

Sula >

Providing systems engineering and mechanisms expertise to the Defence and Space sectors

12th ESMATS

The Story of the Sula Boom

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Once upon a time.....

- > The story starts in Bristol 1979
- > BAe were developing a telescopic boom with the following key features:
 - > Thin walled drawn aluminium tubes (1mm thick)
 - > Sequential deployment latches which use pairs of radial, spring energised plungers and linear guides
 - > Sliding bearings preloaded by tube deformation
 - > Deployed using compressed dry nitrogen
- > It was a sad story, with little chance of a happy ending - or so it seemed



Fresh Hope

- > In 1979 a young engineer was given the chance to save the boom, by designing a mechanical drive system to fit within the existing boom.
- > The baseline concept was selected by rigorous trade-off from of over 30 candidate concepts.
- > A development model was manufacture which demonstrated functionality.
- > The boom development was presented at the **AMS** (held in Huntsville Alabama in 1981)



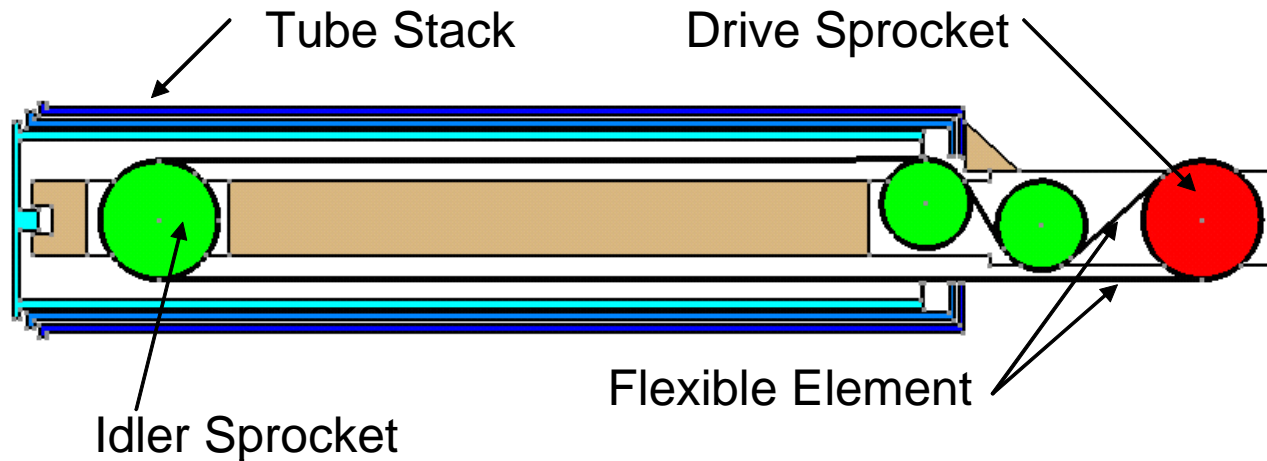
Start with a simple concept & wait....

> Concept comprises:

- > Flexible Drive Element
- > Supported on a top pulley
- > Controlled tension
- > Positive drive interface
- > Drive Actuator

> Implementation:

- > Miniature pitch chain
- > Sprocket on plain bearings
- > Tensioning sprocket
- > Modified chain links
- > Geared brushed motor



Hope is dashed – but then.....

- > Baselined for a secret mission - so no further public development.
- > ESA's boom development programme awarded to Dornier (known as the ERM)
- > Mission aborted in 1982 leaving the telescopic boom design to fade into obscurity
- > Then in May 2005 along come **SSTL** – and they want a boom!
- > But they don't have a lot money or time



And this is what they wanted!

- Compact stowage (150 dia x 450 long envelope)
- Deployed length >3.6m to be achieved within 5 minutes.
- Deployed frequency (with 3kg payload) >1Hz
- Stowed frequency >150 Hz
- Deployed alignment at payload within +/- 3°
- Support and deploy payload harness (10mm dia)
- Minimise power and mass (target <4.5kg)
- Provide indication of deployed length to precision of +/- 10mm.
- Low recurring costs – 2 FMs within 18 months

