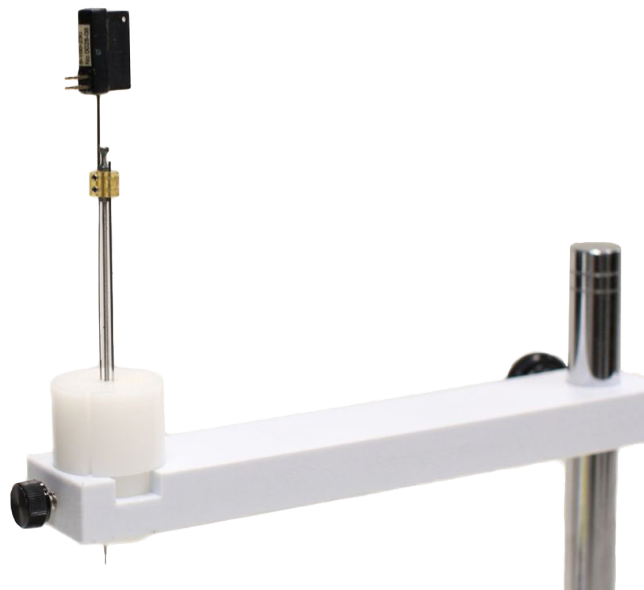


PlexDrive™ Microdrive Technical Guide



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Documentation History

Date	Version	Notes	Author(s)
June 2013	PRBTN0002a	- Added Probe Compatibility calculations and technical specifications. - Improved images and illustrations. - Reformatted document to current branding guidelines.	Stacie Hyatt Yolanda Rowe
November 2009	v1.0	- Initial creation of document.	Chris Heydrick

Introduction

The PlexDrive™ Microdrive (PlexDrive) is a specialty, screw-driven microdrive for positioning one or more V-Probes and U-Probes (probes) in a standard 19mm primate recording chamber. It is simple, robust, economical, and facilitates recording from both superficial and deep brain structures.

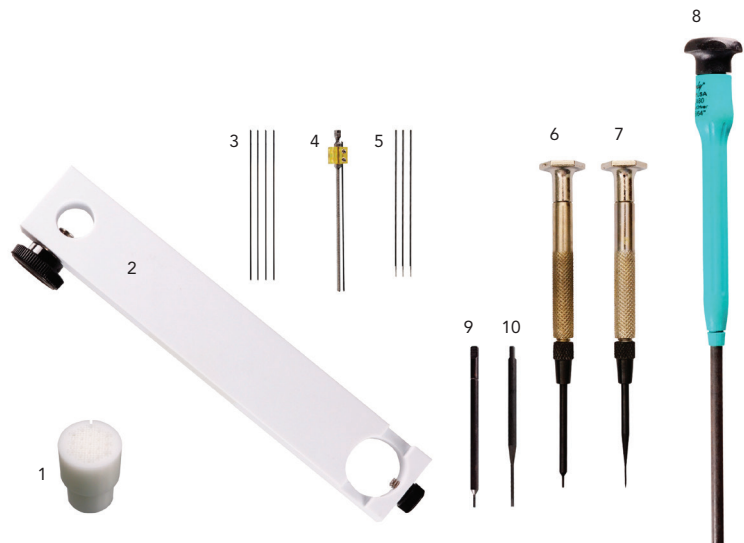
The purpose of this guide is to provide a detailed description of the PlexDrive components, technical specifications, probe compatibility considerations, and offer step-by-step instructions for assembly and usage. Please note that in the interest of space, illustrations are often presented horizontally even though they would be oriented vertically during actual use.

The PlexDrive was designed by Bob Schafer and Tim Buschman at the Desimone and Miller labs at MIT.

