

Propeller Balancing

Achieve ISO-quality balancing with your Flight Stand



Introduction

All Tyto Robotics Flight Stand thrust stands now support propeller balancing. In just a few steps, you can achieve ISO 21940-11 quality balancing of your motors and propellers.

The balancing feature is not included in the standard Flight Stand software package. To purchase a propeller balancing license, contact sales@tytorobotics.com

How it Works

The Flight Stand's built-in accelerometer and RPM probe determine the level of imbalance in your motor and propeller by measuring the system's vibration.

The Flight Stand is able to precisely characterize this imbalance in just two quick spins: one without any added weight, and a second with a trial weight.

Based on the readings obtained during these two spins, a correction weight is recommended by the software. After adding the recommended weight, perform a final spin to verify that your balancing level now meets the ISO quality grade you selected.

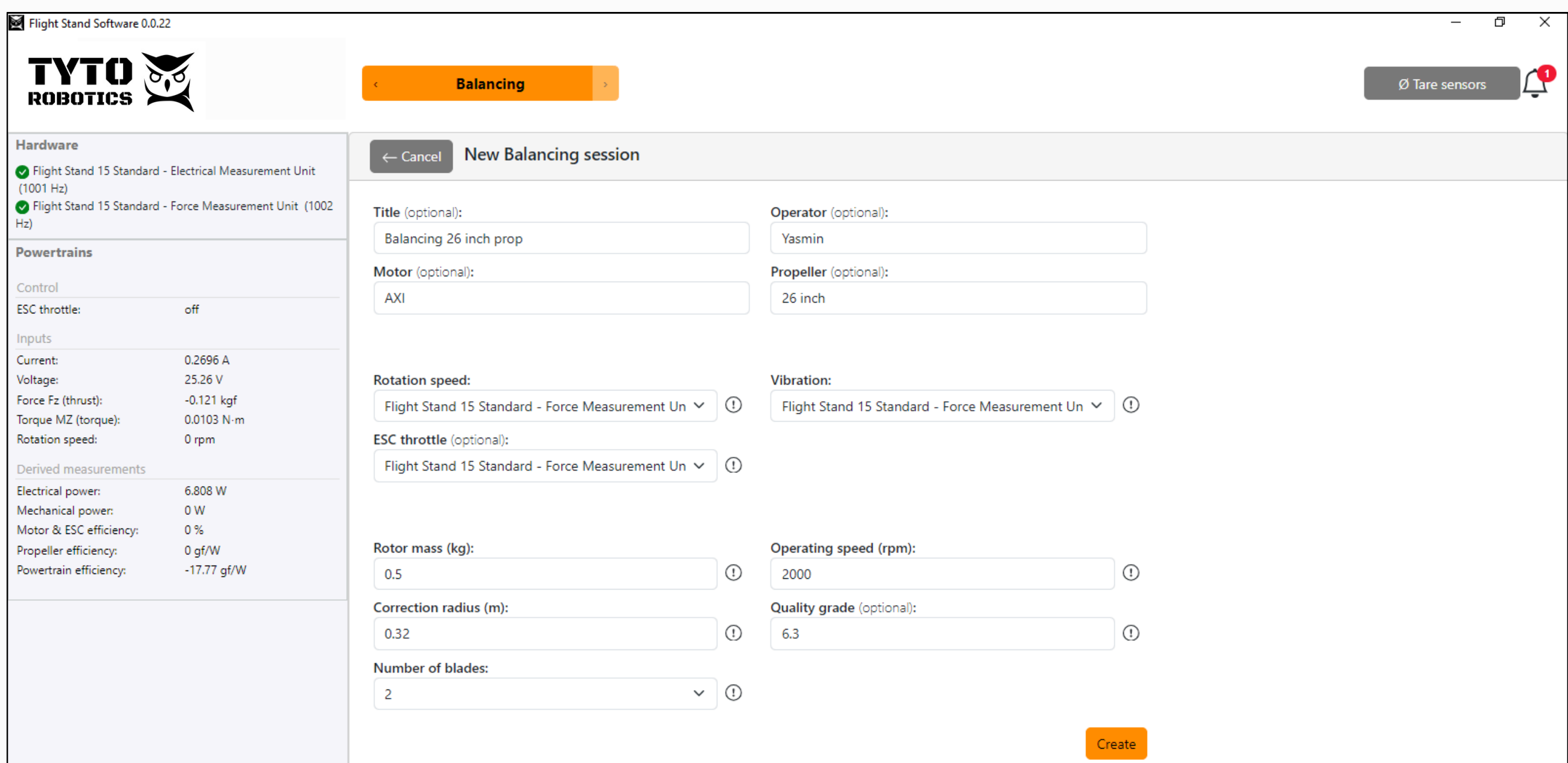
Technical Specifications

	Specification	Value
Measurement Information	Sampling rate	Up to 800 Hz
