LWD 1

The Pulser and How to Test it

Pulser Testing Objectives

At the completion of this presentation you should be able to:

1. **Describe the important differences between the MK VI, VII, & VIII pulsers.**
2. **You will be able to test the pulser and determine whether it should be used.**

The Pulser

- The central component of all four systems
- The same pulser can be used on all four systems
- There are three current versions of the pulser

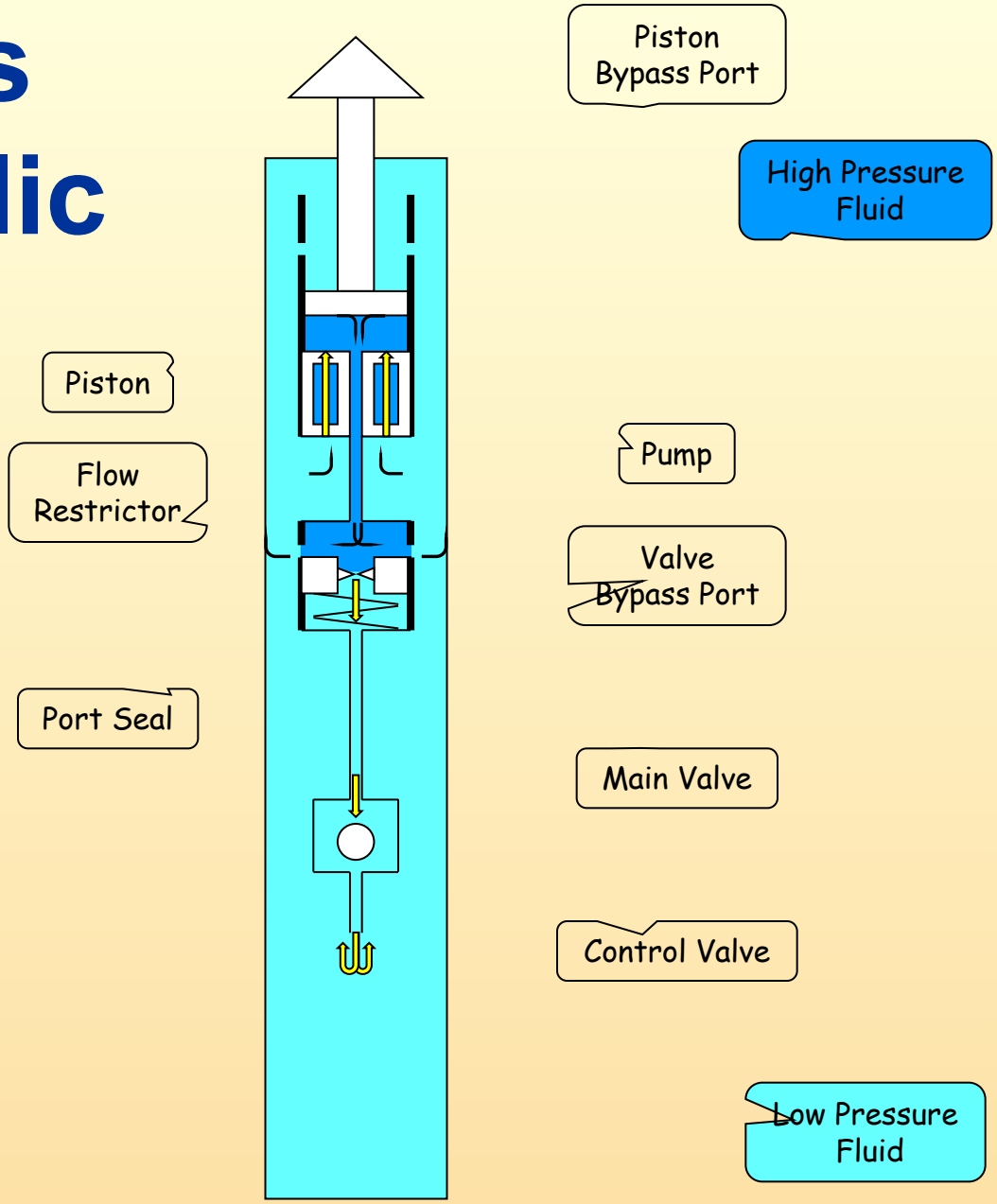
The Pulser

– Generates electrical and hydraulic power

Pulser's Hydraulic Power

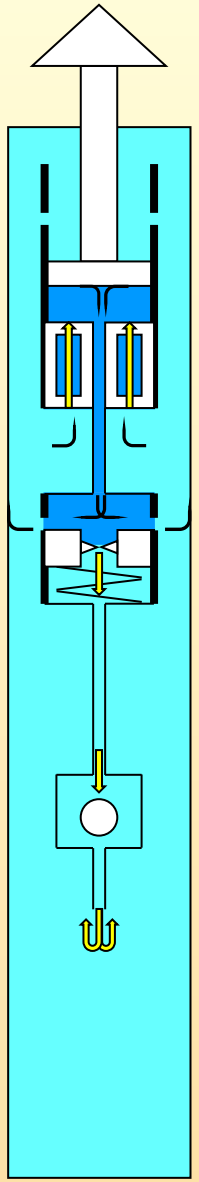
- Operates a poppet/orifice valve that intermittently restricts the fluid flow, producing a pressure increase, or pulse. These pulses are detected on the surface.

Pulser's Hydraulic System



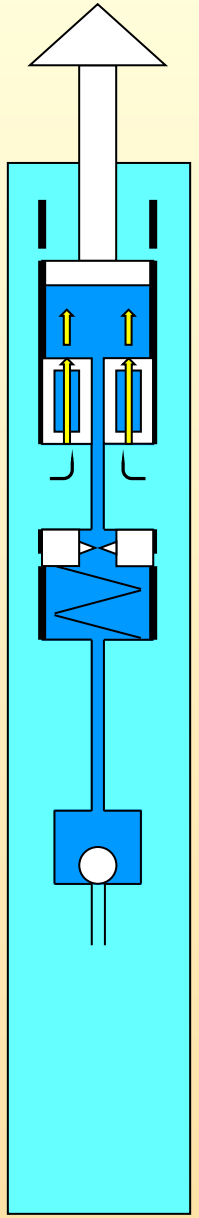
Pulser's Hydraulic System

- Control valve open
  - Flow through control valve
    - Allows flow through main valve
  - Flow through main
    - Pressure drop across flow restrictor moves port seal down against spring
    - Valve bypass port opens
  - Poppet fully retracted



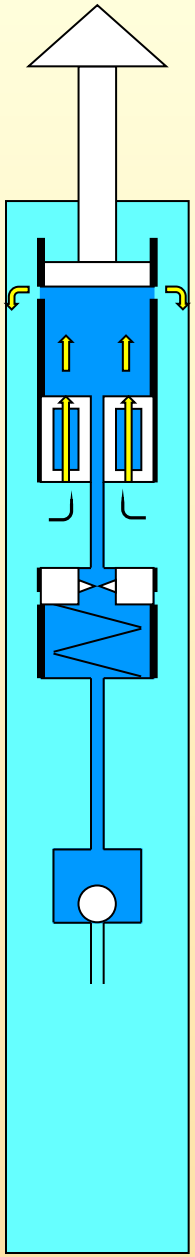
Pulser's Hydraulic System

- Control valve closed
  - No flow through control valve
    - Stops flow through main valve
  - No flow through main valve
    - Spring moves port seal up
    - Valve bypass port closes
    - Piston moves up
  - Poppet partially extended