Components

PlexDrive is used for positioning and advancing probes and includes the following components as identified in the picture below:

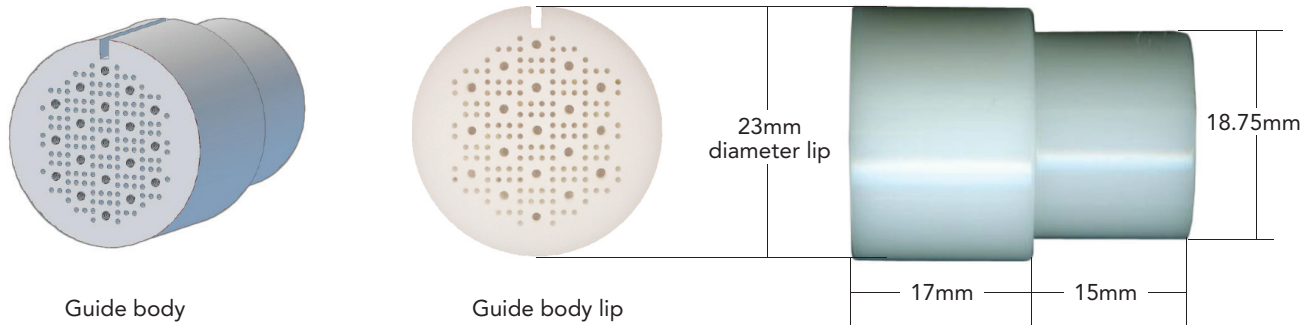
1. Guide body
2. Guide body holder assembly
3. Guide tubes
4. Drive screw assembly
5. Spare stabilization rods
6. 0.028" Hex driver
7. 0.025" Flat screwdriver
8. 5/64" Nut driver
9. Spare hex driver blade
10. Spare screwdriver blade



Caution: The parts included in the PlexDrive kit are not sterile. Appropriate sterilization techniques must be used for any components that may come in contact with exposed tissue or probe which will, in turn, contact tissue (e.g. guide tubes).

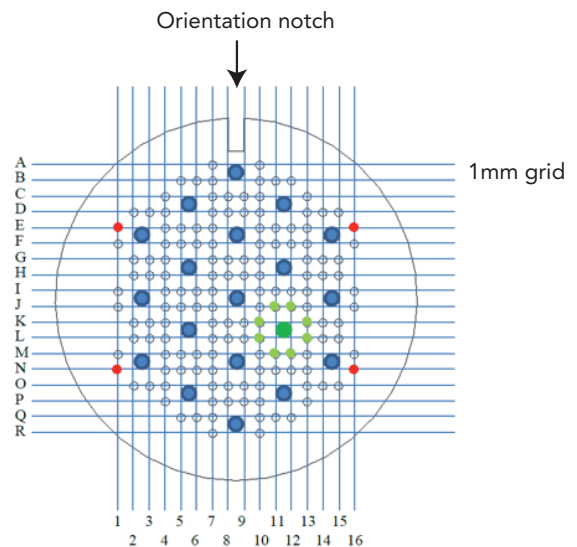
Guide Body

The guide body is a cylindrical block 18.75mm in diameter with a 23mm diameter lip around the top edge designed to slide into a recording chamber with a 19mm internal diameter (ID), and contains 144 small diameter unthreaded holes (0.021" in diameter). These small holes are arranged on a 1mm grid pattern and each can accommodate a 25 gauge guide tube through which the probe passes.



The guide body also contains 19 larger diameter holes (as shown in blue in the illustration below) that are threaded for a #00-90 screw. The drive screw (described in the Drive Screw Assembly section later in this document) is positioned into the threaded hole immediately adjacent to the small hole containing the guide tube. Each of the 144 guide tube holes is accessible from one and only one of the larger threaded holes. For example, if the drive screw is inserted into the dark green hole as depicted in the illustration to the right, the guide tube, and thus probe, may pass through any of the small holes shaded light green. The guide body also has an orientation notch to facilitate reproducible orientation in the chamber.

Note: The small holes marked in red and identified as E1, E16, N1 and N16 in the illustration to the right are not useable. These holes do not go all the way through the guide body.



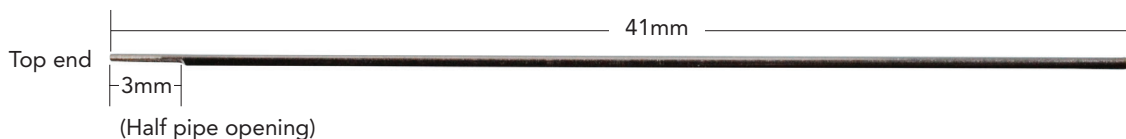
Guide Body Holder Assembly

The guide body holder is a 150mm arm that attaches to any positioning system with a 10mm or 12mm diameter vertical post, and is used to hold the guide body on the animal's head during drive assembly prior to placement in the recording chamber. Additionally, the arm may potentially be used to hold the drive during an acute experiment. There are thumb screws for clamping the holder to a vertical post and for clamping the guide body into the holder.