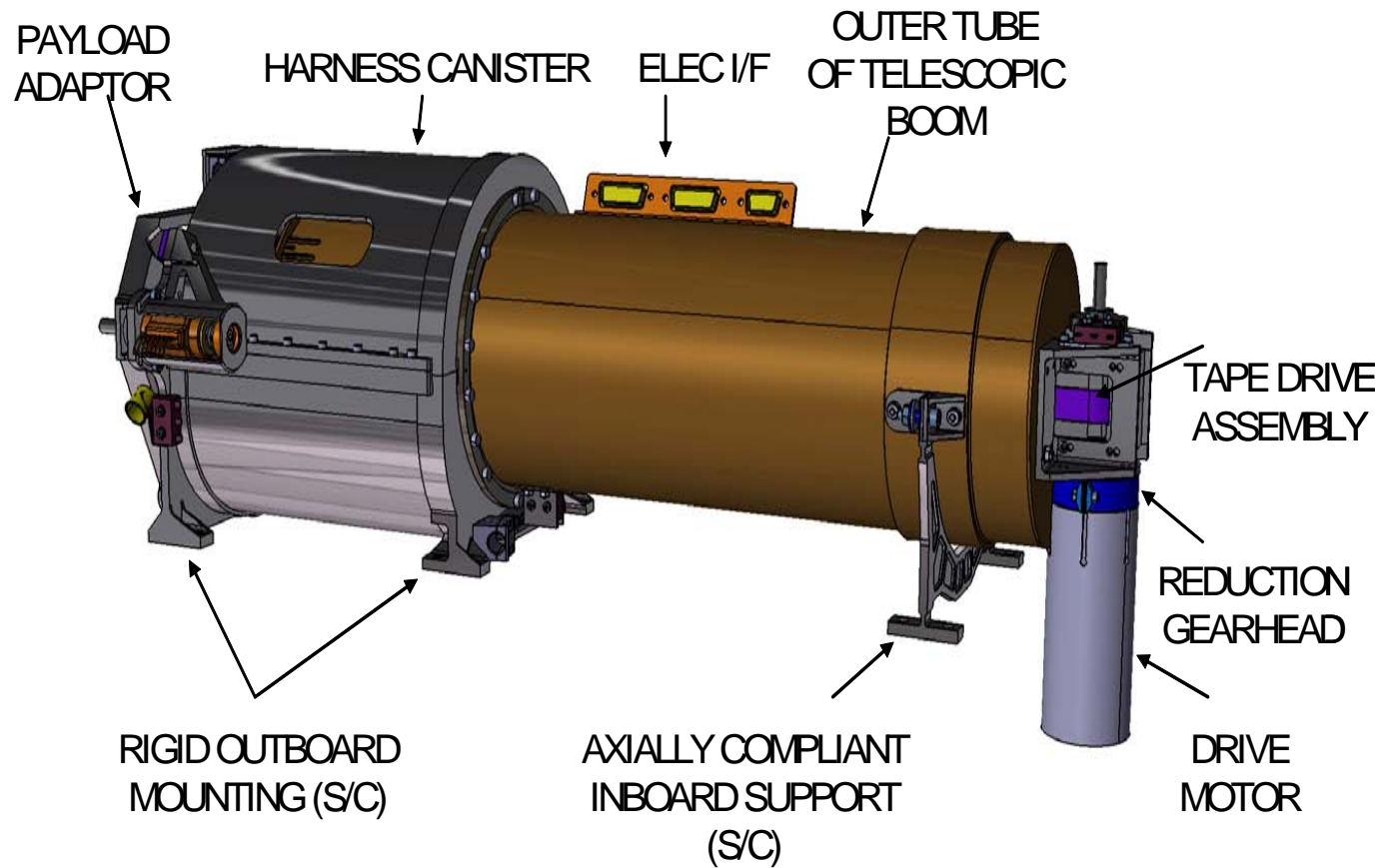


The Approach – “Team UK”

