



# BIPROPELLANT ROCKET ENGINES

Enabling in-space operations and exploration

ENGINE	TRL/ MRL	NOMINAL THRUST N(lb)	SPECIFIC IMPULSE sec	TOTAL IMPULSE MN-s	TOTAL PULSES	MINIMUM PULSE BIT N-s	MASS kg
AJ10-220	9/9	62.3 (14)	282 (steady) 268 (pulsed)	0.685	65,000	0.898	1.95
R-1E	9/9	111 (25)	280	11.1	330,000	0.89	2.0
AR-47	9/9	378 (85)	285	0.150	4,000	1.4	0.51
R-4D-15	9/9	445 (100)	321	13.0	391	35.6	5.44
R-4D-15 (Dual Mode)	8/9	445 (100)	328	15.25	672	35.6	5.44
R-4D-11	9/9	490 (110)	311 (ε=164) 315 (ε=300)	21.7	31,950	15.6	3.76 (ε=164) 4.31 (ε=300)
R-42	9/9	890 (200)	305	24.3	–	44.48	6.58
AR-46	9/9	7060 (1587)	282	2.07	2,000	155.5	3.27
AR-48	9/9	169000 (37800)	234 @ SL	3.2	6	N/A	141
ISE-5 (AR-51)	6/9	22 (5)	298	1.1 (Planned)	TBD	TBD	0.4
R-6D	9/6	22 (5)	293	1.00	300,000	0.031	0.77
AR-49	5/8	111 (25)	320-329 (N2H4) 317 (MMH)	2.2 (Planned)	TBD	TBD	0.54
ISE-100 (AR-50)	6/9	445 (100)	322	8.9 (Planned)	1,000	TBD	2.0
R-42 (Dual Mode)	7/8	890 (200)	326	6.0	140	44.48	7.3
R-40B	9/5	4000 (900)	296	92.1	50,000	111	15.9
AR-40	5/6	26700 (6000)	316	1,440	1,000	N/A	118

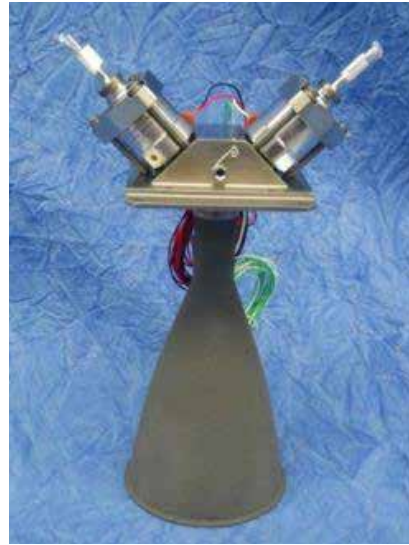


## KEY FEATURES

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.

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.



### 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 percent success rate.

### 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.



### Bipropellant Rocket Engines

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