check the piping.

7. Check for air leaks in the air box and intake manifold.
8. Inspect the exhaust manifold for cracks and leaks.
9. Inspect mufflers for cracked welds and leaks.
10. Inspect the turbocharger or air blower.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Start the unit, and observe it for proper operation.
13. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an engine air intake and/or exhaust system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the air intake and/or exhaust system needed to be serviced.	____	____
2. Performed lockout and tagout procedures	____	____
3. Inspected air filters.	____	____
4. Inspected the air filter housing.	____	____
5. Inspected air restriction indicators.	____	____
6. Ensured that air intake mechanisms were clean and serviceable.	____	____
7. Checked for air leaks in the air box and intake manifold.	____	____
8. Inspected the exhaust manifold for cracks and leaks.	____	____
9. Inspected mufflers for cracked welds and leaks.	____	____
10. Inspected the turbocharger or air blower.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Started the unit and observed it for proper operation.	____	____
13. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	
DA FORM 5988-E	

Troubleshoot the Cause of an Unexpected Shutdown of a Diesel Engine

052-205-2116

Conditions: As a power station mechanic in a tactical or nontactical environment when an unexpected shutdown of a diesel engine occurs, you are given the applicable manufacturer's literature, a general mechanic's tool box, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and a lockout and tagout kit.

DANGER:

1. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Troubleshoot a diesel engine for an unexpected shutdown by identifying the cause, testing the engine according to the applicable manufacturer's literature, and annotating the problem.

Performance Steps
NOTE: This task follows the assumption that all relays and fuses are in good working condition.

1. Review maintenance logbooks, manufacturer's literature, and historical data pertaining to the equipment.
2. Identify the cause of the diesel engine shutdown.
   a. Check for low oil pressure caused by one or more of the following:
      (1) Low oil level.
      (2) Thick oil.
      (3) Faulty oil pressure sensor.
   b. Check for high coolant temperature caused by one or more of the following:
      (1) Clogged radiator.
      (2) Faulty radiator fans.
      (3) Low coolant level.
      (4) High coolant temperature.
   c. Check for low fuel pressure caused by one or more of the following:
      (1) Air in the fuel lines.
      (2) Low fuel level.
   d. Check for low boost pressure.
   e. Check for overspeed due to switch or sensor malfunction.
   f. Check for low hydraulic pressure.
   g. Check for wiring harnesses that are not connected correctly.

NOTE: Check for warning or shutdown lights on the equipment being used.

   h. Check for catastrophic engine failure that caused a broken rod, piston, valve, timing gear, or train.
3. Perform on-site corrections when possible.
4. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
5. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot the cause of an unexpected shutdown of a diesel engine.

Performance Measures	GO	NO-GO
1. Reviewed maintenance logbooks, manufacturer's literature, and historical data pertaining to the equipment.	____	____
2. Identified the cause of the diesel engine shutdown.	____	____
3. Performed on-site corrections when possible.	____	____
4. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
5. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Troubleshoot an Engine Failure to Start

052-205-2118

Conditions: As a power station mechanic in a tactical or nontactical environment when a diesel engine fails to start, you are given the applicable manufacturer's literature, a general mechanic's tool box, a multimeter, a Caterpillar™ electronic technician (ET) tool, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and a lockout and tagout kit.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT THE EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Troubleshoot an engine failure to start by identifying the cause by testing it as specified in the manufacturer's literature for the particular diesel engine.

Performance Steps
NOTE: This task follows the assumption that that all relays and fuses are in good working condition.

1. Review maintenance logbooks, manufacturer's literature, and historical data pertaining to the equipment.
2. Identify warning lights on the generator set through visual inspection.
3. Connect the Caterpillar ET tool and hardware to the engine, and run a diagnostic test if the engine is equipped with an electronic troubleshooting system.
4. Check the engine starter.

NOTE: Checking the voltage and current draw at the starter eliminates troubleshooting from the battery to the starter.

   a. Check the voltage.
   b. Perform a current draw test.

5. Determine what caused the malfunction.
   a. Check for a closed fuel valve.
   b. Check fuel filters.
   c. Check for slow engine-cranking speed.
   d. Check for air in the fuel.
   e. Check for incorrect fuel grade or poor fuel quality.
   f. Check for excessive fuel inlet restriction.
   g. Check the overspeed trip device.
   h. Check for open exhaust valves.
   i. Ensure that reset buttons have been reset.
   j. Check injector operation and timing.
   k. Check for incorrect power assembly components.
   l. Check for starter malfunction.
      (1) Check electrical connections.
      (2) Test the solenoid.

Performance Steps

m. Check electrical harnesses and connections for loose connections or cable corrosion.

6. Perform corrections on-site when possible.
7. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot an engine failure to start.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks, manufacturer's literature, and historical data pertaining to the equipment.	____	____
2. Identified warning lights on the generator set through visual inspection.	____	____
3. Connected the Caterpillar ET tool and hardware to the engine and ran a diagnostic test if the engine was equipped with an electronic troubleshooting system.	____	____
4. Checked the engine starter.	____	____
5. Determined what caused the malfunction.	____	____
6. Performed corrections on-site when possible.	____	____
7. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	TM 9-6115-604-12

Replace a Diesel Engine Piston Assembly

052-205-2119

Conditions: As a power station mechanic in a tactical or nontactical situation when a diesel engine piston assembly has been identified for replacement, you are given a lockout and tagout kit, a general mechanic's tool box, special tools, the applicable manufacturer's literature, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. ENSURE THAT BATTERIES ARE DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO THE ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND OPERATION OF DIESEL ENGINES AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION:

1. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

2. DO NOT REMOVE THE CYLINDER HEADS WITHOUT REMOVING THE INJECTORS. DAMAGE TO THE INJECTOR TIP CAN OCCUR DURING THE REMOVAL OF THE CYLINDER HEAD OR SUBSEQUENT HANDLING. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE.

3. DO NOT USE A CONNECTING ROD THAT IS NICKED OR CUT, OR HAS ANY SIGNS OF DAMAGE ALONG THE RIBBED SURFACES. CONNECTING RODS DAMAGED IN THIS MANNER ARE SUBJECT TO FAILURE. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE.

4. TO AVOID PISTON DAMAGE, DO NOT DRIVE, PRESS, OR FORCE A PISTON PIN FROM THE PISTON. REMOVE THE PISTON PIN USING THUMB PRESSURE ONLY. IF THE PISTON PIN IS DIFFICULT TO REMOVE, HEAT THE PISTON IN HOT WATER OR FOR 15 MINUTES IN AN OVEN SET TO A MAXIMUM TEMPERATURE OF 210°F. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE.

5. TO AVOID DAMAGE TO THE UPPER, MAIN BEARING SHELLS DURING INSTALLATION, TWO TECHNICIANS ARE REQUIRED. ENSURE THAT BEARING SHELLS ARE NOT INTERCHANGED. THE UPPER MAIN BEARING SHELLS HAVE DRILLED HOLES THAT ALLOW LUBRICATING OIL PASSAGE AND MUST BE INSTALLED IN THE CYLINDER BLOCK. IF THE LOWER UNDRILLED BEARING SHELL IS INSTALLED IN THE BLOCK, SEVERE CRANKSHAFT DAMAGE WILL OCCUR. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE.

Standards: Replace a diesel engine piston assembly safely and as specified in the applicable manufacturer's literature.

Performance Steps

1. Perform lockout and tagout procedures.
2. Remove the cylinder head.
3. Remove inspection covers.

Performance Steps

4. Remove the piston assembly.
5. Disassemble the piston and connecting rod.
6. Remove connecting rod bearings.
7. Remove main bearings.
8. Remove the cylinder liner and seals.
9. Inspect the piston and connecting rod assembly.
10. Inspect connecting rod bearings.
11. Inspect the crankshaft journal.
12. Inspect main bearings.
13. Inspect the cylinder liner and seals.
14. Repair defective parts.
15. Replace parts that cannot be repaired.
16. Reassemble the piston and connecting rod.
17. Close out lockout and tagout procedures by removing locking and tagging devices.
18. Operate the prime mover and check for proper operation.
19. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
20. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to replace a diesel engine piston assembly.

Performance Measures	**GO**	**NO-GO**
1. Performed lockout and tagout procedures.	____	____
2. Removed the cylinder head.	____	____
3. Removed inspection covers.	____	____
4. Removed the piston assembly.	____	____
5. Disassembled the piston and connecting rod.	____	____
6. Removed connecting rod bearings.	____	____
7. Removed main bearings.	____	____
8. Removed the cylinder liner and seals.	____	____
9. Inspected the piston and connecting rod assembly.	____	____
10. Inspected connecting rod bearings.	____	____

Performance Measures	GO	NO-GO
11. Inspected the crankshaft journal.	____	____
12. Inspected main bearings.	____	____
13. Inspected the cylinder liner and seals.	____	____
14. Repaired defective parts.	____	____
15. Replaced parts that could not be repaired.	____	____
16. Reassembled the piston and connecting rod.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
18. Operated the prime mover and checked for proper operation.	____	____
19. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
20. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	TM 9-6115-604-12

Service a Hydraulic System

052-205-2120

Conditions: As a power station mechanic in a nontactical environment when maintenance on a hydraulic system is required, you are given a generator with hydraulic system and the applicable technical manual (TM), personal protective equipment (PPE), a general mechanic's tool kit, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and a lockout and tagout kit.

DANGER:

1. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: HYDRAULIC FLUID PRESSURES CAN REACH 3,000 POUNDS PER SQUARE INCH WHILE THE PRIME UNIT IS OPERATING. DO NOT TOUCH SUSPECTED HYDRAULIC SYSTEM LEAKS. FAILURE TO COMPLY MAY CAUSE SERIOUS INJURIES TO UNPROTECTED SKIN OR EYES.

CAUTION:

1. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

2. DO NOT OVERFILL THE HYDRAULIC PUMP. KEEP FLUID LEVELS BETWEEN THE RED AND BLACK LINES ON THE SIGHT GAUGE. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE.

3. HYDRAULIC FLUIDS MAY BE HOT. FAILURE TO WEAR PPE MAY CAUSE SERIOUS INJURIES TO UNPROTECTED SKIN OR EYES.

Standards: Service the hydraulic system safely by ensuring that proper lockout and tagout procedures are followed, inspecting the entire system, and performing scheduled maintenance.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the hydraulic system needs to be serviced.
2. Ensure that service items are on hand before servicing the system.
   a. Ensure that the applicable manufacturer's literature is on hand.
   b. Ensure that a general mechanic's tool kit is on hand.
   c. Ensure that filters are on hand.
   d. Ensure that the correct fluid for the plant application is on hand.
3. Perform safety requirements before servicing the system.
   a. Shut down the unit, and isolate it from the rest of the system.
   b. Perform lockout and tagout procedures.
4. Remove unit side panels.
   a. Remove the large panel, and store it away from the work area.
   b. Remove the left and right small panels of the radiator and aftercooler.
5. Inspect the hydraulic system by tracing the entire system and checking for leaks, loose connections,

Performance Steps

hoses rubbing against each other, and dry-rotted hoses.

a. Check the hydraulic tank on the front of the unit.
b. Check the filter cap and bypass assembly.
c. Check the return-line filter.
d. Check the differential pressure gauge.
e. Check the tank breather.
f. Check the sight glass.
g. Check the hydraulic-tank supply shutoff valve.
h. Check the hydraulic-system cooler.
i. Check the air-to-air aftercooler fan motor.
j. Check the radiator fan motor.
k. Check the hydraulic-fan motor vent.
l. Check the pressure relief control box or hydraulic manifold.
m. Check hydraulic-system pressure gauges.
n. Check the hydraulic pump.

6. Service filters when the unit reaches the required hours of service.
   a. Replace filters.
   b. Clean filter screens.
   c. Replace fluid.

7. Reinstall panels.

8. Perform a functions check on the hydraulic system.

NOTE: For the next step, keep the unit isolated from the rest of the power plant.

   a. Remove safety measures on the unit, not the power plant.
   b. Start the unit.
   c. Operate the unit under no load for 3 to 5 minutes.
   d. Check gauges for proper pressure.
   e. Check hydraulic oil for the correct fluid level, and ensure that it is not cloudy.
   f. Shut down the unit.

9. Ensure that lockout and tagout procedures are closed out by removing locking and tagging devices.

10. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.

11. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a hydraulic system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the hydraulic system needed to be serviced.	____	____
2. Ensured that service items were on hand before servicing the system.	____	____
3. Performed safety requirements before servicing the system.	____	____
4. Removed unit side panels.	____	____
5. Inspected the hydraulic system by tracing the entire system and checking for leaks, loose connections, hoses rubbing against each other, and dry-rotted hoses.	____	____

Performance Measures	GO	NO-GO
6. Serviced filters when the unit reached the required hours of service.	____	____
7. Reinstalled panels.	____	____
8. Performed a functions check on the hydraulic system.	____	____
9. Ensured that lockout and tagout procedures were closed out by removing locking and tagging devices.	____	____
10. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
11. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Produce a Mechanical Drawing

052-205-2123

Conditions: As a power station mechanic in a tactical or nontactical environment when a mechanical drawing is needed for a prime mover system, you are given graph paper, colored pencils, and the appropriate technical manual or manufacturer's literature.

Standards: Produce a mechanical drawing that accurately depicts a mechanical system that can be used for planning future missions or troubleshooting.

Performance Steps

1. Identify the mechanical system to be depicted as a drawing.
2. Identify key items in the system to be produced.
   a. Identify valves.
   b. Identify pumps.
   c. Identify filters.
   d. Identify screens.
   e. Identify fluid flows.
   f. Identify additional components.
3. Represent equipment with correct symbols and color schemes.
4. Create an illustration of the mechanical system.
5. Use the mechanical drawing for a briefing or post drawing.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to produce a mechanical drawing.

Performance Measures	GO	NO-GO
1. Identified the mechanical system to be depicted as a drawing.	____	____
2. Identified key items in the system to be produced.	____	____
3. Represented equipment with correct symbols and color schemes.	____	____
4. Created an illustration of the mechanical system.	____	____
5. Used the mechanical drawing for a briefing or post drawing.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.471

Operate a Caterpillar™ Electronic Technician (ET) Tool

052-205-2124

Conditions: As a power station mechanic in a nontactical environment, you are given a Deployable Power Generation and Distribution System (DPGDS) prime power unit, an operator remote terminal, a Caterpillar ET tool, a serial cable RS-232 connector (part number [PN] 160-0141), a Caterpillar communication adapter II (PN 171-4400), a Caterpillar data link cable (PN 160-0133), the applicable technical manuals (TMs), the applicable manufacturers literature, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. PERFORM THIS TASK WHILE THE ENGINE IS RUNNING. BE AWARE OF MOVING MECHANICAL PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ENSURE THAT THE COMMUNICATION ADAPTOR OPERATES ON 24 VOLTS DIRECT-CURRENT (DC) SUPPLIED BY THE BATTERY THROUGH THE SERVICE TOOL CABLE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE INJURY OR EQUIPMENT DAMAGE.

WARNING: DURING MAINTENANCE ACTIVITIES WITH THE SIDE DOORS OPEN, NOISE LEVELS IN ACCESS OF 113 DECIBELS EXIST WITHIN A 12-FOOT RADIUS OF A DPGDS. PERSONNEL MUST WEAR DOUBLE HEARING PROTECTION WITHIN 12 FEET OF A RUNNING DPGDS. EXPOSURE MUST BE LIMITED TO LESS THAN 2.5 HOURS. HEARING LOSS WILL OCCUR IF THIS NOTICE IS NOT OBSERVED AND ENFORCED.

NOTE: The Caterpillar ET tool can also be used when the engine is not running. To use the Caterpillar ET tool when the engine is not running, ensure that the A/B connection cables have been removed to isolate the DPGDS. The DC breaker must be closed to power the Caterpillar ET tool, and the engine control switch must be in the RUN position.

Standards: Operate the Caterpillar ET tool by installing it while the engine is running. Perform a diagnostic code check to identify any malfunctions in the DPGDS.

Performance Steps
NOTES:

1. Caterpillar part NEXG4523 (service program module for the Caterpillar communication adapter [PN 171-4400]) is updated at regular intervals. Contact Caterpillar, Incorporated, for program updates.

2. Do not troubleshoot logged events while they are listed as inactive.

1. Inventory Caterpillar ET tool parts.

NOTES:

1. The Caterpillar ET tool is designed to help the power station mechanic obtain and analyze data and diagnose potential and existing problems within the electronic system. This tool is required to perform calibrations and read or change programmable parameters.

2. The Caterpillar ET tool can be used to service electronic engines. The Caterpillar communication adaptor is required to communicate with the electronic control module.

Performance Steps

3. The engine control switch should be turned to the OFF and RESET positions so that the engine does not start.

2. Connect the Caterpillar ET tool with the communication adaptor to the engine.
   a. Connect the serial cable RS-232 (PN 160-0141) to the operator remote terminal.
   b. Connect the serial cable RS-232 (PN 160-0141) to the communication adaptor (PN 171-4400).
   c. Connect data link cable (PN 160-0133) to the service connector on the engine.
   d. Use the data link cable (PN 160-0133) to connect the service connector to the communication adaptor (PN 171-4400).

3. Turn the operator's remote terminal to the ON position.
   a. Click on the Caterpillar ET tool icon; the window displays "Caterpillar Electronic Technician."
   b. Click to open the active diagnostic codes; the screen should show the type of engine and the serial number.

NOTE: If there is an active diagnostic code, refer to Caterpillar part RENR2227-02 (Troubleshooting 3406E and 3456 Generator Set Engines) for further instructions.

4. Interpret the code, and correct deficiencies where possible.

5. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.

6. Disconnect and properly store the Caterpillar ET tool and associated cables as specified in the manufacturer's literature.

7. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to operate a Caterpillar™ ET tool.

Performance Measures	**GO**	**NO-GO**
1. Inventoried Caterpillar ET tool parts.	____	____
2. Connected the Caterpillar ET tool and the Caterpillar communication adaptor to the engine.	____	____
3. Turned the operator's remote terminal to the ON position.	____	____
4. Interpreted the code and corrected deficiencies where possible	____	____
5. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
6. Disconnected and properly stored the Caterpillar ET tool and associated cables as specified in the manufacturer's literature.	____	____
7. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1

References

Required

DA FORM 5988-E

Related

Service a Governor for Generating Equipment

052-205-2125

Conditions: As a power station mechanic in a nontactical environment when symptoms of governor faults occur, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable manufacturer's literature, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and the battalion standing operating procedure.

DANGER:

1. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: WHEN DISCONNECTING BATTERY CABLES, ALWAYS DISCONNECT THE NEGATIVE TERMINAL FIRST. WHEN RECONNECTING, CONNECT THE POSITIVE TERMINAL FIRST. FAILURE TO COMPLY MAY RESULT IN SPARKING OR BATTERY EXPLOSION MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Service a governor by inspecting the components/parts and repairing or replacing faulty components/parts as specified in the manufacturer's literature.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the governor system needs to be serviced.
2. Perform lockout and tagout procedures.
3. Perform a visual inspection of the governor exterior for obvious faults.
   a. Check oil levels.
   b. Check for leaking lines.
   c. Check for misalignment.
   d. Check for bent or damaged linkage.
   e. Check for broken or missing hardware.
4. Remove the governor.
5. Clean the governor.
6. Inspect the governor by taking measurements.
7. Repair components/parts that are not within tolerance.
8. Replace components/parts when repairs do not return the governor to operation.
9. Reinstall the governor on the generator or the designated test stand.

NOTE: During governor reassembly, ensure that the linkage is not put on in a way that would prevent equipment shutdown.

10. Close out lockout and tagout procedures by removing locking and tagging devices.
11. Start the unit, and observe it for proper operation; or observe the results while the governor is on a designated test stand.
12. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.

Performance Steps

13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a governor for generating equipment.

Performance Measures	GO	NO-GO
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the governor system needed to be serviced.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Performed a visual inspection of the governor exterior for obvious faults.	____	____
4. Removed the governor.	____	____
5. Cleaned the governor.	____	____
6. Inspected the governor by taking measurements.	____	____
7. Repaired components/parts that were not within tolerance.	____	____
8. Replaced components/parts when repairs did not return the governor to operation.	____	____
9. Reinstalled the governor on the generator or the designated test stand.	____	____
10. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
11. Started the unit and observed it for proper operation or observed the results while the governor was on a designated test stand.	____	____
12. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	
DA FORM 5988-E	

Service an Internal Fuel System for a Diesel Engine

052-205-2126

Conditions: As a power station mechanic in a tactical or nontactical environment during maintenance, you are given a lockout and tagout kit, a general mechanic's tool box, Environmental Protection Agency (EPA) guidelines, the applicable manufacturer's literature, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A POWER SOURCE, SUCH AS UTILITY POWER OR ANOTHER GENERATOR SET, IS CONNECTED TO LOAD TERMINALS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT PERSONAL INJURY OR DEATH.

WARNING:

1. DO NOT ATTEMPT TO SERVICE OR MAKE ADJUSTMENTS, CONNECTIONS, OR RECONNECTIONS OF WIRES OR CABLES UNTIL THE GENERATOR SET IS SHUT DOWN AND COMPLETELY DE-ENERGIZED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. ENSURE THAT THE STRAINER IS ISOLATED FROM THE FUEL SUPPLY PRESSURE TO PREVENT AN OVERFLOW WHEN THE STRAINER IS OPENED. ENSURE THAT CONTAINMENT EQUIPMENT IS AT THE STRAINER TO CATCH THE MINOR AMOUNT OF FUEL AND DEBRIS THAT IS RELEASED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

Standards: Service an internal fuel system for a diesel engine by ensuring that system parameters are met without causing personnel injury or equipment damage.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the internal fuel system needs to be serviced.
2. Perform lockout and tagout procedures.
3. Shut off fuel supply lines.
4. Depressurize and drain the affected portion of the system if required for a specific system service.
5. Drain the water from the fuel-water separator as applicable.

CAUTION: FAILURE TO FOLLOW THE MANUFACTURER'S LITERATURE MAY RESULT IN EQUIPMENT DAMAGE.

Performance Steps

NOTE: The following Inspections and checks are guidelines and may be done in any order. Replace, repair, or clean any defective components/parts as necessary.

6. Remove fuel filters and strainers for replacement or cleaning as required by the maintenance schedule.
7. Inspect pickup pumps and engine-mounted fuel pumps.
   a. Check for loosened mounting bolts.
   b. Check for deteriorated couplings.
   c. Check for loose fittings.
   d. Check for leakage.
8. Clean debris from in-line strainers located on the inlet side of the pumps.
9. Perform a detailed inspection of all portions of the system.
   a. Check for leakage.
   b. Check for damage.
   c. Check for deterioration.
   d. Check for rust.
   e. Check for corrosion.
   f. Check for dry rot.
10. Inspect connection points closely for signs of leakage.
11. Inspect valves closely.
   a. Check for leakage.
   b. Check for damage.
   c. Check for deterioration.
   d. Check for inoperability.
12. Cycle each valve (fully opened and closed) to ensure proper operation.
13. Prime the fuel system to eliminate air.
14. Close out lockout and tagout procedures by removing locking and tagging devices.
15. Start the diesel engine, and observe the fuel system for leaks.
16. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
17. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an internal fuel system for a diesel engine.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the internal fuel system needed to be serviced.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Shut off fuel supply lines.	____	____
4. Depressurized and drained the affected portion of the system if required for a	____	____

Performance Measures	GO	NO-GO
specific system service.		
5. Drained the water from the fuel-water separator as applicable.	____	____
6. Removed fuel filters and strainers for replacement or cleaning as required by the maintenance schedule.	____	____
7. Inspected pickup pumps and engine-mounted fuel pumps.	____	____
8. Cleaned debris from in-line strainers located on the inlet side of the pumps.	____	____
9. Performed a detailed inspection of all portions of the system.	____	____
10. Inspected connection points closely for signs of leakage.	____	____
11. Inspected valves closely.	____	____
12. Cycled each valve (fully opened and closed) to ensure proper operation.	____	____
13. Primed the fuel system to eliminate air.	____	____
14. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
15. Started the diesel engine and observed the fuel system for leaks.	____	____
16. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
17. Ensured that items the listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	FM 10-67-1
	TM 5-6115-456-34P
	TM 5-6115-593-12
	TM 5-6115-593-34

Service an External Fuel System for a Diesel Engine

052-205-2127

Conditions: As a power station mechanic in a tactical or nontactical environment during maintenance, you are given a lockout and tagout kit, a general mechanic's tool box, Environmental Protection Agency (EPA) guidelines, the applicable manufacturer's literature, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF ELECTRICAL POWER GENERATION EQUIPMENT AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A POWER SOURCE, SUCH AS UTILITY POWER OR ANOTHER GENERATOR SET, IS CONNECTED TO THE LOAD TERMINALS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. ENSURE THAT THE SECTION OF THE FUEL DISTRIBUTION SYSTEM BEING SERVICED IS PROPERLY ISOLATED, LOCKED OUT AND TAGGED OUT, DEPRESSURIZED, DRAINED, FLUSHED, AND MADE SAFE (AS REQUIRED) WITH THE LEVEL AND TYPE OF MAINTENANCE TO BE PERFORMED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. DO NOT PERFORM ANY HOT WORK ON A PIPING SYSTEM, TO INCLUDE GRINDING, SAWING, OR SOLDERING. DO NOT PERFORM CUTTING OR WELDING ON A PIPING SYSTEM THAT CONTAINS FLAMMABLE FLUIDS OR FUEL RESIDUES WITHOUT DRAINING, FLUSHING, VENTING, AND MAKING THE PIPING SYSTEM SAFE TO REMOVE AND MAINTAIN FUEL VAPOR LEVELS BELOW THE LOWER EXPLOSIVE LIMIT OF FLAMMABLE LIQUID. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: DO NOT ATTEMPT TO SERVICE OR MAKE ADJUSTMENTS, CONNECTIONS, OR RECONNECTIONS OF WIRES OR CABLES UNTIL THE GENERATOR SET IS SHUT DOWN AND COMPLETELY DE-ENERGIZED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE INJURY OR EQUIPMENT DAMAGE.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY

Standards: Service an external fuel system of a diesel engine by ensuring that system parameters are met without causing injury to personnel or equipment damage.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the external fuel system needs to be serviced.
2. Perform lockout and tagout procedures.
3. Shut off fuel supply lines.

Performance Steps

4. Depressurize and drain the affected portion of the system if required for specific system service.
5. Locate and determine the type of external tank (blivet, fuel pod, or tanker).

NOTE: The following inspections and checks are guidelines and may be done in any order. Replace, repair, or clean defective components/parts as necessary.

6. Remove the fuel-water separator and strainers for replacement or cleaning.
7. Drain the water through the bottom petcocks on aboveground tanks.
8. Clean debris from in-line strainers located on the inlet side of the pumps.
9. Check the fuel system for leaks or faulty components.
    a. Check the external tank for leaks.
    b. Check the external fuel lines for—
        (1) Secure mounting.
        (2) Deteriorated couplings.
        (3) Loose fittings.
        (4) Damage protection.
    c. Check for the proper operation of transfer pumps and the security of the mounting.
    d. Check the fuel for algae or water contamination.
    e. Check for fuel warmer proper operation.
    f. Inspect valves for signs of—
        (1) Leakage.
        (2) Damage.
        (3) Deterioration.
        (4) Operability.
10. Ensure that connection points are properly tightened.

NOTE: The fuel system may need to be primed before putting it back into operation.

11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Start the diesel engine, and observe the fuel system for leaks.
13. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an external fuel system for a diesel engine.

Performance Measures	**GO**	**NO-GO**
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the external fuel system needed to be serviced.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Shut off fuel supply lines.	____	____
4. Depressurized and drained the affected portion of the system if required for a specific system service.	____	____
5. Located and determined the type of external tank (blivet, fuel pod, or tanker).	____	____

Performance Measures	GO	NO-GO
6. Removed the fuel-water separator and strainers for replacement or cleaning.	____	____
7. Drained the water through the bottom petcocks on aboveground tanks.	____	____
8. Cleaned debris from in-line strainers located on the inlet side of the pumps.	____	____
9. Checked the fuel system for leaks or faulty components.	____	____
10. Ensured that connection points were properly tightened.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Started the diesel engine and observed the fuel system for leaks.	____	____
13. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	FM 10-67-1
	TM 5-6115-456-34P
	TM 5-6115-593-12
	TM 5-6115-593-34

Service a Diesel Engine Starting System

052-205-2128

Conditions: As a power station mechanic in a nontactical environment when the diesel engine starting system needs serviced, you are given the applicable manufacturer's literature, a general mechanic's tool box, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT EQUIPMENT IS PROPERLY LOCKED OUT AND TAGGED OUT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Service a diesel engine starting system by testing, cleaning, repairing, or replacing starting system components/parts.

Performance Steps

1. Review maintenance logbooks and historical data pertaining to the equipment to verify that the diesel engine starting system needs to be serviced.
2. Inspect the starting system.

NOTE: Only one of the following starting systems is inspected.

   a. Check the electric start system.
      (1) Test for the correct direct-current (DC) voltage at the starter.
      (2) Inspect for loose or corroded battery terminals and connections.
      (3) Test the battery electrolyte and alkaline level.
      (4) Inspect starter connections.
      (5) Check for starter malfunctions and misalignment.
   b. Check the air start system.
      (1) Inspect air lines for too much moisture.
      (2) Check for air compressor malfunction.
      (3) Inspect air lines, and look for damaged or leaking lines.
      (4) Inspect connections at the starter for damage.
      (5) Check for sufficient air pressure in the reservoir to crank the engine.

3. Correct the appropriate malfunction.

NOTE: Only one of the following starting systems is inspected.

   a. Service the electric start.
      (1) Clean battery terminals and/or connections.
      (2) Refill the battery electrolyte to the proper level.
      (3) Repair the starter and battery terminals or connections.
      (4) Replace the starter, batteries, and/or connections.
   b. Service the air start.
      (1) Drain and clean air lines.
      (2) Repair or replace the air compressor.
      (3) Repair or replace connections at the starter or air compressor.
      (4) Fix or replace damaged air lines.
      (5) Connect the largest air reservoir.

4. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
5. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a diesel engine starting system.

Performance Measures	GO	NO-GO
1. Reviewed maintenance logbooks and historical data pertaining to the equipment to verify that the diesel engine starting system needed to be serviced.	____	____
2. Inspected the starting system.	____	____
3. Corrected the appropriate malfunction.	____	____
4. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
5. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Troubleshoot a Diesel Engine Lube Oil System

052-205-2129

Conditions: As a power station mechanic in a nontactical environment when a diesel engine lube oil system malfunctions, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable technical manuals (TMs), the applicable manufacturer's literature or industry standards, a maintenance logbook, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and applicable personal protective equipment (PPE).

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. EXERCISE EXTREME CAUTION WHEN WORKING IN THE AREA OF ROTATING ENGINE COMPONENTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALWAYS WEAR PPE AS REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: ENGINE OIL IS VERY HOT DURING OPERATION. DO NOT REMOVE OIL OR LUBE OIL COMPONENTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION:

1. EQUIPMENT WITH A CLASS III LEAK SHOULD NOT BE OPERATED AND MUST BE REPAIRED OR SENT FOR REPAIR IMMEDIATELY. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE THAT MAY CAUSE LONG-TERM FAILURE.

2. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

NOTES:

1. All equipment is not the same and may function differently depending on the make, model, and manufacturer. Troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. Tests should be conducted as specified in the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

3. Defective equipment should not be used; it should be repaired or replaced immediately.

Standards: Troubleshoot a diesel engine lube oil system through inspection, fault identification, and fault testing to identify the cause of malfunction.

Performance Steps

1. Review TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment.
2. Ensure that PPE is correctly tested and fully mission-capable.

Performance Steps

3. Inspect tools and testing equipment for serviceability.
4. Perform lockout and tagout procedures.
5. Identify fault locations by checking the equipment fault indicator panel or the engine lube oil system for obvious malfunctions.

NOTE: The following substeps are a guideline and are not all-inclusive. Check for the most obvious and easily corrected problems first.

a. Check the oil level.

NOTE: The reading should be taken when the oil is hot.

b. Check for low oil pressure.

NOTE: This may be caused by a stuck oil relief valve, foreign material on the valve seat that is holding the valve open, broken oil lines, clogged strainers or filters, excessive bearing wear, low oil viscosity, a faulty pump, or diluted or insufficient oil.

c. Check for pump failure.

NOTE: This may be caused by sheared pump gear keys, a broken housing, or damaged gears.

d. Check for oil dilution.

NOTE: This may be caused by water or fuel leaking into the oil.

e. Check oil consumption.

NOTE: Excessive oil consumption may be caused by oil leaks, broken or stuck piston rings, worn cylinder liners, a clogged oil separator screen, improper oil grade, or clogged oil drain holes under piston oil rings. Low oil consumption may be caused by water or fuel leaking into the oil.

