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Terminology for lunar exploration program

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Terminology for lunar exploration program

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FOREWORD

This standard is proposed by China National Space Administration.

This standard is under the jurisdiction of China Astronautics Standards Institute.

In case of any doubt about the contents of English version, the Chinese original shall be considered authoritative.

Introduction

This standard regulates terminology closely related to lunar exploration program. For terminology regulated in other standards, this standard will directly quote them.

This standard describes the concept system classification of lunar exploration program as follows:

1) The concept of unmanned lunar exploration program is divided into six parts according to the actual situations of the lunar exploration system, i.e., lunar exploration system and system engineering, lunar probe, launch vehicle, tracking, telemetry and command, launching site and landing site, and lunar science and ground application. In consideration of future development, terminology related to manned lunar landing will be regarded as an individual conceptual category.
2) The concept of lunar probe is classified and sequenced according to probes required by three steps "orbiting, landing and returning" of unmanned lunar exploration planned by China currently, and is compiled based on service system and payload.
3) Spacecraft researched and developed by unmanned lunar exploration program is collectively referred to as "lunar probe", with the components respectively referred to as orbiter, lander, rover, ascent vehicle, return vehicle, and so on. Spacecraft developed for manned lunar landing is collectively referred to as "manned spacecraft", with the components respectively referred to as orbital module, propelling module, lunar module, command module, and so on.

Terminology of lunar exploration program

1 Scope

This standard specifies basic terminology for research and application of lunar exploration program.

This standard is applicable to lunar exploration program and related fields.

2 Terms and definitions

2.1 Lunar exploration system and system engineering

2.1.1

lunar exploration technology

integrated technology for lunar exploration, exploitation and resource utilization.

2.1.2

lunar exploration system

integrated engineering system for lunar missions composed of lunar probe, launch vehicle, range/launch site, Earth landing ground, Track, Telemetry & Control (TT&C), ground research and application system(GRAS) , and other support facilities.

2.1.3

lunar exploration program

1) integrated engineering for lunar exploration, exploitation and resource utilization.

2) research and development (R&D) tasks of lunar exploration system.

2.1.4

lunar orbiting exploration program

1) integrated space engineering which obtains exploration data by lunar orbiter orbiting the Moon and realizes expected scientific and engineering goals.

2) research and development tasks of lunar orbiting exploration space system.

2.1.5

lunar probe

unmanned probe or spacecraft for lunar exploration, e.g., lunar orbiter (lunar exploration satellite), lunar lander, lunar rover, lunar ascent vehicle and lunar return vehicle.

2.1.6

lunar Probe system

a system composed of lunar probe and corresponding ground support facilities.

2.1.7

launch vehicle system

a system composed of launch vehicle which sends lunar probe into the predefined orbit and its corresponding ground support facilities.

2.1.8

launch site system

A system composed of ground facilities and site for launching of lunar probe and launch vehicle.

2.1.9

tracking, telemetry and command system (TT&C)

a system composed of facilities for tracking, orbit determination, telemetry and command of lunar probe and launch vehicle, which is abbreviated as TT&C system.

2.1.10

ground research and application system (GRAS)

A system composed of facilities for scientific payloads operation control, preparation of exploration plans, reception and record of down-link scientific data, archive, filling, dissemination, data processing, interpretation, application and research.

2.1.11

earth landing system

a system composed of landing area on Earth for return capsule or vehicle, rescue and recovery devices, and corresponding supporting facilities.

2.1.12

lunar orbiting exploration

scientific lunar exploration through remote sensing technologies by lunar orbiter.

2.1.13

in-situ exploration

scientific exploration to landing area by lunar probe on Moon surface.

2.1.14

landing exploration

in-situ exploration to selected area or target in landing area by lunar lander.

2.1.15

roving exploration

in-situ exploration to selected area or target by lunar probe when roving on Moon surface.

2.1.16

lunar sampling

process of collecting lunar samples by lunar probe.

2.1.17

selenology

a subject that studies the Moon in astrochemistry, astronomy, space environment science, astrophysics, composition, internal structure, evolution and formation mechanism.

2.1.18

manned spaceship; manned spacecraft

spaceship or spacecraft with astronauts onboard for short-term living and working which returns to the Earth, such as manned satellite spaceship or manned lunar spaceship.

2.1.19

manned lunar exploration

space mission of sending astronauts to Moon surface with spaceship or spacecraft.

2.1.20

lunar base

lunar exploration infrastructure on Moon which can sustain long time existence and support both unmanned and manned exploration.

2.1.21

launch coordinate system

origin of coordinates O_o is the launch point; O_oX_1 is within the horizontal plane and points to the launching direction; O_oY_1 passes through the launch point and then is along the plumb line; O_oZ_1 is vertical to O_oX_1 and O_oY_1; $O_oX_1Y_1Z_1$ constitutes the right-handed rectangular coordinate system.

2.1.22

moon centered inertial coordinate system

origin of coordinates O_m is the Moon center; O_mX, O_mY and O_mZ are parallel to O_eX_1, O_eY_1 and O_eZ_1 of Earth centered inertial coordinate system respectively; O_mXYZ constitutes the right-handed rectangular coordinate system.