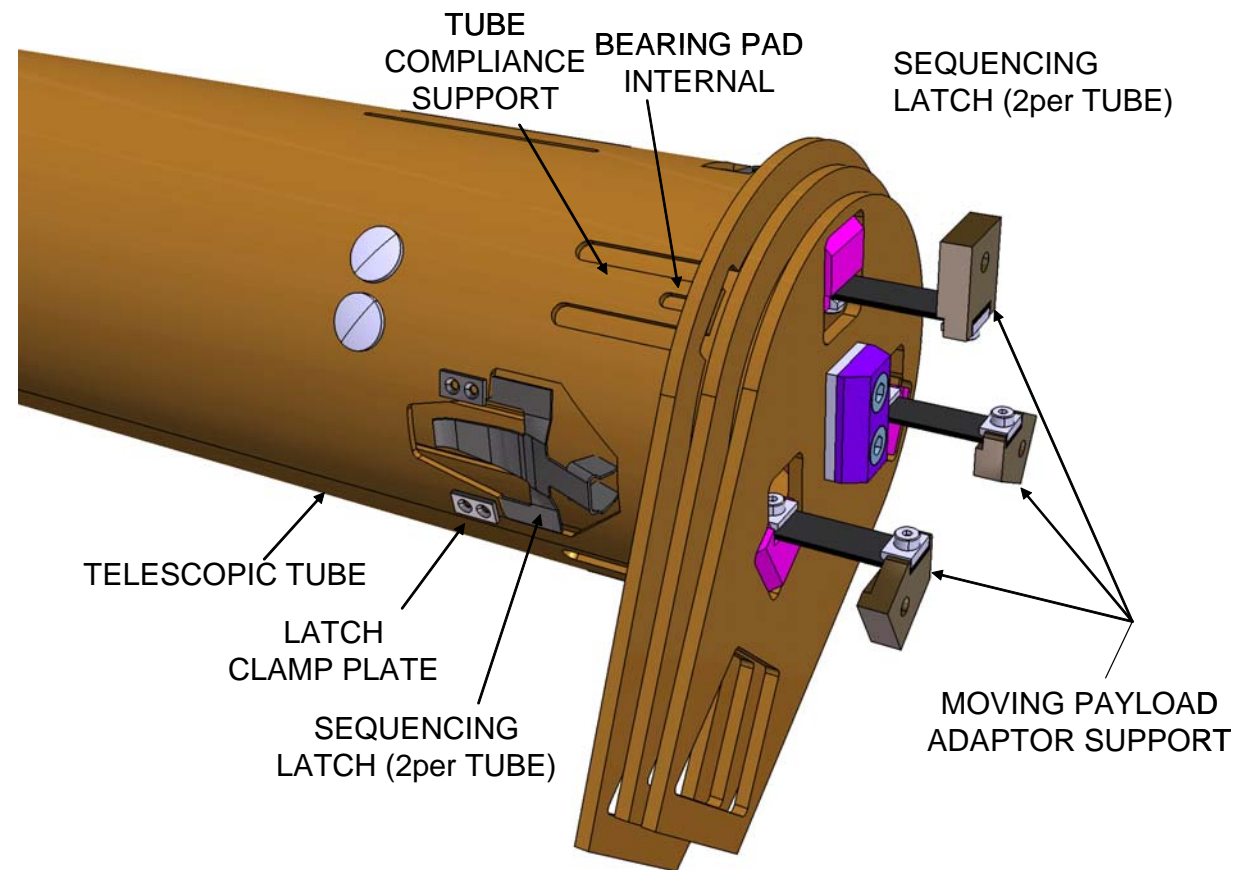
- > Sula using
 - > The experience (concept and lesson learnt)
 - > New ideas
 - > New low cost technology and attitude
 - > Breadboard model (3 tube elements)
- > ESTL using
 - > Experience and processes for flight hardware AIT
 - > Appropriate facilities
- > SSTL using
 - > Experience in low cost programmes
 - > Representative environmental testing



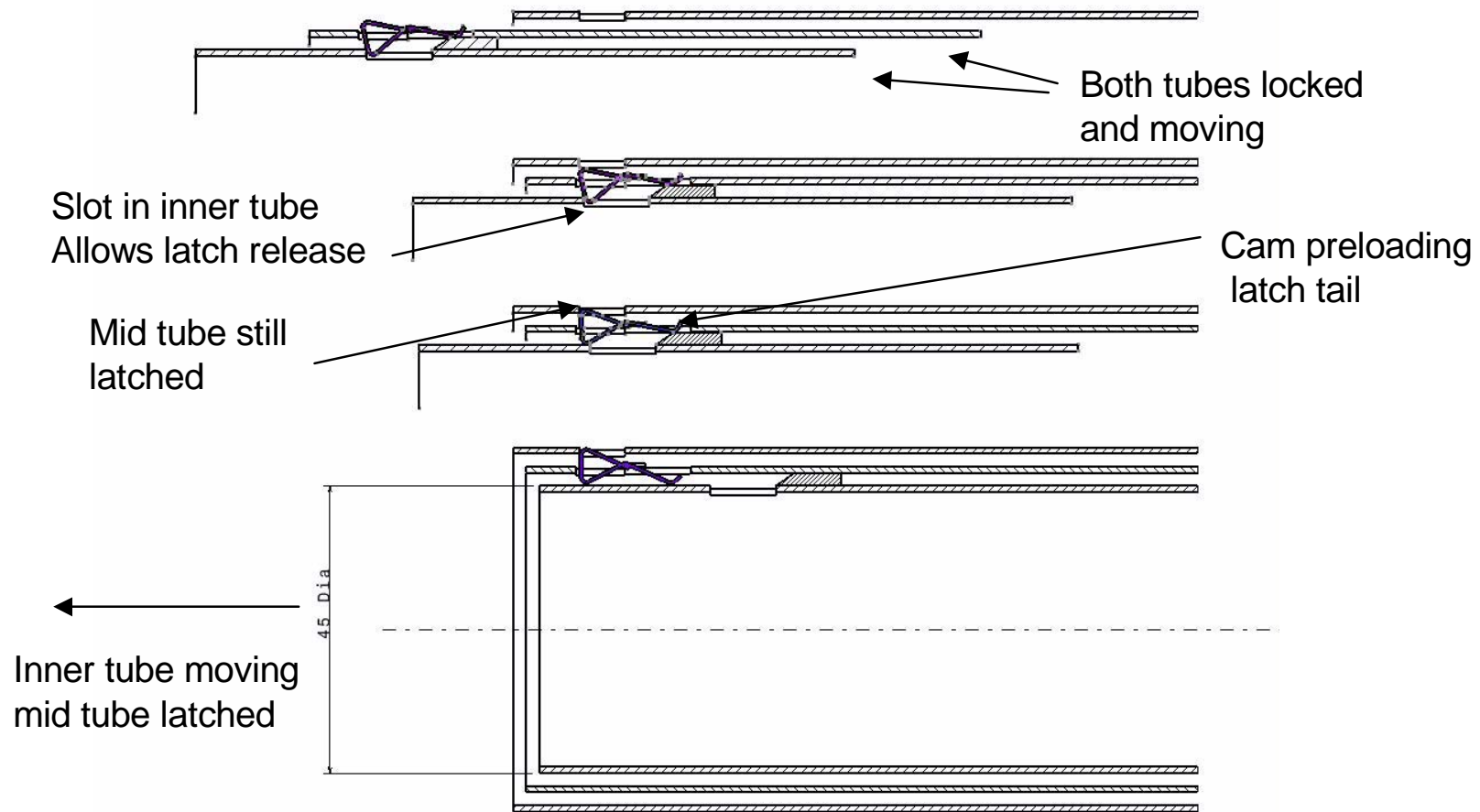
It looks good – doesn't it?



