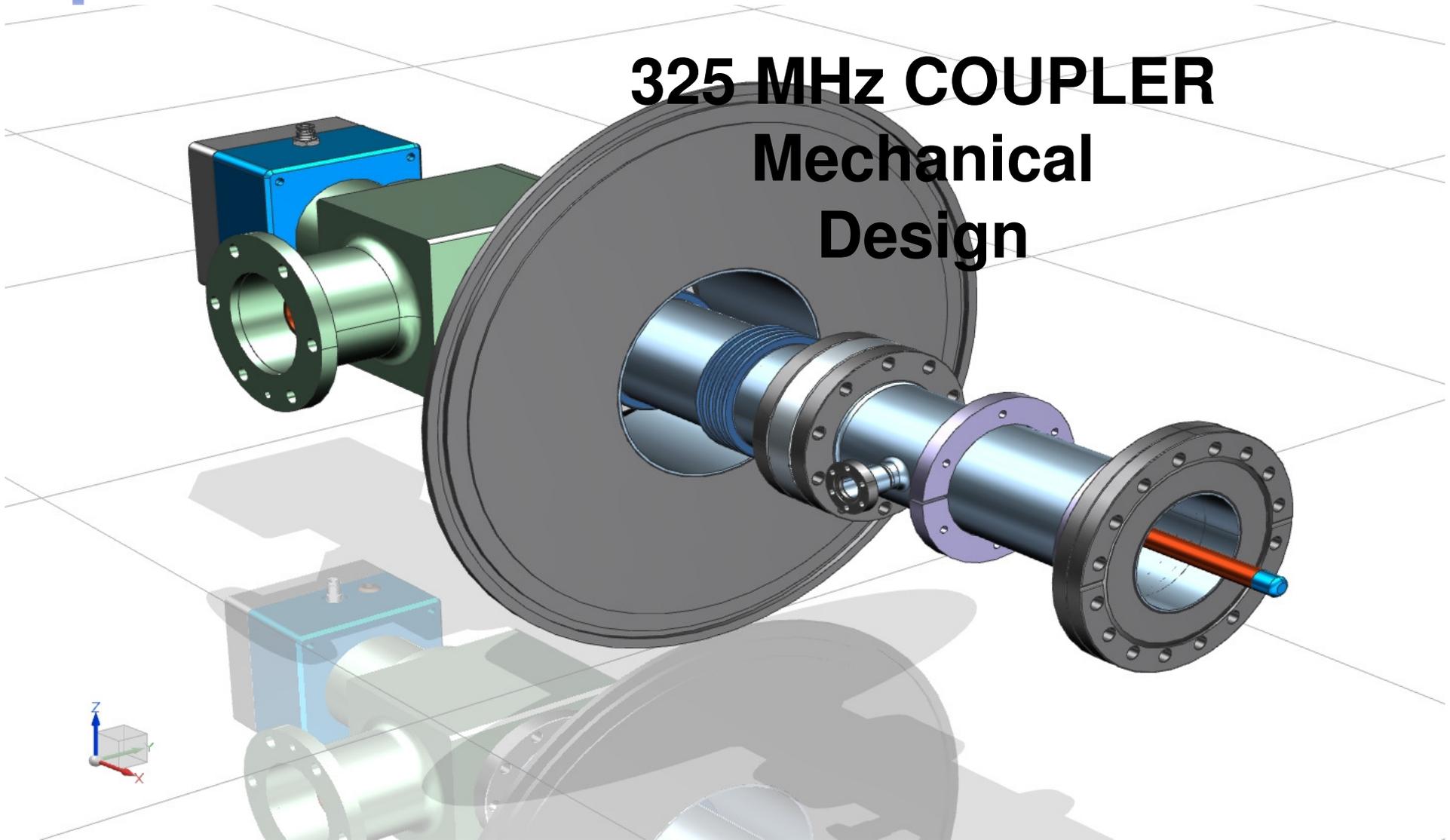




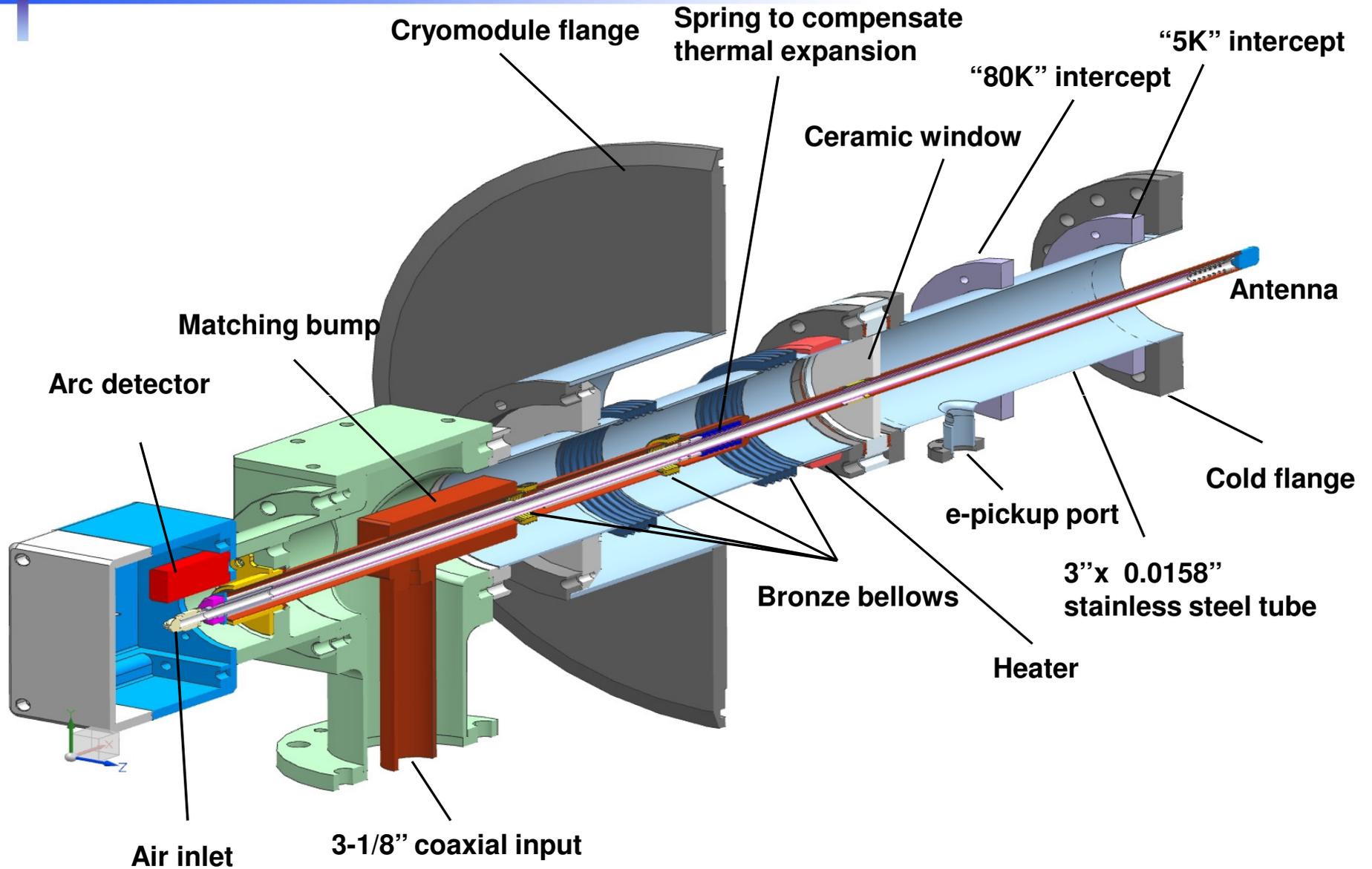
325 MHz COUPLER

Mechanical Design



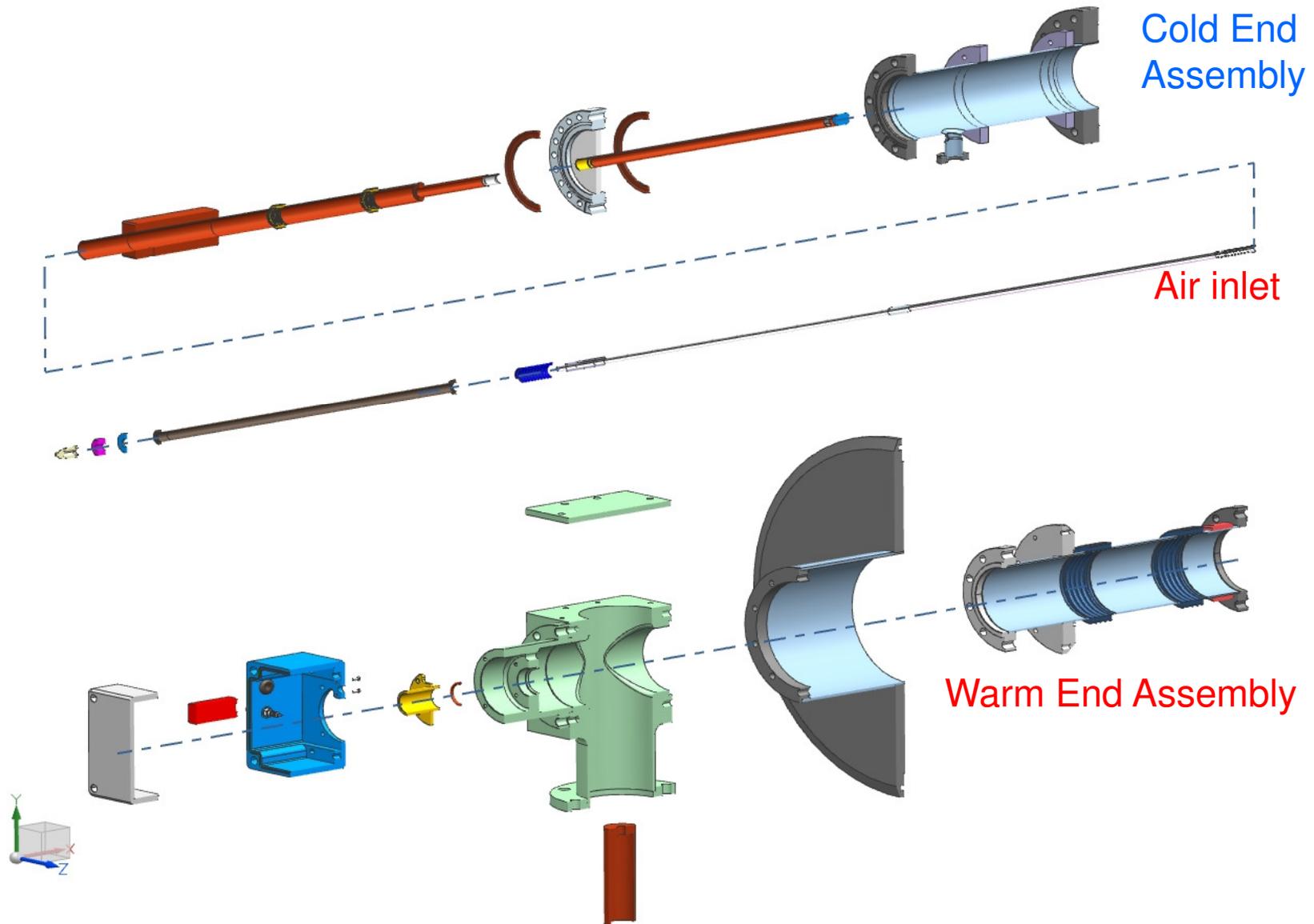


Main components



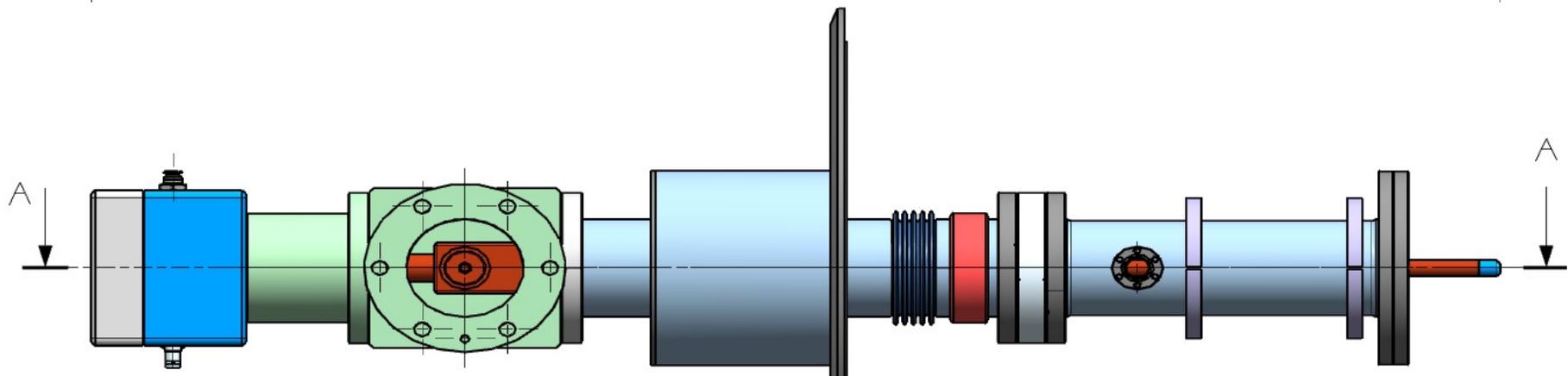
