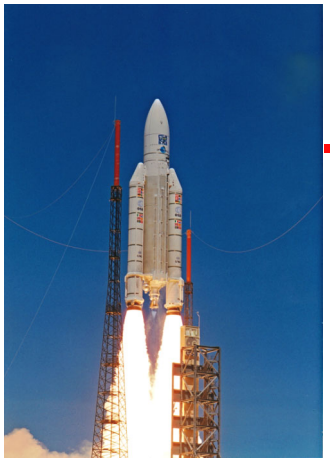
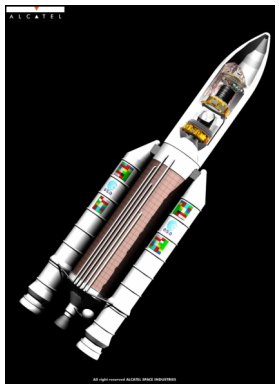
SPIRE & PACS SORPTION COOLERS

INSTRUMENT BASELINE DESIGN REVIEW





30 000 K

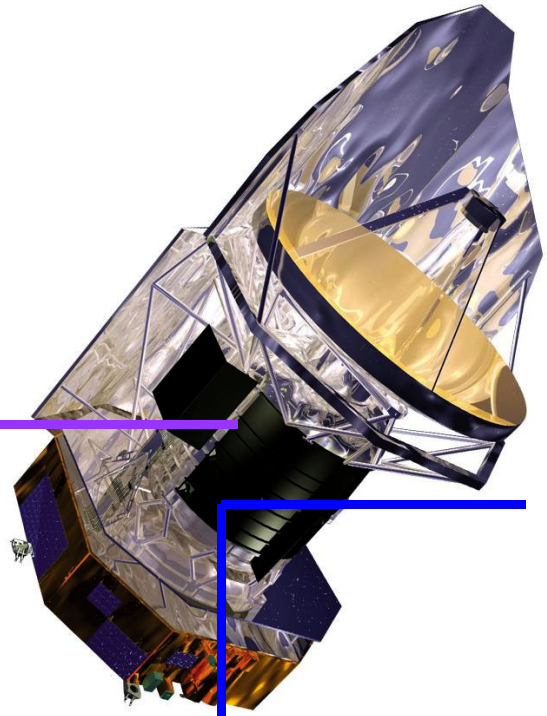
3000 K

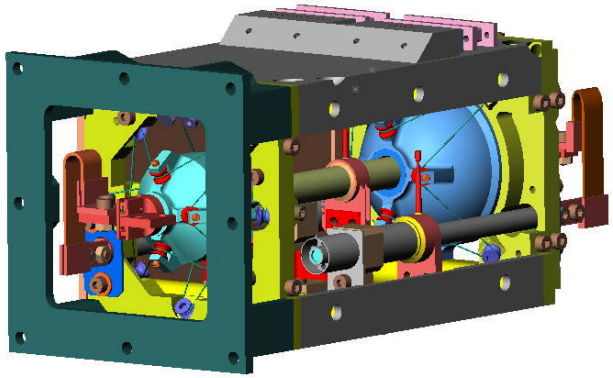
300 K

30 K

3 K

0.3 K



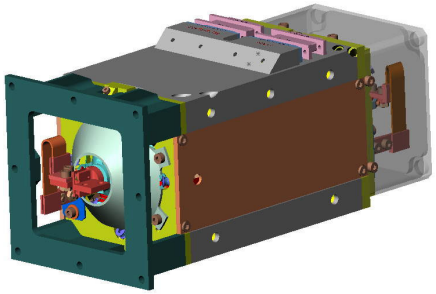


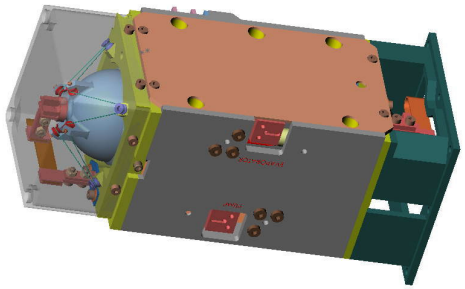
Lionel Duband, L. Clerc, L. Miquet, L. Guillemet, R. Vallcorba, D. Guillaume, D. Communal, Patrick Dupont/Eric Dubois (BV)
SERVICE DES BASSES TEMPERATURES
DRFMC / DSM - CEA GRENOBLE