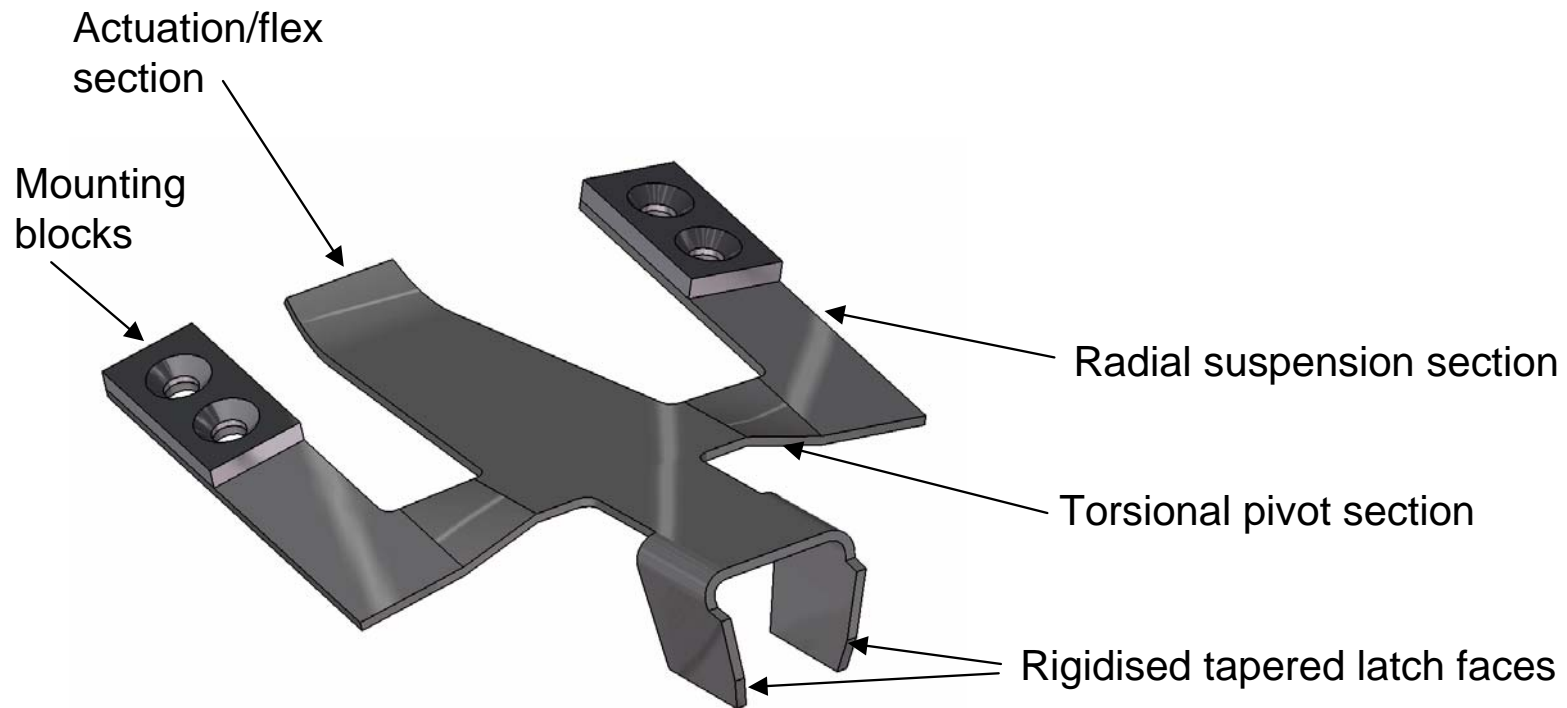
But it's not as simple as it looks



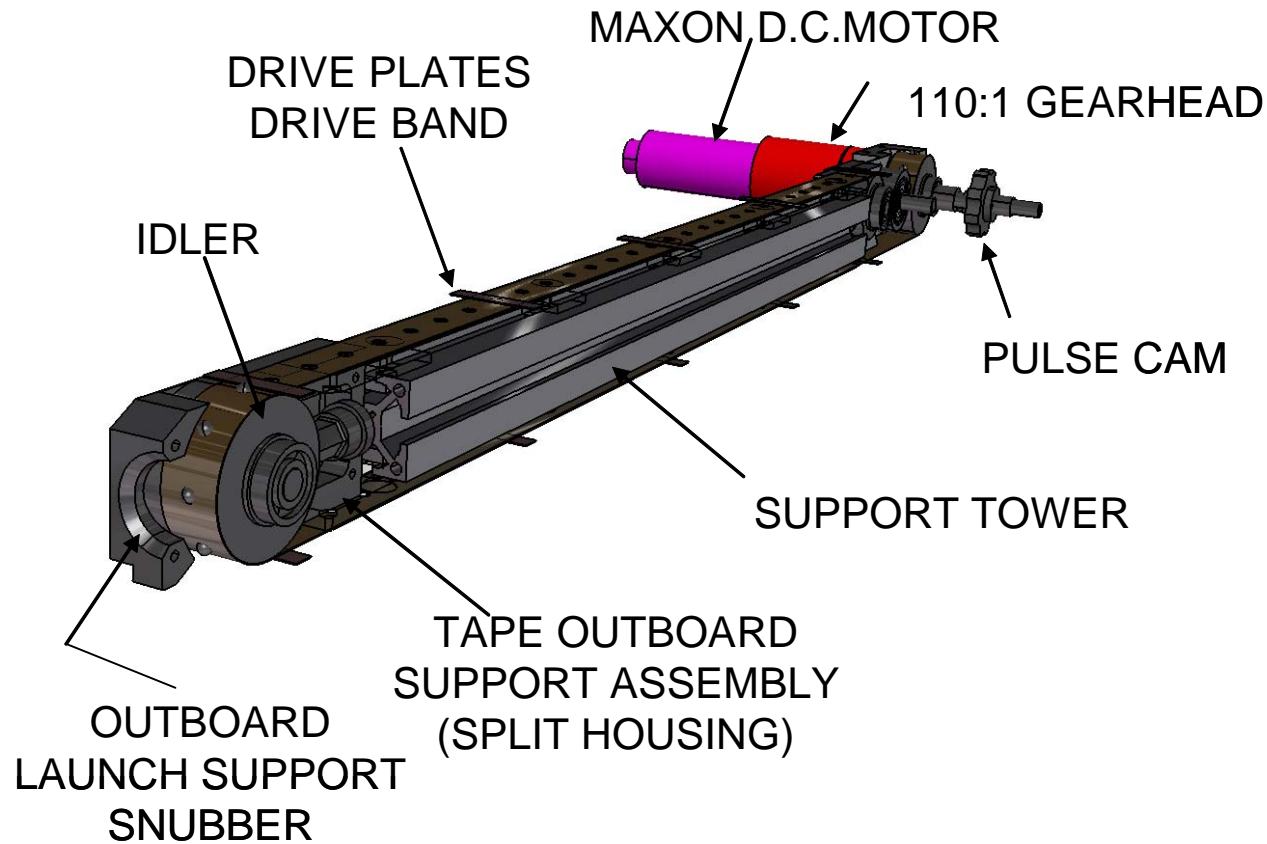
Concentrate – this bits tricky



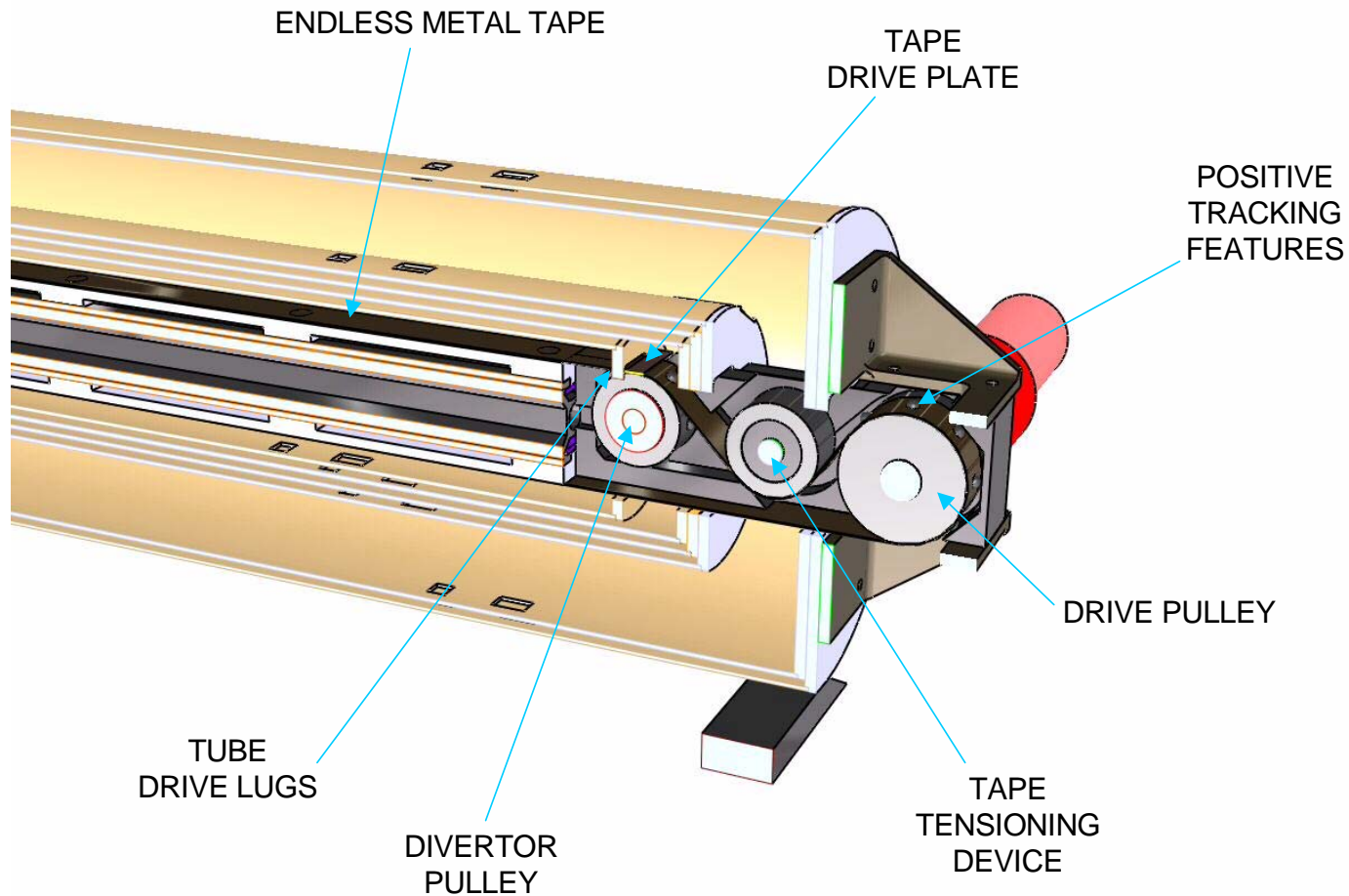