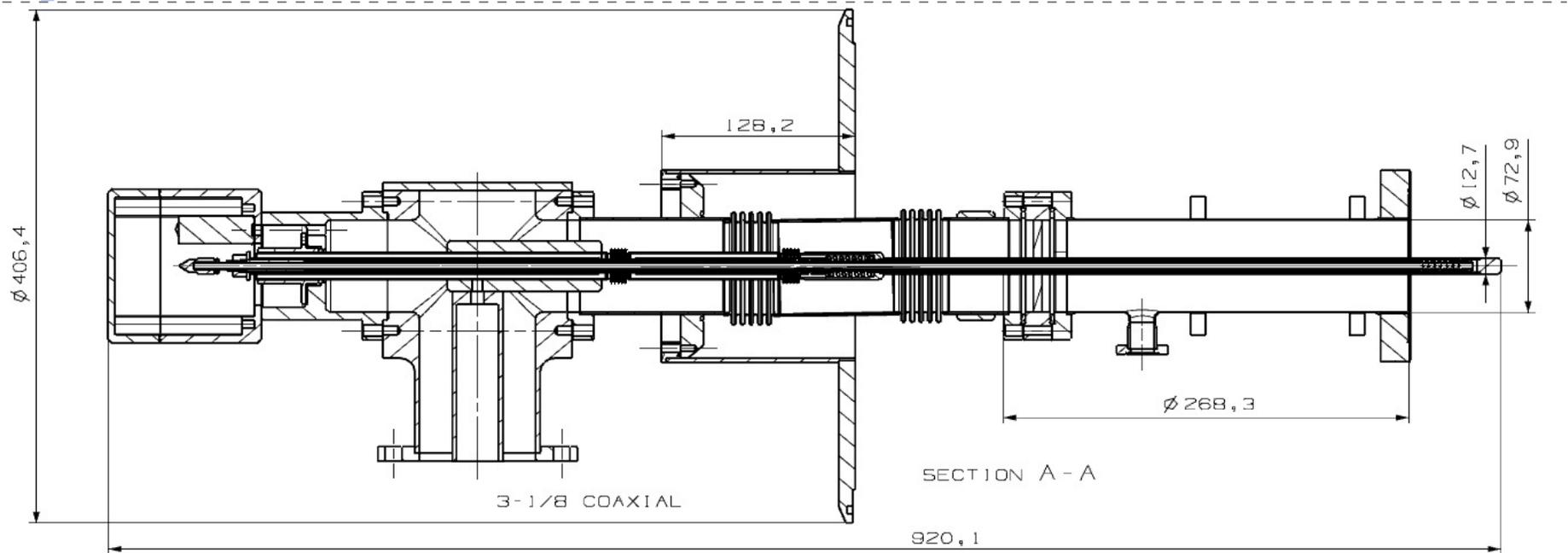


Main components



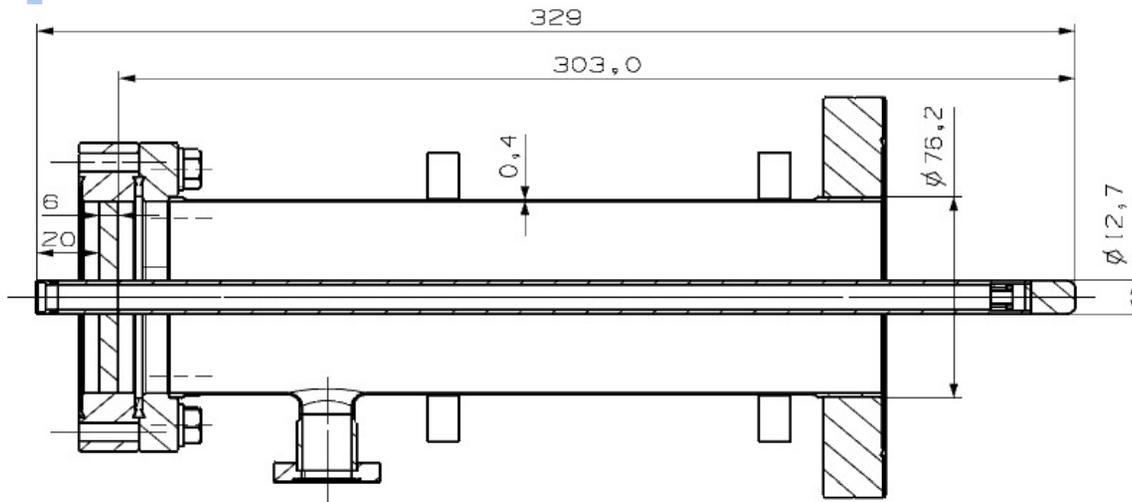


Main components

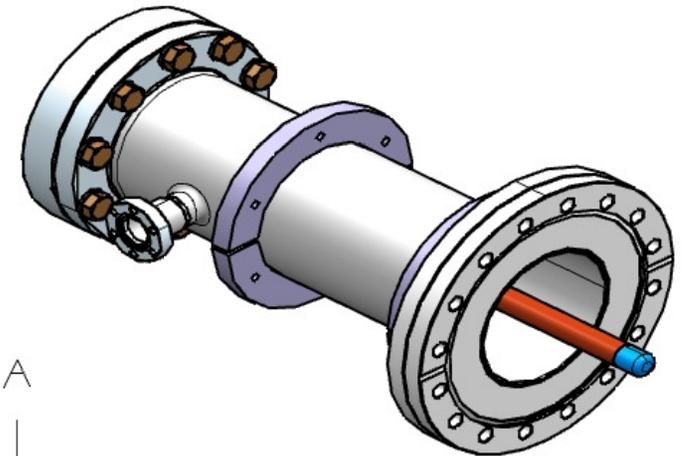
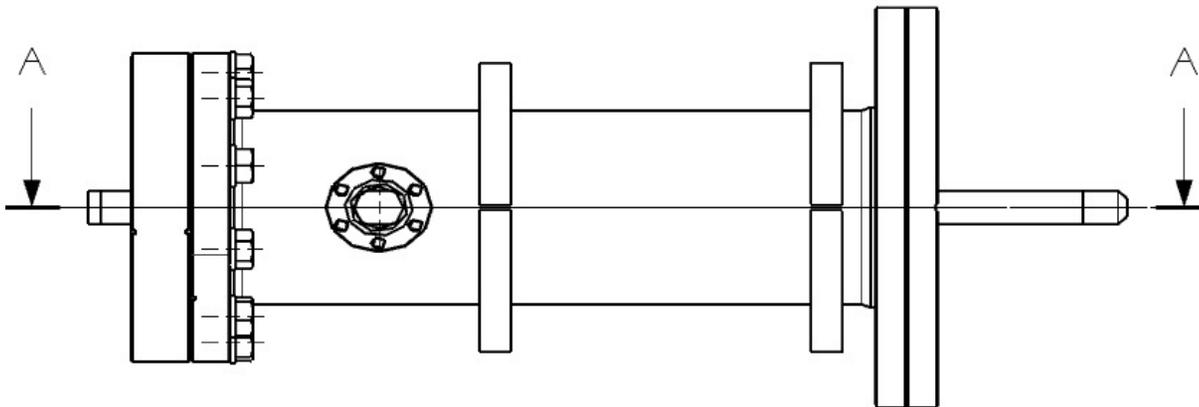




