

# Instructions for installation, operation and maintenance of the Arc Quenching Device (AQD)



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**⚠ WARNING**

**(1) ONLY QUALIFIED ELECTRICAL PERSONNEL SHOULD BE PERMITTED TO WORK ON THE EQUIPMENT.**

**(2) DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON THE EQUIPMENT WHILE ENERGIZED. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING.**

**(3) ALWAYS DE-ENERGIZE PRIMARY AND SECONDARY CIRCUITS BEFORE REMOVING ARC QUENCHING DEVICE.**

**FAILURE TO FOLLOW THESE STEPS FOR ALL PROCEDURES DESCRIBED IN THIS INSTRUCTION LEAFLET COULD RESULT IN DEATH, BODILY INJURY, OR PROPERTY DAMAGE.**

**⚠ CAUTION**

**SPECIFIC OPERATING PROCEDURES MUST BE DEVELOPED BY THE RESPONSIBLE PARTY, BECAUSE OF THE UNIQUE APPLICATION AND VAST VARIETY OF SYSTEM AND USER REQUIREMENTS. FAILURE TO DEVELOP SPECIFIC PROCEDURES COULD LEAD TO IMPROPER USE OR OTHER MORE SERIOUS CONSEQUENCES.**

**⚠ DANGER**

**HAZARDOUS VOLTAGE. WILL CAUSE SEVERE INJURY OR DEATH. DO NOT OPEN SHUTTER IF THE EQUIPMENT IS ENERGIZED.**

**⚠ CAUTION**

**PLEASE READ AND UNDERSTAND THESE INSTRUCTIONS BEFORE ATTEMPTING TO UNPACK, INSTALL, OPERATE, OR MAINTAIN THIS EQUIPMENT.**

**⚠ WARNING**

**THE ARC QUENCHING DEVICE SHOULD NOT, UNDER ANY CIRCUMSTANCES, BE APPLIED OUTSIDE ITS NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS COULD RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.**

**⚠ WARNING**

**IF THE EATON ARC FLASH RELAY OR THE ARC QUENCHING DEVICE ARE NOT INSTALLED AND FUNCTIONAL, THE INCIDENT ENERGY SHOWN ON THE ARC FLASH LABEL FOR ARC QUENCHING SWITCHGEAR MAY NOT BE APPLICABLE AND MAY BE MUCH HIGHER.**

**⚠ WARNING**

**PROPER MAINTENANCE OF THE ARC QUENCHING SYSTEM AND SWITCHGEAR IS NECESSARY TO ENSURE PERFORMANCE.**

**Purpose**

This instruction manual is expressly intended to cover the installation, operation, and maintenance of the Arc Quenching Device (AQD). This AQD may be supplied as part of a complete switchgear assembly or as a separate component. This manual applies only to the AQD.

Arc Quenching switchgear accessory items are discussed briefly in this manual. Field installation instructions for such items, however, are covered in individual instruction leaflets specific to the accessory. This information is also available from the Eaton website at [www.eaton.com/lva](http://www.eaton.com/lva).

For application information, consult Eaton or see applicable Product Guides, Technical Documents, Application Publications, and/or industry standards.

**Safety**

All safety codes, safety standards, and/or regulations must be strictly observed in the installation, operation, and maintenance of this equipment.

**1 Introduction**

**1.1 General information**

**1.2 Safety practices**

To protect personnel associated with the installation, operation, and maintenance of this equipment, the following practices must be followed.

1. Only qualified electrical personnel familiar with the equipment, its operation, and the associated hazards should be permitted to work on the equipment. Additionally, only qualified personnel should be permitted to install or operate the equipment.
2. Always be certain that the primary circuit is de-energized before the AQD is removed to a safe work location to perform maintenance.
3. For maximum safety, only insert a completely assembled and functional AQD into an energized cell.
4. Always ensure that the AQD is in one of its designated cell positions – Withdrawn, Disconnect, or Connect. An AQD permitted to remain in an intermediate position between Disconnect and Connect will result in a non-functional error state.

**1.3 Qualified personnel**

For the purpose of operating and maintaining the AQD, a person should not be considered qualified if the individual is not thoroughly trained in the operation of the AQD and how it interfaces with the assembly in which it is used. In addition, the individual should have knowledge of the connected loads and sources.

