L3HARRIS®
FAST. FORWARD.

BIPROPELLANT ROCKET ENGINES

Enabling in-space operations and exploration

Beginning with the Apollo missions to the Moon, L3Harris has delivered more than 2,500 bipropellant rocket engines for in-space propulsion use. L3Harris has bipropellant in-space rocket engines ranging in thrust level from 2.5-lbf thrust to 6,000-lbf thrust.

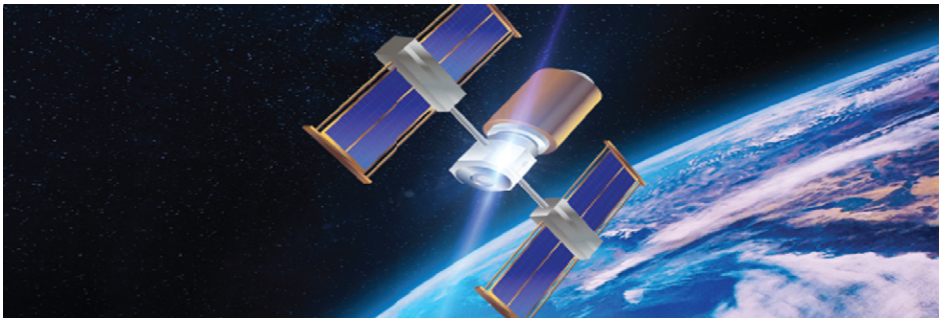
Bipropellant engines produce thrust when two propellant valves open and liquid fuel (typically monomethyl hydrazine or hydrazine) and liquid oxidizer (nitrogen tetroxide) hypergolically ignite in the chamber. The resulting hot gas exits the nozzle, creating thrust.

ISE ENGINE FAMILY

L3Harris' ISE engines — a low cost and low mass bi-propellant family of 5-pound and 100-pound thrusters using high-performance Mon-25 oxidizer — provide system level benefits due to low freezing temperatures. ISE engines are ideal for deep space missions and landing applications.

R-4D ENGINE FAMILY

L3Harris' R-4D engines — a family of 100-pound thrust bipropellant thrusters — were originally developed for the Apollo program and were key to the rescue of the Apollo 13 crew. Since then, the R-4D has evolved into the world's highest reliability apogee-insertion engine available today. R-4D engines have flown over 300 apogee-insertion missions, with a 100% success rate.



KEY FEATURES

Bipropellant engines are used on various spacecraft for a wide variety of missions including geosynchronous-orbiting satellites, International Space Station servicing vehicles and interplanetary exploration to assist with orbit insertion, Delta-V and reaction control.

