Plasma Ignition Troubleshooting For The 4100 MP-AES

Stephen Anderson, September 2012

Protecting the torch during ignition

- Always watch plasma ignitions using the recommended position
- Any signs of Torch Overheating use the Emergency Plasma Off switch

Diagnosing Gas Flows

- Use your finger to confirm the presence of gas flows all the way to the torch connections
  - Plasma Outer Gas flow
  - Plasma Intermediate flow
  - Argon flow
  - Air Injection flow (if EGCM present)
- DO NOT USE THIS TO CONFIRM IGNITER OPERATION

How to check gas flows to the torch loader

- Remove Plasma Torch.
- Using the Gas Control Diagnostics Tab, enable each gas flow to the Intermediate and Outer Flow, one at a time.
- Insert finger into the Torch Loader Assembly.
- Locate the flow channel (Outer/Upper or Intermediate/Lower) and place tool over the gas channel outlet. There should be distinct sense of PRESSURE, not just flow.

Plasma Ignition Problems on the 4100 MP-AES

- Plasma Ignition on the 4100 MP-AES Requires
  - Spark
    - Generated by high voltage discharge
  - Argon Gas Flow
    - Required to transfer spark from igniter to the torch region inside the waveguide
    - Ar supplied by either small on board gas cylinder or connected to installation main Ar gas supply
    - Purity not critical (>99%, typically welding grade Ar acceptable)
  - Detection of plasma formation
    - Achieved using an LED located at the
  - Switch to N_2 gas

Known Causes of Plasma Ignition Problems

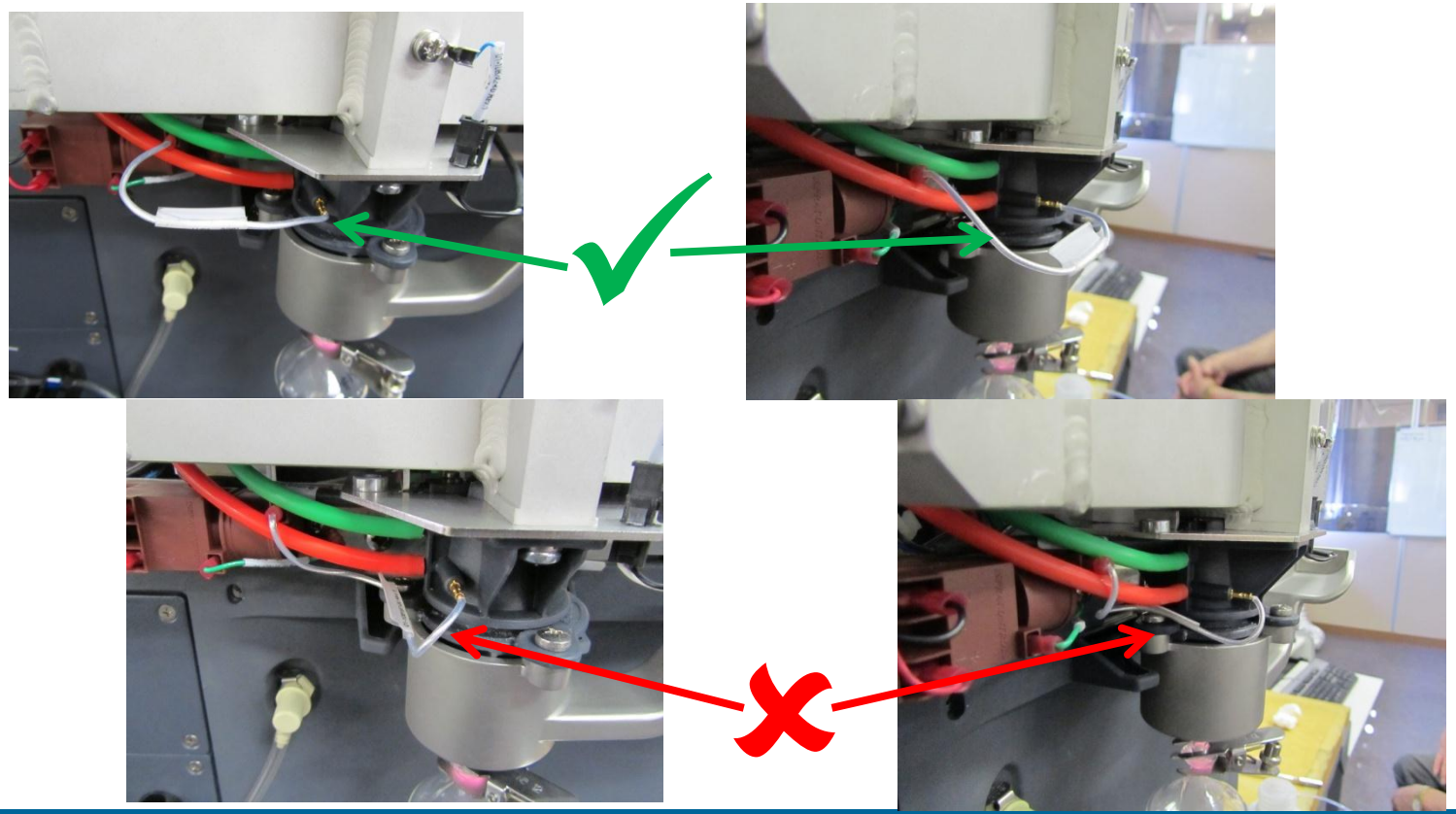
- Faulty Plasma Igniter
- Incorrect looming of the HV lead of the Igniter
- Faulty Ar regulator supplied for the on-board Ar gas supply
- Ar leak at the barbed fitting on the Torch Loader assembly
- Faulty Torch Loader plastic moldings
- Contaminants on the soft rubber sections of the MP plasma Torch
- Blocked orifices in the MP torch
- Inadequate insulation of the HV Ignition Lead
- Leaking gas connections on the Main Gas Control System
- Compressed air supplied at greater than specified supply pressure to an EGCM connected to the Main Gas Control system

