

17. Acronyms and Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
°R	Degrees Rankine
24/7	24 Hours/day, 7 days/week
2-D	Two-Dimensional
3C	Command, Control, and Checkout
3-D	Three-Dimensional
3-DOF	Three-Degrees of Freedom
6-DOF	Six-Degrees of Freedom
A&E	Architectural and Engineering
ACEIT	Automated Cost-Estimating Integrated Tools
ACES	Acceptance and Checkout Evaluation System
ACP	Analytical Consistency Plan
ACRN	Assured Crew Return Vehicle
ACRV	Assured Crew Return Vehicle
AD	Analog to Digital
ADBS	Advanced Docking Berthing System
ADRA	Atlantic Downrange Recovery Area
AEDC	Arnold Engineering Development Center
AEG	Apollo Entry Guidance
AETB	Alumina Enhanced Thermal Barrier
AFB	Air Force Base
AFE	Aero-assist Flight Experiment
AFPG	Apollo Final Phase Guidance
AFRSI	Advanced Flexible Reusable Surface Insulation
AFV	Anti-Flood Valve
AIAA	American Institute of Aeronautics and Astronautics
AL	Aluminum
ALARA	As Low As Reasonably Achievable

AL-Li Aluminum-Lithium
 ALS Advanced Launch System
 ALTV Approach and Landing Test Vehicle
 AMS Alpha Magnetic Spectrometer
 AMSAA Army Material System Analysis Activity
 AOA Analysis of Alternatives
 AOD Aircraft Operations Division
 APAS Androgynous Peripheral Attachment System
 APS Auxiliary Propulsion System
 APU Auxiliary Power Unit
 APU Auxiliary Propulsion Unit
 AR&D Automated Rendezvous and Docking
 ARC Ames Research Center
 ARF Assembly/Remanufacturing Facility
 ASE Airborne Support Equipment
 ASI Augmented Space Igniter
 ASTWG Advanced Spaceport Technology Working Group
 ASTP Advanced Space Transportation Program
 AT Alternate Turbopump
 ATCO Ambient Temperature Catalytic Oxidation
 ATCS Active Thermal Control System
 ATO Abort-To-Orbit
 ATP Authority to Proceed
 ATS Access to Space
 ATV Automated Transfer Vehicles
 ATV All Terrain Vehicle
 B Billion(s)
 BEN Benign
 BFO Blood-Forming Organs
 BFS Backup Flight Software
 BGN Benign Failure

BLS Bureau of Labor Statistics
 BMI Bismaleimide
 BOGS Blade Outer Gas Seal
 BPR Business Process Reengineering
 BRCU Booster Remote Control Unit
 BSM Booster Separation Motor
 Btu. British Thermal Unit
 C Carbon
 C&C Command and Control
 C&W Caution and Warning
 C.I. Confidence Interval
 C₂H₆ Propane
 C₃ Earth Departure Energy
 CAD Computer-Aided Design
 CaLV Cargo Launch Vehicle
 CAM Computer-Aided Manufacturing
 CBC Common Booster Core
 CBM Common Berthing Mechanism
 CBT Computer-Based Training
 CCAFS Cape Canaveral Air Force Station
 CCB Common Core Booster
 CCDH Command, Control, and Data Handling
 CDF Cumulative Distribution Function
 CDR Critical Design Review
 CDV Cargo Delivery Vehicle
 CE&R Concept Exploration and Refinement
 CEEF Crew Escape Effectiveness Factor
 CER Cost Estimating Relationships
 CEV Crew Exploration Vehicle
 CFD Computational Fluid Dynamics
 CFF Catastrophic Failure Fraction

CFM Cryogenic Fluid Management
 CFO Chief Financial Officer
 cg or CG Center of Gravity
 cGy-Eq Centigray Equivalent
 CH₄ Methane
 CHeCS Crew Health Care System
 CHMO Chief Health and Medical Officer
 CIL Critical Items List
 CIR Combustion Integrated Rack
 CL Confidence Level
 ClF₅ Chlorine Pentafluoride
 CLV Crew Launch Vehicle
 CM Crew Module
 cm Centimeters
 CMG Control Moment Gyroscope
 CMRS Carbon Dioxide (CO₂) and Moisture Removal System
 CO₂ Carbon Dioxide
 COAS Crew Optical Alignment Sight
 Comm Communication
 CONUS Continental United States
 CR Change Request
 CRAC Constant Radius Access Circle
 Crit-1 Criticality 1
 CRV Crew Return Vehicle
 CSM Command and Service Module
 CTB Cargo Transfer Bag
 CTS Crew Transportation System
 CWI Combustion Wave Ignition
 CY Calendar Year
 DARE Dynamic Abort Risk Evaluator model
 DAV Descent/Ascent Vehicle