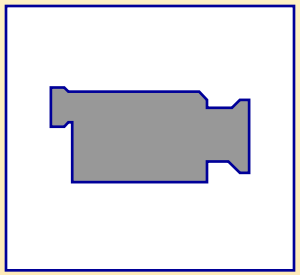


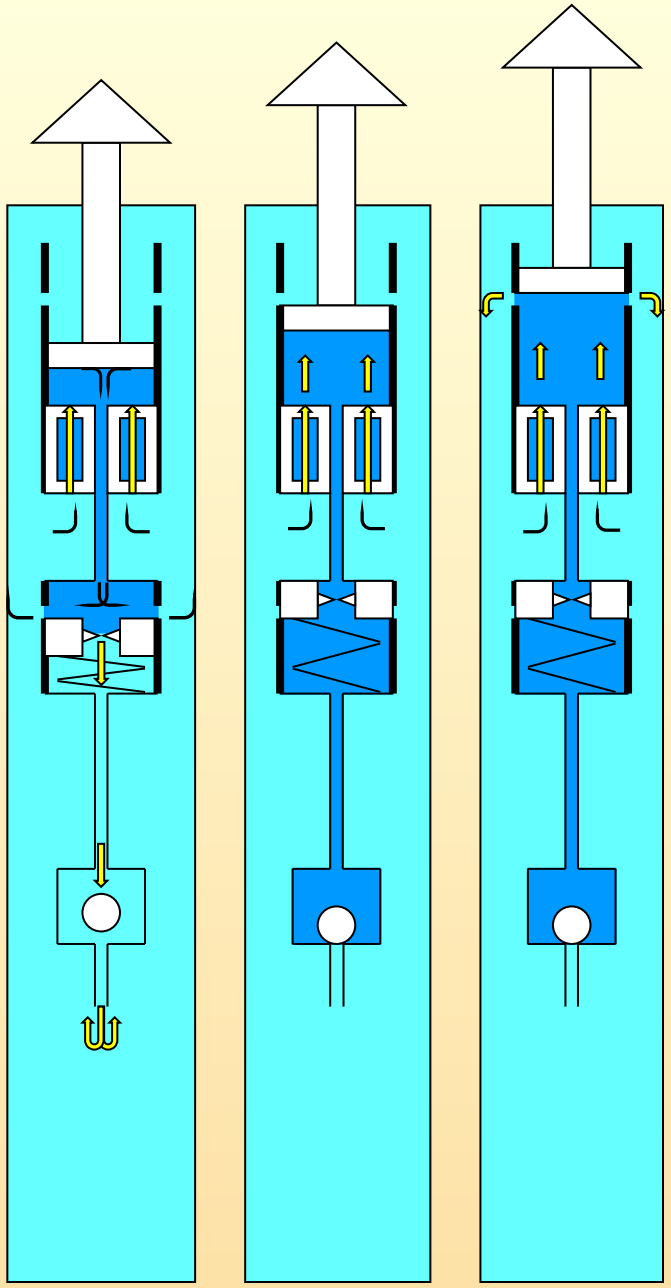
Pulser's Hydraulic System

- Control valve closed
  - No flow through control valve
    - Stops flow through main valve
  - No flow through main valve
    - Spring moves port seal up
    - Valve bypass port closes
    - Piston moves up
    - Piston bypass port opens
  - Poppet fully extended



Pulser's Hydraulic System





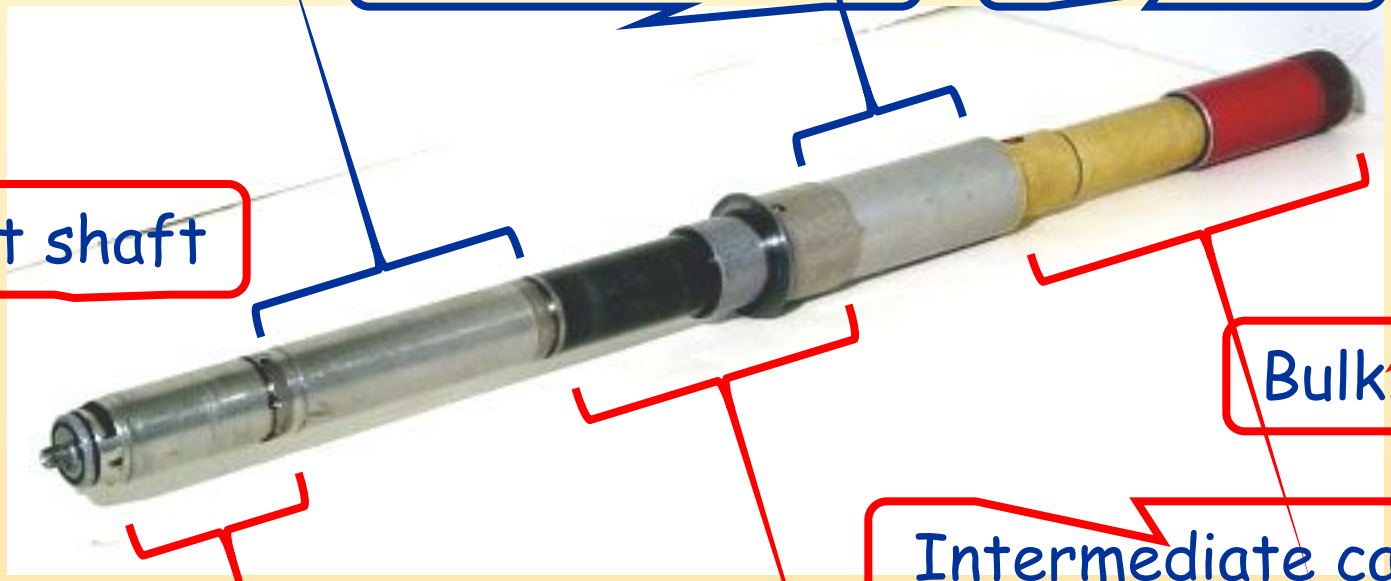
Pulser's Hydraulic System

- The control valve is operated by a signal from the telemetry controller. Closing the control valve causes the poppet to extend into the orifice.

Pulser's Electrical Power

- Generator consists of six fixed coils and eight rotating magnets.
- Electrical power is supplied to the sondes attached to the pulser.

The Parts of a Pulser



Booted Vs. Bootless Pulser

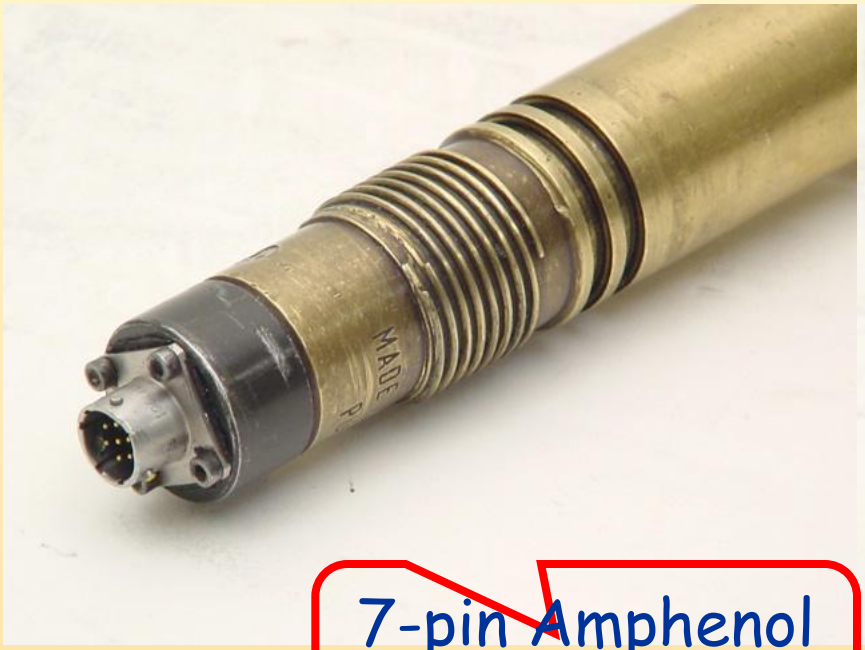
Booted Vs. Bootless Pulser

- Boot
  - Gas permeable
  - Susceptible to damage
  - No moving parts
  - Transmits external pressure to pulser's internal fluid

Booted Vs. Bootless Pulser

- **Bootless**
  - **Increased reliability**
  - **Requires seal pack assembly change every 100 or 200 hours depending on temperature**
  - **Moving parts**
  - **Transmits external pressure to pulser's internal fluid**

Pulser Connections



7-pin Amphenol Connector

4 Cond. Rotational Connector

Pulser Connection

- 7-pin Amphenol
  - Used for DWD
  - Careful assembly required to avoid damage
  - Uses coil cord

Pulser Connection

- 4-Conductor Rotational Connector
  - Used for Solar
  - Easy to make-up connection
  - Increased reliability

The Four Current Pulsers

- Mark 6 DWD
- Mark 7 Solar
- Mark 8 Solar
- Mark 8 DWD

Mark 6 DWD

- 7-Pin Amphenol Connector
- Maximum Temperature 175°C
- Full Stroke (0.374 in.)

Mark 7 Solar

- 4-Conductor Rotational Connector
- Maximum Temperature 200°C
- Full Stroke (0.374 in.)

Mark 8 Solar

- 4-Conductor Rotational Connector
- Maximum Temperature 200°C
- Half Stroke (0.187 in.)

Mark 8 DWD

- 7-Pin Amphenol Connector
- Maximum Temperature 175°C
- Half Stroke (0.187 in.)

How to Identify Pulsers

- **Mark 6 DWD**
  - 7-pin amphenol connector
  - Lower filling screw NOT marked 8
  - Poppet extends 9.5 mm (0.374 in.)
- **Mark 7 Solar**
  - Rotational connector
  - Lower filling screw NOT marked 8
  - Poppet extends 9.5 mm (0.374 in.)

How to Identify Pulsers

How to Identify Pulsers

- **Mark 8 Solar**
  - Rotational connector
  - Lower filling screw MAY BE marked 8
  - Poppet extends 4.8 mm (0.187 in.)
- **Mark 8 DWD**
  - 7-pin amphenol connector
  - Lower filling screw MAY BE marked 8
  - Poppet extends 4.8 mm (0.187 in.)