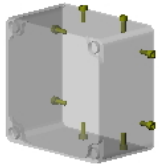
COOLER STATUS - 1

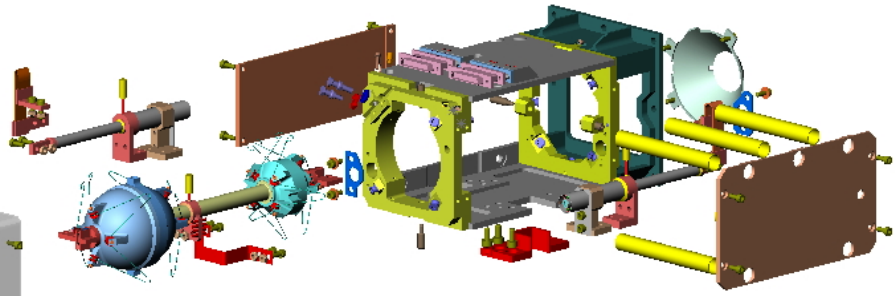
DESIGN : completed

(full compatibility with PACS/SPIRE)



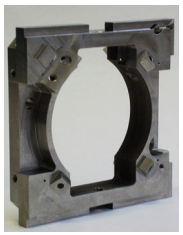


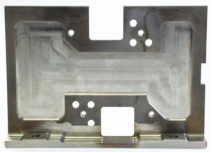




Mechanical performance :
Full numerical modelling done

CQM/STM Manufacturing : completed



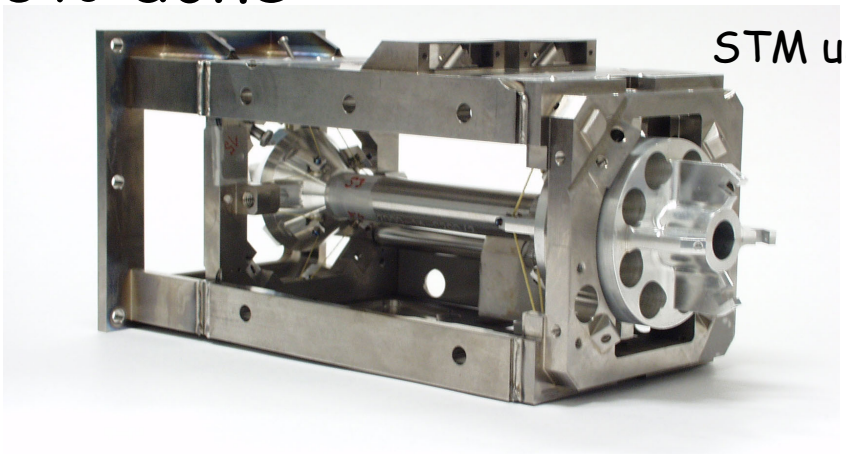


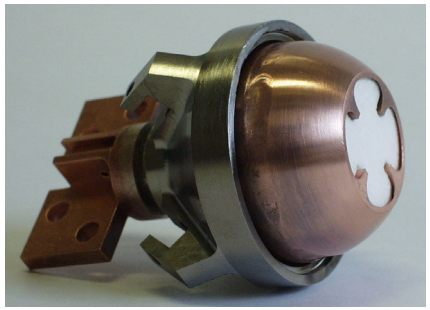
All anomalies dealt with and traced
All parts available

