ORDER

6880.1

# U.S. NATIONAL AVIATION STANDARD FOR THE GLOBAL POSITIONING SYSTEM STANDARD POSITIONING SERVICE

August 16, 1993

## U.S. DEPARTMENT OF TRANSPORTATION
## FEDERAL AVIATION ADMINISTRATION

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# RECORD OF CHANGES

DIRECTIVE NO. 6880.1

| CHANGE TO BASIC | SUPPLEMENT | | | OPTIONAL | CHANGE TO BASIC | SUPPLEMENTS | | | OPTIONAL |
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# FOREWORD

The Global Positioning System (GPS) is scheduled for an initial operational capability by the Department of Defense (DOD) in 1993. This will allow the FAA to approve the use of the GPS Standard Positioning Service (SPS) as a navigation system that can be used for specific phases of air navigation. Full operational capability is scheduled in 1995. Achievement of navigation system performance requires the definition of functional and operational characteristics. This National Aviation Standard defines those functional and operational characteristics of the GPS SPS which are necessary to provide compatibility among the GPS components and to satisfy overall operational use requirements.

The GPS SPS, like most aeronautical systems, will continue to evolve in response to user needs. As the system evolves, proper operation and compatibility among elements of the system must be maintained. This order is intended to provide guidance in this endeavor.

The GPS service opens a new era for aviation and provides a major step toward meeting the need for safe and efficient navigation and traffic control of all civil and military aircraft operating in the National Airspace System (NAS).

David R. Hinson
Administrator

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# CHAPTER 1. GENERAL

1. PURPOSE. United States National Aviation Standards establish the technical base and description of the NAS and its related subsystems. The standards are not regulatory documents that impose rights and duties on the public. Instead, they describe the performance characteristics (e.g., the technical parameters, tolerances, and techniques) of major elements of a system to the extent required to ensure proper operation and compatibility between systems operating in the NAS. This standard was developed jointly by the FAA and the DOD and establishes the U.S. National Aviation Standard for the GPS SPS. In addition to describing the performance characteristics of the GPS SPS, this standard specifies the signal characteristics required from GPS satellites to ensure that aircraft equipped with a GPS receiver[1] can meet the operational requirements necessary to fly in the NAS.

2. DISTRIBUTION. This order is distributed to branch level in the Flight Standards, Aircraft Certification, Air Traffic Plans and Requirements, Air Traffic System Management, and Research and Development Services, Offices of Air Traffic System Effectiveness, Aviation Policy, Plans, and Management Analysis, International Aviation, and the Europe, Africa, and Middle East Office, to division level in the NAS System Engineering, Facility System Engineering, NAS Transition and Implementation, and System Maintenance Services, Offices of Acquisition Policy and Appraisal, Independent Operations Testing and Evaluation, and Aviation System Standards, and to director level in the Office of the Chief Counsel in Washington headquarters, to branch level in the regional Airway Facilities divisions, and the FAA Technical Center, a limited distribution to the Airway Facilities field offices, and the DOD's Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence).

3. APPLICABILITY. This standard pertains to the GPS SPS signal-in-space and performance characteristics.

4. DIRECTED ACTIONS. Subject to applicable rulemaking, programming, and budgetary procedures, actions shall be taken by the FAA and DOD elements concerned to implement this standard.

[1] In this document, a GPS receiver is assumed to interface with an antenna and the necessary flight management equipment for air traffic control and operation in the NAS.

5. AUTHORITY. Under Public Law 85-726, FAA is charged with providing for the regulation and promotion of civil aviation in order to foster its development and safety, and with providing for the safe and efficient use of the airspace by both civil and military aircraft. The DOD is authorized to assist the FAA under the Economy Act, 31 U.S.C. 1553, in making available the GPS SPS for civil aviation applications.

6. GPS CHARACTERISTICS. General system characteristics for the GPS are described in Chapter 2, General System Characteristics, and Appendix 1, GPS SPS and Signal Standards for Aviation Users.

7. REVISIONS. This standard shall be revised through coordination between the FAA and the DOD in response to civil and military operational requirements.

8. USE OF THE GPS SPS IN THE NAS. In accordance with the Federal Radionavigation Plan, the Secretary of Defense will notify the Secretary of Transportation once the DOD has determined that GPS can sustain the SPS. FAA will then notify civil aviation users under what conditions GPS SPS may be used through the appropriate Technical Standard Orders (TSO).

