BY ORDER OF THE COMMANDER
SPACE SYSTEMS COMMAND

SPACE SYSTEMS COMMAND MANUAL
91-710, VOLUME 7

27 DECEMBER 2022

Safety

RANGE SAFETY USER REQUIREMENTS MANUAL - GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

ACCESSIBILITY: Publications and forms are available for downloading or ordering on the e-Publishing website at **www.e-Publishing.af.mil**.

RELEASABILITY: There are no releasability restrictions on this publication.

OPR: HQ SSC/SEK

Certified by: HQ SSC/SEK
(Mr. John G. Orpen)

Supersedes: SPFCMAN91-710V7, 16 June 2020

Pages: 59

This manual implements AFI 91-202, *The U.S. Air Force Mishap Prevention Program*, and is consistent with the policy of AFPD13-6, *Space Policy*, AFPD91-1, *Nuclear Weapons and Systems Surety*, AFPD99-1, *Test and Evaluation*, and the *Memorandum of Agreement between the Department of the Air Force and the Federal Aviation Administration for Launch and Reentry Activity on Department of the Air Force Ranges and Installations*. It includes the references used throughout Volumes 1 through 6 of this publication as well as abbreviations, acronyms, and terms.

This volume applies to all Range Users conducting or supporting operations on SSC ranges. Range Users include any individual or organization that conducts or supports any activity on resources (land, sea, or air) owned or controlled by Space Systems Command (SSC) ranges. This includes such organizations as the DoD, U.S. government agencies, civilian launch operators, and foreign government agencies and other foreign entities that (1) use SSC range facilities and test equipment; (2) conduct prelaunch and launch operations, including payloads to orbital insertion or impact; and/or (3) require on-orbit or other related support. Commercial users intending to provide launch services from one of the ranges shall have a license or license application in process from the Department of Transportation's Federal Aviation Administration (FAA) or have a DoD sponsorship and be accepted by the DoD to use the Eastern Range (ER) at Cape Canaveral Space Force Station (CCSFS) or the Western Range (WR) at Vandenberg Space Force Base (VSFB). Foreign government organizations or other foreign entities shall be sponsored by an appropriate

US government organization or be a customer of a Range User. This volume does not apply to the Air National Guard or Air Force Reserve Command units.

In accordance with SSCI 91-701, *The Space Systems Command Launch and Range Safety Program*, all tailored versions of SSCMAN 91-710 affecting public safety are approved by the Space Launch Delta (SLD) Commander.

The authorities to waive SLD/unit level requirements in this publication are identified with a Tier ("T-0, T-1, T-2, T-3") number following the compliance statement. Waiver authority of non-tiered requirements may not be delegated below the Space Launch Delta Commander level unless specifically stated in this publication. See DAFMAN 90-161, *Publishing Processes and Procedures*, and any SSC supplements for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the publication OPR. Ensure all records generated as a result of processes prescribed in this publication adhere to AFI 33-322, *Records Management and Information Governance Program*, and are disposed of IAW the Air Force Records Disposition Schedule, which is located in the Air Force Records Information Management System. Refer recommended changes and questions about this publication to the OPR using the DAF Form 847, *Recommendation for Change of Publication*; route DAF Forms 847 from the field through the appropriate functional chain of command.

This publication may be supplemented at any level, but all supplements must be approved by HQ SSC Directorate of Safety (HQ SSC/SE), the OPR of this publication, prior to certification and approval. Each range may incorporate Space Launch Delta (SLD)-unique requirements into documents other than a supplement, such as an operating instruction, which is only required to be coordinated internally within the local SLD organization structure and approved at the local level by the Chief of Safety.

SUMMARY OF CHANGES

This document has been updated primarily to reflect organizational changes associated with the establishment of SSC as a USSF Field Command (FLDCOM), and the re-alignment of launch and range safety program management from the former Air Force Space Command publication to an SSC publication. Additionally, updated references, as appropriate, have been reflected in **Attachment 1**.

PAUL J. MEJASICH, NH-04, DAFC
Director of Safety

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

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Prescribed Forms

None

Adopted Forms

DAF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

[T]—tailored

A-50—Aerozine 50

ACI—American Concrete Institute

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPD—Air Force Policy Directive

AFRIMS—Air Force Records Information Management System

AFSPCMAN—Air Force Space Command Manual

AFSS—autonomous flight safety system

AGE—aerospace ground equipment

AHJ—authority having jurisdiction

AHU—air handling unit

AIAA—American Institute of Aeronautics and Astronautics

AIS—Abbreviated Injury Scale

AISC—American Institute of Steel Construction

Al2O3—aluminum oxide

AN—Army-Navy

ANSI—American National Standards Institute

AOP—Allied Ordnance Publication

AOR—area of responsibility

API—American Petroleum Institute

ARAR—Accident Risk Assessment Report

ASCE—American Society of Civil Engineers

ASCII—American Standard Code for Information Interchange

ASME—American Society of Mechanical Engineers

ASNT—American Society for Nondestructive Testing

ASO—Aerospace Surveillance Officer

ASSE—American Society of Safety Engineers

ASSP—American Society of Safety Professionals

ASTM—American Society for Testing and Materials

ASW—Astrodynamic Support Workstation

ATP—acceptance test procedure

AWS—American Welding Society

BDA—blast danger area

BTHLD—below-the-hook-lifting-device

C2H6N2O—nitrosodi-methylamine

C6H6—formaldehyde dimethyl hydrazine, benzene

C7H8—toluene

CAL-OSHA—California Occupational Safety and Health Administration

CCSFS—Cape Canaveral Space Force Station

Cd—drag coefficient

CD—compact disc

CDITS—command destruct independent test set

CDR—critical design review

CDS—command destruct system

CEP—circular error probability

CES—Civil Engineer Squadron

CFR—Code of Federal Regulations

CGA—Compressed Gas Association

CH3NH2—monomethyl hydrazine

CL—coefficient of lift

CMAA—Crane Manufacturers Association of America

CMH—Composite Materials Handbook

CO—carbon monoxide

CO2—carbon dioxide

COLA—collision avoidance

COPV—composite overwrapped pressure vessel

COTS—commercial-off-the-shelf

CPIA—Chemical Propulsion Information Agency

CPU—central processing unit

CRF—change request form

CRTF—Common Real-Time Debris Footprint

CSA—Canadian Standards Association

CSOSA—Commercial Space Operations Support Agreement

CVFA—continuous variable flight azimuth

DAFI—Department of the Air Force Instruction

DAFMAN—Department of the Air Force Manual

DAIP—Danger Area Information Plan

dB—decibel

DC—direct current

DCP—Damage Control Plan

deg—degrees

DEP—Directed Energy Plan

DESR—Defense Explosives Safety Regulation

DFO—distant focusing overpressure

DIN—Deutches Institut für Normung

DoDD—Department of Defense Directive

DoDI—Department of Defense Instruction

DoL—day-of-launch

DOORS—Dynamic Object-Oriented Requirements System

DPF—diesel particulate filter

DRP—Debris Recovery Plan

EBW—exploding bridgewire

EBW-FU—exploding bridgewire firing unit

Ec—expectation of casualty

ECEF—Earth-Centered Earth-Fixed

ECF—Earth-Centered Fixed

ECP—Engineering Change Proposal

ECR—Earth-Centered Rotating

EEAP—emergency evacuation assembly point

EED—electroexplosive device

EEP—emergency evacuation plan

EEPROM—electrically erasable programmable read-only memory

EFG—Earth-fixed Greenwich

EFI—exploding foil initiator

EGSE—electronic ground support equipment

ELS—equivalent level of safety

ELV—expendable launch vehicle

EM—Engineering Manual

EMC—electromagnetic compatibility

EMFR—electromagnetic field radiation; electromagnetic frequency radiation

EMI—electromagnetic interference

EOD—explosive ordnance disposal

EPC—emergency power cutoff

EPROM—erasable programmable read-only memory

ER—Eastern Range

ERP—emergency response plan

ERR—Eastern Range Regulation

ESAD—electronic safe and arm device

ESAD-FU—electronic safe and arm device firing unit

ESD—electrostatic discharge

ESMCR—Eastern Space and Missile Center Regulation

ESP—Explosives Site Plan

ETA—explosive transfer assembly

ETS—explosive transfer system

EWR—Eastern and Western Range

F&ES—Fire and Emergency Services

FCA—flight caution area

FCDC—flexible confined detonation cord

FDE—Force Development Evaluation

FEOP—facility emergency operating plan

FES—fire emergency services

FFDP—Final Flight Data Package

FFPA—final flight plan approval

FHA—flight hazard area

FLDCOM—Field Command

FM—Factory Mutual Engineering Corporation

FMECA—failure modes, effects, and criticality analysis

FPA—flight plan approval

FPE—Fire Protection Engineer

FPGA—field programmable gate array

FSDP—Facility Safety Data Package

FSPO—Flight Safety Project Officer

FSPOC—Flight Safety Project Officer Console

FSS—flight safety system

ft—foot, feet

ft2—square foot

ft—lb—foot pound

ft—lb_f—foot pounds force

FTR—flight termination receiver

FTS—flight termination system

FTSR—Flight Termination System Report

FTU—flight termination unit

GH2—gaseous hydrogen

GHe—gaseous helium

GHz—gigahertz

GIG—Global Information Grid

GN2—gaseous nitrogen

GOP—Ground Operations Plan

GOTS—government-off-the-shelf

GPS—Global Positioning System

GPSV—Guidance and Performance State Vector

GSE—ground support equipment

GSS—ground support system

H2NN(CH3)2)—unsymmetrical dimethyl-hydrazine

HAZCOM—Hazard Communication

HAZMAT—hazardous materials

HCl—hydrogen chloride

HDBK—handbook

HERO—Hazards of Electromagnetic Radiation to Ordnance

HMI—Hoist Manufacturing Institute

HMX—cyclotetramethylenetetra-nitramine

HNO3—nitric acid

HOS—Hazardous Operations Support

HPWT—high performance work team

HQ—Headquarters

HST—Hoist

HVDS—hypergolic vapor detection system

IAW—in accordance with

IBC—International Building Code

ICBM—intercontinental ballistic missile

IEEE—Institute of Electrical and Electronics Engineers

IEMP—Installation Emergency Management Plan

IERS—International Earth Rotation and References Systems Service

IIP—instantaneous impact point

ILL—impact limit line

ILSO—Installation Laser Safety Officer

IR—infrared

IRSO—Installation Radiation Safety Officer

ISA—International Society of Automation

ISEA—International Safety Equipment Association

ISI—in-service inspection

ISP—Intended Support Plan

ITSDF—Industrial Truck Standards Development Foundation

IV&V—independent verification and validation

JHA—job hazard analysis

JP—jet propellant

JSSSEH—Joint Software Systems Safety Engineering Handbook

KDP—Kennedy Documented Procedure

KE—kinetic energy

kHz—kilohertz

KI—stress intensity

KIc—plane-strain fracture toughness

KIe—surface-crack tension specimen fracture toughness

KISCC—stress-corrosion cracking threshold

km—kilometer

km/s—kilometers/second

Kmax—maximum stress intensity factor

KTI—Kennedy Space Center (KSC) Technical Instruction

LAP—Lightning Advisory Panel

lb/ft2—pounds per square foot

LBB—leak before burst

LCC—launch commit criteria

LCOLA—launch collision avoidance

LEL—lower explosive limit

LEOC—Launch Emergency Operations Center

LFU—laser firing unit

LH2—liquid hydrogen

LHe—liquid helium

Li—lithium

LID—load indicating device; laser-initiated device

LIO—laser-initiated ordnance

LIOS—laser-initiated ordnance system

LN2—liquid nitrogen

LNG—liquefied natural gas

LO2—liquid oxygen

LOR—level of rigor

LOX—liquid oxygen

LPS—Lightning Protection System

LRR—Launch Readiness Review

LSRRR—Launch Site Requirements Relief Request

LST——Launch Support Team

LWT—Launch Weather Team

MAC—maximum allowable concentration

MAPTIS—Material and Process Technical Information System

MAWP—maximum allowable working pressure

MBOD—Metric Body Axis Data

MCOV—Metric Covariance

MDA—Missile Defense Agency

MDG—Medical Group

MDL—Mission Data Load

MDMT—minimum design metal temperature

MEOP—maximum expected operating pressure

MFCO—Mission Flight Control Officer

MHE—material handling equipment

MHz—mega Hertz

MIL-HDBK—military handbook

MIL-PRF—military performance specification

MIL-SPEC—military specification

MIL-STD—military standard

MMH—monomethylhydrazine

MMPDS—Metallic Materials Properties Development and Standardization

MOA—memorandum of agreement

MOP—maximum operating pressure

MOU—memorandum of understanding

MPE—maximum predicted environment; maximum permissible exposure

MRB—Material Review Board

MRTFB—Major Range and Test Facility Base

MS—Microsoft ®; military standard

MSA—Mine Safety Appliances

MSP—Mission Support Position

MSPSP—Missile System Prelaunch Safety Package

MSS-SP—Manufacturers Standardization Society – Standard Practice

MST—mobile service tower

MT—metric tracking

N/A—not applicable

N2H4—hydrazine

N2O4—nitrogen tetroxide

NACE—National Association of Corrosion Engineers

NBBI—National Board of Boiler and Pressure Vessel Inspectors

NBIC—National Board of Boiler and Pressure Vessel Inspectors (NBBI) Inspection Code

