DS Series Circuit Breaker Inspection and Testing

Table of Contents

1.0 PURPOSE AND SCOPE .......................................................................................................................... 3
  1.1 Purpose ................................................................................................................................................. 3
  1.2 Scope .................................................................................................................................................... 3

2.0 INFORMATION ......................................................................................................................................... 3

3.0 PRECAUTIONS AND LIMITATIONS ................................................................................................. 3
  3.1 Personnel Safety ................................................................................................................................. 3
  3.2 Equipment Safety ............................................................................................................................... 3
  3.3 Radiation and Contamination Control .............................................................................................. 4
  3.4 Environmental Compliance .............................................................................................................. 4

4.0 PREREQUISITES ...................................................................................................................................... 4
  4.1 Special Tools, Equipment, and Supplies .......................................................................................... 4
  4.2 Performance Documents .................................................................................................................... 5
  4.3 Field Preparations .............................................................................................................................. 5

5.0 PROCEDURE .......................................................................................................................................... 6
  5.1 Switchgear Configuration .................................................................................................................. 6
  5.2 Prepare to Inspect and Test DS Series Circuit Breaker ..................................................................... 6
  5.3 Breaker Cubicle Inspection and Cleaning ....................................................................................... 7
  5.4 General Inspection ............................................................................................................................ 8
  5.5 As-Found Testing ............................................................................................................................... 10
  5.6 Contact Replacement ......................................................................................................................... 14
  5.7 Trip Over-Latch Setting .................................................................................................................... 15
  5.8 Lubrication .......................................................................................................................................... 16
  5.9 Circuit Breaker Testing ....................................................................................................................... 16
  5.10 Trip Unit Testing .............................................................................................................................. 16

CHANGE HISTORY (≤ LAST 5 REV-MODS)

<table>
<thead>
<tr>
<th>Rev-Mod</th>
<th>Release Date</th>
<th>Justification</th>
<th>Summary of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-0</td>
<td>03/01/2016</td>
<td>Converting to WRPS Format</td>
<td>New Procedure; Supersedes ETF-PRO-MN-51466 (EL22052)</td>
</tr>
</tbody>
</table>

USQ Not Required – ETF is a <Hazard Category 3 Radiological Facility

Tank Farm Maintenance Procedure
Effluent Treatment Facility
5.11 Restoration ........................................................................................................... 17
5.12 Acceptance Criteria .............................................................................................. 18
5.13 Review ................................................................................................................... 18
5.14 Records ................................................................................................................... 18

Figure 1 – DS-206 Pole Unit Assembly ........................................................................ 19
Figure 2 – DS-416 Pole Unit Assembly .......................................................................... 20
Figure 3 – DS-632 Pole Unit Assembly .......................................................................... 21
Figure 4 – DS-632 Open Position Stop ........................................................................... 22
Figure 5 – Moving and Fixed Contact Dimensions and Alignment ................................. 23
Figure 6 - DS-206 and DS-416 Contact Engagement and Alignment ......................... 24
Figure 7 – DS-632 Contact Engagement and Alignment ................................................ 25
Figure 8 - Trip Assembly ............................................................................................... 26
Figure 9 - Pole Assembly, Showing Micro Ohm Test Position .................................... 27
Figure 10 - Charging Mechanism .................................................................................. 28
Figure 11 - Charging Mechanism .................................................................................. 29
Figure 12 - Lubrication Locations .................................................................................. 30
Figure 13 - Switches and Relays .................................................................................... 31
1.0 PURPOSE AND SCOPE

1.1 Purpose

This procedure provides instructions for electrical maintenance of Type DS and DSL Series Low Voltage power circuit breakers.

1.2 Scope

This procedure provides instructions for the inspection and testing of the DS series circuit breaker, including general inspection, as-found testing, trip over-latch setting, circuit breaker testing, and trip unit testing. Mid-interval inspection may be performed on individual breakers as directed by the SOM or electrical engineer.

2.0 INFORMATION

None

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Personnel Safety

3.1.1 Due to high arc flash potential, removal of the switchgear main breaker should only be completed with the switchgear completely de-energized (line side voltage de-energized).

