FLYABILITY

ELIOS 3

UT PAYLOAD

User Manual

VERSION 1.2

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1. Before starting

1.1. Intended use

“UT” stands for Ultrasonic Testing, an NDT technique used to inspect materials, detect flaws, or measure thickness using ultrasound without damaging the object being tested.

The UT Payload is a module designed in collaboration between Cygnus Instruments and Flyability. It is mounted on the Elios 3 drone and used to measure the thickness of industrial structures and materials.

When using the UT Payload, you will simultaneously see a digital thickness reading and an A-scan view of the ultrasonic waveform. The A-Scan gives you information to verify the thickness measurement, which is displayed in metric (mm) or imperial (inch) units. Thickness measurements and A-scans can be recorded and transferred to a computer for report generation and analysis by a skilled operator (refer to the chapter “Data interpretation with Inspector”).

When purchasing the Full Package, the UT Payload operates with a range of UT Probes (dual-element transducers). The user selects the right UT Probe to suit the material, surface conditions, and thickness range to be measured and then (before each use) calibrates the UT Payload to a known thickness or velocity of sound of the material under test.

See the Available & Required Training sections and the Correct Use section in the Disclaimers section. Please carefully read the entire User Manual before mounting and using your UT Payload. **This user manual is subject to change without notice.**

The UT Payload is not for use in or re-sale to any country embargoed by the United Kingdom.

1.2. Unboxing the Payload

When you have received your new UT Payload, make sure that the package is not damaged externally. If any substantial damage can be seen on the package, please contact our customer support team (support@flyability.com) before opening it. Although it is protected, do not use something sharp that could damage the Payload while opening the package.

You should find the following items inside your UT package:

	Light Configuration	Full Configuration	Available for purchase as a spare part
Item	#	#	
Core Module			

Flyability/Cygnus UT Gauge	1	1	✘
4-Step Steel Test Block (Metric)	1	1	✘
Quick Start Guide	1	1	✘
Transport Case	1	1	✘
15mm Steel Probe Gain Compensation Block	1	1	✘
Probes			
2MHz Probe	/	1	✔
2MHz Probe Conformity Certificate	/	1	✔
5MHz Probe	1	1	✔
5MHz Probe Conformity Certificate	1	1	✔
7.5MHz Probe	/	1	✔
7.5MHz Probe Conformity Certificate	/	1	✔
Cleaning Module			
Cleaning Tool w/ Brass Brush	/	1	✔
Spare Brass Brushes	/	5	✔
Replacement Cup Assembly	/	/	✔
Replacement Cleaning Motor	/	/	✔
Interchangeable Probe Hoods			
Interchangeable Probe Hood (No Magnets)	1	3	✔
Interchangeable Probe Hood (Flat)	1	3	✔
Interchangeable Probe Hood (Pipe)	1	3	✔
2MHz Probe Hood Membrane	/	9	✔
5MHz Probe Hood Membrane	3	9	✔
7.5MHz Probe Hood Membrane	/	9	✔
Drone Attachment Accessories			
Cable Clip for Cage	8	16	✔

Cable Clip for Rotor Arm	2	4	✔
Cable Clip for Arm Stiffener	2	4	✔
Top Cage Adaptor + Clip	1	2	✔
Bottom Cage Adaptor	1	2	✔
Mounting Stud + Screw	4	8	✔
Tube Holder + Screw	2	4	✔
Extension Arm Accessories			
LLM (Load Limiting Mechanism) + Titanium Thumb Screw	1	2	✔
Short Extension Arm 6cm + 2x Titanium Thumb Screws + Clip	2	4	✔
Long Extension Arm 9cm + 2x Titanium Thumb Screws + Clip	1	2	✔
Axial Rotation Module + 2x Titanium Thumb Screws	1	2	✔
Spare Titanium Thumb Screw	2	4	✔
Spare Top Cage/Extension Arm Clip	4	8	✔
Couplant Accessories			
Pump Gel Tube 95mm	5	10	✔
Sensor Gel Tube 800mm	2	4	✔
Syringe Leur Connector + Nut	1	2	✔
Tube Coupler	1	2	✔
Smart Syringe	1	10	✔
Syringe Plunger Tool	1	2	✔
8oz Bottle EchoPure™ Low Viscosity Couplant	1	2	✔

Remove the UT Payload from the package and conduct a first visual inspection of the product. If any items from the list above are missing or seem damaged, please contact us at support@flyability.com.

1.3. Software requirements

Inspector is the software provided by Flyability to read and analyze the data collected by the Elios 3 UT drone. To smoothly download and work on Inspector (version 2024.07 or higher) with the data captured from the UT Payload, we suggest having a Desktop PC that matches the following specs (or above):

Minimum	Recommended
Windows 11 64-bit	Windows 11 64-bit
Intel Core i5-1135 or AMD equivalent	i7-8750H @2.20GHz (6 cores)
16GB RAM	16+ GB RAM
Iris Xe Graphics (Minimum tested)	Nvidia GTX 1050 or AMD RX 560
30 GB Storage	250+ GB Storage

IMPORTANT! DO NOT open a UT flight with previous versions of Inspector! Only use the 2024.07 version or higher. This could otherwise corrupt the UT data in the opened files.

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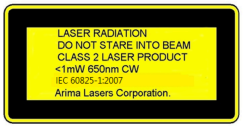
2. Disclaimers

MANDATORY
Read the original instructions

Carefully read the Elios 3 UT Payload user manual and quick start guide before managing the equipment and performing a flight.



Pay attention. The Elios 3 UT Payload is a class 2 laser product. For more info visit: https://www.lasersafetyfacts.com/labels2.html

CE

Flyability SA, EPFL Innovation Park BLDG C, 1015 Lausanne, Switzerland, declares under its sole responsibility that the product described in this user guide conforms with the EMC Directive 2014/30/EU, Low Voltage Directive 2014/35/EU and RoHS Directive 2011/65/EU.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This Class A digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe A est conforme a la norme NMB-003 du Canada.

2.1. Correct Use

Correct use of the UT Payload requires an appropriately trained and qualified UT inspector (see Required Training), identification of the correct equipment (UT Probe, Couplant, and test block) for the specific material, surface conditions, and thickness range to be measured, and correct Calibration.

PLEASE NOTE: the UT Payload offers features that enable an expert operator to manually adjust the A-scan signal displayed, creating options for different measurements. This means that inaccurate measurement data can easily arise if the operator does not understand the manual adjustments or settings or is unqualified or inexperienced in interpreting the displayed information. Incorrect use of the UT Payload, incorrect Calibration, and/or incorrect data interpretation can result in inaccurate measurements and/or readings and possible serious financial loss, damage to components, and facilities, personal injury, and even death.

Neither Flyability, Cygnus Instruments Limited (Cygnus) nor any of its employees, suppliers, or representatives can be held responsible for improper use of the UT Payload, use of third-party probes, and/or inaccurate analysis and interpretation of data.

