IGS Site Guidelines

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1.1. Background

Very strict rules are inconsistent with the voluntary nature of the IGS. However, participating stations must agree to adhere to certain standards and conventions which ensure the quality of the IGS Network. This document lists the conventions that all IGS sites must follow, as well as additional desirable characteristics which, where present, enhance a station's value to the IGS. It is intended to be useful both in the site planning phase and as a reference during ongoing operations, to implementation engineers as well as managers at site operation agencies.

The IGS Governing Board approved the Guidelines in early 2004, and directed the Network Coordinator to maintain the document under a program of continuous review and improvement.

Suggestions for additions or changes, which will be discussed with advisers appropriate to the subject, are welcome at igscb @ igscb.jpl.nasa.gov

1.2. Organization of this document

The document is organized as follows. Chapter 2, *Guidelines for all IGS sites* contains items relevant to every IGS site. It is divided into Section 2.1, " Strictly required equipment and operational characteristics ", containing requirements which each site must meet in order to achieve and retain "IGS station" status, and Section 2.2, " Additionally desired equipment and operaitonal characteristics ", which should be implemented to the extent possible. Section 2.3, "Desired physical characteristics" also addresses qualities desirable for each IGS site, but in particular those which are relevant at the time of site selection and long-term planning. Chapter 3, explains the reference frame site selection process, and details practices which are especially important at reference frame sites. The remaining portions of the document address requirements and desired characteristics for sites able to participate in the collection of various other types of data (in addition to the basic daily GPS data).

1.3. For operators of existing IGS sites

Operators of existing IGS sites should first ensure that their site(s) meet the requirements listed in Section 2.1, " Strictly required equipment and operational characteristics ", and the requirements for any special projects or products the site contributes to, given in the later sections. Section 2.2, " Additionally desired equipment and operaitonal characteristics " and Section 2.3, "Desired physical characteristics", as well as later sections, will provide information on additional equipment or capabilities which would benefit the IGS if implemented.

Because the addition of more sites to the reference frame set is anticipated, and because following the practices listed in Chapter 3, results in the highest quality time series, they are also recommended to be followed wherever possible.

This document should also be reviewed in full at least annually to verify that the strictly required items are being met, and to become familiar with the other desired features, for the purpose of planning future station operation and development.

1.4. For operators of IGS Reference Frame sites

It is particularly important for operators of Reference Frame stations to meet the requirements listed in Section 2.1, " Strictly required equipment and operational characteristics " and as many of the guidelines in Section 2.2, " Additionally desired equipment and operaitonal characteristics " as are possible. Section 2.3, "Desired physical characteristics" discusses physical characteristics associated with high quality Reference Frame sites, and Chapter 3, discusses the Reference frame site selection process and practices that are especially crucial for Reference Frame stations.

1.5. For operators of existing stations which are potential IGS sites

Operators of existing stations which are potential IGS stations should first ensure that their site(s) meet the requirements listed in Section 2.1, " Strictly required equipment and operational characteristics ". Section 2.2, " Additionally desired equipment and operaitonal characteristics " and Section 2.3, "Desired physical characteristics",

as well as later sections, will provide information on additional equipment or capabilities which would benefit the IGS if implemented.

Because the addition of more sites to the reference frame set is anticipated, and because following the practices listed in Chapter 3, results in the highest quality time series, they are also recommended to be followed wherever possible.

The companion document <http://igscb.jpl.nasa.gov/network/guidelines/checklist.html> provides step-by-step instructions to propose a new station, including how to confirm the required unique 4-character IGS site IDs and IERS DOMES numbers.

1.6. For agencies planning station installation

Agencies planning station installation should implement as many of the items in Chapter 2, *Guidelines for all IGS sites* and Section 2.3, "Desired physical characteristics" as are possible.

Because the addition of more sites to the reference frame set is anticipated, and because following the practices listed in Chapter 3, results in the highest quality time series, they are also recommended to be followed wherever possible.

The companion document <http://igscb.jpl.nasa.gov/network/guidelines/checklist.html> provides step-by-step instructions to propose a new station, including how to confirm the required unique 4-character IGS site IDs and IERS DOMES numbers.

