Material Tests of SC Cavities and HeliumTanks for High Pressure Gas Code in Japan

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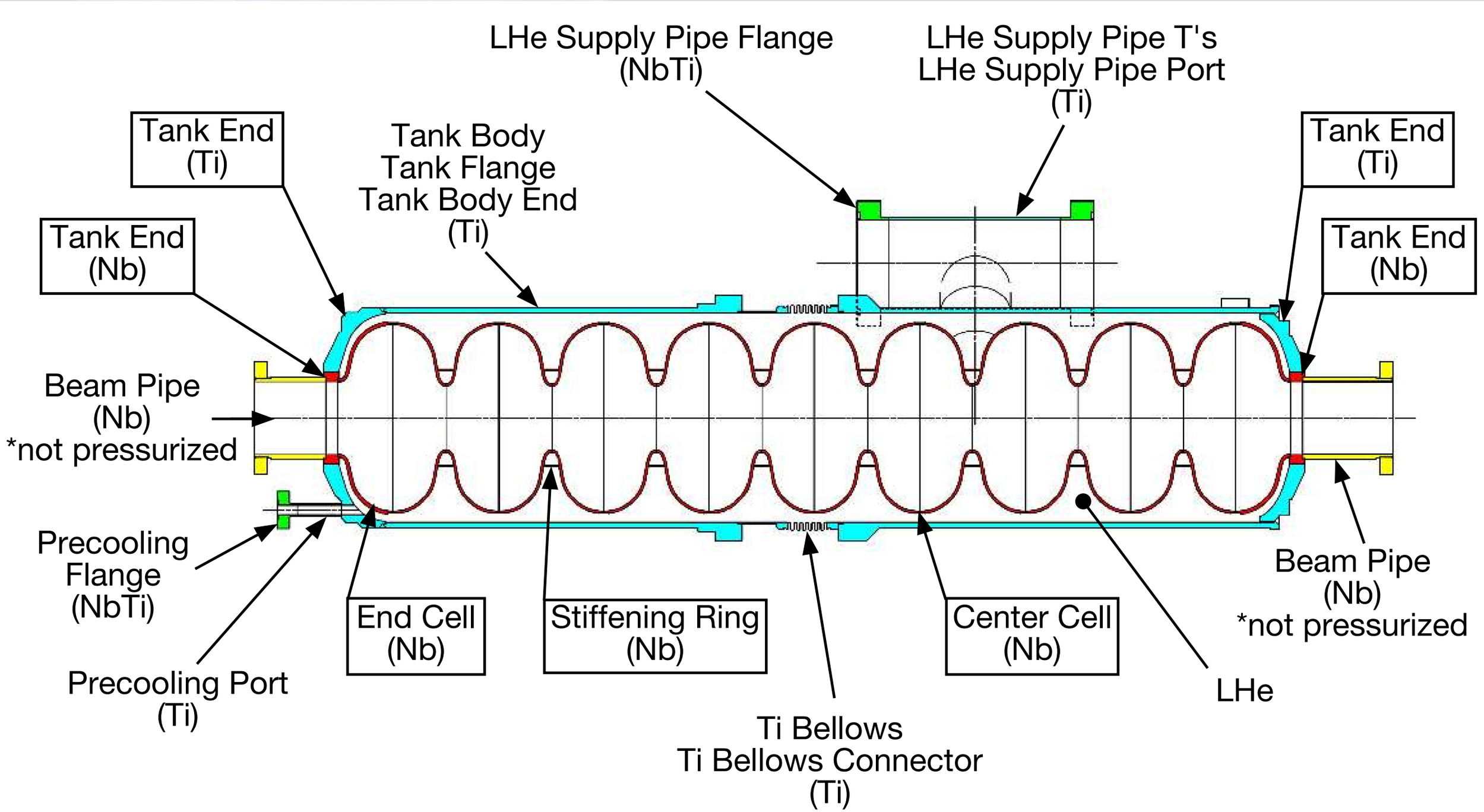
Employed Materials



Formulas for minimum thickness provided in high pressure gas code inapplicable to boxed parts ⟶ Numerical analyses required

