

**Load Gauge Technical Paper**  
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**Subject:**

Load gauges for aircraft tripod and axle jacks.

**Introduction:**

Many of our customers have requested information regarding the application, calibration and necessity of load gauges used on Malabar aircraft jacks. The following information is provided to address these issues and is based upon Malabar's years of experience in supplying and maintaining this type of equipment.

**Malabar Official Policy:**

Load gauges are optional equipment and therefore are not deemed mandatory for the operation and use of our aircraft jacks.

**General:**

The industry standard load gauge is essentially a pressure gauge which has been fitted with a special load scale face which indicates approximate load (U.S. tons and/or pounds) that the jack is supporting. In addition to the load scale, most load gauges retain their pressure scale (psig) for increased functionality. The load gauge (refaced pressure gauge) measures the internal fluid pressure in the jack cylinder. The resultant load is derived from the internal cylinder pressure times the inside area of the cylinder ( $\text{force} = \text{pressure} \times \text{area}$ ). To determine the inside area of the cylinder, the cylinder bore must be known. All gauges furnished by Malabar have the cylinder bore diameter conveniently printed on the gauge face. Cylinder area is derived from the cylinder bore diameter squared times pi divided by 4 ( $\text{area} = \text{dia} \times \text{dia} \times 3.1416 / 4$ ). Fortunately, the operator of the aircraft jack doesn't need to be concerned with the above technical discussion, as he/she can read load directly off the load gauge face. As we will see later, this technical information will become important during calibration of load gauges.

A load gauge does not accurately measure the actual load. It's only purpose is to provide an approximate indication of load. Several factors that contribute to reduced accuracy are: jack plunger(s) seal friction, side load induced plunger bearing friction, weight of plunger(s) and accuracy of the gauge. The gauges supplied by most jack manufactures are accurate to within 1/2 to 1 percent of full scale. Furthermore, load gauges can be adversely affected by mechanical shock and vibration. This is especially evident when jacks are frequently towed at high speed and over rough surfaces. Finally, many jacks are shipped to the customer with the gauge unmounted and packaged in a separate cushioned box since shipping overland may induce mechanical damage if mounted to the jack.

## **Load Gauges Used on Axle Jacks:**

This is the most severe application for a load gauge since axle jacks from 35 to 85 ton are frequently towed at moderate to high speeds (above 5 mph). Many airlines, including American, Delta, Federal Express and United specifically request that axle jacks be furnished without load gauges. While load gauges are a costly option at time of order, they have determined that the gauge maintenance is even more costly. They consider knowledge of the actual jack load when changing tires and brakes to be superfluous.

## **Load Gauges Used on Tripod Jacks:**

Load gauges used on tripod jacks are specified in most cases. Tripod jacks are used to raise the total aircraft structure. Therefore, some knowledge of approximate load is useful to ensure the aircraft is level and the load is properly distributed by the three primary jacks during lifting and lowering. Tripod jacks are usually towed at very low speeds due to the inherent structure and foot pad ground clearance. Furthermore, many airlines store tripod jacks within the hanger, reducing the potential for damaging the load gauge by repeated towing and environmental conditions.

## **Calibration of Load Gauges:**

Many airlines maintain a "master gauge and pump unit" in order to calibrate jack load gauges. All Malabar wide-body tripod jacks are supplied with a gauge isolation valve and tee to facilitate calibration. Smaller Malabar tripod jacks and axle jacks utilize a gauge line that can be easily disconnected in order to perform calibration. The technician performing the calibration will have to prepare a table which shows the equivalent dial reading in psig on the master gauge to tons reading on the load gauge. The table should be assembled using the equations presented above in the section labeled "General". Let's create an example table using the load gauge for model 759A 50 ton Malabar tripod jack. First, note the cylinder bore size printed on the gauge face. The model 759A gauge face reads "TONS ON 6.280 DIA BORE". Perform the following calculations at 1000 psig:

$$\text{dia} = 6.280 \text{ inches}$$

$$\text{area} = 6.280 \times 6.280 \times 3.1416 / 4 = 30.975 \text{ square inches}$$

$$\text{force} = 1000 \text{ psig} \times 30.975 \text{ sq in} = 30,975 \text{ pounds}$$

$$30,975 / 2000 = 15.49 \text{ U.S. tons}$$

The table can now be assembled:

<b>Master Gauge (psig)</b>	<b>Load Gauge (U.S. ton)</b>
1000	15.49
2000	30.97
3000	46.46
4000	61.95
5000	77.44

Since this is a 0-5000 psig gauge, do not test above 5000 psig.

Many load gauges are not easily calibrated in place due to the gauge needle configuration. Some needles do not incorporate an adjustment screw. These needles are pressed on the indicating drive shaft and require a special gauge tool for removal and replacement. In these cases, we recommend the gauge be removed and sent to a shop for calibration.

Load gauge calibration intervals vary with airline policy. Some specify every 6 months, most specify every 12 months while others specify every 24 months. Gauge calibration for jacks that are subjected to rough use, frequent towing or other in-service considerations should be done more often.

We recommend to start out at every 24 months for tripod jacks and every 6 months for axle jacks. If most gauges do not require adjustment at these time periods, then this interval should be satisfactory. However, if many are not within tolerance, the calibration interval should be shortened accordingly.