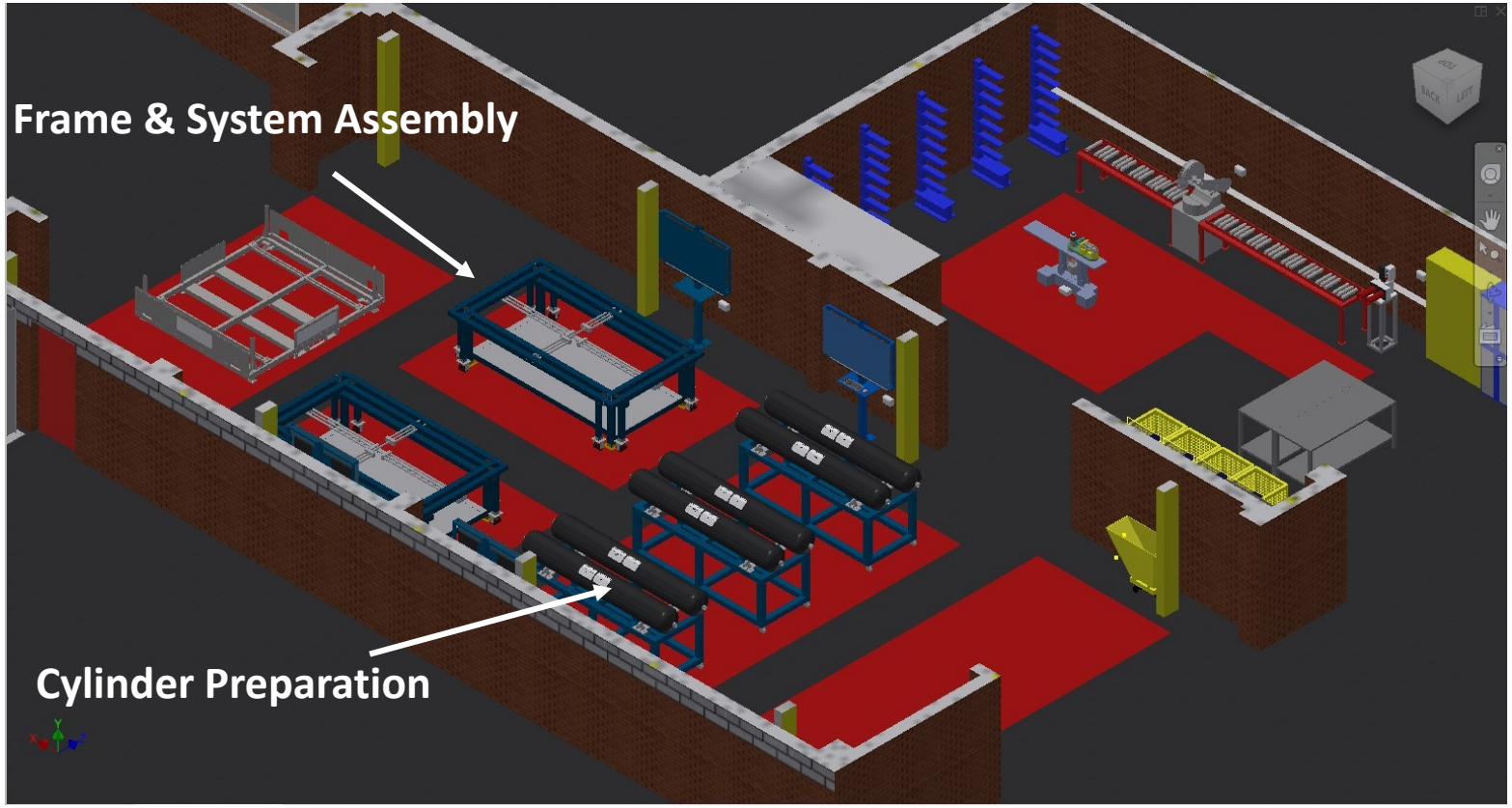
Drop Test

"The drop test is intended to account for a potential internal damage to the container during handling operations."

