

## BACKGROUND AND APPLICATIONS

- EOD - Explosive Ordnance Disposal, the process by which hazardous explosive devices (bombs) are rendered safe
- Today's EOD Technicians must rapidly adapt their tools to counter continuously evolving methods

## DESIGN OVERVIEW

LANL is interested in the development of a small, mechanically actuated wire cutter that can *transmit force through a member across a hinge*, and *adapts to existing hardware*. Our design:

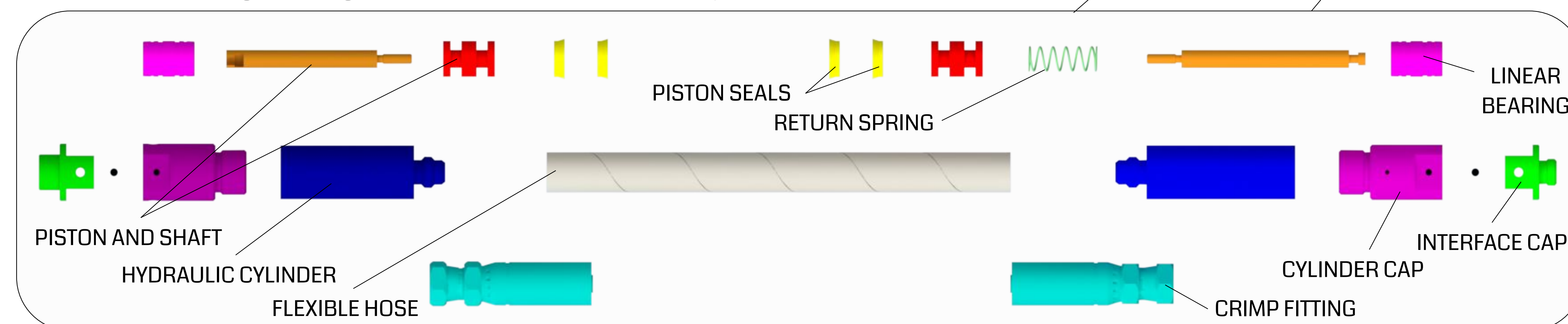
- Features a 'controllable' flexible shaft with 90° of bending actuation
- Allows the cutter tip to be manipulated with 360° of rotation
- Cutting force is delivered through a hydraulic-piston design using tension from cable reels to bend the assembly

## SYSTEM REQUIREMENTS SUMMARY

| KEY REQUIREMENT   | COMPLIANCE |
|---|------------|
| Mechanism shall adapt to existing LANL Handle (provided)                                  | ✓          |
| The tool shall rotate at the handle   | ✓          |
| Cutting tool shall bend relative to shaft   | ✓          |
| The tool head and shaft shall be modular to the force transducing member                  | ✓          |
| Mechanism shall actuate both before and after entering a barrier hole                     | ✓          |
| Mechanism shall be capable of making a cut from a stand-off distance of no less than 2 ft | ✓          |
| The tool head/shaft shall fit through a 1.5 inch diameter hole                            | ✓          |
| The tool shall be ambidextrous  | ✓          |
| The tool shall be operable with gloved hands  | ✓          |
| Tool shall not break if used on a 10-gauge solid core copper wire                         | ✓          |
| Tool shall provide enough force to cut a single 14-gauge solid core copper wire           | ✓          |
| Tool shall be able to make 100 cuts without any performance-reducing blade degradation    | ✓          |