High Pressure Code

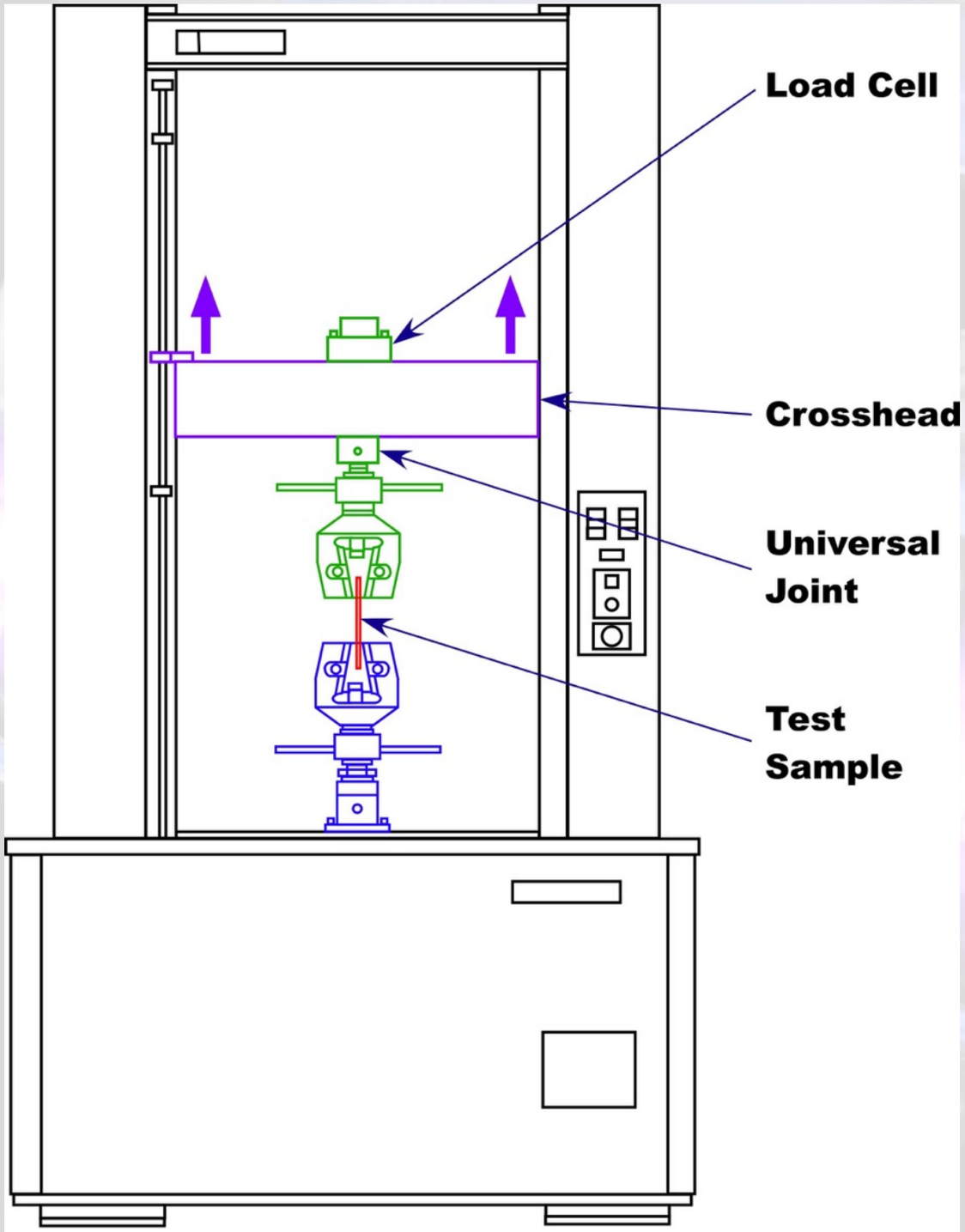
- Nb and NbTi are NOT specified in minimum use temperature table of high pressure gas code in Japan
- Ti is used at temperature lower than minimum use temperature specified in high pressure gas code table (-196 ℃)
- Allowable tensile stress of Nb and NbTi are NOT specified at operation temperature of sc cavities
- Ti is used at temperature lower than minimum use temperature for allowable tensile stress specified in high pressure gas code table (-196 ℃)
- Prior evaluation required for such unspecified matters to calculate strengths of these materials
- Tensile tests and Charpy impact tests are required at room temperature, liquid nitrogen temperature and liquid helium temperature for prior evaluation

