

*Probot*TM

User's Guide



© Eddyfi NDT, Inc.

2800, Louis-Lumière, Suite 100

Québec (QC)

G1P 0A4 CANADA

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General Precautions and Conventions

General Precautions

The following safety precautions are to be observed at all times when using the Eddyfi Probot™. Make sure that you review them **before** turning on the system.

- Keep this document in a safe place for future reference.
- Carefully follow the installation and operation procedures detailed herein.
- Respect the safety warnings on the instrument and in this document.
- The Probot should only be used by qualified personnel.
- When transporting the Probot, it is your responsibility to make sure that you apply the safety precautions dictated by the relevant local governing bodies.
- Always connect the Probot to a properly grounded receptacle, extension cord, or power bar. Grounding a single conductor of a two-conductor outlet is not sufficient protection for the Probot.
- Only connect the system to a power source corresponding to the type indicated on the rating plate.
- If you use the system in a manner that deviates from that specified by Eddyfi, the protection provided on the equipment may be rendered null and void.
- Do not use substitute parts or perform unauthorized modifications to the system.
- Service instructions, when applicable, are intended for trained service personnel only.
- Always make sure that the system is unplugged from any power supply before servicing.
- To avoid dangerous electric shock, do not perform any service on the system unless qualified to do so. If you encounter any problems or have questions regarding this system, contact Eddyfi or an authorized Eddyfi representative.

Safety Precautions

Observe the following safety precautions when using the Probot.

Drive Belts

Because the Probot belts move forward, backward, and vertically, **do not** place your fingers near the belts during operation. Failure to heed this precaution can result in **serious injuries**.

Take-up Reel

The Probot's take-up reel (see page 4) is always under slight tension and is designed to be driven with the probe's push tube spooled around it. Loose clothing, hair, or jewelry in the vicinity of the take-up reel may become entangled during operation. Exercise caution with cables and wires, as they can also be caught in the take-up reel. Failing to observe these precautions can result in **serious injuries and/or material damage**.

Emergency Stop

The EMERGENCY STOP button is located on the front of the system, opposite the take-up reel. There is also an optional remote EMERGENCY STOP button. They are the **only** emergency stop buttons. The EMERGENCY STOP button cuts power to all mechanical systems inside the Probot.

The remote control and software interface are equipped with software stop buttons that halt the Probot and disable the remote control, but they **are not substitutes** for an emergency stop as the system remains under tension.

When the EMERGENCY STOP button is pressed, for safety reasons, you can still open the drive belts, but you cannot close them. Closing the drive belts can only be re-enabled by pressing the EMERGENCY STOP button again. Even if the optional remote EMERGENCY STOP button is an accessory, it still functions as a fail-safe system. If the remote EMERGENCY STOP button's cable is damaged, the Probot stops as it would were the EMERGENCY STOP button on the main drive unit be pressed.

Conventions

Typographical

The following typographical conventions are used throughout this document:

Italic

Used for file names and paths.

Bold

Used to indicate menu items, named user interfaces, and place emphasis on specific words or phrases. Items in bold type are capitalized to reflect the actual interface.

SMALL CAPITALS

Used to indicate instrument interface indications.

Marking and Symbols

The following symbols appear on the instrument and pertain to safety regulations that should be carefully observed:



This label is used as a general warning sign. It indicates that you should refer to this user's guide to obtain the necessary information for proper protection of the instrument and its users.



This label is used to indicate high voltage. It draws your attention to the presence of hazardous voltages (within the product enclosure or accessible externally) that may constitute a risk of electric shock to persons. Always refer to the user's guide to ensure proper protection and safety.



The RoHS compliance logo signifies that this product complies with the Restriction of Hazardous Substances directive 2002/95/EC. This directive restricts the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyl, and polybrominated diphenyl ether in certain classes of electrical and electronic units as of July 1, 2006.



This label acts as a reminder that you should dispose of this system in accordance with your local Waste Electrical and Electronic Equipment (WEEE) regulations. This system was manufactured to the high quality standards of Eddyfi to ensure safe and reliable operation when it is used as stated in this document. Due to its nature, this instrument may contain small quantities of substances known to be hazardous to the environment and to human health if released in the environment. As such, systems falling under WEEE regulations should not be disposed of in the public waste stream.

Safety Indications in This Document

The safety indications in this document are intended to ensure your safety and the integrity of the system.

Warning



The warning indication calls your attention to a procedure or a practice (or the like) that, if performed incorrectly, can result in injury. Do not ignore warning indications — make sure that you understand the condition before proceeding.

Caution



The caution indication calls your attention to a procedure or practice (or the like) that, if performed incorrectly, can result in material damage, loss of data, or both. Do not ignore caution indications — make sure that you understand the condition before proceeding.

Important

Calls attention to information important to completing tasks.

Note

Calls attention to an operating procedure, a practice, or the like that requires special attention. Notes also indicate useful related, but parenthetical information that is not immediately essential.

Chapter 1

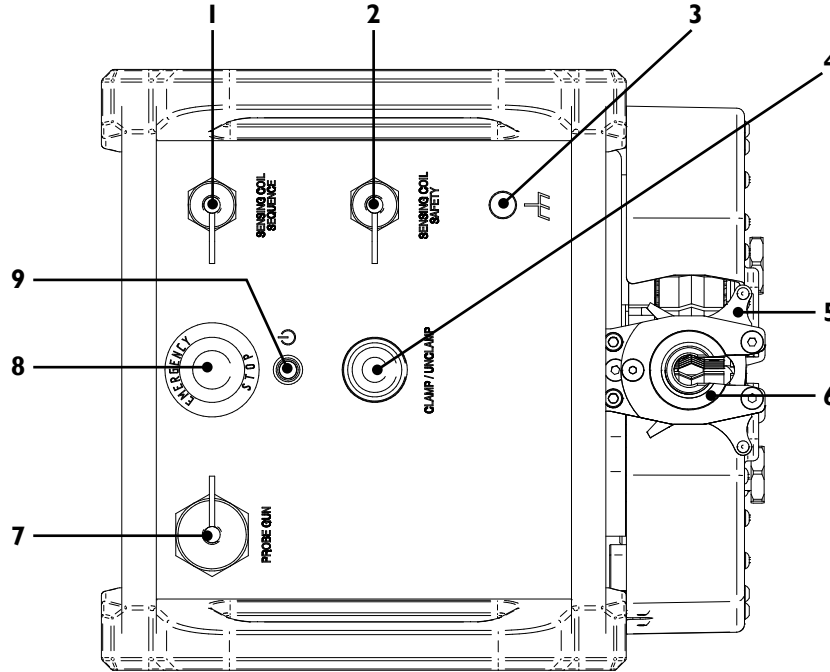
Probot Overview

Introducing the Probot

Thank you for purchasing the Eddyfi Probot™ probe pusher system. This chapter is intended to give you an overview of the system and its components before operation.

Probot Front

Figure I-1 Probot front



1. SENSING COIL SEQUENCE connector

Connect the sensing coil accessory in sensing coil-based automated sequences. This is different from the SENSING COIL SAFETY connector (see 2).

2. SENSING COIL SAFETY connector

Use this connector to connect the sensing coil accessory, which may be used to detect the presence of the probe to help prevent unintentional entry of the probe between the drive belts. This is different from the SENSING COIL SEQUENCE connector (see 1).

3. Grounding screw

Use this screw to ground the system's chassis, if necessary.

Caution

It is necessary to ground the Probot's chassis. If a ground is not provided by the main power connection, you **must** provide a connection to an external earth-referenced ground.

4. CLAMP/UNCLAMP button

Use this button to open and close the drive belts to insert or remove the probe cables. See page 17 for details. Press and hold the

button to clamp the drive belts. Open the belts with a single press.

5. Push tube latching mechanism

There are two such mechanisms, one at each end of the belts. The mechanism illustrated here is the output.

6. Conduit adapter

Connect the conduit here.

7. PROBE GUN connector

Connect the remote control accessory to this connector. See page 25 for details.

8. EMERGENCY STOP button

Use this button to cut all power to the Probot's mechanical subsystems in case of emergency. You can still open the drive belts for safety reasons.

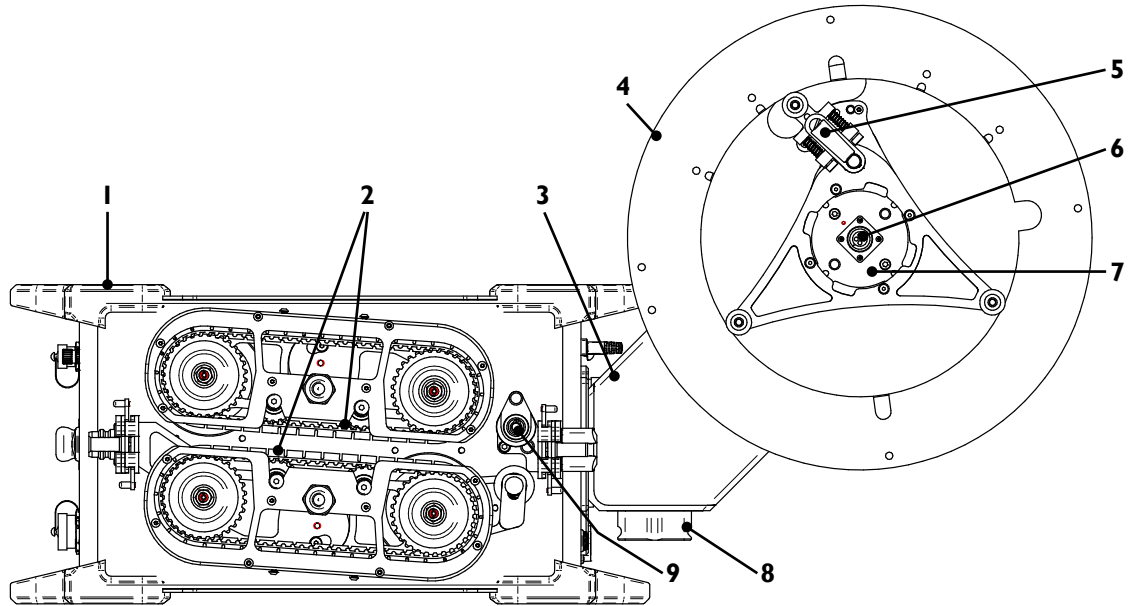
9. Power indicator

Lights green when the Probot is on.



Probot Side (Left Operation)

Figure I-2 Probot side (left operation)



1. Drive unit

Main Probot unit, designed to drive the probe push tube, control the system, and communicate with the various systems such as the test instrument and the remote control. See page 15 for details.

2. Drive belts

The drive belts, as their name implies, drive the probe push tube. The belts are designed to retract (through the CLAMP/UNCLAMP button) to allow you to insert the probe push tube between them. See page 17 for details. The drive belts are illustrated here without their protective guard covers.

Warning

Always exercise caution around the drive belts. Failing to observe this warning can result in **serious injuries**.

3. Take-up reel arm

This arm supports the take-up reel. It is motorized to maintain a tension on the probe and assist the drive unit while rewinding the probe onto the spool. It is removable and reversible for left or right operation. See page 15 for details.

4. Spool

The spool on the take-up reel feeds the probe push tube to the drive unit. See page 15 for details about how to spool the push tube and mount/remove the spool onto the arm.

Warning

Always exercise caution around the take-up reel. Failing to observe this warning can result in **serious injuries**.

5. Take-up reel release mechanism

Use this knob when mounting and removing the take-up reel. See page 15 for details.

6. Slip ring-to-probe connector

Connect your probe to the Probot through this connector. See page 15 for details.

7. Slip ring

The slip ring has two connectors (see 4 and 8). The slip ring is removable and should always be removed from the system prior to mounting and unmounting the spool.

8. Take-up reel arm connectors

There are two connectors at the base of the take-up reel arm to allow for left and right operation. See page 15 for details about how to reverse the take-up reel arm.

9. Probe push tube encoder

This is the default encoder in encoder sequences. See page 42 for details.

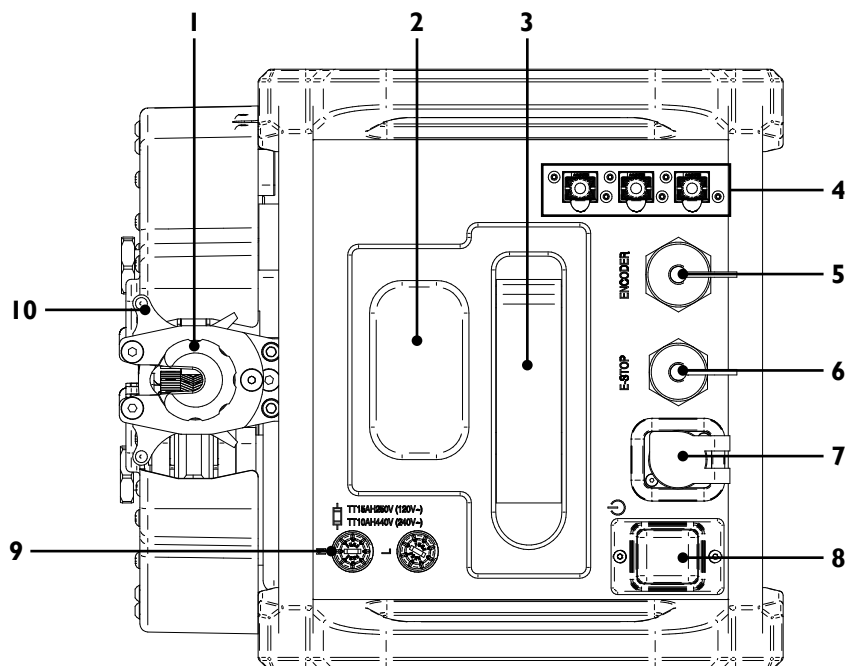
10. Slip ring-to-Ectane® 2 connector

Invisible in this illustration, it is on the opposite side of the slip ring, as you see it. Connect the Ectane2 test instrument to the slip ring with an extension/adaptor cable. See page 15 for details.



Probot Back

Figure I-3 Probot back



1. Probe input security ring

Nozzle through which the probe push tube is fed to the drive belts. The input features a security ring that prevents the push tube from slipping out as it spools off.

2. Take-up reel arm connector

The take-up reel arm holds the arm in place on the system and communicates with the drive unit through this connector.

3. Take-up reel arm release lever

Use this lever to release the take-up reel arm from the drive unit. See page 15 for details.

4. Network ports

There are three network ports on the unit. Use them to connect LAN cables from the acquisition computer and the Ectane 2 test instrument. The remaining port serves as a spare and it does not matter which port is used with which device.

5. ENCODERS connector

This 18-pin connector communicates encoder, remote control, and alarm signals between the Ectane 2 and the Probot.

6. E-STOP connector

This optional connector allows connecting the Probot to an external EMERGENCY STOP button, which is designed to act as a fail-safe device, identical to the EMERGENCY STOP button on the front of the Probot.

7. Power connector

Connect the power cable to this connector.

8. Power switch

Press this switch to turn the unit on or off.

9. Fuses

Should the Probot blow a fuse while in service, you can replace them here.

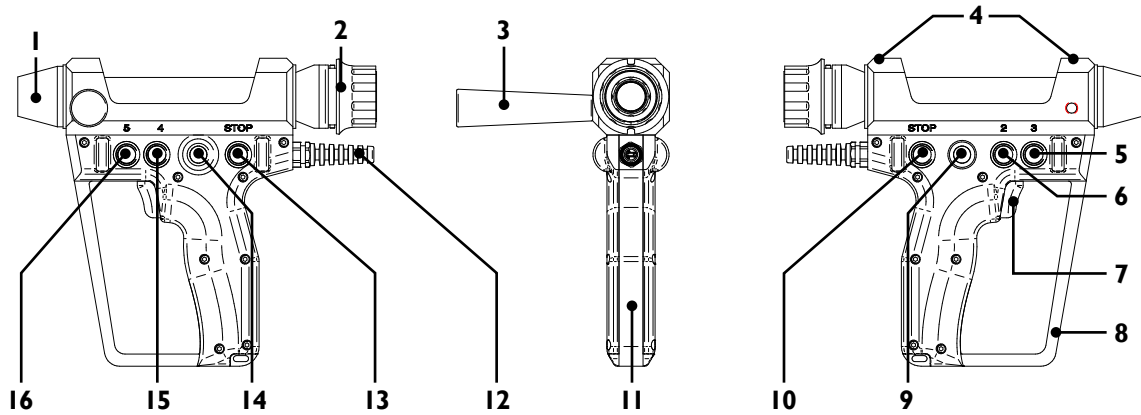
Note

Always replace the fuses when you go from 120V to 240V or the reverse.

10. Push tube latching mechanism

This swivel mechanism latches the probe push tube's position between the drive belts. There are two such mechanisms, one at each end of the belts. The mechanism illustrated is the input.

Remote Control Overview



1. Replaceable nozzle

Designed to the specifications of your probe push tube. Replace it as necessary.

2. Replaceable conduit adapter

Designed to mate with Eddyfi-brand conduit adapters and sized to suit the specifications of your probe push tube. Other conduit adapters available by special order. Contact your Eddyfi representative for details.

3. Stabilization handle

Use this reversible handle to stabilize the remote control during use. You can easily install it on either side of the remote control for right-handed and left-handed use.

4. Anchor points

These threaded M8×1.25 holes may be used with a custom tethering system and are 125 mm (4.9 in) apart.

5. Button 3

User-programmable button mapped to the Ectane2 digital input 3. Refer to the Magnifi® user’s guide for details about how to configure digital inputs.

6. Button 2

User-programmable button mapped to the Ectane2 digital input 2. Refer to the Magnifi user’s guide for details about how to configure digital inputs.

7. Trigger

Typically, the trigger is used to launch a sequence or indicate the readiness of a sequence. Mapped to the Ectane2 digital input 1. See page 27 or the Magnifi user’s guide for details.

8. Knuckle guard

This passive safety feature is intended to offer protection for the operator’s hand.

9. Operation indicator

Lights green when the remote control operator has control over the Probot or that an action is required of the operator. The indicator is associated to **Relay 1** (see page 27).

10. Stop button

Press this button to stop **all probe motion** in atypical situations.

Warning

This button **does not** operate the same way as the EMERGENCY STOP button. It is a software stop **only**. See page 3 for details.



11. Pistol-style grip

This ergonomic grip is designed to enable you to easily handle the remote control.

12. Connector cable

Use the connector at the end of this cable to connect the remote control to the PROBE GUN connector at the front of the system. See page 3 for details.

13. Stop button

See 9.

14. Operation indicator

See 8.

15. Button 4

User-programmable button mapped to the Ectane2 digital input 4. Refer to the Magnifi user’s guide for details about how to configure digital inputs.

16. Button 5

User-programmable button mapped to the Ectane2 digital input 5. Refer to the Magnifi user’s guide for details about how to configure digital inputs.

Software Interface Overview

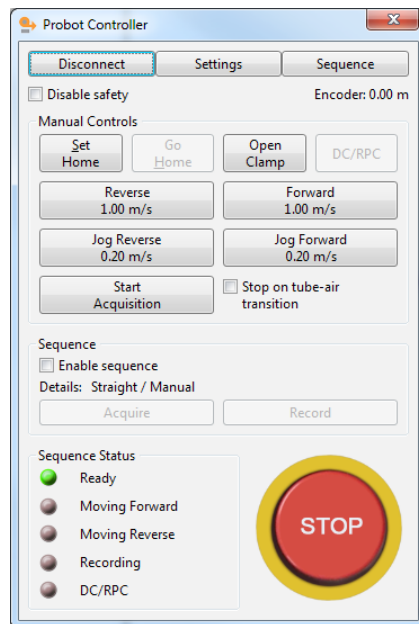
This section briefly explains the Magnifi interfaces that are specific to Probot. For more detailed explanations about how to use Magnifi, refer to its user's guide.

Probot Controller Dialog Box

This Magnifi dialog box is used to control Probot remotely. To display this dialog box, in Magnifi:

- Click the Probot Controller icon () on the Acquisition toolbar.

Figure I-4 Probot Controller dialog box



Connect/Disconnect button

Click this button to connect to and disconnect from the Probot.

Settings button

Click this button to open the **Probot Settings** dialog box. See page 9 for details.

Sequence button

Click this button to open the **Probot Sequence Configuration** dialog box. See page 11 for details.

Disable safety check box

Select this check box to override the safety settings configured for the system in the **Probot Settings** dialog box, such as the safety sensing coil. This may be useful when your safety settings do not give you all the necessary liberty to move your probe during setup. See page 9 for details.

Warning

Exercise caution when using the Probot with disabled safety settings. Operating the Probot without safety settings could lead to damage and/or injuries.



Encoder position

This information field displays the encoder position according in relation to the “home” position. Select your encoder in the **Probot Settings** dialog box. See page 9 for details.

Manual Controls Group

- **Set Home/Set Zero** button: Click this button to configure the “home” or zero position of the probe.
- **Go Home** button: Click this button to force Probot to return the probe to the “home” or zero position defined above.

- **Open Clamp** button: Click this button to open closed drive belts.

Note

For safety reasons, you cannot close the drive belts through Magnifi.

- **DC/RPC** button: Click this button to start an RPC probe’s rotation, to activate saturation coils, or activate any other systems requiring the DC power supply.
- **Reverse** button: Click this button for Probot to pull the probe at the indicated speed. Changes to **Stop**. Configure this speed in the **Probot Settings** dialog box. See page 9 for details.
- **Forward** button: Click this button for Probot to push the probe at the indicated speed. Changes to **Stop**. Configure this speed in the **Probot Settings** dialog box. See page 9 for details.
- **Jog Reverse** button: Click and hold this button for Probot to jog the probe towards the system at the indicated speed. Configure this speed in the **Probot Settings** dialog box. See page 9 for details.
- **Jog Forward** button: Click and hold this button for Probot to jog the probe away from the system at the indicated speed. Configure this speed in the **Probot Settings** dialog box. See page 9 for details.
- **Start Acquisition** button: Click this button to start acquisition **without** enabling the sequence.
- **Stop on tube-air transition** check box: Select this check box if you want Probot to stop pushing or pulling the probe when it detects a tube-to-air transition.

Note

For this to operate properly, the tube-to-air alarm must be configured properly beforehand. Refer to the Magnifi documentation for details about configuring alarms.

Sequence Group

- **Enable sequence** check box: Select this check box to enable the sequence that you have configured. Only when the sequence is enabled are the buttons in the group active.
- **Details:** This information field indicates the type of sequence that you selected in the **Probot Settings** dialog box (see page 9 for details).
- **Sequence** group buttons: These two buttons have different states depending on the sequence you are using.