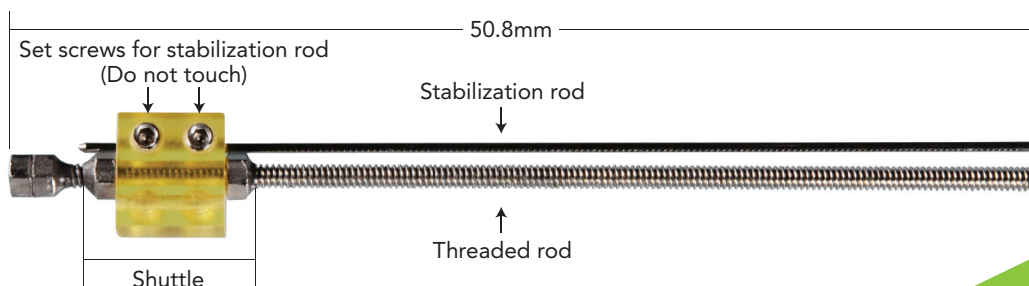
Guide Tubes

A guide tube is a piece of 25 gauge tubing 41mm in length and fits snugly in any one of the 144 unthreaded guide body holes, with just enough room to slide up and down inside the hole. The purpose of the guide tube is to limit the lateral deflection of the probe shaft as it is advanced into the tissue. At one end of the guide tube, half of the circumference of the tube has been removed for approximately 3mm as depicted in the illustration below. This is considered the top end of the guide tube. This half pipe opening makes it easier to insert the probe into the guide tube. Four guide tubes are provided with each PlexDrive kit.



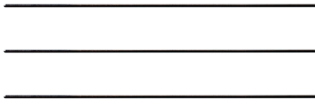
Drive Screw Assembly

A drive screw consists of a shuttle mounted to a length of #00-90 threaded rod and one stabilization rod. The shuttle is depicted in the illustration below and includes the nuts on either side. The probe (not pictured, please see Driver Assembly and Usage in later section) and stabilization rod are clamped into the shuttle using set screws. During operation, threading the drive screw into the guide body generates the linear motion that advances the probe. The drive screw advances $282\mu\text{m}$ ($1/90$ th of an inch) during every 360° rotation. The threaded rod rotates freely inside the shuttle. The stabilization rod enters the guide body and helps prevent the shuttle from rotating with the screw as the screw is turned. Note that the stabilization rod goes into the smaller of the two holes in the shuttle indicated by a chamfer (shallow, angled cut) on the corner of the shuttle.



Spare Stabilization Rods

One stabilization rod is incorporated as part of the Drive Screw Assembly and three spares are supplied in each PlexDrive kit.



0.028" Hex Driver

The hex driver is used to tighten the set screws on the side of the shuttle that hold the guide rod and probe in place.



0.025" Flat Screwdriver

The screwdriver is used to turn the drive screw, which in turn raises or lowers the probe.



5/64" Nut Driver

The nut driver can also be used to turn the drive screw. It is especially useful when initially inserting the drive screw into the guide body, and for coarse positioning of the drive screw assembly prior to inserting the probe. Note that once the probe has been installed into the shuttle, there is not enough clearance around the drive screw assembly to use the nut driver, at which time the screwdriver must be used to advance the probe. If the drive screw fits too snugly in the guide body and is difficult to turn, you may use the nut driver to advance the drive screw assembly into and out of the threaded hole a couple of times. This will make it easier to advance the probe.



Spare Hex Driver Blade

One spare screwdriver blade is supplied in each PlexDrive kit.



Spare Screwdriver Blade

One spare hex driver blade is included in each PlexDrive kit.