Testing the Pulser

- Two tests
  - Resistance
    - Tests electrical resistance of the generator coils and control valve solenoid
  - Extension/retraction
    - Tests hydraulic system

Pulser Test Equipment

- **DWD Electronic Test Kit**
  - **MWD Pulser Test Set and Leads**
  - **Digital Multi-meter**
  - **Coil Cord Pulser to MEP**
  - **Pulser Ground Lead**
  - **BNC Female/Banana Connector (2)**
  - **BNC Cable (36 inch)**
  - **Poppet Retraction Tool**

Additional Test Equipment for Solar Pulsers

- Solar 175 Test Cable Amphenol/9-pin
- 4-pin Male Rotational Test Connector

MWD Pulser Test Set

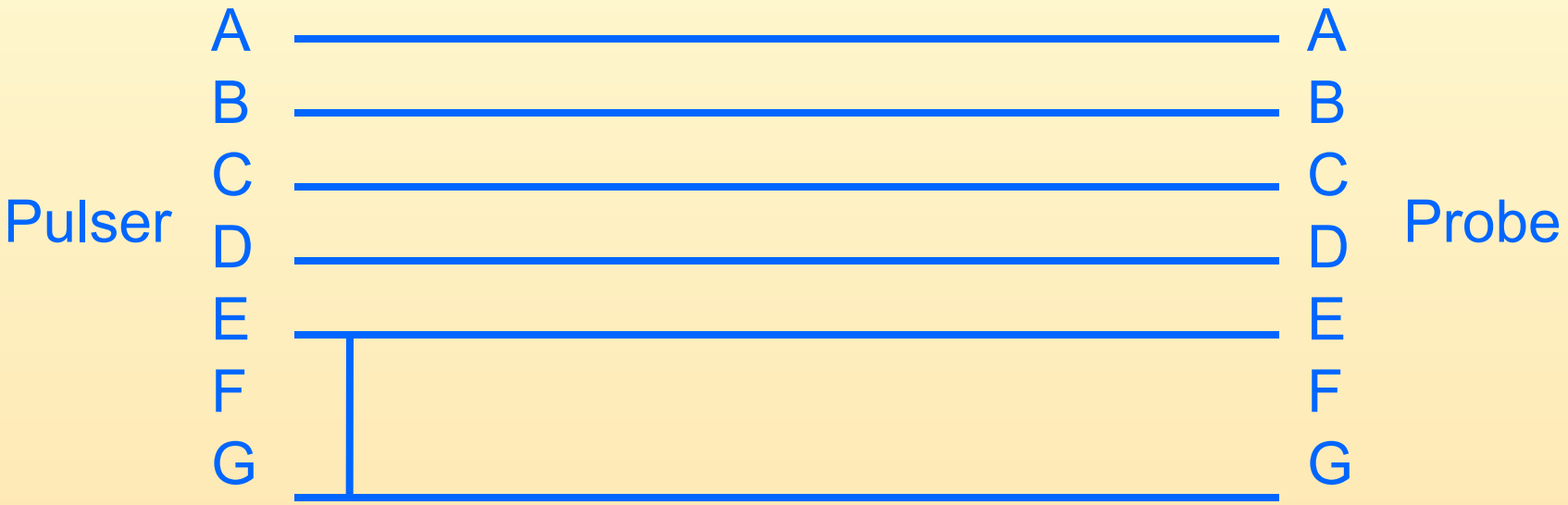
Digital Multi-meter

Coil Cord

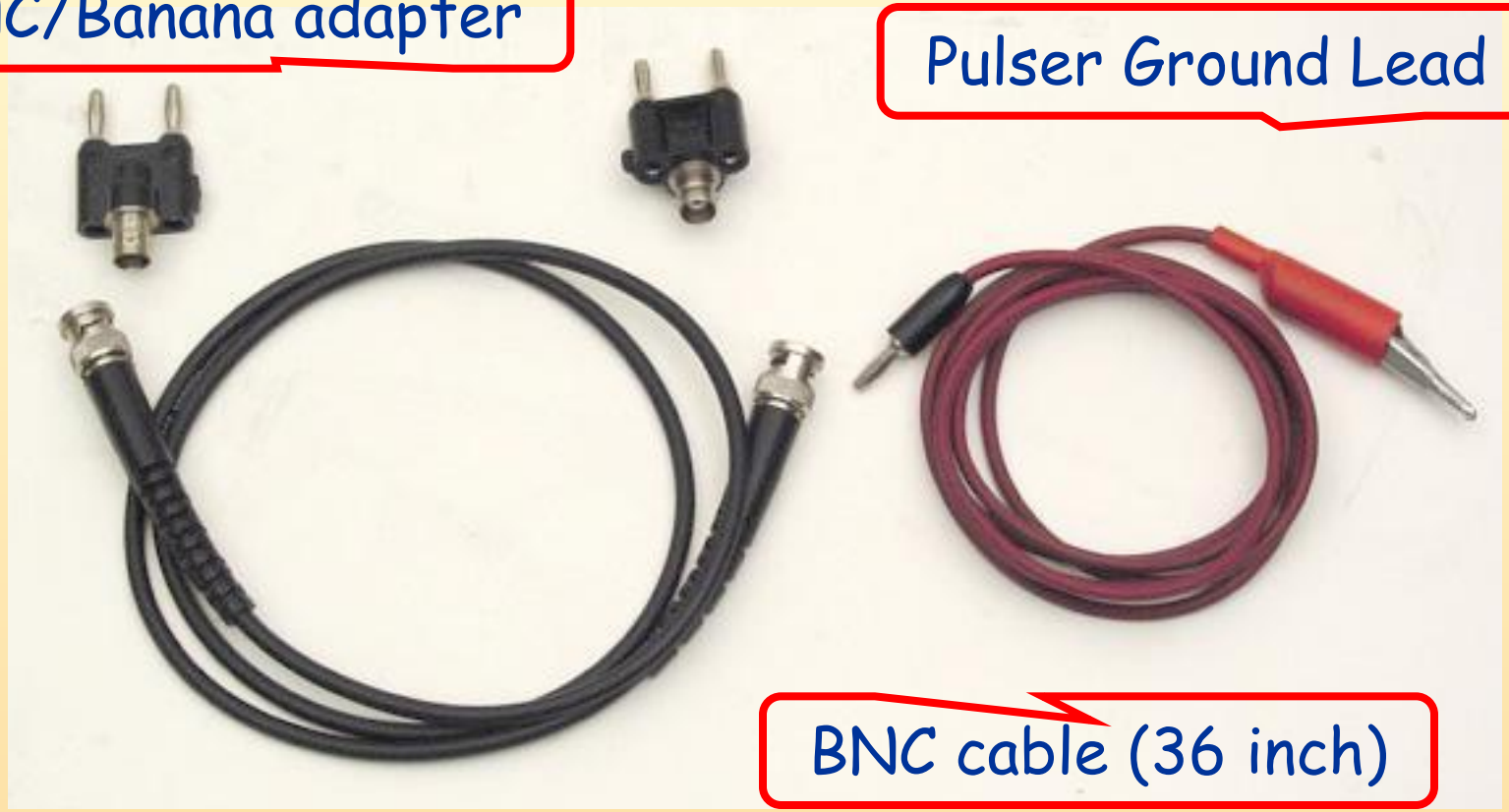
7-Pin Female Amphenol Connector

7-Pin Female Amphenol Connector

Coil Cord



Pulser Resistance Test Equipment



Pulser Extension Test Equipment

Poppet retraction Tool

Pulser Resistance Test Equipment

Solar 175 Test Cable
Amphenol/7-pin

4-pin Male Rotational
Test Connector

Pulser Resistance Test Purpose

- Tests the pulser generator coils for shorts and open circuits
- Tests the pulser control valve solenoid for shorts and open circuits

Pulser Resistance Test Procedure

- Set the 9v switch on the MWD Pulser Test Set to off
- Set the meter to measure resistance and ensure that the scale selected is appropriate for the resistance expected.

Pulser Case Lead Continuity

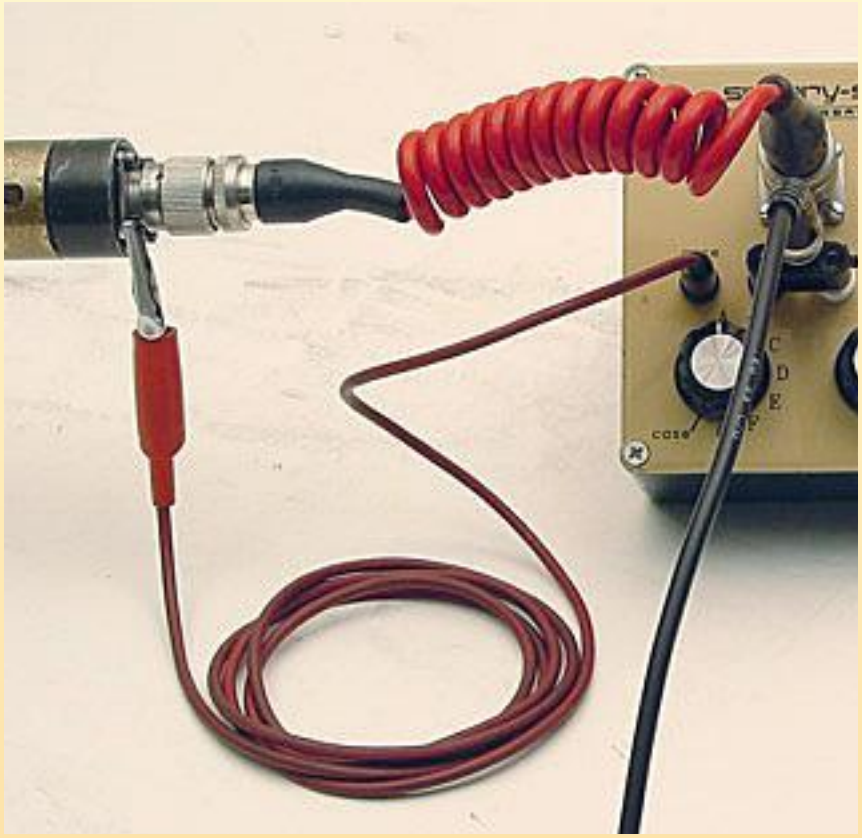
- Measure the pulser case lead resistance
- A reading of 0-1 ohms indicates continuity.

