

Southeast Coast Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure 1.2.08

Fixed-Station Installation of Water-Quality Data Sonde Housings—Version 3.0

Please cite this as:

Starkey, E. N., and D. McCay. 2022. Fixed-station installation of water-quality data sonde housing—Version 3.0. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP—1.2.08. Southeast Coast Network, Athens, Georgia.

Summary

This standard operating procedure (SOP) outlines general considerations and procedures for installing fixed-station data sonde housings. Given the diverse nature of parks and waterbodies served by the Southeast Coast Network estuarine water and sediment quality monitoring protocol (Gregory et al. 2013), sonde housing configurations vary among locations. For this reason, this SOP is intentionally general and offers a range of considerations and options for housing installations. All housing configurations are designed to protect the sonde, increase deployment duration, and increase data quality. Site specific configuration information is maintained as an internal working document.

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #
4/2012	B. Huston		Official publication	1.0
1/2014	A. Rinehart	Updated to reflect changes in mount materials	Old version no longer accurate	2.0
4/26/2021	E. N. Starkey and D. McCay	Updates to reflect range of housing configurations and considerations. Reorganized to add clarity to the document. Updated the title to reflect standard SECN water quality naming convention.	Old version no longer accurate.	3.0

Contents

	Page
Fixed-Station Activities and Workflow Summary.....	4
Equipment/Materials List.....	5
Personal Protective Equipment (PPE)	5
Tools	5
Supplies	6
Sonde Housing	6
Pipe	6
Terminal end.....	7
Sonde Housing Mount.....	7
Overview.....	8
Housing Material Options.....	8
Sites with low current velocities and high fouling	8
Sites with high current velocities and high fouling	9
Sites with low current velocities and low fouling	9
Sites with shallow water depth and low fouling.....	9
Housing Mount Options.....	10
Procedures.....	12
Determine Housing Length and Installation Depth.....	12
Determine Length of Housing Underwater at High Tide	12
Construction of the Housing.....	12
Cut PVC to Length	12
Drill Drain, End Cap and Locking Bolt Holes	12
Install End Cap and Terminal End (PVC) Hardware	15
Attach Brass End (as needed).....	16
Paint the Housing and End Cap.....	16

Add an Anchor Stake (optional).....	17
Install the Mount and Housing	17
Literature Cited	18
Appendix A. Stainless Steel Bracket and Brass End Drawings.....	19

Fixed-Station Activities and Workflow Summary

An overview of fixed-station activities and workflow are presented in Figure 1. SOPs are presented left to right in the general order of operations for each activity. This SOP (1.2.08) pertains to the Installation activity.

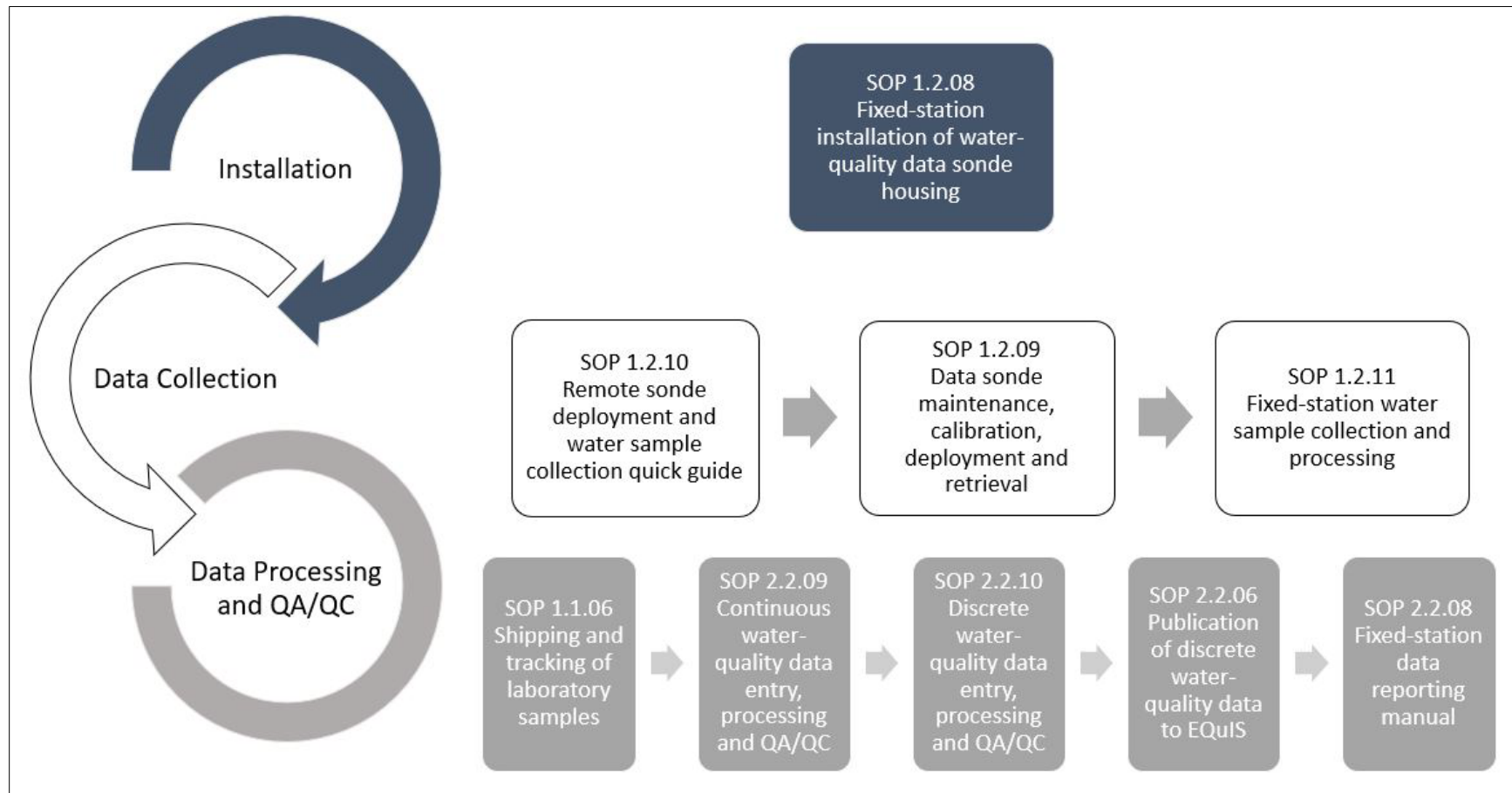


Figure 1. Fixed-station activities and workflow. SOPs are presented left to right in the general order of operations for each activity.