Sequence	Button state	Description
Encoder Air-to-air	Launch	Launches the defined sequence. The button becomes Waiting when the Station operator option is selected and the Disable probe gun lockout check box is selected in the Probot Settings dialog box (see page 9). When the Probe gun operator option is selected in the Probot Settings dialog box, the Launch button is unavailable.
	Waiting	Indicates that you must wait for the remote control operator to perform an action (trigger) before the sequence is initiated. The remote control’s operation indicator turns green to prompt the operator.
	Target	The Target button is available when you select an Encoder or Air-to-air sequence Probot Sequence Configuration dialog box (see page 11). Click this button to indicate to the sequence that it has reached its intended target.
Manual air-to-air	Forward/ Acquire	Initiates the forward motion of the probe and starts acquisition. The probe keeps moving forward until you click the Stop button or the tube-to-air alarm is triggered.
	Stop	When you click the Forward/Acquire or Reverse/Record button, they become Stop . You can stop these operations at any time. Doing so also stops acquisition.
	Reverse/ Record	This button starts data acquisition, recording, and moving the probe in reverse at the record speed. The Forward/Acquire button changes to Stop acquisition . If you are already acquiring data, this only starts recording data. Motion continues until you click one of the stop buttons or until the tube-to-air alarm is triggered.
Manual	Acquire	Starts acquiring data. The button changes states to Stop acquisition , which stops data acquisition and recording.
	Record	Starts data acquisition and recording. The Acquire button changes to Stop acquisition . If already acquiring data, only starts recording data. Note In Manual mode, the probe does not automatically begin moving after you click Record . You must click Forward or Reverse to start probe motion.

Sequence Status Group

This group indicates the status of the Probot through green and red indicators.

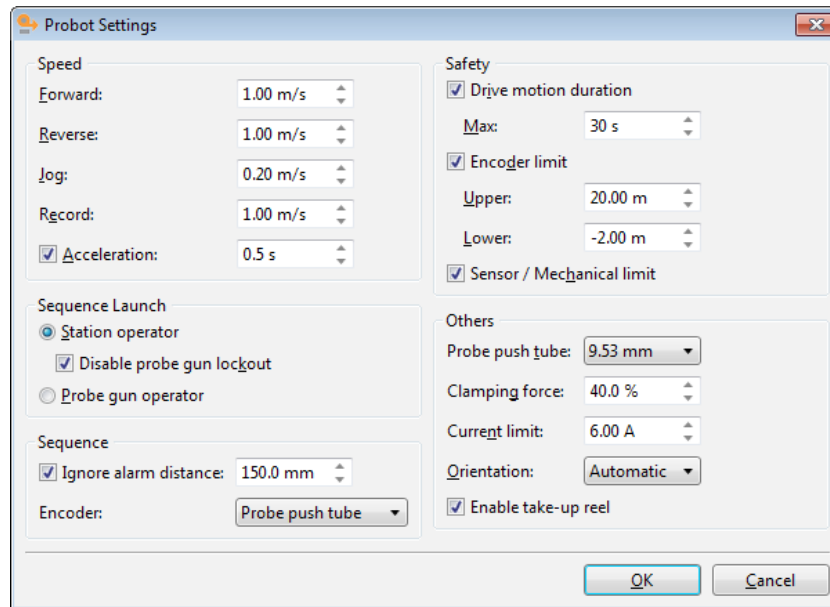
STOP Button

Use the software **STOP** button to stop all Probot motion. The spool remains under slight tension. You must click the button again to release the Probot from this state.

Probot Settings Dialog Box

- Click **Settings** in the **Probot Controller** dialog box (see page 7).
Alternatively, on the Magnifi **Settings** menu, point to **Probot**, and then click **Settings**.

Figure I-5 Probot Settings dialog box



Speed Group

- Forward** text box: Specify the forward speed of Probot in this text box.
- Reverse** text box: Specify the reverse speed of Probot in this text box.
- Jog** text box: Specify the jogs speeds (both forward and reverse) of Probot in this text box.
- Record** text box: Specify the recording speed of Probot in this text box.
- Acceleration** check/text boxes: Select the **Acceleration** check box to enable acceleration. This is useful to reduce whipping of the probe. When this check box is not selected, there is no acceleration—the probe starts and stops immediately.

Safety Group

- Drive motion duration** check box: Select this check box to activate a safety time lapse to stop the probe for the duration specified in the **Max** text box.
- Encoder limit** check box: Select this check box to activate an encoder safety limit to stop the probe at the distances specified in the **Upper** and **Lower** text boxes. The values specified are relative to the “home” or “zero” position.
- Sensor/Mechanical limit** check box: Select this check box to activate a sensor or other mechanical safety limit connected to the system:

Sequence Launch Group

- Station operator** option: Select this option if you want to launch your sequence from Magnifi. The remote control operator confirms the launch sequence when the operator at the workstation releases control. The remote control operator give the final approval and the acquisition’ readiness is communicated through the remote control’s operation indicator (see page 6).

- **Disable probe gun lockout** check box: When this check box is unselected, the station operator cannot launch a sequence until the remote control operator indicates that it is safe to proceed by squeezing the remote control trigger, releasing the operator lockout.
- **Probe gun operator** option: Select this option if you want to launch the sequence from the probe gun.

Sequence Group

- **Ignore alarm distance** check box: Select this check box and specify the distance over which the sequence is to ignore tube-to-air alarms.
- **Encoder** list: Select the encoder used by the system on this list. The probe push tube encoder (see page 4) is the primary encoder. The belt encoder signals are used as a backup when the primary encoder fails. We therefore recommend that you use **Probe push tube**.

Others Group

- **Probe push tube** list: Select the diameter of your push tube on this list.
- **Clamping force** text box: Specify the clamping force as a percentage of the maximum pressure applied by the drive belts to the push tube in this text box.

Note

A lower clamping force allows the Probot to operate at a lower current and a higher speed with less wear and tear on the belts and drive train. A higher clamping force may be needed where it is difficult to push the probe or where slippage occurs.

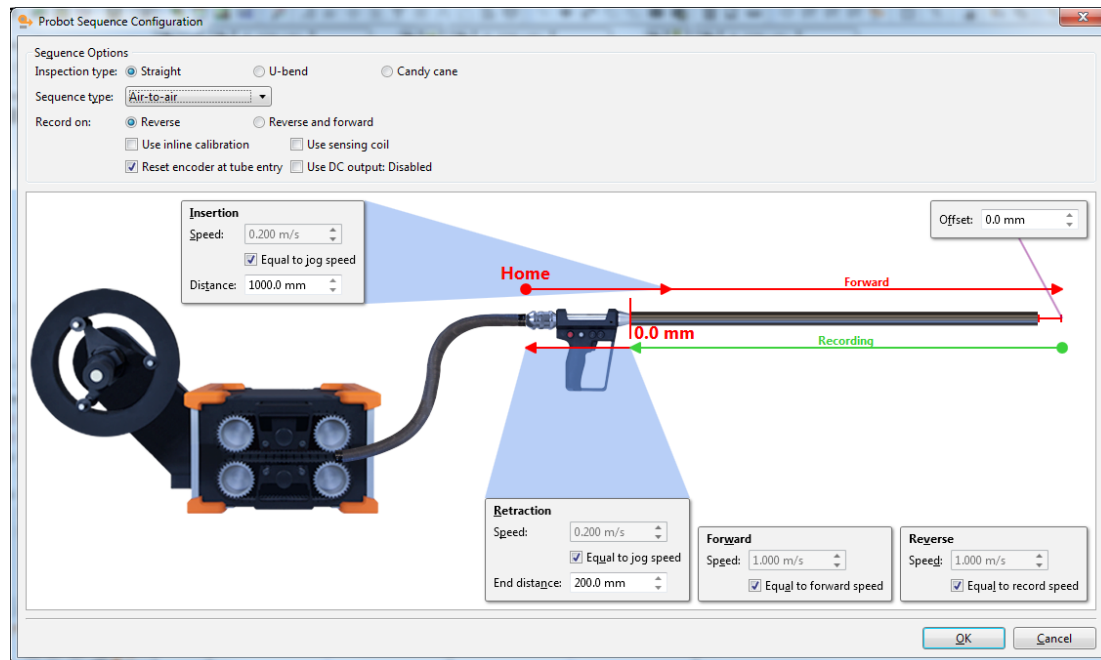
- **Current limit** text box: Specify the current limit in this text box. Using a lower value here can reduce the potential damage to probe heads in case of obstruction.
- **Orientation** list: If necessary, select the orientation of operation of Probot on this list. By default, it is configured to **Automatic**, leaving the system to determine its orientation.
- **Enable take-up reel** check box: Select this check box to indicate to the system that the take-up reel is used. If you plan not to use the take-up reel during your inspection process, clear the check box.

Probot Sequence Configuration Dialog Box

This Magnifi dialog box is used to configure the Probot's automated sequences. To display this dialog box, in Magnifi:

- Click **Sequence** in the **Probot Controller** dialog box (see page 7).
Alternatively, on the Magnifi **Settings** menu, point to **Probot**, and then click **Sequence Configuration**.

Figure I-6 Probot Sequence Configuration dialog box



Depending on the options that you select for your sequence, the sequence display changes to match and allows you to configure several parameters associated with your sequence.

Inspection type

Probot is designed to support three types of inspections:

- **Straight:** Select this option when you inspect straight tubes.
- **U-bend:** Select this option when you inspect U-bend tubes end to end.
- **Candy cane:** Select this option when you inspect U-bend tubes to less than their full length, which may or may not include the U-bend.

Note

Candy cane inspections can only be performed as **Encoder** sequences.

Sequence type

Probot can perform four types of sequences:

- **Encoder:** Select this option when you want to perform an automated sequence that relies entirely on the encoder position.
- **Air-to-air:** Select this option when you want to perform an automated sequence that relies on the probe transitioning in and out of the tube to start and stop.
- **Manual air-to-air:** Select this option when you want to perform a manual sequence that relies on the probe transitioning out of the tube to stop, while other activities are manually controlled by an operator.
- **Manual:** Select this option when you want to perform a completely manual sequence.

Note

The **Sequence type** list is locked to **Encoder** when **Candy cane** is selected as the **Inspection type**.

Record on

Record data in **Reverse** (when Probot is pulling the probe) or in **Reverse and forward** (when the Probot is pushing **and** pulling the probe).

Other Options

The following are common to most sequences.

- **Use inline calibration** check box: If your inspection includes an inline calibration standard, select this check box.
- **Use sensing coil** check box: If your inspection setup is equipped with a sequence sensing coil, select this check box.
- **Reset encoder at tube entry** check box: If you want the Probot's encoder to reset each time the tube-to-air alarm is triggered, select this check box.
- **Use DC output** check box: If you want to record data with a motor unit such as used in rotating pancake coil (RPC) probes, with saturation current probes, or with other systems where a DC power supply is necessary during recording, select this check box.

Important

Before you can use this option, you must configure the DC power supply in Magnifi. Refer to the Magnifi user's guide for details.

Chapter 2

Configuration and Control

Before working with the Probot™ probe pusher system, you must set it up and then configure it. This chapter explains how.

Setting Up Your Hardware

Installing and Connecting the System

1. Place the Probot's drive unit at the inspection site, taking care to place it in the proper direction for operation in relation to the take-up reel:
 - Facing the drive belts, if the take-up reel arm connector is on the **right** of the Probot, you are positioned for **left-hand operation** (the probe exits to the left of the Probot).
 - Facing the drive belts, if the take-up reel arm connector is on the **left** of the Probot, you are positioned for **right-hand operation** (the probe exits to the right of the Probot).

In the interest of simplicity, this procedure only illustrates manipulations for left-hand operation. The operations are the same for right-hand operation.

2. Install the take-up reel on the drive unit.
 - a. Pull the take-up reel arm lock lever outward until it is fully open.

Figure 2-1 Releasing take-up reel arm lock



- b. Remove the take-up reel arm connector cover.

Figure 2-2 Removing take-up reel arm connector cover



Note

Make sure that you store the cover in a safe place.

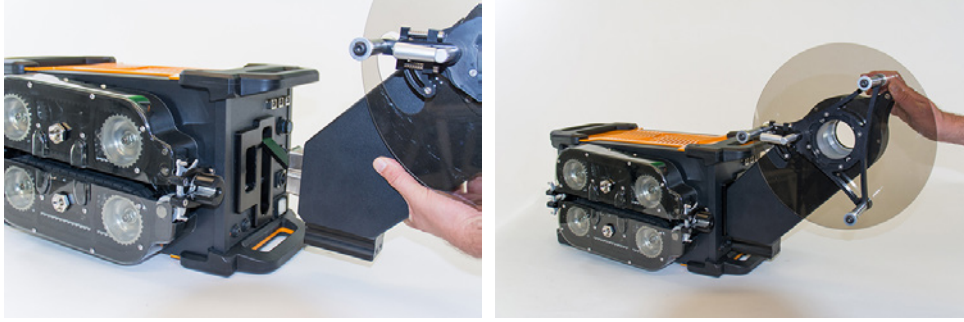
- c. Place the protective cover on the unused connector on the take-up reel arm according to your operation direction.

Figure 2-3 Protective cover



- d. Slide the take-up reel arm's connector into the slot designed for it on the drive unit.

Figure 2-4 Inserting take-up reel arm into drive unit



- e. Holding the arm, make sure that the connector at the base of the take-up reel arm is securely connected.
- f. Return the take-up reel arm lock lever in its original position.

Important

Make sure that the lock lever clicks.

Figure 2-5 Locking take-up reel arm in place



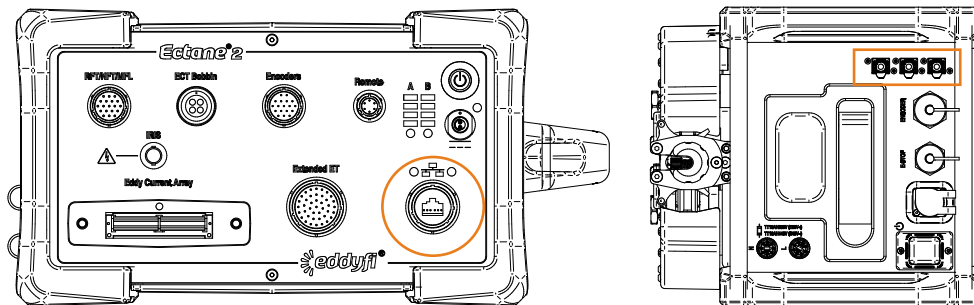
- g. Make sure that the take-up reel arm is secure.

3. Connect an Ethernet cable between the Probot and Ectane[®] 2.

Note

You can use any of the three Ethernet ports to this end.

Figure 2-6 Connecting Ethernet cable (Probot–Ectane 2)



4. Connect an Ethernet cable to one of the remaining two Probot Ethernet ports, and the opposite end of the cable to your laptop or desktop computer.

Notes

- Network connections may also be connected to an external switch or hub, if necessary.
- We assume that all the components are plugged to an external power source. The Ectane 2 can run on battery power for up to 8 hours and most laptop computers can run for some time on their internal batteries.

5. Using the bayonet locking IP68 connector, connect the supplied power cable to the Probot.

Spooling the Probe Push Tube With the Probot

Important

This is a **two-person** operation. Make sure that you read the procedure before spooling a probe and have the appropriate number of personnel present.

1. Turn on the Probot.
2. If the belts are clamped, press the CLAMP/UNCLAMP button to separate them.
3. Turn the system off or press the EMERGENCY STOP button.
4. Pass the probe connector and the entire flexible sheathing of the probe push tube through the opening in the spool's hub.

Note

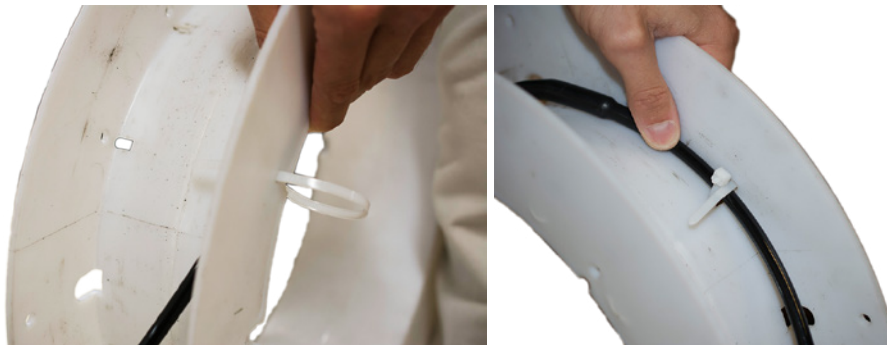
A minimum of 200 mm or 8 in are necessary to be able to connect the probe to the take-up reel's slip ring.

Figure 2-7 Passing push tube through spool



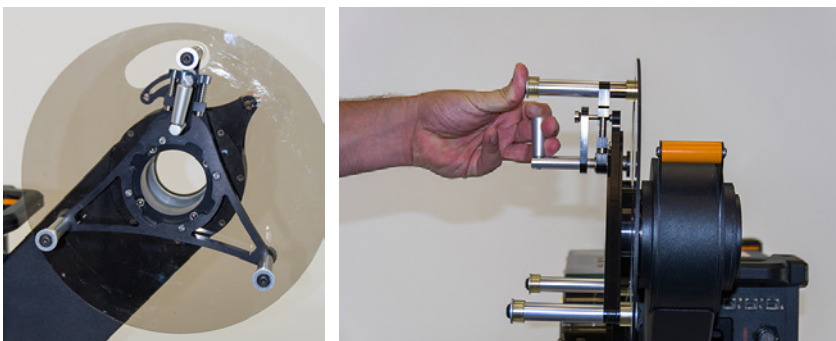
5. Using a tie-wrap, secure the push tube to the spool.

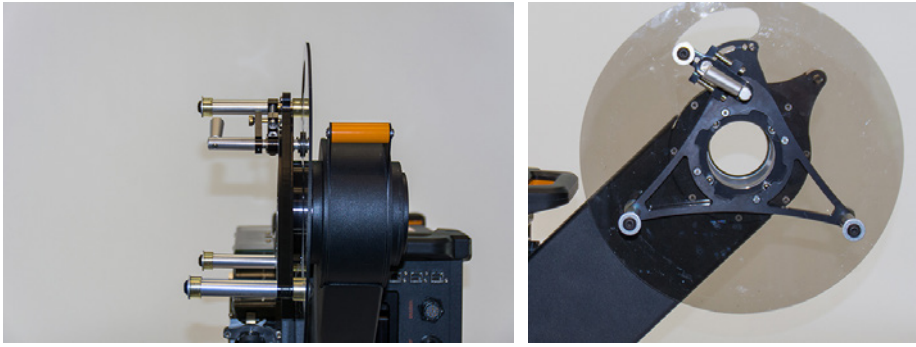
Figure 2-8 Securing push tube to spool



6. Cut the excess portion of the tie-wrap.
7. Pull and turn the take-up reel release knob counterclockwise.
The arm becomes floating, as illustrated.

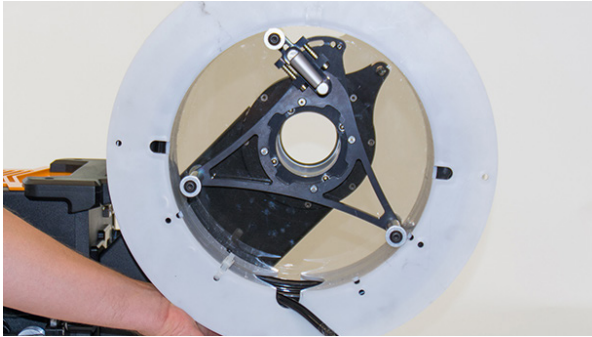
Figure 2-9 Releasing take-up reel





8. Mount the spool on the take-up reel as illustrated, opening opposite the release mechanism.

Figure 2–10 Placing spool on take-up reel



9. Holding the spool in place so that it does not move, swing the floating arm clockwise back into place, and then release the knob to secure the arm in place.

Note

You should hear it click into place, indicating it is secure.

Figure 2–11 Securing spool to take-up reel



10. Open the push tube latching mechanisms at the probe input and output of the Probot.

Note

This can be done with one hand. Open both clamps of each mechanism simultaneously.

Figure 2–12 Releasing push tube guiding mechanism



Note

Make sure that the drive belts are apart. If they are not, turn on the unit, press the CLAMP/UNCLAMP button on the front of the drive unit, and then turn off the Probot or press the EMERGENCY STOP button

11. Using both hands, straighten the probe's push tube, and slide it through the probe input, probe output, and between the drive belts.

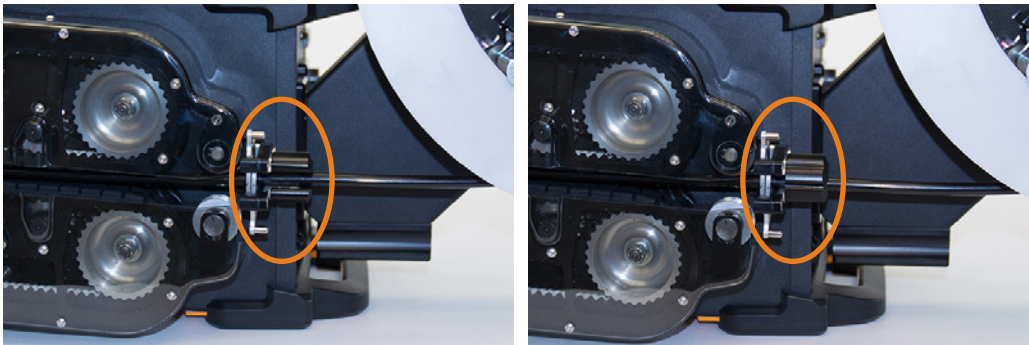
The push tube guiding mechanism snaps shut and secures the push tube in place. You can release the probe.

Note

Make sure that the push tube is centered between the drive belts (inside the groove at the centerline).

12. Turn the probe input security ring counterclockwise to secure it.

Figure 2-13 Closing probe input security ring

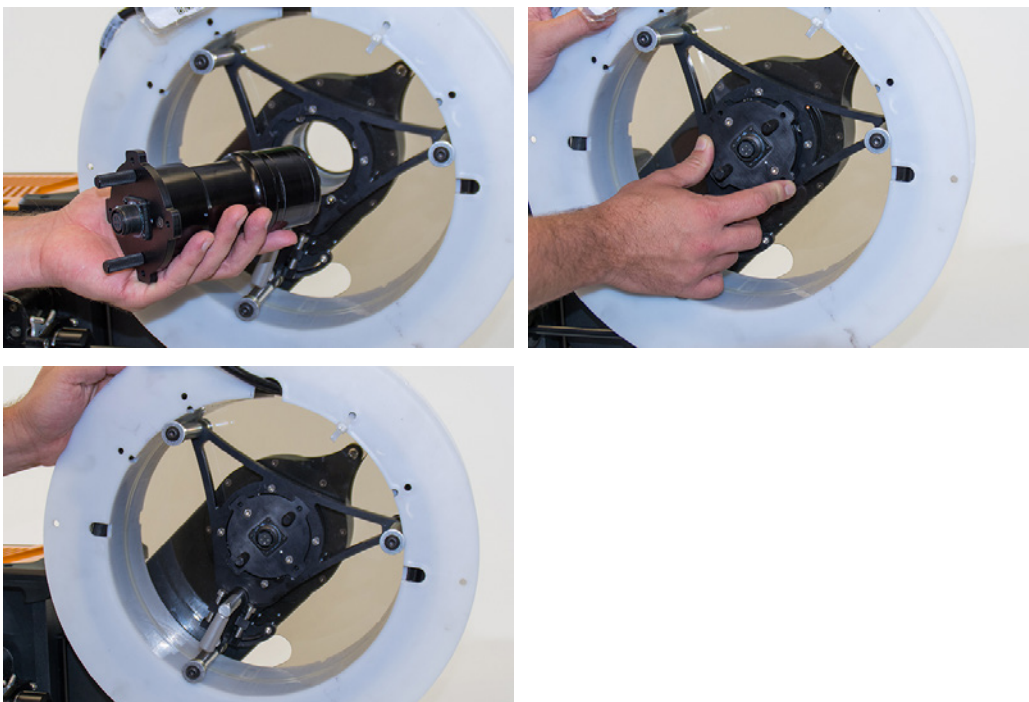


13. Slide the slip ring through the take-up reel arm, making sure that the four “teeth” are aligned with the grooves in the take-up reel arm.