2.1. Strictly required equipment and operational characteristics

Equipment characteristics

2.1.1. The GPS equipment, and its surroundings, must not be disturbed or changed unless a clear benefit outweighs the potential for discontinuities in the time series. Examples include

- Equipment failure
- Planned replacement of obsolete equipment
- Vendor-recommended firmware updates

GPS Receiver

2.1.2. The GPS receiver must

- track both code and phase on L1 and L2 under non-AS (anti-spoofing) as well as AS conditions. Required observables are L1, L2, P2, and at least one of C1 or P1. Equipment capable of reporting both C1 and L1 should do so.
- be capable of, and set to, record data from at least 8 satellites in view, simultaneously
- track with a sampling interval of 30 seconds or smaller
- be set to record data down to a cutoff angle of 10 degrees or less.
- synchronize the actual instant of observation with true GPS time to within +/- 1 millisecond of the full second epoch

Antenna

2.1.3. The GPS antenna must

- have well-defined phase (and gain) pattern to allow mixing with other standard antennas (i.e. the Dorne Margolin choke ring) with negligible error. Antenna gain patterns must be reproducible, i.e. all antennas must have identical phase patterns. Absolute phase center stablity must be within +/- 2mm in the horizontal and +/- 4mm in the vertical relative to a Dorne Margolin choke ring antenna. Antenna to antenna phase center repeatability (minimum 3 measurements, 1 sigma) must be +/- 0.5mm in the horizontal and +/- 1mm in the vertical.

- be represented accurately in the phase center variation file ftp://igscb.jpl.nasa.gov/pub/station/general/igs05.atx If it is not, contact the CB. A calibration from an independent, recognized laboratory such as NGS (http://www.ngs.noaa.gov/ANTCAL) or Geo++ (http://www.geopp.com) will be required.
- be leveled and oriented to True North using the North reference mark and/or antenna RF connector
- be rigidly attached, such that there is not more than 0.1mm motion with respect to the antenna mounting point.

2.1.4. The eccentricities (easting, northing, height) from the primary marker to the antenna reference point (defined for the antenna type in ftp://igscb.jpl.nasa.gov/pub/station/general/antenna.gra) must be surveyed and reported in site logs and RINEX headers to $\leq$1 mm accuracy.

2.1.5. Each eccentricity component must be less than 5 m.

Radomes

2.1.6. Avoid using radomes unless required operationally, for instance due to weather conditions, antenna security, wildlife concerns, etc.

2.1.7. Non-hemispherical radomes especially must be avoided when the shape is not required by site characteristics (e.g. for snow rejection)

2.1.8. If a radome must be used, an entry for antenna+radome pair must be in the phase center variation file ftp://igscb.jpl.nasa.gov/pub/station/general/igs05.atx.

- If you remove an antenna+radome pair found in the uncal_radome list, please make it available to a calibration laboratory for calibration. Contact the Central Bureau at igscb @ igscb.jpl.nasa.gov for assistance.

- Exceptions (for historical reasons) are listed in ftp://igscb.jpl.nasa.gov/pub/station/general/pcv_archive/uncal_radome.txt
- To use an antenna+radome pair not found in either of these files, contact the CB. A calibration from an independent, recognized laboratory such as NGS (http://www.ngs.noaa.gov/ANTCAL) or Geo++ (http://www.geopp.com) will be required.

Operational characteristics

2.1.9. Stations must be permanent and continuously operating.

2.1.10. The station will have obtained a unique IGS 4-character ID and an IERS DOMES number following the procedures in the new station checklist, <http://igscb.jpl.nasa.gov/network/guidelines/checklist.html>.

2.1.11. The operating agency must always have the capability to repair or improve the station and its software systems, including if the original engineers are no longer available.

Data files

2.1.12. All data handling, including receiver communication, reformatting, quality check, and transmission to Data Center (DC), should be automated by computer(s). TIGA stations are excepted if this is not possible.

2.1.13. The station operating agency must archive the raw (native binary) GPS data, or arrange for this at a suitable agency such as a partner agency, or an Operational Data Center.