Conducted Tests

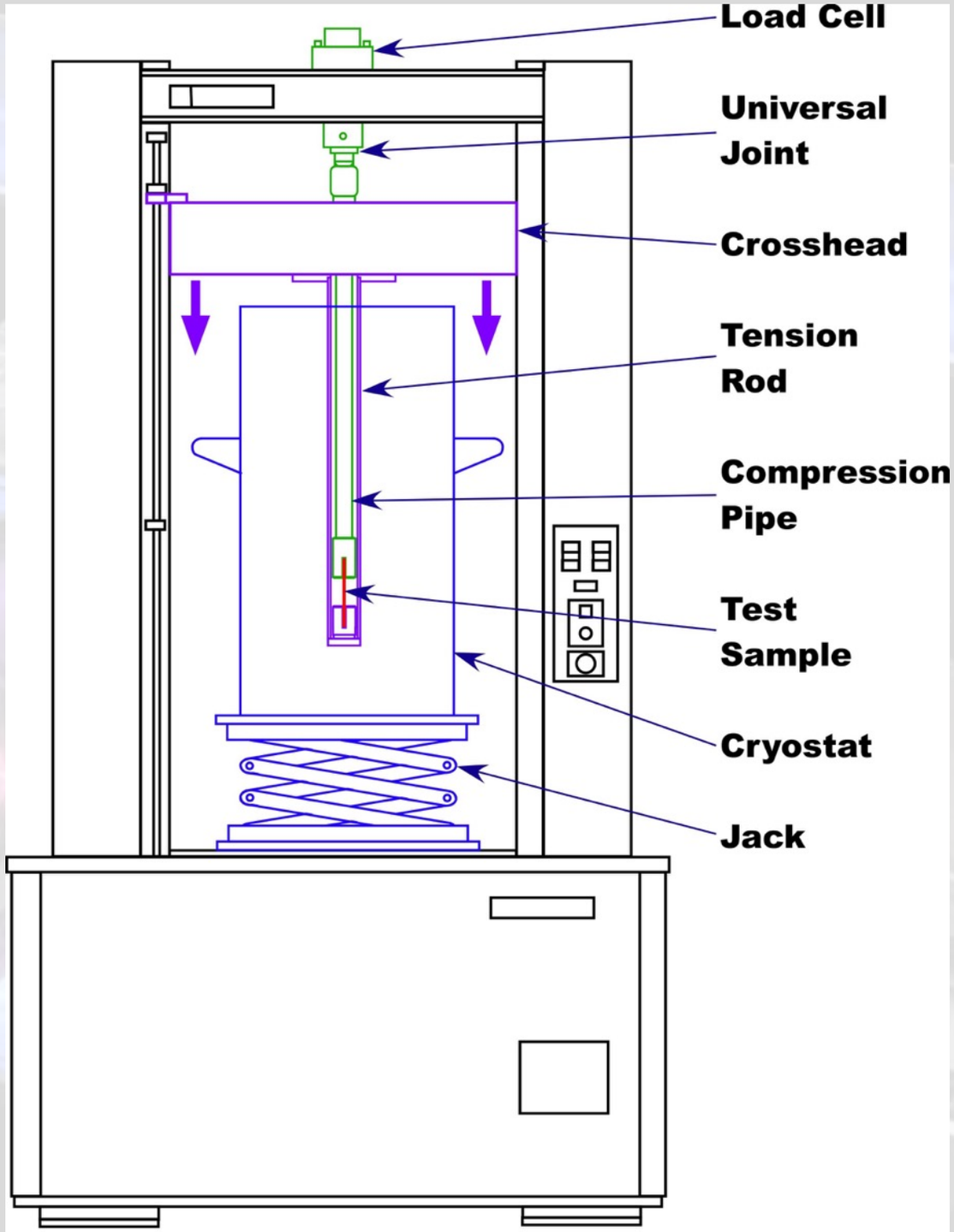
1) Tested Materials
   - Nb
   - Ti
   - NbTi
   - Nb-Nb weld joint (EBW, LBW)
   - Nb-Ti weld joint (EBW)
   - Ti-Ti weld joint (TIG)
   - Ti-NbTi weld joint (TIG)