6. Conduct further testing to identify specific defective components if necessary.
7. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a diesel engine lube oil system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment	____	____
2. Ensured that PPE was correctly tested and fully mission-capable.	____	____
3. Inspected tools and testing equipment for serviceability.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Identified fault locations by checking the equipment fault indicator panel or the engine lube oil system for obvious malfunctions.	____	____
6. Conducted further testing to identify specific defective components if necessary.	____	____
7. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Troubleshoot a Diesel Engine Cooling System

052-205-2130

Conditions: As a power station mechanic in a tactical or nontactical environment when a diesel engine cooling system malfunctions, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable technical manuals (TMs), the applicable manufacturer's literature or industry standards, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and the applicable personal protective equipment (PPE).

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. EXERCISE EXTREME CAUTION WHEN WORKING IN THE AREA OF ROTATING ENGINE COMPONENTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALWAYS WEAR PPE AS REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. ENGINE COOLANT GETS VERY HOT DURING OPERATION. DO NOT REMOVE COOLING SYSTEM COMPONENTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY.

CAUTION:

1. EQUIPMENT WITH A CLASS III LEAK SHOULD NOT BE OPERATED AND MUST BE REPAIRED OR SENT FOR REPAIR IMMEDIATELY. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE THAT MAY CAUSE LONG-TERM FAILURE.

2. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

NOTE:

1. All equipment is not the same and may function differently depending on the make, model, and manufacturer. Troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. Tests should be conducted as specified in the manufacturer's literature or industry standards.

3. Defective equipment should be repaired or replaced immediately and not used until correctly repaired or replaced.

Standards: Troubleshoot a diesel engine cooling system through inspection, fault identification, and fault testing to verify the cause of malfunction.

Performance Steps

1. Review TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment.
2. Ensure that PPE is correctly tested and fully mission-capable.

Performance Steps

3. Inspect tools and testing equipment for serviceability.
4. Perform lockout and tagout procedures.
5. Identify fault locations by checking the equipment fault indicator panel or the engine cooling system for obvious malfunctions.

NOTE: The following substeps are a guideline and are not all-inclusive. Check for the most obvious and easily corrected problems first.

a. Check for a hot engine.

NOTE: This may be due to broken fan belts, plugged radiator core or air passages, or a defective thermostat or temperature switch.

b. Check for low water pressure.

NOTE: This may be due to coolant loss, pump inlet cavitation, a plugged oil cooler, or clogged piping to the pump inlet.

6. Conduct further testing to identify specific defective components if necessary.
7. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a diesel engine cooling system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment.	____	____
2. Ensured that PPE was correctly tested and fully mission-capable.	____	____
3. Inspected tools and testing equipment for serviceability.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Identified fault locations by checking the equipment fault indicator panel or the engine cooling system for obvious malfunctions.	____	____
6. Conducted further testing to identify specific defective components if necessary.	____	____
7. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Troubleshoot a Diesel Engine Air Intake and/or Exhaust System
052-205-2131

Conditions: As a power station mechanic in a nontactical environment when a diesel engine air intake and/or exhaust system malfunctions, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable technical manual (TMs), the applicable manufacturer's literature or industry standards, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and applicable personal protective equipment (PPE).

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. EXERCISE EXTREME CAUTION WHEN WORKING IN THE AREA OF ROTATING ENGINE COMPONENTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALWAYS WEAR PPE AS REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: ENGINE EXHAUST GETS VERY HOT DURING OPERATION. DO NOT REMOVE ANY EXHAUST SYSTEM COMPONENTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

NOTE:

1. All equipment is not the same and may function differently depending on the make, model, and manufacturer. Troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. All tests should be conducted according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

3. Defective equipment should not be used; it should be repaired or replaced immediately.

Standards: Troubleshoot a diesel engine air intake and/or exhaust system through inspection, fault identification, and fault testing to verify the cause of malfunction.

Performance Steps

1. Review TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment.
2. Ensure that PPE is correctly tested and fully mission-capable.
3. Inspect tools and testing equipment for serviceability.
4. Perform lockout and tagout procedures.
5. Identify fault locations by checking the equipment fault indicator panel or the engine air intake and exhaust system for obvious malfunctions.

Performance Steps

a. Check for the engine not starting when turned over at the proper speed.

NOTE: This may be due to exhaust valves stuck open or not at proper clearance.

b. Check for engine loss of power.

NOTE: This may be due to a clogged air intake or air filters, stuck exhaust valves, obstructions in the exhaust, or a faulty turbocharger.

c. Check for an engine knock.

NOTE: This may be due to exhaust valves being out of adjustment.

d. Check for a smoky exhaust.

NOTE: This may be due to dirty air intake filters, an exhaust obstruction, or low compression.

e. Check for a cylinder misfire.

NOTE: This may be due to stuck exhaust valves.

6. Conduct further testing to identify specific defective components if necessary.
7. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot a diesel engine air intake and/or exhaust system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment.	____	____
2. Ensured that PPE was correctly tested and fully mission-capable.	____	____
3. Inspected tools and testing equipment for serviceability.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Identified fault locations by checking the equipment fault indicator panel or the engine air intake and exhaust system for obvious malfunctions.	____	____
6. Conducted further testing to identify specific defective components if necessary.	____	____
7. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Repair a Diesel Engine Lube Oil System

052-205-2132

Conditions: As a power station mechanic in a nontactical environment when a diesel engine lube oil system needs repair, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable technical manuals (TMs), the applicable manufacturer's literature or industry standards, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and applicable personal protective equipment (PPE).

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. EXERCISE EXTREME CARE WHEN WORKING IN THE AREA OF ROTATING ENGINE COMPONENTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALWAYS WEAR PPE AS REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: ENGINE OIL GETS VERY HOT DURING OPERATION. DO NOT REMOVE OIL OR LUBE OIL COMPONENTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION:

1. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

2. EQUIPMENT WITH A CLASS III LEAK SHOULD NOT BE OPERATED AND MUST BE REPAIRED OR SENT FOR REPAIR IMMEDIATELY. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE THAT MAY CAUSE LONG-TERM FAILURE.

NOTES:

1. All equipment is not the same and may function differently depending on the make, model, or manufacturer. Troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. Tests should be conducted as specified in the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

3. Defective equipment should be repaired or replaced immediately and not used until correctly repaired or replaced.

Standards: Repair a diesel engine lube oil system by verifying, repairing, and replacing defective components/parts.

Performance Steps

1. Review the TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment malfunction.
2. Ensure that PPE is correctly tested and fully mission-capable.

Performance Steps

3. Inspect tools and testing equipment for serviceability.
4. Perform lockout and tagout procedures.
5. Verify the defective components/parts.
6. Repair or replace the defective components/parts using the applicable TM, applicable manufacturer's literature, or industry standards.
7. Close out lockout and tagout procedures by removing locking and tagging devices.
8. Perform a functions check on the diesel engine lube oil system.
9. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
10. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to repair a diesel engine lube oil system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed the TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment malfunction.	____	____
2. Ensured that PPE was correctly tested and fully mission-capable.	____	____
3. Inspected tools and testing equipment for serviceability.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Verified the defective components/parts.	____	____
6. Repaired or replaced the defective components/parts using the applicable TM, applicable manufacturer's literature, or industry standards.	____	____
7. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
8. Performed a functions check on the diesel engine lube oil system.	____	____
9. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
10. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Repair a Diesel Engine Cooling System

052-205-2133

Conditions: As a power station mechanic in a nontactical environment when a diesel engine cooling system needs repair, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable technical manuals (TMs), the applicable manufacturer's literature or industry standards, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and applicable personal protective equipment (PPE);

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. EXERCISE EXTREME CAUTION WHEN WORKING IN THE AREA OF ROTATING ENGINE COMPONENTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALWAYS WEAR PPE AS REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THE ENGINE COOLANT GETS VERY HOT DURING OPERATION. DO NOT REMOVE ANY COOLING SYSTEM COMPONENTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION:

1. NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

2. EQUIPMENT WITH A CLASS III LEAK SHOULD NOT BE OPERATED AND MUST BE REPAIRED OR SENT FOR REPAIR IMMEDIATELY. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE THAT MAY CAUSE LONG-TERM FAILURE.

NOTES:

1. All equipment is not the same and may function differently depending on the make, model, or manufacturer. Troubleshooting steps are similar but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. All tests should be conducted as specified in the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

3. Defective equipment should be repaired or replaced immediately and not used until correctly repaired or replaced.

Standards: Repair a diesel engine cooling system by verifying, repairing, and replacing the defective components/parts.

Performance Steps

1. Review the appropriate TMs, applicable manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment malfunction.
2. Ensure that PPE is correctly tested and fully mission-capable.
3. Inspect tools and testing equipment for serviceability.
4. Perform lockout and tagout procedures.
5. Verify the defective components/parts.
6. Repair or replace the defective components/parts using the appropriate TM, applicable manufacturer's literature, or industry standards.
7. Close out lockout and tagout procedures by removing locking and tagging devices.
8. Perform a functions check on the diesel engine cooling system
9. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
10. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to repair a diesel engine cooling system.

Performance Measures	GO	NO-GO
1. Reviewed the appropriate TMs, applicable manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment malfunction.	____	____
2. Ensured that PPE was correctly tested and fully mission-capable.	____	____
3. Inspected tools and testing equipment for serviceability.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Verified the defective components/parts.	____	____
6. Repaired or replaced the defective components/parts using the appropriate TM, applicable manufacturer's literature, or industry standards.	____	____
7. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
8. Performed a functions check on the diesel engine cooling system.	____	____
9. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
10. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Repair an Engine Air Intake and/or Exhaust System

052-205-2134

Conditions: As a power station mechanic in a nontactical environment when a diesel engine air intake and/or exhaust system needs repair, you are given a lockout and tagout kit, a general mechanic's tool box, the applicable technical manuals (TMs), the applicable manufacturer's literature or industry standards, maintenance logbooks, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet), and the applicable personal protective equipment (PPE).

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. EXERCISE EXTREME CAUTION WHEN WORKING IN THE AREA OF ROTATING ENGINE COMPONENTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALWAYS WEAR PPE AS REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: ENGINE EXHAUST GETS VERY HOT DURING OPERATION. DO NOT REMOVE EXHAUST SYSTEM COMPONENTS UNTIL THE ENGINE HAS COOLED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE INJURY.

NOTES:

1. All equipment is not the same and may function differently depending on the make, model, or manufacturer. Troubleshooting steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

2. All tests should be conducted as specified in the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

Standards: Repair a diesel engine air intake and/or exhaust system by verifying, repairing, and replacing the defective components/parts. Annotate repairs on DA Form 2404 or DA Form 5988-E.

Performance Steps

1. Review the appropriate TMs, manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment malfunction.
2. Ensure that PPE is correctly tested and fully mission-capable.
3. Inspect tools and testing equipment for serviceability.
4. Perform lockout and tagout procedures.
5. Verify the defective components/parts.
6. Repair or replace the defective components/parts using the appropriate TM, applicable manufacturer's literature, or industry standards.

Performance Steps

7. Close out lockout and tagout procedures by removing locking and tagging devices.
8. Perform a functions check on the diesel engine air intake and/or exhaust system.
9. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.
10. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to repair an engine air intake and/or exhaust system.

Performance Measures	**GO**	**NO-GO**
1. Reviewed the appropriate TMs, applicable manufacturer's literature or industry standards, maintenance logbooks, and historical data pertaining to the equipment malfunction.	____	____
2. Ensured that PPE was correctly tested and fully mission-capable.	____	____
3. Inspected tools and testing equipment for serviceability.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Verified the defective components/parts.	____	____
6. Repaired or replaced the defective components/parts using the appropriate TM, applicable manufacturer's literature, or industry standards.	____	____
7. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
8. Performed a functions check on the diesel engine air intake and/or exhaust system.	____	____
9. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____
10. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	

Subject Area 4: S3 Electrical-Equipment Maintenance (Power Station) Tasks

Service a Low-Voltage Circuit Breaker

052-206-2100

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given applicable safety standing operating procedures, a general mechanic's tool box, a digital low-resistance ohmmeter, a megohmmeter, a current injection test set, grounding equipment, electrical construction prints, wiring diagrams, and the appropriate manufacturer's literature.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF CIRCUIT BREAKERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE CIRCUIT BREAKER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service the circuit breaker by inspecting and testing it according to the manufacturer's literature. Reinstall or repair the circuit breaker based on the test results.

Performance Steps
NOTES:

1. Conduct tests according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

2. Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Inspect the circuit breaker to ensure that the mechanical functions operate smoothly and that there is no physical damage.
   a. Clean the breaker before testing unless as-found and as-left tests are required.
   b. Operate the circuit breaker to ensure smooth operation.
   c. Inspect the case for cracks or other defects.
   d. Inspect the bolted electrical connections for high resistance.
   e. Inspect the mechanism contacts and arc chutes in the unsealed units.
5. Perform resistance measurements through the bolted connections using a low-resistance ohmmeter.
6. Perform insulation resistance tests pole to pole, pole to ground, and across the open contacts of

Performance Steps

each phase.

7. Perform an insulation resistance test on the control wiring.
8. Perform longtime-delay, time-current characteristic tests by passing 300 percent of the rated current through each pole separately, unless series testing is required to defeat the ground fault functions. Ensure that the circuit breaker trip times fall within the guidelines specified in the manufacturer's literature.
9. Determine the short-time pickup and time delay of the circuit breaker by using the primary current injection test method and ensuring that the times fall within the guidelines specified in the manufacturer's literature.
10. Determine the ground fault pickup and time delay of the circuit breaker by using the primary current injection test method and ensuring that the times fall within the guidelines specified in the manufacturer's literature.
11. Test the instantaneous pickup using the primary current injection method. Apply current using the run-up or pulse method to ensure that the instantaneous trip times of the circuit breaker fall within the guidelines specified in the manufacturer's literature.
12. Ensure that the trip characteristics of the breakers fall within the manufacturer's published time-current characteristic tolerance band, including adjustment factors. Verify the correct operation of the auxiliary features.
    a. Check the trip and pickup indicators.
    b. Check the zone interlocking.
    c. Check the electrical close.
    d. Check the trip operation.
    e. Check the trip free.
    f. Check the antipump function.
13. Close out lockout and tagout procedures by removing locking and tagging devices.
14. Reenergize the circuit.
15. Ensure that the circuits work as designed.
16. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a low-voltage circuit breaker.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Inspected the circuit breaker to ensure that the mechanical functions operated smoothly and that there was no physical damage.	____	____
5. Performed resistance measurements through the bolted connections using a low-	____	____

Performance Measures	GO	NO-GO
resistance ohmmeter.		
6. Performed insulation resistance tests pole to pole, pole to ground, and across the open contacts of each phase.	____	____
7. Performed an insulation resistance test on the control wiring.	____	____
8. Performed longtime-delay, time-current characteristic tests by passing 300 percent of the rated current through each pole separately, unless series testing was required to defeat the ground fault functions. Ensured that the circuit breaker trip times fell within the guidelines specified in the manufacturer's literature.	____	____
9. Determined the short-time pickup and time delay of the circuit breaker by using the primary current injection test method and ensuring that the times fell within the guidelines specified in the manufacturer's literature.	____	____
10. Determined the ground fault pickup and time delay of the circuit breaker by using the primary current injection test method and ensuring that the times fell within the guidelines specified in the manufacturer's literature.	____	____
11. Tested the instantaneous pickup using the primary current injection method. Applied current using the run-up or pulse method to ensure that the instantaneous trip times of the circuit breaker fell within the guidelines specified in the manufacturer's literature.	____	____
12. Ensured that the trip characteristics of the breakers fell within the manufacturer's published time-current characteristic tolerance band, including adjustment factors. Verified the correct operation of the auxiliary features.	____	____
13. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
14. Reenergized the circuit.	____	____
15. Ensured that the circuits worked as designed.	____	____
16. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	NETA™

Install a Medium-Voltage, Nonaerial Air Switch

052-206-2101

Conditions: As a power station electrician in a tactical or nontactical environment when a medium-voltage, nonaerial air switch needs to be installed or replaced, you are given safety standing operating procedures, a general mechanic's tool box, a lockout and tagout kit, grounding equipment, electrical construction prints, wiring diagrams, and the applicable manufacturer's literature.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF SWITCHGEAR AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE SWITCH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely install a medium-voltage, nonaerial air switch in a suitable location to meet mission requirements.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Identify the best location for the switch, such as a secure area with minimal traffic, to ensure easy access during emergencies.
4. Select equipment that is appropriate for the environment and weather when installing a switch outdoors.
5. Follow specific guidelines when installing a switch indoors.
   a. Place the switch in a dry, well-ventilated room.
   b. Leave adequate space around the equipment for operation and maintenance.
   c. Do not use expulsion type fuses where loud noises could startle personnel working in the vicinity.
6. Select a switch that meets safety, mission, and load requirements.
7. De-energize the circuit where the switch will be installed.
8. Isolate the equipment in the work area.
9. Perform lockout and tagout procedures.
10. Install personal protective grounds.
11. Place the switch on a level surface.
12. Install the grounding for case and neutral grounds.
13. Install the equipment to the load.

Performance Steps

14. Install the equipment to the power source.
15. Verify the correct phase sequence.
16. Remove personal protective grounds.
17. Close out lockout and tagout procedures by removing locking and tagging devices.
18. Perform a functions check on the switch.
19. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to install a medium-voltage, nonaerial air switch.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Identified the best location for the switch, such as a secure area with minimal traffic, to ensure easy access during emergencies.	____	____
4. Selected equipment that was appropriate for the environment and weather when installing a switch outdoors.	____	____
5. Followed specific guidelines when installing a switch indoors.	____	____
6. Selected a switch that met safety, mission, and load requirements.	____	____
7. De-energized the circuit where the switch was to be installed.	____	____
8. Isolated the equipment in the work area.	____	____
9. Performed lockout and tagout procedures.	____	____
10. Installed personal protective grounds.	____	____
11. Placed the switch on a level surface.	____	____
12. Installed the grounding for case and neutral grounds.	____	____
13. Installed the equipment to the load.	____	____
14. Installed the equipment to the power source.	____	____
15. Verified the correct phase sequence.	____	____
16. Removed personal protective grounds.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
18. Performed a functions check on the switch.	____	____

Performance Measures	GO	NO-GO
19. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1 NESC® S AND C HANDBOOK TM 5-684

Service an Oil Switch

052-206-2102

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures; a general mechanic's tool box; a digital low-resistance ohmmeter; a megohmmeter; an oil test set; electrical construction prints, wiring diagrams, a high-potential test set; grounding equipment; applicable manufacturer's literature; and ASTM D877, D923, 1500, and D1524 standards.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF OIL SWITCHES AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE SWITCH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THIS TASK SHOULD ONLY BE PERFORMED ON EQUIPMENT THAT DOES NOT CONTAIN POLYCHLORINATED BIPHENYL (PCB). FAILURE TO COMPLY MAY CAUSE SKIN AILMENTS, REPRODUCTIVE DISORDERS, LIVER DISEASE, AND OTHER ADVERSE HEALTH CONDITIONS.

Standards: Safely service the oil switch by inspecting and testing it. Test the oil switch according to the manufacturer's literature. Reinstall or repair the oil switch based on the test results.

Performance Steps
NOTES:

1. Conduct tests according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

2. Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Inspect the oil switch condition visually and manually, and ensure that the mechanical functions operate smoothly and that there is no physical damage.
   a. Clean the unit thoroughly before testing unless as-found or as-left tests are required.
   b. Keep a record of as-left and as-found operation counter readings if applicable.
   c. Inspect the anchorage, alignment, and grounding.
   d. Perform mechanical operator tests according to the manufacturer's literature if applicable.
   e. Verify the correct adjustments and operation of the motor operator limit switches and mechanical interlocks if applicable.

Performance Steps

f. Verify the correct blade alignment and penetration, travel stops, arc interrupter, and mechanical operation.
g. Inspect the insulating assemblies for evidence of physical damage and surface contamination.
h. Check each fuse holder for adequate support and contact.
i. Verify that the fuse sizes and types correspond to the drawings.
j. Test the electrical and mechanical interlock systems for correct operation and sequencing.
k. Verify that the insulating oil level is correct.
l. Inspect and replace gaskets according to the manufacturer's literature as required.
m. Verify that there is appropriate contact lubricant on moving, current-carrying parts.

5. Perform resistance measurements on the bolted connections using a low-resistance ohmmeter, and ensure that the bolt torque levels match the manufacturer's specifications.

6. Remove a sample of the insulating oil according to ASTM D923.
   a. Test it for the correct dielectric breakdown voltage according to ASTM D877.
   b. Test it for the correct color according to ASTM D1500.
   c. Test it for the correct visual condition according to ASTM D1524.

7. Perform a contact-resistance test, and compare the contact resistances of the electrical connections to the values of similar connections according to the manufacturer's literature.

8. Perform insulation resistance tests pole to pole, pole to ground, and across the open poles. Ensure that the test values are not less than 1,000 megohms at a direct-current (DC) test voltage of 2,500 volts (minimum) unless otherwise stated in the manufacturer's literature.

9. Perform an insulation resistance test on the control wiring at 1,000 volts DC (minimum of 2 megohms) according to the manufacturer's literature, and follow the manufacturer's recommendations for units with solid-state components/parts.

10. Perform an overpotential test on each pole with the switch closed, and ensure that the insulation can withstand the applied test voltage.
    a. Test each pole-to-ground with all other poles grounded.
    b. Ensure that the test voltage used is within the manufacturer's specifications.

11. Close out lockout and tagout procedures by removing locking and tagging devices.

12. Reenergize the oil switch.

13. Ensure that the oil switch operates as designed.

14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an oil switch.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Inspected the oil switch condition visually and manually and ensured that the	____	____

Performance Measures	GO	NO-GO
mechanical functions operated smoothly and that there was no physical damage.		
5. Performed resistance measurements on the bolted connections using a low-resistance ohmmeter and ensured that the bolt torque levels matched the manufacturer's specifications.	____	____
6. Removed a sample of the insulating oil according to ASTM D923.	____	____
7. Performed a contact resistance test and compared the contact resistances of the electrical connections to the values of similar connections according to the manufacturer's literature.	____	____
8. Performed insulation resistance tests pole to pole, pole to ground, and across the open poles. Ensured that the test values were not less than 1,000 megohms at a DC test voltage of 2,500 volts (minimum) unless otherwise stated in the manufacturer's literature.	____	____
9. Performed an insulation resistance test on the control wiring at 1,000 volts DC (minimum of 2 megohms) according to the manufacturer's literature and followed the manufacturer's recommendations for units with solid-state components/parts.	____	____
10. Performed an overpotential test on each pole with the switch closed and ensured that the insulation could withstand the applied test voltage.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Reenergized the oil switch.	____	____
13. Ensured that the oil switch operated as designed.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480
	LCH
	NESC®
	NETA™

Service a Vacuum Switch

052-206-2103

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given a vacuum switch, safety standing operating procedures, a general mechanic's tool box, a digital low-resistance ohmmeter, a megohmmeter, a high-potential test set and/or a vacuum bottle test set, grounding equipment, and the applicable manufacturer's literature.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF VACUUM SWITCHES AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE SWITCH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. DO NOT EXCEED THE MAXIMUM VOLTAGE STIPULATED FOR THIS TEST. FAILURE TO COMPLY MAY CAUSE THE VACUUM BOTTLES TO EXPLODE AND MAY RESULT IN PERMANENT INJURY OR DEATH.

WARNING:

1. SOME DIRECT-CURRENT (DC), HIGH-POTENTIAL TEST SETS ARE HALF WAVE-RECTIFIED AND MAY PRODUCE PEAK VOLTAGES IN EXCESS OF THE MANUFACTURER'S RECOMMENDED MAXIMUM FOR VACUUM SWITCHES. FAILURE TO FOLLOW TEST SET INSTRUCTIONS MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. AN APPLICATION OF HIGH VOLTAGE ACROSS AN OPEN GAP IN A VACUUM CAN PRODUCE AN X-RAY EMISSION THAT MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Safely service the vacuum switch by inspecting and testing it. Conduct tests according to the manufacturer's literature when available, and use industry standards when the manufacturer's literature cannot be obtained. Reinstall or repair the vacuum switch based on the test results.

Performance Steps
NOTE: Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from adjacent poles or similar breakers by more than 25 percent of the lowest value.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Inspect the condition of the vacuum switch visually and manually.
   a. Clean the unit thoroughly before testing it unless as-found or as-left tests are required.
   b. Keep a record of as-found and as-left operation counter readings if applicable.
   c. Inspect the anchorage, alignment, and grounding.

Performance Steps

d. Perform the mechanical operator tests according to the manufacturer's literature if applicable.
e. Verify the correct adjustments and operation of the motor operator limit switches and mechanical interlocks if applicable.
f. Measure the contact erosion according to the manufacturer's literature.
g. Inspect the insulating assemblies for evidence of physical damage or contamination.
h. Check each fuse holder for adequate support and contact.
i. Verify that the fuse sizes and types correspond to the drawings.
j. Test the electrical and mechanical interlock systems for correct operation and sequencing.
k. Verify that there is appropriate contact lubricant on moving and sliding surfaces.

5. Perform resistance measurements on the bolted connections using a low-resistance ohmmeter, and ensure that the bolt torque levels match the manufacturer's specifications.
6. Perform a contact resistance test, and compare the contact resistances of the electrical connections to the values of similar connections according to the manufacturer's literature.
7. Verify that open- and close-control devices are operational and functional according to the manufacturer's specifications.
8. Perform insulation resistance tests pole to pole, pole to ground, and across the open poles; and ensure that the test values are not less than 1,000 megohms at a DC test voltage of 2,500 volts (minimum) unless otherwise stated in the manufacturer's literature.
9. Perform a vacuum bottle integrity test across each vacuum bottle with the switch in the OPEN position according to the manufacturer's literature, and ensure that the test set does not trip when an overpotential voltage is applied.
   a. Provide adequate barriers and protection against x-radiation during this test.
   b. Do not perform this test unless the contact displacement of each interrupter is within the manufacturer's tolerance.
10. Reconnect the isolated equipment.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Reenergize the de-energized equipment, and perform a functions check.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a vacuum switch.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Inspected the condition of the vacuum switch visually and manually.	____	____
5. Performed resistance measurements on the bolted connections using a low-resistance ohmmeter and ensured that the bolt torque levels matched the manufacturer's specifications.	____	____

Performance Measures	GO	NO-GO
6. Performed a contact resistance test and compared the contact resistances of the electrical connections to the values of similar connections according to the manufacturer's literature.	____	____
7. Verified that open- and close-control devices were operational and functional according to the manufacturer's specifications.	____	____
8. Performed insulation resistance tests pole to pole, pole to ground, and across the open poles and ensured that the test values were not less than 1,000 megohms at a DC test voltage of 2,500 volts (minimum) unless otherwise stated in the manufacturer's literature.	____	____
9. Performed a vacuum bottle integrity test across each vacuum bottle with the switch in the OPEN position according to the manufacturer's literature and ensured that the test set did not trip when an overpotential voltage was applied.	____	____
10. Reconnected the isolated equipment.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Reenergized the de-energized equipment and performed a functions check.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related
FM 3-34.480
NESC®
NETA™

Service a System Ground

052-206-2104

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance or when a system ground is initially installed, you are given a general mechanic's tool box, a ground-resistive test set, a 3-pound hammer, personal protective gear, electrical construction prints, wiring diagrams, the National Electrical Code (NEC) Handbook, the Institute of Electrical and Electronics Engineers (IEEE) Green Book, and a multimeter.

DANGER:

1. A FAULT IN THE POWER SYSTEM WILL CAUSE A HIGH CURRENT TO FLOW INTO THE GROUND SYSTEM WHILE THE TEST IS IN PROGRESS. ALWAYS WEAR RUBBER GLOVES WHEN TESTING ENERGIZED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Service the system ground by inspecting the ground grid to check for continuity throughout the system and to determine if the minimum ohm level has been met. Repair or correct deficiencies.

Performance Steps
NOTE: Service the equipment if the equipment ground fault or the operation of the neutral overcurrent protective device has been erratic due to suspected ground resistance charges.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Identify the correct resistance level according to Section 250-56 of the NEC Handbook.
4. Disconnect the power to the system if possible.
5. Conduct a visual inspection.
    a. Locate the major components/parts of the system.
        (1) Identify the equipment enclosures.
        (2) Identify the structural members.
        (3) Identify the fencing.
        (4) Identify the lightning rods.
        (5) Identify the system neutrals.
    b. Inspect the connection points for common faults.
        (1) Check for corrosion.
        (2) Check for loose connections.
        (3) Check for broken connections.
        (4) Check for overheating.
6. Service the connection points by repairing, replacing, or cleaning them.
7. Conduct electrical tests.
    a. Perform a fall-of-potential test according to the IEEE Green Book and the test set instructions on the main grounding electrode or system.
        (1) Proceed to the next step if the results are acceptable.
        (2) Reduce the ground resistance by using additional or longer ground rods, treating the soil, or using a combination of each if the results are unacceptable.
    b. Perform point-to-point tests between the main grounding system and the major electrical-equipment frames, lightning rods, and system neutrals.

Performance Steps

(1) Proceed to the next step if the results are acceptable.
(2) Test individual sections, identify deficiencies, and then correct them if the results are unacceptable.

8. Improve ground electrode resistance as needed (see task 052-244-2107).
9. Keep a record of the test results.
10. Reconnect the power to the system.
11. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a system ground.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Identified the correct resistance level according to Section 250-56 of the NEC Handbook.	____	____
4. Disconnected the power to the system if possible.	____	____
5. Conducted a visual inspection.	____	____
6. Serviced the connection points by repairing, replacing, or cleaning them.	____	____
7. Conducted electrical tests.	____	____
8. Improved ground electrode resistance as needed (see task 052-244-2107).	____	____
9. Kept a record of the test results.	____	____
10. Reconnected the power to the system.	____	____
11. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
IEEE GREEN BOOK™	DA FORM 2404
NEC® HANDBOOK	NESC®
	NETA™
	TM 5-684

Service a Nonaerial Air Switch

052-206-2105

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures, a lockout and tagout kit, a general mechanic's tool box, an electrician's tool kit, electrical construction prints, wiring diagrams, a low-resistance ohmmeter, a megohmmeter, a torque wrench, a grounding cluster, conductive grease, nonconductive grease, and the applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF A SWITCHGEAR AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE SWITCH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service the nonaerial air switch by inspecting and testing it according to the manufacturer's literature. Repair the nonaerial air switch based on the test results.

Performance Steps
NOTES:

1. Conduct tests according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

2. Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Perform visual and manual inspections of the nonaerial air switch to identify and correct deficiencies.
   a. Clean the unit before testing it unless as-found and as-left tests are required.
   b. Verify the appropriate anchorage and area clearing.
   c. Verify the appropriate equipment grounding.
   d. Check the blade for the correct—
      (1) Alignment.
      (2) Penetration.
      (3) Travel stops.
      (4) Mechanical operation.
      (5) Contact pressure.
   e. Verify that the fuse sizes and types are correct according to the manufacturer's literature.
   f. Verify that the expulsion-limiting devices are in place on holders that have expulsion type elements.

Performance Steps

g. Verify that each fuse holder has adequate mechanical support.
h. Inspect the bolted electrical connections for high resistance.
   (1) Test by using a low-resistance ohmmeter.
   (2) Verify the tightness of the bolted connections using a calibrated torque wrench according to the manufacturer's literature.
   (3) Perform a thermographic survey.
i. Test the interlocking systems for correct sequencing and operation.
j. Inspect the insulating assemblies for evidence of physical damage or contamination.
k. Exercise the mechanical components/parts.
l. Compare the switchblade clearances with the industry standards.
m. Ensure that the indicating and control devices operate correctly.
n. Verify the operation of the heaters if applicable.
o. Verify that there is appropriate contact lubricant on the moving, current-carrying parts.
p. Verify that there is appropriate contact lubricant on moving and sliding surfaces.