DBFRSC Dual Preburner Fuel Rich Staged Combustion
 DCF Delayed Catastrophic Failure
 DCS Decompression Sickness
 DC-X Delta Clipper Experimental Program
 DDCmplx Design and Development Complexity
 DDInher Design and Development Inheritance
 DDT&E Design, Development, Test, and Evaluation
 deg. Degrees
 Demo Demonstration
 DKR Detra-Kemp-Riddell
 DoD Department of Defense
 DoE Department of Energy
 DOF Degrees of Freedom
 DoT Department of Transportation
 DPT Decadel Planning Team
 DRM Design Reference Mission
 DSN Deep Space Network
 DSS Decelerator System Simulation
 DV Delta Velocity (i.e., change in velocity)
 EAC Estimates at Completion
 EAFB Edwards Air Force Base
 EAP Expert Assessment Panel
 EAS Engine Air Start
 ECLS Environmental Control and Life Support
 ECLSS Environmental Control and Life Support System
 ECU Engine Control Unit
 EDL Entry Descent and Landing
 EDLS Entry, Descent, and Landing System
 EDS Earth Departure Stage
 EDV EELV-Derived Vehicle
 EEE Electrical and Electronic Engineering

EELV Evolved Expendable Launch Vehicle
 EF Error Factor
 EHA Electro-Hydrostatic Actuator
 EI Entry Interface
 EIRA ESAS Initial Reference Architecture
 ELR Excess Lifetime Risk
 ELV Expendable Launch Vehicle
 EMA Electro-Mechanical Actuators
 EMU Extra-vehicular Maneuvering/Mobility Unit
 EO Engine-Out
 EOI Earth-Orbit Insertion
 EOR Earth Orbit Rendezvous
 ERT Expedition Readiness Training
 ESA Exploration Systems Architecture
 ESAS Exploration Systems Architecture Study
 ESD Event Sequence Diagram
 ESMD Exploration Systems Mission Directorate
 ESRT Exploration Systems Research and Technology
 eSSME Expendable Space Shuttle Main Engine
 ET External Tank
 ETO Earth-to-Orbit
 EtOH Ethanol
 EVA Extra-Vehicular Activity
 FAR Federal Acquisition Regulation
 FC Flight Computer
 FCE Flight Crew Equipment
 FDIR/R Fault Detection, Isolation, and Recovery/Reconfiguration
 FES Fluid Evaporator System
 FEV Flash Evaporator System
 FIR Fluids Integrated Rack
 FIRST Flight-Oriented Integrated Reliability and Safety Tool

FIV Fuel Isolation Valve
 Flts Flights
 FLUINT Fluid Integrator
 FM. Failure Mode
 FMC Flight Medicine Clinic
 FMEA. Failure Modes and Effects Analysis
 FMHR. Free Molecular Heating Rate
 FOM Figure of Merit
 FORP Fuel-Oxidizer Reaction Product
 FRAM. Flight-Releasable Attachment Mechanism
 FRGF. Flight-Releasable Grapple Fixture
 FRSC. Fuel-Rich Staged Combustion
 FRSI Flexible Reusable Surface Insulation
 FS Factor of Safety
 FSE Flight Support Equipment
 FSPS Fission Surface Power System
 FSS Fixed Service Structure
 ft Feet
 ft/s Feet Per Second
 FTA. Flight Test Article
 FTINU Fault Tolerant Inertial Navigation Unit
 FTP Fuel Turbopump
 FTS Flight Termination System
 FU Flight Unit
 FY Fiscal Year
 g. Acceleration due to gravity (32 ft/sec)
 G&A General and Administrative
 g/cm² Grams Per Square Centimeter
 GaAs. Gallium Arsenide
 GCH4 Gaseous Methane
 GCR Galactic Cosmic Ray

