

IR Ingersoll Rand®

Sensor I® Expert Electronic Wrenches

USER MANUAL



SENSOR I[®] Expert

User Manual

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 NOTE

The wrench should only be used for its intended purpose, i.e., for tightening, loosening and auditing purposes. It should be operated using a smooth steady pull at moderate speed on the wrench handle with both feet firmly placed on floor. Specifications apply to the wrench only (without additional apparatus). Accuracies cannot be specified when the wrench is used with torque multipliers or if the wrench is operated incorrectly.

 NOTE

The used of universal joints is not recommended. Use of such devices may cause inaccuracies in torque and/or angle measurements. The use of extensions to the handle, or application of force to other parts of the wrench may cause damage, result in personal injury, or may result in inaccurate tightenings.

 NOTE

Exceeding the maximum torque noted on the wrench may cause damage to wrench or loss of calibration.

 NOTE

Always make sure that the socket is fully engaged on the joint before tightening begins. Failure to do so may cause inaccuracies in torque and/or angle measurements.

 NOTE

If the wrench fails to operate using the recommended procedures described in this manual, the cause of malfunction should be corrected by an authorized Ingersoll-Rand technician. For a list of authorized Ingersoll-Rand technician. For a list of authorized Ingersoll-Rand service centers, see Appendix D.

 NOTE

If calibration equipment is not available, it is recommended that the wrench be returned to an authorized Ingersoll-Rand service center for an annual recalibration.

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Application Guidelines for Accurate Use of the Expert Wrench

To all Expert wrench users

February 15, 1999

What distinguishes the Expert wrench from dial wrenches or other digital torque wrenches is one very significant feature: angle. The angle measurement allows users to accurately audit torque dynamically and perform sophisticated tightening methods such as angle and yield control.

The EZ Angle sensor is a major improvement over previous technology. The most obvious change is the removal of the external arm on the ratchet head-eliminating the space constraint. In addition, users no longer need to find a suitable place to attach the reference arm magnet.

Although the Expert wrench is a rugged industrial tool, to achieve precision results, it needs to be treated as a precision instrument. The following outline summarizes the ideal method of use:

Wrench Reset:

The reset process sets the zero reference for both torque and angle. The wrench must be held steady with no torque applied to achieve a good reset. It will indicate a fault if excessive torque or angle is applied while resetting.

For best results, attach the socket to the wrench and place it on the fastener or rest the ratchet head on a table. Hold in the Reset button until the green Run light illuminates and release. You can then move the wrench to the fastener, or begin tightening immediately. To achieve angle accuracy that is better than the documented performance specification place the entire wrench on a table and hold it completely still during reset. This will improve the angle accuracy to better than $\pm 2\%$ of the final angle.

Dynamic Audit:

The Dynamic Audit feature of the Expert wrench audits residual torque currently on the fastener after relaxation and other effects have taken place. On a very hard joint that is audited soon after tightening, this will consistently equate to installation torque. On a very soft joint or a joint audited long after the initial tightening, it may be considerably reduced.

Standard methods are open to variance from operator influence. Experienced auditors try to overcome these difficulties by watching the socket very closely and moving very cautiously. Other operators may have a tendency to pull the wrench until the expected value is reached. Although that specific bolt may end up with the correct torque, it does not tell Quality Control about any possible problems that are occurring with the fastening equipment on line.

The Expert wrench helps eliminate this operator influence by capturing the residual torque after a very small angle is turned regardless of how far or fast the wrench is pulled. In other words, all that is required is a quick pull and the processor takes a "snapshot" of the dynamic torque at the pre-set angle of turn.

To Dynamically Audit Residual Torque:

A table of audit angle values is provided for your convenience. The guiding principle is to set a sufficient angle of turn to ensure the bolt threads are moving when the torque snapshot occurs. The longer the fastener, the greater the required angle.