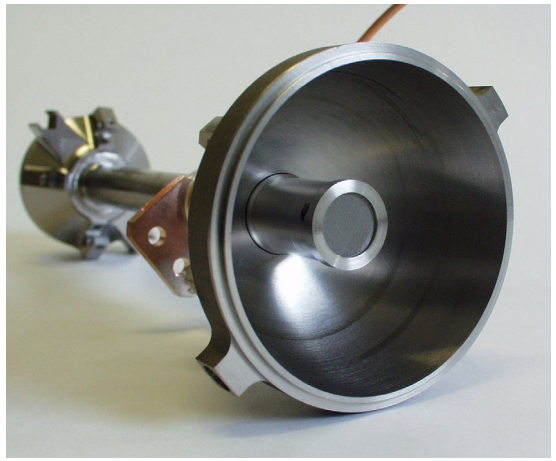
COOLER STATUS - 2

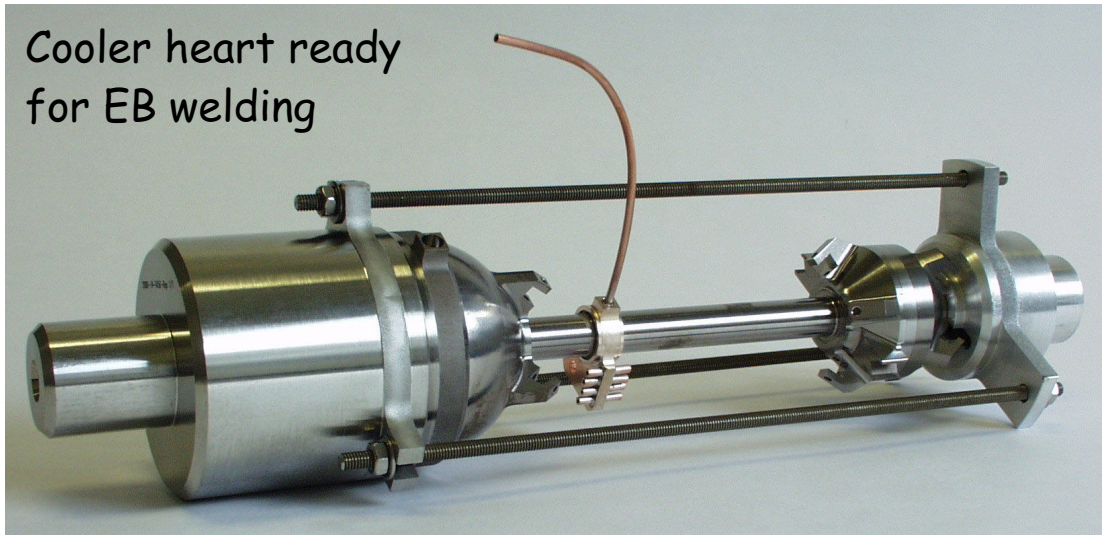
CQM & STM Assembling : 90% done

Slight delay due to subcontractors


STM unit



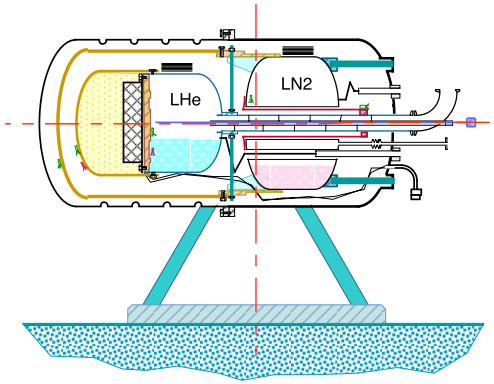



Cooler heart ready
for EB welding

GROUND SUPPORT EQUIPMENT (MAIN)

TEST CRYOSTAT

(2 "small" cryostats available)