3.1.2 Inspection and/or cleaning of cubicles supplied from the load side of the main switchgear breaker may be completed during a complete switchgear outage or with only the main switchgear breaker in the open position. Removal of these breakers where only mid-interval breaker inspection, testing, or maintenance of the breaker is required, may be performed without de-energizing the switchgear bus.

3.2 Equipment Safety

CAUTION - If closing is attempted with leveraging arms in other than TEST or CONNECT position, a trip free closing operation is performed. This trip-free type of operation can cause some parts to become loose or break.
3.3 Radiation and Contamination Control

3.3.1 Work in radiological areas will be performed using a radiological work permit following review by Radiological Control per ALARA Work Planning procedure, TFC-ESHQ-RP_RWP-C-03.

3.4 Environmental Compliance

3.4.1 In the event of a spill/leak/release, notify the SOM/FWS and respond per ETF-ERP-85B-003, Emergency Spill or Release at ETF.

4.0 PREREQUISITES

4.1 Special Tools, Equipment, and Supplies

NOTE - M&TE used to collect acceptance criteria data during performance of this procedure shall meet the following requirements:

- Be within its current calibration cycle as evidenced by an affixed calibration label
- Be capable of desired range
- Accuracy is equal to or greater than M&TE tolerance specified on PM data sheet or is at least four times greater than specified device tolerance.

The following supplies may be needed to perform this procedure:

- 1000 volt megohm meter
- Calibrated digital low resistance ohmmeter, capable of reading in micro-ohms
- Feeler gauge set
- Vacuum cleaner, HEPA filter equipped, as required, with insulated attachments
- Power module for Digi-Trip RMS units (Cutler Hammer Cat #PRTAAPM)
- Lint-free cleaning rags
- CRC electromotive, or equivalent, non-conductive contact cleaner
- Soft bristle brush
- Circuit breaker grease for metal parts, Square D #53701QB12J
- Circuit breaker grease for current carrying parts, Square D #53701AN00T
- 3-M Scotch-Brite pads
- Cart for transporting circuit breaker to maintenance shop
- Voltage rated gloves/sleeves as required for shock protection/voltage checks.
4.2 **Performance Documents**

The following documents may be needed to perform this procedure:
- ETF-25B-001, Electrical Distribution System Startup and Operation
- ETF-25B-002, Electrical Distribution System Shutdown
- H-2-89013, System One Line Diagram (for ETF)
- Vendor’s manual: Instructions for Low Voltage Power Circuit Breakers Type DS and DSL, IB 33-790-1J, November 2010, EATON
- Square D Maintenance Manual 6032-2
- Square D Parts Manual 6030-3.

4.3 **Field Preparations**

4.3.1 **BEFORE** opening main switchgear circuit breaker, **CONFIRM** all loads are shed for switchgear/cubicles being worked per ETF-25B-002.
5.0 PROCEDURE

Special Instructions

Individual breaker inspection and testing may be performed in any logical order, or in parallel.

NOTE - A keyed interlock (A1) is provided to prevent operation of switch A when breaker B is closed. The high voltage switch can be locked open or closed, L-O-C means lock open or lock-closed. The circuit breaker has an interlock to lock the breaker open, L-O means lock-open. Both have an unlocked position.

5.1 Switchgear Configuration

5.1.1 ENSURE danger tape has been applied to master switchgear main breakers.

5.1.2 OBTAIN SOM approval to start maintenance.

5.2 Prepare to Inspect and Test DS Series Circuit Breaker

5.2.1 ENSURE installed circuit breaker is OPEN AND

ENSURE closing springs are discharged.

5.2.2 RACK breaker to a disconnected position.

5.2.3 REMOVE breaker from racking mechanism.

5.2.4 RECORD serial number and sensor rating of each phase of circuit breaker removed on the appropriate PM/S data sheet.

5.2.5 TRANSPORT removed breaker to maintenance area.
5.3 Breaker Cubicle Inspection and Cleaning

**Special Instructions**

Section 5.3 does not need to be performed for mid-interval breaker inspections.

5.3.1 **INSPECT** circuit breaker cubicle for cleanliness.

5.3.1.1 **REMOVE** dust/dirt accumulations with one of the following:
- Vacuum cleaner
- Rags
- Brush.

5.3.1.2 **USE** rag moistened with non-flammable solvent to remove oily dirt.