The following are all of critical importance when using the UT Payload for accurate ultrasonic thickness gauging:

- Required Training
- A complete understanding of ultrasonic wave propagation
- Thorough reading and application of this User Manual
- Proper UT Probe selection
- Good condition and correct zeroing of the UT Probe
- Proper cable length and Couplant selection
- Correct use of the appropriate test blocks for Calibration
- The process of complete and accurate Calibration of the UT Payload
- Correct sound velocity for the material being measured

- Assessment of environmental factors, which may affect the quality of contact between the UT Probe and the surface being tested, such as surface condition, sufficient Couplant, UT Probe stability, and surface contact time
- Proper storage and regular checks of all equipment
- Implementing all fixes and updates or upgrades prior to EACH use

The implementation of these factors is entirely outside the control of Cygnus Instruments and Flyability. It is the sole responsibility of the User to ensure that each and every one of these requirements is met to ensure proper use of the UT Payload.

In the absence of any negligence or other breach of duty by Cygnus, the use of the UT Payload is entirely at your own risk. Any claim relating to any part of the Elios 3 drone system should be referred to Flyability or Flyability Resellers in the first instance.

2.2. Additional risks

Please be aware that an Elios 3 equipped with a UT Payload is more likely to get stuck or crash. To understand the risks associated with performing contact inspections with the UT Payload, it is suggested that you train in easy environments before conducting a UT inspection. To reduce the risks of accidents, we suggest removing the UT Payload for mapping or visual inspection.

Please also consider that the probe can withstand a **maximum contact temperature of 70°C (158°F)**.

2.3. Embedded UT software use

Cygnus Instruments has provided the UT technology within Flyability's UT Payload. A Non-Exclusive End-User Licence Agreement exists between Cygnus and the End-User of the pre-installed embedded UT firmware, granting the End-User the right to use the UT technology, associated IP Rights, and End-User Materials for their intended purpose.

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3. Mounting the UT Payload on the Elios 3

3.1. Drone compatibility

The UT Payload is compatible ONLY with the Elios 3. Elios 1 and Elios 2 drones cannot be equipped with this Payload. Please ensure no cage parts are broken before proceeding with the Payload setup. More information on how to correctly mount the UT Payload will be provided in this chapter.

3.2. Selecting the correct probe

When you purchase the full UT configuration, Flyability provides you with three different twin-crystal piezo-composite probes of varying frequencies: 2 MHz, 5 MHz, and 7.5 MHz. Here you can find the details of each probe and when they should generally be used.

			
Frequency	2 MHz	5 MHz	7.5 MHz
Crystal size	12mm (0.5in)	9.5mm (0.37in)	4.5mm (0.18in)
Tip size	17mm (0.67in)	12.7mm (0.5in)	6.5mm (0.26in)
Use case	For attenuative material (e.g. coating) and thick surfaces	For general purpose and extremely heavy front/back wall pitting or corrosion	For small diameter pipes (e.g. boiler tubes, and thin corroded plates
Thickness ranges*	SE: 2mm - 150mm EE: 5mm - 55mm	SE: 1mm - 150mm EE: 2.2mm - 55mm	SE: 1mm - 50mm EE: 1mm - 25mm

*SE= Single-Echo mode, EE= Echo-Echo mode

Given this information, please select the probe best suited for your next flight. We suggest using the 5MHz probe for most testing purposes and your first flight.

3.3. Selecting the correct hood

Hood is the term used by Flyability to refer to the red cap placed around the probe together with the membrane to help improve the probe's contact with the metal surface. Ensuring that the UT probe is in good contact with the surface being inspected is crucial for obtaining accurate and reliable results. For this reason, each probe is provided with three different hoods made for different surfaces. Below you can find more information on the hoods and when they should generally be used.

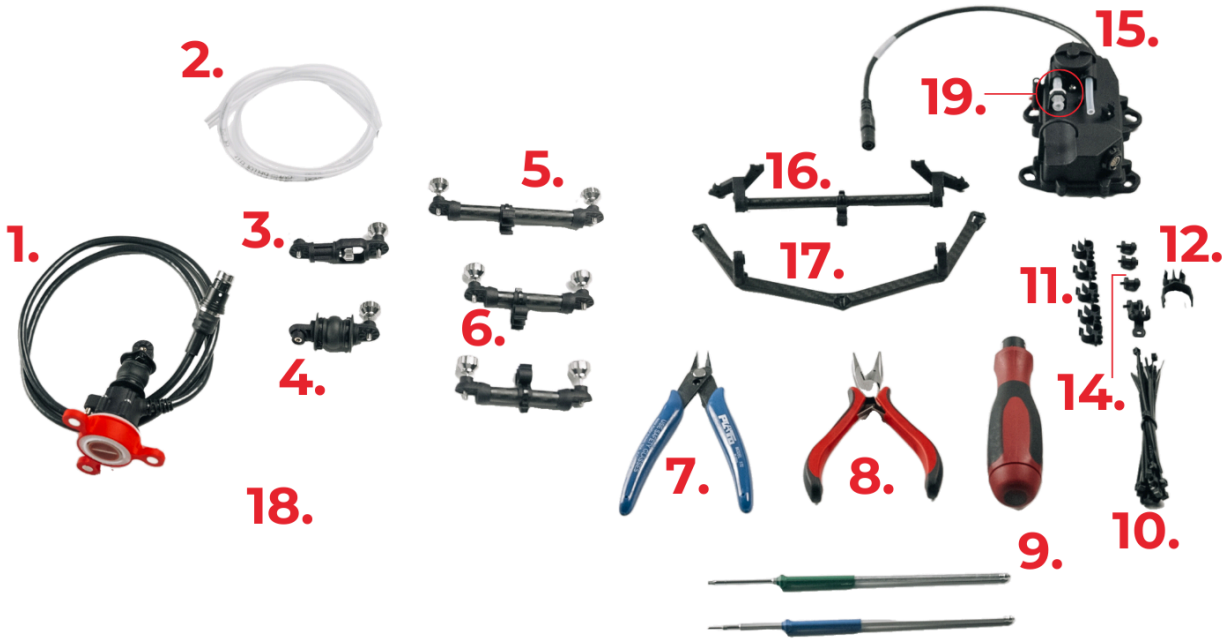
			
Points of contact	3	2	0
Use case	Ideal for flat surfaces like metallic walls or ceilings.	To use on all metallic pipes or when you want less magnetic force on the wall.	Ideal for cases in which you don't want to have a magnetic attachment.

Given this information, please select the probe hood you will need for your next flight. For testing, we suggest using a flat surface hood (1).

