



PPD / EED / Infrastructure Group / D0

**D0 Procedure / Hazard Analysis Document  
D0\_ELE\_MUO\_001**

**Remove / Replace Muon PDT Power Supplies**

Date: 07-Jun-07

Latest revision: 20-Jul-07

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**Safety Approval By (date):** (as necessary)

**Personal Protective Equipment:** (Check protective equipment required for the job.)

- |  |                                       |   |
|--|---------------------------------------|---|
| <input type="checkbox"/> Safety glasses                            | <input type="checkbox"/> Side shields | <input type="checkbox"/> Chemical splash goggles              |
| <input type="checkbox"/> Hearing Protection                        |                                       | ● Hard Hats   |
| <input type="checkbox"/> 3.0 Braising goggles                      |                                       | <input type="checkbox"/> Impact goggles                       |
| <input type="checkbox"/> Face shield                               |                                       | <input type="checkbox"/> Rubber apron                         |
| <input type="checkbox"/> Leather gloves                            |                                       | <input type="checkbox"/> Hot/Cold thermal protective gloves   |
| <input type="checkbox"/> Chemical resistant gloves (specify type): |                                       | <input type="checkbox"/> Respirators                          |
| <input type="checkbox"/> Other required PPE (specify):             |                                       | <input type="checkbox"/> Fall protection equipment (specify): |

Proper radiation dosimetry required for collision hall access.

Log survey meter (LSM) required during controlled access to D0 collision hall.

**Work Plan History Information:** (List any lessons learned accidents from this job, tips from previous jobs)

**Overview:**

Power is supplied to a Muon PDT using 4 individual supplies; two large +5V supplies for analog power (one positive one negative), one large +5V supply for digital power and one small -5V supply, also for digital power. The three large supplies are each attached to a single, large aluminum plate. The fourth supply is attached to a small aluminum plate and the small aluminum plate is attached to the large aluminum plate. An aluminum cover is secured over the small power supply. The large aluminum plates are bolted to the framework of the Muon trusses (in the D0 Detector Collision Hall) at various locations.

**Training Requirements:**

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- Appropriate training to be issued a key to the D0 Collision Hall
- Basic Electrical Safety (minimum)
- D0 Hazard Awareness

**Important Information:**

- There are several supplies which are mounted above open stair wells.
- Getting to / from some Muon PDT Power Supply location in the Muon trusses may involve maneuvering about tight spaces. Cooling fins and other sharp edges found on equipment may be encountered. Vertical ladders may need to be scaled.
- The larger power supplies weigh 12.5 pounds each.
- The small power supply (with aluminum plate) weighs approximately 1 pound.
- The procedure will require two people to change the supply. One needs to be a Muon PDT Expert.

**Required Tools:**

Note; with the exception of the Digital Volt Meter, the following tools should already be located in a tool pouch labeled Muon PDT Power Supply.

- Working flashlight.
- Paper and pen / pencil.
- Digital Volt Meter (DVM)
- 6 7/8 inch long, 1/8 inch flat blade screwdriver.
- 6 inch long, 5/16 inch flat blade screwdriver.
- 4 inch long, 1/8 inch flat blade screwdriver.
- 3 inch long, 1/4 inch flat blade screwdriver.
- 2 inch long, 1/8 inch flat blade screwdriver. Handle shortened to reduce overall length to 3 1/4 inches.
- 5 1/2 inch long, 5/16 inch split-blade screw starter.
- 1 1/2 inch long, 1/4 inch split-blade screw starter.
- Trimmer Adjustment Tool.
- 5/16 inch nut driver.
- Collection of Failure Indication Tags.

**Procedure:**

Ensure that the D0 Control Room personnel responsible for Muon Detector operation are aware of replacement prior to entering D0 Collision Hall.

Follow this procedure for replacing one of the individual power supplies that comprise a Muon PDT Power Supply. Comments in parenthesis ( ) indicate information specifically related to the small power supply used for -5V digital power.

