



Natural Resources  
Canada

Ressources naturelles  
Canada

# Instrumentation Risks in Explosives Testing – Unintended explosion during a time- pressure test

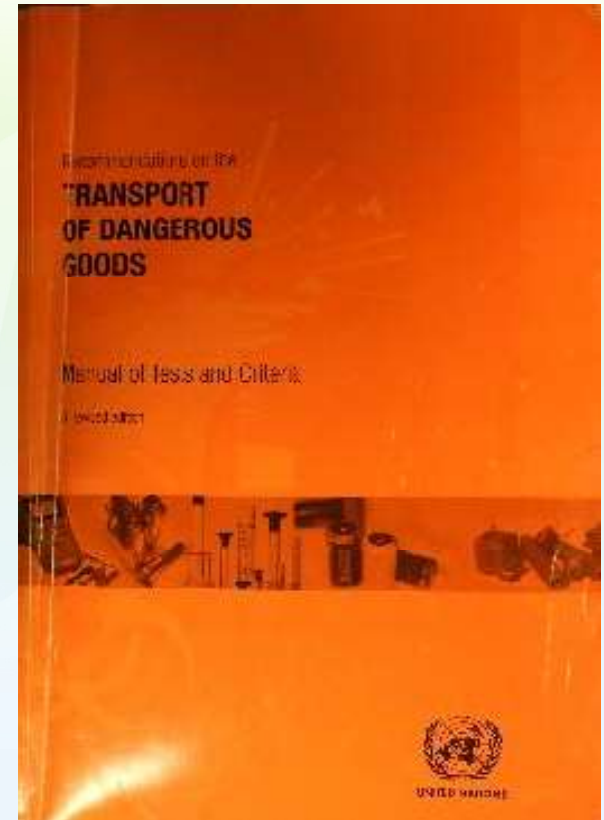
Presented at CEAEC AGM, May 2023, Niagara on the Lake ON



Canada

# The Time-pressure test

- Part of UN Tests Series 1 & 2; Measures the pressure rise time from 690 to 2070 kPa.
- Tested substance is an expl.?



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019



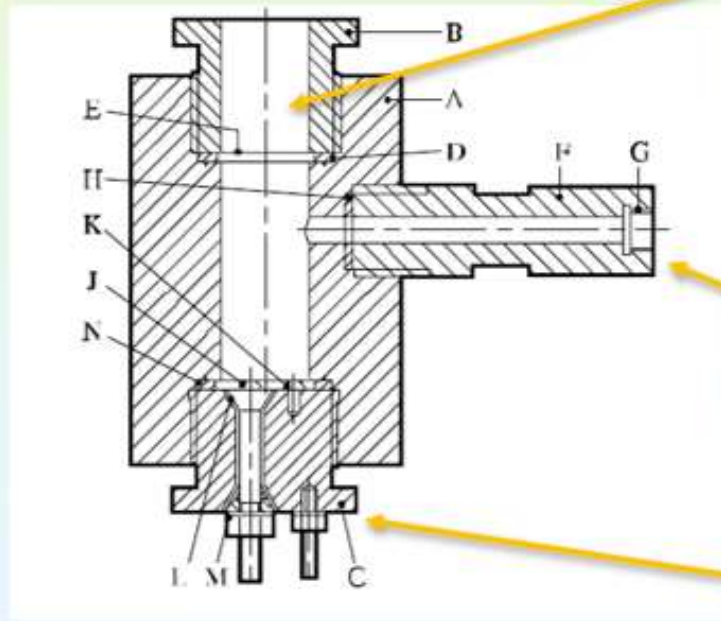
Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# The Time-pressure test

