

Overview

This guideline defines when Lockout/Tagout (LOTO) is required for high voltage diagnostics.

Background

1. Many diagnostics at LLE require high voltage (HV, >50V) power supplies (PS) for their operation
2. Connected devices (e.g., cables and detectors) can store a charge if disconnected from the HV source while the supply is enabled
3. Diagnostics requiring HV supplies are often located in places that are difficult to access, such as near the target chamber (head-bump hazard) and on elevated structures (fall hazard).
4. LLE policies and procedures seek to mitigate the risk of:
 - a. Electrical shocks
 - b. Secondary injuries that could result if a worker were shocked (e.g., fall, head bump, etc.)

Safety practices

1. HV power supplies shall be output-limited (current and voltage) in all applications that permit doing so. Limits shall be as follows (based on Stanford Research PS300 product series):
 - a. ≤ 5 kV, 5mA max
 - b. > 5 kV - ≤ 10 kV, 1mA max
 - c. > 10 kV – ≤ 20 kV, 0.5 mA max
2. Any power supply capable of exceeding the above limits shall not be considered output-limited, and must be LOTO before connecting or disconnecting electrical output connections.
3. Procedures shall dictate that **ONLY** LLE HV-approved connectors (e.g. SHV, **) powered by a current-limited power supply may be connected or disconnected without verifying the state of the power supply output. In all other situations, the power supply must be Locked out/Tagged (LOTO) out per LLE Instruction 6300.
4. HV connections shall use LLE HV-approved connectors (**) when practical (e.g., SHV coaxial connector). Contact the Electrical Safety Officer for connector recommendations or approval.
5. All HV power supplies shall have a label on their front panel indicating maximum output voltage and maximum current.

** LLE policy - MHV connectors are NOT approved for making/breaking “hot” high-voltage connections for the reasons below; they require LOTO.

SHV stands for “Safe High Voltage” as it is a “dead face” connector with a deep buried conductor.

<https://halberdbastion.com/resources/hardware/rf-connectors/rf-connector-series/shv>

“The connector is designed such that when it is being disconnected, the high voltage contact is broken before the ground contact to prevent accidental shocks. The connector is also designed to prevent users from forcing a high voltage connector into a low voltage plug or vice versa (as can happen with MHV and BNC connectors), by reversing the gender compared to BNC.”

MHV stands for “Miniature High Voltage” connector and does not have the same protection level as the SHV when not mated. Also, they can be mated to BNC inadvertently due to their form factor.

<https://halberdbastion.com/resources/hardware/rf-connectors/rf-connector-series/mhv>

“MHV connectors are often considered to be a safety hazard due to the possibility of high voltage on the exposed central pin when not plugged in, and because the ground connection is broken before the power connection when demating. SHV connectors are designed to prevent these hazards, and cannot be mated to BNC connectors.”