

COURSE OUTLINE — Low Voltage Power Circuit Breaker Maintenance



Square D Masterpact NT/NW & Eaton Cutler-Hammer DS II

Safety Precautions

Safety requirements focus on remote racking procedures, arc flash protection, and mandatory verification steps before any maintenance activity. Remote racking devices such as Amidyne Extend-A-Rack and Safe-T-Rack brackets are used to avoid exposure to energized equipment. A safety backup remains positioned two feet outside the arc boundary. Breakers must be open, loads de-energized, and racking rotation counts monitored. Rescue hooks are recommended. Arc flash protection follows NFPA 70E, including incident energy determination, PPE categories, approach boundaries, and labeling. All safety procedures require completion and verification prior to maintenance.

SECTION 1 — Square D Masterpact NT/NW

Masterpact Overview

Square D Masterpact NT and NW breakers are low-voltage air circuit breakers in the 600-volt class, available in fixed and drawout configurations. NT frames range from 800 to 1600 amperes, while NW frames range from 800 to 6300 amperes. Micrologic trip units from the 2.0 through 7.0 series provide LSIG protection. The breakers carry UL 1066 and IEC 60947-2 listings and are widely used in commercial and industrial distribution switchgear.

Masterpact Components

Major components include a spring-charged stored-energy operating mechanism, pole assemblies with silver-alloy main and arcing contacts, Micrologic electronic trip units,

drawout cradles with mechanical interlocks, auxiliary devices such as shunt trip and undervoltage release, and de-ion arc chutes with steel splitter plates.

Visual Inspection and Cleaning

Inspection begins with racking the breaker to the disconnected position, applying LOTO, and confirming zero energy. External housings are checked for cracks, discoloration, and tracking. Main and arcing contacts are examined for pitting and erosion, and wear indicators are referenced. Arc chutes are removed for inspection of splitter plates and carbon buildup. Cleaning is performed using vacuuming, approved solvents, and lint-free cloths before reassembly. These steps align with NFPA 70B, which designates the maintenance requirements as mandatory.

Mechanical Systems

Mechanical maintenance includes repeated charging and discharging of the closing springs, multiple manual close-open cycles to verify latching and trip-free operation, lubrication of pivot points and linkages using Schneider-approved lubricants, operation of the racking mechanism through Connected, Test, and Disconnected positions, and functional checks of auxiliary devices such as shunt trip coils, undervoltage releases, and auxiliary switches.

Electrical Testing

Electrical testing includes insulation resistance measurements at 1000 VDC with a minimum acceptable value of 100 megohms at 40°C, contact resistance testing using a micro-ohmmeter at 100 amperes DC minimum, secondary injection testing of Micrologic trip units to verify LSIG pickup and timing, primary injection testing when required, and dielectric withstand testing at typical values of 2200 VAC for one minute.

Inspection Checklist

A fourteen-item checklist verifies LOTO status, housing condition, main and arcing contact wear, arc chute integrity, spring mechanism performance, close-open cycling, racking mechanism function, insulation and contact resistance values, trip unit operation, auxiliary device performance, torque of fasteners, and lubrication. All items must be confirmed before returning the breaker to service.

Common Failure Modes

Failure modes include contact erosion, spring mechanism fatigue, trip unit malfunction, insulation degradation, racking mechanism wear, and arc chute damage. These issues represent critical patterns observed during inspection and preventive maintenance.

Service Intervals

Service intervals include annual visual inspection and cleaning, three-year standard maintenance with contact inspection, insulation resistance testing, lubrication, and auxiliary device testing, and five-year comprehensive overhaul by a NETA-approved repair center. Immediate inspection is required after any fault interruption.

Video Resources

Training videos include operating handle replacement, spring charging procedures, racking demonstrations, motor installation, teardown examples, and installation sequences for Masterpact NT and NW breakers.

SECTION 2 — Eaton Cutler-Hammer DS II / DSL II

DS II Overview

Cutler-Hammer DS II and DSL II breakers are low-voltage power circuit breakers in the 635-volt class, with frame sizes from 800 to 5000 amperes. DSL II variants provide current-limiting capability with integral series fuses. Breakers are available in drawout and fixed configurations and use Digitrip electronic trip units from the RMS 310+ through 910 families. They are listed to UL 1066 and ANSI C37.50 and use a stored-energy spring-charged operating mechanism.