3.4. Mounting the UT Payload

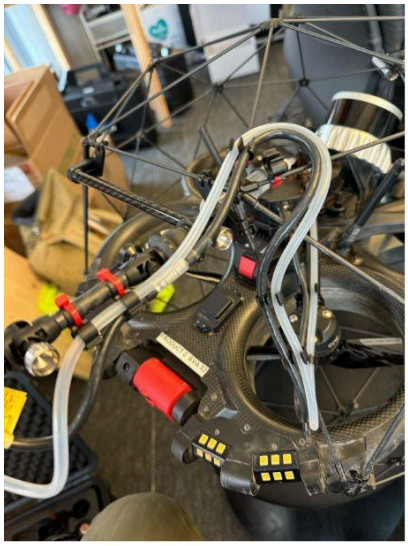
Before starting the process to mount your UT Payload on the Elios 3 drone, make sure that you have the Elios 3 toolbox and the following items with you:

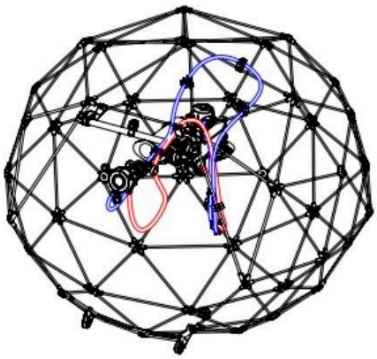
1. 5MHz probe and flat surface hood
2. Sensor gel tube 800mm
3. Axial rotation module + 2x titanium thumb screws
4. LLM (Load Limiting Mechanism) + titanium thumb screw
5. Long extension arm + clip + 2x titanium thumb screws
6. Short extension arms + clip + 2x titanium thumb screws
7. Side cutters
8. Pliers
9. T8 screwdriver (0.4Nm)
10. Standard Elios 3 zip ties
11. Cable clips for the cage
12. Cable clips for the rotor arm
13. Cable clips for the arm stiffener
14. Mounting studs
15. Flyability/Cygnus UT Gauge
16. Tope cage adaptor
17. Bottom cage adaptor
18. Flexible gel pipe
19. Luer syringe connector

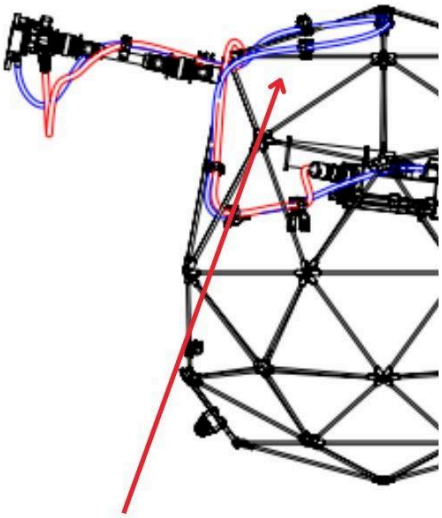


Watch this video to learn how to mount your UT Payload:

IMPORTANT: Check that the cables/tubes are correctly mounted outside the cage to avoid them falling into the propellers, as shown in the image below, and make sure there is no dust before inserting the cable into the drone AUX port.



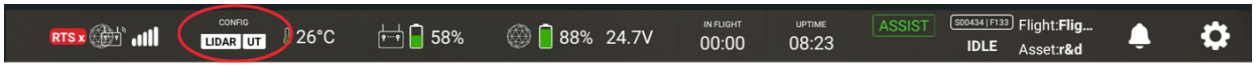




It is CRITICAL that cables are placed outside the cage

Once the UT Payload has been correctly plugged in and the systems have been updated, the drone will automatically detect the new Payload. If this doesn't happen, please try turning the drone off and back on and waiting a few minutes.

To make sure that the UT Payload has been detected, you can check the payload configuration section at the top of Cockpit (see below):



3.5. Adding ultrasonic couplant

To add couplant to the Elios 3 UT Payload, follow these steps:

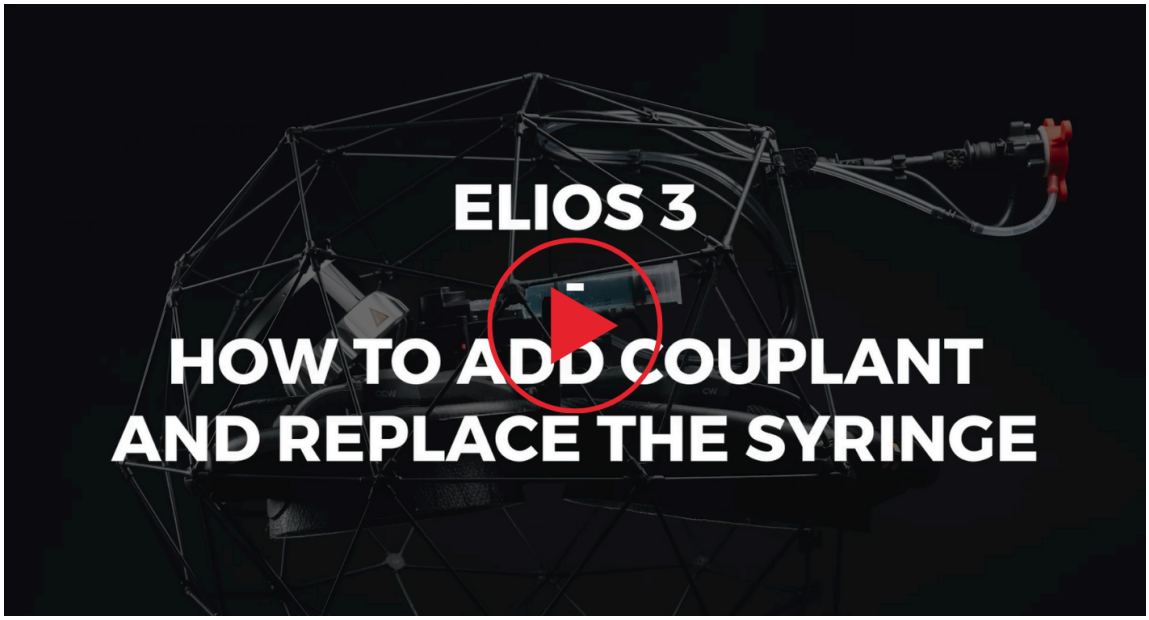
1. Choose the correct couplant. Flyability provides you with a 25cl (8oz) bottle of couplant by EchoPure, which has a viscosity of ~1000CPs (or mPA s) at 20°C. This couplant is food safe; you can find the datasheet here and the batch number is written on the bottle as follows:

PLEASE NOTE: Although most water-based couplants are also appropriate for the UT Payload (provided they have a viscosity of no more than 2000 CPs at 20°C), we do not guarantee the integrity of the equipment if you use other types of couplants. For instance, in previous tests, WD40 permanently damaged the equipment.

2. You can mix the couplant with water if you prefer a more liquid couplant, but this is not mandatory, as we provide a couplant with a viscosity that fits most use cases.

   PLEASE NOTE: The EchoPure operating temperature is between -51°C (-60°F) and 176°C (350°F). Adding water to the couplant or using a water-based couplant may change the usable temperature range and it could freeze under 5°C/41°F conditions and damage the Payload.

3. Add the couplant to the smart syringe using the syringe plunger tool and install the syringe back into the Payload. See how in the video below:



For safety concerns regarding the couplant provided to you by Flyability please refer to this safety sheet.

PLEASE NOTE: Repeated usage (normally >100 refills) or following a long storage period may block the smart syringe plunger. We recommend checking if the syringe functions correctly before each flight.