NDE—non-destructive examination

NDI—non-destructive inspection

NEC—National Electrical Code

NEI—non-explosive initiator

NEMA—National Electrical Manufacturer’s Association

NEPA—National Environmental Policy Act

NFPA—National Fire Protection Association

NIOSH—National Institute for Occupational Safety and Health

nm—nautical miles

NO2—nitrogen dioxide

NOP—neighboring operations personnel

NOTAM—Notice to Air Missions

NOTMAR—Notice to Mariners

NOTU—Naval Ordnance Test Unit

NPT—National Pipe Thread

NRTL—Nationally Recognized Testing Laboratory

NSPM—National Security Presidential Memorandum

NTM—Notice to Mariners

O&M—operating and maintenance

O&SHA—operating and support hazard analysis

OCR—office of corollary responsibility

OD—operations directive

OEEL—occupational and environmental exposure limit

OPR—office of primary responsibility

Ops Sup—operations supplement

OR—Operations Requirements

OSC—Operations Safety Console

OSP—operations safety plan

OSS—Operational Support Squadron

OST—Operations Safety Technician

PA—public address

PAD—percussion activated device

PC—individual probability of casualty

PCC—Post Construction Committee

PDR—preliminary design review

PEL—permissible exposure level

PETN—pentaerythritoltetranitrate

PFDP—Preliminary Flight Data Package

PFPA—preliminary flight plan approval

pH—power of hydrogen

PHA—preliminary hazard analysis

PHE—propellant handlers ensemble

PHL—preliminary hazard list

PI—program introduction

PLC—programmable logic controller

PM—program manager

POC—point of contact; probability of collision

POST—power-on-self-test

pp—present position

PPE—personnel protective equipment

PRD—program requirements document

PSC—pad safety console

PSFB—Patrick Space Force Base

psi—pounds per square inch

psia—pounds per square inch absolute

psig—pounds per square inch gauge

PSM—process safety management

PSO—Pad Safety Officer

PSP—program support plan

PSR—Pre-Ship Review

PTFE—poly-tetrafluoroethylene

PTR—program trouble report; public traffic route

QA—quality assurance

QE—quadrant elevation

QTP—qualification test procedure

R/R—removed and replaced

R/V—reentry vehicle

RADSAFCOM—Radiation Safety Committee (Western Range)

RAM—Radioactive Materials

RASCAD—Range Safety Control and Display

RDS—Records Disposition Schedule

RDX—cyclotrimethylenetrinitramine

RF—radio frequency

RIA—Robotic Industries Association

RID—review item discrepancy

RIPP—range instantaneous impact point/prediction

RLV—reusable launch vehicle

RMP—risk management plan

ROPS—Range Operations Squadron

RP—rocket propellant

RP-1—rocket propellant-1

RPIE—real property installed equipment

RPV—remotely piloted vehicle

RRAT—Range Risk Assessment Tool

RRR—Reentry Readiness Review

RSD—Range Safety display

RSOR—Range Safety Operations Requirements

RT—radiographic testing

RTS—range tracking system

RV—reentry vehicle

S&A—safe and arm

SAE—Society of Automotive Engineers

SAIA—Scaffold and Access Industry Association

SAR—safety assessment report

SAS—Safety Analysis Summary

SCA—Safety Control Authority

SCAPE—self-contained atmospheric protective ensemble

SCC—software control category

SCCB—Software Configuration Control Board

SCF—software critical function; safety critical function

SCM—software configuration management

SCN—specification change notice

SCO—Surveillance Control Officer

SDD—software design document

SDP—software development plan

SDS—safety data sheet

SEAOC—Structural Engineers Association of California

SEI—Structural Engineering Institute

SEW—Weapons Safety Office

SFP—single failure point

SHA—system hazard analysis

SLBM—submarine-launched ballistic missile

SPFCMAN—United States Space Force Manual

SPCS—Space Control Squadron

SPO—System Program/Project Office

SPR—software problem report

SRM—solid rocket motor

SRMU—solid rocket motor upgrade

SRR—System Requirements Review

SSCI—Space Systems Command Instruction

SSCMAN—Space Systems Command Manual

SSHA—subsystem hazard analysis

SSPP—System Safety Program Plan

STP—software test plan; standard temperature and pressure

STR—software trouble report; software test report

SVFA—step-wise variable flight azimuth

SwCI—software criticality index

SWI—Space Wing instruction

T.O.—technical order

TDR—true of date rotating

TDTS—telemetry data transmitting system

THC—toxic hazard corridor

TIA—Telecommunications Industry Association

TIM—technical interchange meeting

TLV—threshold limit value

TMIG—telemetered inertial guidance

TNT—trinitrotoluene

TR—technical report

UAS—unmanned aerial system

UAV—unmanned air vehicle

UDMH—unsymmetrical dimethylhydrazine

UDS—Universal Documentation System

UFC—Unified Facilities Criteria

UL—Underwriters Laboratories

UN—United Nations; Unified

UNR—Unified National Radius

US—United States

USC—United States Code

UT—ultrasonic test

UT1-UTC—Universal Time-Coordinated Universal Time

UV—ultraviolet

VFA—variable flight azimuth

Vrms—volts root mean square

VSFB—Vandenberg Space Force Base

WR—Western Range

WRR—Western Range Regulation

WS—Weather Squadron

WSMCR—Western Space and Missile Center Regulation

Office Symbols

AFETR—Air Force Eastern Test Range

AFGSC—Air Force Global Strike Command

AFRC—Air Force Reserve Command

AFSPC—Air Force Space Command (redesignated as United States Space Force)

ANG—Air National Guard

DAF—Department of the Air Force

DDESB—Department of Defense Explosive Safety Board

DoD—Department of Defense

DOT—Department of Transportation

EPA—Environmental Protection Agency

ESMC—Eastern Space and Missile Center

FAA—Federal Aviation Administration

FAA/AR—Federal Aviation Administration, Office of Aviation Research

FAA/AST—Federal Aviation Administration, Office of Commercial Space

FEMA—Federal Emergency Management Agency

INSRB—Interagency Nuclear Safety Review Board

KSC—Kennedy Space Center

MSFC—Marshall Space Flight Center

NASA—National Aeronautics and Space Administration

NAVFAC—Naval Facilities Engineering Command

NTSB—National Transportation and Safety Board

NRC—Nuclear Regulatory Commission

OSHA—Occupational Safety and Health Administration

OSTP—Office of Science Technology Policy

RCC—Range Commanders Council

SLD—Space Launch Delta

SLD/CC—Space Launch Delta, Commander

SLD/CV—Space Launch Delta, Vice Commander

SLD/SE—Space Launch Delta, Safety Office

SLD/XP—Space Launch Delta, Programs and Plans

SMC—Space and Missile Systems Center

SSC—Space Systems Command

SSC/CC—Space Systems Command, Commander

SSC/SE—Space Systems Command, Directorate of Safety

USCG—United States Coast Guard

USSF—United States Space Force

USSPACECOM—United States Space Command

Terms

"A" Basis Allowables—the minimum mechanical strength values guaranteed by the material producers or suppliers such that at least 99% of the material they produce or supply will meet or exceed the specified values with a 95% confidence level.

"B" Basis Allowables—the mechanical strength values specified by material producers and suppliers such that at least 90% of the materials they produce or supply will meet or exceed the specified values with a 95% confidence level.

abort—an action used to cut short or break-off an action, procedure, or operation, in order to preserve the mission for a future attempt. Aborts can fall into two categories: (1) Contingency abort: re-direction of vehicle flight during ascent or descent in a manner that does not jeopardize public health and safety and the safety of property, in accordance with mission rules and procedures. Contingency abort includes landing at an alternative location that has been designated as a contingency abort location in advance of vehicle flight. (2) Emergency abort: re-direction of vehicle flight during ascent or descent in a manner that minimizes risk to public health and safety and the safety of property. Emergency abort involves failure of a vehicle, safety-critical system, or flight safety system such that contingency abort is not possible.

acceptable hazard—determination of the acceptability of any hazard imposed by a launch vehicle/missile or orbital vehicle launched from or onto the range is solely the responsibility of the Space Launch Delta Commander; the acceptability varies with operational requirements and/or national need and is determined by the Space Launch Delta Commander on a case-by-case basis.

acceptable launch risk—the allowable collective risk to the general public, without higher management review and approval, is an aggregated (all hazards, all people including personnel on ships) expectation of casualty (E_c) of $\leq 100 \times 10^{-6}$. The allowable individual public risk criterion is an aggregated E_c of $\leq 1 \times 10^{-6}$.

acceptance tests—the required formal tests conducted on hardware to ascertain that the materials, manufacturing processes, and workmanship meet specifications and that the hardware is acceptable for its intended use; also, the formal required tests conducted on software and interfaces to ascertain that the code meets specifications and is acceptable for its intended use.

accepted risk—a residual hazard that has been accepted by the Program Manager and the Space Launch Delta Commander.

accumulated risk—the combined collective risk to all individuals exposed to a particular hazard through all phases of an operation.

adequate source—a data source that enables the Mission Flight Control Officer or autonomous flight safety system to determine when a launch vehicle violates established in-flight safety criteria.