	Quality grade	ISO 21940-11 standard
	Operating environment	Indoor
	Balancing RPM range	200 - 15,000 RPM
	Correction method	Added weight
RPM Sensor	Range	Up to 30,000 RPM
	Resolution	0.1 RPM
	Accuracy	±1 RPM
Propeller characteristics	Diameter	Depends on Flight Stand model
	# of blades	1 or more

Balancing Procedure

Step 1: Open the Balancing tab in the Flight Stand software. Click “New Session” and enter your powertrain details and test parameters. Then click “Create”.

The correction radius is the distance from the center of the propeller where the correction weight is placed. We placed the weight toward the blade tip to achieve the desired correction with minimal mass. To reduce the effect on lift and thrust generation, add the tape closer to the propeller's base at 1/4 - 1/3 of its radius.



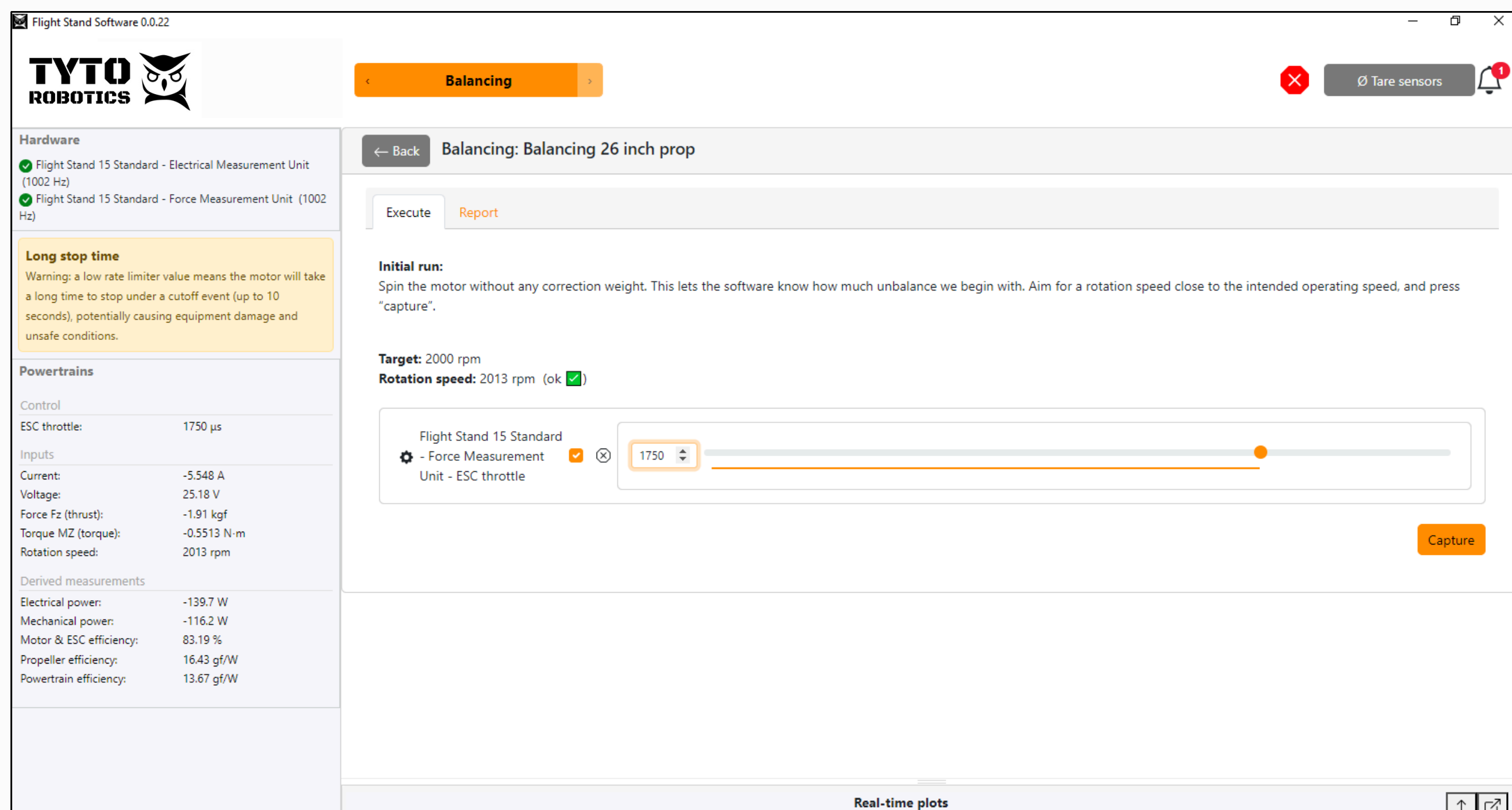
The screenshot shows the 'Flight Stand Software 0.0.22' interface. The 'Balancing' tab is active. On the left, there is a sidebar with hardware and powertrain information. The main area displays a 'New Balancing session' form with the following fields:

- Title (optional):** Balancing 26 inch prop
- Operator (optional):** Yasmin
- Motor (optional):** AXI
- Propeller (optional):** 26 inch
- Rotation speed:** Flight Stand 15 Standard - Force Measurement Un
- Vibration:** Flight Stand 15 Standard - Force Measurement Un
- ESC throttle (optional):** Flight Stand 15 Standard - Force Measurement Un
- Rotor mass (kg):** 0.5
- Operating speed (rpm):** 2000
- Correction radius (m):** 0.32
- Quality grade (optional):** 6.3
- Number of blades:** 2

A 'Create' button is located at the bottom right of the form.

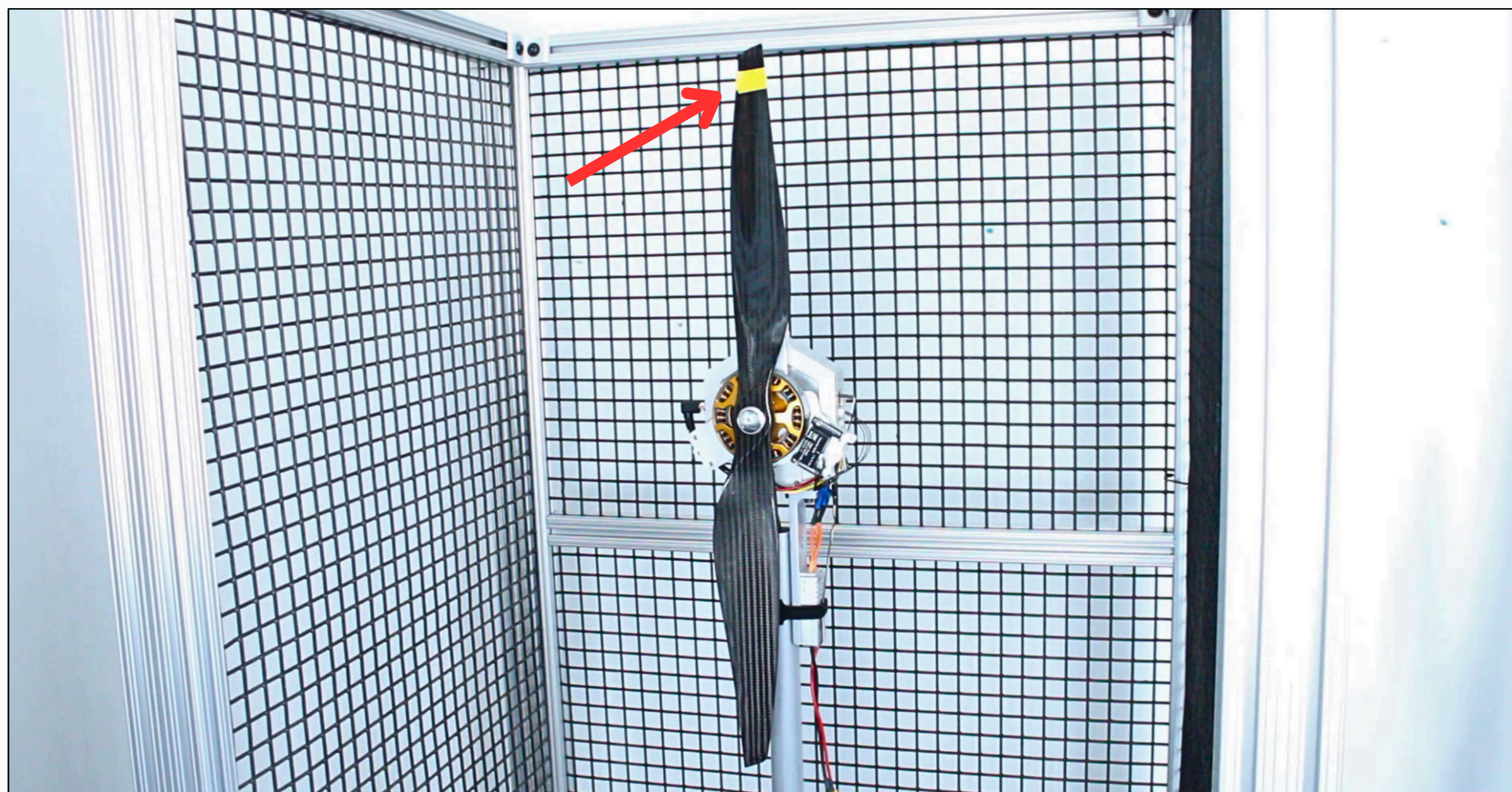
Balancing Procedure

Step 2: Increase the throttle until you reach your target RPM, then click “Capture” to get a base reading. The software will tell you how much weight to add for your trial run.