Equipment/Materials List

Personal Protective Equipment (PPE)

- Eye protection
- Hearing protection
- Leather gloves
- Closed toe shoes
- Dust mask
- Disposable gloves
- Hard hats
- Life jacket

Tools

- Cordless Reciprocating saw and blades
- Cordless drill with bits and 2-inch (5.08 centimeters [cm]) hole saw bit
- Impact drill and drivers for lags and bolts
- Cordless grinder with disks
- PVC saw
- Tape measure
- Set of wrenches
- Ratchet with socket set
- Pliers including but not limited to channel lock, needle nose and lineman's pliers
- Hammers including but not limited to mini sledge and rubber mallet
- Metal file
- Lighter
- Knife
- Brush

- Roller
- Paint pole
- ISO banding tool (if ISO band is used to mount housing)
- Tin Snips (if ISO band is used to mount housing)

Supplies

- Brown exterior paint
- Anti-fouling paint
- PVC cleaner and glue

Sonde Housing

The materials used for housing construction depend on the anticipated current velocities and level of fouling.

Pipe

- For low current velocities
 - 4-inch (10.16 cm) Schedule 40 PVC

OR

- For high current velocities
 - 4-inch (10.16 cm) Schedule 80 PVC
- For all current velocities
 - 4-inch (10.16 cm) flanged end cap
 - 4-inch (10.16 cm) PVC couplings as needed
 - Eye bolt—stainless
 - Shackle—stainless
 - Quarter-inch (0.64 cm) braided line
 - 8-inch (20.32 cm) carriage bolt with hole drilled in end to insert lock
 - Keyed padlock
 - PVC cement and cleaner

Terminal end

- For high fouling environments
 - 2 feet (0.6 meters [m]), schedule 40, 4-inch (10.16 cm) brass end
 - 4-inch (10.16 cm) PVC female threaded adapter (for use with brass end)
 - Stainless self-tapping screws (serve as set screw to secure brass end to threaded adapter)

OR

- For low fouling environments
 - 4-inch (10.16 cm) Schedule 40 PVC—same pipe as used for main housing
 - 8-inch (20.32 cm) stainless steel carriage bolt (bottom bolt that the sonde rests on)

Sonde Housing Mount

Depending on the dock or pier; brackets, bands, or a combination of both may be used to mount the housing to pilings.

- Stainless steel brackets (custom made by UGA [University of Georgia] machine shop for each site) with nuts, bolts, and washers.
- Stainless steel lag bolts with washers to affix brackets to wooden pilings.
- ISO band (316 stainless steel) with accompanying buckles and banding tool:
<http://isostainless.com/>
- Treated wooden 2 × 4 inches (5.08 × 10.16 cm)—may be needed as a shim if using ISO band.

Overview

The Southeast Coast Network (SECN) collects fixed-station water-quality data using continuous data loggers, also referred to as sondes. This SOP (1.2.08) outlines general considerations and procedures for the fixed-station data sonde housing installation activity shown in Figure 1. Given the dynamic nature of estuaries, all data sondes are deployed in a housing to protect them from damage and theft. Since the SECN Estuarine Water and Sediment Quality Monitoring Protocol (Gregory et al. 2013) is implemented in a wide variety of parks, sonde housing configurations vary among locations. All housing configurations are designed to protect the sonde, increase deployment duration, and increase data quality. Site specific configuration information is maintained as an internal working document. Permission must be obtained in writing before anything is attached to a dock.

When choosing the materials to be used and where to mount a sonde housing, the following must be considered:

1. Ability of a dock or pier piling to survive a large storm event (e.g., hurricane, flood).
2. Representativeness of the location in the park, waterbody, and water column.
3. Anticipated range of current velocities.
4. Anticipated level and type of fouling (i.e., soft versus hard; e.g. sediment and algae versus barnacles).
5. Anticipated range of water depths.

In general, each housing consists of a pipe, locking end cap, line to allow the sonde to be lowered into the pipe, and a terminal end with holes that allow for free exchange of water with the environment. Housings are generally mounted to a permanent structure with brackets or bands.

Housing Material Options

Sonde housings are designed for the conditions to be encountered at a given site. In general, the level of fouling and current velocity dictate what materials will be used to construct the housing. Housing configurations for situations encountered throughout the network are discussed below in order of most to least common. Unique situations may dictate departure from these designs.

Sites with low current velocities and high fouling

Housings for these sites are made of 4-inch (10.16 cm) schedule 40 PVC with a terminal end made of brass (2 feet [0.6 m], schedule 40, 4-inch; Figure 2). The brass end prevents biofouling and is relatively resistant to corrosion. These ends are custom made by the University of Georgia (UGA), Instrument Design and Fabrication Shop (machine shop) located in Athens, Georgia ([Instrument Design & Fabrication Shop \(uga.edu\)](http://InstrumentDesign&FabricationShop(uga.edu))). Drawings and specifications are provided in Appendix A.