Cold End Assembly

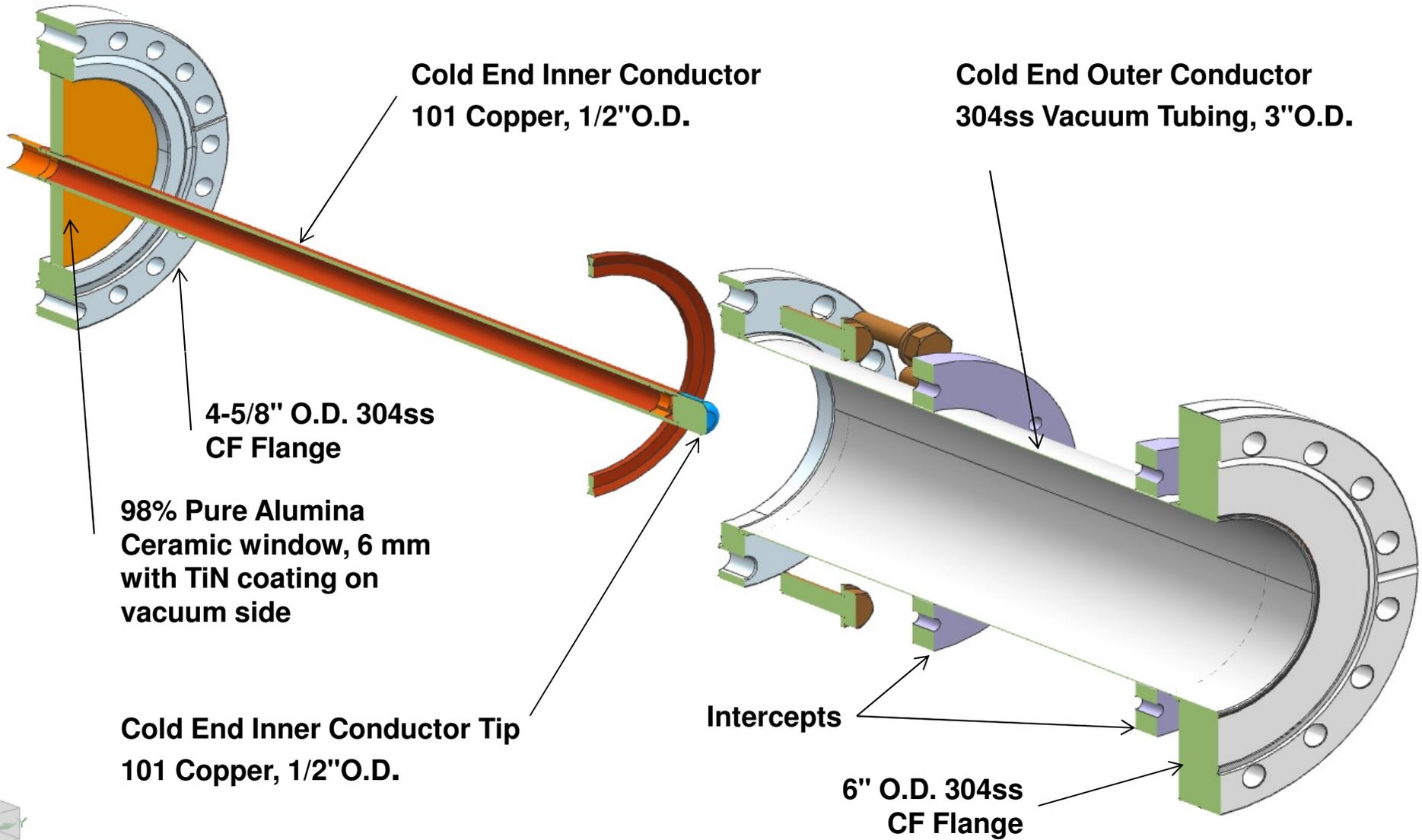


SECTION A - A



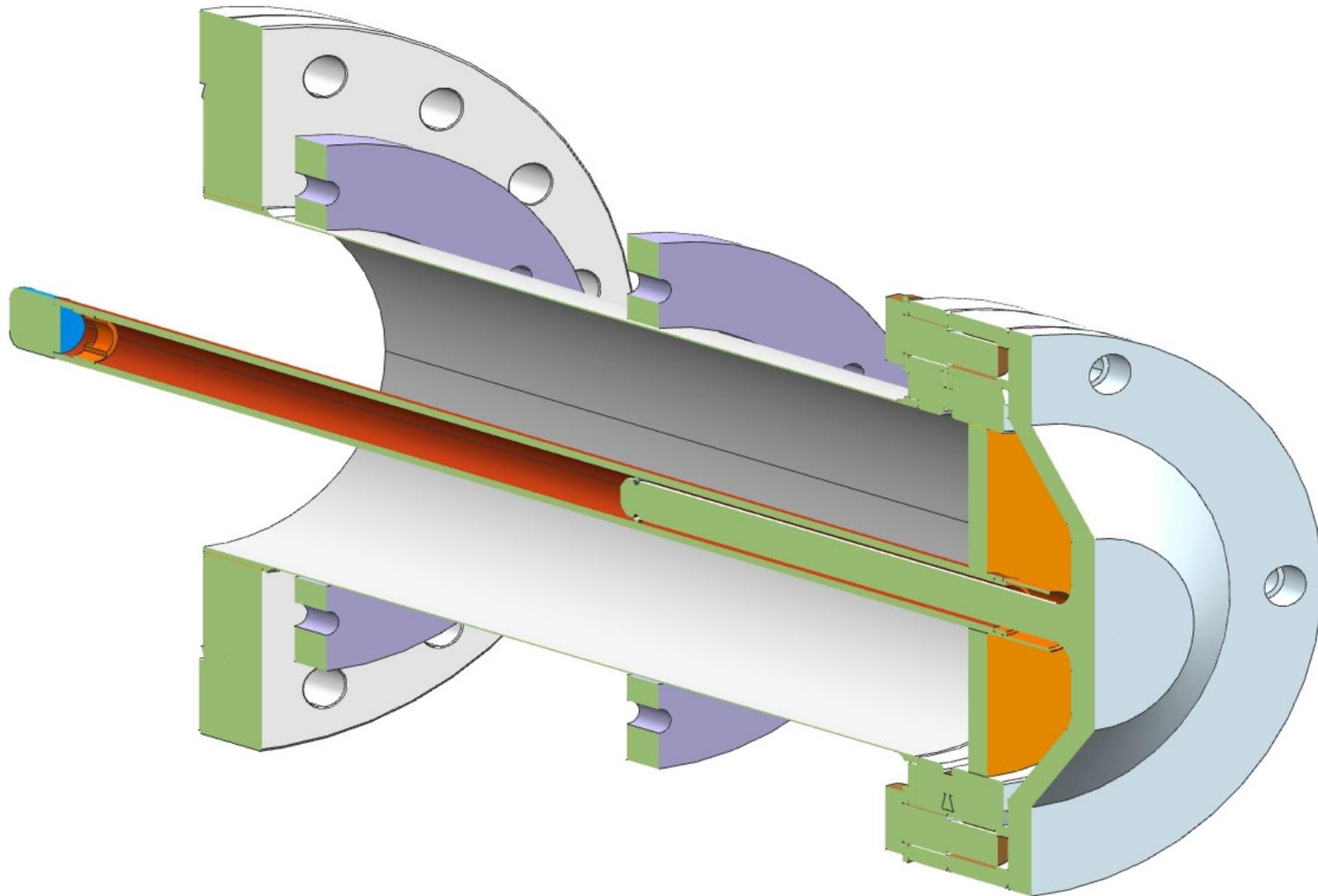


Cold End Assembly



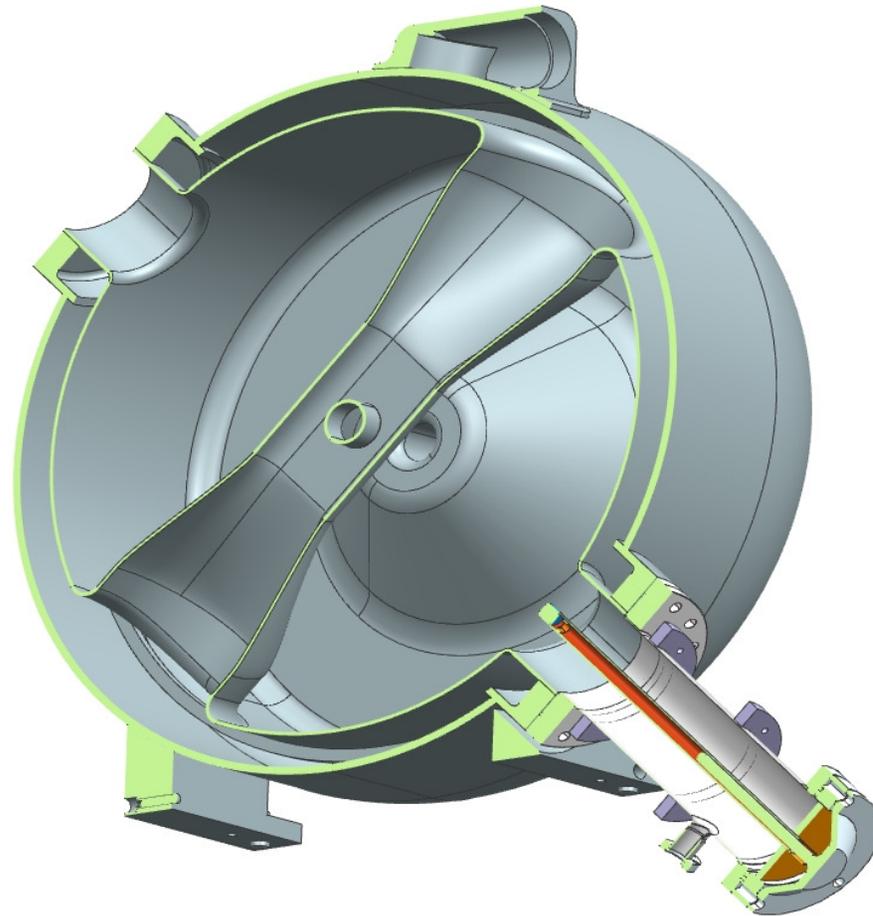


Cold End Assembly Cover



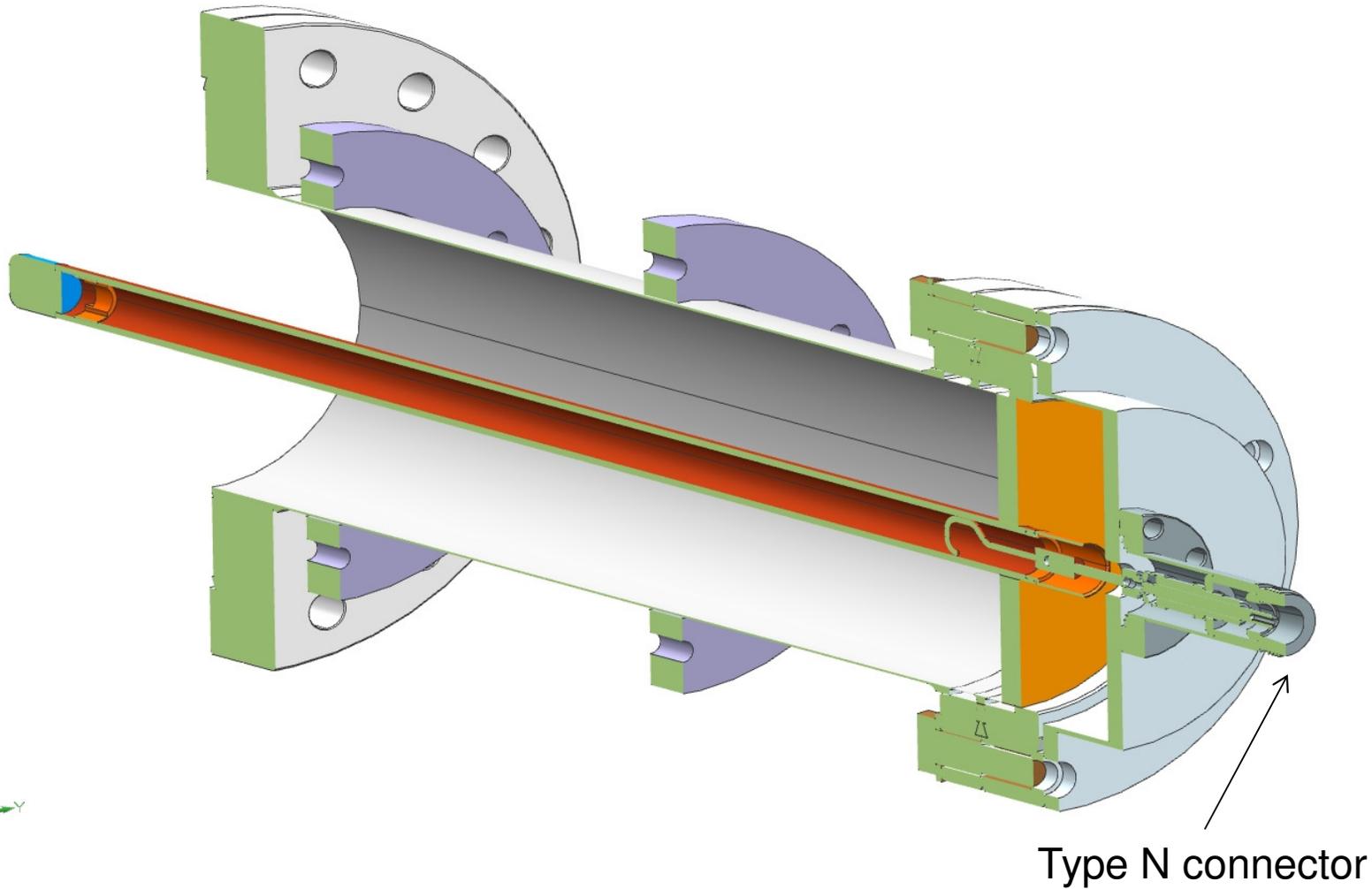


Cold End Assembly Cover



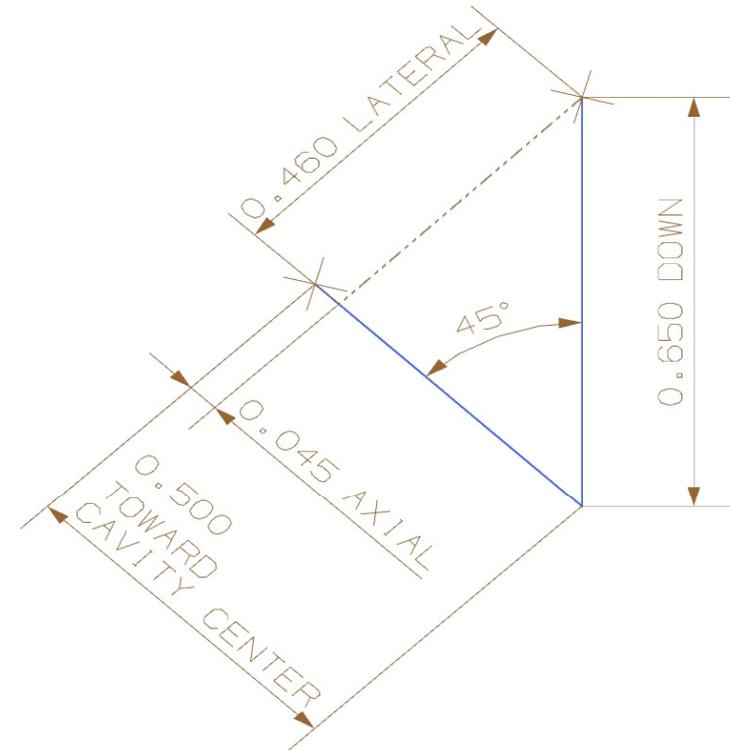
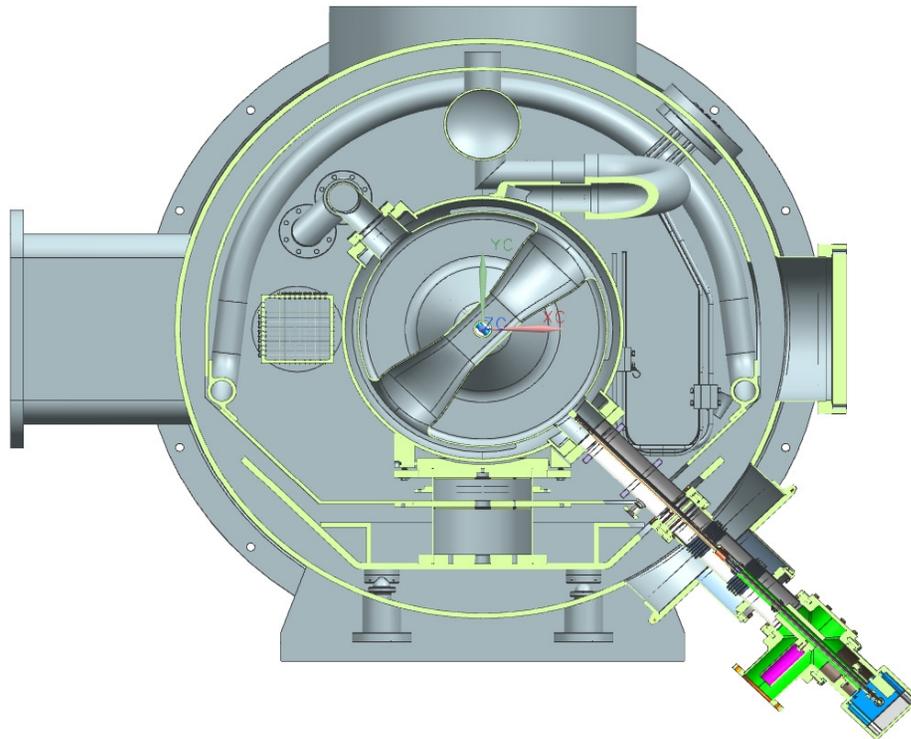