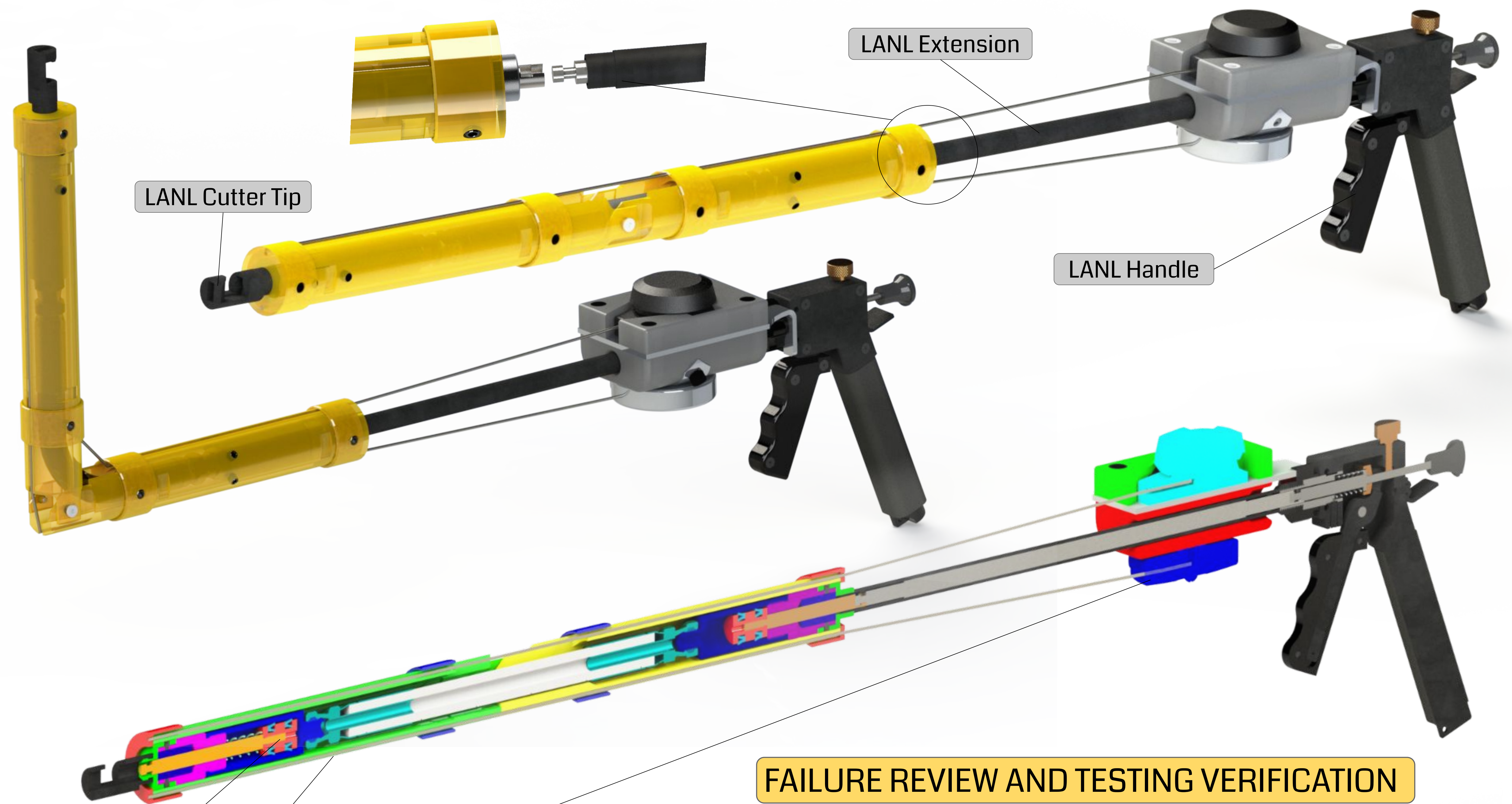
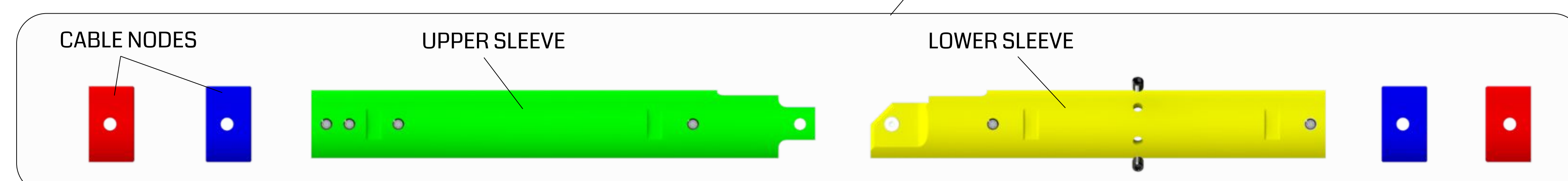
### HYDRAULICS

