Assembly Procedure for ‘‘Design 3’’ SCIGN GPS Antenna Adaptor

Adaptor Parts: _____

You should have the following parts for each adaptor:

	Quantity	Part/Description
☐	1	Top Plate
☐	1	Antenna Bolt (with conical bottom)
☐	1	Clamping Bolt (for clamping the Top Plate onto the Bottom Plate)
☐	2	*Belleville* Washers, stainless, 0.750″ OD, 0.380″ ID by 0.040″ thick.
☐	1	Bottom Plate Assembly
*	1	Leveling Screw (domed top)
*	1	Leveling Screw (‘‘flat’’ top)
*	2	Hollow Locking Set-Screw, stainless, 3/8″x24, 3/16″ long.
*	1	Security Set-Screw (set to 3/32" with *Loctite*).

where the items marked with a * should already be in the Bottom Plate.
You will also need one ‘‘assembly kit’’ (below) to perform the adjustments and assembly:

Assembly Tools: _____

	Quantity	Part/Description
☐	1	Bubble Level: 10′ (for 0.6 mm at the 20 cm radius of the choke-ring).
☐	1	3/16″ hex key—for Leveling Screws and backing, Locking Set-Screws.
☐	1	Small channel-locks for holding Leveling Screws (near their rounded tops) while locking them.
☐	1	3/32″ hex key—for antenna Security Set-Screw. Should already be set.
☐	1	*Loctite* (only) for securing the antenna Security Set-Screw.
☐	1	Crescent wrench (8″)
☐	1	7/32″ open-end combination wrench (special size)—for securing the Top Plate
☐	1	Metal measurement scale (6″), with inches *and* centimeters (to record gap dimensions in four places, and distance to auxiliary ref. datum).

Assembly — General _____

In outline, the Bottom Plate is threaded onto the monument and its azimuth set; then the Leveling Screws are adjusted, to correct for (easily) up to 2½° of tilt of the Bottom Plate, using the Top Plate which is put on temporarily, and these screws are locked down. The Top Plate is then assembled to the antenna separately, so the final step is just bolting the Top Plate/Antenna assembly onto the Bottom Plate.

Ref.: http://www-pfo.ucsd.edu/pfo/monument_design/intro.html, specifically AD3-105.____

If an antenna-covering dome is going to be used, the baseplate must be put on (under) the adaptor before the adaptor’s bottom plate is secured on the monument.

Ref.: http://www-socal.wr.usgs.gov/scign/group/dome/instr_tall.html

Assembly — Detailed _____

A. Bottom-Plate assembly

1. Before putting the plate on, use a compass to establish the direction of true North (for mid Los Angeles, 1994, the magnetic deviation was 14° deviation, meaning true north is **14° west of magnetic north**; the secular change of this deviation is about −1-2′ per year, very small). Then find a distant object that is in the direction of true north and note it. When using the compass avoid proximity to any magnetic objects (e.g., cars, belt buckles) of course.
2. Screw the Bottom Plate onto the monument pipe until it is snug and the line from the center to the domed Leveling-Screw is oriented to true North (sighting on the object you located in the previous step). This coupling employs pipe threads, so they tighten rather abruptly once the conical threads on the pipe and those in the coupling meet. Typically it is possible to get a substantial fraction of a turn after the threads first ''land'', say 1/2 to 3/4ths of a turn. Use a big wrench on the adaptor coupling and, importantly, one on the monument pipe to apply the extra torque to twist the adaptor securely to true north. Don't just rely on a single wrench tugging on the adaptor coupling as this could insult the monument welds and the monument overall.