Pulser Resistance Test Procedure

Connect the meter to the ohms out ports on the test set using the BNC cable and adapters.

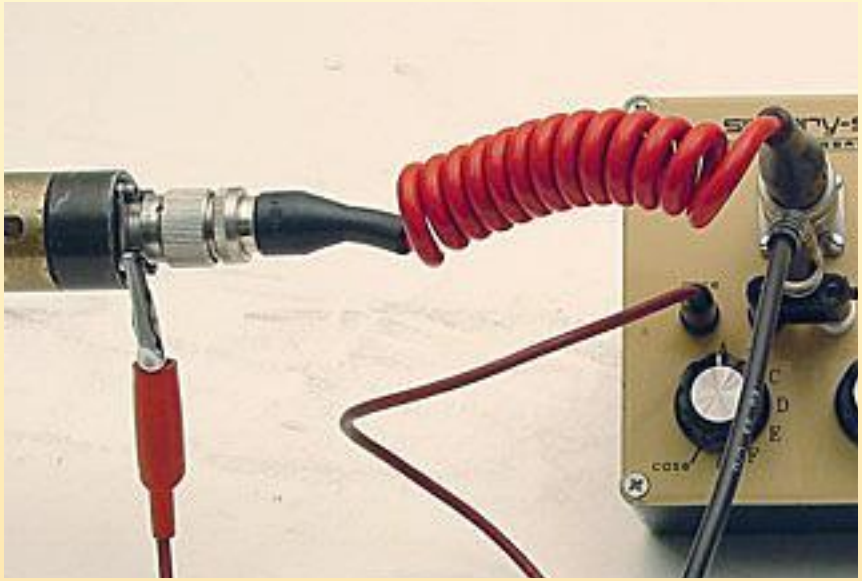
Pulser Resistance Test Procedure

Connect the pulser case lead to the case port on the test set and to the pulser with the alligator clip.



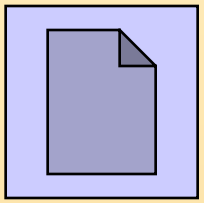
Pulser Resistance Test Procedure

Connect the coil cord from the pulser to the pulser port on the test set.



Pulser Resistance Test Procedure

- Check resistance readings by rotating switches S1 and S2 through all positions shown on the Pulser Test Form.



DWD Pulser Resistances

		Switch S2						
		A	B	C	D	E	F	G
Switch S 1	A	0-1	340-608	>100k	>100k	>100k	Inf	>100k
	B		0-1	>100k	>100k	>100k	Inf	>100k
	C			0-1	9-11k	9-11k	Inf	9-11k
	D				0-1	0-1	Inf	0-1
	E					0-1	Inf	0-1
	F						0-1	Inf
	G							0-1
	Case			>100k	>100k	>100k	Inf	>100k

A = Solenoid, B = Ground, C = Generator A, D = Generator B,
E = Generator C, F = Not used, G = Jumped to E in coil cord

Solar Pulser Resistances

		Switch S2				
		A	B	C	D	E
Switch S1	A	0-1	340-608	Inf	Inf	Inf
	B		0-1	Inf	Inf	Inf
	C			0-1	15-26	15-26
	D				0-1	15-26
	E					0-1

A = Solenoid, B = Ground, C = Generator A,
D = Generator B, E = Generator C

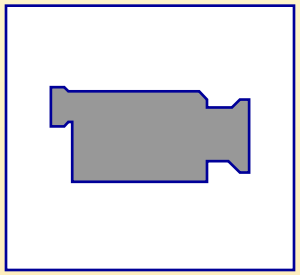
Pulser Resistance Test Procedure

Pulser Resistance Test Procedure

- If any readings are out of specification, check the coil cord and the pulser test set and isolate the defective part.
- Then complete a Failure Report.

Pulser Resistance Test Procedure

What was all that about?



Pulser Extension/Retraction Test Purpose

- Basic test of the hydraulic system
- Tests the seals on the main valve, control valve, the pump rams' seals, and the piston seal
- Tests function of both the main and control valves

Pulser Extension/Retraction Test Procedure

- Clean the pulser; pay particular attention to the three threaded location holes on the pump housing.

Pulser Extension/Retraction Test Procedure

Install an impeller assembly over the intermediate case.

Pulser Extension/Retraction Test Procedure

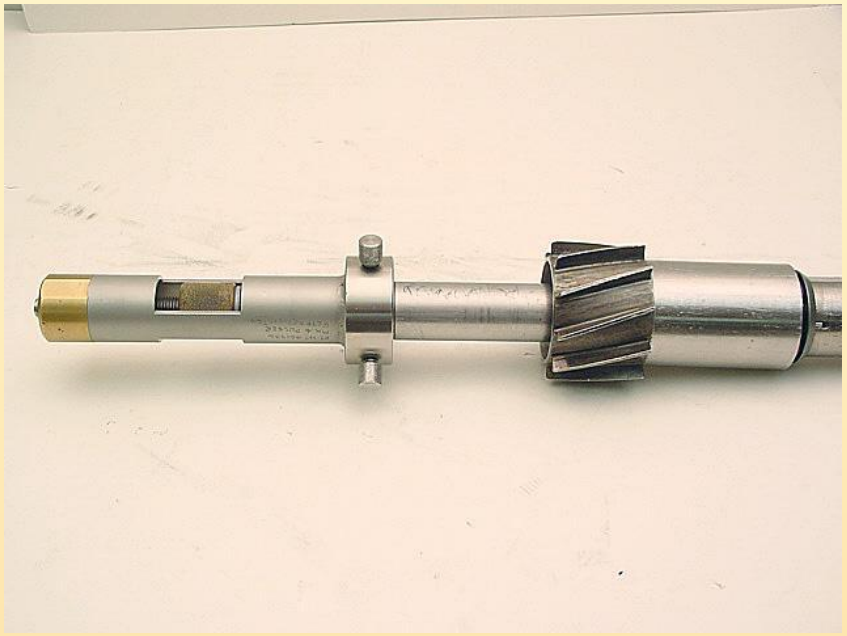
Prepare the poppet retraction tool by screwing the adjuster nut fully onto the shaft

Pulser Extension/Retraction Test Procedure

Slide the retraction tool over the poppet end of the pulser.

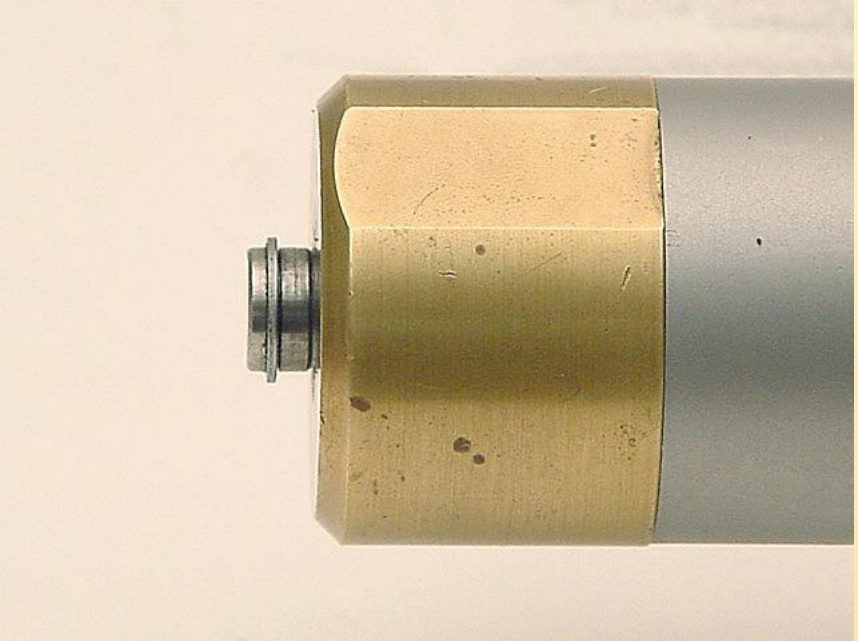
Pulser Extension/Retraction Test Procedure

Insert the locating screws into the threaded holes on the pulser and hand tighten.