For the purpose of installing and inspecting the AQD and its associated switchgear assembly, a qualified person should also be trained with respect to the hazards inherent to working with electricity and the proper way to perform such work. The individual should be able to de-energize, verify, and lock out/tag out circuits in accordance with established safety practices.

**1.4 Other publications and documentation**

In addition to this instruction manual, other printed information and documentation is available and supplied as appropriate. This additional information can include, but not necessarily be limited to, an instruction manual for the Eaton Arc Flash Relay, instruction leaflets for accessory items, renewal parts information, necessary dimensional drawings, and a Product (application) Guide.

## 2 Receiving, handling, and storage

### 2.1 General information

The AQD, when supplied as part of an assembly, may be shipped already installed in its respective breaker compartment. Receiving and handling of this equipment is addressed in an assembly instruction manual supplied with the assembled equipment. This instruction manual applies to only the AQD.

### 2.2 Suggested tools

The following tools are recommended to properly install and maintain the AQD:

- 3/8" ratchet
- 3/8" extension
- T10 Torx screwdriver

### 2.3 Unpacking Arc Quenching Device

Before beginning to unpack a new AQD, read and understand these directions. Following the directions will ensure that no damage is caused.

Shipping containers should be inspected for obvious signs of rough handling and/or external damage incurred during the transportation phase. Record any observed damage for reporting to the transportation carrier and Eaton, once the inspection is completed. All reports and claims should be as specific as possible and include the order number and other applicable nameplate information.

Every effort is made to ensure the AQD arrives at its destination undamaged and ready for installation. Care should be exercised, however, to protect it from impact at all times. Do not remove protective packaging until it is ready for inspection, testing, and/or installation.

When ready to inspect and install an AQD, carefully remove the banding straps and lift off the cardboard box. Remove any additional packing material and internally packed documentation.

### 2.4 Storing Arc Quenching Device

If it is necessary to store the AQD before installation, do so in its original shipping container. Keep the AQD in a clean dry place. Ensure there is ample air circulation and heat, if necessary, to prevent condensation.

### 2.5 Lifting Arc Quenching Device

#### **⚠ CAUTION**

**DO NOT ATTEMPT TO LIFT ARC QUENCHING DEVICE WITH ORDINARY CRANE HOOKS, ROPES, CHAINS, OR OTHER SUCH DEVICES. FAILURE TO FOLLOW THIS CAUTION COULD RESULT IN DAMAGE TO VITAL PARTS SUCH AS FINGER CLUSTERS, BARRIERS AND WIRING, OR THE ENTIRE ARC QUENCHING DEVICE.**

The AQD is designed to be easily lifted from the wooden pallet using an appropriate lifting yoke (part number 87C0345G04) and properly rated overhead or portable lifting device (see **Figure 1**).

Every effort should be made during lifting to minimize AQD swing and tilt.



Figure 1. AQD and lifting yoke.

### 2.6 Arc Quenching Device inspection

The AQD, once removed from its shipping container, should be visually inspected for any obvious damage.

## 2.7 Installing Arc Quenching Device

In structures with specially equipped cells for the AQD, a bolted in cassette with movable extension rails supports the AQD (see **Figure 2**). The extension rails must first be pulled all the way out. Once the rails are fully extended, the AQD can be carefully placed on the extension rails.

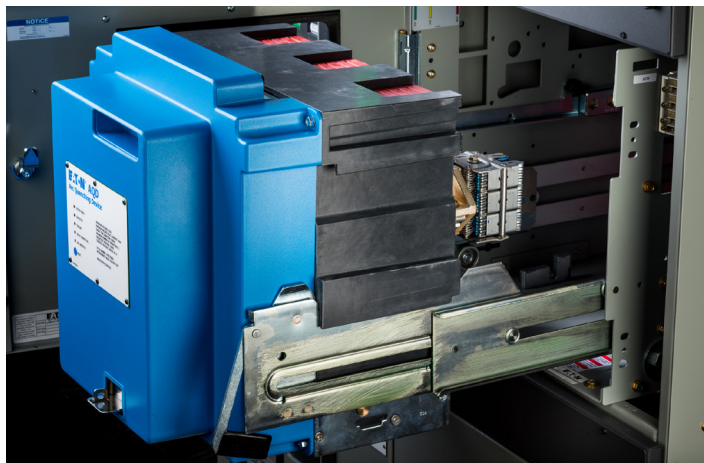


Figure 2. AQD installed on extension rails.