Note

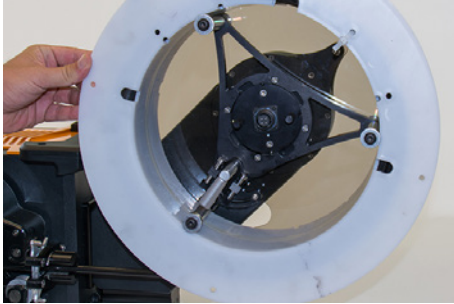
There may be some resistance as the slip ring passes through the take-up reel. This is normal.

Figure 2-14 Sliding slip ring through take-up reel arm



14. Using the two pins on the slip ring, turn it clockwise to lock it into position.

Figure 2–15 Securing slip ring to take-up reel arm



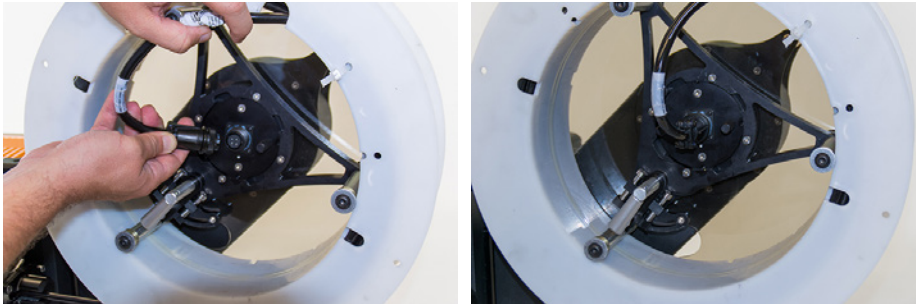
15. Connect the probe connector to the slip ring.

Caution

Make sure that there is no strain on the probe's cable. Strain on the probe's cable reduces the life of the probe and may result in noisy or distorted signals.



Figure 2–16 Connecting probe cable to slip ring



16. Turn on the Probot or release the EMERGENCY STOP button by turning it.

17. Press the CLAMP/UNCLAMP button until the push tube is secure between the belts or the belts stop moving.

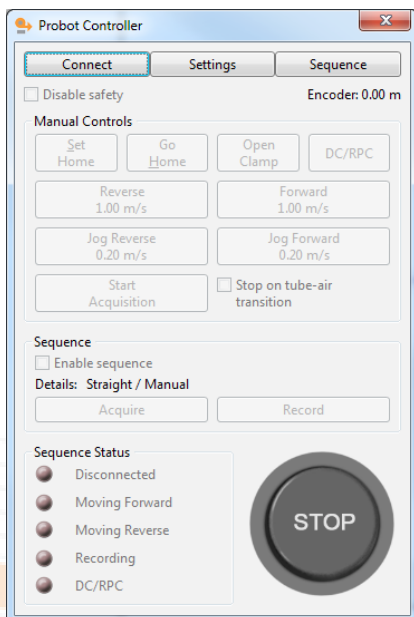
18. In Magnifi®, connect to the Ectane2.

Refer to the Ectane2 documentation for details.

19. In Magnifi, on the **Operation** menu, click **Probot Controller**.

The **Probot Controller** dialog box appears.

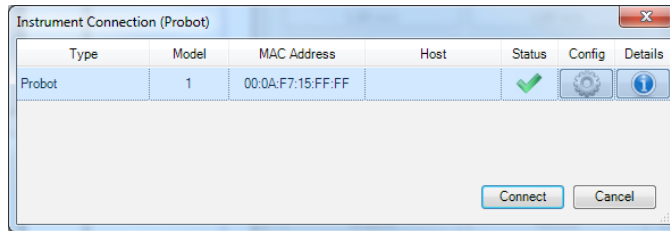
Figure 2–17 Probot Controller dialog box (unconnected)



20. Click **Connect**.

The **Instrument Connection (Probot)** dialog box appears.

Figure 2–18 Instrument Connection (Probot) dialog box

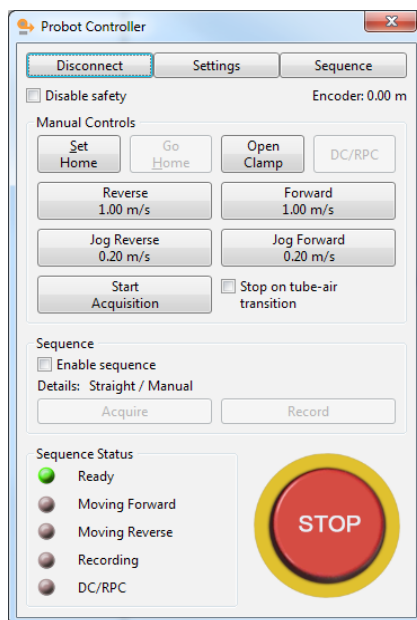


21. Select your Probot, and then click **Connect**.

By default, when the Probot is connected, the system's **STOP** button is active.

22. To release the system, click the **STOP** button.

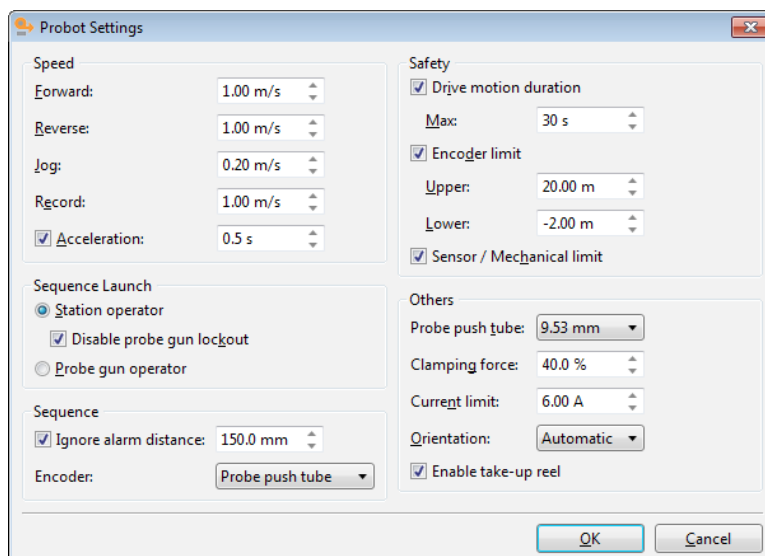
Figure 2–19 Probot Controller dialog box (connected)



23. Click **Settings**.

The **Probot Settings** dialog box appears.

Figure 2–20 Probot Settings dialog box



24. If different, specify 0.2 in the **Jog** text box, and then click **OK**.

Note

0.2m/s (approximately 8in/s) is recommended when spooling a probe.

25. An operator holding the push-tube bundle faces the front of the system, while the other operator operates Magnifi.
26. In the **Probot Controller** dialog box, click and hold the **Jog Reverse** button.
The operator holding the push-tube bundle feeds it to the system.
27. Release the **Jog Reverse** button before the probe reaches the system or when advised by the operator holding the push-tube bundle.

Mounting a Pre-Spooled Probe on the Probot

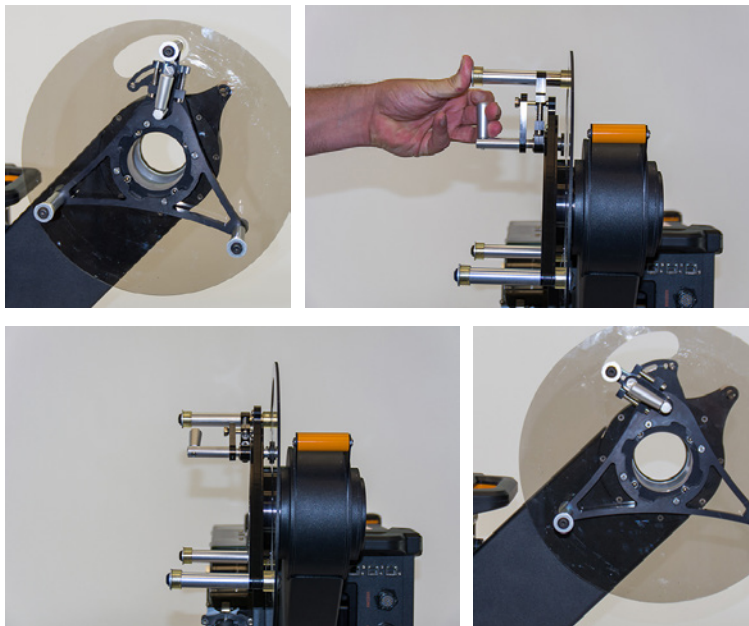


Caution

Leaving a probe on a spool for an extended period of time imparts a curve to the push tube.

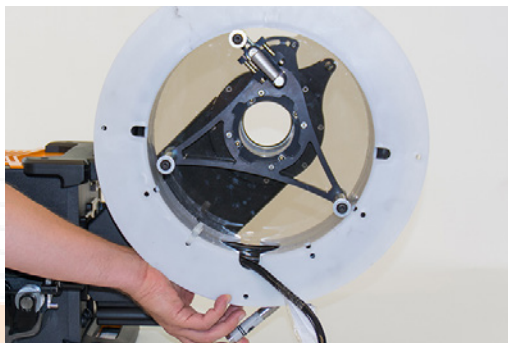
1. Turn on the Probot.
2. If the belts are clamped, press the **CLAMP/UNCLAMP** button to separate them.
3. Turn the system off or press the **EMERGENCY STOP** button.
4. Pull and turn the take-up reel release knob.
The arm becomes floating, as illustrated.

Figure 2–21 Releasing take-up reel



5. Mount the spool on the take-up reel as illustrated, opening opposite the release mechanism.

Figure 2–22 Placing spool on take-up reel

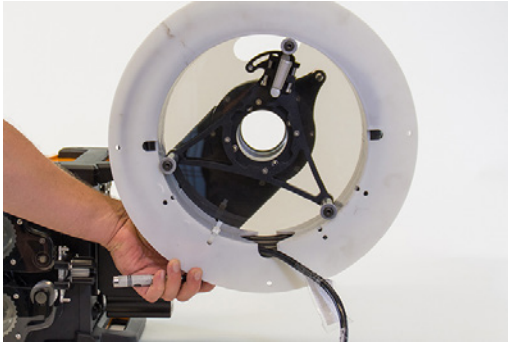


6. Holding the spool in place so that it does not move, swing the floating arm clockwise back into place, and then release the knob to secure the arm in place.

Note

You should hear it click into place, indicating it is secure.

Figure 2–23 Securing spool to take-up reel

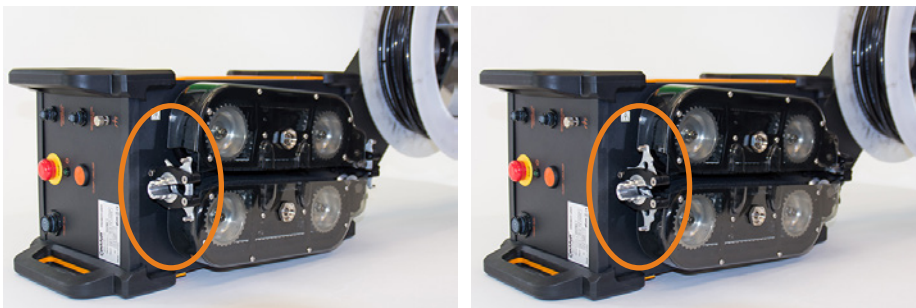


7. Open the push tube latching mechanism at the probe input and output of the Probot.

Note

This can be done with one hand. Open both clamps of each mechanism simultaneously.

Figure 2–24 Releasing push tube guiding mechanism



Note

Make sure that the drive belts are apart. If they are not, turn on the unit, press the CLAMP/UNCLAMP button on the front of the drive unit, and then turn off the Probot or press the EMERGENCY STOP button

8. Using both hands, straighten the probe's push tube, and slide it through the probe input, probe output, and between the drive belts.

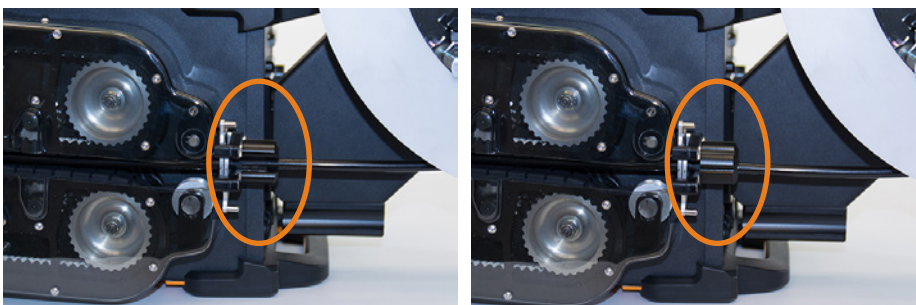
The push tube guiding mechanism snaps shut and secures the push tube in place. You can release the probe.

Note

Make sure that the push tube is centered between the drive belts (inside the groove at the centerline).

9. Turn the probe input security ring counterclockwise to secure it.

Figure 2–25 Closing probe input security ring

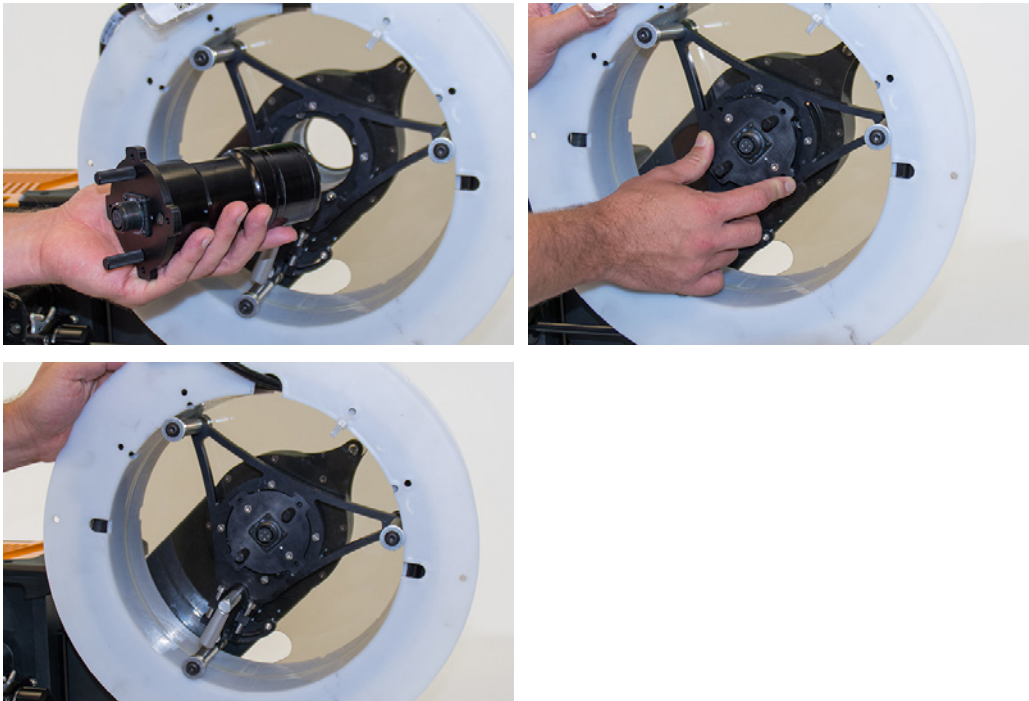


10. Slide the slip ring through the take-up reel arm, making sure that the four “teeth” are aligned with the grooves in the take-up reel arm.

Note

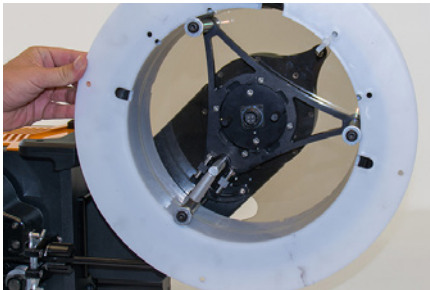
There may be some resistance as the slip ring passes through the take-up reel. This is normal.

Figure 2–26 Sliding slip ring through take-up reel arm



11. Using the two pins on the slip ring, turn it clockwise to lock it into position.

Figure 2–27 Securing the slip ring to take-up reel arm



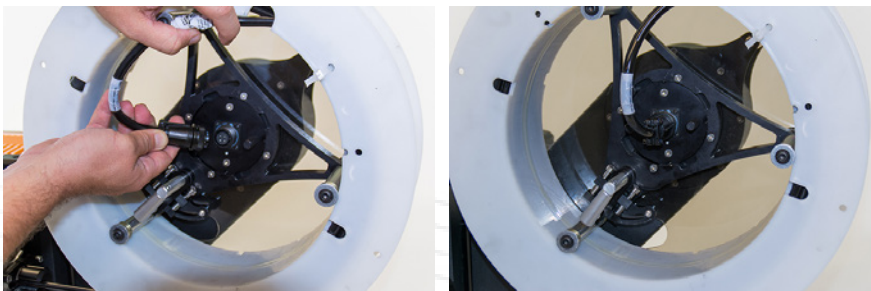
12. Connect the probe connector to the slip ring.

Caution

Make sure that there is no strain on the probe's cable. Strain on the probe's cable reduces the life of the probe and may result in noisy or distorted signals.



Figure 2–28 Connecting probe cable to slip ring

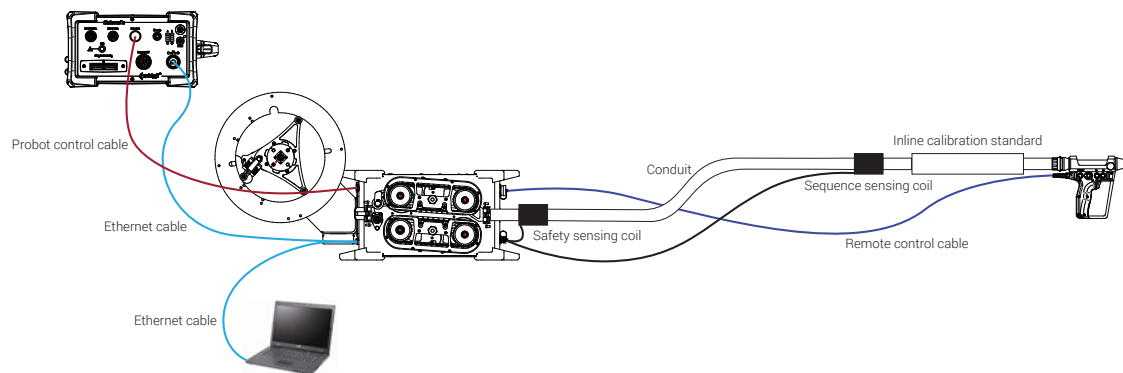


Connecting Accessories to the Probot

Once the probe is spooled and secure in the drive belts, you may install accessories and flexible conduit.

1. If necessary, connect the optional safety sensing coil to the conduit adapter of the Probot or elsewhere within the conduit run, as best suits your requirements.
2. Connect the safety sensing coil to the SENSING COIL SAFETY connector.
3. If necessary, connect a secondary sensing coil near the calibration tube or elsewhere for sensing-coil-sequence operation.
4. Connect this sensing coil to the SENSING COIL SEQUENCE connector.
5. You can connect the optional remote control (probe gun) directly to the last piece of conduit or with a quick-connect connector.
6. Connect the remote control connector to the PROBE GUN connector on the Probot drive.

Figure 2–29 Final system configuration (including accessories)



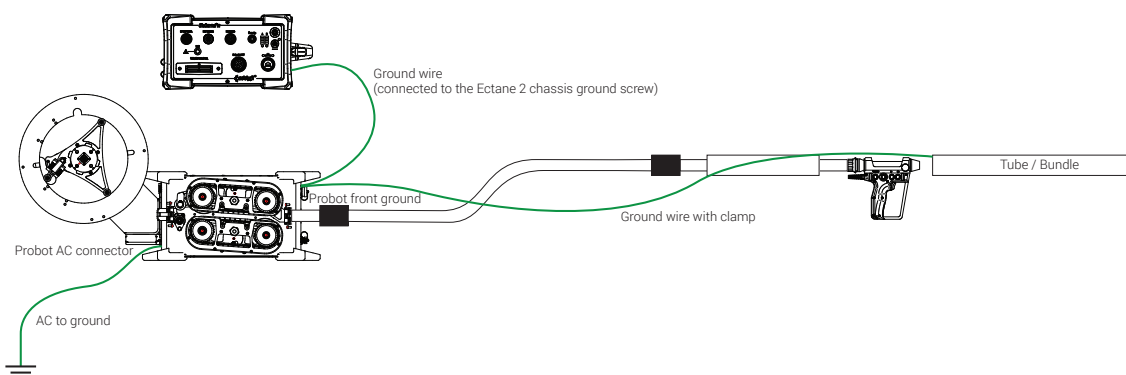
Note

The take-up reel, slip ring, safety and sequence sensing coils, inline calibration standard, and remote control shown above are all optional components that may be used depending on the application.

Grounding Probot

Ground the Probot as illustrated.

Figure 2–30 Grounding Probot



Important

Grounding the system as illustrated is very important to prevent malfunctions. Improper grounding in dry environments, for example, can lead to connection loss and false triggers on input.


Configuring the Probot in Magnifi

The Probot is designed with productivity in mind. It offers fully manual, partially or fully automated air-to-air sequences, and precision encoder-based sequences. It also offers a range of built-in safety features all designed to keep you safe and productive, and to reduce wear and tear on your people and consumables.

To take advantage of these features, the Probot, Ectane 2, and Magnifi must be correctly configured. All the critical configuration settings are stored in the Magnifi setup file, so once your system is configured and fine tuned, you should not have to repeat much, if any, of this initial configuration process.

Configuring Encoders and Digital Inputs

1. In Magnifi, on the **Settings** menu, point to **Acquisition Setup**, and then click **Ectane Configuration**.

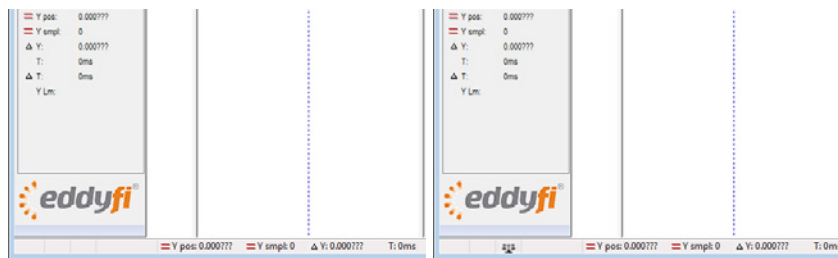
The **Ectane Configuration** dialog box opens. Alternatively, you can click  on the toolbar.

