VDL ETG T&D

OVERVIEW OF POTENTIAL MANUFACTURING TECHNIQUES FOR CORRUGATED BEAMTUBE

Peter van der Heijden
VDL ETG T&D
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- Vacuum basics
- Beampipe materials
- Beamtube rolling
- Rolling corrugation
- Welding
- Leak testing
- Packaging

DESCRIPTION BEAM PIPE REALISATION PROCESSES

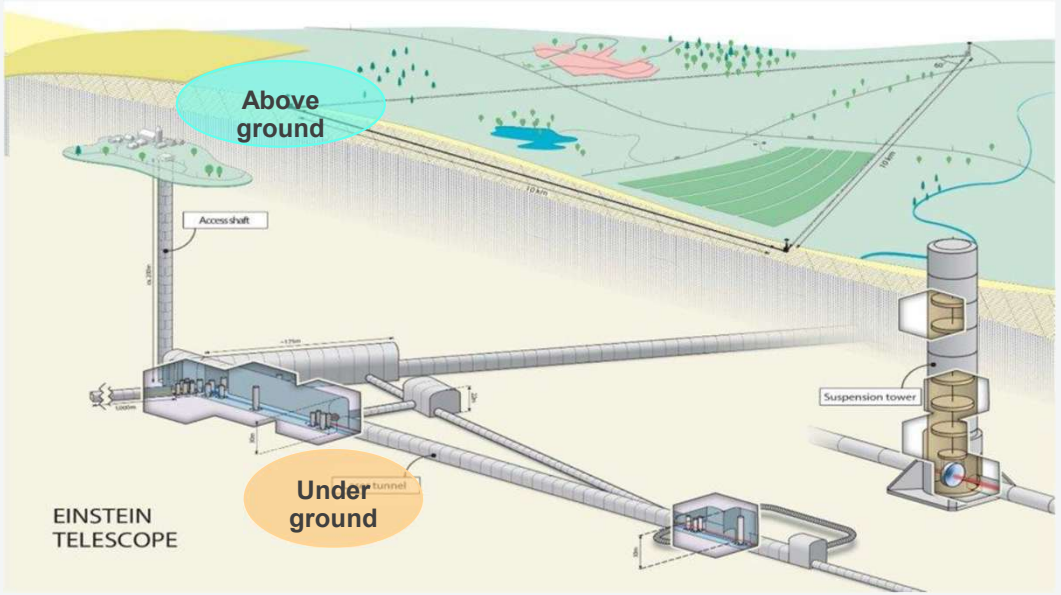
1 - Sheet material AISI 441 → 2 - Cleaning → 3 - Rolling sheet to pipe → 4 - Welding (long seam) → 5 - Cleaning → 6 - Rolling corrugated groves → 7 - Rework pipe ends (interfaces)

→ 8 - Cleaning → 9 Leak testing → 10 - - Welding (Round seam) pipe pieces → 11 - Cleaning bake out → 12 - RGA qualification → 13 - Packaging (cleanliness) → 14 - Packaging (transportation)

→ 15 - Welding to beam pipe (round seam) → 16 - Installing Baffles → 17 - Leak testing → 18 - Pump down (HV) → 19 - Cleaning plasma → 20 - Pump down UHV → 21 - Pump down XHV

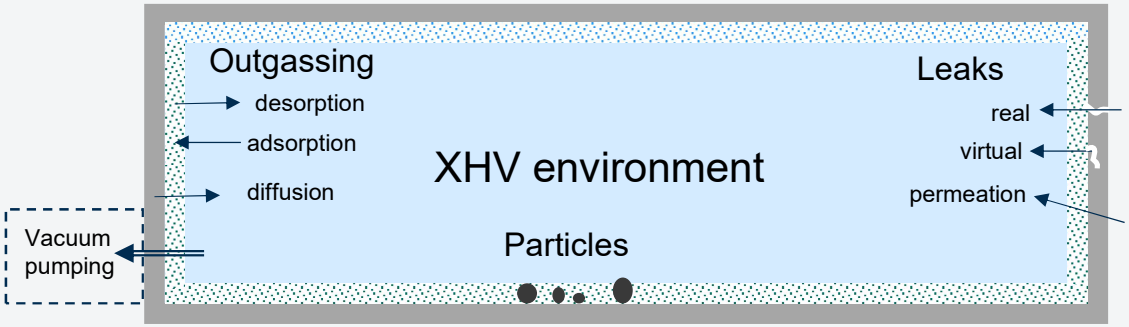
Work packages:

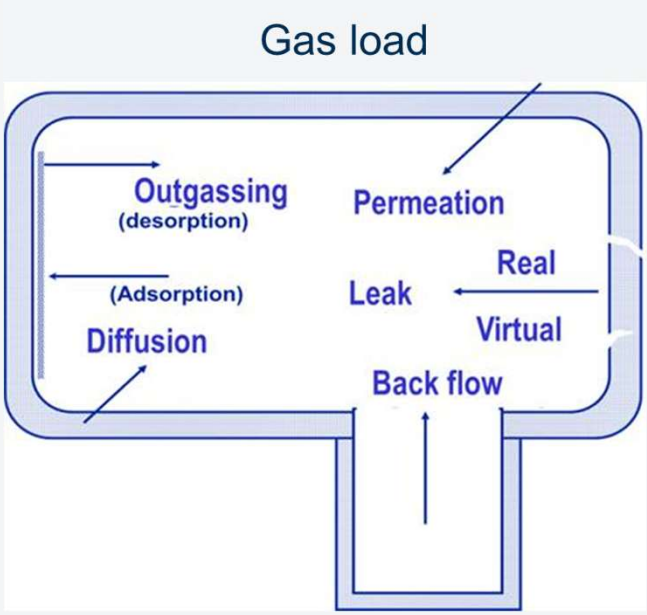
- Work Package 1: Industrialization for manufacturing and cleaning of 120km corrugated vacuum beampipe
- Work Package 2: Measurement and quality control of the cleanliness
- Work Package 3: Industrialization of the packaging and logistics from production to installation and maintenance
- Work Package 4: Plasma assisted bake-out and cleaning