### ⚠ CAUTION

**IT IS IMPORTANT TO TAKE GREAT CARE WHEN PLACING THE ARC QUENCHING DEVICE ON ITS EXTENSION RAILS. IF THE ARC QUENCHING DEVICE IS NOT PROPERLY SEATED ON THE EXTENSION RAILS, IT COULD FALL FROM THE RAILS CAUSING EQUIPMENT DAMAGE AND/OR BODILY INJURY.**

Carefully lower the AQD down onto the extension rails. Be certain that the AQD's two molded drawout rail supports are fully seated in the extension rail cutouts on both sides (see **Figure 3**). Do not remove the lifting yoke from the AQD until it is properly seated on the rails.

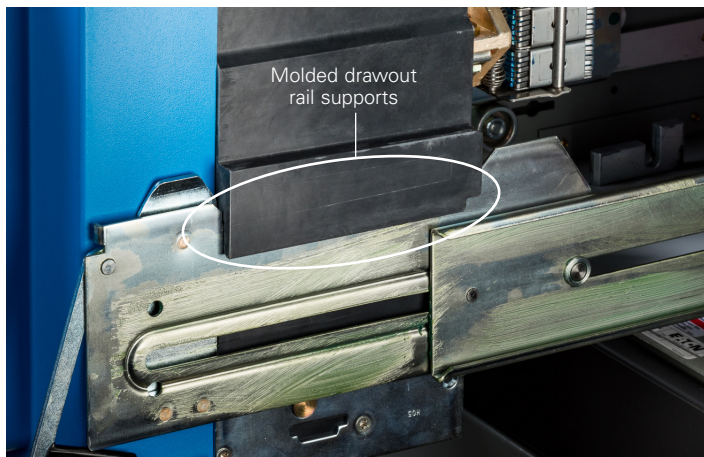


Figure 3. AQD molded drawout rail supports.

Once the AQD is on the extension rails and the lifting yoke is removed, proceed with the rest of the AQD installation.

## 2.8 Rejection interlocks

The AQD and corresponding cassette incorporate rejection interlocks like those used for Magnum Breakers. This is to prevent installation of the AQD into a cassette that is not designed for it, or installation of a breaker in the cassette designed for use with the AQD.

## 3 Equipment description and technical information

### 3.1 Introduction

The AQD is a current limiting, arcing switch with the capability of quenching arcing faults within the equipment that it is protecting. The user will need to be familiar with its features and ratings in order to apply the AQD in a manner that allows for its proper operation. These features and ratings will be described in this section.

### 3.2 Operator interface

The operator interface is located on the front of the AQD (see **Figure 4**) and is fully accessible through the door, even when the AQD is installed in its switchgear cell. This interface communicates status of the AQD to the user and allows for the user to interact with the AQD when in Test mode.



Figure 4. Operator interface on front of AQD.

#### 3.2.1 LED indicating lights

**"AQD READY"**: Illuminated when the AQD is ready to quench an arc, and off otherwise.

**"CAPACITOR FAULT"**: There are capacitors inside the AQD which store the energy needed to activate the current limiting switches. This LED is illuminated when these capacitors fail to hold a charge as they should. This LED is off when the capacitors are in good health.

**"TRIGGER FAULT"**: The triggers are the moving legs of the current limiting switches inside the AQD. If connection to and through these switches is lost, this LED is illuminated. This LED is off when the triggers and their connections are in good health.

**"EAFR CONNECTION FAULT"**: Illuminated if the signal connection to the EAFR-110PLV Arc Detection Relay is lost. The LED will be off if the connection to the relay is in good health.

**"ARC ARRESTED"**: Illuminated if AQD has been operated in Test mode, or if the AQD has quenched an arcing fault.

When in Test Mode, all LED's with the exception of the Arc Arrested LED will flash to indicate that the AQD has been successfully placed into Test mode.

**Under normal operating conditions, only the "AQD READY" LED should be illuminated. If it is off or if other LEDs are illuminated, the AQD will not be operable and the incident energy of the switchgear will increase. See Section 6, Troubleshooting.**

### 3.2.2 Reset button

The Reset button is a multi-function button. In Test mode, the Reset button may be pressed momentarily to reset the AQD after a test has been performed. In AQD Ready mode, the Reset button is used to verify all indicating LED lights on the Operator Interface are operational. All LED's will illuminate as long as the Reset button is held.