5.3.2 **INSPECT** cubicle wiring for the following:
- Damaged insulation
- Loose terminations
- Signs of overheating.

5.3.3 **INSPECT** auxiliary contacts in cubicle for evidence of:
- Arcing
- Overheating.

5.3.4 **RECORD** findings on appropriate PM/S data sheet.
5.4 General Inspection

5.4.1 REMOVE arc chutes AND

COMPLETE visual inspection of breaker for the following:

- Dust deposits and abnormal deposits of carbon
- Bent, broken, loose, or missing parts
- Signs of overheating and arcing
- Bent or broken interlocks
- Broken bearings or bearings that may be frozen due to lack of lubrication
- Any locking rings, snap rings, or cotter pins that might have broken or fallen off
- Insulating barriers that may be damaged.

5.4.2 RECORD results on appropriate PM/S data sheet.

5.4.3 LIGHTLY sand to remove carbon deposits with fine sandpaper or Scotch Brite pads. (Emery cloth or wire brushes are not to be used.)

5.4.4 REMOVE dust with vacuum cleaner.

5.4.5 INSPECT arc chute case for wear.

5.4.6 IF arc chute case wear is severe, REPLACE entire arc chute assembly per vendor manual AND GO TO step 5.4.10.

5.4.7 CHECK steel splitter plates on arc chutes for erosion.

5.4.8 IF excessive splitter plate material has eroded away (this can be determined by comparing a plate near center with a plate near end), REPLACE splitter plates per step 5.4.9, OR

IF steel splitter plates on arc chutes are satisfactory, GO TO step 5.4.10.
5.4 General Inspection (Cont.)

5.4.9 REPLACE splitter plates and corresponding insulating plates as follows:

5.4.9.1 REMOVE top retaining strips.
5.4.9.2 REMOVE splitter plates.
5.4.9.3 CHECK for erosion and carbon at throat of insulating arc chute enclosure AND CLEAN.
5.4.9.4 REPLACE damaged units per parts manual AND RE-INSTALL retaining strips.

5.4.10 INSPECT circuit breaker wiring for the following:
- Damaged insulation
- Loose terminations
- Evidence of overheating.

5.4.11 TIGHTEN all loose connections.

5.4.12 INSPECT circuit breaker hardware for the following:
- Damage
- Rust
- Corrosion
- Loose or missing parts.
5.5 As-Found Testing

NOTE - The contact assemblies are adjustable for amount of engagement only. The lead of the arcing contacts is fixed. The correct engagement of contacts is achieved when vertical surfaces of main fixed contacts and fixed contact cage are parallel. This may be checked with sheets of carbon paper.

- Depending on which model of breaker is being serviced Figure 1, Figure 2, or Figure 3 provides information regarding location of individual breaker components.

5.5.1 INSERT a piece of bond paper and carbon paper between fixed moving contacts.

5.5.2 PERFORM the following:

5.5.2.1 CLOSE circuit breaker.

5.5.2.2 OPEN circuit breaker.

5.5.2.3 CHECK contact point.

5.5.3 ESTIMATE amount of contact mark across face of contact surface AND RECORD on PM/S data sheet.

NOTE - Switching, fault interruptions, and motor inrush currents will cause some burning and pitting of breaker contacts. This is normal.

5.5.4 WITH the breaker open, INSPECT contact tips on the following:

- Moving contacts
- Stationary arcing contacts
- Main contacts.

5.5.5 IF contacts show signs of the following, GO TO Section 5.6 to replace:

- Burnt contacts
- Excessive wear
- Excessive pitting.

5.5.6 MEASURE AND RECORD Dimension (C) between stationary arcing contacts as shown in Figure 5.

5.5.7 IF Dimension (C) is not between 0.34 inch to 0.50 inch, GO TO Section 5.6 for replacing contacts.
5.5 As-Found Testing (Cont.)

Special Instructions

The breaker must be stabilized while charging springs by hand to prevent it from falling.

5.5.8 **CHARGE** closing springs in order to close breaker.

---

**CAUTION**

If closing is attempted with levering arms in other than TEST or CONNECT position, a trip free closing operation is performed. This trip-free type of operation can cause some parts to become loose or break.

---

5.5.8 **CHARGE** closing springs in order to close breaker.