Pulser Extension/Retraction Test Procedure

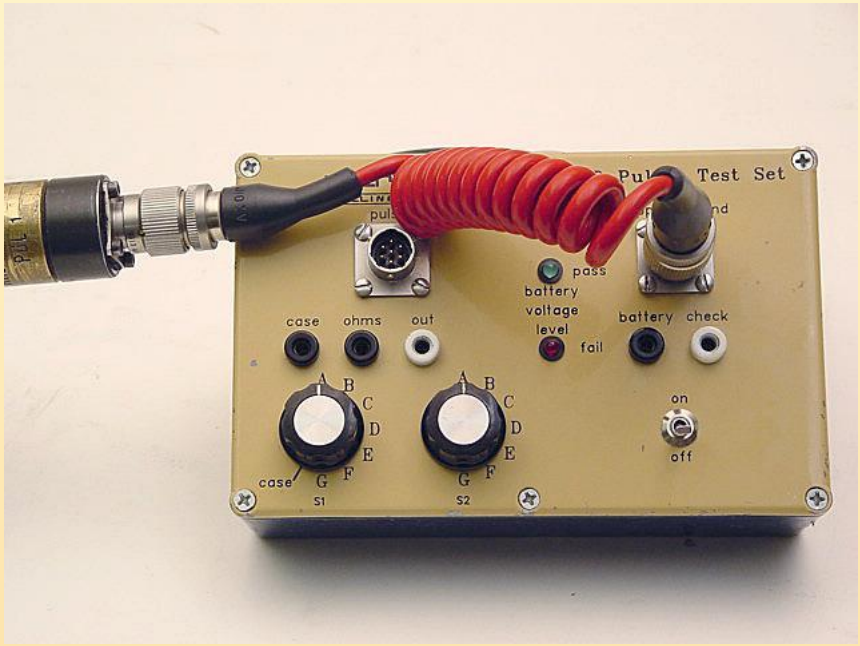
Screw the adjuster nut against the poppet shaft until the first groove on the retraction tool's shaft is aligned with the face of the locking ring.



Pulser Extension/Retraction Test Procedure

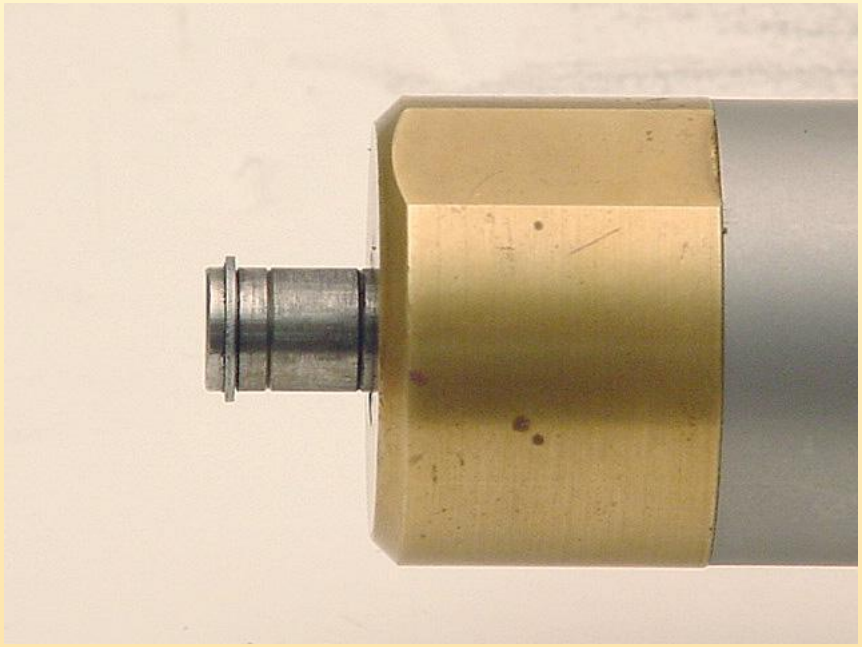
Connect the pulser to the poppet extend socket on the MWD Pulser Test Set using the coil cord

Turn on the 9v switch.



Pulser Extension/Retraction Test Procedure

Rotate the impeller assembly. The retraction tool's shaft should extend to reveal the second groove on the shaft.

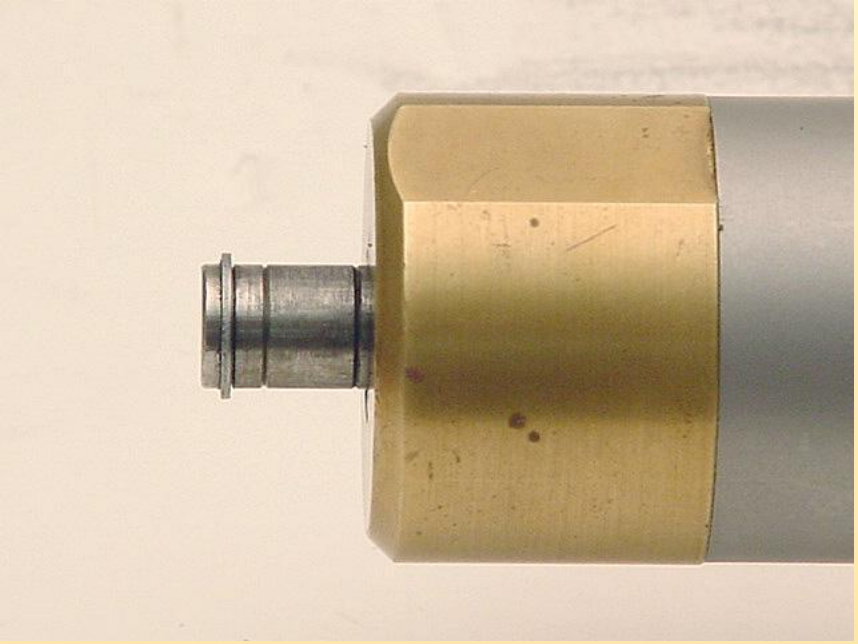


Pulser Extension/Retraction Test Procedure

- Monitor the extension; the retraction tool's shaft must remain extended for 2 minutes without bleeding off and retracting all the way to the first groove.

Pulser Extension/Retraction Test Procedure

Rotate the impeller assembly until the retraction tool's shaft again extends to reveal the second groove on the shaft.



Pulser Extension/Retraction Test Procedure

- Turn off the 9v switch.

Pulser Extension/Retraction Test Procedure

- Monitor retraction
  - For a Booted Pulser
    - The retraction tool's shaft should retract to the first groove in less than 2 seconds.
  - For a Bootless Pulser
    - The retraction tool's shaft should retract to the first groove in about 8 seconds.

Pulser Extension/Retraction Test Procedure

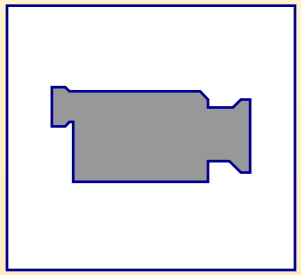
- Record the results on the Pulser Test Sheet.

Pulser Extension/Retraction Test Procedure

- Should the pulser fail to meet the above procedure, return pulser for R&M, stating “Retraction Fault”.

Pulser Extension/Retraction Test Procedure

What was all that about?



Testing an MWD Pulser Test Set

- Test S1 and S2 Switches
- Test Ohms Out and Case Ports
- Test Pulser Connector
- Test Poppet Extend Connector
- Test Internal Batteries

Test S1 and S2 Switches

Set the volt/ohm meter to ohms

Connect the test leads to the black and white ohms out ports.