### 3.3 Secondary connections

The AQD control wiring connections are under the top of the front cover (see **Figure 5**). These draw-out connections mate with the connections in the cell when the AQD is in the Disconnect position. One connector contains all wired connections, including control power, relay outputs, and Modbus communications. The other connector contains the fiber optic connection between the AQD and the EAFR-110PLV.

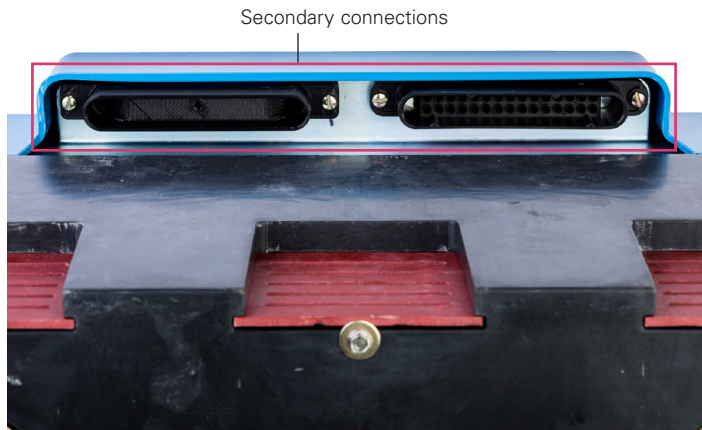


Figure 5. Secondary connections on rear of AQD.

### 3.4 Primary connections

The AQD primary connections are on the back (see **Figure 6**). They connect the AQD to the power bus in the switchgear. These connections are made by motion of the AQD when inserted into its cell. They are fully connected when the AQD is in Connect position, and fully disconnected when in Disconnect position.

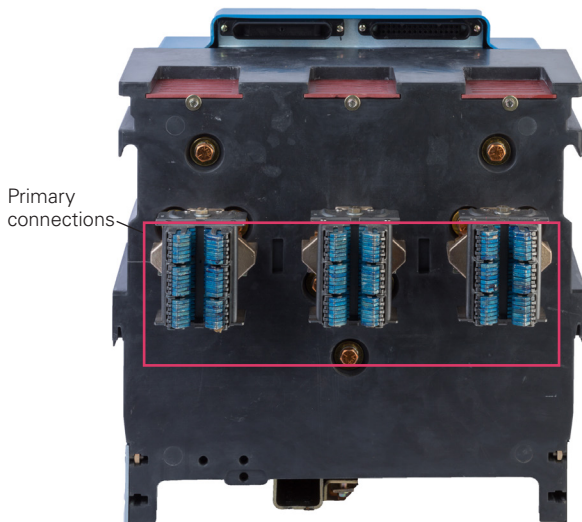


Figure 6. Primary connections on rear of AQD.

### 3.5 Racking mechanism

The AQD's racking mechanism is the same as is used on Eaton's Magnum DS breakers. The same tools used to operate Magnum DS breakers will work with the AQD. A 3/8" square drive extension with ratchet is the tool of choice for operation, and is provided with every new lineup of Magnum DS switchgear. Any standard 3/8" drive will be sufficient for operating the AQD's racking mechanism.

### 3.6 Lifting handles

The lifting handles are features on the AQD that interface with a Magnum Lifting Yoke (see **Figure 7**). They are designed to carry the full weight of the AQD when it is being lifted.



Figure 7. Lifting handles on either side of AQD.

### 3.7 Vents

The vents allow for convective cooling of the AQD after it has quenched an arcing fault. Depending on the current level and duration of the arcing fault, the AQD's current limiting switches will emit heat for up to two hours after the fault event. No heat is emitted from the AQD when under normal switchgear operating conditions.

