LINEAR ACTUATOR

TESTING GUIDE

Ensuring you find the right actuator for your application and mitigating consequential issues from implementing an incompatible solution.

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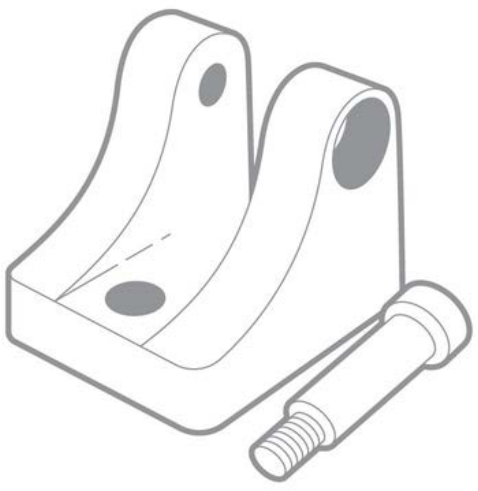
CHAPTER 1:

OVERVIEW

Finding the right actuator for your application can be challenging, especially when it's a drop-in replacement.

So, how do you make sure the actuator you have selected is the right fit for your application? We will go through each step you need to undertake and walk you through the process of testing a sample actuator.

We have also included a convenient checklist at the end of this eBook, ensuring you stay on track and hit all of the testing requirements!



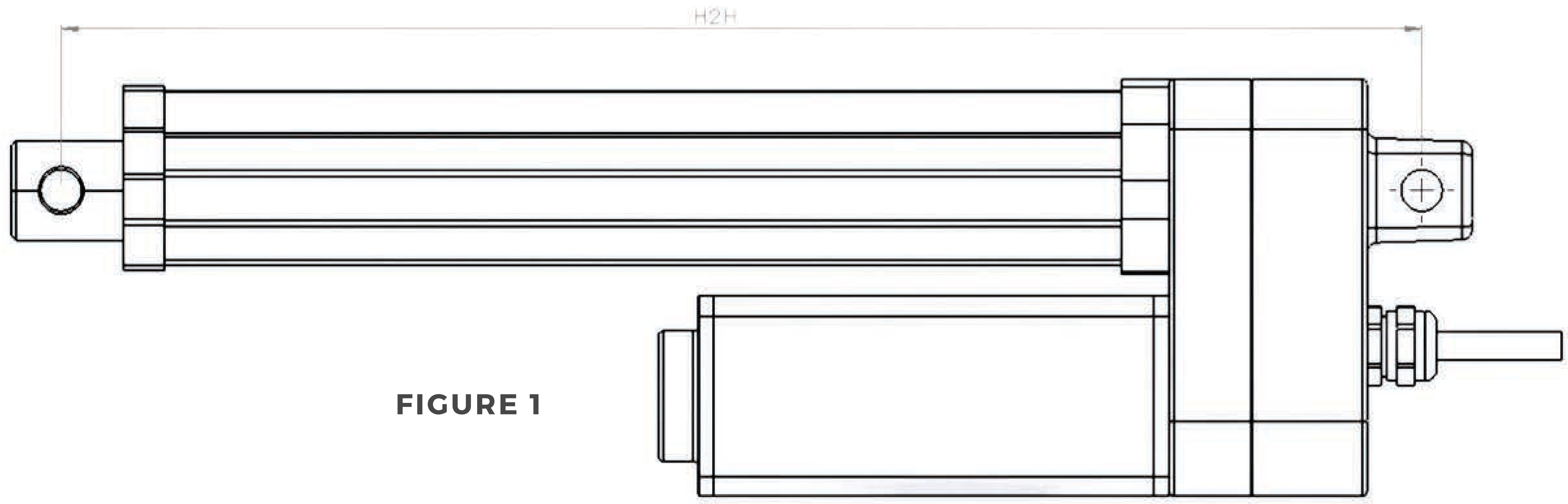


FIGURE 1

CHAPTER 2:

PHYSICAL DIMENSIONS AND SPECIFICATIONS

VISUAL INSPECTION

Visual appearance can be a big factor when selecting an actuator.

This is particularly relevant for applications where it will be visible during normal operation and needs to appeal to the customer. An actuator's build quality can be somewhat determined by looking at the unit and inspecting the quality of the workmanship. This will constitute as the first impression of the unit.

After the first impression, the next thing to check is the retracted hole to hole (H2H) dimensions. This is the dimension from the center of the bottom mounting hole to the center of the top mounting hole.

It is essential to make sure that this dimension lines up with your application's bottom mounting hole center to the top mounting hole center.

If the actuator H2H is shorter than your application's H2H, we can easily fix that by making a custom unit with your required custom H2H. But if the actuator H2H is bigger than application H2H, then the application needs to be adjusted or we can help you look for a different unit.

Once the H2H dimension has been checked and everything fits, the next step is to make sure that the stroke of the actuator provides the right amount of movement. For this step, if none of our in-stock stroke sizes work for you, we can custom manufacture required stroke lengths to suit the needs of the application.

Once the physical dimensions of the actuator have been verified, we will move on to the next step:
Bench Testing.

CHAPTER 3:

BENCH TESTING: SPEED, CURRENT DRAW, & SOUND OR NOISE LEVEL

Now that you have confirmed the physicality of your actuator, conducting a series of bench tests is the **next step** to ensure it will suit your desired application.

These bench tests need to be conducted before taking a deeper dive into lab tests and can be relatively quick. They consist of three main tests:

- **Speed**
- **Current draw**
- **Sound or noise levels**

All three of these tests are by no means necessary as it depends on your application. For example, your application may involve using a linear actuator in an industrial setting, which would mean that testing the noise of the actuator may not be required as these environments are usually quite loud.

However, if you are using the linear actuator to open a door, speed and loudness are vital parameters to know. Use your better judgement to weigh the bench tests that you feel play an important role in your application.