Igniter HV Loom Location

•If the HV loom of the Igniter is located too close to an earth point the spark may not take the path into the torch

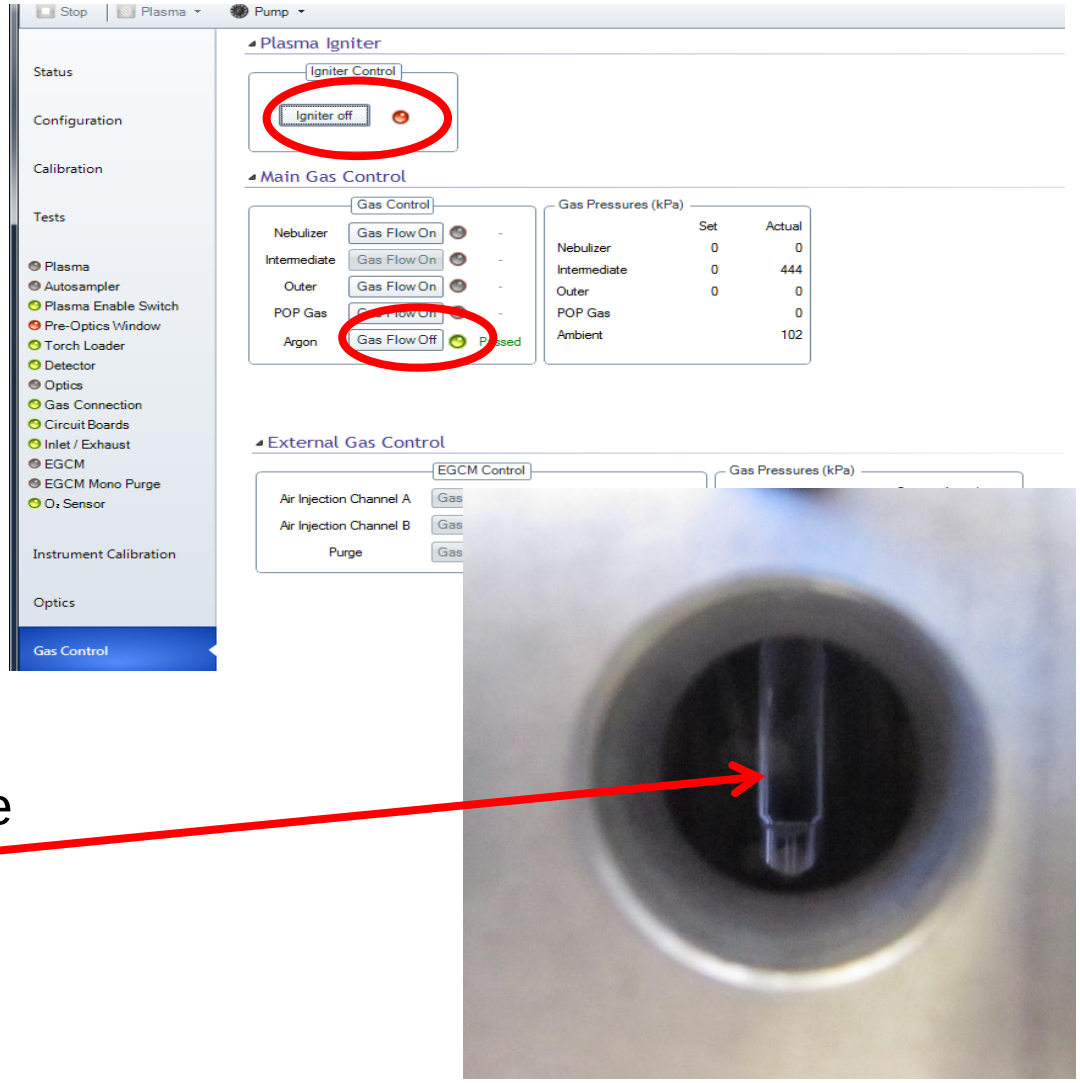
•Easily detected by removing the outer cover enclosing the Waveguide Assembly and inspecting the position of the loom

•Igniter loom can be inadvertently moved during the installation of the Waveguide Cover



Confirm The Igniter Discharge Is Going To The Torch

- Remove the Waveguide Cover
- In service diagnostics:
  - Simultaneously Enable Ar flow and the Ignter
- Observe the Plasma Torch
  - An electric discharge should be visible inside the plasma torch



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Failure to Detect Igniter Discharge In the Plasma Torch

- Ar gas flow problem
  - Incorrect gas supplied to the Ar input
  - Confirm Ar flow using your finger to confirm flow is present to the Torch Loader assembly
- Faulty Igniter
  - Igniter Module
  - HV Igniter cable too close to a ground point
- Torch Problem
  - Check the plasma torch for blockages