Now this bit's smart



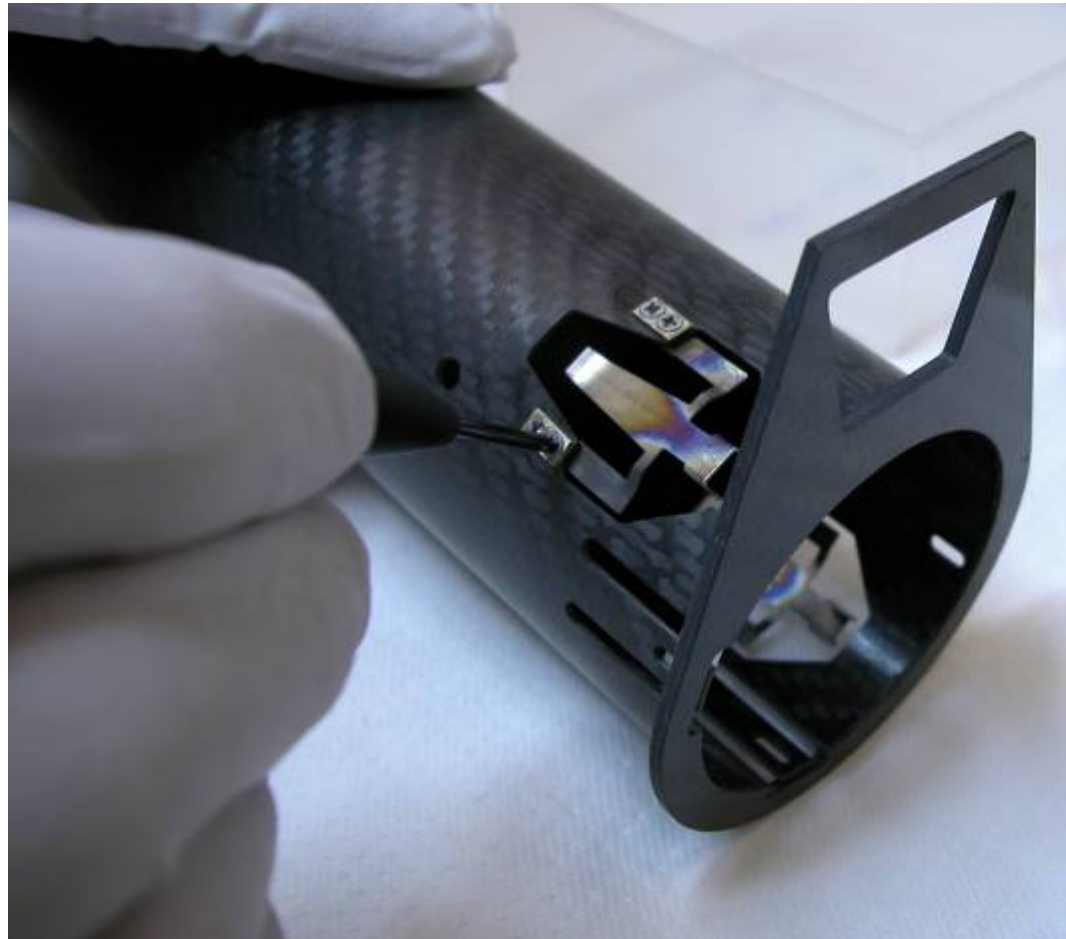
And so is this - really



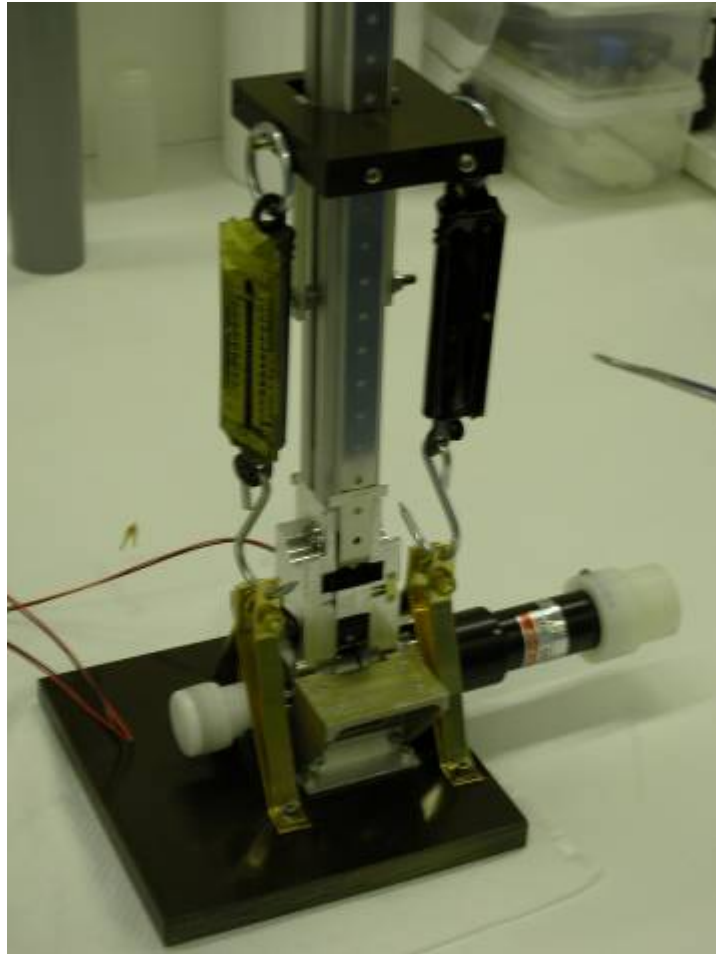
This is how they are supposed to fit



Surprise! It does fit together



That's lucky – this bit seems to work



This just keeps getting better

- > Test rig allows vertical and horizontal deployment.
- > Motorised anti-G device for continuous adjustment
- > Inclinometers for angles
- > Ultrasonic sensors for linear
- > Vertical deployment through a hole in the roof of the ESTL clean room