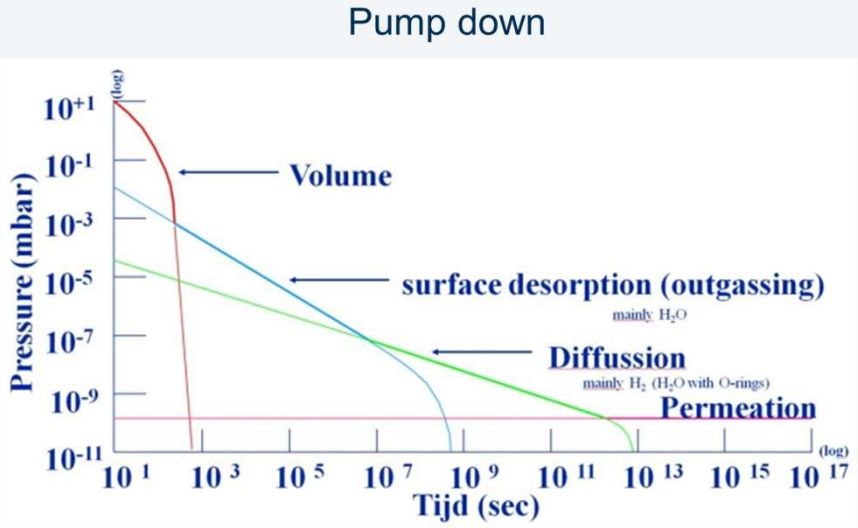


VACUUM BASICS

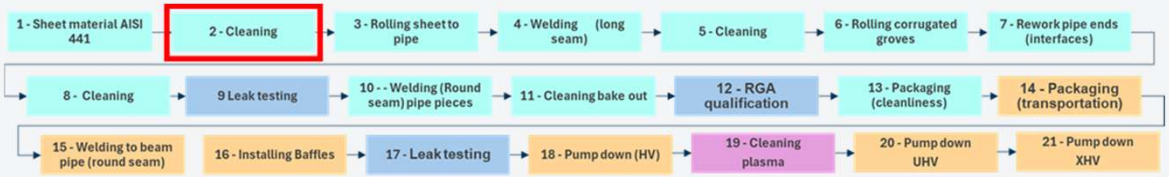
$$p[mbar] = \frac{Q[mbar \cdot l/s]}{S[l/s]}$$







BEAMTUBE MATERIALS



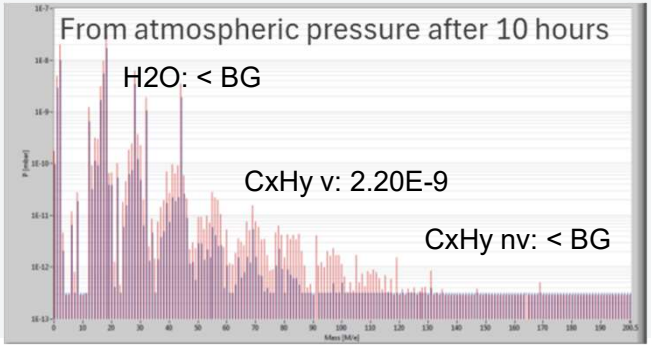
First check if base material *(AISI 441)* can achieve the Outgassing requirements?

RGA Tool VDL ETG:
Inner surface 2092 [cm^2]
Pumping speed 9 [l/s]
Mass spectrometer Inficon Transpector 2
- Mass Range 1-200AMU
- Resolution: < 1amu wide @ 10% peak height over the entire mass range
- Minimum detectable partial pressure: $6.6x10^{-15}$ Mbar

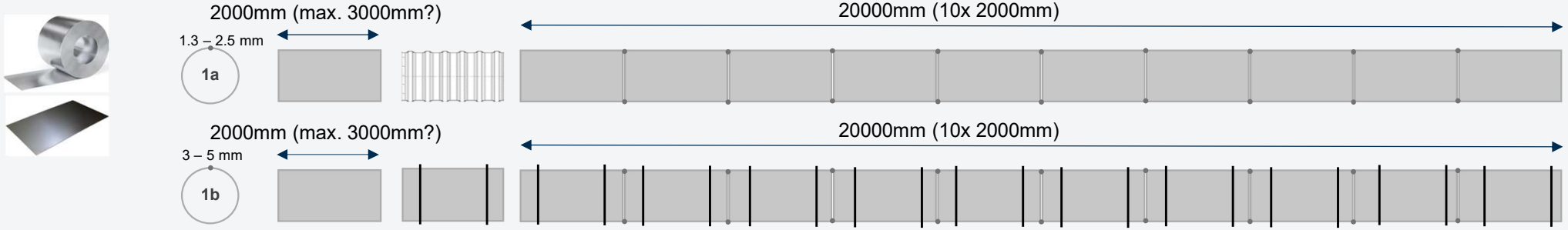
Pressure gauge Inficon BCG450
- Accuracy 10-8 … 50 mbar % of reading ±15

Background measurements RGA tool [mbar l/s] ([mbar l/s cm^2])

- From atmospheric pressure after 10 hours
  - H2O 2.28E-07 (1.09E-10)
  - CxHy v 8.39E-10 (4.01E-13)
  - CxHy nv 2.69E-10 (1.28E-13)
- From in-situ after bake out after 10 hours
  - H2O 8.87E-10 (4.24E-13)
  - CxHy v 1.24E-10 (5.94E-14)
  - CxHy nv 2.17E-10 (1.04E-13)