Sites with high current velocities and high fouling

Housings for these sites are made of 4-inch (10.16 cm) schedule 80 PVC with a terminal end made of brass (2 feet [0.6 m], schedule 40, 4-inch; Figure 2). The brass end prevents biofouling and the schedule 80 PVC can better withstand the strain caused by increased current velocity. Note that 4-inch schedule 80 PVC has the minimum inside diameter necessary for a YSI model EXO sonde to freely slide inside. If a greater schedule PVC is desired, a 6-inch (15.24 cm) diameter is necessary.



Figure 2. Two-foot schedule 40, 4-inch (10.16 cm), brass terminal end.

Sites with low current velocities and low fouling

Housings for these sites are made entirely of 4-inch (10.16 cm) schedule 40 PVC with 2-inch (5.08 cm) holes drilled in the terminal end.

Sites with shallow water depth and low fouling

Housings vary from 4-inch Schedule 40 PVC installed at an angle, to a modified crab pot with sonde installed horizontally (Figure 3).



Figure 3. Sonde mounted inside of a modified crab pot at site CALOmidm02.

Housing Mount Options

Sonde housings are mounted using different mechanisms as park/site conditions dictate. In general, the Southeast Coast Network prefers to mount housings to permanent structures such as pilings that can withstand conditions experienced during a hurricane. The two primary mounting hardware options are stainless steel brackets (Figure 4) and ISO stainless steel bands. In some situations, both brackets and bands may be needed (Figure 5).

Stainless steel brackets are custom built for each site by the University of Georgia (UGA), Instrument Design and Fabrication Shop (machine shop) located in Athens, Georgia ([Instrument Design & Fabrication Shop \(uga.edu\)](http://instrumentdesignandfabricationshop.uga.edu)). Drawings and specifications for the brackets and brass end are provided in Appendix A.

ISO 316 stainless steel bands and hardware can be obtained from <http://isostainless.com/>. Bands are the best option when brackets cannot be permanently affixed to pilings with bolts.

In cases where no permanent infrastructure exists and water is shallow, sondes may be mounted inside a modified crab pot fixed below a marker buoy (Figure 3).



Figure 4. Stainless steel brackets affixing a 4-inch (10.16 cm) schedule 80 PVC sonde housing to a piling at site TIMUking01.



Figure 5. Stainless steel bands and bracket affixing a 4-inch (10.16 cm) schedule 40 PVC sonde housing to a pier at site FOPU1azz01.

Procedures

The following procedures are for a “typical” vertical sonde mount installed on a piling. The exact methods used may vary depending on the characteristics of the installation site.

Determine Housing Length and Installation Depth

Sonde housings are generally mounted vertically so that the sonde will be deployed at between 0.5 meter and 1.0 meter (1.6 ft and 3.3 ft) above the substrate. For this reason, the total housing length is determined by measuring from where the sonde will be accessed (e.g., railing of a dock, within easy reach on a piling) to the substrate and subtracting 0.5 meter (1.6 ft). If the housing will be fitted with a brass terminal end the amount of PVC required will be the total length minus 0.61 meter (2.0 ft).

THE MOST IMPORTANT CONSIDERATION FOR INSTALLATION DEPTH IS THAT THE SONDE SHOULD NOT COME OUT OF THE WATER FOR ANY LENGTH OF TIME DURING THE DEPLOYMENT. If water depth will not allow for a vertical installation or the sonde will leave the water at low tide, consider another installation location or housing configuration.

Determine Length of Housing Underwater at High Tide

Before beginning construction of the housing, measure the distance from the substrate to the approximate high tide level. The high tide level can be estimated from looking at the high-water mark and height at which barnacle growth ceases on pilings. The substrate to high-tide distance minus the height above substrate will be used to determine how much of the pipe will be painted with anti-fouling paint.

Construction of the Housing

Cut PVC to Length

PVC will be cut to the total length measured in the steps above. Note that PVC is sold in 10-foot and 20-foot (3.05 m and 6.1 m) sections. If greater than 10 feet (3.05 m) of pipe is required, a 20-ft section will be cut to length. The use of couplings reduces the strength of the housing and increases the chances of a sonde getting caught in the union as it is lowered or raised in the housing.

Drill Drain, End Cap and Locking Bolt Holes

After cutting the PVC, 2-inch drain holes are cut every 3 feet (1.0 m) on alternating sides of the pipe up to the approximate height of high tide (Figure 6). In addition, if not using a brass end, flow holes are cut in the bottom 2 feet (0.61 m) of the pipe (Figure 7). These holes allow for free exchange of water with the surrounding water column. If insufficient drain holes are present on the upper portion of the housing, a freshwater “lens” may develop if water becomes trapped inside the housing.

Place the end cap on the housing and drill a half-inch (1.27 cm) hole through both the end cap and pipe. This hole will accommodate the locking bolt (Figures 8 and 9).

Insert the locking bolt and drill a small hole in the top of the end cap (off center of the locking bolt). This hole will accommodate the eyebolt from which a line will be tied and the sonde will be suspended.

Drill a hole in the locking bolt to accommodate the lock (Figures 9 and 10).



Figure 6. PVC pipe with drain holes.



Figure 7. PVC pipe with flow holes and bottom bolt.



Figure 8. Locking end cap with bolt installed.



Figure 9. Example of flanged cap, locking bolt and lock.



Figure 10. Example of bolt with hole drilled into it to accept lock.

Install End Cap and Terminal End (PVC) Hardware

If no brass end will be used, and the terminal end of the pipe is PVC, a stainless lag bolt is placed 2 inches (5.1 cm) from the end of the pipe. This lag bolt will prevent the sonde from exiting the pipe and serve as a point on which the sonde can rest during each deployment. Remember to use stainless steel and not a galvanized bolt, as this bolt will need to last for years in saltwater. Pre-drill a hole large enough for the bolt and fasten with washers and nuts.

