

CRYO-006 / REV A

Cryogenic transfer-pipe and compensator family

STATUS: CONCEPT / UNQUALIFIED. Cost unknown. Patent review not performed. EU conformity not determined.

Source and requirements

Original extraction paragraph references: 879, 8932, 8936

Source hydrogen pipe diameter 0.35 m, temperature 20.28 K, neighbouring warm system 303.15 K; grade and insulation unqualified.

Candidate manufacturing route

Fab 2: precision sealing features

Fab 3: tube and fitting machining

Fab 4: qualified joining and insulation assembly

Fab 5: inspection and cryogenic qualification

Governing models

S07, S09, S10, S12, E28, E29 — see the English formula register; use only within each stated domain.

Critical missing evidence

Temperature-dependent contraction and fracture properties

Vacuum insulation, supports and heat ingress

Joint leakage, pressure relief, fatigue and hydrogen compatibility

Cost model and missing quotations

$C_{unit} = (\text{materials} + \text{machine/setup} + \text{energy} + \text{labour} + \text{QA} + \text{overhead}) / \text{accepted units}$. Record currency, price date, batch quantity, yield, rework, contingencies and uncertainty. Avoid double-counting costs included in machine rates. No supplier quotes have been obtained.

Qualified tubing, bellows and joints

Insulation and vacuum components

Cryogenic tests, inspection and operating losses

Patent-review record

Search seed (not executed): cryogenic hydrogen transfer pipe expansion bellows multilayer vacuum insulation
Required records: jurisdictions, search dates, CPC/IPC classifications, patent families, publication PDFs, independent claims chart, legal status and expiry/lapse review. Product geometry and intended use must be frozen sufficiently for a meaningful review.

Patent publication PDFs are not attached because no product-specific patent search or claims assessment has been performed. This dossier is not a patent, clearance opinion or claim of novelty.

EU and other regulatory applicability

Pressure-equipment scope, hazardous atmospheres and installation-specific rules

No qualification follows from a nominal bellows stroke

Starting sources: EUR-Lex Regulation (EU) 2023/1230 and Directive 2014/68/EU where relevant; EPO Espacenet and official registers for patent research. Full applicable standards, legal classification and jurisdiction-specific approvals must be verified.

Acceptance and reproducibility

Define the product measurands, test environment, tolerances, calibrated instrumentation, lot traceability and a statistically justified sampling plan. Numerical convergence, manufacturing yield and service reliability are separate criteria. No 99% feasibility or 98% product-equivalence claim is established.

Release gate

Do not treat a proposed route as a toolpath. Complete geometry, material allowables, process qualification, simulation verification, prototype tests, inspection, conformity review and responsible engineering approval before release.