Instrumentation flange for resonator frequency measurements





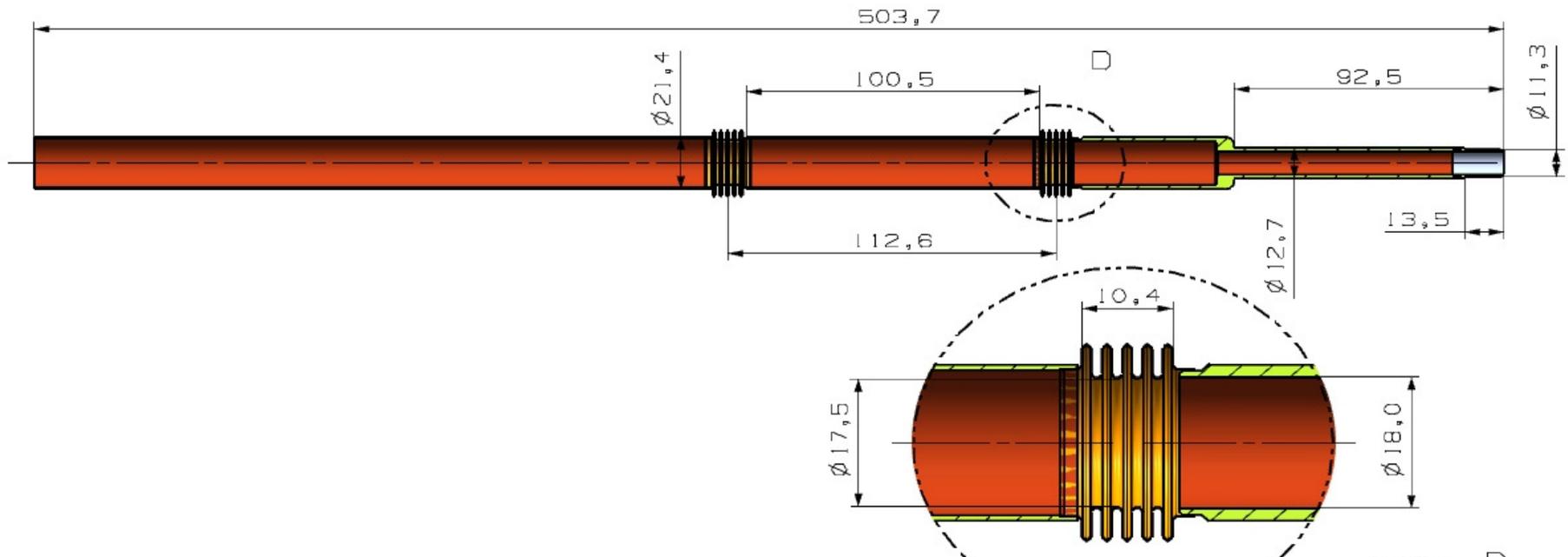
Cavity Coupler flange displacement



According to Tom Nicol estimate the coupler flange moves 0.5 mm down and 0.65 mm toward the cavity center during cooldown. This doesn't include any initial misalignment. In the current support scheme there is no motion along the beamline.



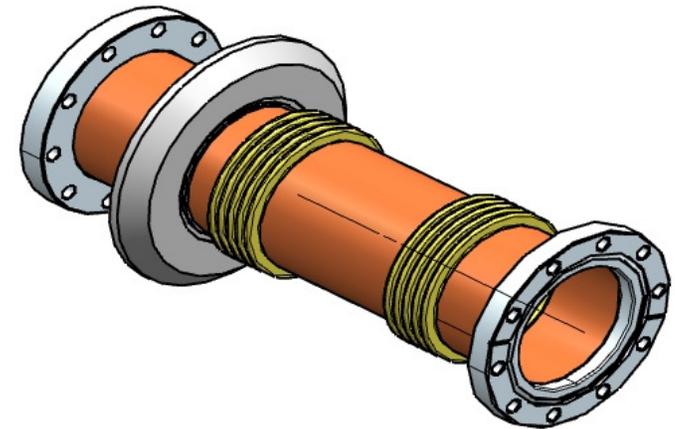
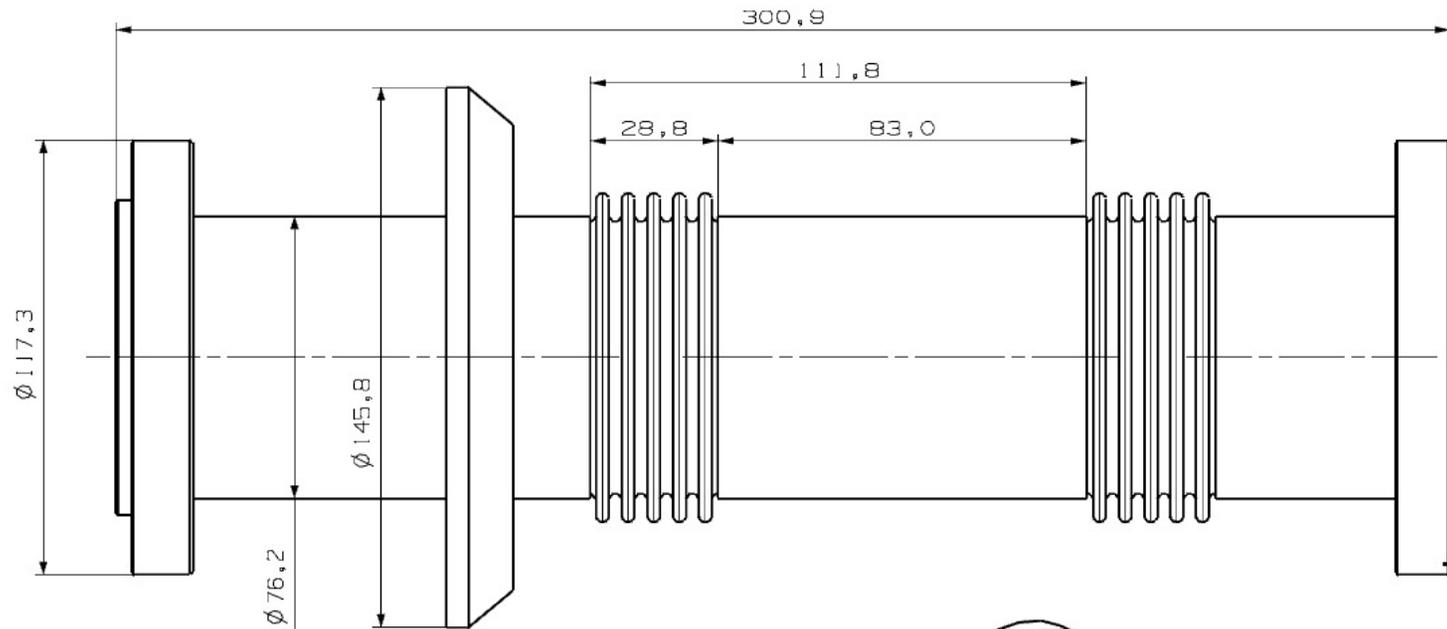
Warm Antenna with bellows



1. C51000 Phosphor Bronze Bellows, Copper Alloy UNS C10100 pipes and 316 SS end piece, Fusion welded.
2. Lateral movement - 3 mm limited by pusher
3. Axial movement per convolution – 0.333 mm, Total Axial movement – 3.33 mm
4. Axial spring rate per convolution – 314 lb/inch, for assembly - 31.4 lbs/in
5. Lateral spring rate for assembly ~ 1 lbs/in
6. Life expectancy is 25 years, 10 cycles per year.
We need 3 mm lateral movement to compensate for cooldown displacement and initial misalignment.



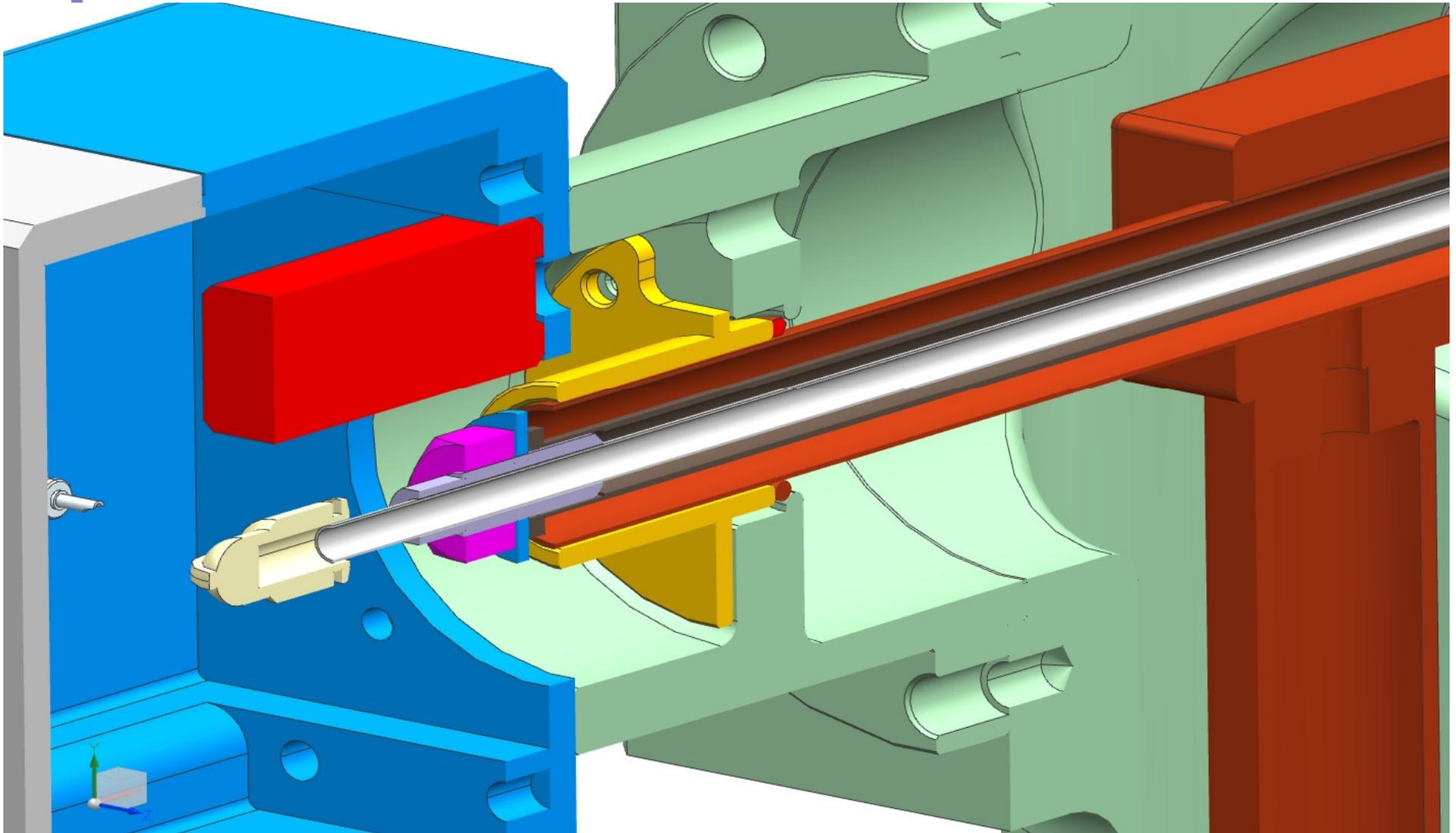
Warm Outer Conductor



1. C51000 Phosphor Bronze Bellows, Copper Alloy
UNS C10100 pipes and 316 stainless steel flanges.
2. Lateral movement - 8 mm
3. Axial movement – 10.7 mm
4. Axial spring rate for assembly – 69 lbs/in
5. Lateral spring rate for assembly – 19 lbs/in
6. Life expectancy is 25 years, 10 cycles per year.