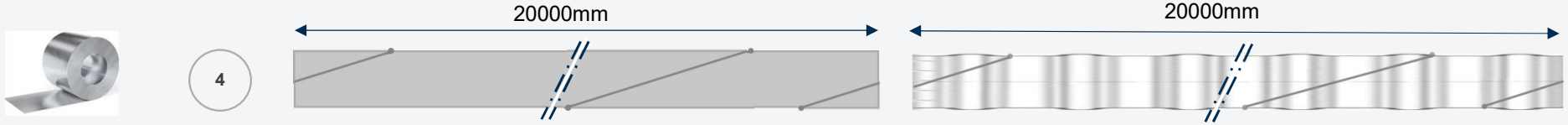


BEAMTUBE ROLLING



20m beam pipe made of 10 pieces of 2m. Process: rolling pipe piece, welding (long seam) , rolling corrugation or supporting rings, welding (round seam). Welding length: 48.28 m

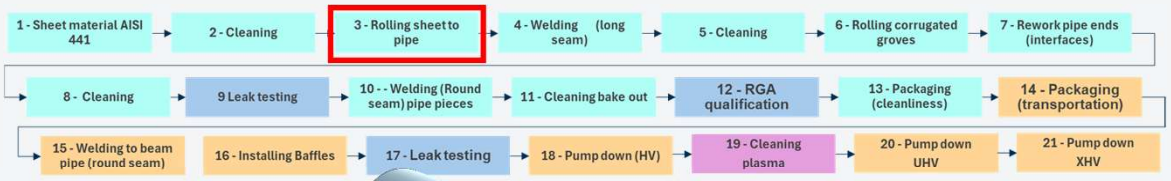
20m beam pipe made of 2 pieces of sheet metal. Process: rolling pipe piece, welding (2 x long seam) , rolling corrugation. Welding length: 40 m

