# Liquid Reusable Boosters For Lunar Direct Polar Moon Base Development

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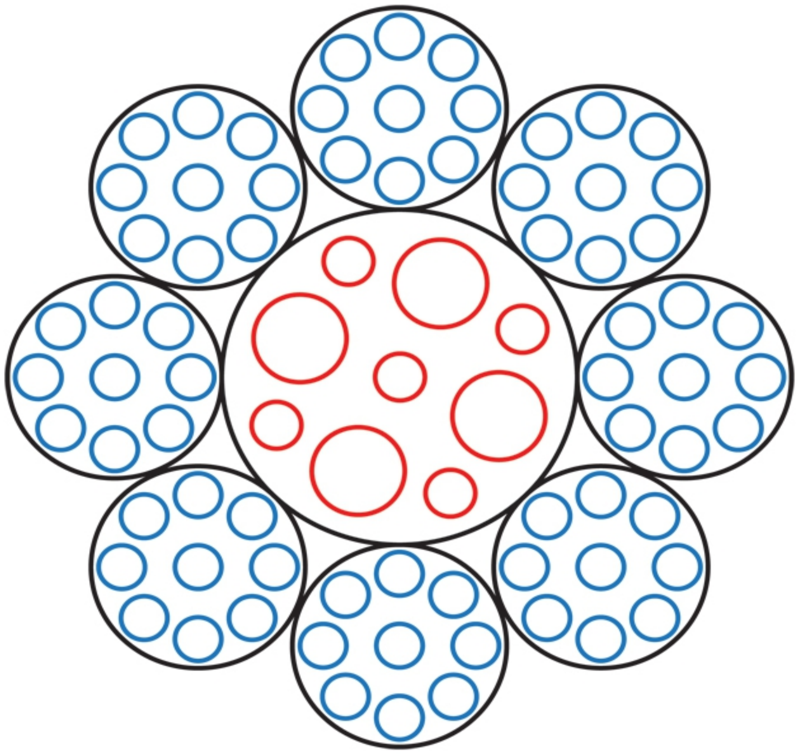

Engine Cluster Diagram for Space Launch System (SLS) Derived Lunar Polar Landings.

The recent December 17th, 2012 demonstration of the Falcon 9 (Grasshopper) launching and hovering using a Merlin 1D hydrocarbon engine dramatically illustrates the landing abilities of large, tall core stage launch vehicle structures on the surface of the moon, and the recovery of their reusable boosters.

The use of ground started space shuttle main engines for lunar aligned high energy trans-lunar-injection (TLI) burns removes the necessity of orbital maneuvering engines such as the J-2X and allows for their application to be directed to the considerably less energetic lunar injection and parabolic arc landings. In terminal lunar landing applications either five (5) RL-10 engines in the SSME interstitial positions, or a single deep throttleable J-2S in the center landing engine position will suffice, depending upon the availability of engines or the necessity or desirability of multiple engine redundancy for lunar landings. Great weight savings in the tank structure may be gained through the use of an ovoidal oxygen tank in lieu of a large payload fairing (shuttle style), thus removing the need to support large payload masses. The tank is stretched to accommodate the extra fuel necessary for sequential low earth orbital (LEO) achievement, TLI, and several days later - direct lunar injection and landing using upper stage engines.

Thus with sufficient booster payload capacity, the entire core stage of the SLS launch vehicle becomes a landed reusable moon base capable of performing all of the functions integrated into it upon launch. The applications include residual fuel boil off conversion for water production, solar power production, navigation and communications, thermal and optical observation and imaging, small rover deployment, control and management, in-situ resource utilization (ISRU) and conversion into storage and habitats.