2) Tests
   - Tensile
   - Charpy impact

Tensile Test Setup

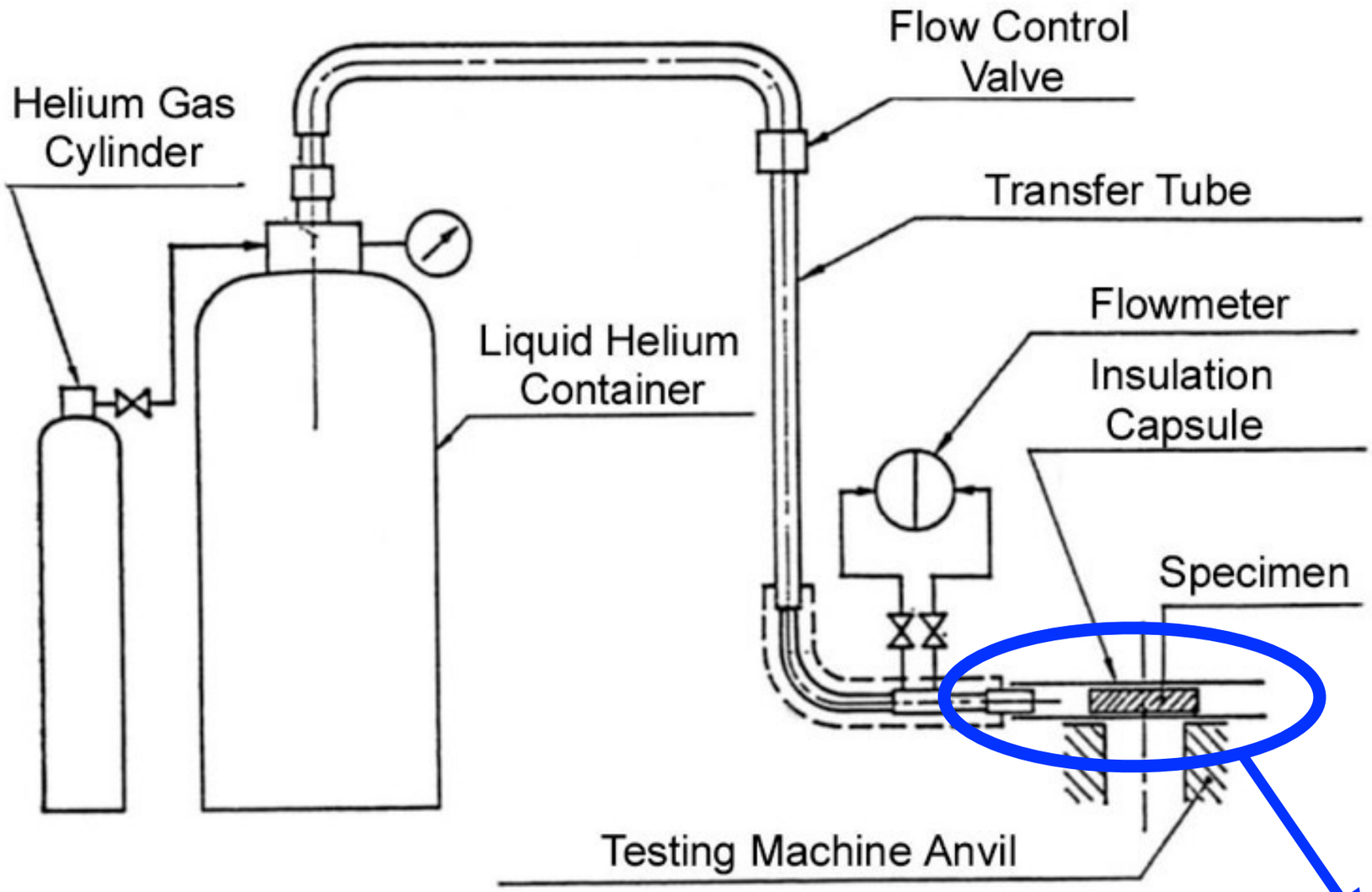


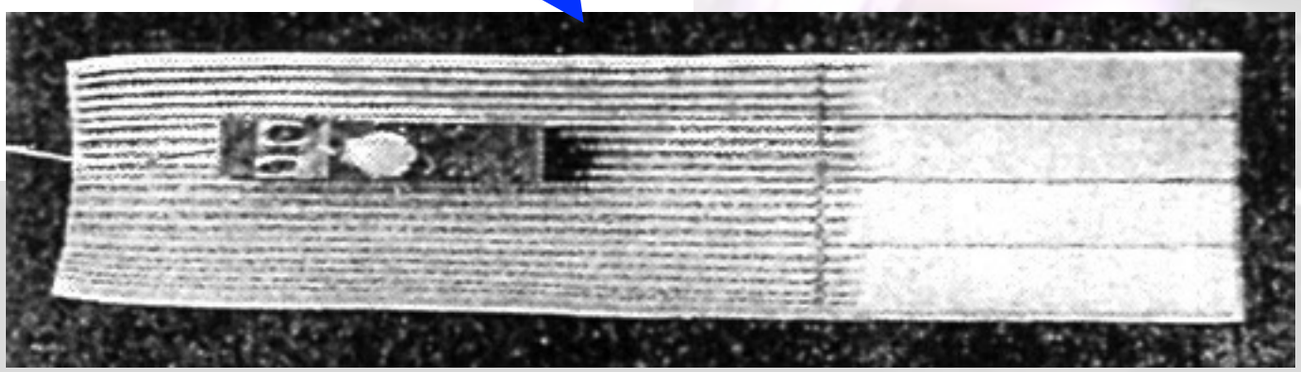
Setup of Tensile Testing at Room Temperature