GDMS Ground Data Management System
 GEM Graphite Epoxy Motor
 GEO Geosynchronous Earth Orbit
 GFE Government-Furnished Equipment
 GG Gas Generator
 GHe Gaseous Helium
 GLOW Gross Liftoff Weight
 GN&C Guidance, Navigation, and Control
 GN2 Gaseous Nitrogen
 GOX Gaseous Oxygen
 GPS Global Positioning System
 GR&A Ground Rules and Assumptions
 GRAM Global Reference Atmospheric Model
 GRC Glenn Research Center
 GSE Government-Supplied Equipment
 GSE Ground Support Equipment
 GSFC–FAA Goddard Space Flight Center – Federal Aviation Administration
 GT Gemini-Titan
 GTO Geosynchronous Transfer Orbit
 H2 Hydrogen
 H2O Water
 H2O2 Hydrogen Peroxide
 HAC Heading Alignment Circle
 HAN Hydroxyl Ammonium Nitrate
 HD Hazard Division
 HDPE High-Density Polyethylene Shielding
 He Helium
 HEO High Earth Orbit
 HEX Heat Exchanger
 HHFO Habitability and Human Factors Office
 HIP Hot Isostatic Press

HLLV Heavy-Lift Launch Vehicle
 HLR Human Lunar Return
 HLV Heavy-Lift Vehicle
 HPFTP High-Pressure Fuel Turbopump
 HPFTP/AT . . . High-Pressure Fuel Turbopump/Alternate Turbopump
 HPOTP/AT . . . High-Pressure Oxidizer Turbopump/Alternate Turbopump
 HPU Hydraulic Power Unit
 HQ Headquarters
 HSRT Human Systems Research and Technology
 HST Hubble Space Telescope
 HTPB Hydroxyl Terminated Poly-Butadiene
 HTV H-11 Transfer Vehicle
 HV Habitable Volume
 HVAC Heating, Ventilating, and Air Conditioning
 HYPAS Hybrid Predictive Aerobraking Scheme
 I&T Integration and Test
 I/F Interface
 IA&C Integration, Assembly, and Checkout
 ICD Interface Control Document
 ICF Instantaneous Catastrophic Failure
 IDT Integrated Discipline Team
 ILC In-Line Configuration
 ILC Integrated Logistics Concepts
 IMLEO Initial Mass in Low Earth Orbit
 IMP Integrated Mission Program
 IMS Integrated Master Schedule
 IMU Inertial Measuring Unit
 in Inch(es)
 INS Inertial Navigation System
 INTROS Integrated Rocket Sizing Program
 IOC Initial Operational Capability

IPAO	Independent Program Assessment Office
IPD	Integrated Powerhead Demonstrator
IR	Infrared
IRD	Interface Requirements Document
IS	Interstages
ISHM	Integrated Systems Health Management
Isp	Specific Impulse
ISPP	In-Situ Produced Propellant
ISRU	In-Situ Resource Utilization
ISS	International Space Station
IT	Information Technology
ITA	Internal Task Agreement
ITAR	International Traffic and Arms Regulations
IVA	Intra-Vehicular Activity
IVHM	Integrated Vehicle Health Management
JOFOC	Justification for Other Than Full and Open Competition
JSC	Johnson Space Center
JWST	James Webb Space Telescope
K	Thousands
K	Kelvin
kg	Kilograms
KJ	Kilojoule
klb	Kilopound
klbf	Thousand Pounds Force
km	Kilometers
km/s	Kilometers Per Second
kN	Kilonewtons
kPa	Kilopascals
KPP	Key Performance Parameters
KSC	Kennedy Space Center
KSLOC	Thousand Software Lines of Codes