Faulty On-board Ar Gas Regulator

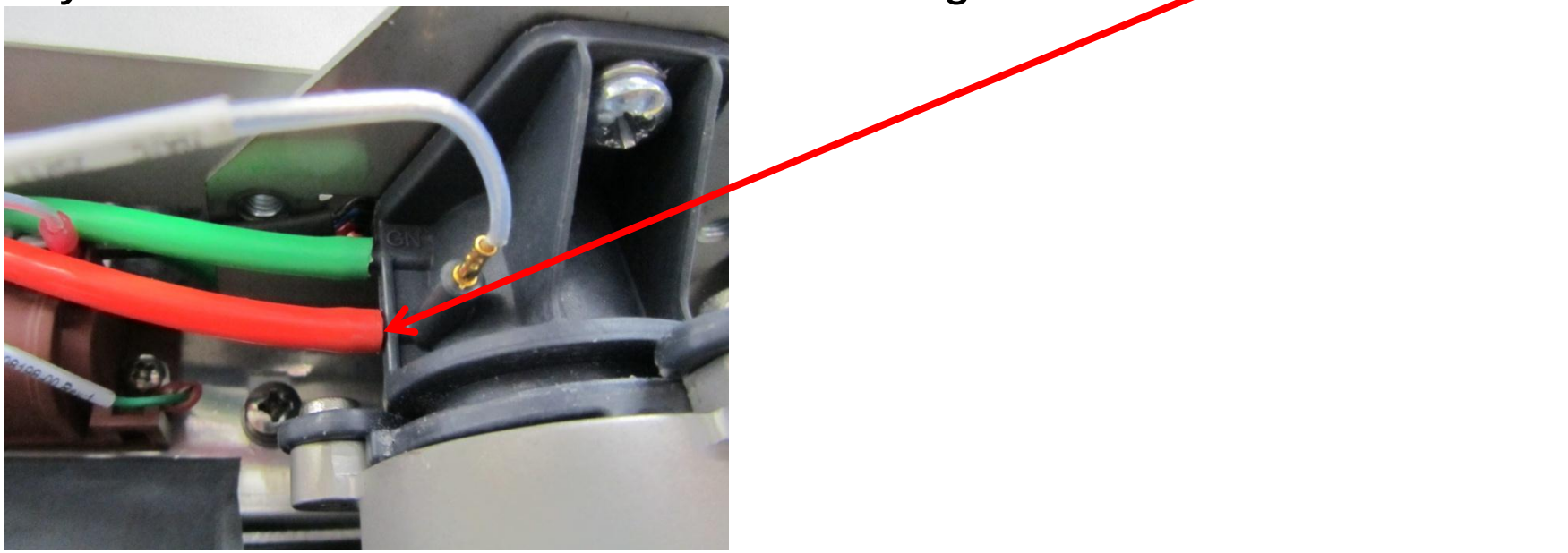
- A number of possible fault states
  - With the Ar regulator firmly attached to the on-board Ar cylinder and Swagelock connection in place, partially and slowly release the Swagelock connection at the Main Gas Control system and confirm that Ar is flowing.
  - In Service Diagnostics, remove the plasma torch and enable Ar flow and confirm pressure at the Intermediate output port of the torch loader assembly
  - In Service Diagnostics, install the torch and enable Ar flow and Igniter, no sparks should be visible in the vicinity of the torch loader assembly.

Reduced Argon Purity Through Diffusion of Atmospheric Gases

- Typical Indication
  - Difficulty igniting after plasma has been off for an extended time (> 1-2 hrs)
  - After successful plasma ignition plasma can be extinguished will reliably ignite if ignited immediately after being extinguished
  - Plasma reliably ignites if the Ar gas supply is purged immediately prior to plasma ignition (using diagnostics)
- Typical Problem
  - The use of Polymer hoses for Ar supply
  - Allows ingress of atmospheric gases via diffusion
  - If instrument is off for an extended time atmospheric gases can permiate through the Polymer Hoses and reduce Ar putrity
  - Long Polymer supply hose are particularly prone to this problem

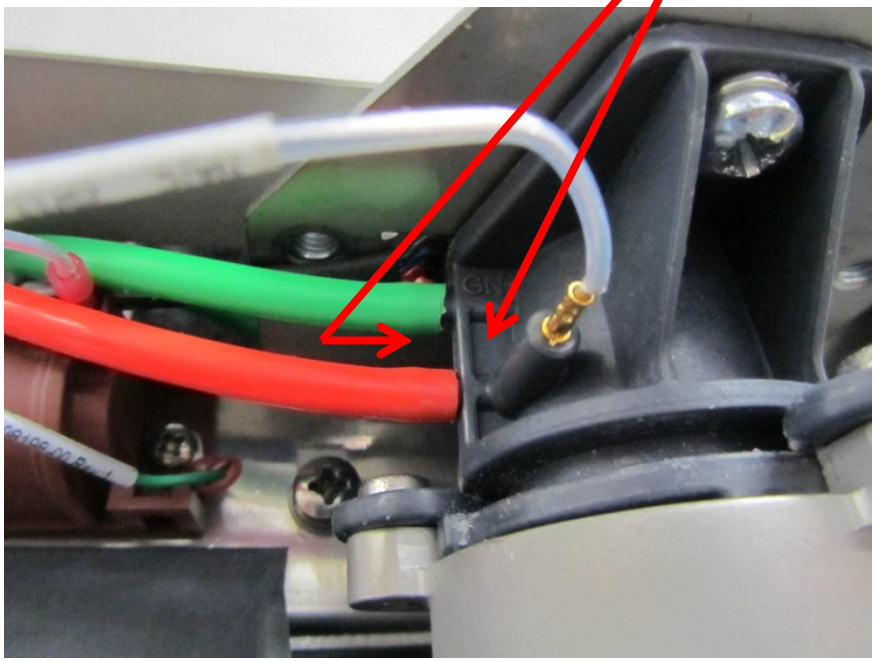
Ar leak at the barbed fitting on the Torch Loader assembly