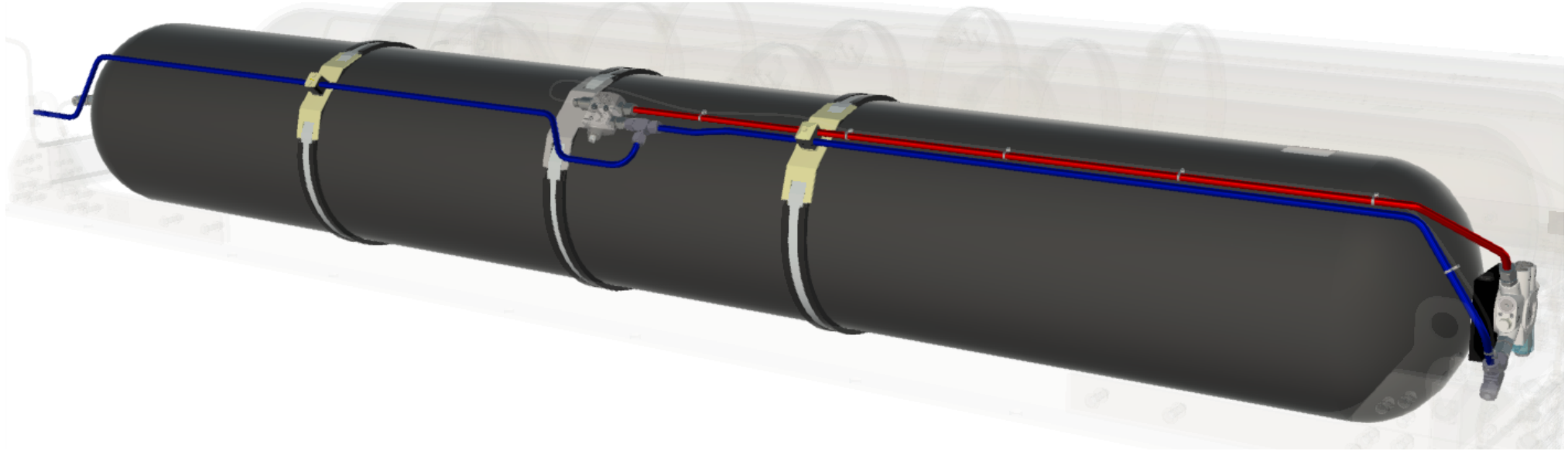


Production Facility

Alternative Fuel System Assembly

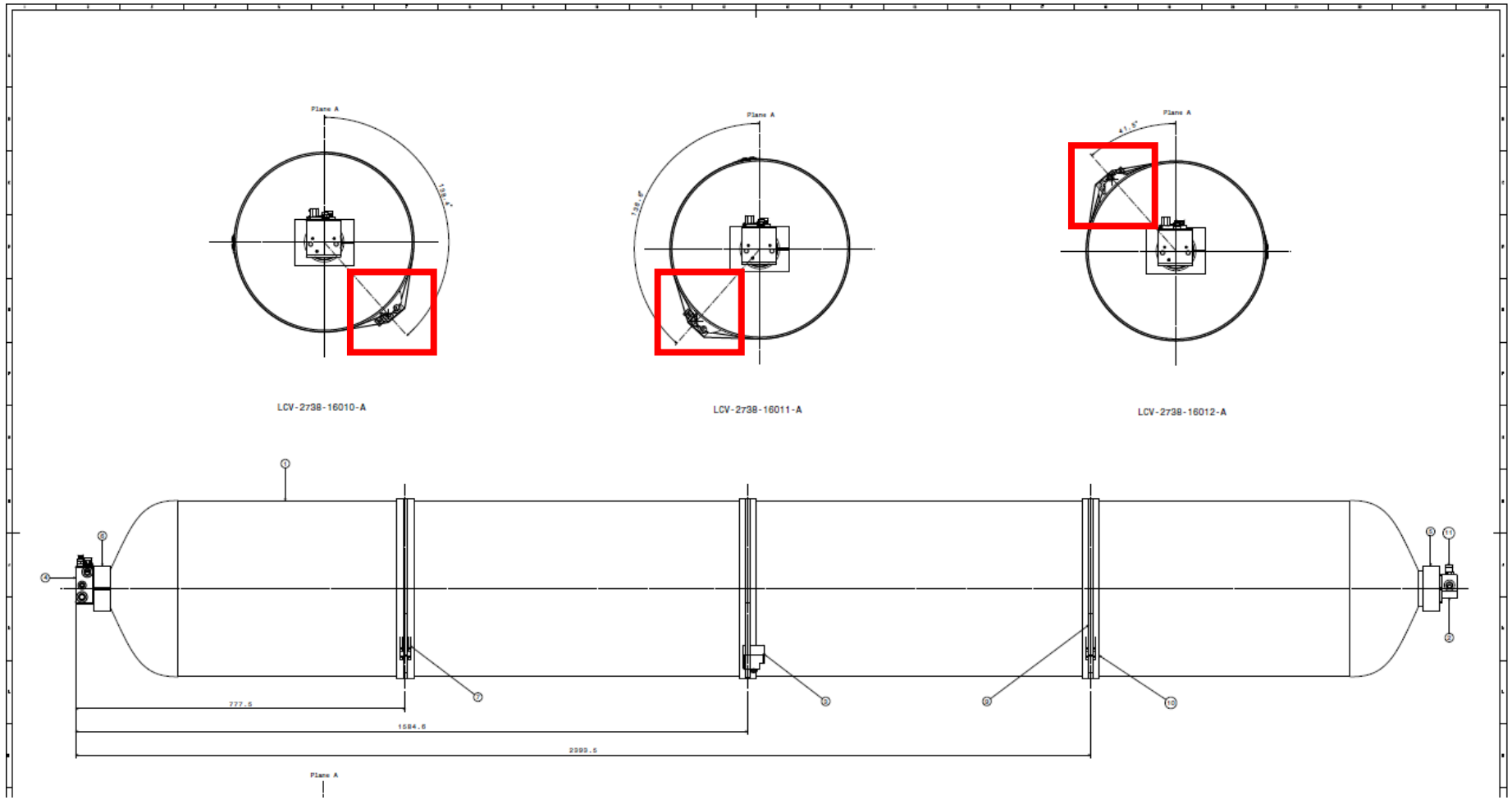
Cylinder Attachment