---

5.5.9 **ROTATE** levering device arms from REMOVE position to TEST position.

5.5.10 **CLOSE** breaker.

5.5.11 **MEASURE AND RECORD** Dimension A as shown in Figure 5.

5.5.12 **IF** Dimension (A) is less than 0.020 inch between stationary arcing contacts and center section of cage, **GO TO** Section 5.6 for replacing contacts.

**NOTE** - Performance of steps 5.5.13 through 5.5.16 checks for proper contact engagement of the moving main contact to the stationary main contact fingers when breaker is in the closed position.

5.5.13 **CLOSE** breaker.

5.5.14 **IF** servicing model DS-632, **PERFORM** the following:

5.5.14.1 **ENSURE** Pin X is free to slide in contact cage when breaker is closed (Figure 6).

5.5.14.2 **IF** adjustment is required, **TURN** the two adjusting studs (Figure 3) equal amounts (to maintain parallelism) until Pin X slides freely in contact cage.
5.5 As-Found Testing (Cont.)

5.5.15 IF servicing model DSL-206 or DS-416, **PERFORM** the following:

5.5.15.1 **CHECK** alignment B as shown in Figure 7. (Main stationary contact fingers should be parallel to fixed contact cage.)

5.5.15.2 **IF** adjustment is required, **PERFORM** the following:

a. **IF** servicing model DSL-206, **TURN** the adjusting nuts (Figure 1) located above and below the insulating block.

b. **IF** servicing model DS-416, **LOosen** the lock nut on the insulating link **AND** **ROTATE** the insulating link (Figure 2).

c. **AFTER** adjustment is complete, **ENSURE** all locking nuts are tight.

5.5.16 **IF** correct contact engagement cannot be obtained, **GO TO** Section 5.6 for replacing contacts.

5.5.17 **ENSURE** breaker is closed.

5.5.18 **MEASURE** contact resistance of each phase, as shown in Figure 9, using a digital low resistance ohmmeter/micro-ohm meter.

5.5.19 **RECORD** values on PM/S data sheet.

**NOTE** - Maximum acceptance criteria are 150 micro-ohms and differential between high and low readings no greater than 10%.

5.5.20 **IF** any contact resistance is not within acceptance criteria, **PERFORM** the following:

5.5.20.1 **REMOVE** main moving contact pivot pin to disassemble main moving contact arm.

5.5.20.2 **CLEAN** joint at main moving contact pivot pin with a clean rag (Figure 9).

5.5.20.3 **REMOVE** carbon from contacts with a 3-M Scotch-Brite pad.

5.5.20.4 **REASSEMBLE** main moving contact arm **AND** **REPEAT** steps 5.5.17 through 5.5.19.
5.5 As-Found Testing (Cont.)

5.5.21 IF contact resistance is within acceptance criteria, CONTINUE with performance of procedure, OTHERWISE NOTIFY FWS of unacceptable resistance.

Special Instructions

Steps 5.5.22 through 5.5.24 apply only to DS-416 motor operated circuit breaker feeding the vapor compressor at ETF. Shop-fabricated test assembly is required to supply 120 VAC power for charging motor.

5.5.22 CHECK electrical operation of circuit breaker with bench-test assembly.

5.5.23 APPLY power until springs are charged, REMOVE power. (Motor should charge springs without straining.)

5.5.24 PERFORM Y Relay test as follows:

5.5.24.1 CONFIRM circuit breaker is OPEN.

5.5.24.2 CONFIRM closing springs are CHARGED.

5.5.24.3 PRESS AND HOLD close bar to close circuit breaker.

5.5.24.4 MAINTAIN close signal AND PRESS trip plate.

5.5.24.5 CHECK that circuit breaker opens and does not reclose until close signal is removed and then reapplied.

5.5.25 REASSEMBLE AND RECHECK breakers.
5.6 Contact Replacement

**Special Instructions**

Performance of this section is only required when called out in Section 5.5 or when directed by the FWS or TA.

**NOTE** - This section provides direction for replacement of fixed and moving contacts.

- Depending on which model of breaker is being serviced Figure 1, Figure 2, or Figure 3 provides information regarding location of individual breaker components. If additional guidance is needed, refer to Square D Maintenance Manual 6032-2 and Parts Manual 6030-3.