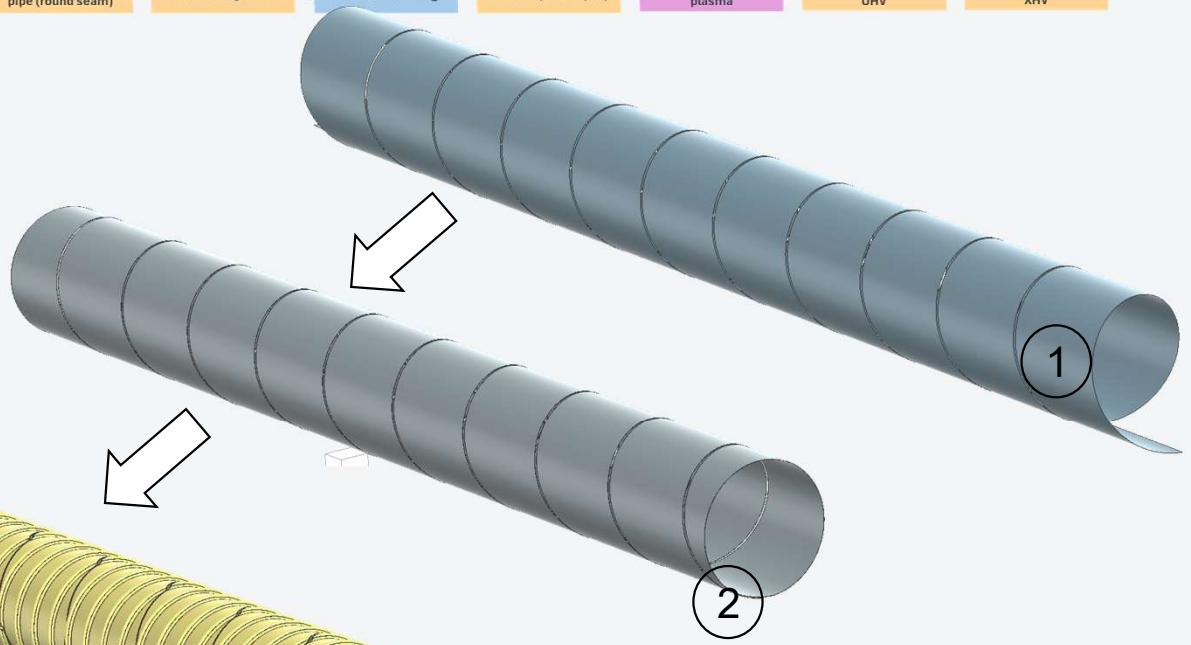


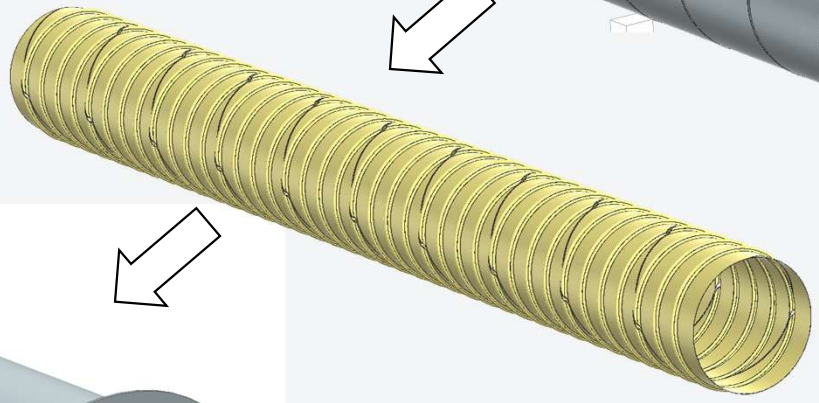
20m beam pipe made of 1 pieces of sheet metal (band width 2 m). Process: spiral rolling pipe piece, welding (1 x long spiral seam) , rolling corrugation. Welding length: 31,5 m