Cylinder Assembly – Type 3



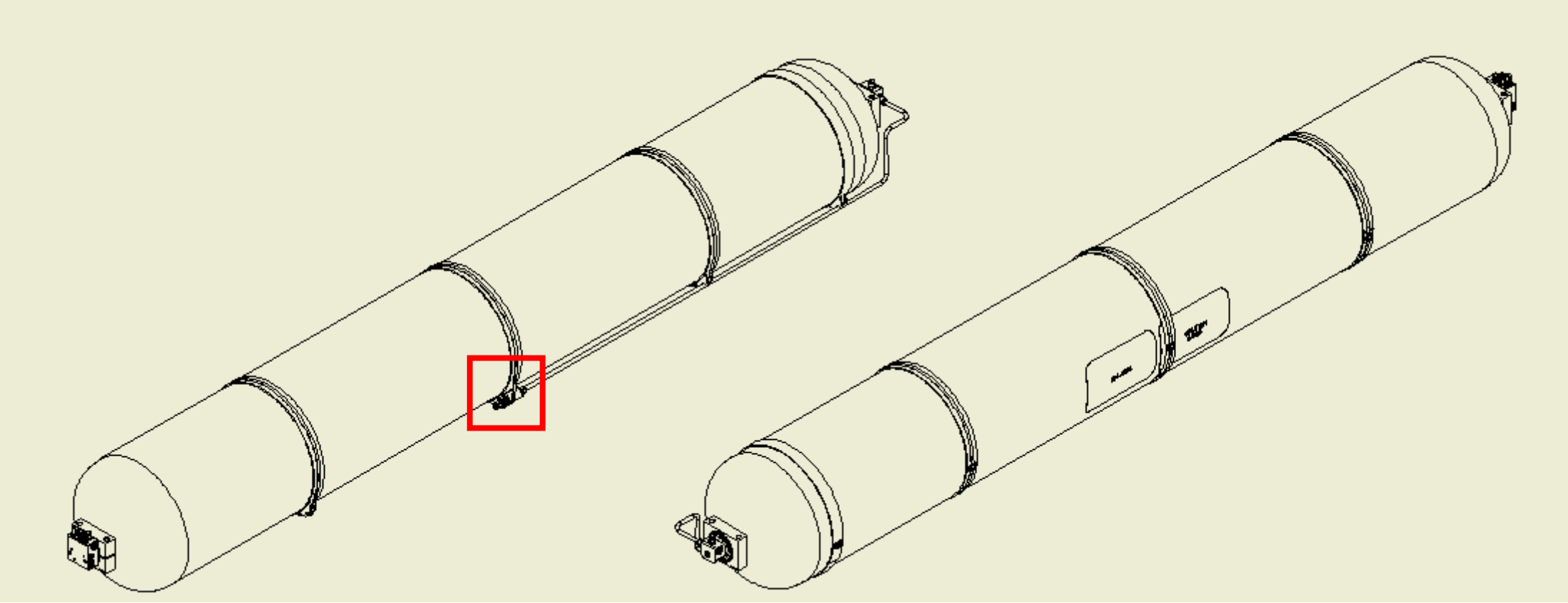
Supply and Vent lines cannot be too rigid due to cylinder expansion