5. Perform insulation resistance tests pole to pole, pole to ground, and across the open contacts of each phase using the voltage specified in the manufacturer's literature, and ensure that the insulation resistance test values are not less than 1,000 megohms at a direct-current (DC) test voltage of 2,500 volts unless otherwise stated in the manufacturer's literature.
6. Perform overpotential tests pole to pole, pole to ground, and across the open contacts of each phase using the voltage specified in the manufacturer's literature, and ensure that the insulation withstands the voltage applied during the test.
7. Perform resistance measurements on the bolted connections using a low-resistance ohmmeter, and ensure that the bolt torque levels match the manufacturer's literature.
8. Measure the contact resistance across each switchblade and fuse holder, and compare the contact resistances of the electrical connections to the values of similar connections and the manufacturer's literature.
9. Measure the resistance across each fuse, and verify that the fuse resistance values do not deviate from each other by more than 15 percent.
10. Perform corrective action as necessary.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Reconnect the air switch to the system.
13. Perform a functions check on the nonaerial air switch.
14. Reenergize the power to the equipment.
15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a nonaerial air switch.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____

Performance Measures	GO	NO-GO
3. Performed lockout and tagout procedures.	____	____
4. Performed visual and manual inspections of the nonaerial air switch to identify and correct deficiencies.	____	____
5. Performed insulation resistance tests pole to pole, pole to ground, and across the open contacts of each phase using the voltage specified in the manufacturer's literature and ensured that the insulation resistance test values were not less than 1,000 megohms at a DC test voltage of 2,500 volts unless otherwise stated in the manufacturer's literature.	____	____
6. Performed overpotential tests pole to pole, pole to ground, and across the open contacts of each phase using the voltage specified in the manufacturer's literature and ensured that the insulation withstood the voltage applied during the test.	____	____
7. Performed resistance measurements on the bolted connections using a low-resistance ohmmeter and ensured that the bolt torque levels matched the manufacturer's literature.	____	____
8. Measured the contact resistance across each switchblade and fuse holder and compared the contact resistances of the electrical connections to the values of similar connections and the manufacturer's literature.	____	____
9. Measured the resistance across each fuse and verified that the fuse resistance values did not deviate from each other by more than 15 percent.	____	____
10. Performed corrective action as necessary.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Reconnected the air switch to the system.	____	____
13. Performed a functions check on the nonaerial air switch.	____	____
14. Reenergized the power to the equipment.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	NESC®
	TM 5-684

Service an Electrical-Equipment Grounding System

052-206-2108

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance or when an electrical-equipment grounding system is initially installed, you are given a general mechanic's took kit, a voltage detector, the National Electric Code Handbook, electrical construction prints, wiring diagrams, personal protective gear, and a multimeter.

DANGER: REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Service an electrical-equipment grounding system by inspecting the grid system and testing for continuity and resistance. Repair or replace deficiencies.

Performance Steps
NOTE: This task does not include ground resistance testing (see task 052-206-2104).

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Conduct a visual inspection.
   a. Locate the major components/parts of the system, such as the equipment enclosures and system neutrals.
   b. Inspect the system for common faults at the connection points, such as corrosion, loose or broken connections, and overheating.
5. Service the connection points by repairing, replacing, or cleaning them.
6. Conduct electrical tests point to point between the main grounding system connection point and the major electrical-equipment frames and system neutrals to ensure a solid bond throughout the system.

NOTE: Resistance values between each bonded frame and ground should be less than 5 ohms. If there is a long distance from the frame and main ground connection point, the total resistance could be over 1 ohm, so it is important to test section by section or point to point.

   a. Proceed to the next step if the test results are acceptable.
   b. Test individual sections to identify and correct deficiencies if the test results are unacceptable.

7. Keep a record of the test results.
8. Close out lockout and tagout procedures by removing locking and tagging devices.
9. Perform a functions check on the electrical-equipment grounding system.
10. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an electrical-equipment grounding system.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Conducted a visual inspection.	____	____
5. Serviced the connection points by repairing, replacing, or cleaning them.	____	____
6. Conducted electrical tests point to point between the main grounding system connection point and the major electrical-equipment frames and system neutrals to ensure a solid bond throughout the system.	____	____
7. Kept a record of the test results.	____	____
8. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
9. Performed a functions check on the electrical-equipment grounding system.	____	____
10. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
NEC® HANDBOOK	FM 3-34.480 NETA™ NFPA 1001

Service a Power Transformer

052-206-2114

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures; a grounding cluster; a general mechanic's tool box; electrical construction prints; wiring diagrams; a digital low-resistance ohmmeter; a megohmmeter; a transformer turn-to-turn ratio test set; an oil test set; a power factor test set; ASTM D877, D923, D971, D974, D1500, D1524, D1816, D2285, D3612, and D3613 standards; the InterNational Electrical Test Association (NETA) Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems; and the applicable manufacturer's literature.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF TRANSFORMERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE TRANSFORMER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THIS TASK SHOULD ONLY BE PERFORMED ON EQUIPMENT THAT DOES NOT CONTAIN POLYCHLORINATED BIPHENYL (PCB). FAILURE TO COMPLY MAY CAUSE SKIN AILMENTS, REPRODUCTIVE DISORDERS, LIVER DISEASE, AND OTHER ADVERSE HEALTH CONDITIONS.

Standards: Safely service a power transformer by inspecting and testing it according to the manufacturer's literature. Reinstall or repair the transformer based on the test results.

Performance Steps
NOTE: Conduct tests according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Service a dry-type power transformer.
   a. Inspect the condition of the transformer visually and mechanically.
      (1) Clean the unit before testing it unless as-found and as-left tests are required.
      (2) Inspect the bolted electrical connections for high resistance, and compare the resistances to the values of similar connections.
      (3) Verify that the cooling fans operate correctly.
      (4) Verify that the bolt torque levels are correct according to the manufacturer's literature.
   b. Perform electrical tests.
      (1) Perform resistance measurements on the bolted connections using a low-resistance ohmmeter.
      (2) Perform insulation resistance tests winding to winding and winding to ground on each phase; and ensure that the test values at 1 minute meet the manufacturer's specifications. If not stated, compare the results by voltage to the NETA Maintenance Testing

Performance Steps

Specifications for Electrical Power Distribution Equipment and Systems.

(3) Perform a turn-to-turn ratio test on each tap setting, and ensure that the test results do not deviate more than 1/2 percent from the adjacent coils or calculated ratio.

(4) Check the pressure of the transformer surge arrestor.

NOTE: Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from similar connections by more than 50 percent of the lowest value.

(5) Color as specified in ASTM D 1500.

(6) Visual condition as specified in ASTM D 1524

5. Service a liquid-filled power transformer.
   a. Inspect the condition of the transformer visually and mechanically.
      (1) Verify that the control, alarm, and trip settings on the temperature indicators are correct according to the manufacturer's literature.
      (2) Verify that the cooling fans and pumps operate correctly.
      (3) Inspect the bolted electrical connections for high resistance, and compare the resistances to the values of similar connections.
      (4) Verify that the bolt torque levels are correct according to the manufacturer's literature.
   b. Perform insulation-resistance tests winding-to-winding and winding-to-ground on each phase. Ensure that the test values at 1 minute met the manufacturer's specifications and, if not stated, the results should be compared by voltage to the InterNational Electrical Test Association (NETA) Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.
   c. Verify that the liquid levels in the tanks and bushings are correct.
   d. Perform turn ratio test on each tap setting and ensure that the test results did not deviate more than one-half percent from either the adjacent coils or the calculated ratio.
   e. Verify that positive pressures are maintained on nitrogen-blanketed transformers.
   f. Perform specific inspections and mechanical tests recommended by the manufacturer.
   g. Verify that the equipment grounding is correct.
   h. Verify the presence of transformer surge arresters.
   i. Measure the insulation resistance of each winding at the designated tap position.
   j. Remove a sample of insulating liquid according to ASTM D923, and test the sample for the—
      (1) Dielectric breakdown voltage specified in ASTM D877 or ASTM D1816.
      (2) Acid neutralization number specified in ASTM D974.
      (3) Interfacial tension specified in ASTM D971.
      (4) Color specified in ASTM D1500.
      (5) Visual condition specified in ASTM D1524.
   k. Remove a sample of insulating liquid, and have a dissolved gas analysis performed according to ASTM D3612.

6. Perform electrical tests.
   a. Perform resistance measurements on the bolted connections using a low-resistance ohmmeter.
   b. Perform insulation resistance tests winding to winding and winding to ground on each phase; and ensure that the test values at 1 minute meet the manufacturer's specifications. If not stated, compare the results by voltage to the NETA Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.
   c. Perform a turn-to-turn ratio test on each tap setting, and ensure that the test results do not deviate more than 1/2 percent from the adjacent coils or calculated ratio.
   d. Perform power factor and dissipation factor tests on the bushings using the ambient temperature, and ensure that the maximum power factor is corrected to 20°C according to the manufacturer's literature.
   e. Perform an excitation test using the test equipment according to the manufacturer's literature.
   f. Measure the resistance of each winding at the designated tap position, and compare the measurements within 1 percent of previously obtained results after factoring in temperature

Performance Steps

corrections.

7. Reconnect the isolated equipment.
8. Close out lockout and tagout procedures by removing locking and tagging devices.
9. Reenergize the de-energized equipment.
10. Check the primary and secondary sides of the transformer for the proper voltages listed on the equipment data plate.
11. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a power transformer.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Serviced a dry-type power transformer.	____	____
5. Serviced a liquid-filled power transformer.	____	____
6. Performed electrical tests.	____	____
7. Reconnected the isolated equipment.	____	____
8. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
9. Reenergized the de-energized equipment.	____	____
10. Checked the primary and secondary sides of the transformer for the proper voltages listed on the equipment data plate.	____	____
11. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
ASTM D1500	NESC®
ASTM D1524	TM 5-686
ASTM D1816	
ASTM D3612	
ASTM D877	
ASTM D923	
ASTM D971	
ASTM D974	

References

Required

NETA™

Related

Service a Distribution Transformer

052-206-2115

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures; a grounding cluster; a general mechanic's tool box; a digital, low-resistance ohmmeter; a megohmmeter; a transformer turn-to-turn ratio test set; an oil test set; a power factor test set; ASTM D877, D923, D971, D974, D1500, D1524, D1816, D2285, D3612, and D3613 standards; the InterNational Electrical Test Association (NETA) Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems; electrical construction prints, wiring diagrams, and the applicable manufacturer's literature.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF TRANSFORMERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE TRANSFORMER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THIS TASK SHOULD ONLY BE PERFORMED ON EQUIPMENT THAT DOES NOT CONTAIN POLYCHLORINATED BIPHENYL (PCB). FAILURE TO COMPLY MAY CAUSE SKIN AILMENTS, REPRODUCTIVE DISORDERS, LIVER DISEASE, AND OTHER ADVERSE HEALTH CONDITIONS.

Standards: Safely service a distribution transformer by inspecting and testing it. Test the transformer according to the manufacturer's literature. Reinstall or repair the transformer based on the test results.

Performance Steps
NOTE: Conduct tests according to the manufacturer's literature when available. Use industry standards when the manufacturer's literature cannot be obtained.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Service a dry-type distribution transformer.
   a. Inspect the condition of the transformer visually and mechanically.
      (1) Clean the unit before testing it unless as-found and as-left tests are required.
      (2) Inspect the bolted electrical connections for high resistance, and compare the resistances to values of similar connections.
      (3) Verify that the cooling fans operate correctly.
      (4) Verify that the bolt torque levels are correct according to the manufacturer's literature.
   b. Perform electrical tests.
      (1) Perform resistance measurements on the bolted connections using a low-resistance ohmmeter.
      (2) Perform insulation resistance tests winding to winding and winding to ground on each phase; and ensure that the test values at 1 minute meet the manufacturer's specifications. If not stated, compare the results by voltage to the NETA Maintenance Testing

Performance Steps

Specifications for Electrical Power Distribution Equipment and Systems.

(3) Perform a turn-to-turn ratio test on each tap setting, and ensure that the test results do not deviate more than 1/2 percent from the adjacent coils or calculated ratio.

(4) Check the pressure of the transformer surge arrestor.

5. Service a liquid-filled distribution transformer.
   a. Inspect the condition of the transformer visually and mechanically.
      (1) Verify that the control, alarm, and trip settings on the temperature indicators are correct according to the manufacturer's literature.
      (2) Verify that the cooling fans and pumps operate correctly.
      (3) Inspect the bolted electrical connections for high resistance, and compare the resistances to values of similar connections.
      (4) Verify that the bolt torque levels are correct according to the manufacturer's literature.
   b. Verify that the liquid levels in the tanks and bushings are correct.
   c. Verify that positive pressures are maintained on nitrogen-blanketed transformers.
   d. Perform specific inspections and mechanical tests recommended by the manufacturer.
   e. Verify that the equipment grounding is correct.
   f. Verify the presence of transformer surge arresters.
   g. Measure the insulation resistance of each winding at the designated tap position.
   h. Remove a sample of insulating liquid according to ASTM D923, and test the sample for the—
      (1) Dielectric breakdown voltage specified in ASTM D877 or ASTM D1816.
      (2) Acid neutralization number specified in ASTM D974.
      (3) Interfacial tension specified in ASTM D971.
      (4) Color specified in ASTM D1500.
      (5) Visual condition specified in ASTM D1524.
   i. Remove a sample of insulating liquid, and have a dissolved gas analysis performed according to ASTM D3612.

6. Perform electrical tests.
   a. Perform resistance measurements on the bolted connections using a low-resistance ohmmeter.
   b. Perform insulation resistance tests winding to winding and winding to ground on each phase; and ensure that the test values at 1 minute meet the manufacturer's specifications. If not stated, compare the results by voltage to the NETA Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.
   c. Perform a turn-to-turn ratio test on each tap setting, and ensure that the test results do not deviate more than 1/2 percent from the adjacent coils or calculated ratio.
   d. Perform power factor and dissipation factor tests on the bushings using the ambient temperature, and ensure that the maximum power factor is corrected to 20°C according to the manufacturer's literature.
   e. Perform an excitation test using the test equipment according to the manufacturer's literature.
   f. Measure the resistance of each winding at the designated tap position, and compare the measurements within 1 percent of previously obtained results after factoring in temperature corrections.

7. Reconnect the isolated equipment.

8. Close out lockout and tagout procedures by removing locking and tagging devices.

9. Reenergize the de-energized equipment.

10. Check the primary and secondary sides of the transformer for the proper voltages listed on the equipment data plate.

11. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a distribution transformer.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Serviced a dry-type distribution transformer.	____	____
5. Serviced a liquid-filled distribution transformer.	____	____
6. Performed electrical tests.	____	____
7. Reconnected the isolated equipment.	____	____
8. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
9. Reenergized the de-energized equipment.	____	____
10. Checked the primary and secondary sides of the transformer for the proper voltages listed on the equipment data plate.	____	____
11. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
ASTM D1500	NESC®
ASTM D1524	TM 5-686
ASTM D1816	
ASTM D3612	
ASTM D877	
ASTM D923	
ASTM D971	
ASTM D974	
NETA™	

Service Bus Bars

052-206-2116

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures, a lockout and tagout kit, a general mechanic's tool box, an electrician's tool kit, a grounding cluster, conductive grease, a crocus cloth, a nonabrasive wiping cloth, a vacuum cleaner, a brush broom, a wire brush, the required torque wrenches, electrical construction prints, wiring diagrams, a digital low-resistance ohmmeter, an infrared (IR) camera, and the applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF SWITCHGEAR BUS WORK AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE BUS WORK. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Service bus bars by cleaning and inspecting them to ensure that they are capable of carrying a rated load safely.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Remove barriers and covers to gain access to the bus bars.

NOTE: If an IR camera is available and the equipment can be energized safely with the barriers and covers removed, perform an IR survey of the electrical connections.

5. Ensure that the grounding cluster is installed and that the equipment being tested is properly grounded.
6. Inspect the bus bars.
   a. Check for discoloration.
   b. Check for excess debris.
   c. Check for tracking.
   d. Check for poor alignment.
   e. Check for improper connections.
   f. Check for moisture.
7. Test electrical connections using a digital low-resistance ohmmeter.
8. Keep a record of the findings from the inspection.
9. Clean the bus bars.
10. Clean the nonconductive material, such as the insulators and standoffs.
11. Correct deficiencies if possible.

Performance Steps

12. Keep a record of deficiencies that cannot be corrected.
13. Remove the grounding cluster.
14. Replace barriers and covers.
15. Close out lockout and tagout procedures by removing locking and tagging devices.
16. Reenergize the equipment.
17. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service bus bars.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Removed barriers and covers to gain access to the bus bars.	____	____
5. Ensured that the grounding cluster was installed and that the equipment being tested was properly grounded.	____	____
6. Inspected the bus bars.	____	____
7. Tested electrical connections using a digital low-resistance ohmmeter.	____	____
8. Kept a record of the findings from the inspection.	____	____
9. Cleaned the bus bars.	____	____
10. Cleaned the nonconductive material, such as the insulators and standoffs.	____	____
11. Corrected deficiencies if possible.	____	____
12. Kept a record of deficiencies that could not be corrected.	____	____
13. Removed the grounding cluster.	____	____
14. Replaced barriers and covers.	____	____
15. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
16. Reenergized the equipment.	____	____
17. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related
DA FORM 2404
NESC®
TM 5-684

Service a Switchgear Enclosure

052-206-2122

Conditions: As a power plant electrician in a tactical or nontactical environment during maintenance intervals, you are given DA Form 2404 (Equipment Inspection and Maintenance Worksheet), a vacuum cleaner or cleaning brush, an external light source, a general mechanic's tool box, electrical construction prints, wiring diagrams, a high-voltage detector, a lockout and tagout kit, and the applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE SERVICING AND MAINTENANCE OF SWITCHGEAR ENCLOSURES AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE SWITCHGEAR. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. USE THE PROPER TEST EQUIPMENT TO TEST FOR VOLTAGE BEFORE OPENING THE SWITCHGEAR ENCLOSURE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: AVOID CONTACT WITH HEATERS IN THE ENCLOSURE, EVEN AFTER THE POWER HAS BEEN REMOVED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Service the switchgear enclosure by cleaning and inspecting it to ensure that nothing infringes upon the safe operation of the switchgear assembly.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Conduct voltage tests with the appropriate voltage detector in the order listed in the substeps.
   a. Check an energized circuit to ensure that the voltage detector is working properly.
   b. Check for the presence of voltage on the de-energized circuit.
      (1) Replace the cover immediately, and trace the incoming power circuits if there is voltage present.
      (2) Remove the power, and verify that there is no voltage present.
   c. Check the energized circuit again to verify that the voltage detector is working properly.
5. Inspect the exterior of the switchgear enclosure.
   a. Check for dents, cracks, and holes on the outer walls.
   b. Check for the integrity of panels, including the top and bottom.
   c. Check for proper hinge and door operation.
   d. Check for the integrity of welds.
   e. Check for broken bolts and missing or loose bolts, nuts, and washers.
   f. Check for grounding connection quality.

Performance Steps

6. Inspect the interior of the switchgear enclosure.
   a. Check for moisture.
   b. Check the condition of weather seals.
   c. Check for the presence of animal remains.
   d. Check for grounding connection quality.
   e. Check for broken bolts and missing or loose bolts, nuts, and washers.
   f. Check for dirt, debris, or anything that might infringe upon the safe operation of the switchgear assembly.
7. Clean and wipe down the interior and exterior of the switchgear enclosure.
8. Correct deficiencies if possible, and record uncorrectable deficiencies on DA Form 2404.
9. Perform an inventory of cleaning supplies and tools.
10. Reconnect the isolated equipment.
11. Close the door, or replace the access panel.
12. Close out lockout and tagout procedures by removing locking and tagging devices.
13. Reenergize the de-energized equipment.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a switchgear enclosure.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Conducted voltage tests with the appropriate voltage detector in the order listed in the substeps.	____	____
5. Inspected the exterior of the switchgear enclosure.	____	____
6. Inspected the interior of the switchgear enclosure.	____	____
7. Cleaned and wiped down the interior and exterior of the switchgear enclosure.	____	____
8. Corrected deficiencies if possible and recorded uncorrectable deficiencies on DA Form 2404.	____	____
9. Performed an inventory of cleaning supplies and tools.	____	____
10. Reconnected the isolated equipment.	____	____
11. Closed the door or replaced the access panel.	____	____
12. Closed out lockout and tagout procedures by removing locking and tagging	____	____

Performance Measures	GO	NO-GO
devices.		
13. Reenergized the de-energized equipment.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required
DA FORM 2404

Related
NESC®
S AND C HANDBOOK
TM 5-684
TM 9-6115-604-12

Perform a Power Factor and Dissipation Factor Test

052-206-2123

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance or when electrical equipment is initially installed, you are given a power factor test set, a general mechanic's tool box, a voltage detector, a hot stick, ground cables with clamps, a grounding stick, safety standing operating procedures, electrical construction prints, wiring diagrams, the applicable manufacturer's literature, and a lockout and tagout kit.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. USE THE PROPER TEST EQUIPMENT TO TEST FOR VOLTAGE BEFORE CONTACTING COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THIS TASK SHOULD NOT BE PERFORMED ON EQUIPMENT THAT CONTAINS POLYCHLORINATED BIPHENYL (PCB). FAILURE TO COMPLY MAY CAUSE SKIN AILMENTS, REPRODUCTIVE DISORDERS, LIVER DISEASE, AND OTHER ADVERSE HEALTH CONDITIONS.

Standards: Perform a power factor and dissipation factor test to determine the condition of the insulation. Verify that the test results are sufficient according to the manufacturer's literature or industry standards before reenergizing the equipment.

Performance Steps

NOTE: Power factor and dissipation factor test results are important for tracking the deterioration of insulation. While single tests are useful, it is critical to keep records of the tests. This will help track the insulation and show if drastic changes in insulation values over a short period of time.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Perform lockout and tagout procedures.
4. Use a voltage detector to verify that no voltage exists at equipment connection points.
5. Install safety grounds.
6. Prepare an as-found wiring diagram that shows the connection configuration used to attach the equipment to the system.
7. Disconnect the cables from the equipment terminals as necessary to perform the test.
8. Mark the cable ends to identify connection points and designated phases.
9. Clean the equipment to be tested after the as-found test is completed if the as-found readings are needed.
10. Employ the test equipment, and perform a power factor and dissipation factor test according to the manufacturer's literature.
11. Keep a record of the test results.
12. Keep a record of the environmental conditions.
13. Determine the status of the insulation by interpreting the test.

Performance Steps

a. Proceed to step 14 if the test results are acceptable.
b. Repair or replace the insulation if the test results are unacceptable.
c. Retest the insulation after repairing or replacing it.

14. Reconnect and torque the cables if necessary.
15. Uninstall the safety grounds.
16. Remove the safety clearance.
17. Close out lockout and tagout procedures by removing locking and tagging devices.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform a power factor and dissipation factor test.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Performed lockout and tagout procedures.	____	____
4. Used a voltage detector to verify that no voltage existed at equipment connection points.	____	____
5. Installed safety grounds.	____	____
6. Prepared an as-found wiring diagram that showed the connection configuration used to attach the equipment to the system.	____	____
7. Disconnected the cables from the equipment terminals as necessary to perform the test.	____	____
8. Marked the cable ends to identify connection points and designated phases.	____	____
9. Cleaned the equipment to be tested after the as-found test was completed if the as-found readings were needed.	____	____
10. Employed the test equipment and performed a power factor and dissipation factor test according to the manufacturer's literature.	____	____
11. Kept a record of the test results.	____	____
12. Kept a recorded of the environmental conditions.	____	____
13. Determined the status of the insulation by interpreting the test.	____	____
14. Reconnected and torqued the cables if necessary.	____	____
15. Uninstalled the safety grounds.	____	____
16. Removed the safety clearance.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging	____	____

Performance Measures	GO	NO-GO
devices.		
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	IEEE RED BOOK™ NETA™ TM 5-684

Service an Air-Magnetic Circuit Breaker

052-206-2124

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures, a general mechanic's tool box, a digital low-resistance ohmmeter, a megohmmeter, a high-potential test set, a power factor test set, wiring diagrams, maintenance logbooks, grounding equipment, and the applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF CIRCUIT BREAKERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE CIRCUIT BREAKER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. THE INSULATION TESTER PRODUCES HIGH VOLTAGE. DO NOT TOUCH THE CABLE BEING TESTED OR THE TEST LEADS. REMOVE THE POWER, AND DISCHARGE AND GROUND THE CIRCUIT FOR TWICE THE AMOUNT OF TIME IT WAS TESTED BEFORE HANDLING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service an air-magnetic circuit breaker by inspecting and testing the circuit breaker according to the manufacturer's literature. If the manufacturer's literature is not available, use the industry standards. Reinstall or repair the circuit breaker based on the test results.

Performance Steps
NOTE: Conduct tests according to the manufacturer's literature. Use industry standards when the manufacturer's literature cannot be obtained.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Keep a record of as-left and as-found operation counter readings.
6. Inspect the condition of the circuit breaker visually and manually.

NOTE: Microhm or millivolt drop values should not exceed high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

a. Clean the circuit breaker before testing it unless as-found and as-left tests are required.
b. Inspect for—
   (1) Anchorage.
   (2) Alignment.
   (3) Grounding.
   (4) Arc chutes.

Performance Steps

(5) Condition, wear, and alignment of moving and stationary contacts.
(6) Puffer operation.

c. Verify that—
(1) Maintenance devices are available for servicing and operating the circuit breaker.
(2) Primary and secondary contact wipes are specified according to the manufacturer's literature.
(3) Proper cell fit and element alignment are present.
(4) Moving, current-carrying parts have appropriate contact lubrications.
(5) Moving, sliding surfaces have the correct amount of appropriate lubrications.
(6) Perform mechanical operator and contact alignment tests for the circuit breaker and operating mechanism.

7. Perform resistance measurements through the bolted connections using a low-resistance ohmmeter, and compare contact resistances of electrical connections to the values of similar connections if the manufacturer's literature is not available.

8. Perform insulation resistance tests pole to pole, pole to ground, and across open poles, and ensure that insulation resistance test values at 1 minute are no less than 1,000 megohms at a direct-current (DC) test voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.

9. Perform an insulation resistance test on the control wiring according to the manufacturer's literature; ensure that the control wiring insulation resistance is a minimum of 2 megohms; and for units with solid-state components/parts, follow the manufacturer's recommendations.

10. Perform tests with the circuit breaker in the TEST position, and ensure that trip and close operations for the circuit breaker work properly.
a. Trip and close the circuit breaker with the control switch.
b. Trip the breaker by operating each protective relay.
c. Verify that the trip-free and antipump functions work properly.

11. Perform a power factor and dissipation factor test on the breaker; compare the results of the power factor and dissipation factor test to the manufacturer's specifications; and if the manufacturer's specifications are not available, compare the test results to similar circuit breakers.

12. Perform an overpotential test according to the manufacturer's literature, and ensure that the insulation withstands the applied overpotential test voltage.

13. Keep a record of the test results.

14. Close out logout and tagout procedures by removing locking and tagging devices.

15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an air-magnetic circuit breaker.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____

Performance Measures	GO	NO-GO
5. Kept a record of as-left and as-found operation counter readings.	____	____
6. Inspected the condition of the circuit breaker visually and manually.	____	____
7. Performed resistance measurements through the bolted connections using a low-resistance ohmmeter and compared contact resistances of electrical connections to the values of similar connections if the manufacturer's literature was not available.	____	____
8. Performed insulation resistance tests pole to pole, pole to ground, and across open poles and ensured that insulation resistance test values at 1 minute were no less than 1,000 megohms at a DC test voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.	____	____
9. Performed insulation resistance tests on the control wiring according to the manufacturer's literature; ensured that the control wiring insulation resistance was a minimum of 2 megohms; and for units with solid-state components/parts, followed the manufacturer's recommendations.	____	____
10. Performed tests with the circuit breaker in the TEST position and ensured that trip and close operations for the circuit breaker worked properly.	____	____
11. Performed a power factor and dissipation factor test on the breaker; compared the results of the power factor and dissipation factor test to the manufacturer's specifications; and if the manufacturer's specifications were not available, compared the test results to similar circuit breakers.	____	____
12. Performed an overpotential test according to the manufacturer's literature and ensured that the insulation withstood the applied overpotential test voltage.	____	____
13. Kept a record of the test results.	____	____
14. Closed out logout and tagout procedures by removing locking and tagging devices.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480
	NETA™

Service an Alternating-Current (AC) Generator Assembly

052-206-2125

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given a multimeter; wire markers; a general mechanic's tool box; an air gap feeler gauge; a high-voltage detector; a lockout and tagout kit; a 5-kilovolt, direct-current (DC) megohmmeter; high-voltage gloves; a grounding stick; wiring diagrams; maintenance logbooks; safety clearance standing operating procedures; and the applicable manufacturer's literature with schematics.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT LOAD CABLES ARE INSTALLED ON PARKING STANDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. USE THE PROPER TEST EQUIPMENT TO TEST FOR VOLTAGE BEFORE CONTACTING COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: COMPRESSED AIR USED FOR CLEANING OR DRYING MAY CREATE AIRBORNE PARTICLES THAT COULD ENTER THE EYES. PRESSURE SHOULD NOT EXCEED 30 POUNDS PER SQUARE INCH. WEARING OF GOGGLES IS REQUIRED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Safely service an AC generator assembly to make it operational. Accurately inspect and test the generator assembly, and repair or replace faulty components/parts.

Performance Steps
NOTE: The procedures below should be used in conjunction with the manufacturer's literature.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Ground the generator leads.
6. Inspect the generator.
   a. Check for excessive contamination (dust, dirt, debris).
   b. Check for excessive operating temperatures.
   c. Check for fractured parts.
   d. Check for loose or missing parts.
   e. Check for lubrication contamination.
   f. Check for stator insulation deterioration.
7. Disconnect and tag the generator leads.

WARNING: BEFORE TESTING THE MAIN OR EXCITER ROTOR WITH AN INSULATION RESISTANCE TESTER, TERMINAL LEADS SHOULD BE DISCONNECTED FROM THE ROTATING RECTIFIER. FAILURE TO COMPLY MAY CAUSE EQUIPMENT DAMAGE.

8. Test the main stator to ensure that ohm values are more than 5.16 megohms.
   a. Apply 5 kilovolts for 60 seconds using a megohmmeter.
   b. Keep a record of the readings.
   c. Perform preventive measures (cleaning, drying, repairing, replacing).

Performance Steps

9. Test the main rotor to ensure that ohm values are more than 2 megohms.
    a. Apply the manufacturer's recommended voltage for 60 seconds using the megohmmeter.
    b. Keep a record of the readings.
10. Test the exciter rotor assembly to ensure that ohm values are more than 1 megohm.
    a. Apply the manufacturer's recommended voltage for 60 seconds using the megohmmeter.
    b. Keep a record of the readings.
    c. Perform preventive measures (cleaning, drying, repairing, replacing).
11. Test the exciter stator to ensure that ohm values are more than 1 megohm.
    a. Apply the manufacturer's recommended voltage for 60 seconds using the megohmmeter.
    b. Keep a record of the readings.
    c. Perform preventive measures (cleaning, drying, repairing, replacing).
12. Test the rotating rectifier.
    a. Remove bolted lead wires from rectifiers at the terminal studs.
    b. Test the resistance between the disconnected lead wire and the base of each rectifier.
    c. Note the reading, and reverse the multimeter probes (one reading will be high and the other low if the rectifier is good).
    d. Repair the rotating rectifier assembly by replacing damaged or defective components/parts.
13. Replace bolted lead wires on rectifiers at the terminal studs.
14. Close out lockout and tagout procedures by removing locking and tagging devices.
15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an AC generator assembly.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Grounded the generator leads.	____	____
6. Inspected the generator.	____	____
7. Disconnected and tagged the generator leads.	____	____
8. Tested the main stator to ensure that ohm values were more than 5.16 megohms.	____	____
9. Tested the main rotor to ensure that ohm values were more than 2 megohms.	____	____
10. Tested the exciter rotor assembly to ensure that ohm values were more than 1 megohm.	____	____
11. Tested the exciter stator to ensure that ohm values were more than 1 megohm.	____	____
12. Tested the rotating rectifier.	____	____

Performance Measures	GO	NO-GO
13. Replaced bolted lead wires on rectifiers at the terminal studs.	____	____
14. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related
DA FORM 2404
NESC®
TM 5-682
TM 9-6115-604-12

Service a Sulfur Hexafluoride (SF6) Circuit Breaker

052-206-2127

Conditions: As a power plant electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures, a general mechanic's tool box, a digital low-resistance ohmmeter, a megohmmeter, a high-potential test set, a power factor test set, wiring diagrams, grounding equipment, and the applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF CIRCUIT BREAKERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE CIRCUIT BREAKER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. DO NOT EXCEED THE MAXIMUM VOLTAGE STIPULATED FOR THIS TEST. FAILURE TO COMPLY COULD CAUSE THE SF6 BOTTLES TO EXPLODE AND MAY RESULT IN PERMANENT INJURY OR DEATH.

Standards: Safely service an SF6 circuit breaker by inspecting and testing it. Test the SF6 circuit breaker according to the manufacturer's literature. Reinstall or repair the circuit breaker based on the test results.

Performance Steps

NOTE: Conduct tests according to the manufacturer's literature. Use industry standards when the manufacturer's literature cannot be obtained.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Inspect the condition of the SF6 circuit breaker visually and manually.