2. Configure the encoder as follows:
 - a. Select the **Encoder I** check box.
 - b. Specify the resolution as 18.796 counts/mm or 477.406 counts/in, depending on the selected units.
 - c. In the **Preset** group, on the **External** and **Action on Start** lists, select **None**.
3. Configure the five digital inputs as follows:
 - a. **Function** is **Remote control**.
 - b. **Logic** is **Active low**.
4. Click **Finish**.

Important

Clicking **Finish** clears the balance state of the probe. It is necessary to balance the probe (hardware null) before beginning acquisition (even if the probe was already balanced). To verify whether your probe is balanced, look for the scale icon in the lower-left corner of the Magnifi window.

Figure 2–31 Probe not balanced/Probe balanced



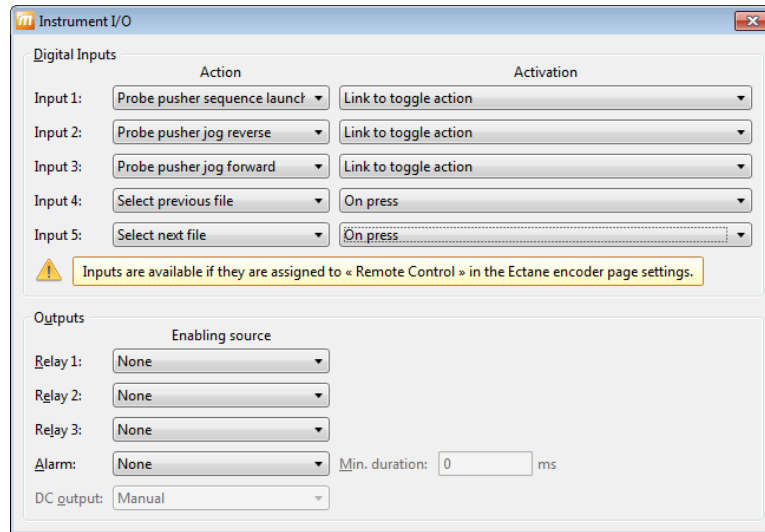
Configuring Digital Inputs and Analog Outputs

Once you've completed the procedures above, proceed as follows.

- In Magnifi, on the **Settings** menu, click **Instrument I/O**.
The **Instrument I/O** dialog box opens. The inputs in this dialog box correspond to the buttons of the Probot's remote control (see page 6).

Associating **Input 1** to the action **Probe pusher sequence launch/ready** is *mandatory*. We recommend that you configure the digital inputs as follows to ensure the correct operation of the Probot under most operational scenarios.

Figure 2–32 Instrument I/O dialog box: Digital input recommended configuration



Input 1 is the trigger of the Probot's remote control (see page 6). With the inputs configured as indicated above, the Probot can be jogged forward or reverse, and the operator can move up and down the inspection list with the remote control.

Input 1

- **Action = Probe pusher sequence launch/ready**
- **Activation = Link to toggle action**

Input 2

- **Action = Probe pusher jog reverse**
- **Activation = Link to toggle action**

Input 3

- **Action = Probe pusher jog forward**
- **Activation = Link to toggle action**

Input 4

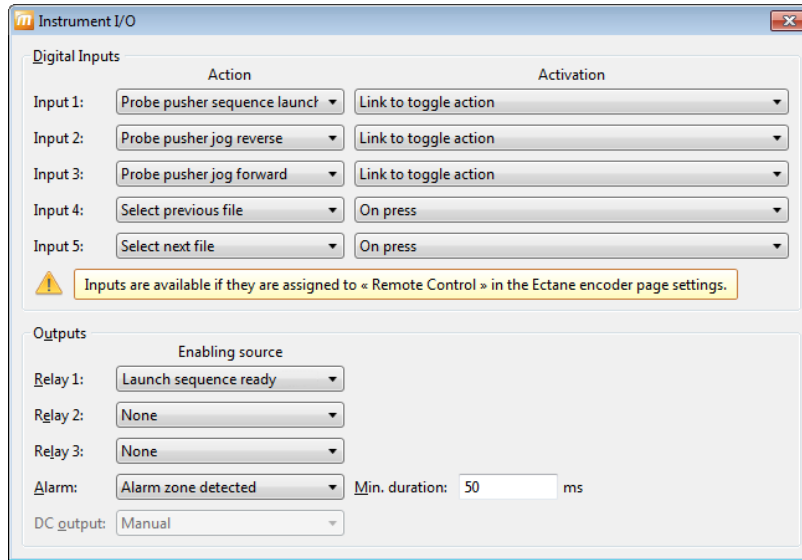
- **Action = Select previous file**
- **Activation = On press**

Input 5

- **Action = Select next file**
- **Activation = On press**

We recommend that you configure the outputs as follows to ensure the correct operation of the Probot under most operational scenarios.

Figure 2–33 Instrument I/O dialog box: Output recommended configuration



Relay 1

- **Enabling source = Launch sequence ready**

Relay 2 and Relay 3

- **Enabling source = None**

Alarm

- **Enabling source = Alarm zone detected**
- **Min. duration = 50**

Available Programmable Input Functions

The following is a list of all of the functions available to the programmable inputs.

Table 2–1 Programmable input functions

Programmable Input Function	Description
Balance	Balances (otherwise known as a hardware null) the probe.
Clear screen	
Start/Stop acquisition	
Start/Stop recording	
Start next file	Selects the next file from the inspection list and begins acquisition.
Select previous file	Selects the previous file in the inspection list.
Select next file	Selects the next file in the inspection list.
Enter no indication code	Inserts a no-indication code in the inspection report.
Start recording/Stop acquisition	Upon pressing the input, recording starts. When pressing the input a second time, recording and acquisition stop.
Start acquisition	
Stop acquisition	
Stop recording	Stops recording data, but the strip charts continue scrolling.
Probe pusher sequence launch/ready	Pressing this input launches a Probot sequence or unlocks the control of the drive when the remote control operator indicates to a station operator that launch may proceed.
Probe pusher jog forward	Moves the probe forward at jog speed.
Probe pusher jog reverse	Moves the probe backward at jog speed.

Configuring a Hardware Alarm

Hardware alarms are perhaps the most sensitive configuration item used with the Probot. Always exercise the utmost care in configuring a hardware alarm for the Probot.

In the following example, we will configure the hardware alarm so that every time the probe is inserted into a tube it stops the probe's motion when it leaves the tube and resets the position encoder to eliminate the effects of mechanical lash.

Configuring a hardware alarm incorrectly may cause unwanted probe stoppages, runaway probes that do not stop moving after leaving the tube, and inaccurate position encoding because the encoder is not reset to correct for mechanical lash.

We recommend using a differential channel to detect the tube end. Differential channels offer several advantages:

- They operate appropriately even if the probe is not balanced or is improperly balanced
- They are independent of direction — they detect the end of the tube whether entering or leaving a tube.

Using a differential channel to detect tube ends also has a disadvantage: the alarm is unable to track whether the probe is in or out of the tube. The alarm can only monitor the change of state. Differential channels are also more sensitive to speed, which can affect their ability to detect tube-to-air transitions.

Overall, a differential channel is generally considered to be the most reliable way of controlling a hardware alarm, which is why it is used throughout this document.

If your probe does not have a differential channel or if you are pursuing other objectives better served by an absolute channel alarm, we recommend that you test it carefully at lower speeds and under controlled conditions before using it in the field.

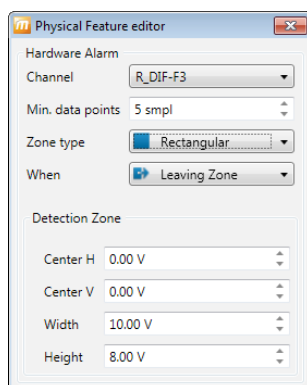
Individual probes and applications have different physical properties and they react differently to the tube-to-air transition and to other signals in tubes. It is therefore impossible to create a one-size-fits-all hardware alarm. Verify and adjust your alarm configuration each time you begin a new application.

Proceed as follows to configure a hardware alarm:

1. In Magnifi, on the **Settings** menu, click **Hardware Alarm**.

The **Physical Feature Editor** dialog box opens.

Figure 2–34 Physical Feature Editor dialog box



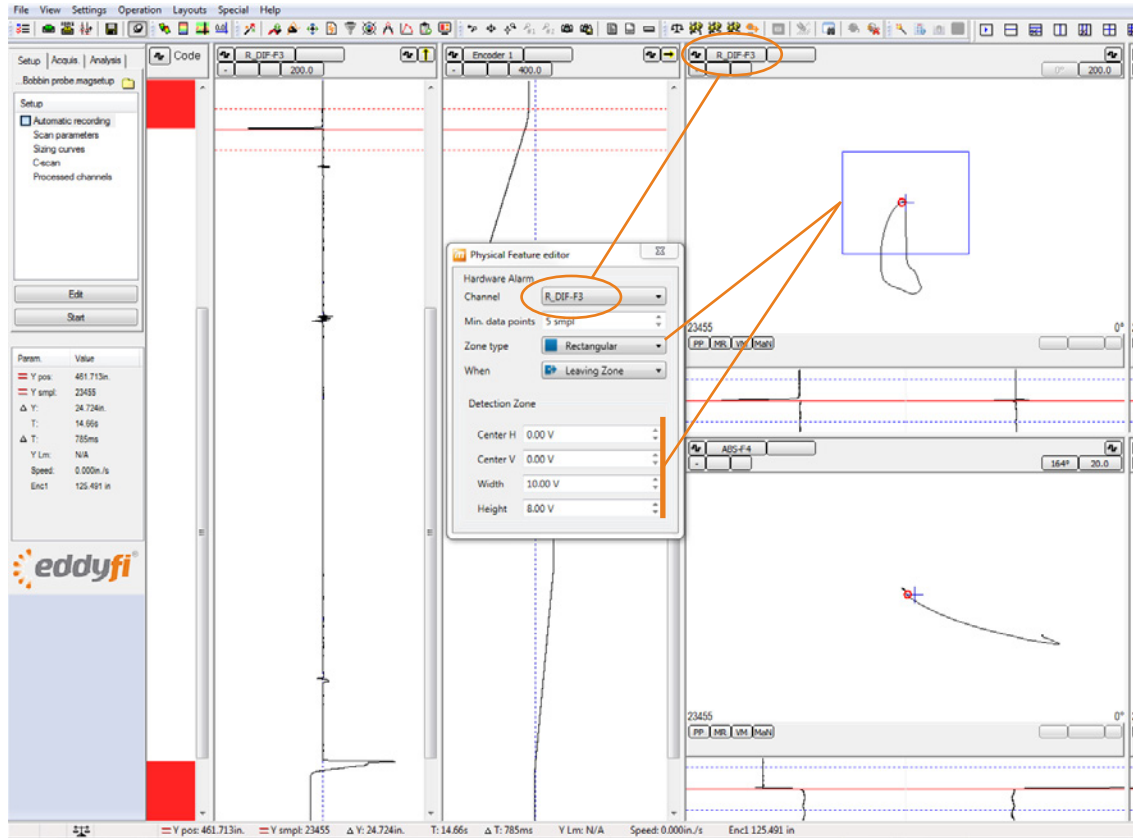
2. In the **Hardware Alarm** group, on the **Channel** list, select the appropriate differential channel.

Notes

- Because hardware alarms can only be applied to raw channels in Magnifi, only raw channels are available on the **Channel** list (R_).
- To configure your hardware alarm, you must collect data from a calibration or an *in situ* tube. You can collect this data manually (pulling a tube) or with the Probot if you feel comfortable doing so at this point.

3. Display the Lissajous of the raw channel that you wish to use for your alarm in Magnifi, as illustrated in the figure below.
 In the Lissajous of the selected channel (R_DIF-F3, in this case), you see the blue alarm boundary (square or pie segment according to the selected **Zone type**).

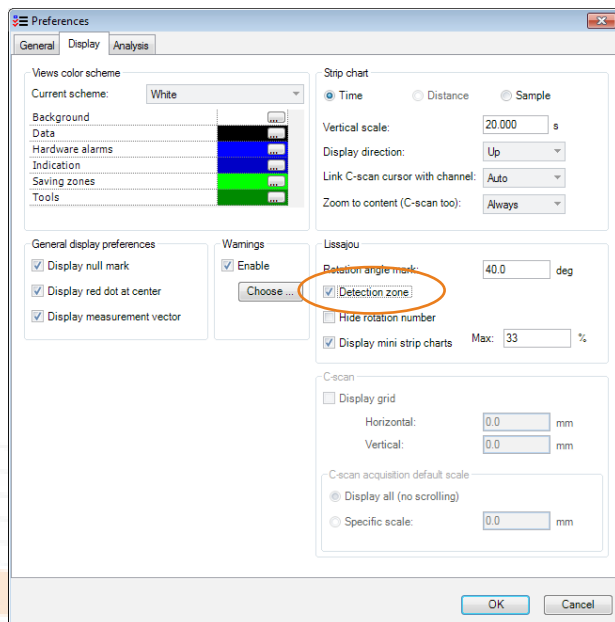
Figure 2–35 Lissajous of raw differential channel 3



Notes

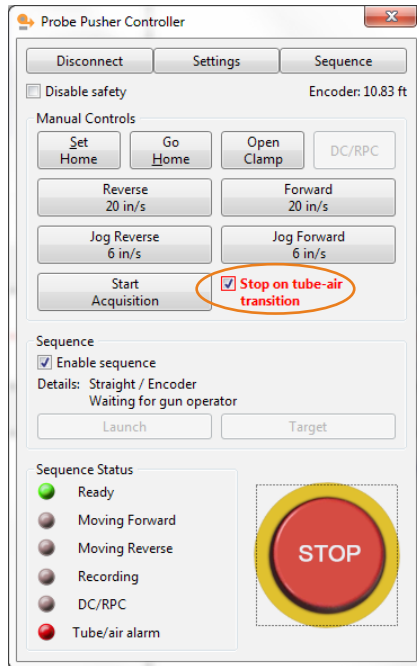
- If you do not see the alarm boundary, verify whether it can be displayed by modifying the Lissajous' voltage. If you still do not see the alarm boundary, on the **Settings** menu, click **Preferences**. On the **Display** tab, in the **Lissajous** group, make sure that the **Detection zone** check box is selected.

Figure 2–36 Ectane display preferences



- Also make sure that in the **Probot Controller** dialog box the **Stop on tube-air transition** check box is selected.

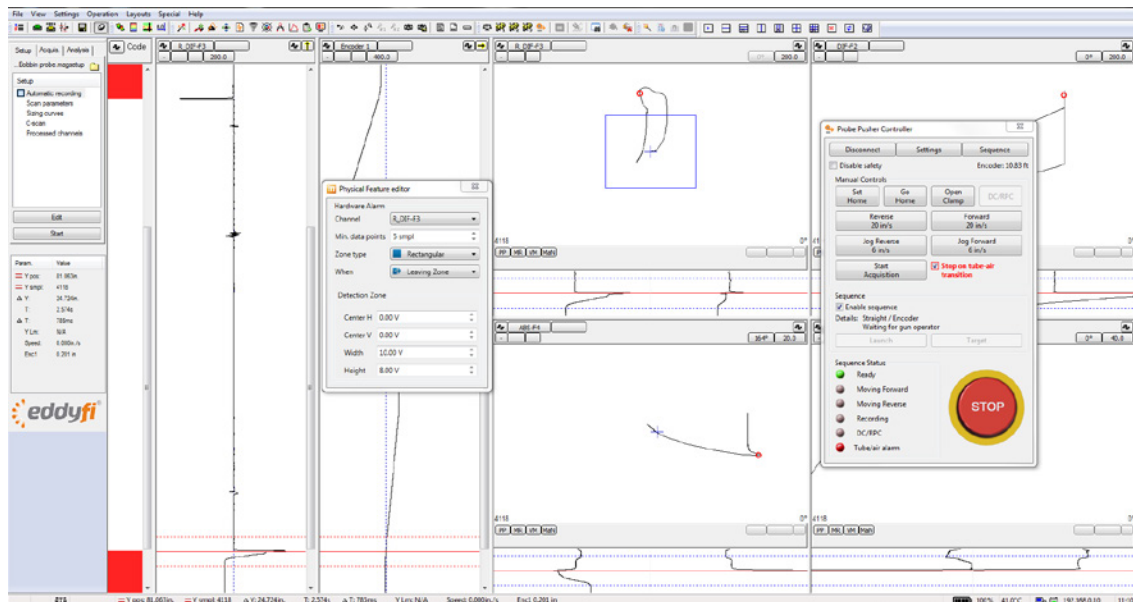
Figure 2–37 Stop on tube-air transition check box



Important

The choice of the channel used to detect the tube end is **very important**. Select a channel that does not saturate or spike, and for which as few others signals as possible are of the same magnitude as the tube-end signal. This is normally the highest frequency, but sometimes other frequencies offer better performance. As mentioned earlier, if you use a differential channel, the alarm can be triggered entering or leaving the tube. The figure below illustrates how the signal from a probe entering the tube can differ from the signal exiting the tube illustrated in Figure 2–35.

Figure 2–38 Example of a differential signal as a probe enters a tube



Establishing Communications With the Probot and Ectane 2

Assemble all the physical components that you want to use, connect the Probot, and then Ectane 2 as follows.


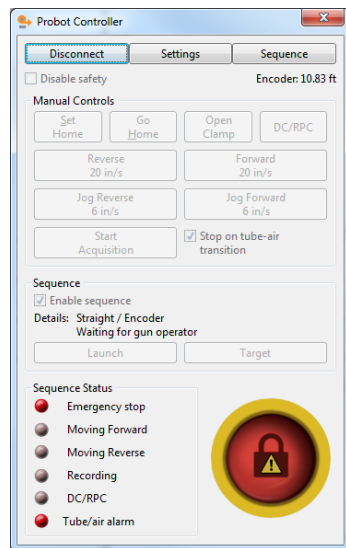
1. Turn on the computer running Magnifi.
2. Start Magnifi.
3. Turn on the Probot.
4. Turn on the Ectane 2.
5. In Magnifi, on the **Operation** menu, click **Probot Controller**.
Alternatively, click  on the toolbar. The **Probot Controller** dialog box opens.
6. In the **Probot Controller** dialog box, click **Connect**.
The **Instrument Connection** dialog box opens. This is the same dialog box as the one for the Ectane 2.
7. Verify the status of the Probot, and then click **Connect**.
By default, when the Probot is connected, the system's **STOP** button is active.

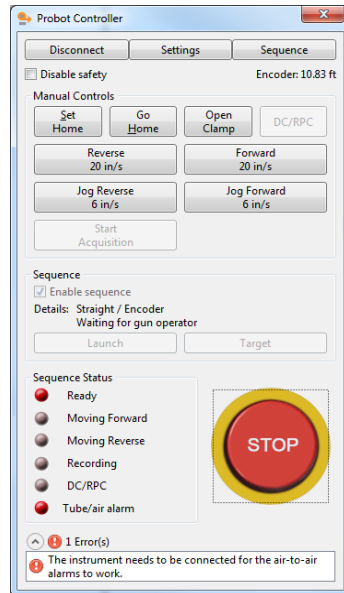
Figure 2–39 Probot Controller dialog box when the EMERGENCY STOP button is depressed



Note

Pressing the EMERGENCY STOP button on the Probot alters the state of the software button in this dialog box. The **only** way to release the EMERGENCY STOP button is to press and turn it. When the EMERGENCY STOP button is depressed, the **STOP** is blocked.

8. Make sure that the probe is installed correctly on the drive and that nothing can become entangled. See “Spooling the Probe Push Tube With the Probot” on page 17 or “Mounting a Pre-Spooled Probe on the Probot” on page 22 for details.
9. In the **Probot Controller** dialog box, click the **Stop** button.

Figure 2–40 Probot Controller dialog box: Stop released

Notes

- If you cannot click the **STOP** button in the **Probot Controller** dialog box, the EMERGENCY STOP button (on the unit or remote) is depressed and must be released prior to operation.
- An error message appears at the bottom of the dialog box warning you that the Probot must be connected for the air-to-air alarms to function. This is due to not being connected to Ectane 2. If the Ectane 2 is connected, the message is caused by not having a configured the alarm channel in the Ectane 2 setup.

10. Connect Ectane 2 to Magnifi.

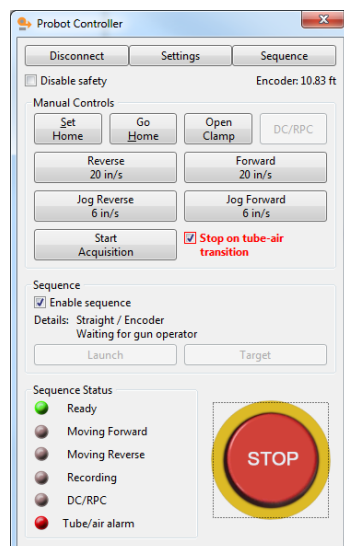
Refer to the Ectane 2 and Magnifi documentation for details.

11. Load an acquisition setup appropriate for the technique and probe that you are using for your inspection.

Note

Magnifi automatically loads the previously used setup when it starts. For the purposes of this manual, we have used a multi-frequency differential and absolute bobbin probe setup.

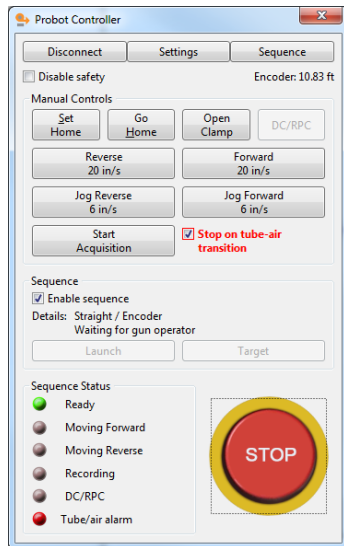
Once connected to Ectane 2 and configured as described above, the **Probot Controller** dialog box appears as illustrated below.

Figure 2–41 Ectane 2 connected

Probot Controller

The **Probot Controller** dialog box is laid out as follows. It serves as your control interface for the Probot.

Figure 2–42 Probot Controller dialog box



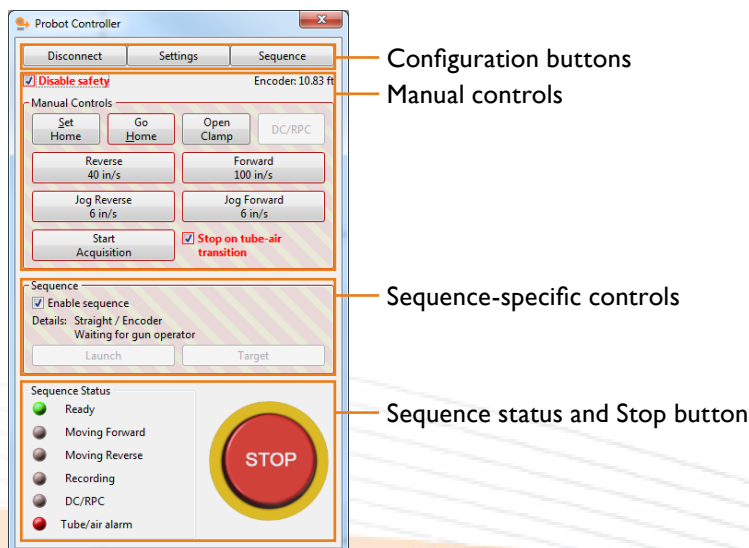
Configuration Buttons

- **Disconnect** button: Click this button when you want to disconnect the controller software from the Probot. Reconnect the Probot as detailed in “Establishing Communications With the Probot and Ectane2” on page 32.
- **Settings** button: Clicking this button opens the **Probot Settings** dialog box. For details, see below.
- **Sequence** button: Clicking this button opens the **Probot Sequence** dialog box. For details, see below.