2.1.14. GPS data (observations and broadcast ephemeris) are to be prepared and distributed in the RINEX format, version 2.00 or greater, as specified in ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt or ftp://igscb.jpl.nasa.gov/pub/data/format/rinex2.txt

- Observation files will normally be exchanged in the Hatanaka Compact form. See the RINEX specification ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt and confirm with your DC.
- All files are ordinarily unix compressed (.Z) for transmission to DCs. Confirm with your DC.
- File naming conventions set forth in the RINEX specification ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt, section 4, "The Exchange of RINEX files", will be followed. Some DCs implement lower-case file type codes and/or site IDs. Confirm with your DC. Case must not be used to distinguish between unique files.

2.1.15. Even if the receiver sampling interval is less than 30 seconds, the data submitted to the IGS archives must have a 30 second interval, with observations aligned to :00 and :30 epochs. Files intended for the LEO Pilot Project's 15min latency/1Hz data areas are excepted.

2.1.16. The header information, especially the 4-character site ID, receiver and antenna information, IERS DOMES number, and antenna eccentricities, must be up-to-date and strictly follow the agreed-upon conventions.

- Specifically, they must match the information in the IGS site log and therefore observe the same equipment naming conventions found in ftp://igscb.jpl.nasa.gov/pub/station/general/rcvr_ant.tab.
- A radome identifier code from ftp://igscb.jpl.nasa.gov/pub/station/general/rcvr_ant.tab must be found in the ANT TYPE field, in columns 17-20 of this field.
- The IERS DOMES number must appear in the MARKER NUMBER field.
- The RINEX headers must begin showing an equipment change as near as possible to the actual time of the change.
- If an advisory of RINEX header inconsistencies is received from the CB, the headers must be corrected as soon as possible.

2.1.17. Transmission of data to the DC must be verified to be uncorrupted.

2.1.18. The minimum requirement for data submission is daily (24 hour) files with a 30 second sampling interval.

- The daily (24 hour) navigation message file contains all messages with TOC/TOE (time of clock, time of ephemeris) at and between 00:00 and 23:59 GPS time of the respective day.
- Metadata correctness for daily (24 hour) data files must be minimally verified prior to transmission to a DC. Site name, number of observations, epoch, equipment types, interval, and eccentricities must be verified to be correct prior to transmission.
- After a communications outage, all recovered daily data files must be submitted to a Data Center.

Site logs

2.1.19. Whenever there is a change to the site information as documented in the station log, the log must be updated.

- Refer to ftp://igscb.jpl.nasa.gov/pub/station/general/sitelog_instr.txt for detailed site log preparation instructions.
- Include the URL to a web page for the site, if one exists. Contact the CB if you have site photos which cannot be made available on a web page.
- Updates must be be sent to the IGS CB (igscb @ igscb.jpl.nasa.gov) within one business day of any change.

2.1.20. If an advisory of site log inconsistencies is received from the CB, the site log must be corrected as soon as possible.

IGS mailing list messages

2.1.21. When sending an message to an IGS mailing list about a particular station or stations, place the 4-character site ID(s) in the Subject. Instructions on sending to the lists can be found in http://igscb.jpl.nasa.gov/faqs.html.

2.1.22. The IGSStation list is generally the correct one for messages related to station operations.

2.1.23. An advisory IGSStation message should be sent in the following cases -- in advance if possible, otherwise within one business day:

- Changes in antenna, radome, monument, receiver, cabling, frequency standard, receiver settings such as elevation cutoff angle, or environment (such as tree removal or building construction); in general, any change which can affect position solutions. Briefly describe in the message what was changed.
- If a RINEX file must be resubmitted to a DC due to corruption, incorrect metadata, etc.
- If a station is expected to be unavailable for more than one week.
- When a site is decommissioned permanently.
- When a problem or error in the station or its site log is discovered and corrected. Briefly describe in the message what was changed.

2.1.24. The agency accepting responsibility for proper station operation must follow the IGSMail list on a regular basis, either by subscribing or regularly checking the web archive. See the MAIL area of <http://igscb.jpl.nasa.gov>.

2.2. Additionally desired equipment and operaitonal characteristics

In addition to the items listed here, please review Section 2.3, “Desired physical characteristics” for physical characteristics desirable for IGS stations.

Equipment characteristics

2.2.1. Receiver support for "all-in-view" tracking

2.2.2. The receiver tracking cutoff is ideally 3 degrees or less, especially for "all in view" receivers.

2.2.3. GPS receivers and ideally other station equipment such as computers should be protected against power failures by providing surge protection and backup power wherever feasible

2.2.4. Antenna types which are already present in the IGS network in reasonable numbers are generally preferred over novel types.