NOTE: Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

a. Clean the circuit breaker before testing unless as-found and as-left tests are required.
b. Keep a record as-left and as-found operation counter readings if applicable.
c. Inspect the anchorage and grounding.
d. Inspect and verify mechanism adjustments according to the manufacturer's literature.
e. Inspect and service the air compressor according to the manufacturer's literature.
f. Inspect and service the hydraulic system according to the manufacturer's literature.
g. Test for gas leaks according to the manufacturer's literature.
h. Verify the correct operation of air and SF6 gas pressure alarms and cutouts.
i. Slow the close/open breaker, and check for binding.
j. Perform a time-travel analysis.
k. Verify that contact lubricant is present on moving, current-carrying parts.

Performance Steps

l. Verify that lubrication is present on moving, sliding surfaces.

6. Perform resistance measurements through the bolted connections using a low-resistance ohmmeter, and compare contact resistances of electrical connections to the values of similar connections and to the values specified in the manufacturer's literature.

7. Perform insulation resistance tests pole to pole, pole to ground, and across open poles; and ensure that insulation resistance test values at 1 minute are no less than 1,000 megohms at a direct-current (DC) voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.

8. Perform an insulation resistance test on the control wiring according to the manufacturer's literature; ensure that the insulation resistance of the control wiring is a minimum of 2 megohms; and for units with solid-state components/parts, follow the manufacturer's recommendations.

9. Perform a power factor and dissipation factor test on the breaker and bushings; compare the results to the manufacturer's specifications; and if the manufacturer's literature is not available, compare the test results to similar circuit breakers.

NOTE: Test results should be within 10 percent of the name plate rating for the bushings.

WARNING: SOME DC, HIGH-POTENTIAL TEST SETS ARE HALF WAVE-RECTIFIED AND MAY PRODUCE PEAK VOLTAGES IN EXCESS OF THE MANUFACTURER'S RECOMMENDED MAXIMUM FOR THE CIRCUIT BREAKER. FAILURE TO FOLLOW TEST SET INSTRUCTIONS MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

10. Perform an overpotential test according to the manufacturer's literature, and ensure that the insulation withstands the applied overpotential test voltage.

11. Verify that the trip, close, trip-free, and antipump functions operate properly; and ensure that the minimum pickup for the trip and close coils conforms to the specifications in the manufacturer's literature.

12. Trip the circuit breaker by operating each protective device.

13. Close out lockout and tagout procedures by removing locking and tagging devices.

14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an SF6 circuit breaker.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Inspected the condition of the SF6 circuit breaker visually and manually.	____	____
6. Performed resistance measurements through the bolted connections using a low-resistance ohmmeter and compared contact resistances of electrical connections to the values of similar connections and to the values specified in the	____	____

Performance Measures	GO	NO-GO
manufacturer's literature.		
7. Performed insulation resistance tests pole to pole, pole to ground, and across open poles and ensured that the insulation resistance test values at 1 minute were no less than 1,000 megohms at a DC voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.	____	____
8. Performed insulation resistance tests on the control wiring according to the manufacturer's literature; ensured that the insulation resistance of the control wiring was a minimum of 2 megohms; and for units with solid-state components/parts, followed the manufacturer's recommendations.	____	____
9. Performed a power factor and dissipation factor test on the breaker and bushings; compared the results to the manufacturer's specifications; and if the manufacturer's literature was not available, compared the test results to similar circuit breakers.	____	____
10. Performed an overpotential test according to the manufacturer's literature and ensured that the insulation withstood the applied overpotential test voltage.	____	____
11. Verified that the trip, close, trip-free, and antipump functions operated properly and ensured that the minimum pickup for the trip and close coils conformed to the specifications in the manufacturer's literature.	____	____
12. Tripped the circuit breaker by operating each protective device.	____	____
13. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	DA FORM 2404
	NESC®
	NETA™
	TM 9-6115-604-12

Identify Electrical Faults Using an Infrared (IR) Camera

052-206-2133

Conditions: As a power station electrician in a tactical or nontactical environment during a maintenance interval, you are given the electrical equipment to be tested, a general mechanic's tool box, an IR or digital camera, the appropriate manufacturer's literature, applicable software, and a computer.

DANGER: KNOW THE SYSTEM VOLTAGES, AND MAINTAIN PROPER, SAFE DISTANCES FROM THE ENERGIZED EQUIPMENT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Identify electrical faults using an IR camera by detecting hot spots in the viewer mode. Keep a record of the images and descriptions. Conduct an IR survey, and prepare a report of the images taken.

Performance Steps

1. Prepare an inventory list of the equipment items or components/parts to be tested.
2. Arrange the inventory list items in a logical sequence.
3. Coordinate with the equipment maintenance supervisor if the system is unknown.
    a. Obtain a description of the system.
    b. Obtain information on known current faults.
    c. Obtain information on symptoms of possible faults.
    d. Obtain information on the possible system hazards.
4. Conduct an IR survey.
    a. View the system with the IR camera for a possible electrical fault.
    b. Photograph the possible electrical fault. Ensure that the camera is—
        (1) Set properly.
        (2) Placed at a proper distance from the electrical fault.
        (3) Properly focused.
        (4) Stable.
    c. Keep a record of the information for each picture, such as the—
        (1) Detailed location.
        (2) Item name or type of equipment.
        (3) Item description.
        (4) Operating condition.
        (5) Environmental conditions.
        (6) Weather (air temperature, wind speed, sky conditions).
        (7) Lighting conditions.
        (8) Radiation transmitters or reflectors.

NOTE: Weather and light conditions can cause a false electrical fault or mask the severity of a potential problem.

    d. Analyze the picture for possible problems, such as—
        (1) Phase imbalance.
        (2) Loose connections.
        (3) Faulty components/parts.
    e. Produce a report of the IR survey if necessary, including—
        (1) A normal picture of the equipment containing the fault during daytime hours.
        (2) An IR picture of the fault.
        (3) A description of the fault.
        (4) The suggested priority of repairs.
        (5) A strip map containing the location of each fault.
5. Brief the report to the individual who requested the IR survey.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to identify electrical faults using an IR camera.

Performance Measures	GO	NO-GO
1. Prepared an inventory list of the equipment items or components/parts to be tested.	____	____
2. Arranged the inventory list items in a logical sequence.	____	____
3. Coordinated with the equipment maintenance supervisor if the system was unknown.	____	____
4. Conducted an IR survey.	____	____
5. Briefed the report to the individual who requested the IR survey.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480

Service a Sulfur Hexafluoride (SF6) Switch

052-206-2134

Conditions: As a power plant electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures, a general mechanic's tool box, a digital low-resistance ohmmeter, a megohmmeter, a high-potential test set, grounding equipment, and the applicable manufacturer's literature.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF SF6 SWITCHES AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE SF6 SWITCH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. DO NOT EXCEED THE MAXIMUM VOLTAGE STIPULATED FOR THIS TEST. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service an SF6 switch by inspecting and testing it. Test the SF6 switch according to the manufacturer's literature. Reinstall or repair the SF6 switch based on the test results.

Performance Steps
NOTE: Conduct tests according to the manufacturer's literature. Use industry standards when the manufacturer's literature cannot be obtained.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Inspect the condition of the SF6 switch visually and manually.

NOTE: Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate the values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

a. Clean the switch before testing unless as-found and as-left tests are required.
b. Keep a record of as-left and as-found operation counter readings if applicable.
c. Inspect the anchorage and grounding.
d. Perform mechanical operator tests according to the manufacturer's literature if applicable.
e. Verify the correct operation and adjustments of motor operator limit switches and mechanical interlocks if applicable.
f. Inspect insulating assemblies for evidence of physical damage or contaminated surfaces.
g. Check each fuse holder for adequate support and contact.
h. Verify that fuse sizes and types correspond to the drawings if provided.
i. Test for gas leaks according to the manufacturer's literature.
j. Verify the correct operation of air and SF6 gas pressure alarms and cutouts.
k. Test electrical and mechanical interlock systems for correct operation and sequencing.

Performance Steps

6. Perform resistance measurements through each pole using a low-resistance ohmmeter, and compare contact resistances of electrical connections to the values of similar connections and to the values specified in the manufacturer's literature.
7. Verify that the open and close operations from control devices are operational if applicable.
8. Perform insulation resistance tests pole to pole, pole to ground, and across open poles; and ensure that insulation resistance test values at 1 minute are no less than 1,000 megohms at a direct-current (DC) test voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.

WARNING: SOME DC, HIGH-POTENTIAL TEST SETS ARE HALF WAVE-RECTIFIED AND MAY PRODUCE PEAK VOLTAGES IN EXCESS OF THE MANUFACTURER'S RECOMMENDED MAXIMUM FOR THE SWITCH. FAILURE TO FOLLOW TEST SET INSTRUCTIONS MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

9. Perform an overpotential test according to the manufacturer's literature.
10. Keep a record of the test results.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an SF6 switch.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Inspected the condition of the SF6 switch visually and manually.	____	____
6. Performed resistance measurements through each pole using a low-resistance ohmmeter and compared contact resistances of electrical connections to the values of similar connections and to the values specified in the manufacturer's literature.	____	____
7. Verified that the open and close operations from control devices were operational if applicable.	____	____
8. Performed insulation resistance tests pole to pole, pole to ground, and across open poles and ensured that insulation resistance test values at 1 minute were less than 1,000 megohms at a DC test voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.	____	____
9. Performed an overpotential test according to the manufacturer's literature.	____	____
10. Kept a record of the test results.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging	____	____

Performance Measures	GO	NO-GO
devices.		
12. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480 NESC® NETA™

Service a Vacuum Circuit Breaker

052-206-2135

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures, a general mechanic's tool box, a digital low-resistance ohmmeter, a megohmmeter, wiring diagrams, a high-potential test set or vacuum bottle test set, grounding equipment, and the applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF VACUUM CIRCUIT BREAKERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHILE A POWER SOURCE IS CONNECTED TO THE SWITCH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. DO NOT EXCEED THE MAXIMUM VOLTAGE STIPULATED FOR THIS TEST. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. AN APPLICATION OF HIGH VOLTAGE ACROSS AN OPEN GAP IN A VACUUM CAN PRODUCE AN X-RAY EMISSION THAT MAY CAUSE IMMEDIATE PERSONAL INJURY.

2. SOME DIRECT-CURRENT (DC), HIGH-POTENTIAL TEST SETS ARE HALF WAVE-RECTIFIED AND MAY PRODUCE PEAK VOLTAGES IN EXCESS OF THE MANUFACTURER'S RECOMMENDED MAXIMUM FOR THE SWITCH. FAILURE TO FOLLOW TEST SET INSTRUCTIONS MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Safely service a vacuum circuit breaker by inspecting and testing it. Test the vacuum circuit breaker according to the manufacturer's literature. Reinstall or repair the vacuum circuit breaker based on the test results.

Performance Steps
NOTE: Conduct tests according to the manufacturer's literature. Use industry standards when the manufacturer's literature cannot be obtained.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Inspect the condition of the vacuum circuit breaker visually and manually.

NOTE: Microhm or millivolt drop values should not exceed the high levels of the normal range as indicated in the manufacturer's literature. If the manufacturer's literature is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

Performance Steps

a. Thoroughly clean the unit before testing unless as-found or as-left tests are required.
b. Keep a record of as-left and as-found operation counter readings if applicable.
c. Inspect the anchorage, alignment, and grounding.
d. Perform mechanical operational tests on the circuit breaker and its operating mechanism.
e. Measure critical distances, such as the contact gap, according to the manufacturer's literature.
f. Verify that lubrication is present on moving, sliding surfaces.

6. Perform resistance measurements through the bolted connections with a low-resistance ohmmeter, and ensure that the bolt torque levels match the manufacturer's literature.
7. Perform a contact resistance test, and compare contact resistances of electrical connections to the values of similar connections and to the values specified in the manufacturer's literature.
8. Verify that trip, close, trip-free, and antipump functions operate properly.
9. Trip the circuit breaker by operating each protective device to verify that open and close protective devices are operational and function according to the recommended values specified in the manufacturer's literature.
10. Perform insulation resistance tests pole to pole, pole to ground, and across open poles; and ensure that insulation resistance test values are no less than 1,000 megohms at a DC voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.
11. Perform a vacuum bottle integrity test across each vacuum bottle with the switch in the OPEN position and according to the manufacturer's literature.
    a. Ensure that the test set does not trip when the overpotential voltage is applied.
    b. Provide adequate barriers and protection against x-radiation during the test.

NOTE: Do not perform this test unless the contact displacement of each interrupter is within the tolerance specified in the manufacturer's literature.

12. Keep a record of the test results.
13. Close out lockout and tagout procedures by removing locking and tagging devices.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a vacuum circuit breaker.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Inspected the condition of the vacuum circuit breaker visually and manually.	____	____
6. Performed resistance measurements through the bolted connections with a low-resistance ohmmeter and ensured that the bolt torque levels matched the manufacturer's literature.	____	____

Performance Measures	GO	NO-GO
7. Performed a contact resistance test and compared contact resistances of electrical connections to the values of similar connections and to the values specified in the manufacturer's literature.	____	____
8. Verified that trip, close, trip-free, and antipump functions operated properly.	____	____
9. Tripped the circuit breaker by operating each protective device to verify that open and close protective devices were operational and functioned according to the recommended values specified in the manufacturer's literature.	____	____
10. Performed insulation resistance tests pole to pole, pole to ground, and across open poles and ensured that insulation resistance test values were no less than 1,000 megohms at a DC voltage of 2,500 volts unless otherwise specified in the manufacturer's literature.	____	____
11. Performed a vacuum bottle integrity test across each vacuum bottle with the switch in the OPEN position and according to the manufacturer's literature.	____	____
12. Kept a record of the test results.	____	____
13. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 3-34.480
	NESC®
	NETA™

Perform an Insulation Resistance Test

052-206-2136

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance or when electrical equipment is initially installed, you are given a megohmmeter or direct-current (DC), high-potential test set; an electrician's tool kit; a voltage detector; wire markers; a hot stick; grounding equipment; applicable manufacturer's literature or industry standards; a lockout and tagout kit; and applicable personal protective equipment.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. USE THE PROPER TEST EQUIPMENT TO TEST FOR VOLTAGE BEFORE CONTACTING THE COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. THE INSULATION TESTER PRODUCES HIGH VOLTAGE. DO NOT TOUCH THE CABLE BEING TESTED OR THE TEST LEADS. REMOVE THE POWER, AND DISCHARGE AND GROUND THE CIRCUIT FOR TWICE THE AMOUNT OF TIME IT WAS TESTED BEFORE HANDLING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. THERE MUST BE NO MATERIALS (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST THE CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THIS TASK SHOULD NOT BE PERFORMED ON EQUIPMENT CONTAINING POLYCHLORINATED BIPHENYL (PCB). FAILURE TO COMPLY MAY CAUSE SKIN AILMENTS, REPRODUCTIVE DISORDERS, LIVER DISEASE, AND OTHER ADVERSE HEALTH CONDITIONS RESULTING IN PERMANENT INJURY OR DEATH.

Standards: Perform an insulation resistance test by determining the condition of the insulation based on the test results and according to the applicable manufacturer's literature or industry standards. Repair or replace the equipment if necessary. Retest repaired or replaced equipment.

Performance Steps

1. Review danger, warning, and caution notices.
2. Perform lockout and tagout procedures on the system where the equipment is installed.
3. Use a voltage detector to verify that there is no voltage at connection points.
4. Install safety grounds.
5. Prepare an as-found wiring diagram that shows the connection configuration used to attach the equipment to the system.
6. Mark cable ends to identify their connection points and designated phases.

NOTE: If as-found results are needed, the equipment should be cleaned after the test.

7. Clean the equipment to be tested.

NOTE: Complete a megohmmeter test before performing a high-potential test. The megohmmeter test is less destructive and can locate faults before the high-potential test can find them.

8. Determine which type of insulation test (such as the megohmmeter or high-potential test) to use.

Performance Steps

9. Disconnect cables from the equipment terminals as necessary to perform the test.
10. Employ the test equipment, and perform the insulation-resistance test according to operation instructions provided with the test set.

NOTE: When electrical equipment has multiple primary and secondary windings, all primary and secondary windings that are not being tested must be shorted together and shorted to the ground.

NOTE: If no standards or test records for the equipment can be found, the minimum accepted standard for the megohmmeter test is 1 megohm per kilovolt of rated voltage plus 1 megohm.

11. Keep a record of the test results.
12. Determine the status of the insulation by interpreting the test.
    a. Proceed to step 13 if results are acceptable.
    b. Clean, repair, or replace the equipment if results are unacceptable.
    c. Retest the equipment.
13. Reconnect and torque cables as necessary.
14. Remove safety grounds.
15. Close out lockout and tagout procedures by removing locking and tagging devices.
16. Reenergize the equipment.
17. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform an insulation resistance test.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Performed lockout and tagout procedures on the system where the equipment was installed.	____	____
3. Used a voltage detector to verify that there was no voltage at connection points.	____	____
4. Installed safety grounds.	____	____
5. Prepared an as-found wiring diagram that showed the connection configuration used to attach the equipment to the system.	____	____
6. Marked cable ends to identify their connection points and designated phases.	____	____
7. Cleaned the equipment to be tested.	____	____
8. Determined which type of insulation test (such as the megohmmeter or high-potential) to use.	____	____
9. Disconnected cables from the equipment terminals as necessary to perform the test.	____	____

Performance Measures	GO	NO-GO
10. Employed the test equipment and performed the insulation-resistance test according to operation instructions provided with the test set.	____	____
11. Kept a record of the test results.	____	____
12. Determined the status of the insulation by interpreting the test.	____	____
13. Reconnected and torqued cables as necessary.	____	____
14. Removed safety grounds.	____	____
15. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
16. Reenergized the equipment.	____	____
17. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	ER 385-1-31
	FM 3-34.480
	FM 5-412
	LCH
	TM 5-682
	TM 5-684
	TM 5-811-1
	TM 5-811-3

Subject Area 5: U4 Power Line Distribution Tasks

Inspect Safety Equipment

052-204-1108

Conditions: As a power line distribution specialist in a tactical or nontactical dry, well-lit environment during scheduled or unscheduled maintenance and when safety equipment needs to be inspected, you are given the applicable equipment technical manuals (TMs), the applicable manufacturer's literature, DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection and Maintenance Worksheet), and the applicable safety standing operating procedures (SOPs).

DANGER: SAFETY EQUIPMENT MUST BE INSPECTED AS SPECIFIED IN THE APPLICABLE EQUIPMENT TM OR MANUFACTURER'S LITERATURE. FAILURE TO PERFORM A REQUIRED INSPECTION MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Inspect safety equipment using the manufacturer's literature, applicable equipment TMs, and applicable SOPs. Remove unsafe equipment from the inventory.

Performance Steps

1. Determine the personal protective equipment (PPE) required for each specific job.
2. Inspect the equipment visually for cracks, rips, tears, and excessive wear.
3. Inspect the equipment manually for cracks, rips, tears, and excessive wear.
4. Check for valid calibration stamps if applicable.
5. Record deficiencies on DA Form 2404.
6. Remove unsafe equipment from the inventory.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to inspect safety equipment.

Performance Measures	**GO**	**NO-GO**
1. Determined the PPE required for each specific job.	____	____
2. Inspected the equipment visually for cracks, rips, tears, and excessive wear.	____	____
3. Inspected the equipment manually for cracks, rips, tears, and excessive wear.	____	____
4. Checked for valid calibration stamps if applicable.	____	____
5. Recorded deficiencies on DA Form 2404.	____	____
6. Removed unsafe equipment from the inventory.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	EM 385-1-1
	LCH
	TM 5-682
	TM 5-684

Prepare a Manhole for Safe Entry

052-204-1113

Conditions: As a power line distribution specialist in a tactical or nontactical environment when a manhole needs to be prepared for safe entry, you are given a three-person team consisting of an entry supervisor, an attendant, and an entrant. You are also given traffic control equipment, a manhole lid removal device, an extraction system for confined-space entry and rescue, a manhole ventilator, a submersible water pump with a hose, a power source for a submersible pump, an air quality tester with the manufacturer's instructions, and the applicable personal protective equipment.

DANGER:

1. IF A MANHOLE COVER IS ENCASED IN ICE, DO NOT STRIKE IT WITH STEEL OR IRON. THE STRIKING OF STEEL OR IRON AGAINST A STEEL COVER MAY RESULT IN AN EXPLOSION IF COMBUSTIBLE GAS IS PRESENT IN THE MANHOLE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. NEVER ENTER A MANHOLE UNTIL ATMOSPHERIC CONDITIONS ARE TESTED AND FOUND TO BE IN COMPLIANCE WITH OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) STANDARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. NEVER ENTER A MANHOLE WITHOUT AN ASSISTANT LOCATED OUTSIDE THE MANHOLE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. DO NOT ENTER A MANHOLE TO PUMP OUT WATER. LOWER THE PUMP OR HOSE INTO THE HOLE, AND REMOVE STANDING WATER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: USE PROPER LIFTING PROCEDURES. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY.

NOTE: Failure to verify whether the manhole is a permit or nonpermit confined space may cause personnel to be subject to fines or legal action.

Standards: Prepare a manhole for safe entry by ensuring that traffic barriers are strategically placed, the cover is properly removed, water is removed, gas detection is performed, ventilation procedures are performed, and the extraction system for confined-space entry and rescue is in the correct position to allow for extraction in the event of an injury.

Performance Steps

1. Ensure that tools and equipment are in proper working condition.
2. Conduct a safety briefing.
3. Set up traffic control equipment.
4. Remove the manhole cover.
5. Test the air quality tester for proper operation.

NOTES:

1. Due to many different manufacturers, it is essential that the manufacturer's instructions for the air quality tester being used are referenced for the proper inspection of the detector and for proper test performance.

2. Different depths of the manhole should be tested. The sampling tube should not come into

Performance Steps
contact with the ground or any other foreign object.

3. While work is being performed in the manhole, the air quality tester should constantly be in use to monitor gases.

6. Test atmospheric conditions using the air quality tester.
   a. Test for combustible gases.
   b. Test for toxic gases.
   c. Test for oxygen deficiency.
7. Pump out water.
8. Ventilate the manhole.
   a. Use the forced-air method.
   b. Use the natural method.
   c. Use the sail method.
9. Install the extraction system for confined-space entry and rescue.
10. Suit the entrant with the safety harness and attach it to the extraction system for confined-space entry and rescue.
11. Assist the entrant into the manhole.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to prepare a manhole for safe entry.

Performance Measures	**GO**	**NO-GO**
1. Ensured that tools and equipment were in proper working condition.	____	____
2. Conducted a safety briefing.	____	____
3. Set up traffic control equipment.	____	____
4. Removed the manhole cover.	____	____
5. Tested the air quality tester for proper operation.	____	____
6. Tested atmospheric conditions using the air quality tester.	____	____
7. Pumped out water.	____	____
8. Ventilated the manhole.	____	____
9. Installed the extraction system for confined-space entry and rescue.	____	____
10. Suited the entrant with the safety harness and attached it to the extraction system for confined-space entry and rescue.	____	____
11. Assisted the entrant into the manhole.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related

AR 385-10
LCH
TM 5-682
TM 5-684
TM 5-811-1

Rescue an Injured Victim From a Utility Pole

052-204-1114

Conditions: As a power line distribution specialist in a tactical or nontactical environment when an individual is responsive or unresponsive and unable to descend a pole on his own, you are given a two-way radio or telephone communication equipment, personal climbing equipment, 1/2-inch-diameter rope (rescue line) that is twice the length of the height from the ground to the highest crossarm plus 10 feet, a sharp skinning knife, hot-line tools, and the applicable personal protective equipment (PPE).

DANGER: TIME IS EXTREMELY CRITICAL THROUGHOUT THIS TASK. FAILURE TO RESCUE A VICTIM IN A TIMELY MANNER MAY RESULT IN PERMANENT INJURY OR DEATH.

Standards: Rescue an injured victim from a utility pole by lowering him to the ground within 1 minute of reaching the victim on the pole. Administer first aid until he is in stable condition or qualified medical personnel arrive.

Performance Steps

1. Evaluate the situation by calling to the victim.
    a. Determine the victim's level of injury or illness before climbing the utility pole.

NOTE: If the victim is conscious and responds in an understanding voice, attempt to talk him down the utility pole.

    b. Prepare to climb the utility pole and aid the victim if he is unconscious, does not respond, or appears to be stunned or dazed.

2. Ensure your own protection.
    a. Contact emergency response personnel.
    b. De-energize the circuit if necessary or practical.
    c. Ensure that rescue line tools, hot sticks, and rubber gloves are properly rated.
    d. Ensure that the utility pole is not energized.
    e. Ensure that the utility pole is not on fire and that there are no damaged conductors or equipment.

3. Climb to the rescue position.
    a. Leap onto the utility pole, ensuring that no part of your body touches the pole and the ground at the same time.
    b. Belt in slightly above and to one side of the victim.
    c. Clear the victim and yourself from energized conductors or equipment using rubber gloves and hot sticks.

4. Determine the victim's condition.
    a. Check him for responsiveness; if he is responsive—
        (1) Ask him to define the problem.
        (2) Reassure him.
        (3) Assist him in descending the utility pole if possible.
        (4) Prepare to lower him to the ground if he cannot descend the utility pole without assistance.
        (5) Administer first aid as needed.
    b. Check his breathing if he is unresponsive.
        (1) Provide an open airway, and administer two short breaths if he is not breathing.
        (2) Lower him to the ground if he is breathing.

5. Lower the victim to the ground.
    a. Position the rescue line over the crossarm for a clear path to the ground, and wrap the short end of the line around the fall line two or more times so that you have a mechanical advantage.

NOTE: It is best to anchor the rescue line 2 to 3 feet out on the crossarm to help maintain the victim's clearance from the utility pole upon descent. If no crossarm is available, place the rescue

Performance Steps

line over any other substantial piece of equipment strong enough to support the victim's weight.

b. Pass the free end of the rescue line around the victim's chest, tying three half hitches with the knot in the front near one armpit, and snug the knot.
c. Remove the slack in the rescue line.
d. Grip the rescue line firmly and securely.

NOTE: If the victim is not breathing, give him two more quick breaths.

e. Cut the victim's safety strap on the opposite side of the desired swing.

DANGER: DO NOT CUT YOUR OWN SAFETY STRAP OR RESCUE LINE. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

f. Lower the victim to the ground.

6. Continue administering first aid until qualified medical personnel arrive.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to rescue an injured victim from a utility pole.

Performance Measures	GO	NO-GO
1. Evaluated the situation by calling to the victim.	____	____
2. Ensured your own protection.	____	____
3. Climbed to the rescue position.	____	____
4. Determined the victim's condition.	____	____
5. Lowered the victim to the ground.	____	____
6. Continued administering first aid until qualified medical personnel arrived.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 4-25.11
	LCH
	TM 5-682
	TM 5-684

Rescue an Injured Victim From a Manhole

052-204-1115

Conditions: As a power line distribution specialist in a tactical or nontactical environment when an individual is responsive or unresponsive and unable to exit the manhole on his own, you are given a two-way radio or telephone communication equipment, an extraction system for confined-space entry and rescue, a safety harness, and the applicable personal protective equipment (PPE).

DANGER: TIME IS EXTREMELY CRITICAL THROUGHOUT THIS TASK. FAILURE TO RESCUE A VICTIM IN A TIMELY MANNER MAY RESULT IN PERMANENT INJURY OR DEATH.

WARNING: CARE SHOULD BE TAKEN WHEN RAISING THE VICTIM OUT OF THE MANHOLE. ENSURE THAT YOU DO NOT INCREASE OR CAUSE FURTHER INJURIES TO THE VICTIM. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Rescue an injured victim from a manhole by raising the victim up and out of the manhole using an extraction system for confined-space entry and rescue. Administer first aid until he is in stable condition or qualified medical personnel arrive.

Performance Steps

1. Evaluate the situation by calling to the victim.
   a. Determine the victim's level of injury or illness before rescuing the victim from the manhole if the victim is conscious and responds in an understanding voice.
   b. Prepare to rescue the victim from a manhole and provide aid if he is unconscious, does not respond, or appears to be stunned or dazed.
2. Ensure your own protection.
   a. Contact emergency response personnel.
   b. De-energize the circuit if necessary or practical.
3. Attempt to raise the victim out of the manhole using the extraction system for confined-space entry and rescue.
   a. Remove obstructions that could interfere with the removal of the victim.
   b. Raise the victim until his buttocks clear the rim of the manhole.
4. Assist the victim out of the manhole.
   a. Position the victim on his back.
   b. Administer first aid.
5. Continue administering first aid until qualified medical personnel arrive.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to rescue an injured victim from a manhole.

Performance Measures	GO	NO-GO
1. Evaluated the situation by calling to the victim.	____	____
2. Ensured your own protection.	____	____
3. Attempted to raise the victim out of the manhole using the extraction system for confined-space entry and rescue.	____	____
4. Assisted the victim out of the manhole.	____	____

Performance Measures	GO	NO-GO
5. Continued administering first aid until qualified medical personnel arrived.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 4-25.11
	LCH
	TM 5-682
	TM 5-684

Rescue an Injured Victim From an Aerial-Bucket Truck

052-204-1116

Conditions: As a power line distribution specialist in a tactical or nontactical environment when an individual is responsive or unresponsive and unable to descend from an aerial-bucket truck without assistance, you are given a two-way radio or telephone communication equipment, an aerial-bucket truck with lower controls, a winch line, and the applicable personal protective equipment (PPE).

DANGER:

1. BEFORE USING THE AERIAL-BUCKET TRUCK NEAR ENERGIZED LINES, THE TRUCK CHASSIS MUST BE GROUNDED FOR SAFETY.

2. OBSTACLES IN THE PATH OF THE AERIAL-BUCKET MUST BE AVOIDED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. THE TRUCK MAY BECOME ENERGIZED AND MUST BE MOUNTED PROPERLY. FAILURE TO ENSURE THAT CONTACT IS NOT MADE BETWEEN YOU, THE TRUCK, AND THE GROUND AT THE SAME TIME MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: Rescue procedures may vary when using a nonorganic bucket truck.

Standards: Rescue an injured victim from an aerial-bucket truck by using the lower controls to lower the bucket to the proper rescue position. Remove the victim from the bucket. Administer first aid until he is in stable condition or qualified medical personnel arrive.

Performance Steps

1. Evaluate the situation by calling to the victim.
    a. Determine the level of injury or illness before attempting rescue procedures.

NOTE: If the victim is conscious and responds in an understanding voice, use self-recovery procedures to talk him down.

    b. Prepare to perform an aerial-bucket truck rescue if the victim is unconscious, does not respond, or appears to be stunned or dazed.

2. Ensure your own protection.
    a. Contact emergency response personnel.
    b. De-energize the circuit if necessary or practical.

3. Lower the bucket until it is 1 foot off the ground.
    a. Leap onto the truck, and ensure that no part of your body touches the truck and the ground at the same time.
    b. Switch the bucket control mode to the lower controls.
    c. Lower the bucket to the ground using the most direct route until it is 1 foot off the ground.

4. Remove the victim from the bucket, and lower him to the ground.
    a. Tilt the bucket to the side at approximately a 90° angle.
    b. Detach the victim's safety lanyard, and remove him from the bucket.
    c. Pull the victim clear of hazards.
    d. Administer first aid as required.

5. Continue administering first aid until qualified medical personnel arrive.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to rescue an injured victim from an aerial-bucket truck.

Performance Measures	GO	NO-GO
1. Evaluated the situation by calling to the victim.	____	____
2. Ensured your own protection.	____	____
3. Lowered the bucket until it was 1 foot off the ground.	____	____
4. Removed the victim from the bucket and lowered him to the ground.	____	____
5. Continued administering first aid until qualified medical personnel arrived.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 4-25.11
	LCH
	TM 5-682
	TM 5-684

Inspect Hot-Line Equipment

052-204-1117

Conditions: As a power line distribution specialist in a tactical or nontactical dry, well-lit environment during scheduled or unscheduled maintenance when hot-line equipment needs to be inspected, you are given the applicable manufacturer's literature with maintenance instructions, DA Form 2404 (Equipment Inspection and Maintenance Worksheet), and the applicable safety standing operating procedures (SOPs).

DANGER: HOT-LINE EQUIPMENT (WHETHER OR NOT SPECIFICALLY ADDRESSED IN THIS TASK) MUST BE MAINTAINED AS SPECIFIED IN THE APPLICABLE MANUFACTURER'S MAINTENANCE INSTRUCTIONS. FAILURE TO PERFORM REQUIRED MAINTENANCE MAY CAUSE EQUIPMENT DAMAGE AND PERMANENT INJURY OR DEATH.

