Calibration Procedure

Introduction

This procedure provides instruction for calibrating Enerpac S & W Series Hydraulic Torque Wrenches.

In this context the term 'calibrate' relates to measuring the output torque of the wrench at a given input pressure. The wrench is operated at 5 different pressures evenly spread across the full operating range of the wrench. At each pressure the wrench is cycled 5 times and averaged. Enerpac S & W wrenches are designed to provide torque output accurate to +/- 3% of the stated working range.

When calibrating a wrench a calibration system is used, this system comprises of several pieces of equipment including, pump, gauges, transducer and readout all of which have their own levels of accuracy. When reviewing the end reading of the wrench these inaccuracies will also be included in the output reading, so they should be subtracted to provide the net accuracy of the wrench.

There are no adjustable components in the wrench to adjust the output torque, however, to gain maximum performance, the wrench should be cleaned and lubricated per the instruction manual.

A wrench which has a variation of more than 3% from the original stated working range is still acceptable for use, however, it should be accompanied by an updated calibration chart showing required pressure deviation (e.g. the stated pressure to achieve 1500lbs.ft is 5,000psi for an S3000, however, if the measured pressure to achieve 1500lbs.ft is 4650 psi , an operator will still achieve the correct required torque when operating the wrench at 4650psi.).

In the system of a low profile wrench a drive unit can be used with a range of different cassettes. It is therefore necessary to calibrate each cassette. Ideally the cassette would be calibrated with the drive unit it will be used with, however, the Enerpac drive unit design has a fixed hydraulic pressure area and has been tested to provide extremely consistent results so any variation from drive unit to drive unit is negligible and will not have material impact on the output accuracy of the wrench.

Determining the system inaccuracy:

A calibration system comprises several pieces of equipment. Each piece of equipment will have its own range of accuracy and should be well maintained with a current calibration record.

The key pieces of Equipment are:

- Hydraulic pressure gauge (used to monitor input pressure to the wrench)
- Torque Transducer (used to measure the output torque of the wrench
- Torque readout (used to display the results from the transducer)

To determine the system inaccuracy the following calculation should be used:

$$Uncertainty\ of\ the\ measurement\ system = D_r + K\sqrt{G^2 + T^2 + F0^2 + R^2}$$

The above calculation does not take into account effects from environmental factors such as temperature and air humidity.

D_r	Digital readout accuracy e.g.±0.1%
K	Coverage factor, standard = 3 for 99% confidence
G	Pressure gauge accuracy e.g.±0.2%
T	Torque transducer accuracy e.g.± 2.0%
F0	Contribution of initial zero position – if unknown use $^1/_{12}$ (0.083333) not required for "smart" transducers.
R	Repeatability – if unknown use 1.0%

$$Expanded\ uncertainty\ of\ the\ measurement\ system = \sqrt{Uncertainty\ of\ the\ measurement\ system^2 + Torque\ wrench\ accuracy\ (\pm 3\%)^2}$$

Calibration Equipment required

To perform calibration of a wrench the following equipment is required

- Torque calibration fixture (includes mounting for the transducer and suitable reaction points for type and capacity of wrench being calibrated)
- Output adaptors (may be required to adapt the output of the wrench to the calibration fixture and transducers)
- Calibrated transducers (sufficiently rated for the full output capacity of the wrench)
- Calibrated torque readout
- A Calibrated pressure gauge, preferably digital
- A suitable hydraulic power pack and hoses

Calibration Procedure

1. Ensure the calibration fixture is fitted with an appropriate capacity transducer and reaction points for the type and output of the wrench.
2. Ensure the wrench correctly interfaces with the calibration fixture, using adaptors where required.
3. Ensure the power pack and hoses have a calibrated gauge on the output to the wrench.
4. * Optional* We recommend prior to recording any readings, the wrench should be operated at 10,000 psi three times, whilst on the calibration fixture. This allows minimizes the effect of hysteresis in the wrench.
    a. Set the power pack pressure to 10,000 psi.
    b. Place the wrench on the calibration fixture and ensure that the wrench is ratcheted back towards the reaction point on the fixture such that the reaction arm/foot is as close to the reaction point as possible.

   c. Operate the wrench in advance and build pressure to 10,000psi, hold for one minute,
   d. Allow the wrench to retract.
   e. Repeat the operation a further two times.
5. Remove the torque wrench from the calibration fixture and set the power pack pressure to 2,000 psi.
6. Replace the wrench on the calibration fixture and ensure that the wrench is ratcheted back towards the reaction point on the fixture such that the reaction arm/foot is as close to the reaction point as possible.
7. Zero the torque readout.
8. Operate the wrench in advance,
   a. Record the readings (power pack pressure and torque output),
   b. Allow the wrench to retract.
   c. Repeat this step a further four times, recording the pressure and torque readings each time.
9. Repeat steps 5-9 increasing the hydraulic pressure at 2,000 psi increments up to 10,000 psi
10. Calculate the averages of the 5 readings at each of the 5 pressure points; plot the torque output graph using the 5 averages.
11. If the average reading at each plotted point is within +/- the expanded uncertainty of the measurement system of the stated working range the wrench can be claimed to be within calibration.
12. If the average reading at any of the plotted points is outside +/- the expanded uncertainty of the measurement system the wrench should be classified out-with calibration. In this case the new calibration curve should be plotted and a supplied with the wrench along with a statement advising that a deviated torque curve is required.