Cylinder Assembly – Type 3 Alternative Design



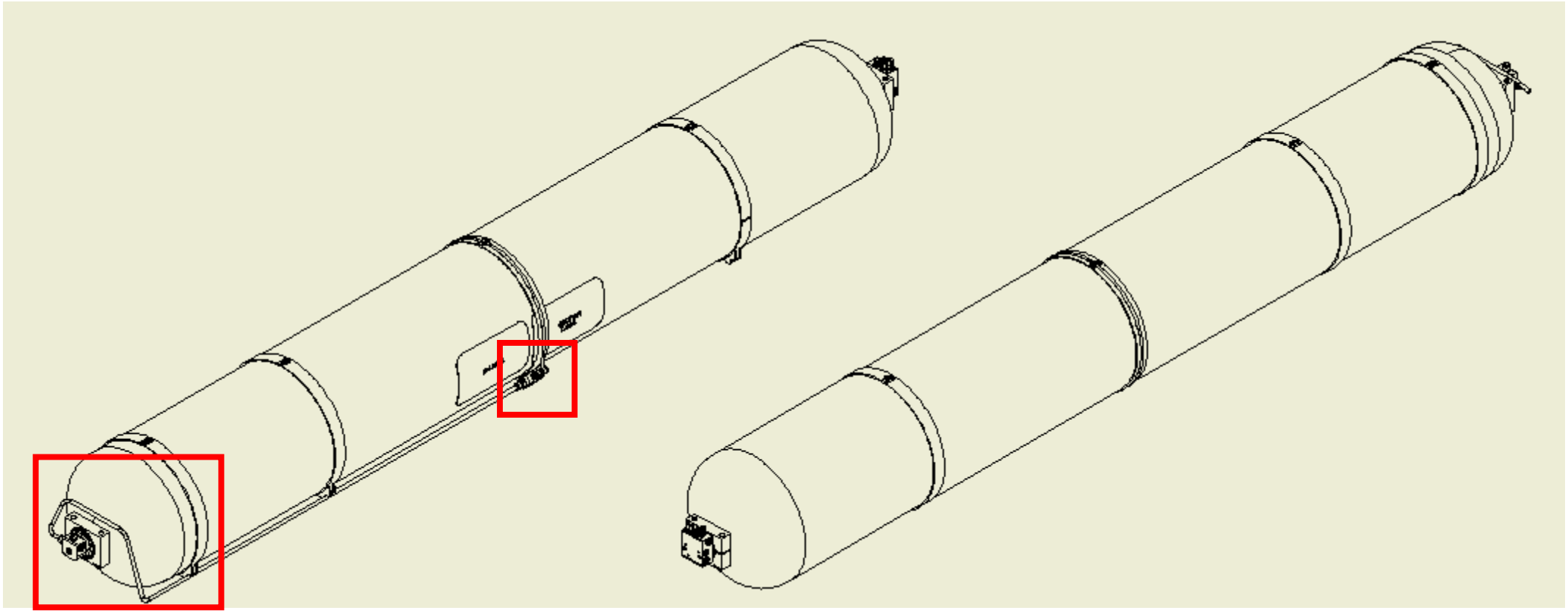
3 different orientations in same system

Cylinder Assembly – Type 3 Alternative Design



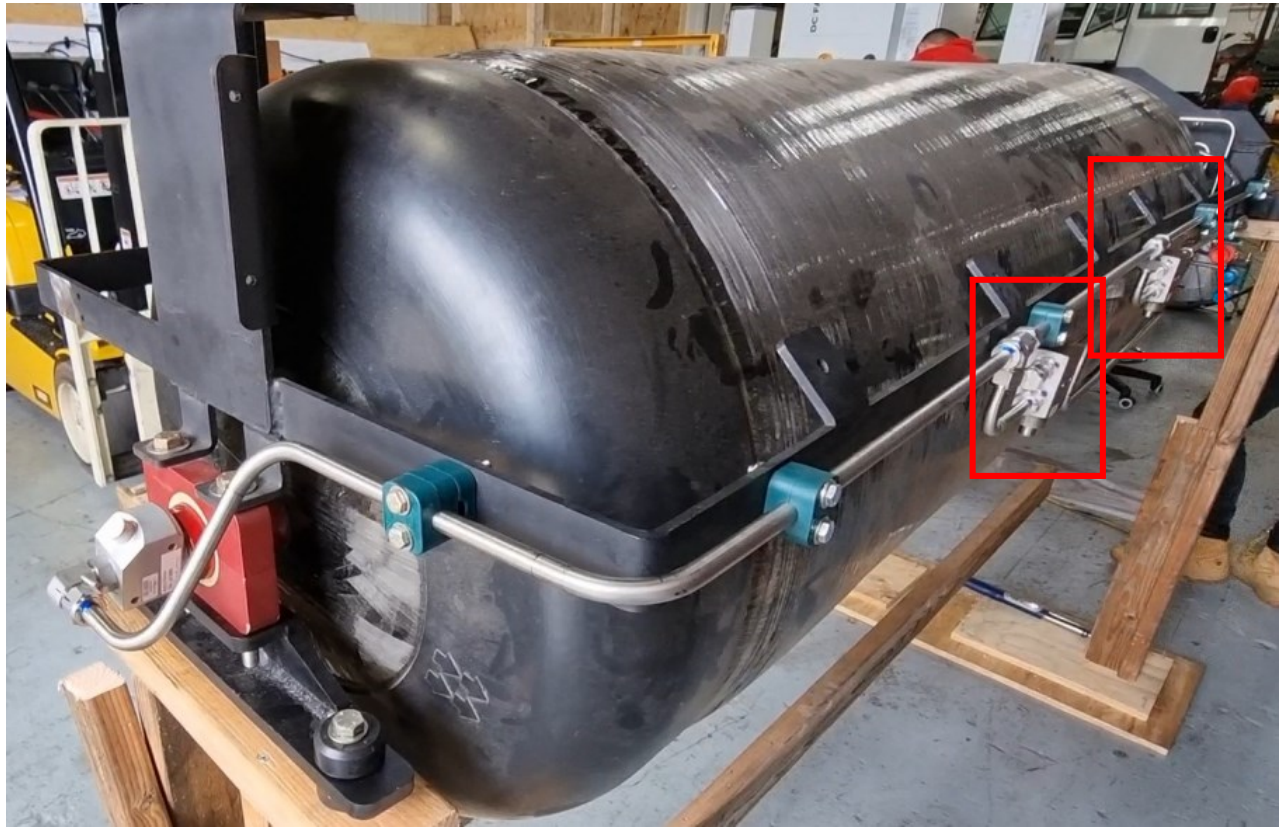
TPRD supply line from End Plug instead of Valve