A to A

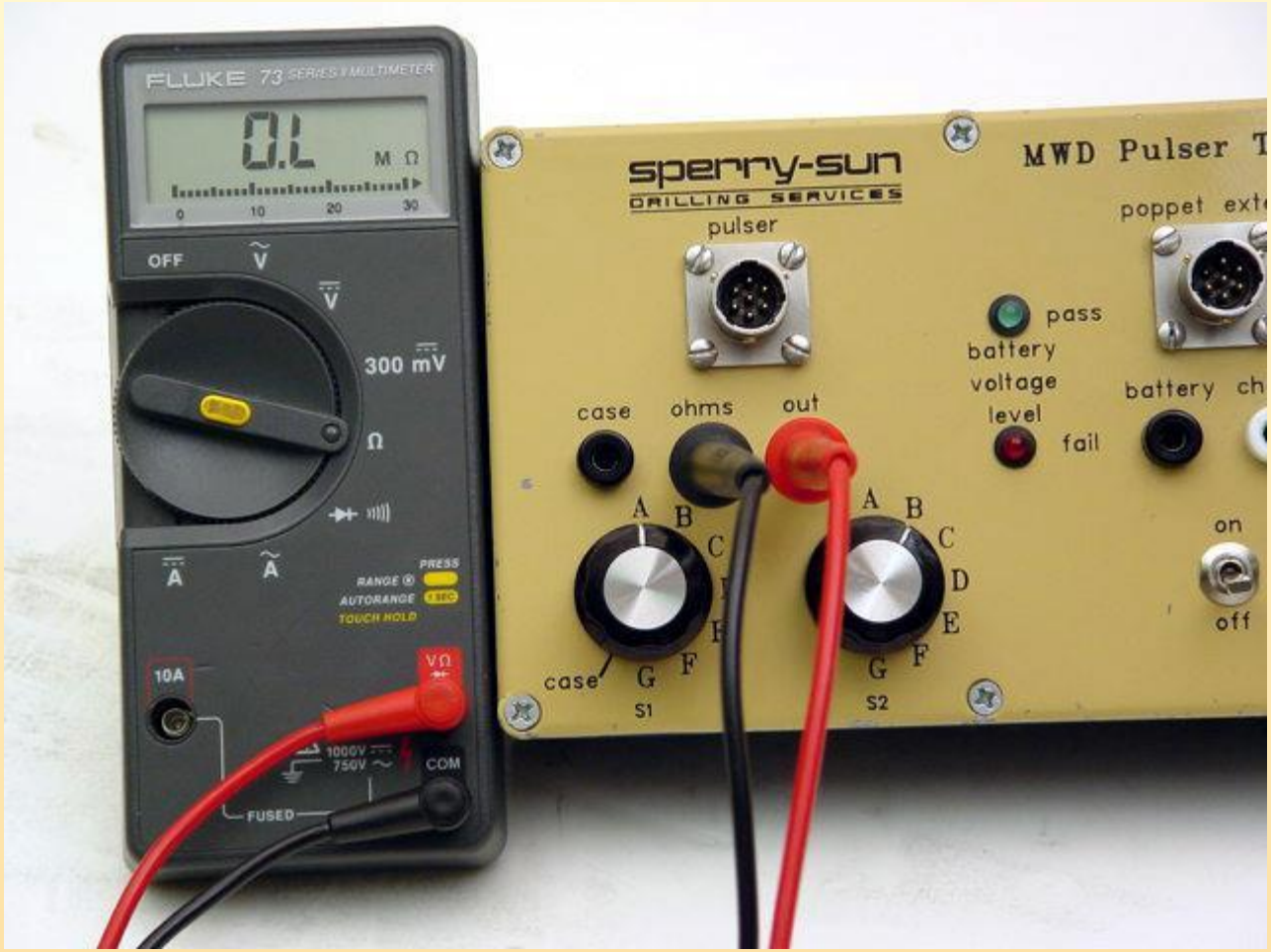
Test S1 and S2 Switches

- Check resistance readings by rotating switches S1 and S2 through all positions on Table 1

Test S1 and S2 Switches Table 1

		Switch S2						
		A	B	C	D	E	F	G
Switch S1	A	0-1	Inf	Inf	Inf	Inf	Inf	Inf
	B		0-1	Inf	Inf	Inf	Inf	Inf
	C			0-1	Inf	Inf	Inf	Inf
	D				0-1	Inf	Inf	Inf
	E					0-1	Inf	Inf
	F						0-1	Inf
	G							0-1

Test S1 and S2 Switches



A to B

Test S1 and S2 Switches

Test Ohms Out & Case Ports

Connect the test leads to the white ohms out port and the black case port.

Test Ohms Out & Case Ports

Rotate switch S2 through positions A to G.

All positions should read infinity.

S2 G

Test Ohms Out & Case Ports

Connect the test leads to the black ohms out port and the black case port.

Test Ohms Out & Case Ports

Rotate switch S1 through positions A to G.

All positions should read infinity.

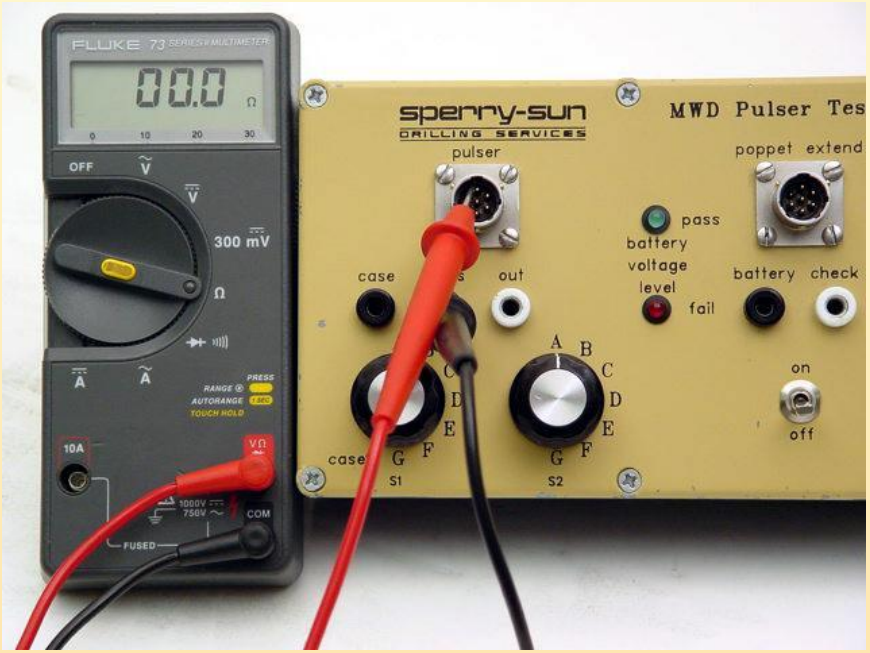
Test Ohms Out & Case Ports

- Move switch S1 to the case position.
- The meter should read 0-1 ohms.

S1 Case

Test Pulser Connector

- Connect the test leads to the black ohms out port and pin A inside the pulser connector on the test set.



Pin A
S1 A

Test Pulser Connector

Rotate switch S1 through positions A to case. The meter should read infinity in all positions except A, which should read 0-1 ohms.

Pin A
S1 Case

Test Pulser Connector

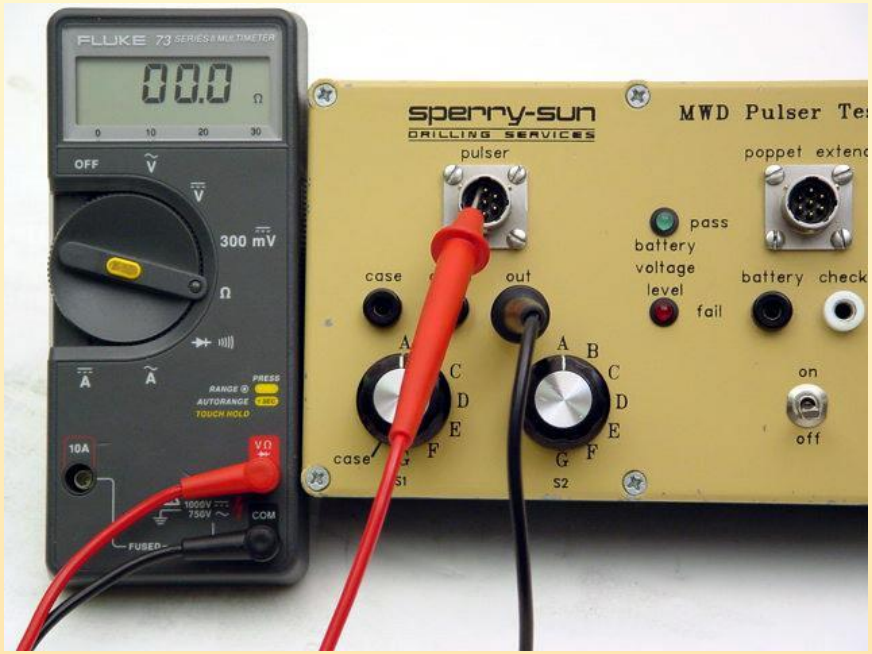
- Repeat this for pins B through G on the pulser connector for all positions shown on Table 2

Test Pulser Connector Table 2

		Switch S1 or S2							
		A	B	C	D	E	F	G	Case
Test Set Pulser Connector	A	0-1	Inf	Inf	Inf	Inf	Inf	Inf	Inf
	B		0-1	Inf	Inf	Inf	Inf	Inf	Inf
	C			0-1	Inf	Inf	Inf	Inf	Inf
	D				0-1	Inf	Inf	Inf	Inf
	E					0-1	Inf	Inf	Inf
	F						0-1	Inf	Inf
	G							0-1	Inf

Test Pulser Connector

- Connect the test leads to the white ohms out port and pin A inside the pulser connector.



Pin A
S2 A

Test Pulser Connector

- Rotate switch S2 through positions A to G. The meter should read infinity in all positions except A, which should read 0-1 ohms.

Pin A
S2 G

Test Pulser Connector

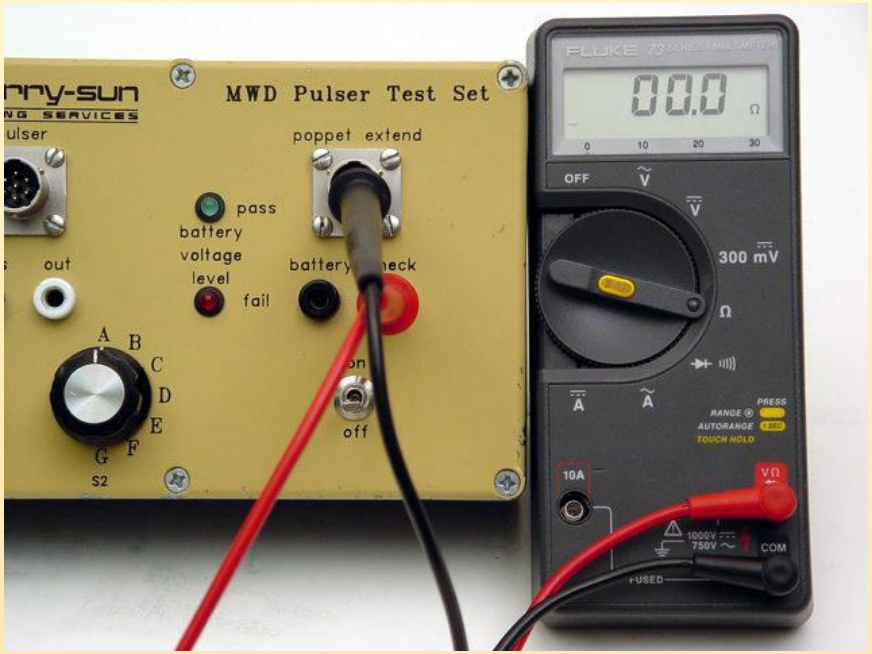
- Repeat this for pins B through G on the pulser connector for all positions shown on on Table 2

Test Poppet Extend Connector

- Ensure that the 9v switch is off.