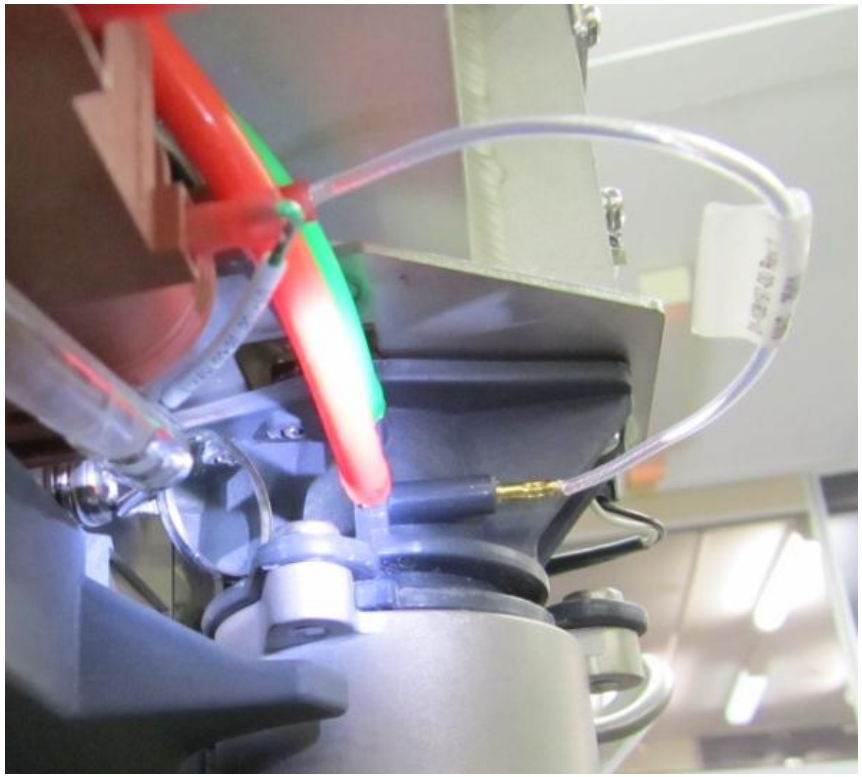
- Typically results in HV arcing to earth points around the Torch Loader
- If a leak is suspected, carefully remove the red hose (intermediate flow) from the barbed fitting, cut off the end of the hose and reattach
- It is recommended to immerse the newly trimmed end of the hose in very hot water to soften before reattaching.



Problems with the Torch Loader Molding Assembly

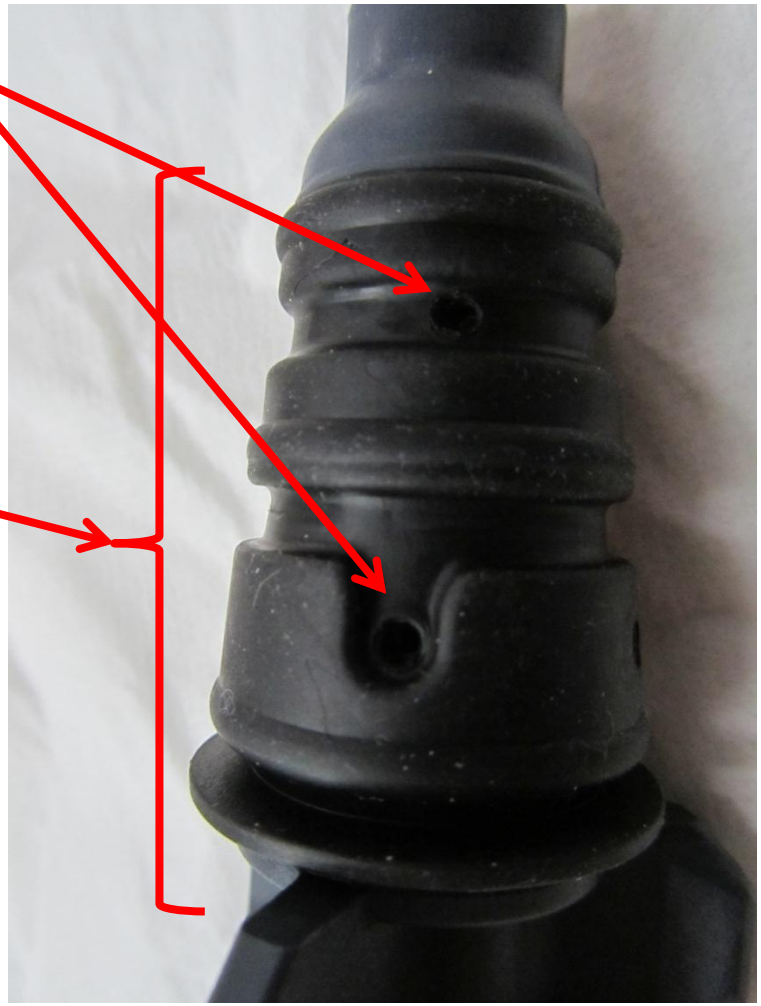
•By removing the Torch Loader Assembly from the Waveguide Assembly or by using a mirror and torch, inspect the Torch Loader molding for holes.
•Inspect both front and back sides