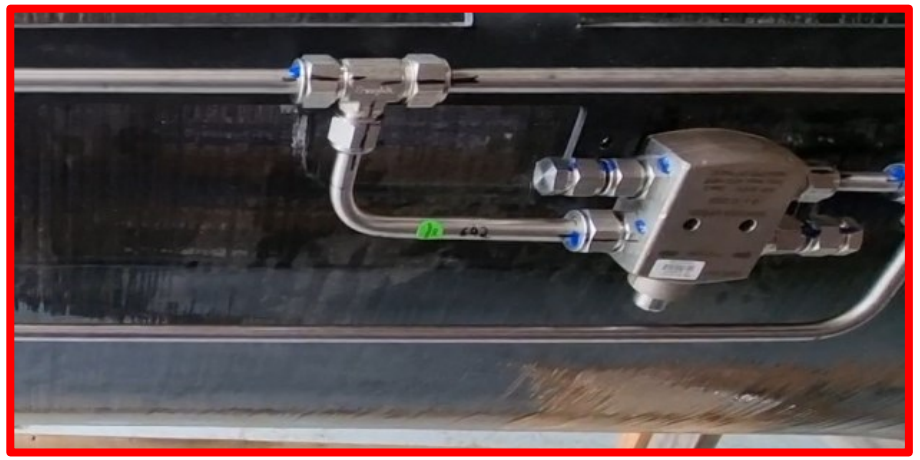
Cylinder Assembly – Type 3 Alternative Design