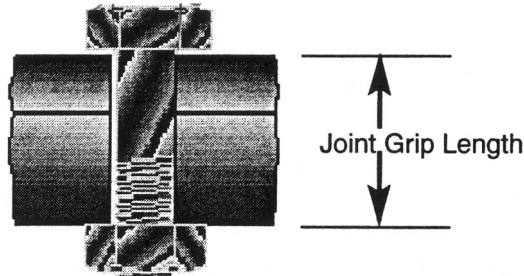
To ensure that an accurate reading is received, the following procedure should be followed:

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1. Set the snug torque to approximately 50% of the expected final torque reading.
2. Set the capture angle (see chart).
3. The operator must then pull the wrench approximately 30° over a period of no more than 2 seconds. Pulling the wrench past the desired audit angle will not have an adverse effect on the audit reading - it will be "captured" at the correct audit angle. The captured torque can be viewed when the parameter shown on the display is "Tq".

Joint Type	Joint Grip Length* (d = bolt diameter)			
	≤ 2d	2d - 5d	5d - 10d	>10d
Hard/Medium	2°	3°	4°	6°
Soft	2°	4°	6°	8°

*The grip length is the total length of the bolt located within the assembly pieces. Keep in mind that adding socket extensions will also call for an increase in angle.



This chart is offered as a guideline only. The optimum value for the capture angle will be influenced by the overall joints stiffness, joint configuration, and frictional conditions. Application testing is recommended to determine the most accurate value for the specific joint under audit.

To Tighten to a Torque

Set the torque value to your target torque, and set high and low torque and angle limits if desired. Snug is set automatically to a default value. This is the point from which the angle is activated. The default snug values for all models are listed in the TOLL DESCRIPTION Technical data table in Chapter 2. Reset the wrench before tightening. The OK light will go on and an alarm will sound when the target is reached. If the wrench is pulled too slowly for a long period (<10° per second for model 40, <5° per second for more than 5 seconds for all other models), the wrench will signal an error by sounding several short beeps.

To Tighten to an Angle

Set the snug torque and target angle as well as any high and low torque and angle limits. Reset the wrench before tightening. The Ok light will go on and an alarm will sound when the target is reached. If the wrench is pulled too slowly for a long period (<10° per second for 5 seconds for model 40, <5° per second for more than 5 seconds for all other models), the wrench will signal an error by sounding several short beeps.

To Tighten to Yield

Snug torque should be set to approximately 50% of the expected proof load torque of the bolt in use. Set any required torque or angle limits, and select your joint type-hard, normal or soft. Reset the wrench before tightening. The OK light will go on and an alarm will sound when the target is reached. If the wrench is pulled too slowly for a long period (<10° per second for 5

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seconds for model 40, <5° per second for more than 5 seconds for all other models), the wrench will signal an error by sounding several short beeps.

 **NOTE**

When using EVS-models, avoid ratcheting when the torque is in the vicinity of the snug torque and between snug and the yield point.

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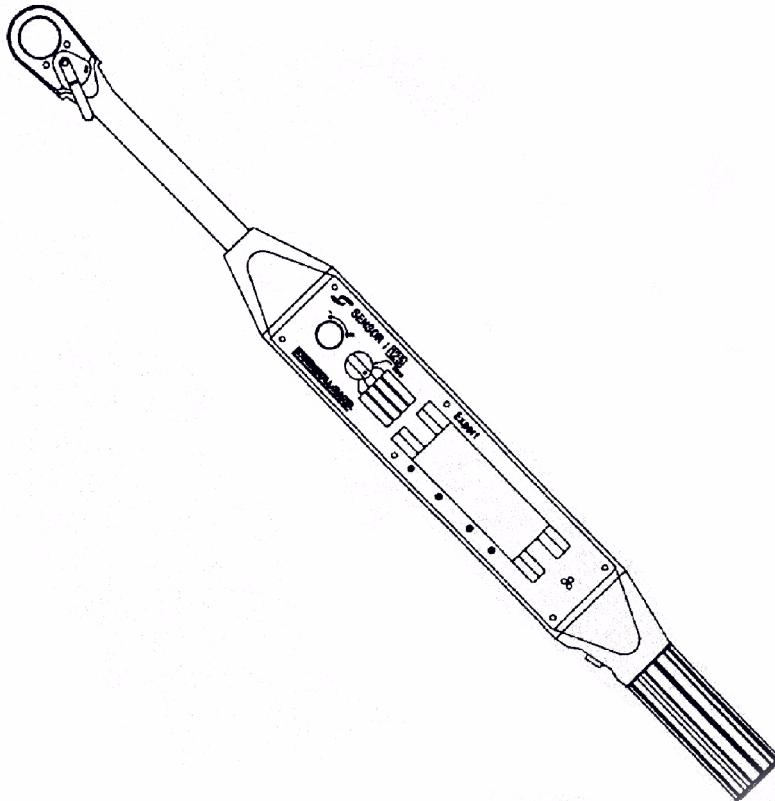