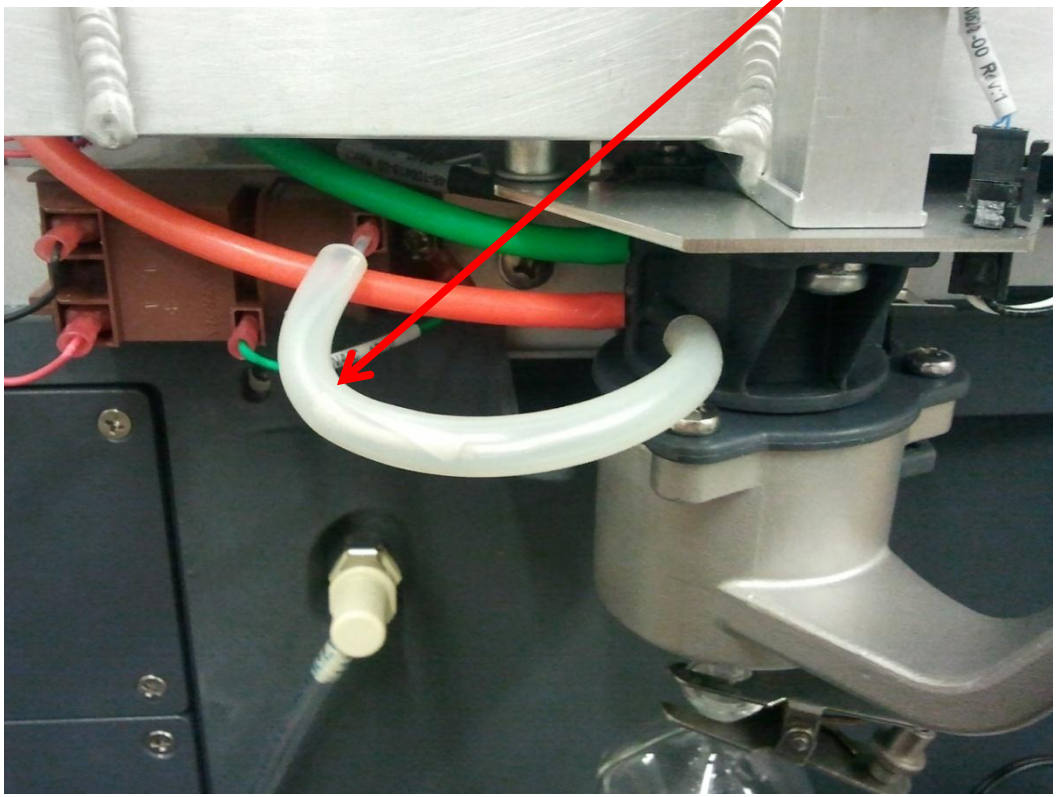
Particulates on the Gas Sealing Surfaces or Blocked Orifices of the MP Plasma Torch

- Checked for blocked orifices
  - Visual Inspection
  - Compressed Gas Flow
- Check for Particulates on the Gas sealing surfaces
- Consider replacing with a New torch



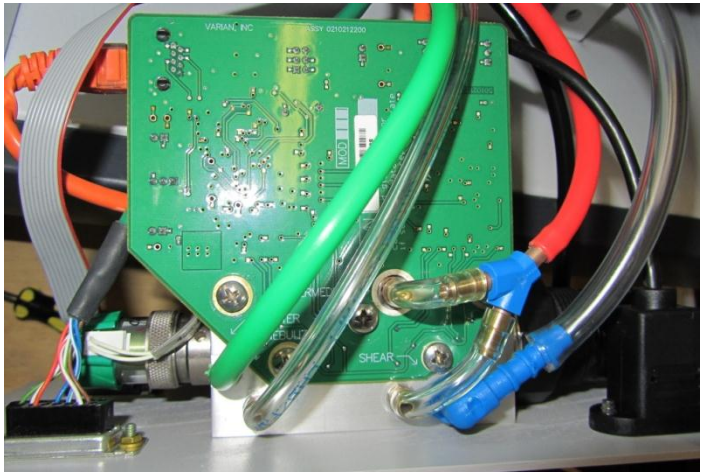
Improved Insulation on the HV Igniter Lead

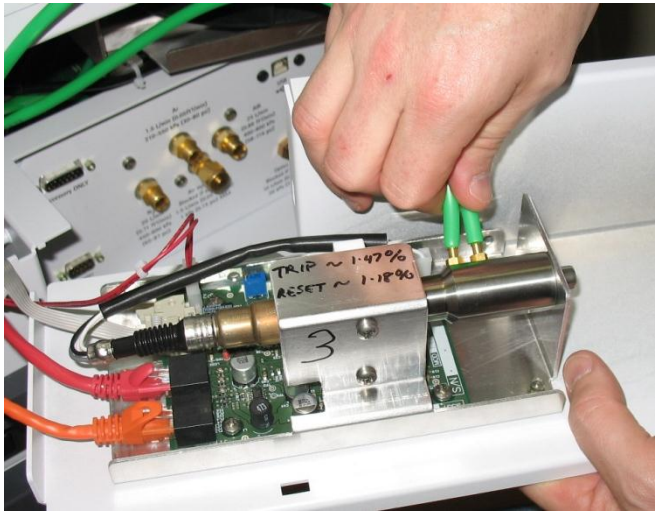
- Ignition problems have also be resolved by improving the insulation on the HV igniter lead
  - Installation of Silicone hosing over the HV lead



Leaking Gas Connections on the Main Gas Control System and Oxygen Sensor Connections