B. Leveling the Top Plate

1. The groove in the Top Plate is in its Bottom side. Put the Clamping Bolt with its two *Belleville* washers (concave sides facing one another) through the hole in the Top Plate. Next push the Antenna Bolt up through Top-Plate clearance hole with the bolt's threaded end sticking out the top side. Place the Top Plate on the Bottom Plate, with the conical surface of the Antenna Bolt resting on the Center Support Bolt and the domed Leveling-Screw of the Bottom Plate fitting into the Top Plate's groove. You'll want to push down on the Top Plate in the area of the Clamping Bolt to keep the Top Plate in place.
2. Now, if you haven't already done this above [ED.: fix this overlap], put the two spring washers into the recess in the Top Plate—make sure they are face-to-face (conical surfaces facing one another), and not nested. Drop the Clamping Bolt through them, and the hole in the Top Plate, and thread it into the hole in the Bottom Plate. Tighten this bolt finger-tight—this will hold the Top Plate in place for leveling.
3. The next step is to do the leveling. To do this you will first have to remove, or back way off, the very short (and easily lost) Locking Set-Screws in the threads for each of the Leveling Screws. These reside just below the actual Leveling Screws, in the same threads. (Or you can use the channel-lock pliers to twist the Leveling Screws, provided the Locking Set-Screws don't get in the way.) Now set the bubble level on the Top Plate and adjust the two Leveling Screws (bottom of the Bottom Plate) to make it level. Each screw will cause the bubble to move in one direction only. The bubble should end up well centered inside the scribed circle for the 10-minute bubble we are using.
4. Once the Top Plate is level, you'll need to lock the Leveling Screws.

   Note we've decided, as policy, to level this platform, not the antenna's ground plane.

   To do this, take the Locking Set-Screws and screw them into the holes that the Leveling Screws are in using the same hex key. (If they are ''hollow'' set-screws such that the wrench can extend through the Locking Set-Screws, don't push the wrench in any farther than necessary to engage the short set-screw.) Use the small channel-lock pliers to hold onto the top of the Leveling Screw to keep it from turning as you screw-in the ''Locking'' Set-Screw onto it. If possible, leave the Top Plate on while you do this so you can check that it is still level. If you have to take the Top Plate off, put it back on to check after you are done. Use of the channel-lock pliers risks galling the important surfaces; be careful.

C. Putting the Top Plate on the Antenna

1. As in step B-2 above, put the Clamping Bolt and spring washers into the recess on the top of the Top Plate. The Security Set-Screw that engages the base of the antenna preamp should have been set (and fixed with a weak *Loctite* just so it can't rattle loose) earlier to extend 3/32" above the surface of the Top Plate. Place the antenna on the Top Plate so the Security Set-Screw fits into the groove. (If your antenna does not have this groove, lower the Set-Screw using the 3/32" Allen wrench.) Then, use the Antenna Bolt to attach the Top Plate to the antenna, with the Clamping Bolt loose (dangling).

   Do not yet tighten the Antenna Bolt. Do not use *Loctite* on this screw (into the antenna).

2. Carefully orient Top Plate so the groove is aligned with antenna's N reference. The primary purpose of the Security Set-Screw is not to force the N alignment, though it does help. Tighten the Antenna Bolt to **30 foot-lbs** using the wrench.
   Toward the end of an 8"-wrench this is roughly 50 lbs; quite tight.

   Note 28-Oct-98 (JF) concern that Antenna Bolt may be too long for some antennas.
   See G. of Remedial actions.

   CAUTION: Make sure the Security Set-Screw is properly seated in the base of the antenna, its notch, before tightening the Antenna Bolt. We don't want to punch a hole into the preamp.

D. Final Assembly

1. Place the Top Plate on the Bottom Plate so 3 upward bolts (Antenna Bolt and 2 Leveling Screws) meet the divot groove and plane in Top Plate.

2. Get the Clamping Bolt into its hole in the Bottom Plate and tighten it using the special open-end wrench. It's important not to overtighten this bolt. The *Belleville* washers are there to provide some elasticity and will do so as long as they are not compressed completely flat. A firm (almost painful) pull with your little finger, cocked at 90 degrees and with the 3"-long wrench near your finger tip, should provide about **5 lbs of pull on the 3" wrench** and cause the **wrench to rotate thru 75°** (about the Clamping Bolt's axis, *not* the axis at the center of the adaptor). This should create about 180 lbs of clamping force holding the two plates together.
   As a test, it should take about 30 lbs of force downward on the outer edge of the choke-ring opposite the Clamping Bolt (in the SW corner) to cause the Top Plate to lift off the Leveling Screws. This test for ''elasticity'' in the system is an important one to carry out.