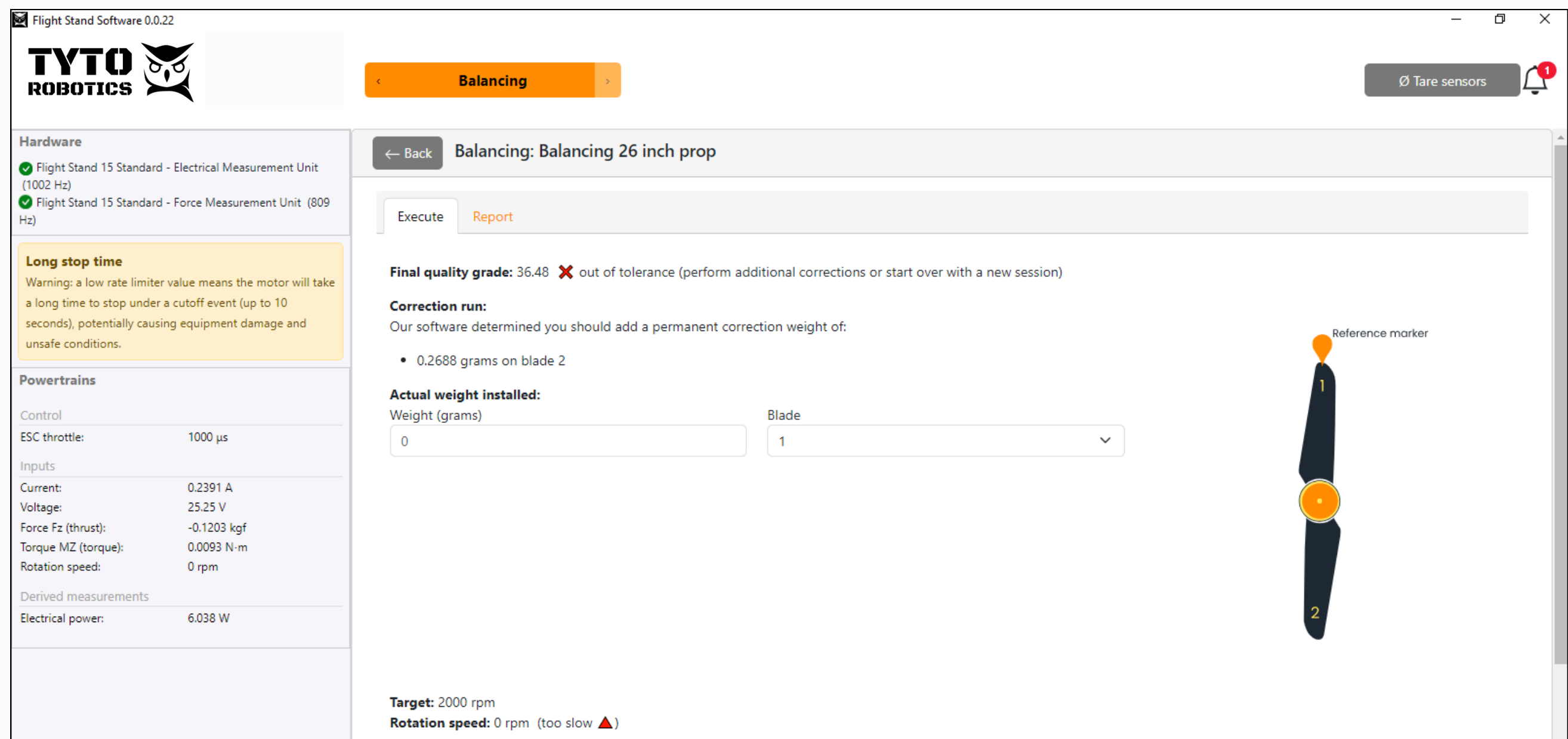
The screenshot shows the Flight Stand Software 0.0.22 interface. On the left, the hardware status is confirmed as 'Flight Stand 15 Standard - Electrical Measurement Unit (1002 Hz)' and 'Flight Stand 15 Standard - Force Measurement Unit (1002 Hz)'. A warning for 'Long stop time' is displayed. The main control area shows the 'Balancing' tab with a 'Balancing: Balancing 26 inch prop' sub-tab. The 'Initial run' instructions are visible, along with a target of 2000 rpm and a current rotation speed of 2013 rpm. A slider for the throttle is set to 1750, and a 'Capture' button is present.

