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Nasa confident of first Space Shuttle flight in 1980

Orbiter Enterprise on the Kennedy launch pad in the middle of last year. The white box on the end of one of the arms protruding from the rotating service tower provides crew access to the Orbiter. If all goes well Nasa hopes to roll out the first flight Orbiter, Columbia, complete with External Tank and Solid Rocket Boosters, in May or June

TECHNICIANS at Nasa's Kennedy
Space Centre (KSC). Florida have
completed stacking of Solid Rocket
Boosters (SRBs) for the first Space
Shuttle flight. First flight external Tank is already in the Vehicle Assembly Building (VAB) at KSC and is scheduled to be mated to the SRBs during February. But the most impor-tant element, Orbiter Columbia, is still undergoing preparations in an adjacent building.
Columbia is having its various sys-tems tested, and thermal protection tiles are being installed. In mid-Janu-ary Columbia, piloted by two astro-nauts, successfully reached orbit dur-

ing a simulated launch in which its computers were linked up with those of the Shuttle simulator in Houston, Texas. This was the second simulated launch—one was achieved just before Christmas—but both have not been as smooth as engineers would have liked.

Preparation of Columbia for first flight received a setback in September last year, when concern about its til-ing made engineers embark on a test programme. Bond strength between each of around 34,000 silica-foam tiles and the metal skin had to be checked. Tiles which are accessible and not in sharply curved areas

will be pull-tested using a vacuum chuck, which grips the tile by suction. If the tile withstands this pull, in-tended to simulate aerodynamic loads during launch and re-entry, it passes and is left in position—if not it is re-moved and re-bonded.

Tiles can only withstand an arti-ficial suction of 95KN/m2

, thus those
which are more highly loaded in flight, plus inaccessible and highly curved tiles, have to be removed and re-bonded to guarantee the joint. Pull-test loads are roughly twice those expected during normal flight, thus providing a considerable safety mar-gin.
Nasa says the tile testing is necessary because of insufficient attention to the mechanical design of tile attachment. The interface be-tween tile and Orbiter skin is a com-plex one (see picture overleaf), be-cause the tiles have to be isolated from stresses in the skin. Isolation is achieved by a synthetic felt insulation bonded to the back of each tile, which is in turn attached to the Orbiter's skin. In addition there are filler bars for waterproofing. Apparently the synthetic felt used was found to have built-in stress concentrations, which to some extent defeated its isolating function.

The stress concentrations are apparently caused during manufac-ture, which involves floating synthetic fibres in a solution that is eventually drained off to leave a felt mat. With natural fibres, such as rabbit fur, this process is all that is needed, because the fibres have barbs which interlock. Synthetic fibres, however, have no barbs and to achieve some interlock-ing the felt mat is "needled," thus turning some fibres so that they run through the felt's thickness. It is this "needling" which introduced undesir-able stress concentrations.

Nasa plans to remove and strengthen any unsatisfactory tile backing before re-bonding. Tile strengthening is achieved by locally reinforcing the inner surface of the tile by baking-on a silica slurry. The bonding process remains essentially the same.

Nasa does not intend to change its flight plan for first flight, currently envisaged as a three-day mission with launch from KSC and landing at Ed-wards AFB in California. There had been proposals for a sub-orbital lob to reduce tile loads, as well as space-page 304 •- -»-