Aerozine 50—a 50-50 blend of hydrazine and unsymmetrical dimethylhydrazine.

aggregated risk—the accumulated risk due to all hazards associated with a flight; see also *accumulated risk*.

all-fire level—the minimum direct current or radio frequency energy that causes initiation of an electroexplosive initiator or exploding bridgewire initiator or laser-initiated device with a reliability of 0.999 at a confidence level of 95% as determined by a Bruceton test. Recommended operating level is all-fire current, as determined by test, at ambient temperature plus 150% of the minimum all-fire current.

allowable load-(stress)—the maximum load (stress) that can be allowed in a material for a given operating environment to prevent rupture or collapse or detrimental deformation; allowable load (stress) in these cases are ultimate load (stress), buckling load (stress), or yield load (stress), respectively.

allowable strength—the ratio of material strength to the specified factor of safety.

antenna—a device capable of radiating or receiving radio frequency energy.

apogee—the point of an object's greatest distance from the center of the Earth, where the object's velocity is lowest. The apogee altitude is the distance of the apogee point above the surface of the Earth.

applied load—the static or dynamic load applied to a structure, excluding load amplification factors.

applied load-(stress)—the actual load (stress) imposed on the structure in the service environment.

arm/disarm device—an electrically or mechanically actuated switch that can make or break one or more ordnance firing circuits; operates in a manner similar to safe and arm devices except they do not physically interrupt the explosive train.

arming plug—a removable device that provides electrical continuity when inserted in a firing circuit.

automatic destruct system—a flight safety system that is installed on each propulsion system on the launch vehicle, including stages, upper stages, and payload systems; this system functions autonomously during flight to render the powered stage non-propulsive in the event of the inadvertent breakup of a vehicle.

autonomous flight safety system—an independent self-contained flight safety system onboard a launch vehicle which replaces the traditional human decision-making process for flight safety with configurable rule-based software logic.

azimuth—the initial launch direction, measured clockwise from zero degrees north.

ballistic coefficient—a design parameter indicating the relative magnitude of inertial and aerodynamic effects; used in performance analysis of objects moving through the atmosphere; also referred to as beta (β); it is given by the expression W/CdA, where W is the weight, Cd is the drag coefficient, and A is the reference area of the object in motion through the atmosphere.

battery capacity—(1) rated capacity: the capacity assigned by the battery manufacturer based on a set of specific conditions such as discharge temperature, discharge current, end of discharge voltage, and state of charge at start of discharge; (2) measured capacity: the capacity determined by the specific qualification tests, including any time the battery is under load during qualification; the end of discharge voltage is the minimum voltage that flight termination system components have been qualified to.

below-the-hook lifting device—structural and mechanical lifting devices and equipment (except for slings, load positioning devices, and load cells) used to connect a crane/hoist hook and a load being lifted, including lifting beams (and arms) and attachment hardware such as bolts and pins (lifting assemblies).

blast danger area—a hazardous clear area; clearance prior to establishment of a major explosive hazard such as vehicle fuel/oxidizer load and pressurization; the area subject to fragment and direct overpressure resulting from the explosion of the booster/payload.

brittle fracture—(1) a type of failure mode in structural materials that usually occurs without prior plastic deformation and at extremely high speed, (2) a type of failure mode such that burst of the vessel is possible during cycling [normally this mode of failure is a concern when cycling to the maximum expected operating pressure (MEOP) or when the vessel is under sustained load at MEOP], and (3) a type of fracture that is characterized by a flat fracture surface with little or no shear lips (slant fracture surface) and at average stress levels below those of general yielding.

Bruceton test method—a statistical method for determining the all-fire and no-fire characteristics of an electroexplosive device using a small sample size, but with high reliability.

burst factor—a multiplying factor applied to the MEOP to obtain the design burst pressure; synonymous with ultimate pressure factor.

casualty—a serious injury or worse, including death, to a human.

casualty area—the area on the ground about the impact point of a fragment within which an exposed person would be expected to become a casualty.

cell—a single electrical energy or electrical charge-storing unit, described by minimum voltage and minimum capacity.

certified inspector—a person qualified and certified in nondestructive examination inspection techniques according to the American Society for Nondestructive Testing, recommended practices (SNT-TC-1A).

collective risk—the total combined risk to all individuals within a category (for example, launch-essential personnel, general public) exposed to any hazard from an operation. Unless otherwise noted, collective risk is the mean number of casualties (E_c) predicted to result from all hazards associated with an operation. Collective risk is specified as either for a mission or per year. The collective risk should include the aggregated and accumulated risk.

collision avoidance—a process designed to prevent collisions between on-orbit tracked objects or to prevent collisions between on-orbit tracked objects and launched vehicles (including spent stages)/payloads by determining and implementing courses of action through careful analysis of validated conjunction assessments and satellite health and mission requirements. The process includes establishing launch wait periods in either the launch window or spacecraft thrust firings based on validated conjunction assessments and accounts for uncertainties in spatial dispersions, arrival time of orbiting objects and/or the launch vehicle/payload, and modeling accuracy.

command control system—the portion of a flight safety system that includes all components needed to send a flight termination control signal to an onboard vehicle flight termination system; a command control system starts with flight termination activation switches at the mission flight control console and ends at each command-transmitting antenna; it includes all intermediate equipment, linkages, and software and any auxiliary transmitter stations that ensure a command signal will reach the onboard vehicle flight termination system from liftoff until the launch vehicle achieves orbit or can no longer reach a populated or other protected area.

command destruct—the process in which a sequence of commands are issued from a ground station or center that, when executed by the flight system, causes the launch vehicle to be destroyed.

command destruct system—a portion of a flight termination system that includes all components on board a launch vehicle that receive a flight termination control signal and achieve destruction of the launch vehicle; a command destruct system includes all receiving antennas, receiver decoders, explosive initiating and transmission devices, safe and arm devices and ordnance necessary to achieving destruction of the launch vehicle upon receipt of a destruct command; a command destruct system is one type of a command terminate system.

command system—the portion of the flight safety system consisting of the airborne flight termination system and the ground flight termination system command transmitter system that sends arm and terminate commands.

command terminate system—a portion of a flight termination system that includes all components on board a launch vehicle that receive a flight termination control signal and achieve termination of the flight of a launch vehicle; a command terminate system includes all receiving antennas, receiver decoders, explosive initiating and transmission devices, safe and arm devices

and ordnance necessary to achieving destruction of the launch vehicle or other devices to stop propulsion or otherwise terminate flight upon receipt of a terminate command.

commercial/FAA-licensed launch—activity licensed by the FAA. This includes activity required to prepare, conduct, or recover from a launch action (to include such activity as a static fire, engine test, booster assembly, launch, etc.) when requesting services, commodities, or resources from USSF under the provisions of 51 USC and/or 10 USC § 2276.

compatibility—the ability of two or more materials or substances to come in contact without altering their structure or causing an unwanted reaction in terms such as permeability, flammability, ignition, combustion, functional or material degradation, contamination, toxicity, pressure, temperature, shock, oxidation, or corrosion.

composite material—the combinations of materials differing in composition or form on macro scale. The constituents retain their identities in the composite; normally, the constituents can be physically identified, and there is an interface between them.

CONDO 8—one model of radar produced by Furuno U.S.A., Inc. and located on the Eastern Range.

conflagration—a destructive fire, usually an extensive one.

conjunction assessment—the process of determining the point of closest approach of two orbiting objects, or between a launch vehicle and an orbiting object, in association with a specified miss-distance screening criteria or the corresponding probability of collision. Associated with the closest approach assessment is the closest approach distance, the times of launch or orbital firing that would result in the closest approach, and meeting the miss-distance or collision probability criteria.

contamination—the introduction of impurities, undesirable material, suspect material, or material potentially out of specification that may render the system or equipment unusable for its intended purpose or in such a state that special measures need to be taken before the equipment or system can be restored to normal service.

control area clears—a hazardous clear area; clearance of defined areas to protect personnel from hazardous operations.

control authority—a single commercial user on-site director and/or manager, a full-time government tenant director and/or commander, or United States Space Force commander responsible for the implementation of launch complex safety requirements.

conventional facility or structure—office buildings, libraries, auditoriums, warehouses, cafeterias, utility buildings, and other facilities whose structures are characterized by well-established design precedents and loading conditions and whose function is non-hazardous.

countdown—the timed sequence of events that must take place to initiate flight of a launch vehicle or reentry of a reentry vehicle.

crew rest—that period of time immediately prior to the beginning of duty as assigned; for launch-essential personnel, it is mandatory that the rest period include the time necessary for meals, transportation, and 8 hours of uninterrupted rest prior to reporting for duty. In preparation for launch operations, rest periods start no earlier than 2 hours after the assigned personnel are released from an earlier launch or range operation. Only the Chief of Safety or Space Launch Delta

Commander has the authority to waive the safety rest period requirements for Mission Ready (Category A) personnel; see also *rest period*.

critical condition—the most severe environmental condition in terms of loads, pressures, and temperatures, or combination thereof imposed on structures, systems, subsystems, and components during service life.

critical facility/structure—a hazardous facility or structure; a facility or structure used to store or process explosives, fuels, or other hazardous materials; a facility or structure used to process DoD high value hardware such as spacecraft, missiles, or any unique item identified by DoD as critical; a facility or structure that contains or is used to process systems determined by Range Safety to be hazardous or critical; a facility housing support equipment used to control or monitor hazardous operations; or a facility or structure determined by Range Safety to be critical.

critical flaw—a specific shape of flaw with sufficient size that unstable growth will occur under the specific operating load and environment.

critical hardware—any hazardous or safety critical equipment or system; non-hazardous DoD high value items such as spacecraft, missiles, or any unique item identified by DoD as critical; non-hazardous, high value hardware owned by Range Users other than the DoD may be identified as critical or non-critical by the Range User; see also *safety critical*.

critical hold scrub point—the time in the countdown when a hold would normally be expected to result in a scrubbed launch attempt.

critical load—a load consisting of critical hardware and/or any personnel.

critical stress intensity factor—the stress intensity factor at which an unstable fracture occurs.

crossrange—the distance measured along a line whose direction is either 90° clockwise (right crossrange) or counter-clockwise (left crossrange) to the projection of a launch vehicle's planned nominal velocity vector azimuth onto a horizontal plane tangent to the ellipsoidal earth model at the launch vehicle's sub-vehicle point; the terms, right crossrange and left crossrange, may also be used to indicate direction.

crossrange direction—measured along the Y axis of the X, Y, Z coordinate system. Left crossrange is measured in the direction of the negative Y axis and right crossrange is measured in the direction of the positive Y axis.

cryogen—a gas that becomes liquefied at or below −150 °C (123 K; −238 °F), such as liquid nitrogen or oxygen.

crystal salts—the formation of salt oxidation by the cathode/electrolyte process in batteries; the resulting salt can inhibit the electrochemical process, be a corrosive to the metal plates, and affect the salt solubility that, in turn, affects the passivation film.

damage tolerance—a measure of the ability of structures to retain load carrying capability after exposure to sudden loads (for example, ballistic impact).

Danger Area Information Plan—an Eastern Range document prepared by Operations Safety specifying roadblocks and the fallback area associated with hazardous areas for each launch complex during launch operations.

decibel—a unit of relative power; the decibel ratio between power levels, P1 and P2, is defined by the relation dB = 10 log (P1/P2).

deorbit—the flight of a vehicle that begins with the final command to commit to a perigee below 70 nautical miles (approximately 130 kilometers), and ends when all vehicle components come to rest on the Earth.

design burst pressure—the calculated pressure (the analytical value that was calculated using an acceptable industry and/or government practice to determine its design pressure) that a component must withstand without rupture and/or burst to demonstrate its design adequacy in a qualification test; during qualification testing, the actual burst pressure for a tested component must demonstrate that the design burst pressure is less than the actual burst pressure; safety factors are based on design burst pressure, not actual burst pressure of a particular component.

design load—see *applied load*.

design safety factor—a factor used to account for uncertainties in material properties and analysis procedures; often called design factor of safety or simply safety factor.

destabilizing pressure—a pressure that produces comprehensive stresses in a pressurized structure or pressure component.

destruct lines—lines established to ensure that a launch vehicle's critical debris impact dispersion does not violate the impact limit line; destruct lines are displayed on the Range Safety display and when the instantaneous impact point, based on valid tracking data, shows that the vehicle will cross the destruct lines, flight termination is authorized.

detent—a releasable element used to restrain a part before or after its motion; detents are common in arming mechanisms; safe and arm device safing pins use a spring-loaded detent to secure the pin in the device.

detonation—an exothermic chemical reaction that propagates with such rapidity that the rate of advance of the reaction zone into the unreacted material exceeds the velocity of sound: (1) the rate of advance of the reaction zone is termed detonation velocity; (2) when this rate of advance attains such a value that it will continue without diminution through the unreacted material, it is termed the stable detonation velocity; (3) when the detonation velocity is equal to or greater than the stable detonation velocity of the explosive, the reaction is termed a high-order detonation; (4) when it is lower, the reaction is termed a low-order detonation.

detonator—an explosive device (usually an electroexplosive device) that is the first device in an explosive train and is designed to transform an input (usually electrical) into an explosive reaction.

detrimental deformation—includes all structural deformations, deflections, or displacements that prevent any portion of the structure from performing its intended function or that reduces the probability of successful completion of the mission.

development test—a test to provide design information that may be used to check the validity of analytic technique and assumed design parameters, to uncover unexpected system response characteristics, to evaluate design changes, to determine interface compatibility, to prove qualification and acceptance procedures and techniques, or to establish accept and reject criteria.

downrange—the distance measured along a line whose direction is parallel to the projection of a vehicle's planned nominal velocity vector azimuth into a horizontal plane tangent to the ellipsoidal Earth model at the vehicle sub-vehicle point; may also be used to indicate direction.

downrange direction—measured in the direction of the positive X axis of the X, Y, Z coordinate system.

drag impact points—debris impact points corrected for atmospheric drag.

ductile behavior—for the purpose of this publication, materials exhibiting ductile behavior are those that exhibit a minimum ultimate strain of 20% elongation prior to failure.

ductile fracture—a type of failure mode in structural materials generally preceded by large amounts of plastic deformation and in which the fracture surface is inclined to the direction of the applied stress.

ductility—the ability of a material to be plastically deformed without fracturing in tension or compression, respectively; two commonly used indices of ductility are the ultimate elongation and the reduction of cross-sectional area; the usual dividing line between ductility and brittleness is 5% elongation.

dudding—the process of permanently degrading an electroexplosive initiator to a state where it cannot perform its designed function.

dwell time—(1) the period during which a launch vehicle impact point is over a populated or other protected area; (2) the period during which an object is subjected to a test condition.

