



Hydrogen Vent Ground Umbilical Quick Disconnect – Flight Seal Advanced Development

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Objective

- This project is a team effort between NASA Engineering (NE) and Team QNA Engineering personnel to provide support for the Umbilical Systems Development project which is funded by Advanced Exploration Systems (AES) and 21st Century Launch Complex.
- Specifically, this project seeks to develop a new interface between the PPBE baselined Legacy SSP LH2 Vent Arm QD probe and SLS vent seal

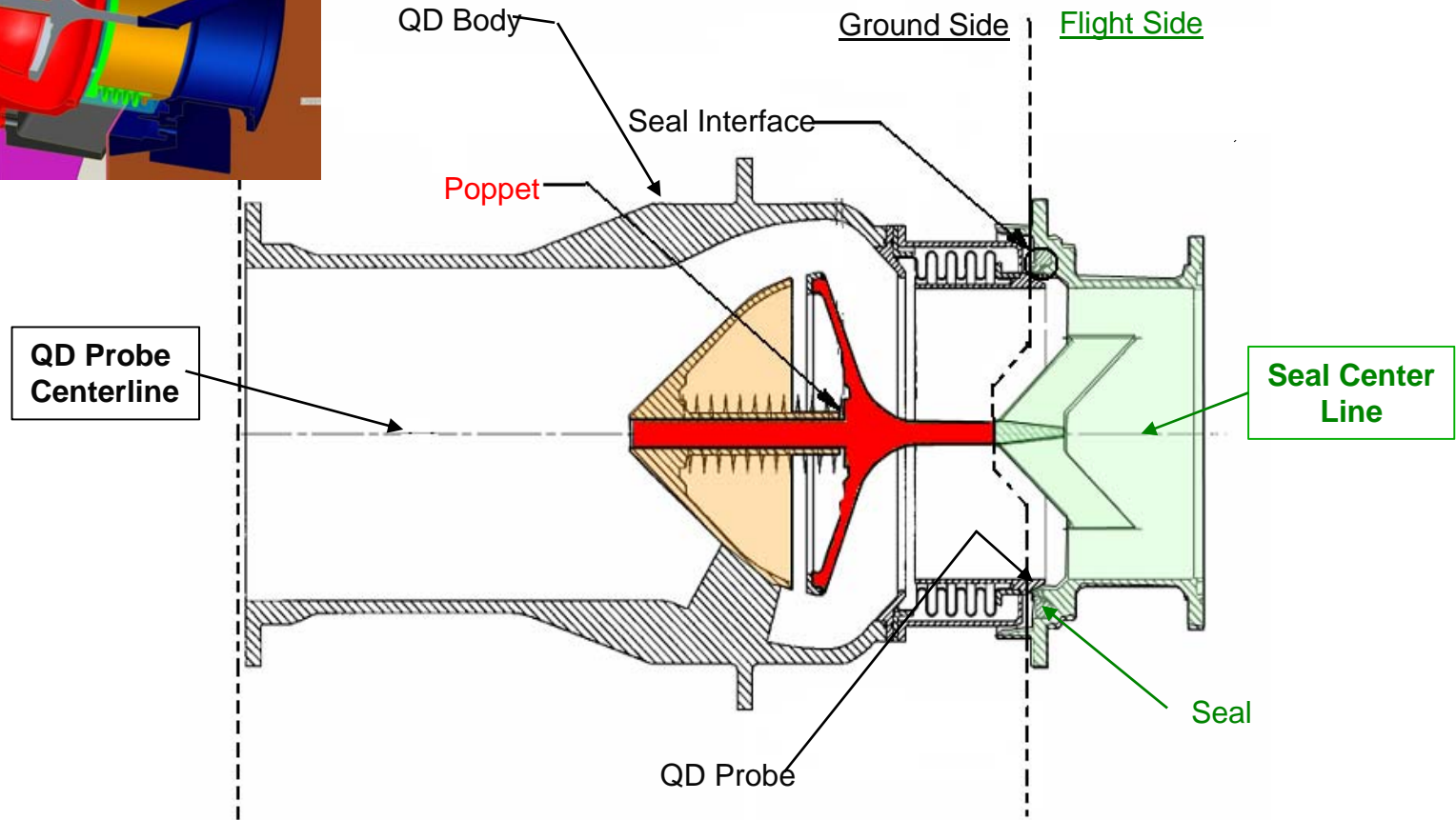
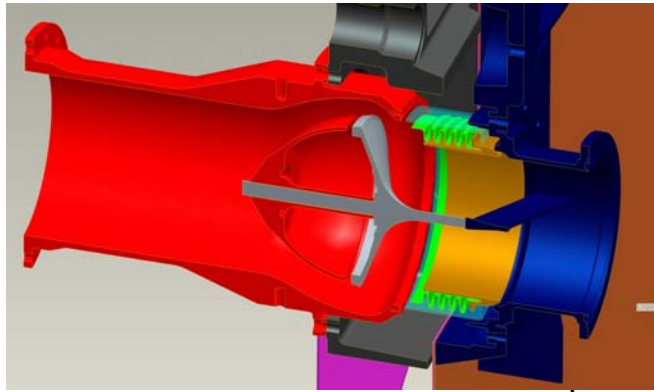




Scope of effort:

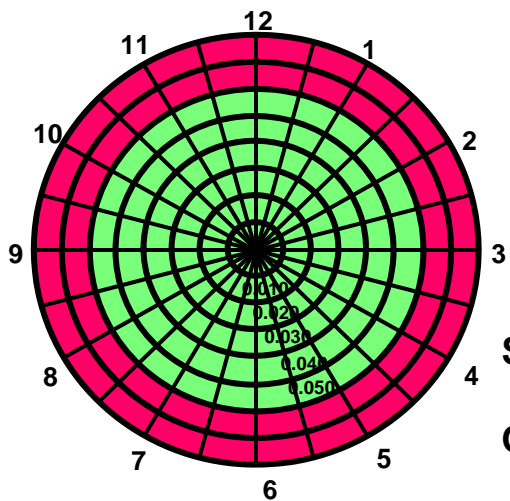
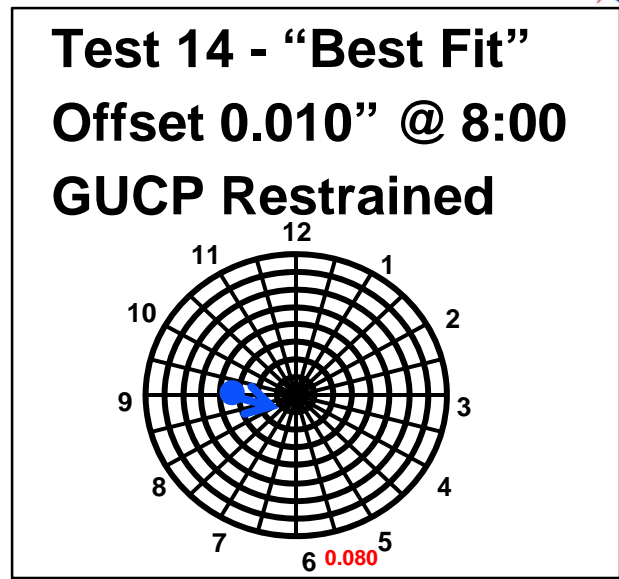
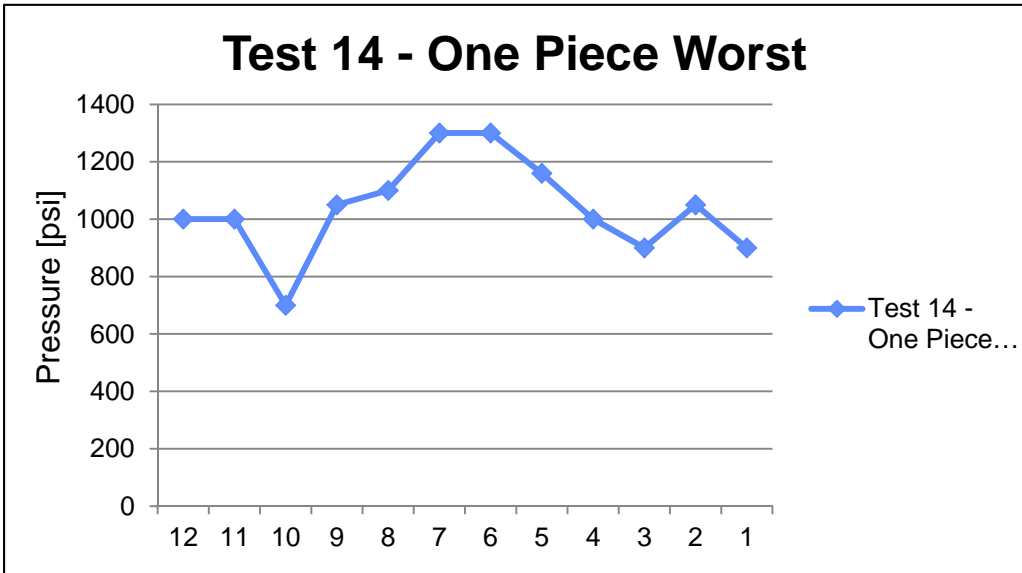
- Utilize existing SSP hardware, GSE and test fixtures
- Correct inherent design issues of SSP LH2 vent
- Utilize NASA analysis tool
- Develop self-aligning hardware interface
- Design new seal configurations for analytical evaluation
- Determine a more balanced spring rate relationship between QD – flight seal
- Optimize the mating position engagement with umbilical arm loads accounted
- Determine the affects of cryogenic operating temperatures on this relationship
- Down select proposed seal designs to best candidates and optimize configurations