9. RELATIONSHIP TO OTHER U.S. NATIONAL AVIATION STANDARDS. A NAS user equipped with a GPS receiver must be capable of responding to a controller's instructions. Therefore, the navigation information requirements of the GPS SPS National Aviation Standard and the VOR/DME/TACAN National Aviation Standards shall be compatible and consistent.

10. REFERENCE DOCUMENTS. The material contained in this standard is taken from Government standards, specifications, and operating procedures. DOD has the responsibility for operating the GPS system; consequently, procedures and signal specifications have been developed by DOD to assist in these operations.
The documents listed in paragraphs 10a and 10b are, therefore, made a part of this standard. In the event of a discrepancy between the referenced documents and this standard, the referenced documents will have precedence.

a. System Specification for the Navstar Global Positioning System, SS-GPS-300D, 11 December 1990.

b. Navstar GPS Space Segment/Navigation User Interfaces, ICD-GPS-200, Revision B, Public Release revision (ICD-GPS-200B-PR) dated 3 July 1991. This document is "U.S. ONLY."

The documents listed above will be superseded by the GPS SPS Signal Specification to be published by DOD and provided to the Department of Transportation for civil distribution.

11. AUTHORITY TO CHANGE THIS ORDER. The Director, NAS System Engineering Service, may issue changes to this order in accordance with appropriate FAA/DOD agreements. The Administrator reserves the authority to approve changes which establish FAA policy, delegate authority, or assign responsibility within the FAA.

12.-19. RESERVED.

# CHAPTER 2. GENERAL SYSTEM CHARACTERISTICS

20. GENERAL SYSTEM DESCRIPTION. The GPS is a satellite-based radiopositioning and time transfer system. GPS consists of three major segments: space, control, and user.

When fully deployed, the space segment will contain 24 operational satellites. The satellites will be deployed in six orbital planes, each containing a total of four satellites. The satellite orbital planes will have an inclination relative to the equator of 55 degrees and the orbit height will be 20,200 km (10,900 nm). Each satellite completes an orbit in approximately 12 hours.

The satellites radiate spread spectrum signals at two frequencies, Ll and L2 (1,575.42 MHz and 1,227.6 MHz, respectively). The capabilities provided by the SPS will be generated only on the Ll frequency. The operational satellites are three axis stabilized, employ solar panels for power, have batteries to carry them through eclipse periods, and weigh about 1,850 pounds (840 kg).

The satellites will be positioned in orbit so that a minimum of four are always observable by a user anywhere on Earth.

The GPS control segment consists of a Master Control Station, five monitor stations, and three ground antennas. The Master Control Station is located at Falcon Air Force Base in Colorado Springs, Colorado. The monitor stations are located at the Master Control Station, Hawaii, Kwajalein, Diego Garcia, and Ascension Island. All monitor stations except Colorado and Hawaii also have ground antennas for two-way communications with the GPS satellites.

The remote monitor stations are unmanned data collection centers under the direct control of the Master Control Station. Each monitor station contains a 12-channel GPS receiver, environmental data sensors, an atomic frequency standard, and a computer processor. The monitor stations use the GPS receivers to track passively all GPS satellites in view and measure pseudorange and delta pseudorange (integrated Doppler) of the satellite spread spectrum signal with respect to the local atomic standard. The monitor stations also detect the navigation data on the spread-spectrum signal.

The environmental sensors collect local meteorological data for later tropospheric signal delay corrections at the Master Control Station. The computer processor controls all data collection at the monitor station and provides the communications interface with the Master Control Station. All data collected at the monitor station are buffered at the monitor station and then relayed upon request to the Master Control Station for processing.

The GPS Master Control Station provides the interface between the control segment and the satellites. It uses an S-band command and control uplink to unload data into a satellite navigation processor. Data uploaded by the Master Control Station can be user navigation data, which the satellite broadcasts in its navigation message, requests for processor diagnostics, or commands to change the satellite time provided to the user in the navigation data message.

The Master Control Station completely controls the operation of the control segment. It performs the computations needed to determine extremely precise satellite orbits and satellite atomic clock errors. It generates updates of satellite uploads of user navigation data and maintains a record of each satellite's navigation processor contents and status.

The updated information is transmitted to each satellite via the ground antennas. The ground antennas also transmit and receive satellite control and monitoring signals.

