# NASA Facts

National Aeronautics and
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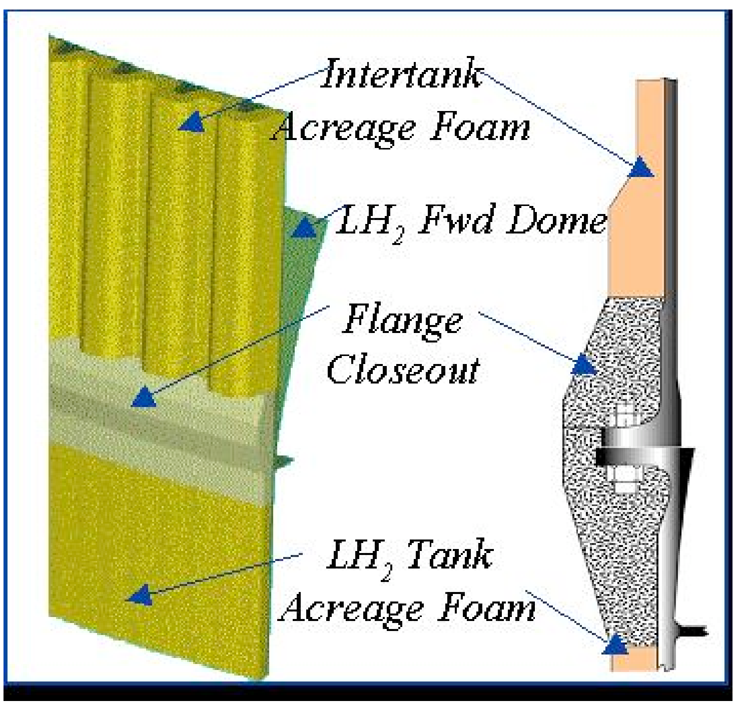
### External Tank Return to Flight Focus Area

## Liquid Hydrogen Tank to Intertank Flange Area

To minimize the potential for debris loss from the External Tank, NASA has completed a top-to-bottom assessment of the tank's Thermal Protection System. The Space Shuttle Program has examined all areas where the tank's foam insulation, a component of the Thermal Protection System, could potentially be lost during flight.




**New Flange Configuration**

As part of this process, the External Tank Project Office has re-evaluated the existing design of the liquid hydrogen tank to the intertank flange area. New requirements established by the Space Shuttle Program Office that allow debris from this area to be no more than 0.04 pounds in mass prompted further testing to reduce the chance of foam loss. Foam divots, or pieces of foam that have come dislodged from this area, have typically weighed less than 0.10 pounds

The External Tank's intertank is the structural connection that joins the liquid hydrogen tank and the liquid oxygen tank. Flanges, which are a connection joint that functions much like a tab or a seam on a shirt, are affixed at the top and bottom of the intertank so the two tanks can be attached to it.

The liquid hydrogen tank flange is at the bottom of the intertank. After the two tanks are joined to the intertank, the flange is insulated with foam.

Testing and analysis revealed gaseous nitrogen used to purge the intertank area can potentially turn to liquid nitrogen when it is exposed to the extreme cold of the liquid hydrogen. The temperature of the liquid hydrogen tank is near minus 423 degrees.

Once liquid nitrogen is formed inside the intertank area it can migrate to any voids – or spaces – in the foam or voids contained in the foam adjacent to the flange that is located near the liquid hydrogen tank. During launch, heating from the decreasing liquid hydrogen level causes the liquid nitrogen to rapidly return to gaseous form, building pressure that causes foam loss. The phenomenon is known as cryo-ingestion. Cryo-pumping is the same as cryo-ingestion except surface air is pulled into voids in the foam when the tank is filled and reaches cryogenic temperatures.

Re-evaluation of the area has resulted in the Project Office initiating an enhanced close-out – or finishing – procedure that includes improved foam application to the stringer area, or intertank ribbing, and to the upper and lower area of the flange. The enhance-ment approach centered on reducing the complexity of the foam application process. The simplified, enhanced process will allow the technician to spray a higher quality product. The combination of reversing the flange bolts, which connect the liquid hydro-gen tank and intertank, and a new mold injection foam closeout process of the intertank stringers provides the technician with a less complex base substrate resulting in a reduction of sprayed defects. In addition, numerous controls and process verifications have been incorporated to assure compli-ance to engineering requirements. These controls include engineering evaluation of processing parameters; real-time and video surveillance of the process; and destructive evaluation (dissection) of “flightlike” witness panels.

In addition to the improved spray applications, steps are being taken to prevent the cryo-ingestion of the intertank nitrogen purge. These steps include the addition of a thread sealant to the flange bolts. These preventative actions reduce the risk potential for TPS debris from the flange region.