### 3.8 Ratings

**Table 1. AQD ratings**

Control power voltage range	118-132 Vac @ 50/60 Hz
Control power consumption	3W
Weight	162 lbs
Maximum primary voltage	635 Vac @ 60 Hz
Maximum arcing fault current	85 kA or 100 kA
Dielectric voltage	2200 Vac
Short time withstand	100 ms or 500 ms @ 85 kA; 100 ms @ 100 kA
Maximum number of quenching operations	1

**Table 2. Breaker interlock contact**

Rated load (resistive)	8 A @ 250 Vac , 5 A @ 30 Vdc
Max switching voltage	250 Vac, 30 Vdc
Max switching current	8 A

**Table 3. Health Contact**

Rated load (resistive)	8 A @ 250 Vac , 5 A @ 30 Vdc
Max switching voltage	250 Vac, 30 Vdc
Max switching current	8 A

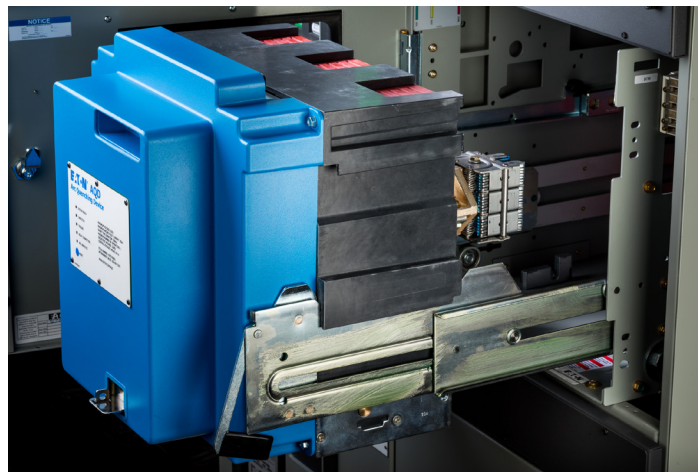
### 4 Operation

#### 4.1 AQD cell positions

The AQD is designed to be installed solely in a Magnum DS Switchgear AQD cell. **It should not be installed in any other cell. Permanent damage and failure of the AQD could result.**

The AQD has three positions once placed on the rails.

##### 4.1.1 Withdrawn position (see Figure 8)



**Figure 8. AQD in the disconnect position.**

Withdrawn is considered any position in which the AQD is on the cell rails but is not pushed into the cell so as to make the secondary connections. In this position, the AQD cell door may not be shut. This position may be used for general inspection of the AQD, but it is recommended that the AQD be fully removed and taken to an area outside the arc flash boundary when performing maintenance.

##### 4.1.2 Disconnect position (see Figure 9)



**Figure 9. AQD in the withdrawn position.**

Disconnect is the position in which the AQD is placed on the cell rails and when pushed in, stops. In this position, the racking mechanism bottoms out on the cell's racking paws and may not be inserted any further in the cell without use of the racking mechanism. All secondary connections are made. When the AQD is to be tested, it must be in the Disconnect position for Test mode to be entered.

#### 4.1.3 Connect position (see Figure 10)



**Figure 10. AQD in the connect position.**

Connect is the position in which the AQD is fully inserted into its cell. The AQD's racking mechanism must be used to move the AQD from Disconnect into Connect position. In this position, all primary and secondary connections are made. The AQD will only enter AQD Ready mode when in Connect position.

**Note:** The AQD does not have a Test position like Magnum DS breakers. The AQD must be tested in Disconnect position. Magnum DS breaker cell switches may be employed in the AQD's cell to communicate whether the AQD is in the Connect position, or is not in the Connect position.

The AQD has limit switches internal to its racking mechanism that interlock the AQD's operation modes with its position. This is to prevent testing when the AQD is connected to the switchgear power bus. It also ensures that the AQD does not enter AQD Ready mode until the AQD is fully connected onto the switchgear power bus.

#### 4.2 Test mode

The AQD employs a Test mode that allows the user to perform a full functional test of the AQD. In Test mode, when the AQD receives a trip signal from the EAFR-110PLV, it will fully operate, but at a reduced power level so as not to damage the current limiting switches. To put the AQD into Test mode, take the following steps.

1. Rack the AQD to the Disconnect position.
2. Connect the Arc Quenching System Tester following the instructions for the Tester. See IB019011EN.

Once both of these conditions have been met, the indicating lights on the AQD Operator Interface will start flashing. The AQD has now been placed into Test mode. Follow the instructions for the Arc Quenching System (AQS) Tester to perform a test. The AQS Tester gives sensor inputs to the EAFR-110PLV to simulate an arc fault event and enables Test mode in the AQD. Once a test has been completed, the "ARC ARRESTED" indicating light on the AQD will be solid on, and all other lights will be off. The user may then press the Reset button to make the AQD ready for another test.