2.2.5. Radomes uniformly manufactured with less than 1mm variability in thickness are preferred

2.2.6. Precise meteorological instrumentation is encouraged.

See Chapter 5, *Guidelines for IGS sites submitting meteorological data* below for further guidance.

2.2.7. Support for GLONASS observations is desirable.

See Chapter 6, *Guidelines for IGS sites with GPS/GLONASS receivers* below for further guidance.

2.2.8. High-quality frequency standards are desirable.

See Chapter 9, *Guidelines for IGS sites participating in IGS timing activities* below for further guidance.

2.2.9. Equipment never used before in the IGS should be avoided until tested and well understood by IGS Analysis Centers (ACs).

- Inform the CB of proposed new types of equipment (any receiver or antenna+radome combination not found in ftp://igscb.jpl.nasa.gov/pub/station/general/igs.snx).
- Test data sets, and analysis of test data, will be helpful. Inform the CB whether these will be available.

2.2.10. The antenna reference point ideally will be mounted directly vertically above the marker (i.e., horizontal eccentricities ideally are zero).

Operational characteristics

2.2.11. Additional monuments are desirable for surveys and testing, but it is preferable to maintain one antenna+receiver pair as the best site for the IGS, rather than to submit more than one "site" to the IGS.

2.2.12. When antenna changes are planned, operate both the new and old antennas at the same time first (if an additional monument and receiver are available), and announce to IGSStation how analysts may get the test data set.

2.2.13. The S1 and S2 observables should be included in daily RINEX files.

2.2.14. Anticipate upgrades to new equipment types, including to support new GNSS signal types, while paying attention to data overlap to avoid discontinuity.

2.2.15. The automated use of a quality check program is recommended to verify data quality (not just metadata correctness), prior to transmission to a DC.

2.2.16. Hourly data is preferred, especially in cases where there are few nearby hourly stations in the region.

See Chapter 4, *Guidelines for IGS sites submitting hourly data* .

2.2.17. Daily files should be transmitted as soon as possible following the end of the day. The usefulness to IGS products and projects rapidly decreases with increasing delay. As a guideline:

RINEX daily file latency impact

<2 hours	Ideal
12:00 UT	Usefulness for rapid orbit generation rapidly declining
16:00 UT	Not usable for rapid orbit generation
3 days	Not useful to most ACs' final orbits or reference frame products

Stations contributing to the TIGA project are excepted.

2.2.18. 3-dimensional local ties between the GPS marker, collocated instrumentation (e.g. DORIS, SLR, VLBI, gravity, tide gauge) and other monuments should be re-surveyed regularly to an accuracy of 1mm and reported in ITRF.

- The marker->antenna reference point (ARP) eccentricities should be reverified during such a survey.
- Repeat the survey after known motion incidents such as earthquakes.

2.2.19. From time to time the agreement with the secondary data center defined in the site log, and its data submission procedures, should be reconfirmed.

2.2.20. Personnel and shipments should be able to reach the site in a reasonable amount of time to effect repairs and maintenance. In remote locations it is advisable to store back-up equipment on site.

2.2.21. Receivers should be set to record data from all satellites, including those newly launched or set 'unhealthy'.

2.2.22. Receivers and RINEX converters should not be set to smooth data.

2.2.23. RINEX version 2.10 (see ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt) is preferred.

2.3. Desired physical characteristics
for planning new sites, or long-term site improvement

While these items are not strict requirements on each IGS site, they are characteristics that contribute to a site having the highest possible value to long-term geodesy. Agencies are encouraged to select potential new sites which meet most of these features, and work toward these characteristics at existing sites.

The site location should:

- be on a stable regional crustal block, away from active faults or other sources of deformation, subsidence, etc. Contact the Reference Frame Coordinator, or the CB for assistance in determining the stability of a particular area, if it is not clear.
- be on firm, stable material, preferably basement outcrop
- have a clear horizon with minimal obscurations above 5 degrees elevation

The site location should *not*:

- be located on soil that might slump, slide, heave, or vary in elevation (e.g. because of subsurface liquid variations)
- have significant changes to the surroundings (changes to buildings or trees; new construction, etc) forseen or likely
- have excessive radio frequency interference
- have excessive RF reflective surfaces (fences, walls, etc.) and other sources of signal multipath
- have excessive natural or man-made surface vibrations from ocean waves or heavy vehicular traffic

A physical marker should be provided, to allow the assignment of an M-type IERS DOMES number (see <http://lareg.ensg.ign.fr/ITRF/DOMES_DESC.TXT>).