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4. Available training

4.1. Suggested training

The drone should now be fully set up but before your first flight, we highly suggest that you follow some UT measurement training. When purchasing the UT Payload, basic online training is included to take you through the different components of the Payload and some basic knowledge on how to use it. You can receive the free training by contacting your sales representative or sales@flyability.com.

It is also possible to purchase an Advanced OEM training option that will be provided in person by the Flyability training team or one of its resellers. If you are interested in purchasing the Oem UT training please contact us at: sales@flyability.com.

PLEASE NOTE: Additional factors that directly affect the use and accuracy of ultrasonic equipment are beyond the scope of the UT Payload basic online training, Flyability OEM UT training, the Quick Start Guide, and this User Manual, which instructs in the setup and operation of the UT Payload within the Elios 3 drone system. The operator of the UT Payload in the Elios 3 must be a well-trained UT inspector qualified by either their organization or another outside agency to the appropriate level of both theory and practical application of ultrasonics. See the next section on Required training.

4.2. Required training

Cygnus Instruments has provided the UT technology within the UT Payload and recommends that users and operators of the UT Payload should have at least the following level of formal qualification:

- a minimum of UT “Level 1” (ASNT or PCN), under the supervision of Level 2 or Level 3 personnel
- when using Manual Gates, the operator should hold a UT “Level 2” qualification

(References: ISO 16809 Clause 5.6; ISO 9712 Clause 6.1, 6.2.)

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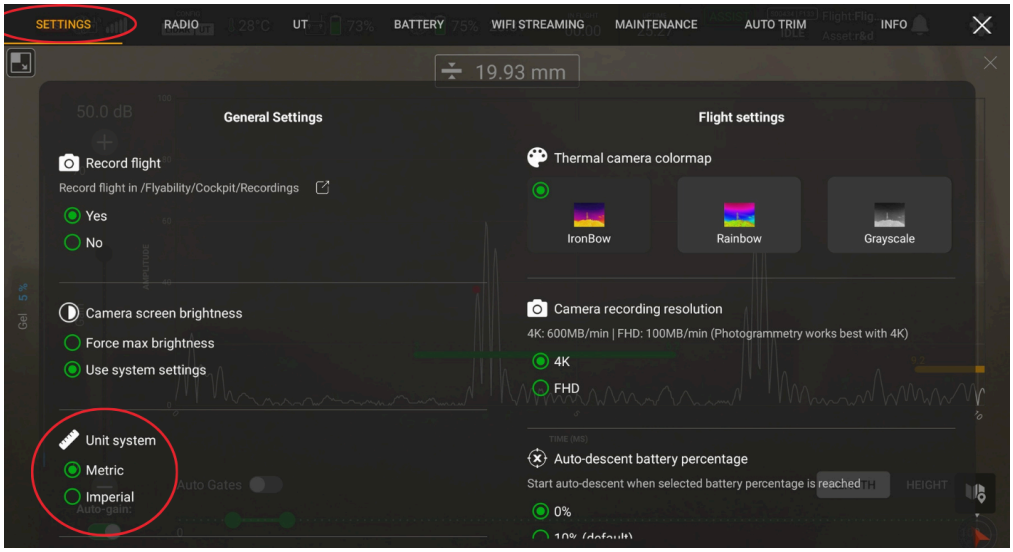
5. Getting ready for your first flight

5.1. Getting accustomed to the UT tabs in Cockpit

The first thing to do is select your desired unit of measure (Metric or Imperial). To do so open settings on the Cockpit app and select the appropriate option:



Before conducting your first flight with the Elios 3 UT, we suggest that you get more accustomed to the updated Cockpit view and the specific UT tabs. To view the UT settings in Cockpit, turn on the drone and the tablet, wait for the UT Payload to be recognized, and then open Cockpit. Finally, click on the settings icon (⚙️) in Cockpit and click on *UT*.

We suggest performing some UT measurements when the drone is not in flight to help you become accustomed to the new UT tabs.

Note: For the first flights, we suggest that you leave the auto-gains and auto-gates turned on. For more information regarding single echo or echo-echo scans, please refer to the Cygnus Instruments website.

5.2. Turn on the system

Now that the UT Payload has been mounted, all the systems have been updated, you have read the user manual, and you have familiarized yourself with the new Cockpit interface, you are ready to perform your first test flight. To do so start by turning on the drone and the remote control.

Make sure that you are in a safe environment for flying the drone, that no one is close to the take-off point, and that you have the correct protective gear.

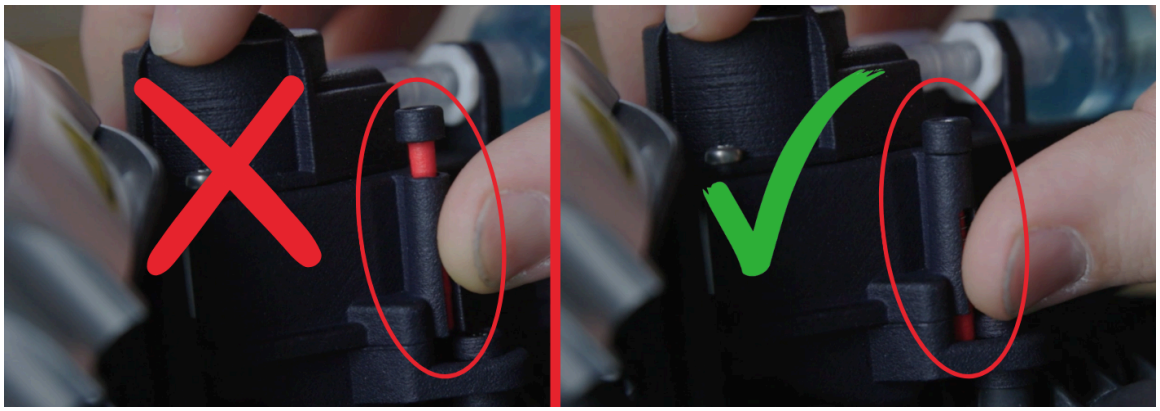
5.3. Routine before conducting a UT flight

a. Check that you have the correct probe and hood

Before starting an inspection, check you have mounted the correct probe and the correct hood for the task. See the Chapter on how to switch the probe or hood.

b. Make sure that the gauge is well-secured to the drone

For safety reasons, it's important that you check before each flight that the gauge is safely secured to the drone structure as shown in the picture below:

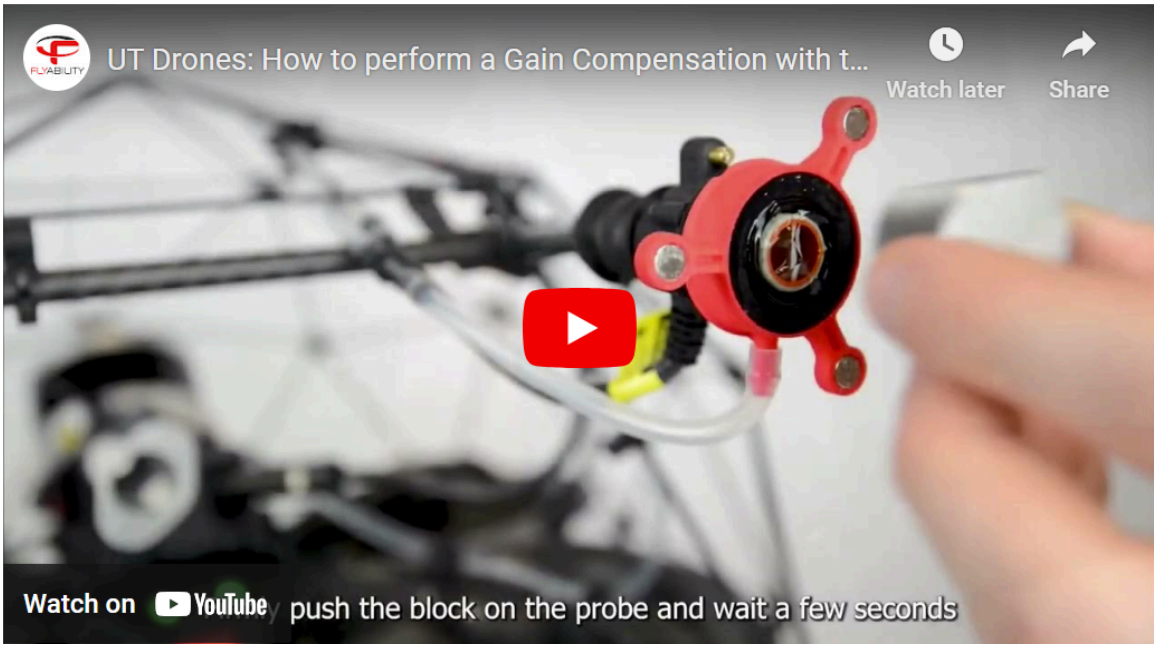


c. Perform probe gain compensation

When you first mount the UT Payload and every time you change the probe, it's important to perform a *probe gain compensation*. This feature allows you to view with more ease the scans detected by the probe. To perform a probe gain compensation:

1. Turn on the drone and check that the UT Payload has been detected by Cockpit.
2. Have the 15mm probe gain compensation block, couplant, and remote close by.
3. Place some couplant on the probe gain compensation block and place it firmly against the probe. Wait a few seconds until you get a clear A-scan on the RC screen and then click on the "Perform" button under "Probe gain compensation".

For more details on how to perform gain compensation check out this video:

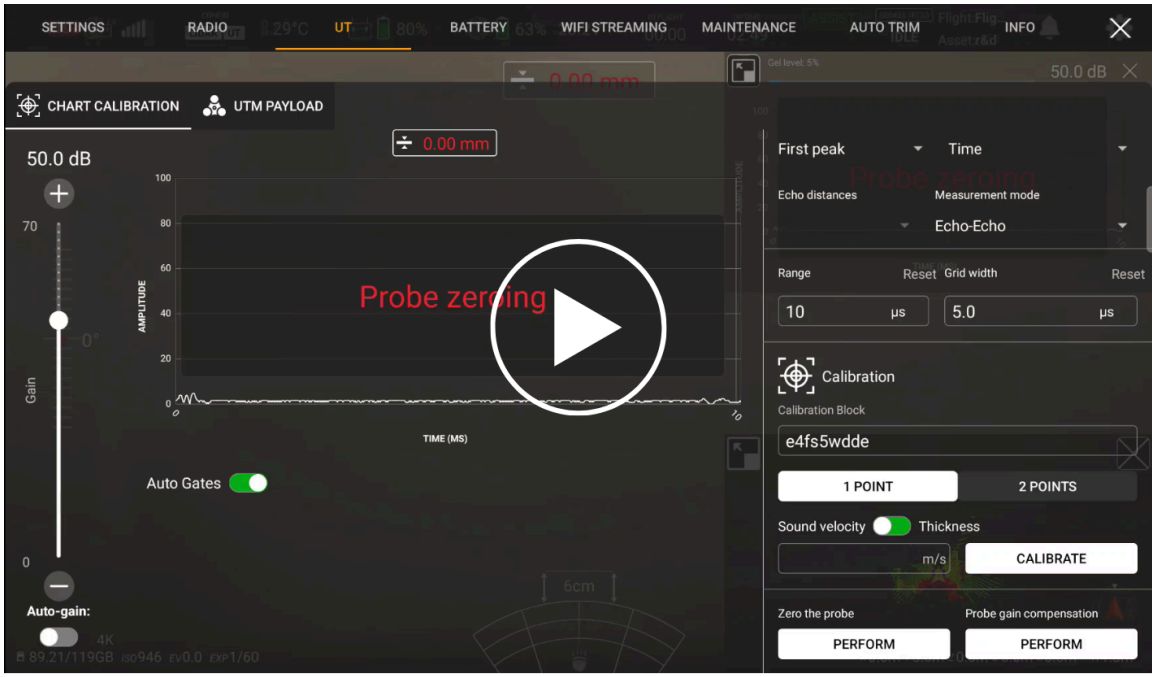


d. Perform probe zero

To compensate for any inherent delay in the probe and the ultrasonic equipment and ensure that the thickness readings are precise, it is important to *Zero the Probe*. This step should be done before each mission or time there is a change in the probe or Payload setup. To perform a probe zero (also known as zero offset or zero calibration):

1. Make sure the drone is on and connected to the tablet.
2. Open the settings on Cockpit (⚙️) and select the *UT* tab.
3. Scroll the right-hand side of the screen until you find the option "*Zero the probe*".
4. Then click on "*Perform*".

Watch this Cockpit recording to see all the steps in action:



e. Perform a calibration

It is important that you calibrate the UT Payload every time you change the probe, you inspect a new material, or there is a significant change in temperature. Perform a 1 point calibration when you are certain that the thickness of the asset is close to the thickness of the block. Perform a 2 point calibration when you want to measure different thicknesses in the same flight/inspection or when you don't know the thickness of the material you will measure.