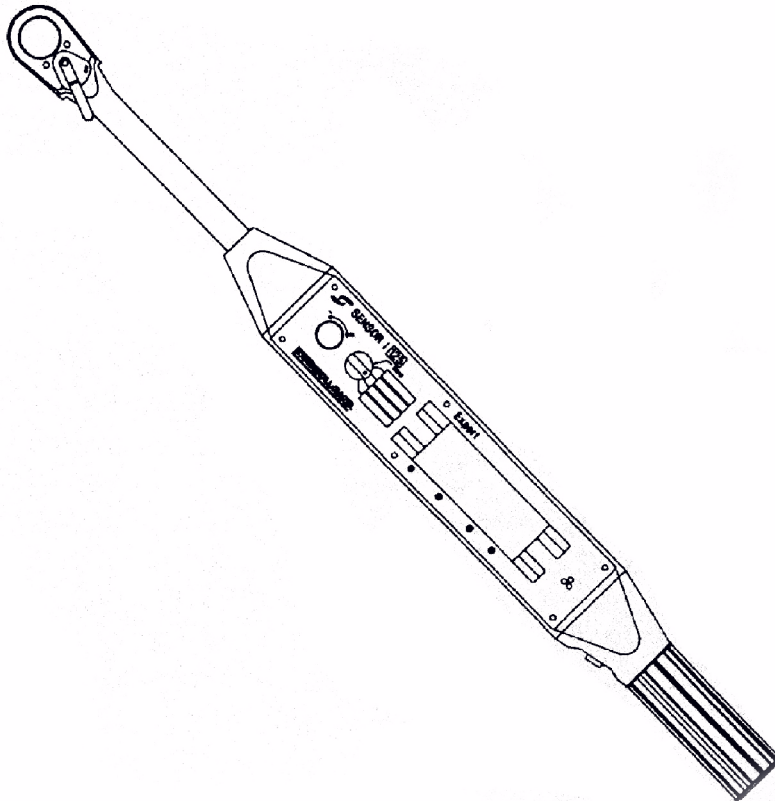
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CHAPTER 1

Introduction



INTRODUCTION

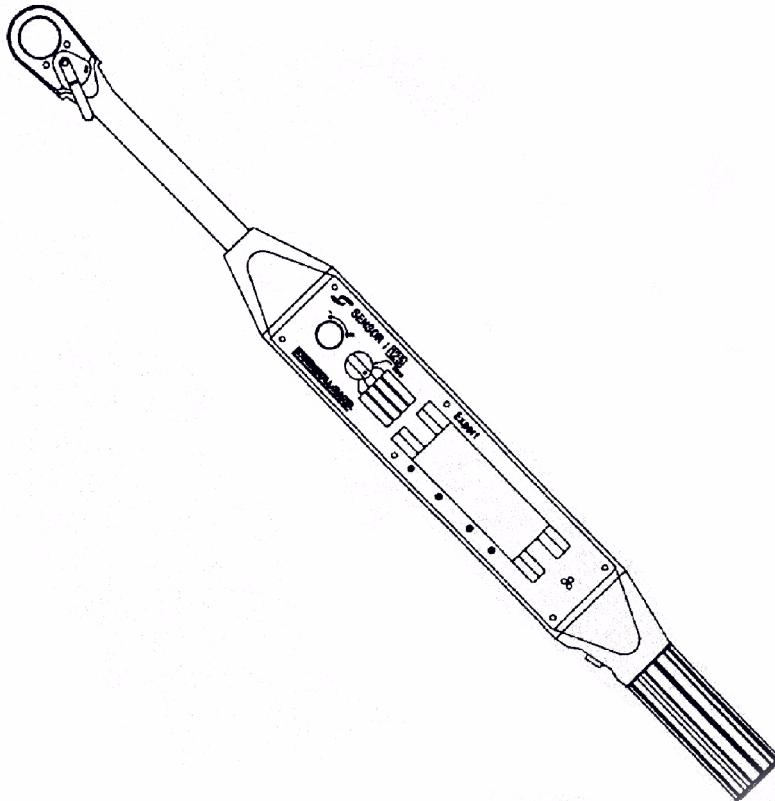
The SENSOR 1[®] EXPERT WRENCH is a hand-operated portable tightening system with a battery-powered microprocessor control system. In addition to standard torque and angle control tightening capabilities, it provides a Yield Control mode of tightening and Dynamic Torque Auditing. It is suitable for laboratory, production, quality control, maintenance and field service.