Eastern Range—part of the National Launch Range facilities, operated by Space Launch Delta 45, part of the United States Space Force, and located at Patrick Space Force Base, Florida; the range includes the operational launch and base support facilities located at Cape Canaveral Space Force Station, Florida, owned or leased facilities on downrange sites such as Ascension; as well as the Jonathan-Dickinson Missile Tracking Annex (Jupiter, Florida), and in the context of launch operations, the Atlantic Ocean.

equivalent level of safety—an approximately equal level of safety; may involve a change to the level of expected risk that is not statistically or mathematically significant as determined by qualitative or quantitative risk analysis; equivalent level of safety replaces the former "meets intent" certification process.

errant launch vehicle—(1) a launch vehicle that, during flight, violates established flight safety criteria and/or operates erratically in a manner inconsistent with its intended flight performance; (2) continued flight of an errant launch vehicle may grossly deviate from planned flight, with the possibility of increasing public risk to unacceptable limits; (3) a launch vehicle that has violated safety criteria (a destruct line) and cannot be destroyed.

expectation of casualty—the mean number of casualties predicted to occur as a result of an operation if the operation were to be repeated many times. This risk is expressed with the following notation: 1E-7 = 10^{-7} = 1 in ten million.

expendable launch vehicle—a launch vehicle designed for single flight use.

explosion proof apparatus—an enclosure that will withstand an internal explosion of gases or vapors and prevent those gases or vapors from igniting the flammable atmosphere surrounding the enclosure, and whose external temperature will not ignite the surrounding flammable atmosphere.

explosive quantity distance site plan—a formal plan for explosives facilities and areas required in accordance with DESR 6055.09 and DESR 6055.09_AFMAN 91-201, detailing explosives quantity operating and storage limits and restrictions and resultant distance clearance requirements.

explosive warhead launch approval—the mandatory prior written approval given by Space Launch Delta Commanders to Range Users who launch vehicles carrying explosive warheads.

explosives—all ammunition, demolition material, solid rocket motors, liquid propellants, pyrotechnics, and ordnance as defined in DESR 6055.09 and DESR 6055.09_AFMAN 91-201 and DESR 6055.09.

explosives facility—any facility that contains explosives or is quantity distance sited or licensed to contain explosives.

F minus Time—the time in normal workdays prior to the scheduled launch day.

facility operator—government organization or contractor responsible for maintaining and/or controlling use of a facility.

factor of safety—the ratio of the yield or ultimate strength of the structure to the applied load; see *factor of safety (ultimate)* and *factor of safety (yield)*.

factor of safety (ultimate)—the ratio of the ultimate stress to the maximum calculated stress based on limit loads. Ultimate Factor of Safety = Ultimate Strength/Limit Load Stress.

factor of safety (yield)—the ratio of the yield stress to the maximum calculated stress based on limit loads. Yield Factor of Safety = Yield Strength/Limit Load Stress.

fail-safe—a design feature in which a system reacts to a failure by switching to or maintaining a safe operating mode that may include system shut down.

failure—the inability of a system or system component to perform a required function within specified limits.

failure, ductile—materials exhibiting a ductile failure mode are those that (1) have ductile behavior under the environmental and operating conditions; i.e., ultimate strain of 20% elongation or greater, and appropriate notch toughness, and (2) provide warning of an oncoming failure via visually detectable (by eye and without magnification aids) deformation of structural components; see also *ductile behavior*.

family performance data—the results of launch vehicle component and system tests and previous flight that represent similar characteristics for a launch vehicle component or system; the data is continuously updated as additional samples of a given component or system are tested or flown; family performance data is used as a baseline for comparison to the results of subsequent tests and flights of the given component or system.

fatigue—the progressive localized permanent structural change that occurs in a material subjected to constant or variable amplitude loads at stresses having a maximum value less than the ultimate strength of the material.

fatigue life—the number of cycles of stress or strain of a specified character that a given material sustains before failure of a specified nature occurs.

fault—a mechanical or structural defect, a human error, or a software error that results in improper commanding/operation.

fault tolerance—the built-in ability of a system to provide continued correct operation in the presence of a specified number of faults, flaws, or failures. Also, the ability of a system, subsystem, or component to not present a hazard due to a failure or a series of failures.

field crane—a crane, which is not permanently installed either inside a building, on top of a structure (e.g., pedestal or tower crane), or on ground-based runway rails (e.g., a gantry crane).

final flight plan approval—the approval for a specific mission based on a detailed analysis of the proposed launch trajectory, impact locations for nominally jettisoned stages, and the ability to establish flight control criteria.

Fire^{+}—the command to initiate destruct energy to EBW used in a typical high voltage firing unit.

Fire^{0}—the command to remove inhibit used in a typical high voltage firing unit.

firing circuit—the current path between the power source and the initiating device.

firmware—computer programs and data loaded in a class of memory that cannot be dynamically modified by the computer during processing; for systems safety purposes, firmware is to be treated as software.

fittings—pressure components of a pressurized system initialized to connect lines, other pressure components, and/or pressure vessels within the system.

flaw—an imperfection or unintentional discontinuity that is detectable by nondestructive examination.

flight azimuth—the instantaneous angular direction of the flight trajectory of a launch vehicle measured in degrees from true North.

flight caution area—a hazardous launch area; the controlled surface area and airspace outside the flight hazard area (FHA) where individual risk from a launch vehicle malfunction during the early phase of flight may exceed 1×10^{-6}; when activated, only personnel essential to the launch operation (launch-essential) or essential to specific/current operations while performing operational critical tasks at the launch base (neighboring operations) are permitted in this area; see also *flight hazard area*, *launch-essential personnel,* and *neighboring operations personnel*.

flight hazard area—a hazardous launch area; the controlled region of land, sea, and air about the launch pad and flight azimuth where individual risk from a malfunction during the early phase of flight may exceed 1×10^{-5}; because the risk of serious injury or death from blast overpressure or debris is so significant, only launch-essential personnel/neighboring operations personnel are permitted in this area during launch. The area must be surveyed, publicized, controlled, or evacuated in order to protect public health and safety and the safety of property.

flight plan approval—an approval process that results from a written application by the Range User; a two-phase approach stemming from a Preliminary Flight Plan Approval and a Final Flight Plan Approval.

flight safety plan—(1) a plan that identifies the flight safety roles to be performed by the Range User’s flight safety personnel; the flight safety rules, limits, and criteria identified by a Range

User's flight safety analysis; (2) and the specific flight safety requirements to be implemented for launch.

flight safety system—a system that provides a means of control during flight for preventing a hazard from a flight vehicle, including any payload hazard, from reaching any populated or other protected area in the event of a flight vehicle failure. A flight safety system includes all airborne and ground hardware, software, and any human-in-the-loop control used to protect the public. Human-in-the-loop controls include associated human-systems interfaces and may involve ground-based Mission Flight Control Officers or Range Safety Officers, flight vehicle-based pilots or Flight Safety Officers, or any combination of such.

flight termination action—the transmission of thrust termination and/or destruct commands to a launched launch vehicle and/or payload.

flight termination system—all components, onboard a launch vehicle, that provide the ability to terminate a launch vehicle's flight in a controlled manner; the flight termination system consists of all command terminate systems, inadvertent separation destruct systems, or other systems or components that are onboard a launch vehicle and used to terminate flight.

foreign government agency or company—a Range User entity who is not a US citizen, not a US company, or not a foreign-registered company with a majority holding by a US company or citizen.

fracture, brittle—for the purpose of this document, those materials that exhibit a failure mode outside of ductile failure.

fracture control—the application of design philosophy, analysis method, manufacturing technology, quality assurance, and operating procedures to prevent premature structural failure due to the propagation of cracks or crack-like flaws during fabrication, testing, transportation and handling, and service.

fracture mechanics—an engineering concept used to predict flaw growth of materials and structures containing cracks or crack-like flaws; an essential part of a fracture control plan to prevent structural failure due to flaw propagation.

fracture toughness—a generic term for measures of resistance to extension of a crack.

function—any electronic commands, such as arm, destruct, safe, and test, issued by the Mission Flight Control Officer and transmitted to the airborne elements of a flight termination system.

fuse—a system used to initiate an explosive train; an electrical safety device consisting of or including a wire or strip of fusible metal that melts and interrupts the circuit when the current exceeds a particular amperage.

gate—the portion of a flight safety limit boundary through which a launch vehicle's tracking icon may pass without flight termination.

general public—all persons who are not in the launch-essential personnel or neighboring operations personnel categories; for a specific launch, the general public includes visitors, media, and other non-operations personnel at the launch site as well as persons located outside the boundaries of the launch site who are not associated with the specific launch; see also *launch-essential personnel* and *neighboring operations personnel*.

ground support equipment (GSE)—non-flight systems, equipment, or devices (with a physical or functional interface with flight hardware) necessary to routinely support the operations of

transporting, receiving, handling, assembly, inspection, test, checkout, servicing, launch, and recovery of space vehicles and payloads at launch, landing, or retrieval sites.

handling structures—structures such as beams, plates, channels, angles, and rods assembled with bolts, pins, and/or welds; includes lifting, supporting, and manipulating equipment such as lifting beams, support stands, spin tables, rotating devices, and fixed and portable launch support frames.

hangfire—a condition that exists when the ignition signal is known to have been sent and reached an initiator, but ignition of the propulsion system is not achieved.

hardware (computer)—physical equipment used in processing.

hazard, hazardous—a condition, procedure or practice that creates a potential for producing death, injury, illness, fire, property damage, equipment damage or environmental damage.

hazard analysis—the analysis of systems to determine potential hazards and recommended actions to eliminate or control the hazards.

hazard area—an area where known products can cause harm to the on- and off-base public.

hazard control—a preventative measure or mitigation put in place for systems or operations to reduce the severity of a hazard or the likelihood of the hazard occurring.

hazard proof—a method of making electrical equipment safe for use in hazardous locations; these methods include explosion proofing, intrinsically safe, purged, pressurized, and non-incendive and must be rated for the degree of hazard present.

hazard severity—the categorization of severity based on potential consequences and probabilities.

hazardous clear areas—safety clearance zones for ground processing that are defined in the Operations Safety Plans for each operating facility; include Blast Danger Area, Control Area Clears, and Toxic Hazard Corridor/Zone.

hazardous commodity—see *hazardous materials*.

hazardous event—the end result of a sequence of operations, failures or events that poses an immediate and direct threat to personnel or hardware.

hazardous facility or structure—a facility or structure used to store, handle, or process hazardous materials or systems and/or perform hazardous operations.

hazardous functions—planned operational events (e.g., motor firings, appendage deployments, stage separations, and active thermal control) whose inadvertent or improper operation or loss (i.e., failure to operate when required) may result in a hazard.

hazardous launch area clearance—required clearances; concurrence from the Chief of Safety must be obtained for all personnel required or requesting to be in a hazardous launch area during a launch operation; launch-essential personnel and neighboring operations personnel may be permitted within the impact limit lines, the FCA, and the FHA provided applicable individual risk criteria are met; non-essential personnel may be permitted inside the impact limit lines with Space Launch Delta Commander approval.

hazardous launch areas—safety clearance zones during launch operations with defined mishap probabilities, including the flight caution area, flight hazard area, vessel/boat exclusion area, and impact limit lines.

hazardous leak before burst—a pressure vessel that exhibits a leak before burst failure mode, either containing a hazardous material or involved with hazardous pressure operations beginning at 250 pounds per square inch gauge (psig).

hazardous materials—liquids, gases, or solids that may be toxic, reactive, or flammable or that may cause oxygen deficiency either by themselves or in combination with other materials.

hazardous operations—those operations classified as hazardous according to the following criteria: (1) consideration of the potential or kinetic energy involved; (2) changes such as pressure, temperature, and oxygen content in ambient environmental conditions; (3) presence of hazardous materials; for example, operations involving equipment or systems with potential for a release of energy or hazardous material that can result in a mishap.