kWe Kilowatts Electric
 L/D Lift-to-Drag (ratio)
 LAD Liquid Acquisition Device
 LADAR. Laser Detection and Ranging
 LAN Local Area Network
 LAN Longitude of Ascending Node
 LaRC. Langley Research Center
 LAS. Launch Abort System
 lb Pound(s)
 lbf Pounds Force
 lbm Pounds Mass
 LC Launch Complex
 LCC. Life Cycle Cost
 LCF Low Cycle Fatigue
 LCH4. Liquid Methane
 LCVG Liquid Cooled Ventilation Garment
 LCX Launch Complex X
 LEAG Lunar Exploration and Analysis Group
 LEM Lunar Excursion Module
 LEO. Low Earth Orbit
 LES Launch Escape System
 LExSWG. Lunar Exploration Science Working Group
 LH2. Liquid Hydrogen
 Li Lithium
 LiDAR Light Detection and Ranging
 LIDS Low-Impact Docking System
 LiOH. Lithium Hydroxide
 LLO. Low Lunar Orbit
 LLV. Lunar Launch Vehicle
 LM Lunar Module
 LNG Liquid Natural Gas

LOC Loss of Crew
 LOI Lunar-Orbit Insertion
 LOM Loss of Mission
 LOR Lunar Orbit Rendezvous
 LOV Loss of Vehicle
 LOX Liquid Oxygen
 LPFTP/AT Low-Pressure Fuel Turbopump/Alternate Turbopump
 LPOTP/AT Low-Pressure Oxidizer Turbopump/Alternate Turbopump
 LPR Libration Point Rendezvous
 LPRE Lunar Polar Resource Extractor
 LRB Liquid Rocket Booster
 LRECM Liquid Rocket Engine Cost Model
 LRO Lunar Reconnaissance Orbiter
 LRPS Lunar Radioisotope Power System
 LRU Line Replaceable Unit
 LRV Lunar Roving Vehicle
 LSAM Lunar Surface Access Module
 LSC Launch Services Contractor
 LSR Lunar Surface Rendezvous
 LTMCC Large-Throat Main Combustion Chamber
 LUT Launch Umbilical Tower
 LV Launch Vehicle
 LVA Launch Vehicle Architecture
 LVHM Launch Vehicle Health Management
 M Million(s)
 m Meters
 M&O Maintenance and Operations
 M&P Material and Processing
 m/s Meters Per Second
 m³ Cubic Meters
 MA Mercury-Atlas

MAF Michoud Assembly Facility
 mbo Stage Burnout Mass
 MCC Main Combustion Chamber
 MCC Mission Control Center
 mdry Stage Dry Mass
 MDU Master Data Unit
 ME Main Engine
 MEA Maintenance Engineering Analysis
 MECO Main Engine Cutoff
 MEIT Multi-Element Integrated Test
 MEOP Maximum Expected Operating Pressure
 MEPAG Mars Exploration Program Analysis Group
 MER Mass Estimating Relationship
 MER Mars Exploration Rover
 MET Mission Elapsed Time
 MeVs Millions of Electron Volts
 MFBF Mean Flights Between Failure
 mgross Stage Gross Liftoff Mass
 mgross-veh Vehicle Gross Liftoff Mass
 MIS Management Information System
 MIT Massachusetts Institute of Technology
 MLE Mid-deck Locker Equivalent
 MLI Multilayer Insulation
 MLP Mobile Launch Platform
 MLUT Mobile Launch Umbilical Tower
 MLV Medium-Lift Vehicle
 MM Mission Mode
 MMH Monomethyl Hydrazine
 MMOD Micrometeoroid/Orbital Debris
 MMSSG Moon-Mars Science Linkage Steering Group
 MON-3 Multiple Oxides of Nitrogen – 3%

MPK Mission Peculiar Kit
 MPPF Multi-Purpose Processing Facility
 MPS Main Propulsion System
 MPTA Main Propulsion Test Article
 MR Mercury-Redstone
 MS Microsoft®
 MSFC Marshall Space Flight Center
 MSL Mars Science Laboratory
 MSS Mobile Service Structure
 mT metric ton(s)
 MTBF Mean Time Between Failure
 MTV Mars Transfer Vehicle
 MUSS Multi-User System and Support
 MWe Megawatts Electric
 N Newtons
 N/A Not Applicable
 N₂ Nitrogen
 N₂H₄ Hydrazine
 N₂O Nitrous Oxide
 NAFCOM NASA and Air Force Cost Model
 NAS National Academy of Sciences
 NASA National Aeronautics and Space Administration
 Nav Navigation
 NBL Neutral Buoyancy Laboratory
 NCRP National Council on Radiation Protection and Measurements
 NEO No Engine-Out
 NEPA National Environmental Policy Act
 NExT NASA Exploration Team
 NGLT Next Generation Launch Technology
 NHRP Next Hop Resolution Protocol
 nmi nautical mile