- The replacement power supply will be provided by the Muon PDT Expert.

- One person will carry the power supply; the other will carry the tool bag to the location of the failed Muon PDT Power Supply.

<b>Detail</b>	<b>Hazard</b>	<b>Precautions / Safety Procedures</b>
Access to some of the locations where Muon PDT Power Supplies are located in the Muon Trusses requires maneuvering through / around areas without much clearance.	Cooling fins on power supplies can have sharp corners. Laceration and puncture wounds are possible if a person were to rub or bump into these fins.	Visually identify the path you must take to maneuver in Muon Trusses. Note locations where space is limited. Share this information with working partner. Carefully maneuver around these spaces, avoiding contact with power supply components whenever possible.
The locations of some of the PDTs in the Muon End Trusses require scaling vertical ladders.	It is impossible to carry Power Supplies and tools up or down a ladder and maintain the recommended 'three points of contact'. Falling from the ladder is a distinct possibility.	Leaving tools and Power Supply on the initial elevation, the first person climbs up (or down as appropriate) the ladder to the next elevation. The second person hands the first person the tool bag and the Power Supply in two distinct operations. One person may use the ladder in reaching to exchange items as long as three points of contact with the ladder are maintained at all times.
Additionally, the locations of some of the Muon PDT Power Supplies are above a person's normal range of reach.	This procedure requires two-handed access to hand tools and the power supply. This does not facilitate maintaining three-points of contact with a ladder.	Members of the D0 Mechanical Support Group will assemble temporary platforms to access such locations. Any temporary platform will be inspected and approved by a Mechanical Engineer prior to use.
Additionally, the locations of some of the Muon PDT Power Supplies are positioned above one of the open stairways in the Muon Truss system.	Working over an open stairway presents the possibility of falling a distance of 4 or more feet.	Members of the D0 Mechanical Support Group will assemble temporary platforms to access such locations. Any temporary platform will be inspected and approved by a Mechanical Engineer prior to use.

- Arriving at the location of the failed power supply, place the replacement power supply and the tool pouch near the area where replacement is to be made. Ensure that neither the pouch nor the power supply is placed in such manner that they would be stepped on, tripped over or knocked away from the work area. The

available space should be large enough to provide a safe place to put the removed supply.

Removal Procedure:

- Note location and orientation of power supply to be removed.
- Using the DVM, measure the DC output voltages from all 4 power supplies at the large 8-position terminal strip. The measured voltage for one of the power supplies should be significantly different from the expected nominal. Verify with the Muon PDT Expert that this power supply is the one to be replaced.
- Note the position and orientation of the power supply to be removed.
- Date and initial a Failure Indication Tag (see example in Figure 1), record any known problems with power supply.

<p style="text-align: center;"><b>FAILED</b></p> <p style="text-align: center;">Muon PDT Power Supply</p> <p style="text-align: center;">Date: _____</p> <p style="text-align: center;">Initials: _____</p>	<p>Comments / suspected problems:</p>
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Figure 1. Front and back side of Failure Indication Tag

- Unplug the 120VAC instrument cord from the distribution / fuse box located near the center of the Muon PDT Power Supply.
- Using a DVM, measure the DC output voltages from all 4 power supplies at the large 8-position terminal strip. Measure from the Black to the colored wire in the twisted pair from each supply. Do not proceed until all measured voltages measure less than 0.2Vdc.
- Follow the small gauge black/white twisted pair of wires from the power supply to be replaced to one of the two small 8-position terminal strips. These wires carry the AC voltage required by the supply to operate. Note the positions of these two wires in the terminal strip and the color of the wires opposite these two wires on the terminal strip. Using a screwdriver, loosen the terminal screws for these two wires and remove the wires from the strip.
- Follow the large gauge (small gauge) twisted pair of wires from the power supply to be replaced to the large 8-position terminal strip. These two wires carry the DC current produced by the supply. Note the positions of these two wires in the terminal strip and the color of the wires opposite these two wires on the terminal strip. Using appropriate screwdriver, loosen the terminal screws for these two wires and remove the wires from the strip.
- Follow the small gauge (none for the -5V digital supply) twisted pair of wires from the power supply to be replaced to the other small 8-position terminal strip.