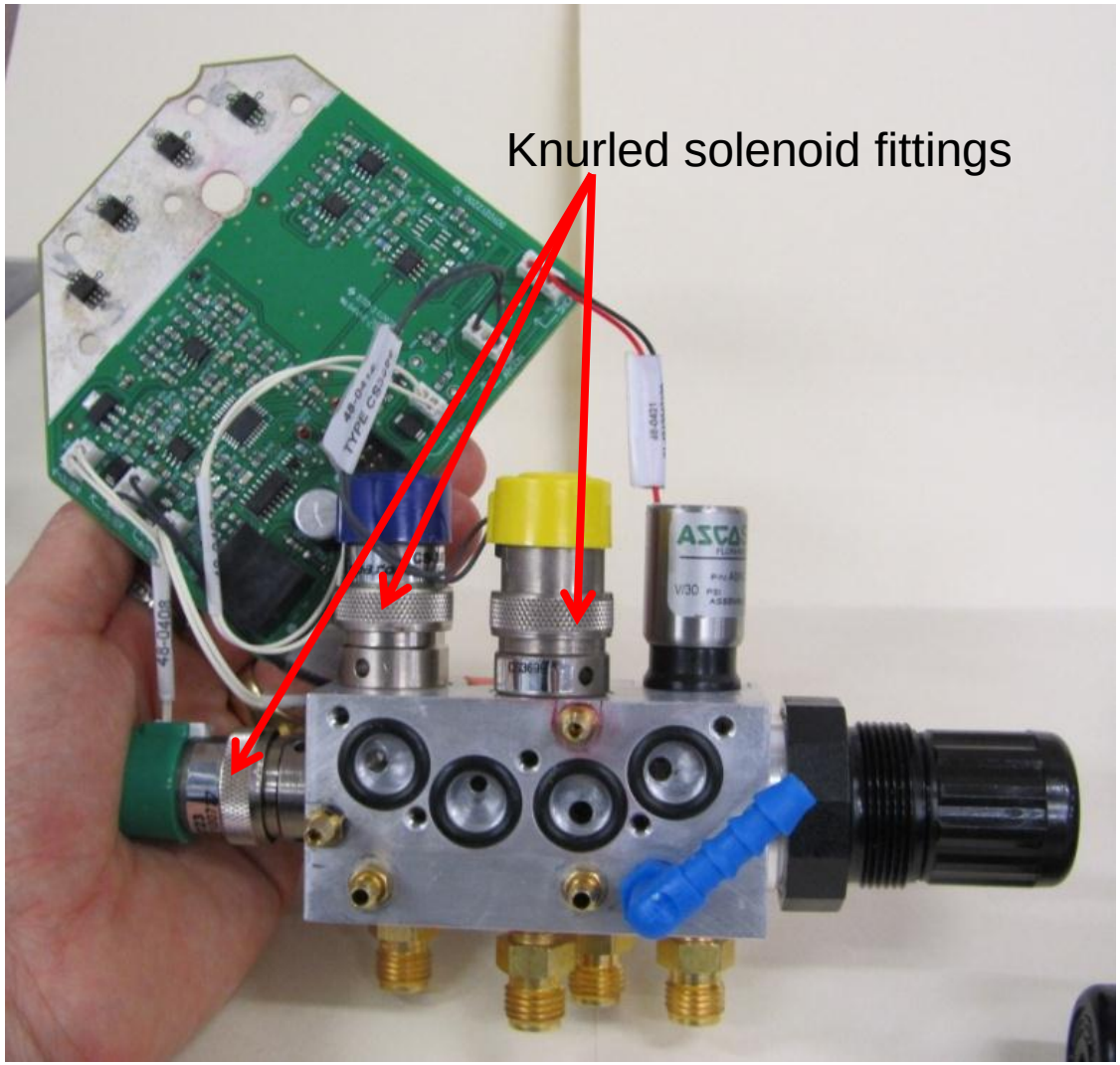
- Confirm gas connections to the Main Gas Control System are firm
- Confirm gas connections to the Oxygen Sensor are firm
- Remove any suspect connection, trim hose ends and refit
  - Consider immersing the cut, trimmed hoses in hot water before reconnecting





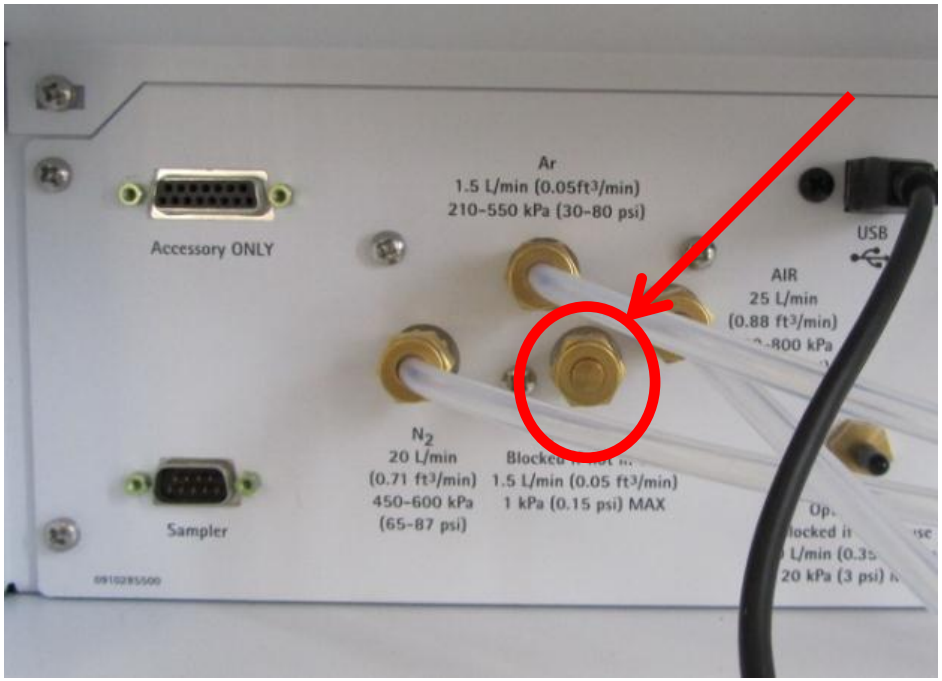
Gas Leaks Due to Loose Solenoid Valve Assembly