New large test cryostat delivered Feb. 2002

Instrumentation in progress

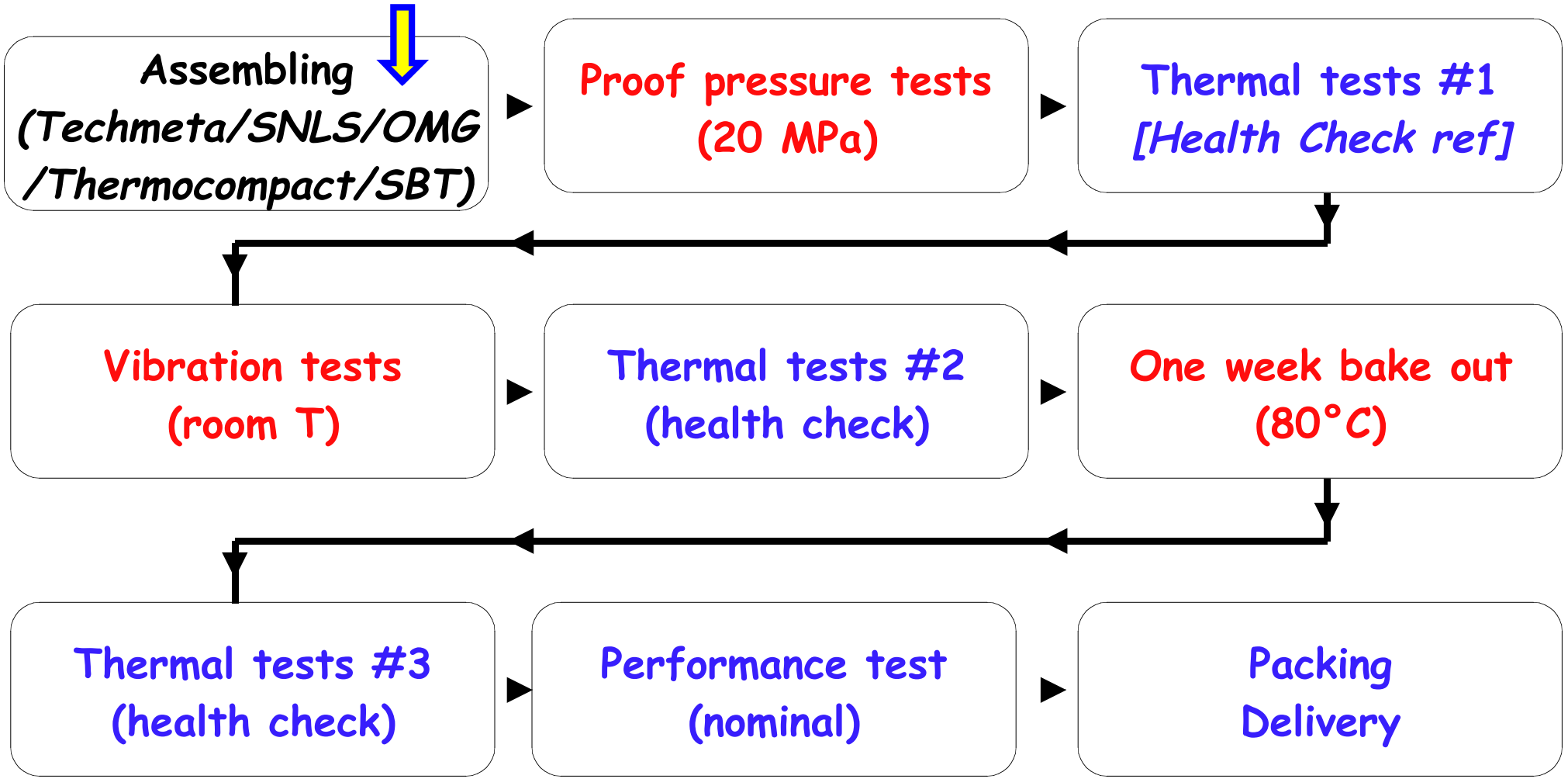
Cryostat needed for performance test

(> 48 hours autonomy)

CLEAN ROOM : Implementation in progress

Expected to be available April 2002

COOLER AIV PLAN



PARTS PROCUREMENT

ITEM	CQM	FM/FS
^{3}He gaz	OK	OK
Titanium Ta6V	OK	≈ OK - TBC
Activated charcoal	OK	OK
Procelit (liquid confinement)	OK	OK
Kevlar cords	OK	OK
Straps	OK	OK
T. sensor	OK	To be provided by SAp
Heater	OK	To be provided by SAp
Connectors	OK	To be provided by SAp

PA PLAN - 1

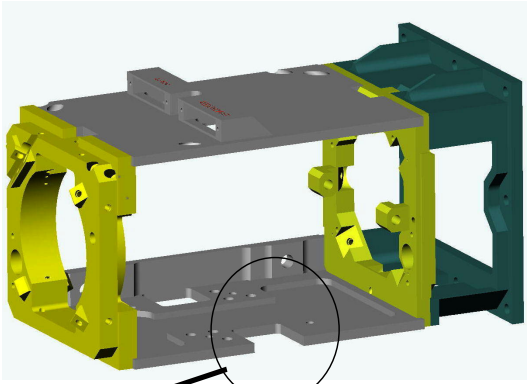
- **PA requirements implemented**
  - covers all project life
  - Potential risks & hazards identification done
  - Cleanliness and contamination control
  - Material evaluation program in progress (Kevlar)
  - DML & DPL done
  - Subcontractors evaluated
  - Non conformance reporting system implemented
  - Configuration control system done
  - Traceability (log book + acceptance data package)