## Reference Design



Burst disc

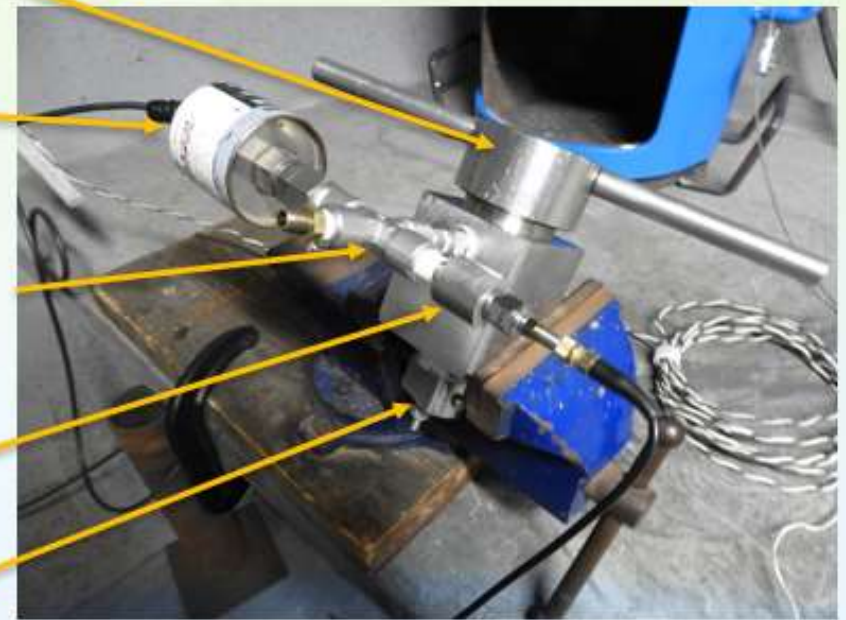
"Standard"  
transducer

Port to  
transducer(s)

"Piezo"  
transducer

Firing plug

## CERL Vessel



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada



# The Incident

- Sample being tested: 5 g of celluloid (<12.6% N content nitrocellulose and camphor).
- The sample ignited while operator was making the electrical connections for the firing system.
- A loud noise ensued.



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Injury Pyramid Theory



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019

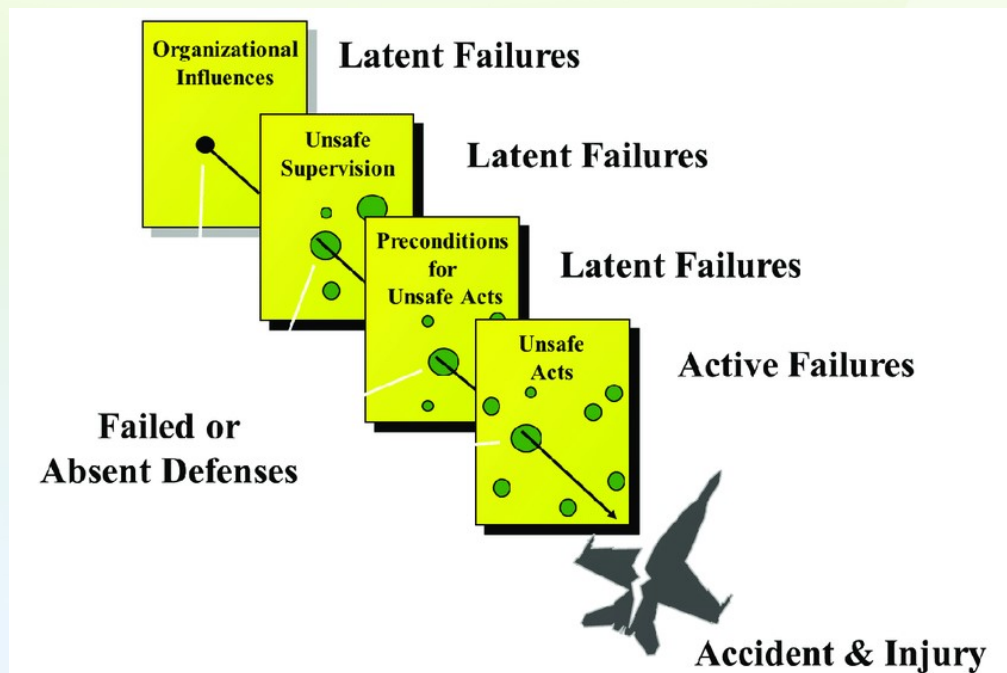


Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Cumulative Act Effect



- Preconditions for unsafe acts include fatigued air crew or improper communications practices.
- Unsafe supervision: e.g, pairing inexperienced pilots on a night flight into known adverse weather
- Organizational influences: e.g, reduction in expenditure on pilot training in times of financial austerity