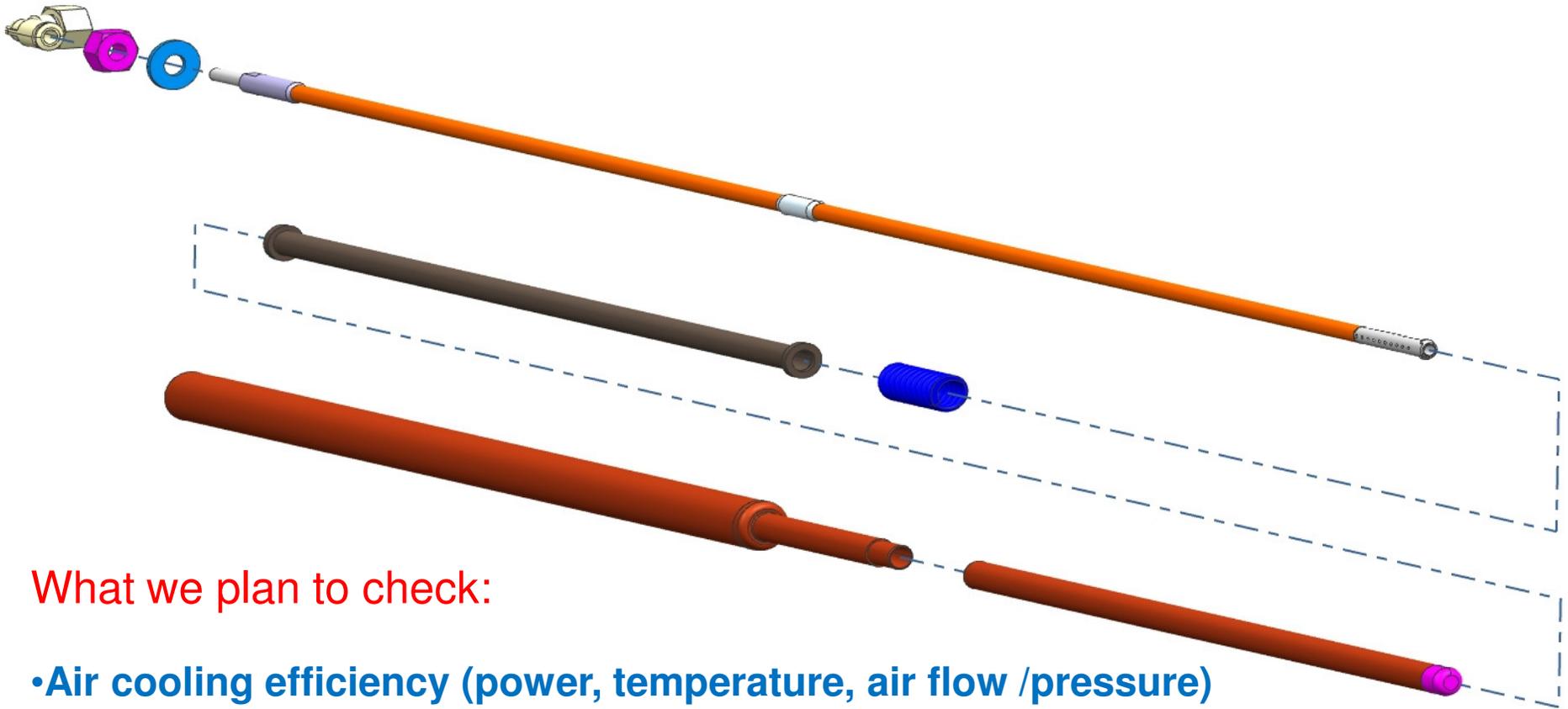


Connection between Cold and Warm Antenna





Test set up for 325 Coupler

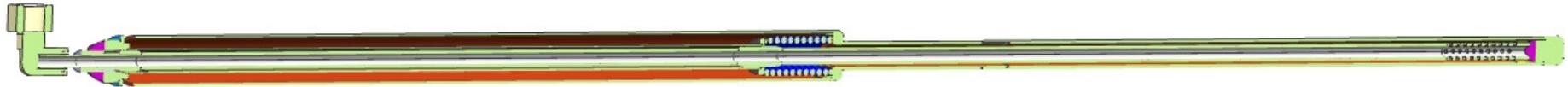
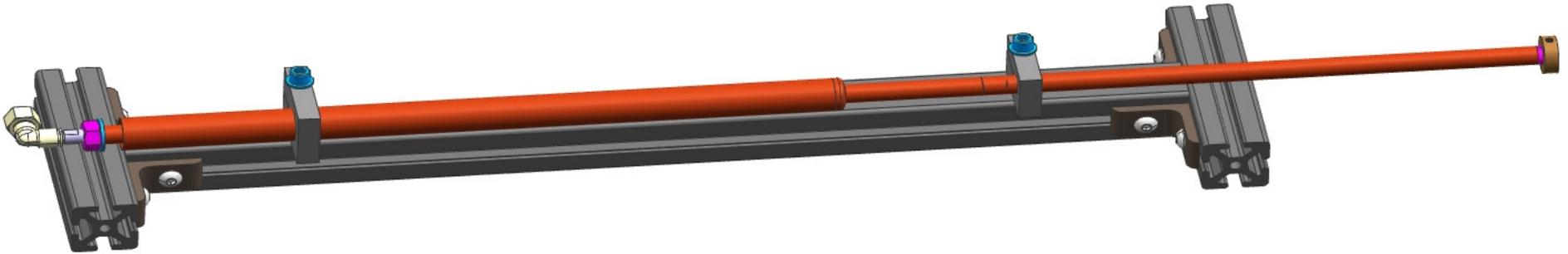


What we plan to check:

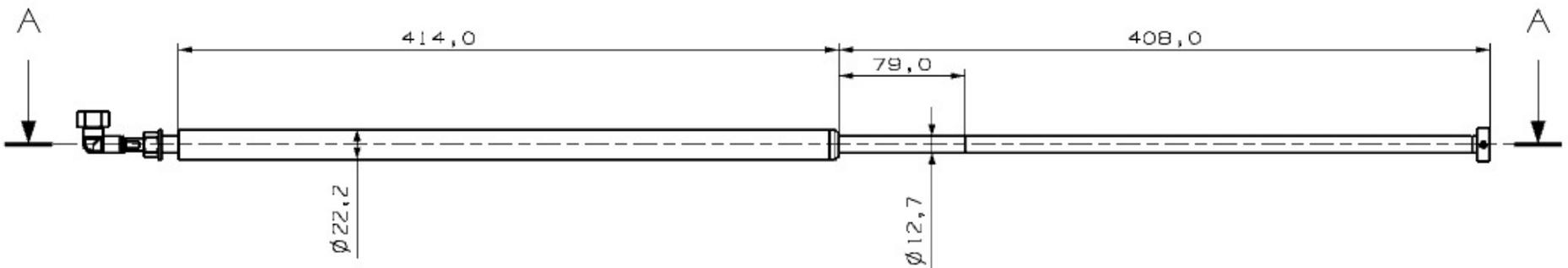
- Air cooling efficiency (power, temperature, air flow /pressure)
- Air flow noise
- Resonance frequency of antennas (325 MHz and 650 MHz)



Test set up for 325 Coupler



SECTION A - A



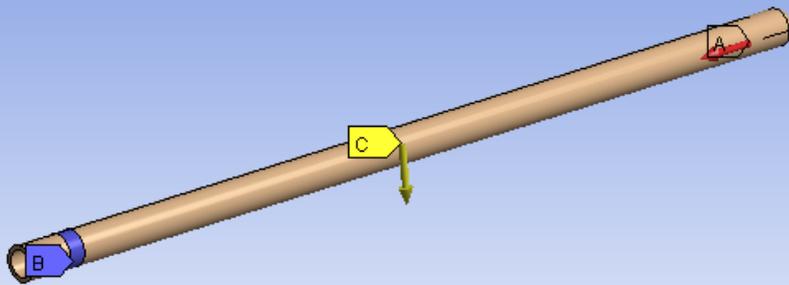


Cold Antenna Stress Analysis

B: Static Structural
Static Structural
Time: 1. s
1/27/2012 10:23 AM



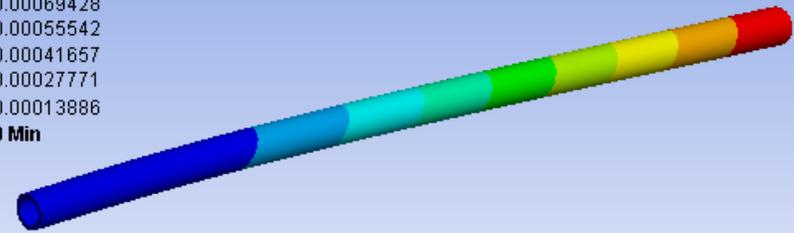
- A** Force: 80. lbf
- B** Fixed Support
- C** Standard Earth Gravity: 386.09 in/s²



B: Static Structural
Total Deformation
Type: Total Deformation
Unit: in
Time: 1
1/27/2012 10:24 AM



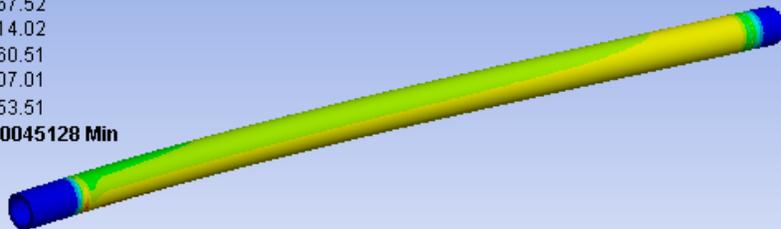
- 0.0012497 Max**
- 0.0011108
- 0.00097199
- 0.00083313
- 0.00069428
- 0.00055542
- 0.00041657
- 0.00027771
- 0.00013886
- 0 Min**



B: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
1/27/2012 10:25 AM



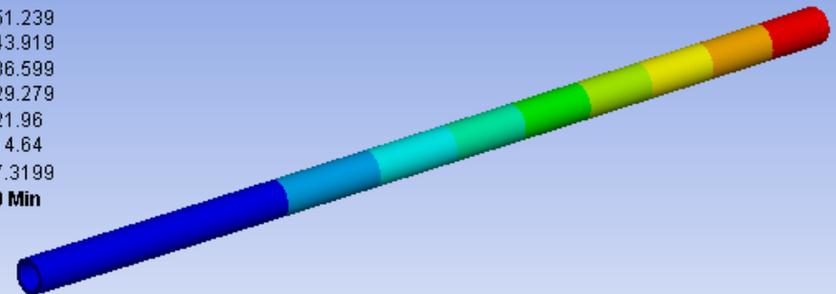
- 1381.5 Max**
- 1228
- 1074.5
- 921.02
- 767.52
- 614.02
- 460.51
- 307.01
- 153.51
- 0.0045128 Min**



C: Modal
Total Deformation
Type: Total Deformation
Frequency: 105.63 Hz
Unit: in
1/27/2012 10:25 AM



- 65.879 Max**
- 58.559
- 51.239
- 43.919
- 36.599
- 29.279
- 21.96
- 14.64
- 7.3199
- 0 Min**



Max Equivalent stress in Cold Antenna is 1381.5 PSI (1883 PSI for 3G) which is less than allowable stress of of 5300 PSI for Copper Alloy UNS C10100. Linear Buckling load multiplier is 23.4.



325 MHz Coupler

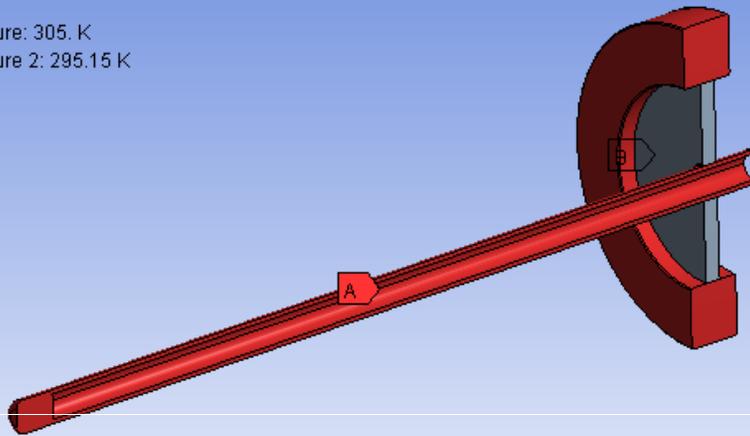
Cold Antenna Stress Analysis

B: Steady-State Thermal

Steady-State Thermal
Time: 1. s
1/27/2012 8:29 AM

- A** Temperature: 305. K
- B** Temperature 2: 295.15 K

ANSYS
13.0

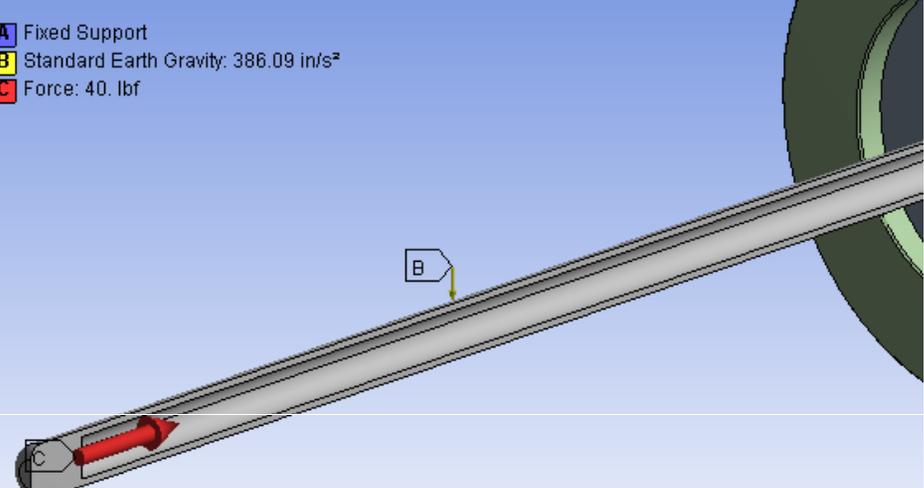


C: Static Structural

Static Structural
Time: 1. s
1/27/2012 11:05 AM

- A** Fixed Support
- B** Standard Earth Gravity: 386.09 in/s²
- C** Force: 40. lbf