2.1.23

moon centered equator coordinate system

origin of coordinates O_m is the Moon center; O_mX_1 is within the Moon equator plane and points to the projection direction of the vernal equinox on the Moon equator; O_mZ_1 is vertical to Moon equator plan and its direction is consistent with angular rotation velocity vector direction of the Moon; O_mY_1 is vertical to O_mX_1 and O_mZ_1; $O_mX_1Y_1Z_1$ constitutes the right-handed rectangular coordinate system.

2.1.24

moon centered landing inertial coordinate system

origin of coordinates O_m is the Moon center; O_mX_L is the connecting line between the Moon center and the starting point of power descent, and the direction from the Moon center to the starting point of power descent is positive; O_mY_L is within the descending orbit plane and points to the probe direction; O_mZ_L is vertical to O_mX_L and O_mY_L, and they constitute the right-handed rectangular coordinate system.

2.1.25

launch window

specified time range for lunar probe launching usually including “launch opportunity window” and “launch time window”. Launch opportunity window refers to the continuous dates of launch;

launch time window refers to time intervals of launch on every launch date.

2.1.26

injection

event or moment when lunar probe enters into predetermined orbit after its separating from launch vehicle.

2.1.27

launching phase

flight phase from the launch vehicle lift-off to separation of the launch vehicle and the lunar probe.

2.1.28

phasing phase

flight phase from separation of the launch vehicle and the lunar probe to entering Earth-Moon transfer orbit.

2.1.29

earth to Moon transfer phase

flight phase of the lunar probe from entrance to Earth-Moon transfer orbit (LTO) (Earth orbit or phasing orbit) to near Moon braking.

2.1.30

lunar orbiting phase

1) flight phase from near Moon braking of the lunar probe to enter lunar orbit to the end of operation life

2) flight phase from near Moon braking of the lunar probe to the beginning of de-orbiting deceleration.

2.1.31

power descent phase

flight phase from lunar orbit powered deceleration to landing on the Moon, also called landing phase.

2.1.32

ascent phase

flight phase from lift-off of lunar probe on Moon surface to lunar orbit or entrance to Moon-Earth transfer orbit.

2.1.33

moon-Earth transfer phase

flight phase from departure of lunar orbit or entrance to Moon-Earth transfer orbit to entrance of return.

2.1.34

return phase

flight phase from entrance of return to reentry of Earth atmosphere and landing on Earth.

2.1.35

interface test between lunar probes and ground TT&C or GRAS

interface test for compatibility and performance between lunar probes and ground TT&C or GRAS on ground.

2.1.36

interface test between lunar probes and launch vehicles

interface test for compatibility between lunar probes and launch vehicles on ground.

2.2 Lunar probe

2.2.1

lunar exploration satellite

lunar orbiter

artificial lunar satellite for lunar observation or near Moon space environment exploration.

2.2.2

lunar lander

lunar probe which lands on Moon for scientific exploration.

2.2.3

lunar rover

lunar probe which roves on Moon surface for scientific exploration.

2.2.4

lunar ascent vehicle

lunar probe which lifts off from Moon surface to enter lunar orbit or reach the entrance to Moon-Earth transfer orbit.

2.2.5

lunar return vehicle

earth reentry vehicle

lunar probe which carries lunar samples , reenters Earth atmosphere and returns to Earth at the end.

2.2.6

mockup

lunar probe model which is used for coordinating layout of probe devices, cables and pipelines and integration simulation.

2.2.7

structural model

lunar probe model which is used for static and dynamic test to check structural strength and structural design correctness at prototype phase.

2.2.8

thermal model

lunar probe model which is used for thermal balance test to check thermal design correctness at prototype phase.

2.2.9

electrical model

lunar probe model which is used for electromagnetic compatibility (EMC) test and electric performance test to check integrated electric performance of probe subsystems at prototype phase.

2.2.10

landing model

lunar probe model which is used for landing deceleration and hovering test and impact buffer test to check landing performance.

2.2.11

engineering qualification model (EQM)

lunar probe with the same configuration as the probe to be launched which is used for ground qualification test at flight model phase.

2.2.12

flight model; flight probe

lunar probe which has passed acceptance test and is used for launching at flight model phase.

2.2.13

phasing orbit

a special orbit of lunar probe before it enters the Earth to Moon orbit or Lunar Transfer orbit (LTO).

2.2.14

Earth-Moon transfer orbit/trajectory or Lunar transfer orbit (LTO)

the trajectory of lunar probe from the Earth orbit to the Moon.

2.2.15

lunar orbit

the trajectory of lunar probe around the Moon.

2.2.16

lunar descent trajectory

the trajectory of lunar probe from the lunar orbit or the lunar gravitational field boundary to the lunar surface.

2.2.17

return trajectory from the Moon

the trajectory of lunar probe from lunar surface or Moon-Earth transfer orbit entrance to the Earth surface.

2.2.18

lunar ascent trajectory

the trajectory of lunar probe from lunar surface to lunar orbit or Moon-Earth transfer orbit entrance .

2.2.19

Moon-Earth transfer trajectory

the trajectory of lunar probe from lunar orbit or Moon-Earth transfer orbit entrance to Earth reentry entrance.

2.2.20

mid-course trajectory correction

1） trajectory adjustment of lunar probe in Earth-Moon transfer orbit to reach the target orbit.

2） trajectory adjustment of lunar probe in return trajectory from the Moon to control the reentry conditions of the lunar probe.

2.2.21

polar lunar orbit

lunar orbit that its inclination is about 90 degree, which means its orbital plane is vertical to Moon equator.

2.2.22

perilune/periselene

the point of least distance to Moon in lunar orbit.

2.2.23

perilune/periselene altitude

the distance between perilune and Moon’s center minus Moon’s mean radius.

2.2.24

apolune/aposelene

the point of greatest distance to Moon’s center in lunar orbit.

2.2.25

apolune/aposelene altitude

the distance between apolune and Moon’s center minus Moon’s mean radius.

2.2.26

lunar sub-point

the point on Moon surface directly below a lunar probe.

2.2.27

patched-conic approach

the orbit design method which divides the transfer orbit into two segments of Keller orbit patched in the influence sphere. Therefore lunar probe is only subject to the Earth gravitation out of the lunar influence sphere and to the lunar gravitation within the lunar influence sphere.

2.2.28

lunar sphere of influence

the region around the Moon where the primary gravitational influence on an orbiting object is the Moon.

2.2.29

lunar perturbation

additional movement of lunar probe caused by lunar non-spherical gravity.

2.2.30

Moon's path

the apparent path of the Moon across the sky.

2.2.31

lunar orbit insertion

the active deceleration of lunar probe in Earth-Moon transfer orbit for entry into lunar orbit.

2.2.32

effects of lunar eclipse

effects on power supply of lunar probe because of the solar radiation intensity variation due to periodical in-and-out of the Earth shadow during the lunar orbiting.

2.2.33

landing

1) the flight process of lunar lander from powered descent orbit to predefined area on lunar surface.

2) the process when return capsule/vehicle enters the Earth atmosphere and descends to predefined area on Earth surface.

2.2.34

landing site

1) predefined area on on lunar surface for lunar lander.

2) predefined area on the Earth surface for recovery of return capsule/vehicle.

2.2.35

soft landing on the Moon

a landing process of lunar probe that does not result in damage to the probe or anything on board by autonomous control of flight trajectory and absorption of landing impact.

2.2.36

landing stability

the capability of lunar lander to land on the lunar surface with predetermined attitude and speed to maintain the balance.

2.2.37

landing impact

impact or load upon lunar lander during landing on the lunar surface.

2.2.38

trafficability

the capability of lunar rover to pass through soft or hard lunar surface without degradation of moving performance.

2.2.39

maneuverability

controllability of lunar rover on the lunar surface.

2.2.40

terrainability

the capability of lunar rover to pass through irregular terrains.

2.2.41

tele-operation

the remote control of lunar probe on the Moon with status monitoring, scenario reconstruction, mission planning, simulation, telemetry and tele-command.

2.2.42

lunar ascend

the powered flight process that lunar probe lifts off from the Moon surface.

2.2.43

lunar orbital rendezvous

the orbital maneuver when ascent vehicle and orbiter arrive at the same position in lunar orbit and fly at the same speed.

2.2.44

lunar orbital docking

the process of joining two rendezvous lunar probes on lunar orbit.

2.2.45

return from the Moon

flight phase of lunar probes from lunar surface or orbit to Earth.

2.2.46

reentry

the flight process when return capsule/vehicle enters the Earth dense atmosphere from the return entrance.

2.2.47

landing on Earth

the process of lunar return capsule/vehicle coming to land on Earth after reentry, including soft

landing and hard landing.

2.2.48

accuracy of landing point on Earth

deviation between the actual position and the nominal position of landing point of return capsule /vehicle on Earth, usually in 3σ .

2.2.49

sample of the Moon

lunar materials, such as rock and regolith collected by lunar probes after landing.

2.2.50

structural and mechanisms subsystem

a subsystem of lunar probe, including structure, assembly parts and mechanisms, which supports instruments, withstand loads, maintain structural integrity and transform input forces and movement into a desired set of output forces and movement.

2.2.51

central bearing cylinder

main cylinder structures in the center of spacecraft or lunar probe, which supports structure and serves for assembling instruments and equipment.

2.2.52

landing gear subsystem

a subsystem of lunar lander for absorption of impact load of landing and guarantee of stability under certain conditions on lunar surface.

2.2.53

landing gear

the device absorbing landing impact load on lunar surface when lunar lander lands on the Moon, also called landing legs.

2.2.54

footpad

a structure on the landing leg for increasing contact area between landing gear and the lunar surface.

2.2.55

thermal control subsystem

a subsystem of lunar probe to keep all the probe parts within acceptable temperature ranges during all mission phases under external environment. .

2.2.56

thermal design

the design of thermal control subsystem to keep all the parts of lunar probe within specified temperature ranges by controlling heat exchange among internal parts of lunar probe, probe surface and

external environment.

2.2.57

passive thermal control

the technology which controls heat exchange of lunar probe by use of different thermal control materials and appropriate configuration.

2.2.58

active thermal control

the technology which autonomously controls internal temperatures of instruments and equipment of lunar probe when internal or external heat flow changes.

2.2.59

thermal radiator

thermal control device which collects extra heat inside lunar probe and radiates heat into the surrounding space.

2.2.60

radioisotopic heat unit

the device which collects heat generated through radio isotopic decay.

2.2.61

electrical power supply and distribute subsystem

a probe subsystem for generation, storage, conversion, conditioning and distribution of electrical power, including power subsystem for power generation, storage and conditioning, and circuit subsystem for power distribution, cable/harness, pyrotechnic device management and connection, etc.

2.2.62

hydrogen nickel / nickle-hydrogen battery

an electrochemical power source based on nickel and hydrogen with negative hydrogen electrode and positive nickel electrode.

2.2.63

lithium ion battery

a rechargeable electrical power source with anode and cathode of intercalated lithium compound.

2.2.64

solar cell array

power generation device of solar cell array connected in serial or parallel and its structures, also called solar array.

2.2.65

body-mounted solar array

solar cell array which is mounted on outer surface of lunar probe.

2.2.66

deployable solar array

solar cell array connected with structure of lunar probe and can be folded on it or deployed.

2.2.67

radioisotopic thermoelectric (power) generator (RTG)

an electrical generator that converts the heat released by the decay of radioactive material into electricity, also called radioisotopic thermoelectric battery.

2.2.68

guidance, navigation and control subsystem

a subsystem to measure, correct and control movement of lunar probe in designed orbit (or path) and attitude, also abbreviated as GNC & GN&C subsystem.

2.2.69

normal flight attitude

a specified attitude during lunar orbiting of lunar probe according to relation between the sunlight and the orbit plane. The X axis of lunar probe is aligned with flight direction within the orbit plane; lunar probe is three-axis stabilized; the solar array is in zero position and vertical with sunlight.

2.2.70

side flight attitude

a specified during lunar orbiting of lunar probe according to relation between the sunlight and the orbit plane. The X axis of lunar probe is vertical to the orbit plane and points to the Sun; lunar probe is three-axis stabilized; the solar array is in zero position and vertical to sunlight.

2.2.71

star orientation mode

the working mode of GNC subsystem to maintain fixed orientation of lunar probe in inertial space with star sensor/tracker and gyroscope.

2.2.72

lunar orientation mode by ultraviolet sensor

the working mode of GNC subsystem to keep attitude in specific orientation by ultraviolet sensor, gyroscope and sun sensor on lunar orbit.

2.2.73

lunar orientation mode by star sensor/tracker

the working mode of GNC subsystem to keep attitude in specific orientation by star sensor/tracker and gyroscope on lunar orbit.

2.2.74

lunar ultraviolet sensor

imaging sensor which can determine lunar probe’s attitudes on lunar orbit by automatic processing of images in ultraviolet wavelengths, also called ultraviolet sensor.

2.2.75

autonomous navigation for landing

real-time determination of power descent motion of lunar probe by onboard instruments without ground support, which can be used for power descent control.

2.2.76

hovering over the Moon

a state and its related operations of lunar probe hovering at certain altitude over the Moon surface during power descent.

2.2.77

terrain identification sensor

the sensor which acquires lunar surface images of the landing site, and provides image information about terrain characteristics such as appearances and geometric properties (e.g., shape and height) of lunar rocks.

2.2.78

landing trajectory

flight path of lunar probe from powered descent to landing on the lunar surface.

2.2.79

vision navigation

guidance of lunar rover to move with terrain information of the lunar surface acquired by cameras.

2.2.80

path planning

determination of optimized path for lunar rover through environmental perception (lunar surface imaging, image matching, feature extraction and obstacle detection) and dead reckoning under constraints.

2.2.81

propulsion subsystem

a subsystem of lunar probe which provides force for orbit maneuvers, as well as momentum for attitude control.

2.2.82

throttling engine

engine which can provide various thrust by controlling the propellant combustion rate.

2.2.83

locomotion subsystem

a subsystem of lunar rover which generates driving force, adapts to terrain of the lunar surface, and bears instruments and equipment.

2.2.84

ground clearance

the minimum distance between the underside of rover structure and the supporting ground (lunar surface).

2.2.85

turn radius

the radius of the smallest circular turn when lunar rover turns at a certain speed.

2.2.86

drawbar pull

difference between lunar regolith thrust and lunar regolith drag along the lunar rover’s motion direction.

2.2.87

wheel sinkage

the distance between the lowest point of wheel and the lunar surface in the vertical direction when rover wheel contacts with the lunar surface, also called sinkage.

2.2.88

wheel-slip

the phenomenon of wheel turning without being able to move the lunar rover or making the rover moving slower than the wheel turning. .

2.2.89

tracking, telemetry, command and data transmitting subsystem

a subsystem of lunar probe which provides radio frequency (RF) transmission channel for communication with ground segment and between probes in space as well as beacon for ground station of very-long-baseline interferometry (VLBI).

2.2.90

X-beacon transmitter

a X-band transmitter of lunar probe as a beacon for ground station of very-long-baseline interferometry (VLBI).

2.2.91

on board data handling subsystem

a subsystem of lunar probe for telemetry, tele-command, program control, on-board autonomous control and timing.

2.2.92

integrated electronics subsystem

a subsystem of lunar rover integrated with onboard data handling (OBDH), navigation and motion control, payload data management, power supply and distribution management, mechanism control such as solar array and locomotion.

2.2.93

central terminal unit

a subsystem or lunar probe that processes telemetry and tele-command messages, provides on-board timing information, controls data bus and remote terminal units.

2.2.94

directional antenna subsystem

an antenna of lunar probe which radiates or receives greater power in specific directions allowing for increased performance by pointing mechanism.

2.2.95

antenna deployment mechanism

a mechanism for stow, release, deployment or lock of the directional antenna of lunar probe.

2.2.96

antenna pointing mechanism

a mechanism which aligns the antenna beams to the given direction, including direct drive and indirect drive.

2.2.97

sound storage device

a device of lunar probe which stores and replays on-orbit audio data.

2.2.98

payload subsystem

a subsystem of lunar probe which is composed of instruments and equipment for scientific exploration.

2.2.99

optics imaging detector system

a system of lunar probe acquiring stereo and multispectral images for mapping and geology study of lunar surface, usually including CCD stereo camera and interference imaging spectrometer.

2.2.100

CCD stereo camera

CCD camera which can acquire two-dimensional images of the same target on the lunar surface in front-view, side-view or back-view direction.

2.2.101

interference imaging spectrometer

scientific instrument of lunar probe which collects point interference images of every pixel for spectrum charts and provides two-dimensional spectral images to analyse major material composition and distribution of the lunar surface.

2.2.102

laser altimeter

scientific instrument of lunar probe which acquires distance between lunar probe and its sub-points by laser ranging to determine the height of lunar surface.

2.2.103

γ-ray spectrometer

scientific instrument which acquires γ-ray spectrum of lunar surface excited by cosmic rays to determine the distribution of elements on lunar surface.

2.2.104

X-ray spectrometer

scientific instrument which acquires X-ray spectrum of lunar surface excited by cosmic rays to determine the distribution of elements on lunar surface.

2.2.105

microwave radiometer

scientific instrument of lunar probe which detects thickness of lunar regolith in different regions through measurement of microwave brightness temperatures of lunar regolith in specific frequency bands according to penetration depths of microwaves in the lunar regolith.

2.2.106

solar high-energy particle detector

scientific instrument of lunar probe which detects composition, proton spectrum and distribution of heavy ions in the solar wind.

2.2.107

solar wind detector

Scientific instrument of lunar probe which detects energy spectrum of plasma in the solar wind, including speed, ion temperature and number density of the solar wind.

2.2.108

panorama camera

scientific instrument of lunar probe which acquires image of the lunar surface, usually composed of a pair of visible light cameras mounted at a certain distance.

2.2.109

descent camera

scientific instrument of lunar probe which takes images of landing area during the powered descent, usually using CMOS camera working at visible spectrum.

2.2.110

alpha proton X-ray spectrometer

scientific instrument of lunar probe which determines elements of lunar regolith based on effects of Rutherford back scattering (RBS) and particle induced X-ray emission on lunar surface.

2.2.111

infrared imaging spectrometer

scientific instrument of lunar probe which acquires spectral information in near-infrared bands and short infrared bands to determine physical properties of lunar regolith including morphology, component and content, and major mineral components of lunar rock on lunar surface.

2.2.112

laser (ranging) reflector/retroreflector

scientific instrument of lunar probe which can reflect incoming light beam back in the direction where it came from, which consists of tetrahedral prisms with three vertical mirrors.

2.2.113

seismograph

scientific instrument of lunar probe which directly measures and records displacement, speed or acceleration of the lunar surface motion arising from Moon quake. It can deduce time, size, direction and depth of Moon quake according to information about measured size, instrument characteristics and field features, and understand propagation characteristics of Moonquake in the Moon, internal structure of the Moon, activity rules of Moon quake and Moon quake mechanism.

2.2.114

ultraviolet camera

optical device of lunar probe acquiring images of the Earth by collecting ultraviolet radiation from Earth plasma sphere on lunar surface.

2.2.115

Moon-based optical telescope/observatory

telescopic optics imaging and data collecting system on lunar surface.

2.2.116

lunar penetrating radar

scientific instrument of lunar probe which detects thickness, distribution of lunar regolith and sub-surface geological structure on lunar surface.

2.2.117

micro mass spectrograph

scientific instrument of lunar probe which performs qualitative and quantitative detection of composition and distribution of rare gases in the lunar regolith according to material identification and confirmation based on mass-to-charge ratio of measured molecules.

2.2.118

flight simulation test

the ground test of lunar probe performances according to actual flight profile, also called flight simulation.

2.2.119

landing test

ground test for verification of lunar probe landing performances including autonomous control, powered descent, landing gears and landing stability.

2.3 Launch vehicle

2.3.1

launch vehicle

A rocket used to carry lunar probe from the Earth into the predefined orbit.Usually it is a multistage rocket.

2.3.2

rocket structure

a subsystem of launch vehicle which bears various internal and external loads during transportation, lifting and flight, and keeps the structural integrity of launch vehicle.

2.3.3

payload fairing

a nose cone structure of launch vehicle used to protect payload and maintains aerodynamic shape of the rocket during flight in the Earth atmosphere, and can be jettisoned after out of the atmosphere.

2.3.4

propulsion system

a subsystem of launch vehicle which provides forward propulsion and control force for rocket flight, including engine subsystem and pressurized feed subsystem.

2.3.5

control system

a subsystem of launch vehicle which performs guidance, navigation and control of rocket during flight to carry payload into the orbit, including guidance subsystem, attitude control subsystem and time sequence control subsystem, etc.

2.3.6

rocket flight sequence

a set of time sequence commands sent during the rocket flight.

2.3.7

telemetry system

a subsystem of launch vehicle which completes measurement, recording and transmission of operating and environment data of the rocket, as well as real-time processing of partial parameters, including onboard telemetry equipment and ground receiving/processing equipment.

2.3.8

tracking and safety system

a subsystem of launch vehicle which performs tracking and measurement, and destruction of rocket in case of failure by cooperating with TT&C system of rocket.

2.3.9

coast phase propellant management and attitude control system

a subsystem of launch vehicle which performs attitude control, last-stage propellant management, terminal velocity correction, and attitude adjustment during the coast phase before separation of the launch vehicle and payload.

2.3.10

cryogenic propellant utilization system

a subsystem of launch vehicle used to guarantee combustion of propellants in coordination, and minimize the unusable propellants at the end of the powered flight.

2.3.11

separation system

a subsystem of launch vehicle which separates connected structures with unlocking mechanism. Rocket separation events during flight include booster separation, stage separation, fairing separation, and separation of the launch vehicle and payload.

2.3.12

auxiliary system

equipments and subsystems of launch vehicle used for various auxiliary works before lift-off except the main systems of rocket, including routine propellant level and temperature measurement, payload fairing air-conditioner, waterproof and dehumidification.

2.4 Ground Tracking, telemetry and command (TT&C)

2.4.1

deep space network

ground tracking, telemetry and command network for deep space probes, usually including deep space station, deep space task center , related ground communication network and other infrastructure.

2.4.2

deep space station

ground station for deep space tracking, telemetry, command and communication tasks, with large-diameter antenna, high-power transmission and high-sensitivity reception.

2.4.3

space tracking, telemetry and command network

an integrated system for tracking, measurement, monitoring, command and control of launch vehicle and spacecraft, including launching command and control center, tracking, telemetry and command center, space mission control center, tracking, telemetry and command station, and various transmission lines and equipment.

2.4.4

space tracking, telemetry and command station

ground station for tracking, measurement and control of spacecraft.

2.4.5

space mission control center

mechanisms and facilities for monitoring, control, command and decision making of spacecraft launch, operation and recovery .

2.4.6

launching command and control center

mechanisms and facilities in the launching site for launching command, as well as monitoring, command and control of launch vehicle and spacecraft during the ascent phase.

2.4.7

tracking, telemetry and command center

mechanisms and facilities for command, coordination and data processing of tracking, telemetry and command station, as well as spacecraft monitoring.

2.4.8

orbit determination accuracy

deviation between spacecraft orbit determined according to observation data and actual flight path.

2.4.9

orbit prediction accuracy

deviation between predicted value of orbit in an epoch moment and actual observed value.

2.4.10

visible orbit arc

an arc section of spacecraft path which can be measured with ground measurement equipment in a region, usually represented with measurable time quantum.

2.4.11

unified S-band system

radio system which shares an S-band carrier channel and completes orbit measurement, tracking, telemetry and command, remote control, and data transmission (voice, message and image) of spacecraft.

2.4.12

rocket tracking, telemetry and command system

system composed of tracking, telemetry and command center and tracking, telemetry and command station (ship) for external trajectory measurement, safety control, telemetry data receiving and processing of launch vehicle during launching phase.

2.4.13

satellite tracking, telemetry and command system

system composed of tracking, telemetry and command center and tracking, telemetry and command station (ship) for trajectory measurement, telemetry data receiving and processing, remote control and data input, and time correction during the period from spacecraft injection to lunar orbiting.

2.4.14

very-long-baseline interferometry (VLBI)

a kind of radio astrometric technology which simultaneously records artificial or natural radio source with two electric telescopes far from each other, and obtains high angular resolution by processing the signals with center processing device.

2.4.15

very-long-baseline interferometry for orbit determination

a method which determines the orbit parameters by processing of spacecraft beacon signals received by VLBI station .

2.4.16

same beam interferometry

a technology which performs differential interferometry when two probes are quite near in an angle and can be observed in a same beam of a ground antenna.

2.4.17

differential one-way ranging

a technology which acquires unambiguous time delay of a probe by two ground stations, and measures distance between probe and ground station.

2.4.18

delta differential one-way ranging

a technology which acquires differential delay through differential one-way ranging of probe and radio star by two ground stations, and determines high-precision angular position of probe in the radio source coordinate system.

2.4.19

differential one-way ranging tone

single tone for differential one-way ranging (DOR) within launch signal spectrum of probe.

2.5 Launching site and landing site

2.5.1

launching site, launch range

specific area for spacecraft launching, including instrumentation area, launching area, command and control center, tracking measurement facilities, service support facilities and management service mechanism.

2.5.2

instrumentation area

specific area for technical preparation of assembly, detection and test before launch vehicle and spacecraft enter the launching area, including launch vehicle assembly and test building, probe assembly and test building, payload preparation building, pyrotechnics storage and test area, and supporting engineering facilities.

2.5.3

launching area

specific area in the launching site for preparation of launch vehicle and spacecraft, loading of propellants and implementation of launching before launch. It includes launch complex, flame diversion trough, and propellant storage and loading facilities.

2.5.4

loading system

Integrated ground facilities which provide propellants for launch vehicle and probe in the launching site, including propellant storage depot, storage container, pipelines, pumps and filling control equipments.

2.5.5

gas supply station

integrated facilities which provide gases for all systems in the launching site, including compressor station, gas bottle depot, gas distribution room, and gas supply and distribution network.

2.5.6

launch vehicle assembly and test building

special building for launch vehicle assembly and test in the instrumentation area.

2.5.7

test-launch control room

special place where launch vehicle, probe and ground service support system are organized and coordinated in the instrumentation area for remote test, control and launching.

2.5.8

launch complex

site in the launching area for launching of launch vehicle and probe, as well as facilities directly related to launching, including launching pad, flame diversion trough, service tower, umbilical tower and underground power room.

2.5.9

launching pad

pedestal in the launch complex to bear and fix launch vehicle and probe. It can be divided into fixed launching pad and mobile launching pad.

2.5.10

umbilical tower

tower steel frame which is fixed in one side of the launching pad, connects with launch vehicle and probe through mobile rotary cantilever, and is used for loading, detection and power supply.

2.5.11

flame diversion trough

reinforced concrete trough under the launching pad which drains high-temperature & high-velocity gas flow generated by ignition of launch vehicle. It can be divided into single-side, double-side and multi-side diversion troughs.

2.5.12

landing point

the location where lunar return capsule/vehicle lands on Earth.

2.5.13

landing site

predetermined ground area where lunar return capsule/vehicle lands on Earth.

2.5.14

recovery

the process when lunar return vehicle reenters the Earth dense atmosphere, lands on the Earth surface safely after deceleration and then is recovered.

2.6 Lunar science and ground application

2.6.1

lunar mare

the visible dark part of the lunar surface of lunar basins filled with lava and with low sunlight reflectivity. Shapes of lunar mares are different, including round, rectangular, polygonal and irregular. Most lunar mares are mutually connected. In most cases, lunar mares are surrounded by mountains. Lunar mares always have such landforms as valley, rille and ridge. Formation of lunar mare is as follows: lunar basins are formed by impact of asteroid, comet or meteorite 3.8 billion years - 4.1 billion years ago, and then filled by lava.

2.6.2

lunar highland; lunar terra

large light-colored or bright areas on the lunar surface. Their surfaces are rough and filled with impact craters, accounting for about 80% of the total area of lunar surface. They are mainly composed of light-colored anorthosite, and have high sunlight reflectivity (0.09~0.12). The visible and bright parts of the lunar surface are the lunar highland areas. The formation of lunar highland is earlier than that of lunar mare. They are also called highland for short.

2.6.3

hinarvallis

wind valleys on the lunar surface, which are always in the shape of straight line or arc. The walls are

steep and bottoms are flat. They may be formed arising from falling of lava in lunar mare along the fault due to tension.

2.6.4

crater

it is the abbreviation of lunar impact crater, which refers to round or sub-round pits of different sizes in the lunar surface. It scatters all over the whole lunar surface, especially the lunar highland areas. The total area of craters with the diameter larger than 1km accounts for about 7%-10% of the total area of the lunar surface. In most cases, the craters are surrounded with ring mountains higher than the lunar surface and radial tectonic lines. Some are filled with lunar mare substances. According to the statistics, the number of craters in the lunar surface exceeds 33000, which are distributed in an uneven way. The number of craters in lunar highlands is larger than that in lunar mares. Most craters are named after ancient famous scholars. Most craters are formed by impact of meteorite. During formation of some craters, volcanic activities may arise due to impact. Only some craters are of volcanic crater nature.

2.6.5

lunar rille

long and thin grooves in the lunar surface. They can be found in lunar mares and lunar highlands, and are quite common in lowlands filled with basalt. Their shapes are different, including straight and curved. Their formation causes are also different. Straight rilles extend in a straight line, and they may be formed by corrosion of soft rock walls; curved rilles may be formed by collapse of lava tubes. Besides, there are jagged curved rilles and large gaps formed by lava cooling. Chained rilles are composed of a chain of connected craters, and formed by gas escape of volcanic conduit or fumarole. Formation of some rilles may be related to radial structure arising from impact of large meteorite.

2.6.6

lunar meteorite

residual ejected materials which are formed by incomplete ablation of ejected materials arising from impact of asteroid or comet after passing through the Earth atmosphere at a high speed and falling on the Earth surface. The evidence of meteorite from the Moon: comparison of mineral components, chemical components and isotopic components of lunar rocks collected by Apollo Project and Lunar Project.

2.6.7

obscure ring

pits which can be deduced to be existent previously according to visible traces in the lunar mares.

2.6.8

optical libration of the Moon

the swing of the Moon along the east-west or south-north direction viewed from the Earth. Swing in the east-west direction is called libration in longitude; swing in the south-north direction is called libration in latitude.

2.6.9

lunar regolith

mixtures on the lunar surface composed of tiny fragments with weak coherency. Generally speaking, they consist of particles, crystalline rocks/minerals and microbreccia/stone chips with glass casing, as well as glass chips. In the lunar mares, lunar regolith is relatively thin, with the thickness of 2m-10m; in the lunar highlands, lunar regolith is relatively thick, with the maximum thickness reaching 100m. The average accumulation rate of lunar regolith is about 2mm per one million years. The accumulation rate during the early stage (3.5 billion years - 4 billion years ago) is larger than that in the later stages by an order of magnitude. Therefore, lunar regolith in the lunar highlands is higher than that in the lunar mares. Composition of lunar regolith is similar to that of lunar rock, while the contents of iron and magnesium elements in the former are lower, because the melting point of the former is lower than that of the latter. Age of lunar regolith is 4.2 billion years - 4.6 billion years (model age: 4.4 billion years - 4.6 billion years), which is larger than that of local interarea. Some scholars hold that it is the product of early magmatic segregation during lunar formation, and some think that it is component of kreep rocks with high radioactivity. Therefore, model age of lunar regolith reflects its age.

2.6.10

lunar dust; lunar fines

powder dusts on the lunar surface, with the grain size smaller than 1mm. They contain glass balls or chips, anorthose, clinopyroxene, ilmenite, olivine, troilite, natural iron fragments, and round-shaped ferro-nickel with the diameter smaller than 1mm. Sometimes, they also contain a small amount of tridymite, christobalite and spinel. Glass accounts for a large proportion in lunar dust. Its composition changes a lot due to melting and rapid cooling of rocks or minerals due to impact of meteorite. Lunar dust in the lunar highlands is quite thin, with the average thickness of 1mm, or even 0, and in the lunar mares and the lunar craters is quite thick. The thermal conductivity of lunar dust is quite small. Most scholars hold that lunar dust is formed due to impact of meteorite, while a few scholars think that it is generated by volcanic ash.

2.6.11

lunar rock

rocks which constitute the Moon. The geologic process in the Moon is smaller and fewer than that in the Earth, so the Moon can keep old and simple rocks. Three types of main rocks in the lunar surface: iron-rich or zinc-rich mare basalt, which fills the wide lowlands of the lunar mares; norite rich in radioactive elements and refractory micro-elements (kreep rock and non mare basalt); aluminum-rich anorthosite, containing 70% gabbro. All lunar rocks are igneous rocks without water, ferric iron or free oxygen. They are products under relative reducing environment.

2.6.12

lunar breccia

breccia distributed in the lunar highlands, which is composed of rock chips and grass chips. Due to thermal and pressure actions arising from impact of meteorite, breccia hardens after welding or compaction. Existence of breccia in the lunar highlands shows impact and explosion of meteorite in the early history of the Moon.

2.6.13

operating management subsystem

subsystem of the ground application system which completes payload on-orbit operation management, prepares the detection plan, and schedules the ground application system operation.

2.6.14

data acquisition subsystem

subsystem of the ground application system which is mainly composed of ground station, and is used to receive and process down-link data of satellite data transmission channels, and record and send landing information.

2.6.15

data preprocessing subsystem

subsystem of the ground application system which determines model and algorithm of payload data preprocessing, performs format conversion, corrective calculation and quality analysis of payload data, and generates standard data products.

2.6.16

data management subsystem

subsystem of the ground application system which is used for storage, backup, filing and release of data of all levels, as well as establishment, management and maintenance of communication connection and time unification of the ground application system.

2.6.17

scientific application and research subsystem

subsystem of the ground application system which checks satellite detection data, coordinates in preparation of scientific plan, organizes special and integrated researches of detection data, and generates lunar science popularization products.

2.7 Manned lunar landing

2.7.1

sealed module

a spacecraft module which prevents gas leakage or reduces gas leakage to the value less than a certain limit.

2.7.2

service module

a spacecraft module which provides power, oxygen and life support for the astronauts.

2.7.3

pressurized module

a sealed module which is filled with a certain atmospheric pressure and components required by the living of the astronauts, and is also called manned module.

2.7.4

orbit module

pressurized module which provides conditions required by the living and working of the astronauts and does not return to the Earth.

2.7.5

propulsion module

a spacecraft module which is mainly used to load propulsion equipment.

2.7.6

lunar landing module

a module which carries the astronaut to descend from the lunar orbit to the lunar surface.

2.7.7

command module

a pressurized module which carries the astronauts to enter the lunar orbit from the Earth surface and return to the Earth from the lunar orbit. It is also called return module.

2.7.8

astronaut

persons who are qualified after training, and have the ability to execute the space flight missions.

2.7.9

space crew member

astronauts who participate in space flights. They are divided into commander and pilot astronaut.

2.7.10

commander

the commander-in-chief of crew members of manned spacecraft.

2.7.11

pilot astronaut

professional astronaut in the manned spacecraft for spacecraft manipulation and control, also called pilot.