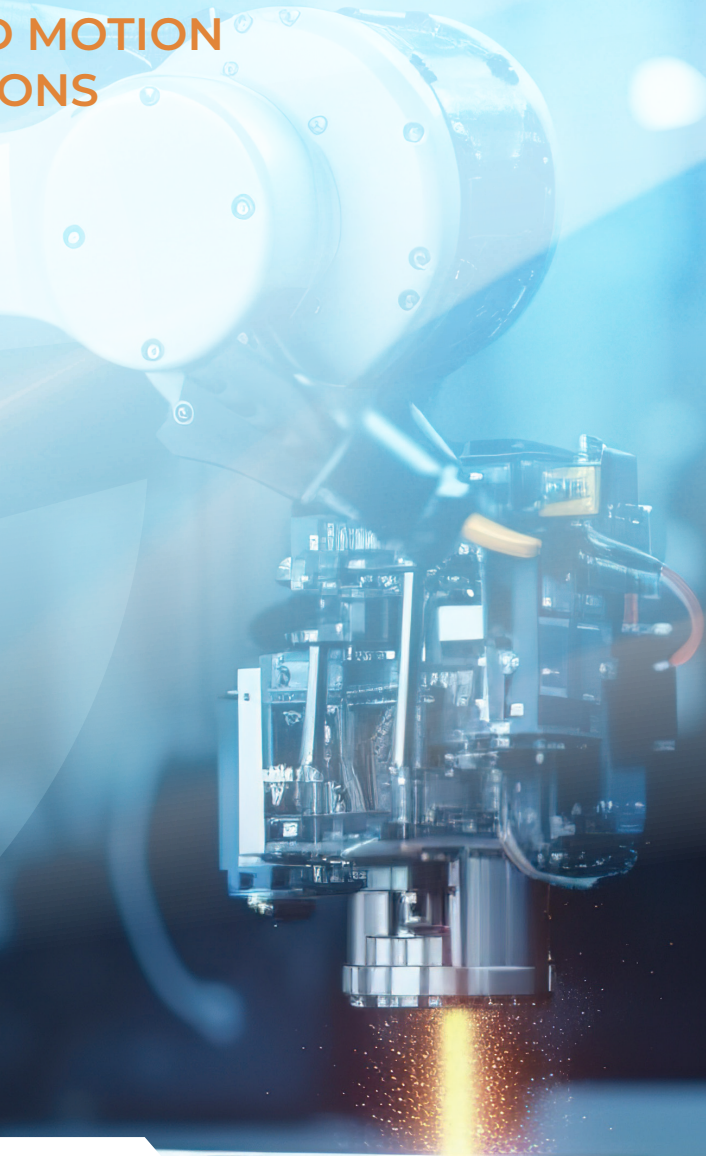
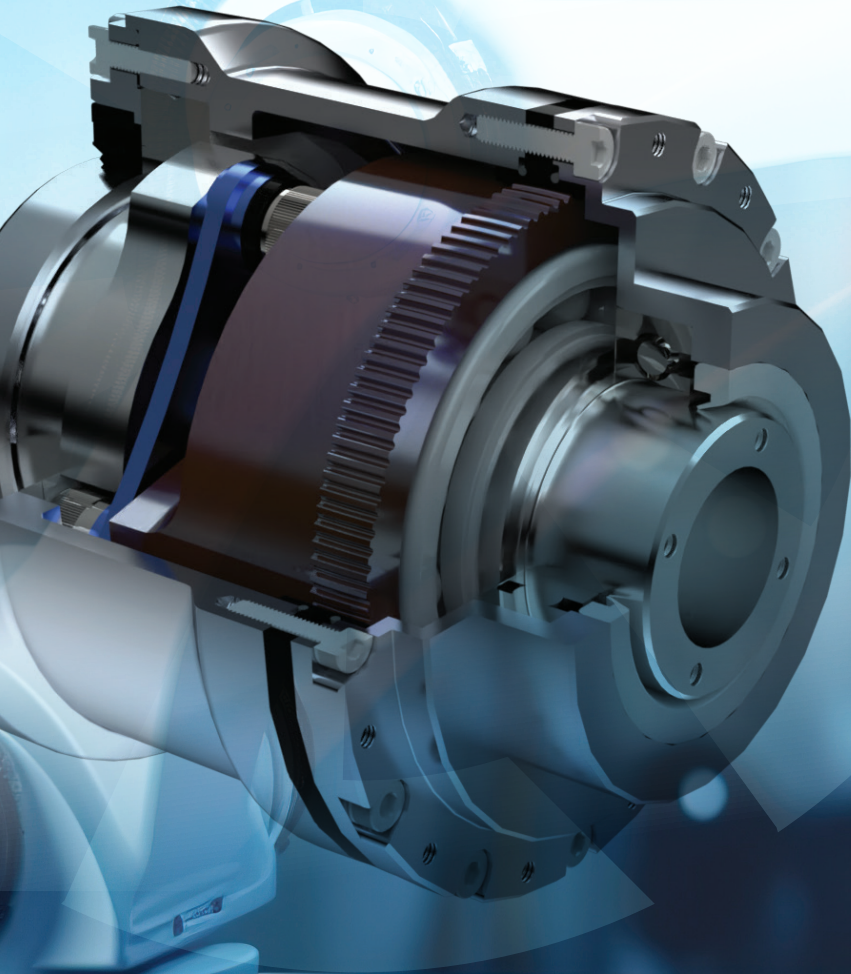




MOTUS LABS

PRODUCT CATALOG 2024

INNOVATING ROBOTICS AND MOTION
CONTROL GEARBOX SOLUTIONS



THE ML2000 PRECISION GEAR SERIES WITH **ORBITAL FLEX™ DESIGN**

17815 Davenport Rd. Suite 130, Dallas, TX 75252
(214) 983-1290

2024-02-20

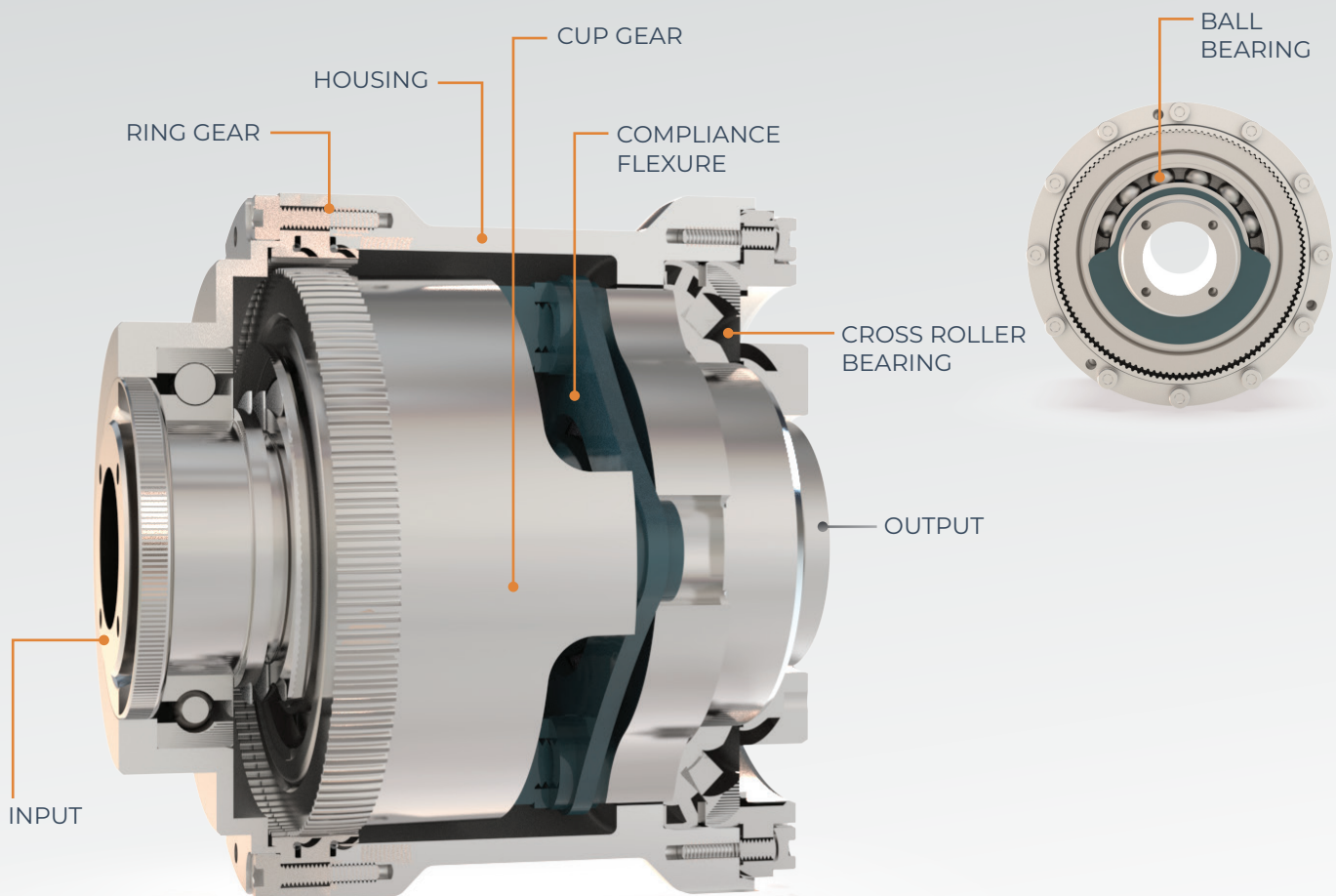
Motus Labs designs and builds precision gear solutions for robotic and motion control applications to enable superior actuator performance.

The ML2000 Series of precision gears delivers high torque, high rigidity, high positional accuracy, linear torsional stiffness and a cross roller output bearing, while maintaining zero backlash for 10,000 hours, unlocking new use cases within the robotics and motion control sectors. These gears feature our Orbital Flex™ design, which includes a rigid cup that orbits within a ring gear to eliminate backlash. To offset the cup's orbiting motion, a compliance flexure couples the input and output motion while transmitting torque.

HOW ORBITAL FLEX WORKS

Orbital Flex is the unique design approach behind the ML2000 Series. It incorporates a rigid cup—which we preload with a 1-degree angle bushing—that orbits within a ring gear, creating a zero-backlash speed reducer with high linear torsional stiffness. During operation, a flexible coupler called the compliance flexure offsets the 1-degree angle, smoothing out the output while delivering high torque and rigidity.

Like “a small cone resting inside a larger cone,” the points meet while the parts rotate, and the compliance flexure absorbs the angular motion. The compliance flexure is what allows the rigid cup to orbit within the ring and also supports the cup's orbiting motion around the ring.



APPLICATIONS



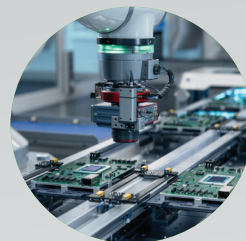
ROBOTICS



FOOD SERVICE



MACHINE TOOLING



ELECTRONICS



MEDICAL DEVICES



WAREHOUSE
AUTOMATION



PACKAGING

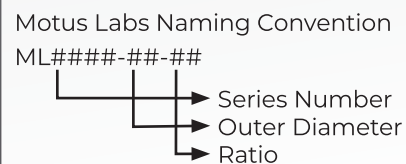
TECHNICAL SPECIFICATIONS

Contact sales for additional sizes and ratios.

ALL ML2000 GEARS DELIVER ZERO-BACKLASH AND LESS THAN 70dB AT RATED.								
MODEL	RATED TORQUE	REPEATABLE PEAK TORQUE*	RATED INPUT SPEED*	REPEATABLE PEAK INPUT SPEED*	EFFICIENCY*	TORSIONAL STIFFNESS	POSITIONAL ACCURACY (ONE WAY)	MASS
	Nm	Nm	RPM	RPM	%	Nm/Arcmin	Arcmin	Kg
AVAILABLE								
ML2000-86-60	45	75	2000	4000	64	7	2	1.5
COMING SOON THE 100:1 VERSIONS								
ML2000-75-100	20	35	2000	4000	TBD	4	3	1
ML2000-86-100	65	90	2000	4000	TBD	7	2	1.3
ML2000-97-100	130	195	2000	4000	TBD	15	2	1.9
ML2000-115-100	270	400	2000	4000	TBD	30	2	4.6

*Under defined conditions

**Rated speed in ambient room

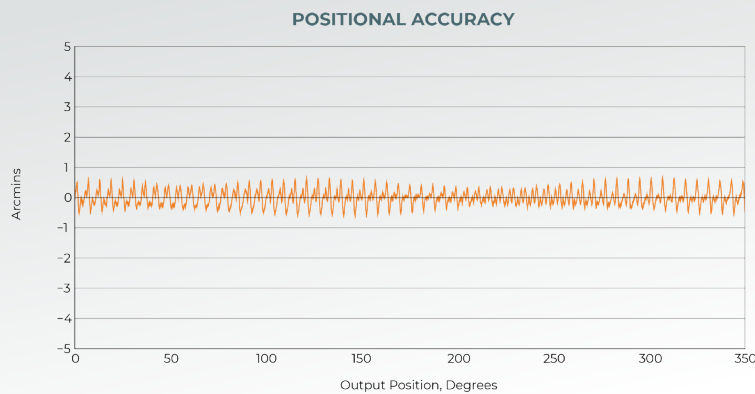


TECHNICAL CHARTS

The following chart values only apply for the ML2000-86-60.

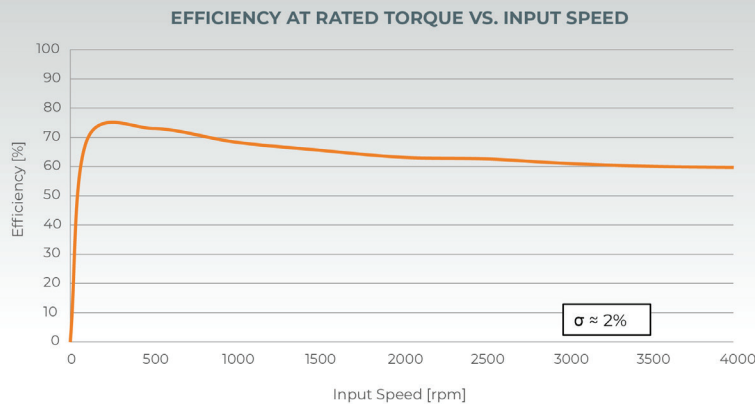
Positional Accuracy

Positional accuracy is the difference between the actual and theoretical output angle of rotation, taken as the difference between the maximum and minimum points of the output after a full 360-degree rotation.



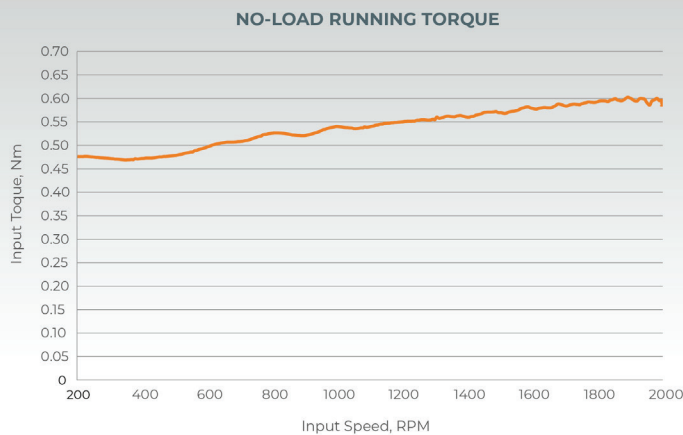
Efficiency

The efficiency of the ML2000 series is dependent on the input speed, output load and operating temperature of the gear reducer—as shown in this sample plot of the efficiency at rated torque for a series of different input speeds.



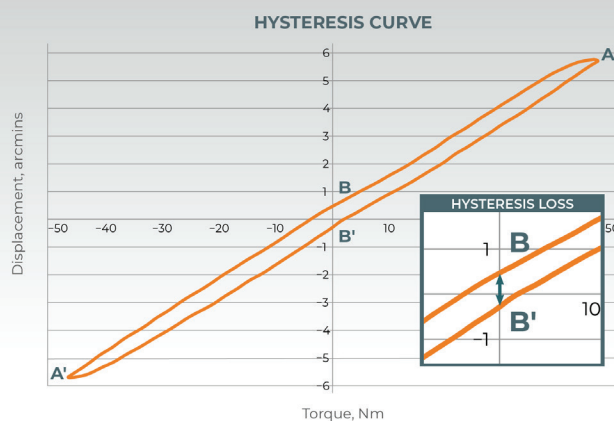
No-Load Running Torque

No-load running torque is the torque required to run the gearbox without applying a torque load to the output.



Hysteresis, Lost Motion and Torsional Stiffness

Hysteresis loss is a result of internal friction and it is measured as the difference of the angle between the intersections of the curve and where torque is 0 Nm. Torsional stiffness is the amount of angular deflection present in the input when applying certain torques. Multiple factors can lead a system's position to deviate, resulting in lost motion.



ADVANTAGES

High Torque and Stiffness With Zero Backlash

The ML2000 with Orbital Flex technology is an innovative, patented gear design that offers accuracy and eliminates backlash, all in a maintenance-free package. At the same time, it achieves high torque and linear torsional stiffness.

Higher Performance Versus Traditional Gear Platforms

Unlike strain wave gears, which use flexible gears to engage the teeth, the Orbital Flex rigid cup eliminates backlash, achieves high precision and provides consistent performance without flexing the gear itself. Compared to lower-precision planetary gears that still introduce some backlash into the system, the Orbital Flex rigid teeth engagement delivers linear torsional stiffness with more precision with a consistent OD across gear ratios. And because the teeth are the only point of wear, Orbital Flex gears have a longer lifespan than gear platforms with multiple fatigue and wear points. In addition, unlike heavy and expensive cycloidal gears, Orbital Flex gears require minimal components, resulting in a compact form factor while delivering high torque with precise output.

Designed, Manufactured, Assembled and Tested in the U.S.A.

The Motus Labs headquarters is located in Dallas, Texas. We manufacture, assemble and test all of our precision gears at our Dallas facility, ensuring each unit achieves consistent specifications for 10,000 hours.



LIFE TESTING JOURNEY

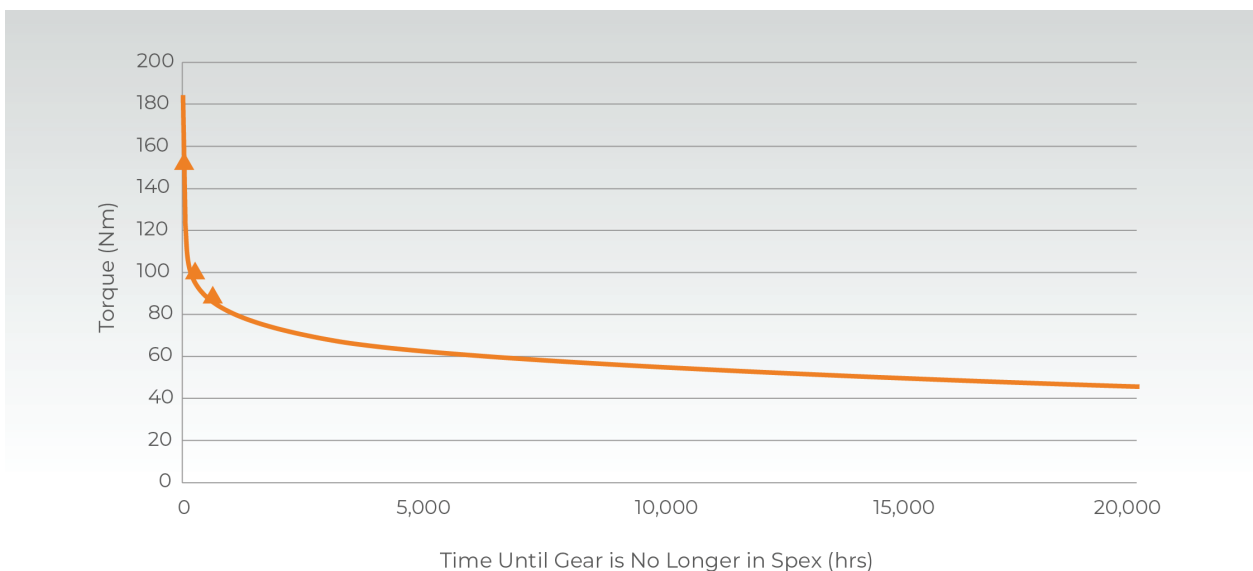
As a research and development (R&D)-focused company, we believe quality control and testing are critical. Our testing group is responsible for test execution and validation, ensuring each ML2000 unit meets specifications to a target time of 10,000 hours. The goal is to determine gearbox characteristics at the point of failure, what causes the failure and how many hours of operation the gearbox delivered at the rated torque prior to failure. We have also partnered with a third party company, [Stress Engineering Services INC.](#), to confirm our approach and validate our [results](#).

Accelerated Life Testing. We run gearboxes at higher, unsupported torque levels at high speeds and until failure is seen. The goal is to fail the gears quickly in order to identify gearbox characteristics prior to failure, as well as the cause of failure. During data analysis, the gears exceeded their initial 10,000-hour target without any failure or degradation to key specifications. For example, backlash did not exceed the 17-arcsec threshold.

Standard Life Testing. We run the gears at a desired torque and speed to confirm the results of the Accelerated Life testing.

Degradation Testing. Due to the gears' superior performance during Accelerating Testing, we also perform Degradation Testing, which involves continuing to test gears on the Accelerated Life and Standard Life benches until failure. The test consisted of three different torque levels with three gears tested for each level. Gears were periodically removed to test for backlash. Once a gear exhibited backlash greater than 17 arcsec, testing ended for that gear and the accumulated run time was recorded. Degradation results are in the accompanying chart.

For the full report, visit our [website](#).



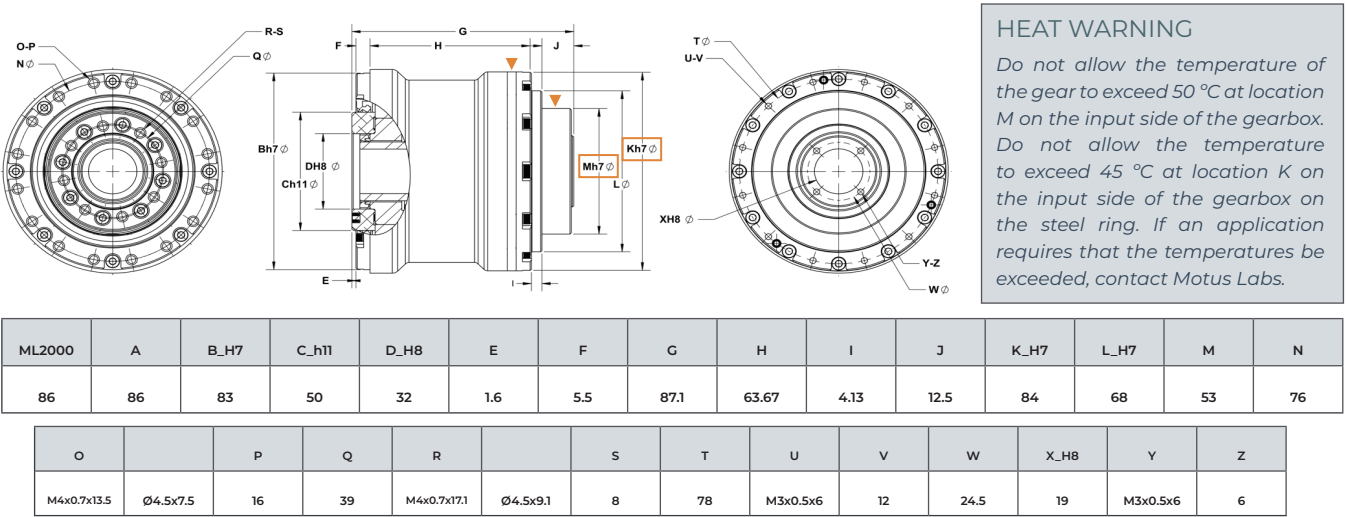
RECOMMENDED MOUNTING INSTRUCTIONS

Gearbox (see O-P in Figure 1). Mount the ML2000 Series to the machine using (16) M4 screws of the output presser, which will hold the gearbox in place. Tighten these screws to a maximum torque of 4.8 Nm in a star pattern. Gearbox can also be mounted U-V.

Gearbox Output (see R-S in Figure 1). Mount to the ML2000 output using (8) M4 screws, tightened to a maximum torque of 4.8 Nm in a star pattern.

Gearbox Input (see Y-Z in Figure 1). Mount to the ML2000 input using (4) M3 screws, tightened to a maximum torque of 2.4 Nm.

Please note—designing a stiff adapter system to the gear output is critical to get the maximum amount of torsional stiffness out of the drive. The bolted connection to the output should be highly stiff. We advise you to use steel bolts with as little length as possible.



ONLINE ENGINEERING RESOURCES

ML2000 Engineering Calculations Guide

Contains the calculations and formats used in determining things like maximum moment load and cross roller bearing calculations.

ML2000 Safety & Handling Instructions

Contains guidance on the correct way to handle the gear and precautions.

ML2000 Stress Engineering Services Review

Stress Engineering Services review on how Motus Labs performed degradation testing and results.

ADDITIONAL INFORMATION

Ordering, shipping and delivery. To request a quote, visit our online contact form. Our typical delivery time frame is 3 to 4 weeks. Delivery for orders over 30 gears will be quoted at the time of order. Expedited deliveries are also available. Shipping options include next day air, two day or standard ground delivery and will be quoted at the time of order.

Customizations. Custom gears are available, and we welcome a solution-based approach.

Handling. Designed as a precision gearbox, the gear should be handled and cared for in the same manner as any other precision device.

Warranty. Our standard warranty is 1 year. For more information, read the Motus Labs Warranty.

Other products. In addition to our precision gears, we offer Quick Integration Kits (QIK) that enable you to quickly and easily integrate ML2000 gears with a motor of choice to keep your project moving forward. To get started simply specify the motor you will use, including the manufacturer, model and CAD drawing. Then, specify the ML2000 gearbox size you need.

ABOUT MOTUS LABS

Headquartered in Dallas, TX, Motus Labs, LLC., designs and manufactures next-generation precision gears for the automation and robotics applications of today and tomorrow. Our innovative and patented gear architecture achieves higher precision, higher torque density, a more compact size and lighter weight than other gears on the market. From lab to launch, Motus Labs is where robotic imagination meets revolutionary innovation.



CONTACT US

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