Technical Specifications

Feature	Specifications and Options	Remarks
Probe compatibility	V-Probes and U-Probes	See details in the Probe Compatibility section.
Guide body dimensions	23mm OD x 32mm length	
Number of holes for probe positioning	144	These holes are threaded.
Diameter of holes for probe positioning	530µm	
Grid pattern spacing	1mm	
Number of drive-screw holes	19	These holes are not threaded.
Recording chamber compatibility	19mm	
Guide tube material	Stainless steel	
Guide tube size	25 gauge	
Guide tube ID	260µm	
Guide tube length	41mm	
Drive screw assembly length	50.8mm	
Device resolution	282µm per turn	

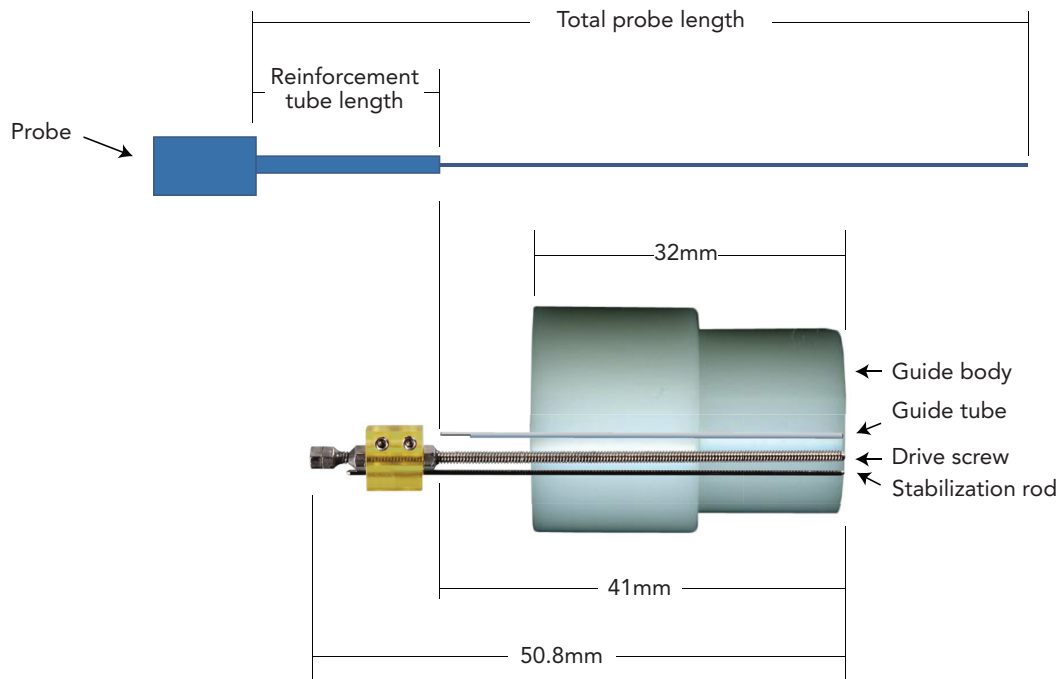
Probe Compatibility

The PlexDrive is compatible with most of Plexon's U-Probes and V-Probes; however, there are limitations based on the specific dimensions and mechanics of the PlexDrive. It is very important to consider the following three issues prior to performing the experiment, or better yet, prior to ordering the probes:

1. First, you must determine if the distance the probe will extend below the PlexDrive will be sufficient to reach the target. To be more specific, the depth range must be sufficient to permit the appropriate electrode sites to reach the appropriate depth.
2. Second, the probe dimensions must allow for the tip to be completely retracted into the PlexDrive so that neither tissue nor the probe itself sustains any damage prior to or during fixation over the subject.
3. Third, the outer diameter of the probe must fit within the PlexDrive guide tube.

Ideally, a lab would order the probes to meet these requirements. However, it is possible that a lab may wish to order the PlexDrive and use it with probes they might already own. Either way, the following information will help determine compatibility.

Below is an illustration of a probe above an illustration of relevant PlexDrive parts. The specific parts and dimensions will help frame the compatibility explanations below.