5.6.1 **REMOVE** bolts that secure the following to the moving arm assembly:
- Moving main contact
- Moving arcing contact.

5.6.2 **INSTALL** new contacts onto the moving arm assembly **AND**

**TIGHTEN** bolts that secure the contacts to the moving assembly.

5.6.3 **REMOVE** bolts that attach fixed contact assembly to the pole unit base **AND**

**REMOVE** fixed contact assembly.

5.6.4 **INSTALL** a new or re-conditioned fixed contact assembly on pole unit with bolts (finger-tight).

5.6.5 **CLOSE** breaker **AND**

**CHECK** Dimension A, as shown in Figure 5, is greater than 0.020 inches. (They should be approximately equal.)

5.6.5.1 **IF** they are not approximately equal, **TRIP** breaker **AND**

**ADJUST** fixed contact assembly until correct alignment is achieved.

5.6.6 **TIGHTEN** bolts that attach fixed contact assembly to pole unit base.
5.6 Contact Replacement (Cont.)

Special Instructions

Steps 5.6.7 and 5.6.8 only pertain to DS-632 breakers; refer to Figure 4 – DS-632 Open Position Stop for information regarding checking for and setting proper clearances on open position stop following contact replacement.

5.6.7 OPEN breaker AND

CHECK for a clearance of 0.004 inch to 0.006 inch between the eccentric cylinders and stop levers.

5.6.8 IF OPEN position stop clearances require adjustment, PERFORM the following:

5.6.8.1 ENSURE the breaker is in the OPEN position AND

LOOSEN OPEN position stop bolt nuts so the eccentric cylinders can turn, but stay in position.

5.6.8.2 ROTATE cylinders to obtain a clearance of 0.004 inch to 0.006 inch between the cylinders and stop levers.

5.6.8.3 TIGHTEN position stop bolt nuts.

5.6.9 AFTER contacts are replaced, RETURN to step 5.5.6.

5.7 Trip Over-Latch Setting

NOTE - Figure 8 is used to assist with performing steps 5.7.1 and 5.7.2.

5.7.1 WITH breaker closed, SLOWLY ROTATE trip shaft adjusting screw clockwise until breaker trips. (This is the “no overlap position.”)

5.7.2 ROTATE trip shaft adjusting screw four complete turns in a counterclockwise direction.

5.7.3 OPEN breaker.

5.7.4 CLEAN circuit breaker.
5.8 Lubrication

5.8.1 LUBRICATE all areas listed in the following figures:
- Figure 10 - Charging Mechanism
- Figure 11 - Charging Mechanism
- Figure 12 - Lubrication Locations
- Figure 13 - Switches and Relays.

5.9 Circuit Breaker Testing

5.9.1 CLOSE breaker.

NOTE - For steps 5.9.2 and 5.9.3, minimum acceptance criteria are 20 meg ohms.

5.9.2 PERFORM a 1000 VDC megger insulation test between each phase and chassis of circuit breaker AND

RECORD results on PM/S data sheet.

5.9.3 PERFORM a 1000 VDC megger insulation test between each phase-to-phase combination AND

RECORD results on PM/S data sheet.

5.10 Trip Unit Testing

5.10.1 TEST automatic characteristics of breaker trip unit, using Digi-Trip self-test and Specified Settings as shown on PM/S data sheet.

5.10.2 RECORD as-left settings on PM/S data sheet.
5.11 Restoration

5.11.1 PLACE circuit breaker in switchgear cubicle or storage as follows:

5.11.1.1 IF circuit breaker is being returned to its original (and still empty) location, GO TO step 5.11.2.

5.11.1.2 IF circuit breaker is being used immediately as a replacement breaker in a new location, GO TO step 5.11.2.

5.11.1.3 IF spare breaker is to be utilized and has been verified to have same frame size and trip characteristics as shown on PM/S data sheet, and has been inspected and determined suitable for use, GO TO step 5.11.2.

5.11.1.4 IF spare breaker was utilized, and original breaker is being returned to its original location, RACK OUT spare breaker, RETURN it to storage AND GO TO step 5.11.2.

5.11.1.5 IF a circuit breaker is being kept as a spare for future use or for parts, PLACE breaker in storage AND GO TO step 5.11.8.