NPD NASA Program Directive
 NPG NASA Procedure and Guideline
 NPOE NPO Energomash
 NPR. NASA Procedural Requirements
 NRO National Reconnaissance Office
 NSI NASA Standard Initiative/Initiator
 NTO Nitrogen Tetroxide
 NTP. Nuclear Thermal Propulsion
 NTS. Nevada Test Sites
 NUREG Nuclear Regulatory Commission
 O&C Operations and Checkout
 O&M. Operations and Maintenance
 O2 Oxygen
 OBC Other Burden Costs
 OCM. Operations Cost Model
 OExP. Office of Exploration
 OMB. Office of Management and Budget
 OML Outer Mold Line
 OMS Orbital Maneuvering System
 OODA. Observation, Orientation, Decision, Action
 Ops Operations
 ORCA Ordnance Remote Control Assembly
 ORSC Oxygen-Rich Staged Combustion
 ORU Orbital Replacement Unit
 OSP Orbital Space Plane
 OTP. Oxygen Turbopump
 P Pressure Transducer
 P(LOC) Probability of Loss of Crew
 P(LOM). Probability of Loss of Mission
 P/C. Probe and Cone
 PA Pad Abort

PAO Public Affairs Office
 PAS Primary Ascent System
 PAS Payload Attach System
 PBAN Polybutadiene Acrylonitrile
 PC Plane Change
 PC Personal Computer
 PCBM Passive Common Berthing Mechanism
 PCM Pulse Code Modulated
 PCM Pressurized Cargo Mission
 PCU Power Control Unit
 PDR Preliminary Design Review
 PEG Powered Explicit Guidance
 PEM Proton Exchange Membrane
 PIC Pyrotechnic Initiator Controller
 PICA Phenolic Impregnated Carbonaceous Ablator
 PLF Payload Fairing
 PMA Pressurized Mating Adapter
 PMA Primary Mating Adapter
 PMAD Power Management and Distribution
 PMS Propulsion Management System
 PNST Prometheus Nuclear Systems Technology
 POD Point of Departure
 POST Program to Optimize Simulated Trajectories
 ppm Parts Per Million
 PRA Probabilistic Reliability Assessment
 PRC Productivity Rate Curve
 PS Primary and Secondary
 psf pounds per square foot
 psi Pounds Per Square Inch
 psia Pounds Per Square Inch Absolute
 PTA Prototype Test Article

PV Photovoltaic
 PV Pressurized Volume
 PV/RFC Photovoltaic/Regenerative Fuel Cell
 PV/W *Formula:* (Pressure · Volume)/Weight
 QD Quantity Distance
 QRAS Quantitative Risk Assessment System
 R&D Research and Development
 R&T Research and Technology
 RAAN Right Ascension of Ascending Node
 RCC Reinforced Carbon-Carbon
 RCG Reaction-Cured Glass
 RCRS Regenerative CO₂ Removal System
 RCS Reaction Control System
 RDU Remote Data Unit
 REID Risk of Exposure-Induced Death
 RF Radio Frequency
 RFC Regenerative Fuel Cell
 RFP Request for Proposals
 RLEP Robotic Lunar Exploration Program
 RMS Remote Manipulator System
 ROM Rough Order Magnitude
 ROW Risks, Opportunities, and Watches
 RP Rocket Propellant
 RPI Kerosene
 RPCU Remote Power Control Unit
 RPL Rated Power Level
 RPSF Rotation Processing and Surge Facility
 RRF Risk Reduction Flight
 RRGU Redundant Rate Gyro Unit
 RSRB Reusable Solid Rocket Booster
 RSS Rotating Service Structure