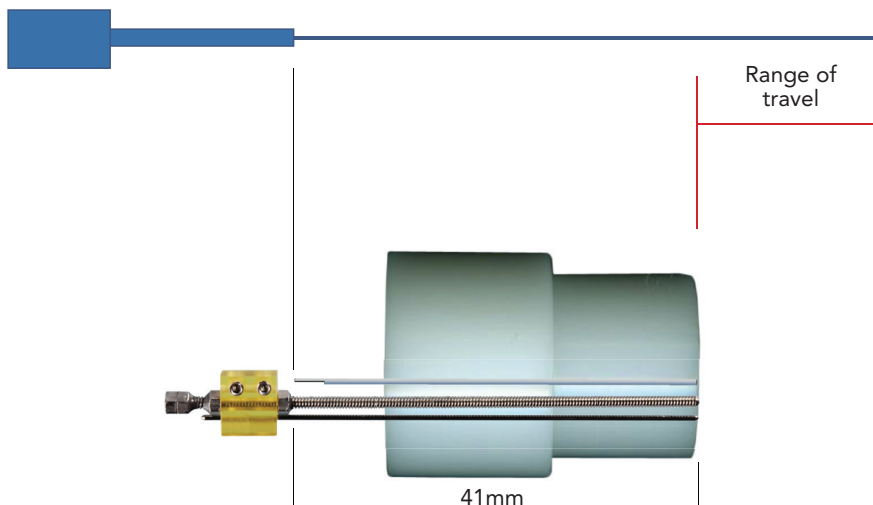


Assembly instructions and additional information regarding parts in the illustrations can be found in the Driver Assembly and Usage section later in this document.

Range of Travel (Depth Range)

The probe specifications must yield a depth range sufficient to permit the appropriate electrode sites to reach the appropriate depth. As the distance the PlexDrive will be positioned above the subject is variable, the range of travel is defined as the maximum distance the probe tip will extend below the guide body. The available range of travel for a specific probe is a factor of two variables and a constant:

- ♦ Total probe length,
- ♦ Reinforcement tube length, and a
- ♦ Fixed variable of 41mm related to the PlexDrive dimensions.



The formula is written as follows:

$$(\text{Total Probe Length} - \text{Reinforcement Tube Length}) - 41\text{mm} = \text{Range of travel}$$

For example, a standard probe with a total length of 100mm and a reinforcement tube length of 30mm would yield a range of travel of 29mm. Therefore, the probe tip will extend a maximum of 29mm below the base of the guide body.

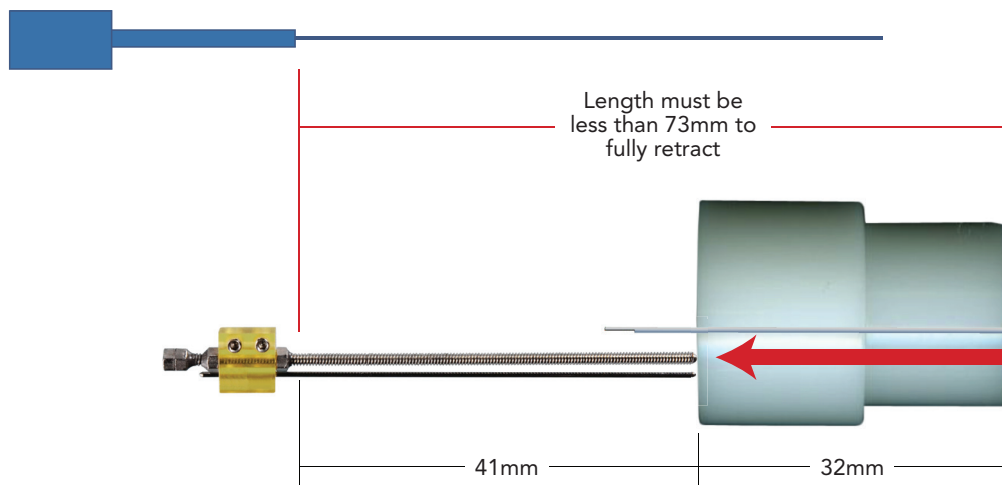
$$\text{Example: } (100\text{mm} - 30\text{mm}) - 41\text{mm} = 29\text{mm}$$

Tip Retraction Compatibility

Probe dimensions must also allow for the tip to be completely retracted into the PlexDrive guide body so that neither tissue nor the probe itself sustains any damage prior to use. The calculation required to determine tip retraction compatibility is an inequality incorporating the same two variables from the previous calculation with a different constant:

- Total probe length,
- Reinforcement tube length, and a
- Fixed variable of 73mm related to the PlexDrive dimensions (the 41mm length of the drive screw fully lowered plus the 32mm to fully retract the drive screw through the guide body).