Standards: Inspect hot-line equipment, ensuring that maintenance is performed according to the applicable manufacturer's literature with maintenance instructions, DA Form 2404, and applicable SOPs. Remove unsafe equipment from the inventory.

Performance Steps

1. Inspect hot sticks.
    a. Check for valid calibration stamps.
    b. Inspect for excessive wear to the fiberglass.
2. Inspect grounding sticks.
    a. Check for valid calibration stamps.
    b. Inspect for excessive wear to the fiberglass.
    c. Check for good electrical connections to grounding cables.
3. Inspect ground clusters.
    a. Check for valid calibration stamps.
    b. Inspect for excessive wear.
    c. Inspect for obvious damage.
    d. Check for good electrical connections on interconnecting cables.
4. Inspect rubber gloves.
    a. Check for valid calibration stamps.
    b. Perform user tests by filling the gloves with air and rolling them while feeling for air leaks and cracks.
    c. Ensure that leather liners are serviceable and free of holes.
5. Inspect rubber sleeves.
    a. Check for valid calibration stamps.
    b. Perform user tests by rolling the rubber sleeves while feeling for holes and cracks.
6. Inspect rubber blankets and mats.
    a. Check for valid calibration stamps.
    b. Perform user tests by rolling the rubber blankets and mats while looking for holes and cracks.
7. Inspect flash suits.
    a. Check for valid calibration stamps.
    b. Inspect for holes.
    c. Check for face shield damage.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to inspect hot-line equipment.

Performance Measures	GO	NO-GO
1. Inspected hot sticks.	____	____
2. Inspected grounding sticks.	____	____
3. Inspected ground clusters.	____	____
4. Inspected rubber gloves.	____	____
5. Inspected rubber sleeves.	____	____
6. Inspected rubber blankets and mats.	____	____
7. Inspected flash suits.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2404	LCH
	TM 5-682
	TM 5-684

Maintain Climbing and Rigging Equipment

052-204-1118

Conditions: As a power line distribution specialist in a tactical or nontactical environment during scheduled or unscheduled maintenance when climbing and rigging equipment needs maintenance, you are given the applicable cleaning and maintenance supplies, the applicable manufacturer's literature, and the applicable personal protective equipment (PPE).

DANGER: FAILURE TO FOLLOW PROPER MAINTENANCE PROCEDURES MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. ONLY APPROVED CLEANING MATERIALS SHOULD BE USED TO CLEAN LEATHER PRODUCTS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. INCORRECT MAINTENANCE OF RIGGING EQUIPMENT MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

WARNING: CARE SHOULD BE TAKEN WHILE SHARPENING GAFFS TO AVOID INJURY.

NOTES:

1. Defective equipment should not be used. It should be repaired or replaced immediately.

2. There are several different manufacturers of climbing equipment. Ensure that the appropriate manufacturer's literature is referenced before performing equipment maintenance.

Standards: Maintain climbing and rigging equipment by inspecting it, performing maintenance on it, and storing it as stated in the applicable manufacturer's literature.

Performance Steps

1. Inventory the climbing and rigging equipment.
2. Ensure that all items are included in the inventory.
    a. Include climber gaffs (two each).
    b. Include a safety strap.
    c. Include a body belt.
    d. Include a hard hat.
    e. Include a pair of gloves.
    f. Include safety glasses.
    g. Include a climbing equipment storage bag.
    h. Include a handline.
    i. Include a block and tackle.
    j. Include a chain hoist.
3. Inspect leather products.
    a. Check leather products for faults.
        (1) Check for tears.
        (2) Check for cracks.
        (3) Check for enlarged eyelet holes.
        (4) Check for stretching.
        (5) Check for hard or dry leather.
    b. Check stitched areas for broken, ragged, or rotted threads.

Performance Steps

4. Inspect metal products.
    a. Check the metal products for faults.
        (1) Check for rust.
        (2) Check for cracks.
        (3) Check for breaks.
        (4) Check for loose attachments.
        (5) Check for wear that might affect overall product strength.
    b. Check the gaffs to determine if the cutting edges have been sharpened and shaped.

5. Inspect the hard hat.
    a. Check the hard hat for cracks, burns, and overall cleanliness.
    b. Inspect the suspension system for fraying and broken suspension components.
    c. Inspect the chin strap for elasticity.
    d. Check the expiration date.

6. Inspect the protective eyewear.

7. Maintain leather products.
    a. Clean leather surfaces.
        (1) Wipe off surface dirt using a neutral soap and moist sponge.
        (2) Wipe off soap with a clean cloth.
    b. Rub the leather with saddle soap.
        (1) Work up a good lather.
        (2) Clean the surface with a sponge.
        (3) Ensure that the saddle soap thoroughly penetrates the surface areas.
        (4) Wipe off excess saddle soap with a clean cloth.
    c. Apply neat's-foot oil to the leather parts using your hands.
        (1) Ensure that the leather parts are oiled sufficiently.
        (2) Allow the leather to dry in a cool, shady area for 24 hours.
        (3) Remove excess oil by rubbing vigorously with a clean cloth.

8. Maintain climber gaffs.
    a. Use the TH slots on the gaff gauge to measure gaff thickness.
    b. Use the W slots on the gaff gauge to measure gaff width.
    c. Shape gaffs into the correct thickness according to the applicable manufacturer's literature if required.

9. Test climber gaffs.
    a. Check climber gaffs using the plane test.
    b. Check climber gaffs using the cutout test.

10. Maintain the handline.
    a. Uncoil the handline.
        (1) Secure one end of the handline to a stationary object.
        (2) Stretch the handline taut to remove twists and kinks; and center the hook, splice, or knot at the free end of the rope.
    b. Check the handline.
        (1) Check for cuts.
        (2) Check for frays.
        (3) Check for cracks.
        (4) Continuous smooth movement of the rope through the block sheave.
    c. Recoil the handline for storage.
        (1) Ensure that loops are the same length (about 3 feet).
        (2) Wrap the last 6 to 8 feet of rope around the coil.
            (a) Place the coil of the rope around your wrist.
            (b) Turn the coil, with your arm held horizontally at your elbow, away from your body.

Performance Steps

(c) Guide the remaining rope around the coil until there is 2 feet remaining.
(d) Grasp the secured rope with your hand that is holding the coil, and pull the rope through the coil making a loop.
(e) Give the loop a twist, and place it over the top of the coil.
(f) Snug the loop around the coil.
(g) Hang the handline in a clean, dry area.

11. Maintain the block and tackle.
    a. Check the rope and blocks.
        (1) Check for cuts.
        (2) Check for frays.
        (3) Check for breaks.
        (4) Check for cracks.
        (5) Check for continuous smooth movement of the rope through the block sheaves.
    b. Wipe the wooden parts with linseed oil.
    c. Wipe the metal parts with machine oil.
    d. Hang the chain hoist in a clean, dry area.

12. Maintain the chain hoist.
    a. Check the chain hoist.
        (1) Check for a slipping brake mechanism.
        (2) Check for cracks.
        (3) Check for chemical damage.
        (4) Check for deformation.
        (5) Check for a worn chain.
        (6) Check for proper lubrication.
        (7) Check for free movement of the hooks.
    b. Wipe the chain hoist with a light coat of machine oil.
    c. Hang the chain hoist in a clean, dry area.

13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Give the Soldier a requirement to maintain climbing and rigging equipment.

Performance Measures	**GO**	**NO-GO**
1. Inventoried the climbing and rigging equipment.	____	____
2. Ensured that all items were included in the inventory.	____	____
3. Inspected leather products.	____	____
4. Inspected metal products.	____	____
5. Inspected the hard hat.	____	____
6. Inspected the protective eyewear.	____	____
7. Maintained leather products.	____	____
8. Maintained climber gaffs.	____	____
9. Tested climber gaffs.	____	____
10. Maintained the handline.	____	____

Performance Measures	GO	NO-GO
11. Maintained the block and tackle.	____	____
12. Maintained the chain hoist.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	FM 5-125
	LCH
	TM 5-682
	TM 5-684

Perform Operator Preventive-Maintenance Checks and Services (PMCS) on a Line Truck With Auxiliary Equipment

052-204-1119

Conditions: As a power line distribution specialist in a tactical or nontactical environment performing before, during, after, and weekly line truck operations or when PMCS on a line truck with auxiliary equipment needs to be done, you are given the technical or user's manuals for the truck being inspected, maintenance logbooks, and DA Form 2404 (Equipment Inspection and Maintenance Worksheet) or DA Form 5988-E (Equipment Inspection Maintenance Worksheet).

CAUTION: VEHICLES WITH A CLASS III LEAK SHOULD NOT BE OPERATED AND MUST BE SENT FOR REPAIR IMMEDIATELY. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE THAT MAY CAUSE LONG-TERM FAILURE.

NOTE: For different line trucks, consult the user's manual for correct PMCS.

Standards: Perform operator PMCS on a line truck with auxiliary equipment before, during, and after operation or when directed to do so.

Performance Steps

1. Perform before-operation PMCS.
    a. Inspect the vehicle exterior for damage and deficiencies, checking for—
        (1) A cracked or broken windshield.
        (2) Cracked, broken, or inoperable windshield wipers.
        (3) A cracked or damaged hood.
        (4) Cracked, broken, or inoperable headlights.
        (5) Cracked, broken, or inoperable marker and directional lights.
        (6) Cracked, broken, or inoperable reverse lights and alarm.
        (7) Cracked, torn, or missing hood latches.
        (8) Leaks, spills, or drips underneath the vehicle.
        (9) Cracked or broken side windows.
        (10) Cracked or broken side mirrors.
        (11) Cracked, sliced, or torn tires (inside and outside).
        (12) Broken handles, dents, or other damage on the side tool-bin door that may prevent the bins from opening, closing, or locking properly.
        (13) Cracked or frayed cable steps.
    b. Inspect the engine and engine components for damage and deficiencies.
        (1) Check the following fluid levels:
            (a) Engine oil.
            (b) Coolant.
            (c) Power steering fluid.
            (d) Windshield washer fluid.
        (2) Check for leaks or spills.
        (3) Check wiring for cracks, frays, and broken wires.
        (4) Check hoses for cracks, tears, breaks, and signs of dry rot.
        (5) Check belts for cracks, frays, missing teeth, and signs of dry rot.
    c. Inspect the cab interior for damage and deficiencies.
        (1) Check gauges for correct operation.
        (2) Check interior lights for cracks, breaks, and correct operation.
        (3) Check the horn for correct operation.
        (4) Ensure that you have basic issue items.
        (5) Inspect seat belts for cracks, frays, rips, and tears; and ensure that they lock correctly.
        (6) Inspect the bench seat for cracks, rips, and tears.
    d. Check the hydraulic-fluid level.

Performance Steps

2. Perform during-operation PMCS, and annotate the deficiencies.
   a. Check the boom for correct operation.
   b. Check the digger/auger for correct operation.
   c. Check outriggers for correct operation.
   d. Check the engine and transmission for correct operation.
   e. Check the electrical system for correct operation.
3. Perform after-operation PMCS.
   a. Ensure that tools are placed in the correct tool bins.
   b. Ensure that the fuel tank is full.
   c. Ensure that trash, limbs, and scrap is removed and correctly discarded.
   d. Ensure that personal gear is removed from the vehicle.
   e. Ensure that stock is placed in the stock bins.
4. Perform weekly-operation PMCS.
   a. Remove and blow out air filters.
   b. Wash and clean windows and mirrors.
   c. Wash the fully extended upper boom (third stage) with water.
   d. Wash and clean the hydraulic-tank top.
   e. Sweep the back of the truck bed.
5. Record actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform operator PMCS on a line truck with auxiliary equipment.

Performance Measures	**GO**	**NO-GO**
1. Performed before-operation PMCS.	____	____
2. Performed during-operation PMCS and annotated the deficiencies.	____	____
3. Performed after-operation PMCS.	____	____
4. Performed weekly-operation PMCS.	____	____
5. Recorded actions taken on DA Form 2404 or DA Form 5988-E and maintenance logbooks.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
DA FORM 2404	EM 385-1-1
DA FORM 5988-E	LCH
	TM 5-684

Install a Grounding Set

052-204-1120

Conditions: As a power line distribution specialist in a tactical or nontactical environment when a grounding set needs to be installed, you are given electrical construction prints, applicable climbing and rigging equipment, hot-line tools, a voltage detector, a lockout and tagout kit, the Lineman's and Cableman's Handbook (LCH), and the applicable personal protective equipment (PPE).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE ELECTRICAL POWER GENERATION EQUIPMENT AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE VOLTAGE DETECTOR AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

3. ALL SYSTEMS ARE CONSIDERED ENERGIZED UNTIL THE ENERGY SOURCE IS REMOVED, LOCKED OUT (WHEN POSSIBLE), TAGGED OUT, AND GROUNDED. WHEN ENERGY-ISOLATING DEVICES CANNOT BE PHYSICALLY LOCKED OUT, USE TAGOUT PROCEDURES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Install a grounding set by electrically connecting conductors to the ground. Ensure that conductors are at the same electrical potential using the provided grounding and test equipment.

Performance Steps

1. Inspect tools and equipment for serviceability.
2. Perform lockout and tagout procedures.
3. Test phases to ensure that they are isolated and that there is no voltage present.
4. Connect one end of the grounding conductor to an established ground (usually the grounded neutral conductor).

NOTE: A driven ground rod at the work site connected to the neutral conductor provides additional protection.

5. Install a grounding cluster block on the pole below the work area if work is to be performed on a wooden pole.

NOTE: Ensure that the grounding cluster is physically and electrically connected to the established ground before moving to the next step.

6. Connect the other end of the grounding conductor, using a hot-line tool, to the bottom conductor on vertical constructions or the closest conductor on horizontal constructions.
7. Install grounds or jumpers from a grounded conductor to the ungrounded conductor in sequence until all conductors are grounded and short-circuited together.
8. Double-check connections to ensure that they are clean and tight.
9. Ensure that all parts of the grounding circuit have adequate current-carrying capacity for the distribution system to be grounded.
10. Remove the grounds (when work is complete) in the exact reverse sequence of installation,

Performance Steps

ensuring that established ground connection removal was last.

11. Close out lockout and tagout procedures by removing locking and tagging devices.

WARNING: BEFORE THE LOCKOUT OR TAGOUT DEVICES ARE REMOVED AND ELECTRIC CIRCUITS OR EQUIPMENT ARE REENERGIZED, APPROPRIATE TESTS AND VISUAL INSPECTIONS MUST BE CONDUCTED BY AUTHORIZED PERSONNEL (THE INSTALLER). THE INSTALLER WILL VERIFY THAT TOOLS; MECHANICAL RESTRAINTS; AND ELECTRICAL JUMPERS, SHORTS, AND GROUNDS HAVE BEEN REMOVED. THE ENTIRE WORK AREA IS INSPECTED AND NONESSENTIAL ITEMS ARE REMOVED FROM THE SYSTEM. FAILURE TO COMPLY MAY CAUSE IMMEDIATE INJURY OR EQUIPMENT DAMAGE.

12. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier install a grounding set.

Performance Measures	**GO**	**NO-GO**
1. Inspected tools and equipment for serviceability.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Tested phases to ensure that they were isolated and that there was no voltage present.	____	____
4. Connected one end of the grounding conductor to an established ground (usually the grounded neutral conductor).	____	____
5. Installed a grounding cluster block on the pole below the work area if work was performed on a wooden pole.	____	____
6. Connected the other end of the grounding conductor, using a hot-line tool, to the bottom conductor on vertical constructions or the closest conductor on horizontal constructions.	____	____
7. Installed grounds or jumpers from a grounded conductor to the ungrounded conductor in sequence until all conductors were grounded and short-circuited together.	____	____
8. Double-checked connections to ensure that they were clean and tight.	____	____
9. Ensured that all parts of the grounding circuit had adequate current-carrying capacity for the distribution system to be grounded.	____	____
10. Removed the grounds (when work was completed) in the exact reverse sequence of installation, ensuring that established ground connection removal was last.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
LCH	EM 385-1-1
	TM 5-684
	TM 5-811-3

Install High-Intensity Lights and Ballasts

052-204-1121

Conditions: As a power line distribution specialist in a tactical or nontactical environment at a site needing illumination, you are given electrical construction prints, poles, mounting brackets, high-intensity lights, ballasts and wiring as specified in electrical construction prints, an electrician's tool kit, a voltage detector, applicable climbing and rigging equipment, a multimeter, the applicable manufacturer's literature, wiring diagrams, the Lineman's and Cableman's Handbook (LCH), and the applicable personal protective equipment (PPE).

DANGER:

1. FOLLOW ELECTRICAL SAFETY PRACTICES AND WEAR APPLICABLE PPE AS REQUIRED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLE IS NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERSONAL INJURY OR DEATH.

WARNING: ENSURE THAT YOU LIFT WITH YOUR LEGS. BE AWARE OF THE POSITION OF YOUR HANDS AND FINGERS, AND WEAR EYE PROTECTION IF NEEDED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Install high-intensity lights and ballasts on a pre-positioned pole to fully illuminate the designated area.

Performance Steps

1. Review the applicable manufacturer's literature, electrical construction prints, and wiring diagrams.
2. Perform lockout and tagout procedures.
3. Ensure that personnel follow safety clearances.
4. Ascend the pole if necessary.
5. Wear the correct PPE.
   a. Wear a hard hat.
   b. Wear leather work gloves.
   c. Wear insulated protective equipment if working near live circuits.
   d. Wear steel-toed safety boots.
   e. Wear safety glasses.
6. Install the mounting bracket on the pole.
7. Mount the lighting fixture and ballast onto the bracket.
8. Ensure that the mounted equipment is secured to the pole for safety purposes.
9. Install the distribution and control wiring.
10. Close out lockout and tagout procedures by removing locking and tagging devices.
11. Energize the circuit.

Performance Steps

12. Verify that the lamp illuminates the designated area.
13. Adjust the lamp to illuminate the designated area if necessary.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to install high-intensity lights and ballasts.

Performance Measures	**GO**	**NO-GO**
1. Reviewed the applicable manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Ensured that personnel followed safety clearances.	____	____
4. Ascended the pole if necessary.	____	____
5. Wore the correct PPE.	____	____
6. Installed the mounting bracket on the pole.	____	____
7. Mounted the lighting fixture and ballast onto the bracket.	____	____
8. Ensured that the mounted equipment was secured to the pole for safety purposes.	____	____
9. Installed the distribution and control wiring.	____	____
10. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
11. Energized the circuit.	____	____
12. Verified that the lamp illuminated the designated area.	____	____
13. Adjusted the lamp to illuminate the designated area if necessary.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required
LCH

Related
AEH
EM 385-1-1
ER 385-1-31
FM 5-125
FM 5-412
NEC® HANDBOOK
TM 5-682
TM 5-684
TM 5-811-1
TM 5-811-3

Install Distribution Equipment (De-energized)

052-204-1122

Conditions: As a power line distribution specialist in a tactical or nontactical environment when distribution equipment needs to be installed or replaced (de-energized), you are given electrical construction prints, applicable distribution equipment as specified in the electrical construction prints, wiring diagrams, applicable climbing and rigging equipment, an electrician's tool kit, a voltage detector, a lockout and tagout kit, grounding equipment, safety standing operating procedures (SOPs), manufacturer's literature, the Lineman's and Cableman's Handbook (LCH), and the applicable personal protective equipment (PPE).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. IT IS VITAL TO ENSURE THAT THE CIRCUIT IS COMPLETELY DE-ENERGIZED AND CORRECTLY GROUNDED BEFORE PERFORMING ANY WORK. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

4. NEVER POSITION YOURSELF UNDER A SUSPENDED LOAD. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: All distribution equipment is not the same and may function differently depending on the make, model, or manufacturer. Installation steps are similar, but may vary. Always consult the applicable manufacturer's literature for each piece of equipment.

Standards: Install distribution equipment (de-energized) as specified in the applicable manufacturer's literature. Ensure that hardware is mechanically tight and electrically connected.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Ensure that PPE is properly tested and fully mission-capable.
4. Inspect tools and climbing and rigging equipment for serviceability.
5. Perform lockout and tagout procedures.
6. Ascend the pole to the desired height if necessary.
7. Test phases to ensure that there is no voltage present.
8. Install personal protective grounds.

Performance Steps

9. Install rigging equipment as necessary.
10. Raise and position (safely) the distribution equipment to be installed.
11. Install mounting hardware as stated in the applicable manufacturer's literature.
12. Remove rigging equipment.
13. Connect the distribution equipment electrically according to the applicable manufacturer's literature.
14. Verify the correct phase sequence.
15. Position or sag conductors to the appropriate clearance according to the applicable manufacturer's literature.
16. Remove personal protective grounds.
17. Close out lockout and tagout procedures by removing locking and tagging devices.
18. Perform a functions check on the electrical distribution system.
19. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to install distribution equipment (de-energized).

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Ensured that PPE was properly tested and fully mission-capable.	____	____
4. Inspected tools and climbing and rigging equipment for serviceability.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Ascended the pole to the desired height if necessary.	____	____
7. Tested phases to ensure that there was no voltage present.	____	____
8. Installed personal protective grounds.	____	____
9. Installed rigging equipment as necessary.	____	____
10. Raised and positioned (safely) the distribution equipment to be installed.	____	____
11. Installed mounting hardware as stated in the applicable manufacturer's literature.	____	____
12. Removed rigging equipment.	____	____
13. Connected the distribution equipment electrically according to the applicable manufacturer's literature.	____	____
14. Verified the correct phase sequence.	____	____

Performance Measures	GO	NO-GO
15. Positioned or sagged conductors to the appropriate clearance according to the applicable manufacturer's literature.	____	____
16. Removed personal protective grounds.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
18. Performed a functions check on the electrical distribution system.	____	____
19. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
LCH	EM 385-1-1
	ER 385-1-31
	FM 3-34.480
	FM 5-125
	FM 5-412
	FM 5-424
	NESC®
	NETA™
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Secure Conductor to Insulator (De-energized)

052-204-1123

Conditions: As a power line distribution specialist in a tactical or nontactical environment when a conductor needs to be secured to an insulator after the lines have been properly sagged (de-energized), you are given a conductor, appropriately sized clips/ties for the conductors, applicable climbing and rigging equipment, safety standing operating procedures (SOPs), the Lineman's and Cableman's Handbook (LCH), hot-line tools, a voltage detector, grounding equipment, the applicable personal protective equipment (PPE), and a lockout and tagout kit.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT, AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT THE CIRCUIT IS COMPLETELY DE-ENERGIZED AND CORRECTLY GROUNDED BEFORE PERFORMING ANY WORK. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST THE CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Secure the conductor to the insulator (de-energized). Ensure that phases are level and conductors are not stressed.

Performance Steps

1. Perform lockout and tagout procedures.
2. Ascend the pole to the required height if necessary.
3. Test phases to ensure that there is no voltage present.
4. Install personal protective grounds.
5. Determine the best tie method for each location.
    a. Use preformed tie wires if available.

NOTE: Preformed tie wires are not one size fits all. They must match the application and the conductor size.

    b. Use armor rod ties when applicable.

NOTES:

1. Armor rod ties are used to protect conductors from damage due to vibration and are placed on the conductors the same way as preformed tie wires.

2. Never cross tie wires.

    c. Use a top tie when the conductor is in the top groove of the insulator.
        (1) Center the tie wire on the top of the insulator, pulling one end toward you and one end away from you. (Both sides of the wire should be of equal length and positioned under the conductor.) Wrap both ends halfway around the insulator.

Performance Steps

(2) Tighten both wire ties against the insulator; and wrap two close wraps, three spaced wraps, and two more close wraps around the conductor.
(3) Bend the ends back, and cut off excess tie wire.

d. Use a side tie when the conductor pulls against the side of the insulator.
(1) Center the tie wire on the back side of the insulator, pulling the ends toward you, forming a U. (Both sides of the wire should be equal in length and positioned under the conductor.)
(2) Tighten the wire ties against the insulator; and wrap two close wraps, three spaced wraps, and two more close wraps around the conductor.
(3) Bend the ends back, and cut off excess tie wire.

6. Inspect the ties to ensure that conductors remain secure.
7. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to secure a conductor to an insulator (de-energized).

Performance Measures	**GO**	**NO-GO**
1. Performed lockout and tagout procedures.	____	____
2. Ascended the pole to the required height if necessary.	____	____
3. Tested phases to ensure that there was no voltage present.	____	____
4. Installed personal protective grounds.	____	____
5. Determined the best tie method for each location.	____	____
6. Inspected the ties to ensure that conductors remained secure.	____	____
7. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
LCH	EM 385-1-1
	TM 5-682
	TM 5-684
	TM 5-811-1
	TM 5-811-3

Climb a Utility Pole

052-204-1124

Conditions: As a power line distribution specialist in a tactical or nontactical environment when installation, maintenance, or repairs to an overhead distribution system are needed at a minimum height of 25 feet, you are given applicable climbing and rigging equipment, a 2-pound hammer, a brace and a 3/8-inch bit, a 3/8-inch wooden dowel (1 foot long), a shovel, and the applicable personal protective equipment (PPE).

WARNING:

1. IF A POLE IS FOUND TO BE DEFECTIVE, IT SHOULD BE SCHEDULED FOR REPLACEMENT AS SOON AS POSSIBLE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. WHEN POSSIBLE, INDIVIDUALS NOT ASCENDING THE POLE MUST MAINTAIN A MINIMUM DISTANCE OF 10 FEET FROM THE POLE BASE TO ENSURE THAT THEY ARE NOT STRUCK BY DROPPED OBJECTS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

3. USE PROPER CLIMBING TECHNIQUES TO AVOID SLIPPING OR FALLING, WEAR LONG SLEEVES AND GLOVES TO AVOID SPLINTERS. WEAR PROTECTIVE EYEWEAR WHENEVER METAL IS USED TO STRIKE METAL. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Climb a utility pole to a minimum height of 35 feet, belt in, hitchhike down 5 feet, hitchhike back up to eye level, circle right and assume a good working position, circle left and assume a good working position, hitchhike down 5 feet, unbelt, and descend the pole without falling.

Performance Steps

1. Perform a utility pole serviceability inspection.
    a. Visually inspect the pole for—
        (1) Shell rot.
        (2) Large cracks or splits.
        (3) Signs of soil erosion around the pole base.
        (4) Hollow spots.
        (5) Woodpecker holes.
        (6) Burned spots.
    b. Perform a sound test with a 2-pound hammer; and check for butt rot, shell rot, and heart rot.

WARNING: ALWAYS BE AWARE OF OBJECTS THAT ARE OVERHEAD WHEN SOUNDING THE POLE. LOOSE OR ROTTED ITEMS MAY FALL AND CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

NOTE: Strike the pole in several different locations and at different heights. A good pole will sound solid when struck with a hammer. A decayed pole will sound hollow or like a drum.

    c. Perform a probe test with the brace and bit if necessary.
        (1) Remove the dirt around the pole to a depth of 12 to 18 inches and an area wide enough to operate the brace and bit.
        (2) Drill a 3/8-inch hole below the ground line into the butt of the pole at a downward angle of 30° to 45°.
        (3) Ensure that you drill deep enough to reach the center of the pole.
        (4) Check the wood shavings for decay.
        (5) Plug the drilled hole with a 3/8-inch wooden dowel to prevent further decay.
        (6) Fill the hole in with dirt, and tamp it.
    d. Mark the poles that do not pass the tests so that they are easily identified.

Performance Steps

2. Inspect equipment.
   a. Inspect PPE.
   b. Inspect climbing equipment.
   c. Inspect tools.
   d. Inspect the handline.
3. Lay out the handline, and attach it to the body belt.
4. Ascend the utility pole until you are eye level with the lag screw, and then belt in.

NOTE: When performing this task, ensure that you use the proper climbing technique. Start 6 inches above the ground with subsequent steps being 8 to 10 inches apart. Your feet should not be directly above one another. Maintain adequate spacing between your heels. Your toes should be pointing up and out with your weight on your heels. Use your legs to climb, not your arms. Keep your body straight and your knees away from the pole at all times. Ensure that you use the inverted-J method when inserting the gaff into the pole, and always lock your weight-supporting leg.

5. Hitchhike down 5 feet, and then hitchhike back up until you are eye level with the lag screw.
6. Circle to the right until you are positioned directly below the crossarm.
7. Assume a good working position that allows you to reach the end of the crossarm, and then return to the start position.
8. Circle to the left until you are positioned directly below the crossarm.
9. Assume a good working position that allows you to reach the end of the crossarm, and then return to the start position.
10. Hitchhike down the pole 5 feet.
11. Unbelt and descend the pole.

NOTE: When descending the pole, ensure that you follow. Keep your body straight, keep your knees away from the pole, and lock your weight-supporting leg. Ensure that your weight remains on your heel, aim your gaff toward the heart of the pole below your body, and let your body weight aid in your descent as the gaff penetrates the pole. Ensure that your uppermost leg is horizontal with the ground each time you drop. Remove the upper gaff by moving your upper knee away from the pole, and ensure that your last step is approximately 6 inches above the ground.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to climb a utility pole.

Performance Measures	**GO**	**NO-GO**
1. Performed a utility pole serviceability inspection.	____	____
2. Inspected equipment.	____	____
3. Laid out the handline and attached it to the body belt.	____	____
4. Ascended the utility pole until he was eye level with the lag screw and then belted in.	____	____

Performance Measures	GO	NO-GO
5. Hitchhiked down 5 feet, and then hitchhiked back up until he was eye level with the lag screw.	____	____
6. Circled to the right until he was positioned directly below the crossarm.	____	____
7. Assumed a good working position that allowed him to reach the end of the crossarm and then returned to the start position.	____	____
8. Circled to the left until he was positioned directly below the crossarm.	____	____
9. Assumed a good working position that allowed him to reach the end of the crossarm and then returned to the start position.	____	____
10. Hitchhiked down the pole 5 feet.	____	____
11. Unbelted and descended the pole.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 5-125
	LCH
	TM 5-682
	TM 5-684

Perform a Crossarm Change Out

052-204-1126

Conditions: As a power line distribution specialist in a tactical or nontactical environment when a crossarm needs to be replaced due to deterioration or upgrades, you are given applicable climbing and rigging equipment, a groundman, the required hand tools, the applicable personal protective equipment (PPE), and a lockout and tagout kit.

WARNING:

1. WHEN POSSIBLE, INDIVIDUALS NOT ACSENDING THE POLE MUST MAINTAIN A MINIMUM DISTANCE OF AT LEAST 10 FEET FROM THE BASE OF THE POLE TO ENSURE THAT THEY ARE NOT STRUCK BY DROPPED OBJECTS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

2. USE PROPER CLIMBING TECHNIQUES TO AVOID SLIPPING OR FALLING, WEAR LONG SLEEVES AND GLOVES TO AVOID SPLINTERS, AND WEAR PROTECTIVE EYEWEAR WHEN USING METAL TO STRIKE METAL. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Perform a crossarm change out from a minimum height of 35 feet and in less than 30 minutes by removing the old crossarm, lowering it to the ground, and raising and installing the new crossarm.

Performance Steps

1. Inspect the climbing equipment, tools, and handline for defects.
2. Perform lockout and tagout procedures.
3. Lay out the handline, and attach it to your body belt.
4. Ascend the pole until you are eye level with the lag screw, and then belt in.
5. Remove the crossarm.
    a. Remove the lag screw.
    b. Hitchhike up and attach the handline to the pole using the collar rope with the hook facing down.
    c. Tie the clove hitch to the end of the crossarm.
    d. Remove the through-bolt nut.
    e. Remove the crossarm, and place it on the safety strap.
    f. Lower one end of the crossarm to allow hanging it on your safety strap using the insulator pin.
    g. Tie a half-hitch loop below the insulator pin.
    h. Communicate your intentions with the groundman, guide the crossarm down, and allow the groundman to lower the crossarm to the ground.
6. Install the new crossarm.
    a. Place the safety strap over the head of the through bolt.
    b. Tell the groundman to raise the crossarm by using the insulator pin end of the crossarm being sent up first to just below your feet.
    c. Correctly communicate your intentions with the groundman, and then guide the crossarm up until you are able to rest the insulator pin on your belt.
    d. Remove the half hitch.
    e. Tell the groundman to raise the crossarm to allow you to set the crossarm across your safety strap.
    f. Install the crossarm onto the through bolt.
    g. Tighten the through-bolt nut.

Performance Steps

h. Remove the clove hitch.
i. Level the crossarm.
j. Drive in the lag screw.
k. Lower the handline.