Step 3: Add the trial weight to the propeller at the correction radius specified in Step 1. Increase the throttle until you reach the target RPM, then click “Capture” to get a reading.



Balancing Procedure

Step 4: The software will suggest a permanent correction weight to achieve a passing balancing grade. Add the weight to your propeller, increase the throttle and click Capture.



Hardware

- ✓ Flight Stand 15 Standard - Electrical Measurement Unit (1002 Hz)
- ✓ Flight Stand 15 Standard - Force Measurement Unit (809 Hz)

Long stop time
 Warning: a low rate limiter value means the motor will take a long time to stop under a cutoff event (up to 10 seconds), potentially causing equipment damage and unsafe conditions.

Powertrains

Control
 ESC throttle: 1000 μ s

Inputs
 Current: 0.2391 A
 Voltage: 25.25 V
 Force Fz (thrust): -0.1203 kgf
 Torque MZ (torque): 0.0093 N-m
 Rotation speed: 0 rpm

Derived measurements
 Electrical power: 6.038 W

Balancing: Balancing 26 inch prop

Execute Report

Final quality grade: 36.48 ✗ out of tolerance (perform additional corrections or start over with a new session)

Correction run:
 Our software determined you should add a permanent correction weight of:

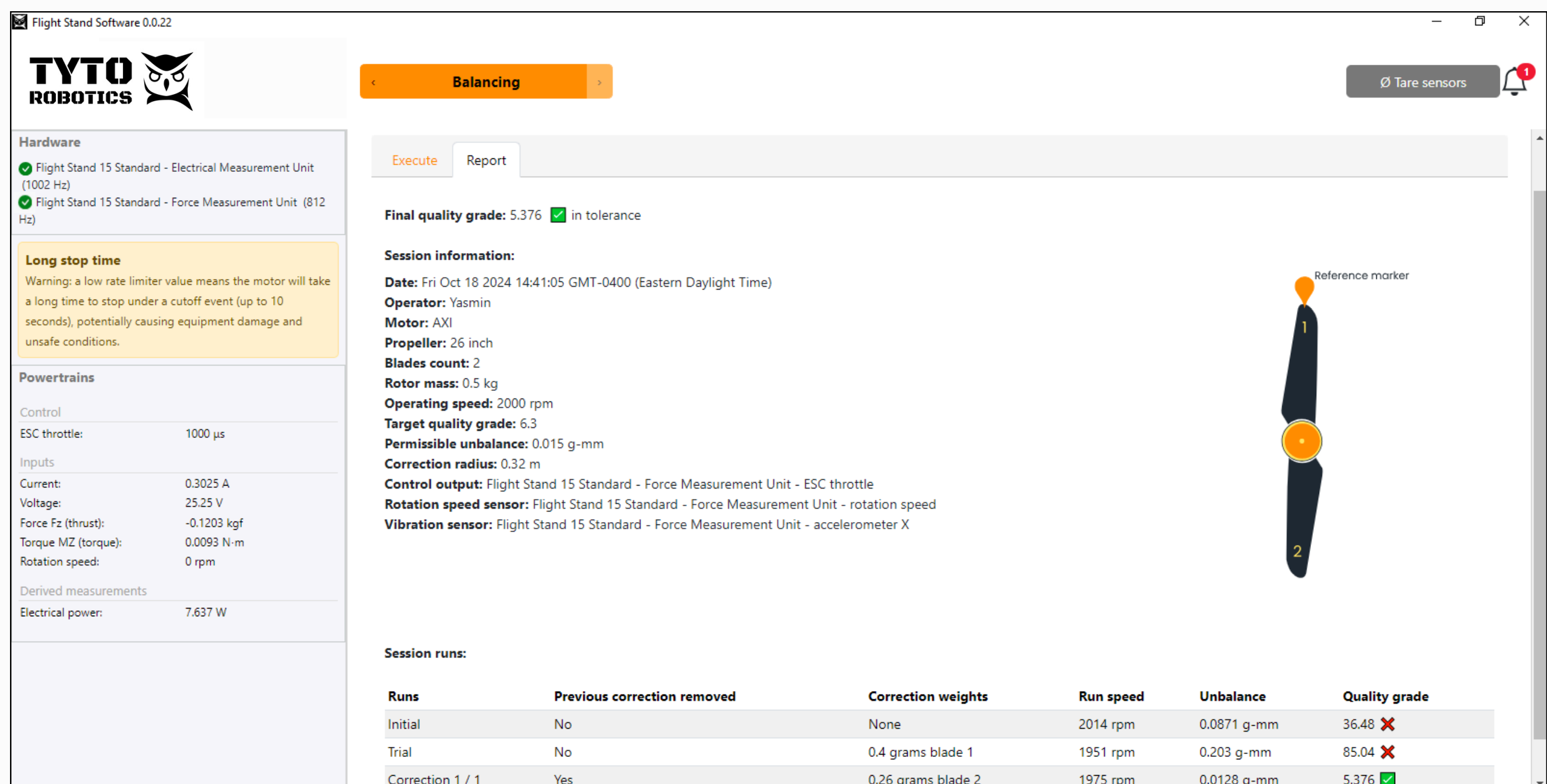
- 0.2688 grams on blade 2

Actual weight installed:
 Weight (grams): Blade:

Reference marker

Target: 2000 rpm
 Rotation speed: 0 rpm (too slow ▲)

Step 5: You should now get a green check mark next to your Final quality grade indicating that you are within tolerance. In some cases it may suggest an additional correction weight to achieve a passing balance. You can view the test summary in the Report tab.