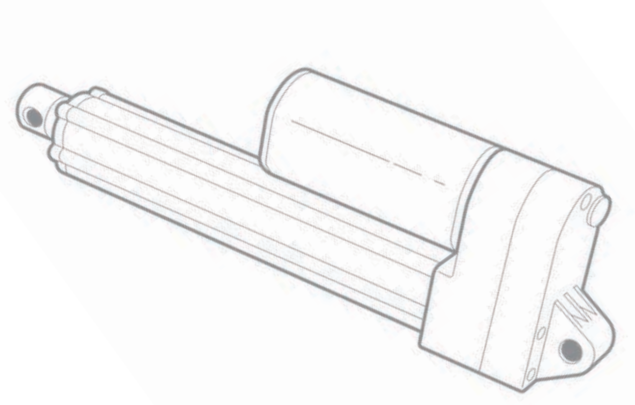
SPEED

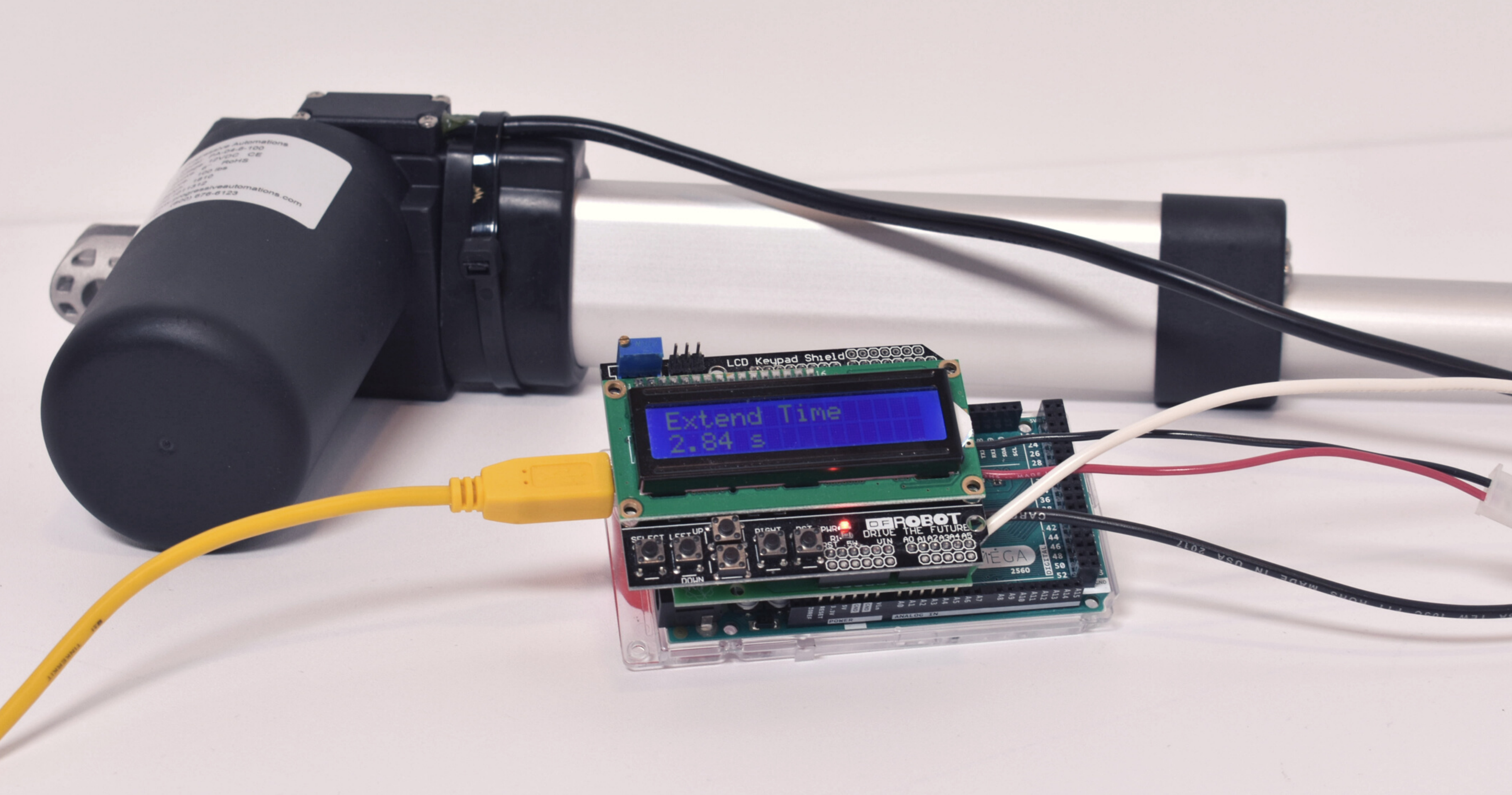
The linear speed test involves timing how long it takes for the linear actuator to extend and retract fully.

This will then provide an “inches per second” value that can be compared with the linear actuator’s datasheet value. Note that this test's speed value can be a rough estimate since further, more accurate speed tests will be done when conducting lab tests.

As mentioned earlier, depending on the application, some tests are more important than others.

Speed is important in a number of applications such as opening a door or hatch, or handling items along an assembly line.





SPEED

To do a quick speed measurement, follow the steps below:

1. Power the linear actuator based on its electrical specifications. Since this is just a bench test, there is no need to attach switches or a control box. Simply apply a positive and negative voltage from a power supply or battery to allow the rod to extend/retract fully.

2. Once the rod has reached its end position, grab a stopwatch, and zero it.

3. Switch the leads on the power supply or battery and get ready to start the timer the moment the rod begins extending/retracting.

4. Stop the timer once it reaches its extended/retracted position, note the time, and repeat for the opposite direction.

5. Divide the stroke of the linear actuator by the time it took to extend/retract. For example, if your actuator's stroke is 40 inches and it took 10 seconds to extend/retract, the speed is 4 inches/second.

Compare this speed measurement with the linear actuators datasheet to determine if it closely matches.

> This speed measurement is just an initial test and will aid in determining if it is the right linear actuator for the job.

The speed will reduce when under load and if the voltage applied is lower than the rated voltage. Please note that depending on the type and the manufacturer of the actuator, there may be a speed tolerance.

If your speed measurement differs significantly from the rated specs, it is best to reach out to the manufacturer for troubleshooting.

CURRENT DRAW

The current draw of the linear actuator with no-load is important to test as it will provide evidence that it is functioning according to its datasheet specifications.

Furthermore, determining the current will ensure that your system can handle it and will help to find the appropriate corresponding parts that go with the linear actuator (e.g., a sufficiently rated power supply and control box).

Simply connect a multimeter in series with one of the leads of a powered linear actuator, and watch the amperage reading as you extend/ retract the rod.

Based on the reading, you can determine a power supply that can handle that current draw. Bear in mind that the current draw will increase when the linear actuator is loaded.

SOUND / NOISE LEVEL

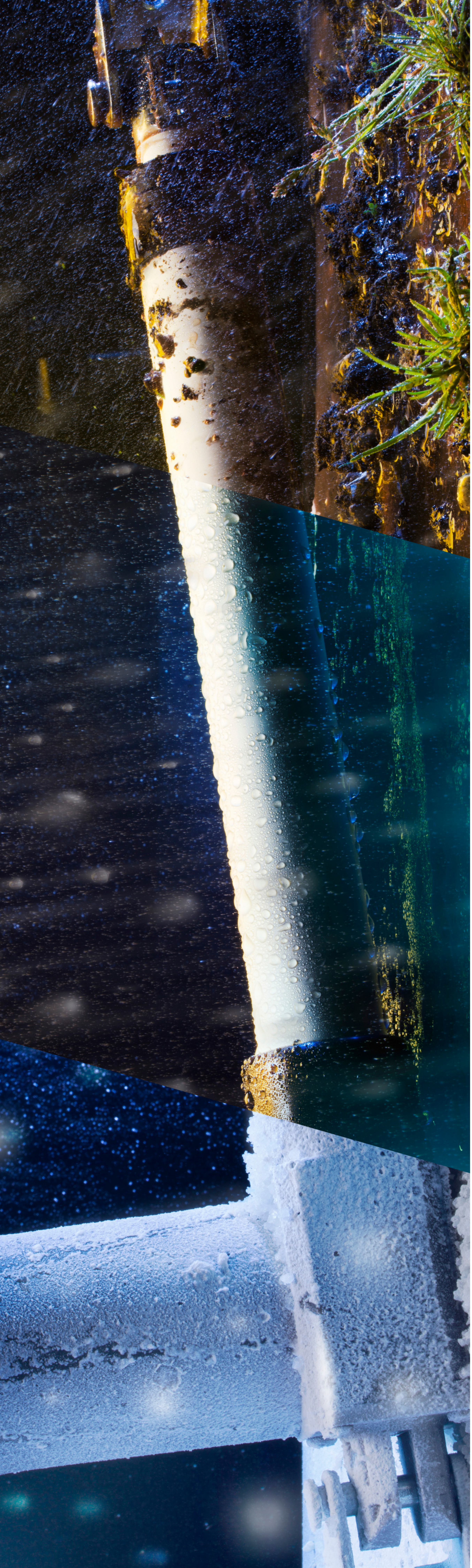
As mentioned, the sound/noise level of an actuator may not be critical if it is going to be used in an industrial application. However, for consumer-facing applications, such as a door/hatch or a lever inside a coffee machine, the noise level needs to be determined.

Use a decibel meter held close to the linear actuator as you power it to extend/retract the rod. Ensure this test is done in a quiet environment to avoid background noise from skewing the results.

Note the highest decibel rating. What now? How does this value correlate to a decision on whether it is noisy or ideal for your application?

Use the table below of familiar sounds and their decibel value to decide on the noise level of the linear actuator and whether it falls within a range that suits your application.

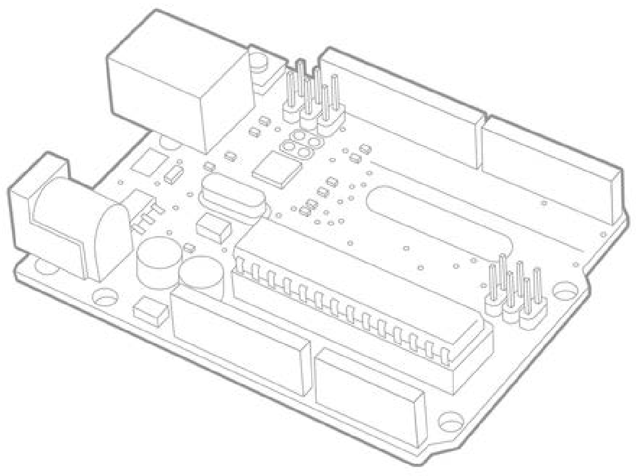
DECIBEL LEVEL	EXAMPLES	PERMITTED EXPOSURE (hours/day)
10	Breathing	-
20	Whisper	-
30	Library	-
50	Quiet office	-
60	Conversational speed / electric shaver	-
65	Piano practice	-
70	Noisy restaurant	-
75	Alarm clock	-
80	Vacuum cleaner	-
85	Garbage disposal / busy hotel lobby	-
90	Tractor / subway	8
100	Blender / factory noise	2
105	Motorcycle / orchestra	1
110	Power saw / heavy truck / mower	0.5

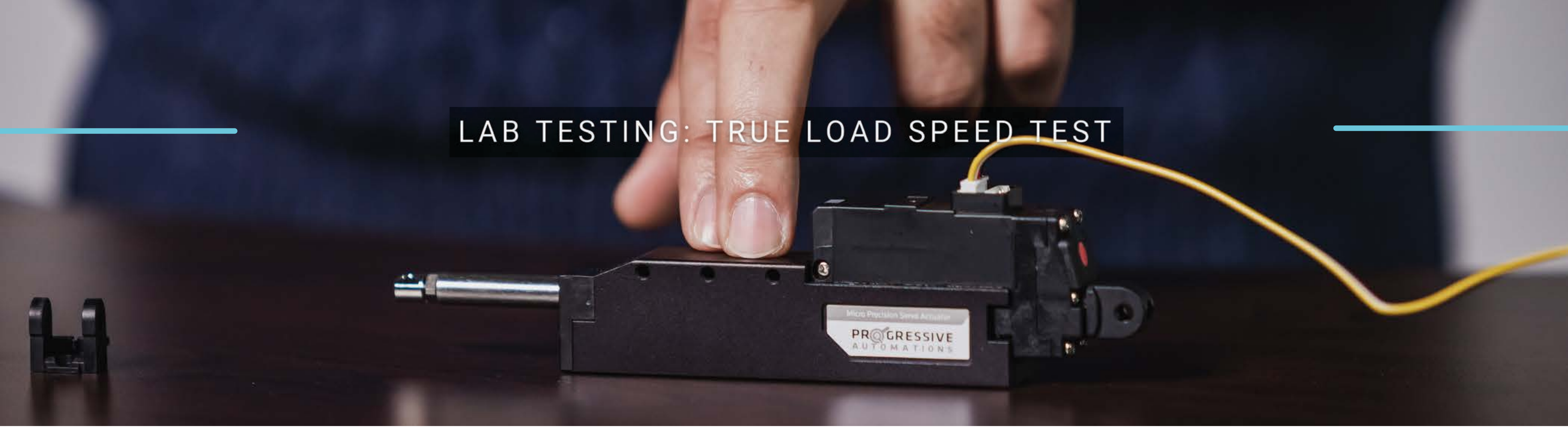


CHAPTER 4:

LAB TESTING

- True Load Speed Test
- System Current Draw
- Environmental Compatibility
- Duty Cycle
- Accelerated Lifecycle Test





Once bench testing of the linear actuator has been completed, it is time to test it under load. The load should match what will be expected when in the desired application. The bench test methods are all applicable to the lab tests, with a few additions.

The lab tests also include:

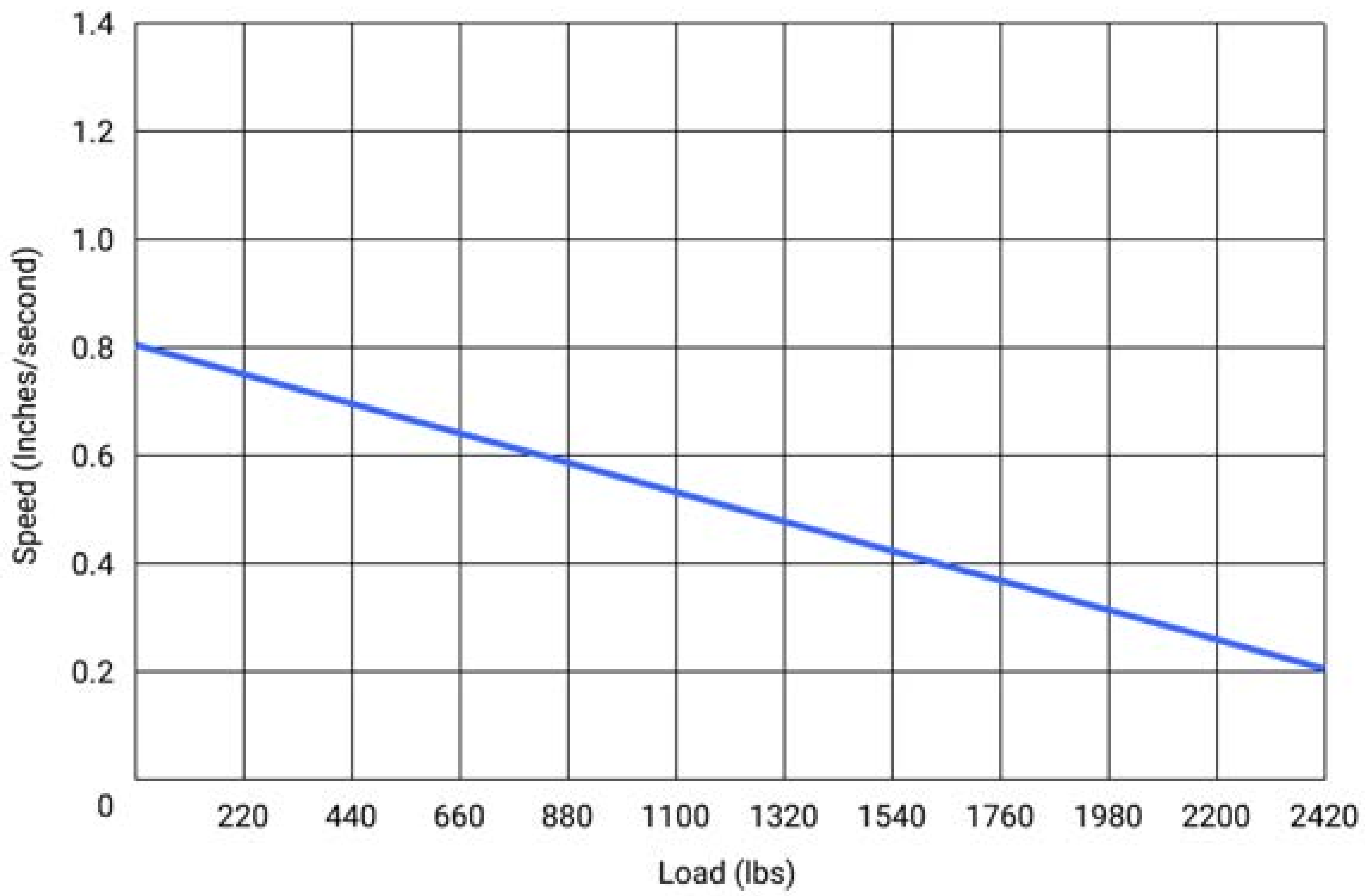
1. True load speed test
2. System current draw
3. Duty cycle test
4. Environmental compatibility of the linear actuator

By conducting these lab tests, it will provide you with even deeper accuracy on the compatibility of the chosen actuator with your application.

TRUE LOAD SPEED TEST

The speed results from the bench test will be the maximum speed that is possible for your linear actuator. When your actuator is under load, it will slow down the speed to a rate that is proportional to the load (see below for reference).

DC Speed Versus Load



> Measuring the speed of the linear actuator under load will help determine whether it still falls within a specific range to work within your application.

To measure the speed of the linear actuator, ensure it is loaded with a weight that resembles how it will operate in your application.

Then redo the step-by-step process used with the speed bench test using a stopwatch.

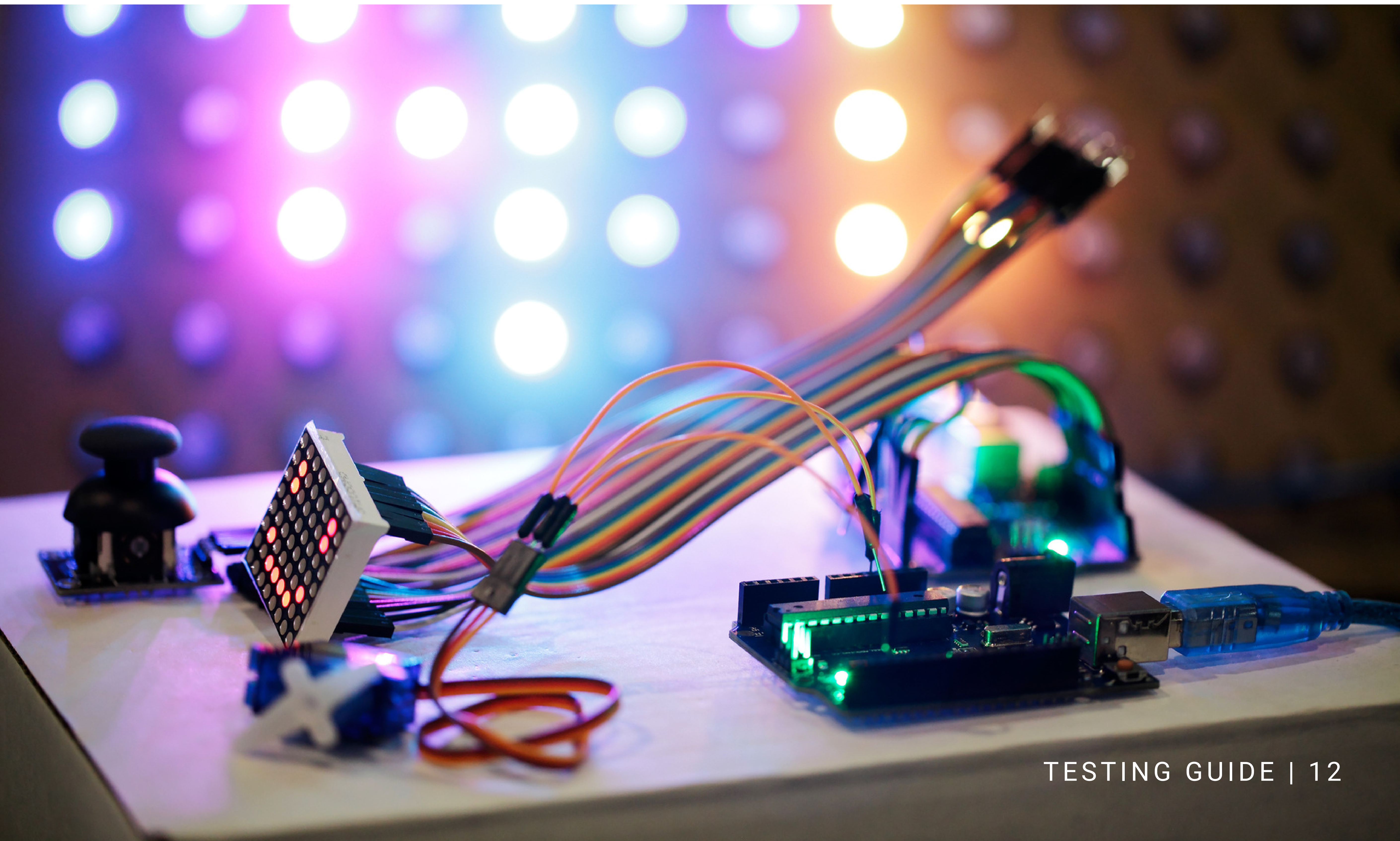
This method is for applications where speed is not a crucial factor.

For applications where precision speed measurements are needed for the linear actuator under load, use an automated time measurement system.

This system will involve using a ***microcontroller*** (e.g., Arduino) with code that will start/stop a timer when either of the two end stroke limit switches of the linear actuator is reached. Please reach out to us if this is the case, as we can help with setting up a jig to achieve this.

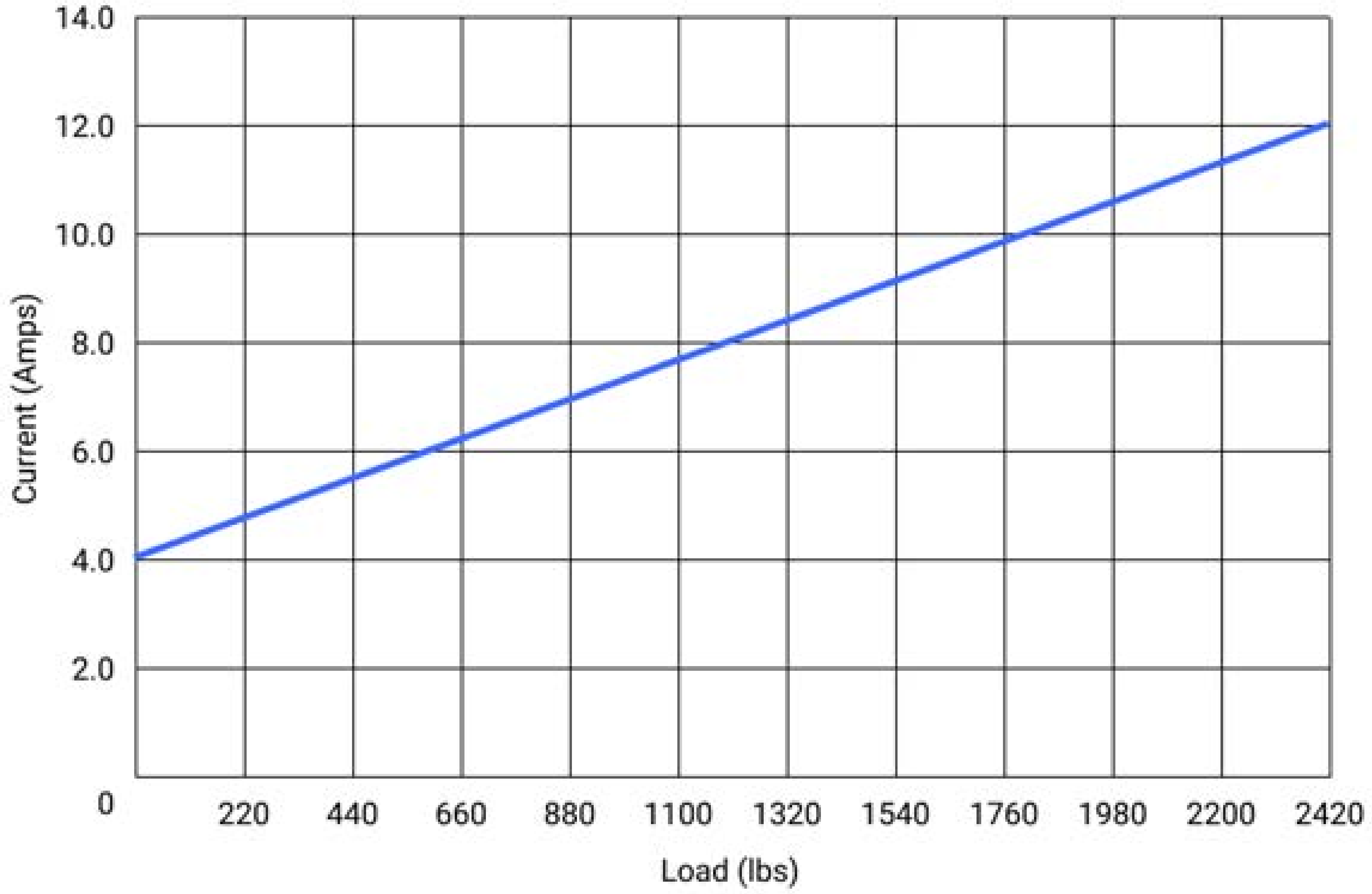
Lastly, depending on your application, you may also want to test the limits of your linear actuator by applying a load close to its rated maximum load to see how the speed changes and how the linear actuator responds.

(e.g., does the motor get hot? Is the movement of the stroke still smooth and controlled?)



SYSTEM CURRENT DRAW

DC Current Versus Load



Since the linear actuator is now under load, the speed will decrease, and the actuator will draw more current. Knowing the current draw of the linear actuator under load will help select an appropriate power supply.

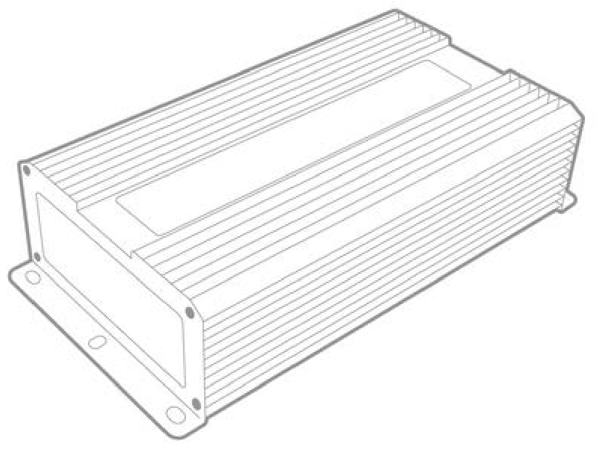
> It is important to take into consideration **other electrical components** that are being attached to the actuator such as a control box, active sensors, etc.

These additional components can draw current from the power supply and result in the linear actuator not receiving enough current to reach its full-load capacity.

To measure the current draw of the linear actuator under load, use a multimeter, as in the bench test.

Alternatively, much like for the lab speed test, use a microcontroller with a current sensor module connected in series. Please reach out to us if you need help with setting up a jig to achieve this.

Once you know the current draw of your whole system, you can size your power supply accordingly to ensure the linear actuator can receive enough current when under full load.



ENVIRONMENTAL COMPATIBILITY

Progressive Automations' linear actuators come with an International Protection Marking (IP) rating. It is a rating of a product's ability to withstand liquid and dust intrusion. The IP rating system uses a 2-digit system to define its protection rating for all products. The first digit represents protection against solids and the second against liquids.

Once a product has completed testing at an approved facility, it will achieve a specific numeric rating, which can be deciphered using the IP rating chart below:

IP (INGRESS PROTECTION) RATING GUIDE

SOLIDS	LEVEL OF INGRESS PROTECTION	WATER	LEVEL OF INGRESS PROTECTION
1	Protected against a solid object greater than 50mm (such as a hand) (50N of force).	1	Protected against vertically failing drops of water for 10 minutes at rate of 1mm/min.
2	Protected against a solid object greater than 12.5mm (such as a finger) (10N of force).	2	Protected against diagonally failing (up to 15°) drops of water for 10 minutes at rate of 3mm/min.
3	Protected against a solid object greater than 2.5mm (such as a screwdriver) (3N of force).	3	Protected against diagonally failing (up to 60°) sprays of water for 5 minutes at 0.7 LPM at 80-100 kPa.
4	Protected against a solid object greater than 1mm (such as a wire) (3N of force).	4	Protected against water splashed from all directions for 5 minutes at 10 LPM at 80-100 kPa.
5	Dust protected. Limited ingress of dust permitted. Will not interfere with operation of equipment.	5	Protected against a 6.3mm water nozzle for 3 minutes at 12.5 LPM at 30 kPa at a distance of 3 meters.
6	Dust tight. No ingress of dust	6	Protected against a 12.5mm water nozzle for 3 minutes at 100 LPM at 100 kPa at a distance of 3 meters.
	PROGRESSIVE AUTOMATIONS FORWARD THINKING	7	Protected against 30 minute submersion at a depth of 1 meter.
		8	Protected against continuous submersion for long periods at a depth of 3 meters.
		9K	Protected against powerful, high temperature water jets.

ENVIRONMENTAL COMPATIBILITY

Based on your application, testing the IP rating of a linear actuator might be helpful. For example, if you know that your linear actuator is going to be exposed to a lot of water, the PA-10 model has the highest IP rating with IP68M and IP69K.

It can operate underwater and can withstand high-pressure water jets when it is not in motion.

The best way to test this kind of linear actuator is to simply submerge it in water and let it run.

However, units rated for IP66, like the PA-04 Linear Actuator and PA-09 Mini Industrial Actuator, can also withstand both dust and moderate liquid ingress.

These linear actuators are best suited to tests within the environment of the intended application. If you know that the linear actuator will not get exposed to dust or water, you can opt for a lower IP rating for your application.

An IP rating does not test for outdoor/weather resistance during seasonal changes and long periods (e.g., years outside during multiple seasons).

Therefore, consider the environment you are going to use the linear actuator in to make sure it is suited for that environment.

Progressive Automations offers various certifications besides the IP rating.

These certifications could be requirements that may apply to your application. Speak to us if you require specific certifications for your actuator and/or application.

It is generally best practice to mount the actuator with the stroke end pointing downwards if there is any risk of water exposure.

This way, gravity will pull liquid away from the motor housing and help prevent premature failure.

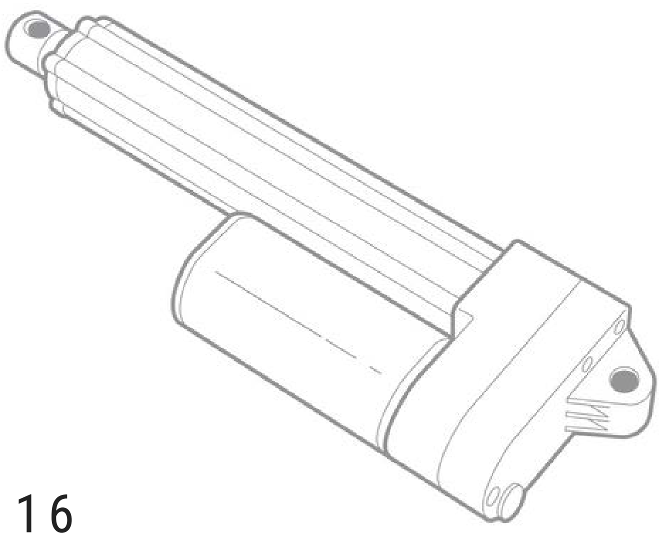
DUTY CYCLE

The duty cycle of a linear actuator is the ratio of on-time and off-time and is expressed as a percentage.

> If your application requires the linear actuator to run continuously, the duty cycle is incredibly important **to ensure you do not burn out the motor.**

For applications like this, the duty cycle would need to be 100%. To achieve a 100% duty cycle, a brushless DC motor will need to be used, as opposed to a standard brushed DC motor.

For linear actuators with a brushed DC motor, Progressive Automations offers a 20% duty cycle, which limits how long it can run.



The duty cycle for Progressive Automations linear actuators is based on a 20-minute period, which means that at a 20% duty cycle, the linear actuator can run continuously for 4 minutes, and then needs to rest for 16 minutes.

The same principle applies to anything under 20 minutes. For example, using 10 minutes at a 20% duty cycle, the linear actuator can run for 2 minutes and then needs to rest for 8 minutes.

Anything over 20 minutes at a 20% duty cycle will damage the motor due to overheating. The best way to test the duty cycle of your linear actuator is to set it up using a microcontroller, as before.

However, the code will need to be adjusted to allow the actuator to turn on and off at set times (e.g., run for 2 minutes, rest for 8 minutes, and repeat). Ensure the actuator is loaded accordingly and check up on the system at set time intervals to ensure it is still running as intended. Repeat the test until you are satisfied that the linear actuator will work in your application.

ACCELERATED LIFECYCLE TEST

After all of the specs have been verified, it is also important to make sure the life rating of the actuator is enough.

We offer actuators rated for 20,000 cycles and we also offer actuators rated for 300,000 cycles.

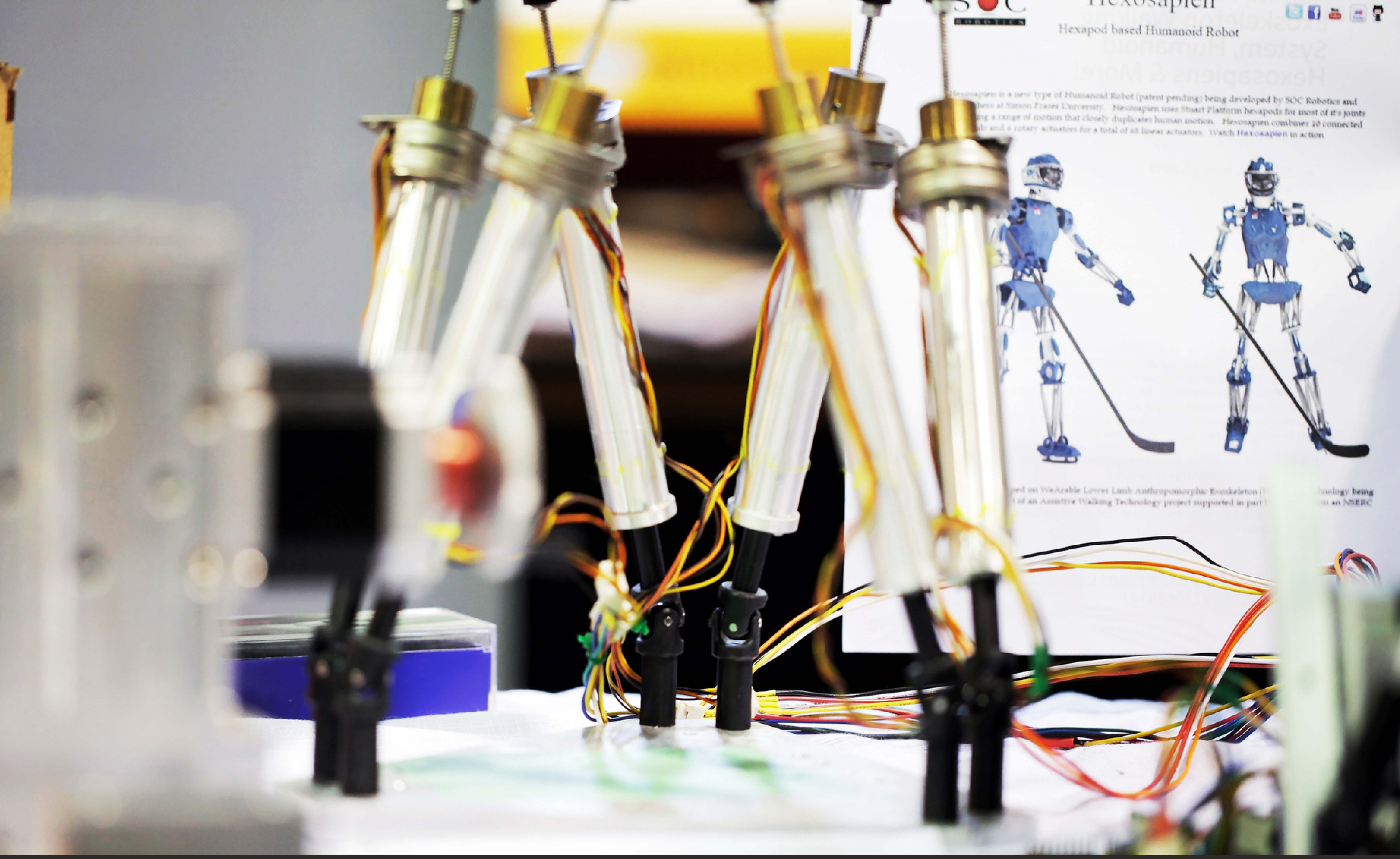
Some applications require the actuator to be operated only once a day, and some require it to be operated a couple of hundred times a day.

In scenarios where the actuator will be used quite often, it is very crucial to make sure the actuator will live up to the required life of the application.

Some applications do not allow for easy removal of parts so making sure that the actuator is rated for enough life is important.

This can be achieved by using a simple jig setup (if you are familiar with creating such setups).

If you would like to do some accelerated testing yourself but you are unsure as to how to do it, please feel free to reach out to us and we can provide you with the right equipment to do so.



CHAPTER 5:

FIELD TESTING

Field testing is also considered to be a crucial part of the testing procedure. After completing the lab testing, it is advised to install the actuator into the application and let it run for a predetermined period.

This will ensure the actuator operates under load as the application requires it to.

> Every application will be different so the extent of testing will differ based on needs.

However, it is recommended to test the actuator to the application limits (but within actuator specifications) to ensure the actuator is indeed the right fit.

It is only after Lab Testing and Field Testing that a true decision can be made based on the results of these tests.

Progressive Automations advises high volume end users to perform all these tests to avoid running into any problems down the road due to an under-spec'd actuator in the application.

CHAPTER 6:

CONCLUSION

To mitigate issues down the road with your application, conducting all of the tests outlined in this eBook is critical. Each application is unique, and while a certain actuator may seem like the perfect solution, it still needs to be thoroughly examined and tested.

Through visual inspections, bench testing, and lab testing, we are confident you will identify any weaknesses and/or thoroughly validate that this product is the best solution for you.

As mentioned, we have included an actuator testing checklist below for you to print and refer to throughout your testing process. This will ensure you stay on track and account for all testing requirements.

If you have any queries or wish to discuss our products further, please do not hesitate in reaching out to us!

We are experts in what we do, and want to ensure you find the best solution for your application.

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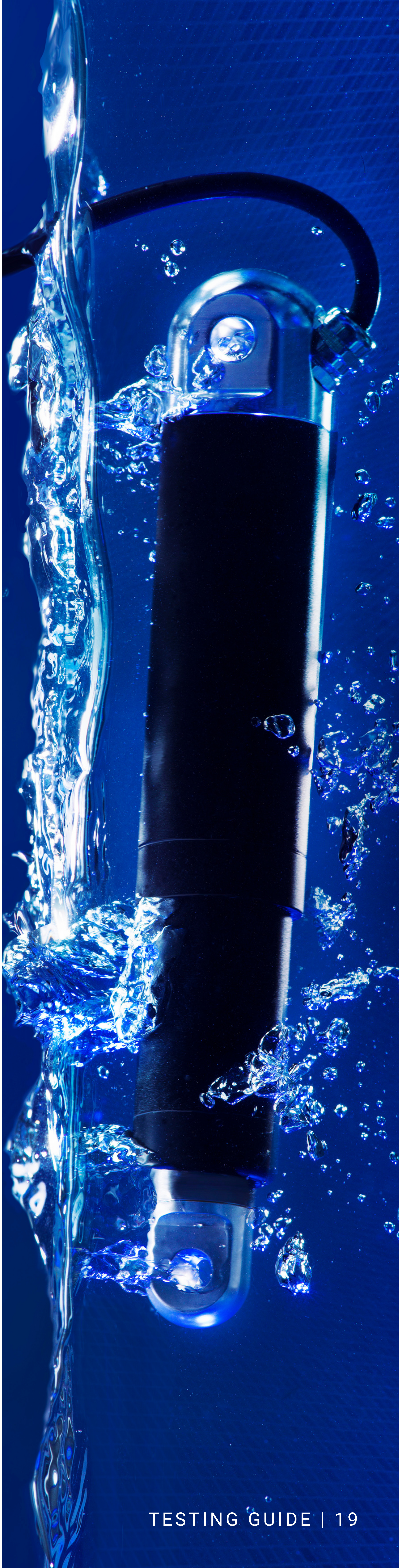

CHECKLIST FOR TESTING:

VISUAL INSPECTION	
Check specs on sticker	
Check build quality and finish	
Check for excessive grease residue	
Check H2H length	
BENCH TEST	
Check linear speed	
Check actuator current draw	
Check actuator sound for abnormalities	
Check actuator noise level (decibels)	
LAB TEST	
Check speed at true load	
Check system current draw	
Check environmental compatibility	
Check duty cycle	
Perform accelerated lifecycle test	

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