Attach the eyebolt to the inside of the end cap (Figures 9 and 11). After the eye bolt is installed, damage the threads to prevent tampering. If the eye bolt is tampered with, or breaks, retrieving the sonde becomes very difficult.

Cut a piece of braided line the length of the housing. Tie one end to the eyebolt and the other end to a stainless-steel anchor shackle (Figure 11). This is how the sonde will be deployed and retrieved from the housing. A foot or so of slack line prevents the sonde ‘hanging’ from the eyebolt and allows it to rest directly on the bolt at the end of the housing. Use a lighter to fuse (melt) the ends of the line to prevent fraying.



Figure 11. Example of sonde, shackle, rope, eye bolt and flanged cap.

Attach Brass End (as needed)

If a brass end (Figure 2) will be used, glue a 4-inch (10.16 cm) threaded PVC coupling (Figure 12) to the end of the pipe. Let the glue set before threading on the brass end. A metal pipe or rod can be inserted into the flow holes of the brass end to help twist it tight. Once tightened, place two self-tapping screws through the coupling and just barely into the brass. These will serve as set screws that prevent the brass end from twisting loose.

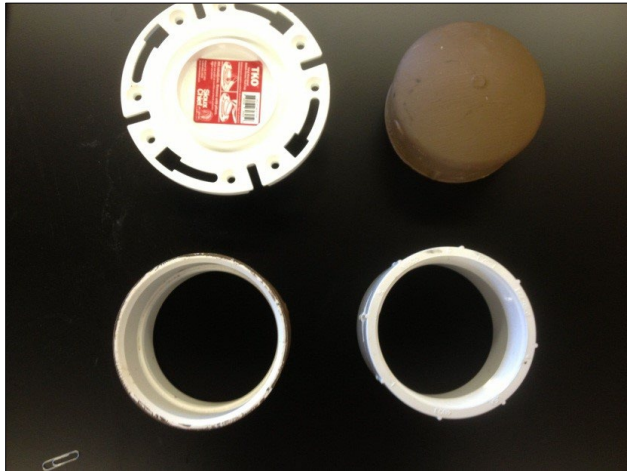


Figure 12. Clockwise from top left, examples of flanged cap, dome cap, threaded female adapter, and coupling.

Paint the Housing and End Cap

The inside and outside of the housing are painted with anti-fouling paint from the end up to the anticipated level of high tide (Figures 6 and 7). The antifouling paint is applied to the outside with a roller and the inside with a rag and a long pole. Painting the brass end may extend the life of the brass by several years. The antifouling paint will reduce soft and hard fouling during the first three to five years of service. The outside of the housing is painted with brown exterior paint from the top down to the antifouling paint. This coating of exterior paint reduces the effect of UV radiation on the pipe and helps it blend in with the surroundings.

Add an Anchor Stake (optional)

Anchor stakes are occasionally added to the bottom of the sonde housing (Figure 13). This helps stabilize the housing and prevents the bottom from moving with the tides. Stainless angle stock is the preferred anchor stake material. This method is especially useful in exceptionally deep installations and areas with high current velocities.



Figure 13. Sonde housing with brass end and anchor stake.

Install the Mount and Housing

The exact mount installation procedure depends on the type of structure or piling to which the housing will be affixed. For wood pilings it is preferable to use brackets that screw directly into the wood. For concrete or other materials, it may be preferable to clamp brackets around the piling or use bands (see Housing Mount Options section above). Regardless of the method, permission must be obtained from park resource or facility managers prior to installation.

The exact number of brackets or bands needed for an installation varies depending on site characteristics. Use as many brackets or bands as necessary to keep the sonde housing straight and prevent movement with the tides.

If using brackets, it is often helpful to install the top bracket and then align subsequent brackets with a plumb bob. The housing can then be stood up and bolted into place.

In cases where current velocities have an extreme effect on the integrity of the housing, consider affixing a stainless-steel chain to the brass end and a bracket. The chain helps prevent the bottom from moving with the tides and transfers the weight of the brass end from the PVC to a bracket (Figure 14).

A hard hat must be used if any overhead work will be conducted.

When the sonde housing is secured, an official NPS SECN water quality monitoring sticker will be applied to the pipe in a visible location (Figures 4 and 5).

Document all depths, lengths, distances and type/number of brackets used. Record all installation notes in the internal working document for station descriptions. This information is valuable if the housing becomes damaged and must be rebuilt.



Figure 14. Sonde housing installed with multiple brackets and chain to prevent damage by extreme current velocity during incoming and outgoing tides.

Literature Cited

Gregory, M. Brian, J. C. DeVivo, E. M. DiDonato, C. J. Wright, and E. Thompson. 2013. Protocol for monitoring estuarine water and sediment quality in selected Southeast Coast Network parks. Natural Resource Report NPS/SECN/NRR—2013/644. National Park Service, Fort Collins Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2194106> (last accessed June 2022).

Appendix A. Stainless Steel Bracket and Brass End Drawings

Drawings are provided by the University of Georgia Instrument Design and Fabrication Shop. High resolution images and CAD files are stored on the SECN server.