The user segment consists of the GPS receivers and the associated equipment. The GPS receivers, using data transmitted by the satellites, derive position, navigation, and time information and display the appropriate data to the individual GPS users.

GPS operation is based upon the concept of satellite ranging. Users figure their position on Earth by measuring their distance from a group of satellites in space. The satellites act as precise reference points. Position determinations are based on the measurement of the transit time of RF signals from a number of GPS satellites.

The GPS SPS, which will be provided to the civil aviation community, is the standard level of positioning and timing accuracy available to any user on a worldwide basis. The DOD has committed to providing a daily, worldwide horizontal positioning accuracy of 100 meters (2 drms, 95 percent probability) and 300 meters (99.99 percent probability), vertical position accuracy within 140 meters (95 percent probability), and timing accuracy within 340ns (95 percent probability) when the system becomes operational.

21. GPS SPS SIGNAL CHARACTERISTICS. The Ll carrier is modulated by up to two bit streams, each of which is the addition of a pseudorandom noise (PRN) ranging code and navigation data. Appropriate code-division-multiplexing techniques allow differentiation between the satellites even though they all transmit at the same L-band frequencies. Internal failures detected by a satellite shall cause the satellite to transmit codes which do not correspond to those of any working satellite, and which are

designed to protect users from using incorrect information. This failure-mode code is termed nonstandard C/A (NSC).

22. C/A CODE. C/A code characteristics are based on an optimized 24-satellite constellation as defined in Appendix 2.

23. NAVIGATION DATA. The system navigation data include satellite ephemeris, system time, satellite clock behavior data, and status messages. The content and characteristics of the navigation data stream shall be as defined in Appendix 2.

24. GPS SPS CHARACTERISTICS. C/A code characteristics based on a 24-satellite constellation shall be as defined in Appendix 2. Table 2-l defines performance characteristics of the GPS SPS given a properly designed receiver tracking four satellites at a time.

25. POSITIONING ACCURACY. Positioning accuracy at any given location and at any given time is determined by multiplying two factors: Position Dilution of Precision (PDOP) and User Equivalent Range Error (UERE). PDOP depends on the geometry of the satellites in view. UERE, which is independent of PDOP, is a measure of the error in the range measurement to each satellite as seen by the receiver. (The ranging error for each satellite will be different depending upon its performance and the time since it was last uploaded by the Control Segment.) The Control Segment's one sigma estimate of the space and control segment contribution to the UERE is transmitted in the navigation message as the User Range Accuracy (URA). GPS SPS is planned to provide the capability to obtain horizontal positioning accuracy within 100 meters (2 drms, 95 percent probability) and 300 meters (99.99 percent probability) and vertical positioning accuracy within 140 meters (95 percent probability).

26. TIMING ACCURACY. Timing accuracy with respect to GPS time is derived by multiplying the UERE by the Time Dilution of Precision (TDOP) and dividing the result by the speed of light. SPS timing accuracy with respect to Coordinated Universal Time (UTC) shall be within 340ns (95 percent) and 900ns or better 99.99 percent of the time. The difference between GPS time and UTC shall be included in the navigation message.

27. AVAILABILITY. GPS will provide availability approaching 100 percent, to be refined based on orbital experience. This estimate is based upon a 24-satellite constellation with at least four satellites in view above a 5.0 degree masking angle with a PDOP of 6 or less.

28. FIX RATE. The fix rate is essentially continuous. Actual time to first fix depends on user equipment capability and initialization with current satellite almanac data.

29. FIX DIMENSIONS. GPS is based on the Earth-centered World Geodetic System of 1984 (WGS-84). Defense Mapping Agency (DMA) Technical Report 8350.2 describes WGS-84. National Oceanic and Atmospheric Administration (NOAA) Professional Paper No. 2 describes North American Datum of 1983 (NAD-83) and compares it with WGS-84. The system provides three-dimensional positioning and velocity fixes, as well as extremely accurate time information.