GH2 Vent Interface - Alignment

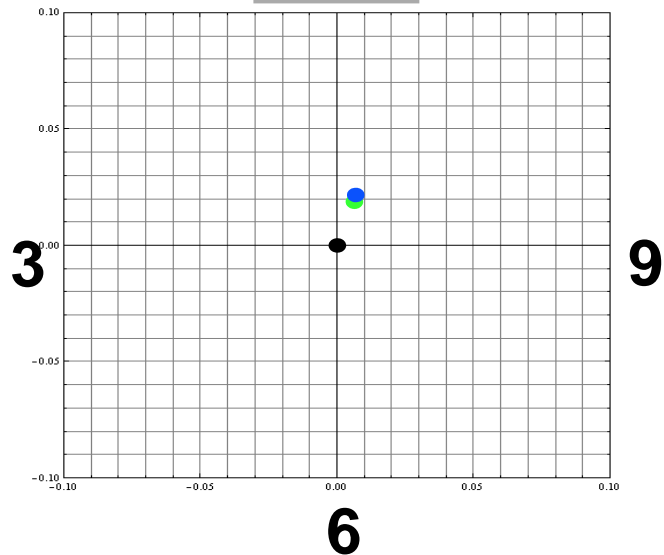


Section View

GH2 Vent Interface - Alignment



SSP Spider Chart Requirement
Offset < 0.050"



GH2 Vent Interface – Alignment Hardware

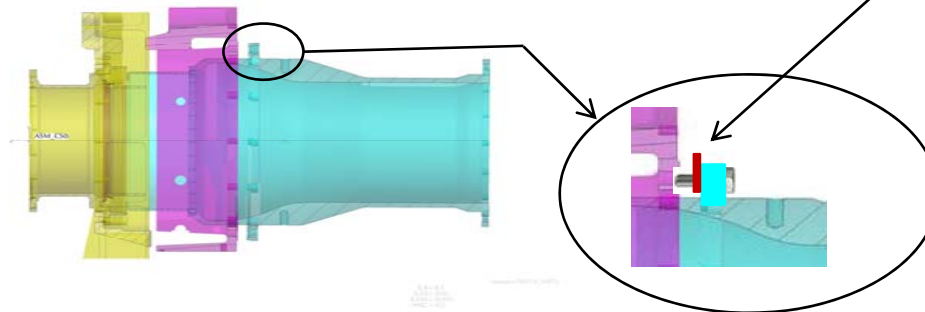
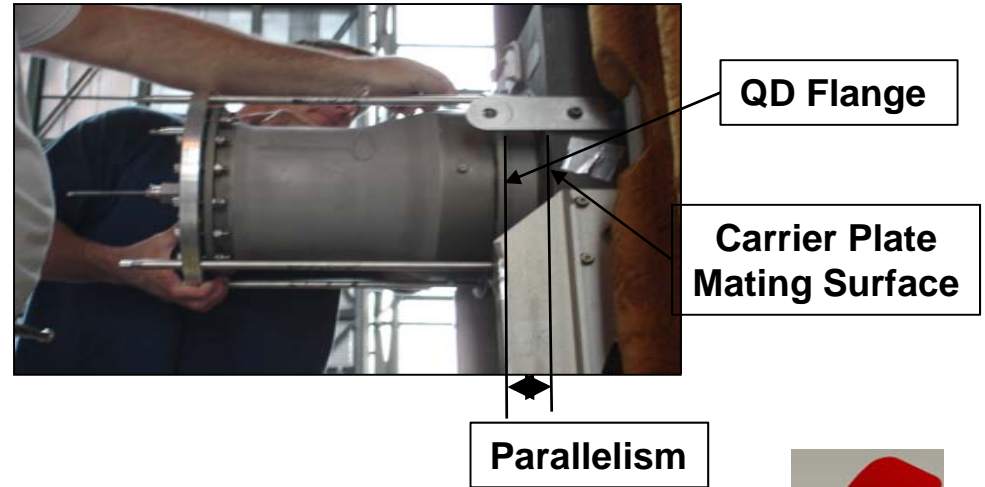


Max Offset	
12 to 6	0.002
11 to 5	0.014
10 to 4	0.023
9 to 3	0.024
8 to 2	0.018
7 to 1	0.010



SLS Recommendation – Develop Concentricity Tool

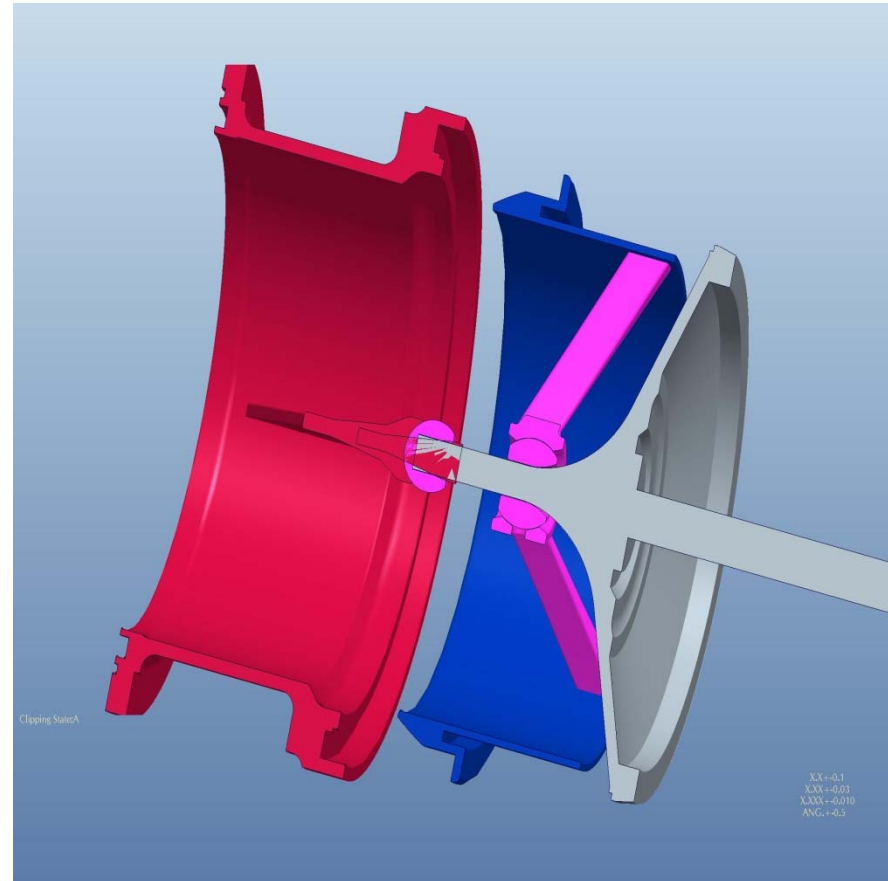
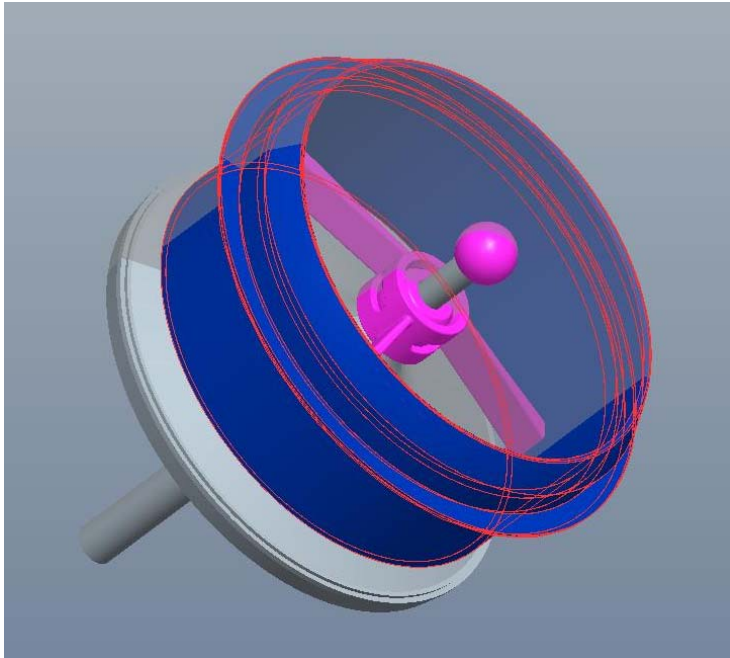
GH2 Vent Interface – Alignment Recommendations