The GPS monument should:

- be of ultra-stable design. See http://igscb.jpl.nasa.gov/network/monumentation.html for additional information.
- be isolated from unstable surface material (e.g. freezing/melting cycles in cold climates) and extend into stable subsurface formation
- remain durable, maintainable, accessible, and well-documented.

Additional monuments

- Ancillary stable monuments should be provided for local geodetic control, reference, azimuth, parallel operation of replacement antennas, and especially for recovery in the event that the primary monument is destroyed
- A minimum of three footprint monuments are recommended to be located 10 to 15 km away (roughly in a triangle pattern) to aid in distinguishing between local, regional, and large-scale ground motions, unless the area has a dense GPS array.

Station infrastructure should include:

- Ample, reliable power and communications (preferably Internet) to enable reliable data transfer
- Physical site security appropriate to local necessity

Other desirable instrumentation

- Other geophysical systems -- such as SLR, VLBI, DORIS, absolute or superconducting gravimeters, Earth tide gravimeters, seismometers, strain meters, ocean tide gauges -- are also desirable and will enhance the value of the station for multi-disciplinary studies
- Other scientific systems which rely on accurate positioning, such as timing labs, are also recommended where appropriate

3.1. About Reference Frame Sites

The IGS Reference Frame Working Group (RFWG) periodically selects a set of globally distributed, stable sites to be used in reference frame determination. Excellent documentation of site history is particularly critical for these stations, and the station position time series must be free of jumps whose cause or magnitude is not well understood. All IGS products rely on the reference frame to be accurate, reliable, and stable.

The RFWG has the expertise to weigh station locations and characteristics in choosing the Reference Frame station set. Although there is some motivation to keep stations from one realization of the frame to the next, stations may be removed or replaced as the WG sees fit. All the required and desired guidelines from Chapter 2, *Guidelines for all IGS sites* are equally, and even more so, required and desired for Reference Frame sites. The characteristics from Section 2.3, “Desired physical characteristics” are also all considered in the selection process and highly desirable. The degree of compliance in many cases will have an effect on time series, residuals, and velocity estimates important to frame determination.

3.2. Additional Reference Frame Site Selection Criteria

The RFWG will also weigh the following criteria in selecting reference frame sites.

- Significant distance from the nearest reference frame station
- For coordinates and velocities useful to Reference Frame determination, sufficient observing history is needed (usually >2 years)

- Operated by an institution with a long-term commitment and geodetic expertise
- Relation to regional/national geodetic network, if one exists
- Likelihood of site being abandoned or overtaken by other uses should be very low
- Consistently high-quality raw data, with good tracking, low multipath, and low quantity of cycle slips
- Priority is given to stations with nearby installations of other space geodetic systems (SLR, VLBI, and DORIS) and which undergo regular surveys

3.3. Practices for Reference Frame sites

Sites chosen as reference frame sites must continue to follow the required procedures in Chapter 2, *Guidelines for all IGS sites* and strive toward the characteristics in Section 2.3, "Desired physical characteristics". Additionally, reference frame determination requirements dictate that reference frame sites follow these practices.

3.3.1. 3-dimensional local ties between the GPS marker, collocated instrumentation (e.g. DORIS, SLR, VLBI, gravity, tide gauge) and other monuments should be re-surveyed at least every two years to an accuracy of 1 mm and reported in ITRF.

3.3.2. Survey measurements, field notes, and reduced results should be preserved and be made publicly accessible

3.3.3. All survey data, but especially ties to other IERS and IGS markers, should be rigorously reduced in a geocentric frame related to ITRF (preferably ITRF itself) and the results be made available in SINEX format (defined at http://tau.fesg.tu-muenchen.de/~iers/web/sinex/format.php), including full variance-covariance information

3.3.4. Moving to another monument must be avoided except in extreme circumstances, requiring prior announcement and submission of overlapping data sets starting one year in advance. Analysis of the two sets is helpful; results should be documented in the site log and in an IGSStation message.