Instrument Design & Fabrication Shop

Office of Research Services | University of Georgia

955 East Whitehall Road, Athens, Georgia 30602

Office: 706.542.5996

<http://research.uga.edu/ids/>

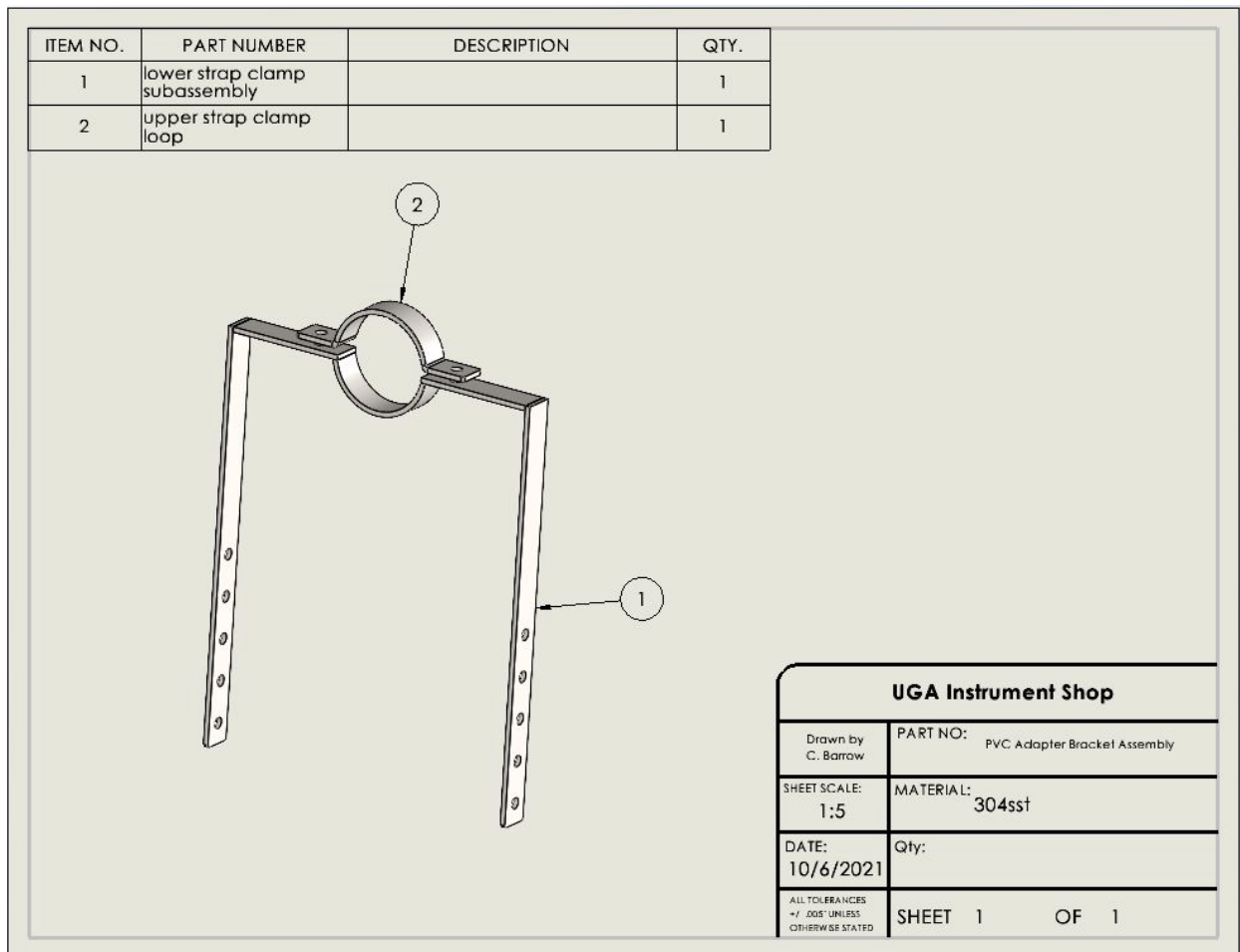


Figure A-1. Overview drawing of the stainless-steel sonde mount bracket.

