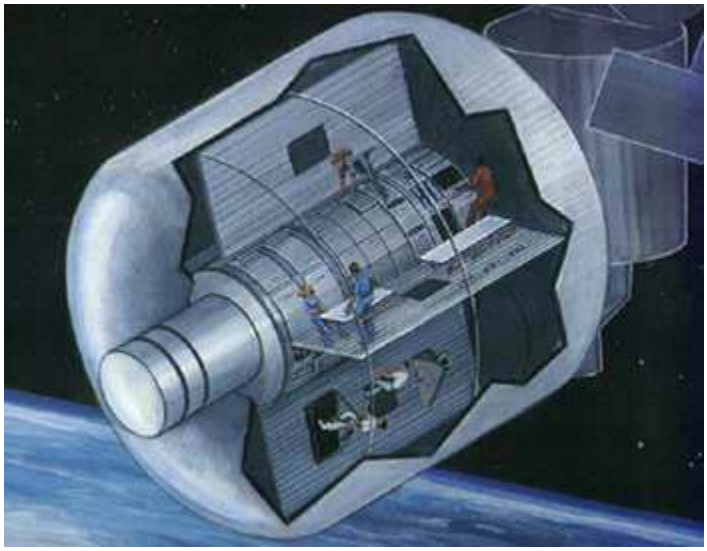
MARS TRANS HAB



MARS TRANS HAB and MOD Protection

From 1977 through 2000, the Mars Trans Hab (MTH) Design Study Team developed design concepts for a manned Mars transportation system. The study team proposed an MTH spacecraft that is launched into orbit during an STS mission, following construction of the International Space Station (ISS). The MTH would transfer from low Earth orbit into a high Earth orbit, after which the MTH crew would ferry from the ISS to the MTH via an X-38 vehicle prior to beginning the 200-day trip to a Martian orbit.

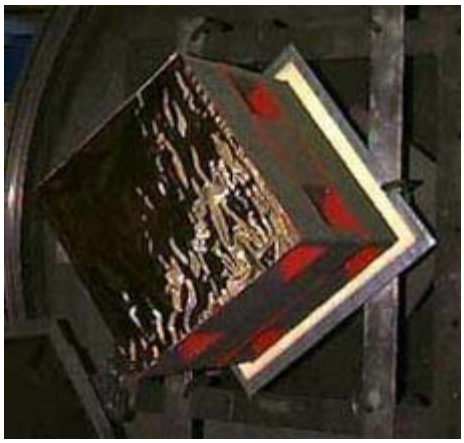
The design team's fundamental structural design is based upon a cylindrical Central Structural Core (CSC). An airlock, consisting of a cylindrical structural shell and hatch, is affixed to one end of the CSC. Enveloping the core is an inflatable shell which serves several functions, including shell stiffness and thermal insulation, as well as meteoroid and orbital debris (MOD) protection. The MTH shell features a deployable multi-shock shield consisting of three Nextel AF-10 bumpers, each separated by a 10 cm standoff of low-weight open-cell foam which serves as the support materialThe rear wall consists of five layers of Kevlar fabric. The foam is initially compressed for launch into a package approximately 5 cm thick. After achieving orbit, the foam is allowed to expand to its full 30 cm standoff. The pressure bladder is located behind the Kevlar wall. As assessment of the shell's ability to withstand the MOD environment is summarized in the recent report, Mars Trans Hab Meteoroid and Orbital Debris Shield Performance Assessment, Glen Shortliffe and Eric Christiansen, JSC 27892, June, 1997.

MARS TRANS HAB

Baseline Shield Performance

In the first phase of testing, a total of seven hypervelocity impact (HVI) experiments were performed to assess the response of the Mars Module Shield (MMS) concepts. The baseline MMS was capable of withstanding projectile impacts of aluminum spheres measuring up to 6.35 mm in diameter, each traveling about 6.5 km/s and impacting normal to the target.

Further research was performed to investigate the effect of the heavy RTV adhesive used to bond the layers of the MMS together. In two separate experiments, the RTV was omitted from the target configuration. In both cases, it was observed that a 4.76 mm projectile was sufficient to fail the modified MMS shield. Clearly, the RTV layers improved the HVI performance of the shield. Because the RTV is not considered to be part of the overall shield design, further HVI testing is warranted using targets more closely approximating flight hardware, without the RTV coatings.



The Mars Trans Hab baseline shield is a multi-shock shield consisting of three Nextel AF-10 bumpers spaced apart by supporting layers of open cell foam

MARS TRANS HAB

Baseline Shield Performance

The cored foam layers used in five of the MMS experiments are believed to have contributed a net shielding benefit by the fact that they fully support the Nextel layers. They also appear to mitigate lateral expansion of the debris cloud which results in smaller entry holes and reduced tearing within the Nextel layers. For this reason, the shielding properties of cored foam "lightening holes", used as a Nextel support mechanism and as a debris cloud mitigation material, should be further investigated.

The probability of no penetration (PNP) for the Mars module was estimated to be 98% over the entire mission. This PNP does not reflect the MOD threat to the MTH propulsion system or the airlock. The mission parameters and shield ballistic limits must be further refined in order to assess the integrated PNP for the whole spacecraft.