Disable Safety Check Box

The Probot controller comes with a number of built-in safety features intended to minimize the possibility of unintentionally damaging probes. There can be times when it is necessary to temporarily disable these safety features. To do so, select the **Disable safety** check box. When it is selected, the **Probot Controller** dialog box appears as illustrated here.

Figure 2–43 Probot Controller dialog box when safety settings are disabled



Manual Controls Group

All the speeds configured in the **Probot Settings** dialog box appear on the buttons of the **Manual Controls** group.

- **Set Home:** Sets the encoder to the home position. The value of the home position can be zero or some other number according to the type of sequence you have chosen. When working with sequences, it is important to pay particular attention whether the sequence makes a distinction between home and zero.
- **Go Home:** Click this button to return the probe to the home position at the jog speed. More on the jog speed below.
- **Open Clamp:** This button opens the Probot clamp, releasing pressure on the probe wand. There is no Close Clamp function at the computer station. The drive clamp can only be closed from the Probot itself.
- **DC/RPC:** This button engages the DC power supply used with rotating probes (RPC) or DC magnetic saturation probes.
- **Forward and Reverse:** These two buttons are toggles. Toggles remain engaged until you click them a second time. These two toggles are used to move the probe forward (away from the Probot) or in reverse (toward the Probot). Clicking one of the buttons causes the probe to move at the speed configured in the **Settings** dialog box (opened by clicking the **Settings** button). The probe continues to move until you click the button again or you click the **STOP** button.
- **Jog Forward and Jog Reverse:** These two buttons are also depress buttons. Such buttons must remain clicked to operate and stop operating as soon as they are released. These two buttons are used to move the probe forward (away from the Probot) or in reverse (toward the Probot) at the jog speed configured in the **Settings** dialog box (opened by clicking the **Settings** button). Typically, jog speeds are considerably lower than normal speeds to allow for the safe movement of the probe outside tubes or near the Probot.

Sequence Status and Stop Button

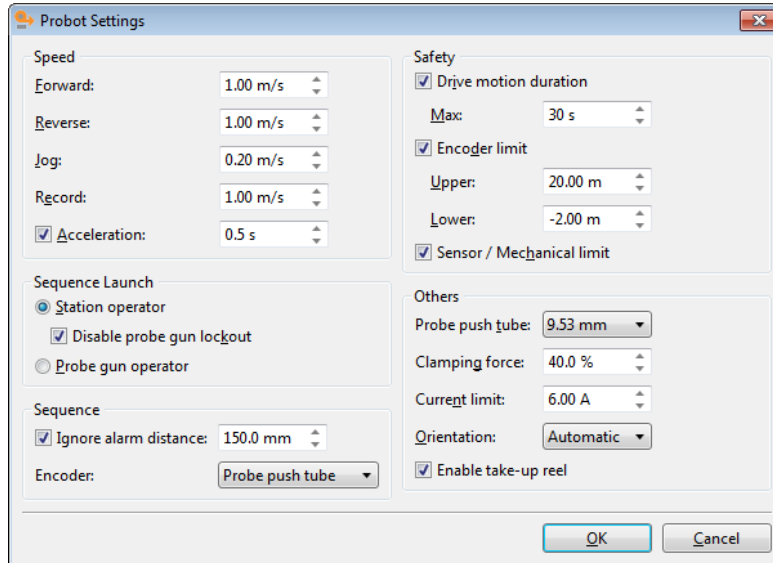
The indicators in this section use a color code to communicate the status of the various elements in the configured sequence as they occur. Gray = inactive or unused, green = active or ready, red = stopped or faulty. The **STOP** button stops all controller motion, while maintaining minimum tension in the take-up reel, effectively placing the system in a stopped state, as illustrated in Figure 2–42.

Configuring Probot Settings

Proceed as follows to configure the Probot settings.

- In the **Probot Controller** dialog box, click **Settings**.
The **Probot Settings** dialog box opens.

Figure 2–44 Probot Settings dialog box



In this dialog box, you can see the following groups:

- **Speed**
- **Sequence Launch**
- **Sequence**
- **Safety**
- **Others**

Speed Group

Configure the **Forward**, **Reverse**, **Jog**, and **Record** speeds to values meeting the requirements of your inspection technique.

Important

We strongly recommend that new operators use lower speeds until they are completely comfortable with the operation of the Probot.

Note

The **Record** speed is separate from the **Forward** and **Reverse** speeds. They can often have the same value, but rotating probes (RPC), for example, require that the recording speed be considerably lower than the speeds used to insert and retract the probe.

Select the **Acceleration** check box to enable the feature, and then specify the acceleration period. Using the acceleration feature is an extremely useful tool for extending probe life.

Sequence Launch Group

In this group, select whether sequences are to be launched by the station operator or by the remote control (probe gun) operator. The station operator is the person operating the system from a computer and the remote control operator is the person operating the system from the remote control.

If you select the **Station operator** option, you can also select the **Disable probe gun lockout** check box. If you do not select the **Disable probe gun lockout** check box, the station operator cannot launch a sequence until the remote control operator releases the lockout, indicating that it is safe to proceed, by squeezing the remote control trigger.

Sequence Group

If you want to ignore the tube-air alarm when the **Stop on tube-air transition** check box is selected in the **Probot Controller** dialog box, select the **Ignore alarm distance** check box, and then specify a numerical value in the text box. Doing so enables motion up to the specified distance before beginning to respond to a tube-air alarm. If you do not select the **Ignore alarm distance** check box, you may find yourself unable to move your probe when it is outside a tube unless you clear the **Stop on tube-air transition** check box in the **Probot Control** dialog box.

Select whether you want to use the belt drive encoder or the probe push tube encoder on the **Encoder** list. We recommend using **Probe push tube**. Select **Belt** if the probe push tube encoder fails or is otherwise unsuitable.

Safety Group

The Probot is equipped with three independent safety systems designed to prevent runaway probes and/or probes being wheeled through the drive belts. These three safety systems are **Drive motion duration** (time), **Encoder limit** (distance) and **Sensor/Mechanical limit**.

Drive Motion Duration

Select the **Drive motion duration** check box to activate the safety system, and then specify the maximum duration after which all probe motion must stop. Calculate this value according to the longest tube run, the length of the probe, or a combination of the two.

Example 1: Drive motion duration based on probe length

- Probe length: 19.8 m (65 ft)
- Conduit length from Probot to tubesheet face: 3.1 m (10 ft)
 - Available probe length: $19.8\text{ m} - 3.1\text{ m} = 16.7\text{ m}$ (55 ft or 660 in)
- Forward speed: 1.02 m/s (40 in/s)
 - Maximum time before the probe dies after running away: $16.7\text{ m} \div 1.02\text{ m/s}$ ($660\text{ in} \div 40\text{ in/s}$) = 16.5 s
- **Drive motion duration** check box: selected
 - **Max.** text box: 16

Example 2: Drive motion duration based on tube length (length of tube to be inspected significantly less than the probe length)

- Tube length: 6.1 m (20 ft or 240 in)
- Maximum probe overrun before damage occurs: approximately 0.9 m (3 ft or 36 in)
 - Maximum distance before damage occurs: $6.1\text{ m} + 0.9\text{ m} = 7\text{ m}$ (276 in)
- Forward speed: 1.02 m/s (40 in/s)
 - Maximum time before damage occurs: $7\text{ m} \div 1.02\text{ m/s}$ ($276\text{ in} \div 40\text{ in/s}$) = 6.9 s
- **Drive motion duration** check box: selected
 - **Max.** text box: 7

The choice to base this safety system on the probe's length or the tube's length depends on your particular situation; *i.e.*, how long is the probe, how long is the tube to be inspected, and what conditions would inflict the most damage to the probe in the event it runs away.

Note

Do not be overly conservative in configuring this safety system. If **Drive motion duration** is too conservative, there is a risk that the operator will disable this safety feature to false shutdowns.

Encoder Limit

The second safety system used by the Probot is **Encoder limit**. Select the **Encoder limit** check box to activate the safety system, and then specify the positions (upper and lower) beyond which you do not want the probe to travel (based on zero being at or near the end of the tube).

Example

- Tube length: 6.1 m (20ft)
- Distance beyond tube end where probe could be damaged: 0.9 m (3ft)
- Conduit length from Probot to tubesheet face: 3.1 m (10ft)
 - Upper limit: 6.7 m (22ft) to avoid damage
 - Lower limit: -1.5 m (-5ft) to avoid running into the drive

Note

These distances are based on zero being set at or near the end of the tube.

Sensor / Mechanical Limit

The third and last Probot safety system is **Sensor/Mechanical limit**. This safety system is a sensor or mechanical limit switch placed along the conduit and activated by the passage of the probe that disables its motion. The Probot can be equipped with up to two such devices, where the one closest to the tube can be used as an integral part of a sequence and the other is used as **Sensor/Mechanical limit**.

Others Group

Other settings include:

- **Probe push tube:** Select the diameter of the probe's push tube on this list.
- **Clamping force:** Specify the amount of clamping force (as a percentage of the maximum available force) in this text box.

Note

The maximum clamping force is not always necessary. A lighter clamping reduces belt and drive train wear. A higher clamping force may be required where it is difficult to push the probe or when slippage occurs.

- **Current limit:** This protects the drive and, to some degree, the probe when an obstruction is encountered while driving the probe. The optimal current limit value depends on the required driving force and the likelihood of encountering obstructions. Setting the current limit too low results in nuisance stoppages, while setting it too high does not protect the probe or the Probot.
- **Orientation:** The Probot can be oriented for left-hand operation or right-hand operation (see figures below) and contains a sensor that automatically determines this orientation. When facing the drive belts, the probe exits on the left of a left-hand oriented Probot. Similarly, when facing the drive belts, the probe exits on the right of a right-hand oriented Probot. In the **Settings** dialog box, in the **Others**, the simplest selection is **Automatic**. However, if the automatic orientation feature does not operate properly, you can always select **Left hand** or **Right hand**.

Figure 2-45 Left-hand configuration

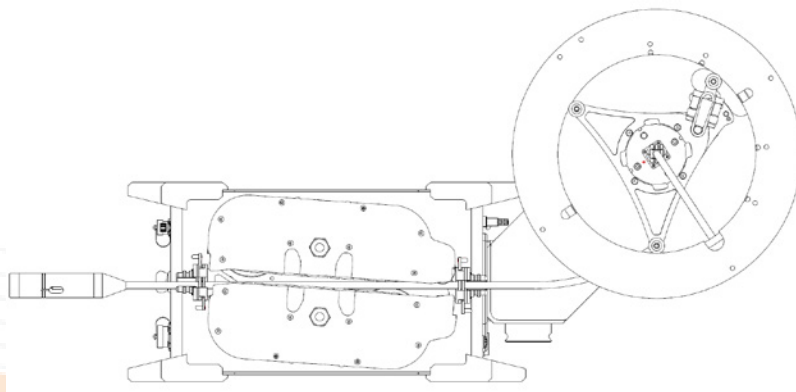
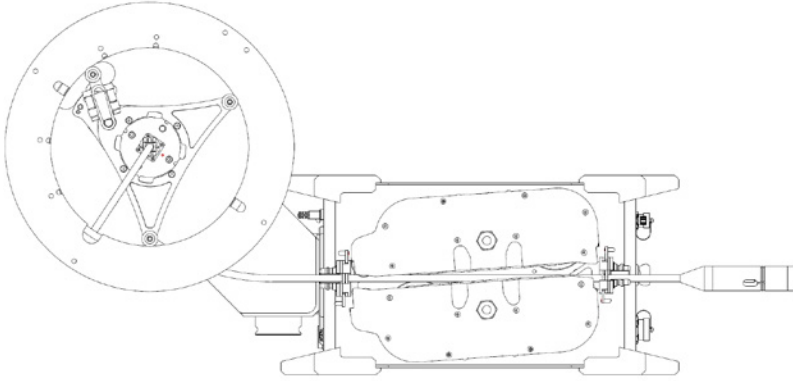


Figure 2–46 Right-hand configuration

- **Enable take-up reel:** Some applications (such as IRIS or short-length ET inspections where space is limited) do not use the take-up reel. If the take-up reel is not needed, clear the **Enable take-up reel** check box.

When you have completed your modifications to the Probot settings, save your Magnifi setup. This will retain all these settings for the next time you want to perform the same application.

Initial Setup and Operation of the Probot

We are now going to start moving the probe. Before doing so, however, we will review a typical cycle and what features are available in Magnifi to help control the Probot and our probe.

Encoder Strip Chart

- One of the very useful tools in Magnifi is the encoder strip chart. With this chart it is possible to see, at a glance, whether the probe is moving or stationary, accelerating or decelerating.
- To view the encoder strip chart, simply select the encoder channel you are using (the one you configured on page 26) in a long strip chart and set that strip chart to display the horizontal component only. Set the strip chart voltage to display all of the encoder signal (usually a large number).

Figure 2–47 Encoder strip chart



- A breakdown of a typical insertion-retraction sequence are detailed in the figure below. Basic functions of the encoder strip chart are:
 - Vertical lines indicate that there is no motion
 - Lines that slope to the right indicate forward motion
 - Lines that slope to the left indicate reverse motion
 - It is normal for the lines to wrap the screen when they reach the edge.
 - The steepness of the slope is an indication of velocity (steeper = faster)
 - Curves indicate acceleration
 - A sudden displacement of the encoder trace to the baseline (zero) indicates that the air-tube alarm has reset the encoder

Figure 2–48 Typical probe insertion-retraction sequence view with encoder strip chart

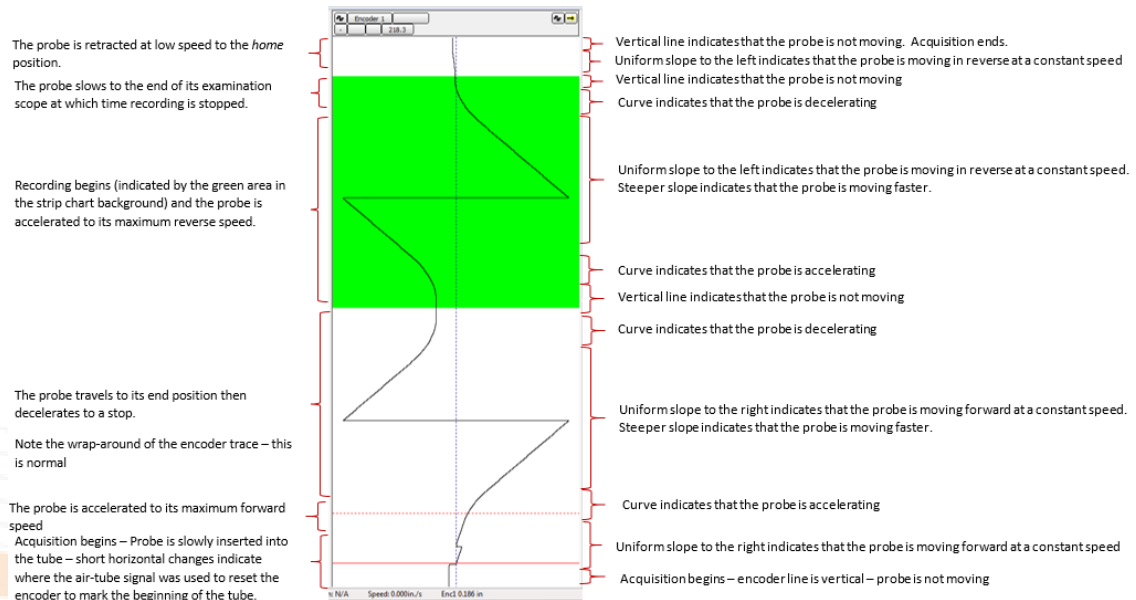
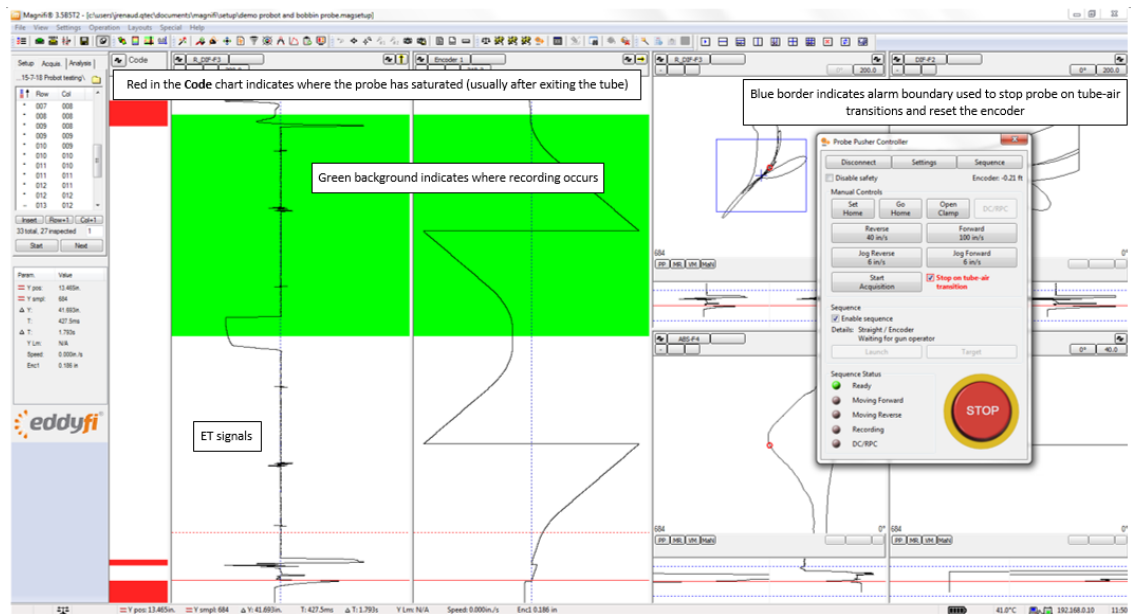


Figure 2–49 Complete view of probe insertion-retraction sequence shown above



Before you continue, perform the following:

- Double check that the safety systems described on page 37 are enabled.
- **Important** — Acquisition should be running any time the probe is being moved (preferably in setup mode — if you do wish to operate in acquisition mode, ensure that the **Automatic recording** check box in setup mode is clear).
- Jog the probe forward until it is at the end of the tube. Click on **Set Home**.
- Jog the probe forward until it enters the tube and is free of supports, tubesheets, deposits or other environmental phenomena that could affect probe balance. If it is not possible to balance the probe within the tube in such a manner, balance the probe in a defect free area of the calibration standard. In all cases, inspection instructions take precedence over these guidelines.
- Once the probe is balanced, jog the probe out of the tube and validate that the tube-air alarm is functioning correctly; i.e., that normal tube signals are not at risk of activating the alarm and that the signal caused by the probe exiting (or entering) the tube activate the alarm (leave the blue bordered alarm boundary).
- If you want to operate with **Stop on tube-air transition** enabled (recommended), jog forward some distance into the tube (several feet is preferable) and with **Stop on tube-air transition** enabled, click **Reverse**. The probe should move in reverse and stop at the end of the tube. If it does not stop at the end of the tube click/press **STOP** as quickly as possible to avoid damaging the probe.
 - If the probe does not stop at the end of the tube, double check that acquisition was running when you clicked **Reverse**, verify that your alarm is configured correctly and that **Stop on tube-air transition** is selected.
- Once the probe stops satisfactorily in reverse, test operation of the **Stop on tube-air transition** feature in the forward direction.

Note

It is good practice to jog to the far end of the tube once to ensure that there are no obstructions and that your probe has been properly wound on the spool.

- Jog forward into the tube and click **Forward**. The probe should move forward and stop at the far end of the tube.
- Fine tune the position of the probe at the end of the tube in such a way that it just exits the tube. Note the distance indicated by the encoder for future reference.
- Jog reverse until the probe re-enters the tube, and then click **Reverse** to return the probe to the near end of the tube.

You are now ready to select a sequence and begin acquisition!

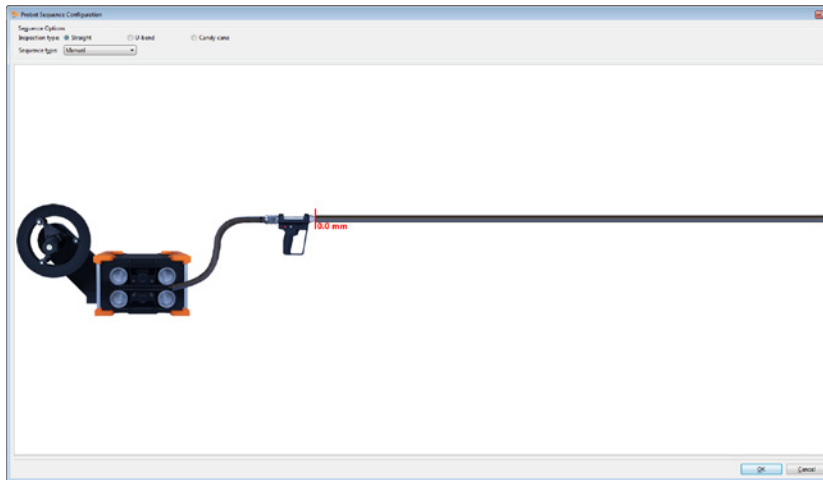
Sequences

The Probot functions as a system following prescribed sequences configured to best meet the user's needs. Sequences available to the Probot are **Manual**, **Manual air to air**, **Air to air**, and **Encoder**. Within these sequences, you can also use a sensing coil as an integral part of the sequence. In this section, we will review each of these sequences in some detail and introduce configuration steps and concepts along the way.

Manual Sequence

The manual sequence is, simply, no sequence at all. To select a manual sequence, in the **Probot Controller** dialog box, click the **Sequence** button. The **Probot Sequence Configuration** dialog box opens.