SLS Recommendation – Parallelism Retainer Clips

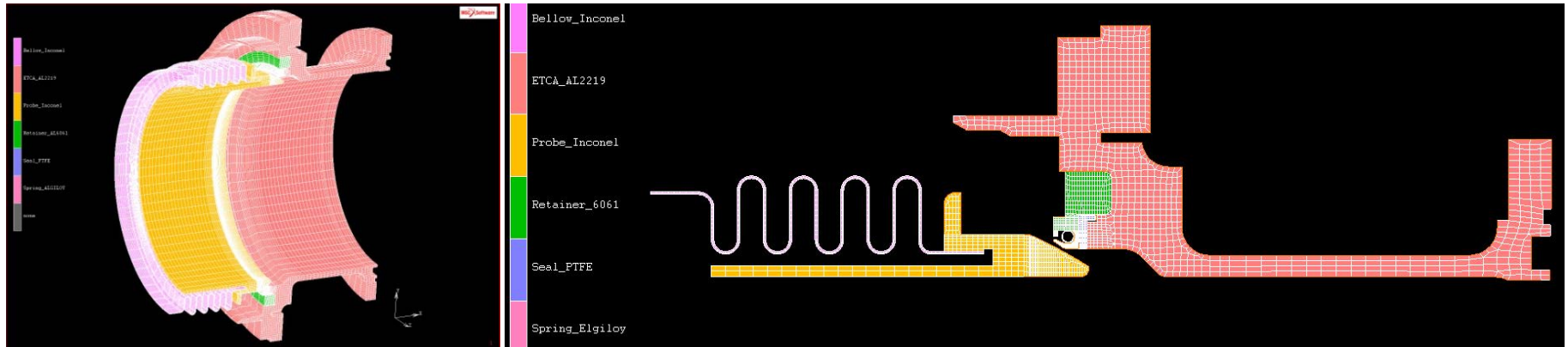
An installation GSE bolt with a retainer clip should be considered. This fastener would help maintain parallelism during the installation process by capturing the QD flange on the inside face until QD guide pin removal.

GH2 Vent Interface – Alignment Hardware



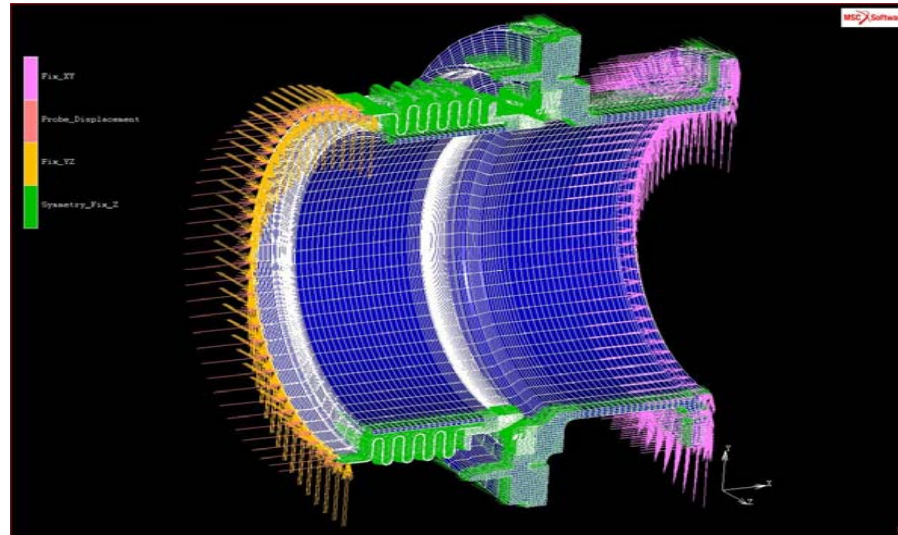
SLS Recommendation – Self-Aligning Probe

GH2 Vent Interface – Analysis Tool



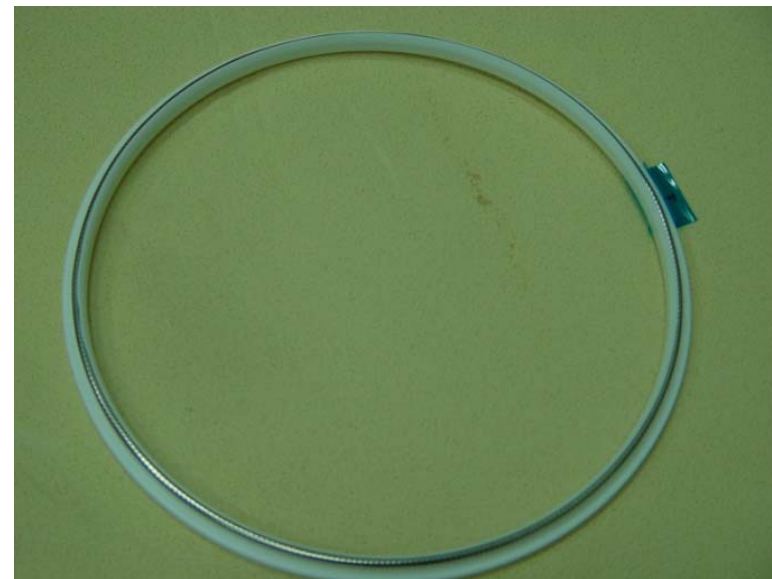
Part	Material Description	Young's Modulus (psi)	Poisson's Ratio (in/in)	Yield Strength (psi)	Ultimate Strength (psi)	Elongation at Break	Mass Density (lbm/in ³)	CTE (10 ⁻⁶ in/in/F ⁰)
One-Piece Seal	FEP-Fluorocarbon	70,000	0.46	1700	2500 ~ 3500	300.00%	0.011	70°: 125 -130°: -417°:
Two-Piece Seal	Polytetrafluoroethylene (PTFE or Teflon)	70,000	0.46	1700	3,500	400.00%	0.078	70°: 75 -130°: -417°:
Retainer	AL 6061 T6511 (Shapes Extruded)	9,900,000	0.33	35,000	38000 ~ 42000	6.00%	0.098	70°: 12.65 -130°: 11.8 -417°: 8.3
Spring	ELGILOY S4-71A (Elgiloy® AMS 5876)	27,500,000	0.226	75400	125000	38.00%	0.3	70°: 8.428 -130°: -417°
ETCA	AL 2219 T851-ULTR	10,500,000	0.33	46000	62,000	6.00%	0.103	70°: 12.2 -130°: 11.3 -417°: 8
Probe	Inconel 718 (seam welded to bellow)	29,400,000	0.29	145,000	180,000	15%	0.297	70°: 12.8 -130°: 6.2 -417°: 4.8
Bellow	Inconel 718 (3 ply welded together)	29,400,000 (3,396,000)	0.29	145,000	180,000	15%	0.297	70°: 12.8 -130°: 6.2 -417°: 4.8