Hazardous Operations Support—a Western Range contractor responsible for specific security operations.

hazardous pressure systems—the systems used to store and transfer hazardous fluids such as cryogens, flammables, combustibles, hypergols; systems with operating pressures that exceed 250 psig; systems with stored energy levels exceeding 14,240 ft-lb; systems that are identified by Range Safety as safety critical; see also *safety critical*.

hazardous procedure—a designation for a particular type of Range User procedure; a document containing specific steps in sequential order used to safely process hazardous materials or conduct hazardous operations; hazardous procedures have specific content requirements delineated in Volume 6, Attachment 3 and require Range Safety approval.

head winds—winds blowing from the reference launch azimuth.

high voltage exploding bridgewire—an initiator in which the bridgewire is designed to be exploded (disintegrated) by a high energy electrical discharge that causes the explosive charge to be initiated.

hoist angle—an angle at which the load line is pulled during hoisting.

hold—a temporary delay in the countdown, test, or practice sequence for any reason.

holdfire—an interruption, either by enabling or disabling, of the capability of a vehicle to initiate launch or reentry. Holdfire interruption may occur through a combination of hardware, software, or manual methods.

hot flow—a flow of live commodity in a newly assembled system to normally passivate system walls and components and to remove residual non-active contaminants or flushing fluid; the hot flow is not intended for leak checks because of the potential hazards due to leaks.

Hydraset®—the trade name for a closed circuit hydraulically operated instrument installed between a crane hook and load that allows precise control of lifting operations and provides an indication of applied load; precision load positioning device.

hydraulic—operated by water or any other liquid under pressure; includes all hazardous fluids as well as typical hydraulic fluids that are normally petroleum-based.

hydrogen embrittlement—a mechanical-environmental failure process that results from the initial presence or absorption of excessive amounts of hydrogen in metals, usually in combination with residual or applied tensile stresses.

hygroscopic—absorbs moisture from the air.

hypergolic—a propellant that ignites spontaneously upon contact, such as certain rocket fuels and oxidizers.

igniter—a device containing a specifically arranged charge of ready burning composition, usually black powder, used to amplify the initiation of a primer.

imminent danger—any condition, operation, or situation that occurs on the range where a danger exists that could reasonably be expected to cause death or serious physical harm, immediately or before the imminence of such danger can be eliminated through control procedures; these situations also include health hazards where it is reasonably expected that exposure to a toxic substance or other hazard will occur that will cause harm to such a degree as to shorten life or cause a substantial reduction in physical or mental efficiency even though the resulting harm may not manifest itself immediately.

impact dispersion area—an area surrounding an impact point that accounts for uncertainties in factors influencing the final impact of a debris piece; the extent and configuration of the area is based on the launch vehicle and/or payload dispersion.

impact limit line—a hazardous launch area; the boundary within which trajectory constraints and flight termination systems are used to contain an errant launch vehicle and vehicle debris. Launch essential and neighboring operations personnel are permitted within the impact limit lines. With Space Launch Delta Commander approval, non-essential personnel may be permitted within this area; however, the collective risk will not exceed acceptable standards for the general public; see also *general public*, *launch-essential personnel*, *neighboring operations personnel*, *non-essential personnel*, *public*.

inadvertent separation destruct system—an automatic destruct system that uses mechanical means to trigger the destruction of a launch vehicle stage; see *automatic destruct system*.

independent—not capable of being influenced by other systems.

indication—the response or evidence from the application of a nondestructive examination including visual inspection.

individual risk—the risk that any single person will suffer a consequence; unless otherwise noted, individual risk is expressed as the probability that any individual will become a casualty from a given hazard (E_c expected casualties) at a specific location and event.

in-family—a launch vehicle component or system test result indicating that the component or system's performance conforms to the family performance data that was established by previous test results.

inhibit—an independent and verifiable mechanical and/or electrical device that prevents a hazardous event from occurring. The inhibit device has direct interrupt authority of the hazardous event initiation sequence, and is not a monitor or control of the inhibit device or inhibit device function. Software controls or inhibit controls are not considered inhibits.

initial crack size—a crack dimension determined by nondestructive examination methods or proof test logic.

initial flaw—a flaw in a structural material before the application of load and/or environment.

initiator—a device employed to cause an explosive event; includes low voltage electroexplosive devices and high voltage exploding bridgewire devices.

instantaneous impact point—a predicted impact point, following thrust termination of a launch vehicle.

interrupter—a mechanical barrier in a fuse that prevents transmission of an explosive effect to some elements beyond the interrupter.

intrinsically safe—incapable of producing sufficient energy to ignite an explosive atmosphere and two fault tolerant against failure with single fault tolerance against its most hazardous failure at 1.5 times the maximum voltage or energy.

ionizing radiation—gamma and X-rays, alpha and beta particles, and neutrons.

jettisoned body—vehicle components separated at planned event times; examples of components include stages, fairings, thrust termination parts, solid rocket motors, and associated hardware.

Job Hazard Analysis (JHA)—an Occupational Safety and Health Administration (OSHA) term that defines a technique that focuses on job tasks as a way to identify hazards before they occur (see OSHA 3071 (2002, Revised), *Job Hazard Analysis*, for details).

L minus Time—the absolute time prior to the scheduled launch time. L minus Time may be measured in seconds, minutes, hours, and days and includes all scheduled countdown holds; L minus Time will always be equal or greater than T minus Time.

Laser Class (1-4)—the laser categories assigned in ANSI Z136.1; Class 4 being the most dangerous.

launch abort—the termination of a launch sequence in an unplanned manner or the failure of the launch vehicle to liftoff for reasons not immediately known.

launch area—the facility or location where launch vehicles and payloads are processed and launched; includes any supporting sites; also known as launch head. The launch area extends to the over-water areas used during submarine-launched ballistic missile intercontinental ballistic missile tests and launches where the range controls the launch for countdown.

launch area safety—safety requirements involving risks limited to personnel and/or property located on the launch base; involves multiple commercial users, government tenants, or host base units; this is the on-base component of public safety.

launch azimuth—the horizontal angular direction initially taken by a launch vehicle at liftoff; measured clockwise in degrees from true North.

launch complex—a defined area that supports launch vehicle or payload operations or storage; includes launch pads and/or associated facilities.

launch complex safety—safety requirements involving risk that is limited to personnel and/or property located within the well-defined confines of a launch complex (or missile silo), facility, group of facilities, recovery site, and adjacent facilities used by the control authority for launch

vehicle, reentry vehicle, and/or payload processing; for example, within the fence line; involves risk only to those personnel and/or property under the control of the control authority.

launch danger zone—a combination of the sea surface area and air space measured from the launch point and extending downrange along the intended flight azimuth; the size of the launch danger zone is based on the potential hazard to ships and aircraft.

launch-essential personnel—the minimum number of persons necessary to successfully and safely complete a hazardous or launch operation and whose absence would jeopardize the completion of the operation; this designation also includes people required to perform emergency actions according to authorized directives, people whose presence is necessary to perform their assigned duties (e.g., mission assurance personnel performing an observation in compliance with contractual obligations), persons specifically authorized by the Space Launch Delta Commanders to perform scheduled activities, and those personnel in training; the Range Users and Space Launch Delta Commanders jointly determine, with Range Safety concurrence, the number of launch-essential personnel allowed within safety clearance zones or hazardous launch areas; see also *safety clearance zones*, *hazardous launch area*, and *launch-essential personnel*.

launch processing—all preflight preparation of a launch vehicle at a launch site, including buildup of the launch vehicle, integration of the payload, and fueling.

launch safety—requirements, processes and procedures designed to protect the public, launch base personnel (government and contractor), and range infrastructure from the hazards associated with launch operations.

launch safety program—a comprehensive safety program for launch vehicles and related operations and facilities starting with program introduction at a range. It addresses design, manufacturing, transportation, ground handling/processing, pre-launch testing, launch of space systems through orbital insertion, reentry, and/or impact of suborbital systems. This includes collision avoidance through orbital insertion, attainment of Earth escape velocity or reentry, and/or end of programmed range safety control. Also includes safety of activities connected with the deployment (debris minimization), and recovery (if required) of test vehicles or payloads that don't obtain initial orbit (either planned or unplanned).

launch site—the specific geographical location from which a launch takes place.

launch (or reentry) system—the integrated set of subsystems, personnel, products, and processes that, when combined together, safely carries out a launch or reentry.

launch vehicle—a vehicle that carries and/or delivers a payload to a desired location; a generic term that applies to all vehicles that may be launched from the Eastern and Western ranges, including but not limited to airplanes; all types of space launch vehicles; manned space vehicles; missiles; rockets and their stages; probes, aerostats, and balloons; drones; remotely piloted vehicles; unmanned aerial systems; projectiles, torpedoes, and air-dropped bodies.

launch window—a period of time during which the flight of a launch vehicle may be initiated.

lead angle—an angle in which the load line is pulled during hoisting. Commonly used to refer to an angle in line with the grooves in the drum or sheaves.

leak before burst—a failure mode in which it can be shown that any initial flaw will grow through the wall of a pressure vessel or pressurized structure and cause leakage rather than brittle

fracture/burst before leak; normally determined at or below maximum expected operating pressure.

lifting/handling critical operation—a lifting/handling operation in which failure/loss of control presents a risk of loss of DoD high value property or causing secondary hazards (e.g., explosion or toxic release), to include those with the potential to extend beyond the established operational envelope of the lifting/handling equipment.

lifting/handling non-critical operation—industrial type lifting/handling operations involving inert items and governed by OSHA regulations and ASME standards.

liftoff—for the purposes of flight safety analyses, liftoff occurs during a launch countdown with any motion of the launch vehicle with respect to the launch platform (that includes a carrier aircraft), including any intentional or unintentional separation from the launch platform.

limit load—the calculated maximum loads to which a structure may be subjected during its lifetime of service; i.e., the applied load (static or dynamic) multiplied by applicable load amplification factors; see *limit load (design load)*.

limit load (design load)—the maximum load or combination of loads a part or structure is expected to experience at any time during its intended operation and expected environment; limit load = (load factor) x (rated load).

limits of a useful mission—the trajectory data or other parameters that bound the performance of a useful mission, including flight azimuth limits.

lines—the tubular pressure components of a pressurized system provided as a means for transferring fluids between components of the system.

liquid electrolyte—an electrolyte that stays in liquid form throughout an electrical reaction.

load factor—a factor that accounts for unavoidable deviations of the actual load from the nominal value. Examples of load factors include wind, shock, seismic, and dynamic load factors.

loading spectrum—a representation of the accumulated loadings anticipated for the structure under all expected operating environments; significant transportation and handling loads are included.

low cycle fatigue (strain-life fatigue) curve—a curve normally plotted in terms of cyclic strain amplitude versus the number of cycles to failure.

low noise amplifier—amplifier used in the initial stages of electronic signal processing to minimize the introduction of noise.

major leak or spill—a leak or spill that could affect regions beyond the immediate work area, constitute a hazard to personnel, or involve damage to facilities or equipment; a major leak or spill is more than one gallon.

major mishap—an event or incident that has the potential of resulting in a fatality or major damage such as the loss of a processing facility, launch complex, launch vehicle, or payload.

mandatory (in reference to instrumentation or capability)—a system that must be made operationally ready to support Range Safety and be fully mission capable before entering the plus count.

margin of safety—the percentage by which the allowable load (stress) exceeds the limit load (stress) for specific design conditions.