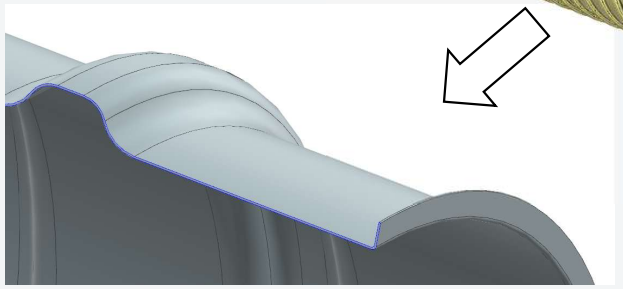
BEAMTUBE ROLLING

SPIRAL ROLLING PIPE PIECE



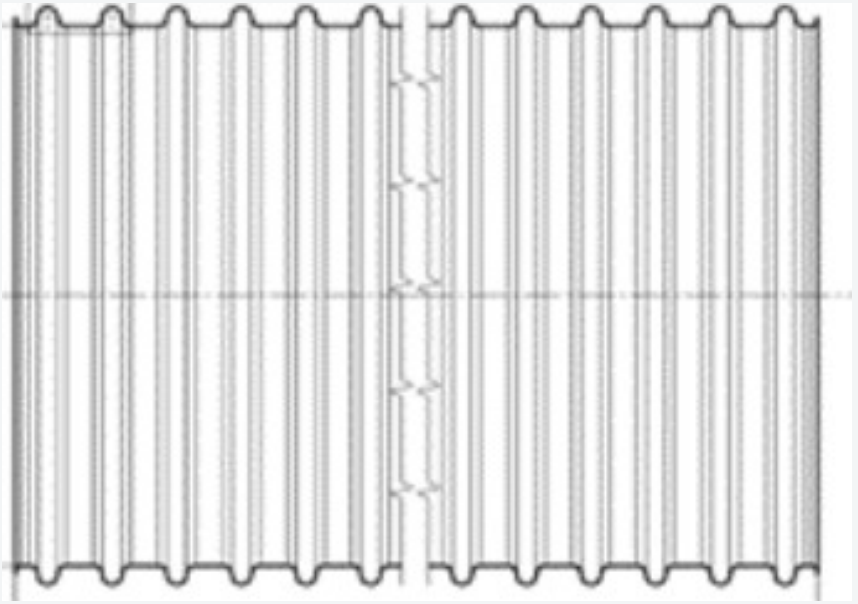




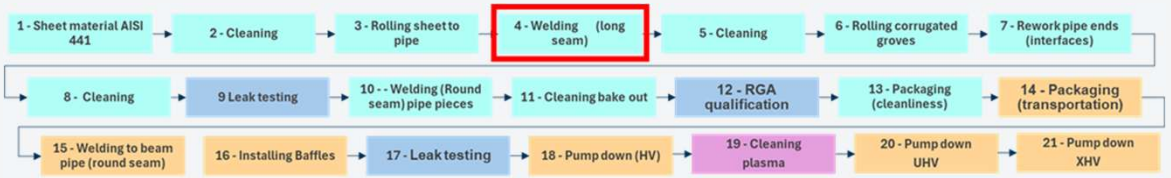


ROLLING CORRUGATION

In development, no information available yet



WELDING

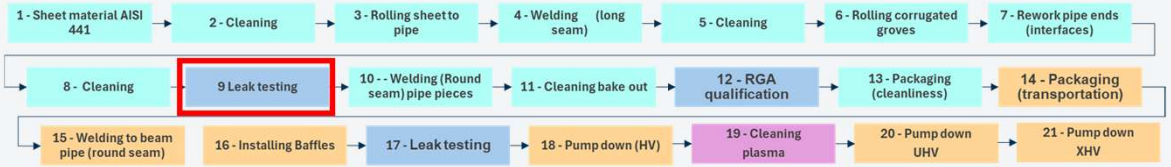


In development, still working on selection of welding techniques;

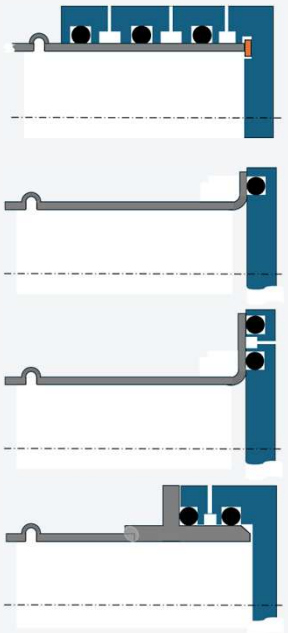
Welding techniques:
- Orbital TIG welding
- K-TIG welding
- Vacuum laser welding

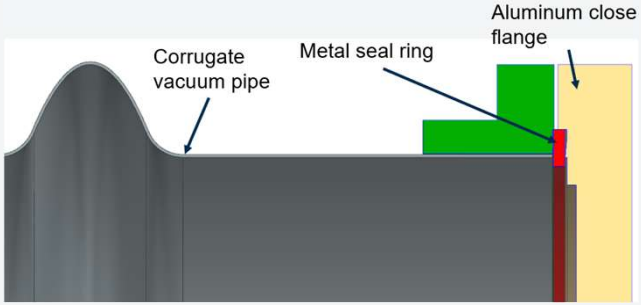
Key-words:
- Reliability
- Process control
- Speed
- Cleanliness
- Automation

