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FASTENING TECHNOLOGY

DC Electric Assembly Tool Calibration

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Electric Assembly Tool Calibration

Torque

Method: Torque is measured by a torque transducer located inside the tool. A torque-induced strain is converted into an electric signal which is converted to a digital torque reading based on a **"calibration factor"**. Each tool model has a default **"nominal"** torque calibration factor which is calculated based on the nominal transducer sensitivity, the gear ratio and the average gear efficiency. Each physical tool has yet another separate **"specific"** calibration factor which further refines the calibration value for this particular tool.

The specific calibration factor is set by comparing the **"internal"** torque indicated on the tool controller readout with the actual torque measured by a master **"external"** torque measurement system. A number of sample readings are taken (we recommend 30) and the specific calibration factor is determined to bring the averages of these internal and external readings into agreement.

This procedure is best done **"dynamically"** with the readings occurring simultaneously while the tool is in operation. The new specific calibration factor is stored in the tool memory and automatically loaded on power-up into any controller to which the tool has been connected.

Variables: The calibration factor is affected by the torque transducer gage, the gear ratios in the tool, and by the efficiency of the gears. It is the change in gear efficiency throughout the life of the tool that will have the greatest effect on the specific calibration factor value. Often the gears will become more efficient after some use and then, near the end of their life, the efficiency will begin to decrease.

Torque transducers used in Stanley QPM tools are manufactured to the following specifications:

Sensitivity:	2.0 mV/V ± 0.5% at Full Load
Zero Offset:	± 2.0% of Full Load
Non-linearity:	± 0.25% of Full Load
Temperature Compensation:	+45°F to +200°F

The specific calibration factor limit for new tools is typically ±4% from the nominal value for a double-step, straight assembly tool and ±6% for the same tool equipped with an angle head. A specific calibration value outside these limits would indicate unusual gear efficiency or some other parts-related problem.

Validation: Once a tool has been put into service, torque calibration should be validated and adjusted at regular intervals, either time-based or cycle-based. A variation greater than the values for new tools is expected and does not necessarily mean the transducer is defective. To allow for normal wear and associated efficiency changes, we recommend setting a limit of ±8% from the nominal torque calibration value for straight tools and ±10% for angle tools. When this recommended limit is exceeded, the tool should be serviced and any worn gearing components should be replaced.

If a transducer has been overloaded, the Zero Offset and the Sensitivity values will most likely change. It is normally not necessary to remove the torque transducer from an assembly tool and inspect it as a separate unit. Stanley controllers allow you to check the Zero Offset and to determine when the transducer should be replaced.

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Angle

Method: The tool's angle calibration is a function of an output from the tool's angle sensor located in the brushless motor, and the tool's total gear ratio. The fixed sensor (analog resolver or Hall sensor) output signal is converted to angular position within the controller and used to measure angular rotation of the motor shaft. As with the torque calibration value, the angle calibration value is stored in the tool's memory at the factory.

Variables: The angle calibration value is basically the total gear ratio set when the tool is built and therefore never needs adjusting unless the total gear ratio is changed. We generally obtain ±1 degree accuracy at the output spindle, however any backlash (looseness) and/or load deflection in the gearing can cause this number to vary. In practice, zeroing and subsequently counting angle from a substantial "snug" torque greatly reduces this variation.

Validation: The angle calibration value can be validated by zeroing and then manually rotating the tool's output any number of full revolutions. The number of degrees indicated on the display should agree with the amount of rotation of the tool's output spindle. Alternatively, since the tool's indicated speed is derived from the same signal, simply comparing this indicated speed to that of a master tachometer can also quickly verify the angle calibration.

When an angle control fastening strategy is used, some users require that the indicated angle be compared to that of a master angle encoder. In-line rotary torque transducers are commonly available with built-in angle encoders. Since most angle control strategies require rotating a specified angle beyond a defined snug torque, a torque/angle monitoring device with this capability should be used as the master device. The user should be aware that even when the tool and the in-line torque/angle monitoring device are both programmed to measure angle relative to a snug torque, slight differences in torque calibration at this snug torque can result in large differences in the angular starting point.

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