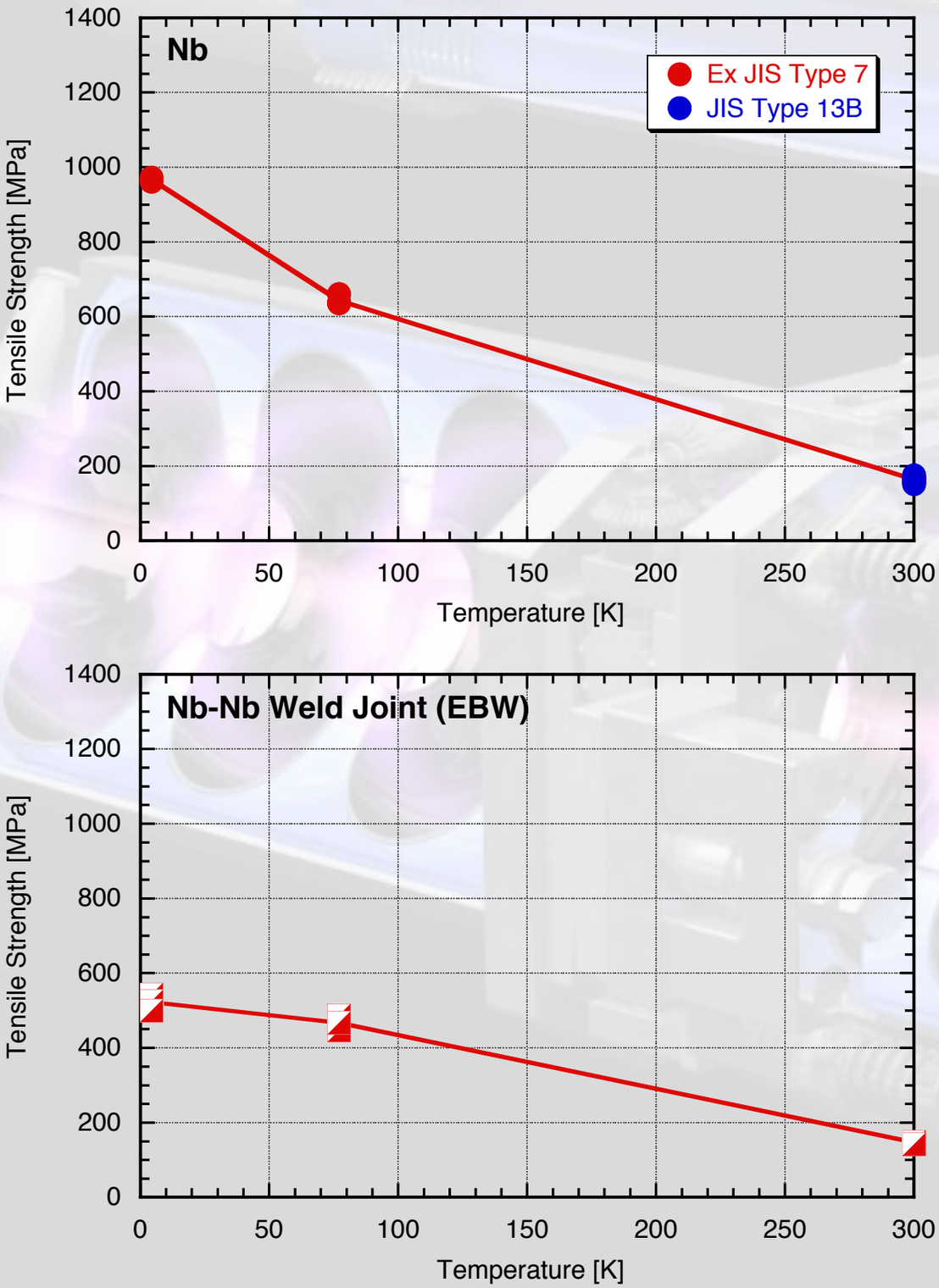
Setup of Tensile Testing at LHe Temperature