Yield Margin of Safety = $\left[\left(\frac{Yield\ Strength}{Limit\ Load\ Stress}\right) \text{x } (Yield\ Factor\ of\ Safety)\right] - 1$

Ultimate Margin of Safety = $\left[\left(\frac{Ultimate\ Strength}{Limit\ Load\ Strength}\right) \text{x } (Ultimate\ Factor\ of\ Safety)\right] - 1$

margin of safety (1) (primary definition)—the percentage by which the allowable strength (yield or ultimate) of a member exceeds the applied load.

MS = $\left(1 - \frac{Applied\ Load}{Allowable\ Strength}\right) \text{x } 100$

margin of safety (2) (alternate definition)—the additional allowable strength of the structure over that allowable strength (yield or ultimate) required to carry the limit loads.

MS = $\frac{Allowable\ Strength}{Applied\ Load} - 1$

material handling equipment—equipment used to handle lift, support, or manipulate critical or non-critical hardware; includes, but is not limited to, cranes, hoists, sling assemblies, Hydrasets® and load cells, handling structures, and personnel work platforms.

material toughness—the ability of a material to carry load or deform plastically in the presence of a notch. It can be described as the critical stress-intensity factor under conditions of plane stress (K_c) or plane strain (K_{Ic}).

materials, brittle—those materials that undergo little plastic tensile or shearing deformation before rupture; see also *ductile behavior*.

materials, ductile—those materials that undergo considerable plastic tensile or shearing deformation before rupture, and have sufficient notch toughness to fracture in a ductile manner at operating temperatures and under impact loading.

maximum allowable working pressure—the maximum pressure at which a component or system can continuously operate based on allowable stress values and functional capabilities. It is the basis for the pressure setting of the pressure relieving devices protecting the vessel; synonymous with maximum design pressure.

maximum expected operating pressure—the highest pressure that a pressure vessel, pressurized structure, or pressure component is expected to experience during its service life and retain its functionality, in association with its applicable operating environments; includes the effect of temperature, pressure transients and oscillations, vehicle quasi-steady, and dynamic accelerations and relief valve operating variability. Maximum expected operating pressure is synonymous with the maximum design pressure for aerospace pressure vessels and pressurized structures. For ground support equipment, maximum expected operating pressure is the not-to-exceed pressure during normal service.

maximum ground operating pressure—the maximum pressure to which a pressure vessel will be pressurized after loading with a specified fluid as part of the vehicle ground processing pre-launch checkout.

Megger—high voltage resistance meter.

minor leak or spill—a leak or spill that does not affect regions beyond the immediate work area, constitute a hazard to personnel, or involve damage to facilities or equipment; a minor leak or spill is less than one gallon.

misfire—a condition that exists when it is known that the ignition signal has been sent but did not reach an initiator and ignition of the propulsion system was not achieved.

mishap—an unplanned event or series of events resulting in death, injury, occupational illness, or damage to or loss of equipment or property or damage to the environment.

mismating—the improper installation and/or connection of connectors.

missile—a rocket-propelled or jet-propelled expendable vehicle used to deliver a warhead. It may use a ballistic trajectory or fly under active guidance and control.

Missile System Prelaunch Safety Package—a data package demonstrating compliance with the system safety requirements of Volume 3, which serves as a baseline for safety related information on the system throughout its life cycle.

Mission Flight Control Officer—the individual responsible for initiating range "Command" destruct for an errant launch vehicle, solid rocket motor/solid rocket booster, and/or upper stage vehicle.

Mission Rules—a document of agreements between the Range User and Space Launch Delta Commander or a designator specifying, in detail, those requirements and procedures not covered by this document.

mission scrub—the termination of a launch operation.

monitor circuit—a circuit used to verify the status of a system, such as an inhibit directly; control circuits can be monitored but they cannot serve as a monitor circuit.

near miss—an undesired and unexpected event resulting in no personal injury or illness, or personal injury or illness requiring only first aid, and/or incidental damage, but with potential for causing a mishap or negative mission impact.

neighboring operations personnel—those individuals, not associated with the specific/current operation or launch under consideration, who are required to perform safety, security, or operationally critical tasks and who are aware of the launch mission risks and trained in mitigation tasks or accompanied by properly trained escorts; see also *operationally critical task.*

no-fire level—the maximum direct current or radio frequency energy at which an electroexplosive initiator shall not fire with a reliability of 0.999 at a confidence level of 95% as determined by a Bruceton test and shall be capable of subsequent firing within the requirements of performance specifications.

noise margin—the margin between the worst-case noise level and logic circuitry threshold.

nominal vehicle—a properly performing launch vehicle whose instantaneous impact point does not deviate from the intended instantaneous impact point locus.

noncompliance—a noticeable or marked departure from requirements, standards, or procedures; includes equivalent level of safety determinations (formerly meets intent certifications) and waivers.

non-credible—determined to be so improbable that such an occurrence is virtually impossible, based on careful analysis of the potential hazard and mode of prevention such as permanent physical barriers and/or enforced separation distance; cost and convenience are not valid rationales for a determination of non-credible.

non-critical hardware—equipment and systems used for standard industry use; equipment or systems that are determined not to be hazardous, of high value, or safety critical.

nondestructive examination—any testing, inspection, or evaluation that does not cause harm to or impair the usefulness of an object satisfies the meaning of the word nondestructive; in common usage, nondestructive testing often refers just to test methods and test equipment with only a general reference to materials and/or parts; (1) nondestructive inspection relates to specific written requirements, procedures, personnel, standards, and controls for the testing of a particular material of a specific part; (2) nondestructive evaluation is concerned with the decision making process, the determination of the meaning of the results, of the final acceptance or rejection of the material of part, and may be qualitative or quantitative.

non-essential personnel—those persons not deemed launch-essential or neighboring operations personnel; includes the general public, visitors, the media, and any persons who can be excluded from Safety Clearance Zones with no effect on the operation or parallel operations.

non-hazardous procedure—a designation for a particular type of Range User procedure; a document containing general or specific steps in sequential order to ensure proper execution of a non-hazardous, non-safety critical process; non-hazardous procedures do not have specific content requirements and do not require Range Safety approval.

non-incendive—will not ignite group of gases or vapors for which it is rated. Similar to intrinsically safe, but does not include failure tolerance ratings; used in rating electrical products for Class I, Division 2 locations only.

non-operating environment—an environment that a launch vehicle component experiences before flight and when not otherwise being subjected to acceptance tests; non-operating environments include, but need not be limited to, storage, transportation, and installation.

normal flight—a properly performing vehicle whose real-time vacuum instantaneous impact point does not deviate from the nominal vacuum instantaneous impact point by more than the sum of the wind effects and the three-sigma guidance and performance deviations in the uprange, downrange, left-crossrange, or right-crossrange directions. Synonymous with normal vehicle, nominal flight, nominal vehicle, and nominal trajectory, as used in this manual.

operating environment—an environment that a launch vehicle component will experience during acceptance testing, launch countdown, and flight; includes shock, vibration, thermal cycle, acceleration, humidity, and thermal vacuum.

operating life—(1) the period of time beginning with activation of the component or installation of the component on a launch vehicle, whichever is earlier, for which the component is capable of satisfying all its performance specifications through the end of flight; (2) the period of time in

which prime power is applied to electrical or electronic components without maintenance or rework.

operation—a scheduled activity where range assets are necessary to support Range User requirements for a specified time period.

operation hazard—a hazard derived from an unsafe condition created by a system or operating environment or by an unsafe act.

operationally critical task—a task that is essential for continuing critical and subsequent launch processing operations.

operations safety plan—the detailed safety procedures used for missile operations; these plans are written by the Range Contractor and Operations Safety; includes Explosives Safety Plans, Facility Safety Plans, and Safety Operational Plans.

optical coverage ratio—the percentage of the surface area of the cable core insulation covered by a shield.

orbital insertion—the point at which a vehicle achieves a minimum 70-nautical mile perigee based on a computation that accounts for drag.

ordnance—all ammunition, demolition material, solid rocket motors, pyrotechnics, and explosives as defined in DESR 6055.09 and DESR 6055.09_AFMAN 91-201.

ordnance component—a component such as a squib, detonator, initiator, igniter, or linear shaped charge in an ordnance system.

ordnance operation—any operation consisting of shipping, receiving, transportation, handling, test, checkout, installation and mating, electrical connection, render safe, removal and demating, disposal, and launch of ordnance.

out-of-family—a component or system test or flight result where the component or system's performance does not conform to the family performance data that was established by previous test or flight results and is an indication of a potential problem with the component or system requiring further investigation and corrective action.

passive component—a flight termination system component that does not contain active electronic piece parts such as microcircuits, transistors, and diodes; includes, but need not be limited to, radio frequency antennas, radio frequency couplers, and cables and rechargeable batteries, such as nickel cadmium batteries.

passive device—a device that permits signals to transient through it without modifying the signals.

payload—the object(s) within a payload fairing carried or delivered by a launch vehicle to a desired location or orbit; a generic term that applies to all payloads that may be delivered to or from the Eastern or Western Ranges; includes but is not limited to satellites, other spacecraft, experimental packages, bomb loads, warheads, reentry vehicles, dummy loads, cargo, and any motors attached to them in the payload fairing.

performance specification—a statement prescribing the particulars of how a component or part is expected to perform in relation to the system that contains the component or part; includes specific values for range of operation, input, output, or other parameters that define the component's or part's expected performance.

perigee—the point in an object's orbit nearest to the center of the Earth, and where the object's velocity is greatest. The perigee altitude is the distance of the perigee point above the surface of the Earth.

personnel work platforms—platforms used to provide personnel access to flight hardware at off-pad processing facilities as well as at the launch pad; they may be removable, extendible, or hinged.

plus count—the portion of a launch operation beginning with vehicle ignition and concluding with Range Safety's release of all instrumentation.

pneumatic—operated by air or other gases under pressure.

populated area—an outdoor location, structure, or cluster of structures that may be occupied by people; sections of roadways and waterways that are frequented by automobile and boat traffic are populated areas; agricultural lands, if routinely occupied by field workers, are also populated areas.

positive control—the continuous capability to ensure acceptable risk to the public is not exceeded throughout each phase of powered flight for thrusting stages, throughout each phase of flight using control surfaces, until orbital insertion, or until the final impact point is established for suborbital missions.

positive interrupt circuit—comprised of an inhibit that physically interrupts the energy source providing power to the electronic safe and arm device firing unit.

powered flight—that portion of flight of a vehicle when thrust occurs; it does not include the coast phases of the flight.

pre-launch—launch related activities occurring during early acquisition phases, ground handling, processing, and transportation operations prior to ignition (liftoff) actions.

preliminary flight plan approval—the approval given when Range Safety accepts flight limits and conditions, flight trajectories, booster configurations, flight termination system configurations, and other flight characteristics.

pressure component—a component such as lines, fittings, valves, regulators, and transducers in a pressurized system; normally pressure vessels or pressurized structures are excluded, because of the potential energy contained; they generally require additional analysis, test, and inspection.

pressure cycle—term used in pressure vessel qualification testing that refers to a complete MEOP cycle taken from ambient pressure to MEOP or above the cycle threshold pressure and back down to ambient pressure.

pressure system—any system above 0 psig that is classified as follows: low pressure, 0 to 500 psi; medium pressure, 501 to 3000 psi; high pressure, 3001 to 10,000 psi; ultra-high pressure, above 10,000 psi. The degree of hazard of a pressure system is proportional to the amount of energy stored, not the amount of pressure it contains; therefore, low-pressure, high-volume systems can be as hazardous to personnel as high pressure systems; see *pressurized system*.

pressure vessel—a container that stores pressurized fluids and (1) contains stored energy of 14,240 foot pounds (19,130 joules) or greater based on adiabatic expansion of a perfect gas; or (2) contains gas or liquid which will create a mishap (accident) if released; or (3) will experience a MEOP greater than 250 psia; excluded are special equipment including batteries, cryostats (or dewars), heat pipes, and sealed containers; or (4) per the ASME definition, summarized briefly; pressure containers that are integral pumps or compressors, hot water heaters and boilers, vessels

pressurized in excess of 15 psi (regardless of size), and vessels with a cross-sectional dimension greater than 6 inches (regardless of length of the vessel or pressure).

pressurized structure—a structure designed to carry both internal pressure and vehicle structural loads; the main propellant tank of a launch vehicle is a typical example.

pressurized system—a system that consists of pressure vessels or pressurized structures, or both, and other pressure components such as lines, fittings, valves, and bellows that are exposed to and structurally designed largely by the acting pressure; electrical or other control devices required for system operation are not included; a pressurized system is often called a pressure system; see *pressure system*.

primacord—an explosive detonating cord.

primary battery—a battery that is not intended to be recharged and that is disposed of in controlled conditions when the battery has delivered all of its electrical energy.

probability of casualty—the likelihood that a person will suffer a serious injury or worse, including a fatal injury, due to all hazards from an operation at a specific location.

program—the coordinated group of tasks associated with the concept, design, manufacture, preparation, checkout, and launch of a launch vehicle and/or payload to or from, or otherwise supported by the Eastern or Western ranges and the associated ground support equipment and facilities.