## Table 2.1. GPS SPS Performance Characteristics

| Accuracy (Meters)* | | | Availability | Coverage | Reliability | Fiix Rate | Fix Dimension | System Capacity | Ambiguity Potential |
|---|---|---|---|---|---|---|---|---|---|
| Predictable | Repeatable | Relative | | | | | | | |
| SPS<br>Horz-100<br>Vert-140<br>Time-340ns | Hon - 100<br>Vert - 140 | **<br>Horz - 1<br>Vert - 1.5 | Expected to approach 100% | Worldwide continuous (PDOP ≤ 6) | 98% probability that a 21-satellite constellation will be operating | Essentially continuous | 3D<br>Velocity<br>(' [illegible])<br>[illegible]<br>Time | Unlimited | None |

*Horizontal (2 drms); vertical (95 percent); time (95 percent) with respect to UTC
**Preliminary estimates
***System specifications not defined for SPS

NOTE: Table is based on a 5.0° mask angle and Position Dilution Of Precision (PDOP) ≤ 6

30. CAPACITY. The capacity is unlimited.

31. AMBIGUITY. There is no ambiguity.

32. INTEGRITY. Integrity is the ability of a system to provide timely warnings to users when the system should not be used for navigation. Both the FAA and DOD have recognized the requirement for additional integrity capabilities in the GPS architecture and system design for aviation and other uses of GPS. Minimum integrity requirements are being established by the FAA and investigations are underway by FAA and DOD to identify the optimum cost-effective GPS integrity concepts to meet flight safety requirements.

33.-39. RESERVED.

## APPENDIX 1. GPS SPS AND SIGNAL STANDARDS FOR AVIATION USERS

# APPENDIX 1. GPS SPS AND SIGNAL STANDARDS FOR AVIATION USERS

The following is a listing of the GPS SPS signal and performance characteristics for proper system operation and safe utilization by aviation users in controlled airspace:

- Each GPS satellite shall transmit ephemeris and clock data on GPS frequency L, 1575.42 MHz.

- The minimum SPS signal strength to be received (power levels defined for a 3 dBi linearly polarized receiving antenna near the ground) from each satellite is -160.0 dbw. The maximum received signal strength is not expected to exceed -158 dbw.

- Daily predictable horizontal position accuracy for any position worldwide shall be 100m (2 drms, 95 percent probability) and 300m (99.99 percent probability).

- Daily predictable vertical accuracy for any position shall be within 140m (95 percent probability) and 500m or better 99.99 percent of the time.

- SPS timing accuracy will be within 340ns of UTC 95 percent probability and 900ns or better 99.99 percent probability.

- There shall be no ambiguity in position information.

- User capacity shall be unlimited.

- System availability shall be approximately 100 percent. The DOD requirement for availability of 21 operational satellites is 98 percent.

- System integrity, timely warnings to users when the system should not be used for navigation, shall be 10 seconds, or better, for nonprecision approaches and adjustable to other standards for other phases of flight.

# APPENDIX 2. EXCERPTS FROM DOD INTERFACE CONTROL DOCUMENT (ICD)-GPS-200 FOR AVIATION USERS OF THE GPS SPS

# APPENDIX 2. EXCERPTS FROM DOD INTERFACE CONTROL DOCUMENT (ICD)-GPS-200 FOR AVIATION USERS OF THE GPS SPS

The DOD's (ICD)-GPS-200 is the current source for system technical information for the GPS SPS. The DOD will prepare and provide to the DOT a GPS SPS Signal Specification. After publication of the specification, this appendix will be amended as necessary. Selected information on the GPS user interfaces and each satellite's L, signal is as follows:

1. USER INTERFACES FOR THE GPS SPS. The interface between the GPS Space Segment satellites and the GPS SPS aviation users consists of an L-band radio frequency (RF) link (L, on the frequency of 1575.42 MHz) on each satellite. Utilizing these links, the satellites provide continuous earth coverage with signals which provide the GPS SPS to the users including GPS time, ranging codes, and system data needed to accomplish the GPS navigation mission. Only the L, radio frequency signals are intended for suitably equipped aviation users under this U.S. National Aviation Standard.

2. $L_1$ SIGNAL INFORMATION. The carrier of the L, link for SPS users is modulated by a bit train, which is a composite generated by the Modulo-2 addition of a PRN ranging code and the downlink system data (referred to as NAV data). The signal polarization of the transmitted signal shall be right-hand circularly polarized. The ellipticity for L, shall be no worse than 1.2 dB for the angular range of ±14.3° from boresight. For each satellite, all transmitted signal elements (carrier, codes, and data) are coherently derived from the same on-board frequency source. The ranging codes provide appropriate code-division-multiplexing techniques which allow differentiation between the satellites even though they all transmit at the same L-band frequency. The C/A ranging code which provides the SPS is 1 ms in duration at a chipping rate of 1.023 Mbps.