To perform a 1 point calibration:

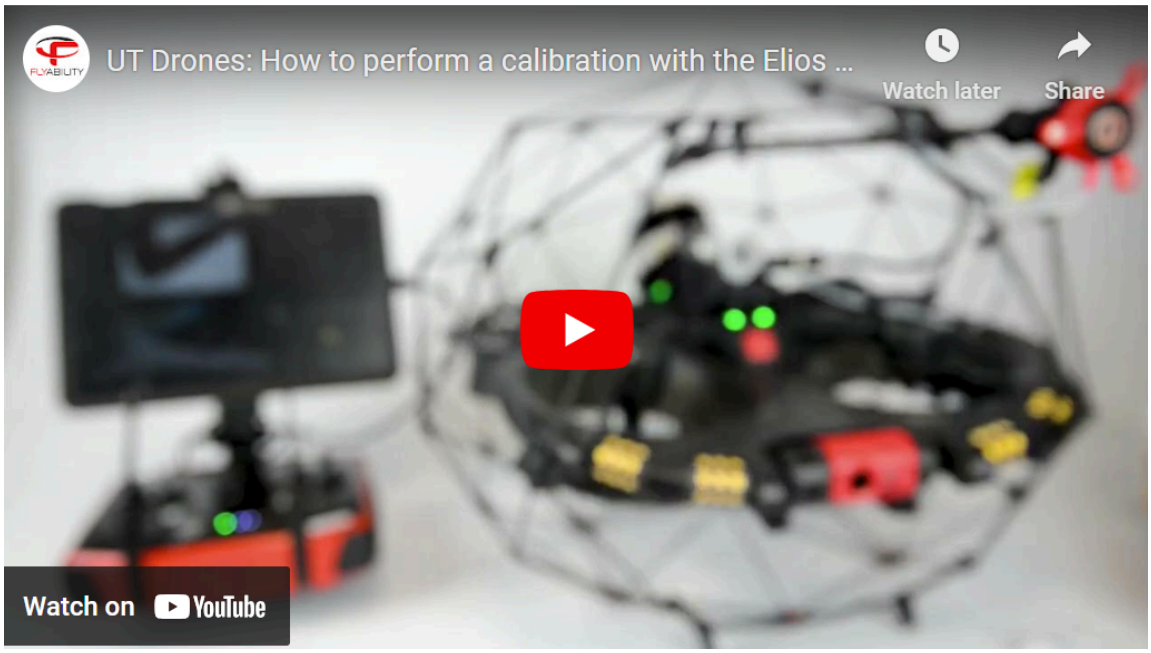
1. Connect the remote to the drone and open the UT settings page on Cockpit.
2. Under *calibration* assign a name to the calibration block and then choose “1 point” in the interface and set the toggle to “thickness”. Make sure you select a calibration block corresponding to the thickness of the material you will measure.
3. Set the initial parameters, including selecting the appropriate frequency.
4. Place some couplant on the calibration block and then firmly hold it in contact with the UT probe. Choose a thickness of the calibration block as close as possible to the asset you want to inspect. If you are not sure about the thickness of the material you want to inspect, you should perform a 2 point calibration.

   *To perform a 2 point calibration simply select “2 point” and conduct this step twice.

5. Once the A-scan is clean and stable, press the “Calibrate” button.
6. Confirm that the thickness measurement displayed on Cockpit is correct (equal or close to the calibration block measure) and if there are discrepancies try to perform again the calibration or perform a “2 points” calibration. It’s normal to get values that are +/- 0.1.

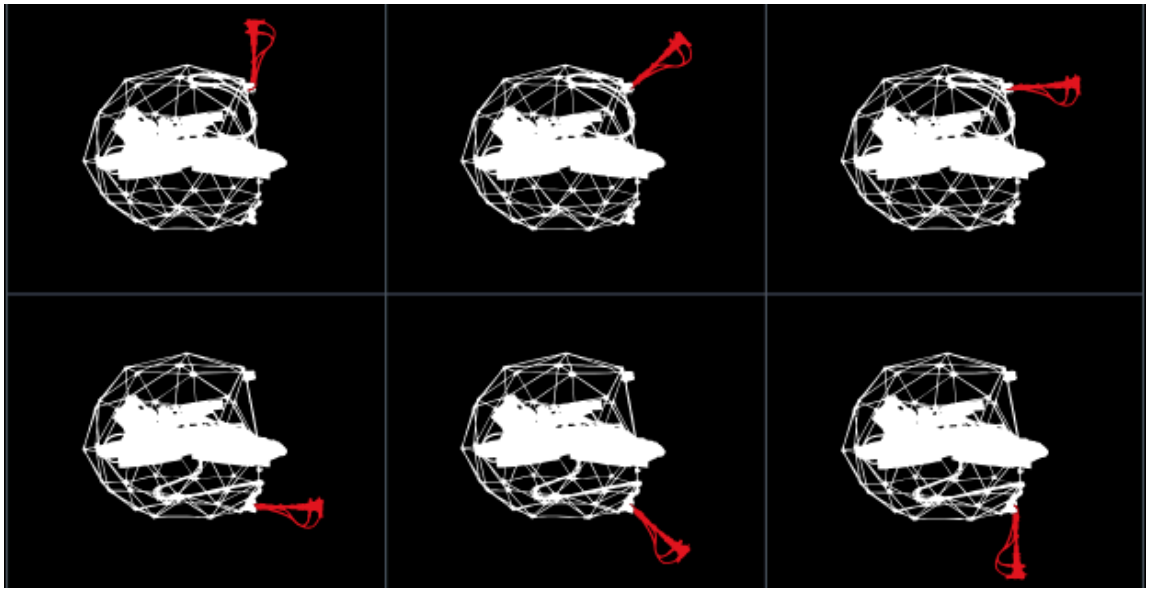
The date and time of your last calibration are displayed at the top of the calibration tab.

See here how to perform a 1-point and 2-point calibration:



f. Adjust the arm in the correct position

The UT Payload can be angled in different ways to allow you to measure almost any surface. You can position the probe to scan a surface above, in front, or below the drone. Here are some tips on how you can orient the Payload arm for better measurements:



Watch this quick video to understand how you can change the angulation of the probe:

IMPORTANT NOTE: Please pay attention when flying through narrow openings like manholes with the UT Payload mounted. In particular, there are two situations to be aware of:

1. In vertical manholes, when the arm is oriented straight up (1), the Payload may touch the top of the opening and potentially unbalance the drone. The LLM will allow the arm to bend and assist you but in order for this to work you will need to maintain speed while passing through the manhole.

2. When the arm is oriented straight down (6) it is best to fly backward into the opening. Flying forward through a manhole with the arm oriented straight down carries the risk of hooking the manhole with the probe, which will cause the drone to flip forward.

For horizontal manholes (e.g., manhole on the road), the LLM's ability to bend the arm will allow you to fly through openings without any problem.

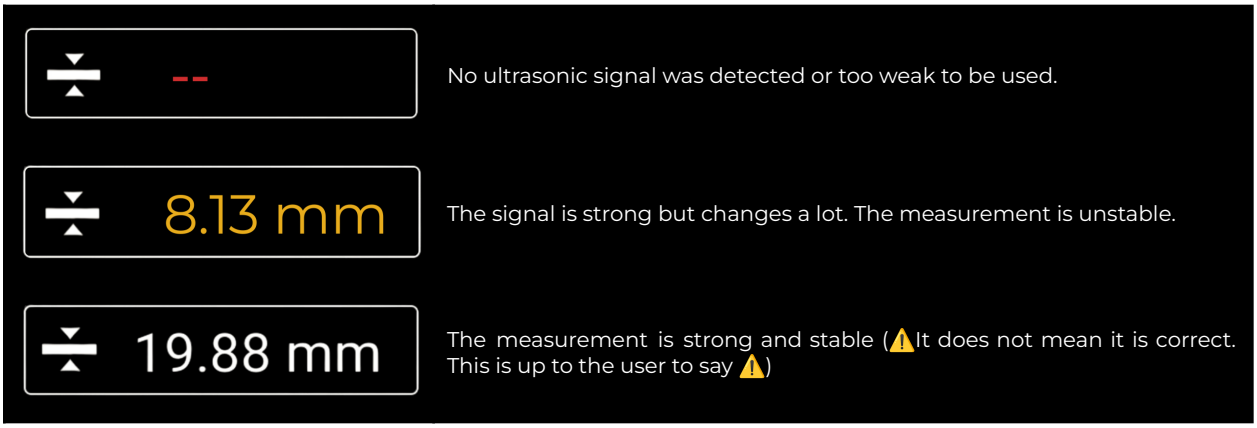
g. Take your first measurement (not in flight)

Before you take off for a flight it is suggested to take a first measurements not in flight. To do so, press the AUX button on the remote to dispense the couplant until you see it reach and cover the probe. By hand, move the drone and place the probe in contact with a metallic surface. The Payload should then start measuring the metal's thickness and display an A-scan on Cockpit. Make sure the measurement is correct.