#### 4.3 AQD Ready mode

The AQD's Ready mode indicates that the AQD is ready to activate in a quenching operation. The "AQD READY" indicating light will be solid on, and the AQD Health relay will change state when this mode is entered. The AQD must be in the Connect position in order to enter this mode. Entering this mode is also conditional on all monitored internal critical components being fully functional, including the monitored connection to the EAFR-110PLV. If any of these conditions are not met, the "AQD READY" light will not illuminate.

##### 4.3.1 Quenching operation

When the AQD receives a trip signal from the EAFR-110PLV, it will activate the current limiting switches. Activation of the switches in this mode is a one-time operation.

After the AQD has performed a quenching operation, the "ARC ARRESTED" indicating light will be steady on. Only in this case will this indicating light be powered by a battery. The battery allows for indication that the AQD has operated even when control power is lost. The light will stay illuminated for the life of the battery, which is approximately 72 hours when powering the light.

The AQD's Health relay will return to its normal unpowered state if control power is lost to the AQD after the event. The Breaker Interlock Form-A relay will also revert to its normal state in the open position. This contact is wired in to the closing circuit of the main protective device upstream of the AQD. The intent is to prevent an operator from re-energizing the equipment after an arcing fault until the spent AQD has been removed and replaced.

#### 4.4 After an arc fault event

After an arc fault event has been quenched by the AQD, the EAFR system (see manuals MN026004EN and MN026007EN) will direct the operator to the location of the arc fault inside the equipment. If present, any resultant debris should be cleaned out, and any soot should be wiped off of the equipment where accessible, and the equipment should be returned to its normal operating condition. It is recommended that a power frequency withstand (dielectric) test be performed on the equipment prior to re-energizing after the event. For low voltage switchgear, consult ANSI Standard C37.20.1 for dielectric testing requirements.

The AQD must be removed and replaced. It cannot not be repaired or refurbished. If a replacement AQD is not available, one may be purchased by contacting Eaton's Low Voltage Switchgear Aftermarket Salesperson. See phone number on the AQD's operator interface or contact your local Eaton sales representative. Before returning the system to service, all tripped EAFR relays will need to be reset. This is accomplished by pressing the Set button on each relay for 1 second. This will clear all relay trip statuses, and return them to their normal protective state. Test the entire arc quenching system, including the EAFRs, the AQD and all arc flash point sensors, before re-energizing. Refer to the EAFR manuals and the Arc Quenching System Tester manual (IB019011EN) for more information.

**Instructions for using switchgear without AQD after arc fault event**

The switchgear may be reenergized after a fault with the AQD removed, but the protection it provides will be lost. Note that this will change the incident energy rating of the equipment and PPE requirements. It is recommended that the switchgear not be placed back into service until the AQD can be replaced. However, the following steps may be taken to operate the switchgear without the AQD.

1. If not already removed, remove the used AQD from its cell. Leaving the AQD in its cell upon re-energization of the switchgear may cause additional arcing in which the equipment and personnel will be unprotected.
2. Open the secondary instrument door above the AQD cell, and locate the black jumper on the empty secondary terminal block.
3. Move the black jumper from its storage location to pins Q3 and Q4. This completes the Spring Release circuit for the Main Circuit Breaker, and allows that breaker to be reclosed.
4. The Main Breaker may now be reclosed and the switchgear energized.

**4.5 Communications**

The AQD employs Modbus RTU communications. The customer Modbus connections are located at the customer terminal blocks in the instrument compartment above the AQD cell. See Appendix A1 for wiring details.

**4.5.1 Modbus Via Eaton Power Xpert Gateway**

The AQD can be monitored through the Eaton Power Xpert Gateway. For instructions on connecting via the Eaton Gateway, reference the Gateway’s instruction manual (MN152006EN). Monitored items are as follows:

**Table 4.**

	<b>Description</b>
<b>AQD Ready</b>	Mimics “AQD Ready” indicating light. Indication that the AQD is in DQD Ready Mode
<b>EAFR Connection Fault</b>	Mimics “EAFR Connection Fault” indicating light. Health of fiber optic connection with EAFR
<b>Trigger Fault</b>	Mimics “Trigger Fault” indicating light. Health of Trigger Ribbon
<b>Cap Charged</b>	Charge status of triggering energy storage capacitors
<b>Capacitor Fault</b>	Mimics “Capacitor Fault” indicating light. Health of triggering energy storage capacitors
<b>Test Mode</b>	Indication that the AQD is in Test Mode
<b>Slave Healthy</b>	Health of slave Main Control Unit (MCU). The slave offers redundancy of the main processor. If the slave MCU is not working, the AQD will still operate correctly, but MCU redundancy will be lost. Preparations should be made to have the AQD repaired by Eaton, or replaced.