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019

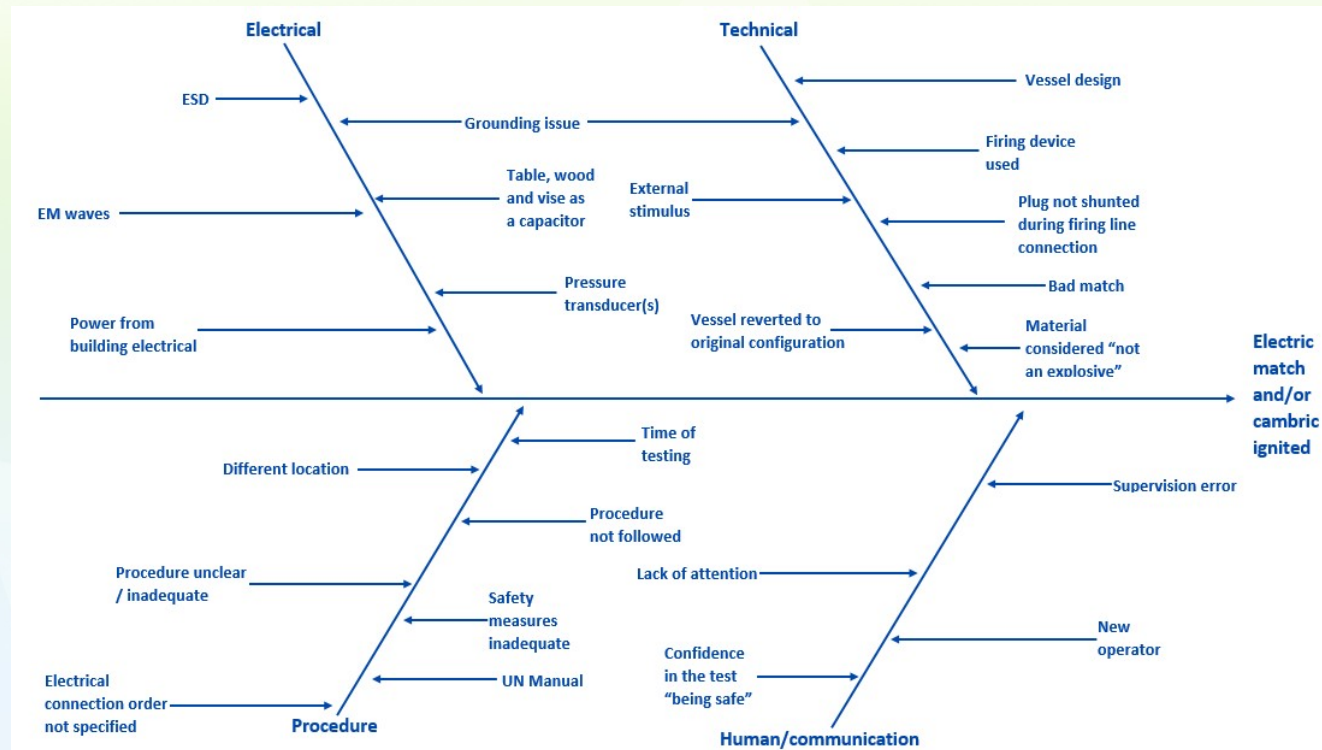


Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Brain Storming & Mapping



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019