GH2 Vent Interface – Analysis Tool

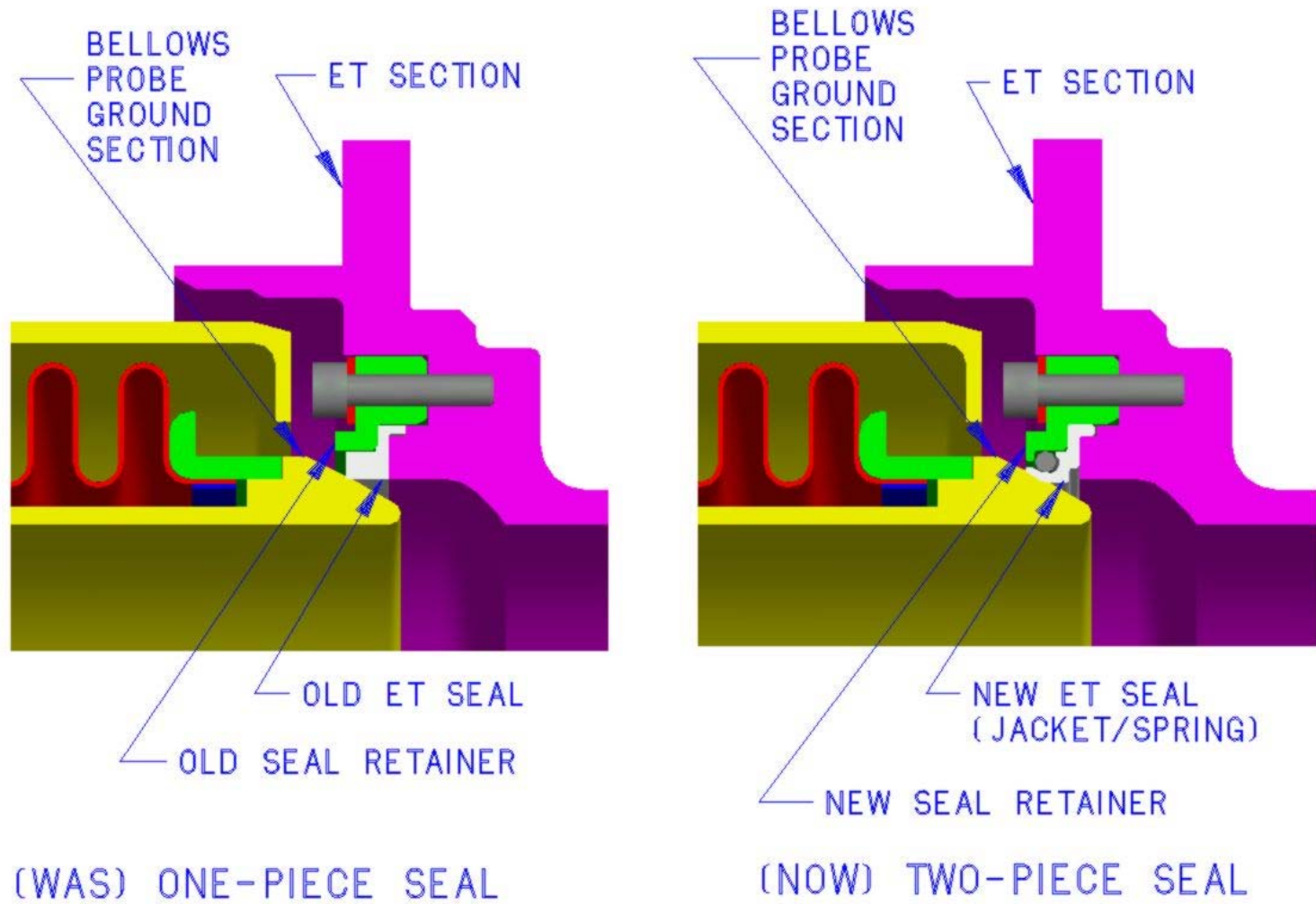


**One-Piece Seal
(Previous Design)**

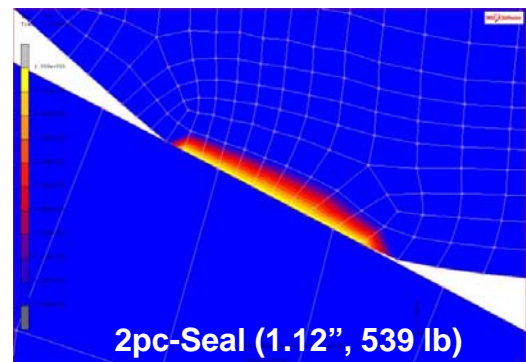
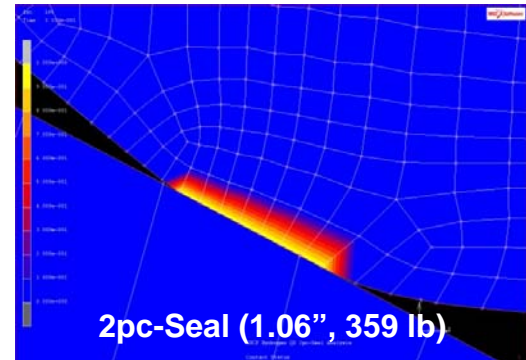
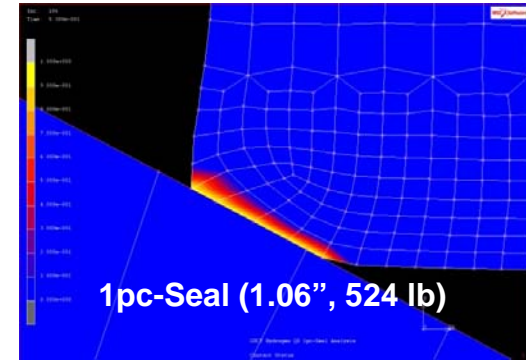
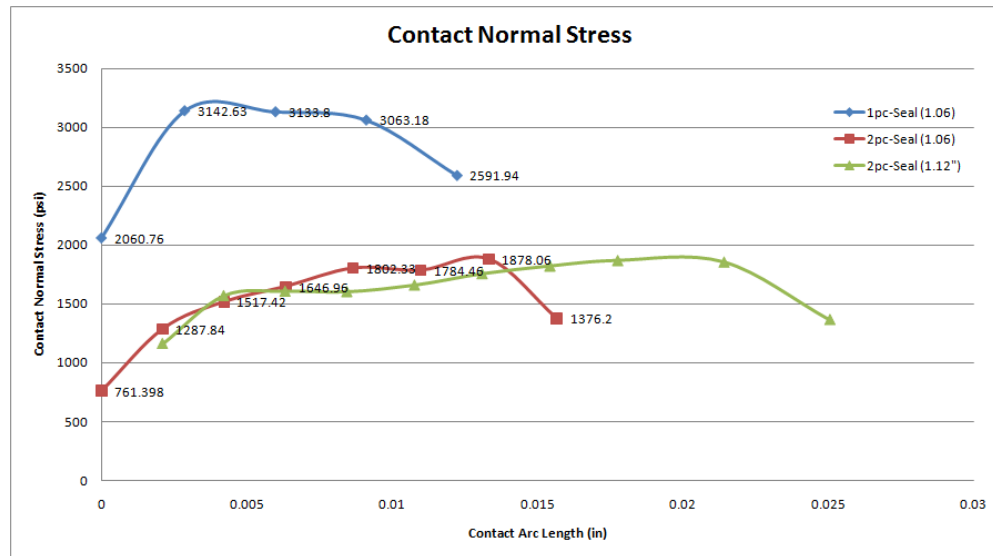
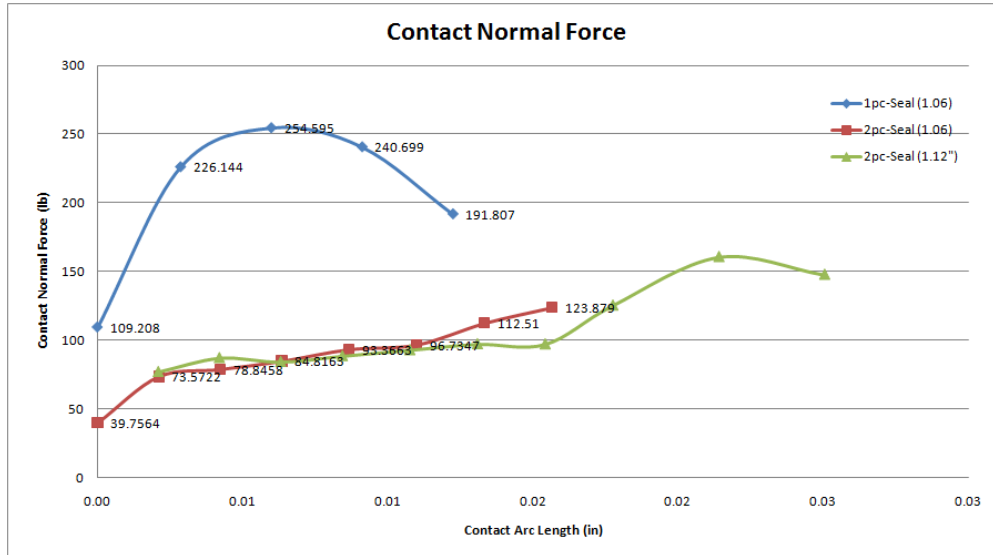
**Two-Piece Seal
(Current Design)**