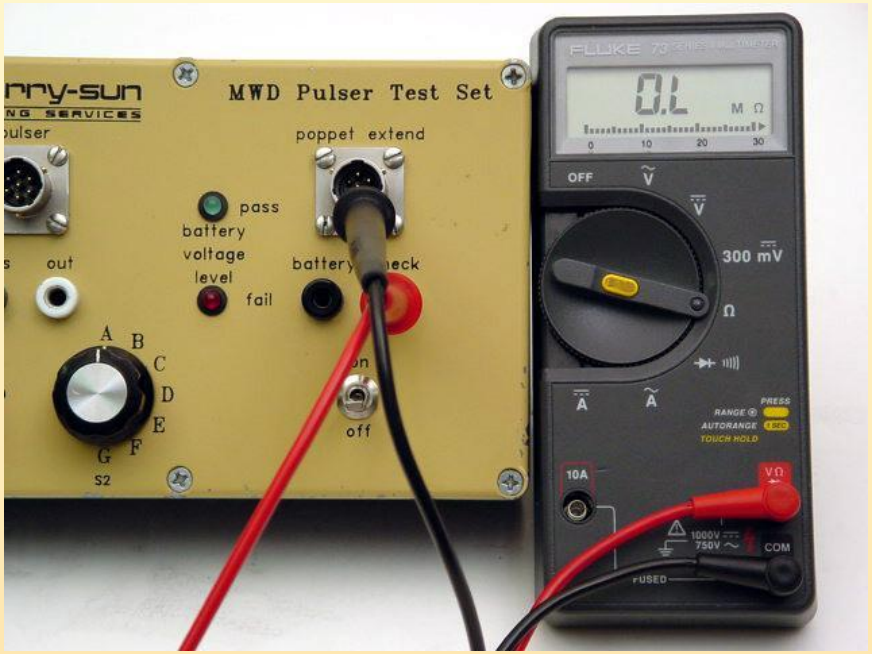
Test Poppet Extend Connector

- Place one test lead in the white battery check port and touch the other lead to each pin inside the poppet extend connector.



Test Poppet Extend Connector

- Each pin should read infinity except pin A which should read 0-1 ohms.