MAIN PROJECT DOCUMENTATION

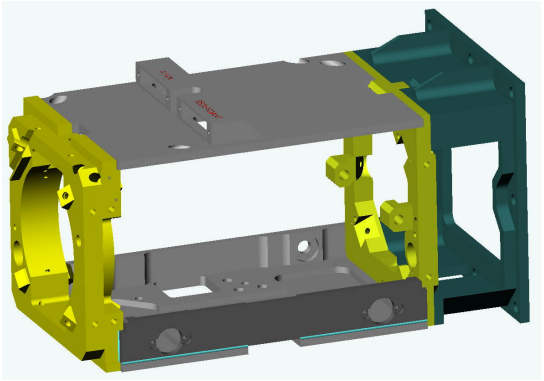
doc. Name	completion	status
Cooler Specifications	Released	Not formally approved
ICD	Released	Not formally approved
PA Plan	Released	Approved
Developement Plan	Released	Not formally approved
Detailed Planning	Released	-
DML/DPL	Released	under review
H/W tree	Released	under review
MAIV Flow Chart	Released	Not formally approved
AIV Plan	Released	Not formally approved
FMECA	Released	Under review
Cleanliness Philosophy	Released	Not formally approved
All procedures	In progress	Internal to SBT

TO DATE : PROBLEMS & SOLUTIONS

Deformation of structure after EB welding



Deformation max. :
≈ 400 µm on 150 mm plate



Angle iron added

Anomaly spotted and traced

↓

MRBs (internal & subcontractors)