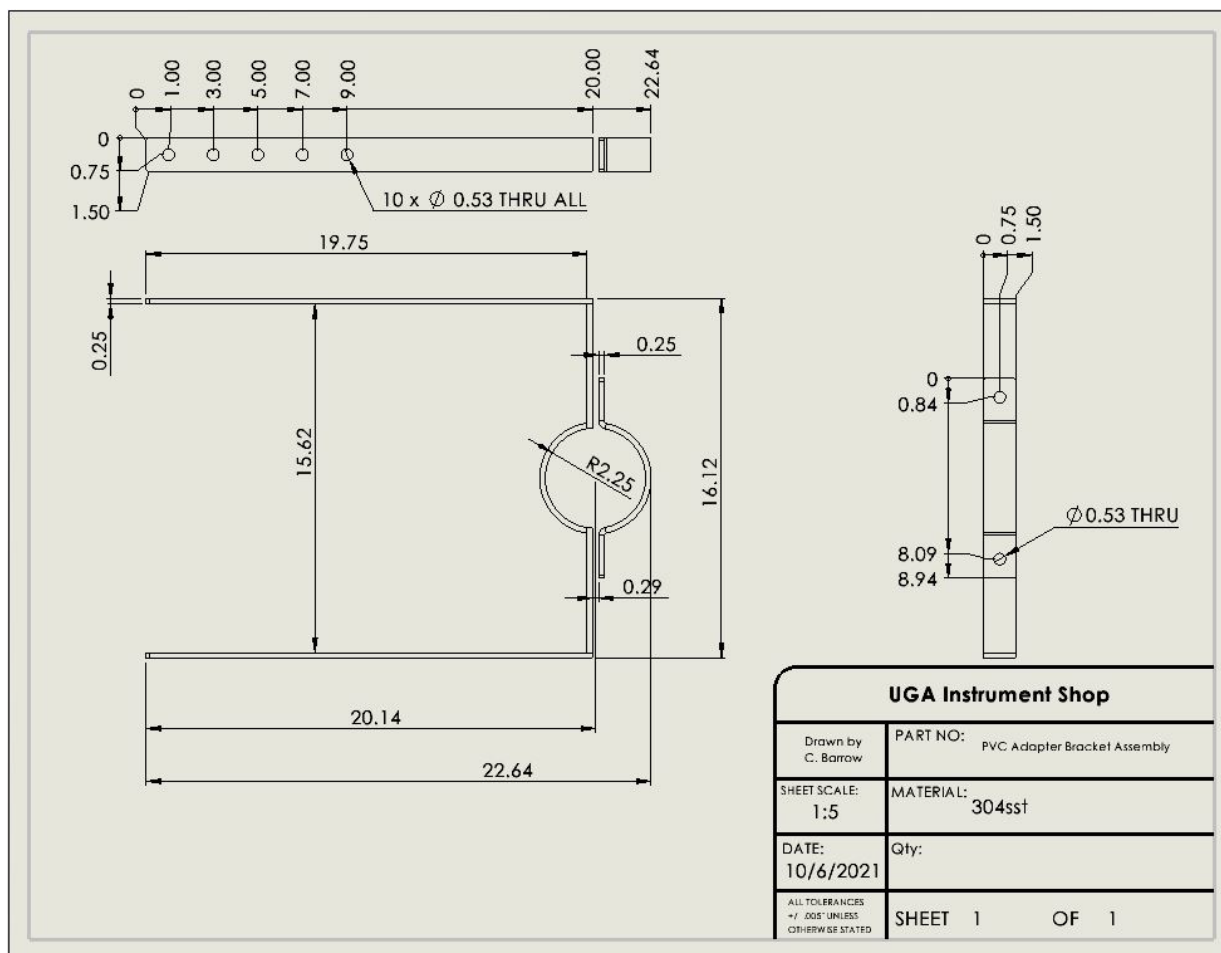


Figure A-2. Detailed drawing of the stainless-steel sonde mount bracket.

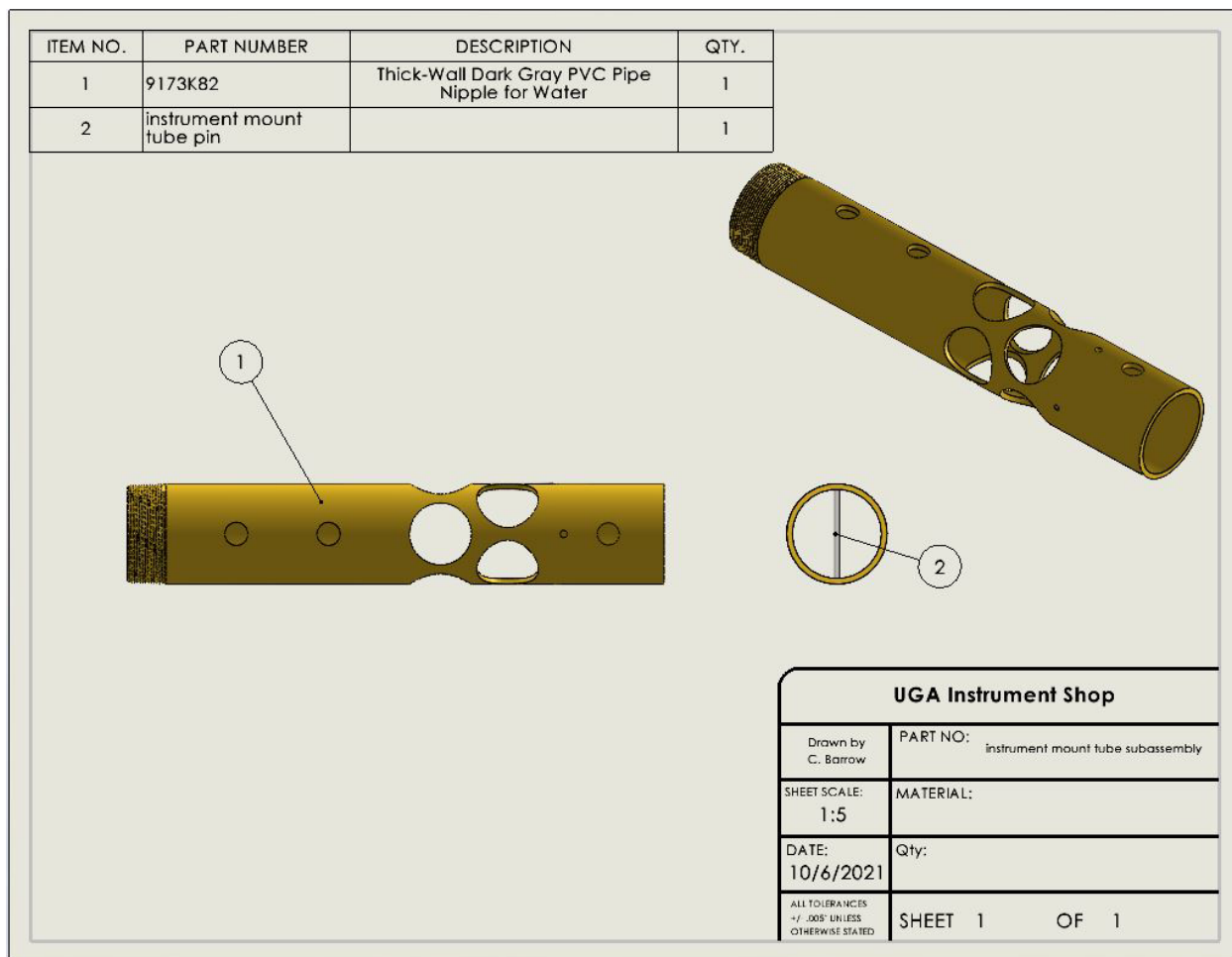


Figure A-3. Overview drawing of the brass end.