TPRD supply routing difficult due to space claim of system

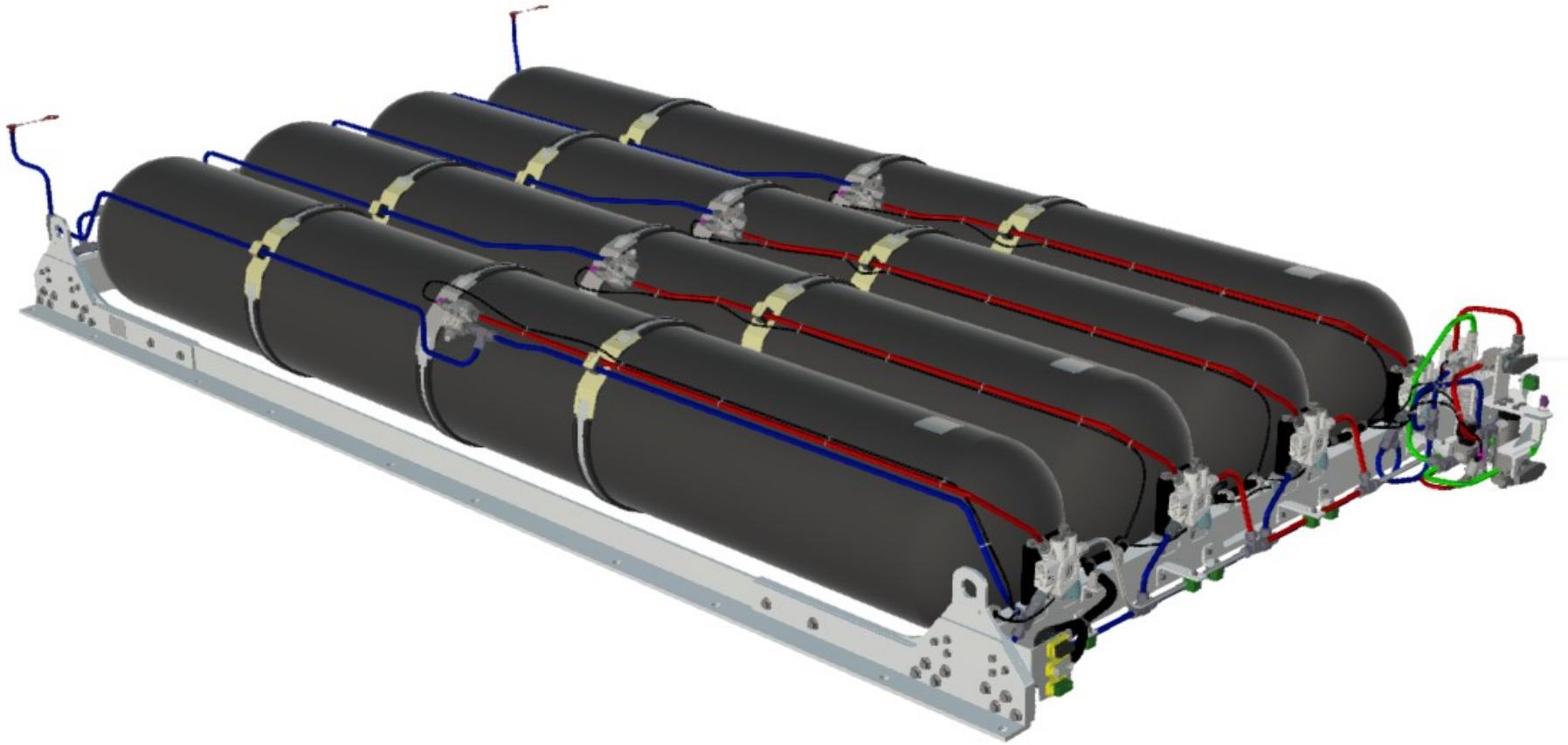
Cylinder Assembly – Type 4 with multiple remote tprd units