7. Unbelt and descend the pole.
8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform a crossarm change out.

Performance Measures	**GO**	**NO-GO**
1. Inspected the climbing equipment, tools, and handline for defects.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Laid out the handline and attached it to his body belt.	____	____
4. Ascended the pole until he was eye level with the lag screw and then belted in.	____	____
5. Removed the crossarm.	____	____
6. Installed the new crossarm.	____	____
7. Unbelted and descended the pole.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
	EM 385-1-1
	FM 5-125
	LCH
	TM 5-684
	TM 5-811-1

Perform Groundman Duties

052-204-1127

Conditions: As a power line distribution specialist in a tactical or nontactical environment when a lineman needs assistance from a groundman, you are given applicable climbing and rigging equipment, the required hand tools, and the applicable personal protective equipment (PPE).

DANGER: A GROUNDMAN MUST ALWAYS BE PREPARED TO RESCUE A VICTIM FROM A UTILITY POLE AND ADMINISTER FIRST AID. TIME IS EXTREMELY CRITICAL. THE TIME IT TAKES TO RESCUE AN INJURED VICTIM AND THE EXTENT OF HIS INJURIES COULD BE THE DIFFERENCE BETWEEN PERMANENT DISABILITIES OR VICTIM DEATH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: WHEN POSSIBLE, INDIVIDUALS NOT ASCENDING THE POLE MUST MAINTAIN A 10-FOOT RADIUS FROM THE POLE BASE TO ENSURE THAT THEY ARE NOT STRUCK BY DROPPED OBJECTS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Perform groundman duties by ensuring that safety precautions are followed, supporting the lineman, and raising or lowering the equipment and tools as directed by the lineman who is performing tasks on the utility pole.

Performance Steps

1. Set up a safety zone with at least a 10-foot radius from the pole base.
2. Inspect the climbing and rigging equipment, tools, and handlines for defects.
3. Observe and assist the lineman from the ground as he performs his tasks.
4. Communicate properly with the lineman during each task performed.
5. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that the task standards can be met.

Brief Soldier: Direct the Soldier to perform groundman duties.

Performance Measures	GO	NO-GO
1. Set up a safety zone with at least a 10-foot radius from the pole base.	____	____
2. Inspected the climbing and rigging equipment, tools, and handlines for defects.	____	____
3. Observed and assisted the lineman from the ground as he performed his tasks.	____	____
4. Communicated properly with the lineman during each task performed.	____	____
5. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 5-125

References

Required	Related
	LCH
	TM 5-684

Interpret an Electrical One-Line Diagram

052-204-1128

Conditions: As a power line distribution specialist in a tactical or nontactical environment where there is a system fault, scheduled services due, or a needed or proposed system upgrade, you are given an electrical one-line diagram for an electrical distribution system.

Standards: Interpret an electrical one-line diagram by identifying the electrical flow and electrical symbols and their relationships.

Performance Steps

1. Identify the correct electrical one-line diagram for the electrical system.
2. Identify the lines and symbols on the diagram.
3. Determine the functions of symbols on the one-line diagram and the relationships between electrical devices.
4. Identify possible electrical paths depending on switchgear positioning.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to interpret an electrical one-line diagram.

Performance Measures	GO	NO-GO
1. Identified the correct electrical one-line diagram for the electrical system.	____	____
2. Identified the lines and symbols on the diagram.	____	____
3. Determined the functions of symbols on the one-line diagram and the relationships between electrical devices.	____	____
4. Identified possible electrical paths depending on switchgear positioning.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	FM 5-412
	LCH
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Splice a Medium-Voltage Power Cable

052-204-1129

Conditions: As a power line distribution specialist in a tactical or nontactical environment during an initial installation of cables where power cables must be joined or a power cable is damaged beyond repair, you are given an applicable splice kit with instructions, applicable tools specified in the splice kit instructions, an electrician's tool kit, a lockout and tagout kit, grounding equipment, a megohmmeter test set, a voltage detector, applicable manufacturer's literature, applicable personal protective equipment, applicable climbing and rigging equipment, two conductor grips, universal sticks with attachments, and resistor sticks for overhead splices.

DANGER: A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT CABLES ARE NOT ENERGIZED. MATERIALS (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. THE SPLICER'S TOOLS, HANDS, AND SPLICING MATERIALS MUST BE KEPT CLEAN DURING CONSTRUCTION. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. EMPLOY EVERY RESOURCE TO PREVENT MOISTURE (DRIPPINGS, CONDENSATION, PERSPIRATION) FROM ENTERING THE JOINT INSULATION. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

NOTE: There are several types of splicing kits available for use with medium-voltage power cables. Each kit contains specific instructions on how to make the splice. Always follow the manufacturer's guidelines for the particular kit used.

Standards: Splice a medium-voltage power cable so that the splice meets the rating of the original cable and does not create an electrical hazard to personnel or equipment. Ensure that the cable is capable of transmitting the maximum electrical load without excessive heating and is at the full mechanical strength of the conductors.

Performance Steps

1. Perform lockout and tagout procedures.

NOTES:

1. If the two cables are not long enough to be spliced, an additional length of cable will be needed.

2. Some performance steps will be omitted when splicing overhead, medium-voltage cable.

2. Inspect the splice kit.
   a. Use the correct splice kit for the cable.
   b. Inventory the kit to ensure that all components/parts are present.

3. Prepare the cable, and splice it according to the manufacturer's literature.
   a. Measure and mark the cable.
   b. Inspect the cable for carbon particles, and remove those that are found.
   c. Inspect the cable jacket for nicks, and remove those that are found.

4. Align cables so that the ends of the conductors conjoin squarely.
   a. Ensure that cuts are squarely made and leave a smooth edge.
   b. Perform ring cuts as needed without causing damage to other cable parts.

Performance Steps

5. Remove the jacket using the distance indicated by the splice kit instructions.

NOTES:

1. Cuts should be made square to the conductor.

2. Steps 6 through 9 are used for splicing underground, medium-voltage cable only.

6. Remove the cable metallic shield using the distance indicated in the splice kit instructions.

NOTE: Do not ring-cut into the metallic shielding or insulation when removing the jacket.

7. Remove the high-voltage insulation layer using the distance indicated in the splice kit instructions.
8. Remove the semiconductor from the metallic-shield edge using the distance indicated in the splice kit instructions.
9. Apply the connector using the correct compression tool.
    a. Measure back the depth needed for the conductor to penetrate the connector plus the distance indicated by the splice kit.
    b. Clean the entire area of the splice with cable-cleaning solvent.
    c. Remove sharp edges.
    d. Place two crimps on the connector, and ensure an offset between each crimp that is approximately 90°.

NOTE: Steps 10 through 12 are used for splicing overhead, medium-voltage cable only.

10. Ensure that overhead conductors are resagged.
11. Splice overhead, medium-voltage cables.
    a. Use the automatic sleeve splice.
        (1) Rig as necessary.
        (2) Trim to the desired length.
        (3) Clean and insert conductors into the sleeve ends.
    b. Use the compression sleeve splice.
        (1) Rig as necessary.
        (2) Trim to the desired length.
        (3) Clean and insert conductors into the sleeve ends.
        (4) Crimp the sleeve using a compression tool.
    c. Use the western union splice.
        (1) Rig as necessary.
        (2) Trim to the desired length.
        (3) Clean and wrap the conductors.
12. Clean surfaces with an approved solvent to remove carbon dust and residue.

NOTE: Steps 13 through 16 are used for splicing underground, medium-voltage cable only.

13. Replace the high-voltage insulation layer according to the manufacturer's literature.
14. Apply a semiconductive layer from the edge of the shielding tape to the edge of the opposing shield according to the manufacturer's literature.
15. Recreate a shield layer across the splice connector according to the manufacturer's literature.
16. Attach a ground to the shield according to the manufacturer's literature, and leave the ground long enough to reach the grounding point.

NOTE: Steps 17 through 19 are used for medium-voltage splices only.

17. Apply an outer jacket to the power cable according to the manufacturer's literature to prevent moisture from entering.

Performance Steps

18. Test the splice to ensure that it meets the cable rating.
19. Close out lockout and tagout procedures by removing locking and tagging devices.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to splice a medium-voltage power cable.

Performance Measures	GO	NO-GO
1. Performed lockout and tagout procedures.	____	____
2. Inspected the splice kit.	____	____
3. Prepared the cable and spliced it according to the manufacturer's literature.	____	____
4. Aligned cables so that the ends of the conductors conjoined squarely.	____	____
5. Removed the jacket using the distance indicated by the splice kit instructions.	____	____
6. Removed the cable metallic shield using the distance indicated in the splice kit instructions.	____	____
7. Removed the high-voltage insulation layer using the distance indicated in the splice kit instructions.	____	____
8. Removed the semiconductor from the metallic-shield edge using the distance indicated in the splice kit instructions.	____	____
9. Applied the connector using the correct compression tool.	____	____
10. Ensured that overhead conductors were resagged.	____	____
11. Spliced overhead, medium-voltage cables.	____	____
12. Cleaned surfaces with an approved solvent to remove carbon dust and residue.	____	____
13. Replaced the high-voltage insulation layer according to the manufacturer's literature.	____	____
14. Applied a semiconductive layer from the edge of the shielding tape to the edge of the opposing shield according to the manufacturer's literature.	____	____
15. Recreated a shield layer across the splice connector according to the manufacturer's literature.	____	____
16. Attached a ground to the shield according to the manufacturer's literature and left the ground long enough to reach the grounding point.	____	____
17. Applied an outer jacket to the power cable according to the manufacturer's literature to prevent moisture from entering.	____	____
18. Tested the splice to ensure that it met the cable rating.	____	____
19. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	FM 5-412
	LCH
	NESC®
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Terminate a Medium-Voltage Power Cable

052-204-1130

Conditions: As a power line distribution specialist in a tactical or nontactical environment during an initial installation of cables when power cables must be terminated or when an existing power cable termination is damaged beyond repair, you are given an electrician's tool kit, a lockout and tagout kit, grounding equipment, a megohmmeter test set, a voltage detector, an applicable termination kit with instructions, applicable tools specified in the termination kit instructions, applicable manufacturer's literature, and applicable personal protective equipment.

DANGER: A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. THE SPLICER'S TOOLS, HANDS, AND TERMINATION MATERIALS MUST BE CLEAN DURING CONSTRUCTION. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. EMPLOY EVERY RESOURCE TO PREVENT MOISTURE (DRIPPINGS, CONDENSATION, PERSPIRATION) FROM ENTERING THE JOINT INSULATION. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

NOTE: There are several different types of termination kits available for use with a medium-voltage power cable. Each kit contains specific instructions on how to construct the termination. Always follow the manufacturer's guidelines for the particular kit used.

Standards: Terminate a medium-voltage power cable so that the termination meets the rating of the original cable and does not cause an electrical hazard to personnel or damage to equipment. The cable must be able to transmit the maximum electrical load without undue heating, and it must be at the full mechanical load strength of the conductors.

Performance Steps

1. Perform lockout and tagout procedures.

NOTE: Some performance steps will be omitted when terminating an overhead, medium-voltage cable.

2. Inspect the termination kit.
   a. Use the correct termination kit for the cable.
   b. Inventory the kit to ensure that all components/parts are present.
3. Prepare the cable and termination according to the manufacturer's literature.
   a. Measure and mark the cable.
   b. Inspect the cable for carbon particles, and remove those that are found.
   c. Inspect the primary cable insulation, and remove those that are found.
   d. Cut the cable to the proper length.
4. Remove the jacket using the distance indicated in the manufacturer's literature, and ensure that the length required for the lug is added to the measure-back distance.
5. Remove the shield using the distance indicated in the manufacturer's literature.
6. Remove the semiconductor using the distance indicated in the manufacturer's literature.

Performance Steps

7. Remove the high-voltage insulation layer using the distance indicated in the manufacturer's literature.
8. Install the termination lug using the correct compression tool.
   a. Place two crimps on the lug, and rotate it approximately 90° between each crimp.
   b. Remove sharp edges.
9. Clean surfaces using an approved solvent to remove carbon dust and residue.
10. Replace the high-voltage insulation layer according to the manufacturer's literature.
11. Apply a semiconductive layer according to the manufacturer's literature.
12. Recreate a shield layer according to the manufacturer's literature.
13. Attach a ground according to the manufacturer's literature, and ensure that it is long enough to reach the grounding point.
14. Apply a high-voltage insulation layer according to the manufacturer's literature.
15. Apply an outer jacket to prevent moisture from entering the power cable according to the manufacturer's literature.
16. Test the splice to ensure that it meets the cable rating.
17. Close out lockout and tagout procedures by removing locking and tagging devices.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to terminate a medium-voltage power cable.

Performance Measures	**GO**	**NO-GO**
1. Performed lockout and tagout procedures.	____	____
2. Inspected the termination kit.	____	____
3. Prepared the cable and termination according to the manufacturer's literature.	____	____
4. Removed the jacket using the distance indicated in the manufacturer's literature and ensured that the length required for the lug was added to the measure-back distance.	____	____
5. Removed the shield using the distance indicated in the manufacturer's literature.	____	____
6. Removed the semiconductor using the distance indicated in the manufacturer's literature.	____	____
7. Removed the high-voltage insulation layer using the distance indicated in the manufacturer's literature.	____	____
8. Installed the termination lug using the correct compression tool.	____	____
9. Cleaned surfaces using an approved solvent to remove carbon dust and residue.	____	____
10. Replaced the high-voltage insulation layer according to the manufacturer's literature.	____	____
11. Applied a semiconductive layer according to the manufacturer's literature.	____	____

Performance Measures	GO	NO-GO
12. Recreated a shield layer according to the manufacturer's literature.	____	____
13. Attached a ground according to the manufacturer's literature and ensured that it was long enough to reach the grounding point.	____	____
14. Applied a high-voltage insulation layer according to the manufacturer's literature.	____	____
15. Applied an outer jacket to prevent moisture from entering the power cable according to the manufacturer's literature.	____	____
16. Tested the splice to ensure that it met the cable rating.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	FM 3-34.480
	FM 5-412
	LCH
	NESC®
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Conduct a Safety Briefing

052-204-2207

Conditions: As a power line distribution supervisor in a tactical or nontactical environment before work begins on a jobsite, you are given a detailed job description and applicable safety standing operating procedures (SOPs).

Standards: Conduct a safety briefing to inform personnel of dangers, warnings, cautions, and risks related to the jobsite based on the detailed job description and applicable safety SOPs.

Performance Steps

1. Perform an initial walk-through of the jobsite.
2. Note possible hazards and associated risks.
3. Inform personnel (verbally) of possible hazards and associated risks.
4. Remind personnel that everyone at the jobsite is a safety officer who has the responsibility of stopping and reporting future hazards and unsafe actions.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions.

Brief Soldier: Direct the Soldier to conduct a safety briefing.

Performance Measures	GO	NO-GO
1. Performed an initial walk-through of the jobsite.	____	____
2. Noted possible hazards and associated risks.	____	____
3. Informed personnel (verbally) of possible hazards and associated risks.	____	____
4. Reminded personnel that everyone at the jobsite was a safety officer who had the responsibility of stopping and reporting future hazards and unsafe actions.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
FM 5-19	AR 385-10
	EM 385-1-1
	ER 385-1-31
	LCH
	TM 5-682
	TM 5-684

Conduct a Safety Inspection

052-204-2208

Conditions: As a power line distribution supervisor in a tactical or nontactical environment before or during work on a jobsite, you are given a safety checklist, a detailed job description, and applicable safety standing operating procedures (SOPs).

DANGER: ALWAYS WEAR THE PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE DEATH OR PERMANENT INJURY.

Standards: Conduct a safety inspection using the safety checklist, detailed job description, and applicable safety SOPs. Record deficiencies on the safety checklist. Stop actions that appear to be unsafe.

Performance Steps

1. Obtain standards for the inspection.
2. Inform personnel of the inspection.
3. Conduct the inspection.
4. Note deficiencies found during the inspection on the safety checklist.
5. Inform personnel of deficiencies found during the inspection.
6. Verify that the deficiencies are corrected.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions.

Brief Soldier: Direct the Soldier to conduct a safety inspection.

Performance Measures	GO	NO-GO
1. Obtained standards for the inspection.	____	____
2. Informed personnel of the inspection.	____	____
3. Conducted the inspection.	____	____
4. Noted deficiencies found during the inspection on the safety checklist.	____	____
5. Informed personnel of deficiencies found during the inspection.	____	____
6. Verified that the deficiencies were corrected.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
FM 5-19	AR 385-10
	EM 385-1-1
	ER 385-1-31
	LCH
	TM 5-682
	TM 5-684

Develop a Bill of Materials (BOM) List

052-204-2211

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when materials are needed for an electrical construction project, you are given electrical construction prints, TM 5-811-1, the Lineman's and Cableman's Handbook (LCH), paper, pencils, a calculator, and DA Form 2702 (Bill of Materials).

Standards: Develop a BOM list that reflects the total materials required to complete an electrical construction project. Materials must be the sizes and types specified in the electrical construction prints, TM 5-811-1, and the LCH. Record materials on DA Form 2702.

Performance Steps

1. Review the electrical construction prints.
2. Complete a BOM list.
   a. Record the stock or part number indicated on the electrical construction prints if applicable.
   b. Record the item name or description indicated on the electrical construction prints.
   c. Record the number of required pieces indicated on the electrical construction prints if applicable.
   d. Record the sizes and lengths of items indicated on the electrical construction prints if applicable.
   e. Record the unit of issue and indicate whether the item is a spool or a length or if the item is issued as "each."
   f. Record the estimated waste of each item.
   g. Total the quantities needed based on the number of pieces, units of issue, required lengths, and estimated wastes for each item.
   h. Record the total quantity of each item.
3. Complete DA Form 2702.
   a. Complete the heading with the current information of the unit.
   b. Record the stock or part number.
   c. Record the name and description of the item.
   d. Record the unit of issue.
   e. Record the total quantity of each item.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to develop a BOM list.

Performance Measures	GO	NO-GO
1. Reviewed the electrical construction prints.	____	____
2. Completed a BOM list.	____	____
3. Completed DA Form 2702.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2702	FM 3-34.480

References

Required	Related
LCH	FM 5-412
TM 5-811-1	TM 5-684

Energize an Electrical Distribution System

052-204-2212

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when an electrical distribution system must be energized or reenergized, you are given applicable, electrical one-line diagrams; electrical construction prints; the manufacturer's literature; a two-way radio or telephone communication equipment; safety standing operating procedures (SOPs); the Lineman's and Cableman's Handbook (LCH); and applicable personal protective equipment (PPE).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE, ELECTRICAL POWER GENERATION EQUIPMENT AND ITS ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. SYSTEMS WILL BE CONSIDERED ENERGIZED UNTIL THE SOURCE OF ENERGY IS REMOVED, LOCKED OUT (WHEN POSSIBLE), TAGGED OUT, AND GROUNDED. WHEN ENERGY-ISOLATING DEVICES CANNOT BE PHYSICALLY LOCKED OUT, USE TAGOUT PROCEDURES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Energize an electrical distribution system following the one-line diagram, safety SOPs, LCH, and applicable manufacturer's literature.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the electrical one-line diagrams, electrical construction prints, and manufacturer's literature.
3. Request permission from the project supervisor to energize the electrical distribution system.
4. Perform an inspection with the project supervisor and personnel who performed work on the distribution system to ensure that all personnel are notified that the distribution system will soon be reenergized.
5. Ensure that each lockout and tagout device is removed by the installer or designated representative if the installer is not available.

DANGER: BEFORE LOCKOUT OR TAGOUT DEVICES ARE REMOVED AND ELECTRICAL CIRCUITS OR EQUIPMENT ARE REENERGIZED, APPROPRIATE TESTS AND VISUAL INSPECTIONS WILL BE CONDUCTED BY THE INSTALLER. THE INSTALLER WILL VERIFY THAT PERSONNEL, TOOLS, MECHANICAL RESTRAINTS, ELECTRICAL JUMPERS, SHORTS, AND GROUNDS HAVE BEEN REMOVED. THE ENTIRE WORK AREA WILL BE INSPECTED AND NONESSENTIAL ITEMS WILL BE REMOVED FROM THE SYSTEM. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

6. Ensure that personnel, PPE, hot-line equipment, climbing and rigging equipment, and tools are safely positioned or removed from the area to be reenergized.
7. Reenergize the distribution system.
8. Perform a functions check on the electrical distribution system.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare

the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to energize an electrical distribution system.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the electrical one-line diagrams, electrical construction prints, and manufacturer's literature.	____	____
3. Requested permission from the project supervisor to energize the electrical distribution system.	____	____
4. Performed an inspection with the project supervisor and personnel who performed work on the distribution system to ensure that all personnel were notified that the distribution system would soon be reenergized.	____	____
5. Ensured that each lockout and tagout device was removed by the installer or designated representative if the installer was not available.	____	____
6. Ensured that personnel, PPE, hot-line equipment, climbing and rigging equipment, and tools were safely positioned or removed from the area to be reenergized.	____	____
7. Reenergized the distribution system.	____	____
8. Performed a functions check on the electrical distribution system.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
LCH	EM 385-1-1
	ER 385-1-31
	FM 3-34.480
	FM 5-412
	NESC®
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Locate an Underground Cable and/or a Fault

052-204-2213

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when an underground cable or fault needs to be located, you are given a cable fault locator with the manufacturer's literature, an electrician's tool kit, and applicable personal protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A POWER SOURCE IS CONNECTED TO THE CABLES. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. DO NOT USE CLAMP-ON OR DIRECT-CONNECT METHODS OF FAULT FINDING UNTIL YOU HAVE VERIFIED THAT THE CABLES ARE DE-ENERGIZED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely and accurately locate an underground cable or fault according to the manufacturer's literature.

Performance Steps

1. Review danger, warning, and caution notices.
2. Perform lockout and tagout procedures.
3. Determine the best test method for locating the cable or fault (inductive, flexible coupler, direct-connect).
4. Perform preoperational checks on the test equipment according to the manufacturer's literature.
5. Connect the test set to the cable.
6. Locate the underground cable by tracing it from the source to the load.
7. Mark the path of the cable with flags.
8. Perform a preoperational check on the test equipment according to the manufacturer's literature.
9. Connect the fault locator to the cable being tested.
10. Set up the fault locator for surge tracing.
11. Operate the surge detector, and follow the marked cable path until a thump indicates the location of the fault.
12. Locate the fault by tracing it from the source to the fault location.
13. Repair the fault in the cable.
14. Test the repairs.

Performance Steps

15. Mark the cable location from the source to the load.
16. Remove the test equipment from the circuit being tested.
17. Close out lockout and tagout procedures by removing locking and tagging devices.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to locate an underground cable and/or fault.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Performed lockout and tagout procedures.	____	____
3. Determined the best test method for locating the cable or fault (inductive, flexible coupler, direct-connect).	____	____
4. Performed preoperational checks on the test equipment according to the manufacturer's literature.	____	____
5. Connected the test set to the cable.	____	____
6. Located the underground cable by tracing it from the source to the load.	____	____
7. Marked the path of the cable with flags.	____	____
8. Performed a preoperational check on the test equipment according to the manufacturer's literature.	____	____
9. Connected the fault locator to the cable being tested.	____	____
10. Set up the fault locator for surge tracing.	____	____
11. Operated the surge detector and followed the marked cable path until a thump indicated the location of the fault.	____	____
12. Located the fault by tracing it from the source to the fault location.	____	____
13. Repaired the fault in the cable.	____	____
14. Tested the repairs.	____	____
15. Marked the cable location from the source to the load.	____	____
16. Removed the test equipment from the circuit being tested.	____	____
17. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	ER 385-1-31

References

Required	Related
	FM 3-34.480
	FM 5-412
	LCH
	TM 5-682
	TM 5-684
	TM 5-811-1
	TM 5-811-3

Perform Live-Line Testing

052-204-2214

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when live-line distribution equipment needs to be tested, you are given a one-line diagram, the applicable climbing and rigging equipment, hot-line tools, a voltage detector, a clamp-on amp meter, safety standing operating procedures (SOPs), the applicable manufacturer's literature, the Lineman's and Cableman's Handbook (LCH), applicable personal protective equipment (PPE), insulating protective equipment, electrical construction prints, wiring diagrams, and DA Form 2702 (Bill of Materials).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL KNOWLEDGEABLE IN THE INSTALLATION, OPERATION, AND MAINTENANCE OF MEDIUM-VOLTAGE, ELECTRICAL POWER GENERATION EQUIPMENT, AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST THE CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Perform live-line testing to determine whether the line is energized.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Ensure that PPE, hot-line equipment, and test equipment is correctly tested and fully mission-capable.
4. Complete DA Form 2702, and include the tools and equipment necessary to perform this task.
5. Ensure that personnel are safely positioned or removed from the area to be tested.
6. Perform an initial equipment self-test.
7. Test each phase conductor or circuit part with adequately rated test equipment.
   a. Check a known energized circuit to ensure that the test equipment is working correctly.
   b. Check a known de-energized circuit to ensure that the test equipment is working correctly.
   c. Test the identified energized circuit, and verify the test results.
8. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform live-line testing.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____

Performance Measures	GO	NO-GO
3. Ensured that PPE, hot-line equipment, and test equipment was correctly tested and fully mission-capable.	____	____
4. Completed DA Form 2702 and included the tools and equipment necessary to perform the task.	____	____
5. Ensured that personnel were safely positioned or removed from the area to be tested.	____	____
6. Performed an initial equipment self-test.	____	____
7. Tested each phase conductor or circuit part with adequately rated test equipment.	____	____
8. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2702	EM 385-1-1
LCH	ER 385-1-31
	FM 3-34.480
	FM 5-412
	TM 5-682
	TM 5-684
	TM 5-811-1
	TM 5-811-3

Perform Maintenance on Electrical Distribution Equipment

052-204-2216

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when maintenance must be performed on electrical distribution equipment, you are given electrical one-line diagrams for the distribution equipment, applicable climbing and rigging equipment, hot-line tools, an electrician's tool kit, a voltage detector, a lockout and tagout kit, grounding equipment, safety standing operating procedures (SOPs), the applicable manufacturer's literature or industry standards, the Lineman's and Cableman's Handbook (LCH), the applicable personal protective equipment (PPE), electrical construction prints, wiring diagrams, and insulating protective equipment.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT THE CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE TESTER AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST THE CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN A SOURCE OF POWER IS CONNECTED TO THE DISTRIBUTION SYSTEM. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

5. THIS TASK SHOULD ONLY BE PERFORMED ON EQUIPMENT THAT DOES NOT CONTAIN POLYCHLORINATED BIPHENYL (PCB). FAILURE TO COMPLY MAY CAUSE SKIN AILMENTS, REPRODUCTIVE DISORDERS, LIVER DISEASE, AND OTHER ADVERSE HEALTH CONDITIONS RESULTING IN PERMANENT INJURY OR DEATH.

6. DO NOT EXCEED THE MAXIMUM VOLTAGE STIPULATED FOR SPECIFIC TESTS. FAILURE TO COMPLY WITH RATED VOLTAGES MAY CAUSE EQUIPMENT DAMAGE AND RESULT IN PERMANENT INJURY OR DEATH.

7. THE INSULATION TESTER PRODUCES A HIGH VOLTAGE. TO AVOID PERSONAL INJURY DURING THE TEST, DO NOT TOUCH THE CABLE BEING TESTED OR THE TEST LEADS. ALWAYS REMOVE THE POWER, AND DISCHARGE AND GROUND THE CIRCUIT FOR TWICE THE AMOUNT OF TIME THAT IT WAS TESTED BEFORE HANDLING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: HEATERS IN THE ENCLOSURE MAY CAUSE SERIOUS BURNS EVEN AFTER THE POWER HAS BEEN REMOVED. CONTACT WITH HEATERS MAY CAUSE IMMEDIATE PERSONAL INJURY.

NOTE: Conduct tests as specified in the manufacturer's literature or industry standards.

Standards: Perform maintenance on electrical distribution equipment by inspecting and testing as specified in the applicable manufacturer's literature. Reinstall or repair equipment based on the test results.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Ensure that PPE is correctly tested and fully mission-capable.
4. Inspect tools and testing equipment for serviceability.
5. Perform lockout and tagout procedures.
6. Ascend the pole to the required height if necessary.
7. Test the phases to ensure that there is no voltage present.
8. Install personal protective grounds.
9. Perform maintenance on electrical distribution equipment by inspecting and testing it according to the applicable manufacturer's literature.
10. Record the inspection and test results.
11. Repair or replace equipment based on the inspection and test results.
12. Remove personal protective grounds.
13. Close out lockout and tagout procedures by removing locking and tagging devices.
14. Perform a functions check on the electrical distribution system.
15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform maintenance on electrical distribution equipment.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Ensured that PPE was correctly tested and fully mission-capable.	____	____
4. Inspected tools and testing equipment for serviceability.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Ascended the pole to the required height if necessary.	____	____
7. Tested the phases to ensure that there was no voltage present.	____	____
8. Installed personal protective grounds.	____	____
9. Performed maintenance on electrical distribution equipment by inspecting and testing it according to the applicable manufacturer's literature.	____	____
10. Recorded the inspection and test results.	____	____
11. Repaired or replaced equipment based on the inspection and test results.	____	____

Performance Measures	GO	NO-GO
12. Removed personal protective grounds.	____	____
13. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
14. Performed a functions check on the electrical distribution system.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
LCH	EM 385-1-1
	ER 385-1-31
	FM 3-34.480
	FM 5-412
	NESC®
	NETA™
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Manage a Power Line Crew

052-204-2217

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when work must be performed on electrical distribution equipment, you are given a power line distribution crew, a line truck with a cable trailer, safety standing operating procedures (SOPs), applicable manufacturer's literature, the Lineman's and Cableman's Handbook (LCH), and personal protective equipment (PPE).

DANGER:

1. ALWAYS WEAR THE PPE REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRONICS AND CONTROL INSTRUMENTATION AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. IT IS VITAL FOR EACH INDIVIDUAL TO UNDERSTAND THE ASSIGNMENT AND TO CARRY IT OUT WITHOUT HESITATION WHEN THE SUPERVISOR GIVES A COMMAND. FAILURE TO COMPLY MAY CAUSE IMMEDIATE DEATH OR PERMANENT INJURY.

5. NEVER LIFT OBJECTS WITHOUT A GROUND GUIDE TO ASSIST OR WITHOUT ANOTHER INDIVIDUAL TO HELP ENSURE THAT THE OBJECT DOES NOT BEGIN TO SWAY OUT OF CONTROL. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING:

1. BEFORE MOVING A LINE TRUCK, YOU MUST PERFORM PREVENTIVE-MAINTENANCE CHECKS AND SERVICES. YOU MUST ALSO BE LICENSED ON THE EQUIPMENT OR BE ACCOMPANIED BY A LICENSED DRIVER IN THE VEHICLE CAB TO ENSURE THAT CORRECT OPERATING PROCEDURES ARE FOLLOWED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

2. WHEN EXTENDING THE SECOND STAGE OF THE BOOM OR WHEN WINCHING UP, ENSURE THAT THE WINCH HOOK DOES NOT GET PULLED INTO THE WINCH LINE GUIDE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Manage a power line crew by ensuring that the power line crew adheres to work and safety requirements of the applicable manufacturer's literature, safety SOPs, and the LCH.

Performance Steps

1. Review danger, warning, and caution notices.
2. Ensure that the PPE has been correctly tested and is fully operable.
3. Ensure that DA Form 2702 (Bill of Materials) includes all items necessary to perform the task.
4. Inspect tools and climbing and rigging equipment for serviceability.
5. Develop a plan for obtaining nonorganic tools and equipment necessary to perform any mission.
6. Issue a safety briefing that highlights safety precautions and the concept of the operation.

Performance Steps

7. Assign personnel positions, and ensure that they understand roles.
8. Supervise the operation of a line truck with auxiliary equipment.
9. Ensure that tasks are performed to standard and that safety procedures are followed.
10. Ensure that PPE, climbing and rigging equipment, and tools are correctly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to manage a power line crew.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Ensured that the PPE was correctly tested and fully operable.	____	____
3. Ensured that DA Form 2702 included all items necessary to perform the task.	____	____
4. Inspected tools and climbing and rigging equipment for serviceability.	____	____
5. Developed a plan for obtaining nonorganic tools and equipment necessary to perform any mission.	____	____
6. Issued a safety briefing that highlighted safety precautions and the concept of the operation.	____	____
7. Assigned personnel positions and ensured that they understood roles.	____	____
8. Supervised the operation of a line truck with auxiliary equipment.	____	____
9. Ensured that tasks were performed to standard and that safety procedures were followed.	____	____
10. Ensured that PPE, climbing and rigging equipment, and tools were correctly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2702	EM 385-1-1
LCH	ER 385-1-31
	FM 3-34.480
	FM 5-412
	NESC®
	NETA™
	TM 5-682
	TM 5-684
	TM 5-686
	TM 5-811-1
	TM 5-811-3

Supervise the Installation of Underground Cable

052-204-2218

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when an underground cable needs to be installed, you are given electrical construction prints, applicable electrical distribution equipment as specified in the electrical construction prints, wiring diagrams, a line truck with a cable trailer, applicable digging or trenching equipment, a voltage detector, a lockout and tagout kit, grounding equipment, safety standing operating procedures (SOPs), the applicable manufacturer's literature, the Lineman's and Cableman's Handbook (LCH), the applicable personal protective equipment (PPE), and DA Form 2702 (Bill of Materials).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. A VOLTAGE DETECTOR SHOULD BE USED TO ENSURE THAT CABLES ARE NOT ENERGIZED. MATERIAL (SUCH AS A LEAD SHEATH THAT ACTS AS A SHIELD) MUST NOT BE BETWEEN THE VOLTAGE DETECTOR AND THE CONDUCTORS OF THE CIRCUIT BEING TESTED. FAILURE TO TEST CABLES MAY CAUSE PERMANENT INJURY OR DEATH.

