National Aeronautics and Space Administration

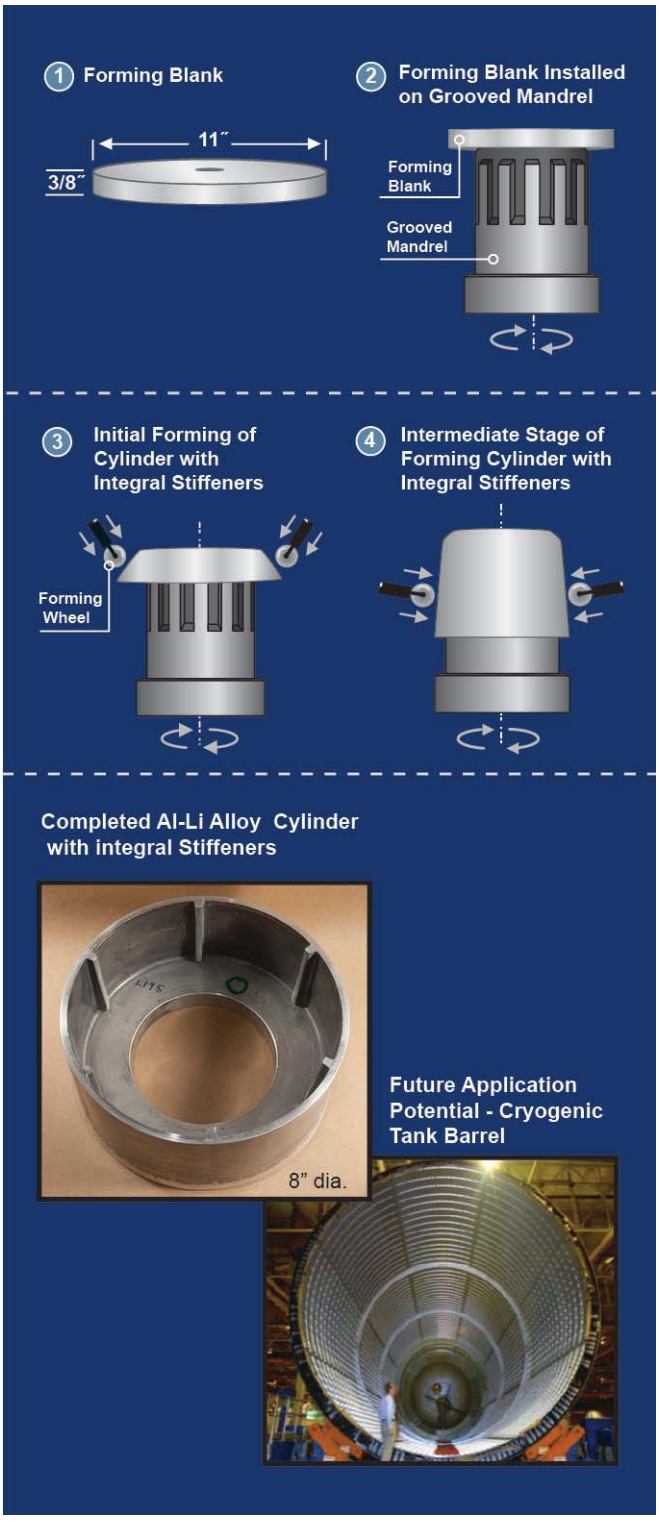
Innovative Manufacturing of Cylinders with Integral Stiffeners

NASAfacts

The current manufacturing method for launch vehicle structures such as cryogenic propellant tanks (cryotanks) relies on traditional metals fabrication technologies developed in the 1950s. The Space Shuttle External Tank (ET) represents state-of-the-art manufacturing of metallic cryotanks and is the baseline for NASA's Space Launch System (SLS). The ET is machined from 2-inch thick aluminum lithium (Al-Li) alloy plate to form the integrally stiffened skin structure of the cryotank and has in excess of half a mile of welds. New and revolutionary metal forming techniques are being explored to significantly reduce weight and cost and improve the safety and reliability of cryotanks.

A combined spin/flow forming process is under development that could revolutionize cryotank fabrication by producing a net shape integrally stiffened cylinder (ISC) in one forming operation. During this one step process, a rotating circular blank is formed over a cylindrical mandrel which has grooves that correspond to the stiffener shape. Metal flows into the grooves as the stiffeners and cylinder take shape.

NASA is working to optimize and scale up the ISC process to fabricate large, aerospace quality Al-Li alloy cryotanks. The goal is to form net shape cryotank walls (skin) and stiffeners in one forming operation. This will eliminate the need for machining and longitudinal welding of the cryotank barrel sections. For an ET size cryotank, raw material scrap rate would be reduced from 90% to 5% translating into an ~ $8M savings per tank. Eliminating welds, weld defects and thick weld lands will increase safety and lower overall cryotank weight.



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