QUICK TIP! Always check before each flight that the smart syringe is attached to the UT module and correctly tightened.

5.4. What does the color of my scan mean

You may notice that the thickness indication on Cockpit may change between red, orange, and white. This is because each color has a different meaning:



5.5. Testing the setup

Before performing your first mission with the Elios 3 UT, we suggest that you conduct a first test flight and UT measurement in a safe environment. This step is important to make sure that everything is working properly and that you can recover the drone safely in case of any failures. It is recommended that you pick an open room area where you cannot lose the drone.

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6. Your first flight

6.1 Take-off

You are now ready for your first Elios 3 UT flight. Turn on the drone and the remote control, wait for the UT Payload to be detected, and take off.

To perform a UT measurement while in flight, fly closer to the surface you want to inspect until the UT Payload magnetically locks onto the surface. If there is couplant on the probe, a measurement should appear, if not there are 2 ways of dispensing couplant:

- Press the ***AUX button*** on the remote controller. This solution is the easiest but requires removing your finger from the Joystick. The drone will keep stable on its own while you do so.
- Combinedly press the ***FN + ATTI/Sport buttons***. This solution is more difficult but allows you to keep control of the drone. It may be useful when you want to fly in manual mode.

As long as you keep pressing, the couplant keeps flowing. Most of the time you need less than a second to dispense enough couplant. It may take a few flights to get used to dispensing couplant efficiently. If you are happy with the measurement, detach and move on to the next spot that needs inspecting.

To make it easier to identify the measured spots in post-processing we suggest taking points of interest (POIs) every time you are taking a measurement.

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7. Problems you may encounter during a flight

7.1. Surface conditions

Contaminants on the surface, such as dirt, grease, or corrosion, can interfere with the coupling between the transducer and the material. Proper cleaning is necessary to ensure reliable UT measurements. When purchasing the full package, Elios 3 UT is provided with a dedicated cleaning tool that can be mounted on the drone. See here how to use the Elios 3 cleaning tool.

Please also consider that the probe can withstand a **maximum contact temperature of 70°C (158°F)**.

7.2. Bad coupling

Sometimes, despite the patented lip, when the surface is a bit dirty or uneven there could be some air trapped between the probe and the surface. It can be difficult to understand when this is the case so when you have a bad reading (red) of the surface we suggest always trying to detach and reattach on the same spot of couplant or simply dispensing more couplant to see if an air bubble caused the issue.

7.3. Surface smoothness

When the surface is very uneven due, for example, to heavy pitting, the sound may not bounce back correctly and it could be difficult to receive a correct measurement (most likely orange reading). In this case, try detaching from the surface and reattaching to a different spot close to the original one.

7.4. Out of couplant

If you run out of couplant during a flight you must return the drone to the take-off point and refill the couplant dispenser before proceeding with the next measurement. You will always be able to see the couplant level in the top left corner of the Cockpit:

We also suggest having several smart syringes filled with couplant before starting an inspection. In this way, you will not have to refill them manually on the field but rather you will be able to quickly swap the syringe before a flight, reducing inspection time and avoiding the issue of being out of couplant.

7.5. Surface curvature

The surface curvature may influence the contact between the transducer and the surface, leading to possible noise in the scans. To limit this issue, Flyability provided you with a hood designed specifically for pipes (with two magnets). For small pipes, we also suggest using the 7.5MHz probe.

In order to unclip the hood from the probe, you need to:

1. Press axially the hood in the direction of the probe
2. Rotate counterclockwise a quarter of a turn
3. Release the hood

See here how you can swap hoods:

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8. How to use the Elios 3 UT Cleaning Module

When the surface conditions start to become difficult to measure (e.g., heavy dust or light rust) and you cannot get a clean reading, the first thing you can do is switch to the 2MHz probe. Lower frequency probes, like the 2MHz, have better penetration capabilities and are less affected by surface conditions. They can more effectively transmit ultrasound through rough or dirty surfaces, providing more reliable and accurate measurements in such challenging conditions.

However, if this is not enough to get a clear A-scan, you may want to consider using the Cleaning Module provided with all Flyability premium UT packages or available for separe purchase. This tool is ideal for removing thin layers of dust and dirt from the surface you want to inspect. By using a brass brush, the Cleaning Module, cleans the surface where the ultrasonic probe will be placed. This product is motorized to ensure consistent and effective cleaning, removing light dust, scaling, and light paint scaling from a 50mm diameter circular area on the wall without damaging the surface. This helps to ensure better coupling between the probe and the surface for accurate ultrasonic measurements.

To use the cleaning module:

1. Remove the UT probe and gel pipes. Then mount the Cleaning Module as shown below:

2. Once the cleaning module has been correctly mounted, fly to the spot you want to measure and place the cleaning tool over it. The magnets on the extremities of the cleaning tool should attach it firmly to the metal surface.

3. Once attached, create a POI of the spot you are cleaning so that you will be able to easily find it again later in the 3D map of your asset.

4. Press and keep pressing the AUX button for around 20 to 30 seconds to perform the cleaning.

5. Detach from the surface and you should now see a round cleaner spot. If no other spots need cleaning, exit the asset and remove the cleaning tool from the drone.

6. To continue with the UT inspection, mount the UT probe and gel tubes back on the drone and using the live map locate the POI recorded. Fly to the POI and with the help of the laser place the probe in contact with the cleaned surface.

IMPORTANT NOTE: Please remember to remove the syringe and replace it with the provided cap every time the cleaning module is used and make sure the gel tube extremity (coming out of the pump)is secured in its clip. This helps avoid any unwanted particles entering the gel dispensing system.

Please also consider that using the cleaning module can have an impact on the drone motor's maintenance time and on the front payload camera sanity as unexpected metallic dust and particles can be torn off from the surfaces.

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9. UT data interpretation with Inspector

To operate the UT Payload you will need the **2024.07** update for the Elios 3 onboard software, Cockpit and Inspector, **or any later update**. To learn how to upgrade to the latest version of Inspector click this link. For more information on how to work with Inspector 5 see here.