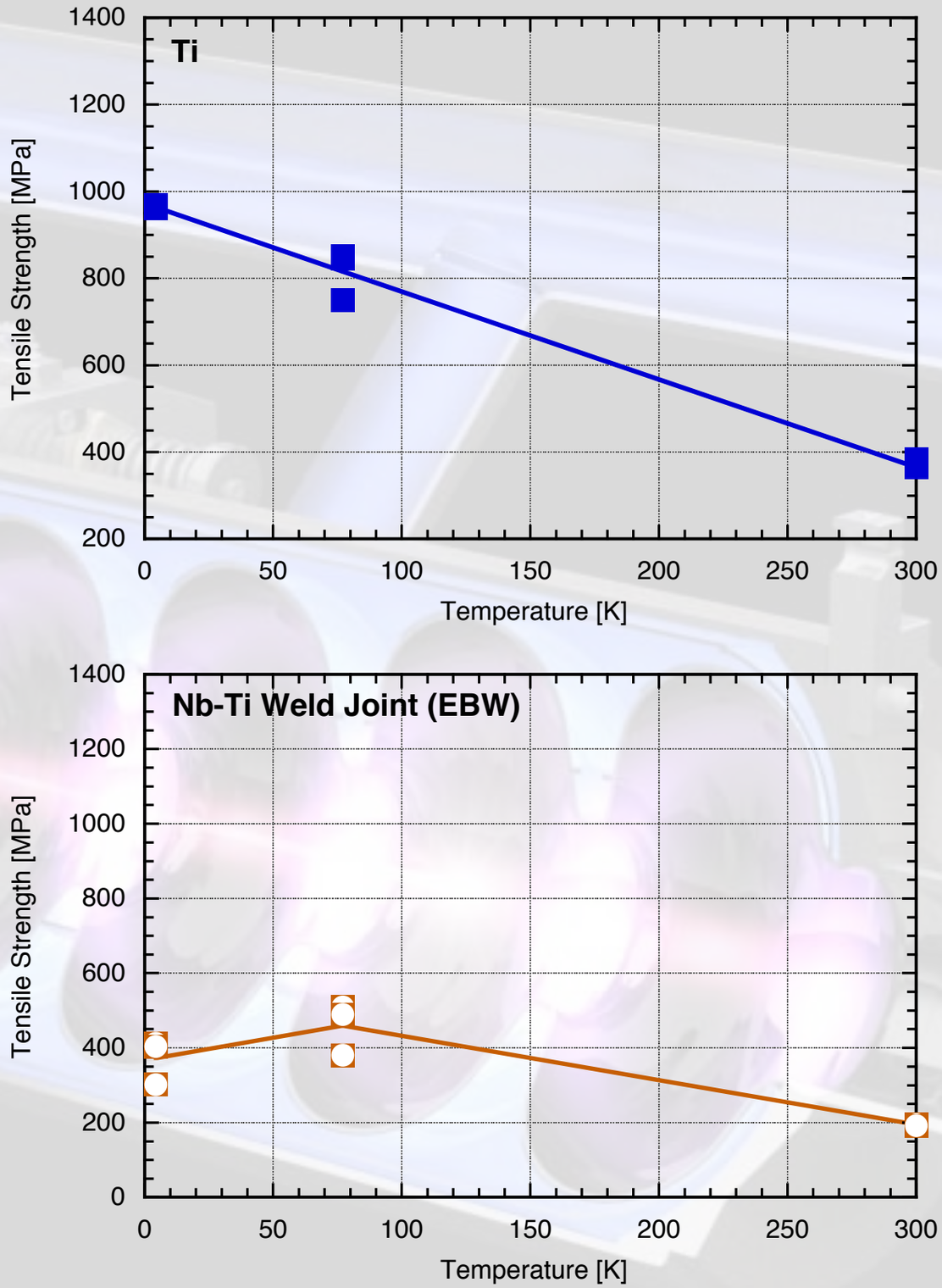
Charpy Impact Test Setup



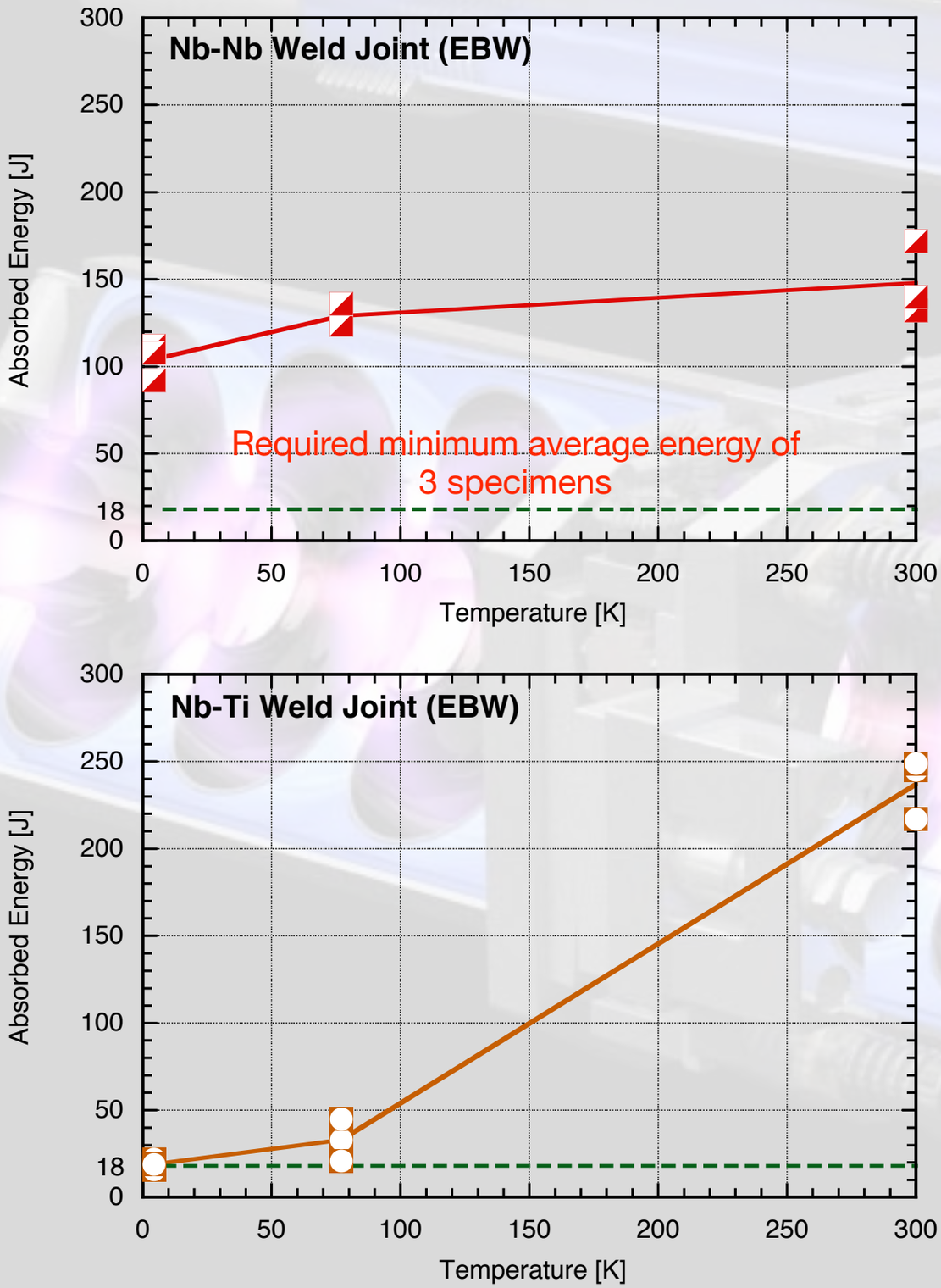


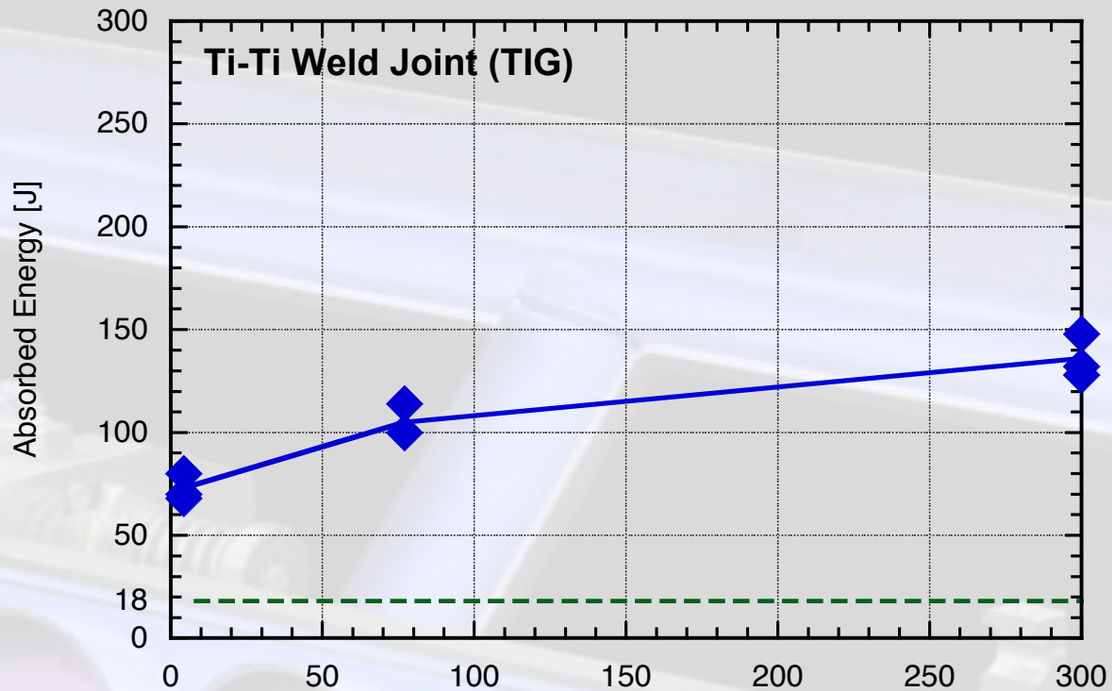
Tensile Tests

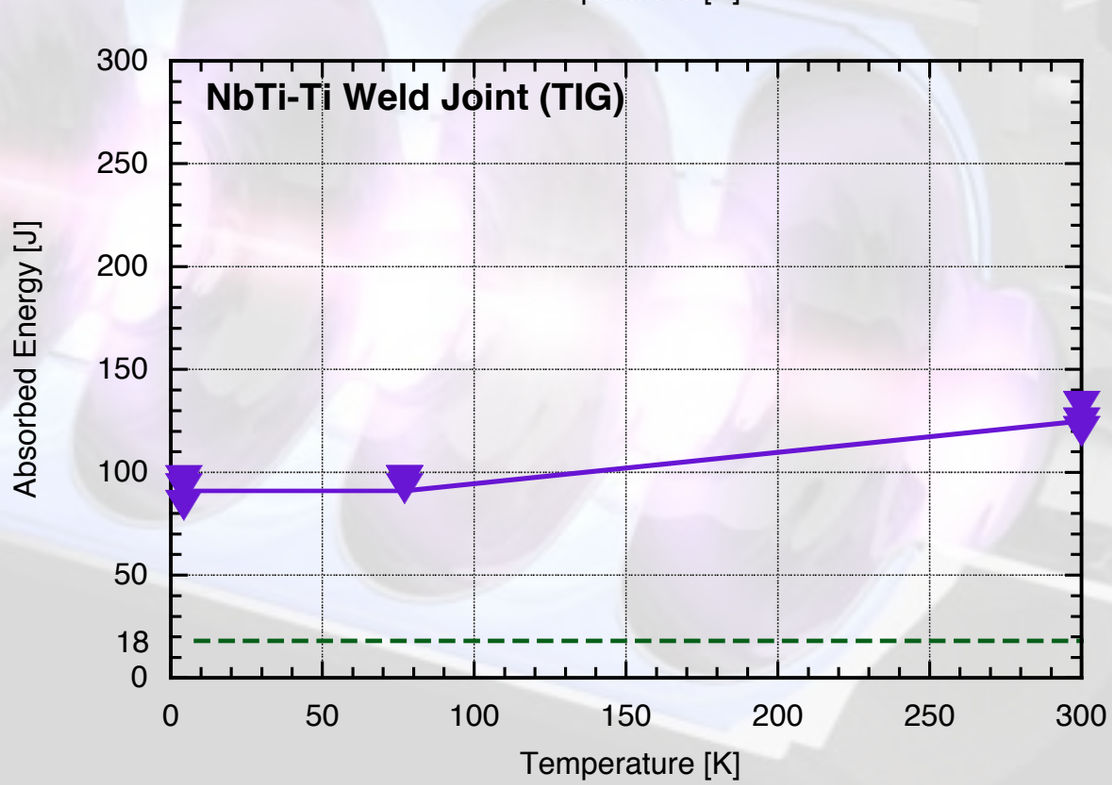




Impact Tests







Summary

- Tensile tests and Charpy impact tests have been conducted at room temperature, liquid nitrogen temperature and liquid helium temperature to ensure enough strengths of employed materials for sc cavities and helium tanks
- Employment of Nb, Ti and NbTi at operation temperature (design temperature) is approved by prior evaluation of the high pressure gas authority in Japan (KHK)
  - Material tests for employed materials and their strengths
  - Numerical analyses for strength calculation (minimum thickness)
  - Alternative methods of pressure test and tightness leak test