Operating and Service Manual

SLIP RING TORQUE SENSOR
1100 Series

WARNING—SEE SAFETY NOTE INSIDE TO AVOID THE POTENTIAL FOR PERSONAL INJURY.
INTENDED USE

Rotating shaft torque sensors are intended for use between a power source and its load. They may be used to measure the power output of a drive (such as an electric motor) and a suitable load. They are also used to measure the torque required to operate a given load.

In simple terms, a rotating shaft torque sensor is an instrumented jack shaft. The housing serves to hold brushes that provide electrical connections between rotating slip rings and the stationary housing. It may be shaft supported or foot mounted. See page 3 for mechanical set-up.

SAFETY NOTE

Personal injury to the operator, as well as damage to equipment can result if the torque sensor is operated beyond the ultimate overload (300% of the rated capacity) or ultimate extraneous load limits (200% of the extraneous load limits on page 3) or higher than maximum rated speed. When in doubt consult the factory.

Safety shield guards should be installed over all exposed rotary components to protect the operator from injury in case of malfunction.

Certificate of Conformance and Calibration Traceability

This is to certify that the products described herein meet the specifications and performance requirements described in this manual. Test reports and other pertinent information are on file and are available for inspection by your representative and/or the U.S. Government representative upon request.

Calibration was performed with a test system utilizing a reference load cell or deadweights and an electronic indicator. The test system was within current calibration requirements at the time of the test and is traceable to the U.S. National Bureau of Standards.

Limited Warranty—Product Liability

The Company's products are warranted to be free from defects in material and workmanship for one year from date of shipment from the factory. The Company's obligation is limited to repairing, or at their option, replacing products and components which, on verification, prove to be defective, at the factory in Troy, Michigan. The Company shall not be liable for installation charges, for expenses of Buyer for repairs or replacements, for damages from delay or loss of use, or other indirect or consequential damages of any kind. The Company extends this warranty only upon proper use of the product in the application for which intended and does not cover products which have been modified without the Company's approval, or which have been subjected to unusual physical or electrical stress, or upon which the original identification marks have been removed or altered. Transportation charges for material shipped to the factory for warranty repair are to be paid by the shipper. The Company will return items repaired or replaced under warranty prepaid. No item shall be returned for repair without prior authorization from the Company.

Whenever the design of the equipment to be furnished or the system in which it is to be incorporated originate with the buyer, manufacturer's warranty is limited specifically to matters relating to furnishing of equipment free of defects in material and workmanship, and assumes no responsibility for implied warranties of fitness for purpose or use.
OPERATING PRINCIPLES

Lebow Torque Sensors consist of specially designed structures which perform in a predictable and repeatable manner when a torque is applied. This torque is translated into a signal voltage by the resistance change of strain gages which are applied to the torque sensor structure. The change in resistance indicates the degree of deformation, and in turn, the torque on the structure.

The strain gages are connected in a 4 arm (Wheatstone Bridge) configuration, which acts as an adding and subtracting electrical network and allows compensation for temperature effects as well as cancellation of signals caused by extraneous loading.

A fixed excitation voltage is applied between A and D of the bridge. A torque applied to the structure unbalances the Wheatstone Bridge, causing an output voltage to appear between B and C. This voltage is proportional to the applied torque. When the shaft of a torque sensor is rotating, means must be provided to transfer the signal voltage from the rotational element to a stationary surface. This is accomplished through the use of slip rings.

Mechanical Set-Up

Floating Shaft Mounting (housing unsupported)
When mounted (housing unsupported) a good quality, "single flex" coupling should be used on each end of the torque shaft to connect it to your drive and loading devices.

All standard torque sensors in this series are provided with precision ground shaft diameters, and double keyways on each end. Any coupling used should be sized to achieve a light press or slip fit on the shaft. Install a full length key in each keyway provided. The keys can be made from commercially available key stock, and should be precision fitted.

Inline mounting requires that the housing assembly be restrained from rotating. A housing is provided with a tapped hole for mounting a restraining strap. The restraining strap should be relatively flexible. Woven wire straps or light nylon webbing are acceptable.

Foot Mounting (housing supported)
When installing your torque sensor with the foot mount option, we recommend installation of a "double flex" coupling on each end of the torque shaft which will compensate for angular and parallel misalignment.

After proper alignment is verified, at least two dowel pin holes should be drilled through the foot mount plate into the surface below. Installation of dowel pins will aid in realignment should the torque sensor be removed and reinstalled at a later date.

The same precision fitting requirement outlined above applies. Foot mounting requires that the torque shaft be aligned as well as possible with drive and loading device. Ideally, it should be within .001 inches per inch of shaft diameter. Consult coupling manufacturer for selection of the best couplings for your application.