Figure 2–50 Probot Sequence Configuration

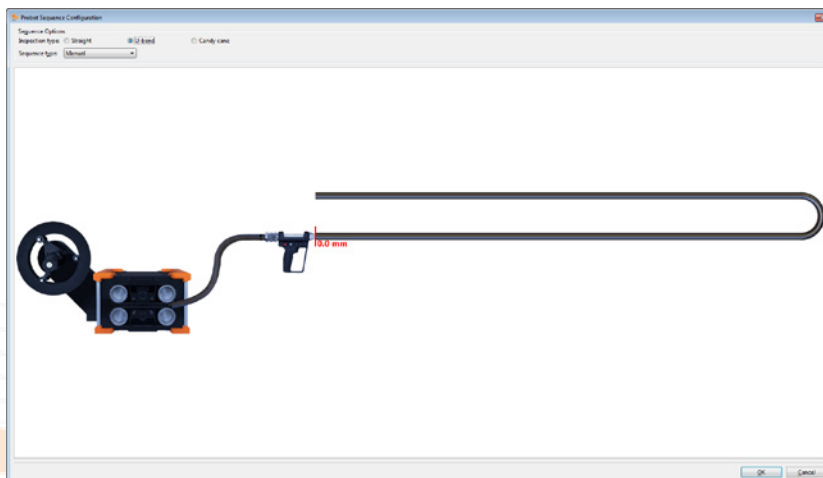


Manual sequences are used when an operator wants to control all motion and recording manually. It is not recommended to use the manual sequence at very high speeds. Manual sequences can only be operated from the computer station; *i.e.*, not from the remote control (probe gun).

In the figure above, you can see the basic layout of the **Probot Sequence Configuration** dialog box. Top left, you can see the **Sequence Options**, where you can select the **Inspection type** and the **Sequence type**. According to the type of sequence selected, the representation at the bottom of the dialog box changes. These representations serve two purposes: i) aid the user with a visual description of the system and ii) provide an intuitive means of configuring sequence options.

As illustrated above, **Inspection type** is **Straight** and **Sequence type** is **Manual**. The manual sequence does not offer much in terms of representation. You can see the Probot, a conduit, the remote control (probe gun), and the tube. It is possible to display the tube as a U-bend or candy cane by selecting the appropriate **Inspection type**. An example of a U-bend inspection type is illustrated below.

Figure 2–51 Manual sequence with a U-bend



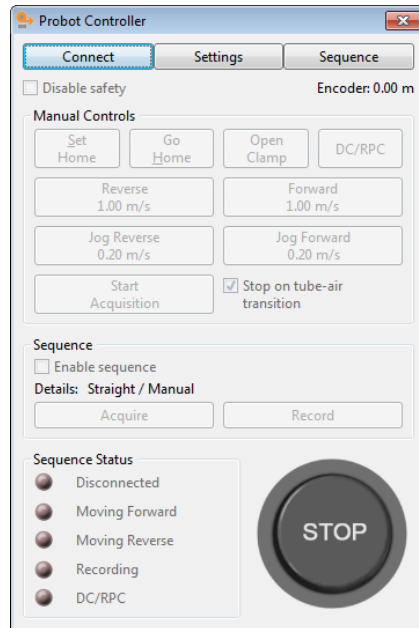
The zero reference at the beginning of the tube is a reminder to set the zero position of the encoder before beginning by clicking the **Set Home** button in the **Probot Controller** dialog box.

With the exception of the safety limits configured on page 37, with the manual sequence you are completely on your own. Click **Forward** or **Reverse** to move the probe forward or in reverse until you instruct it to stop. Similarly, to record data, you must click **Record**, click **Jog Forward**, **Jog Reverse**, **Forward**, or **Reverse** to move the probe, click **STOP** to stop motion, and **Stop record** to stop saving data to file.

Note

In the **Probot Controller** dialog box below, in the area labeled Sequence, Details that the inspection and sequence types are displayed to remind the operator which sequence type has been selected.

Figure 2–52 Probot Controller dialog box when in manual sequence mode

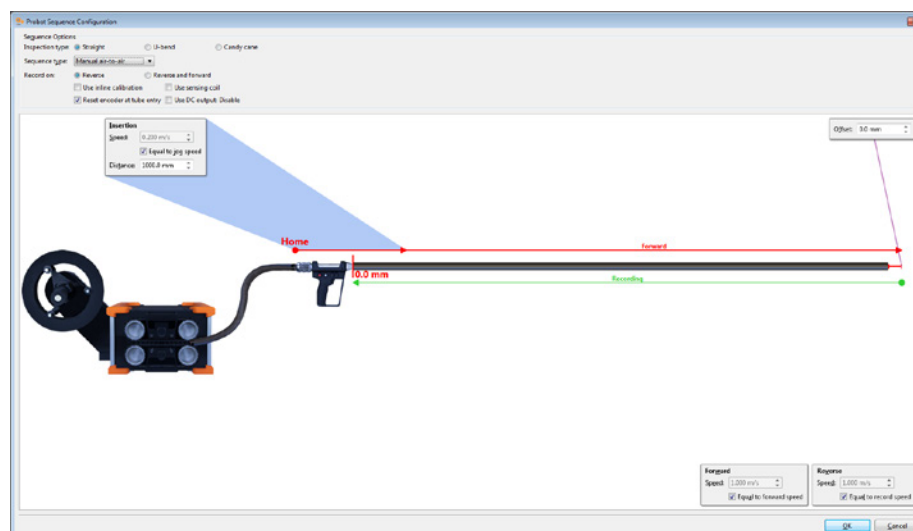


Manual Air-to-Air Sequence

The next sequence type is the Manual air-to-air sequence. It is similar to the manual sequence with the exception that, when configured correctly, the probe stops automatically at the end of the tube. Manual air-to-air sequences are usually performed through a computer station, not with the remote control.

A graphical representation of the Manual air-to-air sequence is illustrated in the figure below. Note that you can configure more options than with the Manual sequence.

Figure 2–53 Manual air-to-air sequence



In addition to stopping automatically at the tube end, there is an insertion feature that advances the probe at a different speed for a short distance and a configurable offset at the end of the tube. **Insertion** is a common feature to most the Probot sequences. During the insertion phase the probe is typically moving slower and is temporarily ignoring any tube-air alarms on its way into the tube. In the **Insertion** window, you can configure **Speed** or select the **Equal to jog speed** check box for the insertion speed to be the same as the jog speed. You can also specify the **Distance** (length of insertion phase). A bit of fine tuning to determine the optimal insertion speed and distance is normal. When in doubt, it is safest to insert more slowly and for a longer distance. Once you become more comfortable with the Probot functions, you can decrease the insertion distance for maximum efficiency.

Offset is a common feature to most Probot sequences and is used to push the probe a bit further out of the tube after it is stopped by the tube-air alarm. Offsets are commonly used for array probes to ensure that all modules of the probe have left the tube before recording begins. The normal offset for bobbin probes is zero. Some fine tuning is normal if you want a suitable offset for an array or multiple-module probe.

Note

It is normal for the probe to protrude further past the end of the tube at higher speeds than at lower speeds (inertia).

Other configuration options are: **Use inline calibration**, **Use sensing coil**, **Reset encoder at tube entry**, and **Use DC output**.

Use inline calibration places an inline calibration standard in the sequence representation. This feature is available in most of the sequences. In **Manual air-to-air**, this has very little effect other than to change the visual representation of the sequence. **Use of inline calibration** is covered in more detail in Air-to-air sequences (below) and Encoder sequences.

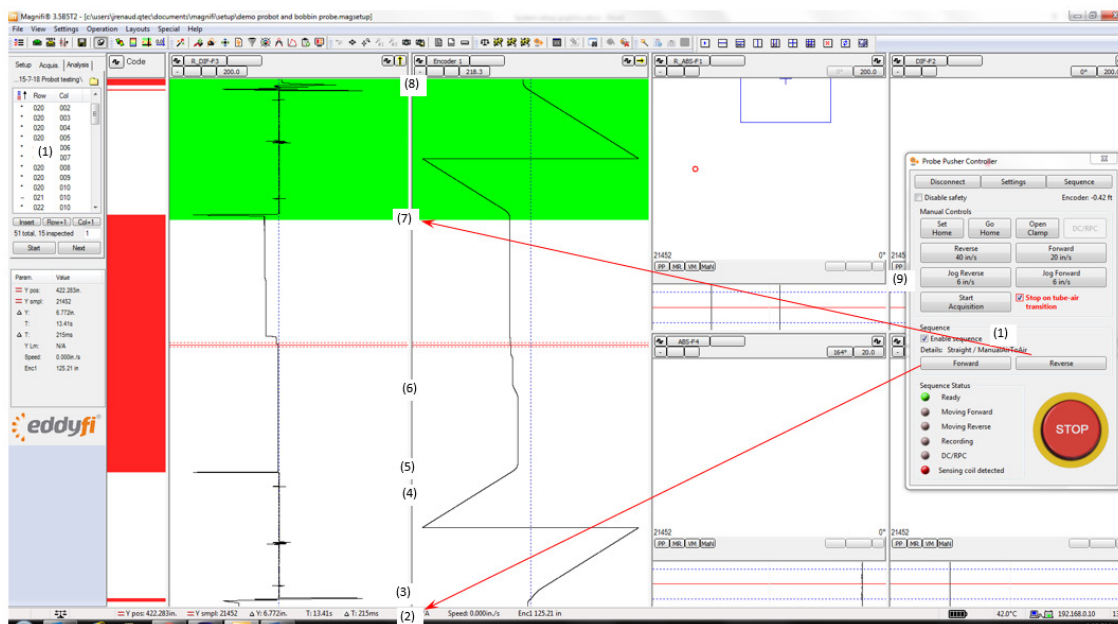
Reset encoder at tube entry, as stated, resets the encoder as the probe enters the tube if the alarm is correctly configured as explained on page 29. This feature is available in most of the sequences. It is generally good practice to always enable this feature. Note that the encoder may reset multiple times during the insertion phase and it is only the final reset that is used to establish the position in the tube.

Forward and **Reverse** speeds can be set **Equal to forward speed** or **Equal to record speed** by selecting the appropriate check boxes in the **Probot Sequence Configuration** dialog box or, if left clear, can be set to a different speed, as required. This feature is commonly used where very high speeds are used as part of a sequence and lower speeds are preferred for manual movement of the probe.

In a Manual air-to-air sequence:

1. Magnifi is in **Acquisition** mode, **Enable sequence** is selected in the **Probot Controller** dialog box, and the correct encode (zone/row/tube or column) is selected.
2. Click **Forward/Acquire** in the **Probot Controller** dialog box.
3. The probe advances the insertion distance at the insertion speed.
4. After the insertion distance, the probe begins moving forward at the **Forward** speed until it encounters the tube end.
5. At the tube end, the tube air alarm halts the forward motion of the probe.
6. If an **Offset distance** is specified, the probe moves ahead by the offset distance.
7. The probe moves no further until the operator clicks **Reverse/Record** in the **Probot Controller** dialog box at which time recording begins and the probe moves in the reverse direction at the recording speed.
8. When the probe arrives at the near tube end, the tube-air alarm halts motion of the probe.
9. If the operator wants to retract the probe further, he/she must do so by clicking **Jog Reverse** in the **Probot Controller** dialog box.

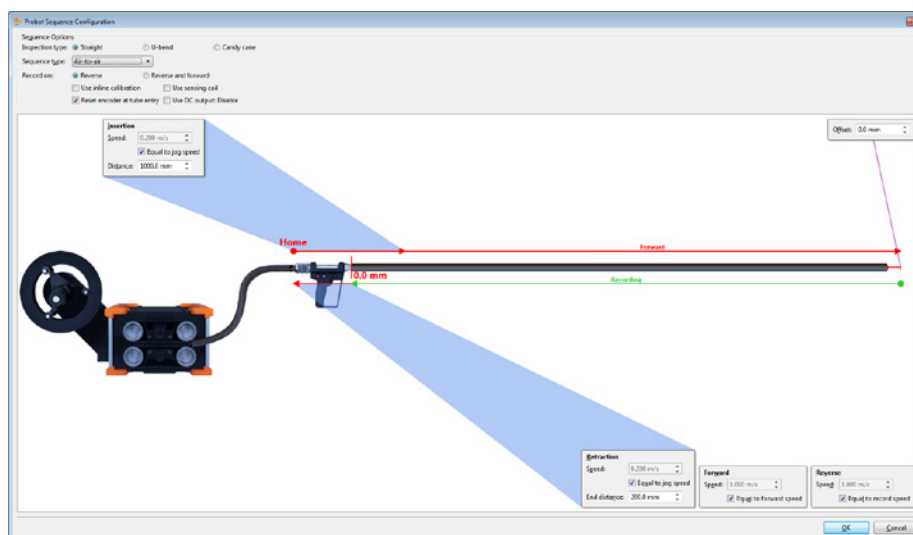
Figure 2–54 Eddy current and encoder signals from a Manual air-to-air sequence



Air-to-Air Sequence

The air-to-air sequence is the first of the fully automated sequences. The typical configuration of an air-to-air sequence that does not use a sensing coil or inline calibration standard appears below. The configuration options are essentially the same as those of the manual air-to-air sequence.

Figure 2–55 Air-to-air sequence



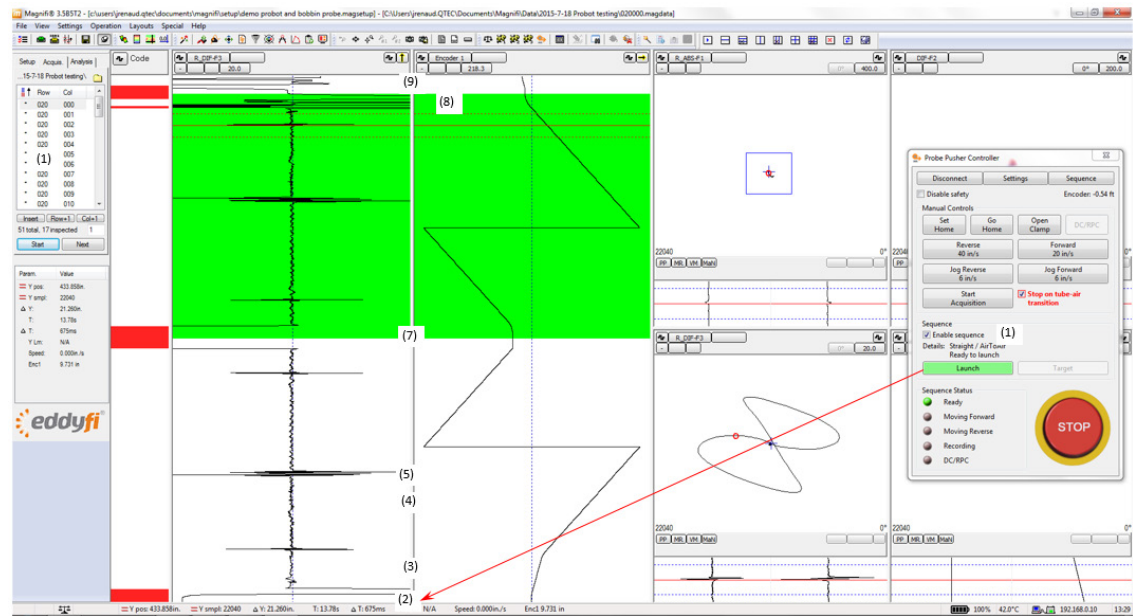
In an Air-to-air sequence:

1. Magnifi is in Acquisition mode, **Enable sequence** is selected in the **Probot Controller** dialog box and the correct encode (zone/row/tube or column) is selected.
2. Click the **Launch** button in the **Probot Controller** dialog box.
3. The probe advances the insertion distance at the insertion speed.
4. After the insertion distance, the probe begins moving forward at the **Forward** speed until it encounters the tube end.
5. At the tube end, the tube-air alarm halts the forward motion of the probe.
6. If an **Offset distance** is configured, the probe moves ahead by the offset distance (none shown in the figure below).
7. Recording begins automatically and the probe moves in reverse at the recording speed.

8. When the probe arrives at the near end of the tube, the tube-air alarm halts probe motion and stops data recording.
9. The probe is moved the **Retraction** distance, at which time the sequence is complete.

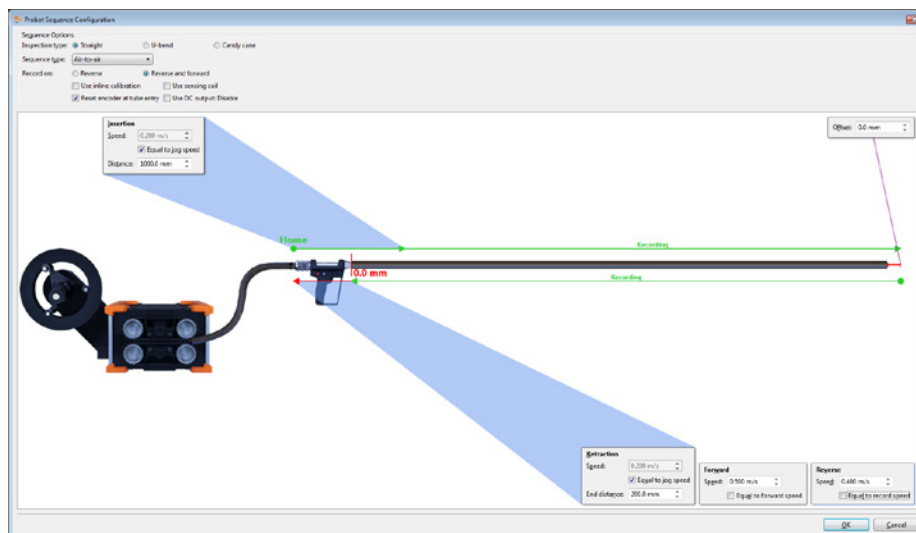
Once the sequence has been launched the operator has two options; a) hit the Stop button to halt motion and abort the sequence or b) click on the Target button to simulate the arrival of the probe at the tube end. Clicking the Target button will stop forward motion of the probe, add the offset (if applicable), begin recording and moving in reverse and complete the sequence in a normal fashion. The Target button is a useful tool where multiple, different examination extents are required on a tube basis.

Figure 2–56 Eddy current and encoder signals from an Air-to-air sequence



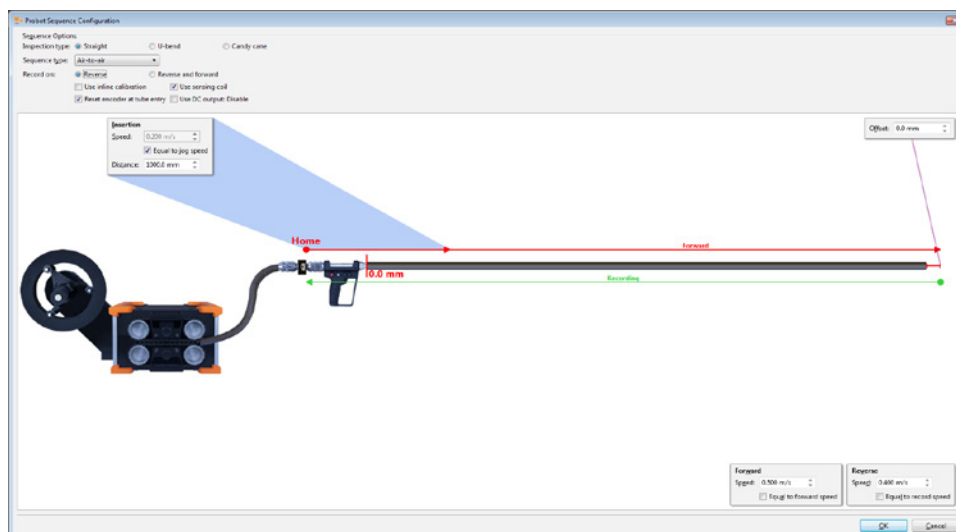
Other variations of the Air to air sequence are illustrated in the figures below. In the following figure, **Reverse and Forward** is selected for **Record on**. Notice that there are now two lines indicating recording in the representation. This feature is common to all sequence modes.

Figure 2–57 Air-to-air sequence, Record: Reverse and forward



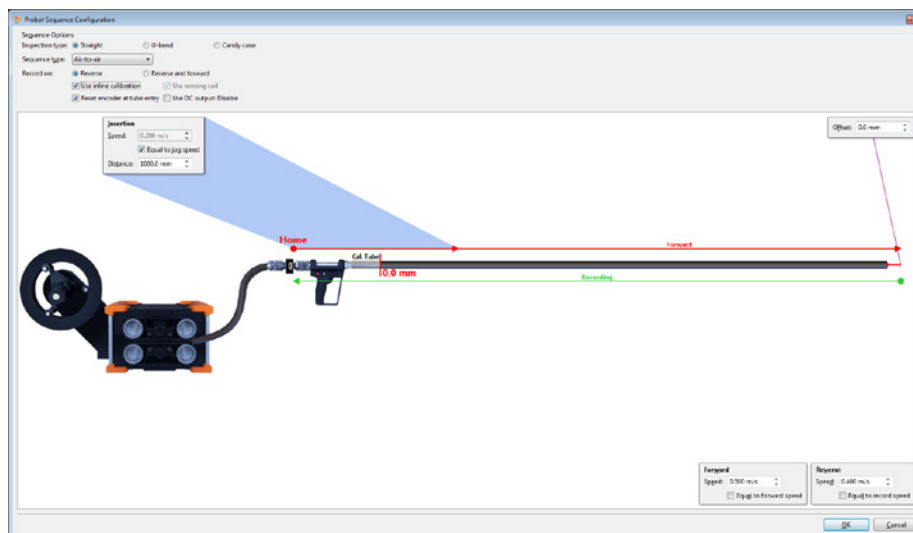
In the following figure, **Use sensing coil** is selected. The probe does not stop at the end of the tube on the reverse stroke, but continues moving in reverse and records until it encounters the sensing coil. Note that there is no retraction phase in a sensing coil sequence.

Figure 2–58 Air-to-air sequence, Use sensing coil selected



In the following figure, **Use inline calibration** is selected. Using a sensing coil is mandatory with an Air-to-air sequence to be able to record an inline calibration standard. Operation of this sequence is essentially the same as operating the sequence with a sensing coil, but without the inline calibration standard, the only difference being the distance the probe travels after leaving the tube is usually longer. Note that the **Insertion Distance** must be set sufficiently long to get past the calibration standard and into the tube. If the insertion distance is too short, the Probot detects the end of the calibration tube before entering the tube and begins recording prematurely. Some fine tuning of these settings is normal.

Figure 2–59 Air-to-air sequence with Use inline calibration selected



Encoder Sequence

Encoder sequences use the position of the probe as measured by one of the Probot's built-in encoders to control the motion of the probe. Encoder sequences are the best choice in high-speed applications where minimizing the wear and tear of the probe is also an objective. Encoder sequences are best suited to applications where the extent of the examination is constant from tube to tube.