Hardware

- ✓ Flight Stand 15 Standard - Electrical Measurement Unit (1002 Hz)
- ✓ Flight Stand 15 Standard - Force Measurement Unit (812 Hz)

Long stop time
 Warning: a low rate limiter value means the motor will take a long time to stop under a cutoff event (up to 10 seconds), potentially causing equipment damage and unsafe conditions.

Powertrains

Control
 ESC throttle: 1000 μ s

Inputs
 Current: 0.3025 A
 Voltage: 25.25 V
 Force Fz (thrust): -0.1203 kgf
 Torque MZ (torque): 0.0093 N-m
 Rotation speed: 0 rpm

Derived measurements
 Electrical power: 7.637 W

Balancing

Execute Report

Final quality grade: 5.376 ✓ in tolerance

Session information:
 Date: Fri Oct 18 2024 14:41:05 GMT-0400 (Eastern Daylight Time)
 Operator: Yasmin
 Motor: AXI
 Propeller: 26 inch
 Blades count: 2
 Rotor mass: 0.5 kg
 Operating speed: 2000 rpm
 Target quality grade: 6.3
 Permissible unbalance: 0.015 g-mm
 Correction radius: 0.32 m
 Control output: Flight Stand 15 Standard - Force Measurement Unit - ESC throttle
 Rotation speed sensor: Flight Stand 15 Standard - Force Measurement Unit - rotation speed
 Vibration sensor: Flight Stand 15 Standard - Force Measurement Unit - accelerometer X

Session runs:

Runs	Previous correction removed	Correction weights	Run speed	Unbalance	Quality grade
Initial	No	None	2014 rpm	0.0871 g-mm	36.48 ✗
Trial	No	0.4 grams blade 1	1951 rpm	0.203 g-mm	85.04 ✗
Correction 1 / 1	Yes	0.26 grams blade 2	1975 rpm	0.0128 g-mm	5.376 ✓