   GPS time is established by the Control Segment and shall be referenced to UTC, as maintained by the U.S. Naval Observatory (USNO), with a zero time-point defined as midnight on the night of January 5, 1980/morning of January 6, 1980.

The system navigation data includes satellite ephemeris, system time, satellite clock behavior data, status messages, etc. A navigation data stream is transmitted by each satellite on the L, carrier at a rate of 50 bps. The basic message structure format shall be a 1500-bit frame made up of five subframes, each subframe being 300 bits long. Subframes 4 and 5 shall be subcommutated 25 times each, so that a complete data message requires the transmission of 25 frames. The 25 versions of subframes 4 and 5 are referred to as pages 1 through 25 of each subframe. Each subframe shall consist of 10 words, each 30 bits long; the most significant bit (MSB) of all words shall be transmitted first.

Subframes 1, 2, and 3 and each page of subframes 4 and 5 shall contain a telemetry (TLM) word and a handover word (HOW), both generated by the satellite. The TLM word shall be transmitted first, immediately followed by the HOW. The latter shall be followed by eight data words, each of which shall be generated by the Control Segment. Each word in each frame shall contain parity. The satellite shall generate (calculate) parity for the TLM and HOW words only; the Control Segment shall generate parity for all other words of each frame.

# APPENDIX 3. GPS SPS INTEGRITY

## RESERVED

# APPENDIX 4. GPS NOTAM's FOR CIVIL AVIATION

RESERVED

# APPENDIX 5. GLOSSARY OF ACRONYMS

| | |
|---|---|
| C/A | Coarse Acquisition |
| DME | Distance Measuring Equipment |
| DOD | Department of Defense |
| DOT | Department of Transportation |
| drms | Distance Root Mean Square |
| FAA | Federal Aviation Administration |
| FDI | Fault Detection and Isolation |
| GDOP | Geometric Dilution of Precision |
| GIC | GPS Integrity Channel |
| GLAD | GPS SPS Local Area Differential |
| GPS | Global Positioning System |
| HOW | Handover Word |
| ICD | Interface Control Document |
| IFR | Instrument Flight Rules |
| IRN | Interface Revision Notices |
| MCS | Master Control Station |
| NAS | National Airspace System |
| NOTAM | Notice to Airmen |
| NSC | Nonstandard C/A Code |
| PDOP | Position Dilution of Precision |
| PRN | Pseudorandom Noise |
| RAIM | Receiver Autonomous Integrity Monitoring |
| RF | Radio Frequency |
| SPS | Standard Positioning Service |
| TACAN | Tactical Air Navigation |
| TDOP | Time Dilution of Precision |
| TLM | Telemetry |
| UERE | User Equivalent Range Error |
| USN0 | United States Naval Observatory |
| UTC | Coordinated Universal Time |
| VOR | Very High Frequency Omnidirectional Radio |
| WGS | World Geodetic System |

# APPENDIX 6. DEFINITION OF TERMS

ACCURACY. The degree of conformance between the estimated or measured position and/or velocity of a platform at a given time and its true position and/or velocity. Radionavigation system accuracy is usually presented as a statistical measure of system error and is specified as:

a. Predictable - The accuracy of a position with respect to the geographic or geodetic coordinates of the Earth.

b. Repeatable - The accuracy with which a user can return to a position having coordinates which have been measured previously with the same navigation system.

c. Relative - The accuracy with which a user can determine one position relative to another position regardless of any error in their true positions.

ARGUMENT OF LATITUDE. The angular distance measured in the orbit plane from the ascending node to the orbiting object.

AVAILABILITY. The availability of a navigation system is the percentage of time that the services of the system are usable. Availability is an indication of the ability of the system to provide usable service within the specified coverage area. Signal availability is the percentage of time that navigational signals transmitted from external sources are available for use. Availability is a function of both the physical characteristics of the environment and the technical capabilities of the transmitter facilities.

COORDINATED UNIVERSAL TIME (UTC). An international time system based on an atomic standard maintained within 1 second of astronomical time (UT1 is based on the Earth's rotation) by the addition or deletion of leap seconds.

COVERAGE. The coverage provided by a radionavigation system is that surface area or space volume in which the signals are adequate to permit the user to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions, and other factors that affect signal availability.