ANSYS
13.0

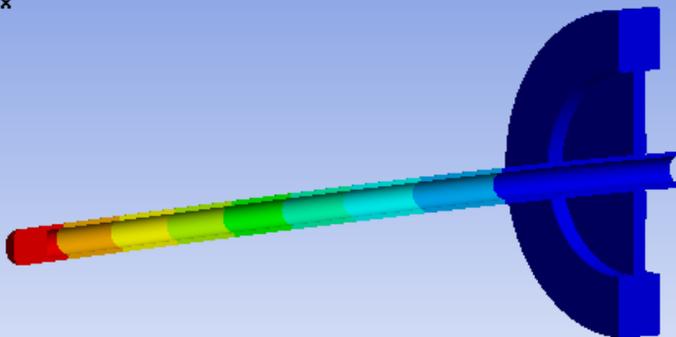


C: Static Structural

Total Deformation
Type: Total Deformation
Unit: in
Time: 1
1/27/2012 11:07 AM

- 0.0027119 Max**
- 0.0024106
- 0.0021093
- 0.0018079
- 0.0015066
- 0.0012053
- 0.00090397
- 0.00060265
- 0.00030132
- 0 Min**

ANSYS
13.0

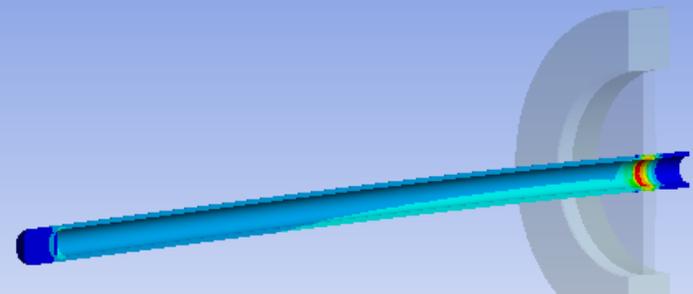


C: Static Structural

Equivalent Stress 4
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
1/27/2012 11:32 AM

- 4393.9 Max**
- 3905.7
- 3417.5
- 2929.3
- 2441.1
- 1952.9
- 1464.7
- 976.52
- 488.32
- 0.12497 Min**

ANSYS
13.0



Max Equivalent stress in Cold Antenna is 4393.9 PSI which is less than allowable stress of of 5300 PSI for Copper Alloy UNS C10100.

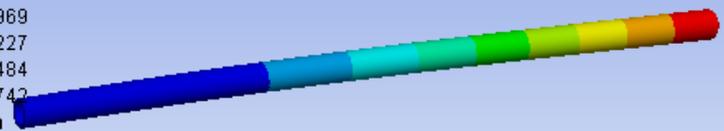
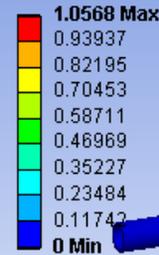
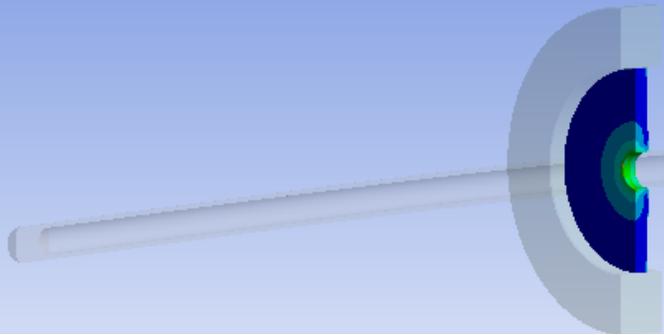
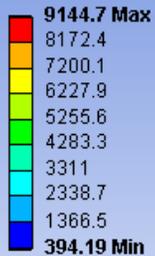


Cold Antenna Stress Analysis

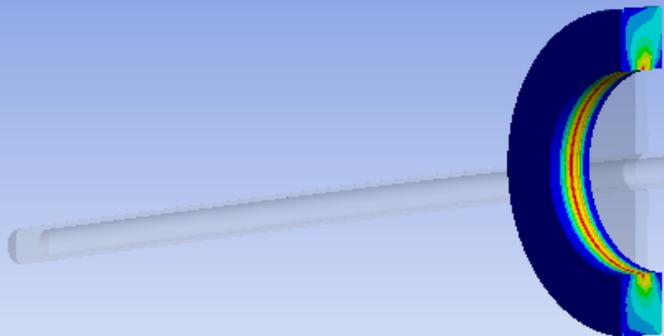
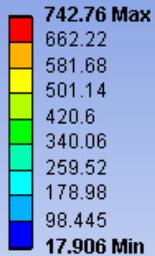
C: Static Structural
Equivalent Stress 3
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
1/27/2012 11:31 AM



D: Linear Buckling
Total Deformation
Type: Total Deformation
Load Multiplier: 23.407
Unit: in
Time: 23.407
2/1/2012 1:37 PM



C: Static Structural
Equivalent Stress 2
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
1/27/2012 11:09 AM



Max Equivalent stress in Cold Antenna is less than allowable. First Modal frequency is 105.63 Hz. Linear Buckling load multiplier is 23.4.

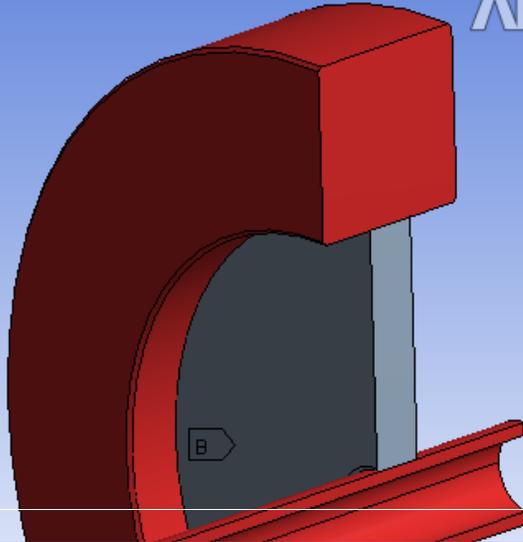


325 MHz Coupler

Cold Antenna Stress Analysis at 120 C

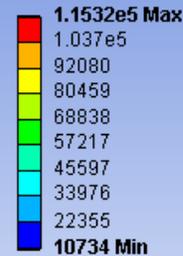
B: Steady-State Thermal
Steady-State Thermal
Time: 1. s
1/27/2012 9:51 AM

- A** Temperature: 120. °C
- B** Temperature 2: 120. °C



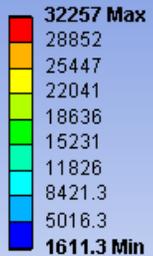
ANSYS
13.0

C: Static Structural
Equivalent Stress 3
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
1/27/2012 9:49 AM



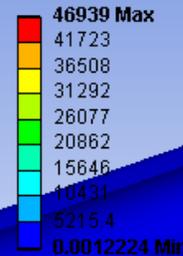
ANSYS
13.0

C: Static Structural
Equivalent Stress 2
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
1/27/2012 9:48 AM



ANSYS
13.0

C: Static Structural
Equivalent Stress 4
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
1/27/2012 9:50 AM

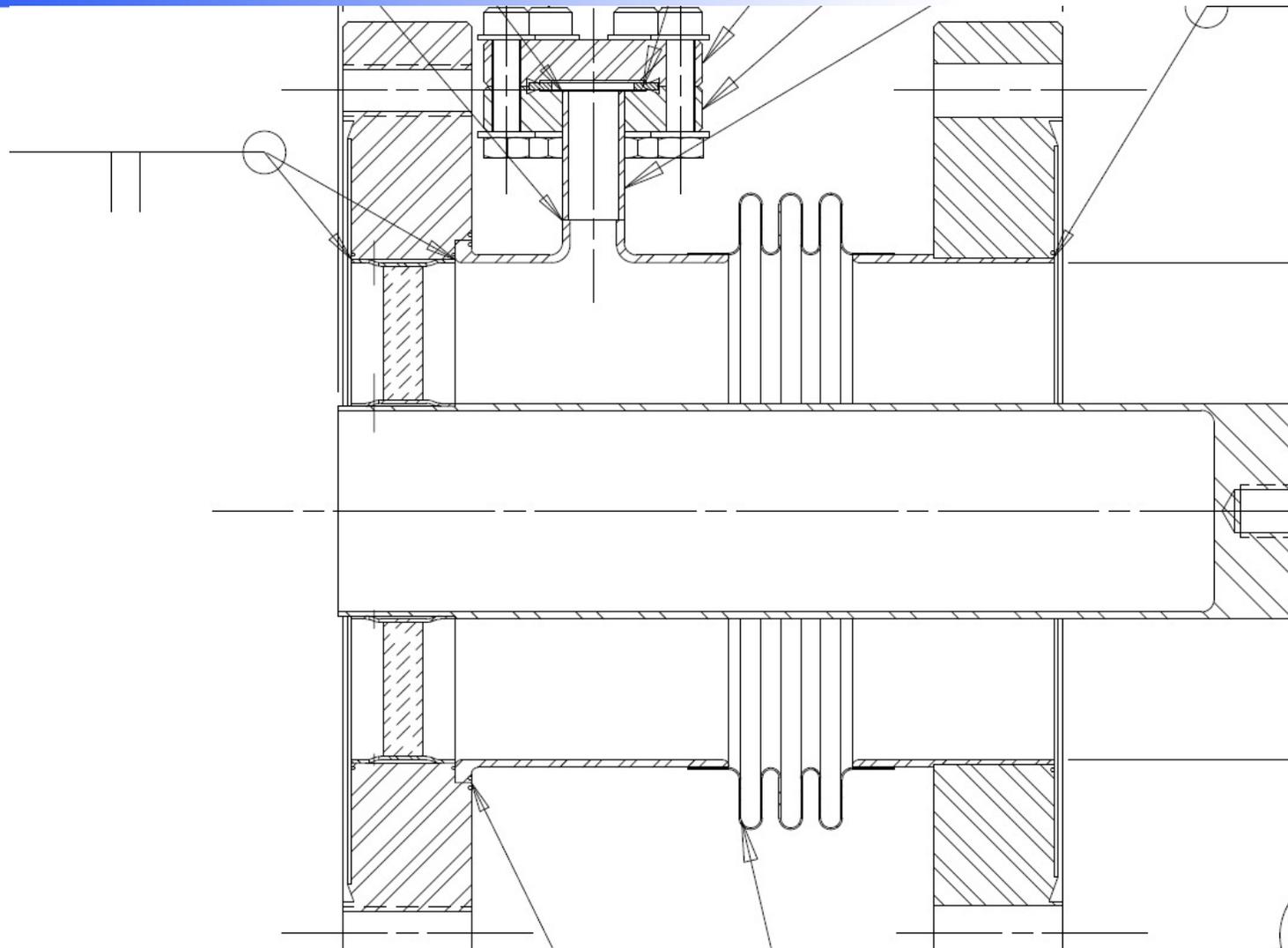


ANSYS
13.0

At 120 C stresses are too high. Need to use sleeves to protect ceramic disc.