Program Introduction—the initial planning document submitted by a potential customer, in accordance with Universal Documentation System requirements, to the Space Launch Delta to identify general program requirements and schedules.

Project Firing Tables—a document that contains mission unique flight constants and launch window schedule.

proof factor—a multiplying factor applied to the limit load or maximum expected operating environment to obtain proof load or proof pressure for use in the acceptance testing.

proof pressure—(1) the product of maximum expected operating environment and a proof factor accounting for the difference in material properties between test and service environment (such as temperature); used to give evidence of satisfactory workmanship and material quality; for example, demonstrating that the component and/or system will not deform, leak, or fail; (2) may be used to establish maximum initial flaw sizes for safe-life demonstration.

propellant servicing—any dynamic operation involving propellants such as transfer, sampling, pressurization, decontamination, connecting and disconnecting lines, and venting.

propellant storage tank—any container of propellants greater than one gallon. Application of the requirements of this document to storage tanks will normally vary with the size of the tank and associated hazards. Containers less than one gallon will also be subject to operational controls, as appropriate, as would any container of flammable liquid.

protected area—a populated or other area not controlled by a launch operator that is not evacuated during flight and that must, in order to protect the public, be protected from the effects of nominal and non-nominal launch vehicle flight.

public—all persons not in the launch essential personnel category; see also *neighboring operations personnel* and *general public*.

public safety—safety involving risks to the general public of the US or foreign countries and/or their property (both on- and off-base); includes the safety of people and property that are not involved in supporting a launch along with those that may be within the boundary of a launch site.

qualification tests—the required tests used to demonstrate that the design, manufacturing, and assembly have resulted in hardware conforming to specification requirements.

quantization—an error introduced into a measurement when analog data is converted to discrete digital levels; since these digital levels are discrete values, values that fall in between are assigned to the closest pre-assigned level.

radiation source—materials, equipment, or devices that generate or are capable of generating ionizing radiation including naturally occurring radioactive materials, by-product, source materials, special nuclear materials, fission products, materials containing induced or deposited radioactivity, nuclear reactors, radiographic and fluoroscopic equipment, particle generators and accelerators, radio frequency generators such as certain klystrons and magnetrons that produce X-rays, and high voltage devices that produce X-rays.

radio frequency silence—turning off or powering down of radio frequency emitters within a particular area; local radio frequency silence is normally required when the launch vehicle and mobile transmitters are operating in the area.

radioactive equipment or device—equipment or devices that generate, or are capable of generating, ionizing radiation including radiographic and fluoroscopic equipment, particle generators and accelerators, radio frequency generators such as certain klystrons and magnetrons that produce X-rays, and high voltage devices that produce X-rays.

radioactive material—materials that generate, or are capable of generating, ionizing radiation including naturally occurring radioactive materials, by-product materials, source materials, special nuclear materials, fission products, materials containing induced or deposited radioactivity, and nuclear reactors.

radioactive material launch approval—approval granted by Range Safety to Range Users intending to launch radioactive materials.

range or ranges—in this publication, range or ranges refers to the Eastern Range at Cape Canaveral Air Force Station, Kennedy Space Center, and Patrick Air Force Base, and the Western Range at Vandenberg Air Force Base.

range contractor—the Launch Base Support and Range Technical Services contractors and all subcontracted agencies required for operation and maintenance of the ER and WR; for the purposes of this publication, the term range contractor also refers to National Aeronautical and Space Administration and Kennedy Space Center contractors as applicable.

range instantaneous impact point/prediction—the range from the launch point to the instantaneous impact point along the earth ellipsoid.

Range Safety critical systems—includes all airborne and ground subsystems of the flight safety system.

Range Safety Launch Commit Criteria—hazardous or safety critical parameters, including, but not limited to, those associated with the launch vehicle, payload, ground support equipment, flight safety system, hazardous area clearance requirements, and meteorological conditions that must be within defined limits to ensure that public, launch area, and launch complex safety can be maintained during a launch operation.

Range Safety Program—a program implemented to ensure that launch and flight of launch vehicles and payloads present no greater risk to the general public than that imposed by the over-flight of conventional aircraft; such a program also includes launch complex and launch area safety and protection of national resources.

Range Safety Representative—a government employee or member of the US Space Force assigned to the Space Launch Delta Safety office, or a contractor employee designated and authorized by the Space Launch Delta Safety office to act on behalf of the organization.

range tracking system—includes the tracking aid and/or GPS and associated subsystems as defined in RCC 324.

Range Users—any individual or organization that conducts or supports any activity on resources (land, sea, or air) owned or controlled by USSF ranges; includes such organizations as the Department of Defense, United States government agencies, civilian launch operators, and foreign government agencies and other foreign entities that use USSF range facilities and test equipment; conduct prelaunch and launch operations, including payloads to orbital insertion or impact; and/or require on-orbit or other related support.

rated load—the maximum static load or force that can be imposed on the part or structure at any time during its intended operation and expected environment.

rated load (static or dynamic)—the load to which the structure was designed to withstand.

Recertification File—a file that contains data showing that a specific piece of material handling equipment/material ground support equipment meets the periodic test and inspection requirements of this document.

recovery area—the location where reentry vehicles and their payloads are recovered during their respective final phase of flight, and only immediate safing and servicing operations may be performed before relocation to a recovery site; includes any landing facilities, pads, supporting sites, or facilities. The recovery area extends to any adjacent water areas overflown during approach to the final resting location and the immediate surrounding areas and communities hazarded by the returning vehicle.

recovery site—a defined area or facility that supports post-recovery operations, processing, or storage for the reentry vehicle and its payload after flight; includes pads, hangars, and/or associated facilities.

redundant—a situation in which two or more independent means exist to perform a function.

reenter; reentry—to return or attempt to return, purposefully, a reentry vehicle and its payload or human being, if any, from Earth orbit or from outer space to Earth.

reentry vehicle—a vehicle designed to return from space to Earth substantially intact. A reusable launch vehicle that is designed to return from Earth orbit or from outer space to Earth substantially intact is a reentry vehicle.

referee fluid—a compatible fluid, other than that used during normal system operations, that is used for test purposes because it is safer due to characteristics such as less (or non-) explosive, flammable, or toxic and/or easier to detect.

remote control—control of a system from a remote and safe location.

required (in reference to instrumentation or capability)—a system that must be made operationally ready to support Range Safety.

residual strength—the maximum value of nominal stress, neglecting the area of the crack, that a cracked body is capable of sustaining.

residual stress—the stress that remains in a structure after processing, fabrication, assembly, testing, or operation; for example, welding induced residual stress.

resource safety—the protection of facilities, support equipment, or other property from damage due to mishaps; also known as resource protection.

rest period—the period of time immediately prior to the beginning of the duty period; for launch-essential personnel, it is mandatory that the rest period include the time necessary for meals, transportation, and 8 hours of uninterrupted rest prior to reporting for duty. Rest periods in preparation for launch operations will start no earlier than 2 hours after the assigned personnel are released from an earlier launch or range operations. Only the Chief of Safety or Space Launch Delta Commander has the authority to waive the safety rest period requirements for mission ready personnel; see also *crew rest*.

reusable launch vehicle—a vehicle, stage or payload that has been launched by any launching process, completed a prescribed mission, and returned to Earth for recertification and probable reuse in a follow-on mission.

risk—a measure that takes into consideration both the probability of occurrence and the consequence of a hazard to a population or installation. Risk is measured in the same units as the consequence such as number of injuries, fatalities, or dollar loss. For Range Safety, risk is expressed as casualty expectation or shown in a risk profile; see also *collective risk* and *individual risk*.

risk analysis—a study of potential risk.

risk study—the analysis of systems (hardware, software, firmware, and procedures) to determine potential hazards that could result in loss of personnel, injury to personnel, loss or degradation of the system or loss of life or injury to the public; see also *hazard analysis*.

safe & arm device—a device that provides mechanical interruption (safe) or alignment (arm) of the explosive train and electrical interruption (safe) or continuity (arm) of the firing circuit.

safe/arm plug—normally two plugs; the arm plug is inserted in the firing circuit to provide continuity; the arm plug is removed and the safe plug inserted that shorts the electroexplosive device leads and provides static bleed capability, although some circuits have this protection inherent in their design; shorting plugs and connectors that are placed on electroexplosive leads after disconnecting the cable are not the same as safing plugs, although they may perform similar functions.

safety—the programs, risk management activities, and organizational and cultural values dedicated to preventing injuries and accidental loss of human and material resources, and to protecting the environment from the damaging effects of mishaps.

safety clearance zones—the restricted areas designated for day-to-day prelaunch processing and launch operations to protect the public, launch area, and launch complex personnel; these zones are established for each launch vehicle and payload at specific processing facilities, including launch complexes; includes hazard clearance area and hazardous launch area.

safety critical—essential to safe performance or operation. A safety-critical system, subsystem, component, condition, event, operation, process, or item, is one whose proper recognition, control, performance, or tolerance, is essential to mitigating hazards that may result in major system damage, death, severe injury, or a mishap with either catastrophic or critical consequences.

safety critical computer system function—a computer function containing operations that, if not performed, if performed out of sequence, or if performed incorrectly, may result in improper or lack of required control functions that may directly or indirectly cause a hazard to exist.

safety critical facility—a hazardous facility or a facility that is used to store, handle, or process systems determined to be safety critical by Range Safety.

safety critical load—a load that if dropped could result in a secondary hazard such as an explosion or release of toxics that could impact the public or launch area personnel (e.g., hoisting a solid rocket motor, fueled spacecraft, or fueled launch vehicle).

safety critical procedure—a designation for a particular type of Range User procedure; a document containing steps in sequential order used to reliably process safety critical systems or conduct safety critical operations; non-hazardous safety critical procedures have no specific content requirements but do require Range Safety review and approval.

safety device—also known as safety feature or safety control. A safety device is levied on the system design to control the cause of an identified hazard or to mitigate the effect of the hazard. As a result, the probability and/or severity of a hazard can be reduced to an acceptable level. Safety devices can take numerous forms in a design. No matter what form a safety device takes, its purpose is to prevent an undesirable (hazardous) event from occurring. Safety devices may be wholly or partly mechanical, electrical, or software in nature. A safety device may inherently be part of the system or be specifically added to a system. Safety devices may include the following: (1) Barriers - a physical means to keep personnel away from hazardous energy or to contain/deflect hazardous energy if it were released. (2) Fail-safe design - a design feature in which a system reacts to a failure by switching to or maintaining a safe operating mode that may include system shutdown. (3) Inhibit - a device that prevents system operation if a predetermined condition is not satisfied. (4) Interlock - a device that may be inserted into the system to prevent system operation (often used in maintenance). (5) Interrupt - a device that disrupts system operation if a predetermined condition is violated. (6) Redundancy/fault tolerance - the built-in ability of a system to provide continued correct operation in the presence of a specific number of faults or failures. (7) Special system features - systems or devices, such as fire suppression and hazardous gas detection, which control and/or warn of system hazards.