Extraneous Loads Limits
When an inline mounting of the torque sensor shaft is not possible, where pulley sprockets or gears are required, this will cause extraneous loads and bending moments on the torque sensor. These loads and moments must not exceed the limits defined by the following equation:

\[ F \leq \frac{T}{4} \]
\[ F \times N \leq \frac{T}{4} \]
(Whichever is attained first)

Where:
- \( F \) = side force (lbs.)
- \( T \) = rated capacity of sensor (lbs.)
- \( N \) = distance from centerline of pulley or sprocket to end of housing (inches).

Flange Mounting
The standard 1115 series torque sensors are supplied with splined shaft ends and flanged housing to conform to AND specifications. The components to which this torque sensor is mounted must conform to the same specifications. The outside dimensions supplied in this manual gives the dimensions of both splines and mounting flanges for reference.

Before installing this model, lubricate both the splined shaft ends with a high melting point, high pressure lubricant. The splines should be relubricated periodically.
Electrical Connection, All Series

A wiring schematic is supplied in this manual, showing the function of each pin of the torque sensor receptacle. It should be followed when connecting your instrument cable to the mating connector (supplied with each torque sensor).

Use only shielded cable to connect the sensor to the indicator. The use of Belden Cable (or equivalent quality) is recommended. Use Belden 8723 for cables 20 feet or less. Use Belden 8725 for cables over 20 feet.

Use a high quality 60/40 rosin core solder for soldering operations. After soldering operations are complete, be sure to clean all connections thoroughly with rosin solvent.

Check all connections for continuity; be sure there is at least 5000 megohms resistance between adjacent pins of the mating connector with 50 VDC applied.

Connections to the readout instrument should be made in accordance with the manufacturer's instructions.

WIRING

When connected as shown, output goes up-scale (positive) for clockwise torque. WestERN Regional Code.

Maintenance — Routine Maintenance Not Requiring Complete Disassembly

Cleaning the Slip Ring Assembly
Cleaning of the slip rings is indicated when a "noisy" or erratic torque signal is observed.

Access to the slip ring assembly is gained by removing the brush carrier assembly. Wash the slip rings and their epoxy carrier with a low residue solvent, such as from TT, applied with a gauze pad or a lint free cloth.

After cleaning the slip ring area, use the same procedures to clean the inner surfaces of the brush carrier assembly. Use "Q-TIPS" to clean the bore of the brush holders.

CAUTION: Do not submerge the brush carrier in the solvent. This may cause the insulation to loosen or swell.

Replacing the Brushes
Brushes should be changed when their length is less than ¾", or if they become oil soaked or otherwise damaged. (See figure on this page.)

It is not necessary to remove the brush carrier to change the brushes. Remove the insulated brush caps. This will expose the brass cap and spring of the brush assembly. Pull firmly on the spring and cap to remove the entire brush assembly.

NOTE: If any brush is stuck, and cannot be pulled out, the brush carrier should be removed and the brush knocked out with a small drift punch. Be sure to support the brush holder so that it will not be loosened.

When replacing the brush assemblies, note that each brush has a groove cut in one side. There is a corresponding dimple in each brush holder. The groove and dimple must be aligned. Bouncing the brush assembly in the brush holder will produce a sharp metallic click if they are in proper alignment.

Servicing the Air Brush Lift Option
The air cylinder supplied with this option seldom requires servicing, except when a contaminated air supply is used.

Normally, a 60 to 90 P.S.I. air supply is required for satisfactory operation. The brushes are engaged when air is on. If a malfunction of the air lift is observed, first check the air supply pressure.

NOTE: Air pressure only moves the piston; it does not control brush pressure.

If the air supply pressure is correct, remove the air cylinder from the torque sensor. Remove the "snubber" (a gray colored fitting on the air cylinder used to slow down closing of the brush carrier) and thoroughly clean both parts in solvent. Relubricate the air cylinder plunger rod. Install the cylinder and snubber on the torque sensor, and reconnect the air supply.

If the air lift continues to malfunction, consult the factory.

Maintenance — Requiring Complete Disassembly of the Torque Sensor

Do not attempt the following procedure without reading the entire procedure and studying the assembly drawing and typical parts breakdown, page 7.

Bearing and/or Shaft Replacement
Remove the brush carrier assembly and magnetic pickup, (if supplied). Remove the snap ring at either end of the housing.

Place the torque sensor in an arbor press and press the sensor shaft assembly from the housing. The arbor press is necessary to provide a mechanical advantage.
Maintenance—Requiring Complete Disassembly of the Torque Sensor (Continued)

Do not apply excessive pressing force to the sensor shaft—very little force is required to remove the shaft assembly. The housing must be firmly supported and aligned with the ram so that the shaft does not tilt as it is removed; otherwise the coin silver slip rings or the sensor shaft itself may be damaged.