GH2 Vent Interface – Analysis Tool



GH2 Vent Interface – Analysis Tool



GH2 Vent Interface – Analysis Tool

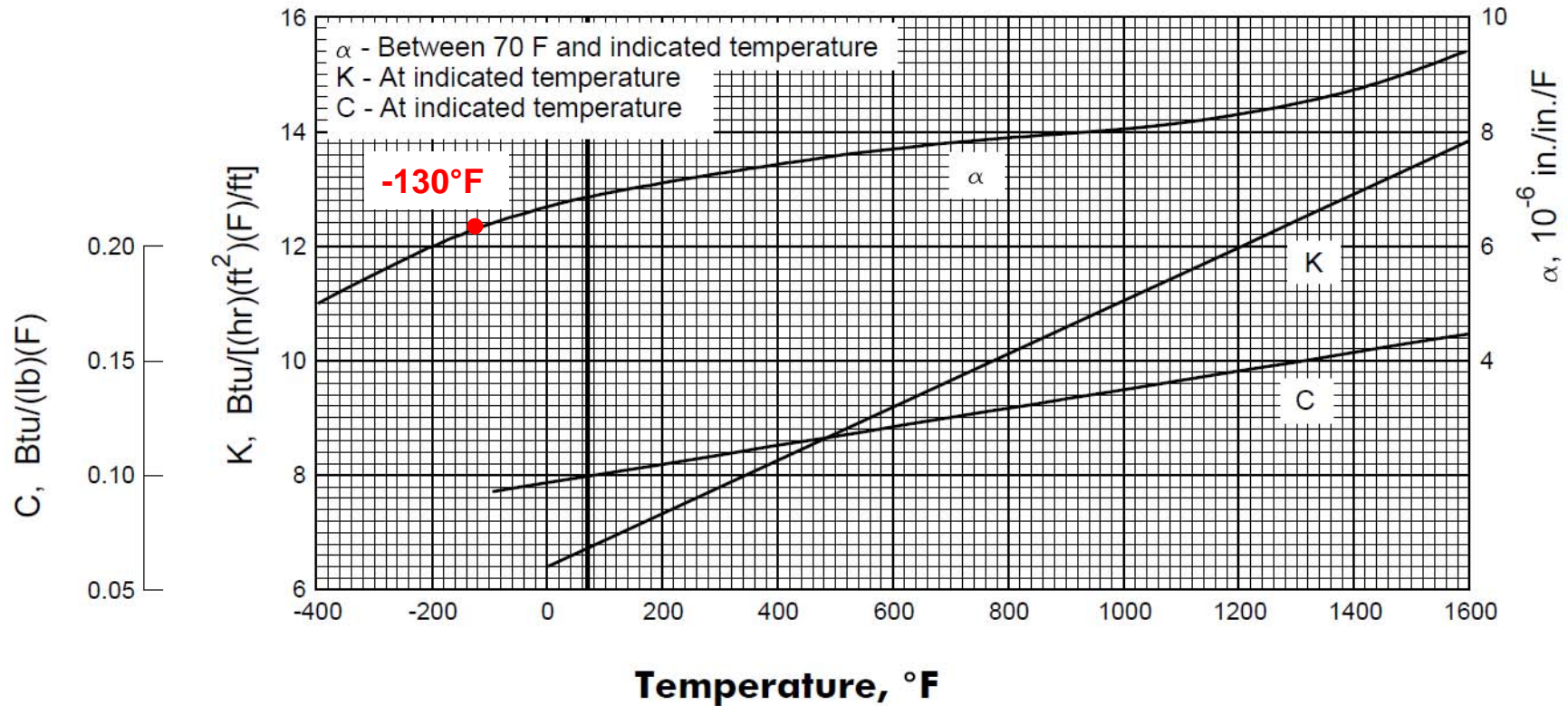
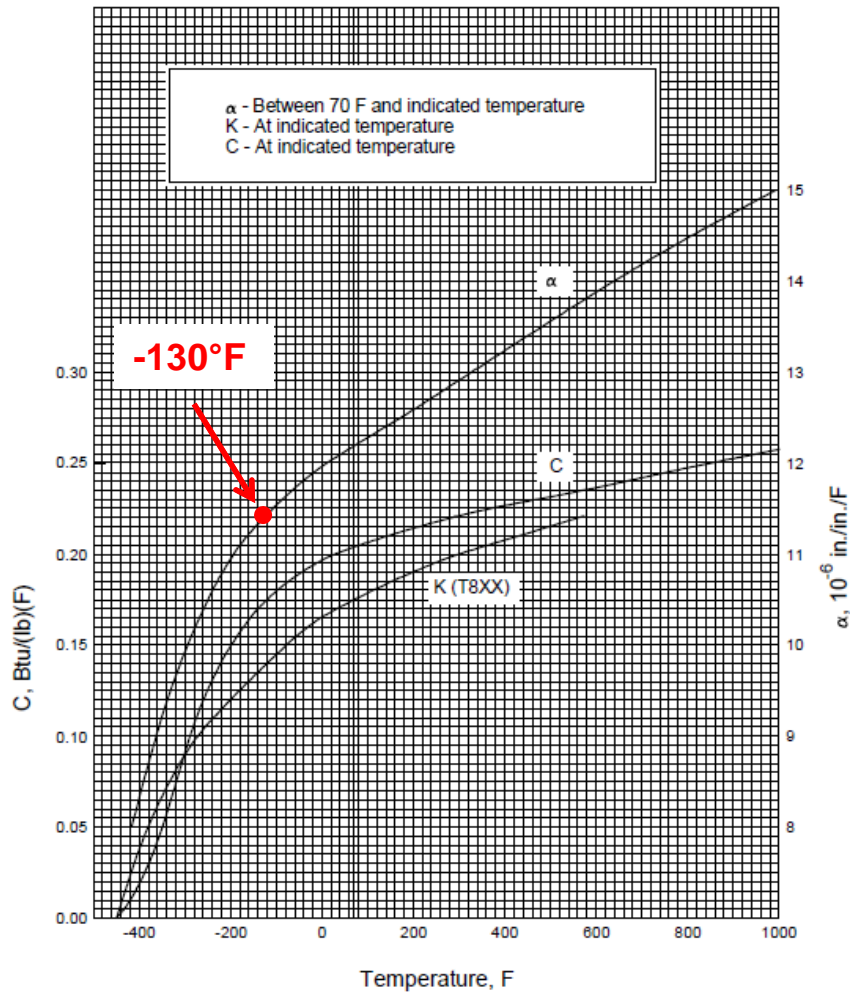


Figure 6.3.5.0. Effect of temperature on the physical properties of Inconel 718.