Remote TPRD and tubing attached to framework holding the cylinder assembly

System Assembly



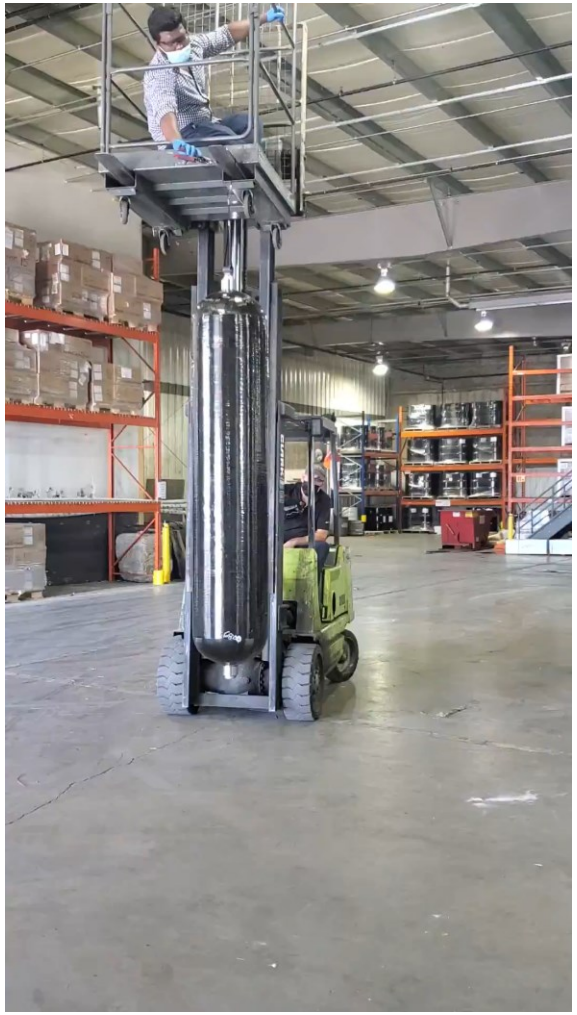
T3 System

LUXFER
GAS CYLINDERS

System Installation

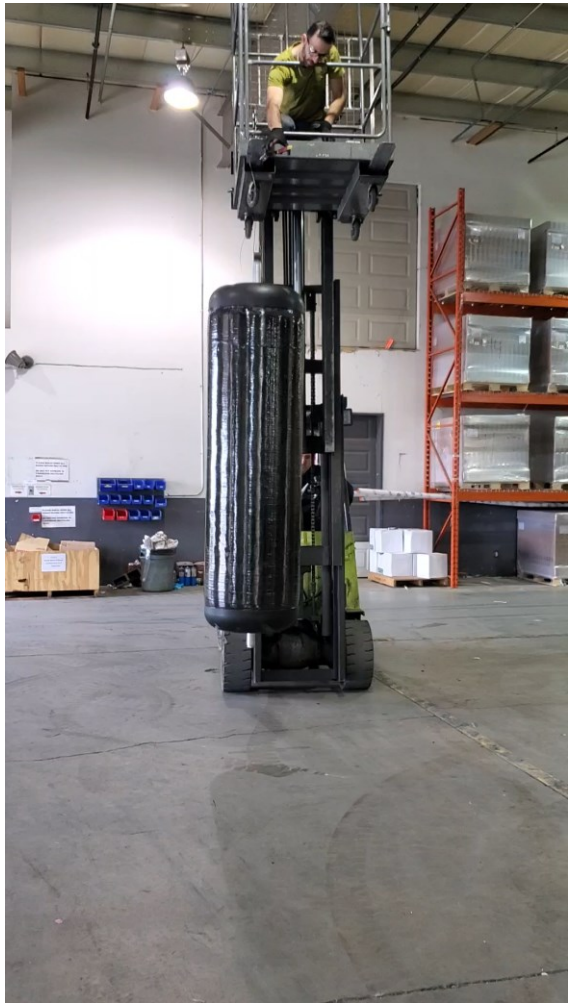
T3 System Attachment

The Drop Test



Type 3 drop test - If a cylinder is dropped, everyone will know it has happened

The Drop Test



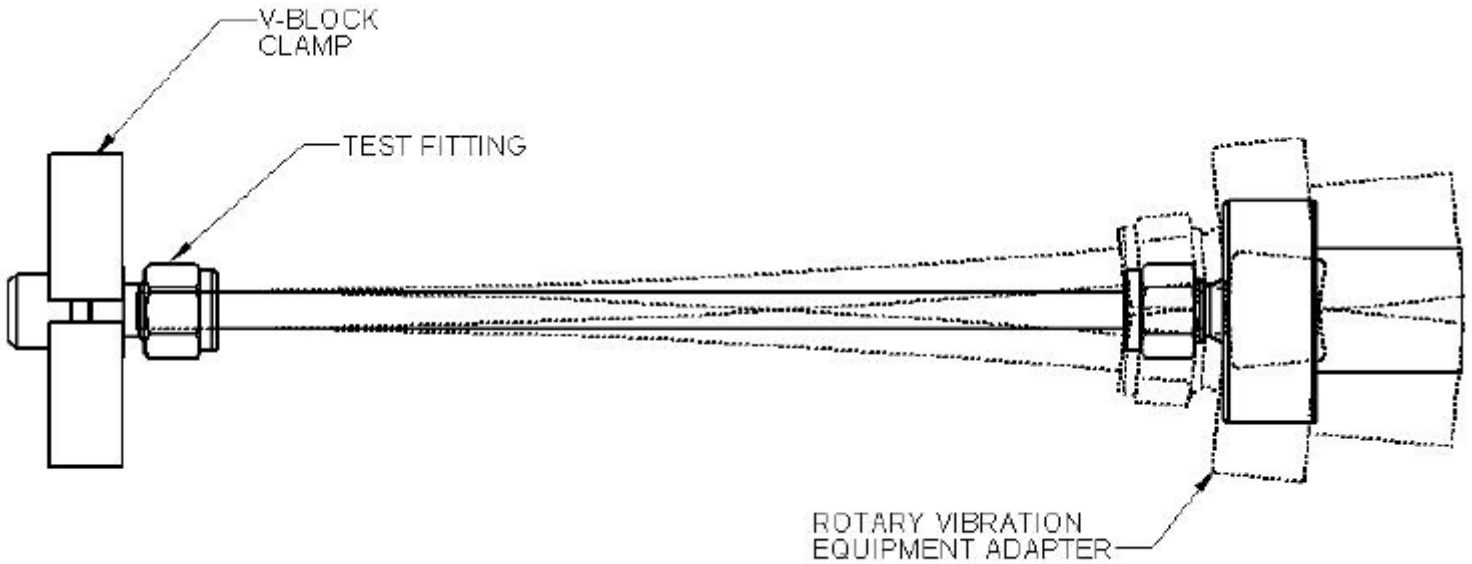
Type 4 drop test - If a cylinder is dropped, everyone will know it has happened

