

UPPER STAGE  
ENGINES\_

**MOOG**  
**ISP**



## Upper Stage Engines

The LEROS family of flight proven, bipropellant, dual mode apogee engines has demonstrated performance improvements over three design generations. These engines provide high performance, cost-effective solutions for satellite orbit insertion and interplanetary missions. The LEROS 2b adds MMH/MON apogee capability to the LEROS family, offering high performance in a coated columbium engine at an excellent value.



Photo Credit: NASA



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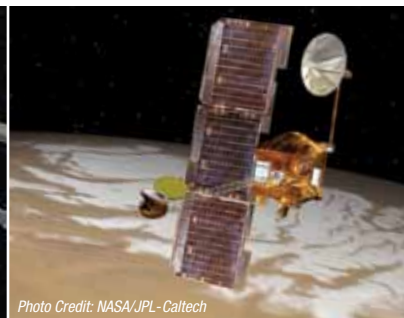


Photo Credit: NASA/JPL-Caltech

# Upper Stage Engines

Performance Characteristics			
Characteristic	LEROS 1b	LEROS 1c	LEROS 2b
Typical Application	Deep Space Trajectory Correction Planetary Orbit Insertion	Orbit Insertion Comsats	Orbit Insertion Comsats
Nominal Thrust	635N (143 lbf)	458N (103 lbf)	407N (91 lbf)
Specific Impulse @ NDP	317 sec	324 sec	318 sec
Propellants	Hydrazine/MON	Hydrazine/MON	MMH/MON
Thrust Range	587 - 707 N (131 – 158 lbf)	386 – 470 N (86 – 105 lbf)	367 – 456 N (82 – 102 lbf)
Mixture Ratio Range (O/F)	0.8 – 0.9	0.78 – 0.89	1.43 – 1.81
Mixture Ratio at Nominal Inlet Pressures (O/F)	0.85	0.85	1.65
Throughput	4,170 kg (9,174 lbs)	4,300 kg (9,560 lbs)	3,893 kg (8,564 lbs)
Inlet Pressure Range	218 – 300 psia (235 nom.) / (15 – 20 bars)	190 – 300 psia (245/235 F/O nom) / (13 – 20 bars)	196 – 247 psia (223 nom) / (13 – 17 bars)
Maximum Duration Single Firing	2,520 sec	5,800 sec (Performed in orbit)	4,000 sec
Cumulative Duration, Qual	20,500 sec	31,000 sec	29,900 sec
Engine Mass	4.5 kg (9.9 lbs)	4.3 kg (9.5 lbs)	5.0 kg (11 lbs)
Restarts Demonstrated (Chamber temp. <100°C at start >1300°C at finish)	70	72	75
Qualified Valve Cycles	10,500	10,500	10,500
Length	540 mm (21 in)	527 mm (20 in)	671 mm (26 in)
Diameter	289 mm (11 in)	288 mm (11 in)	334 mm (13 in)



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