- Confirm the knurled fittings holding the solenoid valve assembly together is NOT loose
- Confirm the Valve is NOT loosely attached to the Manifold



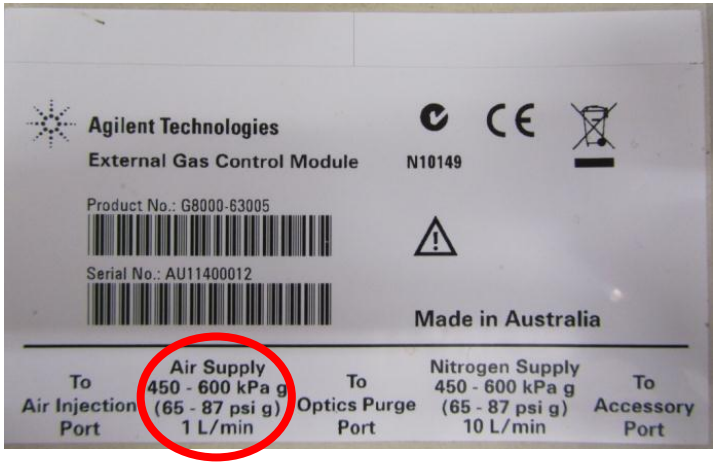
Air Injection Port

- If not in use ensure the Air Injection port is capped
  - If left uncapped, known to cause
  - Performance problems
  - Plasma Ignition problems
  - Torch melt problems
- The correct Swagelok fitting should be used to ensure proper sealing



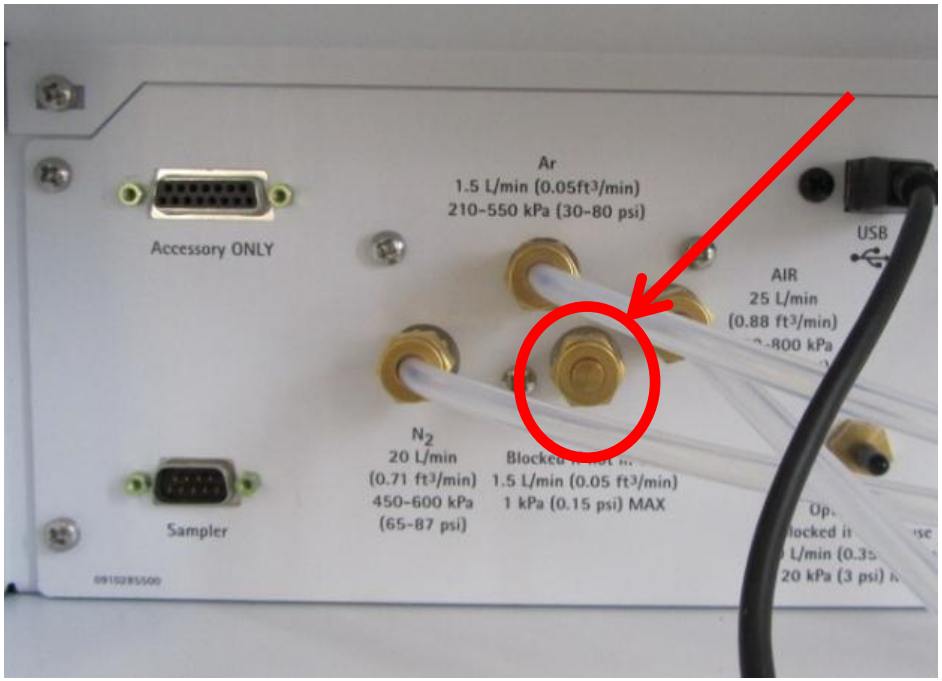
Air Injection via the EGCM

- If an EGCM is connected to the Air Injection port of the Main Gas Control system
  - Confirm the supplied air pressure to the EGCM is within recommended limits
  - Excessive air pressure to the EGCM can cause the solenoid on the EGCM to leak, injecting air into the plasma continuously