The total probe length minus the reinforcement tube length must be less than 73mm.



The formula is written as follows:

$$(\text{Total Probe Length} - \text{Reinforcement Tube Length}) < 73\text{mm}$$

For example, if we once again select our standard probe with a total length of 100mm and a reinforcement tube length of 30mm, the difference of 70mm is in fact less than 73mm. Thus the inequality is true and the probe passes the tip retraction compatibility test.

$$\text{Example: } (100\text{mm} - 30\text{mm}) < 73\text{mm}$$

$$70 < 73$$

However, if the probe had a total length of 100mm and a reinforcement tube length of 20mm, the resulting 80mm is not less than 73mm.

$$\text{Example: } (100\text{mm} - 20\text{mm}) < 73\text{mm}$$

$$80 \not< 73$$

In this case, the inequality is FALSE, and the probe fails the test. If the probe has not yet been purchased, there are two choices:

- ♦ Extend the length of reinforcement tube, or
- ♦ Reduce the total length of the probe.

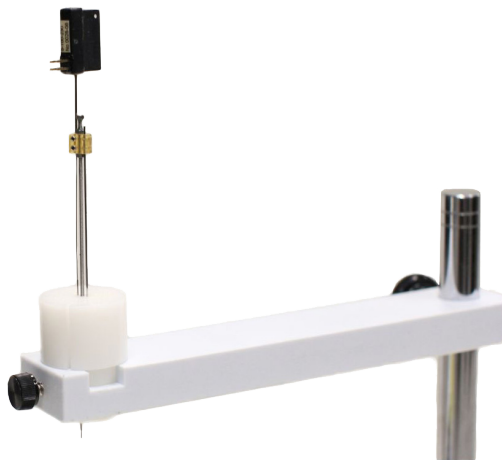
If either the total length or the reinforcement tube length is changed, it may be necessary to recalculate the range of travel formula from the previous section as well.

Guide Tube Compatibility

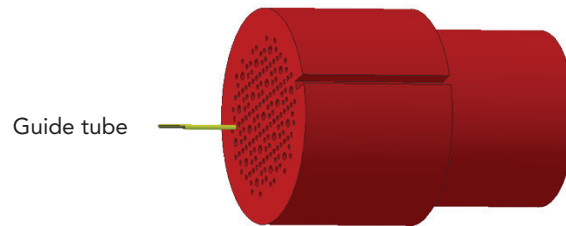
The size of the guide tube is dictated by the size of the holes in the guide body through which it must pass. The guide body holes support a 25 gauge guide tube with an inner diameter of 260µm. Accordingly, U-Probes or V-Probes with a smaller diameter are compatible with the PlexDrive and will fit through the guide tubes.

Driver Assembly and Usage

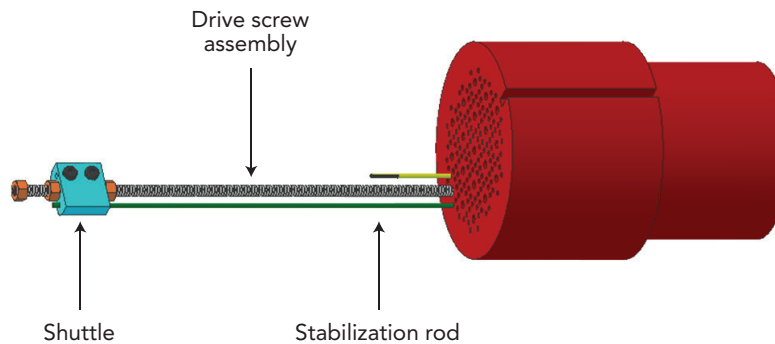
The photo below depicts the PlexDrive Microdrive fully assembled. The following six steps will describe and illustrate how to assemble your PlexDrive. It is recommended to complete all six steps prior to usage on an animal.