NOTE: The sensor shaft must be supported so that it does not drop when the bearings clear the housing. (Bearings are a slip fit in the housing and a press fit on the shaft.)

Wrap the slip ring surfaces with a soft material such as tissue paper, and tape for protection during subsequent operations.

Carefully press the bearings from the sensor shaft observing the same precautions as described above. Proceed with the maintenance for which disassembly was required.

Damaged bearings may be replaced by the equivalent as shown in the "Recommended Spare Parts List" in this manual. We cannot recommend that the customer relubricate bearings, unless approved by the bearing manufacturer.

Resurfacing the Slip Rings

Place the sensor shaft assembly in a lathe and adjust for a run-out of less than 0.0005 inches (TIR) of the shaft bearing diameters.

Cut the rings with a sharp tool, using a fine feed to minimize tool marks. Turn each ring individually, removing only enough material to eliminate run-out and dents or scratches. Do not allow the tool to run into the epoxy insulation or the cutting edge may be dulled.

After the rings are turned, the epoxy should be undercut approximately 0.010 inches below the ring surface.

The ring surfaces may be polished lightly with 400 to 600 grit abrasive paper to remove tool marks. Slip ring run-out should not exceed 0.0005 inches (TIR).

NOTE: Do not polish the slip rings while the shaft is assembled in the housing, as abrasive material may enter the bearings. Clean the ring and insulator surfaces and proceed with assembly.

Assembly of Rotating Shaft Torque Sensors

Press both bearings on the shaft bearing journals. Install a snap ring in the brush carrier cavity end of the housing. Place the torque sensor housing in an arbor press with the brush carrier cavity down. Press the shaft assembly in until the lower bearing contacts the snap ring. Consult the assembly drawing for the exact arrangement of the parts.

Install the snap ring and shim (if used) in the housing. The sensor shaft should spin freely at this stage of assembly. Shaft end play should be two to six thousandths of an inch. If the shaft does not spin freely, the bearings have been preloaded by the pressing operation. Apply a light pressure to the shaft, with the press, in the opposite direction to relieve preload.

Install the brush carrier assembly. Install the magnetic pickup so that the tip just touches the counter gear then move back ¼ to ½ turn. Hold the pickup body and tighten the lock nut.

CAUTION: The threads are easily stripped. Rotate the shaft manually to be certain that the magnetic pickup does not touch the gear.

If you do not understand the procedures outlined herein, or desire any additional information, please call or write the factory.

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Brush Spring Selection Guide

All standard Lebow slip ring assemblies and rotary shaft torque sensors (except 1102, 1103, 1253, 6118 and 6142) use the 1488 series brush spring assembly. There are several possible spring pressures available.

- 10983-10: 8 psi spring (standard)
- 10983-11: 15 psi spring
- 10983-12: 25 psi spring (low speed)

Notice that there are three spring pressures available.

There are two reasons for these variable spring rates:

1. In extremely dirty or oily environments, some contamination reaches the slip rings. A higher spring pressure than standard may provide a better "scrubbing" action, thus reducing required cleaning frequency.

2. In most applications, some level of vibration is transmitted to the slip ring assembly. As this vibration passes through certain frequencies, the brush-spring assembly may start to "bounce" on the slip ring, and sliding contact is lost. By installing higher spring rates, or by mixing spring rates, the "bouncing" can be eliminated, or we can insure that at least one brush per ring is in contact at all times.
TROUBLE SHOOTING

1. Check power and torque sensor connections to the indicator.
2. Check torque sensor cable for correct interconnection with indicator in use.
3. Verify the sensor excitation and output resistance as shown below.

CAUTION: Ohmmeter should not apply more than 10 volts to the torque sensor bridge.

4. Check bridge resistance to ground (case of sensor) with a 50 volt megohmmeter. Should be greater than 5000 megohms.

RETURN PROCEDURE

When returning a unit for service take care to package all material so as to prevent shipping damage. Transportation charges must be prepaid.

Please include a letter or report outlining the defect or complaint, as well as description of how the part was being used. Also give the name, telephone number, and complete mailing address of the person acquainted with the equipment being serviced so we can contact him if necessary.

CALIBRATION DATA

BRIDGE RESISTANCE (OHMS):
input ___________; output ___________

OUTPUT (MV/V):
   CW (+) ___________; CCW (-) ___________

NONLINEARITY (% of F.S.) ___________

HYSTÉRESIS (% of F.S.) ___________

SHUNT CALIBRATION: Resistor _________ k ohms

<table>
<thead>
<tr>
<th>Pins</th>
<th>Equivalent Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/A</td>
<td>CW (+)</td>
</tr>
<tr>
<td>B/D</td>
<td>CCW (-)</td>
</tr>
</tbody>
</table>

NOTE: An electrical signal equivalent to that produced by a known torque can be obtained by shunting one arm of the torque sensor's strain gage bridge with a precision wire wound resistor. Shunt resistor and equivalent torque values for this sensor are shown above. They are determined during factory calibration of the torque sensor. The values shown are valid only if the shunt is connected at or near the torque sensor and the indicator used has an input impedance of at least 50k ohms.

SPECIFICATIONS

SENSOR: 4 arm strain gage bridge

EXCITATION VOLTAGE: 20 VDC or VAC RMS Max.

ZERO BALANCE: Within 1% of rated output

REPEATABILITY: 0.05% of full scale

OVERLOAD: 150% of rated capacity

EFFECT OF TEMP. ON ZERO: 0.002% of F.S./°F

EFFECT OF TEMP. ON OUTPUT: 0.002% of reading/°F

COMPENSATED TEMP. RANGE: 70°F to 170°F

USEABLE TEMP. RANGE: -20°F to 200°F
Model 1104-1121

Disassembled view - Typical rotating shaft torque sensor with slip rings.

<table>
<thead>
<tr>
<th>Model</th>
<th>C</th>
<th>L</th>
<th>N</th>
<th>P</th>
<th>U</th>
<th>K</th>
<th>A</th>
<th>D</th>
<th>D</th>
<th>E</th>
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*100 and 200 lb. In. Units; U = \(\frac{1}{4}\)" K = \(\frac{3}{4}\)" Sq.

Optional Features and Accessories

**Foot Mounting**—Foot mount plate and housing available for models 1104, 1105, 1106, 1107, 1108, 1109, and 1114.

**Flanged Housing**—Mounting flanges on one or both ends of housing can be supplied on models 1104, 1105, 1106, 1107, 1108, 1109, 1114, 1118 and 1121. Consult factory.

**Splined Shafts**—Available for all models in place of standard keyed shaft ends. Consult factory.

**Brush Lifters**—Recommended for protracted runs in which continuous readings are not taken. When released, brushes do not contact the rings.

**Speed Sensor**—A 60-tooth gear and a magnetic pickup provides an output of 60 pulses per shaft revolution. On models 1104, 1105, 1114 and 1115 for speeds less than 200 RPM Zero Velocity Speed Sensor is recommended. On models 1106, 1107, 1108, 1109, 1228, 1241, 1248, 1118 and 1121 for speeds less than 100 RPM Zero Velocity Speed Sensor is recommended. Zero Velocity Speed Sensor not available on model 1102.

**Couplings**—Couplings to compensate for angular and parallel misalignment should be recommended and supplied by coupling manufacturers. Lebow will provide a list of manufacturers upon request but assumes no liability for their performance.

**Air Oil Mist Bearings**—Standard grease pack bearings should not operate for more than 200-300 hours continuous at rated speed or more than 1000 hours at 40% of rated speed. If exceeded, request air oil mist bearing option for 2000 hours continuous operation at rated speed. Air oil mist also provides approximately 40% higher speed rating. For the exact rating consult the factory.
Model 1115A-1115K

Dimensions

<table>
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<tr>
<th>Model</th>
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<th>B</th>
<th>C</th>
<th>D</th>
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<td>.984</td>
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<tr>
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Internal and External Spline Data

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<th>Pitch</th>
<th>No. of Teeth</th>
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<td>20/30</td>
<td>24</td>
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Storage and Recalibration

This torque sensor may be stored for an indefinite period at room temperature in a dry place.

While this method of system calibration is usually very reliable and accurate, it is recommended that the equivalent load values be periodically verified by calibrating the system with known, accurate mechanical means. Edmir Lebow recommends a maximum of one year between recertification.

Replacement Parts

Replacement parts are available. Consult factory for parts, price and delivery.

The items listed below were selected with minimum downtime as the criterion. Beyond actual physical damage or loss, the remaining components should not require replacement.

(1) Sensor Shaft Assembly — complete with Slip Ring Assembly and Factory Calibration, less bearings.

Part No.: ____________________________

(1) Brush Carrier Assembly — complete with Receptacle, wired and insulated, less Brush Spring Assemblies.

Part No.: ____________________________

(1) Bearing, shaft input end.
Manufacturer's Part No.: ____________________________

(1) Bearing, shaft output end.
Manufacturer's Part No.: ____________________________

(8) Brush Spring Assemblies Part No.: 10983-10

(8) Brush Holder Caps Part No.: 10781