Do not operate the Payload with any earlier version of the software!

See here all the information about the Elios 3 system updates.

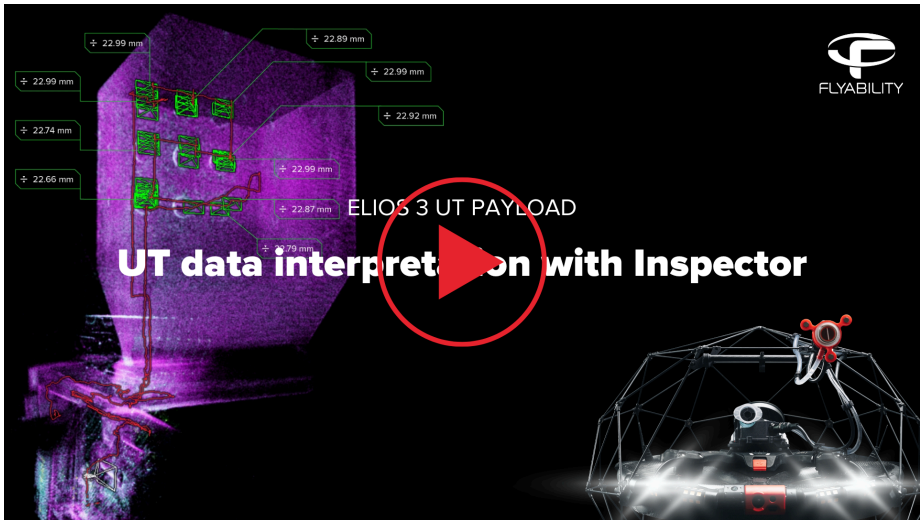
9.1. Download your fight data

Once you have completed a UT inspection with your Elios 3, you will want to download the collected data to a PC to process and analyze this data or to share it with other parties. To do so, normally download your flight data as you would for any other flight. Refer to this document for more information.

9.2. Find and understand your UT measurements

Once you have opened your inspection on Inspector, you will see the 3D view on the left side of the screen with any POIs you have recorded and the drone trajectory, the video view will be on the right, and the timeline of your inspection is on the bottom. You can also open the flight data bar on the far right side of the screen where you will be able to retrieve the list of UT measurements and the relevant UT detailed window, create an inspection report, select or unselect individual flights, and more.

Watch this video to learn how you can view, analyze, and download your UT data in Inspector.



9.2.1. The 3D view

The 3D view is one of the most useful tools of Inspector as, if the inspection was performed correctly, it will contain all the information you need to review a mission. The *Asset Management* feature released by Flyability will allow you to automatically mesh all the 3D models collected during an inspection into a single model, giving you an accurate representation of the asset. In this unified model, you will also have localized all your UT measurements. To display them go to the "settings" button (⚙) and select "Show UT measurements". You will now see the thickness values directly displayed on the POIs of the 3D map.

If you click on one of the POIs shown on the map, a panel will open on the right showing a list of all the collected POIs and the relevant UT measurement if present. You can click on the thickness symbol (⊣⊢) to open a window with the details of the measurement and review the A-Scan.

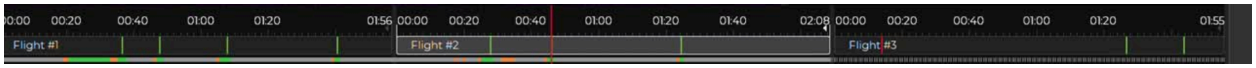
9.2.2. The inspection timeline

The line on the bottom represents the timeline of your inspection. An inspection is one or more flights. Under each flight, you will see a horizontal line representing a thickness measurement. This line will be colored according to the UT signal quality. Each color has the following meaning:

- **Grey:** the signal was too low to get a clear reading
- **Orange:** there was a good signal but the measurement is not stable
- **Green:** there was a good signal and stable measurement

However, please be aware that the measurement should not automatically be considered correct even if it is green. This should depend on the judgment of the person reviewing the data.

See an example here below:



9.2.3. The UT detailed window

The UT detailed window will give you more information about the measurements. The most important information you will find there is the recorded A-Scan.

The system records 8 A-Scans per second and you can find them by opening the UT window. Even after your flight, you will be able to see the graphical representation of the ultrasonic wave as it travels through the material, showing the echoes received by the probe, together with the thickness value corresponding to each position of the drone in the 3D map. This will allow you to locate your measurement in the asset: An essential feature to create your report and to compare measurements over time.

9.2.4. The video recording

The video recording is mainly useful to see if the probe was correctly attached to the surface while taking the measurement. It is possible to have "False positives" due to the couplant dripping in front of the probe, so when you have a doubt on a measurement it can be useful to review the video feed and assess the placement of the probe.

9.3. Reviewing your measurements

Now it's time to check the validity of the measurements. To do so, you need to have some technical knowledge about UT. It is strongly recommended to have a UT level 2 certification to review and approve the collected data.

Open your UT detailed window to see the A-Scan. Go through each UT POI and check if the A-scan is correct. If you are not satisfied with the A-Scan, you can click on the side arrows (< >) to navigate frame by frame and find the A-scan you prefer among all the A-scan that were recorded at that position.

Once all the POIs have been reviewed, the data is ready to be exported as a CSV file or downloaded in your report.

10. Maintenance and care

Please find all the general maintenance information about the Elios 3 here. For any additional concerns regarding the maintenance and care of the UT Payload please read the following chapter or contact our support team at support@flyability.com.

10.1. Handling the UT Payload

Properly cleaning and storing the Payload will reduce the risks of damaging it. Be aware that strong collisions may also be harmful to the Payload and therefore it is not suggested to store it at height or where it may fall.

Do not remove the Payload in particularly dusty and dirty environments to avoid particles entering the AUX cable port and connector which could damage the Payload.

10.2. Storing the UT

When storing the Elios 3 UT Payload we suggest placing it back into the original box that it arrived in and away from direct sunlight. Although no damage should occur, we suggest storing the Payload in a dry and dark environment at room temperature. Please make sure no dust or dirt enters the gauge and gel dispensing cables. Always place the provided caps when not in use.

After a long period of storage we suggest changing the smart syringe as the plunger may get blocked.

10.3. Removing the UT Payload

We always suggest to remove the UT Payload when you are conducting inspections that don't require capturing UT measurements as there is an increased chance of crashing the drone when the UT Payload is mounted. If you wish to remove the UT Payload from the Elios 3 drone you can watch the video here below to learn more:

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11. Support and contact information

For additional support information please access the Flyability Knowledge Base at the following address: https://knowledge.flyability.com/ut-payload or contact us at support@flyability.com.

12. Resources

12.1. Technical Specifications

Please find and download the Elios 3 UT technical specifications here.

12.2. UT Payload Method Statement

Please find and download the Elios 3 UT method statement here.

12.3. UT Payload Quick Start Guide

Please find the Elios 3 UT quick start guide here.

12.4. White Paper

Testing Elios 3's spot thickness measurements' accuracy vs. manual devices. Download here.

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