safety factor—for pressure systems, the ratio of design burst pressure over the maximum allowable working pressure or design pressure; for mechanical systems, it can also be expressed as the ratio of tensile or yield strength over the maximum allowable stress of the material.

safety holds—a safety hold (the stopping of procedures, activities, countdown, etc.) shall be initiated to prevent the start of a launch/reentry operation or to stop a launch/reentry operation that is already underway if it violates public, launch area, launch complex safety, recovery area, recovery site safety, launch commit criteria, or reentry commit criteria; the holdfire capability, emergency voice procedures, or light indication system of each launch/reentry system used to prevent launch/reentry in the event of loss of range safety critical systems or violations of mandatory launch commit/reentry criteria.

safety kernel—an independent computer program that monitors the state of a system to determine when potentially hazardous system states occur or when transitions to potentially hazardous system states may occur; the safety kernel is designed to prevent the system from entering a hazardous state and/or return it to a known safe state.

safety margins (destruct)—margins used to avoid overly restrictive flight termination limits; normally based on launch vehicle three-sigma performance characteristics.

safety operating plan—a type of operations safety plan; standard operating procedure.

safe-venting device/pressure relief device—any device or structural design that allows the pressurized structure to control/release internal pressure.

safing procedures—the process of taking a system that is in a hazardous configuration and performing those tasks necessary to bring it to a condition which is safe for further activities; safing procedures are part of the backout procedures for a system.

secondary battery—a battery that may be restored after discharge by the passage of electrical current in the opposite direction to that of discharge.

self-test capability—the capability of a microprocessor to employ a self-test to detect errors and to output the results via telemetry.

serious mishap—an event or incident that has the potential of resulting in injury to personnel and damage to high value property or that might require the use of contingency or emergency procedures.

service life—(1) the total life expectancy of a part or structure; service life starts with the manufacture of the structure and continues through all acceptance testing, handling, storage, transportation, operations, refurbishment, retesting, and retirement; (2) the period of time between the initial lot acceptance testing and the subsequent age surveillance testing for ordnance.

shall—mandatory action.

shelf life, battery—the specified period of time a battery may be stored in a logistical environment and still perform to all required specifications when placed in service.

shelf life, explosive—the period of time an explosive material may be stored without becoming unfit for use.

shield (RF)—a metallic barrier that completely encloses a device for the purpose of preventing or reducing induced energy.

should—recommended action.

sigma—standard deviation.

single failure point—in general, a component that, if failed, could lead to the overall failure of the system (for example, in a mechanical system, a component such as a lug, link, shackle, pin, bolt, rivet, or a weld that, if failed, could cause a system inability to support a load using load path analysis).

single failure point analysis—in general, an analysis to identify single failure points; for mechanical systems, a load path analysis; a stress analysis of the resultant system after the first load path failure (of a single failure point); twice the resultant dead weight shall be used in the analysis to account for the sudden redistribution of the load and an allowable stress of 90% of the ultimate material stress shall be used.

single flight azimuth—an operation or mission in which the flight azimuth remains fixed throughout the launch window.

single point ground—the one interconnection for a grounded circuit with other circuits.

single point of contact—the Range User's one point of contact for range operations.

sling—a lifting assembly and associated hardware used between the load and the hoisting device hook.

soft goods—the nonmetal materials in a pressure system that are used to form a seal or seat for metal-to-metal contact or between other hard surfaces.

software—a combination of associated computer instructions and computer data that enable a computer to perform computational or control functions. Software includes computer programs, procedures, rules, and any associated documentation pertaining to the operation of a computer system. Software includes new development, complex programmable logic devices (firmware), non-developmental items (NDI), commercial-off-the shelf (COTS), government-off-the-shelf (GOTS), re-used, Government furnished equipment (GFE), and Government-developed software used in the system.

software design description—a representation of a software system created to facilitate analysis, planning, implementation, and decision-making; a blueprint or model of the software system; used as the primary medium for communicating software design information.

software single point of failure—a single error or fault of any software element or component that renders the system, including the operators, incapable of operating as intended; occurs when failure of one or more software entities prevents the system from operating as intended due to a single specific instance of a fatal operational condition.

solid electrolyte—an electrolyte that is absorbed in a gelatinous or semi-solid composition.

Space Launch Squadron—an United States Space Force unit that provides oversight of space launch operations at the Eastern and Western ranges.

space launch system anomaly—any parameter (pressure, temperature, voltage, acceleration, etc.) that deviates outside the prescribed or expected range of values. Any occurrence that represents an unusual, irregular, abnormal, or unexplained departure from expected results.

Space Launch Delta Commander—in this document, the term Space Launch Delta Commander refers exclusively to the commanders of Space Launch Delta 30 and Space Launch Delta 45; the term Range Commander refers to the commander of the Eastern or Western Range in accordance with Department of Defense Directive 3200.11 and is the same individual as the Space Launch

Delta Commander; the terms Range Commander and Spacelift Commander refer to tasks or functions performed by the Space Launch Delta Commander.

Space Systems Command—a Space Force organization that develops and acquires space launch vehicles, satellites, and range systems for the United States Space Force (formerly known as Space and Missile Systems Center).

standing by—being at the scene and not on call.

static firing—testing of a propulsion system by securing it to a rigid structure and preventing powered flight.

storage life—the period of time after manufacturing is complete until the component is activated or installed on a launch vehicle (whichever is earlier) or used during ground processing, during which the component may be subjected to storage environments and must remain capable of satisfying all its performance specifications.

stress-corrosion cracking—a mechanical-environmental induced failure process in which sustained tensile stress and chemical attack combine to initiate and propagate a crack or a crack-like flow in a metal part.

stress intensity factor—a parameter that characterizes the stress-strain behavior at the tip of a crack contained in a linear elastic, homogeneous, and isotropic body.

stress versus cycles—normally plotted in the form of a curve/diagram and is cyclic stress amplitude versus the number of cycles to failure.

structural component—a component such as a bolt, lug, hook, shackle, pin, rivet, or weld in a piece of material handling equipment, platform, or support structure.

structural sling—a rigid or semi-rigid fixture that is used between the load and hoisting device hook, such as spreader bars, equalizer bars, and lifting beams.

suborbital—object trajectory that does not complete a full orbit of the Earth.

sub-vehicle point—the location on an ellipsoidal Earth model where the normal to the ellipsoid passes through the launch vehicle's center of gravity. The term is the same as the weapon system term sub-missile point.

super high frequency—3 GHz to 30 GHz.

support agency—any agency acting in support of a primary Range User.

support structure—a structure used to support hardware or equipment, such as support stands and fixed or portable launch support frames.

surface inspection—a nondestructive examination method used for detection of surface and near surface discontinuities.

system hazard—a hazard associated with a hardware system and that generally exists even when no operation is occurring; system hazards that may be found at a launch site include, but are not limited to, explosives and other ordnance, solid and liquid propellants, toxic and radioactive materials, asphyxiants, cryogens, and high pressure.

system safety—the application of engineering and management principles, criteria, and techniques to achieve acceptable risk within the constraints of operational effectiveness and suitability, time, and cost throughout all phases of the system life-cycle.

T minus Time—countdown clock time; T minus 0 is launch time; time prior to the scheduled launch time not including built-in holds in the countdown; normally measured in seconds, minutes, and hours.

T minus X—a time late in the minus count after which a holdfire switch will not be activated.

tail winds—winds blowing toward the launch azimuth.

telemetry—vehicle systems measurements made available to ground based users via S-band downlinks.

Telemetry Doppler Nominal Acceleration and Radar—a Kalman filter used for Range Safety tracking displays at the Western Range.

terminate—if an abort cannot be implemented to put the vehicle in a safe configuration and there are no other alternatives to maintaining public safety, the flight safety system or the contingency management system will be activated. This may include destruction of the vehicle.

testing laboratory (nationally recognized)—laboratories such as Underwriters Laboratories, Inc., or Factory Mutual Engineering Corporation, that use nationally recognized testing standards and provide benchmark(s) to certified products as evidence of successful testing.

threshold limit value—time weighted average concentrations that must not be exceeded during any 8-hour work shift of a 40-hour work week.

threshold sensitivity—the minimum radio frequency input signal level at which a command receiver decoder meets all performance specifications.

toxic hazard corridor—a hazardous clear area; clearance of a sector in which toxic material may reach predetermined concentration levels.

toxic hazard zone—a generic term that describes an area in which predicted concentration of propellant or toxic byproduct vapors or aerosols may exceed acceptable tier levels; predictions are based on an analysis of potential source strength, applicable exposure limit, and prevailing meteorological conditions; toxic hazard zones are plotted for potential, planned, and unplanned propellant releases, and launch operations.

transponder—the portion of the airborne range tracking system that receives and decodes interrogations and generates replies to the interrogations; the transponder permits the ground instrumentation radar to furnish significantly greater precision and accuracy data at much greater distances and prevents mistracking of powered vehicles due to interference of exhaust plumes or spent stages.

trilateration—the use of ranging data from three geographically suitable radar sites to produce high quality tracking data.

ultimate load—the product of the limit load and the design ultimate load factor. It is the load that the structure must withstand without rupture or collapse in the expected operating environment.

ultimate strength—the maximum stress developed by the material before rupture, based on the original area, in tension, compression, or shear.

unexecutable code—any form of software instructions or data resident in computer memory that is neither executed as a program nor vectored to or read as data by a program.

uprange—the distance measured along a line that is 180° to the downrange direction; the term uprange may also be used to indicate direction.

uprange direction—measured in the direction of the negative X axis of the X, Y, Z coordinate system.

variable flight azimuth—an operation or mission in which the flight azimuth of the trajectory varies either continuously or step-wise (in discreet steps) throughout the launch window.

vehicle—launch vehicle and/or payload.

verification—the act or process of confirming or having the accuracy checked on items or activities used to provide proof of compliance to requirements. Verification is a broad term that encompasses various methods such as test, demonstration, inspection, and analysis as a means to show compliance; items or activities used to provide proof that recommended actions taken to eliminate or control hazards have been implemented. These recommended actions are determined through the hazard analysis process.

visible damage—for composite pressure vessels; anomalies that are visible to the naked eye under not less than 15 foot candles at a distance no greater that 24 inches and not less than a 30° angle; lighting up to 50 foot candles may be used for the detection of small anomalies.

volumetric inspection—a nondestructive testing method to determine the presence of discontinuities throughout the volume of a material.

waiver—a designation used when, through an error in the manufacturing process or for other reasons, a hardware noncompliance is discovered after hardware production, or an operational noncompliance is discovered after operations have begun at the Eastern or Western ranges; a decision that allows a launch operator to continue with a launch, including launch processing, even though the launch operator does not satisfy a specific safety requirement and is not able to demonstrate an equivalent level of safety.

Western Range—part of the National Launch Range facilities, operated by Space Launch Delta 30, part of United States Space Force, and located at Vandenberg Space Force Base, California; the range includes the operational launch and base support facilities located at Vandenberg Space Force Base radar tracking sites and ground stations located on sites uprange and downrange along the Pacific Coast (including United States Navy facilities at Point Mugu), and in the context of launch operations, the Pacific Ocean.

wet stand time—(1) the time from activation and initial load pulse to the beginning of qualification operational environmental testing of a liquid electrolyte battery; (2) for the actual use of batteries, the wet stand time is from the time of activation and initial load test to end of use.

window closure—a period of time when launch or reentry is not permitted in order to avoid a collision with an object in orbit. A window closure may occur within a launch or reentry window, may delay the start of a window, or terminate a window early.

Space Launch Delta Safety—the Space Launch Delta organization responsible for launch and range safety functions; headed by the Space Launch Delta Chief of Safety; this office ensures that

the Launch and Range Safety Program meets range and Range User needs and does not impose undue or overly restrictive requirements on a program; also known as Range Safety.

WP-S—a classification for a fitting(s) that is manufactured from seamless product by a seamless method of manufacturer (marked with class symbol, WP-S).

WP-WX—a classification for a fitting(s) that contains welds where all welds have been radiographed (marked with class symbol, WP-WX).

yield strength—the stress at which there is an appreciable increase in strain with no increase in stress; typically defined as the stress that will induce a specified permanent set (yield point, usually 0.2% strain offset).