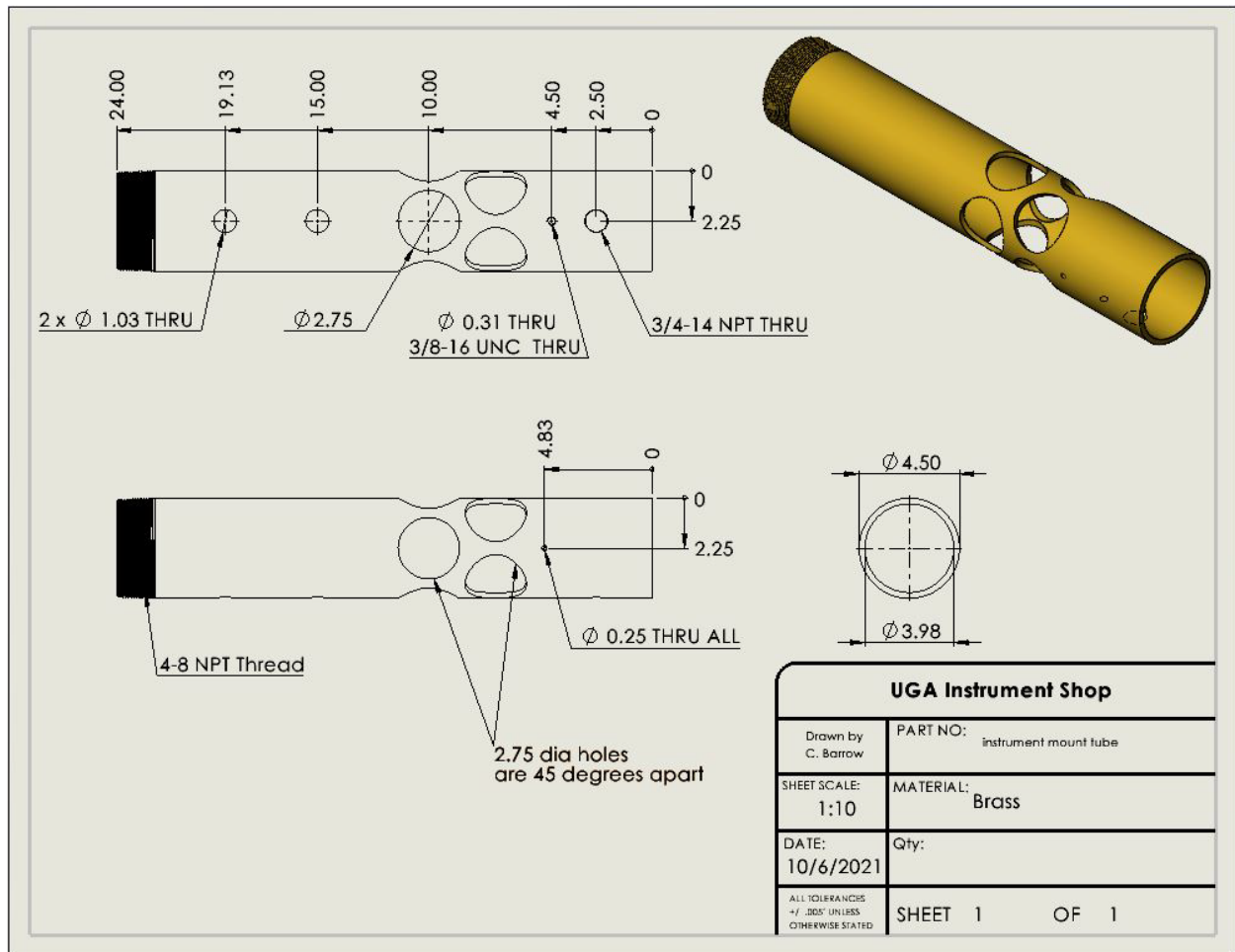


Figure A-4. Detailed drawing 1 of 2 for the brass end.