3.3.5. When antenna change is unavoidable, minimize position discontinuities by first operating the new antenna on an nearby ancillary monument, and announce to IGSStation how analysts may get the test data set.

4.1. Strictly required

4.1.1. Data are to be prepared in RINEX files, both for observations and broadcast navigation messages. See the RINEX specification, ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt. Files are named as in section 4 of the RINEX specification, but with the file sequence letter "f" replaced with an hour sequence code ('a'=00:00UT to 00:59UT .. 'x' = 23:00UT to 23:59UT).

4.1.2. Hourly files are to be transmitted simultaneously, or at least in quick succession, to at least two data centers under normal operations. If one of these two centers is temporarily unavailable, it is not necessary to instead send files to a third center during this period.

4.1.3. Hourly files should be transmitted as soon as possible following the end of the hour. The usefulness to IGS products and projects rapidly decreases with increasing delay. As a guideline:

RINEX hourly file latency impact

<5 min	Ideal
20 min	Not useful to near-real-time troposphere or ultrarapid products during critical processing hours of the analysis cycle
06:30 UT	Cannot be used in current ultrarapid product submission
12:30 UT	Cannot be used in current ultrarapid product submission
18:30 UT	Cannot be used in current ultrarapid product submission
00:30 UT	Cannot be used in current ultrarapid product submission

4.1.4. After a communications outage, the missed hourly files should be transmitted, but only for files less than 3 days old.

5.1. Strictly required

5.1.1. Minimum set of observables is pressure and temperature.

5.1.2. Data are to be prepared in RINEX files. See the RINEX specification, ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt.

5.1.3. Observation interval must be no more than 60 minutes.

5.1.4. Pressure sensor noise must be no more than 0.5 hPa.

5.1.5. Temperature sensor accuracy must be at least 1 Kelvin.

5.1.6. Drift and bias must be minimized.

5.1.7. Temperature effects on the pressure measurements should be minimized, e.g. with solar shielding or by placing the sensor in a nearby building if necessary

5.1.8. Measurement of the instrument height in relation to the GPS antenna mark must have an accuracy of 1 m or better

5.1.9. Data is to be transmitted on the same schedule as the RINEX observation files (hourly for hourly sites; otherwise daily)

5.1.10. Instruments are to be calibrated periodically according to the manufacturer's recommendations

5.2. Additionally desired

5.2.1. An observation interval of 10 minutes is optimal.

Most guidelines are given in the IGLOS-PP Call for Participation at http://igscb.jpl.nasa.gov/projects/iglos/

6.1. Strictly required

Physical characteristics

6.1.1. The receiver must

- meet the IGS requirements for GPS receivers in Chapter 2, *Guidelines for all IGS sites*
- tag observations in GPS time (not UTC or GLONASS), and time tags for all sats must be identical (simultaneous observations)

Operational characteristics

6.1.2. Data must be submitted in M(MIXED) RINEX files. See the RINEX specification at ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt.

6.2. Additionally Desired

6.2.1. The characteristics discussed in Section 2.2, " Additionally desired equipment and operaitonal characteristics " are also desired in GPS/GLONASS stations.

Most guidelines are given in the Call for Participation at http://igscb.jpl.nasa.gov/projects/leo/leocfp.html

7.1. Strictly required

7.1.1. Data are to be prepared in RINEX files, both for observations and broadcast navigation messages. See the RINEX specification, ftp://igscb.jpl.nasa.gov/pub/data/format/rinex210.txt and LEO modifications, http://igscb.jpl.nasa.gov/mail/igsmail/2001/msg00129.html.

Most guidelines are given in the TIGA web page and Call for Participation at http://op.gfz-potsdam.de/tiga/.

8.1. Strictly required

8.1.1. Tide Gauge data, preferable hourly data, must be stored at a Tide Gauge data (PSMSL, UHSLC, NTF) or be made available to the public on request.

8.1.2. All Tide Gauge Benchmarks and additional benchmarks, including the GPS Antenna Reference Point, must be re-leveled by a first-order leveling or GPS ties on a routine basis. The repetition period depends on the local geographical/geological situation. The ties should have an accuracy of 1mm or better.

8.1.3. An observation log ("TIGA Observing Log") has to be provided for any participating station. The log contains supplemetary information not in the IGS log and is provided to the public.