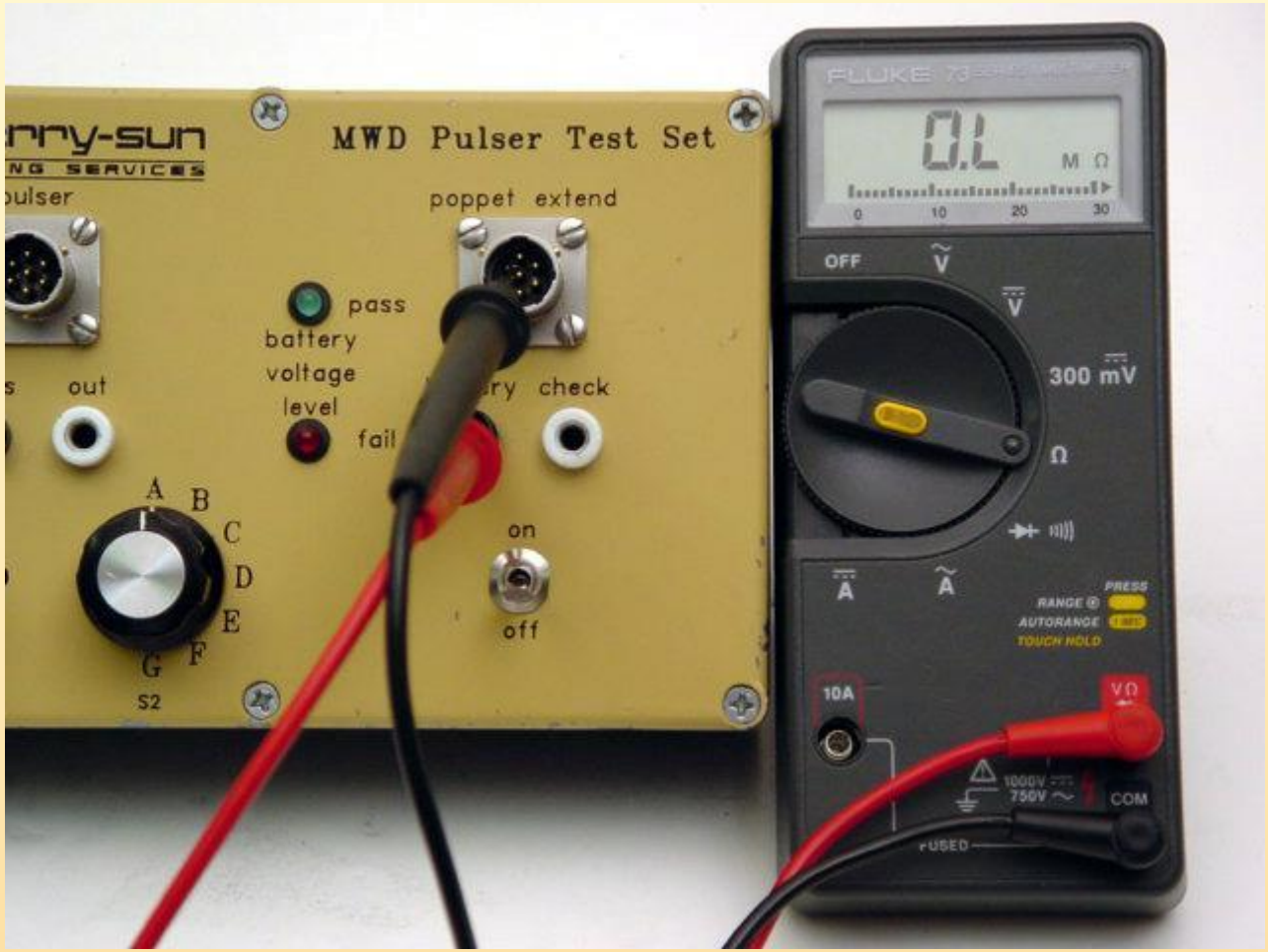


Pin B

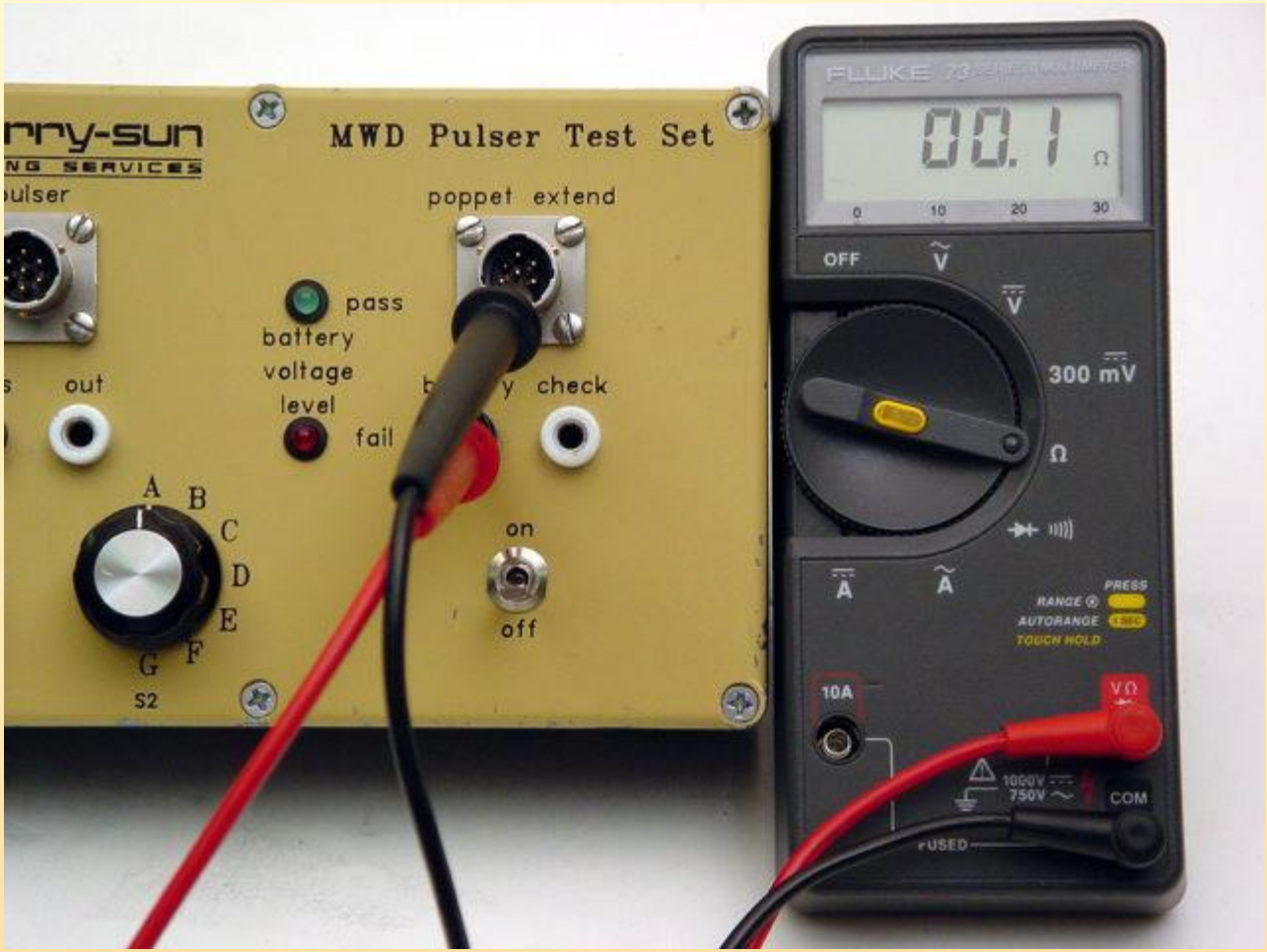
Test Poppet Extend Connector

- Remove the test lead from the white battery check port and place it in the black battery check port.
- Touch the other lead to each pin inside the poppet extend connector.

Test Poppet Extend Connector



Test Poppet Extend Connector



Test Poppet Extend Connector

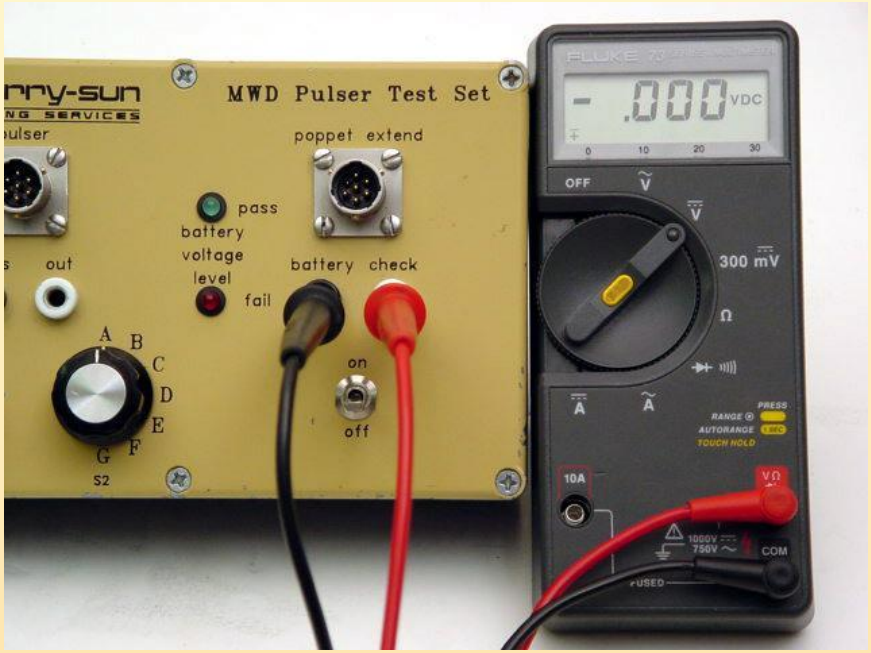
- Each pin should read infinity except pin B which should read 0-1 ohms.

Test Internal Batteries

- Set the meter to the DC voltage range to test the eight 1.5 volt AA battery cells (12 volts).

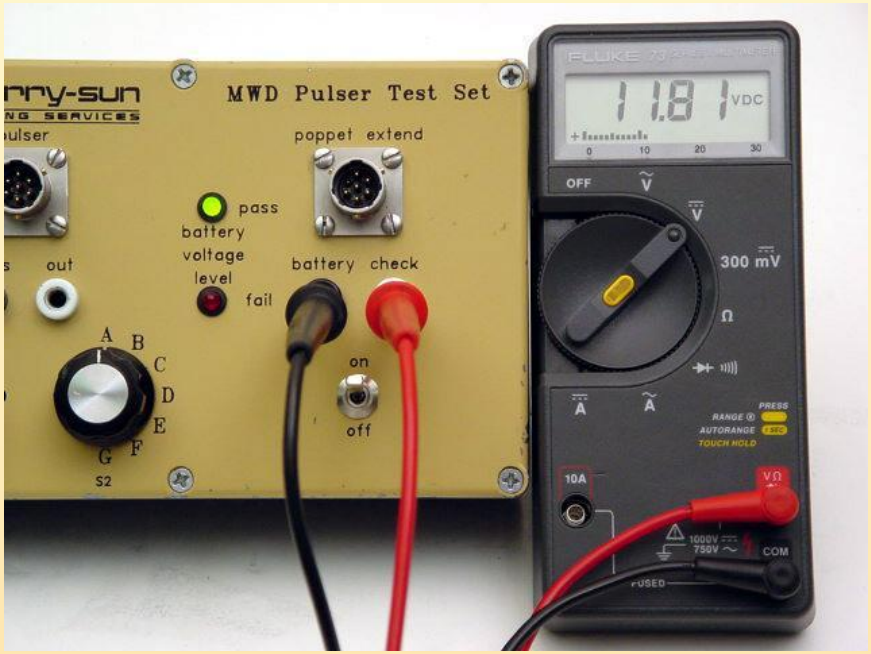
Test Internal Batteries

- Connect the test leads to the battery check ports. Black is negative, white is positive.



Test Internal Batteries

- Check the internal battery voltage by switching the 9v switch on.
- The meter should read greater than 10 volts.



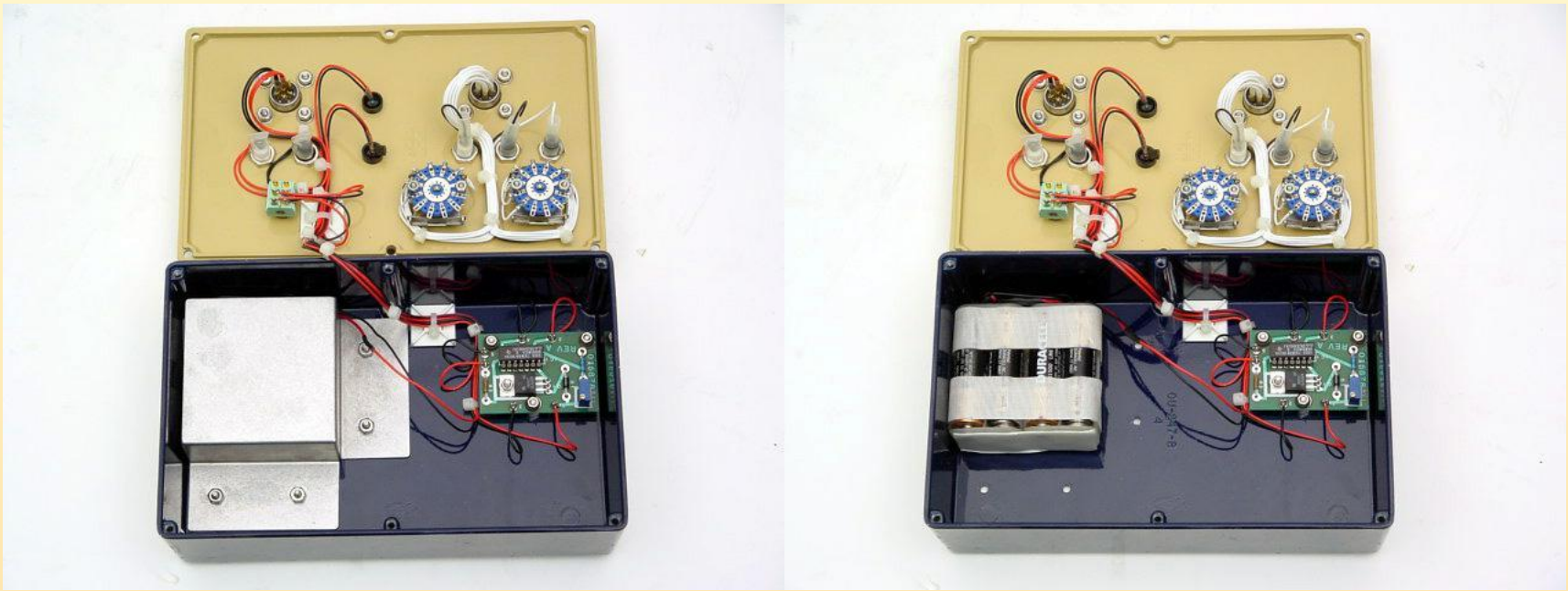
Test Internal Batteries

- Turn the 9v switch off and remove the meter leads from the battery check ports.

Replace Internal Batteries

- If the voltage is lower than 10 volts, open the test set and replace the eight 1.5 volt battery cells.

Replace Internal Batteries



8 AA 1.5V Cells