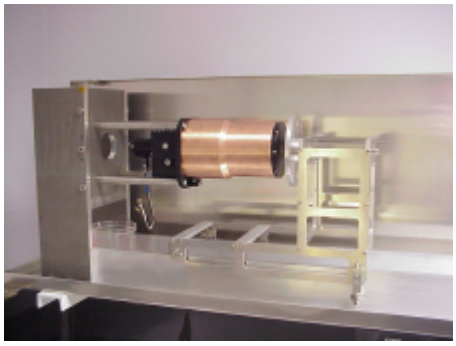
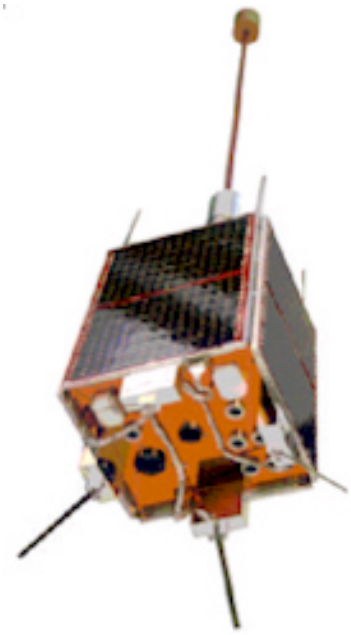
SSTL-Weitzmann 6m Deployable Boom

The SSTL-Weitzmann boom is a compact system for deploying payloads or instruments, or to form the basis of a gravity gradient attitude system, on a 6 metre rigid boom. The STACER tube, on which it is based, has a heritage of over 25 years, during which more than 600 units have been used on a variety of spacecraft and sounding rockets.

The SSTL-Weitzmann boom is a deployable boom system capable of extending a tip mass or payload by up to 6 metres. It is typically used to provide spatial distance between sensors and their platform (spacecraft or sounding rockets) or with a tip mass on gravity gradient stabilised satellites.

The system is extremely compact when stowed (102 x 115 x 264 mm) and lightweight (2.2 kg), making it ideally suited for small satellite missions where volume and mass are at a premium. Deployment is initiated by applying power to dual redundant pyro-cutters which release the STACER mechanism. A deployment switch is toggled as the boom extends, where the number of transitions indicates the deployed length.





During deployment the STACER forms one coil at a time, thus at the end of deployment a fully tubular structure is in place, with a good level of overlap between adjacent coils. Once deployed, the boom is a very rigid structure, with similar behaviour to a thin walled tube. In comparison to longitudinally 'split tape' type booms the SSTL-Weitzmann boom exhibits uniform cantilever bending stiffness and significantly improved torsion and thermal characteristics.

The boom has an extensive heritage, dating back for over 25 years, during which over 600 STACER units have been used on a variety of sounding rocket and spacecraft missions. As well as producing the SSTL-Weitzmann booms, SSTL extensive and valuable experience in their integration and operation on spacecraft which can be passed on to users of the boom - so far 9 SSTL spacecraft have already successfully deployed such booms.

Features

- **Flexible payload** accommodation
- Available as a complete **gravity gradient system** with tip mass
- **Low cost, short lead time** mean the boom is ideally suited for small missions
- **Rigid structure -** the tubular design results in a rigid structure with low thermal deflection
- **Flight proven**- over 600 STACER units sold
- **Non-magnetic** materials used throughout the boom
- **Test & Performance Data** available on request

Applications

- Deployable tip mass system for gravity gradient stabilised spacecraft
- One-off deployment use for extended lifetime ADCS
- Aerodynamic stabilisation
- Instrument boom for sensors on spacecraft or sounding rockets are available from Kaleva Design (www.kalevadesign.com).

Specification

- Maximum deployable distance:
  6000 mm +305 / -0 mm
- Stowed volume:
  102 x 115 x 264 mm
- Deployed volume:
  102 x 115 x 6264 mm
- Mass (excluding tip mass): 2.2kg
- Available tip masses:
  1.0 to 13.0 kg
- Deployed flexural stiffness:
  3 (tip) to 12 (base) Nm^2
- Flexible payload accommodation
- Deployment speed controllable,
  typically 0.3 metres / second
- Available deployment thrust:
  17 Newtons
- Switch indicates deployed length

Qualification / Heritage

- Over 600 STACER units in the last 25 years
- Successfully deployed on these SSTL missions: UoSAT -5, KITSAT-1, S80/T, HealthSat, POSAT, CERISE, FASAT-Bravo, TMSAT, CLEMENTINE
- Selected for UoSAT-12, TiungSat, PICOSat, Tsinghua-1

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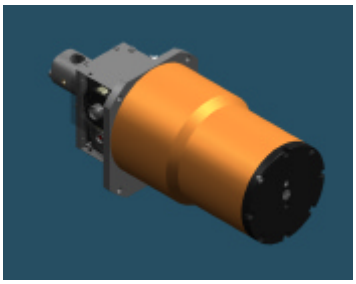
Description

The mechanism consists of two major sub-assemblies, separated by a circular mounting plate. Ahead of the mounting plate (in the deployment direction), the STACER element in its canister is located centrally, surrounded by a spring loaded telescopic section whose purpose it is to reliably initiate the deployment sequence, and to extend the boom support nozzles which provide pointing accuracy and cantilever stiffness.

The canister shaped tip mass is placed coaxially over the telescopic section and is seated in a circumferential recess in the mounting plate. Located aft of the mounting plate is a flyweight brake mechanism which acts through a spool-wound restraint line connected internally to the STACER tip shaft to limit the deployment speed to a desired level. A cam-operated limit switch senses spool rotations and monitors deployment speed an distance.



Deployment is initiated with a pyrotechnic bolt cutter located aft of the brake mechanism. The cutter acts on a shear bolt loaded in tension to the STACER tip shaft which is connected to the tip mass. The resulting compressive load on the tip mass is reacted by the mounting plate interface and thereby holds the tip mass securely. A cap placed over the shear bolt head provides a positive lock on the bolt and also captures the severed bolt head with an energy-absorbing lead slug.

A safety locking screw is provided which secures the tip mass to the mounting plate and thus prevents accidental deployment. To increase reliability, the unit is fitted with a redundant backup cutter.

Other SSTL Products

- **ADCS -** magnetometers, Sun and Earth sensors, star mappers, quartz rate gyros, wheels, magnetorquers.
- **ODCS -** GPS receivers for orbit and attitude determination, cold gas and resistojet propulsion systems. Hybrid rockets currently in development.
- **Gravity gradient ADCS module -** An ADCS module based on the UoSAT gravity gradient stabilisation well proven low cost system.
- **Complete low cost small satellite solutions**, based on SSTL range of nano, micro, enhanced micro and mini satellites, including technology/know-how transfer and rapid and affordable access to space.
- Complete **spacecraft sub-systems**, unit level equipment and Ground Segments

affordable access to space

Environmental (Acceptance Level)

- Random Vibration: 15 g, 3 axes
- Pressure: atmospheric to hard vacuum
- Radiation: not affected after deployment
- Thermal:

  <100 ºC prior to deployment

  no requirements once deployed

Electrical Interface & Pyrotechnics

- Dual redundant pyro-cutters placed in series
- Pyro-cutters classed as “Class C” explosives safe for flight and train travel
- 4-pin connector
- Pyro-cutter actuation:

  No-fire current: 1.0 A for 1 min.

  All-fire current: 5 A for >10 msec.

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