Ceramic to metal connection

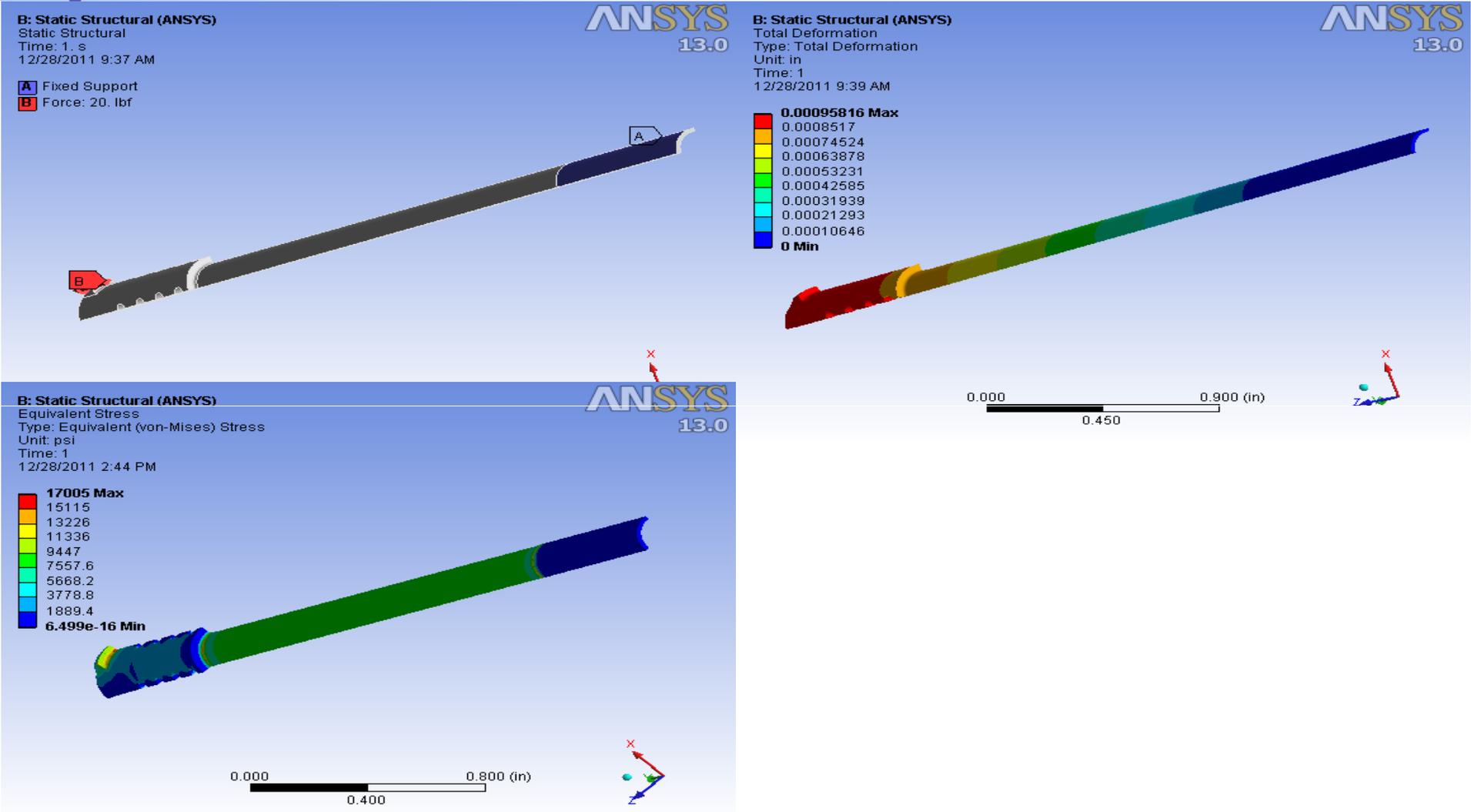


Khabibuline-Nicol design Coupler



325 MHz Coupler

Coupler Air Inlet Connection Stress Analysis

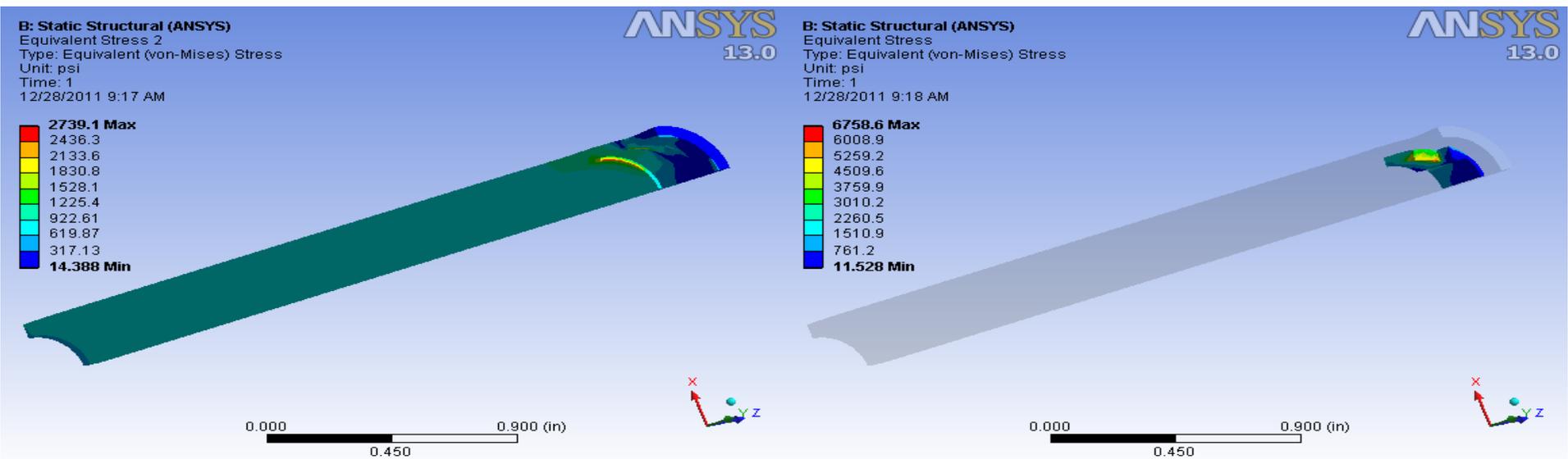
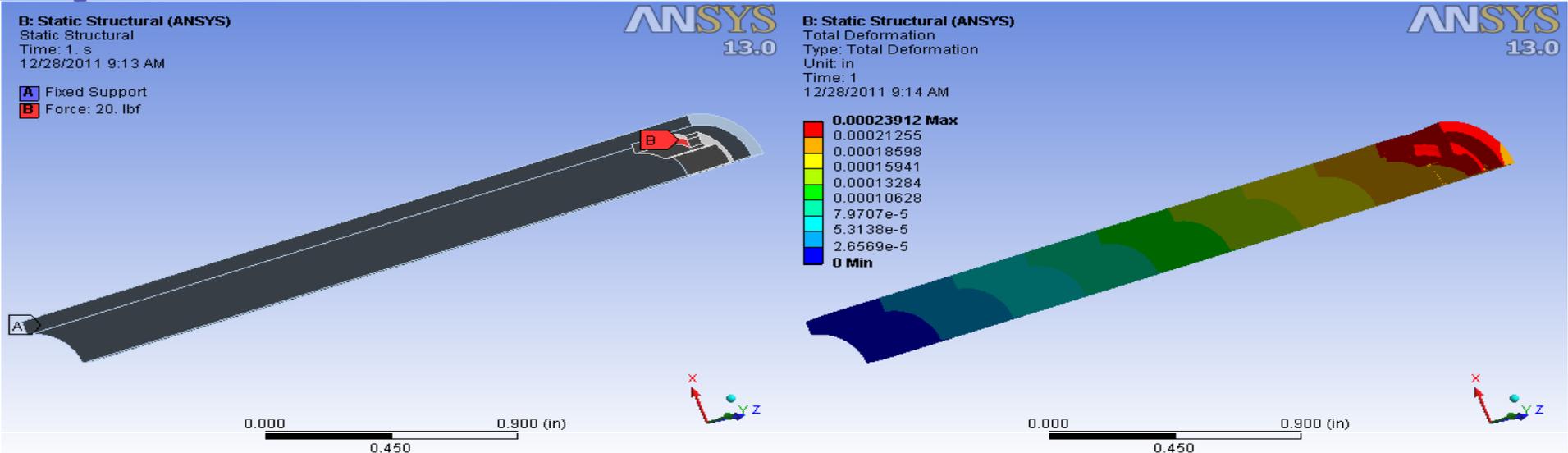


Max Equivalent stress in Connection is 17005 PSI which is less than allowable stress of 20,000PSI for 316 stainless steel



325 MHz Coupler

Coupler Air Inlet Connection Stress Analysis

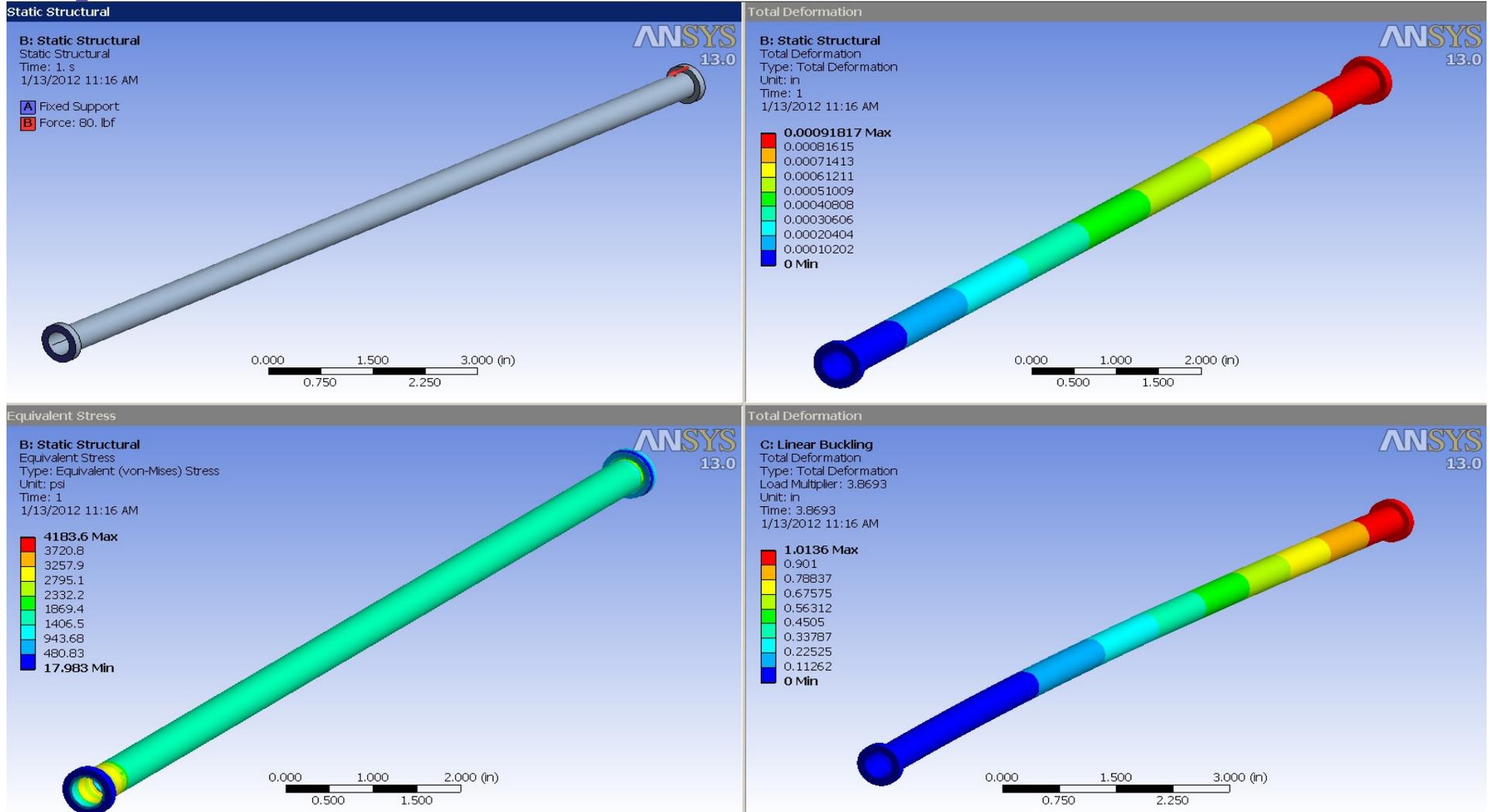


Max Equivalent stress in Connection is 6758.6 PSI which is less than allowable stress of 20,000PSI for 316 stainless steel



325 MHz Coupler

Coupler Pusher Stress Analysis



Max Equivalent stress in Pusher is 4183.6 PSI which is less than allowable stress of 20,000PSI for 316 stainless steel



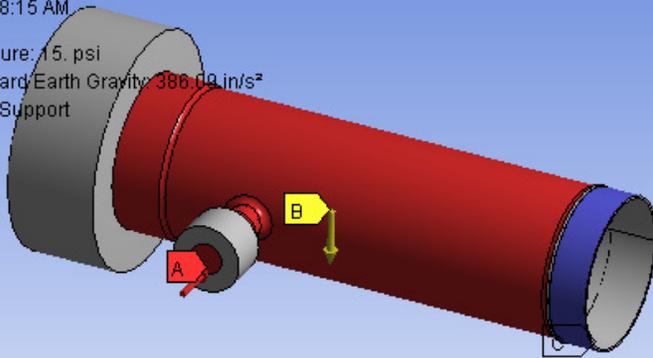
325 MHz Coupler

Cold Outer Conductor Stress Analysis at 15 PSI

B: Static Structural

Static Structural
Time: 1. s
2/1/2012 8:15 AM

- A** Pressure: 15. psi
- B** Standard Earth Gravity: 386.09 in/s²
- C** Fixed Support