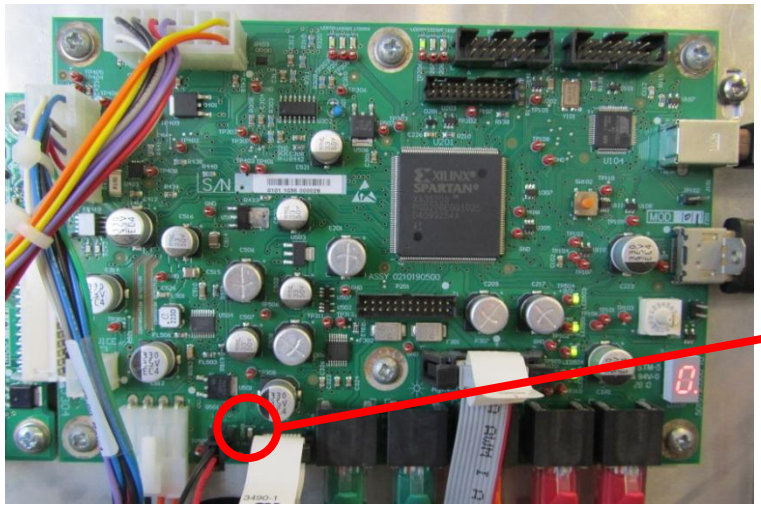
Accessories

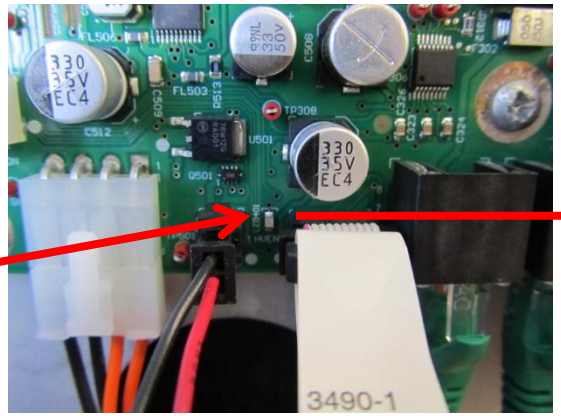
- If an EGCM is attached and the Air injection connected to the Instrument Services Panel disconnect/disable
  - Disconnection and removal ensures no possible interference of the accessory with the operation of the instrument
  - Ensure the air injection port is capped if not connected

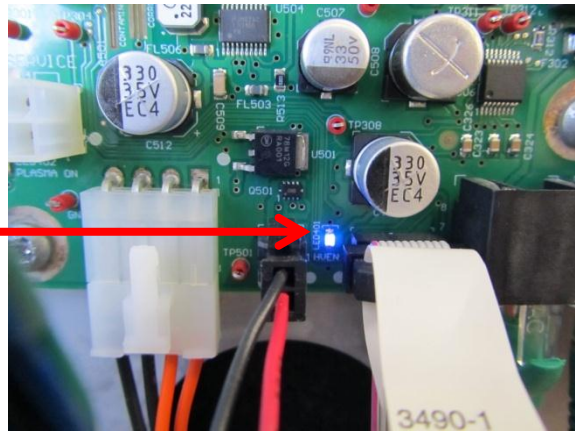


Main Control Board “Blue” LED401, HVEN (High Voltage Enabled)

- If all interlock conditions are met, (HVEN) should turn on during the gas purge process and stay on until the plasma is extinguished
- Failure of LED401 to turn on and stay on, can indicate a Main Control Board Problem
  - If LED401 does not remain ON and there is no indication of error state that will prevent the plasma ignition replace the main control board







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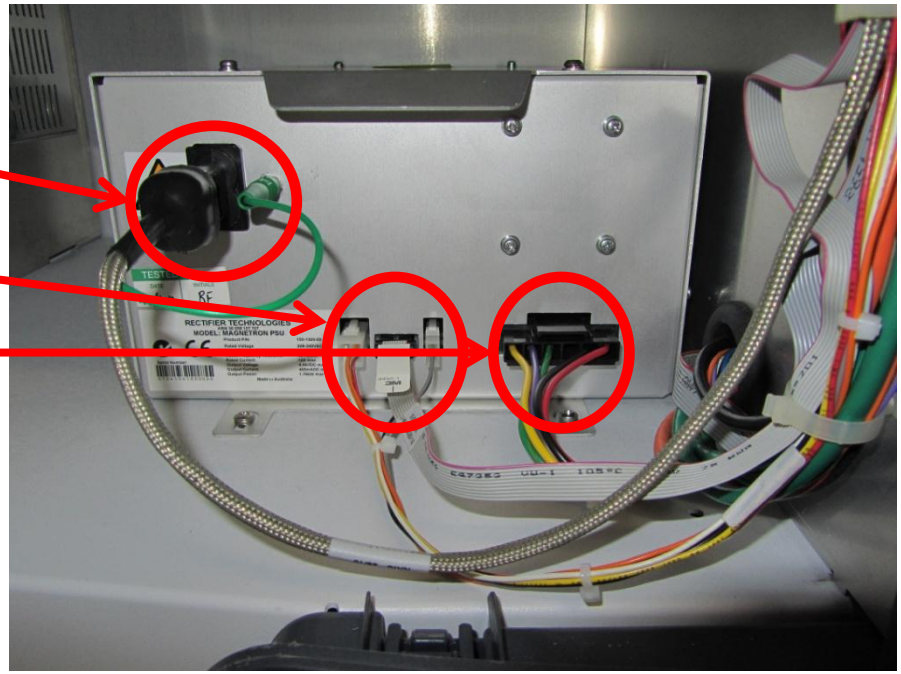
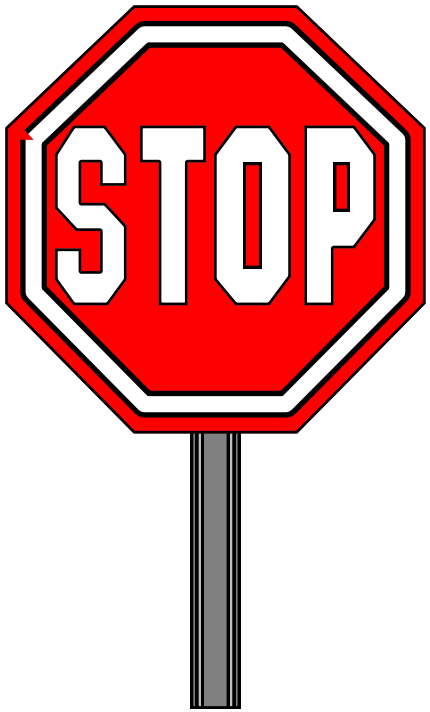
Check Electrical Connection to the HVPS

- Turn the off the 4100 MP-AES
- Disconnect and reconnect all electrical looms to the HVPS
  - High Voltage Loom to Magnetron
  - Communication and Interlocks
  - Mains Voltage and Fan Mains Control




STOP