Now lets see if we can break it

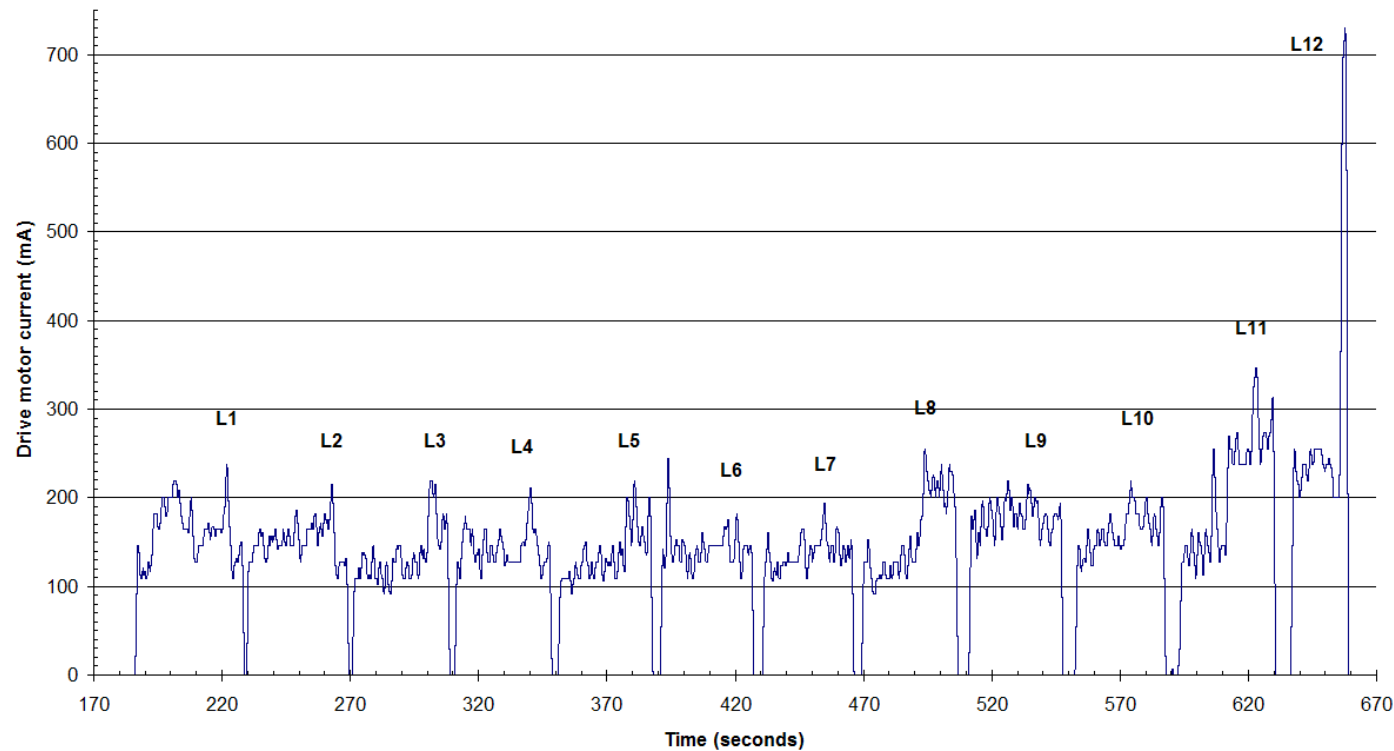


- > Drive life tested in T.V
- > Over 40 full deployments including repeatability measurements
- > 3 off qualification level vibration tests
- > Partial horizontal deployment in vacuum
- > 4 full deployments at thermal extremes (-20 & +60 deg C)



Wow - it even works in space

- > Launched on SSTL CFE Sat - both booms successfully deploy in March 2007



A happy ending ..aahhhh...

- > The Design met its specification
- > The Boom is up there, where it belongs
- > Mainly due to the use of a continuous evolving breadboard model.
- > Greatly helped by having
 - ❖ A co-operative customer ...
 - ❖ ... and a reliable partner
- > The customers are happy!



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... and the young engineer (from 1978) went on to become a well known and highly paid consultant.

- now that is a good ending!