RTV. Room Temperature Vulcanized
 S&A Safe and Arm
 S&MA. Safety and Mission Assurance
 SAIC Science Applications International Corporation
 SARSAT. Search and Rescue Satellite-aided Tracking
 SBIR Small Business Innovation Research
 SCAPE Self-Contained Atmospheric Protection Ensembles
 SCAWG. Space Communications Architecture Working Group
 SCBA Strip Collar Bonding Approach
 SCE Station Control Electronics
 SDILV. Shuttle-Derived In-line Launch Vehicle
 SDLV. Shuttle-Derived Launch Vehicle
 SDV. Shuttle-Derived Vehicle
 SE&I Systems Engineering and Integration
 sec Second(s)
 SECO Second Stage Engine Cutoff
 SEER–SEM. SEER Software Estimation Model
 SEG. Space Shuttle Entry Guidance
 SEI. Space Exploration Initiative
 SFT Single Fault Tolerant
 SHAB Surface Habitat
 SiC. Silicon Carbon
 SIGI. Space Integrated GPS Instrumentation
 SII Saturn Second Stage
 SINDA Systems Improved Numerical Differencing Analyser
 SIP. Strain Isolation Pad
 SIRCA. Silicon Infused Reusable Ceramic Ablator
 SIVB. Saturn V Third Stage
 SLF Shuttle Landing Facility
 SLI. Space Launch Initiative
 SLOC Software Lines of Code

SM. Service Module
 SMAC. Spacecraft Maximum Allowable Concentration
 SMD Science Missions Directorate
 SOA. State-of-the-Art
 SOFI Spray-On Foam Insulation
 SOMD. Space Operations Missions Directorate
 SOMS Shuttle Orbiter Medical System
 SORT Simulation and Optimization of Rocket Trajectories
 SPA Spacecraft/Payload Adapter
 SPA South Pole-Aitken (basin on the Moon)
 SPACE. Screening Program for Architecture Capability Evaluation
 SPASE. Standardized Propulsive Skip Entry
 SPE Solar Particle Event
 SPF Single Point Failure
 SPS Service Propulsion System
 SPST Space Propulsion Synergy Team
 SRB. Solid Rocket Booster
 SRM Solid Rocket Motor
 SRR. System Requirements Review
 SSC Stennis Space Center
 SS-LV. Single-Stick Launch Vehicle
 SSME Space Shuttle Main Engine
 SSP Space Shuttle Program
 SSPF Space Station Processing Facility
 SSRMS Space Station Remote Manipulator System
 SSTO. Single-Stage-to-Orbit
 STA Static Test Article
 STA Structural Test Article
 STD. Standard
 stg Stage
 STH. System Test Hardware

STO	System Test Operations
STPPO	Space Transportation Programs and Projects Office
STS	Space Transportation System
STTR	Small Business Technology Transfer
SUF	Startup Failure
SV	Space Vehicle
SVMF	Space Vehicle Mockup Facility
SW	Software
T/W	Thrust-to-Weight (ratio)
TAL	Trans-Atlantic Abort Landing
TBD	To Be Determined
TBR	To Be Resolved
TC	Thermocouple
TCA	Thrust Chamber Assembly
TCS	Thermal Control System
TDRSS	Tracking and Data Relay Satellite System
TEI	Trans-Earth Injection
TEP/ODE	Thermal Equilibrium Program/One Dimensional Equilibrium
TFU	Theoretical First Unit
TIFF	Throttle-Insensitivity Failure Fraction
TLI	Trans-Lunar Injection
TNT	Trinitrotoluene, i.e., $\text{CH}_3\text{C}_6\text{H}_2(\text{NO}_2)_3$
TPS	Thermal Protection System
TPSX	Thermal Protection System Expert
TRL	Technology Readiness Level
Tt 1/2	Test Type 1, Test Type 2
TV	Television
TVC	Thrust Vector Control
TVS	Thermal Vacuum Stability
U.S.	United States
UCA	Un definitized Contract Actions

UCM Unpressurized Cargo Mission
UHF Ultrahigh Frequency
URCU Upper Stage Remote Control Unit
US Upper Stage
USAF United States Air Force
USOS United States On-orbit Segment
UV Ultra-Violet
VAB Vehicle Assembly Building
VDC Volts Direct Current
VIPA Vehicle Integrated Performance Analysis Team
VITO Vehicle Integration and Test Office
VITT Vehicle Integrated Test Team
VP Vacuum Perigee
VPF Vertical Processing Facility
VR Virtual Reality
WAN Wide Area Network
WBS Work Breakdown Structure
WCS Waste Collection System
 ΔV Delta Velocity, i.e., change in velocity