↓

Implementation of solution

↓

Qualification

Impact on FM : None

Structure modified accordingly

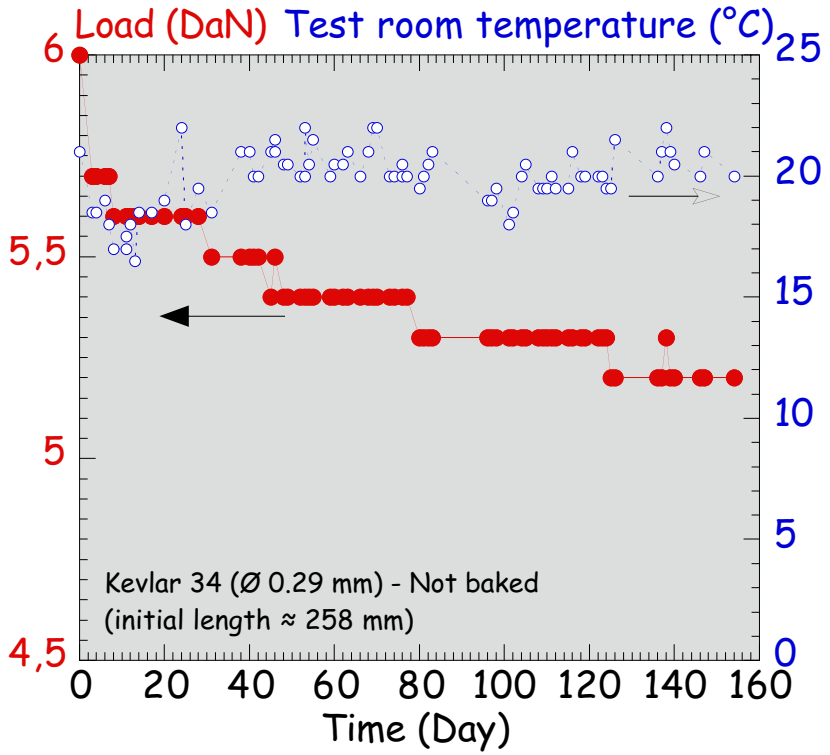
No delta qualification expected

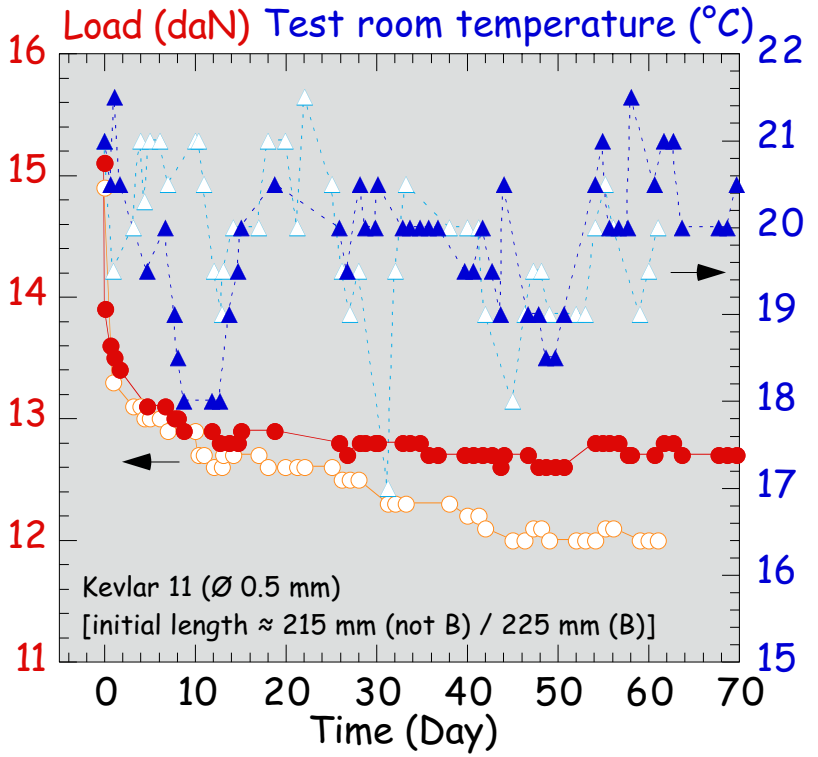
KEVLAR CHARACTERIZATION

Tests performed	Status	Comments
Ultimate strength	Checked	Consistent with available data
Young's modulus – room T	Checked	Idem
Young's modulus – LN2	Checked	Idem
Influence of Ø pulley	Checked	Integrated in design
Influence of turns around pulley	Checked	Idem
Tensioning and locking technique	Available	Procedure established
Creep	Checked	No problem foreseen
Influence of baking	Checked	No problem spotted so far
Fatigue behaviour – room T	On going	
Low T cycling under tension	On going	No problem spotted so far
Thermal conductivity	≈ checked	Will be measured again

Test report available : HSO-SBT-TN 046 Issue 1.0
"EXPERIMENTAL CHARACTERISATION OF KEVLAR 29 CORDS"