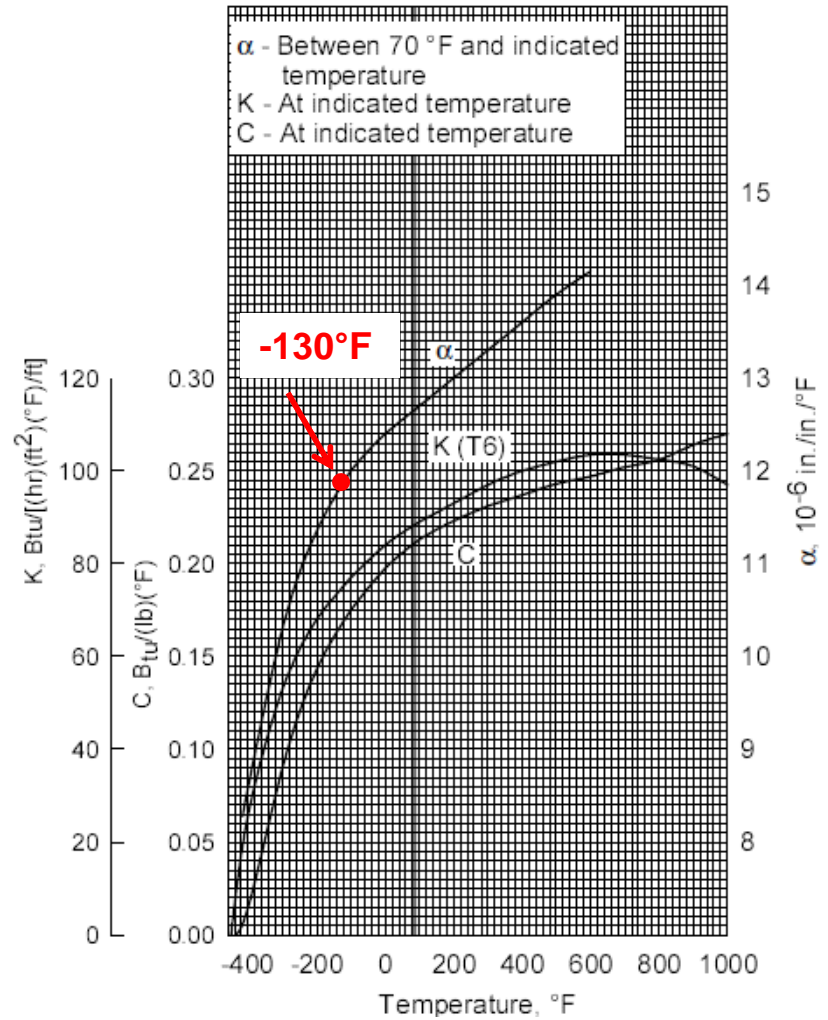
GH2 Vent Interface – Analysis Tool



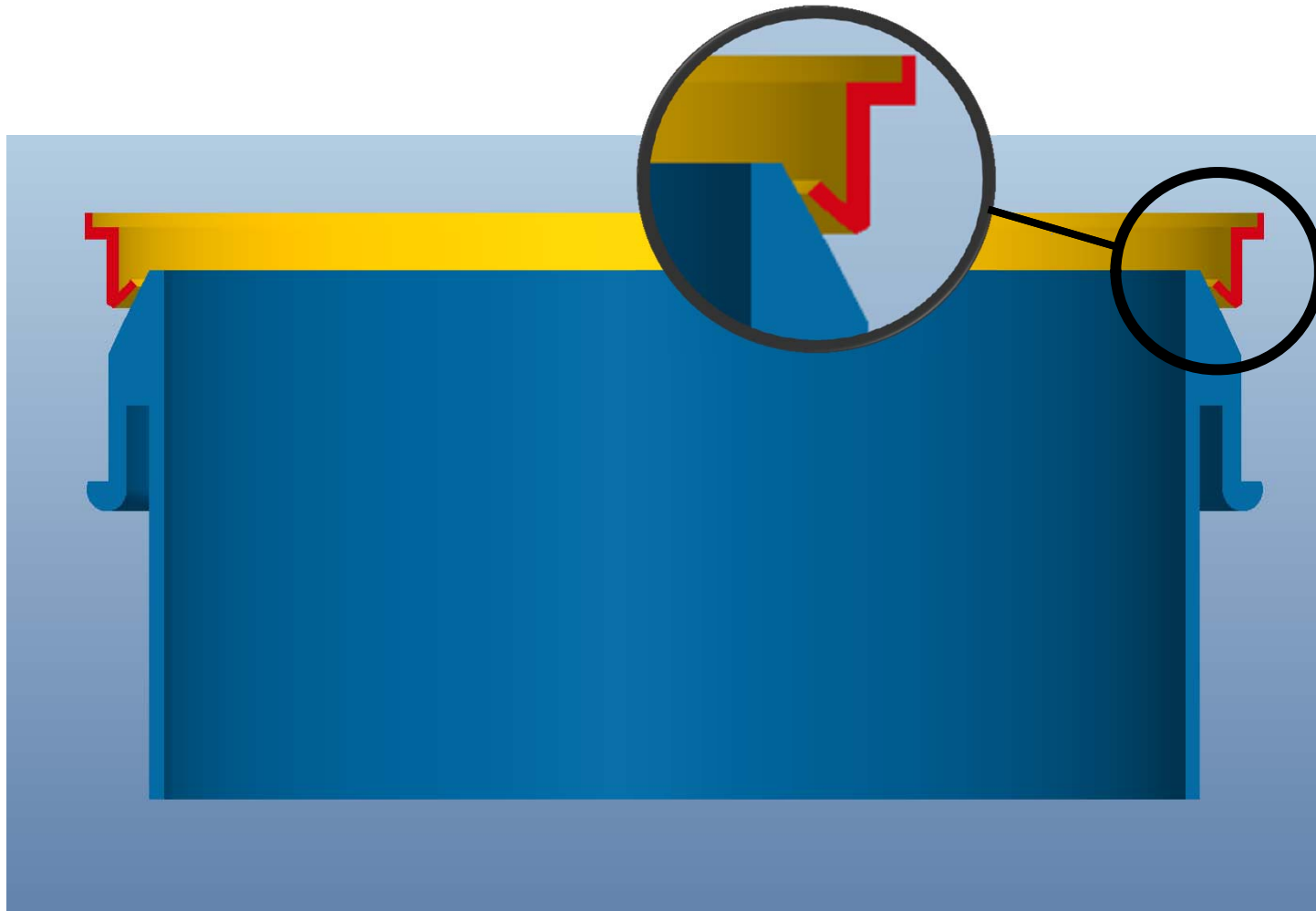
2219 Aluminum Alloy



6061 Aluminum Alloy

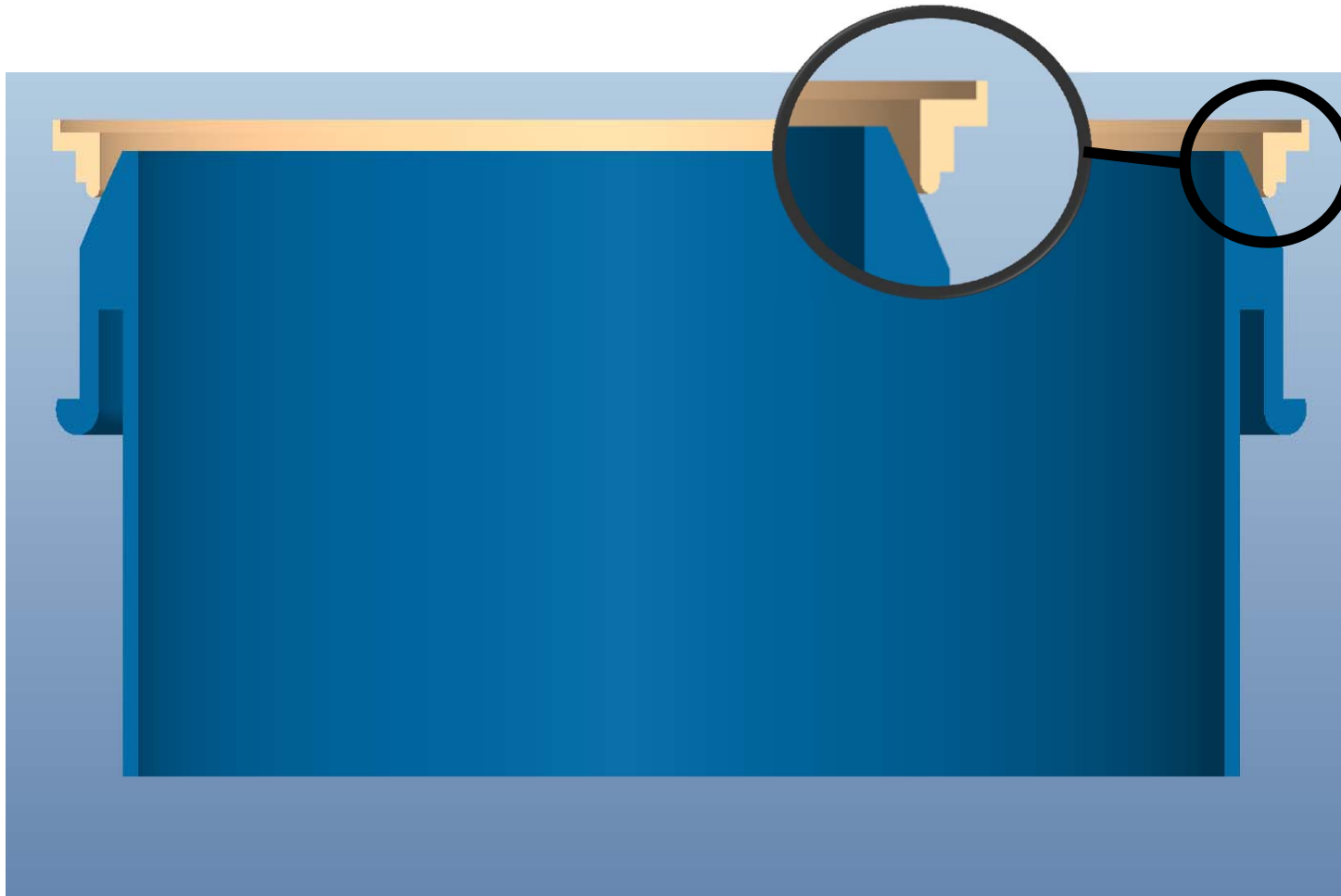


GH2 Vent Interface – New Seal Development