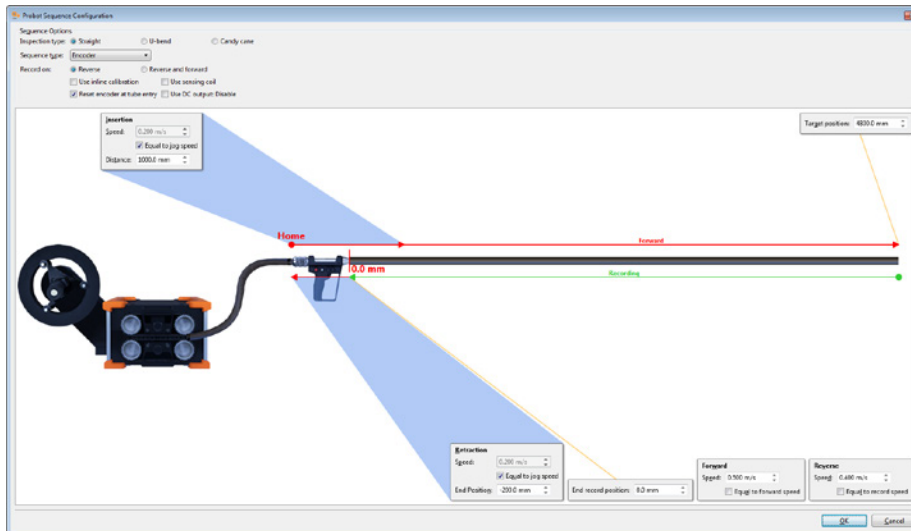
Basic Encoder Sequence

Encoder sequences use position references to configure motion within the sequence. Position is always measured from zero. The Home and zero positions are usually not the same. This is a different concept from air-to-air sequences where offsets and retraction are both based on distances as measured from the detected tube end. The **Target position** appearing below is the position to where the probe is pushed before halting and reversing direction. The **Retraction End Position** is the position to where the probe is retracted at the end of the sequence. It is normally a negative number indicating that the

Retraction End Position is somewhere behind the end of the tube. Some fine tuning of **Target position** and **Retraction End Position** is normal to achieve optimal performance.

In the **Probot Controller** dialog box, **Set Home** configures the encoder to the **Retraction End Position** specified below. Similarly, **Go Home** in the **Probot Controller** dialog box moves the probe to the **Retraction End Position** specified below.

Figure 2–60 Encoder sequence



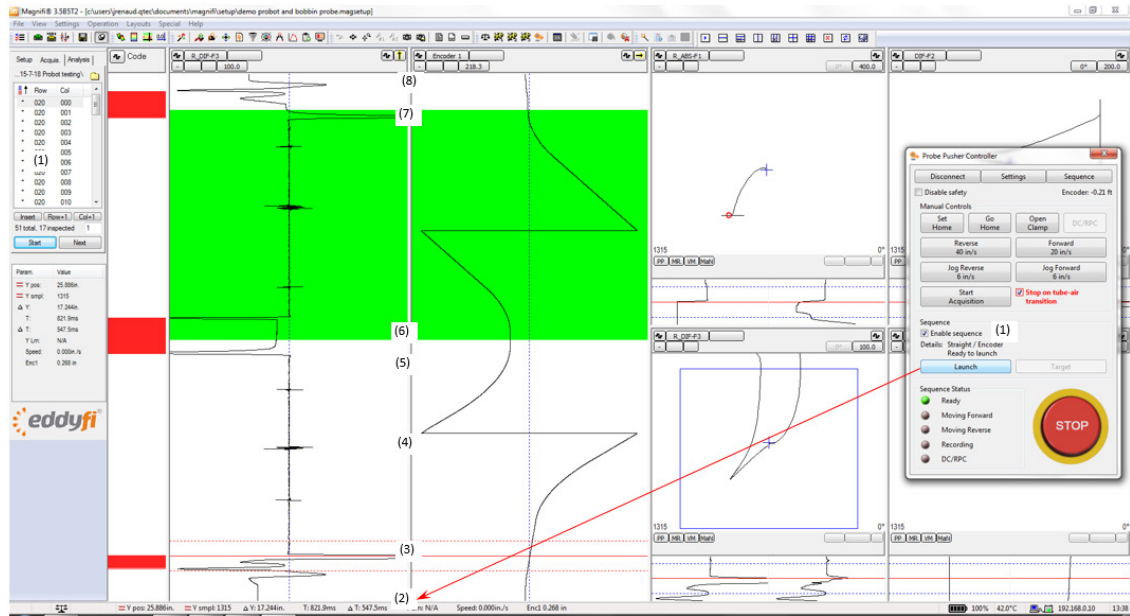
Similar to earlier sequences, a number of options can be configured in the **Probot Sequence Configuration** dialog box. You can choose to record only in reverse or in the forward and reverse directions. You can also choose whether to use an inline calibration standard and/or sensing coil as part of the sequence (see below for details). Finally, you can choose not to reset the encoder at the entry to the tube end and/or to enable a DC output for RPC or saturation coil purposes. We recommend that you select **Reset encoder at tube entry** in most applications.

In an encoder sequence:

1. Magnifi is in Acquisition mode, **Enable sequence** is selected in the **Probot Controller** dialog box and the correct encode (zone/row/tube or column) is selected.
2. In the **Probot Controller** dialog box, click **Launch**.
3. The probe advances the insertion distance at the insertion speed.
4. After the insertion distance, the probe begins moving forward at the **Forward** speed until it encounters the **Target position**.
5. At the **Target position**, the forward motion of the probe halts.
6. Recording automatically begins and the probe moves in the reverse direction at the recording speed.
7. Recording continues until the probe arrives at the **End record position**.
8. The probe is automatically retracted (at the retraction speed) to the **Retraction End Position** at which time the sequence is complete.

Once the sequence is launched, the operator has two options: i) click/press **STOP** to halt motion and abort the sequence or ii) click **Target** in the **Probot Controller** dialog box to simulate the arrival of the probe at the target position. Clicking **Target** stops forward motion of the probe, adds the offset (if applicable), begins recording and moving in reverse, and completes the sequence as normal. The **Target** button is useful where multiple different examination extents are required on a tube-by-tube basis. Note the curved encoder traces in the following figure, indicating the acceleration and the deceleration of the probe. We recommend using acceleration and deceleration to increase probe life. We strongly recommend using them whenever using high speeds.

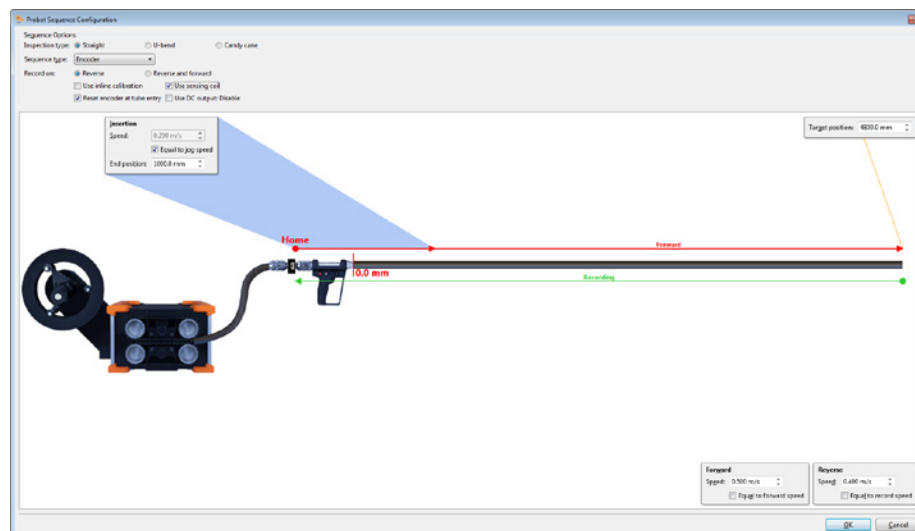
Figure 2–61 Eddy current and encoder signals from an Encoder sequence



Encoder Sequence with Use Sensing Coil

Configuring an encoder sequence with **Use sensing coil** appears below. The encoder sequence configured in this manner uses no **Retraction position** and recording continues to the sensing coil. It is important to note that **Set Home** in the **Probot Controller** dialog box is replaced with **Set Zero** (because the exact location of the sensing coil does not need to be known). Set the zero position by placing the probe at the entry of the tube and clicking **Set Zero** in the **Probot Controller** dialog box. This is usually only necessary when initially setting up the system, as the **Reset encoder at tube entry** feature takes care of establishing the zero position once the first sequence is in progress. Clicking **Go Home** in the **Probot Controller** dialog box sends the probe in reverse until it encounters the sensing coil.

Figure 2–62 Encoder sequence with Use sensing coil selected

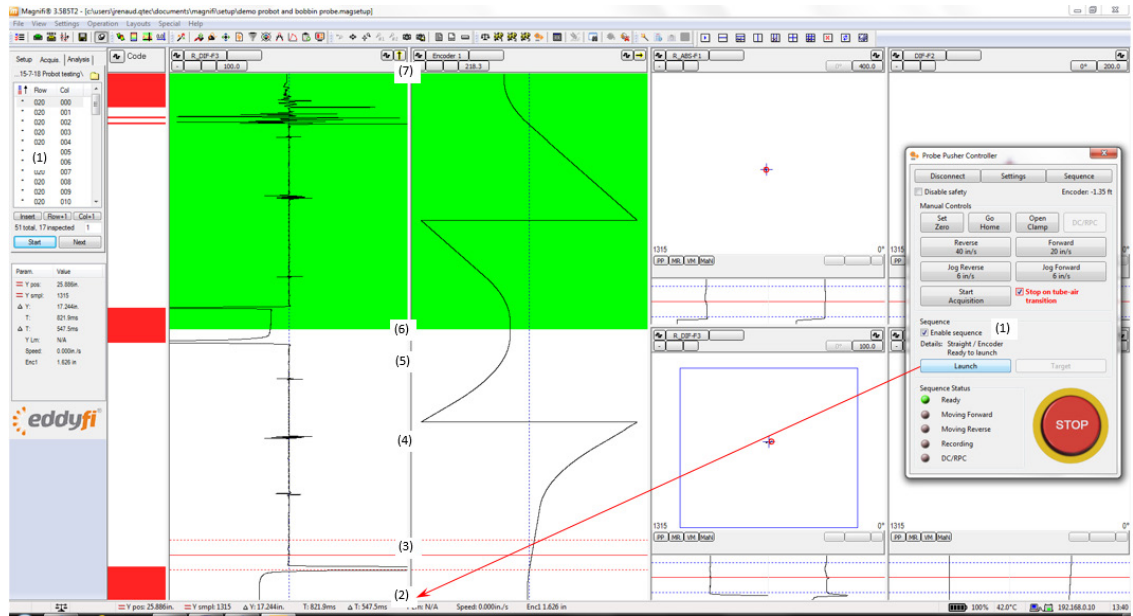


In an encoder sequence with sensing coil enabled:

1. Magnifi is in Acquisition mode, **Enable sequence** is selected in the **Probot Controller** dialog box and the correct encode (zone/row/tube or column) is selected.
2. Click **Launch** in the **Probot Controller** dialog box.
3. The probe advances the insertion distance at the insertion speed.
4. After the insertion distance, the probe begins moving forward at the **Forward** speed until it encounters the **Target position**.

5. At the **Target position**, forward motion of the probe halts.
6. Recording begins automatically and the probe moves in the reverse direction at the recording speed.
7. Recording continues until the probe arrives at the sensing coil at which time both recording and motion halt.

Figure 2–63 Eddy current and encoder signals from an Encoder sequence with the sensing coil enabled

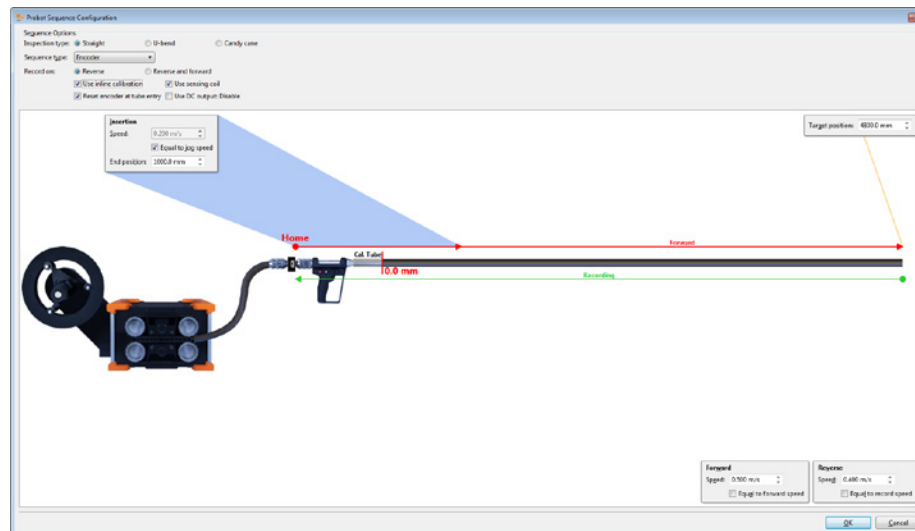


Once the sequence is launched, the operator has two options: i) click/press **STOP** to halt motion and abort the sequence or ii) click **Target** in the **Probot Controller** dialog box to simulate the arrival of the probe at the target position. Clicking **Target** stops the forward motion of the probe, adds the offset (if applicable), begins recording and moving in reverse, and completes the sequence as normal. **Target** is a useful tool where multiple, different examination extents are required on a tube-by-tube basis. Note the curved encoder traces in the figure above indicating the acceleration and the deceleration of the probe. Use of acceleration and deceleration (configured as illustrated in Figure 30) is recommended as a means of improving probe life and is strongly recommended whenever high speeds are used.

Encoder Sequence with Use Inline Calibration and Use Sensing Coil Enabled

Configuring an encoder sequence with **Use inline calibration** and **Use sensing coil** appears below. Note that with the encoder sequence configured in this manner, no **Retraction** position is specified and recording continues to the sensing coil. It is important to note that **Set Home** in the **Probot Controller** dialog box is replaced with **Set Zero** (since the exact location of the sensing coil does not need to be known). Set the zero position by placing the probe at the entry to the tube and pressing the Set Zero button on the Probot Controller window. This is usually only required when initially setting the system up as the **Reset encoder at tube entry** feature will take care of establishing the zero position once the first sequence is in progress. Also note that clicking **Go Home** in the **Probot Controller** dialog box sends the probe in reverse until it encounters the sensing coil. This sequence is effectively identical to the encoder with sensing coil sequence with the exception that the illustration changes to reflect the presence of an inline calibration standard.

Figure 2–64 Encoder sequence with Use sensing coil and Use inline coil selected

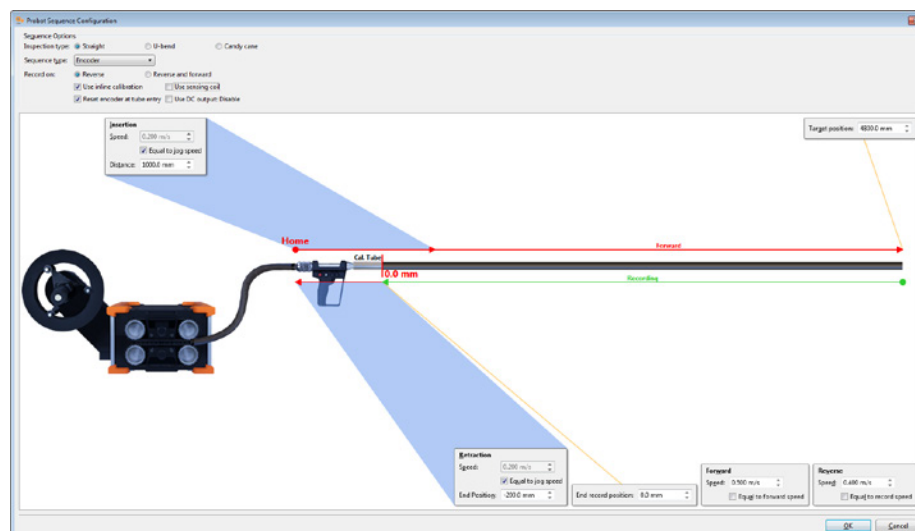


Encoder Sequence with Use Inline Calibration Enabled and Use Sensing Coil Disabled

The **Target position** illustrated below is the position to where the probe is pushed before halting and reversing direction. The **End record position** is the position to which recording continues. It is normally a negative number and should be long enough to allow recording to include the complete length of the inline calibration standard. The **Retraction End Position** is the one to which the probe is retracted at the end of the sequence. It is normally a negative number at some point behind the end of the inline calibration tube. Some fine tuning of **Target position**, **End record position**, and **Retraction End Position** is normal to achieve optimal performance.

In the **Probot Controller** dialog box, **Set Home** sets the encoder equal to **Retraction End Position** specified in the figure below. Similarly, **Go Home** in the **Probot Controller** dialog box moves the probe to the **Retraction End Position** specified here.

Figure 2–65 Encoder sequence with Use inline calibration selected and Use sensing coil disabled



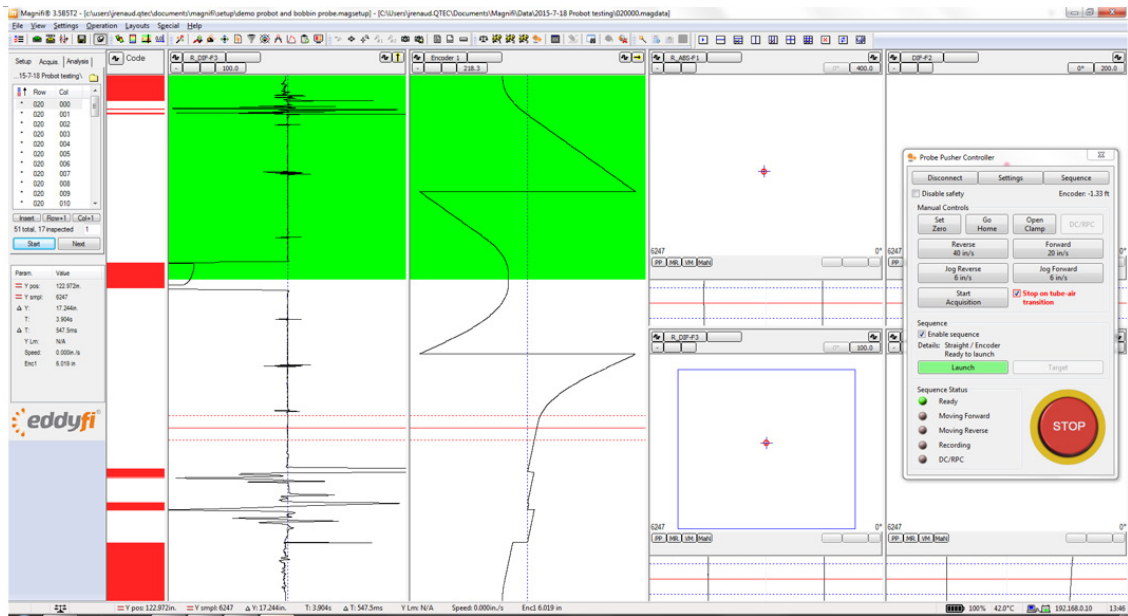
In an encoder sequence with an inline calibration standard and no sensing coil enabled:

1. Magnifi is in Acquisition mode, **Enable sequence** is selected in the **Probot Controller** dialog box and the correct encode (zone/row/tube or column) is selected.
2. Click **Launch** in the **Probot Controller** dialog box.
3. The probe advances the insertion distance at the insertion speed.
4. After the insertion distance, the probe begins moving forward at the **Forward** speed until it encounters the **Target position**.

5. At the **Target position**, forward motion of the probe halts.
6. Recording begins automatically and the probe moves in reverse at the recording speed.
7. Recording continues until the probe arrives at the **End record position**.
8. The probe is automatically retracted (at the retraction speed) to the **Retraction End Position** at which time the sequence is complete.

Once the sequence is launched the operator has two options: i) click/press **STOP** to halt motion and abort the sequence or ii) click **Target** in the **Probot Controller** dialog box to simulate the arrival of the probe at the target position. Clicking **Target** stops the forward motion of the probe, adds the offset (if applicable), begins recording and moving in reverse, and completes the sequence as normal. **Target** is a useful tool where multiple, different examination extents are required on a tube-by-tube basis. Note the curved encoder traces in the following figure indicating the acceleration and the deceleration of the probe. Using acceleration and deceleration is recommended as a means of prolonging probe life and is strongly recommended whenever high speeds are used.

Figure 2–66 EC and encoder signals from encoder sequence: Use inline calibration enabled, Use sensing coil disabled



Chapter 3

Connector References

SENSING COIL SEQUENCE Connector

Table 3–1 SENSING COIL SEQUENCE connector specifications

Specification	Description
Number of contacts	6
Part numbers	ITT Cannon KPT07A10-6SA206 Eddyfi NDT, Inc. MACN0189
Suggested cable connector	Amphenol PT06E-10-6P(470) Eddyfi NDT, Inc. MACN0208

Figure 3–1 SENSING COIL SEQUENCE connector

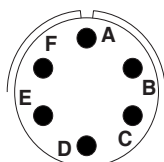


Table 3–2 SENSING COIL SEQUENCE connector pinout

Pin	I/O	Signal	Description
A	Supply Output	+24V	+24V DC supply output, maximum 250mA
B	Input	SENSCOIL_1	Sensing coil signal (Vin-LO < 1.35V DC, Vin-HI > 3.65V DC, +24V DC max.)
C	–	NC	Unconnected — Reserved
D	–	GND	Ground
E	–	NC	Unconnected — Reserved
F	–	NC	Unconnected — Reserved

SENSING COIL SAFETY Connector

Table 3–3 SENSING COIL SAFETY connector specifications

Specification	Description
Number of contacts	6
Part numbers	ITT Cannon KPT07A10-6SA206 Eddyfi NDT, Inc. MACN0189
Suggested cable connector	Amphenol PT06E-10-6P(470) Eddyfi NDT, Inc. MACN0208

Figure 3–2 SENSING COIL SAFETY connector

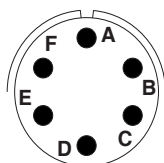


Table 3–4 SENSING COIL SAFETY connector pinout

Pin	I/O	Signal	Description
A	Supply Output	+24V	+24V DC supply output, maximum 250mA
B	Input	SENSCOIL_2	Sensing coil signal (Vin-LO < 1.35V DC, Vin-HI > 3.65V DC, +24V DC max.)
C	–	NC	Unconnected — Reserved
D	–	GND	Ground
E	–	NC	Unconnected — Reserved
F	–	NC	Unconnected — Reserved

PROBE GUN Connector

Table 3–5 PROBE GUN connector specifications

Specification	Description
Number of contacts	26
Part numbers	ITT Cannon KPT07E16-26SA206 Eddyfi NDT, Inc. MACN0190
Suggested cable connector	ITT Cannon KPT06F16-26PA206 Eddyfi NDT, Inc. MACN0245

Figure 3–3 PROBE GUN connector

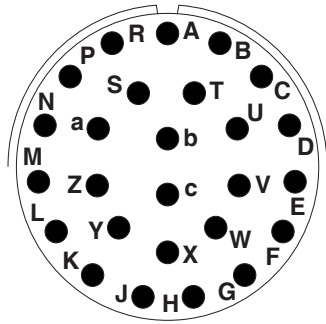


Table 3–6 PROBE GUN connector pinout

Pin	I/O	Signal	Description
A	–	NC	Unconnected — Reserved
B	–	NC	Unconnected — Reserved
C	Supply Output	+24V	+24Vdc supply output, maximum 150 mA
D	–	GND	Ground
E	Input	GUN_KILLSWITCH	Emergency stop button (Vin-LO < 1.35V DC, Vin-HI > 3.65V DC, +24V DC max.)
F	–	NC	Unconnected — Reserved
G	–	NC	Unconnected — Reserved
H	–	NC	Unconnected — Reserved
J	–	NC	Unconnected — Reserved
K	–	NC	Unconnected — Reserved
L	TTL Input	GUN_BUTTON5	User-defined trigger signal input to control the automatic acquisition sequence. Connected to the ENCODER connector (pin R).
M	Relay Contact	GUN_LED	Probot remote control LED signal.
N	–	GND_CHASSIS	Chassis ground
P	–	NC	Unconnected — Reserved
R	–	NC	Unconnected — Reserved
S	TTL Input	GUN_BUTTON1	User-defined trigger signal input to control the automatic acquisition sequence. Connected to the ENCODER connector (pin E).
T	TTL Input	GUN_BUTTON3	User-defined button 3 signal input to control the automatic acquisition sequence. Connected to the ENCODER connector (pin F).
U	TTL Input	GUN_BUTTON2	User-defined button 2 signal input to control the automatic acquisition sequence. Connected to the ENCODER connector (pin G).
V	TTL Input	GUN_BUTTON4	User-defined button 4 signal input to control the automatic acquisition sequence. Connected to the ENCODER connector (pin T).
W	–	+5V	+5V DC supply output, maximum 250 mA
X	–	NC	Unconnected — Reserved
Y	–	NC	Unconnected — Reserved
Z	–	NC	Unconnected — Reserved
a	–	NC	Unconnected — Reserved
b	–	NC	Unconnected — Reserved
c	–	NC	Unconnected — Reserved

Network ports

Table 3–7 Network port specifications

Specification	Description
Connector type	RJ45, female
Part numbers	PEI Genesis, Amphenol RJF22B00SCC Eddyfi NDT, Inc. MACN4016

Figure 3–4 Network port

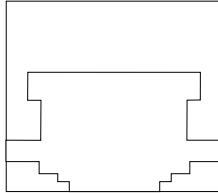


Table 3–8 Network port pinout

Pin	I/O	Signal	Description
1	Output	TX+	Data transmission
2	Output	TX-	Data transmission
3	Input	RX+	Data reception
4	–	NC	No connection
5	–	NC	No connection
6	Input	RX-	Data reception
7	–	NC	No connection
8	–	NC	No connection

Important

Probot must be connected through a shielded category 5e Ethernet cable or better.