- Piston and cylinder design + flexible hose allows for transmission of force around a hinge using Shimano mineral oil for hydraulic fluid



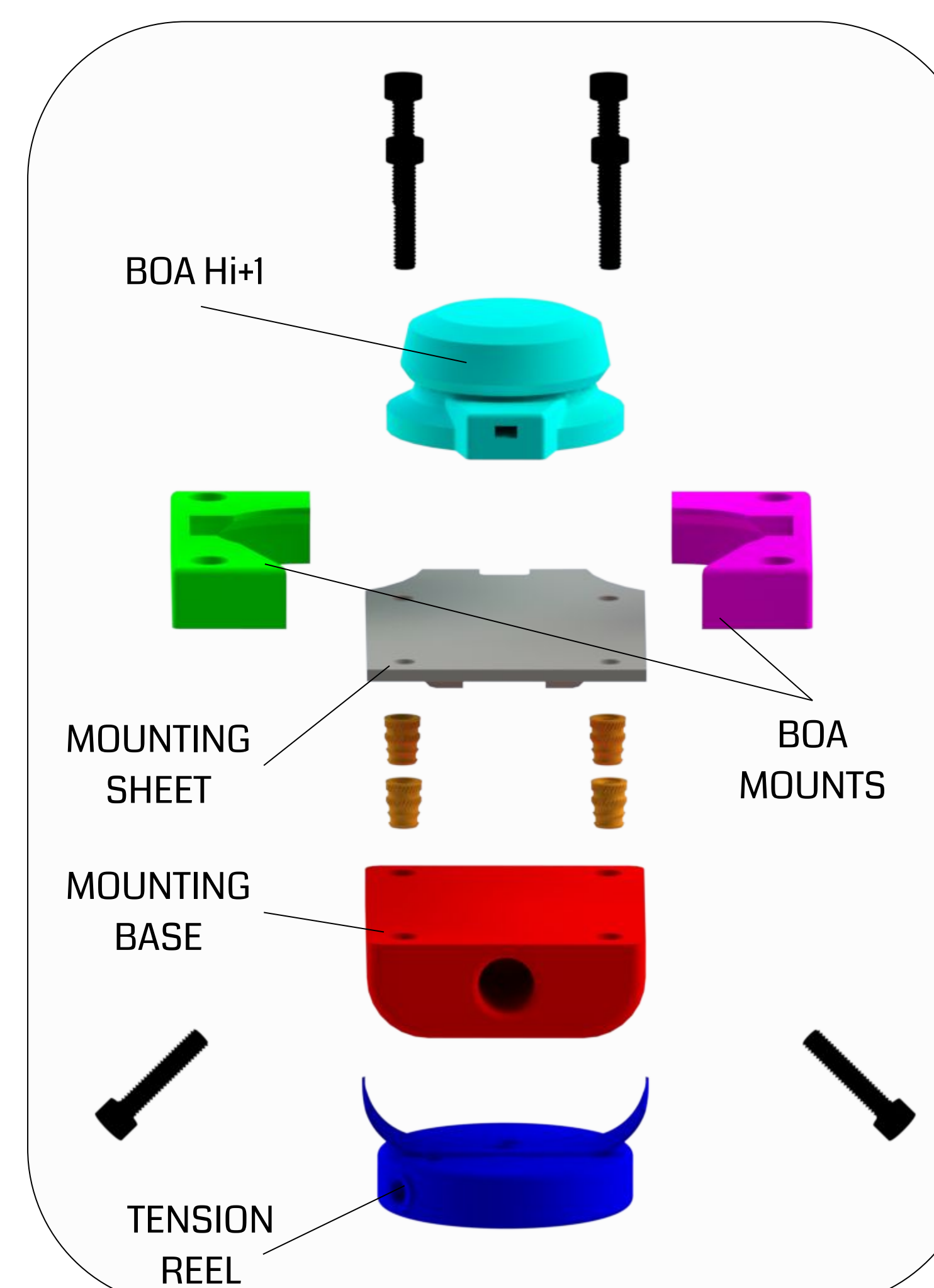
### STRUCTURE

- Houses and guides the motion of the hydraulic subsystem
- Ultem 1000 used for light weight and durability

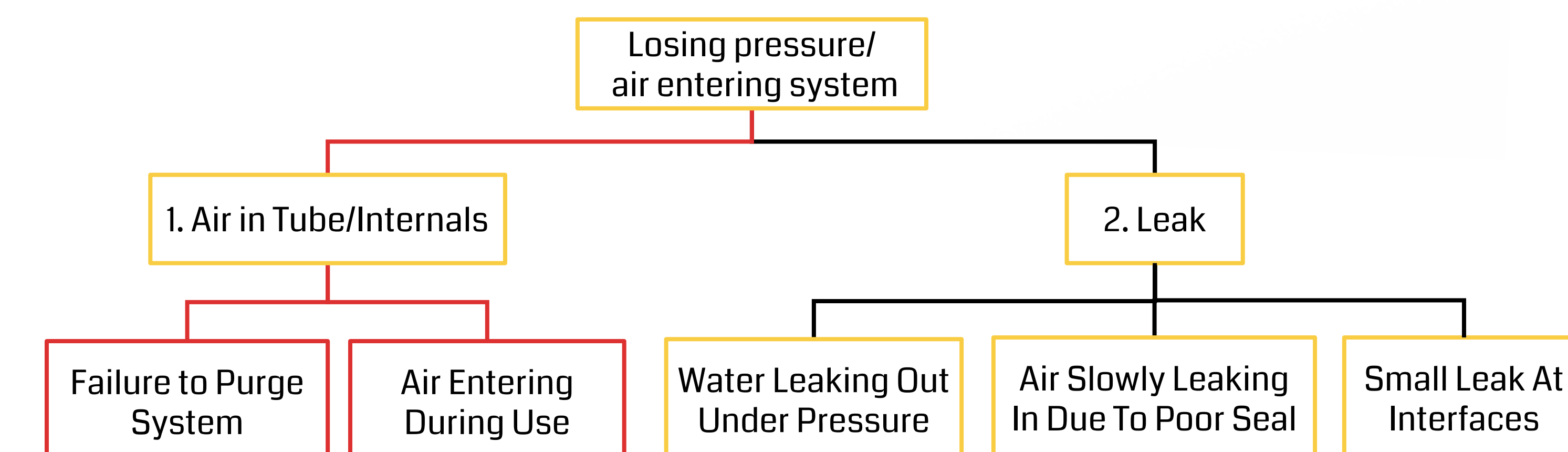


### ACTUATION

- Pulley and tension system
- Boa Hi+1 for tension and retraction
- 3D printed, lightweight mount



## FAILURE REVIEW AND TESTING VERIFICATION



- 18 distinct testing requirements:
  - **System design** - Integration and modularity with existing LANL tool
  - **Environmental testing** - Field setting, water, dirt, drop, etc
  - **Performance testing** - Long-term use, larger than intended wires
- 16/18 requirements passed\*, all core requirements achieved

## LESSONS LEARNED

- Maintaining design simplicity can be more difficult than expected
- Design for manufacturability is important, but if the assembly process is not considered during design unexpected issues can occur

## POTENTIAL IMPROVEMENT

- Weight, or the 'tactile feel' of the tool in hand
- Smaller tool size (given the ability to meet extremely tight tolerances)
- Ease of bleeding the system and overall difficulty to assemble
- Stronger tension reel for actuation return