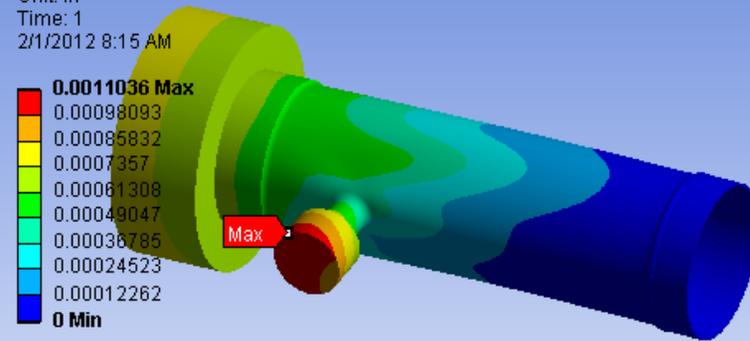


ANSYS
13.0

B: Static Structural

Total Deformation
Type: Total Deformation
Unit: in
Time: 1
2/1/2012 8:15 AM

- 0.0011036 Max
- 0.00098093
- 0.00085832
- 0.0007357
- 0.00061308
- 0.00049047
- 0.00036785
- 0.00024523
- 0.00012262
- 0 Min

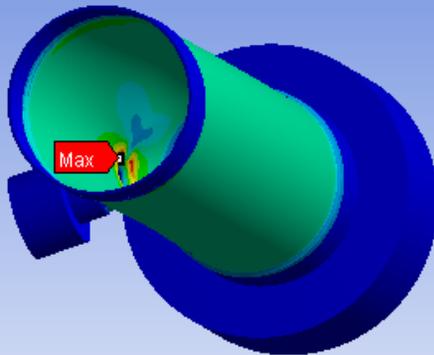


ANSYS
13.0

B: Static Structural

Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
2/1/2012 8:16 AM

- 3263.6 Max
- 2901
- 2538.4
- 2175.8
- 1813.1
- 1450.5
- 1087.9
- 725.25
- 362.63
- 0.00028688 Min

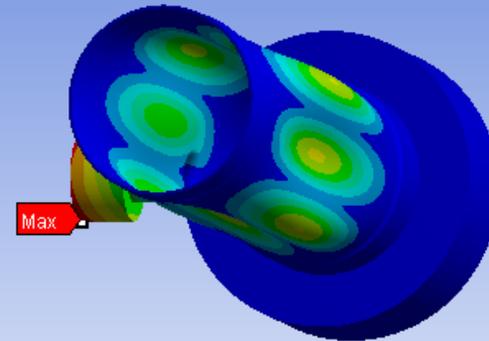


ANSYS
13.0

C: Linear Buckling

Total Deformation
Type: Total Deformation
Load Multiplier: 5.8162
Unit: in
Time: 5.8162
2/1/2012 9:04 AM

- 1.0663 Max
- 0.94782
- 0.82935
- 0.71087
- 0.59239
- 0.47391
- 0.35543
- 0.23696
- 0.11848
- 0 Min



ANSYS
13.0

Max Equivalent stress in Outer Conductor is 3263.6 PSI which is less than allowable stress of 20,000PSI for 316 stainless steel



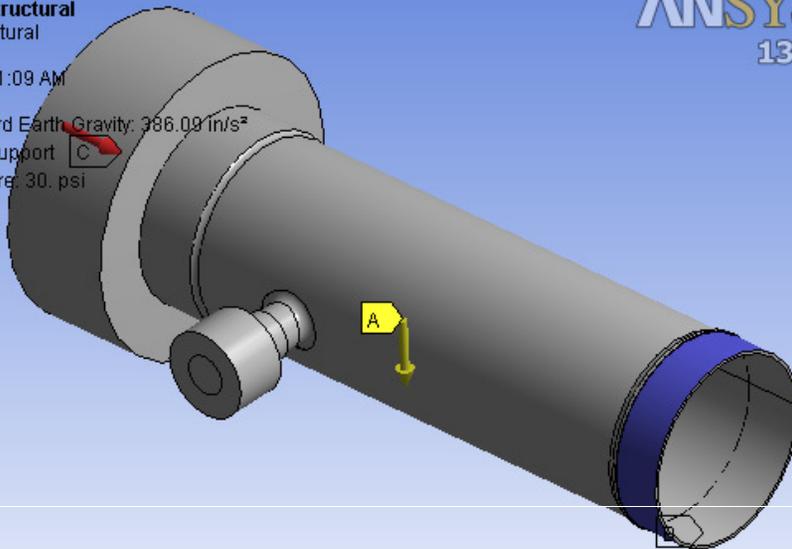
325 MHz Coupler

Cold Outer Conductor Stress Analysis at 30 PSI

B: Static Structural

Static Structural
Time: 1. s
2/1/2012 11:09 AM

- A** Standard Earth Gravity: 386.09 in/s²
- B** Fixed Support
- C** Pressure: 30. psi

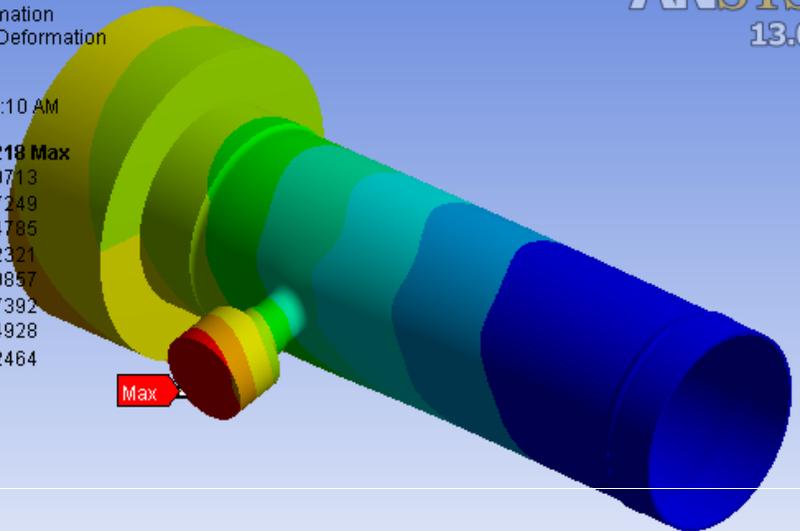


ANSYS
13.0

B: Static Structural

Total Deformation
Type: Total Deformation
Unit: in
Time: 1
2/1/2012 11:10 AM

- 0.0011218 Max
- 0.00099713
- 0.00087249
- 0.00074785
- 0.00062321
- 0.00049857
- 0.00037392
- 0.00024928
- 0.00012464
- 0 Min

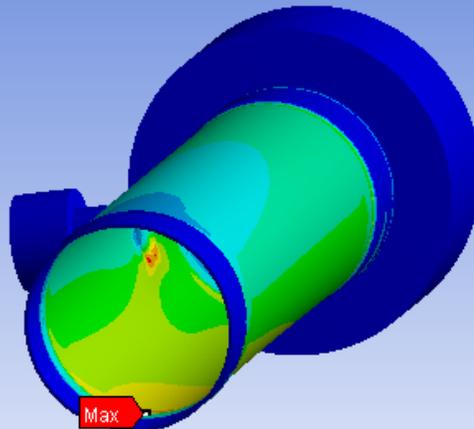


ANSYS
13.0

B: Static Structural

Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: psi
Time: 1
2/1/2012 11:11 AM

- 2972.4 Max
- 2642.1
- 2311.9
- 1981.6
- 1651.3
- 1321.1
- 990.8
- 660.53
- 330.27
- 0.00033888 Min

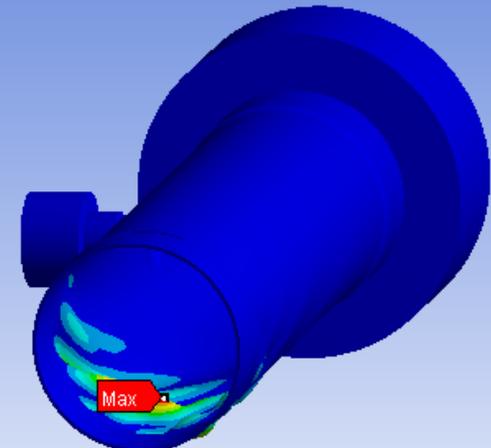


ANSYS
13.0

C: Linear Buckling

Total Deformation
Type: Total Deformation
Load Multiplier: 98.007
Unit: in
Time: 98.007
2/1/2012 11:12 AM

- 1.0029 Max
- 0.89147
- 0.78004
- 0.66886
- 0.55717
- 0.44574
- 0.3343
- 0.22287
- 0.11143
- 0 Min

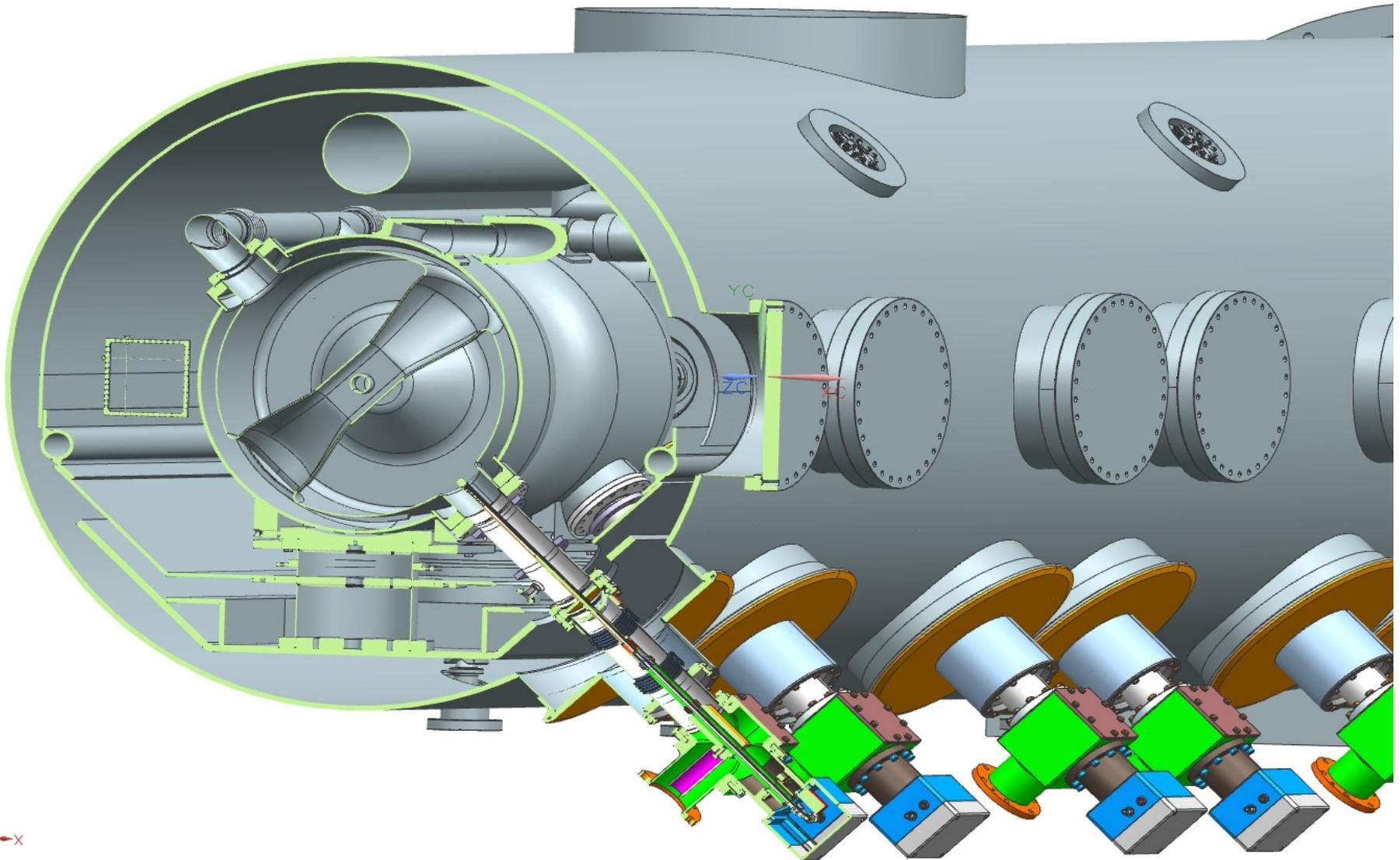


ANSYS
13.0

Max Equivalent stress in Outer Conductor is 2972.4 PSI which is less than allowable stress of 20,000PSI for 316 stainless steel



Coupler and Cryomodule





Coupler and Cryomodule