ENCODER Connector

Table 3–9 ENCODER connector specifications

Specification	Description
Number of contacts	18
Part numbers	ITT Cannon KPT07A14-18SA206 Eddyfi NDT, Inc. MACN0216
Suggested cable connector	SOURIAU 851-06JC1418P54FC Eddyfi NDT, Inc. MACN0074

Figure 3–5 ENCODER connector

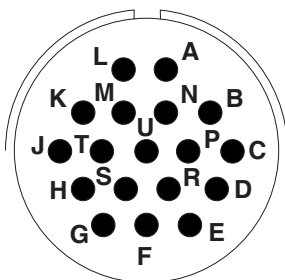


Table 3–10 ENCODER connector pinout

Pin	I/O	Signal	Description
A	TTL Output	ϕ B1	Encoder output, phase B, axis 1

Pin	I/O	Signal	Description
B	–	NC	Unconnected — Reserved
C	–	NC	Unconnected — Reserved
D	–	GND	Ground
E	TTL Output	Output1	User-defined trigger signal input to control the automatic acquisition sequence. Connected to the PROBE GUN connector (pin S).
F	TTL Output	Output3	User-defined button 3 signal input to control the automatic acquisition sequence. Connected to the PROBE GUN connector (pin T).
G	TTL Output	Output2	User-defined button 2 signal input to control the automatic acquisition sequence. Connected to the PROBE GUN connector (pin U).
H	Input	CTRLA1	Motor control signal (Vin-LO < 2.3V DC, Vin-HI > 2.45V DC)
J	Input	CTRLR2	Motor control signal (Vin-LO < 2.3V DC, Vin-HI > 2.45V DC)
K	Input	CTRLR3	Motor control signal (Vin-LO < 2.3V DC, Vin-HI > 2.45V DC)
L	Input	CTRLR1	Probot remote control LED signal
M	–	NC	Unconnected — Reserved
N	–	NC	Unconnected — Reserved
P	–	NC	Unconnected — Reserved
R	TTL Output	Output5	User-defined button 4 signal input to control the automatic acquisition sequence. Connected to the PROBE GUN connector (pin V).
S	–	NC	Unconnected — Reserved
T	TTL Output	Output4	User-defined trigger signal input to control the automatic acquisition sequence. Connected to the PROBE GUN connector (pin L).
U	TTL Output	φ A1	Encoder output, phase A, axis 1

E-STOP Connector

Table 3–11 E-STOP connector specifications

Specification	Description
Number of contacts	8
Part numbers	Amphenol PT07A12-8S-027 Eddyfi NDT, Inc. MACN0263
Suggested cable connector	ITT Cannon KPT06F12-8PA206 Eddyfi NDT, Inc. MACN0268

Figure 3–6 E-STOP connector

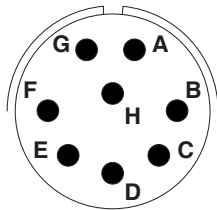


Table 3–12 E-STOP connector pinout

Pin	I/O	Signal	Description
A	Input	REM_ESTOP	Signal to detect the remote emergency stop switch position.
B	Supply Output	+24V	24V DC supply output, maximum 150 mA
C	Input	CABLE_DETECT	24V signal used to detect the presence of a remote emergency stop.
D	–	NC	Unconnected — Reserved
E	–	GND CHASSIS	Chassis ground
F	–	NC	Unconnected
G	–	NC	Unconnected
H	–	NC	Unconnected

Take-Up Reel Arm Connector

The take-up reel arm connector is specific and designed by Eddyfi. For details about this connector, contact us directly at info@eddyfi.com.

Chapter 4

Specifications

The following are the specifications of the Probot™.

General Specifications

Table 4–1 Probot general specifications

Specification	Value
Weight	Drive without belts or protective covers: 22.3 kg (49 lb) Drive: 23.6 kg (52 lb) Take-up reel: 6.4 kg (14 lb)
Dimensions (W×H×D)	Drive: 307×277×554 mm (12.1×10.9×21.8 in) Drive and take-up reel: 361×521×940 mm (14.2×20.5×37.0 in)
Operating temperature range	0–45 °C (32–113 °F)
IP rating	Designed for IP65
Speed range	0–2.5 m/s (0–100 in/s) Wide range of speeds to accommodate various inspection techniques
Push force	Peak: 445 N (100 lbf) Continuous: 245 N (55 lbf)
Supported push tube sizes	9.53 mm (3/8 in) 7.94 mm (5/16 in) 6.35 mm (1/4 in) — optional belt required
Supported probe diameters	7–23 mm (0.276–0.906 in)
Spool outer diameter	406.4 mm (16 in)
Spool capacity	33.5 m (9.53 mm tubing) [110 ft (3/8 in tubing)]
Encoder resolution	18.796 counts/mm (477.406 counts/in)
AC input voltage	110–120V / 220–240V 50–60 Hz

Chapter 5

Quick Reference

Magnifi Configuration

Table 5–1 Initial Magnifi® Setup

Item	Input	Feature	Setting	See	Comments
ET Configuration	ET setup	Load or create	N/A		Load or create ET/ECA setup
Encoders	Encoder 1	Check box	Selected	page 26	
		Type list	Quadrature		
		Unit list	mm or inches		
		Resolution text box	18.796 counts/mm or 477.406 counts/in		
		Preset External list	None		
		Preset Action On Start	None		
		Preset Value	0.000		
	Encoder 2	Check box	Clear		Not required for Probot
	Encoder 3	Check box	Clear		Not required for Probot
Digital inputs	1 to 5	Function list	Remote control		
	1 to 5	Logic list	Active low		
Instrument I/O Digital Inputs	Input 1	Action list	Probot sequence launch/ready	page 27	
		Activation list	Link to toggle action		
	Input 2	Action list	Probot jog reverse		
		Activation list	Link to toggle action		
	Input 3	Action list	Probot jog forward		
		Activation list	Link to toggle action		
	Input 4	Action list	Select previous file		
		Activation list	On press		
	Input 5	Action list	Select next file		
		Activation list	On press		
Instrument I/O Outputs	Relay 1	Enabling source list	Launch sequence ready		
	Relay 2	Enabling source list	None		Not required for Probot
	Relay 3	Enabling source list	None		Not required for Probot
	Alarm	Enabling source list	Alarm zone detected		
		Min. duration	50		
Settings Hardware Alarm	Hardware Alarm group	Channel list	Differential channel (recommended)	page 29	
		Min. data points text box	5		
		Zone type list	Rectangular		
		When list	Leaving Zone		
	Detection Zone	Center H	0 volts		
		Center V	0 volts		
		Width	10 volts		
		Height	8 volts		
Preferences	Display tab	Detection zone check box	Selected		Fine tune, as necessary
Save Magnifi setup					

Table 5–2 Tested Magnifi Setup

Item	Input	Feature	Setting	Comments
ET Configuration	ET setup	Load	N/A	Load eddy current setup. Refer to Magnifi documentation for details.
Save Magnifi setup				

Physical Connections

Table 5-3 Physical Probot™ Connections

Item	Connect	To	Through	See	Comments	
LAN	PC or laptop	Probot	Cat 5 cable or equivalent	page 15	Alternatively may be connected to a suitable switch or hub.	
	Ectane®2	Probot	Cat 5 cable or equivalent			
Power	PC or laptop	110–120V / 220–240V, 50–60Hz	Power cord		Optional with laptop	
	Ectane 2	110–120V / 220–240V, 50–60Hz	Power cord			Optional with Ectane 2
	Probot	110–120V / 220–240V, 50–60Hz	Power cord			
Assembly	Take-up reel	Probot	Latch mechanism		Optional when take-up reel is not used.	
	Probe	Probe spool	Spooling			
	Probe spool	Take-up reel	Release mechanism			
	Slip ring	Take-up reel	Bayonet mount			
Assembly	Probe	Slip ring	Slip ring-to-probe connector		May require adapter cable	
	Slip ring	Data/extension cable	Slip ring-to-probe connector			
	Extension cable	Ectane 2	Slip ring-to-Ectane 2 connector			
	Probe	Probot	Quick latch & belt clamp			
	Conduit	Probot	Conduit connector			
	Safety sensing coil	Conduit	Conduit connectors			Optional
	Sequence sensing coil	Conduit	Conduit connectors			
	Inline calibration standard	Conduit and/or probe gun	Conduit connectors			
Remote control	Probe gun	Conduit	Conduit connectors		If used	
	Ectane 2	ENCODER connector	Probot encoder cable		Required	
	Probe gun	PROBE GUN connector	Probot remote control cable			
	Safety sensing coil	SENSING COIL SAFETY connector	Probot sensing coil cable			
	Sequence sensing coil	SENSING COIL SEQUENCE connector	Probot sensing coil cable			

Probot Configuration

Table 5–4 Initial Probot configuration

Item	Group	Feature	Setting	See	Comments
Probot Controller	N/A	Disable safety check box	Clear	page 34	Use caution if operating with safety disabled
	Manual Controls	Stop on tube-air transition check box	Selected		
	Sequence	Enable sequence check box	Selected		
	N/A	Stop button	Not depressed		Depress stop button to lock Probot drive motion
Probot Settings	Speed	Forward	Inspection technique dependent	page 36	
		Reverse	Inspection technique dependent		
		Jog	Inspection technique dependent		
		Record	Inspection technique dependent		
		Acceleration check box	0.5 s		Default value shown
	Sequence Launch	Station operator or Probe gun operator	Select as necessary		
		Disable probe gun lockout check box	Select or clear as necessary		
	Sequence	Ignore alarm distance check box	Select or clear as necessary		Recommendation: select
		Ignore alarm distance text box	Inspection technique dependent		Typical minimum 25.4 mm (1 in)
		Encoder list	Probe push tube		Belt encoder can be less accurate
	Safety	Drive motion duration check box	Selected		Recommendation: select
		Max text box	Inspection technique dependent		
		Encoder limit check box	Selected		Recommendation: select
		Upper text box	Inspection technique dependent		
		Lower text box	Inspection technique dependent		Negative number shorter than distance to drive
	Others	Sensor/Mechanical limit check box	Selected		Recommendation: select
		Probe push tube list	Inspection technique dependent		Select push tube size nearest to used
		Clamping force text box	Inspection technique dependent		Recommendation: lowest force to avoid slippage
		Current limit text box	Inspection technique dependent		
Orientation list		Automatic	Select if automatic detection fails		
Enable take-up reel check box		Selected	Clear when not using take-up reel		

Save Magnifi setup

Table 5–5 Existing tested Probot configuration

Item	Input	Setting	Value	Comments
Probot settings	Magnifi setup	Load	N/A	Load a Magnifi setup to load the associated Probot settings. Refer to Magnifi documentation for details.

Save Magnifi setup

Sequence Configuration

Table 5–6 Initial sequence configuration

Item	Feature	Setting	See	Comments
Probot Sequence Configuration	Inspection type option	Straight, U-bend, Candy cane	page 42	Select type according to setup
	Sequence type list	Encoder, Air-to-air, Manual air-to-air, Manual		Select most appropriate type for your inspection. Encoder recommended for high-speed applications
	Record on option	Reverse, Reverse and forward		Select appropriate recording method
	Use inline calibration check box	Select or clear as necessary		
	Use sensing coil check box	Select or clear as necessary		
	Reset encoder at tube entry check box	Select or clear as necessary		Recommended: select
	US DC output: Disable check box	Select or clear as necessary		

Save Magnifi setup

Table 5–7 Manual air-to-air sequence configuration

Item	Feature	Setting	See	Comments
Insertion	Equal to jog speed check box	Select or clear as necessary	page 43	Select to match reverse speed to jog speed
	Speed text box	Specify value		Specify if not equal to jog speed
	Distance text box	Specify value		Specify insertion distance here. Measured from home to end of insertion phase
N/A	Offset text box	Specify value		Specify additional distance beyond end of tube which you want probe to go. Measured from point where probe is stopped by tube-air alarm
Reverse	Equal to record speed check box	Select or clear as necessary		Select to match reverse speed to recording speed
	Speed text box	Specify value		Specify reverse speed if not equal to record speed
Forward	Equal to forward speed check box	Select or clear as necessary		Select to match reverse speed to forward speed
	Speed text box	Specify value	Specify reverse speed if not equal to forward speed	

Save Magnifi setup

Table 5–8 Air-to-air sequence configuration

Item	Feature	Setting	See	Comments
Insertion	Equal to jog speed check box	Select or clear as necessary	page 45	Select to match reverse speed to jog speed
	Speed text box	Specify value		Specify reverse speed here if not equal to jog speed
	Distance text box	Specify value		Specify insertion distance. Measured from home to end of insertion phase
N/A	Offset text box	Specify value		Specify additional distance beyond end of tube to which you want the probe to go. Measured from point where probe is stopped by tube-air alarm
Reverse	Equal to record speed check box	Select or clear as necessary		Select to match reverse speed to record speed
	Speed text box	Specify value		Specify reverse speed if not equal to record speed
Forward	Equal to forward speed check box	Select or clear as necessary		Select to match reverse speed to forward speed
	Speed text box	Specify value		Specify reverse speed if not equal to forward speed
Retraction	Equal to jog speed check box	Select or clear as necessary		Select to match retraction speed to jog speed
	Speed text box	Specify value		Specify the retraction speed if not equal to jog speed
	End distance text box	Specify value		Specify retraction distance. Measured from point where probe is stopped by tube-air alarm
Save Magnifi setup				

Table 5–9 Encoder sequence configuration

Item	Feature	Setting	See	Comments
Insertion	Equal to jog speed check box	Select or clear as necessary	page 47	Select to match reverse speed to jog speed
	Speed text box	Specify value		Specify reverse speed if not equal to jog speed
	Distance text box	Specify value		Specify insertion distance
N/A	Target position text box	Specify value		Specify target position
Reverse	Equal to record speed check box	Select or clear as necessary		Specify reverse speed if not equal to record speed
	Speed text box	Specify value		Select to match reverse speed to record speed
Forward	Equal to forward speed check box	Select or clear as necessary		Select to match reverse speed to forward speed
	Speed text box	Specify value		Specify reverse speed if not equal to forward speed
N/A	End record position check box	Select or clear as necessary		Specify record distance. Measured from point where probe is stopped by tube-air alarm
Retraction	Equal to jog speed check box	Select or clear as necessary		Select to match retraction speed to jog speed
	Speed text box	Specify value		Enter retraction speed if not equal to jog speed
	End position text box	Specify value		Specify retraction distance. Measured from point where probe is stopped by tube-air alarm
Save Magnifi setup				

Chapter 6

Maintenance

Replacing the Drive Belts

To change or replace the drive belts of the Probot™, proceed as follows.

Note

Replacement drive belts are sold separately. Contact your Eddyfi representative for details.



Warning

Before proceeding, make sure that the Probot is disconnected from its external power source. Ignoring this warning could result in serious injury.

1. Place the Probot on its side on a flat, stable surface as illustrated here.

Figure 6-1 Placing the Probot on its side



2. With a 25.4 mm (1 in) wrench or socket, loosen the bolts securing the drive belt protective covers, and then remove them manually.

Note

These bolts may only be finger tight. There are no sensors to detect when guards are removed. Only trained personnel should perform this operation.

Figure 6-2 Unscrewing drive belt protective cover bolt

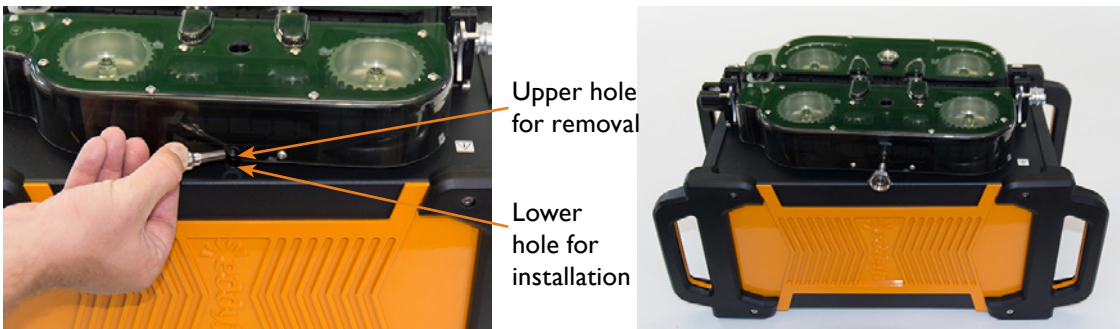


3. Align the first bolt with the threaded hole above the belt, and then screw it in. This has the effect of distancing the protective cover from the drive belts and releasing belt tension.

Important

There are **two** threaded holes. Insert the bolt in the **upper** threaded hole.

Figure 6-3 Raising drive belt protective cover



- Once the bolt is fully inserted, holding the drive belt protective cover by the bolt, and then set it aside.

Figure 6-4 Removing drive belt protective cover



- Repeat steps 3 to 4 to remove the second drive belt protective cover.

Figure 6-5 Probot without drive belt protective covers



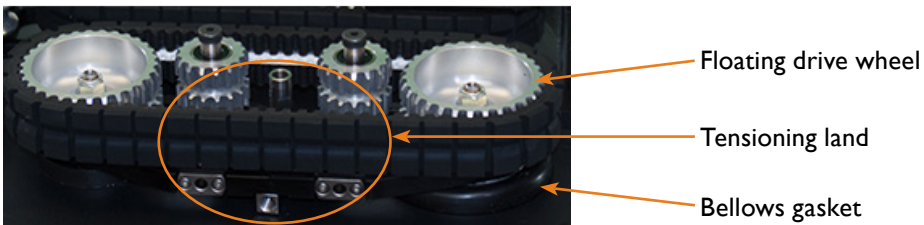
- Locate the floating drive wheels.

Note

Each of the two wheel sets has one floating drive wheel and one fixed drive wheel. The floating drive wheel is the one with a bellows gasket (flexible gasket flange).

- Locate the tensioning land.

Figure 6-6 Floating drive wheel and tensioning land



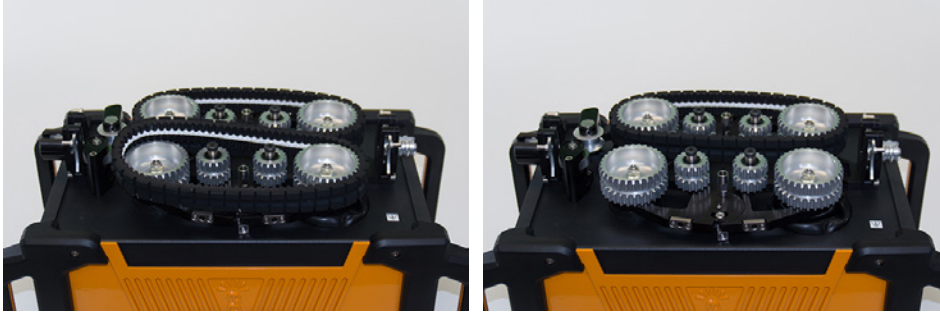
- Without using tools, push the floating drive wheel to the left and slightly outward while prying the tensioning land outward.

Figure 6-7 Loosening the drive belts



9. Remove the belt.

Figure 6–8 Removing the drive belt



10. Orient the Probot so that the second floating drive wheel is to your right.
11. Remove the second belt.

Figure 6–9 Removing the second drive belt



12. Locate the first replacement belt.
13. Mesh the replacement belt on the fixed drive wheel and then on the floating drive wheel. Make sure that the belt is properly meshed on the wheels.
14. Without using tools, push the floating drive wheel to the right and slightly inward while prying the tensioning land inward.
15. Orient the Probot so that the second floating drive wheel is to your right.
16. Repeat steps 12 to 14 for the second replacement belt.
17. Locate the drive belt protective covers and remove the bolts from them.
18. Align the protective cover pins with the two holes intended to receive them on the tensioning land and then push the drive belt protective cover over the drive belt.

You can push in the protective covers two different ways:

- Align the cover pins with the pin holes. Using both hands, place your thumbs on the idler wheel (small pulley) and your remaining fingers on top of the protective cover and squeeze both components together. You should only need a small amount of force should to stretch the drive belt.
- Align the cover pins with the pin holes. Remove the bolt from the protective cover. Insert the bolt into the lower hole illustrated in Figure 6–3. Screw the bolt until it is finger tight. Remove the bolt.

Note

Make sure that the pins are fully inserted.

19. Repeat step 18 for the second protective cover.

20. Using the drive belt protective cover bolts, secure the protective covers back in place.

Figure 6–10 Securing drive belt protective covers with bolts



Cleaning the Probot

By design, the Probot only requires minimal maintenance. Only a regular inspection of the instrument is recommended. Eddyfi strongly recommends a regular factory-performed preventive maintenance by an officially qualified Eddyfi technician.

The Probot's external surfaces can be cleaned as necessary.

1. Make sure that the instrument is disconnected from its power source.
2. Make sure that the connectors are covered by their protective caps.
3. To bring the instrument back to its original finish, clean it with a soft cloth.

Warning

Do not clean the instrument with a spray or water jet. Doing so may damage the Probot.

To remove stubborn stains, use a cloth moistened with soft, soapy solution. Do not use abrasive products or powerful solvents as they can damage the finish. Wait until the instrument is completely dry before connecting the power cord and cables.





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