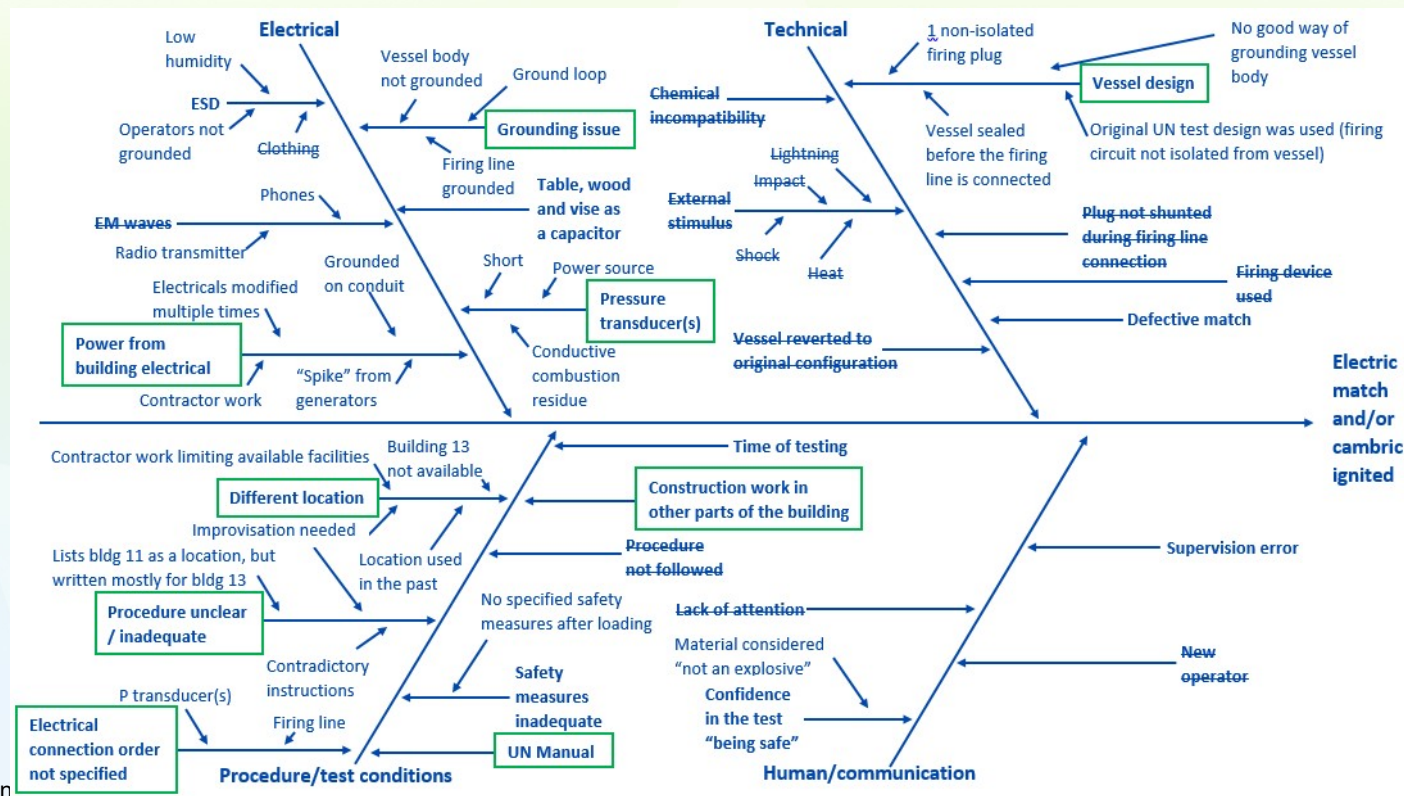


Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Brain Storming & Mapping



© Her Majesty the Queen



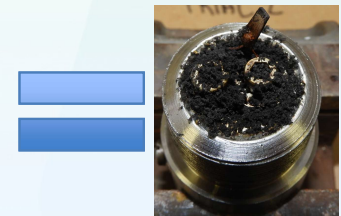
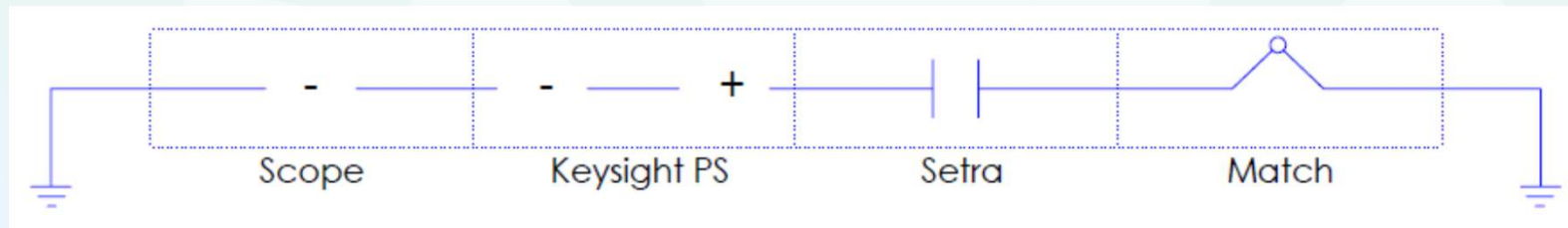
Natural Resources  
Canada