E. Recording of Dimensions

1. **Reference Height:**
   The reference datum for both the *vertical and horizontal* measurements is the divoted top of the Center Support Screw, visible when the Top Plate/Antenna assembly is removed. As the two parts that are between the Center Support Screw and the base of the antenna (the Antenna Bolt and the Top Plate) are machined, the adaptor is a 'fixed-height' fixture, with reference height: **0.0083 m.**

   All stations using this type adaptor should be easily identifiable from their RINEX file headers; they should show 8.3 mm in the antenna-height record.

   http://www-pfo.ucsd.edu/pfo/monument_design/AD3-103.____

2. **Measurement from Auxiliary Reference Mark (ECC) to Bottom Plates**.
   Diagram [AD3-104] ''ECC Reference'' shows how we'd like this measurement made.

   http://www-pfo.ucsd.edu/pfo/monument_design/AD3-104.____

   This auxiliary reference drill hole on the monument is neither the vertical nor horizontal datum. Recording of this dimension allows for any subsequent removal and replacement of the adaptor

(either deliberately or because of vandalism) without loss of the antenna's absolute position.
See SCIGN Site Construction Report form.

3. **Measurements of gap between plates**.
As a check on the assembly and to provide an archival record of the set-up, it's a good idea to make measurements of the gap between the upper and lower (adaptor) plates. The average value for the gap, measured in four places, should be equal to the value recorded for the adaptor, in the course of the ''acceptance testing'' on its machining. The difference in the opposing gap measurements give measure of the tilt of the lower plate (and thus the central support post) which may be useful for checking on integrity of the adaptor/monument should there be concerns of it being disturbed.
See SCIGN Site Construction Report form.

Adaptors: SCIGN Review and Remedial Activities — 21-Oct-98:

SCIGN Adaptors — Final Check-out and Remediation — (revised) March 1999

in conjunction with
• Dome Introduction (~50, 3/99), and
• Site Upgrades (~40, 1999)

The plan is to carry out a final check-out and do some remedial work (if necessary) on the adaptors during the installation of tall domes-and-baseplates (March 1999), the dome's baseplate installation being most easily done by removing and reinstalling the adaptor. Note that it is possible to install the dome's baseplate without removing the adaptor as the baseplates can be ''split'' and reassembled under the adaptor.

A. **Formalized installation procedure:**

Main document: **[d3adaptor.assembly]** [This]
Tools — listing: (included in the above).
Torques: these are called out in the assembly document for the adaptor assembly (and we are working on them for the dome/baseplate screws). Please pay close attention to the desired tightening torques.

B. **Alignment to True north:**

To determine the magnetic declination correction for a given drilling-site you may visit the Web site:

http://www.ngdc.noaa.gov/seg/potfld/geomag.shtml

and then select: ''Geomag Declination on-line''
Typical range of values for southern California: 12.75° (Yuma) to 14.5° (Lompoc)

We should just make up a map or table for our area. _____□□
This could be easily done by interrogating the Web site a few dozen times for different locations and contouring the results. The declination changes very smoothly and we are not seeking great accuracy, though we are seeking consistently and a 2° error (which is possible if we ignore the spatial variation of the declination) is something we should try to avoid.
Oddly, I couldn't quickly locate a local SoCal declination chart on the Web, though with more searching it ought to be possible to find one. _____□□

C. **Eccentric Reference Height Mark:**

We want a reference-height divot, ECC, to be created (drilled), labeled, and measured to, *before* and *after* the adaptor's removal for the dome's baseplate installation. Location/description of the desired Eccentric Reference Mark (divot) is shown in diagram:

Drawing: **[AD3-104] ''ECC Reference''**

Labeling of this mark should consist of the four-character station code (name) stamped above the divot (if the name is known), and the letters ''ECC' stamped below.