**4.5.2 Modbus Via non-Eaton Gateway**

For connection to the AQD through a communications gateway other than the Power Xpert Gateway, use the following connection parameters:

**Default Slave Address:** 01

**Baud Rate:** 9600 bps

**Table 5.**

	<b>Register Address</b>	<b>Register Value</b>
<b>AQD Ready</b>	40002	1: Ready, 0:Not ready
<b>EAFR Connection Fault</b>	40003	1: Connected, 0:Not connected
<b>Trigger Fault</b>	40004	1: Connected, 0:Not Connected
<b>Cap Charged</b>	40005	1: Charged, 0:Not charged
<b>Capacitor Fault</b>	40006	1: Capacitors are healthy, 0: Capacitors are not healthy
<b>Test Mode</b>	40010	1: Functional mode is selected, 0: Functional mode is not selected
<b>Slave Healthy</b>	40011	1: Second MCU is healthy and generating the heartbeat pulse, 0: Second MCU is not healthy
<b>Modbus Address</b>	40014	1: Factory default

**4.5.3 Modbus Address Set and Reset**

The Modbus address is stored in Modbus register 40014. Upon connecting to the AQD for the first time via the Modbus factory default address, it may be set to the preferred address. Control power must be cycled to the AQD in order for the Modbus address change to take effect.

If the Modbus address is ever lost, it may be reset to the factory default by the following procedure.

1. Remove control power from the AQD.
2. While holding the Reset button on the AQD, return control power to the AQD.
3. All LED’s on the AQD should blink synchronously 5 times, and then the Reset button should be released.
4. The Modbus address has been reset to the factory default.



## 5 Maintenance

### 5.1 Battery replacement

The AQD employs a battery to power the "ARC ARRESTED" light after it has performed a quenching operation (see section 4.3.1). This battery will degrade over time and should be replaced every 15 years.

#### 5.1.1 Battery type

CR2450, 3V, Lithium coin type

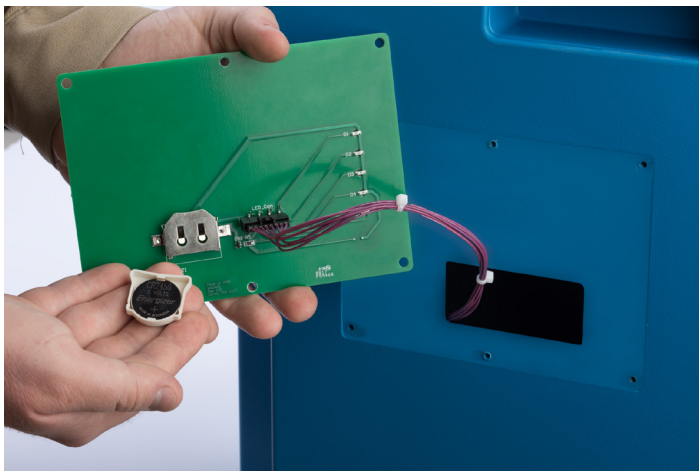
#### 5.1.2 Replacement instructions

1. Remove the AQD from its cell and take to a zone outside of the arc flash boundary.
2. Using a T10 screwdriver, remove the (6) 6-32 screws holding the Operator Interface panel on the front cover (see **Figure 11**).



**Figure 11. Removing the operator interface on the front of the AQD.**

3. Being careful not to put stress on the cable connecting the Interface, remove and replace the battery on the rear of the Interface (see **Figure 12**).