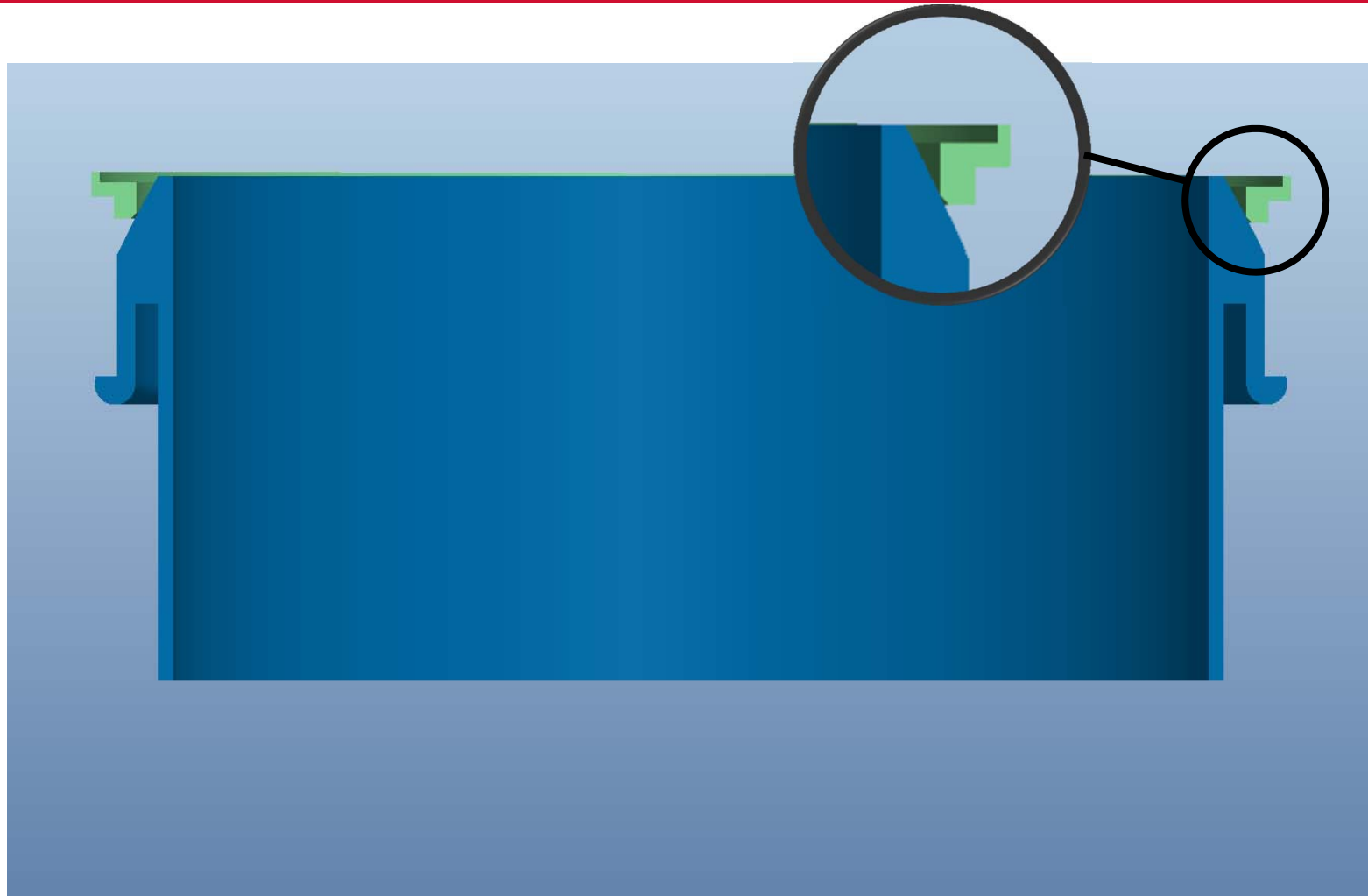
Proposed Seal Design #1 – Pressurized “V”

GH2 Vent Interface – New Seal Development



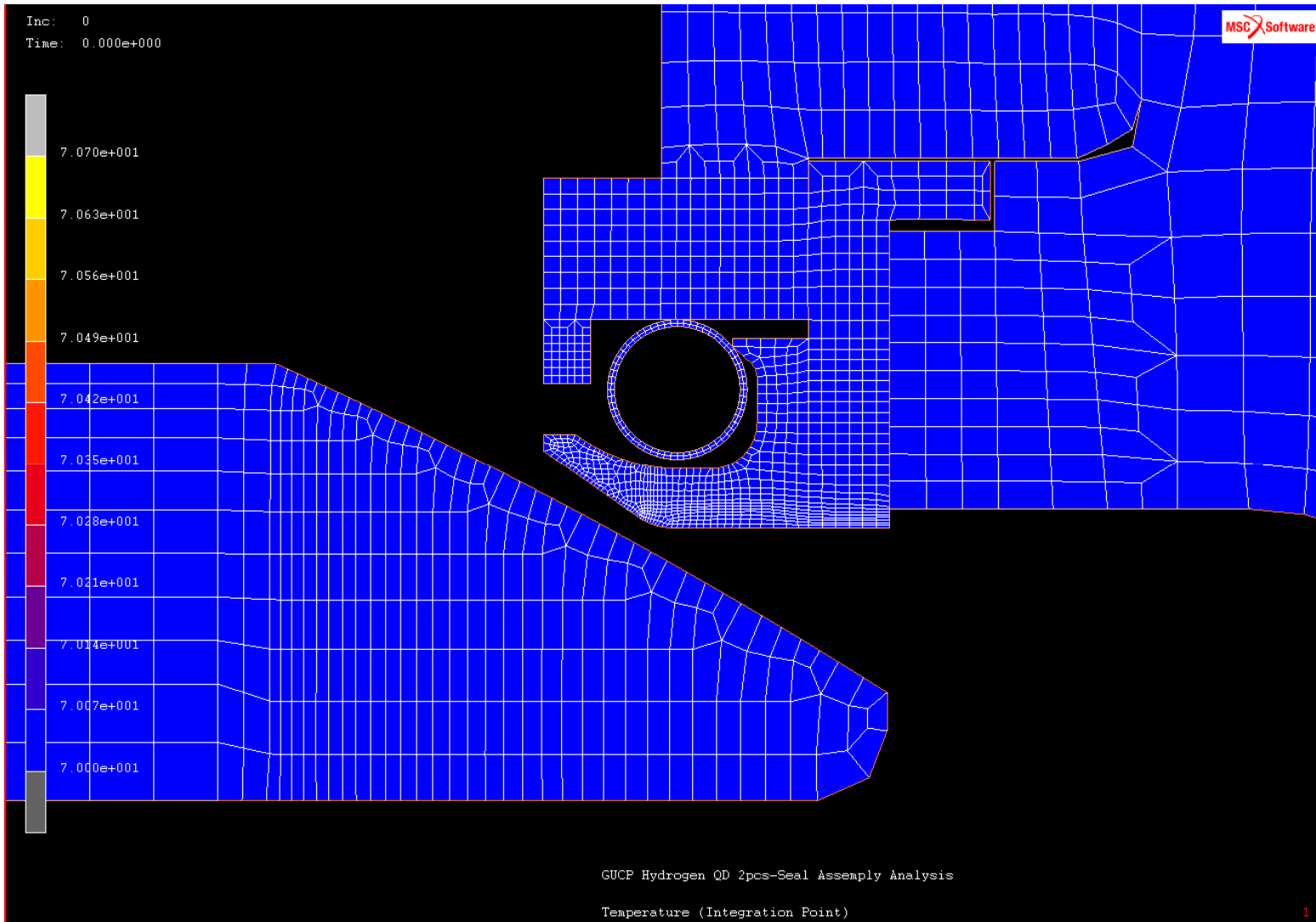
Proposed Seal Design # 2 – Raised Radius