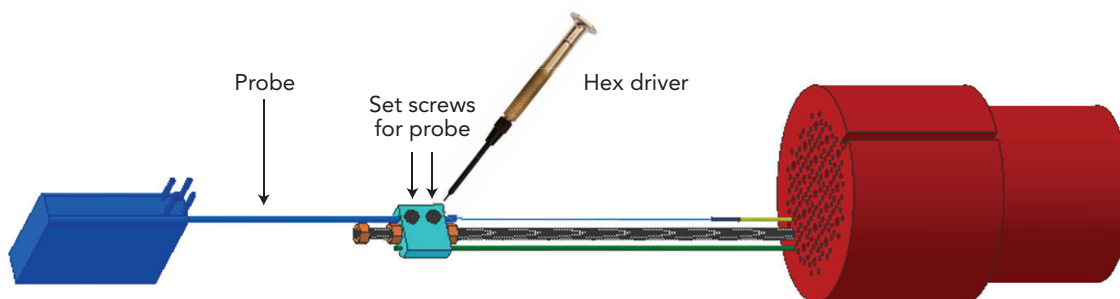
Step 1: Begin by inserting a guide tube into one of the small unthreaded holes in the guide body where the probe will be positioned. Slide the guide tube in until the bottom of the tube is flush with the bottom of the guide body.



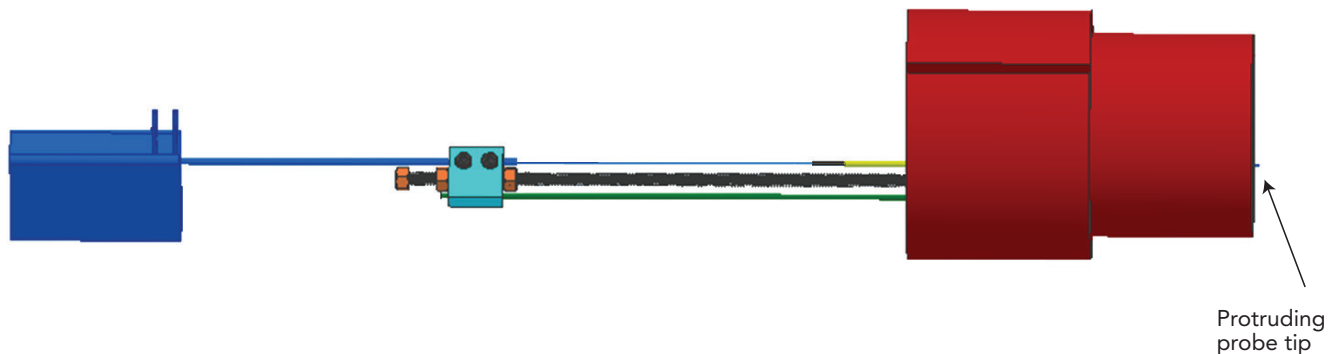
Step 2: Carefully start threading the drive screw assembly into the nearest of 19 threaded holes. Rotate the stabilization rod so that it goes into the small hole on the other side of the screw directly opposite the guide tube.