3. NEVER POSITION YOURSELF UNDER A SUSPENDED LOAD. FAILURE TO COMPLY MAY CAUSE OR PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Supervise the installation of underground cable by ensuring that the cable is safely installed at the appropriate depth and according to cable ratings in the safety SOPs, the applicable manufacturer's literature, and the LCH.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Ensure that PPE is correctly tested and fully mission-capable.
4. Complete DA Form 2702 for the tools and equipment necessary to perform this task.
5. Inspect tools and rigging equipment for serviceability.
6. Develop a plan for obtaining nonorganic tools and the equipment necessary to perform the mission.
7. Issue a safety briefing that highlights safety precautions and the concept of the operation.
8. Assign personnel positions, and ensure that they understand their role in accomplishing this task.
9. Determine if the mobile- or stationary-reel method of reeling out the conductors will be used.

NOTE: Conductors should never be removed from a nonrotating reel or coil. Failure to rotate the reel or coil will cause the conductors to twist and kink, resulting in their damage.

10. Inspect conductors to ensure that they were not damaged during reeling out.
11. Ensure that conductors are placed on conductor support devices in the proper sequence.

Performance Steps

12. Ensure that the underground cable is installed according to electrical construction prints.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to supervise the installation of underground cable.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Ensured that PPE was correctly tested and fully mission-capable.	____	____
4. Completed DA Form 2702 for the tools and equipment necessary to perform the task.	____	____
5. Inspected tools and rigging equipment for serviceability.	____	____
6. Developed a plan for obtaining nonorganic tools and the equipment necessary to perform the mission.	____	____
7. Issued a safety briefing that highlighted safety precautions and the concept of the operation.	____	____
8. Assigned personnel positions and ensured that they understood their role in accomplishing the task.	____	____
9. Determined if the mobile- or stationary-reel method of reeling out the conductors would be used.	____	____
10. Inspected conductors to ensure that they were not damaged during reeling out.	____	____
11. Ensured that conductors were placed on conductor support devices in the proper sequence.	____	____
12. Ensured that the underground cable was installed according to electrical construction prints.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2702	AR 385-10
LCH	EM 385-1-1
	ER 385-1-31
	FM 3-34.480
	TM 5-682
	TM 5-684
	TM 5-811-1

References

Required	Related
	TM 5-811-3

Supervise the Loading and Unloading of Utility Poles

052-204-2219

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when utility poles need to be loaded and unloaded, you are given a line truck with auxiliary equipment, a pole trailer, a cant hook, lifting tongs, chains, hoists, cable slings, wheel chocks, ground guides, safety standing operating procedures (SOPs), the applicable personal protective equipment (PPE), and DA Form 2702 (Bill of Materials).

DANGER:

1. NEVER LIFT OBJECTS WITHOUT A GROUND GUIDE TO ASSIST IN FINDING THE LOCATION OF THE ITEMS BEING LIFTED AND ANOTHER INDIVIDUAL TO HELP ENSURE THAT THE OBJECT DOES NOT BEGIN TO SWAY OUT OF CONTROL. FAILURE TO COMPLY MAY CAUSE DEATH, PERMANENT INJURY, OR EQUIPMENT DAMAGE.

2. NEVER POSITION YOURSELF UNDER A SUSPENDED LOAD. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Supervise the loading and unloading of utility poles by ensuring that the poles are loaded and unloaded safely.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Ensure that PPE is correctly tested and fully mission-capable.
3. Complete DA Form 2702 for the tools and equipment necessary to perform this task.
4. Inspect tools and rigging equipment for serviceability.
5. Develop a plan for obtaining nonorganic tools and the equipment necessary to perform the mission.
6. Issue a safety briefing that highlights safety precautions and the concept of the operation.
7. Assign personnel positions, and ensure that they understand their role in accomplishing this task.
8. Ensure that equipment brakes are set and wheels are chocked.
9. Ensure that utility poles are loaded and unloaded safely.
10. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to supervise the loading and unloading of utility poles.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Ensured that PPE was correctly tested and fully mission-capable.	____	____
3. Completed DA Form 2702 for the tools and equipment necessary to perform the task.	____	____

Performance Measures	GO	NO-GO
4. Inspected tools and rigging equipment for serviceability.	____	____
5. Developed a plan for obtaining nonorganic tools and the equipment necessary to perform the mission.	____	____
6. Issued a safety briefing that highlighted safety precautions and the concept of the operation.	____	____
7. Assigned personnel positions and ensured that they understood their role in accomplishing the task.	____	____
8. Ensured that equipment brakes were set and wheels were chocked.	____	____
9. Ensured that utility poles were loaded and unloaded safely.	____	____
10. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2702	AR 385-10
	EM 385-1-1
	ER 385-1-31
	FM 3-34.480
	LCH
	TM 5-682
	TM 5-684
	TM 5-811-1

Supervise the Mechanical Erection of a Utility Pole

052-204-2220

Conditions: As a power line distribution supervisor in a tactical or nontactical environment when a utility pole needs to be mechanically erected, you are given a line truck, tampers, a shovel, applicable guying equipment, applicable pole-grounding equipment, a butt man, a truck operator, ground guides, the Lineman's and Cableman's Handbook (LCH), wiring diagrams, electrical construction prints, safety standing operating procedures (SOPs), the applicable personal protective equipment (PPE), and DA Form 2702 (Bill of Materials).

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF ELECTRICAL DISTRIBUTION SYSTEMS AND POWER EQUIPMENT AND THE ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. NEVER POSITION YOURSELF UNDER A SUSPENDED LOAD. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Supervise the mechanical erection of a utility pole by ensuring that the utility pole is facing the proper direction, firmly embedded into the ground at the proper depth, and rigged and raised in a safe manner.

Performance Steps

1. Review danger, warning, and caution notices before proceeding.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Ensure that PPE is correctly tested and fully mission-capable.
4. Complete DA Form 2702 for the tools and equipment necessary to perform this task.
5. Inspect tools and rigging equipment for serviceability.
6. Develop a plan for obtaining nonorganic tools and the equipment necessary to perform the mission.
7. Issue a safety briefing that highlights safety precautions and the concept of the operation.
8. Assign personnel positions, and ensure that they understand their role in accomplishing this task.
9. Inspect the hole to ensure that is the appropriate depth.
10. Ensure that rigging is done so that the pole does not slip.
11. Ensure that the pole is lowered into the center of the hole.
12. Inspect the pole while it is in the hole to ensure that the hole is the proper depth and that the pole is centered, facing the correct direction, and correctly aligned.
13. Ensure that the pole is tamped.
14. Ensure that a watershed was created at the pole base.
15. Recheck the pole depth, centering, facing, and alignment before mounting the hardware.
16. Ensure that guys and anchors are installed as stated in the electrical construction prints.
17. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to supervise the mechanical erection of a utility pole.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices before proceeding.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Ensured that PPE was correctly tested and fully mission-capable.	____	____
4. Completed DA Form 2702 for the tools and equipment necessary to perform the task.	____	____
5. Inspected tools and rigging equipment for serviceability.	____	____
6. Developed a plan for obtaining nonorganic tools and the equipment necessary to perform the mission.	____	____
7. Issued a safety briefing that highlighted safety precautions and the concept of the operation.	____	____
8. Assigned personnel positions and ensured that they understood their role in accomplishing the task.	____	____
9. Inspected the hole to ensure that it was the appropriate depth.	____	____
10. Ensured that rigging was done so that the pole did not slip.	____	____
11. Ensured that the pole was lowered into the center of the hole.	____	____
12. Inspected the pole while it was in the hole to ensure that the hole was the proper depth and that the pole was centered, facing the correct direction, and correctly aligned.	____	____
13. Ensured that the pole was tamped.	____	____
14. Ensured that a watershed was created at the pole base.	____	____
15. Rechecked the pole depth, centering, facing, and alignment of the pole before mounting the hardware.	____	____
16. Ensured that guys and anchors were installed as stated in the electrical construction prints.	____	____
17. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
DA FORM 2702	AR 385-10
LCH	EM 385-1-1
	ER 385-1-31
	FM 3-34.480
	TM 5-682
	TM 5-684
	TM 5-811-1
	TM 5-811-3

Subject Area 6: S3 and E5 Combined Tasks

Service a Potential Transformer

052-264-2106

Conditions: As a power station electrician in a tactical or nontactical environment during maintenance, you are given a general mechanic's tool box, a digital low-resistance ohmmeter, a megohmmeter, a transformer turn-to-turn ratio tester, grounding equipment, applicable safety standing operating procedures, wiring diagrams, maintenance logbooks, and the manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF TRANSFORMERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN THE POWER SOURCE IS CONNECTED TO THE TRANSFORMER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service a potential transformer by inspecting and testing it according to the manufacturer's literature, and record the results. Reinstall or repair the potential transformer based on the test results.

Performance Steps
NOTE: Tests should be conducted according to the manufacturer's literature. When the manufacturer's literature is not available, industry standards should be used.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Inspect the condition of the potential transformer visually and manually to ensure that mechanical functions operate smoothly and that there is no physical damage to the oil switch.
6. Test the fuses.
7. Perform individual continuity checks on primary and secondary windings of the transformer to ensure that the winding resistance is consistent with the manufacturer's specifications.
8. Perform an insulation resistance test on the transformer at a test voltage recommended in the manufacturer's literature.
    a. Ensure that insulation resistance readings are a minimum of 20 megohms from the primary lead to the ground terminal.
    b. Ensure that insulation resistance readings are a minimum of 20 megohms from the secondary lead to the ground terminal.
    c. Ensure that insulation resistance readings are a minimum of 20 megohms from the primary lead to the secondary lead terminal.

Performance Steps

9. Perform a transformer turn-to-turn ratio test.
10. Reconnect the isolated equipment.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a potential transformer.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Inspected the condition of the potential transformer visually and manually to ensure that mechanical functions operated smoothly and that there was no physical damage to the oil switch.	____	____
6. Tested the fuses.	____	____
7. Performed individual continuity checks on primary and secondary windings of the transformer to ensure that the winding resistance was consistent with the manufacturer's specifications.	____	____
8. Performed an insulation resistance test on the transformer at a test voltage recommended in the manufacturer's literature.	____	____
9. Performed a transformer turn-to-turn ratio test.	____	____
10. Reconnected the isolated equipment.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
	NESC®
	NETA™

Service a Current Transformer (CT)

052-264-2107

Conditions: As a power station electrician or instrument technician in a tactical or nontactical environment during maintenance, you are given safety standing operating procedures; a general mechanic's tool box; a digital, low-resistance ohmmeter; a megohmmeter; a lockout and tagout kit; grounding equipment; maintenance logbooks; and the applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF TRANSFORMERS AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT THE TRANSFORMER IS DE-ENERGIZED AND ELECTRICALLY SHORTED BEFORE SERVICING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN THE POWER SOURCE IS CONNECTED TO THE TRANSFORMER. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service a CT by inspecting and testing it according to the manufacturer's literature, and record the results. Reinstall or replace the CT based on the test results.

Performance Steps
NOTE: Tests should be conducted according to the manufacturer's literature. When the manufacturer's literature is not available, industry standards should be used.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Test the circuit for voltage.
   a. Proceed to step 6 if no voltage is present.
   b. Stop if voltage is present, and do not proceed to step 6 until voltage is no longer present.
      (1) Check the schematics for proper circuit identification.
      (2) Check for possible back-fed circuits.
      (3) Check for the proper installation of safe clearances.
6. Inspect the condition of the CT visually and manually to ensure that mechanical functions operate smoothly and that there is no physical damage.
7. Perform a continuity check on the transformer winding to ensure that the winding resistance is consistent with the manufacturer's specifications.
8. Verify the CT ratio.

Performance Steps

9. Perform an insulation resistance test on the transformer, and connect a megohmmeter across the lead terminal or a to-ground terminal at a test voltage specified in the manufacturer's literature to ensure that insulation resistance readings are a minimum of 100 megohms.
10. Reconnect the isolated equipment.
11. Close out lockout and tagout procedures by removing locking and tagging devices.
12. Ensure that the equipment is operating as designed.
13. Keep a record of the test results and actions taken.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a CT.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Tested the circuit for voltage.	____	____
6. Inspected the condition of the CT visually and manually to ensure that mechanical functions operated smoothly and that there was no physical damage.	____	____
7. Performed a continuity check on the transformer winding to ensure that the winding resistance was consistent with the manufacturer's specifications.	____	____
8. Verified the CT ratio.	____	____
9. Performed an insulation resistance test on the transformer and connected a megohmmeter across the lead terminal or a to-ground terminal at a test voltage specified in the manufacturer's literature to ensure that insulation resistance readings were a minimum of 100 megohms.	____	____
10. Reconnected the isolated equipment.	____	____
11. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
12. Ensured that the equipment was operating as designed.	____	____
13. Kept a record of the test results and actions taken.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required

Related

NETA™

TM 5-686

Solder an Electrical or Electronic Component

052-264-2108

Conditions: As a power station instrument technician or a power station electrician in a tactical or nontactical environment when producing a new electronic circuit or repairing an existing electronic circuit, you are given a soldering iron, solder and rosin flux, a multimeter, an electronic tool kit, appropriate technical manuals or bulletins, and the applicable manufacturer's literature with schematics.

DANGER: REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THE SOLDERING IRON IS VERY HOT DURING OPERATION. USE CAUTION TO AVOID SETTING YOURSELF OR THE WORKPLACE ON FIRE. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

NOTE: KEEP THE WORK AREA NEAT AND ORGANIZED AND THE METER AND EQUIPMENT STABLE WHILE PERFORMING THIS TASK. FAILURE TO COMPLY MAY LEAD TO UNRELIABLE TEST READINGS.

Standards: Solder an electrical or electronic component to complete a new or existing circuit so that the resistance measures 0 ohms.

Performance Steps

1. Identify components/parts to be soldered.
2. Inspect components/parts for damage and serviceability.
3. Prepare components/parts to be soldered.
   a. Clean surfaces to be soldered.
   b. Apply rosin flux to surfaces to be soldered.
   c. Insert each electronic component/part individually into its proper position.
   d. Ensure that the polarity-sensitive components/parts are properly oriented.
   e. Place heat sink clips on the leads for temperature-sensitive components.
   f. Secure electrical components to minimize movement during the soldering process.
4. Solder the components/parts together using the appropriate technique.
   a. Ensure good thermal contact between the tip of the soldering iron and the components/parts.
   b. Melt the solder directly to the components/parts, allowing the solder to flow into the connection.
   c. Remove the soldering iron and solder when enough solder has filled the area to create a good electrical and secure union between the two components/parts.
   d. Ensure that the components/parts do not move during or after the soldering process until the solder cools.
5. Inspect the final product for flaws and damage.
6. Test the connection using a multimeter to ensure that the resistance measures 0 ohms.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to solder an electrical or electronic component.

Performance Measures	GO	NO-GO
1. Identified components/parts to be soldered.	____	____
2. Inspected components/parts for damage and serviceability.	____	____
3. Prepared components/parts to be soldered.	____	____
4. Soldered the components/parts together using the appropriate technique.	____	____
5. Inspected the final product for flaws and damage.	____	____
6. Tested the connection using a multimeter to ensure that the resistance measured 0 ohms.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	TB SIG 222

Perform Advanced, Electrical Troubleshooting Procedures

052-264-2109

Conditions: As a power station electrician or power station instrument technician in a tactical or nontactical environment when an electrical circuit or distribution system requires troubleshooting, you are given safety standing operating procedures, a lockout and tagout kit, a multimeter, an electrician's tool kit, a megohmmeter, electrical construction prints, wiring diagrams, maintenance logbooks, and the manufacturer's literature with schematics.

DANGER:

1. TROUBLESHOOTING ELECTRICAL CIRCUITS AND DISTRIBUTION SYSTEMS REQUIRES CONDUCTORS TO BE ENERGIZED AND IN OPERATION. DE-ENERGIZE AND GROUND ELECTRICAL CIRCUITS BEFORE PHYSICAL CONTACT OR WHEN WORKING IN CLOSE PROXIMITY WITH ELECTRICAL COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Perform advanced, electrical troubleshooting procedures using systematic procedures. Safely troubleshoot the electrical circuit or distribution system by identifying the possible cause of the malfunction, testing to verify the cause of the malfunction and making repairs (if possible) to correct the malfunction.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify portions of the circuit or system that are without power or have improper voltage levels.
5. Check and reset tripped protective devices (circuit breakers, fuses, protective relays).
6. Check voltage levels.
   a. Check for indications of shorts or opens from phase to neutral.
   b. Check for indications of shorts or opens from phase to phase.
   c. Check for indications of shorts or opens from phase to ground.
   d. Check for indications of shorts or opens from ground to neutral.
   e. Check for indications of shorts or opens from phase and line voltages of three-phase systems.
7. Check conductor ends.
   a. Check for proper termination.
   b. Check for a solid electrical connection.
   c. Check for loose connections.
8. Check conductors electrically for shorts and opens.

NOTE: Continuity between phases may indicate a short. Opens across closed breakers and switches indicate failure of the device.

9. Perform underground cable and/or fault procedures if necessary.
10. Check the physical condition of the conductors.
    a. Inspect conductors from end to end when a short or open is indicated in previous steps.
    b. Check for burnt insulation.

Performance Steps

11. Conduct a load assessment to find the initial cause of the fault.
12. Replace defective components/parts.
    a. Replace or splice faulty cables.
    b. Replace faulty circuit breakers.
    c. Ensure that protective relays are operating properly at correct settings.
    d. Replace blown fuses.
13. Monitor the circuits.
14. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to perform advanced, electrical troubleshooting procedures.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified portions of the circuit or system that were without power or had improper voltage levels.	____	____
5. Checked and reset tripped protective devices (circuit breakers, fuses, protective relays).	____	____
6. Checked voltage levels.	____	____
7. Checked conductor ends.	____	____
8. Checked conductors electrically for shorts and opens.	____	____
9. Performed underground cable and/or fault procedures if necessary.	____	____
10. Checked the physical condition of the conductors.	____	____
11. Conducted a load assessment to find the initial cause of the fault	____	____
12. Replaced defective components/parts.	____	____
13. Monitored the circuits.	____	____
14. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	**Related**
	EM 385-1-1

Determine the Transformer Polarity

052-264-2110

Conditions: As a power station electrician or instrument technician in a tactical or nontactical environment during scheduled or unscheduled maintenance intervals, you are given an electrician's tool kit, a variable-voltage source alternating-current (AC), a multimeter, a 0- to 10-volt AC ammeter, a milliammeter, a 12-volt battery, a switch, varying lengths of Number 12 American wire gauge for connecting meters, a variable-voltage source battery or direct-current (DC), a lockout and tagout kit, a grounding stick, high-voltage gloves, safety standing operating procedures, maintenance logbooks, and transformers to be tested.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. USE PROPER TEST EQUIPMENT TO TEST FOR VOLTAGE BEFORE CONTACTING COMPONENTS/PARTS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: THIS TASK SHOULD NOT BE PERFORMED ON EQUIPMENT THAT CONTAINS POLYCHLORINATED BIPHENYL (PCB). FAILURE TO COMPLY MAY CAUSE SKIN AILMENTS, REPRODUCTIVE DISORDERS, LIVER DISEASE, OR IMMEDIATE PERSONAL INJURY.

Standards: Determine the polarity of a transformer, and mark the transformer accordingly.

Performance Steps
NOTE: An additive, single-phase power or potential transformer will have the high-voltage terminal H1 opposite the low-voltage terminal X2 and the H2 opposite the X1. When a single-phase power or potential transformer is said to be subtractive, the high-voltage terminal H1 is opposite X1 and H2 is opposite X2. Current transformers (CTs) will normally have the polarity marked on the X1 or X2 terminals, but they still have to be tested and verified.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature, electrical construction prints, and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Ground out residual voltage.
   a. Ground out the primary side.
   b. Ground out the secondary side.
6. Keep a record of how the transformer is wired.
7. Disconnect the transformer.
8. Apply grounds on the incoming and load cables.
9. Test for polarity on a single-phase power and potential transformer, and proceed to step 11 if the test is performed on a CT.
   a. Connect the variable AC source to the H1 and H2 terminals.
   b. Connect a jumper wire from the H1 terminal to the X2 terminal.
   c. Connect a multimeter to the H2 and X1 terminals to measure the voltage.
   d. Apply AC voltage consistent with the ratio of the transformer, such as 120 volts for a 120:1 transformer ratio.
   e. Record the voltage readings.

Performance Steps

f. Turn off the variable AC source.
g. Ground the transformer terminals.
h. Remove the jumper wire from the H1 and X2 terminals, and place it on the H2 and X1 terminals.
i. Connect the multimeter to the H1 and X2 terminals.
j. Apply the same AC voltage that was applied in step 9d.
k. Record the voltage readings.
l. Determine if the voltage reading in step 9e is higher than the one in step 9k. (The transformer is additive if the reading is higher; the transformer is subtractive if it is lower.)
m. Turn off the variable AC source.
n. Ground the transformer terminals.
o. Remove the variable AC source and jumper wire.

10. Mark the appropriate polarity on the transformer.

11. Test for polarity on a CT using the current- or inductive-kick method.

DANGER: THE SECONDARY WINDINGS OF CTs SHOULD HAVE A CLOSED CIRCUIT ACROSS THEIR SECONDARY TERMINALS WHEN POWER IS APPLIED TO THE PRIMARY TERMINALS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

a. Connect a 12-volt battery to the primary conductor of the CT and a switch in series with the battery. (The positive side of the battery should be on the load side [H1 terminal], and the negative side should be on the H2 terminal.)
b. Connect a milliammeter across the secondary winding of the transformer. (The positive lead of the milliammeter should be connected to the appropriate polarity mark if indicated or to the X1 terminal if not indicated. Connect the negative lead to the remaining secondary terminal.)
c. Close the switch momentarily, and note the movement of the ammeter. (The transformer is connected in subtractive polarity if the ammeter moves in the positive direction. It is connected in additive polarity if the ammeter moves in the negative direction.)

12. Record the test results.

13. Mark the appropriate polarity on the CT.

14. Remove the grounds from incoming and load cables.

15. Reconnect the transformer.

16. Close out lockout and tagout procedures by removing locking and tagging devices.

17. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to determine the transformer polarity.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature, electrical construction prints, and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Grounded out residual voltage.	____	____

Performance Measures	GO	NO-GO
6. Kept a record of how the transformer was wired.	____	____
7. Disconnected the transformer.	____	____
8. Applied grounds on the incoming and load cables.	____	____
9. Tested for polarity on a single-phase power or potential transformer and proceeded to step 11 if the test was performed on a CT.	____	____
10. Marked the appropriate polarity on the transformer.	____	____
11. Tested for polarity on a CT using the current- or inductive-kick method.	____	____
12. Recorded the test results.	____	____
13. Marked the appropriate polarity on the CT.	____	____
14. Removed the grounds from incoming and load cables.	____	____
15. Reconnected the transformer.	____	____
16. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
17. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	EM 385-1-1
	TM 5-686

Service an Automatic Transfer Switch (ATS)

052-264-2112

Conditions: As a power plant operator in a tactical or nontactical environment during maintenance intervals, you are given a lockout and tagout kit, a general mechanic's tool box, an electrician's tool kit, a low-resistance ohmmeter, a megohmmeter, a torque wrench, maintenance logbooks, wiring diagrams, a grounding cluster, conductive and nonconductive grease, and applicable manufacturer's literature with schematics.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND MAINTENANCE OF SWITCHGEAR AND POWER EQUIPMENT AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. DO NOT TOUCH EXPOSED ELECTRICAL CONNECTIONS WHEN THE POWER SOURCE IS CONNECTED TO THE SWITCH. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service an ATS by inspecting and testing it according to the manufacturer's literature, and record the results. Repair or replace the ATS based on the test results.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Perform lockout and tagout procedures.
5. Perform a visual and manual inspection of the ATS.

NOTE: Microhm or millivolt drop values should not exceed high levels of the normal range as specified in the manufacturer's literature. If the manufacturer's literature is not available, investigate values that deviate from adjacent poles or similar breakers by more than 25 to 50 percent of the lowest value.

a. Verify the appropriate anchorage and area clearance.
b. Verify the appropriate equipment grounding.
c. Verify the correct blade alignment, penetration, travel stops, and mechanical operation.
d. Verify that fuse sizes and types are according to the manufacturer's literature.
e. Verify that expulsion-limiting devices are in place on holders having expulsion type elements.
f. Verify that each fuse holder has adequate mechanical support.
g. Inspect bolted electrical connections for high resistance.
    (1) Use the low-resistance ohmmeter.
    (2) Verify the tightness of bolted connections using a calibrated torque wrench according to the manufacturer's specifications.
    (3) Perform a thermographic survey.
h. Test interlocking systems for correct operation and sequencing.
i. Inspect insulating assemblies for evidence of physical damage or contaminated surfaces.
j. Exercise mechanical components/parts.
k. Compare switchblade clearances with industry standards.
l. Verify that indicating and control devices are operating correctly.

Performance Steps

m. Verify the operation of heaters if applicable.
n. Clean the unit before testing unless as-found and as-left tests are required.
o. Verify contact lubrication on moving, current-carrying components/parts.
p. Verify lubrication on moving, sliding surfaces.

6. Check for proper control function according to the manufacturer's literature.
   a. Test the automatic control.
   b. Test the manual control.
7. Perform insulation resistance tests pole to pole, pole to ground, and across open contacts of each phase; and ensure that test values are not less than 1,000 megohms at a direct-current (DC) test voltage of 2,500 volts or at the voltage recommended by the manufacturer.
8. Perform overpotential tests pole to pole, pole to ground, and across open contacts of each phase at the voltage recommended by the manufacturer.
9. Perform resistance measurements through the bolted connections using a low-resistance ohmmeter to ensure that bolt torque levels are according to the manufacturer's literature.
10. Measure the contact resistance across each switchblade and fuse holder according to the manufacturer's literature.
11. Measure resistance across each fuse to ensure that values did not deviate from each other by more than 15 percent.
12. Perform corrective actions as necessary.
13. Close out lockout and tagout procedures by removing locking and tagging devices.
14. Perform a function check on the ATS.
15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an ATS.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Performed lockout and tagout procedures.	____	____
5. Performed a visual and manual inspection of the ATS.	____	____
6. Checked for proper control function according to the manufacturer's literature.	____	____
7. Performed insulation resistance tests pole to pole, pole to ground, and across open contacts of each phase and ensured that test values were not less than 1,000 megohms at a DC test voltage of 2,500 volts or at the voltage recommended by the manufacturer.	____	____

Performance Measures	GO	NO-GO
8. Performed overpotential tests pole to pole, pole to ground, and across open contacts of each phase at the voltage recommended by the manufacturer.	____	____
9. Performed resistance measurements through the bolted connections using a low-resistance ohmmeter to ensure that bolt torque levels were according to the manufacturer's literature.	____	____
10. Measured the contact resistance across each switchblade and fuse holder according to the manufacturer's literature.	____	____
11. Measured resistance across each fuse to ensure that values did not deviate from each other by more than 15 percent.	____	____
12. Performed corrective actions as necessary.	____	____
13. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
14. Performed a function check on the ATS.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

Service a Voltage Regulator

052-264-2113

Conditions: As a power station instrument technician or a power station electrician in a tactical or nontactical environment during maintenance, you are given a lockout and tagout kit, a multimeter, a relay test set, an electronic phase shifter (EPS)-1000, an electronic tool kit, maintenance logbooks, appropriate technical manuals, and the manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT THE POWER TO THE VOLTAGE REGULATOR IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ENSURE THAT POTENTIAL TRANSFORMERS FEEDING THE VOLTAGE REGULATOR ARE DE-ENERGIZED BEFORE SERVICING. FAILURE TO COMPLY MAY CAUSE INJURY OR EQUIPMENT DAMAGE.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

NOTE: KEEP THE WORK AREA NEAT AND ORGANIZED AND THE REGULATOR STABLE WHILE PERFORMING THIS TASK. FAILURE TO COMPLY MAY LEAD TO UNRELIABLE TEST READINGS.

Standards: Safely service a voltage regulator by testing and calibrating it according to the manufacturer's literature, and record the results. Reinstall or replace the regulator based on the test results.

Performance Steps
NOTE: The low-voltage side of the potential transformer that supplies voltage to the regulator may be fuse-protected. To further isolate the circuit electrically and as an additional measure of safety, this fuse may be removed. Check the schematics for verification.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify the circuit connected to the voltage regulator by using schematics.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage.
   a. Proceed to step 7 if no voltage is present.
   b. Stop if voltage is present, and perform checks until the voltage is no longer present.
      (1) Check the schematics for proper circuit identification.
      (2) Check for back-fed circuits.
      (3) Check for the proper installation of safe-clearance procedures.
      (4) Check for violations of safe-clearance procedures.
7. Remove the voltage regulator, and tag attached leads.
8. Inspect the voltage regulator for damage.
9. Test the voltage regulator according to the manufacturer's literature, and record the results.
   a. Test the regulator output with no voltage at sensing inputs.
   b. Test the regulator output with the correct voltage at sensing inputs.
   c. Test the regulator output with high and low voltage at sensing inputs.

Performance Steps

d. Check for the proper operation of the manual voltage adjustment.

10. Compare the results with the manufacturer's specifications, and correct them as necessary.
    a. Calibrate the regulator.
    b. Reinstall the regulator.
    c. Replace the regulator.
11. Test the circuit for voltage.
    a. Proceed to step 12 if no voltage is present.
    b. Stop if voltage is present, and perform checks until the voltage is no longer present.
        (1) Check the schematics for proper circuit identification.
        (2) Check for back-fed circuits.
        (3) Check for the proper installation of safe-clearance procedures.
        (4) Check for violations of safe-clearance procedures.
12. Reinstall the voltage regulator.
    a. Attach tagged leads.
    b. Verify connections by using the schematics.
13. Close out lockout and tagout procedures by removing locking and tagging devices.
14. Perform a functions check on the voltage regulator.
15. Keep a record of the test results and actions taken.
16. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a voltage regulator.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified the circuit connected to the voltage regulator by using schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage.	____	____
7. Removed the voltage regulator and tagged attached leads.	____	____
8. Inspected the voltage regulator for damage.	____	____
9. Tested the voltage regulator according to the manufacturer's literature and recorded the results.	____	____
10. Compared the results with the manufacturer's specifications and corrected them as necessary.	____	____
11. Tested the circuit for voltage	____	____
12. Reinstalled the voltage regulator.	____	____

Performance Measures	GO	NO-GO
13. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
14. Performed a functions check on the voltage regulator.	____	____
15. Kept a record of the test results and actions taken.	____	____
16. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	TM 5-6115-593-12 TM 5-6115-593-34

Service an Uninterruptible Power Supply (UPS)

052-264-2114

Conditions: As a power station instrument technician or a power station electrician in a tactical or nontactical environment during maintenance, you are given a multimeter, a relay test set, an oscilloscope, an electronic tool kit, applicable manufacturer's literature with schematics, appropriate technical manuals with schematics, maintenance logbooks, and wiring diagrams.

DANGER:

1. SERVICING AND TESTING A UPS MUST BE DONE WITH THE COMPONENTS/PARTS ENERGIZED. CARE MUST BE TAKEN TO AVOID TOUCHING THE ENERGIZED EQUIPMENT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

Standards: Safely service a UPS according to the manufacturer's literature, and record the results.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Measure the power supplied to the load from the primary source.
5. Identify inputs and outputs of the UPS.
6. Isolate the UPS and the supplied load from the incoming power supply.
7. Compare the UPS output with specified parameters.
   a. Determine the current UPS output.
   b. Check for voltage sag in the UPS output.
   c. Compare the power supplied to the measurement from steps 7a and 7b.
   d. Proceed to step 10 if the output is acceptable.
8. Check for proper battery charging.
   a. Check the voltage level of the rectifier output.
   b. Check the waveform of the rectifier output for the proper direct-current (DC).
   c. Replace or repair the malfunctioning rectifier or filter if necessary.
9. Check for proper inverter operation.
   a. Check the voltage level of the inverter output.
   b. Check the waveform output of the inverter for the proper sine wave.
   c. Replace or repair the inverter if necessary.
10. Service the batteries.
11. Return the UPS and load to the incoming power supply.
12. Perform a functions check on the UPS.
13. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare

the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service a UPS.