These wires are used by the power supply to sense the output voltage. Note the positions of these two wires in the terminal strip and the color of the wires opposite these two wires on the terminal strip. Using appropriate screwdriver, loosen the terminal screws for these two wires and remove the wires from the strip.

- (For removal of the small 5V power supply for -5V digital power, the aluminum cover needs to be removed first. Two lock nuts secure this cover to the aluminum plate; use the nut driver to remove these nuts. Care should be taken to ensure the nuts are not dropped.) Using a flat blade screwdriver, slightly loosen each of the 5 screws (4 screws in the plate holding the -5V supply) holding the supply to the aluminum plate. Note; two of the screws are located near the top of the supply and two located near the bottom of the supply, in rectangular shaped openings. The fifth screw can be accessed through the round opening in the cooling fins. The use of the flashlight to observe screwdriver engagement is recommended.
- Using the long split-blade screwdriver, remove the screws loosened in the step above, using the split-blade feature to secure the screw to the screwdriver, ensuring that the screw is not dropped.
- Support the power supply by hand as the final screws are removed and prepare to carry the supply away from the aluminum plate.
- Attach the completed Failure Indication Tag to power supply.
- Set the removed power supply aside in a safe location.

#### Installation Procedure:

- Preload the long split-blade screwdriver with a screw. Pick up the replacement power supply and position it in the proper location on the aluminum plate. Ensure that the power supply orientation matches that of the removed supply.
- Using the split-blade screwdriver with screws loaded, insert screws through the chassis of the power supply and into the tapped holes in the aluminum plate. Drive screws until snug.
- Using the flat blade screwdriver, tighten all 5 (4) screws. (Place the aluminum cover for the small 5V power supply for -5V digital power supply on the screws protruding from the aluminum plate. Install and secure the two nuts using the nut driver.)
- Locate the small-gauge sense wires (none for -5V digital power supply) from the replacement power supply. Dress the wires to the proper positions on one of the two small 8-position terminal strips. Verify that the color of the wires on either side of the terminal strip match the arrangement found prior to removing the original power supply. Insert the wires and tighten terminal screws using appropriate screwdriver.
- Locate the large-gauge (small-gauge) DC supply wires from the replacement power supply. Dress the wires to the proper positions on the large 8-position terminal strip. Verify that the color of the wires on either side of the terminal strip match the arrangement found prior to removing the original power supply. Insert the wires and tighten terminal screws using appropriate screwdriver.

- Locate the small-gauge black/white AC wired from the replacement power supply. Dress the wires to the proper positions on the other small 8-position terminal strip. Verify that the color of the wires on either side of the terminal strip match the arrangement found prior to removing the original power supply. Insert the wires and tighten terminal screws using appropriate screwdriver.
- Visually verify sense, AC and DC supply wire connections to terminal strips. Verify tightness of terminal screws for all positions on all terminal strips.
- Connect the AC instrument cord into the receptacle on the distribution / fuse box to complete the replacement.
- Using the DVM, measure the DC voltages found at the large 8-position terminal strip and record. Measure from the Black to the colored wire in the twisted pair from each supply. Working with the Muon PDT Expert, adjust the potentiometer on the front of the replaced power supply to set the output voltage at the proper potential using the Trimmer Adjustment Tool.
- Exiting the Muon Truss area with failed power supply and tool bag, be aware of the same risks involved in accessing the power supply location.
- The Muon PDT Expert should verify that the PDT is operating properly by running Zero Bias runs and using the PDT Resource Monitor.