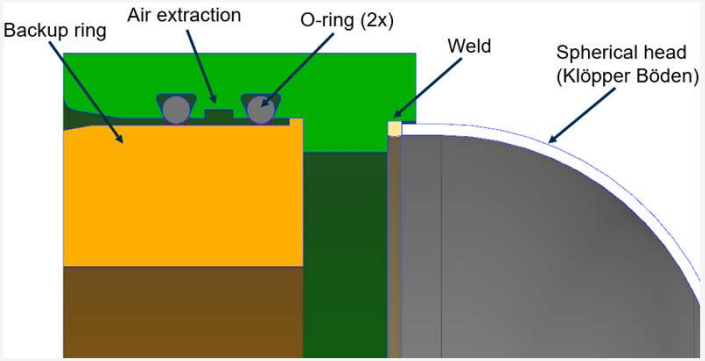
LEAK TESTING

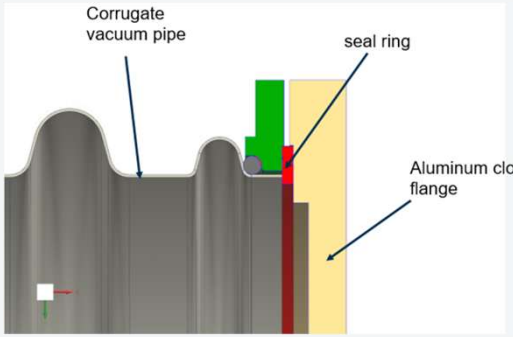


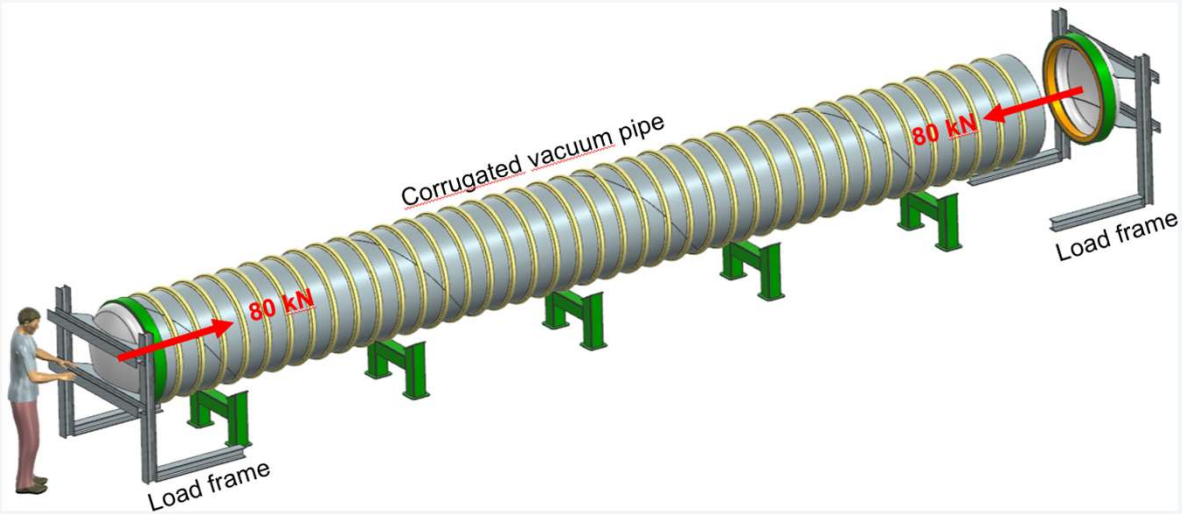
Leak test flange options:



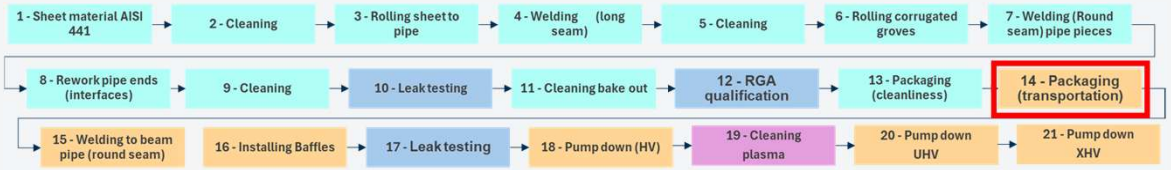








PACKAGING



In development, no information available yet

TRANSPORTATION