DS II Components

Components include the stored-energy mechanism, silver-faced main and arcing contacts, de-ion arc chutes with steel splitter plates, Digitrip solid-state trip units, levering mechanisms with Connect, Test, and Disconnect positions, self-aligning primary disconnects, and auxiliary devices such as shunt trip, undervoltage trip, auxiliary switches, bell alarm contacts, latch check switches, and motor operators.

Visual Inspection and Cleaning

Inspection begins with levering the breaker to the disconnected position, applying LOTO, and confirming zero energy. The breaker frame and molded components are checked for cracks, burn marks, and discoloration. Main and arcing contacts are inspected using Eaton wear indicators. Arc chutes are examined for cracked or warped splitter plates and carbon buildup. The switchgear compartment is inspected for stationary contact condition,

shutter operation, and interlock function, followed by cleaning with vacuuming and approved solvents.

Mechanical Systems

Mechanical maintenance includes repeated charging and discharging of the closing springs, multiple close-open operations, lubrication using Eaton-recommended grease such as Mobilgrease SHC, operation of the levering mechanism through all positions with verification of interlocks and shutter movement, and testing of auxiliary devices including shunt trip, undervoltage release, latch check switches, and bell alarm contacts.

Electrical Testing

Electrical testing includes insulation resistance measurements at 1000 VDC with a minimum acceptable value of 100 megohms at 40°C, contact resistance testing using a micro-ohmmeter, secondary injection testing of Digitrip units to verify LSIG pickup and timing, primary injection testing when required, and dielectric withstand testing per ANSI/IEEE C37.59.

Inspection Checklist

Checklist items include LOTO verification, breaker frame condition, main and arcing contact wear, arc chute condition, spring mechanism performance, close-open cycling, levering mechanism function, shutter operation, insulation and contact resistance values, Digitrip testing, auxiliary device operation, lubrication, and primary disconnect condition.

Common Failure Modes

Failure modes include contact welding, mechanism binding due to hardened lubricant, Digitrip malfunction, arc chute deterioration, primary disconnect erosion, and interlock failures.

Service Intervals

Service intervals include annual routine inspection, three-year comprehensive maintenance with electrical testing, five-year major overhaul per NETA MTS, and immediate post-fault inspection.

Video Resources

Video resources include DS and DS II reconditioning demonstrations, finger cluster maintenance, motor replacement procedures, disassembly sequences, trip unit mounting, and operational troubleshooting.

SECTION 3a — Breaker Maintenance (General)

General maintenance content compares Masterpact and DS II breakers in terms of manufacturer, voltage class, frame range, trip units, diagnostics, standards, maintenance tiers, and service tools. Common failures resulting from inadequate maintenance include dust accumulation, lack of lubrication, arc chute deterioration, mechanical wear, electronic component failures, wiring defects, and failures in plastic subcomponents. Photographic examples illustrate cracked arc chutes, carbon deposits, burned arc dividers, worn pivot points, damaged insulating links, and other defects. Cleaning methods include vacuuming, pressurized air, wiping, brushing, and solvent use, with caution regarding asbestos-containing arc chutes. Lubrication guidance emphasizes light application, removal of old grease, and the lubrication point counts for DS II and Masterpact breakers.

SECTION 3b — Breaker Curves & Trip Coordination

Breaker curve content covers interpretation of time-current curves using logarithmic axes, including the thermal and magnetic regions and the meaning of curve band width. LSIG protection elements are defined and explained. Coordination principles include current selectivity, time selectivity, energy selectivity, and Zone Selective Interlocking. Practical coordination scenarios demonstrate settings for a Masterpact upstream and a DS II downstream, including selectivity ratio checks and ZSI behavior. Additional material addresses motor inrush characteristics, trip unit theory, and DIP-switch-based trip units.

Motor inrush characteristics based on nameplate, the empirical times 6 multiplier for inrush current and how overlap is prevented with short term trip of similar magnitude.