5.11.2 ENSURE the following have been removed from circuit breaker and/or cubicle:
- Tools
- Parts
- Materials.

5.11.3 RECORD serial number and sensor rating of each phase of spare or replacement circuit breaker to be installed.

5.11.4 INSTALL circuit breaker to TEST position.

5.11.5 MANUALLY OPERATE breaker a minimum of two times, leaving in OPEN position.

5.11.6 COMPLETE installation of circuit breaker.

5.11.7 ENSURE trip unit is set per PM/S data sheet.
5.11 Restoration (Cont.)

5.11.8 **REPEAT** steps 5.2.1 through 5.11.7, for each additional circuit breaker being inspected and tested.

5.11.9 **RESTORE** switchgear/cubicle to service in accordance per ETF-25B-001.

5.11.10 **INFORM** SOM and CRO that test is complete.

5.12 Acceptance Criteria

Acceptance criteria has been met when steps in this procedure have been satisfactorily performed and results are recorded on the data sheet(s).

5.13 Review

5.13.1 **INFORM** FWS test is complete.

5.13.2 (FWS) **REVIEW AND ENSURE** the following:

- Completed data sheets meet the acceptance criteria
- Comments sections are filled out appropriately
- Work requests needed as a result of this procedure are identified and generated
- Work request number(s) of any work documents generated as a result of this procedure, are recorded in the Comments/Remarks section of the data sheet.

5.14 Records

The performance of this procedure generates no records. However PM/S data sheets associated with the procedure are records and are maintained in the work package as record material.

The record custodian identified in the Company Level Records Inventory and Disposition Schedule (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.
Figure 1 – DS-206 Pole Unit Assembly

Model DS-206 Pole Unit Assembly
Front View

Model DS-206 Pole Unit Assembly - Back View

- Arcing Contact Spring
- Main Contact Spring
- Stationary Main Contact Fingers
- Moving Arcing Contacts
- Moving Contact Assembly
- Pivot Block
- Hinge Spring
- Insulating Link Adjusting Nut (Lower)
Figure 2 – DS-416 Pole Unit Assembly

DS-416 Pole Unit Assembly - Front View

DS-416 Pole Unit Assembly - Rear View
Figure 3 – DS-632 Pole Unit Assembly

DS-632 Pole Unit Assembly – Front View

DS-632 Pole Unit Assembly – Back View
Figure 4 – DS-632 Open Position Stop

1. ANTI-REBOUND LATCH
2. OPEN POSITION STOP (ADJUSTABLE FOR DS-632 ONLY)
Figure 5 – Moving and Fixed Contact Dimensions and Alignment
Figure 6 - DS-206 and DS-416 Contact Engagement and Alignment

Vertical faces of the main fixed contacts and fixed contact cage are parallel.
Figure 7 – DS-632 Contact Engagement and Alignment

Pin X
Should slide free
in the contact cage
**Figure 8 - Trip Assembly**

1. Trip Latch
2. Trip Latch Pivot Pin
3. Roller Constraining Link
4. Shunt Trip Device
5. Shunt Trip Armature
6. Shunt Trip Coil
7. Trip Shaft Lever
8. Trip Shaft
9. Trip Shaft Latch Surface
10. Main Drive Link
11. Trip Shaft Adjusting Screw
12. Trip Actuator

a) Shunt Trip  
b) Trip Shaft Actuator
Figure 9 - Pole Assembly, Showing Micro Ohm Test Position

MAIN MOVING CONTACT PIVOT PIN

PERFORM MICRO-OHM TEST ACROSS THIS JUNCTION ON EACH PHASE
Lubrication Location List for Figure 9
1. The spring-charge indicator surface engaging with the cut-off switch link.
2. The cam surface operating the cut-off switch link.
3. The pins on both ends of the constraining link.
5. The curved surface of the trip latch.
8. The surface of the cut-off switch link.
9. The main spring pins on each end of the crankshaft and fixed ends.
Lubrication Location List for Figure 10

2. The cam surface operating the cut-off switch link.
9. The main spring pins on each end of the crankshaft and fixed ends.
Figure 12 - Lubrication Locations

Lubrication Location List for Figure 11
4. Shunt trip moving armature surface.
7. The trip shaft.
Lubrication Location List for Figure 12

6. Spring release moving armature surfaces.