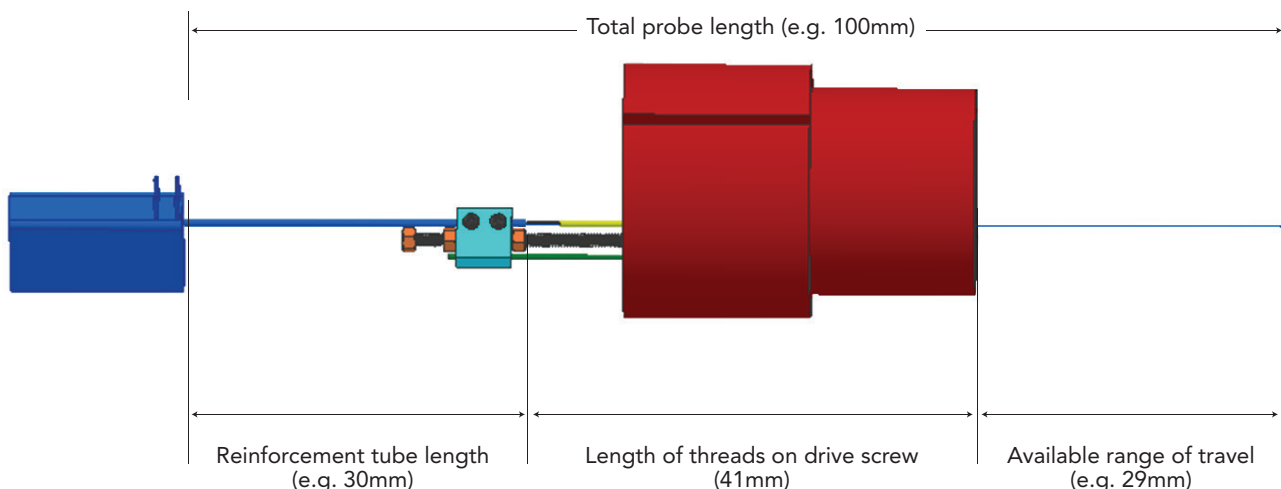
Step 3: Slide the probe into the shuttle on the drive screw. The tip of the probe should slide into the notch on the side of the guide tube. Continue lowering the probe until the bottom of the reinforcement tube is flush with the bottom of the shuttle and tighten the set screws with a hex driver to hold it in place.



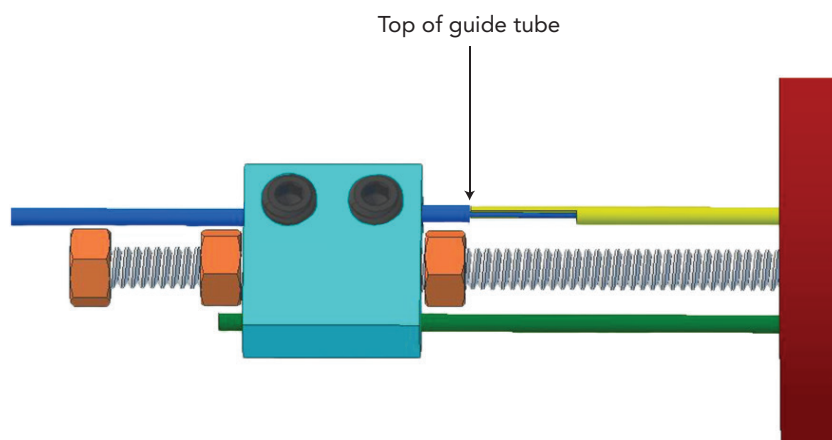
Step 4: Turn the drive screw to lower the probe until the tip is slightly protruding from the bottom of the guide body, then reverse it until the tip is no longer exposed. Note that the probe advances $282\mu\text{m}$ ($1/90$ th of an inch) for every 360° rotation of the drive screw.



Step 5: After the PlexDrive is configured as described above, be certain to know your available range of travel (see Probe Compatibility section to calculate). Note that the range of motion will vary by probe specifications. In the example provided earlier and illustrated below, a standard probe with a total length of 100mm and a reinforcement tube length of 30mm would yield a range of travel (depth range) of 29mm. Therefore, if the base of the PlexDrive guide body was flush with the brain's surface, then the tip of the probe could reach a maximum depth of 29mm. If you attempt to advance the probe further than 29mm, the threaded rod will begin to protrude from the bottom of the guide body and shortly thereafter, the shuttle will hit the top of the guide tube.



Step 6: Stop advancing the probe when the bottom of the nut on the shuttle is aligned with the top of the guide tube. Set up is complete.



About Plexon Inc

Plexon is a pioneer and leading innovator of custom, high-performance data acquisition, behavior and analysis solutions specifically designed for scientific research. We collaborate with and supply thousands of customers including the most prestigious neuroscience laboratories around the globe driving new frontiers in areas including basic science, brain-machine interfaces (BMI), neurodegenerative diseases, addictive behaviors and neuroprosthetics. Plexon offers integrated solutions for *in vivo* neurophysiology, optogenetics, and behavioral research – backed by its industry-leading commitment to quality and customer support. For more information, please visit www.plexon.com.

Sales Support

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