Keeping record of the adaptor's height above the reference divot (measured to its center) before and after the dome's baseplate is introduced allows us to keep track of any change introduced by the work. The final measurements are also essential later on should the monument adaptor be tampered with in some fashion (vandalized); having the measurement will allow us to ''recover'' the adaptor's, and thus the mark's position. This is important.

Record the results in the [SCIGN Site Construction Report]. □

(Early measurements of this are available in Wyatt document: [d3adaptor.heights]).

You must be sure to make the measurements to the adaptor's bottom surface, which is just barely accessible through the bottom of the dome's baseplate (once it's on) and difficult to distinguish from the welding groove. Don't measure into the welding groove; the diagram shows what we want. Again, we should plan on using a high quality machinist ruler.

D. **Measurement of Gap** — for a recording of the adaptor's orientation (level):

We want adaptor lower-plate-to-upper-plate gap measurements made in accordance with the table in the SCIGN Site Construction Report.

Record the results in the [SCIGN Site Construction Report]. □

(Early measurements of this are available in Wyatt document: [d3adaptor.heights]).

Gap measurements: should be made using (at least) a high quality machinist ruler.

Make measurements in four places, in both metric and English units.

E. **Introduce bigger-diameter Security Screw** (if determined to be necessary):

Some of the earlier adaptors have a small diameter Security Screw such that the antenna can twist somewhat more than we'd like before the antenna bolt is cinched down (at which point it shouldn't be able to twist, regardless), leaving the antenna not as precisely oriented as we'd like. The replacement Security Screws have been made with greater head diameters (originally specified to be 0.110" ±0.005", changed to 0.118"; groove in the antenna base: 0.125").

Adaptors which are candidates for screw replacement: need to check only pre-SN 44 adaptors.

We have a test-jig tool (actually two exist): Jig inner diameter is 0.117", such that an *acceptable* screw-point is one that *does _not_* fit into the jig.

Height: it's very important that the screws sticks up the right amount, 3/32", as shown in diagram:

Drawing: **[AD3-101] ''Cross Section.''**

If it's lower it won't engage adequately, higher and it will punch a hole into the antenna base.

Use *Loctite* to secure the screw. This is provided in the installation kit.

F. **Replacement of any non stainless steel** *Belleville* **washers.**

We suspect some of the earliest adaptors have non-stainless *Belleville* washers under the Clamping Bolt. We are concerned about them corroding away and the adaptor's upper plate becoming loose.

Candidates: As with the Security Screws we only suspect the pre-SN 44 adaptors as possibly having this problem.

Magnet Test? We tried using a magnet to check on composition, but even the new stainless steel ones are magnetic. This is not a good test.

Corrosion: Our main concern is deterioration of the washers for whatever reason. Any washers that show significant rust should be replaced, *and reported to us*. _____□□ Please.

G. **Shorter Antenna bolts for other-than-*Ashtech*-and-*Magellan* antennas.**

We know we must use shorter-than-standard-length Antenna Bolts for some ''other'' manufacturers antenna.

Design length decided upon 28-Oct-98 [d3adaptor.batchprb]. Shorten by 4 mm.

[Revised 9-Apr-99:]

We just discovered that the new-style *Ashtech* antennas have shallower mounting holes (only 5/8") by a factor of two over what they were initially. All of the initial Antenna Bolts, 1 1/8" in overall length, are too long by 0.025" (shucks, we almost avoided this surprise), and will **not** be compatible with the new antennas, or possibly with other-manufacturer's equipment.

We are currently machining a set of new Antenna Bolts some 0.099" shorter, which will be swapped in during SCIGN's antenna swap. The new bolts will be safely compatible with any bolt hole 5/8" or 15 mm deep.

Reference drawing: [AD3-003] ''Bolt#1'', Alternative short length.

H. **Dome Installation.**

Instructions: http://www-socal.wr.usgs.gov/scign/group/dome/instr_tall.html
Drawing: **[AD3-105] ''Complete Assembly''**