**Figure 12. Replacing the battery on the rear of the operator interface.**

4. Reinstall the Operator Interface panel on the front cover.

## 6 Troubleshooting

**Table 6.**

Issue	Action
EAFR Connection Fault light illuminated	Check power to EAFR 110PLV and fiber optic cable for breaks or loose connections
Capacitor Fault light illuminated	Capacitor failed. AQD is inoperable. Consult factory
Trigger Fault light illuminated	Trigger failed. AQD is inoperable. Consult factory
Reset button fails to illuminate all LEDs when pressed while AQD is in AQD Ready mode	Replace operator interface

**Appendix**

**A1. Wiring diagrams**

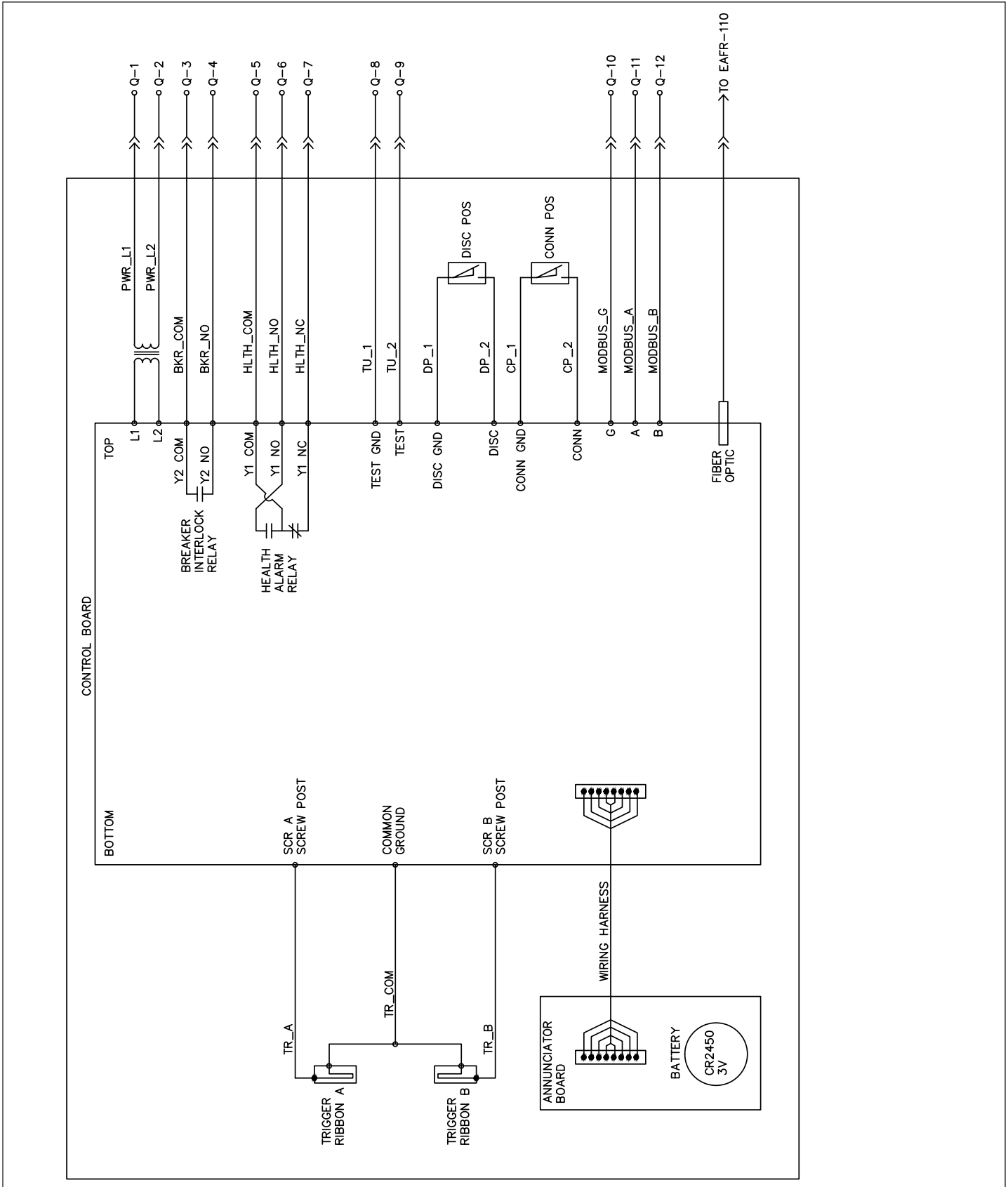


Figure 13. AQD Schematic.

**A2. Document references**

IB019011EN - Instruction manual for Arc Quenching System Tester

MN026007EN - EAFR-110 Current and Arc Light Sensor Relay User Manual

MN026004EN - EAFR-101 Arc Point Sensor Relay User Manual

**A3. Renewal parts**

Replacement AQD: 478C709G01

Replacement Customer Interface panel: 9259C95G01

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