Performance Measures	GO	NO-GO
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Measured the power supplied to the load from the primary source.	____	____
5. Identified inputs and outputs of the UPS.	____	____
6. Isolated the UPS and the supplied load from the incoming power supply.	____	____
7. Compared the UPS output with specified parameters.	____	____
8. Checked for proper battery charging.	____	____
9. Checked for proper inverter operation.	____	____
10. Serviced the batteries.	____	____
11. Returned the UPS and load to the incoming power supply.	____	____
12. Performed a functions check on the UPS.	____	____
13. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

Subject Area 7: S3 and S2 Combined Tasks

Service an Electronic Governor

052-264-2105

Conditions: As a power station mechanic or instrumentation technician in a tactical or nontactical environment during maintenance, you are given an engine; a lockout and tagout kit; TM 5-6115-456-15, TM 9-6115-604-12, and TM 9-6115-604-34 or the manufacturer's literature with schematics; maintenance logbooks; and a general mechanic's tool box.

DANGER:

1. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. HAZARDOUS VOLTAGES APPEAR AT TERMINALS INSIDE THE HIGH-VOLTAGE CABINET DURING GENERATOR SET OPERATION. OBSERVE SAFETY PRECAUTIONS APPLICABLE TO MAINTENANCE ON HIGH-VOLTAGE EQUIPMENT. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: NOISE LEVELS IN EXCESS OF 85 DECIBELS EXIST WITHIN A 50-FOOT RADIUS OF OPERATING EQUIPMENT. PERSONNEL MUST WEAR SINGLE HEARING PROTECTION WITHIN A 50-FOOT RADIUS. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY.

Standards: Service an electronic governor. Determine if the electronic governor meets specifications in the appropriate TM or manufacturer's literature. If the electronic governor fails to meet specifications, perform adjustments or replacements necessary to bring the electronic governor to a serviceable condition.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Identify the circuit or device being tested.
5. Perform lockout and tagout procedures.
6. Inspect electrical connections for cleanness, correctness, and tightness.
7. Inspect the magnetic pickup for tightness, proper clearance, and proper voltage.
8. Check for proper voltages on related electronic governor circuitry according to the TM or manufacturer's literature.
9. Test the governor system components/parts according to the TM or manufacturer's literature.
10. Repair faulty electronic governor system components/parts if possible.
11. Replace faulty electronic governor system components/parts that cannot be repaired.
12. Adjust the electronic governor for gain, stability, frequency, and droop.
13. Close out lockout and tagout procedures by removing locking and tagging devices.
14. Energize the circuit, and check for proper operation.

Performance Steps

15. Verify adjustments made to the governor during operation.
    a. Adjust the governor for initial engine start-up.
    b. Adjust the governor when the engine is at operating temperature to obtain engine speed.
        (1) Maintain optimum speed.
        (2) Maintain desired speed.
        (3) Maintain stability.
16. Perform a load test on the generator to ensure proper operation.
17. Keep a record of the test results and actions taken.
18. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an electronic governor.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Identified the circuit or device being tested.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Inspected electrical connections for cleanness, correctness, and tightness.	____	____
7. Inspected the magnetic pickup for tightness, proper clearance, and proper voltage.	____	____
8. Checked for proper voltages on related electronic governor circuitry according to the TM or manufacturer's literature.	____	____
9. Tested the governor system components/parts according to the TM or manufacturer's literature.	____	____
10. Repaired faulty electronic governor system components/parts if possible.	____	____
11. Replaced faulty electronic governor system components/parts that could not be repaired.	____	____
12. Adjusted the electronic governor for gain, stability, frequency, and droop.	____	____
13. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
14. Energized the circuit and checked for proper operation.	____	____
15. Verified adjustments made to the governor during operation.	____	____
16. Performed a load test on the generator to ensure proper operation.	____	____

Performance Measures	GO	NO-GO
17. Kept a record of the test results and actions taken.	____	____
18. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
TM 9-6115-604-12	EM 385-1-1
TM 9-6115-604-34	

Troubleshoot the Improper Operation of an Electrical Motor

052-264-2115

Conditions: As a power station electrician or mechanic in a nontactical environment when an electric motor needs service, you are given the manufacturer's literature with schematics, wiring diagrams, a megohmmeter, a multimeter, maintenance logbooks, a steel brush, contact cleaner, compressed air, and a general mechanic's tool box.

DANGER:

1. THIS TASK SHOULD ONLY BE PERFORMED BY QUALIFIED INDIVIDUALS WHO ARE KNOWLEDGEABLE IN THE INSTALLATION AND OPERATION OF ELECTRICAL MOTORS, ALTERNATING-CURRENT (AC) SYSTEMS, AND DIRECT-CURRENT (DC) SYSTEMS AND THEIR ASSOCIATED HAZARDS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. ALWAYS WEAR THE PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR INSPECTIONS IN HAZARDOUS AREAS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

3. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

4. ELECTRICAL CIRCUITS, CONDUCTORS, COMPONENTS/PARTS, AND EQUIPMENT SHOULD BE CONSIDERED ELECTRICALLY ENERGIZED UNTIL THE ENERGY SOURCE IS REMOVED. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

WARNING: COMPRESSED AIR USED FOR CLEANING OR DRYING CAN CREATE AIRBORNE PARTICLES THAT MAY ENTER THE EYES. PRESSURE SHOULD NOT EXCEED 30 POUNDS PER SQUARE INCH. GOGGLES ARE REQUIRED. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Safely service an electrical motor by inspecting and testing it according to the manufacturer's literature. Repair or replace the motor based on the test results.

Performance Steps

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Record critical data from the motor manufacturer's data plate.
5. Perform a visual inspection of the motor.
    a. Inspect the outer casing.
    b. Inspect the connections.
    c. Inspect the mounting hardware.
    d. Inspect the ventilation.

NOTE: Electric motor windings cannot be wet; keep the motor dry, or dry the motor before conducting tests.

6. Start the motor to perform checks.
    a. Check for data plate voltage.
    b. Check for current draw.
    c. Check for the correct temperature.
    d. Check for abnormal noise.

Performance Steps

7. Disconnect the motor leads, and ensure that they are isolated and marked.
8. Disassemble the motor, and label the bell ends.
9. Clean the motor.
10. Identify the type of electric motor (series, shunt, compound).
11. Test motor components/parts.
12. Reassemble the motor.
13. Adjust and lubricate the motor as needed.
14. Return the motor to operation, testing it for proper operating parameters according to the manufacturer's literature.
15. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to troubleshoot the improper operation of an electrical motor.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Recorded critical data from the motor manufacturer's data plate.	____	____
5. Performed a visual inspection of the motor.	____	____
6. Started the motor to perform checks.	____	____
7. Disconnected the motor leads, and ensured that they were isolated and marked.	____	____
8. Disassembled the motor, and labeled the bell ends.	____	____
9. Cleaned the motor.	____	____
10. Identified the type of electric motor (series, shunt, compound).	____	____
11. Tested motor components/parts.	____	____
12. Reassembled the motor.	____	____
13. Adjusted and lubricated the motor as needed.	____	____
14. Returned the motor to operation, testing it for proper operating parameters according to the manufacturer's literature.	____	____
15. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

Subject Area 8: S2 and E5 Combined Tasks

Service an Auxiliary and/or an Instrumentation Sensing Device

052-264-2104

Conditions: As a power station instrument technician or power station mechanic in a tactical or nontactical environment during maintenance intervals, you are given a lockout and tagout kit, a multimeter, an oscilloscope, maintenance logbooks, wiring diagrams, appropriate technical manuals, an electronic tool kit, and the applicable manufacturer's literature with schematics.

DANGER:

1. ENSURE THAT POWER TO THE SENSING DEVICE IS DISCONNECTED BEFORE SERVICING. APPLY SAFE-CLEARANCE PROCEDURES TO ASSOCIATED CIRCUITS. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

2. REMOVE RINGS, NECKLACES, OTHER JEWELRY, AND LOOSE CLOTHING. FAILURE TO COMPLY MAY CAUSE PERMANENT INJURY OR DEATH.

CAUTION: KEEP THE WORK AREA NEAT AND ORGANIZED WHILE PERFORMING THIS TASK. FAILURE TO COMPLY MAY CAUSE IMMEDIATE PERSONAL INJURY OR EQUIPMENT DAMAGE.

Standards: Safely service auxiliary and sensing devices by testing and calibrating or replacing them. Test the devices according to the manufacturer's literature, and record the results. Reinstall or replace the auxiliary or sensing device based on the test results.

Performance Steps

NOTE: Direct-current (DC) control voltage for sensing devices may be removed by opening the circuit breaker and disconnecting the batteries. Verify by using the schematics.

1. Review danger, warning, and caution notices.
2. Review the manufacturer's literature and wiring diagrams.
3. Review maintenance logbooks and historical data pertaining to the equipment.
4. Use the schematics to identify the circuit of the sensing device being tested.
5. Perform lockout and tagout procedures.
6. Test the circuit for voltage.
    a. Proceed to step 7 if no voltage is present.
    b. Stop if voltage is present, and do not proceed to step 7 until voltage is no longer present.
        (1) Check the schematics for proper circuit identification.
        (2) Check for possible back-fed circuits.
        (3) Check for the proper installation of safe clearances.
7. Remove the sensing device and tagged leads.
8. Test the sensing device according to the manufacturer's literature, and record the results.
    a. Test the speed switches for continuity switching on contacts.
    b. Check the pickups with the engine running if possible.
    c. Check the pressure and temperature sensors for continuity within specified ranges.
9. Compare the test results with the manufacturer's specifications, and take proper action.
    a. Calibrate the sensing device.
    b. Reinstall the sensing device.

Performance Steps

c. Replace the sensing device.

10. Test the circuit for voltage.
    a. Proceed to step 11 if no voltage is present.
    b. Stop if voltage is present, and do not proceed to step 11 until voltage is no longer present.
       (1) Check the schematics for proper circuit identification.
       (2) Check for possible back-fed circuits.
       (3) Check for the proper installation of safe clearances.
11. Reinstall the sensing device.
    a. Attach tagged leads.
    b. Verify connections.
12. Close out lockout and tagout procedures by removing locking and tagging devices.
13. Energize the circuit.
14. Perform a function check.
15. Keep a record of the test results and actions taken.
16. Ensure that the items listed in the conditions are properly cleaned and stored.

Evaluation Preparation: Setup: Provide the Soldier with the items listed in the conditions. Give the Soldier a safety briefing before starting the test, and ensure that safety precautions are followed. Prepare the testing area and equipment in advance to ensure that task standards can be met.

Brief Soldier: Direct the Soldier to service an auxiliary and/or an instrumentation sensing device.

Performance Measures	**GO**	**NO-GO**
1. Reviewed danger, warning, and caution notices.	____	____
2. Reviewed the manufacturer's literature and wiring diagrams.	____	____
3. Reviewed maintenance logbooks and historical data pertaining to the equipment.	____	____
4. Used the schematics to identify the circuit of the sensing device that was tested with the schematics.	____	____
5. Performed lockout and tagout procedures.	____	____
6. Tested the circuit for voltage.	____	____
7. Removed the sensing device and tagged leads.	____	____
8. Tested the sensing device according to the manufacturer's literature and recorded the results.	____	____
9. Compared the test results with the manufacturer's specifications and took proper action.	____	____
10. Tested the circuit for voltage.	____	____
11. Reinstalled the sensing device.	____	____
12. Closed out lockout and tagout procedures by removing locking and tagging devices.	____	____
13. Energized the circuit	____	____

Performance Measures	GO	NO-GO
14. Performed a function check.	____	____
15. Kept a record of the test results and actions taken.	____	____
16. Ensured that the items listed in the conditions were properly cleaned and stored.	____	____

Evaluation Guidance: Score the Soldier GO if all measures are passed (P). Score the Soldier NO-GO if any measure is failed (F). If the Soldier fails any measure, show him how to do it correctly.

References

Required	Related
	TM 5-6115-593-12 TM 5-6115-593-34

Appendix A

Metric Conversion Chart

This appendix complies with current Army directives, which state that the metric system will be incorporated into all new publications. Table A-1 is a metric conversion chart.

Table A-1. Metric Conversion Chart

U.S. Units	Multiplied By	Equals Metric Units
Length		
Feet	0.30480	Meters
Inches	2.54000	Centimeters
Inches	0.02540	Meters
Inches	25.40010	Millimeters
Miles (statute)	1.60930	Kilometers
Miles (nautical)	1.85320	Kilometers
Yards	0.91400	Meters
Area		
Square inches	6.45160	Square centimeters
Square feet	0.09290	Square meters
Square yards	0.83610	Square meters
Volume		
Cubic inches	16.38720	Cubic centimeters
Cubic feet	0.02830	Cubic meters
Cubic yards	0.76460	Cubic meters
Gallons	3.78540	Liters
Fluid ounces	29.57300	Milliliters
Quarts	0.94600	Liters
Weight		
Ounces	28.34900	Grams
Pounds	453.59000	Grams
Pounds	0.45359	Kilograms
Short tons	0.90700	Metric tons
Long tons	1.01600	Metric tons
Foot-pounds	1.38300	Newton-meters
Pressure		
Pounds per square inch	6.90000	Kilopascals

Table A-1. Metric Conversion Chart (continued)

Metric Units	Multiplied By	Equals U.S. Units
Length		
Centimeters	0.39370	Inches
Meters per second	2.23700	Miles per hour
Millimeters	0.03937	Inches
Kilometers	0.62137	Miles (statute)
Kilometers	0.53960	Miles (nautical)
Meters	3.28080	Feet
Meters	39.37000	Inches
Meters	1.09360	Yards
Area		
Square centimeters	0.15500	Square inches
Square meters	10.76400	Square feet
Square meters	1.19600	Square yards
Volume		
Cubic centimeters	0.06100	Cubic inches
Cubic meters	35.31440	Cubic feet
Cubic meters	1.30790	Cubic yards
Milliliters	0.03380	Fluid ounces
Liters	1.05700	Quarts
Liters	0.26420	Gallons
Weight		
Grams	0.03527	Ounces
Kilograms	2.20460	Pounds
Metric tons	1.10200	Short tons
Metric tons	0.98400	Long tons
Newton-meters	0.73800	Foot-pounds
Pressure		
Kilopascals	0.14493	Pounds per square inch

Appendix B

Wire Gauge Size Conversion Chart

This appendix contains wire gauge size conversions. Table B-1 is a wire gauge size conversion chart.

Table B-1. Wire Gauge Size Conversion Chart

AWG	Diameter		Cross Section Area			
	Inches	Millimeters	Square Inches	Square Millimeters	Circular Mils	Resistance Ohms/Meters
0000	0.460000	11.6800	0.16620000	107.20000	211600.000	0.000161
000	0.409600	10.4000	0.13180000	85.03000	167800.000	0.000203
00	0.364800	9.2660	0.10450000	67.43000	133100.000	0.000256
0	0.324900	8.2520	0.08289000	53.48000	105500.000	0.000323
1	0.289300	7.3480	0.06573000	42.41000	83690.000	0.000407
2	0.257600	6.5430	0.05123000	33.63000	66370.000	0.000513
3	0.229400	5.8270	0.04134000	26.27000	52630.000	0.000647
4	0.204300	5.1890	0.03278000	21.15000	41740.000	0.000815
5	0.187900	4.6200	0.02600000	16.77000	33100.000	0.001030
6	0.162000	4.1150	0.02062000	13.30000	26250.000	0.001300
7	0.144300	3.6650	0.01635000	10.55000	20820.000	0.001630
8	0.128500	3.2640	0.01297000	8.36600	16510.000	0.002060
9	0.114400	2.9060	0.01028000	6.63400	13090.000	0.002600
10	0.101900	2.5880	0.00815600	5.26100	10380.000	0.003280
11	0.090740	2.3050	0.00646700	4.17200	8234.000	0.004130
12	0.080810	2.0530	0.00512900	3.30900	6530.000	0.005210
13	0.071960	1.8280	0.00406700	2.62400	5178.000	0.006570
14	0.064080	1.6280	0.00322500	2.08100	4107.000	0.008290
15	0.057070	1.4500	0.00255800	1.65000	3257.000	0.010400
16	0.050820	1.2910	0.00202800	1.30900	2583.000	0.013200
17	0.045260	1.1500	0.00160900	1.03800	2048.000	0.016600
18	0.04030	1.0240	0.00127600	0.82310	1600.000	0.020900

Table B-1. Wire Gauge Size Conversion Chart (continued)

AWG	Diameter		Cross Section Area			
	Inches	Millimeters	Square Inches	Square Millimeters	Circular Mills	Resistance Ohm/Meters
19	0.035890	0.9116	0.00101200	0.65270	1288.000	0.026400
20	0.031960	0.8118	0.00080230	0.51760	1022.000	0.033300
21	0.028460	0.7229	0.00063630	0.41050	810.100	0.042000
22	0.025350	0.6439	0.00050460	0.32560	642.400	0.053000
23	0.022570	0.5733	0.00040010	0.25820	509.500	0.066800
24	0.020100	0.5105	0.00031730	0.20470	404.000	0.084200
25	0.017900	0.4547	0.00025170	0.16240	320.400	0.106000
26	0.015840	0.4049	0.00019960	0.12880	254.100	0.134000
27	0.014200	0.3607	0.00015830	0.10210	201.500	0.169000
28	0.012640	0.3211	0.00012550	0.08098	159.800	0.213000
29	0.011260	0.2860	0.00009954	0.06422	126.700	0.268000
30	0.010030	0.2548	0.00007894	0.05093	100.500	0.339000
31	0.008928	0.2268	0.00006260	0.04039	79.700	0.427000
32	0.007950	0.2019	0.00004964	0.03023	63.210	0.538000
33	0.007080	0.1796	0.00003944	0.02545	50.220	0.679000
34	0.006305	0.1601	0.00003122	0.02014	39.750	0.856000
35	0.005615	0.1426	0.00002476	0.01597	31.520	1.080000
36	0.005000	0.1270	0.00001963	0.01267	25.000	1.360000
37	0.004453	0.1131	0.00001557	0.01005	19.830	1.720000
38	0.003965	0.1007	0.00001235	0.00797	15.720	2.160000
39	0.003531	0.0897	0.00000979	0.00632	12.470	2.730000
40	0.003145	0.0799	0.00000777	0.00501	9.888	3.440000
41	0.002800	0.0711	0.00000616	0.00397	7.842	
42	0.002494	0.0633	0.00000488	0.00315	6.219	
43	0.002221	0.0564	0.00000387	0.00250	4.932	

Table B-1. Wire Gauge Size Conversion Chart (continued)

AWG	Diameter		Cross Section Area			
	Inches	Millimeters	Square Inches	Square Millimeters	Circular Mils	Resistance Ohm/Meters
44	0.001978	0.0502	0.00000307	0.00198	3.911	
45	0.001761	0.0447	0.00000244	0.00157	3.102	
46	0.001568	0.0398	0.00000193	0.00125	2.460	
47	0.001397	0.0355	0.00000153	0.00099	1.951	
48	0.001244	0.0316	0.00000122	0.00078	1.547	
49	0.001107	0.0281	0.00000096	0.00062	1.227	
50	0.000986	0.0251	0.00000076	0.00049	0.973	

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Glossary

Section I
Acronyms & Abbreviations

(R)	registered trademark
1SG	first sergeant
AC	active component; alternating current
ACCP	Army Correspondence Course Program
AEH	American Electricians' Handbook
AIT	advanced individual training
AN	annually; Army Navy
ANCOC	Advanced Noncommissioned Officer Course
AR	angle of repose; armor; Army regulation
ARNG	Army National Guard
ARNGUS	Army National Guard of the United States
ASI	additional skill identifier
ASTM	American Society for Testing and Materials
ATS	air traffic service; assign terminal service; automatic transfer switch
attn	attention
AWG	American wire gauge
BA	biannually
BDAR	battle damage assessment and repair
BNCOC	Basic Noncommissioned Officer Course
BOM	bill of materials
BW	biweekly; biological warfare
CATS	combined arms training strategy; combined arms training strategies
CMF	career management field
CPL	corporal
CSM	command sergeant major

CT	counterterrorism; current transformer; cycle time
CTT	common task test; common task training
DA	Department of the Army; data adapter; data administrator; direct action; directorate for administration; double agent; aerospace drift
DC	Dental Corps; direct current; dislocated civilian; District of Columbia
DPGDS	Deployable Power Generation and Distribution System
DSLC	digital synchronizer and load controller
EM	earthmoving; electromagnetic; electronic media; engineer manual; enlisted member
eng	engineer
EPA	Environmental Protection Agency; evasion plan of action
EPMS	Enlisted Personnel Management System
EPS	electronic phase shifter
ER	evaluation report; engineer regulation
ET	electronic technician; electronic tool; endotracheal; engineering test
F	Fahrenheit; fail; failed; frequency; full
FLA	full load amperes
FM	field manual; flare multiunit; force module; frequency-modulated; frequency modulation
freq	frequency
GE	general engineering; General Electric®
GED	general education development; gasoline engine driven
GEN; gen	general; generator
IEEE	Institute of Electrical and Electronics Engineers
IR	incident report; information requirement; infrared; intelligence requirements
JOAP	Joint Oil Analysis Program
KVA	kilo volt-ampere
LCH	Lineman's and Cableman's Handbook; light combat helicopter
LED	light-emitting diode

LRA	local reproduction authorized; locked rotor amperes
MEP	military environmental protection; mobile electric power
METL	mission-essential task list
MIG	metal inert gas
MO	Missouri; monthly; month; medical officer; maintenance and operations
MOS	military occupational specialty; minimum operating strip; minimal operational strip
MSDS	material safety data sheet; mission-specific data set
MSG	message; master sergeant
NA	not applicable; nation assistance; national archives; not available
NCO	noncommissioned officer
NCOES	Noncommissioned Officer Education System
NEC	National Electrical Code
NESC	National Electrical Safety Code
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
OSHA	Operational Safety and Health Act; Occupational Safety and Health Administration
P	needs practice; pass; passed; barometric pressure; mean radius of curvature
pam	pamphlet
PCB	polychlorinated biphenyl
PFC	private first class
PLC	provisional load class; programmable logic controller
PLDC	Primary Leadership Development Course
PMCS	preventive-maintenance checks and services
PN	part number
POL	petroleum, oils, and lubricants

PPE	protective posture equipment; personal protective equipment
PU	power unit
PVC	point of vertical curvature; polyvinyl chloride
PVT	private; point of vertical tangency; positioning, velocity, timing; pressure, volume, temperature
QA	quality assurance
QC	quality control
QT	quart; quarterly; qualification test
reg	regiment; regulation; register
S AND C	switchgear and control
SA	Secretary of the Army; semiannually; situational awareness; security assistance; staging area
SD	solvent, dry cleaning; self-destruct; special duty; slope distance
SF6	sulfur hexafluoride
SFC	special forces command; sergeant first class
SGM	sergeant major
SGT	sergeant
sig	signal
SL	skill level; side lap; switch locator; slow curing (asphalt)
SM	Soldier's manual; service member
SMAW	shielded metal arc welding
SMCT	Soldier's manual of common tasks
SOP	standing operating procedure
SPC	specialist; standard printing color
SSG	staff sergeant
STP	Soldier training publication
sust	sustainment
TB	technical bulletin

TC	technical coordinator; training circular; track commander; tank commander
TG	trainer's guide
tm; TM	team; technical manual; theater missile; trademark
TMDE	test, measurement, and diagnostic equipment
tng	training
TRADOC	United States Army Training and Doctrine Command
UPS	universal polar stereographic; uninterruptible power supply
USAR	United States Army Reserve
USASMA	United States Army Sergeants Major Academy
UTP	unshielded twisted pair
VA	vertical angle; Virginia; volt-ampere; vulnerability assessment
WK	week; weekly

Section II
Terms

bus
A fixed assembly of conductors or bars for connecting power generating equipment and associated electrical equipment to a grid or cubicles.

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References

Required Publications

Required publications are sources that users must read in order to understand or to comply with this publication.

Army Regulations

AR 614-200	Enlisted Assignments and Utilization Management. 27 June 2007

Department of Army Forms

DA forms are available on the APD website <www.apd.army.mil>.

DA FORM 2028	Recommended Changes to Publications and Blank FORMS.
DA FORM 2404	Equipment Inspection and Maintenance Worksheet.
DA FORM 2702	Bill of Materials.
DA FORM 3758-R	Calibration and Repair Requirements Worksheet (LRA).
DA FORM 5164-R	Hands-On Evaluation.
DA FORM 5988-E	Equipment Inspection Maintenance Worksheet (EGA).

Field Manuals

FM 25-4	How to Conduct Training Exercises. 10 September 1984
FM 25-5	Training for Mobilization and War. 25 January 1985
FM 5-19	Composite Risk Management. 21 August 2006
FM 5-424	Theater of Operations Electrical Systems. 25 June 1997
FM 7-0	Training for Full Spectrum Operations. 12 December 2008
FM 7-1	Battle Focused Training. 15 September 2003

Other Product Types

ASTM D1500	Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale). 1 November 2004 <http://www.astm.org/Standards/D1500.htm>
ASTM D1524	Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field. 1 October 2004 <http://www.astm.org/Standards/D1524.htm>
ASTM D1816	Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes. 1 February 2004 <http://www.astm.org/Standards/D1816.htm>
ASTM D3612	Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography. 10 October 2002 <http://www.astm.org/Standards/D3612.htm>
ASTM D877	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes. 10 October 2002 <http://www.astm.org/Standards/D877.htm>
ASTM D923	Standard Practices for Sampling Electrical Insulating Liquids. 10 October 1997 <http://www.astm.org/Standards/D923.htm>
ASTM D971	Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method. 1 October 2004 <http://www.astm.org/Standards/D971.htm>
ASTM D974	Standard Test Method for Acid and Base Number by Color-Indicator Titration. 1 November 2004 <http://www.astm.org/Standards/D974.htm>

DA LABEL 80	US Army Calibrated Instrument. 1 December 1977
EM 385-1-1	Safety and Health Requirements. 3 November 2003 <http://140.194.76.129/publications/eng-manuals/em385-1-1/2003_English/toc.htm>
ENG FORM 1925	Danger-Main Hold Card. <http://140.194.76.129/publications/forms/>
ENG FORM 1927-R	Safe Clearance Request. <http://140.194.76.129/publications/forms/>
ENG FORM 2198	Operation Log. <http://140.194.76.129/publications/forms/>
ER 385-1-31	Safety & Occupational Health. The Control of Hazardous Energy (Safe Clearance). 1 August 1994 <http://140.194.76.129/publications/eng-regs/er385-1-31/toc.htm>
IEEE GREEN BOOK™	IEEE Green Book Standard 142: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems. 1991
LCH	The Lineman's and Cableman's Handbook, 11th Edition, McGraw-Hill. 2007
NEC® HANDBOOK	National Electrical Code Handbook. 2008 <http://code.necplus.org>
NETA™	Maintenance Testing Specifications for Electrical Power Distribution Equipment & Systems. 2007 <http://www.netaworld.org/>
NFPA 70E	Standard for Electrical Safety Requirements for Employee Workplaces. 2004
OSHA REG 1910.147	The Control of Hazardous Energy (Lockout/Tagout). 1 September 1989 <http://www.osha.gov/index.html>
UGLYS™	Ugly's Electrical References. 2005

Soldier Training Publications

STP 21-1-SMCT	Soldier's Manual of Common Tasks Skill Level 1. 14 December 2007
STP 21-24-SMCT	Soldier's Manual of Common Tasks (SMCT) Warrior Leader Skill Level 2, 3, and 4. 9 September 2008

Technical Bulletins

TB 43-180	Interactive Electronic Technical Manual (IETM) for Calibration and Repair Requirements for the Maintenance of Army Materiel. 1 January 2009

Technical Manuals

TM 5-551K	Plumbing and Pipefitting. TO 40P-1-131. 29 July 1971
TM 5-6115-593-12	Operator and Organizational Maintenance Manual for Generator Set, Diesel Engine Driven, Tactical Skid Mounted, 500 kW, 3 Phase, 4 Wire; 120/208 and 240/416 Volts DOD Model MEP-029A; Class Utility, Hertz 50/60; (NSN 6115-01-318-6302) Including Optional KTS DOD Models MEP-029AHK; Nomenclature Housing Kit; (NSN 6115-01-070-7550) MEP-029ACM; Automatic Control Module; (NSN 6115-01-275-7912); MEP-029ARC, Remote Control Module. (NSN 6115-01-070-7553); MEP-029ACC, Remote control Cable (NSN 6115-01-087-4127) {TO 35C2-3-463-1}. 17 July 1990
TM 5-682	Facilities Engineering: Electrical Facilities Safety. 8 November 1999
TM 5-704	Construction Print Reading in the Field {AFM 85-27}. 2 January 1969
TM 5-811-1	Electric Power Supply and Distribution {AFJMAN 32-1080}. 28 February 1995
TM 9-6115-604-12	Operator and Unit Maintenance Manual for Generator Set, Diesel Engine Driven, Air Transportable Skid Mounted, 750 kW, 3 Phase, 4 Wire, 2400/4160 and 2200/3800 Volts (DOD Model MEP 208A) Class Prime Utility Hz 50/60 (NSN 6115-00-450-5881) {NAVFAC P-8-6-33-12}. 31 August 1995

TM 9-6115-604-34	Direct Support, General Support and Depot Level Maintenance Manual for Generator Set, Diesel Engine Driven, Air Transportable Skid MTD; 750 KW, 3 PHASE, 4 WIRE, 2400/4160 AND 2200/3800 VOLTS DOD MODEL MEP 208A PRIME UTILITY CLASS 50/60 HERTZ (NSN 6115-00-450-5881) {NAVFAC P-8-633-34}. 30 August 1996

Related Publications

Related publications are sources of additional information. They are not required in order to understand this publication.

Army Regulations

AR 385-10	The Army Safety Program (*RAR 001, 2008/11/07). 23 August 2007

Field Manuals

FM 10-67-1	Concepts and Equipment of Petroleum Operations. 2 April 1998
FM 3-34.471	Plumbing, Pipe Fitting, and Sewerage. 31 August 2001
FM 3-34.480	Engineer Prime Power Operations. 4 April 2007
FM 4-25.11	First Aid {NTRP 4-02.1.1;AFMAN 44-163(I);MCRP 3-02G}. 23 December 2002
FM 4-30.31	Recovery and Battle Damage Assessment and Repair. {MCRP 4-11.4A}. 19 September 2006
FM 5-125	Rigging Techniques, Procedures, and Applications. 3 October 1995
FM 5-412	Project Management. 13 June 1994
FM 55-509-1	Introduction to Marine Electricity. 1 September 1994

Other Product Types

AEH	American Electricians' Handbook, 14th Edition, McGraw Hill. 2002
IEEE RED BOOK™	IEEE Red Book Standard 141: IEEE Recommended Practice for Electric Power Distribution for Industrial Plants. 1993
INTRO CIRCUIT ANALYSIS	Introductory Circuit Analysis, 10th Edition, Prentice Hall. 4 March 2002
NESC®	National Electrical Safety Code. 2007 <http://standards.ieee.org/nesc>
S AND C HANDBOOK	Switchgear and Control Handbook, 3rd Edition, McGraw-Hill. 1998

Technical Bulletins

TB 385-4	Safety Requirements for Maintenance of Electrical and Electronic Equipment. 1 July 2008
TB SIG 222	Solder and Soldering. 5 March 1985

Technical Manuals

TM 5-315	Firefighting and Rescue Procedures in Theaters of Operations. 20 April 1971
TM 5-6115-456-34P	Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools): Electric Power Plants, DED, Skid MTD; 1500 KW, 4160 V, AC (Electromotive Model MP36A-60 HZ) (NSN 6115-00-250-4402), 1250 KW 4160 V, AC (MP36A-50 HZ) (6115-00-250-4403). 15 February 1980

TM 5-684	Facilities Engineering - Electrical Exterior Facilities. {NAVFAC MO-200;AFJMAN 32-1082}. 29 November 1996
TM 5-686	Power Transformer Maintenance and Acceptance Testing. 16 November 1998
TM 5-811-3	Electrical Design: Lightning and Static Electricity Protection {AFM 88-9, Chap 3}. 29 March 1985

Training Aids

5180-02-502-9507	BDAR Maintainer Kit

Training Circulars

TC 9-510	Metal Body Repair and Related Operations. 30 September 1993
TC 9-60	Communications-Electronics Fundamentals, Basic Principles of Alternating Current and Direct Current. 30 August 2004

STP 5-21P2-SM-TG
31 March 2009

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