L3Harris In-Space Chemical Bipropellant Rocket Engines

ENGINE MODEL	TRL/ MRL	THRUST, LB	SS ISP, SEC	OXIDIZER/ FUEL	O/F	INLET PRESSURE, PSIA	TOTAL IMP, LB-SEC	LIFE, PULSES	LONG BURN, SEC	LENGTH, IN	DIAM., IN	WT, LB	VALVE TYPE
R-6D	Q, F, NIP 9/6	5 (1.3-7.75)	295	MON-3/ MMH	1.25-1.65	220 (150-370)	225,000	300,000	500	9.97	2.17	1.7	Direct-acting solenoid or torque motor; single seat or dual seat.
R-6F	Dev 6/6	5 (3.0-6.25)	305	MON-3/ MMH	1.61	220 (150-370)	TBD	TBD	TBD	11.4	2.4	2.1	Direct-acting solenoid; dual seat, upstream latch.
ISE-5	A-Dev 6/7	5	280	MON-25/ MMH	1.0	360	4,795 demo >100,000 planned	50,000	>1000 (600 demo)	6.84	2.50	1.0	Direct-acting cartridge solenoid; single seat.
AJ10-220	Q, F, IP 9/9	14 (9.5-22)	282	MON-3/ MMH	1.65	220 (145-370)	154,000	65,000+	300	7.5	2.9	4.3	Torque Motor; dual seat.
AR-49	A-Dev 6/7	25	315	MON-3/ N_2H_4	0.85	250	7,755 demo >250,000 planned	50,000	>1000 (95 demo)	11.6	4.8	1.6	Direct-acting cartridge solenoid; single seat.
ISE-25	A-Dev 5/7	25	318	MON-25/ MMH	1.59	250	7,755 demo >500,000 planned	50,000	>1000 (95 demo)	11.6	4.8	1.6	Direct-acting cartridge solenoid; single seat.
R-1E	Q, F, IP 9/9	25 (14.5-31)	280.5	MON-3/ MMH	1.65	240 (125-350)	2,500,000	330,000	3,600	12.28	4.38	4.4	Direct-acting solenoid; single-seat.
AR-47	Q, F, IP 9/9	85 (76-94	285	MON-3/ MMH	1.65	650 (550-760)	34,000	4,000	400	7.36	3.11	1.12	Gas-operated, solenoid pilot; single seat.
ISE-100	A-Dev 6/7	100	313 demo 320 planned	MON-25/ MMH	1.59	360	50,000 demo >1M planned	>1,000	>1000 (25 demo)	12.2	5.9	4.4	Direct-acting cartridge solenoid.
R-4D-15 "HiPAT™"	Q, F, IP 9/9	100 (85-115)	322	MON-3/ MMH	1.65	220 (100-400)	2,927,000	391	7,200	28.57	15.25	12.0	Direct-acting solenoid; single seat, dual coil.
DM R-4D-15 "Dual-mode HiPAT™"	Q, IP 8/9	100 (70-125)	328	MON-3/ N_2H_4	0.85-1.00	235 (100-400)	3,430,000	672	4,000	28.57	15.25	12.0	Direct-acting solenoid; single seat, dual coil.

ENGINE MODEL	TRL/ MRL	THRUST, LB	SS ISP, SEC	OXIDIZER/ FUEL	O/F	INLET PRESSURE, PSIA	TOTAL IMP, LB-SEC	LIFE, PULSES	LONG BURN, SEC	LENGTH, IN	DIAM., IN	WT, LB	VALVE TYPE
R-4D-11	Q, F, IP 9/9	110	315	MON-3/ MMH	1.65	220 (60-425)	4,873,000	59,000	12,000	29.0	14.84	9.5	Direct-acting solenoid; single seat, dual coil.
R-4D-16 "AMBR"	Dev 6/6	120	329	MON-3/ N_2H_4	0.85-1.00	220	TBD	TBD	2,700	28.5	14.6	10.8	Direct-acting solenoid; single seat, dual coil.
ISE-200	A-Dev 5/7	200	317	MON-25/ MMH	1.59	360	>2M planned	>1000	>1000 (50 demo)	11.9	6.28	3.1	Direct-acting cartridge solenoid.
R-42	Q, F, IP 9/9	200 (140-305)	305	MON-3/ MMH	1.65	220 (145-370)	5,456,700	134	3,940	31.0	15.34	14.5	Direct-acting solenoid; dual seat.
DM R-42	Q 8/7	200	327	MON-3/ N_2H_4	0.85-1.00	235	1,200,000	142	1,800	28.0	15.0	16.0	Direct-acting solenoid; single seat, dual coil.
R-40B	Q, F, NIP 9/4	900	296	MON-3/ MMH	1.65	240 (150-400)	20.7M	50,000	500	28.0	15.8	35	Line-pressure actuated, solenoid pilot; single seat.
ISE-900	A-Dev 3/6	860	304 (304-317)	MON-25/ MMH	1.65	320-400	>20M planned	2,000	>1000 planned	17.6	9.7	14.0	Gas-operated, solenoid pilot; single seat.
AR-46	Q, F, IP 9/9	1,587	277 min	MON-3/ MMH	1.65	650 (600-700)	465,000	2,000	66	15.63	6.0	7.2	Gas-operated, solenoid pilot; single seat.
AR-40	A-Dev ** 5/5	6,000	316	MON-3/ MMH	1.65	240	324M	56 min	300 planned	78	46	288	Pneumatic ball, gas solenoid pilot; dual seat.

Q=Qualified, F=Flown, IP=In-Production, NIP=Not In Production, Dev= Past Development, A-Dev = Active Development

**, Re-development of Qualified and Flown, Space Shuttle Orbital Maneuvering Engine for Orion Spacecraft

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