KEVLAR - CREEP



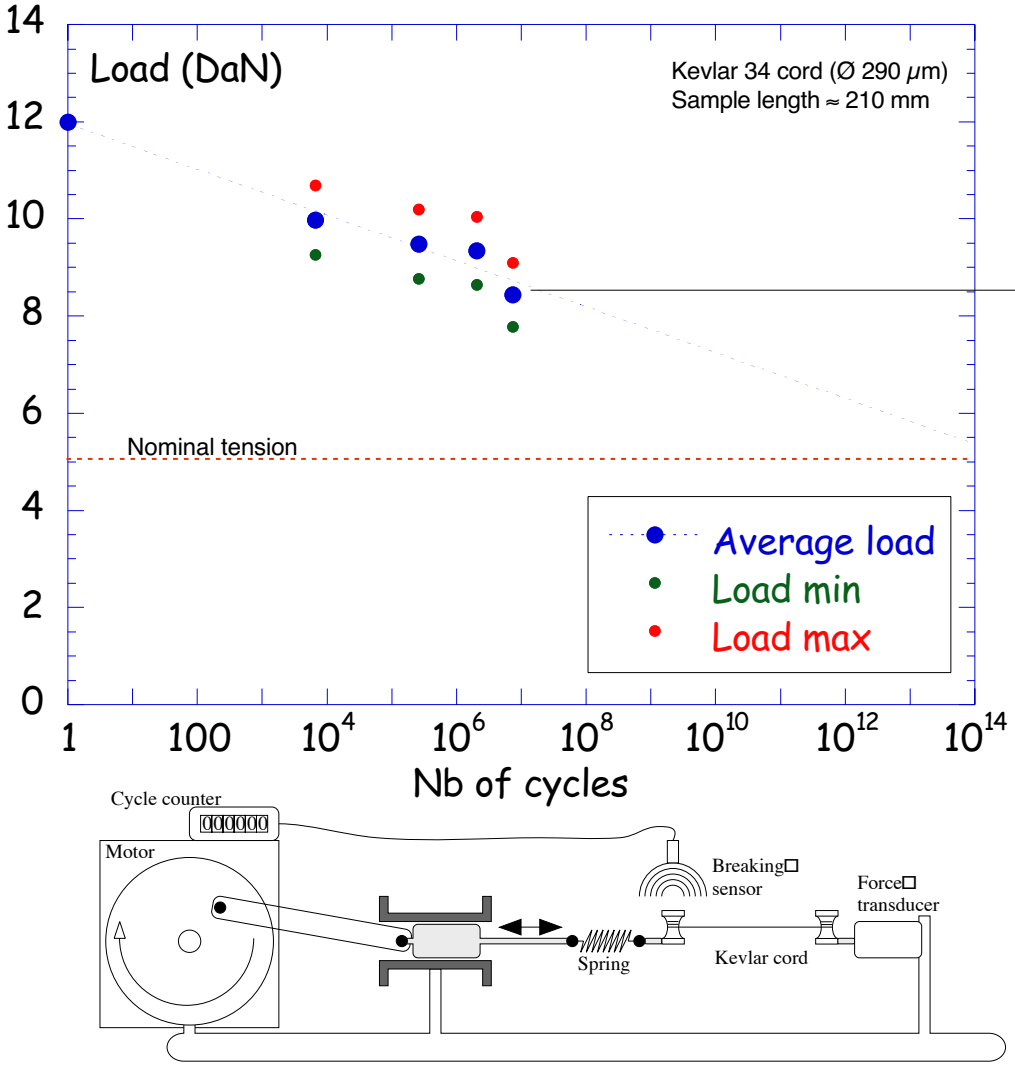


Kevlar not baked
Kevlar baked (80°C)
T - not baked sample (°C)
T - 80°C baked sample (°C)

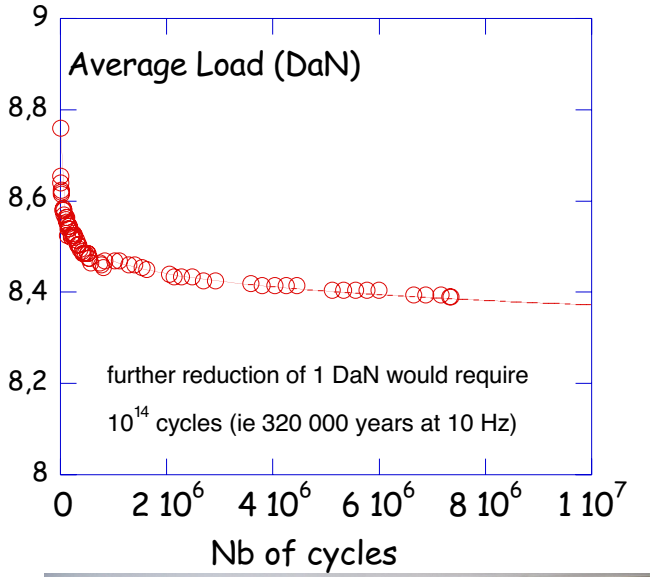
Δ tension 10% ⟺
- 4 years for Kev. 34
- 40 years for Kev. 11

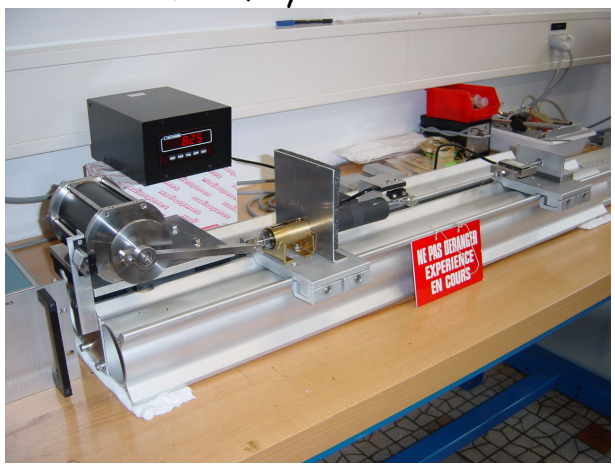
Note : Resonant frequencies independent of cords tension

KEVLAR - FATIGUE (+ CREEP)