GH2 Vent Interface – New Seal Development



Proposed Seal Design #1 – SSP One Piece Chamfer

GH2 Vent Interface – Analysis Tool

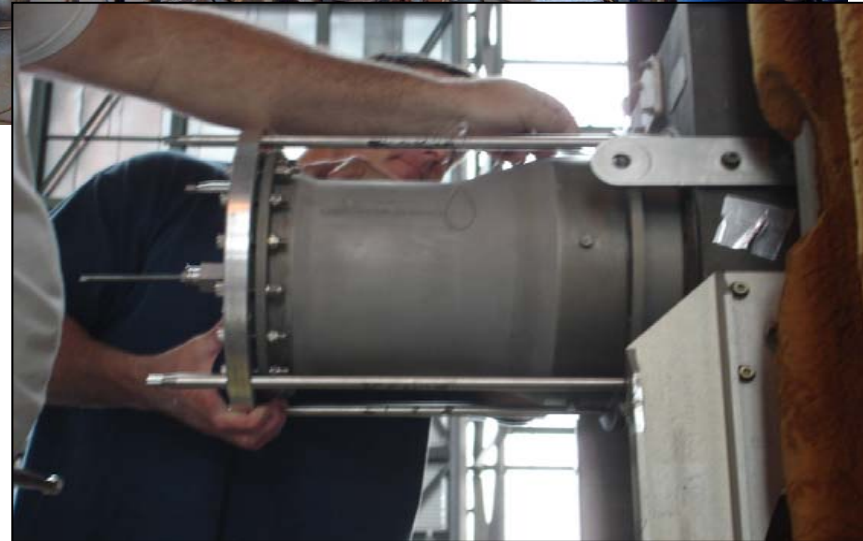
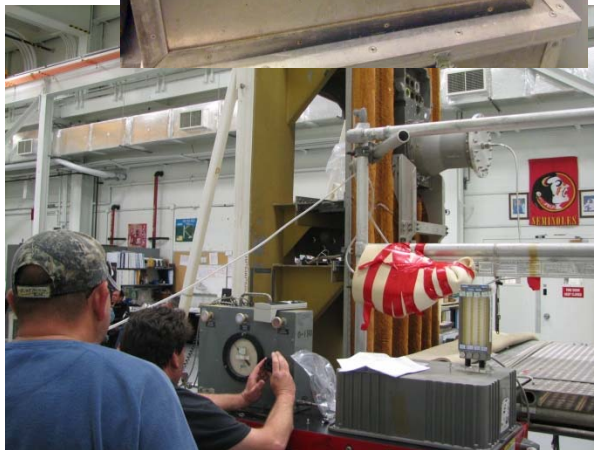


GH2 Vent Interface – New Seal Testing

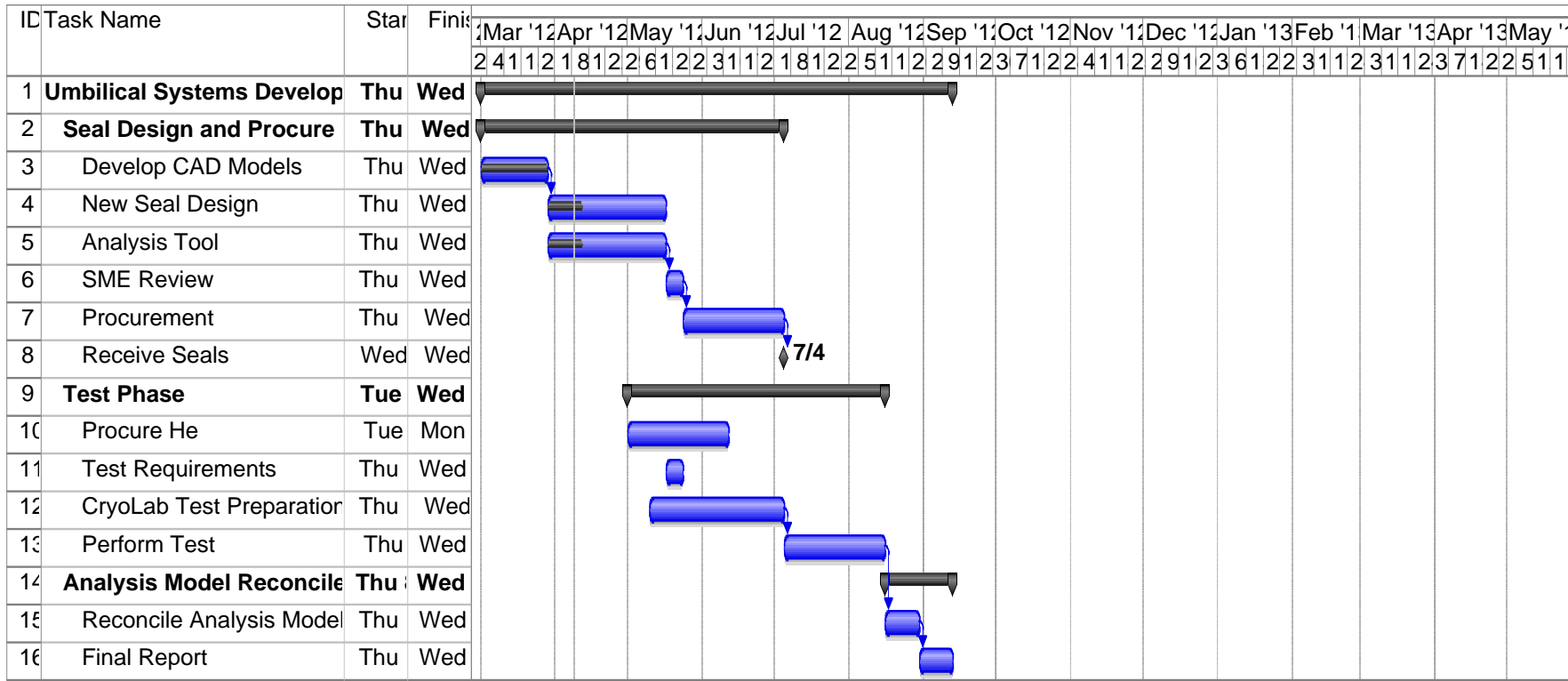


Existing Equipment:

- SSP Carrier Plate
- SSP QD (Stiff / Weak Spring Rate)
- QD Hardware (inc. QD/GUCP spacers)
- QD Pressure Test Fixture
- ET Test Fixture
- Pressure Panel
- Cryogenic Testing Hardware



GH2 Vent Interface – New Seal Testing



Preliminary Discussion have happened with SLS (Boeing) Core (Boeing) and full briefing during TIM (April 10-12)