Ressources naturelles  
Canada

Canada



# The “Root” cause



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019

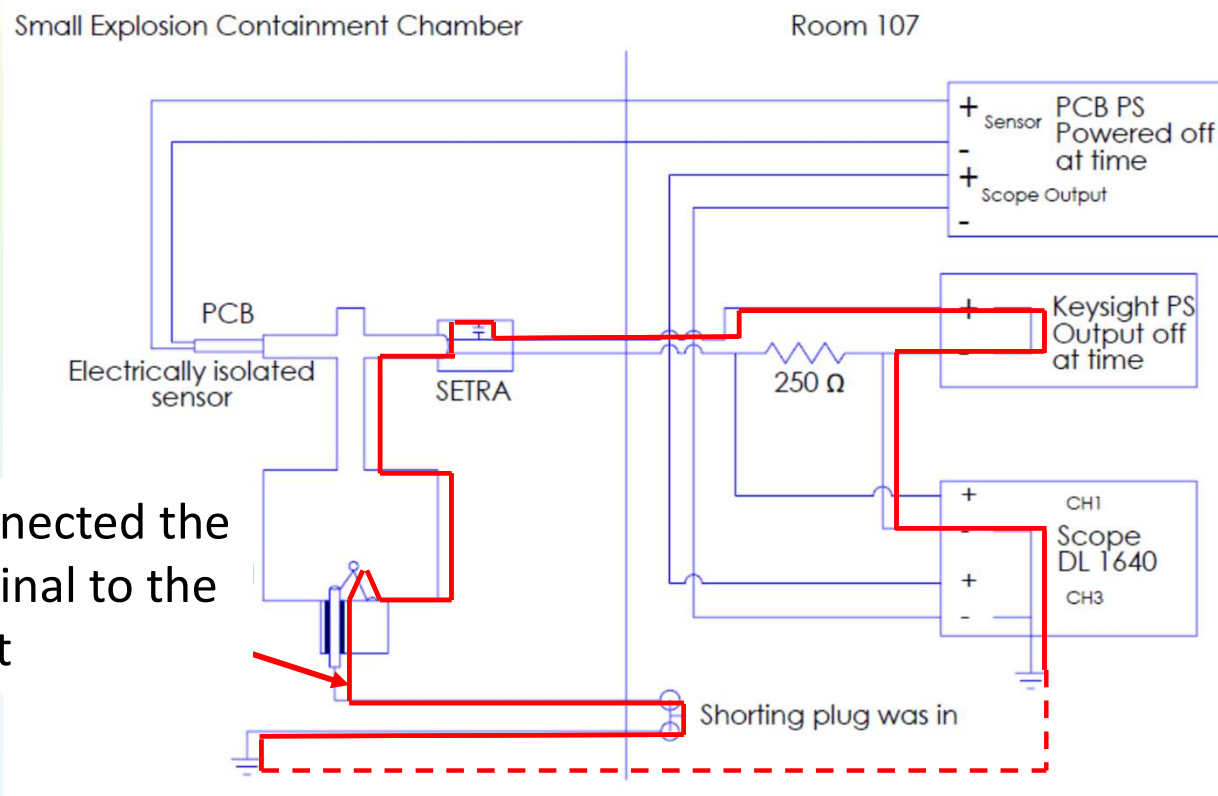


Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# The “Root” cause



Operator connected the isolated terminal to the firing line first

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019

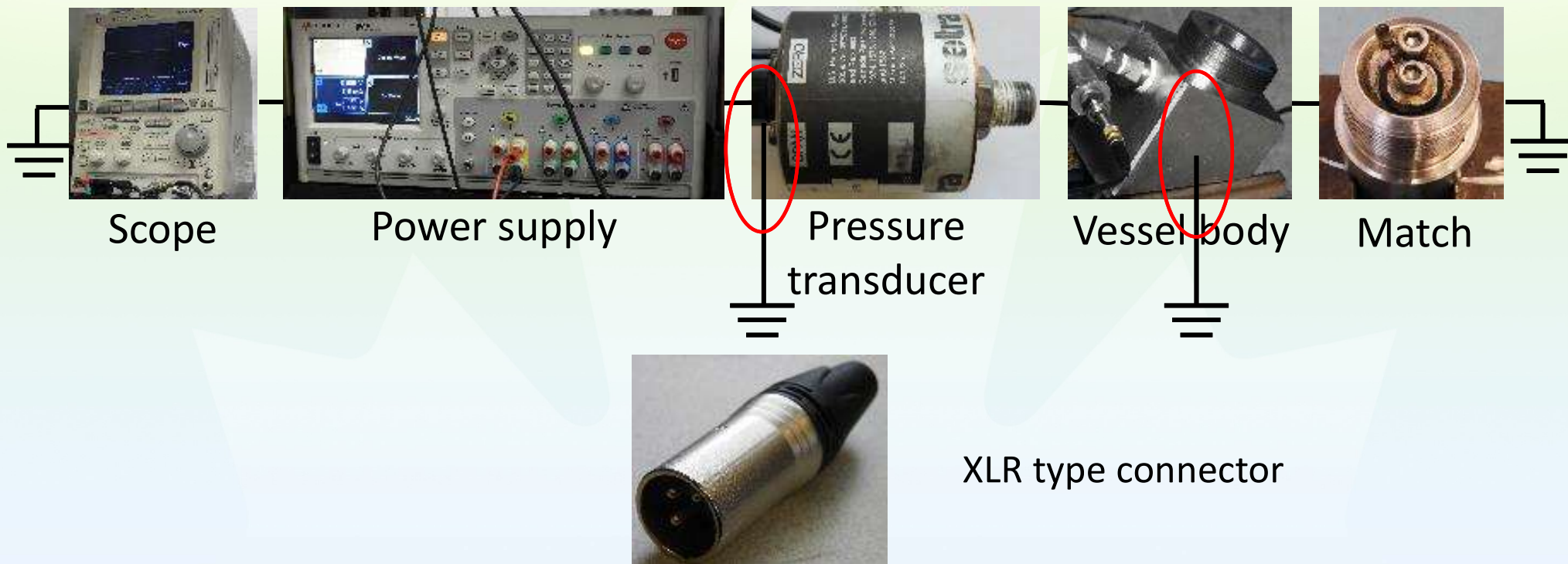


Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Findings & Recommendations



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Findings & Recommendations

- The capacitor meant for signal noise reduction in the Setra pressure transducer acted as a “battery” which caused the initiation of the electric igniter when the connection to the firing line was made.
- Instrumentation can act as an energy source in unexpected ways.
- Safety assessment of testing with Electro-explosive Devices (EED) takes into account power sent to instrumentation, but not necessarily how the electronics inside the instrumentation are designed.
- Likelihood of an event is low, but the consequences can be dire.
- Always check the instrumentation for potential energy storage.
- Always isolate firing lines?
- **Does the UN test need to be modified?**

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2019



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada