



***NASA Scientific
and Technical
Information***

Scope and Subject Category Guide



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The NASA Scope and Subject Category Guide



National Aeronautics and Space Administration
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Introduction

*The NASA Scope and Subject Category Guide** is a ready-reference tool to assist authors, indexers, and information managers in the high-level classification of technical aerospace materials. In addition, the Guide can serve as an aid to searching in databases that use the NASA category scheme, for example, the NASA Aeronautics and Space Database and the commercially available Aerospace Database. Finally, for those information managers tasked with compiling collections of aerospace materials, this resource can be used as a guide in the selection of appropriate materials.

The guide comprises a 2-level subject classification scheme consisting of 10 broad subject divisions further divided into 76 specific subject categories. The scope of the scheme is comprehensive in that it covers, not only areas of aerospace technology and the natural space sciences, but also supporting areas of engineering, physics, chemistry, and the Earth and life sciences. A more specific treatment is given to those areas that are most pertinent to aerospace research.

The display for each subject category provides (1) the category name and corresponding number, (2) a description of the scope of the category including cross references, and (3) a general indication of the relevance of certain topics to NASA activities and aerospace research in general. In addition, each category display includes a listing of 'Input Subjects of Specific Interest.' In all there are over 2,200 input subjects which are presented as a browsable index to further support the identification of appropriate subject categories.

Comments on the content, organization, or features of this guide are invited. Contact the NASA Center for AeroSpace Information at help@sti.nasa.gov or call the NASA STI Help Desk at 301-621-0390.

* The guide is a revision of *The NASA Scientific and Technical Information System—Its Scope and Coverage* (NASA SP-7065), last published in 1988. This revised resource has been thoroughly updated and incorporates the research areas covered in the NASA Aeronautics and Space Database and the NASA Technology Plan (<http://technologyplan.nasa.gov/>) created by the NASA Office of the Chief Technologist.

TABLE OF CONTENTS

INTRODUCTION	i
AERONAUTICS	1
01 Aeronautics (General)	1
02 Aerodynamics.....	2
03 Air Transportation And Safety.....	4
04 Aircraft Communications And Navigation	6
05 Aircraft Design, Testing And Performance	8
06 Avionics And Aircraft Instrumentation.....	10
07 Aircraft Propulsion And Power.....	12
08 Aircraft Stability And Control.....	14
09 Research And Support Facilities (Air).....	16
ASTRONAUTICS	18
12 Astronautics (General)	18
13 Astrodynamics	19
14 Ground Support Systems and Facilities (Space).....	20
15 Launch Vehicles and Launch Operations.....	22
16 Space Transportation and Safety.....	23
17 Space Communications, Spacecraft Communications, Command and Tracking	24
18 Spacecraft Design, Testing and Performance	26
19 Spacecraft Instrumentation and Astrionics	29
20 Spacecraft Propulsion and Power	31
CHEMISTRY AND MATERIALS	33
23 Chemistry and Materials (General).....	33
24 Composite Materials	34
25 Inorganic, Organic, and Physical Chemistry.....	35
26 Metals and Metallic Materials.....	37
27 Nonmetallic Materials	39
28 Propellants and Fuels	41
29 Space Processing.....	43
ENGINEERING	44
31 Engineering (General).....	44
32 Communications and Radar	45
33 Electronics and Electrical Engineering	47
34 Fluid Mechanics and Thermodynamics.....	49
35 Instrumentation and Photography.....	51
36 Lasers and Masers	53
37 Mechanical Engineering.....	54
38 Quality Assurance and Reliability.....	56
39 Structural Mechanics.....	57
GEOSCIENCES	59
42 Geosciences (General)	59
43 Earth Resources and Remote Sensing.....	60
44 Energy Production and Conversion.....	62
45 Environment Pollution.....	63
46 Geophysics.....	64
47 Meteorology and Climatology.....	66
48 Oceanography.....	68

LIFE SCIENCES	69
51 Life Sciences (General)	69
52 Aerospace Medicine	71
53 Behavioral Sciences	73
54 Man/System Technology and Life Support.....	74
55 Exobiology	76
MATHEMATICAL AND COMPUTER SCIENCES	77
59 Mathematical and Computer Sciences (General)	77
60 Computer Operations and Hardware	78
61 Computer Programming and Software	80
62 Computer Systems.....	81
63 Cybernetics, Artificial Intelligence and Robotics.....	82
64 Numerical Analysis	84
65 Statistics and Probability	85
66 Systems Analysis and Operations Research.....	86
67 Theoretical Mathematics	87
PHYSICS	88
70 Physics (General)	88
71 Acoustics	89
72 Atomic and Molecular Physics.....	90
73 Nuclear Physics	91
74 Optics	92
75 Plasma Physics	93
76 Solid-State Physics.....	94
77 Physics of Elementary Particles and Fields.....	95
SOCIAL AND INFORMATION SCIENCES	96
80 Social and Information Sciences (General)	96
81 Administration and Management	97
82 Documentation and Information Science	98
83 Economics and Cost Analysis	99
84 Law, Political Science and Space Policy.....	100
85 Technology Utilization and Surface Transportation.....	101
SPACE SCIENCES	102
88 Space Sciences (General)	102
89 Astronomy	103
90 Astrophysics	104
91 Lunar and Planetary Science and Exploration.....	105
92 Solar Physics	106
93 Space Radiation.....	107
GENERAL	108
99 General	108
SUBJECT INDEX	109

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation and avionics; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air). For related information see also ASTRONAUTICS (*categories 12 through 20*).

01 Aeronautics (General)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics see *categories 02 through 09*. For information related to space vehicles see *12 Astronautics*.

Definition

Aeronautics – The science and art of designing, constructing, and operating aircraft. *AGARD Multilingual Aeronautical Dictionary*, 1980.

NASA Interest

Exhaustive Interest: Aircraft production and new technologies related to maintenance and repair of aircraft; general discussions of atmospheric flight and aircraft, both manned and unmanned.

Negative Interest: Military deployment and tactics for aircraft.

Input Subjects of Specific Interest

- Aeronautics
- Aircraft maintenance
- Aircraft manufacturing
- Aircraft production
- Aircraft repair
- Maintenance (aircraft)

02 Aerodynamics

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans, and other elements of turbomachinery. For related information see also *34 Fluid Mechanics and Thermodynamics*.

Definition

Aerodynamics – The science that deals with the motion of air and other gaseous fluids and with the forces acting on bodies when the bodies move through such fluids, or when such fluids move against or around the bodies. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All information dealing with the effects of relative motion on the flow of air or other gases and vapors, at any velocity, over aircraft, air cushion vehicles, land transportation vehicles, spacecraft, launch vehicles, missiles, and their components; over geometric shapes of models used in laboratory and wind tunnel tests, e.g., cones, plates, shells, spheres, and cylinders; flow over rotors and other turbomachine elements; forces acting on bodies in aerodynamic flow, including aerodynamic lift and drag.

Selective Interest: Aerodynamics of ground support equipment for aerospace research, results of aerodynamic testing for these effects, or the aerodynamics of surface structures.

Negative Interest: Aerodynamics of ships and bridges.

Input Subjects of Specific Interest

- Aerodynamic derivatives
- Aerodynamic flow fields
- Aerodynamic heating
- Aerodynamic noise (airframe generated)
- Aerodynamic studies of skin friction
- Aerodynamic wakes
- Aerodynamics of protuberances and substructures
- Aeroelasticity (theory)
- Aerothermodynamics
- Air cushion vehicle aerodynamics
- Air flow separation
- Air launched weapons (aerodynamics)
- Aircraft aerodynamics
- Airfoil aerodynamics
- Airship aerodynamics
- Autogyro aerodynamics
- Balloon aerodynamics
- Boundary layer aerodynamics
- Boundary layer control
- Boundary layer flow (aerodynamics)
- Buffeting
- Canard aerodynamics
- Cascade aerodynamics
- Compressible flow (aerodynamics)
- Control surface aerodynamics
- Coriolis forces (aerodynamics)
- Drag reduction (effects and techniques)

- Exit aerodynamics
- Flow visualization (aerodynamic applications)
- Glider aerodynamics
- Ground effect machine aerodynamics
- Helicopter aerodynamics
- High speed aerodynamics
- Hovercraft aerodynamics
- Hypersonic aerodynamics
- Inlet aerodynamics
- Internal flow in turbomachinery (theory)
- Laminar flow (aerodynamics)
- Land transportation vehicles (aerodynamics)
- Launch vehicle aerodynamics (for specific launch vehicles see *15 Launch Vehicles and Launch Operations*)
- Lifting body aerodynamics
- Lighter-than-air craft (balloons, airships) aerodynamics
- Low speed aerodynamics
- Missile aerodynamics
- Nozzle aerodynamics
- Parachute aerodynamics
- Propeller aerodynamics
- Reentry vehicle aerodynamics
- Rocket aerodynamics (for specific rockets see *15 Launch Vehicles and Launch Operations*)
- Rogallo wing aerodynamics
- Rotary wing aircraft aerodynamics
- Rotor aerodynamics
- Sailplane aerodynamics
- Sonic boom (aerodynamically generated)
- Spacecraft aerodynamics (for specific spacecraft see *18 Spacecraft Design, Testing and Performance*)
- Stabilization surfaces (aerodynamics)
- STOL aerodynamics
- Subsonic aerodynamics
- Supercritical airfoils
- Supercritical wings
- Supersonic aerodynamics
- Transitional flow (aerodynamics)
- Transonic aerodynamics
- Turbulent flow (aerodynamics)
- Ultralight aircraft (aerodynamics)
- Unsteady flow (aerodynamics)
- Vortices (aerodynamics)
- VSTOL aerodynamics
- VTOL aerodynamics
- Wakes (effects of turbulent flow behind aircraft)
- Wind tunnel tests (aerodynamics)
- Wing aerodynamics

03 Air Transportation and Safety

Includes passenger and cargo air transport operations; airport ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in *09 Research and Support Facilities (Air)*. Air traffic control is covered in *04 Aircraft Communications and Navigation*. For related information see also *16 Space Transportation and Safety* and *85 Technology Utilization and Surface Transportation*.

Definition

Air Transportation – The conveyance of cargo and passengers by means of airplanes, helicopters, and other airborne vehicles. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Aircraft Safety – Techniques used to prevent aircraft failures or accidents; the degree to which an aircraft is free of the risk of malfunction or accidents. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All information dealing with air transportation, flight safety, aircraft accidents, and aircraft operating problems.

Selective Interest: Land transportation information that deals with transportation and safety to, from, and at airports.

Input Subjects of Specific Interest

- Accidents and emergencies (aircraft)
- Air piracy (incident or safety aspects)
- Air safety
- Air transportation
- Aircraft accidents
- Aircraft aging (safety)
- Aircraft ditching
- Aircraft emergencies
- Aircraft in-flight collision
- Aircraft licensing
- Aircraft near miss
- Aircraft operating problems
- Aircraft safety
- Aircraft search and rescue operations
- Aircrew licensing
- Aircrew training
- Airport operations
- Airport security
- Airworthiness
- Baggage handling (aircraft)
- Bird collision (air transportation and safety)
- Bird ingestion (air transportation and safety)
- Cargo air transport operations
- Cargo handling (aircraft)
- Cargo transportation (aircraft)
- Clear air turbulence (aircraft safety)

- Collision avoidance (aircraft safety)
- Crashworthiness (aircraft)
- Ejection systems and seats (air transportation and safety)
- Emergency locator transmitters
- Escape systems (aircraft)
- Explosions (aircraft)
- Fail safety systems (aircraft)
- Fire (aircraft)
- Flight hazards (aircraft)
- Flight safety (aircraft)
- Flotation devices
- Foreign object damage (FOD)
- Foreign object ingestion (air transportation and safety)
- Icing (aircraft)
- Inspection (aircraft safety)
- Lightning discharge on aircraft
- Parachutes (personal and aircraft applications)
- Passenger air transport operations
- Passenger handling (air transportation)
- Passenger transportation (air)
- Public nuisance implications
- Restraint harness (aircraft)
- Safety systems (aircraft)
- Search and rescue operations (air)
- Seat belts (aircraft)
- Severe storms (aircraft safety)
- Shoulder harness (aircraft)
- Survival (aircraft operations)
- Taxiing (aircraft)

04 Aircraft Communications and Navigation

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *06 Avionics and Aircraft Instrumentation*, *17 Space Communications*, *Spacecraft Communications*, *Command and Tracking*, and *32 Communications and Radar*.

Definition

Aircraft Communication – The conveyance of information to or from aircraft by radio or other signals. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Air Navigation – The art, science, or action of plotting and directing the course of an aircraft through the air from one place to another. Adapted from the *United States Air Force Dictionary*. Woodford Agee Heflin, ed., Princeton, NJ: D. Van Nostrand Co., Inc.

NASA Interest

Exhaustive Interest: Information on development and utilization of communications and navigation systems for airlines, general aviation, and military aviation including air traffic control. Includes all techniques and equipment specifically intended for the transmittal of data to or from aircraft. For detailed equipment and designs see *33 Electronics and Electrical Engineering*.

Selective Interest: Communications and navigation techniques and theory of potential interest to aeronautical research and development.

Negative Interest: Commercial telephone operations; courier and messenger services; and ship navigation, unless related to aeronautics.

Input Subjects of Specific Interest

- Air navigation
- Air traffic control
- Air-sea navigation
- Aircraft command and control
- Aircraft communications
- Aircraft tracking
- All weather global position determination
- Approach control (aircraft)
- Celestial navigation (aircraft)
- Collision avoidance (aircraft control)
- Communications networks (aircraft)
- Communications system (aircraft)
- Consol/Consolan navigation system
- Decca navigation system
- Digital communications systems (aircraft)
- Doppler navigation systems
- Electromagnetic devices (radiators, sensors and other equipment) for navigation systems
- Global positioning systems (aircraft)
- Ground based and space based radar for air navigation
- Ground control approach (GCA) systems
- Guidance system design (aircraft)
- Inertial navigation systems (aircraft)

- Inertial sensors and measurement units (aircraft)
- Instrument landing systems (ILS)
- Instrument navigation systems
- Ionospheric effects on radio transmission (aircraft)
- Laser communications systems (aircraft)
- Laser tracking systems (aircraft)
- Long range navigation system (LORAN)
- Man-machine communications (aircraft)
- Microwave communications systems (aircraft)
- Microwave Landing System (MLS)
- Microwave receivers (aircraft)
- Microwave transmitters (aircraft)
- Navigation computer systems (aircraft)
- Navigation display devices (aircraft)
- Navigation system design (aircraft)
- Navigation systems (aircraft)
- Omega navigation system
- Omnidirectional radio range system (OMNI)
- Passive sensors, trackers, and references (aircraft)
- Radar communications systems (aircraft)
- Radar detection (aircraft navigation)
- Radar imagery (aircraft navigation)
- Radar tracking systems (aircraft)
- Radio communications system (aircraft)
- Range and angle measurement (aircraft)
- Sea navigation (aircraft related)
- Speech analysis (aircraft voice communication)
- Speech compression (aircraft voice communication)
- Systems for adverse weather avoidance
- Systems for collision avoidance
- Tactical air navigation system (TACAN)
- Telemetry (aircraft applications)
- Terrain avoidance systems
- Terrain following
- Tropospheric scatter (aircraft communications/ navigation disruption)
- Very high frequency omnirange (VOR) navigation
- Voice communications systems (aircraft)
- Wave propagation (aircraft communications effects)

05 Aircraft Design, Testing and Performance

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information see also *18 Spacecraft Design, Testing and Performance*; and *39 Structural Mechanics*. For land transportation vehicles see *85 Technology Utilization and Surface Transportation*.

Definition

Aircraft Design – The act of conceiving and planning the structure, systems, and performance characteristics of an aircraft vehicle or any other apparatus, machine or contrivance intended to be borne up either by dynamic action of the air upon the object’s surfaces, or by the object’s own buoyancy. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Aircraft Testing – Testing by means of actual or simulated flight of an aircraft to see how the aircraft or any equipment used on an aircraft performs or tests of an aircraft component to determine its suitability or reliability in flight. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Aircraft Performance – The manner or effectiveness with which an aircraft vehicle or any airborne structure, machine, or contrivance functions while in operation. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Design, development, testing, or evaluation of any complete aircraft, system, or component; performance characteristics or operating problems that affect or are affected by vehicle or component design.

Input Subjects of Specific Interest

- Aeroelasticity (property)
- Aircraft components
- Aircraft configurations
- Aircraft descriptions (types/names/designations)
- Aircraft design
- Aircraft development
- Aircraft evaluation
- Aircraft flight tests
- Aircraft performance
- Aircraft reliability
- Aircraft simulation
- Aircraft structural fatigue
- Aircraft structures
- Aircraft testing
- Airship performance
- Boattail configurations (aircraft)
- Body-tail combinations (aircraft design)
- Cabin pressurization (aircraft)
- Deicing systems (aircraft)
- Depressurization systems (aircraft)
- Ejection systems and seats (design)

- Expandable structures (aircraft)
- Fins (aircraft)
- Fuselages
- Gliders (sailplanes, hang gliders)
- Helicopter design
- Helicopter ground resonance
- Helicopter performance
- Helicopter rotor dynamics
- Highly Maneuverable Aircraft Technology (HiMAT)
- Hydraulic systems (aircraft)
- Inflatable structures (aircraft)
- In-flight simulation (aircraft)
- Landing gear (aircraft)
- Lifting bodies
- Lighter-than-air craft (balloons, airships) design
- Models (aircraft)
- Noise reduction (aircraft structures)
- Pneumatic systems (aircraft)
- Power lift technology
- Pressurization systems (aircraft)
- Pressurized cabins (aircraft)
- Remotely piloted vehicles (RPV)
- Tail surfaces
- TAV (transatmospheric vehicles) (aircraft)
- Tilt rotor aircraft
- Tires (aircraft)
- Transatmospheric vehicles (TAV) (aircraft)
- Transition Flight
- Wheels (aircraft)
- Wind tunnel tests (aircraft and components)
- Wing-body combinations (aircraft design)
- Wing-nacelle combinations (aircraft design)
- Wings

06 Avionics and Aircraft Instrumentation

Includes all avionics systems, cockpit and cabin display devices, and flight instruments intended for use in aircraft. For related information see also *04 Aircraft Communications and Navigation*; *08 Aircraft Stability and Control*; *19 Spacecraft Instrumentation and Astrionics*; and *35 Instrumentation and Photography*.

Definition

Aircraft Instrumentation – Any electronic or mechanically-based instrument or instrument system designed for detecting, measuring, displaying, recording, telemetering, processing, or analyzing different values or quantities encountered in the flight of an aircraft; often supporting the general control of the aircraft. Adapted from the *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Design, arrangement, installation, and use of aviation electronics and devices for detecting, measuring, displaying, recording, telemetering, processing, or analyzing values or quantities characterizing the flight environment, vehicle state, or other phenomena encountered in aircraft flight.

Selective Interest: Instruments or displays and off-the-shelf equipment from other transportation media that could be transferred to, or modified for, aircraft use.

Input Subjects of Specific Interest

- Airborne computers
- Airborne radar displays
- Aircraft control computer systems
- Aircraft instrumentation
- Aircraft systems monitoring instruments
- Airspeed indicators
- Alarm systems (aircraft)
- Altimeters (aircraft)
- Analyzing devices (aircraft)
- Anticollision devices
- Attitude indicators (aircraft)
- Avionics
- Blind flying instruments
- Cabin display devices (aircraft)
- Cathode ray tubes (aircraft systems)
- Cockpit display devices
- Compasses
- Control position indicators (aircraft)
- Detecting devices (aircraft)
- Display devices (aircraft)
- Engine fuel quantity gages
- Engine oil pressure gages
- Engine oil temperature gages
- Engine propulsion system instruments and gages
- Engine RPM indicators
- Fire control radar
- Fire warning systems
- Flight control computer systems
- Flight instruments (aircraft)
- Flight recorders (aircraft)
- Fluid flow sensors (aircraft)
- Gyroscopes (aircraft)
- Heads-up displays (aircraft)

- Horizon sensors (aircraft)
- Infrared sensors (aircraft)
- Instrument arrangement (aircraft)
- Instrument design (aircraft)
- Instrument displays (aircraft)
- Instrument installation (aircraft)
- Instrument landing systems (ILS) displays
- Landing gear position indicators (aircraft)
- Laser altimeters (aircraft)
- Laser instruments (aircraft)
- Mach meters
- Navigation instruments (design and development)
- Onboard computer systems for aircraft
- Pilot support systems (aircraft)
- Position indicators (aircraft)
- Power plant instruments and gages (aircraft)
- Propulsion system instruments and gages (aircraft)
- Rate of climb indicators
- Recording devices (aircraft)
- Sensors for aircraft equipment and operation
- Skin temperature indicators (aircraft)
- Stall indicators
- Target acquisition
- Target-signature modeling (aircraft)
- Telemetry devices (aircraft)
- Terrain clearance indicators
- Turn and bank indicators
- Warning systems (aircraft)

07 Aircraft Propulsion and Power

Includes primary propulsion systems and related systems and components, e.g., gas turbine engines, compressors, and fuel systems; and onboard auxiliary power plants for aircraft. For related information see also *20 Spacecraft Propulsion and Power*; *28 Propellants and Fuels*; and *44 Energy Production and Conversion*.

Definition

Aircraft Propulsion – The action or process of imparting motion to an aircraft by means of a force such as a thrust of air or energy released by burning fuel. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Aircraft Power Supplies – Electric power sources for the normal operation of aircraft. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All air-breathing engines and chemical, electric, hybrid, magnetohydrodynamic, or other types of energy conversion devices suitable for propulsion of aircraft or to provide a source of energy or power for the aircraft or its systems.

Selective Interest: Engines, rockets, and power conversion devices from other applications if readily convertible to aircraft use.

Negative Interest: Conventional, stationary power sources, and propulsion units for land and sea vehicles not modified for aircraft use.

Input Subjects of Specific Interest

- Aerodynamic noise (propulsion systems)
- Afterburner controls
- Afterburners (aircraft engines)
- Airbreathing engines (aircraft)
- Aircraft engine design
- Aircraft engine maintenance
- Aircraft engine performance
- Aircraft engine simulation
- Aircraft engine testing
- Aircraft engines
- Aircraft fuel systems
- Aircraft hydraulic systems (power)
- Aircraft pneumatic systems (power)
- Aircraft power systems
- Aircraft propellers
- Aircraft propulsion system components
- Aircraft propulsion systems
- Auxiliary power systems (aircraft)
- Auxiliary power units (APU) (aircraft)
- Bird ingestion (aircraft engines)
- Bypass jet engines
- Carburetors (aircraft engines)

- Centrifugal compressors (aircraft)
- Chemical propulsion engines (aircraft)
- Combustors (aircraft engines)
- Compression ignition engines (aircraft)
- Compressors (aircraft engines)
- Cooling systems (aircraft engines)
- Diesel engines (aircraft)
- Diffusers (aircraft engines)
- Ejectors (aircraft)
- Electric power systems (aircraft)
- Electric power units (aircraft)
- Electric propulsion systems (aircraft)
- Engine control systems (aircraft)
- Engine ingestion
- Engine noise (aircraft)
- Engine noise suppressors (aircraft)
- Exhaust systems (aircraft engines)
- Exit controls (aircraft engines)
- Fan jet engines
- Foreign object ingestion (aircraft engines)
- Fuel distribution pumps (aircraft)
- Fuel distribution systems (aircraft)
- Fuel injection systems (aircraft)
- Fuel system components (aircraft)
- Fuel systems (aircraft)
- Fuel tanks (aircraft)
- Gas turbine engines (aircraft)
- Gasoline engines (aircraft)
- Injection systems (aircraft engines)
- Inlet controls (aircraft engines)
- Inlets (aircraft)
- Internal combustion engines (aircraft)
- Jet engines
- Noise reduction (aircraft engines)
- Nozzles (aircraft)
- Nuclear engines (aircraft)
- Nuclear propulsion systems (aircraft)
- Piston engines (aircraft)
- Pneumatic systems (aircraft propulsion and power)
- Propellers (tractor, pusher, contrarotating, propfan)
- Propulsion system components (aircraft)
- Propulsion systems (aircraft)
- Pulsejet engines
- Pumps (aircraft engines and fuel systems)
- Quiet engines (aircraft)
- Ramjet engines (aircraft)
- Reciprocating engines (aircraft)
- Rocket engines (aircraft)
- Rotary engines (aircraft)
- Scramjet engines (aircraft)
- Spark ignition engines (aircraft)
- Stirling cycle engines (aircraft)
- Superchargers (aircraft engines)
- Throttle controls (aircraft)
- Thrust reverser controls
- Thrust reversers (aircraft engines)
- Turbine blade cooling
- Turbine blade vibration
- Turbines (aircraft engines)
- Turbofan engines
- Turboprop engines
- Turborocket engines (aircraft)
- Ultra bypass engines
- Wind tunnel tests (propulsion systems)

08 Aircraft Stability and Control

Includes flight dynamics, aircraft handling qualities, piloting, flight controls, and autopilots. For related information see also *05 Aircraft Design, Testing and Performance* and *06 Avionics and Aircraft Instrumentation*.

Definition

Aircraft Stability – The property of an aircraft to maintain its attitude or to resist displacement, and if displaced, to develop forces and moments tending to restore the original condition. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Aircraft Control – To direct the movements of an aircraft with particular reference to changes in attitude and speed. Adapted from the *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Research, development, testing, evaluation, or performance topics related to the stability and control of any complete aircraft, or the interaction between the vehicle's components and the control of the aircraft in flight.

Selective Interest: Piloting as it affects the stability, control, and maneuverability of an aircraft.

Input Subjects of Specific Interest

- Air launched weapons (stability)
- Aircraft control
- Aircraft stability
- Aircraft trim
- Attitude control (aircraft)
- Autopilots (aircraft)
- Body-tail combinations (stability and control)
- Control effectiveness (aircraft)
- Control surface interactions (aircraft)
- Dutch roll
- Dynamic stability (aircraft)
- Flight control (aircraft)
- Flight dynamics (aircraft)
- Flight management systems
- Flight path control (aircraft)
- Flutter (aircraft)
- Fly-by-light control (FBL)
- Fly-by-wire control (FBW)
- Flying qualities (aircraft)
- Handling qualities (aircraft)
- Lateral control (aircraft)
- Lateral stability (aircraft)
- Longitudinal control (aircraft)
- Longitudinal stability (aircraft)
- Maneuvering (aircraft)
- Missiles (performance)
- Operational effects of atmospheric variables (weather, buffeting, turbulence, wind shear)
- Pitch control (aircraft)

- Pitch stability (aircraft)
- Roll control (aircraft)
- Roll stability (aircraft)
- Spin recovery
- Stability (aircraft)
- Stability augmentation (aircraft)
- Stability derivatives (aircraft)
- Stabilization surfaces (aircraft)
- Static stability (aircraft)
- Vibration (aircraft)
- Voice command for aircraft
- Wind tunnel tests (stability and control)
- Wing rock
- Wing-body combinations (stability and control)
- Wing-nacelle combinations (stability and control)
- Yaw control (aircraft)
- Yaw stability (aircraft)

09 Research and Support Facilities (Air)

Includes airports, runways, hangers, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see *03 Air Transportation and Safety*. For astronomical facilities see *14 Ground Support Systems and Facilities (Space)*.

Definition

Facility – 1. A physical plant such as real estate and improvements thereto (including buildings and equipment) which provides the means of assisting or making easier the performance of a function. 2. Any part or adjunct of a physical plant, or any item of equipment that is an operating entity and which contributes or can contribute to the execution of a function by providing some specific kind of operating action or operation. *A Compendium of Authenticated Logistics Terms and Definitions*. Fred Gluck, ed., Department of the Air Force, 1970.

NASA Interest

Exhaustive Interest: All facilities and equipment associated with airports and airways; tracking and communications installations; and test facilities and simulators of direct interest to aeronautical activities, including wind tunnels, shock tubes, and test stands.

Selective Interest: Research, development, and test laboratories having potential interest to aeronautics activities; specialized equipment to generate unusual or extreme conditions of temperature, pressure, stress and strain, etc.

Negative Interest: Administrative and housekeeping functions at supporting facilities, commonly available off-the-shelf instrumentation and equipment systems, and commercial equipment not developed specifically for aeronautical use.

Input Subjects of Specific Interest

- Aircraft ground handling equipment
- Aircraft servicing equipment
- Airport access
- Airport lighting
- Airport planning
- Airport security
- Airports and airways
- Altitude test facilities
- Checkout facilities (aircraft)
- Checkout systems (aircraft)
- Clean rooms (aircraft manufacturing and test facilities)
- Control towers
- Crash test facilities
- Development facilities (aircraft)
- Engine test stands (aircraft)
- Flight simulators (aircrew training and aircraft development)
- Ground support equipment (aircraft)
- Ground support facilities (aircraft)
- Ground support systems (aircraft)

- Ground support vehicles (aircraft)
- Hangar facilities
- High temperature test facilities (aircraft)
- Low temperature test facilities (aircraft)
- Maintenance facilities (aircraft)
- Overhaul facilities (aircraft)
- Pressure test facilities (aircraft)
- Repair facilities (aircraft)
- Research facilities (aircraft)
- Runway approach lighting and markers
- Runway construction
- Runway lighting
- Runway surfaces and grooving
- Runways
- Shock tubes and tunnels
- Simulators (aircraft)
- Structures test facilities (aircraft)
- Support facilities (aircraft)
- Temperature test facilities (aircraft)
- Test facilities (aircraft)
- Tracking and communications installations (aircraft)
- Wind tunnel test facilities (aircraft)

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and launch operations; space transportation and safety; spacecraft communications, command, and tracking; spacecraft design, testing and performance; spacecraft instrumentation and astronics; and spacecraft propulsion and power. For related information see also AERONAUTICS (*categories 01 through 09*).

12 Astronautics (General)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see (*categories 13 through 20*). For extraterrestrial exploration see *91 Lunar and Planetary Science and Exploration*.

Definition

Astronautics – The science of space flight including the design, construction, and operation of spacecraft. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Spacecraft production, manufacturing, and maintenance; space based manufacturing and maintenance; space colonization.

Negative Interest: Military or defense applications of launch vehicles and spacecraft.

Input Subjects of Specific Interest

- Astronautics
- In-orbit maintenance, servicing and refueling
- Launch vehicle maintenance
- Launch vehicle manufacturing
- Launch vehicle production
- Maintenance (spacecraft)
- Mission planning (space)
- Space based maintenance and servicing
- Space colonies
- Space colonization
- Space exploration (mission planning)
- Space manufacturing and assembly
- Space programs
- Space vehicle maintenance
- Space vehicle manufacturing
- Space vehicle production
- Spacecraft maintenance
- Spacecraft manufacturing
- Spacecraft production

13 Astrodynamics

Includes powered and free flight trajectories; orbital and launching dynamics.

Definition

Astrodynamics – The practical application of celestial mechanics, astrobballistics, propulsion theory, and allied fields to the problem of planning and directing the trajectories of space vehicles. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Theoretical analysis and actual orbit and trajectories of launch vehicles and spacecraft.

Input Subjects of Specific Interest

- Aerobraking
- Astrobballistics
- Astrodynamics
- Atmospheric entry effects
- Ballistic trajectories
- Free-flight trajectories
- Gravitational effects (orbital effects on launch vehicles and spacecraft)
- Interplanetary trajectories
- Launch vehicle trajectories
- Launching dynamics
- Orbit dynamics of spacecraft
- Orbital maneuvers (trajectories)
- Orbital rendezvous
- Powered trajectories
- Projectile trajectories
- Propulsion effects on launching, trajectories, and orbits
- Reentry dynamics
- Reentry trajectories
- Space flight dynamics (theory)
- Spacecraft orbits
- Spacecraft trajectories
- Swingby maneuver
- Trajectory analysis
- Trajectory optimization
- Two-and three-body problems (trajectory analysis)

14 Ground Support Systems and Facilities (Space)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and test chambers and simulators. Also includes extraterrestrial bases and supporting equipment. For related information see also *09 Research and Support Facilities (Air)*.

Definition

Ground Support Systems and Facilities (Space) – That ground-based equipment, land, and buildings, including all implements, tools, and devices (mobile or fixed), required to inspect, test, adjust, calibrate, appraise, gage, measure, repair, overhaul, assemble, disassemble, transport, safeguard, record, store, or otherwise function in support of a rocket, space vehicle, or the like, either in the research and development, or in an operational phase, or in support of the guidance system used with the missile vehicle, or the like. Modified from the term Ground-Support Equipment. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: All information dealing with spaceports; launch towers; spacecraft and launch vehicle simulators; test facilities for spacecraft, launch vehicles and propulsion systems, and transporters; shuttlecraft landing facilities; ground-support equipment.

Selective Interest: Hangars, maintenance facilities, airports, airways, launch complexes, land transportation information that deals with transportation and safety to, from, and on launch complexes, and aerial navigation and tracking facilities when used in support of astronomical activities.

Negative Interest: Military mobile transporters and missile storage silos.

Input Subjects of Specific Interest

- Accelerators (aerospace)
- Assembly buildings
- Astronaut training facilities
- Automatic picture transmission (APT) ground stations
- Block houses
- Checkout facilities (space)
- Checkout systems (space)
- Clean rooms (space)
- Deep space instrumentation facilities
- Development facilities (space)
- Electromagnetic launchers (facilities)
- Engine test blocks (space)
- Engine test stands (space)
- Extraterrestrial bases
- Flight simulators (space)
- Gravity simulators
- Ground support equipment (space)
- Ground support facilities (space)
- Ground support systems (space)
- Ground support vehicles (space)
- High temperature test facilities (space)
- Laser range finder facilities

- Laser space communications facilities
- Launch complexes
- Launch facilities
- Launch pads and bases
- Launch towers
- Launch vehicle simulators
- Light gas guns (launch facilities)
- Low temperature test facilities (space)
- Lunar and planetary bases
- Lunar gravity simulators
- Lunar roving vehicles
- Maintenance facilities (space based, ground based)
- Mobile lunar laboratories
- Mobile planetary laboratories
- Mobile transporters
- Optical tracking stations
- Overhaul facilities (space)
- Payload operations and support
- Planetary roving vehicles
- Pressure test facilities (space)
- Rail accelerators, railguns, launchers (applications)
- Range safety
- Recovery equipment and vehicles
- Remote launch monitoring facilities
- Repair facilities (space based, ground based)
- Research facilities (space)
- Rocket engine test pads
- Rocket sleds
- Rocket test facilities
- Rover vehicles
- Shuttlecraft landing facilities
- Simulators (space)
- Solar heating simulators
- Solar simulators
- Space facility for cryogenic materials
- Space research facilities
- Space simulators
- Space vacuum simulators
- Spacecraft maintenance facilities
- Spacecraft production facilities
- Spacecraft simulators
- Spaceport planning
- Spaceports
- Special vehicles (land, sea, air) (used as bases and for transportation or rescue of astronautics or astronautic-oriented equipment)
- Storage facilities for propellants and cryogenics
- Structures test facilities (space)
- Support facilities
- Surface exploration vehicles
- Temperature test facilities (space)
- Test facilities (space)
- Test range facilities
- Test ranges
- Umbilical towers
- Vacuum test facilities
- Wind tunnel test facilities (launch and space vehicles)
- Wind tunnel tests (launch and space vehicles)

15 Launch Vehicles and Launch Operations

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing, and Performance*; and *20 Spacecraft Propulsion and Power*.

Definition

Launch Vehicles – Rockets or other vehicles used to transport satellites, space probes, or other payloads from the Earth (or other terrestrial surface) to space. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Design, research, development, testing, evaluation, and performance of any launch vehicle, combination of launch vehicle and space vehicle, launch system components, and all operating procedures and problems related to launch vehicles.

Negative Interest: Design, performance, and effects of military weapons and warheads delivered by launch vehicle; pyrotechnic rockets used for displays and festivals.

Input Subjects of Specific Interest

- Boosters (launch vehicles)
- Combinations of launch vehicles and space vehicles
- Commercial launch vehicles
- Countdown
- Design of launch vehicles, tanks, components, systems
- Electromagnetic launchers (operations)
- Launch operations
- Launch vehicle auxiliary systems
- Launch vehicle configurations
- Launch vehicle design
- Launch vehicle dynamics
- Launch vehicle performance
- Launch vehicle preparation
- Launch vehicle stability
- Launch vehicle testing
- Launch vehicles
- Light gas guns (launch operations)
- Multistage launch vehicles
- Nose cones
- Orbit-on-demand vehicles
- Reentry launch vehicles
- Reusable launch vehicles
- Rocket launchers
- Rockets
- Satellite launching dynamics
- Separation and staging techniques (for stages of launch vehicles)
- Single-stage launch vehicles
- Sounding rockets

16 Space Transportation and Safety

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety*; *15 Launch Vehicles and Launch Operations*; and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

Definition

Space Transportation – The conveyance of payloads or personnel to, through, or from outer space. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All information dealing with crew and payload space transportation; flight safety; rescue operations and techniques. Systems specific to ground operations, maintenance and support, and launch complex construction are covered in *14 Ground Support Systems and Facilities (Space)*.

Input Subjects of Specific Interest

- Accidents and emergencies (spacecraft)
- Cargo handling (spacecraft)
- Cargo transportation (spacecraft)
- Escape systems (spacecraft)
- Explosions (spacecraft)
- Extravehicular activity (EVA) (operations)
- Fire (spacecraft)
- Flight safety (spacecraft)
- Orbiting maneuvering vehicles
- Parachutes (spacecraft applications)
- Passenger handling (space transportation)
- Passenger transportation (space)
- Payload Assist Module (PAM)
- Payload delivery (space transportation)
- Payload handling (space transportation)
- Payload retrieval (space transportation)
- Recovery of spacecraft
- Restraint harness (spacecraft)
- Safety systems (spacecraft)
- Search and rescue operations (space)
- Shoulder harness (spacecraft)
- Space debris (spaceflight hazard)
- Space flight commercialization
- Space flight hazards
- Space operation emergencies
- Space rescue
- Space shuttle operations
- Space transportation
- Spacecraft ditching
- Spacecraft retrieval
- Survival (space operations)

17 Space Communications, Spacecraft Communications, Command and Tracking

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information see also *04 Aircraft Communications and Navigation*; and *32 Communications and Radar*.

Definition

Space Communications – The act of, or methods for, conveying information to, from, or through outer space. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Spacecraft Communications – The act of, or methods for, conveying information to or from manned or unmanned spacecraft. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Spacecraft Command – All operations associated with the uplinking of instructions to a spacecraft in order to maintain or adjust the operational status of the spacecraft and its subsystems. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Spacecraft Tracking – The process of following the movements of a spacecraft or space platform by radar, optical, or other means. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All techniques, research, development, and application of methods, systems, and equipment intended for the transmittal of data to, or from, launch vehicles, space vehicles, communications and scientific satellites, and lunar and planetary bases; ground and space based tracking and data acquisition stations and systems; launch vehicle and space vehicle navigation and guidance.

Selective Interest: Communication and navigation techniques and theory of potential interest to space flight.

Negative Interest: Telephone, teletype, radio, radar, and microwave equipment and technology not having aerospace communication, command, or tracking applications.

Input Subjects of Specific Interest

- Astronavigation
- Automatic picture transmission (APT)
- Celestial navigation (spacecraft)
- Collision avoidance (spacecraft)
- Command and control of spacecraft
- Communications blackouts (reentry)
- Communications networks (space)
- Communications systems (space)

- Deep Space Network
- Digital communications systems (spacecraft)
- Global positioning systems (spacecraft)
- Ground based data acquisition stations
- Ground based data acquisition systems
- Ground based tracking stations
- Ground based tracking systems
- Guidance system design (spacecraft)
- Inertial navigation systems (spacecraft)
- Inertial sensors and measurement units (spacecraft)
- Laser communications systems (spacecraft)
- Laser tracking systems (spacecraft)
- Launch vehicle navigation
- Man-machine communications (spacecraft)
- Manned space flight network
- Microwave communications systems (spacecraft)
- Microwave receivers (spacecraft)
- Microwave transmitters (spacecraft)
- Navigation computer systems (spacecraft)
- Navigation display devices (spacecraft)
- Navigation system design (spacecraft)
- Navigation systems (spacecraft)
- Optical communications (space)
- Orbital maneuvers (control)
- Radar communications systems (spacecraft)
- Radar detection (spacecraft navigation)
- Radar imagery (spacecraft navigation)
- Radar tracking systems (spacecraft)
- Radio blackout (loss of communications)
- Radio communications systems (spacecraft)
- Range and angle measurement (spacecraft)
- Rendezvous guidance
- Search and rescue operations (communications)
- Shuttle Imaging Radar (theory and techniques)
- Space based data acquisition stations
- Space based data acquisition systems
- Space communications
- Space communications networks
- Space flight communication techniques and theory
- Space flight navigation techniques and theory
- Space navigation
- Space tracking and data acquisition network (STADAN)
- Spacecraft command
- Spacecraft communications
- Spacecraft control (communications)
- Spacecraft navigation
- Spacecraft tracking
- Speech analysis (spacecraft voice communications)
- Speech compression (spacecraft voice communications)
- Station keeping
- Target-signature modeling (spacecraft)
- Telemetry (spacecraft applications)
- Tracking and communications installations (spacecraft)
- Tracking networks
- Tracking stations
- Voice communications systems (spacecraft)
- Wave propagation (spacecraft communications effects)

18 Spacecraft Design, Testing and Performance

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance*; *39 Structural Mechanics*; and *16 Space Transportation and Safety*.

Definition

Spacecraft Design – The act of conceiving and planning the structure, systems, and performance characteristics of any type of spacecraft including space probes, satellites, space platforms and space stations. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Spacecraft Testing – Tests, by whatever means, of a spacecraft or any equipment, system, or component used in, or on, a spacecraft to determine its suitability for, and reliability in, space flight. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Spacecraft Performance – The manner or effectiveness in which any space vehicle, space platform, or space station functions while in operation in space, or in a simulated space environment. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Research, development, testing, evaluation, or performance of any complete spacecraft, system, or component; operating problems that affect or are affected by design, development, testing, evaluation, or performance.

Input Subjects of Specific Interest

- Active communication satellites
- Active satellite stabilization
- Artificial satellites
- Astronomical observatory satellites
- Attitude control (spacecraft)
- Autopilots (spacecraft)
- Cabin pressurization (spacecraft)
- Capture devices (spacecraft)
- Communication satellites
- Control effectiveness (spacecraft)
- Control systems design (spacecraft)
- Depressurization systems (spacecraft)
- Docking (spacecraft)
- Dynamic stability (spacecraft)
- Expandable structures (spacecraft)
- Fins (spacecraft)
- Flight control (spacecraft)
- Flight dynamics (spacecraft)
- Flight path control (spacecraft)
- Flutter (spacecraft)
- Flying qualities (spacecraft)
- Free flyers (spacecraft)

- Geophysical satellites
- Handling qualities (spacecraft)
- Hydraulic systems (spacecraft)
- Inflatable structures (spacecraft)
- Inlets (spacecraft)
- International Space Station (design)
- Landing gear (spacecraft)
- LANDSAT (configurations)
- Lateral control (spacecraft)
- Lateral stability (spacecraft)
- Longitudinal control (spacecraft)
- Longitudinal stability (spacecraft)
- Lunar landers
- Lunar orbiters
- Maneuvering (spacecraft)
- Manned orbital laboratories
- Manned spacecraft
- Meteorite protection
- Meteorological satellites
- Models (spacecraft)
- Navigation satellites
- Observation satellites
- Passive communication satellites
- Passive satellite stabilization
- Piloting (spacecraft)
- Pitch control (spacecraft)
- Pitch stability (spacecraft)
- Planetary landers
- Planetary orbiters
- Planetary probes
- Plasma wakes (spacecraft)
- Pneumatic systems (spacecraft)
- Pressurization systems (spacecraft)
- Pressurized cabins (spacecraft)
- Radiation effects on spacecraft and components
- Roll control (spacecraft)
- Roll stability (spacecraft)
- Satellite stabilization
- Satellites for air, land, or sea navigation
- Satellites for air, land, or sea traffic control
- Scientific satellites
- Search and rescue satellites
- SEASAT (configurations)
- Separation and staging techniques (spacecraft)
- Space flight dynamics (performance and testing)
- Space laboratories
- Space platforms
- Space probes
- Space station control
- Space station design
- Space stations
- Spacecraft antennas
- Spacecraft cabins
- Spacecraft charging
- Spacecraft components
- Spacecraft control (design and performance)
- Spacecraft design
- Spacecraft environmental control
- Spacecraft external contamination
- Spacecraft flight simulation
- Spacecraft flight tests
- Spacecraft performance
- Spacecraft simulation
- Spacecraft structures
- Spacecraft systems
- Spacecraft testing
- Spacecraft thermal control
- Spacelab (design and testing)
- Stability (spacecraft)
- Stability augmentation (spacecraft)
- Stability derivatives (spacecraft)
- Stabilization surfaces (spacecraft)
- Static stability (spacecraft)
- Synchronous satellites
- Tethered satellite systems
- Tracking and data relay satellites
- Unfoldable structures (spacecraft)
- Vibration (spacecraft) (see *39 Structural Mechanics* for effects on structural elements and fatigue)
- Viking space probe
- Weather satellites
- Wind tunnel tests (spacecraft)

- Yaw control (spacecraft)
- Yaw stability (spacecraft)

19 Spacecraft Instrumentation and Astrionics

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information see also *06 Avionics and Aircraft Instrumentation*; for spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; for spaceborne telescopes and other astronomical instruments see *89 Astronomy*.

Definition

Astrionics – Astronautical electronics, particularly the development and use of electronic equipment and systems for space vehicles and platforms.

Spacecraft Instrumentation – The design, development, installation, and use of electronic, optical, gyroscopic, and other instruments that play a role in the control of the spacecraft, or that function to measure, record, display, or process different values or quantities encountered in the flight of a spacecraft. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Design, arrangement, installation, and use of devices for detecting, measuring, recording, telemetering, processing, or analyzing values or quantities characterizing an environment, spaceflight, launch vehicle, spacecraft, or other experimental phenomena encountered in launch vehicle and spacecraft flight.

Selective Interest: Instruments or displays and off-the-shelf equipment from other transportation media that could be transferred or modified for spacecraft or launch vehicle use.

Input Subjects of Specific Interest

- Ablation sensors (spacecraft)
- Alarm systems (spacecraft)
- Altimeters (spacecraft)
- Analyzing devices (spacecraft)
- Astrionics
- Attitude indicators (spacecraft)
- Bioelectronic instruments (spacecraft)
- Biomedical instruments (spacecraft)
- Cabin display devices (spacecraft)
- Cathode ray tubes (spacecraft systems)
- Control position indicators (spacecraft)
- Detecting devices (spacecraft)
- Display devices (spacecraft)
- Flight instruments (spacecraft)
- Flight recorders (spacecraft)
- Fluid flow sensors (spacecraft)
- Gyroscopes (spacecraft)
- Heads-up displays (spacecraft)
- Horizon sensors (spacecraft)
- Infrared sensors (spacecraft)
- Instrument arrangement (spacecraft)
- Instrument design (spacecraft)
- Instrument displays (spacecraft)
- Instrument installation (spacecraft)
- Instrument pointing systems (IPS)
- Landing gear position indicators (spacecraft)

- Laser altimeters (spacecraft)
- Laser instruments (spacecraft)
- Micrometeoroid sensors (spacecraft)
- Navigation display devices (design and development)
- Onboard computer systems for spacecraft
- Onboard instrument systems for spacecraft
- Onboard sensors and recorders for spacecraft
- Passive sensors, trackers, and references (spacecraft)
- Pointing systems
- Position indicators (spacecraft)
- Propulsion system instruments and gages (spacecraft)
- Recording devices (spacecraft)
- Sensors for spacecraft equipment
- Skin temperature indicators (spacecraft)
- Space cabin atmosphere sensors
- Spacecraft control computer systems
- Spacecraft instruments
- Spacecraft systems monitoring instruments
- Star trackers (navigation)
- Telemetry devices (spacecraft)
- Thermal protection sensors
- Two-gas sensors (spacecraft)
- Warning lights (spacecraft)

20 Spacecraft Propulsion and Power

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power*, *28 Propellants and Fuels*, *15 Launch Vehicles and Launch Operations*, and *44 Energy Production and Conversion*.

Definition

Spacecraft Propulsion – The action or process of imparting motion to a spacecraft by means of a force such as a thrust of air or energy released by burning fuel. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Spacecraft Power Supplies – Sources of electrical energy, including batteries, generators, and energy conversion devices, that support the normal operation of spacecraft. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All chemical, electric, magnetohydrodynamic, hybrid, or other types of energy conversion suitable for propulsion or stationkeeping of spacecraft, satellites, space probes, planetary probes, space stations, and lunar probes; and for use as auxiliary power sources for spacecraft; including liquid rocket engines, solid rocket engines, ion engines, plasma rocket engines, electric rocket engines, etc., including their components.

Negative Interest: Propulsion and mobile or stationary power sources for earthbound use or transportation, e.g., ship, locomotive, automobile, aircraft, and truck propulsion; mobile or stationary electric power plants, unless directly applicable to spacecraft use.

Input Subjects of Specific Interest

- Attitude thrusters
- Auxiliary power systems (spacecraft)
- Auxiliary power units (APU) (spacecraft)
- Boosters (spacecraft)
- Chemical power sources (spacecraft)
- Chemical propulsion engines (spacecraft)
- Clustered rockets
- Combustion chambers (spacecraft)
- Combustors (spacecraft)
- Ejectors (spacecraft)
- Electric power systems (spacecraft)
- Electric power units (spacecraft)
- Electric propulsion systems (spacecraft)
- Electric rocket engines
- Electrostatic rocket engines
- Electrothermal rocket engines
- Fuel distribution pumps (spacecraft)
- Fuel distribution systems (spacecraft)
- Fuel injection systems (spacecraft)
- Fuel system components (spacecraft)
- Fuel systems (spacecraft)
- Fuel tanks (spacecraft)
- Hybrid propellant rocket engines
- Igniters (rocket engines)

- Ion propulsion
- Ion rocket engines
- Liquid propellant rocket engines
- Low thrust engines
- Magnetohydrodynamic (MHD) power sources
- Magnetohydrodynamic (MHD) thrusters
- Main propulsion system components (spacecraft)
- Main propulsion systems (spacecraft)
- Multistage rockets
- Nozzles (spacecraft)
- Nuclear engines (spacecraft application)
- Nuclear power sources (spacecraft application)
- Nuclear propulsion systems (spacecraft application)
- Nuclear rocket engines
- Onboard solar arrays
- Onboard solar generators
- Plasma propulsion (spacecraft applications)
- Pneumatic systems (spacecraft propulsion and power)
- Propellant flow systems (spacecraft)
- Propellant injectors, pumps, and tanks (spacecraft)
- Propulsion system components (spacecraft)
- Propulsion systems (spacecraft)
- Pumps (spacecraft)
- Refueling in orbit
- Retrorockets
- Rocket engine design
- Rocket engine exhaust plumes
- Rocket engine noise
- Rocket engines (spacecraft)
- Rocket throttling systems
- Solar sails
- Solid propellant rocket engines
- Space power reactors (application)
- Spacecraft auxiliary power sources
- Spacecraft engine design
- Spacecraft hydraulic systems (power)
- Spacecraft pneumatic systems (power)
- Spacecraft power systems
- Spacecraft propulsion
- Spacecraft vehicle booster engines
- Systems for energy conversion (spacecraft)
- Thrust vector control devices (spacecraft)
- Turborocket engines (spacecraft)
- Vector control engines (spacecraft)
- Vernier engines (spacecraft)

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic, organic and physical chemistry; metals and metallic materials; nonmetallic materials; propellants and fuels; and space processing.

23 Chemistry and Materials (General)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see *categories 24 through 29*. For astrochemistry see *category 90 Astrophysics*.

Definition

Chemistry – The science that studies the composition, structure, properties, interactions, and transformations of elemental matter and compounds. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Materials – In general, the substances of which aircraft, launch vehicles, and space vehicles are composed; specifically, the metals, alloys, ceramics, and plastics used in structural, protective, and electronic functions. Adapted from the *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Properties, composition, structure, synthesis, and manufacture of compounds and materials used for aircraft, launch and space vehicles, launch site equipment, space structures, and other aerospace applications.

Selective Interest: Studies of chemistry or materials having no aerospace applications.

Input Subjects of Specific Interest

- Chemical analysis techniques
- Chemical manufacturing
- Chemical processing (general)
- Chemistry (general)
- Materials (general)
- Separations chemistry
- Spectroscopic analysis (chemistry)

24 Composite Materials

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

Definition

Composite Materials – Structural materials of metals, ceramics, or plastics with built-in strengthening agents which may be in the form of filaments, foils, powders, or flakes of a different compatible material. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Physical and mechanical properties, production, handling, testing, and evaluation of composite materials for use in aircraft, rockets, launch vehicles, space vehicles, reentry vehicles, aircraft and spacecraft propulsion systems, and supporting facilities.

Selective Interest: Research and development on composite materials having potential aerospace applications.

Negative Interest: Routine developments of structural composite materials for use in housing, heavy industry, and earthbound transportation, unless a potential exists for aerospace use.

Input Subjects of Specific Interest

- Ablative materials (composite)
- Boron fiber materials
- Carbon fiber materials
- Ceramic matrix composites
- Composite materials
- Epoxy matrix composites
- Fatigue (composite materials)
- Fiber composites
- Fiber-matrix interfaces
- Filament materials
- Filament wound structures (composite materials)
- Filament-matrix materials
- Flammability (composite materials)
- Glass fiber reinforced plastics
- Honeycomb materials
- Insulation (composite materials)
- Laminates
- Mechanical properties (composite materials)
- Metal filament systems
- Metal matrix composites (MMC)
- Offgassing/outgassing (composite materials)
- Polymer matrix composites
- Reinforcing fibers (composite materials)
- Shear strength (composite materials)
- Stacking sequence (composite materials)
- Surface properties (composite materials)
- Tensile strength (composite materials)
- Testing of materials (composite materials)
- Whisker composites
- Whiskers (composite materials)
- Woven composites

25 Inorganic, Organic, and Physical Chemistry

Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see *category 34 Fluid Dynamics and Thermodynamics*. For astrochemistry see *category 90 Astrophysics*.

Definition

Inorganic Chemistry – The study of the composition, properties, structure, and reactions of the chemical elements and all their compounds with the exception of hydrocarbons and their derivatives. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Organic Chemistry – The study of the composition, properties, structure, and reactions of carbon-based compounds, specifically hydrocarbons and their derivatives and normally excluding carbon oxides, metallic carbonates, carbides, and carbon-sulfur and carbon-nitrogen compounds. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Physical Chemistry – The application of the laws, principles, and techniques of physics to the study of chemical properties, transformations, and reactions. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space administration.

NASA Interest

Exhaustive Interest: Chemistry of elements and compounds characteristic of NASA's aerospace, planetary, and astronomical interests; combustion theory and processes of direct relevance to aircraft, launch vehicle, and spacecraft materials and propulsion; and low pressure and vacuum reactions.

Negative Interest: Chemical research of elements, processes, and compounds that do not have possible aerospace applications.

Input Subjects of Specific Interest

- Alkali metal vapors
- Analytical chemistry
- Catalysts (chemical)
- Chemical analysis
- Chemical engineering
- Chemiluminescence
- Chemistry of compounds
- Chemistry of elements
- Chromatography (application)
- Combustion chemistry
- Combustion kinetics
- Combustion physics
- Combustion processes
- Combustion theory
- Computational chemistry
- Detonation processes
- Electrochemical processes
- Electrochemistry
- Electrophoresis
- Ferromagnetic resonance

- Flame studies
- Flammability
- Gas absorption
- Gaseous reactions
- Gas-solid reactions
- Gas-surface interactions
- Gas-surface reactions
- Ignition studies (general)
- Infrared gas analysis
- Inorganic chemistry
- Low pressure chemistry
- Luminescence (chemistry)
- Mass spectroscopy (application)
- Organic chemistry
- Organometallic materials
- Osmosis (chemistry)
- Photochemistry
- Physical chemistry
- Polarography (application)
- Pyrolysis
- Quantum chemistry
- Radiation chemistry
- Spectrophotometry (application)
- Spectroscopic chemical analysis (application)
- Thermochemistry
- Vacuum chemistry

26 Metals and Metallic Materials

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

Definition

Metallic Materials – Materials that are like metal; having the properties of metal; containing or consisting of metal.

NASA Interest

Exhaustive Interest: Physical, chemical, and mechanical properties; testing, evaluation, and protection of metals, alloys, and related compositions for use in aircraft, rockets, launch vehicles, space vehicles, reentry vehicles, aircraft and spacecraft propulsion systems, and supporting facilities (other than conventional building structural materials).

Selective Interest: Research and development on metallic materials that have potential aerospace applications.

Negative Interest: Routine developments of structural metallic materials for use in housing, heavy industry, and earthbound transportation, unless a potential exists for aerospace use.

Input Subjects of Specific Interest

- Alloys
- Cermets
- Chemical properties of alloys
- Chemical properties of metals
- Coatings (metallic)
- Compression strength (metallic materials)
- Corrosion
- Creep strength (metallic materials)
- Crystal structure (metallic materials)
- Crystals (metallic)
- Development of alloys
- Eutectics
- Eutectoids
- Evaluation of alloys
- Evaluation of metals
- Fatigue (metallic materials)
- Ferrites
- Fibers (metallic materials)
- Flammability (metallic materials)
- Heat treatment of metals
- Hydrogen embrittlement
- Intermetallics
- Mechanical properties of alloys
- Mechanical properties of metals
- Metal crystals
- Metallic fibers
- Metallic materials
- Metallography
- Metallurgy
- Metals
- Microstructure of welded joints
- Offgassing/outgassing (metallic materials)
- Packing (metallic materials)
- Phase equilibrium
- Physical properties of alloys
- Physical properties of metals
- Powder metallurgy
- Protection of alloys

- Protection of materials (metallic)
- Protective coatings (metallic materials)
- Refractory materials
- Reinforcing filaments (metallic materials)
- Research on metallic materials
- Sealants (metallic materials)
- Shear strength (metallic materials)
- Sintering (metallic materials)
- Stress corrosion cracking
- Surface hardening of metals
- Surface properties (metallic materials)
- Tensile strength (metallic materials)
- Testing of alloys
- Testing of materials (metallic materials)
- Vacuum arc melting
- Welded joints (microstructure)
- Whiskers (metallic materials)

27 Nonmetallic Materials

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials*.

Definition

Nonmetallic Materials – Materials that do not have the properties of, or do not contain, metal and that are able to combine with hydrogen to form stable compounds, acids, acidic oxides, and anions.

NASA Interest

Exhaustive Interest: Physical, chemical, and mechanical properties; testing, evaluation, and protection of nonmetallic materials (other than conventional building structural materials).

Selective Interest: Research and development on nonmetallic materials that have potential aerospace applications.

Negative Interest: Routine developments of structural nonmetallic materials for use in housing, heavy industry, and earthbound transportation, unless a potential exists for aerospace use.

Input Subjects of Specific Interest

- Ablative materials (nonmetallic)
- Adhesives
- Ceramic materials
- Chemical properties of nonmetallic materials
- Cleaners
- Coatings (nonmetallic)
- Compression strength (nonmetallic materials)
- Creep strength (nonmetallic materials)
- Crystal structure (nonmetallic materials)
- Crystals (nonmetallic)
- Development of nonmetallic materials
- Elastomers
- Evaluation of nonmetallic materials
- Fabrics (nonmetallic materials)
- Fatigue (nonmetallic materials)
- Fibers (nonmetallic materials)
- Film strength
- Flammability (nonmetallic materials)
- Foam materials
- Fullerenes
- Glass materials
- Graphite
- Greases
- Hydraulic fluids
- Insulation (nonmetallic materials)
- Lubricants
- Lubrication properties of nonmetallic materials
- Mechanical properties of nonmetallic materials
- Nonmetallic fibers
- Nonmetallic materials
- Offgassing/outgassing (nonmetallic materials)
- Packing (nonmetallic materials)
- Paints
- Paper
- Patching compounds

- Physical properties of nonmetallic materials
- Plastics
- Plywoods
- Polymers
- Protection of materials (nonmetallic)
- Protective coatings (nonmetallic)
- Radomes (nonmetallic materials)
- Reinforcing filaments (nonmetallic)
- Research on nonmetallic materials
- Rubber
- Sealants (nonmetallic materials)
- Shear strength (nonmetallic materials)
- Silicon materials
- Solvents
- Surface properties (nonmetallic materials)
- Tensile strength (nonmetallic materials)
- Testing of materials (nonmetallic)
- Textiles
- Whiskers (nonmetallic materials)
- Woods

28 Propellants and Fuels

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power*; *20 Spacecraft Propulsion and Power*; and *44 Energy Production and Conversion*.

Definition

Propellants – Any agent used for consumption or combustion in rockets and from which the rockets derive their thrust such as fuels, oxidizers, additives, catalysts, or any compounds or mixtures of these. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Fuels – Any substance used to produce heat, either by chemical or nuclear reaction, as used, e.g., in a heat engine. *NASA Aeronautical Dictionary*. Frank Davis Adams, ed., 1959.

NASA Interest

Exhaustive Interest: Physical, chemical, and mechanical properties; testing, evaluation, storage and handling procedures of rocket propellants and aircraft fuels. For facilities to store or handle fuels or propellants see *09 Research and Support Facilities (Air)* and *14 Ground Support Systems and Facilities (Space)*.

Selective Interest: Research and development of fuels and propellants for earthbound transportation systems and power production that have potential aerospace applications.

Negative Interest: Routine developments of fuels for marine, automotive, home heating, heavy industry, and other earthbound applications.

Input Subjects of Specific Interest

- Aircraft fuels
- Boiloff
- Boron-based fuels
- Burning rates
- Catalysts (propellants)
- Chemical properties of propellants and fuels
- Combustion characteristics (propellants and fuels)
- Combustion controllability (propellants and fuels)
- Combustion instability (propellants and fuels)
- Combustion kinetics (propellants and fuels)
- Combustion of propellants and fuels
- Combustion products (propellants and fuels)
- Cryogenic propellants
- Decomposition (propellants and fuels)
- Development of propellants and fuels
- Evaluation of propellants and fuels
- Exotic propellants and fuels
- Explosives
- Flames and flame propagation (propellants and fuels)
- Fluorine/oxygen propellants
- Fuels
- Gelled propellants and fuels
- Handling of propellants and fuels
- High energy propellants and fuels
- Hybrid propellants and fuels

- Hydrazine propellants
- Hydrides
- Hydrogen propellants and fuels
- Hypergolic propellants
- Igniters (propellants)
- Ignition studies (propellants and fuels)
- Jet engine fuels
- Kerosene based fuels
- Liquid fuels
- Liquid hydrogen (propellants and fuels)
- Liquid oxygen (propellants and fuels)
- Liquid petroleum gas (LPG)
- Liquid propellants
- Lithergolic propellants
- Manufacture of propellants
- Mechanical properties of propellants and fuels
- Metal based propellants and fuels
- Monopropellants
- Nitrate based propellants and fuels
- Oxidizers
- Physical properties of propellants and fuels
- Piston engine fuels
- Propellant grains
- Propellants
- Pyrotechnics
- Rocket propellants
- Service life of propellants and fuels
- Solid propellant curing
- Solid propellants
- Space storable propellants
- Storage of propellants and fuels
- Testing of propellants and fuels
- Thermal characteristics
- Thixotropic propellants
- Vaporization of propellants and fuels

29 Space Processing

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see *84 Law, Political Science and Space Policy*.

Definition

Space Processing – Synthesis, processing, forming, and fabrication of compounds or materials in space or in a simulated space environment; normally involving techniques that exploit low-gravity or high-vacuum conditions.

NASA Interest

Exhaustive Interest: All aspects of space processing including the effects of space or simulated space environments on the chemical, structural, and physical properties of materials and compounds as related to manufacturing or processing in space.

Input Subjects of Specific Interest

- Alloy formation (space processing)
- Biological materials (space processing)
- Composite material formation (space processing)
- Containerless processing
- Crystal growth (space processing)
- Electrophoresis operations in space (EOS)
- Fluids behavior (space processing)
- Glass formation (space processing)
- Macromolecular crystallography (space processing)
- Materials processing in space
- Materials separation in space
- Microgravity (space processing)
- Multiphase materials processing in space
- Pharmaceutical preparation (space processing)
- Polymers (space processing)
- Reduced gravity effects (materials)
- Space based equipment for space processing
- Space commercialization (space processing)
- Space processing of materials

ENGINEERING

Includes engineering; communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics. For related information see also PHYSICS (*categories 70 through 77*).

31 Engineering (General)

Includes general research topics related to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

Definition

Engineering – The useful application of scientific or other systematic knowledge of the properties of matter and the sources of energy in nature. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Vacuum technology; aerospace safety engineering; control and display technology; cryogenics.

Selective Interest: Computer aided manufacturing; air cushion vehicle technology; applied mechanics; engineering with potential aerospace application.

Negative Interest: Engineering technology with no aerospace applications.

Input Subjects of Specific Interest

- Applied mechanics
- Civil engineering
- Computer aided manufacturing (CAM) (engineering)
- Cryogenics
- Display engineering
- Engineering (general)
- Fire prevention
- Industrial process control
- Industrial safety procedures
- Liquefied gases
- Metrication
- Metrology
- Safety procedures (engineering)
- Vacuum technology

32 Communications and Radar

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also *04 Aircraft Communications and Navigation*; and *17 Space Communications, Spacecraft Communications, Command and Tracking*; for search and rescue, see *03 Air Transportation and Safety*; and *16 Space Transportation and Safety*.

Definition

Communications – A field of specialization covering radio, optical, and wire transmission and receipt of information, and related electronic devices and their uses. Adapted from the *United States Air Force Dictionary*. Woodford Agee Heflin, ed., Princeton, NJ: D. Van Nostrand Co., Inc.

Radar – Radio detection and ranging, i.e., a method, system or technique of using beamed, reflected and timed radio waves for detecting, locating or tracking objects (such as rockets), for measuring altitude, etc., in any of various activities, such as air traffic control or guidance. The electronic equipment or apparatus used to generate, transmit, receive, and usually, to display radio scanning or locating waves; a radar set. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: All equipment, techniques, and applications specifically intended for the transmittal of data, voice communications, code, or other intelligence to, from, or between aircraft, scientific and communications satellites, launch vehicles, manned or unmanned spacecraft, lunar and planetary bases; ground based tracking and communication stations; tracking and data acquisition networks; telemetry theory and techniques related to aerospace experiments.

Selective Interest: Earth-based communications techniques and theory of potential interest for aerospace applications.

Negative Interest: Commercial telephone, teletype, television, and radio operations unless directly related to aerospace communications; courier and messenger service.

Input Subjects of Specific Interest

- Antenna design
- Antenna radiation patterns
- Antenna theory
- Communications (general)
- Communications blackouts (electromagnetic interference)
- Communications coding
- Communications equipment
- Communications interference
- Communications networks (theory and techniques)
- Communications noise

- Communications satellite operational problems
- Communications systems (theory and techniques)
- Communications techniques
- Communications theory
- Data transmission applications
- Data transmission development
- Data transmission equipment
- Data transmission research
- Data transmission techniques
- Digital communications systems (theory and techniques)
- Electromagnetic interference
- Electromagnetic radiation (communications)
- Electromagnetic wave propagation
- Electronic countermeasures
- Frequency assignment
- Global communications
- Ionospheric effects on radio transmission (communications)
- Ionospheric propagation (communications)
- Ionospheric scatter (communications)
- Large deployable space antennas
- Laser communications
- Laser optical radar
- Lidar
- Man-machine communications (theory and techniques)
- Microwave communications systems (application and design)
- Microwave radiation (communications)
- Microwave receivers (theory and techniques)
- Microwave techniques
- Microwave theory
- Microwave transmitters (theory and techniques)
- Modulation (signals)
- Networks (communications)
- Optical communications (applications)
- Phase shift keying (PSK)
- Phased array radar
- Radar (theory and techniques)
- Radar absorbing materials
- Radar antenna design
- Radar antennas (theory and techniques)
- Radar clutter
- Radar communications systems (theory and techniques)
- Radar detection (communications)
- Radar imagery (communications)
- Radar receivers (theory and techniques)
- Radar scattering
- Radar tracking systems (theory and techniques)
- Radar transmitters (theory and techniques)
- Radio (theory and techniques)
- Radio antenna design
- Radio antennas (theory and techniques)
- Radio communication systems (theory and techniques)
- Radomes (design)
- Satellite communications (earth communications)
- Satellite networks (earth communications)
- Side looking radar (theory and techniques)
- Signal analyzers
- Signal decoding
- Signal detection
- Signal encoding
- Signal generators (theory and techniques)
- Signal modulators
- Signal processing
- Speech analysis (electromagnetic aspects)
- Speech data compression (communications)
- Synthetic aperture radar
- Telemetry (theory and techniques)
- Television systems (aerospace applications)
- Transmitters (theory and techniques)
- Tropospheric scatter (electromagnetic effects)
- Voice communications
- Wave propagation (electromagnetic)
- Whistlers (electromagnetic)

33 Electronics and Electrical Engineering

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment; and microelectronics and integrated circuitry. For related information see also *60 Computer Operations and Hardware*; and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar*.

Definition

Electronics – Study and application of the motions of electrons through vacuum or gaseous, conducting, or semiconducting media. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Electrical Engineering – Branch of engineering related to the design, development, and operation of electrical devices and systems. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Theory, development, design, testing, performance, and operations of electric components, devices, and circuitry that have direct application in aircraft, launch vehicles, space vehicles, and their components and equipment; launch, research, and testing facilities, and the electric components and equipment used in these.

Selective Interest: Theory, research, development, design, testing, performance, and operation of electric equipment, components, devices, and circuitry having potential applications for aerospace use, or for use under extreme or unusual conditions or environments.

Negative Interest: Research, development, design, testing, performance, and operation of components, devices, and circuitry of electronic-electrical equipment for commercial nonaerospace applications.

Input Subjects of Specific Interest

- Amplifiers
- Audio amplifiers
- Batteries (electrical design)
- Bridge circuits
- Capacitors
- Cathode ray tubes (electrical design)
- Charge-coupled devices
- Chips (integrated circuits)
- Chokes (electric, electronic)
- Circuit theory
- Converters
- Crystals (electronic applications)
- Dielectrics (electronic applications)
- Diodes
- Dividers (electric)
- Electric circuits
- Electric motors
- Electric power units (electrical design)

- Electrical components
- Electrical engineering
- Electrical relays
- Electromechanics
- Electron beam devices
- Electron tubes
- Electronic circuits
- Electronic components
- Electronic packaging
- Electronic test equipment
- Electronics
- Field effect transistors (FET)
- Filters (electric, electronic)
- Fuses (electric)
- Generators (electrical design)
- Inductors (electric)
- Insulation (electric, electronic)
- Integrated circuits
- Inverters
- Klystrons
- Light emitting diodes (LED)
- Lithography (circuit fabrication)
- Magnets (electrical, electronics application)
- Microcircuits
- Microelectronics
- Microminiaturization
- Modulators (electric, electronic devices)
- Nanodevices (electronic)
- Networks (circuitry)
- Opto-acoustic electronics
- Optoelectronics (applications)
- Oscillators
- Photoelectric devices
- Photomultipliers
- Power amplifiers
- Power packs (electric)
- Power supplies electric)
- Printed circuits
- Radomes (electrical properties)
- Rail accelerators, railguns, launchers (theory)
- Rectifiers
- Regulators (voltage, current)
- Resistors
- Semiconductor devices
- Servomechanisms (electrical aspects)
- Signal generators (applications)
- Silicon cells (electrical properties)
- Sneak circuit analysis
- Solar cells (electrical design)
- Solar state circuitry
- Solid state devices
- Superconductivity (applications)
- Surface wave acoustic devices (electronic design)
- Switches
- Switching circuits
- Switching theory
- Test equipment (electrical properties)
- Thin films (electronic applications)
- Thyratrons
- Transducers
- Transformers
- Transistors
- Transmission lines
- Traveling wave tubes
- Triodes
- Tunnel diodes
- Vacuum tubes
- Very large scale integration (VLSI)
- VHSIC
- Waveguides
- X-ray tubes

34 Fluid Mechanics and Thermodynamics

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics*.

Definition

Fluid Mechanics – The experimental and mathematical study of the mechanical properties of gases and liquids at rest and in motion. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Heat Transfer – The transfer or exchange of heat by radiation, conduction, or convection within a substance and between the substance and its surroundings. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

Thermodynamics – Study and application of principles describing the relation of heat transfer to various forms of energy, and the behaviors of physical systems where temperature is a significant feature. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Theories, research, and studies on the forces, flow, mechanical properties and heat transfer of liquids or gases having specific relevance to aerospace interests or under conditions encountered in aircraft, spacecraft, launch vehicles, space vehicles, propulsion systems, or support facilities. Theory, research, and development on heat transfer of relevance also to the thermodynamic properties of elements, compounds, materials, and substances found in aerospace science and technology. (Those subjects concerned with astronomical, solar, and stellar phenomena and their interactions should be included in *89 Astronomy* or *90 Astrophysics*.)

Selective Interest: Research developments, and studies of liquids and gases and heat transfer of potential interest for aerospace applications or under unusual or extreme conditions.

Negative Interest: Heat transfer and flow of liquids and gases over wires, through channels, ducts, and pipes related to normal powerplant, reservoir, irrigation, and residential-business use unless related to remote sensing, Earth resources, or for other potential aerospace application.

Input Subjects of Specific Interest

- Ablation
- Ablation cooling
- Atomizers
- Boiling
- Boltzmann transport theory
- Boundary layer flow (general)

- Cavitation
- Compressible flow (general)
- Computational fluid dynamics
- Convection
- Enthalpy
- Entropy
- Equations of State
- Flow (general)
- Flow characteristics
- Flow equations
- Flow measurement
- Flow visualization (general applications)
- Flow with heat addition
- Fluidics
- Fluid dynamics
- Fluid flow
- Fluid forces
- Fluid heat transfer
- Fluid kinematics
- Fluid mechanics
- Fluidics
- Free energy
- Gas dynamics
- Gas flow
- Gas forces
- Gas heat transfer
- Gas mechanics
- Gaseous film cooling
- Heat exchangers (aerospace applications)
- Heat pipes (aerospace applications)
- Heat shields (aerospace applications)
- Heat sinks (aerospace applications)
- Heat transfer
- Hydraulics
- Hydrodynamics
- Hydrostatics
- Incompressible flow
- Induction heating
- Internal flow in ducts (applications)
- Internal flow in turbomachinery (applications)
- Inviscid flow
- Laminar flow (general)
- Liquid settling
- Liquid sloshing
- Mass transfer
- Mixing of gases
- Mixing of liquids
- Multiphase flow
- Navier-Stokes equations
- Pneumatics
- Radiative transfer
- Radiators (aerospace applications)
- Rheology
- Shock waves
- Skin friction
- Sprays
- Temperature-pressure phenomena
- Thermal radiation
- Thermodynamic properties
- Thermodynamics
- Transitional flow (general)
- Transpiration cooling
- Turbulence models
- Turbulent flow (general)
- Unsteady flow (general)
- Viscous flow
- Vortices (general)

35 Instrumentation and Photography

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Avionics and Aircraft Instrumentation*; and *19 Spacecraft Instrumentation and Astrionics*.

Definition

Instrumentation – The design, assemblage, arrangement, installation, and use of devices for controlling, detecting, measuring, recording, or displaying data; or supporting devices for transmitting, processing, or analyzing data. Adapted from the *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

Photography – A process for recording visual images by exposing a light-sensitive substance to radiation such as visible light, infrared radiation, or x-rays. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Design, development, installation, and use of devices for detecting, measuring, recording, telemetering, processing, or analyzing values or quantities related to aeronautical or space flight; the environment within or outside the flight vehicle; the physical operation and well being of the flight vehicle and its structure during all phases of flight; the facilities for testing and/or developing the flight vehicle; the observations and experiments performed as a result of the flight of these vehicles.

Selective Interest: Instrument design, development, and theory for other purposes that have potential aerospace applications because of advanced or unusual features, or are developed for extreme environments or unusual test conditions.

Negative Interest: Commercial off-the-shelf photographic equipment and instrument design and development for general use for artistic or commercial applications.

Input Subjects of Specific Interest

- Ablation sensors (design and techniques)
- Accelerometers
- Alarm systems (design and techniques)
- Analyzing devices (design and techniques)
- Anemometers (design and techniques)
- Atomic clocks (design and techniques)
- Attitude indicators (design and techniques)
- Bioelectronic instruments (theory and techniques)
- Bioinstrumentation (theory and techniques)
- Biomedical instruments (theory and techniques)
- Bragg cells (design and techniques)
- Cameras
- Darkroom equipment

- Detectors
- Earth sensors
- Electron microscopes
- Electro-optical systems (instrumentation)
- Emissivity measurements
- Filters (photographic)
- Flow visualization (instrumentation)
- Fluid flow sensors (general)
- Gages (general)
- Geophysical sensors (design and techniques)
- Gyroscopes (design and operation)
- Holography
- Image enhancement
- Infrared sensors
- Instrument design (theory and techniques)
- Instrumentation
- Interferometers
- Ion mass spectrometers
- Laser doppler velocimeters
- Laser instruments (design and operation)
- Lenses (photographic)
- Mass spectrometers
- Measuring instruments
- Micrometeoroid sensors (instrumentation)
- Microscopes
- Multimode sensors
- Multispectral sensors
- Nondestructive testing instruments
- Optical imaging devices (design and techniques)
- Optical measuring instruments (design and techniques)
- Oscilloscopes
- Photographic processing equipment
- Photographic supplies
- Photography
- Photometry
- Phototheodolites
- Physiological monitoring devices (theory and techniques)
- Position sensors
- Precision time and time interval (PTTI)
- Pressure transducers
- Radiation instruments
- Radiography
- Recording devices
- Remote sensors
- Scatterometers (design and techniques)
- Schlieren optics
- Sensors
- Shock tube instruments
- Spectral analysis instruments
- Spectrometers
- Spectrophotometers
- Spectroscopes
- Strain gages
- Tape recorders
- Temperature measuring instruments
- Test facility instruments
- Thermocouples (design and techniques)
- Time measurement equipment
- Tomography (design and techniques)
- Transducers (applications)
- Two-gas sensors (general)
- Ultrasonic testing equipment
- Vidicon cameras
- Wind tunnel instruments

36 Lasers and Masers

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also *76 Solid-State Physics*

Definition

Lasers – Devices for producing light by emission of energy stored in a molecular or atomic system when stimulated by light or an electric discharge. (From Light Amplification by Stimulated Emission of Radiation.). *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

Masers – Amplifiers or oscillators utilizing the principle of microwave amplification by stimulated emission of radiation. Adapted from the *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Fundamental research, theory, and development of lasers and masers with particular or potential aerospace application to drilling and welding of materials, electronic devices, space communications, tracking, navigation, and optical radar.

Negative Interest: Laser medical and surgical use unless related to specific aerospace disorders.

Input Subjects of Specific Interest

- Chemical lasers
- Dye lasers
- Gas lasers
- Glass lasers
- Laser amplifiers
- Laser applications
- Laser beams
- Laser cavities
- Laser damage
- Laser drilling (theory and techniques)
- Laser materials
- Laser modulators
- Laser optics
- Laser radiation effects
- Laser radiation hazards
- Laser research
- Laser theory
- Laser tracking systems (general)
- Lasers
- Lasertrons
- Liquid lasers
- Masers
- Orotrons
- Parametric amplifiers
- Quantum generators
- Semiconductor lasers
- Short pulsed lasers
- Solid state lasers
- Tunable lasers

37 Mechanical Engineering

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

Definition

Mechanical Engineering – Branch of engineering dealing with the design, development and operation of machines including mechanical devices and prime movers, vehicles, machine tools, and manufacturing machinery. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Design, development, and testing of all mechanical devices, equipment, and systems that are applied to launch vehicles, spacecraft, space stations, or aerospace support equipment.

Selective Interest: Potential aerospace applications of machine elements and processes, manufacturing processes, nonpower auxiliary systems, and equipment.

Input Subjects of Specific Interest

- Airbreathing engines (nonaircraft)
- Auxiliary systems (mechanical)
- Bearings
- Bonding
- Brayton cycle turbines (mechanical engineering)
- Brazing
- Cams
- Centrifugal compressors (nonaircraft)
- Centrifugal pumps
- Ceramic engines
- Cladding
- Clutches
- Compression ignition engines (nonaircraft)
- Containers
- Dies
- Diesel engines (nonaircraft)
- Drives
- Electrodeposition
- Electron beam welding
- Electroplating
- Fasteners
- Filters (mechanical)
- Fittings
- Fixtures
- Flywheels
- Friction measurement
- Friction phenomena
- Gaskets
- Gasoline engines (nonaircraft)
- Gears
- Heat pumps
- Heating, ventilation, and air conditioning (HVAC)

- Hydraulic systems (general)
- Impact phenomena
- Impact testing
- Internal combustion engines (nonaircraft)
- Joining
- Laser welding
- Lubrication
- Machine elements
- Machine processes
- Machinery
- Manufacturing processes
- Materials fabrication
- Materials forming
- Materials handling
- Materials manufacturing
- Mechanical engineering
- Mechanical equipment
- Mechanics (practical)
- Metal forming
- Micromachining
- Mounts (supports)
- Nanodevices (mechanical)
- Packaging
- Packing (machine elements)
- Piston engines (nonaircraft)
- Plasma spraying
- Plating
- Pneumatic systems (general)
- Powertrains
- Pressure vessels
- Pumps (nonaircraft)
- Reaction wheels
- Reciprocating engines (nonaircraft)
- Refrigeration
- Robotics (hardware)
- Rollers
- Rotary engines (nonaircraft)
- Seals (stoppers)
- Servomechanisms (mechanical aspects)
- Shafts (machine elements)
- Spark ignition engines (nonaircraft)
- Springs (mechanical)
- Stirling cycle engines (nonaircraft)
- Throttle controls (nonaircraft)
- Tools
- Tribology
- Turbine engines (nonaircraft)
- Vacuum forming
- Valves
- Welding techniques

38 Quality Assurance and Reliability

Includes approaches to, and methods for reliability analysis and control, quality control, inspection, maintainability, and standardization.

Definition

Quality Assurance – A system of activities whose purpose is to provide assurance and show evidence that the overall quality control task is in fact being done effectively. The system involves a continuing evaluation of the adequacy and effectiveness of the overall quality control program with a view to having corrective measures initiated where necessary. *AGARD Multilingual Aeronautical Dictionary*, 1980.

Reliability – Of a piece of equipment or a system, the probability of specified performance for a given period of time when used in the specified manner. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Quality control, quality assurance, and reliability theories, procedures, and practices specifically applicable to aircraft, space vehicles, launch vehicles, supporting facilities, other aerospace applications, and related equipment.

Selective Interest: Quality control, quality assurance, and reliability theories, procedures, and practices specifically concerned with developments and techniques for nonaerospace oriented activities that may be unusual or of use within the aerospace effort.

Input Subjects of Specific Interest

- Accelerated life testing
- Clean rooms (general)
- Environmental test facilities
- Environmental testing
- Failure rates
- Fault detection (quality control)
- Inspection
- Inspection methods
- Life prediction
- Life testing
- Maintainability (procedures and theory)
- Nondestructive testing
- Quality assurance
- Quality control
- Radiography (quality control)
- Redundancy systems
- Reliability (procedures and theory)
- Reliability criteria
- Sampling techniques (quality control)
- Service life
- Shock testing (quality control)
- Ultrasonic testing (quality control)

39 Structural Mechanics

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structures. For applications see *05 Aircraft Design, Testing and Performance*; and *18 Spacecraft Design, Testing and Performance*.

Definition

Structural Mechanics – The mechanics of structures and the analysis of their behavior under thermal or mechanical loads by means of structural analysis and structural testing.

NASA Interest

Exhaustive Interest: Theory, design, development and testing of structures and structural elements developed for use in aircraft, space vehicles, and launch vehicles; the static and dynamic responses of such structures.

Selective Interest: Theory, design, development, and testing of lightweight or unusual structures or structural elements of potential aerospace use.

Negative Interest: Structures of structural elements of conventional types utilized in bridges, buildings, ships, ocean platforms, heavy transportation, radio and microwave towers, and the like unless specifically aimed at aerospace use.

Input Subjects of Specific Interest

- Acoustoelasticity
- Adhesive joints (structural stability)
- Aeroelasticity (structural flexibility)
- Beams (structures)
- Bending
- Bolted joints
- Bonded structures
- Buckling
- Columns
- Combined loads
- Compression
- Compression loads
- Compression strength (structural)
- Cones (structures)
- Crack propagation
- Cracks
- Cylinders (structures)
- Dynamic structural analysis
- Elasticity
- Energy
- Energy absorption (structures)
- Fatigue (structural)
- Filament wound structures (design and tests)
- Flutter (structural)
- Fracture mechanics
- Honeycomb structures
- Lightweight structural elements
- Lightweight structures
- Panels (structures)
- Photoelasticity
- Plasticity
- Plates (structural elements)
- Rings (structures)
- Riveted joints

- Sandwich structures
- Shear loads
- Shear strength (structures)
- Shells (structures)
- Shock testing (structural analysis)
- Stress (structural)
- Stress analysis
- Structural analysis
- Structural design
- Structural elements
- engineering
- Structural fatigue
- Structural mechanics
- Structural testing
- Structural theory
- Structural vibration effects
- Tensile strength (structures)
- Tension loads
- Thermal stress
- Thermoelasticity (structural materials)
- Trusses
- Vibration (structures)
- Vibration testing
- Viscoelasticity (structural materials)
- Wave propagation (structural response)
- Weight analysis
- Weld strength
- Welded structures

GEOSCIENCES

Includes geosciences; earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography. For related information see also SPACE SCIENCES (*categories 88 through 93*).

42 Geosciences (General)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

Definition

Geosciences – Sciences that study the Earth, e.g., its structure, behavior, atmosphere, environment, and global systems.

NASA Interest

Exhaustive Interest: Airborne and spaceborne surveys of the Earth and its resources; evaluation of data collected from such surveys; the Earth's structure and its behavior and global systems.

Selective Interest: Earth studies of potential interest to remote sensing or general planetology, or related to global systems.

Negative Interest: Earth studies having no relation to airborne or spaceborne surveys, to the Earth's structure, properties, or global systems, or to any aerospace science.

Input Subjects of Specific Interest

- Earth sciences
- Geology (general)
- Geosciences
- Minerals (petrology)
- Petrography
- Petrology

43 Earth Resources and Remote Sensing

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis of remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photography. For related instrumentation see *35 Instrumentation and Photography*.

Definition

Earth Resources – Power sources and renewable or nonrenewable materials occurring naturally on Earth. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Remote Sensing – The collection of information about an object or phenomena by a recording device that is not in physical contact with it. The term is usually restricted to mean the methods for, and activity of, recording features and phenomena of the Earth's surface from a remote platform or vehicle. Typically the methods used record reflected or radiated electromagnetic energy, such as radiometry, photometry, spectrometry, and photographic and radar techniques. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Remote sensing as conducted from the air or from space, supporting ground truth studies.

Selective Interest: Theory, studies, results, developments, mapping, photographic presentations, and the like resulting from and related to earth resources; the Earth's geothermal reservoirs and its solar energy base.

Negative Interest: Geology and geodesy of a routine, earthbound study unless for ground truth or related purposes.

Input Subjects of Specific Interest

- Aerial photography
- Cartography
- Computer processing of earth resources data
- Crop disease detection
- Crop forecasts
- Desertification
- Earth resources
- Foliage sensing
- Forest fire detection
- Geodesy (remote sensing)
- Geological exploration
- Geological survey
- Geothermal resources
- Ground truth
- Hydrology
- Infrared imagery (remote sensing)
- Infrared signatures (earth resources)
- LANDSAT (remote sensing applications)
- Limnology
- Littoral regions

- Mapping
- Mineral deposits
- Multispectral band scanners (remote sensing applications)
- Orography
- Petroleum deposits
- Photogrammetry
- Radar detection (earth resources)
- Radar imagery (remote sensing)
- Remote sensing of earth resources
- Scatterometers (remote sensing applications)
- SEASAT (remote sensing applications)
- Shuttle Imaging Radar (earth resources)
- Side looking radar (earth resources)
- Signature analysis (earth resources)
- Snow and ice observations
- Soil identification
- Thematic mapping
- Timber inventory
- Very Long Base Interferometry (applications)
- Water resources

44 Energy Production and Conversion

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power*; *20 Spacecraft Propulsion and Power*; and *28 Propellants and Fuels*.

Definition

Energy Production – The production of electricity, combustible fuels, nuclear and thermonuclear fuels, and heating and cooling by renewable resources.

Energy Conversion – The change of a working substance or natural power into a more useable form of energy such as electricity or mechanical motion. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Techniques, equipment, and systems that may provide power or fuel for aircraft, space vehicles, launch vehicles, satellites, orbital stations, extraterrestrial bases.

Selective Interest: Earth based energy production and conversion, energy for transportation, and new developments in energy technology (new sources, high efficiency units, etc.); lightweight, low cost power units with potential for aerospace application.

Negative Interest: Solar, wind, nuclear and hydroelectric power plants for routine commercial applications; coal energy conversion.

Input Subjects of Specific Interest

- Alternative energy sources
- Brayton cycle turbines (applications)
- Chemical energy conversion devices
- Electric batteries (applications)
- Electric energy conversion devices
- Energy management technology
- Energy production
- Energy storage
- Fuel cells
- Generators (applications)
- Geophysical energy conversion devices
- Hybrid energy conversion devices
- Magnetohydrodynamic (MHD) energy conversion devices
- Microwave energy conversion devices
- Microwave energy transmission
- Photovoltaic energy conversion devices
- Silicon cells (applications)
- Solar cells (energy conversion)
- Solar heating (space applications)
- Solar power (space applications)
- Thermionic energy conversion devices
- Thermoelectricity
- Windpower

45 Environment Pollution

Includes atmospheric, water, soil, noise, and thermal pollution.

Definition

Environment Pollution – Alterations of the natural environment that are harmful to life; normally as produced by human activities. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Air, noise, thermal, atmospheric pollution, and contamination resulting from air, earthbound, and space transportation.

Selective Interest: Industrial, commercial, and residential air, noise, and thermal atmospheric and water pollution as it impacts air and space transportation, or is monitored by aircraft or spacecraft.

Negative Interest: Air, noise, thermal, water pollution, sewage pollution, and contamination from industrial, commercial, and residential sources with no relation to aerospace activities.

Input Subjects of Specific Interest

- Aerosols (pollution aspects)
- Air pollution
- Atmospheric analysis (pollution)
- Atmospheric pollution
- Atmospheric sampling (pollution)
- Biosphere (pollution aspects)
- Commercial pollution
- Contamination control
- Environmental clean up
- Environmental engineering
- Environmental modifications
- Environmental monitoring
- Environmental pollution
- Exhaust emissions (pollution)
- Greenhouse effect (pollution aspects)
- Indoor air pollution
- Industrial pollution
- Noise abatement
- Noise pollution
- Ozone depletion (pollution aspects)
- Pollution control
- Pollution monitoring
- Radioactive contamination
- Residential pollution
- Soil pollution
- Sonic boom (noise pollution)
- Stratospheric pollution
- Thermal pollution
- Transportation pollution
- Waste treatment (pollution control)
- Water pollution
- Water treatment (pollution control)

46 Geophysics

Includes Earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology*; and *93 Space Radiation*.

Definition

Geophysics – The physics of the Earth and its environment, i.e., its solid earth, air, waters and (by extension) space. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: Physics of the Earth, including its atmosphere and its hydrosphere, as revealed by aircraft, satellite, and manned spacecraft observations; observation of natural phenomena; upper atmosphere and ionosphere; geomagnetism and Earth gravitational field; paleontology related to development of life; geological investigations having potential relevance to ground truth for remote sensing or Earth evolution and structure.

Selective Interest: Geology of direct interest to aerospace activities.

Negative Interest: Surface surveys; surface or seismic prospecting; assaying processes or records.

Input Subjects of Specific Interest

- Aeronomy
- Aerosols (atmospheric physics)
- Air glow
- Atmospheric boundary layers (atmospheric physics)
- Atmospheric circulation (atmospheric physics)
- Atmospheric density
- Atmospheric electricity
- Atmospheric optics
- Atmospheric physics
- Atmospheric radiation
- Atmospheric scattering
- Atmospheric structure
- Atmospheric studies (physical processes)
- Atmospheric studies (physical processes)
- Atmospherics
- Aurora
- Biosphere (physical processes)
- Continental drift
- Earth gravitational field
- Earth magnetic field
- Earth origins
- Earth structure
- Earth-reflected radiation
- Fault detection (geological)
- General circulation models (atmosphere)
- Geochemistry
- Geodesy (physics)
- Geology (Earth structure)

- Geomagnetism
- Geomorphology
- Geophysical sensors (applications)
- Geophysics
- Glaciology
- Gravitational anomalies (terrestrial)
- Gravitational theory (terrestrial)
- Gravitational waves (terrestrial)
- Greenhouse effect (atmospheric physics)
- Hydrosphere studies
- Infrared spectrometry (atmosphere)
- Ionosphere (Earth)
- Ionospheric electron density
- Ionospheric physics
- Ionospheric plasmas
- Ionospheric scintillation
- Lithology
- Lower atmosphere studies
- Magnetism (terrestrial)
- Magnetosphere (Earth)
- Noctilucent clouds
- Ozone depletion (atmospheric physics)
- Plate tectonics
- Rocket/balloon geophysical studies
- Seismology
- Soil mechanics
- Solar-atmosphere interactions
- Space geodesy
- Stratospheric circulation
- Stratosphere
- Tectonics
- Upper atmosphere studies
- Very Long Baseline Interferometry (geophysics applications)
- Volcanoes
- Whistlers (upper atmosphere)

47 Meteorology and Climatology

Includes weather observation forecasting and modification.

Definition

Meteorology – The study dealing with the phenomena of the atmosphere especially as they relate to weather and climate. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Climatology – Branch of meteorology that studies the average weather conditions and statistical variations for a specified region over an extended period of time. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Earthbound, air, and space observations and measurements of global meteorological conditions and phenomena; weather forecasting of particular interest to, and use by, the aerospace community; and meteorological and climatological satellite studies; unusual global weather systems and climate trends.

Selective Interest: Research and observations not related to aerospace activities, but contributing to a better understanding of weather and climatological problems.

Negative Interest: Routine, day-to-day local weather forecasting.

Input Subjects of Specific Interest

- Anabatic winds
- Anemometers (applications)
- Atmospheric boundary layer (climatology)
- Atmospheric circulation (meteorology)
- Atmospheric cloud physics
- Atmospheric energy exchanges
- Atmospheric interactions
- Atmospheric studies (meteorological)
- Atmospheric turbulence
- Barometric pressure
- Catabatic winds (also katabatic)
- Clear air turbulence (meteorology)
- Climate models
- Climatology
- Cloud cover analysis
- Cloud patterns
- Cloud seeding
- Clouds (meteorology)
- Coriolis forces (meteorology)
- Cyclones
- Diurnal effects (meteorology)
- El Nino
- Energy exchanges in the atmosphere
- Fog dissipation and formation
- Global meteorology
- Global warming
- Hail
- Hurricanes
- Ice crystals (meteorology)
- Jet streams (meteorology)

- Katabatic winds (also catabatic)
- La Nina
- Lightning
- Macrometeorology
- Meteorological anomalies
- Meteorological parameters
- Meteorological satellite studies
- Meteorological sounding rocket studies
- Meteorology
- Microbursts
- Micrometeorology
- Monsoons
- Precipitation (meteorology)
- Rain
- Seasonal variations
- Snow
- Solar-atmospheric interactions
- Storm cells
- Synoptic meteorology
- Temperature variations (meteorology)
- Thunderstorms
- Tornadoes
- Typhoons
- Weather forecasting
- Weather modification
- Wind
- Wind shear

48 Oceanography

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics; and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

Definition

Oceanography – The science that deals with the study and exploration of seas and oceans. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Studies by aerospace means of air-sea interactions, marine resources, and the ocean floor; ocean currents and wave phenomena; also marine studies having potential relevance to ground truth for remote sensing and climate modeling.

Selective Interest: Ocean floor core drilling related to age studies, plate movement, and Earth structure.

Negative Interest: Oil and mineral drilling and searching; and fish location.

Input Subjects of Specific Interest

- Air-sea interactions
- Biological oceanography
- Biosphere (oceanography)
- Chlorophyll concentration
- Dynamic oceanography
- General circulation models (ocean)
- Marine biology
- Marine resources
- Ocean circulation
- Ocean currents
- Ocean floor studies
- Ocean wave studies
- Oceanography
- Physical oceanography
- Phytoplankton concentration
- Salinity (oceanography)
- Sea ice
- Sea water
- Sediments (oceanography)
- Temperature variations (oceanography)
- Thermoclines (oceanography)
- Wave phenomena (oceanography)

LIFE SCIENCES

Includes life sciences; aerospace medicine; behavioral sciences; man/system technology and life support; and exobiology.

51 Life Sciences (General)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see *categories 52 through 55*.

Definition

Life Sciences – A collective discipline encompassing biology, physiology, psychology, medicine, and sometimes sociology and other related areas. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Effects of space environments and simulated space environments on plants, animals, and microorganisms; diurnal effects on animals and plants.

Selective Interest: Studies of genetics, sterilization, biology, botany, zoology, and diurnal studies having potential aerospace implications or applications.

Negative Interest: Biological and agricultural research having no relation to aerospace.

Input Subjects of Specific Interest

- Acceleration effects (biological, animal and plant)
- Altitude effects (biological, animal and plant)
- Animal biology
- Atmospheric pressure effects (biological, animal and plant)
- Biochemistry
- Bioelectronic instruments (applications, animal and plant)
- Bioengineering (general)
- Biological evolution (terrestrial)
- Biology (general)
- Botany
- Chronobiology (animal and plant)
- Circadian rhythm (animal and plant)
- Diurnal effects (biological, animal and plant)
- Ecology
- Electromagnetic field effects (biological, animal and plant)
- Environmental effects (biological, animal and plant)
- Estivation
- Farming in space (general)
- Genetics (animal and plant)
- Gravitational effects (biological, animal and plant)

- Hibernation
- Life sciences
- Magnetic field effects (biological, animal and plant)
- Microbiology
- Microgravity effects (biological, animal and plant)
- Origin of life (terrestrial)
- Osmosis (biological)
- Plants
- Quarantine (animal and plant)
- Radiation effects (biological, animal and plant)
- Reduced gravity effects (biological, animal and plant)
- Space environment effects (biological, animal and plant)
- Telemedicine
- Temperature effects (biological, animal and plant)
- Weightlessness effects (biological, animal and plant)
- Zero gravity effects (biological, animal and plant)

52 Aerospace Medicine

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects of those environments. For psychological and behavioral effects of aerospace environments see *53 Behavioral Science*. For the effects of space on animals and plants see *51 Life Sciences*.

Definition

Aerospace Medicine – That branch of medicine dealing with the effects of flight through the atmosphere or in space upon the human body and with the prevention or cure of physiological or psychological malfunctions arising from these effects. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

NASA Interest

Exhaustive Interest: All general biological and physiological effects of atmospheric and space flight on the human being.

Selective Interest: Stress, physiological, and radiation effects of conventional medicine on the human being with direct application to aerospace flight and environments.

Negative Interest: Medicine, pharmacology, and radiation effects of conventional medicine and biology with no aerospace applications.

Input Subjects of Specific Interest

- Acceleration effects (biological, human)
- Aerospace medicine
- Altitude effects (biological, human)
- Anthropometry
- Atmospheric pressure effects (human)
- Bioastronautics
- Bioelectronic instruments (aerospace medicine)
- Bioengineering (aerospace medicine)
- Biomedical instruments (aerospace medicine)
- Cardiac physiology (human)
- Centrifugal motion effects
- Circadian rhythm (human)
- Clinical chemistry
- Confinement (effects, human)
- Coriolis forces (physiological effects, human)
- Deceleration effects (human)
- Decompression sickness
- Diurnal effects (human)
- Effects of atmospheric flight (human)
- Effects of radiation (human)
- Effects of space flight (human)
- Effects of stress (human)
- Electromagnetic field effects (physiological, human)
- Environmental effects (human)
- Exercise
- Extravehicular activity (EVA)(physiological effects)

- Fatigue (physiological, human)
- Genetics (human)
- Gravitational effects (biological, human)
- High temperature effects (human)
- Hypoxia (human)
- Low temperature effects (human)
- Magnetic field effects (human)
- Microgravity effects (human)
- Motion sickness
- Orthostatic tolerance
- Pathology (human)
- Perception (biological, human)
- Pharmacology
- Physiological effects of flight (human)
- Physiological factors (human)
- Physiological monitoring devices (human)
- Physiology (human)
- Quarantine (human)
- Radiation effects (human)
- Radiobiography (human)
- Radiobiology (human)
- Reduced gravity effects (physiological, human)
- Sensory deprivation (physiological effects, human)
- Sensory organs (human)
- Sleep deprivation (physiological effects, human)
- Space adaptation (physiological, human)
- Space environment effects (physiological, human)
- Stress (physiological effects, human)
- Stress effects of atmospheric flight (physiological, human)
- Stress effects of space flight (physiological, human)
- Temperature effects (human)
- Tomography (medical applications)
- Toxicology (human)
- Vestibular effects (human)
- Visual acuity
- Weightlessness effects (physiological, human)
- Zero gravity effects (physiological, human)

53 Behavioral Sciences

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

Definition

Behavioral Sciences – Sciences such as psychology, sociology, or anthropology that deal with human action and aim to establish generalizations concerning man's behavior in society.

NASA Interest

Exhaustive Interest: Behavior and psychological effects of aerospace environments on humans, alone or in groups; and the mental adaptation to flight in the Earth's atmosphere or in space.

Selective Interest: Mental and emotional effects of small group behavior, isolation, confinement, and the like as they might affect aerospace flight adaptation of man.

Negative Interest: Clinical psychology and psychiatry that would have little or no application to aerospace activities.

Input Subjects of Specific Interest

- Aviation psychology
- Behavioral sciences
- Confinement (psychological effects, human)
- Crew evaluation
- Crew training
- Effects of radiation (psychological, human)
- Effects of stress (psychological, human)
- Fatigue (psychological, human)
- Flying training
- Group behavior
- Human behavior
- Isolation effects (psychological, human)
- Mental adaptation to flight
- Perception (psychological, human)
- Pilot performance
- Psychological effects of flight
- Psychological factors
- Sensory deprivation (psychological effects, human)
- Sleep deprivation (psychological effects, human)
- Social interaction
- Sociological research (psychology, human)
- Space adaptation (psychological effects, human)
- Stress (psychological effects, human)
- Weightlessness effects (psychological, human)

54 Man/System Technology and Life Support

Includes human factors engineering, bionics, man-machine systems, life support, space suits and protective clothing. For related information see also *16 Space Transportation and Safety* and *52 Aerospace Medicine*.

Definition

Man-Machine System – A system in which the functions of the man and the machine are interrelated and necessary for the operation of the system. *AGARD Multilingual Aeronautical Dictionary*, 1980.

Life Support System – That complex of equipment which provides for the maintained health, comfort, and security of a vehicle occupant. Usage excludes atmospheric control (environmental control) but includes provision of food and water, waste collection and disposal, escape and survival gear. *AGARD Multilingual Aeronautical Dictionary*, 1980.

NASA Interest

Exhaustive Interest: Equipment and systems specifically concerned with the human aspects of aeronautical and space flight.

Selective Interest: Equipment, systems, and life support from non-aerospace activities (other transportation systems, oceanography, mining, industry, and the like) that may have an application in the human aspects of aeronautical and space flight.

Negative Interest: Industrial- and transportation-related equipment, systems, etc. with no aerospace applications.

Input Subjects of Specific Interest

- Bioengineering (man-machine systems)
- Bioinstrumentation (physiological monitoring)
- Bionics
- Cabin pressurization (life support)
- Closed ecological systems
- Extravehicular activity (EVA) (equipment)
- Farming in space (life support)
- Flight suits
- Food (space missions)
- Food preparation (space missions)
- Food storage (space missions)
- Helmets
- Human factors engineering
- Human productivity in space
- Life support
- Man-machine systems
- Manned maneuvering units
- Man-system interfaces
- Oxygen systems (life support)
- Pressurized cabins (life support)
- Protection measures (human)
- Protective clothing
- Quarantine procedures
- Radiation safety measures (physiological)

- Remote manipulator arms (human interface)
- Space cabin atmosphere
- Space cabin oxygen supplies
- Space cabin water supplies
- Space flight feeding
- Space hygiene
- Space sanitation
- Space suits
- Spacecraft sterilization (interior)
- Teleoperators (human interface)
- Waste products conversion (aerospace vehicles)
- Waste products disposal (aerospace vehicles)
- Waste products storage (aerospace vehicles)

55 Exobiology

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Science*.

Definition

Exobiology – Field of biology that deals with the search for extraterrestrial life and the conditions that may give rise to life on other planets or elsewhere in the Universe. May also be defined to include the study of effects of extraterrestrial environments on living organisms. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All facets of biology concerning outer space (beyond the Earth's atmosphere) and the planets (other than planet Earth); including the search for extraterrestrial life and the origin of life in the Universe.

Selective Interest: Biological research concerned with the nature and origin of life on Earth; the chemical composition, growth, development, and reproduction of life on Earth; the adaptation of life to extremes of altitude, temperature, atmospheric conditions, drought, etc. with possible applications to exobiology and the search for extraterrestrial life.

Negative Interest: Medical, agricultural and botanical, animal, and microbial biology as it relates to and results from existing earthbound life.

Input Subjects of Specific Interest

- Abiogenesis
- Amino acid analysis (extraterrestrial)
- Astrobiology
- Biochemical detection of life
- Bioinstrumentation (extraterrestrial life)
- Biology (extraterrestrial)
- Chemical evolution
- Culturing (exobiology)
- Enzyme analysis (extraterrestrial)
- Exobiology
- Extraterrestrial biochemistry
- Extraterrestrial biology
- Extraterrestrial environment effect (exobiology)
- Extraterrestrial life
- Extreme temperature effects (exobiology)
- Gravitational effects (exobiology)
- Life detection
- Magnetic field effects (exobiology)
- Nature of life
- Origin of life (extraterrestrial)
- Planetary biology
- Protobiological evolution
- Reproduction of extraterrestrial life
- Soil sampling and analysis (extraterrestrial life)
- Space Biology
- Spontaneous generation of life

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences; computer operations and hardware; computer programming and software; computer systems; cybernetics, artificial intelligence and robotics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 Mathematical and Computer Sciences (General)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

Definition

Mathematics – The study of the logical relationships among abstract entities. These relationships are expressed in numbers, symbols, and signs and may also be applied to concrete instances such as measures and properties of shapes. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Computer Sciences – The study of the development and use of electronic and optoelectronic devices that store, process, and retrieve information, and of theoretical and applied disciplines that are related and have contributed to these devices and their capabilities.

NASA Interest

Exhaustive Interest: Mathematics and computer theory and technology used in aerospace systems or used to model aerospace equipment or natural space phenomena.

Selective Interest: Mathematics and computer science technology having potential aerospace applications.

Input Subjects of Specific Interest

- Computer sciences (general)
- Mathematical sciences (general)

60 Computer Operations and Hardware

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

Definition

Computer Operations – The physical and procedural control of computers; also the electronic responses of a computer to instructions.

Computer Hardware – Electronic, optoelectronic, and electromechanical devices that make up a computer.

NASA Interest

Exhaustive Interest: All computer hardware operations and specific hardware in use, under development, or in theory for use in aerospace flight; as test equipment for aerospace hardware, research, or development; for aerospace launch, takeoff, landing, flight control, or navigation.

Selective Interest: Computer operations and specific hardware for land or sea navigation; for transportation control systems; for industrial applications and testing or study purposes with a potential for aerospace application; and for machine tool control.

Negative Interest: Pocket calculators, desk calculators, and computer operations and hardware developed for routine operations such as banking, inventory control, production line control, and the like.

Input Subjects of Specific Interest

- Analog computers
- Architecture (computers)
- Automatic data processors (ADP)
- Central processing units (CPU)
- Computer buffers
- Computer display devices
- Computer graphics (hardware)
- Computer hardware
- Computer hardware design
- Computer interfacing equipment
- Computer manufacturing
- Computer memory devices
- Computer operations
- Computer peripheral equipment
- Computer printers
- Computer storage devices
- Computer storage techniques
- Computers (hardware)
- Data input devices
- Data processing
- Digital computers
- Digital storage devices
- Digital storage techniques
- Firmware
- Hybrid computers
- Input devices
- Mainframes
- Mechanical computers
- Memory devices (computer)
- Microcomputers

- Minicomputers
- Modems
- Multiprocessors (hardware)
- Optical scanners (computer, peripheral equipment)
- Output devices (computers)
- Parallel processors (hardware)
- Personal computers
- Plotters
- Processors (hardware)
- Random access memories (RAM)
- Read-only memories (ROM)
- Remote input equipment
- Remote readout equipment
- Remote terminals
- Spaceborne computers
- Supercomputers

61 Computer Programming and Software

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

Definition

Computer Programming – The preparation of a formalized sequence of instructions that can be recognized and implemented by a computer. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Software – All computer programs, procedures, and routines associated with the operation of a computer, including applications, utility, and systems programs; and related documentation.

NASA Interest

Exhaustive Interest: All computer programming and software concerned with aerospace activities including those for flight computers, test facilities, navigation, control, manufacturing, data processing from the results of these activities, and for the purpose of advancing the state-of-the-art of aerospace research and development.

Selective Interest: Computer programming and software from all sources, e.g., transportation, industry, university, etc. that would have possible aerospace application.

Negative Interest: Computer programming and software for routine medical, banking, ship operation, production line control, and the like, not having application to aerospace activities.

Input Subjects of Specific Interest

- Algorithms (computer operations)
- CAD (computer aided design)
- CAM (computer aided manufacturing)
- Coding techniques (computer programming)
- Compilers (software)
- Computer aided design (CAD)
- Computer aided manufacturing (CAM)
- Computer graphics (software)
- Computer programming
- Computer routines
- Computer software
- Computerized simulation (general)
- Data acquisition programs
- Debugging programs
- Diagnostic procedures (software)
- Error correction codes
- Fault tolerant software
- Flight computer software
- Interpreters (software)
- Operating systems (computers)
- Programming (computers)
- Programming languages
- Protocol checking
- Software debugging
- Software engineering

62 Computer Systems

Includes computer networks and distributed processing systems. For information systems see 82 *Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

Definition

Computer Systems – Defined configurations of hardware, software and processes used to fulfill data and information processing requirements.

NASA Interest

Exhaustive Interest: Computer systems used for aerospace applications, e.g., launch control, tracking, navigation, communications, weather forecasting, aerospace data compilation and processing, test data calculation, aeronautical and space vehicle control, etc.

Selective Interest: Computer systems used for data compilation and processing in such fields as navigation, mathematics, manufacturing, earth resources, transportation, information handling, etc., that may have possible aerospace application.

Negative Interest: Computer systems for routine business and commercial operations; manufacturing and industrial operations and control; conventional data compilation and processing for academic purposes unless applicable to aerospace activities.

Input Subjects of Specific Interest

- Communications computer systems
- Computer networks
- Computer systems
- Computer systems engineering
- Computer time sharing
- Data compilation systems
- Data management systems
- Data processing systems
- Distributed data processing
- Internets
- Local area networks (LAN)
- Parallel processing
- Self-repairing computer systems
- Wide area networks (WAN)

63 Cybernetics, Artificial Intelligence and Robotics

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also *54 Man/System Technology and Life Support*.

Definition

Cybernetics – The study of methods of control and communication which are common to living organisms and machines. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-7.

Artificial Intelligence – A discipline concerned with the development of computer and extended-robotic systems that can exhibit intelligent action. May also be defined as a subfield of computer science concerned with concepts and methods of symbolic inference by a computer and the symbolic representation of the knowledge to be used in making inferences.

Robotics – A discipline that employs the principles and techniques of mechanical and electrical engineering and artificial intelligence to develop programmable or self-controlled machines that often include sensory systems and a degree of intelligence. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All aspects of cybernetics, artificial intelligence, and robotics that relate to aerospace activities.

Selective Interest: Cybernetics, artificial intelligence, and robotics of interest to nonaerospace activities that have potential aerospace application.

Input Subjects of Specific Interest

- Adaptive control theory
- Artificial intelligence
- Automata theory
- Automatic control
- Computer vision
- Control systems design
- Control theory
- Cybernetics
- Expert systems
- Feed forward control
- Feedback control
- Filter theory (control)
- Information theory
- Knowledge based systems
- Knowledge representation
- Machine learning
- Multivariable control
- Neural networks
- Optimal control
- Pattern recognition
- Remote manipulator arms (robotics)
- Robot control
- Robot dynamics
- Robot sensors
- Robot vision
- Robotics

- Scene analysis (robotics)
- Speech recognition
- Teleoperators (robotics)

64 Numerical Analysis

Includes iteration, differential and difference equations, and numerical approximation.

Definition

Numerical Analysis – Study of approximation methods using arithmetic techniques for the solution of mathematical problems. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All facets of numerical analysis.

Input Subjects of Specific Interest

- Algorithms (mathematics)
- Approximation
- Boundary value problems
- Calculus
- Collocation methods
- Computational grids
- Convergence (mathematics)
- Difference equations
- Differential equations
- Differentiation (mathematics)
- Eigenvalues/Eigenvectors
- Finite difference methods
- Finite element methods
- Finite volume methods
- Fourier analysis
- Galerkin method
- Harmonic analysis (mathematics)
- Integral equations
- Iteration
- Mathematical analysis
- Matrices
- Multigrid methods
- Numerical analysis
- Numerical integration
- Rayleigh-Ritz method
- Runge-Kutta method
- Spectral methods (mathematics)
- Spline functions
- Variational methods

65 Statistics and Probability

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

Definition

Statistic – A quantity calculated from a sample of observations, usually as an estimate of some population parameter such as mean or standard deviation. *AGARD Multilingual Aeronautical Dictionary*, 1980.

Probability – A real number in the scale 0-1 attached to a random event. It can be related to a long run relative frequency of occurrence or degrees of belief that an event will occur. *AGARD Multilingual Aeronautical Dictionary*, 1980.

NASA Interest

Exhaustive Interest: All statistical and probability theory, sampling techniques, reliability theory and techniques related to aerospace activities, aircraft and spacecraft control, facilities, development, and manufacturing.

Selective Interest: Statistics and probability related to transportation, agriculture, water pollution, and air pollution of possible aerospace interest or application.

Negative Interest: Statistics and probability concerned with banking, housing, home furnishing, and general manufacturing of a nonaerospace nature.

Input Subjects of Specific Interest

- Analysis of variance
- Bayesian statistics
- Data sampling
- Data smoothing
- Error analysis (statistics)
- Markov processes
- Martingales
- Maximum likelihood estimation
- Minimax techniques
- Monte Carlo method
- Prediction analysis
- Probability
- Probability density functions
- Random sampling
- Regression analysis
- Sampling techniques (statistics)
- Statistical techniques
- Statistics
- Stochastic processes
- Time series analysis
- Weibull distributions

66 Systems Analysis and Operations Research

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

Definition

Systems Analysis – The examination of an activity, procedure, method, technique, or a business to determine what must be accomplished and how the necessary operations may best be accomplished. *AGARD Glossary of Documentation Terms, Third Revision*. H. A. Stolk, ed., 1968.

NASA Interest

Exhaustive Interest: All systems analysis theory and all aerospace related practice, procedures, and applications.

Selective Interest: Systems analysis practice, procedures, and applications from transportation, manufacturing, communications, and scientific fields having potential interest for aerospace activities.

Negative Interest: Systems analysis and operations research related to business, banking, and management with no aerospace applications.

Input Subjects of Specific Interest

- Decision theory
- Dynamic programming
- Game theory
- Linear programming
- Mathematical modeling (systems analysis)
- Mathematical programming
- Network analysis
- Operations research
- Optimization (mathematics)
- Queueing theory
- Systems analysis

67 Theoretical Mathematics

Includes algebra, functional analysis, geometry, topology, set theory, group theory and number theory.

Definition

Theoretical Mathematics – A classificatory term referring to various specialized areas of mathematics and the logic and foundations of mathematics and other formal systems.

NASA Interest

Exhaustive Interest: Mathematical theories applied to aerospace research.

Selective Interest: Mathematical theories with applications that may be of potential use for aerospace activities.

Input Subjects of Specific Interest

- Abelian groups
- Algebraic systems
- Banach spaces
- Boolean algebra
- Differential geometry
- Field theory (mathematics)
- Fractals
- Functional analysis
- Fuzzy sets
- Geometry
- Group theory
- Hamiltonian functions
- Hilbert spaces
- Mathematical logic
- Mathematical theories
- Number theory
- Operator theory (mathematics)
- Riemann surfaces
- Set theory
- Theoretical mathematics
- Topology

PHYSICS

Includes physics; acoustics; atomic and molecular physics; nuclear physics; optics; plasma physics; solid-state physics; and physics of elementary particles and fields. For related information see also ENGINEERING (*categories 31 through 39*).

70 Physics (General)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography*; for geophysics, astrophysics, or solar physics see *46 Geophysics*, *90 Astrophysics*, or *92 Solar Physics*.

Definition

Physics – The science that studies the elementary principles and laws of nature.

NASA Interest

Exhaustive Interest: The elements of physics as they relate to aeronautics, astronautics, and the aerospace sciences.

Selective Interest: The elements of physics from all fields that might have potential aerospace applications.

Negative Interest: Nuclear physics for weaponry, large-scale commercial electricity generation, and other applications not having aerospace potential.

Input Subjects of Specific Interest

- Antigravity
- Brownian movement
- Chaos
- Dynamics (physics)
- Electromagnetic radiation (theory)
- Electromagnetism
- Electrostatics
- Ferromagnetism
- Field theory (physics)
- Kinetics
- Magnetism
- Many-body problems
- Mechanics (theory and analysis)
- Physics
- Solitary waves

71 Acoustics

Includes sound generation, transmission, and attenuation. For noise pollution see *Environment Pollution*. For aircraft noise see also *02 Aerodynamics* and *07 aircraft Propulsion and Power*.

Definition

Acoustics – The study of sound, including its production, transmission, and effects. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration. NASA SP-7.

NASA Interest

Exhaustive Interest: Acoustic theory, noise generation, sound attenuation, and related phenomena as they apply to aerospace equipment and vehicles and their operating environment. For specific applications see *02 Aerodynamics; 05 Aircraft Design, Testing, and Performance; 07 Aircraft Propulsion and Power; 15 Launch Vehicles and Launch Operations; 18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power*.

Selective Interest: Noise generation, sound attenuation, and other acoustic phenomena related to other means of transportation, manufacturing, and construction with potential aerospace applications.

Negative Interest: Noise generation, sound attenuation, and acoustic phenomena with no potential aerospace application.

Input Subjects of Specific Interest

- Acoustic scattering
- Acoustic theory
- Acoustics (general)
- Aeroacoustics
- Aerodynamic noise (general)
- Doppler effect (acoustics)
- Noise attenuation
- Noise generation
- Noise measurement
- Noise propagation
- Noise reduction (general)
- SODAR (sound detection and ranging)
- Sonic boom (theory)
- Sound absorption
- Sound attenuation
- Sound generation
- Sound generation in ducts
- Sound propagation
- Sound transmission
- Surface acoustic wave devices (theory)
- Ultrasonic applications
- Ultrasonic theory
- Underwater acoustics
- Wave propagation (acoustic)

72 Atomic and Molecular Physics

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see *73 Nuclear Physics*.

Definition

Atomic Physics – The study of the structure and characteristics of atoms. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Molecular Physics – The study of the structure and characteristics of molecules. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: The basic theories and formulas of atomic and molecular physics as they relate to aeronautics, astronautics, and aerospace sciences. Those elements of atomic and molecular physics that have actual or potential application to the aerospace program.

Selective Interest: Those applications that have potential use to the aerospace sciences.

Negative Interest: Basic theories and formulas of atomic and molecular physics that have no application to the aerospace sciences.

Input Subjects of Specific Interest

- Absorption of radiation by atoms
- Activation analysis
- Atomic beam measurements
- Atomic collisions
- Atomic electron properties
- Atomic energy levels
- Atomic frequency standards
- Atomic physics
- Atomic reactions
- Atomic spectra
- Atomic structure
- Electron collisions
- Electron scattering
- Electronic structure
- Emission of radiation by atoms
- Fluorescence
- Intermolecular forces
- Ion beams (theory)
- Ion dynamics
- Ion exchange
- Luminescence (atomic physics)
- Molecular beams
- Molecular collision theory
- Molecular energy
- Molecular interactions
- Molecular physics
- Molecular properties
- Molecular spectra
- Molecular spectroscopy
- Molecular structure
- Photon interactions with atoms and molecules
- Radiation absorption by atoms
- Theories of atomic physics
- Theories of molecular physics

73 Nuclear Physics

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

Definition

Nuclear Physics – The study of the structure and characteristics of atomic nuclei. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: The basic theories and formulas of nuclear physics and testing and research equipment to support these developments as they relate to aeronautics, astronautics, and aerospace sciences.

Selective Interest: Those applications of nuclear physics that may be of use to the aerospace program, e.g., propulsion systems and power sources, suitable for aerospace use.

Negative Interest: Large, commercial nuclear reactor applications; ship propulsion reactors.

Input Subjects of Specific Interest

- Alpha rays (theory)
- Atomic fuels
- Beta rays (theory)
- Electron beams (nuclear interactions)
- Gamma rays (theory)
- Ion beams (nuclear interactions)
- Nuclear decay
- Nuclear engines (theory)
- Nuclear fission
- Nuclear fuels
- Nuclear fusion (theory)
- Nuclear magnetic resonance
- Nuclear particles
- Nuclear physics
- Nuclear power sources (theory)
- Nuclear propulsion systems (theory)
- Nuclear reactions
- Nuclear reactor theory
- Nuclear reactors
- Nuclear research equipment
- Nuclear scattering
- Nuclear structure
- Nuclear test equipment
- Proton beams (nuclear interactions)
- Radioisotopes
- Reactor radiation safety measures (space applications)
- Reactor theory
- Spacepower reactors (theory)
- X-ray radiation (theory)

74 Optics

Includes light phenomena and the theory of optical devices; for specific optical devices see also 35 *Instrumentation and Photography*. For lasers see 36 *Lasers and Masers*.

Definition

Optics – Branch of physical science concerned with the transmission, generation, manipulation, and detection of electromagnetic radiation in the wavelength range from vacuum ultraviolet to the far infrared. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Theories of light transmission and lenses, light absorption, reflection, and scattering as they relate to aeronautics, astronautics, and space sciences.

Selective Interest: Optics and light phenomena with potential aerospace use.

Negative Interest: Industrial, commercial, and household applications of optics and light phenomena, lenses, and eyeglasses.

Input Subjects of Specific Interest

- Bragg cells (optical applications)
- Cassegrain optics
- Coherent light
- Electron optics theory
- Fiber optics
- Geometrical optics
- Infrared optics
- Infrared radiation effects (optical applications)
- Infrared signatures (optical applications)
- Infrared spectra
- Lens theory
- Lenses (optical properties)
- Light absorption
- Light reflection
- Light scattering
- Light transmission
- Liquid optics
- Luminescence (optics)
- Modulation (optics)
- Nonlinear optics
- Optical bistability
- Optical coatings
- Optical communications (theory)
- Optical fibers
- Optical imaging devices (theory)
- Optical materials
- Optical properties
- Optical waveguides
- Optics
- Optoelectronics (optics)
- Photon beams
- Photonics
- Polarization (optics)
- Refraction (optics)
- Schlieren optics
- Telescopes (optical properties)
- Tomography (optics)
- Ultraviolet radiation (optics)
- Wave propagation (optics)
- X-ray optics

75 Plasma Physics

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

Definition

Plasma Physics – The study of the nature and properties of highly ionized gases (comprised of ions and free electrons). *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Theoretical magnetohydrodynamics and plasma fusion; research and test equipment for studies in plasma physics as related to aerospace sciences.

Selective Interest: Applications of magnetohydrodynamics and plasma fusion that may be of interest for propulsion, power sources, and other uses in the aerospace program.

Negative Interest: Heavy industrial and commercial applications; large power reactors.

Input Subjects of Specific Interest

- Electrogasdynamics
- Electrohydrodynamics
- Electron density (plasma physics)
- Fusion devices
- Hydromagnetics (plasma physics)
- Ion beams (plasma physics)
- Laser interaction with plasmas
- Magnetogasdynamics
- Magnetohydrodynamics
- Magnetoplasmas
- MHD generators
- Microwave interaction with plasmas
- Nuclear fusion (plasma physics)
- Plasma conductivity
- Plasma diagnostics
- Plasma dynamics
- Plasma flow
- Plasma fusion
- Plasma oscillations
- Plasma physics
- Plasma physics research equipment
- Plasma pinch
- Plasma propulsion (theory)
- Plasma seeding
- Plasma sheath
- Plasma theory
- Plasma waves
- Stellarators
- Tokamak devices
- Whistlers (plasma physics)

76 Solid-State Physics

Includes condensed matter physics, crystallography, and superconductivity. For related information see also *33 Electronics and Electrical Engineering*; and *36 Lasers and Masers*.

Definition

Solid-State Physics – The study of the physical structure and properties of solid matter, including electrical conduction in metal crystals and semiconductors, superconductivity, and photoconductivity. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All facets of solid-state physics and the solid-state effects in electrical and electronic devices as they relate to aeronautics, astronautics, and aerospace sciences.

Selective Interest: Commercial applications of solid-state physics that might have a potential for use in aerospace applications.

Negative Interest: Solid-state physics with no application to aerospace science.

Input Subjects of Specific Interest

- Acceptors (solid state)
- Band structure of solids
- Condensed matter physics
- Conductivity (solid state)
- Critical field curves of superconducting materials
- Critical temperatures of superconducting materials
- Crystal defects
- Crystal growth (general)
- Crystal structure (semiconductors)
- Crystallography
- Dielectric materials properties
- Donors (solid state)
- Electrical transport properties in solids
- Electron energy bands
- Electron motion in conductors
- Electron paramagnetic resonance (solid state)
- Energy gaps in semiconductors
- Epitaxy
- Holes (electron deficiencies)
- Lattice vibrations
- Liquid crystals
- Mossbauer effect
- Piezoelectricity
- Radiation effects in semiconductors
- Semiconductor materials
- Solid state physics
- Solidification (solid state)
- Superconducting materials
- Superconductivity (theory)
- Thermoelectric materials
- Thin films (theory, deposition and growth)

77 Physics of Elementary Particles and Fields

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics*, *73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry*.

Definition

Elementary Particle Physics – Branch of physics concerned with the nature and properties of subatomic particles especially through the study of high-energy collisions and decays.

Statistical Mechanics – Branch of physics concerned with predictions of the behavior of macroscopic systems based on the interactions of the microscopic constituents of the system, where the number of constituents is very large. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Selective Interest: Aspects of elementary particles, field theory, and statistical physics for those applications that may be of use to the aerospace program.

Input Subjects of Specific Interest

- Annihilation reactions
- Baryons
- Boltzmann statistics
- Bose and Fermi statistics
- Bosons
- Elementary particle interactions
- Elementary particles
- Fermions
- Gauge field theory
- High energy physics
- Kaons
- Leptons
- Mesons
- Momentum transfer (particle interactions)
- Neutrinos
- Neutron properties
- Neutron spectra
- Particle physics
- Quantum chromodynamics (QCD)
- Quantum electrodynamics (QED)
- Quantum mechanics
- Quarks
- S-matrix theory
- Statistical physics
- String theory
- Strong interactions (field theory)
- Supergravity (field theory)
- Superstring theory
- Supersymmetry
- Symmetry breaking
- Theoretical physics
- Theory of relativity
- Unified field theory
- Weak interactions (field theory)

SOCIAL AND INFORMATION SCIENCES

Includes social sciences; administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and technology utilization and surface transportation.

80 Social and Information Sciences (General)

Includes general research topics related to sociology; educational programs and curricula.

Definition

Social Sciences – A group of sciences dealing with special phases of human society such as economics, sociology, political science, ethics, and education.

NASA Interest

Exhaustive Interest: Sociological research as it relates to aerospace professional groups, and opportunities, and scientific education; socioeconomic impact of aerospace and aerospace related subjects.

Selective Interest: Sociological studies with potential application to aerospace research activities.

Negative Interest: Social studies having no application to aerospace programs.

Input Subjects of Specific Interest

- Educational curricula
- Educational programs
- Social sciences
- Sociological research (humanities)

81 Administration and Management

Includes management planning and research.

Definition

Administration – The act of performing, or people who perform executive functions for an entity such as an institution or a business.

Management – Act or art of conducting, directing, supervising, or controlling the operation of a business, enterprise, or similar endeavor.

NASA Interest

Exhaustive Interest: Administration and management of NASA programs and the aerospace industrial activities.

Selective Interest: Administration and management techniques and assessment of technology applicable to aerospace research activities.

Negative Interest: Routine administration or management with no application to aerospace research activities.

Input Subjects of Specific Interest

- Administration
- Administrative planning
- Budgeting (management)
- Contract procurement
- Contract supervision
- Critical path method
- Decision making
- Management
- Management planning
- Management research
- Management tools
- PERT (Program Evaluation and Review Technique)
- Program management
- Project management
- Research management
- Research planning
- Space commercialization (management)

82 Documentation and Information Science

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer program documentation see *61 Computer Programming and Software*.

Definition

Documentation – The creating, collecting, organizing, storing, citing, and disseminating of documents, or the information recorded in documents. *Compilation of Terms in Information Sciences Technology*. Florence Casey, ed., Federal Coordinating Council for Science and Technology, April 1970.

Information Science – The study of generating, acquiring, processing, storing, retrieving, disseminating, and using information; and the development of methods for the useful organization of data and dissemination of information. *Compilation of Terms in Information Sciences Technology*. Florence Casey, ed., Federal Council for Science and Technology, April 1970.

NASA Interest

Exhaustive Interest: All facets of documentation and information science theory applicable to the processing, retrieval, and dissemination of aerospace information.

Selective Interest: Documentation and information science methods and procedures of possible application to the processing, retrieval, and dissemination of aerospace information.

Negative Interest: Public or community library procedures and techniques.

Input Subjects of Specific Interest

- Copyright regulations
- Databases
- Document miniaturization
- Document processing
- Documentation
- Geographical information systems
- Graphic arts
- Information retrieval
- Information science
- Information storage
- Information systems
- Internet resources
- Lexicography
- Library science
- Manuals (refer to appropriate category for manuals on specific subjects)
- Mechanical drawing
- Microfiche techniques
- Micrography
- Project documentation
- Reprography
- Space Station Information System
- Technical writing

83 Economics and Cost Analysis

Includes cost effectiveness studies.

Definition

Economics – Study of the production, distribution, and consumption of goods and services. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

Cost Analysis – Examination of the effects on expenses and profits of various procedures that might be used by a business or enterprise in creating or supplying its goods or services.

NASA Interest

Exhaustive Interest: Those elements of economics and cost analysis that would directly impact the aerospace program.

Selective Interest: Those elements of economics and cost analysis that would have possible application to the aerospace program, e.g., production forecasts, marketing predictions, or aerospace transportation funding forecasts.

Negative Interest: The economics and cost analysis of household, routine business and marketing, manufacturing, and local, state, and Federal government procedures that have no impact on aerospace activities.

Input Subjects of Specific Interest

- Aircraft production economics
- Airline economics
- Cost analysis
- Cost effectiveness studies
- Economic impacts
- Economics
- Insurance (aerospace)
- Marketing predictions
- Marketing research
- Production costs
- Production forecasts
- Space transportation economics
- Transportation funding forecasts (aerospace)

84 Law, Political Science and Space Policy

Includes aviation law; space law and policy; international law; international cooperation; and patent policy.

Definition

Law (Jurisprudence) – A written rule or collection of rules for action or conduct binding upon the population of a community. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All aspects of law and political science, both domestic and international, that are concerned with or directly affect the aerospace programs.

Negative Interest: Domestic and international civil law, shipping and other transportation law, and political science.

Input Subjects of Specific Interest

- Aerospace agreements
- Air piracy (legal aspects)
- Air transport regulations
- Civil aeronautical law
- Congressional legislation
- Federal aviation laws
- Government/industry relationships
- International cooperation
- International law
- Law
- Legal liability of commercial aviation
- Legal liability of general aviation
- Legal liability of manned space flight
- Legal liability of unmanned space flight
- Patent law
- Patent policy
- Political science
- Space commercialization (legal aspects)
- Space law
- Space policy
- Transfer of responsibility (space applications)
- Treaties

85 Technology Utilization and Surface Transportation

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety*, *16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

Definition

Urban Technology – The application of aerospace development to city problems.

Urban Transportation – The conveyance of, or means for conveying, people and goods in and around cities.

NASA Interest

Exhaustive Interest: NASA program spin-offs

Selective Interest: Surface and mass transportation that might serve NASA or provide improved transportation as a result of the NASA aerospace effort.

Negative Interest: Routine ship, railroad, bus, trucking, or automotive transportation.

Input Subjects of Specific Interest

- Air cushion vehicles
- Electric vehicles
- Fresh water sources
- Global positioning system (surface navigation)
- Ground effect machines
- Hybrid vehicles
- Hydrofoil vehicles
- Land transportation vehicles (development and technology)
- Maglev vehicles
- Mass transportation
- Rapid transit systems
- Sewage disposal
- Space technology applications to urban problems
- Surface transportation
- Technology transfer
- Technology utilization
- Urban technology
- Urban transportation
- Waste products conversion (urban technology)
- Waste products disposal (urban technology)
- Waste treatment (development and technology)
- Water treatment (development and technology)

SPACE SCIENCES

Includes space sciences; astronomy; astrophysics; lunar and planetary science and exploration; solar physics; and space radiation. For related information see also GEOSCIENCES (*categories 42 to 48*).

88 Space Sciences (General)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 93*.

Definition

Space Sciences – The specific discipline associated with the development of knowledge about the universe. *Apollo Terminology*, August 1963. *Dictionary of Technical Terms for Aerospace Use*. Wm. H. Allen, ed., Washington, DC: National Aeronautics and Space Administration, 1965. NASA SP-6001.

NASA Interest

Exhaustive Interest: Scientific studies of the regions beyond the Earth's atmosphere.

Negative Interest: Pseudoscientific reports on the universe and unidentified flying objects.

Input Subjects of Specific Interest

- Space sciences (general)

89 Astronomy

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

Definition

Astronomy – The science that treats of the location, magnitudes, motions, and constitution of celestial bodies and structures. The science now includes a number of specialized branches such as radio astronomy, X-ray astronomy, astrometry, astrophysics, celestial mechanics, and cosmology. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: Except for astrophysics, all facets of astronomy including radio and gamma-ray astronomy, observations of celestial bodies, their structure, motions, and locations.

Input Subjects of Specific Interest

- Asteroid belt
- Asteroids (observation)
- Astrometry
- Astronomical instruments
- Astronomy
- Binaries (observation)
- Black holes (observation)
- Celestial bodies (observation)
- Celestial motion (observation)
- Comets (observation)
- Discovery of celestial bodies
- Ephemerides of celestial bodies
- Extrasolar planets (observation)
- Galaxies (observation)
- Gamma-ray astronomy
- Hubble telescope
- Identification of celestial bodies
- Infrared astronomy
- Infrared telescopes
- Large Space Telescope
- Meteoroids (observation)
- Meteors (observation)
- Moons (observation)
- Natural satellites (observation)
- Nebulae (observation)
- Novae (observation)
- Observation of celestial bodies
- Observatories
- Optical telescope facilities
- Optical telescopes
- Planet location
- Pulsars (observation)
- Quasars (observation)
- Radar telescope and range finder facilities
- Radar telescopes
- Radio astronomy
- Radio telescope facilities
- Radio telescopes
- Spaceborne astronomy
- Spectroscopy (astronomy)
- Star trackers (observation)
- Stars (observation)
- Stellar spectroscopy
- Supernovae (observation)
- Telescopes (operation)
- Ultraviolet astronomy
- X-ray astronomy
- X-ray telescopes
- Zodiacal light

90 Astrophysics

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

Definition

Astrophysics – Study of the physical characteristics and processes associated with celestial bodies and interstellar space. The application of the laws of physics to the study of the celestial bodies and astronomical phenomena such as luminosity, size, mass, density, temperature, and chemical composition. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All facets of the physical properties of celestial bodies, interplanetary, interstellar, and intergalactic properties; data analysis and calculations of celestial mechanics. For planetary science see *91 Lunar and Planetary Science and Exploration*.

Input Subjects of Specific Interest

- Astrochemistry
- Astrophysics
- Binaries (astrophysics)
- Black holes (astrophysics)
- Celestial body orbits
- Celestial body physical properties
- Celestial body trajectories
- Celestial mechanics
- Cosmic dust
- Cosmic noise
- Cosmology
- Dark matter
- Galactic evolution
- Galactic structure
- Galaxies (astrophysics)
- Galaxy clusters
- Gravitational collapse (astrophysics)
- Gravitational theory (astrophysics)
- Gravitational waves (astrophysics)
- Hydromagnetics (astrophysics)
- Intergalactic dust
- Intergalactic gases
- Intergalactic matter
- Interplanetary dust
- Interplanetary gases
- Interplanetary matter
- Interplanetary shock waves
- Interstellar dust
- Interstellar gases
- Interstellar matter
- Magellanic clouds
- Magnetism (extraterrestrial)
- Nebulae (astrophysics)
- Novae (astrophysics)
- Nuclear astrophysics
- Physical properties of celestial bodies
- Pulsars (astrophysics)
- Quasars (astrophysics)
- Solar System evolution
- Space plasmas
- Stars (astrophysics)
- Stellar evolution
- Stellar luminosity
- Stellar magnetic fields
- Stellar mass accretion
- Stellar physics
- Stellar systems
- Supergravity (astrophysics)
- Supernovae (astrophysics)
- Universe

91 Lunar and Planetary Science and Exploration

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

Definition

Lunar Exploration – Scientific investigation of the moon by means of probes or manned or unmanned missions.

Planetary Exploration – Scientific investigation of the planets and their satellites, asteroids and other bodies by means of manned or unmanned missions.

NASA Interest

Exhaustive Interest: All facets of lunar and planetary sciences, and manned, unmanned, or remote exploration of planets and their structure, including planets within the solar system or elsewhere within the universe.

Input Subjects of Specific Interest

- Asteroids (characteristics and composition)
- Comet exploration
- Comets (characteristics and composition)
- Flyby missions
- Gas giant planets
- Lunar exploration
- Lunar mapping
- Lunar photography
- Lunar samples
- Lunar structure
- Manned flights (space exploration)
- Manned lunar exploration
- Manned planetary exploration
- Mars exploration
- Meteorites
- Meteoroids
- Meteors
- Moons (characteristics and composition)
- Natural satellites (characteristics and composition)
- Planetary atmospheres
- Planetary exploration
- Planetary mapping
- Planetary motion
- Planetary photography
- Planetary samples
- Planetary satellites (characteristics and composition)
- Planetary structure
- Planetology
- Remote exploration of planets
- Selenography
- Selenology
- Soil sampling and analysis (planetology)
- Solar System bodies
- Tektites
- Terrestrial planets
- Unmanned flights (space exploration)
- Unmanned lunar exploration
- Unmanned planetary exploration

92 Solar Physics

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation*.

Definition

Solar Physics – The study of the structure and activities of the Sun. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All facets of solar physics.

Input Subjects of Specific Interest

- Alpha rays (solar)
- Beta rays (solar)
- Chromosphere (solar)
- Lunar eclipses
- Photosphere (solar)
- Solar activity
- Solar atmosphere
- Solar constants
- Solar corona
- Solar cycles
- Solar density
- Solar eclipses
- Solar flares
- Solar magnetic field
- Solar mass
- Solar physics
- Solar radiation
- Solar radio emissions
- Solar spectra
- Solar structure
- Solar wind
- Sun
- Sunspots

93 Space Radiation

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics*.

Definition

Extraterrestrial Radiation – Electromagnetic or particle radiation emitted from a source beyond the Earth's atmosphere. *NASA Thesaurus*, NASA/SP-1998-7501/VOL1. Washington, DC: National Aeronautics and Space Administration.

NASA Interest

Exhaustive Interest: All facets of space radiation.

Input Subjects of Specific Interest

- Alpha rays (space)
- Beta rays (space)
- Cosmic radiation
- Galactic radiation
- Gamma rays (space)
- Inner Earth radiation belts
- Intergalactic radiation
- Interstellar radiation
- Outer Earth radiation belts
- Radiation belts
- Space radiation
- Stellar radiation
- Ultraviolet radiation (space)
- Van Allen belts
- X-ray radiation (space)

GENERAL

Includes aerospace related reports of a general or broad nature; histories, biographies, or overviews of aerospace programs.

99 General

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

NASA Interest

Exhaustive Interest: Histories of NASA programs and missions; biographies of NASA astronauts; NASA appropriations hearings.

Selective Interest: Histories of aeronautics and astronautics; biographies of astronauts, aviation pioneers, pilots and aerospace related scientists; reports on aerospace subjects of such wide coverage and of such broad nature that no predominate or suitable subject category can be found.

Negative Interest: Histories, biographies, or reports that are unrelated to aerospace.

Input Subjects of Specific Interest

- Aeronautical history
- Appropriations hearings (NASA)
- Astronautical history
- Biographies of astronauts, aviation pioneers, pilots, and scientists
- Histories of aeronautics and space programs

Subject Index

A

Input Subject	Category	Page
Abelian groups	67	89
Abiogenesis	55	78
Ablation	34	50
Ablation cooling	34	50
Ablation sensors (design and techniques).....	35	52
Ablation sensors (spacecraft)	19	29
Ablative materials (composite).....	24	34
Ablative materials (nonmetallic)	27	39
Absorption of radiation by atoms	72	93
Accelerated life testing	38	57
Acceleration effects (biological human)	52	73
Acceleration effects (biological, animal and plant)	51	71
Accelerators (aerospace)	14	21
Accelerometers	35	52
Acceptors (solid state)	76	97
Accidents and emergencies (aircraft).....	03	4
Accidents and emergencies (spacecraft)	16	24
Acoustic scattering	71	92
Acoustic theory	71	92
Acoustics (general).....	71	92
Acoustoelasticity	39	58
Activation analysis	72	93
Active communication satellites	18	27
Active satellite stabilization	18	27
Adaptive control theory.....	63	84
Adhesive joints (structural stability).....	39	58
Adhesives	27	39
Administration.....	81	100
Administrative planning.....	81	100
Aerial photography.....	43	62
Aeroacoustics	71	92
Aerobraking.....	13	20
Aerodynamic derivatives.....	02	2
Aerodynamic flow fields	02	2
Aerodynamic heating	02	2
Aerodynamic noise (airframe generated).....	02	2
Aerodynamic noise (general)	71	92
Aerodynamic noise (propulsion systems)	07	12
Aerodynamic studies of skin friction	02	2
Aerodynamic wakes	02	2
Aerodynamics of protuberances and substructures	02	2
Aeroelasticity (property).....	05	8
Aeroelasticity (structural flexibility).....	39	58
Aeroelasticity (theory)	02	2
Aeronautical history	99	111
Aeronautics	01	1
Aeronomy.....	46	66
Aerosols (atmospheric physics)	46	66
Aerosols (pollution aspects)	45	65
Aerospace agreements	84	103
Aerospace medicine	52	73
Aerothermodynamics	02	2
Afterburner controls.....	07	12
Afterburners (aircraft engines).....	07	12

Input Subject	Category	Page
Air cushion vehicle aerodynamics	02	2
Air cushion vehicles	85	104
Air flow separation.....	02	2
Air glow.....	46	66
Air launched weapons (aerodynamics).....	02	2
Air launched weapons (stability).....	08	14
Air navigation.....	04	6
Air piracy (incident or safety aspects).....	03	4
Air piracy (legal aspects)	84	103
Air pollution	45	65
Air safety	03	4
Air traffic control.....	04	6
Air transport regulations.....	84	103
Air transportation	03	4
Airborne computers.....	06	10
Airborne radar displays	06	10
Airbreathing engines (aircraft).....	07	12
Airbreathing engines (nonaircraft).....	37	55
Aircraft accidents	03	4
Aircraft aerodynamics	02	2
Aircraft aging (safety)	03	4
Aircraft command and control.....	04	6
Aircraft communications.....	04	6
Aircraft components.....	05	8
Aircraft configurations	05	8
Aircraft control	08	14
Aircraft control computer systems	06	10
Aircraft descriptions (types/names/designations)	05	8
Aircraft design.....	05	8
Aircraft development.....	05	8
Aircraft ditching	03	4
Aircraft emergencies	03	4
Aircraft engine design	07	12
Aircraft engine maintenance	07	12
Aircraft engine performance	07	12
Aircraft engine simulation.....	07	12
Aircraft engine testing	07	12
Aircraft engines	07	12
Aircraft evaluation.....	05	8
Aircraft flight tests.....	05	8
Aircraft fuel systems	07	12
Aircraft fuels.....	28	41
Aircraft ground handling equipment	09	16
Aircraft hydraulic systems (power).....	07	12
Aircraft in-flight collision.....	03	4
Aircraft instrumentation.....	06	10
Aircraft licensing	03	4
Aircraft maintenance.....	01	1
Aircraft manufacturing.....	01	1
Aircraft near miss	03	4
Aircraft operating problems	03	4
Aircraft performance	05	8
Aircraft pneumatic systems (power)	07	12
Aircraft power systems.....	07	12
Aircraft production.....	01	1
Aircraft production economics.....	83	102
Aircraft propellers.....	07	12
Aircraft propulsion system components	07	12
Aircraft propulsion systems.....	07	12

Input Subject	Category	Page
Aircraft repair	01	1
Aircraft safety	03	4
Aircraft search and rescue operations	03	4
Aircraft servicing equipment	09	16
Aircraft simulation	05	8
Aircraft stability	08	14
Aircraft structures	05	8
Aircraft systems monitoring instruments	06	10
Aircraft testing	05	8
Aircraft tracking	04	6
Aircraft trim	08	14
Aircrew licensing	03	4
Aircrew training	03	4
Airfoil aerodynamics	02	2
Airline economics	83	102
Airport access	09	16
Airport lighting	09	16
Airport operations	03	4
Airport planning	09	16
Airport security	03	4
Airports and airways	09	16
Air-sea interactions	48	70
Air-sea navigation	04	6
Airship aerodynamics	02	2
Airship performance	05	8
Airspeed indicators	06	10
Airworthiness	03	4
Alarm systems (aircraft)	06	10
Alarm systems (design and techniques)	35	52
Alarm systems (spacecraft)	19	29
Algorithms (computer operations)	61	82
Algorithms (mathematics)	64	86
Alkali metal vapors	25	35
All weather global position determination	04	6
Alloy formation (space processing)	29	43
Alloys	26	37
Alpha rays (solar)	92	109
Alpha rays (space)	93	110
Alpha rays (theory)	73	94
Alternative energy sources	44	64
Altimeters (aircraft)	06	10
Altimeters (spacecraft)	19	29
Altitude effects (biological, animal and plant)	51	71
Altitude effects (biological, human)	52	73
Altitude test facilities	09	16
Amino acid analysis (extraterrestrial)	55	78
Amplifiers	33	48
Anabatic winds	47	68
Analog computers	60	80
Analysis of variance	65	87
Analytical chemistry	25	35
Analyzing devices (aircraft)	06	10
Analyzing devices (design and techniques)	35	52
Analyzing devices (spacecraft)	19	29
Anemometers (applications)	47	68
Anemometers (design and techniques)	35	52
Animal biology	51	71
Annihilation reactions	77	98
Antenna design	32	46
Antenna radiation patterns	32	46
Antenna theory	32	46
Anthropometry	52	73
Anticollision devices	06	10

Input Subject	Category	Page
Antigravity	70	91
Applied mechanics	31	45
Approach control (aircraft)	04	6
Appropriations hearings (NASA)	99	111
Approximation	64	86
Architecture (computers)	60	80
Artificial intelligence	63	84
Artificial satellites	18	27
Assembly buildings	14	21
Asteroid belt	89	106
Asteroids (characteristics and composition)	91	108
Asteroids (observation)	89	106
Astrionics	19	29
Astroballistics	13	20
Astrobiology	55	78
Astrochemistry	90	107
Astro dynamics	13	20
Astrometry	89	106
Astronaut training facilities	14	21
Astronautical history	99	111
Astronautics	12	19
Astronavigation	17	25
Astronomical instruments	89	106
Astronomical observatory satellites	18	27
Astronomy	89	106
Astrophysics	90	107
Atmospheric boundary layer (climatology)	47	68
Atmospheric boundary layers (atmospheric physics)	46	66
Atmospheric circulation (atmospheric physics)	46	66
Atmospheric circulation (meteorology)	47	68
Atmospheric cloud physics	47	68
Atmospheric density	46	66
Atmospheric electricity	46	66
Atmospheric energy exchanges	47	68
Atmospheric entry effects	13	20
Atmospheric interactions	47	68
Atmospheric optics	46	66
Atmospheric physics	46	66
Atmospheric pollution	45	65
Atmospheric pressure effects (biological, animal and plant)	51	71
Atmospheric pressure effects (human)	52	73
Atmospheric radiation	46	66
Atmospheric scattering	46	66
Atmospheric structure	46	66
Atmospheric studies (meteorological)	47	68
Atmospheric studies (physical processes)	46	66
Atmospheric turbulence	47	68
Atmospherics	46	66
Atomic beam measurements	72	93
Atomic clocks (design and techniques)	35	52
Atomic collisions	72	93
Atomic electron properties	72	93
Atomic energy levels	72	93
Atomic frequency standards	72	93
Atomic fuels (space applications)	72	94
Atomic fuels (space applications)	73	94
Atomic physics	72	93
Atomic reactions	72	93
Atomic spectra	72	93
Atomic structure	72	93
Atomizers	34	50

Input Subject	Category	Page
Attitude control (aircraft)	08	14
Attitude control (spacecraft).....	18	27
Attitude indicators (aircraft)	06	10
Attitude indicators (design and techniques).....	35	52
Attitude indicators (spacecraft)	19	29
Attitude thrusters.....	20	31
Audio amplifiers.....	33	48
Aurora	46	66
Autogyro aerodynamics	02	2
Automata theory.....	63	84
Automatic control.....	63	84
Automatic data processors (ADP).....	69	80
Automatic picture transmission (APT)	17	25
Automatic picture transmission (APT) ground stations.....	14	21
Autopilots (aircraft).....	08	14
Autopilots (spacecraft)	18	27
Auxiliary power systems (aircraft)	07	12
Auxiliary power systems (spacecraft)	20	31
Auxiliary power units (APU) (aircraft)	07	12
Auxiliary power units (APU) (spacecraft)	20	31
Auxiliary systems (mechanical)	37	55
Aviation psychology.....	53	75
Avionics.....	06	10

B

Baggage handling (aircraft)	03	4
Ballistic Trajectories.....	13	20
Balloon aerodynamics.....	02	2
Banach spaces.....	67	89
Band structure of solids	76	97
Barometric pressure	47	68
Baryons	77	98
Batteries (electrical design)	33	48
Bayesian statistics.....	65	87
Beams (structures)	39	58
Bearings	37	55
Behavioral sciences.....	53	75
Bending.....	39	58
Beta rays (solar)	92	109
Beta rays (space)	93	110
Beta rays (theory).....	73	94
Binaries (astrophysics)	90	107
Binaries (observation).....	89	106
Bioastronautics.....	52	73
Biochemical detection of life	55	78
Biochemistry	51	71
Bioelectronic instruments (aerospace medicine)	52	73
Bioelectronic instruments (applications, animal and plant)	51	71
Bioelectronic instruments (spacecraft)	19	29
Bioelectronic instruments (theory and techniques)	35	52
Bioengineering (aerospace medicine).....	52	73
Bioengineering (general).....	51	71
Bioengineering (Man-machine systems)	54	76
Biographies of astronauts, aviation pioneers, pilots, and scientists	99	111
Bioinstrumentation (extraterrestrial life).....	55	78
Bioinstrumentation (physiological monitoring).....	54	76
Bioinstrumentation (theory and techniques)	35	52

Input Subject	Category	Page
Biological evolution (terrestrial).....	51	71
Biological materials (space processing)	29	43
Biological oceanography.....	48	70
Biology (extraterrestrial)	55	78
Biology (general).....	51	71
Biomedical instruments (aerospace medicine)	52	73
Biomedical instruments (spacecraft).....	19	29
Biomedical instruments (theory and techniques) ...	35	52
Bionics.....	54	76
Biosphere (oceanography)	48	70
Biosphere (physical processes)	46	66
Biosphere (pollution aspects).....	45	65
Bird collision (air transportation and safety).....	03	4
Bird ingestion (air transportation and safety).....	03	4
Bird ingestion (aircraft engines).....	07	12
Black holes (astrophysics).....	90	107
Black holes (observation).....	89	106
Blind flying instruments.....	06	10
Block houses	14	21
Boattail configurations (aircraft).....	05	8
Body-tail combinations (aircraft design).....	05	8
Body-tail combinations (stability and control)	08	14
Boiling	34	50
Boiloff	28	41
Bolted joints	39	58
Boltzmann statistics	77	98
Boltzmann transport theory	34	50
Bonded structures	39	58
Bonding.....	37	55
Boolean algebra.....	67	89
Boosters (launch vehicles)	15	23
Boosters (spacecraft).....	20	31
Boron fiber materials.....	24	34
Boron-based fuels	28	41
Bose and Fermi statistics.....	77	98
Bosons.....	77	98
Botany	51	71
Boundary layer aerodynamics	02	2
Boundary layer flow (aerodynamics).....	02	2
Boundary layer flow (general)	34	50
Boundary value problems	64	86
Bragg cells (design and techniques)	35	52
Bragg cells (optical applications)	74	95
Brayton cycle turbines (applications).....	44	64
Brayton cycle turbines (mechanical engineering)....	37	55
Brazing	37	55
Bridge circuits	33	48
Brownian movement	70	91
Buckling	39	58
Budgeting (management)	81	100
Buffeting	02	2
Burning rates.....	28	41
Bypass jet engines	07	12

C

Cabin display devices (aircraft).....	06	10
Cabin display devices (spacecraft)	19	29
Cabin pressurization (aircraft).....	05	8
Cabin pressurization (life support).....	54	76
Cabin pressurization (spacecraft).....	18	27
CAD (computer aided design).....	61	82

Input Subject	Category	Page	Input Subject	Category	Page
Calculus.....	64	86	Chemiluminescence.....	25	35
CAM (computer aided manufacturing).....	61	82	Chemistry (general).....	23	33
Cameras.....	35	52	Chemistry of compounds.....	25	35
Cams.....	37	55	Chemistry of elements.....	25	35
Canard aerodynamics.....	02	2	Chips (integrated circuits).....	33	48
Capacitors.....	33	48	Chlorophyll concentration.....	48	70
Capture devices (spacecraft).....	18	27	Chokes (electric, electronic).....	33	48
Carbon fiber materials.....	24	34	Chromatography (application).....	25	35
Carburetors (aircraft engines).....	07	12	Chromosphere (solar).....	92	109
Cardiac physiology (human).....	52	73	Chronobiology (animal and plant).....	51	71
Cargo air transport operations.....	03	4	Circadian rhythm (animal and plant).....	51	71
Cargo handling (aircraft).....	03	4	Circadian rhythm (human).....	52	73
Cargo handling (spacecraft).....	16	24	Circuit theory.....	33	48
Cargo transportation (aircraft).....	03	4	Civil aeronautical law.....	84	103
Cargo transportation (spacecraft).....	16	24	Civil engineering.....	31	45
Cartography.....	43	62	Cladding.....	37	55
Cascade aerodynamics.....	02	2	Clean rooms (aircraft manufacturing and test facilities).....	09	16
Cassegrain optics.....	74	95	Clean rooms (general).....	38	57
Catabatic winds (also katabatic).....	47	68	Clean rooms (space).....	14	21
Catalysts (chemical).....	25	35	Cleaners.....	27	39
Catalysts (propellants).....	28	41	Clear air turbulence (aircraft safety).....	03	4
Cathode ray tubes (aircraft systems).....	06	10	Clear air turbulence (meteorology).....	47	68
Cathode ray tubes (electrical design).....	33	48	Climate models.....	47	68
Cathode ray tubes (spacecraft systems).....	19	29	Climatology.....	47	68
Cavitation.....	34	51	Clinical chemistry.....	52	73
Celestial bodies (observation).....	89	106	Closed ecological systems.....	54	76
Celestial body orbits.....	90	107	Cloud cover analysis.....	47	68
Celestial body physical properties.....	90	107	Cloud patterns.....	47	68
Celestial body trajectories.....	90	107	Cloud seeding.....	47	68
Celestial mechanics.....	90	107	Clouds (meteorology).....	47	68
Celestial motion (observation).....	89	106	Clustered rockets.....	20	31
Celestial navigation (aircraft).....	04	6	Clutches.....	37	55
Celestial navigation (spacecraft).....	17	25	Coatings.....	37	55
Central processing unit (CPU).....	60	80	Cockpit display devices.....	06	10
Centrifugal compressors (aircraft).....	07	12	Coding techniques (computer programming).....	61	82
Centrifugal compressors (nonaircraft).....	37	55	Coherent light.....	74	95
Centrifugal motion effects.....	52	73	Collision avoidance (aircraft control).....	04	6
Centrifugal pumps.....	37	55	Collision avoidance (aircraft safety).....	03	5
Ceramic engines.....	37	55	Collision avoidance (spacecraft).....	17	25
Ceramic materials.....	27	39	Collocation methods.....	64	86
Ceramic matrix composites.....	24	34	Columns.....	39	58
Cermets.....	26	37	Combinations of launch vehicles and space vehicles.....	15	23
Chaos.....	70	91	Combined loads.....	39	58
Charge-coupled devices.....	33	48	Combustion chambers (spacecraft).....	20	31
Checkout facilities (aircraft).....	09	16	Combustion characteristics (propellants and fuels).....	28	41
Checkout facilities (space).....	14	21	Combustion chemistry.....	25	35
Checkout systems (aircraft).....	09	16	Combustion controllability (propellants and fuels).....	28	41
Checkout systems (space).....	14	21	Combustion instability (propellants and fuels).....	28	41
Chemical analysis.....	25	35	Combustion kinetics (propellants and fuels).....	28	41
Chemical analysis techniques.....	23	33	Combustion kinetics.....	25	41
Chemical energy conversion devices.....	44	64	Combustion of propellants and fuels.....	28	41
Chemical engineering.....	25	35	Combustion physics.....	25	35
Chemical evolution.....	55	78	Combustion processes.....	25	35
Chemical lasers.....	36	54	Combustion products.....	28	41
Chemical manufacturing.....	23	33	Combustion theory.....	25	35
Chemical power sources (spacecraft).....	20	31	Combustors (aircraft).....	07	13
Chemical processing (general).....	23	33	Combustors (spacecraft).....	20	31
Chemical properties of alloys.....	26	37	Comet exploration.....	91	108
Chemical properties of metals.....	26	37	Comets (characteristics and composition).....	91	108
Chemical properties of nonmetallic materials.....	27	39			
Chemical properties of propellants and fuels.....	28	41			
Chemical propulsion engines (aircraft).....	07	12			
Chemical propulsion engines (spacecraft).....	20	31			

Input Subject	Category	Page
Comets (observation).....	89	106
Command and control of spacecraft.....	17	25
Commercial launch vehicles.....	15	23
Commercial pollution.....	45	65
Communication satellites.....	18	27
Communications (general).....	32	46
Communications blackouts (electromagnetic interference).....	32	46
Communications blackouts (reentry).....	17	25
Communications coding.....	32	46
Communications computer systems.....	62	83
Communications equipment.....	32	46
Communications interference.....	32	46
Communications networks (aircraft).....	04	6
Communications networks (space).....	17	25
Communications networks (theory and techniques).....	32	46
Communications noise.....	32	46
Communications satellite operational problems.....	32	47
Communications system (aircraft).....	04	6
Communications systems (space).....	17	25
Communications systems (theory and techniques).....	32	47
Communications techniques.....	32	47
Communications theory.....	32	47
Compasses.....	06	10
Compilers (software).....	61	82
Composite material formation (space processing).....	29	43
Composite materials.....	24	34
Compressible flow (aerodynamics).....	02	2
Compressible flow (general).....	34	51
Compression.....	39	58
Compression ignition engines (aircraft).....	07	13
Compression ignition engines (nonaircraft).....	37	55
Compression loads.....	39	58
Compression strength (metallic materials).....	26	37
Compression strength (nonmetallic materials).....	27	39
Compression strength (structural).....	39	58
Compressors (aircraft engines).....	07	13
Computational fluid dynamics.....	34	51
Computational grids.....	64	86
Computer aided design (CAD).....	61	82
Computer aided manufacturing (CAM) (Engineering).....	31	45
Computer aided manufacturing (CAM).....	61	82
Computer display devices.....	60	80
Computer graphics (hardware).....	60	80
Computer graphics (software).....	61	82
Computer hardware.....	60	80
Computer hardware design.....	60	80
Computer interfacing equipment.....	60	80
Computer manufacturing.....	60	80
Computer memory devices.....	60	80
Computer networks.....	62	83
Computer operations.....	60	80
Computer peripheral equipment.....	60	80
Computer printers.....	60	80
Computer processing of earth resources data.....	43	62
Computer programming.....	61	82
Computer routines.....	61	82
Computer sciences (general).....	59	79
Computer software.....	61	82

Input Subject	Category	Page
Computer storage devices.....	60	80
Computer storage techniques.....	60	80
Computer systems.....	62	83
Computer systems engineering.....	62	83
Computer time sharing.....	62	83
Computer vision.....	63	84
Computerized simulation (general).....	61	82
Computers (hardware).....	60	80
Condensed matter physics.....	76	97
Conductivity (solid state).....	76	97
Cones (structures).....	39	58
Confinement (effects, human).....	52	73
Confinement (psychological effects, human).....	53	75
Congressional legislation.....	84	103
Consol/Consolan navigation system.....	04	6
Containerless processing.....	29	43
Containers.....	37	55
Contamination control.....	45	65
Continental drift.....	46	66
Contract procurement.....	81	100
Contract supervision.....	81	100
Control effectiveness (aircraft).....	08	14
Control effectiveness (spacecraft).....	18	27
Control position indicators (aircraft).....	06	10
Control position indicators (spacecraft).....	19	29
Control surface aerodynamics.....	02	2
Control surface interactions (aircraft).....	08	14
Control systems design (spacecraft).....	18	27
Control systems design.....	63	84
Control theory.....	63	84
Control towers.....	09	16
Convection.....	34	51
Convergence (mathematics).....	64	86
Converters.....	33	48
Cooling systems (aircraft engines).....	07	13
Copyright regulations.....	82	101
Coriolis forces (aerodynamics).....	02	2
Coriolis forces (meteorology).....	47	68
Coriolis forces (physiological effects, human).....	52	73
Corrosion.....	26	37
Cosmic dust.....	90	107
Cosmic noise.....	90	107
Cosmic radiation.....	93	110
Cosmology.....	90	107
Cost analysis.....	83	102
Cost effectiveness studies.....	83	102
Countdown.....	15	23
Crack propagation.....	39	58
Cracks.....	39	58
Crash test facilities.....	09	16
Crashworthiness (aircraft).....	03	5
Creep strength (metallic materials).....	26	37
Creep strength (nonmetallic materials).....	27	39
Crew evaluation.....	53	75
Crew training.....	53	75
Critical field curves of superconducting materials.....	76	97
Critical path method.....	81	100
Critical temperatures of superconducting materials.....	76	97
Crop disease detection.....	43	62
Crop forecasts.....	43	62
Cryogenic propellants.....	28	41

Input Subject	Category	Page
Cryogenics.....	31	45
Crystal defects.....	76	97
Crystal growth (general).....	76	97
Crystal growth (space processing).....	29	43
Crystal structure (metallic materials).....	26	37
Crystal structure (nonmetallic materials).....	27	39
Crystal structure (semiconductors).....	76	97
Crystallography.....	76	97
Crystals (electronic applications).....	33	48
Crystals (metallic).....	26	37
Crystals (nonmetallic).....	27	39
Culturing (exobiology).....	55	78
Cybernetics.....	63	84
Cyclones.....	47	68
Cylinders (structures).....	39	58

D

Dark matter.....	90	107
Darkroom equipment.....	35	52
Data acquisition programs.....	61	82
Data compilation systems.....	62	83
Data input devices.....	60	80
Data management systems.....	62	83
Data processing.....	60	80
Data processing systems.....	62	83
Data sampling.....	65	87
Data smoothing.....	65	87
Data transmission applications.....	32	47
Data transmission development.....	32	47
Data transmission equipment.....	32	47
Data transmission research.....	32	47
Data transmission techniques.....	32	47
Databases.....	82	101
Debugging programs.....	61	82
Decca navigation system.....	04	6
Deceleration effects (human).....	52	73
Decision making.....	81	100
Decision theory.....	66	88
Decomposition (propellants and fuels).....	28	41
Decompression sickness.....	52	73
Deep space instrumentation facilities.....	14	21
Deep Space Network.....	17	26
Deicing systems (aircraft).....	05	8
Depressurization systems (aircraft).....	05	8
Depressurization systems (spacecraft).....	18	27
Desertification.....	43	62
Design of launch vehicles, tanks, components, systems.....	15	23
Detecting devices (aircraft).....	06	10
Detecting devices (spacecraft).....	19	29
Detectors.....	35	53
Detonation processes.....	25	35
Development facilities (aircraft).....	09	16
Development facilities (space).....	14	21
Development of alloys.....	26	37
Development of nonmetallic materials.....	27	39
Development of propellants and fuels.....	28	41
Diagnostic procedures (software).....	61	82
Dielectric materials properties.....	76	97
Dielectrics (electronic application).....	33	48
Dies.....	37	55

Input Subject	Category	Page
Diesel engines (aircraft).....	07	13
Diesel engines (nonaircraft).....	37	55
Difference equations.....	64	86
Differential equations.....	64	86
Differential geometry.....	67	89
Differentiation (mathematics).....	64	86
Diffusers (aircraft engines).....	07	13
Digital communications systems (aircraft).....	04	6
Digital communications systems (spacecraft).....	17	26
Digital communications systems (theory and techniques).....	32	47
Digital computers.....	60	80
Digital storage devices.....	60	80
Digital storage techniques.....	60	80
Diodes.....	33	48
Discovery of celestial bodies.....	89	106
Display devices (aircraft).....	06	10
Display devices (spacecraft).....	19	29
Display engineering.....	31	45
Distributed data processing.....	62	83
Diurnal effects (biological, animal and plant).....	51	71
Diurnal effects (human).....	52	73
Diurnal effects (meteorology).....	47	68
Dividers (electric).....	33	48
Docking (spacecraft).....	18	27
Document miniaturization.....	82	101
Document processing.....	82	101
Documentation.....	82	101
Donors (solid state).....	76	97
Doppler effect (acoustics).....	71	92
Doppler navigation systems.....	04	6
Drag reduction (effects and techniques).....	02	2
Drives.....	37	55
Dutch roll.....	08	14
Dye lasers.....	36	54
Dynamic oceanography.....	48	70
Dynamic programming.....	66	88
Dynamic stability (aircraft).....	08	14
Dynamic stability (spacecraft).....	18	27
Dynamic structural analysis.....	39	58
Dynamics (physics).....	70	91

E

Earth gravitational field.....	46	66
Earth magnetic field.....	46	66
Earth origins.....	46	66
Earth resources.....	43	62
Earth sciences.....	42	61
Earth sensors.....	35	53
Earth structure.....	46	66
Earth-reflected radiation.....	46	66
Economic impacts.....	83	102
Economics.....	83	102
Educational curricula.....	80	99
Educational programs.....	80	99
Effects of atmospheric flight (human).....	52	73
Effects of radiation (human.....	52	73
Effects of radiation (psychological, human).....	53	75
Effects of space flight (human).....	52	73
Effects of stress (human).....	52	73
Effects of stress (psychological, human).....	53	75

Input Subject	Category	Page
Eigenvalues/Eigenvectors	64	86
Ejection systems and seats (air transportation and safety)	03	5
Ejection systems and seats (design)	05	8
Ejectors (aircraft)	07	13
Ejectors (spacecraft)	20	31
El Nino	47	68
Elasticity	39	58
Elastomers	27	39
Electric batteries (applications)	44	64
Electric circuits	33	48
Electric energy conversion devices	44	64
Electric motors	33	48
Electric power systems (aircraft)	07	13
Electric power systems (spacecraft)	20	31
Electric power units (aircraft)	07	13
Electric power units (electrical design)	33	48
Electric power units (spacecraft)	20	31
Electric propulsion systems (aircraft)	07	13
Electric propulsion systems (spacecraft)	20	31
Electric rocket engines	20	31
Electric vehicles	85	104
Electrical components	33	49
Electrical engineering	33	49
Electrical relays	33	49
Electrical transport properties in solids	76	97
Electrochemical processes	25	35
Electrochemistry	25	35
Electrodeposition	37	55
Electrogasdynamics	75	96
Electrohydrodynamics	75	96
Electromagnetic devices (radiators, sensors and other equipment) for navigation systems	04	6
Electromagnetic field effects (biological, animal and plant)	51	71
Electromagnetic field effects (physiological, human)	52	73
Electromagnetic interference	32	47
Electromagnetic launchers (facilities)	14	21
Electromagnetic launchers (operations)	15	23
Electromagnetic radiation (communications)	32	47
Electromagnetic radiation (theory)	70	91
Electromagnetic wave propagation	32	47
Electromagnetism	70	91
Electromechanics	33	49
Electron beam devices	33	49
Electron beam welding	37	55
Electron beams	73	94
Electron collisions	72	93
Electron density (plasma physics)	75	96
Electron energy bands	76	97
Electron microscopes	35	53
Electron motion in conductors	76	97
Electron optics theory	74	95
Electron paramagnetic resonance (solid state)	76	97
Electron scattering Electronic structure	72	93
Electron tubes	33	49
Electronic circuits	33	49
Electronic components	33	49
Electronic countermeasures	32	47
Electronic packaging	33	49
Electronic test equipment	33	49
Electronics	33	49

Input Subject	Category	Page
Electro-optical systems (instrumentation)	35	53
Electrophoresis	25	35
Electrophoresis operations in space (EOS)	29	43
Electroplating	37	55
Electrostatic rocket engines	20	31
Electrostatics	70	91
Electrothermal rocket engines	20	31
Elementary particle interactions	77	98
Elementary particles	77	98
Emergency locator transmitters	03	5
Emission of radiation by atoms	72	93
Emissivity measurements	35	53
Energy	39	58
Energy absorption (structures)	39	58
Energy exchanges in the atmosphere	47	68
Energy gaps in semiconductors	76	97
Energy management technology	44	64
Energy production	44	64
Energy storage	44	64
Engine control systems (aircraft)	07	13
Engine fuel quantity gages	06	10
Engine ingestion	07	13
Engine noise (aircraft)	07	13
Engine noise suppressors (aircraft)	07	13
Engine oil pressure gages	06	10
Engine oil temperature gages	06	10
Engine propulsion system instruments and gages	06	10
Engine RPM indicators	06	10
Engine test blocks (space)	14	21
Engine test stands (aircraft)	09	16
Engine test stands (space)	14	21
Engineering (general)	31	45
Enthalpy	34	51
Entropy	34	51
Environmental clean up	45	65
Environmental effects (biological, animal and plant)	51	71
Environmental effects (human)	52	73
Environmental engineering	45	65
Environmental modifications	45	65
Environmental monitoring	45	65
Environmental pollution	45	65
Environmental test facilities	38	57
Environmental testing	38	57
Enzyme analysis (extraterrestrial)	55	78
Ephemerides of celestial bodies	89	106
Epitaxy	76	97
Epoxy matrix composites	24	34
Equations of State	34	51
Error analysis (statistics)	65	87
Error correction codes	61	82
Escape systems (aircraft)	03	5
Escape systems (spacecraft)	16	24
Estivation	51	71
Eutectics	26	37
Eutectoids	26	37
Evaluation of alloys	26	37
Evaluation of metals	26	37
Evaluation of nonmetallic materials	27	39
Evaluation of propellants and fuels	28	41
Exercise	52	73
Exhaust emissions (pollution)	45	65

Input Subject	Category	Page
Exhaust systems (aircraft engines)	07	13
Exit aerodynamics	02	2
Exit controls (aircraft engines).....	07	13
Exobiology	55	78
Exotic propellants and fuels	28	41
Expandable structures (aircraft).....	05	9
Expandable structures (spacecraft)	18	27
Expert systems	63	84
Explosions (aircraft).....	03	5
Explosions (spacecraft)	16	24
Explosives	28	41
Extrasolar planets (observation).....	89	106
Extraterrestrial bases	14	21
Extraterrestrial biochemistry.....	55	78
Extraterrestrial biology.....	55	78
Extraterrestrial environment effect (exobiology).....	55	78
Extraterrestrial life.....	55	78
Extravehicular activity (EVA) (equipment).....	54	76
Extravehicular activity (EVA) (operations).....	16	24
Extravehicular activity (physiological effects) (EVD)	52	74
Extreme temperature effects (exobiology).....	55	78

F

Fabrics (nonmetallic materials)	27	39
Fail safety systems (aircraft).....	03	5
Failure rates	38	57
Fan jet engines.....	07	13
Farming in space (general).....	51	71
Farming in space (life support)	54	76
Fasteners.....	37	55
Fatigue (composite materials)	24	34
Fatigue (metallic materials).....	26	37
Fatigue (nonmetallic materials).....	27	39
Fatigue (physiological, human).....	52	74
Fatigue (psychological, human).....	53	75
Fatigue (structural).....	39	58
Fault detection (geological).....	46	66
Fault detection (quality control).....	38	57
Fault tolerant software.....	61	82
Federal aviation laws	84	103
Feed forward control	63	84
Feedback control	63	84
Fermions.....	77	98
Ferrites.....	26	37
Ferromagnetic resonance	25	35
Ferromagnetism	70	91
Fiber composites.....	24	34
Fiber optics	74	95
Fiber-matrix interfaces	24	34
Fibers (metallic materials)	26	37
Fibers (nonmetallic materials).....	27	39
Field effect transistors (FET)	33	49
Field theory (mathematics).....	67	89
Field theory (physics).....	70	91
Filament materials	24	34
Filament wound structures (composite materials) ..	24	34
Filament wound structures (design and tests).....	39	58
Filament-matrix materials	24	34
Film strength	27	39
Filter theory (control)	63	84

Input Subject	Category	Page
Filters (electric, electronic).....	33	49
Filters (mechanical).....	37	55
Filters (photographic).....	35	53
Finite difference methods.....	64	86
Finite element methods	64	86
Finite volume methods.....	64	86
Fins (aircraft).....	05	9
Fins (spacecraft)	18	27
Fire (aircraft)	03	5
Fire (spacecraft).....	16	24
Fire control radar	06	10
Fire prevention	31	45
Fire warning systems.....	06	10
Firmware	60	80
Fittings.....	37	55
Fixtures.....	37	55
Flame studies.....	25	36
Flames and flame propagation (propellants and fuels)	28	41
Flammability (composite materials).....	24	34
Flammability (metallic materials).....	26	37
Flammability (nonmetallic materials).....	27	39
Flammability.....	25	36
Flight computer software	61	82
Flight control (aircraft)	08	14
Flight control (spacecraft)	18	27
Flight control computer systems	06	10
Flight dynamics (aircraft)	08	14
Flight dynamics (spacecraft)	18	27
Flight hazards (aircraft).....	03	5
Flight instruments (aircraft)	06	10
Flight instruments (spacecraft).....	19	29
Flight management systems	08	14
Flight path control (aircraft)	08	14
Flight path control (spacecraft)	18	27
Flight recorders (aircraft)	06	10
Flight recorders (spacecraft).....	19	29
Flight safety (aircraft).....	03	5
Flight safety (spacecraft)	16	24
Flight simulators (aircrew training and aircraft development)	09	16
Flight simulators (space)	14	21
Flight suits	54	76
Flotation devices.....	03	5
Flow (general)	34	51
Flow Characteristics.....	34	51
Flow equations	34	51
Flow measurement.....	34	51
Flow visualization (general applications).....	34	51
Flow visualization (instrumentation)	35	53
Flow with heat addition.....	34	51
Fluerics	34	51
Fluid dynamics	34	51
Fluid flow	34	51
Fluid flow sensors (aircraft)	06	10
Fluid flow sensors (general).....	35	53
Fluid flow sensors (spacecraft)	19	29
Fluid forces.....	34	51
Fluid heat transfer	34	51
Fluid kinematics	34	51
Fluid mechanics	34	51
Fluidics	34	51
Fluids behavior (space processing)	29	43

Input Subject	Category	Page
Fluorescence.....	72	93
Fluorine/oxygen propellants.....	28	41
Flutter (aircraft).....	08	14
Flutter (spacecraft).....	18	27
Flutter (structural).....	39	58
Flyby missions.....	91	108
Fly-by-light control (FBL).....	08	14
Fly-by-wire control (FBW).....	08	14
Flying qualities (aircraft).....	08	14
Flying qualities (spacecraft).....	18	27
Flying training.....	53	75
Flywheels.....	37	55
Foam materials.....	27	39
Fog dissipation and formation.....	47	68
Foliage sensing.....	43	62
Food (space missions).....	54	76
Food preparation (space missions).....	54	76
Food storage (space missions).....	54	76
Foreign object damage (FOD).....	03	5
Foreign object ingestion (air transportation and safety).....	03	5
Foreign object ingestion (aircraft engines).....	07	13
Forest fire detection.....	43	62
Fourier analysis.....	64	86
Fractals.....	67	89
Fracture mechanics.....	39	58
Free energy.....	34	51
Free flyers (spacecraft).....	18	27
Free-flight Trajectories.....	13	20
Frequency assignment.....	32	47
Fresh water sources.....	85	104
Friction measurement.....	37	55
Friction phenomena.....	37	55
Fuel cells.....	44	64
Fuel distribution pumps (aircraft).....	07	13
Fuel distribution pumps (spacecraft).....	20	31
Fuel distribution systems (aircraft).....	07	13
Fuel distribution systems (spacecraft).....	20	31
Fuel injection systems (aircraft).....	07	13
Fuel injection systems (spacecraft).....	20	31
Fuel system components (aircraft).....	07	13
Fuel system components (spacecraft).....	20	31
Fuel systems (aircraft).....	07	13
Fuel systems (spacecraft).....	20	31
Fuel tanks (aircraft).....	07	13
Fuel tanks (spacecraft).....	20	31
Fuels.....	28	41
Functional analysis.....	67	89
Fuselages.....	05	9
Fuses (electric).....	33	49
Fusion devices.....	75	96
Fuzzy sets.....	67	89

G

Gages (general).....	35	53
Galactic evolution.....	90	107
Galactic radiation.....	93	110
Galactic structure.....	90	107
Galaxies (astrophysics).....	90	107
Galaxies (observation).....	89	106
Galaxy clusters.....	90	107

Input Subject	Category	Page
Galerkin method.....	64	86
Game theory.....	66	88
Gamma rays (space).....	93	110
Gamma rays (theory).....	73	94
Gamma-ray astronomy.....	89	106
Gas absorption.....	25	36
Gas dynamics.....	34	51
Gas flow.....	34	51
Gas forces.....	34	51
Gas giant planets.....	91	108
Gas heat transfer.....	34	51
Gas lasers.....	36	54
Gas mechanics.....	34	51
Gas turbine engines (aircraft).....	07	13
Gaseous film cooling.....	34	51
Gaseous reactions.....	25	36
Gaskets.....	37	55
Gasoline engines (aircraft).....	07	13
Gasoline engines (nonaircraft).....	37	55
Gas-solid reactions.....	25	36
Gas-surface interactions.....	25	36
Gas-surface reactions.....	25	36
Gauge field theory.....	77	98
Gears.....	37	55
Gelled propellants and fuels.....	28	41
General circulation models (atmosphere).....	46	66
General circulation models (ocean).....	48	70
Generators (applications).....	44	64
Generators (electrical design).....	33	49
Genetics (animal and plant).....	51	71
Genetics (human).....	52	74
Geochemistry.....	46	66
Geodesy (physics).....	46	66
Geodesy (remote sensing).....	43	62
Geographical information systems.....	82	101
Geological exploration.....	43	62
Geological survey.....	43	62
Geology (Earth structure).....	46	66
Geology (general).....	42	61
Geomagnetism.....	46	67
Geometrical optics.....	74	95
Geometry.....	67	89
Geomorphology.....	46	67
Geophysical energy conversion devices.....	44	64
Geophysical satellites.....	18	27
Geophysical sensors (applications).....	46	67
Geophysical sensors (design and techniques).....	35	53
Geophysics.....	46	67
Geosciences.....	42	61
Geothermal resources.....	43	62
Glaciology.....	46	67
Glass fiber reinforced plastics.....	24	34
Glass formation (space processing).....	29	43
Glass lasers.....	36	54
Glass materials.....	27	39
Glider aerodynamics.....	02	3
Gliders (sailplanes, hang gliders).....	05	9
Global communications.....	32	47
Global meteorology.....	47	68
Global position system (surface navigation).....	85	104
Global positioning systems (aircraft).....	04	6
Global positioning systems (spacecraft).....	17	26
Global warning.....	47	68

Input Subject	Category	Page
Government/industry relationships	84	103
Graphic arts	82	101
Graphite	27	39
Gravitational anomalies (terrestrial)	46	67
Gravitational collapse (astrophysics)	90	107
Gravitational effects (biological, animal and plant)	51	72
Gravitational effects (biological, human)	52	74
Gravitational effects (exobiology)	55	78
Gravitational effects (orbital effects on launch vehicles and spacecraft)	13	20
Gravitational theory (astrophysics)	90	107
Gravitational theory (terrestrial)	46	67
Gravitational waves (astrophysics)	90	107
Gravitational waves (terrestrial)	46	67
Gravity simulators	14	21
Greases	27	39
Greenhouse effect (atmospheric physics)	46	67
Greenhouse effect (pollution aspects)	45	65
Ground based and space based radar for air navigation	04	6
Ground based data acquisition stations	17	26
Ground based data acquisition systems	17	26
Ground based tracking stations	17	26
Ground based tracking systems	17	26
Ground control approach (GCA) systems	04	6
Ground effect machine aerodynamics	02	3
Ground effect machines	85	104
Ground support equipment (aircraft)	09	16
Ground support equipment (space)	14	21
Ground support facilities (aircraft)	09	16
Ground support facilities (space)	14	21
Ground support systems (aircraft)	09	16
Ground support systems (space)	14	21
Ground support vehicles (aircraft)	09	17
Ground support vehicles (space)	14	21
Ground truth	43	62
Group behavior	53	75
Group theory	67	89
Guidance system design (aircraft)	04	6
Guidance system design (spacecraft)	17	26
Gyroscopes (aircraft)	06	10
Gyroscopes (design and operation)	35	53
Gyroscopes (spacecraft)	19	29

H

Hail	47	68
Hamiltonian functions	67	89
Handling of propellants and fuels	28	41
Handling qualities (aircraft)	08	14
Handling qualities (spacecraft)	18	27
Hangar facilities	09	17
Harmonic analysis (mathematics)	64	86
Heads-up displays (aircraft)	06	11
Heads-up displays (spacecraft)	19	29
Heat exchangers (aerospace applications)	34	51
Heat pipes (aerospace applications)	34	51
Heat pumps	37	55
Heat shields (aerospace applications)	34	51
Heat sinks (aerospace applications)	34	51
Heat transfer	34	51

Input Subject	Category	Page
Heat treatment of metals	26	37
Heating, ventilation, and air conditioning (HVAC)	37	55
Helicopter aerodynamics	02	3
Helicopter design	05	9
Helicopter ground resonance	05	9
Helicopter performance	05	9
Helicopter rotor dynamics	05	9
Helmets	54	76
Hibernation	51	72
High energy physics	77	98
High energy propellants and fuels	28	41
High speed aerodynamics	02	3
High temperature effects (human)	52	74
High temperature test facilities (aircraft)	09	17
High temperature test facilities (space)	14	21
Highly maneuverable aircraft technology (HiMAT)	05	9
Hilbert spaces	67	89
Histories of aeronautics and space programs	99	111
Holes (electron deficiencies)	76	97
Holography	35	53
Honeycomb materials	24	34
Honeycomb structures	39	58
Horizon sensors (aircraft)	06	11
Horizon sensors (spacecraft)	19	29
Hovercraft aerodynamics	02	3
Hubble telescope	89	106
Human behavior	53	75
Human factors engineering	54	76
Human productivity in space	54	76
Hurricanes	47	68
Hybrid computers	60	80
Hybrid energy conversion devices	44	64
Hybrid propellant rocket engines	20	31
Hybrid propellants and fuels	28	42
Hybrid vehicles	85	104
Hydraulic fluids	27	39
Hydraulic system (aircraft)	05	9
Hydraulic systems (general)	37	56
Hydraulic systems (spacecraft)	18	28
Hydraulics	34	51
Hydrazine propellants	28	42
Hydrides	28	42
Hydrodynamics	34	51
Hydrofoil vehicles	85	104
Hydrogen embrittlement	26	37
Hydrogen propellants and fuels	28	42
Hydrology	43	62
Hydromagnetics (astrophysics)	90	107
Hydromagnetics (plasma physics)	75	96
Hydrosphere studies	46	67
Hydrostatics	34	51
Hypergolic propellants	28	42
Hypersonic aerodynamics	02	3
Hypoxia (human)	52	74

I

Ice crystals (meteorology)	47	68
Icing (aircraft)	03	5
Identification of celestial bodies	89	106

Input Subject	Category	Page
Igniters (propellants)	28	42
Igniters (rocket engines).....	20	31
Ignition studies (propellants and fuels)	28	42
Ignition studies (general).....	25	36
Image enhancement	35	53
Impact phenomena.....	37	56
Impact testing	37	56
Incompressible flow	34	51
Indoor air pollution.....	45	65
Induction heating	34	51
Inductors (electric)	33	49
Industrial pollution	45	65
Industrial process control	31	45
Industrial safety procedures	31	45
Inertial navigation systems (aircraft).....	04	6
Inertial navigation systems (spacecraft).....	17	26
Inertial sensors and measurement units (aircraft)	04	7
Inertial sensors and measurement units (spacecraft).....	17	26
Inflatable structures (aircraft).....	05	9
Inflatable structures (spacecraft).....	18	28
In-flight simulation (aircraft).....	05	9
Information retrieval	82	101
Information science.....	82	101
Information storage.....	82	101
Information systems.....	82	101
Information theory	63	84
Infrared astronomy.....	89	106
Infrared gas analysis.....	25	36
Infrared imagery (remote sensing).....	43	62
Infrared optics	74	95
Infrared radiation effects (optical applications).....	74	95
Infrared sensors (aircraft).....	06	11
Infrared sensors (spacecraft).....	19	29
Infrared sensors	35	53
Infrared signatures (earth resources).....	43	62
Infrared signatures (optical applications)	74	95
Infrared spectra.....	74	95
Infrared spectrometry (atmosphere).....	46	67
Infrared telescopes.....	89	106
Injection systems (aircraft engines).....	07	13
Inlet aerodynamics	02	3
Inlet controls (aircraft engines)	07	13
Inlets (aircraft).....	07	13
Inlets (spacecraft).....	18	28
Inner Earth radiation belts.....	93	110
In-orbit maintenance, servicing and refueling	12	19
Inorganic chemistry.....	25	36
Input devices	60	80
Inspection (aircraft safety).....	03	5
Inspection	38	57
Inspection methods	38	57
Instrument arrangement (aircraft).....	06	11
Instrument arrangement (spacecraft).....	19	29
Instrument design (aircraft).....	06	11
Instrument design (spacecraft).....	19	29
Instrument design (theory and techniques)	35	53
Instrument displays (aircraft)	06	11
Instrument displays (spacecraft)	19	30
Instrument installation (aircraft).....	06	11
Instrument installation (spacecraft).....	19	30
Instrument landing systems (ILS).....	04	7

Input Subject	Category	Page
Instrument landing systems (ILS) displays	06	11
Instrument navigation systems.....	04	7
Instrument pointing systems (IPS).....	19	30
Instrumentation	35	53
Insulation (composite materials)	24	34
Insulation (electric, electronic).....	33	49
Insulation (nonmetallic materials).....	27	39
Insurance (aerospace).....	83	102
Integral equations.....	64	86
Integrated circuits.....	33	49
Interferometers	35	53
Intergalactic dust	90	107
Intergalactic gases	90	107
Intergalactic matter.....	90	107
Intergalactic radiation.....	93	110
Intermetallics	26	37
Intermolecular forces	72	93
Internal combustion engines (aircraft).....	07	13
Internal combustion engines (nonaircraft).....	37	56
Internal flow in ducts (applications).....	34	51
Internal flow in turbomachinery (applications).....	34	51
Internal flow in turbomachinery (theory)	02	3
International cooperation	84	103
International law.....	84	103
International Space Station (design)	18	28
Internet resources	82	101
Internets.....	62	83
Interplanetary dust.....	90	107
Interplanetary gases.....	90	107
Interplanetary matter	90	107
Interplanetary shock waves.....	90	107
Interplanetary Trajectories	13	20
Interpreters (software).....	61	82
Interstellar dust.....	90	107
Interstellar gases	90	107
Interstellar matter	90	107
Interstellar radiation.....	93	110
Inverters.....	33	49
Inviscid flow.....	34	51
Ion beams (nuclear interactions).....	73	94
Ion beams (plasma physics)	75	96
Ion beams (theory)	72	93
Ion dynamics	72	93
Ion exchange	72	93
Ion mass spectrometers.....	35	53
Ion propulsion	20	32
Ion rocket engines	20	32
Ionosphere (earth)	46	67
Ionospheric effects on radio transmission (aircraft)	04	7
Ionospheric effects on radio transmission (communications).....	32	47
Ionospheric electron density.....	46	67
Ionospheric physics	46	67
Ionospheric plasmas	46	67
Ionospheric propagation (communications)	32	47
Ionospheric scatter (communications).....	32	47
Ionospheric scintillation	46	67
Isolation effects (psychological, human)	53	75

Input Subject	Category	Page
---------------	----------	------

Iteration	64	86
-----------------	----	----

J

Jet engine fuels.....	28	42
Jet engines.....	07	13
Jet streams (meteorology).....	47	68
Joining.....	37	56

K

Kaons	77	98
Katabatic winds (also catabatic).....	47	69
Kerosene based fuels.....	28	42
Kinetics.....	70	91
Klystrons	33	49
Knowledge based systems	63	84
Knowledge representation	63	84

L

La Nina.....	47	69
Laminar flow (aerodynamics).....	02	3
Laminar flow (general)	34	51
Laminates	24	34
Land transportation vehicles (aerodynamics).....	02	3
Land transportation vehicles (development and technology)	85	104
Landing gear (aircraft)	05	9
Landing gear (spacecraft).....	18	28
Landing gear position indicators (aircraft).....	06	11
Landing gear position indicators (spacecraft)	19	30
LANDSAT (configurations).....	18	28
LANDSAT (remote sensing applications).....	43	62
Large deployable space antennas.....	32	47
Large Space Telescope.....	89	106
Laser altimeters (aircraft)	06	11
Laser altimeters (spacecraft)	19	30
Laser amplifiers	36	54
Laser Applications.....	36	54
Laser beams.....	36	54
Laser communications	32	47
Laser communications systems (aircraft)	04	7
Laser communications systems (spacecraft).....	17	26
Laser damage	36	54
Laser Doppler velocimet	35	53
Laser drilling (theory and techniques)	36	54
Laser instruments (aircraft).....	06	11
Laser instruments (design and operation).....	35	53
Laser instruments (spacecraft).....	19	30
Laser interaction with plasmas.....	75	96
Laser materials	36	54
Laser modulators.....	36	54
Laser optical radar	32	47
Laser optics	36	54
Laser radiation effects	36	54
Laser radiation hazards	36	54
Laser range finder facilities	14	21
Laser research	36	54
Laser space communications facilities.....	14	21
Laser theory.....	36	54

Input Subject	Category	Page
---------------	----------	------

Laser tracking systems (general).....	36	54
Laser tracking systems (spacecraft)	17	26
Laser welding	37	56
Lasers	36	54
Lasertrons.....	36	54
Lateral control (aircraft)	08	14
Lateral control (spacecraft)	18	28
Lateral stability (aircraft).....	08	14
Lateral stability (spacecraft)	18	28
Lattice vibrations.....	76	97
Launch complexes	14	22
Launch facilities	14	22
Launch operations.....	15	23
Launch pads and bases.....	14	22
Launch towers.....	14	22
Launch vehicle aerodynamics (for specific launch vehicles see	15	3
Launch vehicle auxiliary systems	15	23
Launch vehicle configurations.....	15	23
Launch vehicle design.....	15	23
Launch vehicle dynamics.....	15	23
Launch vehicle maintenance	12	19
Launch vehicle manufacturing	12	19
Launch vehicle navigation	17	26
Launch vehicle performance.....	15	23
Launch vehicle preparation.....	15	23
Launch vehicle production.....	12	19
Launch vehicle simulators	14	22
Launch vehicle stability.....	15	23
Launch vehicle testing	15	23
Launch vehicle Trajectories	13	20
Launch vehicles	15	23
Launch Vehicles and Space Vehicles).....	02	3
Launching dynamics	13	20
Law	84	103
Legal liability of commercial aviation.....	84	103
Legal liability of general aviation	84	103
Legal liability of manned space flight	84	103
Legal liability of unmanned space flight.....	84	103
Lens theory.....	74	95
Lenses (optical properties)	74	95
Lenses (photographic).....	35	53
Leptons.....	77	98
Lexicography.....	82	101
Library science	82	101
Lidar	32	47
Life detection.....	55	78
Life prediction.....	38	57
Life sciences.....	51	72
Life support	54	76
Life testing.....	38	57
Lifting bodies	05	9
Lifting body aerodynamics.....	02	3
Light absorption	74	95
Light emitting diodes (LED).....	33	49
Light gas guns (launch facilities)	14	22
Light gas guns (operations).....	15	23
Light reflection.....	74	95
Light scattering.....	74	95
Light transmission.....	74	95
Lighter-than-air craft (balloons, airships) aerodynamics	02	3
Lighter-than-air craft (balloons, airships) design	05	9

Input Subject	Category	Page
Lightning	47	69
Lightning discharge on aircraft	03	5
Lightweight structural elements	39	58
Lightweight structures	39	58
Limnology	43	62
Linear programming	66	88
Liquefied gases	31	45
Liquid crystals	76	97
Liquid fuels	28	42
Liquid hydrogen (propellants and fuels)	28	42
Liquid lasers	36	54
Liquid optics	74	95
Liquid oxygen (propellants and fuels)	28	42
Liquid petroleum gas (LPG)	28	42
Liquid propellant rocket engines	20	32
Liquid propellants	28	42
Liquid settling	34	51
Liquid sloshing	34	51
Lithergolic propellants	28	42
Lithography (circuit fabrication)	33	49
Lithology	46	67
Littoral regions	43	62
Local area networks (LAN)	62	83
Long range navigation system (LORAN)	04	7
Longitudinal control (aircraft)	08	14
Longitudinal control (spacecraft)	18	28
Longitudinal stability (aircraft)	08	14
Longitudinal stability (spacecraft)	18	28
Low pressure chemistry	25	36
Low speed aerodynamics	02	3
Low temperature effects (human)	52	74
Low temperature test facilities (aircraft)	09	17
Low temperature test facilities (space)	14	22
Low thrust engines	20	32
Lower atmosphere studies	46	67
Lubricants	27	39
Lubrication	37	56
Lubrication properties of nonmetallic materials	27	39
Luminescence (atomic physics)	72	93
Luminescence (chemistry)	25	36
Luminescence (optics)	74	95
Lunar and planetary bases	14	22
Lunar eclipses	92	109
Lunar exploration	91	108
Lunar gravity simulators	14	22
Lunar landers	18	28
Lunar mapping	91	108
Lunar orbiters	18	28
Lunar photography	91	108
Lunar roving vehicles	14	22
Lunar samples	91	108
Lunar structure	91	108

M

Mach meters	06	11
Machine elements	37	56
Machine learning	63	84
Machine processes	37	56
Machinery	37	56
Macrometeorology	47	69

Input Subject	Category	Page
Macromolecular crystallography (space processing)	29	43
Magellanic clouds	90	107
Maglev vehicles	85	104
Magnetic field effects (biological, animal and plant)	51	72
Magnetic field effects (human)	52	74
Magnetic field effects	55	78
Magnetism (extraterrestrial)	90	107
Magnetism (terrestrial)	46	67
Magnetism	70	91
Magnetogasdynamics	75	96
Magnetohydrodynamic (MHD) energy conversion devices	44	64
Magnetohydrodynamic (MHO) power sources	20	32
Magnetohydrodynamic (MHO) thrusters	20	32
Magnetohydrodynamics	75	96
Magnetoplasmas	75	96
Magnetosphere (earth)	46	67
Magnets (electrical, electronics application)	33	49
Main propulsion system components (spacecraft)	20	32
Main propulsion systems (spacecraft)	20	32
Mainframes	60	80
Maintainability (procedures and theory)	38	57
Maintenance (aircraft)	01	1
Maintenance (spacecraft)	12	19
Maintenance facilities (aircraft)	09	17
Maintenance facilities (space based, ground based)	14	22
Management	81	100
Management planning	81	100
Management research	81	100
Management tools	81	100
Maneuvering (aircraft)	08	14
Maneuvering (spacecraft)	18	28
Man-machine communications (aircraft)	04	7
Man-machine communications (spacecraft)	17	26
Man-machine communications (theory and techniques)	32	47
Man-machine systems	54	76
Manned flights (space exploration)	91	108
Manned lunar exploration	91	108
Manned maneuvering units	54	76
Manned orbital laboratories	18	28
Manned planetary exploration	91	108
Manned space flight network	17	26
Manned spacecraft	18	28
Man-system interfaces	54	76
Manuals (refer to appropriate category for manuals on specific subjects)	82	101
Manufacture of propellants	28	42
Manufacturing processes	37	56
Many-body problems	70	91
Mapping	43	63
Marine biology	48	70
Marine resources	48	70
Marketing predictions	83	102
Marketing research	83	102
Markov processes	65	87
Mars exploration	91	108
Martingales	65	87
Masers	36	54

Input Subject	Category	Page	Input Subject	Category	Page
Mass spectrometers.....	35	53	Microelectronics.....	33	49
Mass spectroscopy (application).....	25	36	Microfiche techniques.....	82	101
Mass transfer.....	34	51	Micrography.....	82	101
Mass transportation.....	85	104	Microgravity (space processing).....	29	43
Materials (general).....	23	33	Microgravity effects (biological, animal and plant).....	51	72
Materials fabrication.....	37	56	Microgravity effects (human).....	52	74
Materials forming.....	37	56	Micromachining.....	37	56
Materials handling.....	37	56	Micrometeoroid sensors (instrumentation).....	35	53
Materials manufacturing.....	37	56	Micrometeoroid sensors (spacecraft).....	19	30
Materials processing in space.....	29	43	Micrometeorology.....	47	69
Materials separation in space.....	29	43	Microminiaturization.....	33	49
Mathematical analysis.....	64	86	Microscopes.....	35	53
Mathematical logic.....	67	89	Microstructure of welded joints.....	26	37
Mathematical modeling (systems analysis).....	66	88	Microwave communications systems (aircraft).....	04	7
Mathematical programming.....	66	88	Microwave communications systems (application and design).....	32	47
Mathematical sciences (general).....	59	79	Microwave communications systems (spacecraft).....	17	26
Mathematical theories.....	67	89	Microwave energy conversion devices.....	44	64
Matrices.....	64	86	Microwave energy transmission.....	44	64
Maximum likelihood estimation.....	65	87	Microwave interaction with plasmas.....	75	96
Measuring instruments.....	35	53	Microwave Landing System (MLS).....	04	7
Mechanical computers.....	60	80	Microwave radiation (properties).....	32	47
Mechanical drawing.....	82	101	Microwave receivers (aircraft).....	04	7
Mechanical engineering.....	37	56	Microwave receivers (spacecraft).....	17	26
Mechanical equipment.....	37	56	Microwave receivers (theory and techniques).....	32	47
Mechanical properties (composite materials).....	24	34	Microwave techniques.....	32	47
Mechanical properties of alloys.....	26	37	Microwave theory.....	32	47
Mechanical properties of metals.....	26	37	Microwave transmitters (aircraft).....	04	7
Mechanical properties of nonmetallic materials.....	27	39	Microwave transmitters (spacecraft).....	17	26
Mechanical properties of propellants and fuels.....	28	42	Microwave transmitters (theory and techniques).....	32	47
Mechanics (practical).....	37	56	Mineral deposits.....	43	63
Mechanics (theory and analysis).....	70	91	Minerals (petrology).....	42	61
Memory devices (computer).....	60	80	Minicomputers.....	60	81
Mental adaptation to flight.....	53	75	Minimax techniques.....	65	87
Mesons.....	77	98	Missile aerodynamics.....	02	3
Metal based propellants and fuels.....	28	42	Missiles (performance).....	08	14
Metal crystals.....	26	37	Mission planning (space).....	12	19
Metal filament systems.....	24	34	Mixing of gases.....	34	51
Metal forming.....	37	56	Mixing of liquids.....	34	51
Metal matrix composites (MMC).....	24	34	Mobile lunar laboratories.....	14	22
Metallic fibers.....	26	37	Mobile planetary laboratories.....	14	22
Metallic materials.....	26	37	Mobile transporters.....	14	22
Metallography.....	26	37	Models (aircraft).....	05	9
Metallurgy.....	26	37	Models (spacecraft).....	18	28
Metals.....	26	37	Modems.....	60	81
Meteorite protection.....	18	28	Modulation (optics).....	74	95
Meteorites.....	91	108	Modulation (signals).....	32	47
Meteoroids (observation).....	89	106	Modulators (electric, electronic devices).....	33	49
Meteoroids.....	91	108	Molecular beams.....	72	93
Meteorological anomalies.....	47	69	Molecular collision theory.....	72	93
Meteorological parameters.....	47	69	Molecular energy.....	72	93
Meteorological satellite studies.....	47	69	Molecular interactions.....	72	93
Meteorological satellites.....	18	28	Molecular physics.....	72	93
Meteorological sounding rocket studies.....	47	69	Molecular properties.....	72	93
Meteorology.....	47	69	Molecular spectra.....	72	93
Meteors (observation).....	89	106	Molecular spectroscopy.....	72	93
Meteors.....	91	108	Molecular structure.....	72	93
Metrication.....	31	45	Momentum transfer (particle interactions).....	77	98
Metrology.....	31	45	Monopropellants.....	28	42
MHD generators.....	75	96	Monsoons.....	47	69
Microbiology.....	51	72	Monte Carlo method.....	65	87
Microbursts.....	47	69			
Microcircuits.....	33	49			
Microcomputers.....	60	80			

Input Subject	Category	Page
Moons (characteristics and composition)	91	108
Moons (observation)	89	106
Mossbauer effect	76	97
Motion sickness	52	74
Mounts (supports)	37	56
Multigrid methods	64	86
Multimode sensors	35	53
Multiphase flow	34	51
Multiphase materials processing in space	29	43
Multiprocessors (hardware)	60	81
Multispectral band scanners (remote sensing applications)	43	63
Multispectral sensors	35	53
Multistage launch vehicles	15	23
Multistage rockets	20	32
Multivariable control	63	84

N

Nanodevices (electronic)	33	49
Nanodevices (mechanical)	37	56
Natural satellites (characteristics and composition)	91	108
Natural satellites (observation)	89	106
Nature of life	55	78
Navier-Stokes equations	34	51
Navigation computer systems (aircraft)	04	7
Navigation computer systems (spacecraft)	17	26
Navigation display devices (aircraft)	04	7
Navigation display devices (design and development)	19	30
Navigation display devices (spacecraft)	17	26
Navigation instruments (design and development)	06	11
Navigation satellites	18	28
Navigation system design (aircraft)	04	7
Navigation system design (spacecraft)	17	26
Navigation systems (aircraft)	04	7
Navigation systems (spacecraft)	17	26
Nebulae (astrophysics)	90	107
Nebulae (observation)	89	106
Network analysis	66	88
Networks (circuitry)	33	49
Networks (communications)	32	47
Neutral networks	63	84
Neutrinos	77	98
Neutron properties	77	98
Neutron spectra	77	98
Nitrate based propellants and fuels	28	42
Noctilucent clouds	46	67
Noise abatement	45	65
Noise attenuation	71	92
Noise generation	71	92
Noise measurement	71	92
Noise pollution	45	65
Noise propagation	71	92
Noise reduction (aircraft engines)	07	13
Noise reduction (aircraft structures)	05	9
Noise reduction (general)	71	92
Nondestructive testing	38	57
Nondestructive testing instruments	35	53
Nonlinear optics	74	95

Input Subject	Category	Page
Nonmetallic fibers	27	39
Nonmetallic materials	27	39
Nose cones	15	23
Novae (astrophysics)	90	107
Novae (observation)	89	106
Nozzles (aircraft)	07	13
Nozzles (spacecraft)	20	32
Nuclear astrophysics	90	107
Nuclear decay	73	94
Nuclear engines (aircraft)	07	13
Nuclear engines (spacecraft application)	20	32
Nuclear engines (theory)	73	94
Nuclear fission	73	94
Nuclear fuels	73	94
Nuclear fusion (plasma physics)	75	96
Nuclear fusion (theory)	73	94
Nuclear magnetic resonance	73	94
Nuclear particles	73	94
Nuclear physics	73	94
Nuclear power sources (spacecraft application)	20	32
Nuclear power sources (theory)	73	94
Nuclear propulsion systems (aircraft)	07	13
Nuclear propulsion systems (spacecraft application)	20	32
Nuclear propulsion systems (theory)	73	94
Nuclear reactions	73	94
Nuclear reactor theory	73	94
Nuclear reactors	73	94
Nuclear research equipment	73	94
Nuclear rocket engines	20	32
Nuclear scattering	73	94
Nuclear structure	73	94
Nuclear test equipment	73	94
Number theory	67	89
Numerical analysis	64	86
Numerical integration	64	86

O

Observation of celestial bodies	89	106
Observation satellites	18	28
Observatories	89	106
Ocean circulation	48	70
Ocean currents	48	70
Ocean floor studies	48	70
Ocean wave studies	48	70
Oceanography	48	70
Offgassing/outgassing (composite materials)	24	34
Offgassing/outgassing (metallic materials)	26	37
Offgassing/outgassing (nonmetallic materials)	27	39
Omega navigation system	04	7
Omnidirectional radio range system (OMNI)	04	7
Onboard computer systems for aircraft	06	11
Onboard computer systems for spacecraft	19	30
Onboard instrument systems for spacecraft	19	30
Onboard sensors and recorders for spacecraft	19	30
Onboard solar arrays	20	32
Onboard solar generators	20	32
Operating systems (computers)	61	82
Operational effects of atmospheric variables (weather, buffeting, turbulence, wind shear) ..	08	14
Operations research	66	88

Input Subject	Category	Page
Operator theory (mathematics)	67	89
Optical bistability.....	74	95
Optical coatings.....	74	95
Optical communication (space)	17	26
Optical communications (applications).....	32	47
Optical communications (theory)	74	95
Optical fibers	74	95
Optical imaging devices (design and techniques)....	35	53
Optical imaging devices (theory)	74	95
Optical materials.....	74	95
Optical measuring instruments (design and techniques).....	35	53
Optical properties	74	95
Optical scanners (computer, peripheral equipment)	60	81
Optical telescope facilities	89	106
Optical telescopes.....	89	106
Optical tracking stations	14	22
Optical waveguides	74	95
Optics	74	95
Optimal control	63	84
Optimization (mathematics).....	66	88
Opto-acoustic electronics	33	49
Optoelectronics (applications).....	33	49
Optoelectronics (optics)	74	95
Orbit dynamics of spacecraft	13	20
Orbital maneuvers (control).....	17	26
Orbital maneuvers (trajectories).....	13	20
Orbital rendezvous	13	20
Orbiting maneuvering vehicles	16	24
Orbit-on-demand vehicles.....	15	23
Organic chemistry	25	36
Organometallic materials	25	36
Origin of life (extraterrestrial)	55	78
Origin of life (terrestrial)	51	72
Orography	43	63
Orotrons	36	54
Orthostatic tolerance	52	74
Oscillators.....	33	49
Oscilloscopes.....	35	53
Osmosis (biological).....	51	72
Osmosis (chemistry)	25	36
Outer Earth radiation belts.....	93	110
Output devices (computers).....	60	81
Overhaul facilities (aircraft)	09	17
Overhaul facilities (space).....	14	22
Oxidizers	28	42
Oxygen systems (life support)	54	76
Ozone depletion (atmospheric physics).....	46	67
Ozone depletion (pollution aspects).....	45	65

P

Packaging	37	56
Packing (machine elements).....	37	56
Packing (metallic materials).....	26	37
Packing (nonmetallic materials).....	27	39
Panels (structures).....	39	58
Paper.....	27	39
Parachute aerodynamics	02	3
Parachutes (personal and aircraft applications)	03	5
Parachutes (spacecraft applications).....	16	24
Parallel processing (hardware).....	60	81

Input Subject	Category	Page
Parallel processing.....	62	83
Parametric amplifiers	36	54
Particle physics	77	98
Passenger air transport operations	03	5
Passenger handling (air transportation)	03	5
Passenger handling (space transportation).....	16	24
Passenger transportation (air)	03	5
Passenger transportation (space).....	16	24
Passive communication satellites.....	18	28
Passive satellite stabilization	18	28
Passive sensors, trackers, and references (aircraft)	04	7
Passive sensors, trackers, and references (spacecraft).....	19	30
Patching compounds.....	27	40
Patent law.....	84	103
Patent policy.....	84	103
Pathology (human).....	52	74
Pattern recognition	63	84
Payload assist module (PAM).....	16	24
Payload delivery (space transportation)	16	24
Payload handling (space transportation)	16	24
Payload operations and support	14	22
Payload retrieval (space transportation).....	16	24
Perception (biological, human).....	52	74
Perception (psychological, human).....	53	75
Personal computers.....	60	81
PERT (Program Evaluation and Review Technique).....	81	100
Petrography	42	61
Petroleum deposits	43	63
Petrology	42	61
Pharmaceutical preparation (space processing).....	29	43
Pharmacology.....	52	74
Phase equilibrium.....	26	37
Phase shift keying (PSK)	32	47
Phased array radar.....	32	47
Photochemistry	25	36
Photoelasticity.....	39	58
Photoelectric devices.....	33	49
Photogrammetry.....	43	63
Photographic processing equipment.....	35	53
Photographic supplies	35	53
Photography.....	35	53
Photometry.....	35	53
Photomultipliers	33	49
Photon beams.....	74	95
Photon interactions with atoms and molecules	72	93
Photonics.....	74	95
Photosphere (solar)	92	109
Phototheodolites.....	35	53
Photovoltaic energy conversion devices	44	64
Physical chemistry.....	25	36
Physical oceanography.....	48	70
Physical properties of alloys.....	26	37
Physical properties of celestial bodies.....	90	107
Physical properties of metals.....	26	37
Physical properties of nonmetallic materials.....	27	40
Physical properties of propellants and fuels.....	28	42
Physics.....	70	91
Physiological effects of flight (human).....	52	74
Physiological factors (human)	52	74
Physiological monitoring devices (human).....	52	74

Input Subject	Category	Page
Physiological monitoring devices (theory and techniques).....	35	53
Physiology (human).....	52	74
Phytoplankton concentration.....	48	70
Piezoelectricity.....	76	97
Pilot performance.....	53	75
Pilot support systems (aircraft).....	06	11
Piloting (spacecraft).....	18	28
Piston engine fuels.....	28	42
Piston engines (aircraft).....	07	13
Piston engines (nonaircraft).....	37	56
Pitch control (aircraft).....	08	14
Pitch control (spacecraft).....	18	28
Pitch stability (aircraft).....	08	15
Pitch stability (spacecraft).....	18	28
Planet location.....	89	106
Planetary atmospheres.....	91	108
Planetary biology.....	55	78
Planetary exploration.....	91	108
Planetary landers.....	18	28
Planetary mapping.....	91	108
Planetary motion.....	91	108
Planetary orbiters.....	18	28
Planetary photography.....	91	108
Planetary probes.....	18	28
Planetary roving vehicles.....	14	22
Planetary samples.....	91	108
Planetary satellites (characteristics and composition).....	91	108
Planetary structure.....	91	108
Planetology.....	91	108
Plants.....	51	72
Plasma conductivity.....	75	96
Plasma diagnostics.....	75	96
Plasma dynamics.....	75	96
Plasma flow.....	75	96
Plasma fusion.....	75	96
Plasma oscillations.....	75	96
Plasma physics.....	75	96
Plasma physics research equipment.....	75	96
Plasma pinch.....	75	96
Plasma propulsion (spacecraft applications).....	20	32
Plasma propulsion (theory).....	75	96
Plasma seeding.....	75	96
Plasma sheath.....	75	96
Plasma spraying.....	37	56
Plasma theory.....	75	96
Plasma wakes (spacecraft).....	18	28
Plasma waves.....	75	96
Plasticity.....	39	58
Plastics.....	27	40
Plate tectonics.....	46	67
Plates (structural elements).....	39	58
Plating.....	37	56
Plotters.....	60	81
Plywoods.....	27	40
Pneumatic systems (aircraft propulsion and power).....	07	13
Pneumatic systems (aircraft).....	05	9
Pneumatic systems (general).....	37	56
Pneumatic systems (spacecraft propulsion and power).....	20	32
Pneumatic systems (spacecraft).....	18	28

Input Subject	Category	Page
Pneumatics.....	34	51
Pointing systems.....	19	30
Polarization (optics).....	74	95
Polarography (application).....	25	36
Political science.....	84	103
Pollution control.....	45	65
Pollution monitoring.....	45	65
Polymer matrix composites.....	24	34
Polymers (space processing).....	29	43
Polymers.....	27	40
Position indicators (aircraft).....	06	11
Position indicators (spacecraft).....	19	30
Position sensors.....	35	53
Powder metallurgy.....	26	38
Power amplifiers.....	33	49
Power packs (electric).....	33	49
Power plant instruments and gages (aircraft).....	06	11
Power supplies electric).....	33	49
Powered trajectories.....	13	20
Powered Trajectories.....	13	20
Powertrains.....	37	56
Precipitation (meteorology).....	47	69
Precision time and time interval (PTTI).....	35	53
Prediction analysis.....	65	87
Pressure test facilities (aircraft).....	09	17
Pressure test facilities (space).....	14	22
Pressure transducers.....	35	53
Pressure vessels.....	37	56
Pressurization systems (aircraft).....	05	9
Pressurization systems (spacecraft).....	18	28
Pressurized cabins (life support).....	54	76
Pressurized cabins (spacecraft).....	18	28
Pressurized cabins (aircraft).....	05	9
Printed circuits.....	33	49
Probability.....	65	87
Probability density functions.....	65	87
Processors (hardware).....	60	81
Production costs.....	83	102
Production forecasts.....	83	102
Program management.....	81	100
Programming (computers).....	61	82
Programming languages.....	61	82
Project documentation.....	82	101
Project management.....	81	100
Projectile Trajectories.....	13	20
Propellant flow systems (spacecraft).....	20	32
Propellant grains.....	28	42
Propellant injectors, pumps, and tanks (spacecraft).....	20	32
Propellants.....	28	42
Propeller aerodynamics.....	02	3
Propellers (tractor, pusher, contrarotating, propfan).....	07	13
Propulsion effects on launching, trajectories, and orbits.....	13	20
Propulsion system components (aircraft).....	07	13
Propulsion system components (spacecraft).....	20	32
Propulsion system instruments and gages (aircraft).....	06	11
Propulsion system instruments and gages (spacecraft).....	19	30
Propulsion systems (aircraft).....	07	13
Propulsion systems (spacecraft).....	20	32

Input Subject	Category	Page
Protection measures (human)	54	76
Protection of alloys	26	38
Protection of materials (metallic)	26	38
Protection of materials (nonmetallic)	27	40
Protective clothing	54	76
Protective coatings (metallic materials)	26	38
Protective coatings (nonmetallic)	27	40
Protobiological evolution	55	78
Protocol checking	61	82
Proton beams (nuclear interactions)	73	94
Psychological effects of flight	53	75
Psychological factors	53	75
Public nuisance implications	03	5
Pulsars (astrophysics)	90	107
Pulsars (observation)	89	106
Pulsejet engines	07	13
Pumps (aircraft engines and fuel systems)	07	13
Pumps (nonaircraft)	37	56
Pumps (spacecraft)	20	32
Pyrolysis	25	36
Pyrotechnics	28	42

Q

Quality assurance	38	57
Quality control	38	57
Quantum Chromodynamics (QCD)	77	98
Quantum Electrodynamics (QED)	77	98
Quantum generators	36	54
Quantum mechanics	77	98
Quarantine (animal and plant)	51	72
Quarantine (human)	52	74
Quarantine procedures	54	76
Quarks	77	98
Quasars (observation)	89	106
Quasars(astrophysics)	90	107
Queueing theory	66	88
Quiet engines (aircraft)	07	13

R

Radar (theory and techniques)	32	47
Radar absorbing materials	32	47
Radar antenna design	32	47
Radar antennas (theory and techniques)	32	47
Radar clutter	32	47
Radar communications systems (aircraft)	04	7
Radar communications systems (spacecraft)	17	26
Radar communications systems (theory and techniques)	32	47
Radar detection (aircraft navigation)	04	7
Radar detection (communications)	32	47
Radar detection (earth resources)	43	63
Radar detection (spacecraft navigation)	17	26
Radar imagery (aircraft navigation)	04	7
Radar imagery (communications)	32	47
Radar imagery (remote sensing)	43	63
Radar imagery (spacecraft navigation)	17	26
Radar receivers (theory and techniques)	32	47
Radar scattering	32	47
Radar telescope and range finder facilities	89	106

Input Subject	Category	Page
Radar telescopes	89	106
Radar tracking systems (aircraft)	04	7
Radar tracking systems (spacecraft)	17	26
Radar tracking systems (theory and techniques)	32	47
Radar transmitters (theory and techniques)	32	47
Radiation absorption by atoms	72	93
Radiation belts	93	110
Radiation chemistry	25	36
Radiation effects (biological, animal and plant)	51	72
Radiation effects (human)	52	74
Radiation effects in semiconductors	76	97
Radiation effects on spacecraft and components	18	28
Radiation instruments	35	53
Radiation safety measures (physiological)	54	76
Radiative transfer	34	51
Radiators (aerospace applications)	34	51
Radio (theory and techniques)	32	47
Radio antenna design	32	47
Radio antennas (theory and techniques)	32	47
Radio astronomy	89	106
Radio blackout (loss of communications)	17	26
Radio communication systems (theory and techniques)	32	47
Radio communications system (aircraft)	04	7
Radio communications systems (spacecraft)	17	26
Radio telescope facilities	89	106
Radio telescopes	89	106
Radioactive contamination	45	65
Radiobiography (human)	52	74
Radiobiology (human)	52	74
Radiography (quality control)	38	57
Radiography	35	53
Radioisotopes	73	94
Radomes (design)	32	47
Radomes (electrical properties)	33	49
Radomes (nonmetallic materials)	27	40
Rail accelerators, railguns, launchers (applications)	14	22
Rail accelerators, railguns, launchers (theory)	33	49
Rain	47	69
Ramjet engines (aircraft)	07	13
Random access memories	60	81
Random sampling	65	87
Range and angle measurement (aircraft)	04	7
Range and angle measurement (spacecraft)	17	26
Range safety	14	22
Rapid transit systems	85	104
Rate of climb indicators	06	11
Rayleigh-Ritz method	64	86
Reaction wheels	37	56
Reactor radiation safety measures (space applications)	73	94
Reactor theory	73	94
Read-only memories	60	81
Reciprocating engines (aircraft)	07	13
Reciprocating engines (nonaircraft)	37	56
Recording devices (aircraft)	06	11
Recording devices (spacecraft)	19	30
Recording devices	35	53
Recovery equipment and vehicles	14	22
Recovery of spacecraft	16	24
Rectifiers	33	49

Input Subject	Category	Page
Reduced gravity effects (biological, animal and plant).....	51	72
Reduced gravity effects (materials).....	29	43
Reduced gravity effects (physiological, human).....	52	74
Redundancy systems.....	38	57
Reentry dynamics.....	13	20
Reentry launch vehicles.....	15	23
Reentry Trajectories.....	13	20
Reentry vehicle aerodynamics.....	02	3
Refraction (optics).....	74	95
Refractory materials.....	26	38
Refrigeration.....	37	56
Refueling in orbit.....	20	32
Regression analysis.....	65	87
Regulators (voltage, current).....	33	49
Reinforcing fibers (composite materials).....	24	34
Reinforcing filaments (metallic materials).....	26	38
Reinforcing filaments (nonmetallic).....	27	40
Reliability (procedures and theory).....	38	57
Reliability criteria.....	38	57
Remote exploration of planets.....	91	108
Remote input equipment.....	60	81
Remote launch monitoring facilities.....	14	22
Remote manipulator arms (human interface).....	54	77
Remote manipulator arms (robotics).....	63	84
Remote readout equipment.....	60	81
Remote sensing of earth resources.....	43	63
Remote sensors.....	35	53
Remote terminals.....	60	81
Remotely piloted vehicles (RPV).....	05	9
Rendezvous guidance.....	17	26
Repair facilities (aircraft).....	09	17
Repair facilities (space based, ground based).....	14	22
Reproduction of extraterrestrial life.....	55	78
Reprography.....	82	101
Research facilities (aircraft).....	09	17
Research facilities (space).....	14	22
Research management.....	81	100
Research on metallic materials.....	26	38
Research on nonmetallic materials.....	27	40
Research planning.....	81	100
Residential pollution.....	45	65
Resistors.....	33	49
Restraint harness (aircraft).....	03	5
Restraint harness (spacecraft).....	16	24
Retrorockets.....	20	32
Reusable vehicles.....	15	23
Rheology.....	34	51
Riemann surfaces.....	67	89
Rings (structures).....	39	58
Riveted joints.....	39	58
Robot control.....	63	84
Robot dynamics.....	63	84
Robot sensors.....	63	84
Robot vision.....	63	84
Robotics (hardware).....	37	56
Robotics.....	63	84
Rocket aerodynamics.....	15	3
Rocket engine design.....	20	32
Rocket engine exhaust plumes.....	20	32
Rocket engine noise.....	20	32
Rocket engine test pads.....	14	22
Rocket engines (aircraft).....	07	13

Input Subject	Category	Page
Rocket engines (spacecraft).....	20	32
Rocket launchers.....	15	23
Rocket propellants.....	28	42
Rocket sleds.....	14	22
Rocket test facilities.....	14	22
Rocket throttling systems.....	20	32
Rocket/balloon geophysical studies.....	46	67
Rockets.....	15	23
Rogallo wing aerodynamics.....	02	3
Roll control (aircraft).....	08	15
Roll control (spacecraft).....	18	28
Roll stability (aircraft).....	08	15
Roll stability (spacecraft).....	18	28
Rollers.....	37	56
Rotary engines (aircraft).....	07	13
Rotary engines (nonaircraft).....	37	56
Rotary wing aircraft aerodynamics.....	02	3
Rotor aerodynamics.....	02	3
Rover vehicles.....	14	22
Rubber.....	27	40
Runge-Kutta method.....	64	86
Runway approach lighting and markers.....	09	17
Runway construction.....	09	17
Runway lighting.....	09	17
Runway surfaces and grooving.....	09	17
Runways.....	09	17

S

Safety procedures (engineering).....	31	45
Safety systems (aircraft).....	03	5
Safety systems (spacecraft).....	16	24
Sailplane aerodynamics.....	02	3
Salinity (oceanography).....	48	70
Sampling techniques (quality control).....	38	57
Sampling techniques (statistics).....	65	87
Sandwich structures.....	39	59
Satellite communications (earth communications).....	32	47
Satellite launching dynamics.....	15	23
Satellite networks (earth communications).....	32	47
Satellite stabilization.....	18	28
Satellites for air, land, or sea navigation.....	18	28
Satellites for air, land, or sea traffic control.....	18	28
Scatterometers (design and techniques).....	35	53
Scatterometers (remote sensing applications).....	43	63
Scene analysis (robotics).....	63	84
Schlieren optics.....	74	95
Scientific satellites.....	18	28
Scramjet engines (aircraft).....	07	13
Sea ice.....	48	70
Sea navigation (aircraft related).....	04	7
Sea water.....	48	70
Sealants (metallic materials).....	26	38
Sealants (nonmetallic materials).....	27	40
Seals (stoppers).....	37	56
Search and rescue operations (air).....	03	5
Search and rescue operations (communications).....	17	26
Search and rescue operations (space).....	16	24
Search and rescue satellites.....	18	28
SEASAT (configurations).....	18	28
SEASAT (remote sensing applications).....	43	63

Input Subject	Category	Page
Seasonal variations.....	47	69
Seat belts (aircraft).....	03	5
Sediments (oceanography).....	48	70
Seismology.....	46	67
Selenography.....	91	108
Selenology.....	91	108
Self-repairing computer systems.....	62	83
Semiconductor devices.....	33	49
Semiconductor lasers.....	36	54
Semiconductor materials.....	76	97
Sensors.....	35	53
Sensors for aircraft equipment and operation.....	06	11
Sensors for spacecraft equipment.....	19	30
Sensory deprivation (physiological effects, human).....	52	74
Sensory deprivation (psychological effects, human).....	53	75
Sensory organs (human).....	52	74
Separation and staging techniques (for stages of launch vehicles).....	15	23
Separation and staging techniques (spacecraft).....	18	28
Separations chemistry.....	23	33
Service life.....	38	57
Service life of propellants and fuels.....	28	42
Servomechanisms (electrical aspects).....	33	49
Servomechanisms (mechanical aspects).....	37	56
Set theory.....	67	89
Severe storms (aircraft safety).....	03	5
Sewage disposal.....	85	104
Shafts (machine elements).....	37	56
Shear loads.....	39	59
Shear strength (composite materials).....	24	34
Shear strength (metallic materials).....	26	38
Shear strength (structures).....	39	59
Sheer strength (nonmetallic materials).....	27	40
Shells (structures).....	39	59
Shock testing (quality control).....	38	57
Shock testing (structural analysis).....	39	59
Shock tube instruments.....	35	53
Shock tubes and tunnels.....	09	17
Shock waves.....	34	51
Short pulsed lasers.....	36	54
Shoulder harness (aircraft).....	03	5
Shoulder harness (spacecraft).....	16	24
Shuttle Imaging Radar (earth resources).....	43	63
Shuttle imaging radar (theory and techniques).....	17	26
Shuttlecraft landing facilities.....	14	22
Side looking radar (earth resources).....	43	63
Side looking radar (theory and techniques).....	32	47
Signal analyzers.....	32	47
Signal decoding.....	32	47
Signal detection.....	32	47
Signal encoding.....	32	47
Signal generators (applications).....	33	49
Signal generators (theory and techniques).....	32	47
Signal modulators.....	32	47
Signal processing.....	32	47
Signature analysis (earth resources).....	43	63
Silicon cells (applications).....	44	64
Silicon cells (electrical properties).....	33	49
Silicon materials.....	27	40
Simulators (aircraft).....	09	17
Simulators (space).....	14	22

Input Subject	Category	Page
Single-stage launch vehicles.....	15	23
Sintering (metallic materials).....	26	38
Skin friction.....	34	51
Skin temperature indicators (aircraft).....	06	11
Skin temperature indicators (spacecraft).....	19	30
Sleep deprivation (physiological effects, human)....	52	74
Sleep deprivation (psychological effects, human) ...	53	75
S-matrix theory.....	77	98
Sneak circuit analysis.....	33	49
Snow.....	47	69
Snow and ice observations.....	43	63
Social interaction.....	53	75
Social sciences.....	80	99
Sociological research (humanities).....	80	99
Sociological research (psychology, human).....	53	75
SODAR (sound detection and ranging).....	71	92
Software debugging.....	61	82
Software engineering.....	61	82
Soil identification.....	43	63
Soil mechanics.....	46	67
Soil pollution.....	45	65
Soil sampling and analysis (extraterrestrial life)....	55	78
Soil sampling and analysis (planetology).....	91	108
Solar activity.....	92	109
Solar atmosphere.....	92	109
Solar cells (electrical design).....	33	49
Solar cells (energy conversion).....	44	64
Solar constants.....	92	109
Solar corona.....	92	109
Solar cycles.....	92	109
Solar density.....	92	109
Solar eclipses.....	92	109
Solar flares.....	92	109
Solar heating (space applications).....	44	64
Solar heating simulators.....	14	22
Solar magnetic field.....	92	109
Solar mass.....	92	109
Solar physics.....	92	109
Solar power (space applications).....	44	64
Solar radiation.....	92	109
Solar radio emissions.....	92	109
Solar sails.....	20	32
Solar simulators.....	14	22
Solar spectra.....	92	109
Solar state circuitry.....	33	49
Solar structure.....	92	109
Solar System bodies.....	91	108
Solar System evolution.....	90	107
Solar wind.....	92	109
Solar-atmosphere interactions.....	46	67
Solar-atmospheric interactions.....	47	69
Solid propellant curing.....	28	42
Solid propellant rocket engines.....	20	32
Solid propellants.....	28	42
Solid state devices.....	33	49
Solid state lasers.....	36	54
Solid state physics.....	76	97
Solidification (solid state).....	76	97
Solitary waves.....	70	91
Solvents.....	27	40
Sonic boom (aerodynamically generated).....	02	3
Sonic boom (noise pollution).....	45	65
Sonic boom (theory).....	71	92

Input Subject	Category	Page
Sound absorption	71	92
Sound attenuation	71	92
Sound generation	71	92
Sound generation in ducts.....	71	92
Sound propagation	71	92
Sound transmission.....	71	92
Sounding rockets.....	15	23
Space adaptation (physiological, human)	52	74
Space adaptation (psychological effects, human).....	53	75
Space based data acquisition stations.....	17	26
Space based data acquisition systems	17	26
Space based equipment for space processing	29	43
Space based maintenance and servicing.....	12	19
Space Biology.....	55	78
Space cabin atmosphere.....	54	77
Space cabin atmosphere sensors	19	30
Space cabin oxygen supplies.....	54	77
Space cabin water supplies.....	54	77
Space colonies.....	12	19
Space colonization.....	12	19
Space commercialization (legal aspects).....	84	103
Space commercialization (management).....	81	100
Space commercialization (space processing).....	29	43
Space communications	17	26
Space communications networks.....	17	26
Space debris (spaceflight hazard).....	16	24
Space environment effects (biological, animal and plant)	51	72
Space environment effects (physiological, human).....	52	74
Space exploration (mission planning).....	12	19
Space facility for cryogenic materials	14	22
Space flight commercialization	16	24
Space flight communication techniques and theory	17	26
Space flight dynamics (performance and testing)....	18	28
Space flight dynamics (theory)	13	20
Space flight feeding.....	54	77
Space flight hazards	16	24
Space flight navigation techniques and theory	17	26
Space geodesy.....	46	67
Space hygiene.....	54	77
Space laboratories.....	18	28
Space law	84	103
Space manufacturing and assembly.....	12	19
Space navigation	17	26
Space operation emergencies	16	24
Space plasmas	90	107
Space platforms.....	18	28
Space policy.....	84	103
Space power reactors (application)	20	32
Space probes.....	18	28
Space processing of materials	29	43
Space programs	12	19
Space radiation.....	93	110
Space rescue.....	16	24
Space research facilities	14	22
Space sanitation.....	54	77
Space sciences (general)	88	105
Space shuttle operations.....	16	24
Space simulators.....	14	22
Space station control	18	28
Space station design.....	18	28

Input Subject	Category	Page
Space Station Information System.....	82	101
Space stations	18	28
Space storable propellants	28	42
Space suits.....	54	77
Space technology applications to urban problems	85	104
Space tracking and data acquisition network (STADAN)	17	26
Space transportation.....	16	24
Space transportation economics.....	83	102
Space vacuum simulators.....	14	22
Space vehicle maintenance	12	19
Space vehicle manufacturing.....	12	19
Space vehicle production	12	19
Spaceborne astronomy.....	89	106
Spaceborne computers	60	81
Spacecraft aerodynamics.....	18	3
Spacecraft antennas.....	18	28
Spacecraft auxiliary power sources.....	20	32
Spacecraft cabins.....	18	28
Spacecraft charging.....	18	28
Spacecraft command.....	17	26
Spacecraft communications	17	26
Spacecraft components	18	28
Spacecraft control (communications).....	17	26
Spacecraft control (design and performance).....	18	28
Spacecraft control computer systems.....	19	30
Spacecraft design	18	28
Spacecraft Design, Testing and Performance)	02	3
Spacecraft ditching.....	16	24
Spacecraft engine design.....	20	32
Spacecraft environmental control	18	28
Spacecraft external contamination.....	18	28
Spacecraft flight simulation	18	28
Spacecraft flight tests	18	28
Spacecraft hydraulic systems (power)	20	32
Spacecraft instruments	19	30
Spacecraft maintenance	12	19
Spacecraft maintenance facilities	14	22
Spacecraft manufacturing	12	19
Spacecraft navigation.....	17	26
Spacecraft orbits.....	13	20
Spacecraft performance	18	28
Spacecraft pneumatic systems (power).....	20	32
Spacecraft power systems	20	32
Spacecraft production	12	19
Spacecraft production facilities	14	22
Spacecraft propulsion.....	20	32
Spacecraft retrieval.....	16	24
Spacecraft simulation.....	18	28
Spacecraft simulators	14	22
Spacecraft sterilization (interior).....	54	77
Spacecraft structures	18	28
Spacecraft systems	18	28
Spacecraft systems monitoring instruments	19	30
Spacecraft testing	18	28
Spacecraft thermal control	18	28
Spacecraft tracking.....	17	26
Spacecraft Trajectories.....	13	20
Spacecraft vehicle booster engines	20	32
Spacelab (design and testing).....	18	28
Spaceport planning.....	14	22
Spaceports	14	22

Input Subject	Category	Page
Spacepower reactors (theory).....	73	94
Spark ignition engines (aircraft).....	07	13
Spark ignition engines (nonaircraft)	37	56
Spectral analysis instruments	35	53
Spectral methods (mathematics).....	64	86
Spectrometers.....	35	53
Spectrophotometers.....	35	53
Spectrophotometry (application).....	25	36
Spectroscopes.....	35	53
Spectroscopic analysis (chemistry)	23	33
Spectroscopic chemical analysis (application)	25	36
Spectroscopy (astronomy).....	89	106
Speech analysis (aircraft voice communication).....	04	7
Speech analysis (electromagnetic aspects).....	32	47
Speech analysis (spacecraft voice communications)	17	26
Speech compression (aircraft voice communication).....	04	7
Speech compression (spacecraft voice communications)	17	26
Speech data compression (communications).....	32	47
Speech recognition.....	63	84
Spin recovery.....	08	15
Spline functions.....	64	86
Spontaneous generation of life.....	55	78
Sprays.....	34	51
Springs (mechanical).....	37	56
Stability (aircraft).....	08	15
Stability (spacecraft).....	18	28
Stability augmentation (aircraft)	08	15
Stability augmentation (spacecraft).....	18	28
Stability derivatives (aircraft)	08	15
Stability derivatives (spacecraft)	18	28
Stabilization surfaces (aerodynamics).....	02	3
Stabilization surfaces (aircraft).....	08	15
Stabilization surfaces (spacecraft).....	18	28
Stacking sequence (composite materials)	24	34
Stall indicators.....	06	11
Star trackers (navigation).....	19	30
Star trackers (observation)	89	106
Stars (astrophysics)	90	107
Stars (observation)	89	106
Static stability (aircraft)	08	15
Static stability (spacecraft)	18	28
Station keeping.....	17	26
Statistical physics	77	98
Statistical techniques.....	65	87
Statistics.....	65	87
Stellar evolution	90	107
Stellar luminosity.....	90	107
Stellar magnetic fields.....	90	107
Stellar mass accretion.....	90	107
Stellar physics.....	90	107
Stellar radiation	93	110
Stellar spectroscopy.....	89	106
Stellar systems.....	90	107
Stellarators.....	75	96
Stirling cycle engines (aircraft)	07	13
Stirling cycle engines (nonaircraft)	37	56
Stochastic processes.....	65	87
STOL aerodynamics	02	3
Storage facilities for propellants and cryogenics.....	14	22
Storage of propellants and fuels.....	28	42

Input Subject	Category	Page
Storm cells.....	47	69
Strain gags.....	35	53
Stratosphere.....	46	67
Stratospheric circulation.....	46	67
Stratospheric pollution	45	65
Stress (physiological effects, human)	52	74
Stress (psychological effects, human).....	53	75
Stress (structural)	39	59
Stress analysis.....	39	59
Stress corrosion cracking	26	38
Stress effects of atmospheric flight (physiological, human)	52	74
Stress effects of space flight (physiological, human).....	52	74
String theory.....	77	98
Strong interactions (field theory)	77	98
Structural Analysis	39	59
Structural design	39	59
Structural elements.....	39	59
Structural fatigue.....	39	59
Structural mechanics.....	39	59
Structural testing	39	59
Structural theory.....	39	59
Structural vibration effects.....	39	59
Structures test facilities (aircraft)	09	17
Structures test facilities (space).....	14	22
Subsonic aerodynamics.....	02	3
Sun	92	109
Sunspots	92	109
Superchargers (aircraft engines)	07	13
Supercomputers	60	81
Superconducting materials.....	76	97
Superconductivity (applications).....	33	49
Superconductivity (theory).....	76	97
Supercritical airfoils.....	02	3
Supercritical wings.....	02	3
Supergravity (field theory)	77	98
Supergravity (astrophysics).....	90	107
Supernovae (astrophysics)	90	107
Supernovae (observation)	89	106
Supersonic aerodynamics.....	02	3
Superstring theory.....	77	98
Supersymmetry	77	98
Support facilities (aircraft).....	09	17
Support facilities.....	14	22
Surface acoustic wave devices (theory).....	71	92
Surface exploration vehicles	14	22
Surface hardening of metals	26	38
Surface properties (composite materials).....	24	34
Surface properties (metallic materials).....	26	38
Surface properties (nonmetallic materials)	27	40
Surface transportation	85	104
Surface wave acoustic devices (electronic design).....	33	49
Survival (aircraft operations).....	03	5
Survival (space operations)	16	24
Swingby maneuver	13	20
Switches	33	49
Switching circuits.....	33	49
Switching theory	33	49
Symmetry breaking.....	77	98
Synchronous satellites.....	18	28
Synoptic meteorology.....	47	69

Input Subject	Category	Page
Synthetic aperture radar	32	47
Systems analysis.....	66	88
Systems for adverse weather avoidance	04	7
Systems for collision avoidance	04	7
Systems for energy conversion (spacecraft)	20	32

T

Tactical air navigation system (TACAN)	04	7
Tail surfaces	05	9
Tape recorders.....	35	53
Target acquisition.....	06	11
Target-signature modeling (aircraft)	06	11
Target-signature modeling (spacecraft)	17	26
TAV (transatmospheric vehicles) (aircraft)	05	9
Taxing (aircraft)	03	5
Technical writing	82	101
Technology transfer	85	104
Technology utilization.....	85	104
Tectonics	46	67
Tektites.....	91	108
Telemedicine	51	72
Telemetry (aircraft applications)	04	7
Telemetry (spacecraft applications)	17	26
Telemetry (theory and techniques)	32	47
Telemetry devices (aircraft)	06	11
Telemetry devices (spacecraft).....	19	30
Teleoperators (human interface).....	54	77
Teleoperators (robotics)	63	85
Telescopes (operation)	89	106
Telescopes (optical properties).....	74	95
Television systems (aerospace applications).....	32	47
Temperature effects (biological, animal and plant)	51	72
Temperature effects (human)	52	74
Temperature measuring instruments	35	53
Temperature test facilities (aircraft).....	09	17
Temperature test facilities (space).....	14	22
Temperature variations (meteorology).....	47	69
Temperature variations (oceanography).....	48	70
Temperature-pressure phenomena	34	51
Tensile strength (composite materials)	24	34
Tensile strength (metallic materials).....	26	38
Tensile strength (nonmetallic materials).....	27	40
Tensile strength (structures)	39	59
Tension loads	39	59
Terrain avoidance systems.....	04	7
Terrain clearance indicators	06	11
Terrain following	04	7
Terrestrial planets.....	91	108
Test equipment (electrical properties).....	33	49
Test facilities (aircraft)	09	17
Test facilities (space).....	14	22
Test facility instruments	35	53
Test range facilities	14	22
Test ranges	14	22
Testing of alloys	26	38
Testing of materials (composite materials).....	24	34
Testing of materials (metallic materials).....	26	38
Testing of materials (nonmetallic)	27	40
Testing of propellants and fuels	28	42
Tethered satellite systems.....	18	28

Input Subject	Category	Page
Textiles.....	27	40
Thematic mapping	43	63
Theoretical mathematics	67	89
Theoretical physics.....	77	98
Theories of atomic physics.....	72	93
Theories of molecular physics	72	93
Theory of relativity.....	77	98
Thermal characteristics	28	42
Thermal pollution.....	45	65
Thermal protection sensors.....	19	30
Thermal radiation.....	34	51
Thermal stress	39	59
Thermionic energy conversion devices	44	64
Thermochemistry.....	25	36
Thermoclines (oceanography)	48	70
Thermocouples (design and techniques)	35	53
Thermodynamic properties	34	51
Thermodynamics	34	51
Thermoelasticity (structural materials)	39	59
Thermoelectric materials.....	76	97
Thermoelectricity	44	64
Thixotropic propellants	28	42
Throttle controls (aircraft).....	07	13
Throttle controls (nonaircraft).....	37	56
Thrust reverser controls	07	13
Thrust reversers (aircraft engines)	07	13
Thrust vector control devices (spacecraft).....	20	32
Thunderstorms	47	69
Thyratrons.....	33	49
Tilt rotor aircraft.....	05	9
Timber inventory.....	43	63
Time measurement equipment	35	53
Time series analysis.....	65	87
Tires (aircraft)	05	9
Tokamak devices.....	75	96
Tomography (design and techniques)	35	53
Tomography (medical applications).....	52	74
Tomography (optics).....	74	95
Tools.....	37	56
Topology	67	89
Tornadoes.....	47	69
Toxicology (human).....	52	74
Tracking and communications installations (aircraft)	09	17
Tracking and communications installations (spacecraft).....	17	26
Tracking and data relay satellites	18	28
Tracking networks	17	26
Tracking stations	17	26
Trajectory analysis.....	13	20
Trajectory optimization	13	20
Transatmospheric vehicles (TAV) (aircraft).....	05	9
Transducers (applications)	35	53
Transducers	33	49
Transfer of responsibility (space applications).....	84	103
Transformers.....	33	49
Transistors.....	33	49
Transition Flight.....	05	9
Transitional flow (aerodynamics)	02	3
Transitional flow (general).....	34	51
Transmission lines.....	33	49
Transmitters (theory and techniques)	32	47
Transonic aerodynamics	02	3

Input Subject	Category	Page
Transpiration cooling	34	51
Transportation funding forecasts (aerospace).....	83	102
Transportation pollution.....	45	65
Traveling wave tubes	33	49
Treaties.....	84	103
Tribology.....	37	56
Triodes.....	33	49
Tropospheric scatter (electromagnetic effects).....	32	47
Trusses	39	59
Tunable lasers	36	54
Tunnel diodes.....	33	49
Turbine blade cooling	07	13
Turbine blade vibration.....	07	13
Turbine engines (nonaircraft)	37	56
Turbines (aircraft engines).....	07	13
Turbofan engines	07	13
Turboprop engines	07	13
Turborocket engines (aircraft)	07	13
Turborocket engines (spacecraft).....	20	32
Turbulence models.....	34	51
Turbulent flow (aerodynamics)	02	3
Turbulent flow (general).....	34	51
Turn and bank indicators	06	11
Two-and three-body problems (trajectory analysis)	13	20
Two-gas sensors (general)	35	53
Two-gas sensors (spacecraft).....	19	30
Typhoons.....	47	69

U

Ultra bypass engines	07	13
Ultralight aircraft (aerodynamics).....	02	3
Ultrasonic applications	71	92
Ultrasonic testing (quality control)	38	57
Ultrasonic testing equipment	35	53
Ultrasonic theory.....	71	92
Ultraviolet astronomy.....	89	106
Ultraviolet radiation (optics)	74	95
Ultraviolet radiation (space).....	93	110
Umbilical towers	14	22
Underwater acoustics.....	71	92
Unfoldable structures (spacecraft)	18	28
Unified field theory.....	77	98
Universe	90	107
Unmanned flights (space exploration).....	91	108
Unmanned lunar exploration	91	108
Unmanned planetary exploration.....	91	108
Unsteady flow (aerodynamics)	02	3
Unsteady flow (general).....	34	51
Upper atmosphere studies.....	46	67
Urban technology.....	85	104
Urban transportation	85	104

V

Vacuum arc melting.....	26	38
Vacuum chemistry.....	25	36
Vacuum forming.....	37	56
Vacuum technology.....	31	45
Vacuum test facilities.....	14	22

Input Subject	Category	Page
Vacuum tubes	33	49
Valves.....	37	56
Van Allen belts.....	93	110
Vaporization of propellants and fuels	28	42
Variational methods	64	86
Vector control engines (spacecraft)	20	32
Vernier engines (spacecraft)	20	32
Very high frequency omnirange (VOR) navigation.....	04	7
Very Large Scale Integration (VLSI).....	33	49
Very Long Base Interferometry (applications)	43	63
Very Long Baseline Interferometry (geophysics applications).....	46	67
Vestibular effects (human)	52	74
VHSIC.....	33	49
Vibration (aircraft)	08	15
Vibration (structures).....	39	59
Vibration testing.....	39	59
Vidicon cameras.....	35	53
Viking space probe.....	18	28
Viscoelasticity (structural materials)	39	59
Viscous flow	34	51
Visual acuity.....	52	74
Voice command for aircraft	08	15
Voice communications	32	47
Voice communications systems (aircraft).....	04	7
Voice communications systems (spacecraft).....	17	26
Volcanoes.....	46	67
Vortices (general).....	34	51
VSTOL aerodynamics	02	3
VTOL aerodynamics.....	02	3

W

Wakes (effects of turbulent flow behind aircraft)....	02	3
Warning lights (spacecraft).....	19	30
Warning systems (aircraft).....	06	11
Waste products conversion (aerospace vehicles)....	54	77
Waste products conversion (urban technology)	85	104
Waste products disposal (aerospace vehicles).....	54	77
Waste products disposal (urban technology)	85	104
Waste products storage (aerospace vehicles).....	54	77
Waste treatment (development and technology)	85	104
Waste treatment (pollution control)	45	65
Water pollution.....	45	65
Water resources.....	43	63
Water treatment (development and technology).....	85	104
Water treatment (pollution control)	45	65
Wave phenomena (oceanography)	48	70
Wave propagation (acoustic).....	71	92
Wave propagation (aircraft communications effects)	04	7
Wave propagation (electromagnetic)	32	47
Wave propagation (optics)	74	95
Wave propagation (spacecraft communications effects)	17	26
Wave propagation (structural response)	39	59
Waveguides	33	49
Weak interactions (field theory).....	77	98
Weather forecasting	47	69
Weather modification.....	47	69
Weather satellites	18	28

Input Subject	Category	Page
Weight analysis	39	59
Weightlessness effects (biological, animal and plant)	51	72
Weightlessness effects (physiological, human)	52	74
Weightlessness effects (psychological, human).....	53	75
Weibull distributions	65	87
Weld strength	39	59
Welded joints (microstructure)	26	38
Welded structures.....	39	59
Welding techniques.....	37	56
Wheels (aircraft).....	05	9
Whisker composites	24	34
Whiskers (composite materials)	24	34
Whiskers (metallic materials).....	26	38
Whiskers (nonmetallic materials).....	27	40
Whistlers (electromagnetic)	32	47
Whistlers (plasma physics).....	75	96
Whistlers (upper atmosphere).....	46	67
Wide area networks (WAN)	62	83
Wind.....	47	69
Wind shear	47	69
Wind tunnel instruments.....	35	53
Wind tunnel test facilities (aircraft).....	09	17
Wind tunnel test facilities (launch and space vehicles)	14	22
Wind tunnel tests (aerodynamics).....	02	3
Wind tunnel tests (aircraft and components).....	05	9
Wind tunnel tests (launch and space vehicles)	14	22
Wind tunnel tests (propulsion systems)	07	13
Wind tunnel tests (spacecraft).....	18	28
Wind tunnel tests (stability and control)	08	15
Windpower	44	64
Wing aerodynamics.....	02	3
Wing rock.....	08	15

Input Subject	Category	Page
Wing-body combinations (aircraft design).....	05	9
Wing-body combinations (stability and control).....	08	15
Wing-nacelle combinations (aircraft design)	05	9
Wing-nacelle combinations (stability and control).....	08	15
Wings	05	9
Woods	27	40
Woven composites	24	34

X

X-ray astronomy.....	89	106
X-ray optics	74	96
X-ray radiation (space).....	93	110
X-ray radiation (theory).....	73	94
X-ray telescopes	89	106
X-ray tubes	33	49

Y

Yaw control (aircraft).....	08	15
Yaw control (spacecraft).....	18	28
Yaw stability (aircraft)	08	15
Yaw stability (spacecraft).....	18	28

Z

Zero gravity effects (biological, animal and plant)	51	72
Zero gravity effects (physiological, human)	52	74
Zodiacal light.....	89	106