The control system is powered by a rechargeable NiMH battery located inside the wrench handle (model 125, 250 & 400) or in the lower portion of the control unit (model 40). The wrench has a toggle lever used to select the ratchet direction. Angle reference is either measured internally by the EZ angle or via an attachable spring arm with a magnet (EA-models). Attachable spring arms can be fitted with options such as suction cups or alligator clips.

The digital display shows a digital readout of either dynamic torque peak torque, or angle. Audible signals and displays indicate the completion of tightening for Dynamic Torque Audit, Torque Control, Yield Control (elastic limit of bolt), or Angle Control procedures.

CHAPTER 2

Tool Description



TOOL DESCRIPTION

<i>Technical Data</i>	40	125	250	400
Length:	13.5" (343 mm)	26" (665 mm)	42.5" (1080 mm)	48.5" (1232 mm)
Square Drive:	3/8" (9.5 mm)	1/2" (12.5 mm)	3/4" (19mm)	3/4" (19 mm)
Weight:				
Tool	2.4 lb (1.1 Kg)	5 lb (2.3 Kg)	12 lb (5.5 Kg)	13.8 lb (6.3 Kg)
Control Unit	2.2 lb (1.0 Kg)			
Torque Operational Range:	4.5-45 Nm (45-450 dNm) 3.3-33 lb.ft. (40-400 in-lb)	20 - 170 Nm 15 - 125 lb.ft.	108-340Nm (80-250 lb.ft)	130-540 Nm 100-400 lb.ft
Minimum Snug Torque (default value for Torque control mode)	2.3 Nm (23 dNm) 1.7 lb.ft. (20 in-lb)	10 Nm (7 lb.ft.)	24 Nm (18 lb.ft.)	24 Nm (18 lb.ft.)
Torque Resolution:	1 in-lb	0.1 Nm	0.1 Nm	0.1 Nm
Torque Accuracy: Full Scale	± 1 %	± 0.5 %	± 0.5 %	± 0.5 %
Maximum Angle:	1999°	1999°	1999°	1999°
Angle Resolution:	1°	1°	1°	1°
Angle Accuracy:				
Angle Reference Arm (EA-models)	±1°	±1°	±1°	±1°
EZ Angle* (EVS-models)	±4 %	±4 %	±4 %	±4 %
Power Supply Voltage	7.5 V	7.5 V	7.5 V	7.5 V
Operating time between charges	5.5 hours	5.5 hours	5.5 hours	5.5 hours
Charging time	14 hours	14 hours	14 hours	14 hours
Battery Charger Input Voltage	220/110 V	220/110 V	220/110 V	220/110 V
Operating Temperature Range	0-50° C	0-50° C	0-50° C	0-50° C
* Under recommended conditions				

 NOTE

These specifications apply to the wrench and its control system only (without additional apparatus). Accuracies cannot be specified when the wrench is used with torque multipliers or if the wrench is operated incorrectly.

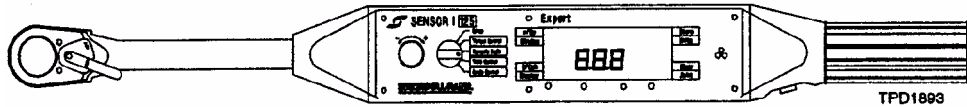
 NOTE

The use of universal joints is not recommended. Use of such devices may cause inaccuracies in torque and/or angle measurements.