8.1.4. Survey measurements, field notes, and reduced results should be preserved and be made publicly available.

8.2. Additionally desired

8.2.1. Air pressure, temperature, wind speed, direction, and gust are desirable.

8.2.2. GPS data latency should be less than 460 days

https://goby.nrl.navy.mil/index.php#stations also includes gps equipment, cabling, and frequency distribution information.

9.1. Strictly required

9.1.1. A precise external frequency standard such as a hydrogen MASER or modern cesium standard.

9.1.2. The time measured at the receiver should track the external reference, not the internal oscillator.

9.1.3. When using a hydrogen MASER, receiver and antenna electronics should experience minimal variation in delay over the local range of temperatures. This guideline will be revised to give a numerical guideline for the delay characteristics, when a recommendation from the Clock Products Working Group is available.

9.1.4. When using a cesium standard, receiver and antenna electronics should experience minimal variation in delay over the local range of temperatures. This guideline will be revised to give a numerical guideline for the delay characteristics, when a recommendation from the Clock Products Working Group is available.

9.1.5. Antenna cables' delay should have minimal variation in delay over the local range of temperatures. This guideline will be revised to give a numerical guideline for the delay characteristics, when a recommendation from the Clock Products Working Group is available.

9.1.6. Antenna cables should have low power loss between 1-2 GHz.

9.1.7. Air-dielectric cables are not recommended unless continually kept dry.

9.1.8. Cables should be placed so as to minimize temperature variations

- Bury cables at least 1m if possible
- Avoid uneven or extreme exposure to sunlight

9.1.9. Signal reflections in the cable should be at least 40dB below the direct signal at the receiver. Avoid abrupt bends in cables.

9.1.10. Equipment carrying the time/frequency signal to the receiver must also have low sensitivity to environmental variations.

9.2. Additionally desired

9.2.1. A receiver designed for time transfer.

9.2.2. Additional guidelines are available in CCTF document CCTF-01/36 from http://www1.bipm.org/cc/CCTF/Allowed/15/CCTF_01_36.pdf

This document was assembled from many preceding documents, including "Standards for IGS Stations and Operational Centers", "Procedures for Becoming an IGS Station," "Network Issues" (from the proceedings of the IGS 2002 Workshop in Ottawa), "ISGN Sites Criteria," documents from several IGS Pilot Projects, "Guidelines for IGEX98 Sites," UNAVCO, Inc. Plate Boundary Observatory (PBO) Permanent Station System GPS Receiver and Antenna Equipment Request for Proposal (RFP), EUREF Permanent Network guidelines, and IGS Reference Frame Working Group discussions from early 2003. Thanks are due to the many authors who collaborated on these documents, and to IGS colleagues who have provided suggestions on this version.

Maintenance of this document is managed by the IGS Network Coordinator at the IGS Central Bureau. Please direct comments, questions, and suggestions to igscb @ igscb.jpl.nasa.gov.

Revision History

December 2003

Initial version approved by IGS Governing Board

February 2004

1. Expanded TIGA section.
2. Added Time section, largely from CCTF document

September 2004

1. Specified required observables.
2. Specified RINEX version 2.00 or greater required; 2.10 preferred.
3. Specified radome to appear in columns 17-20 of ANT TYPE RINEX field
4. Removed instructions to send IGLOSMails (list decommissioned).
5. Clarified that hourly data does not need to be sent to a 3rd DC when one of the 2 ordinary DCs is not available.

Jun 30 2006

1. Request calibration when an uncalibrated radome is removed.
2. Specified IERS DOMES number to appear in MARKER NUMBER field of RINEX header
3. Updated IGLOS-PP CfP URL
4. Specified when IGSMail *and* IGSStation messages are required.
5. Updated ultrarapid orbit generation schedule
6. Stated minimum met observables.
7. Updated SINEX specification URL

1 Dec 2006

1. Adopt antenna electrical characteristics in line with UNAVCO, Inc. Plate Boundary Observatory (PBO) Permanent Station System GPS Receiver and Antenna Equipment Request for Proposal (RFP)
2. State "Antenna types which are already present in the IGS network in reasonable numbers are generally preferred over novel types."
3. several updates to reflect absolute antenna calibration file igs05.atx