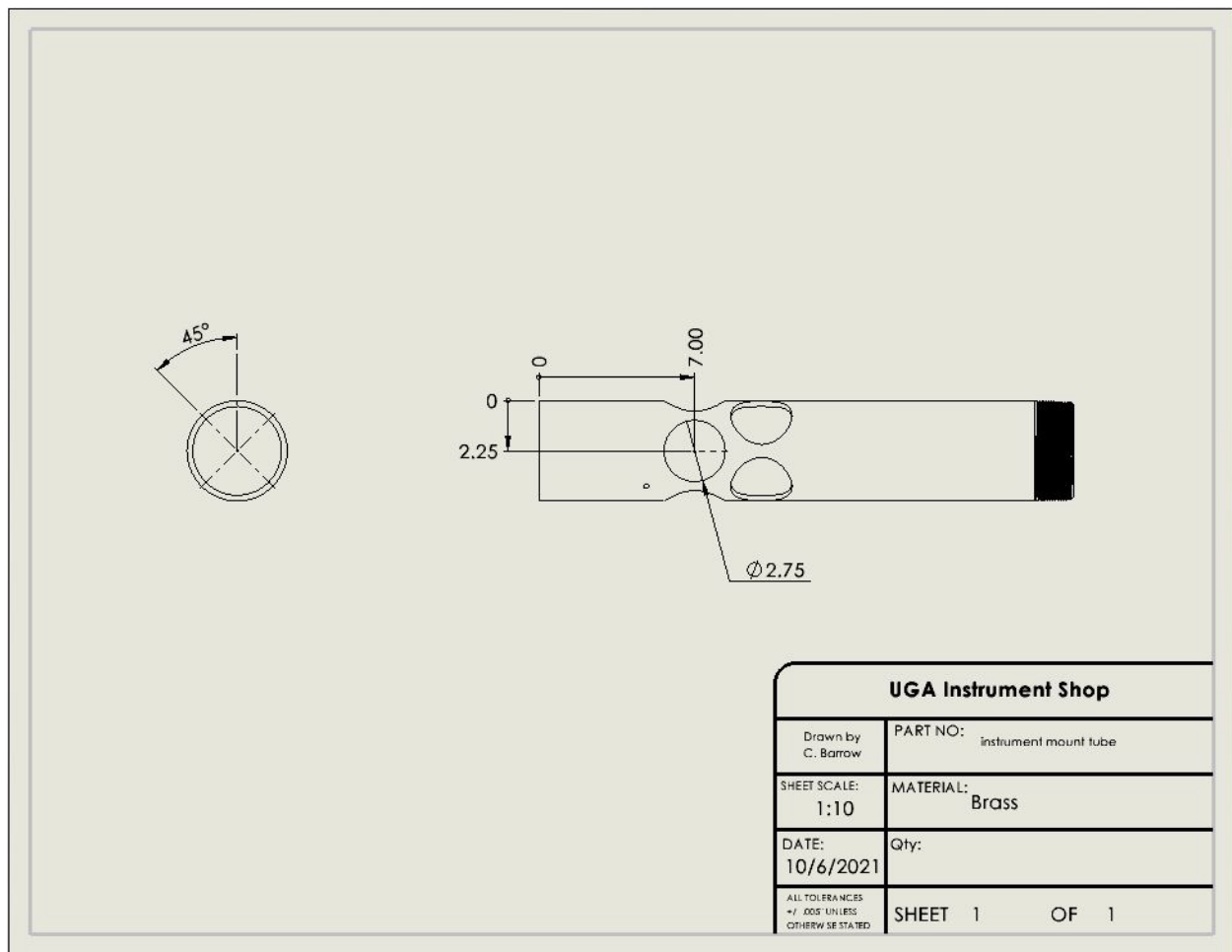


Figure A-5. Detailed drawing 2 of 2 for the brass end.

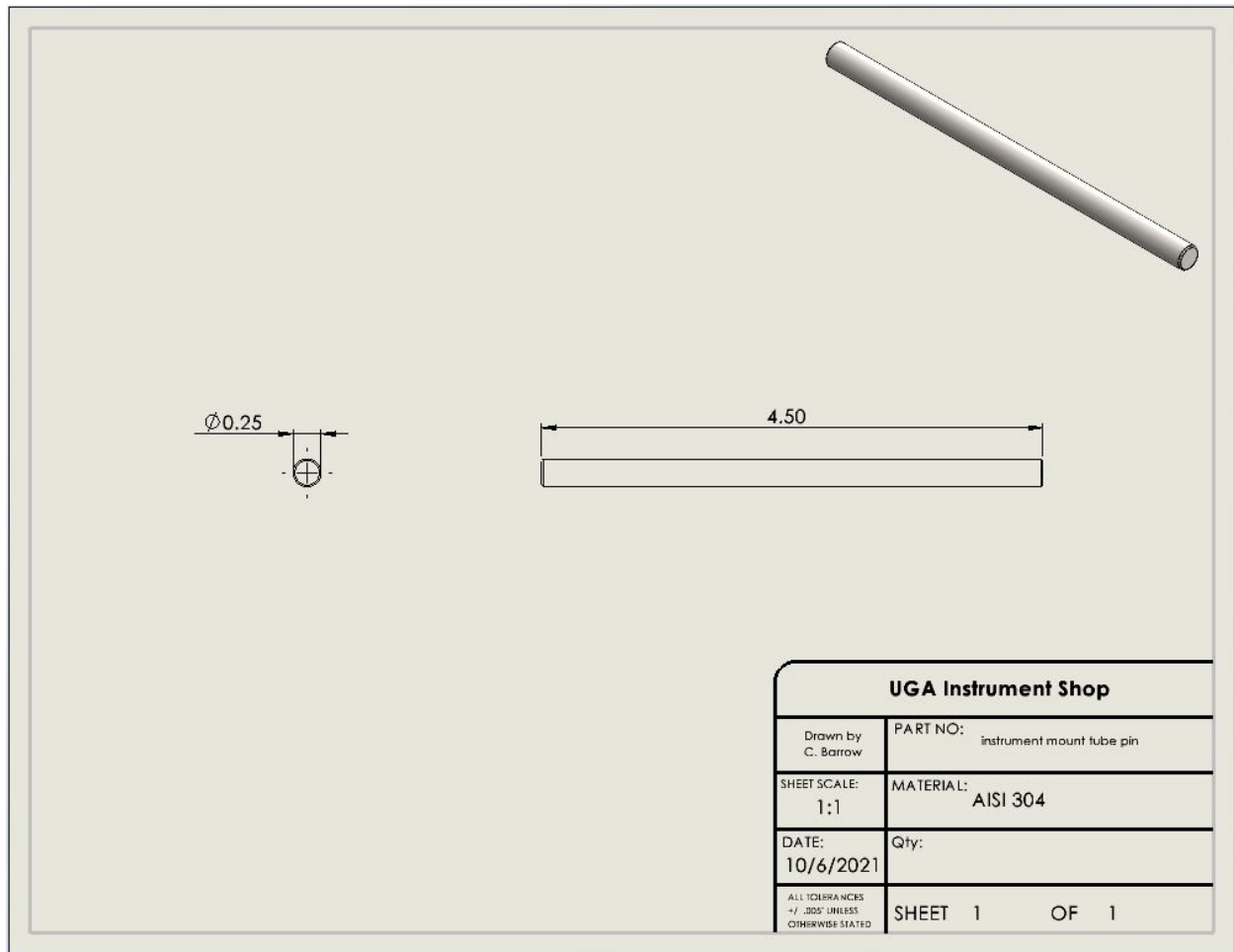


Figure A-6. Detailed drawing of the brass end pin (sonde stop).