Broke after
≈ 3 months



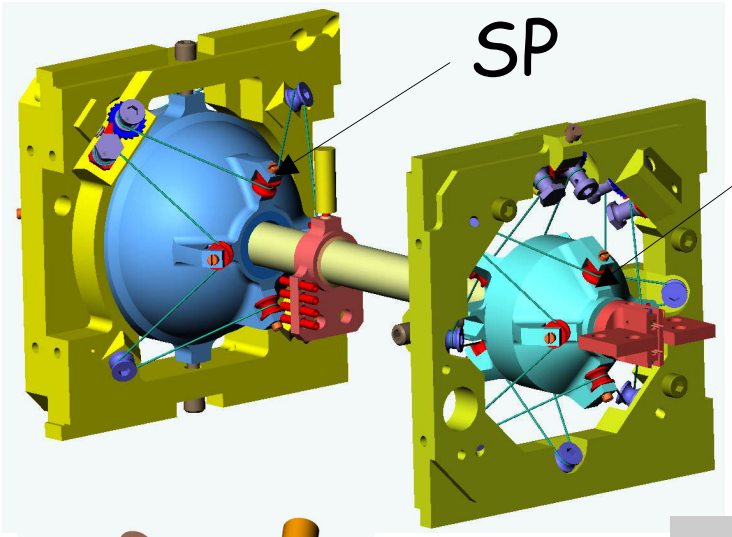


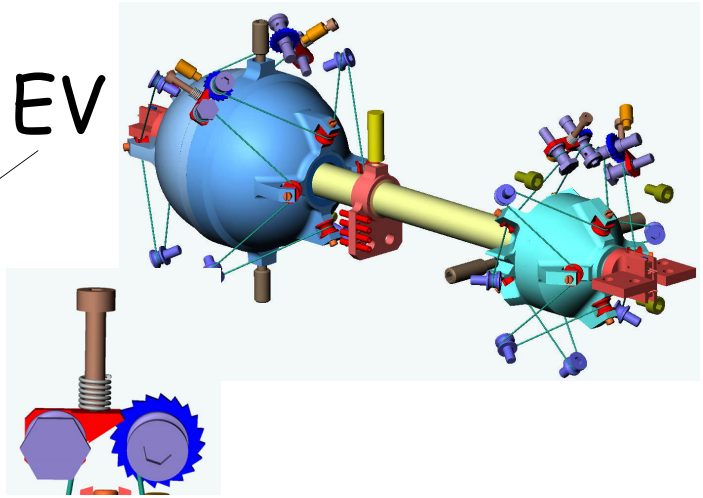
KEVLAR - FAQs

Frequently Asked Questions

Fragile in compression ?	**True**	Requires careful design of pulleys, capstans and locking mechanism
Negative thermal expansion ?	**True**	According to available data
Creep ?	**True**	But not significant enough to affect the suspension system Solution : pretension at nominal + ΔTension Further verifications to be done
From 2 previous points : loose of tension at low Temperature ?	**Wrong**	Young's modulus increases by 40 to 50%. As a result tension actually increases ! **! CAREFUL with pretension value !** Will be verified in the coming weeks @ LN2
Fatigue ?	**True**	But no real impact as long as nominal tension is ≤ 50% breaking strength
Moisture ?	**True**	Under investigation - but no particular problem foreseen

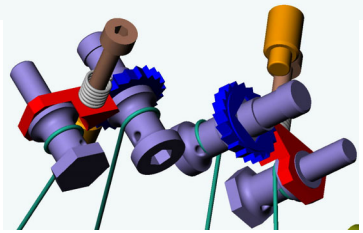
KEVLAR SUSPENSION SYSTEM





Nominal loading
constraint:
EV : 5 DaN / 757 MPa
SP : 15 DaN / 760 MPa

(breaking strength 1600 MPa)



Failure	Lowest frequency (Hz)	RMS constraint (MPa)
No defect	482	16.8
Broken cord on EV side	295.5	41
Broken cord on SP side	310.8	104
All cords on EV broken	119	198

(calculations performed at room T)

Calculations performed using specification as of mid 2001 ≈ 21 G rms New spec. down to 14 G rms max.

Test report : HSO-SBT-TN 055
"SPIRE & PACS Sorption cooler mechanical performance"

OPEN ISSUES AND CRITICAL AREAS

ELECTRICAL ISOLATION

SPIRE ECR issued - Recently agreed by PACS (Feb. 15)

Impact :

- *need to identify/qualify solution*
- *but cooler already built*
- *planning : to be evaluated, but some margin available today*

KEVLAR TENSION

development of dedicated tool

- various solutions being evaluated

CONCLUSION

- PA plan implemented
- STM available within 1 month
- CQM available this summer, but pending ECR electrical isolation
- Kevlar charact. continue/data built up new tests at LN2 and LHe planned

- *out of SBT "territory" : cryostat straps need attention*