Drop Tests

Drop Test

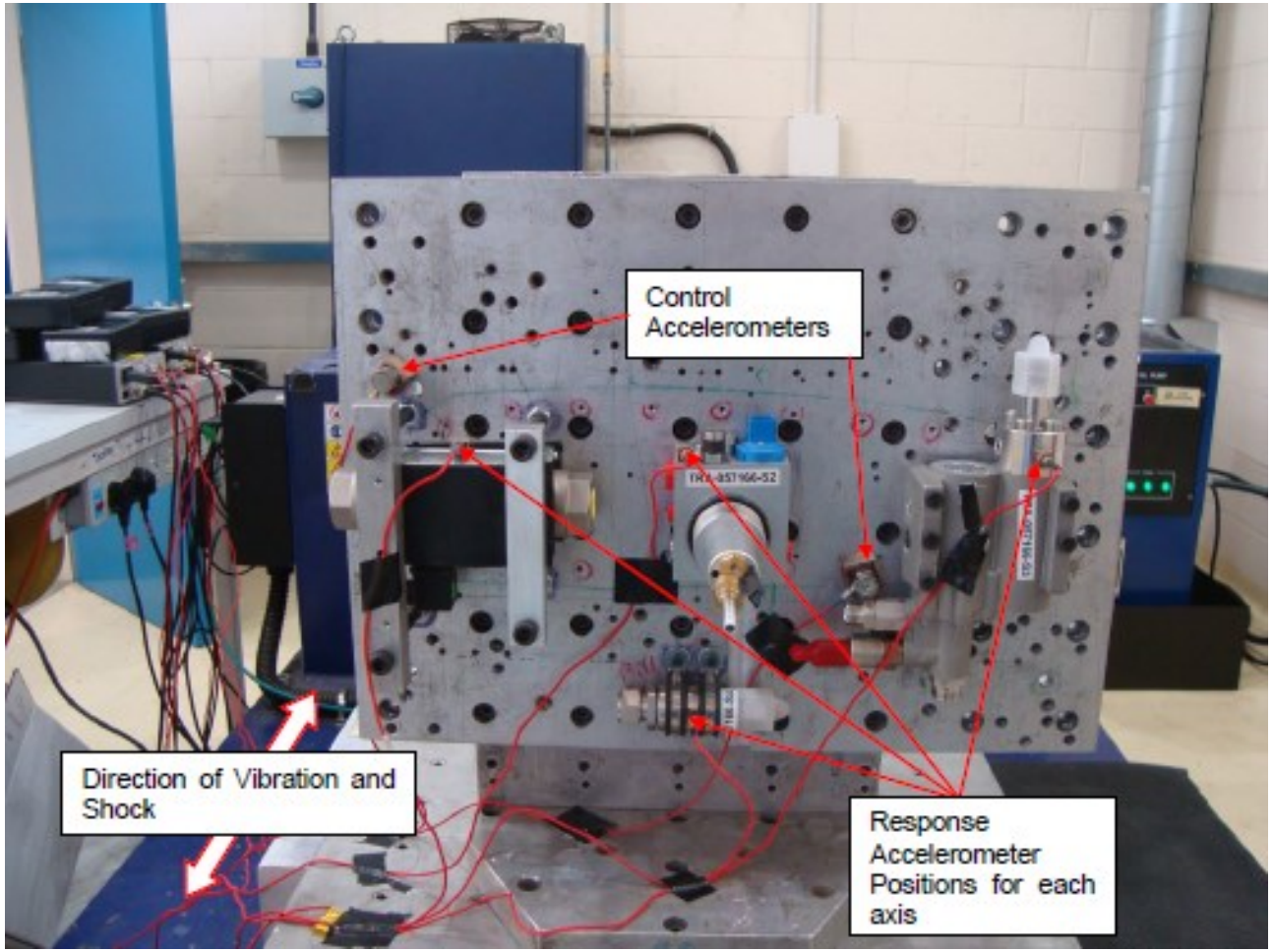
- All 3 tests have primary impact and secondary impacts
- No determined position of supply line, no guarantee supply line will get damaged
- Amount of damage will vary from nothing to catastrophic
- Vent lines are not included but just as important

External Testing – Rotary Flex Test



Popular Mechanical Grip Type Fitting Manufacturer

External Testing – Vibration and Shock Testing



BS EN 61373 Vibration and Shock Testing Test Setup

Risks

Hydraulic Cycle Test

- How do we guarantee that air is removed from the system, specifically at the remote tprd units?
- Hydraulic media may be introduced in to areas that are not easily flushed out afterwards

Pneumatic Cycle Test

- Does not address situations where remote tprd's are mounted to the frame
- How would this work with memory alloy remote tprd's?
- If there is a fault with the assembly of the test specimen, the expensive and time consuming test will be invalid and may have to start again from the beginning
- Increased costs in type approval testing may prevent many projects starting

Summary

The TPRD’s are evaluated during testing at component level.
Tubing and fittings are tested by manufacturer.
The testing does not reproduce what happens during handling and installation.
The position and geometry between designs is almost infinite.
The probability of a cylinder assembly being dropped during handling or installation is extremely low.
If ever an incident occurred, a simple inspection of the assembly will remove any damaged parts.