DIFFERENTIAL. A technique used to improve radionavigation system accuracy by determining positioning error at a known location and subsequently transmitting the determined error, or corrective factors, to users of the same radionavigation system operating in the same area.

DISTANCE ROOT MEAN SQUARE (drms). The root-mean-square value of the distances from the true location point of the position fixes in a collection of measurements. As used in this document, 2 drms is the radius of a circle that contains at least 95 percent of all possible 2-dimensional (horizontal) fixes that can be obtained with a system at any one place. Actually, the percentage of fixes contained within 2 drms varies between approximately 95.5 percent and 98.2 percent, depending on the degree of ellipticity of the error distribution.

FAULT DETECTION AND ISOLATION (FDI). The combination of internal and external integrity monitoring which will identify any source error of GPS navigation signals and negate the effect within the system. FDI encompasses GIC and RAIM.

GEOGRAPHIC LONGITUDE OF ASCENDING NODE. The angle between the plane of the reference median and the plane through the polar axis and the normal to the spheroid.

GEOMETRIC DILUTION OF PRECISION (GDOP). The ratio of position error of a multilateration system. GDOP is the measure of the “goodness” of the geometry of the multilateration sources as seen by the observer; a low GDOP is desirable, a high GDOP undesirable. Applied to GPS, GDOP is a measure of overall positional and temporal accuracy.

GLOBAL POSITIONING SYSTEM (GPS). A space-based positioning, velocity, and time system composed of space, control, and user segments. The space segment, when fully operational, will be comprised of an optimized 24-satellite constellation in six orbital planes. The control segment consists of five monitor stations, three ground antennas, and a master control station. The user segment consists of antennas and receiver-processors that provide positioning, velocity, and precise timing to the user.

GPS INTEGRITY CHANNEL (GIC). GIC is an augmentation to the GPS which broadcasts civil GPS integrity information to users in a designated area, based upon measurements made by a ground-based monitor or network of monitors collecting and processing GPS SPS signals.

INTEGRITY. The ability of a system to provide timely warnings to users when the system should not be used for navigation.

NATIONAL AIRSPACE SYSTEM (NAS). The NAS includes U.S. airspace; air navigation facilities, equipment, and services; airports or landing areas; aeronautical charts, information, and service; rules, regulations, and procedures; technical information; and labor and material used to control and/or manage flight activities in airspace under the jurisdiction of the United States. System components shared jointly with the military are included in the NAS.

NAVIGATION. The process of planning, recording, and controlling the movemeni of a craft or vehicle from one place to another.

POSITION DILUTION OF PRECISION (PDOP). The ratio of user-referenced three-dimensional position error to measurement error of a multilateration system.

RADIONAVIGATION. The determination of position, or the obtaining of information relating to position, for the purposes of navigation by means of the propagation properties of radio waves.

RECEIVER AUTONOMOUS INTEGRITY MONITORING (RAIM). A technique whereby a GPS receiver/processor determines the integrity of the GPS navigation signals without reference to sensors or non-DOD integrity systems other than the receiver itself. This determination is achieved by a consistency check among redundant pseudorange measurements.

RELIABILITY. The probability of performing a specified function without failure under given conditions for a specified period of time.

REQUIRED NAVIGATION PERFORMANCE (RNP). A statement of the navigation performance accuracy necessary for operation within a defined airspace including the operating parameters of the navigation systems used within that airspace.

RIGHT ASCENSION OF ASCENDING NODE. A celestial coordinate; the angular distance taken along the celestial equator from the vernal equinox eastward to the hour circle of a given celestial body.

STANDARD POSITIONING SERVICE (SPS). The GPS SPS is a positioning and timing service which will be available to all GPS users on a continuous, worldwide basis with no direct charge as described in the Federal Radionavigation Plan. SPS is provided on the GPS L, frequency which contains a coarse acquisition (C/A) code and a navigation message.

SUPPLEMENTAL NAVIGATION SYSTEM. An approved navigation system that can be used in controlled airspace of the NAS in conjunction with another approved navigation system.

TIME DILUTION OF PRECISION (TDOP). The time error of GDOP.

USER EQUIVALENT RANGE ERROR (UERE). The component of system accuracy which is independent of location and time, that represents the receiver ranging error among the four satellites in view that provide the lowest GDOP.



*U.S. G.P.O.:1993-343-273:80185