 NOTE

Exceeding the maximum torque, noted on the wrench, may cause damage to wrench or loss of calibration.

Functions of Components



Expert 125, 250 and 400 Models

Wrench Housing

Incorporates all the electronics and digital display.

Wrench Handle

Houses the charger/data port connector for battery charging and serial port communications.

Wrench Head

Contains the angle reference arm potentiometer (EA-models) and ratchet head. The wrench head can be indexed 60° either side of the wrench body for ease of reading the display.

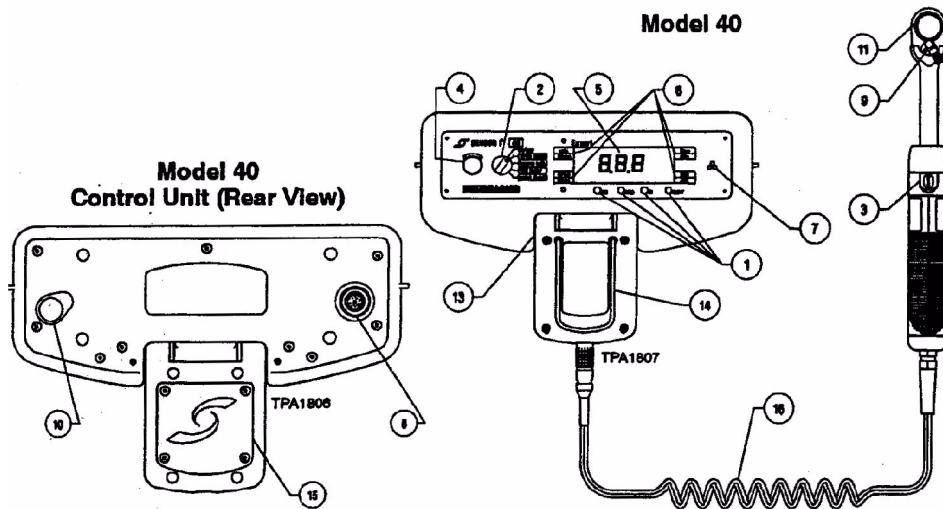
NOTE

Factory Calibration of models 125, 250 and 400 was conducted with the wrench head in the normal, non-indexed position. This position is recommended where high accuracy of angle values is required. If the wrench is to be used in the $\pm 60^\circ$ indexed position and angle accuracies equal to or better than $\pm 10\%$ are required, then recalibration of angle in the indexed position is recommended.

Torque accuracy remains unaffected by indexing the wrench head.

Functions of Components

Expert 40



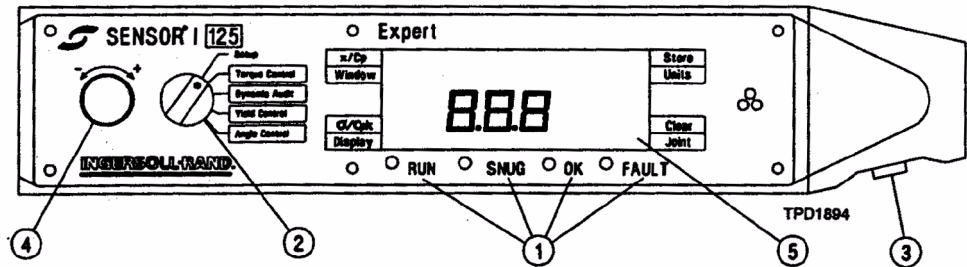
Handheld Tool

Consists of the ratchet head, reset switch, cable and the angle measurement device. The head cannot be indexed relative to the handle. The plug at the end of the tool cable connects to the receptacle on the lower portion of the Control Unit.

Control Unit

Houses the electronics, power supply and interface connectors for the tool cable and battery charger/data communications port. The tool connects to the receptacle in the lower portion of the Control Unit. The front panel on the upper portion of the Control Unit is the same as all other Expert Wrenches.

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1. Control System Status Lights

These lights are used to signal operating status:

- RUN** The control system is ready to begin a cycle.
- SNUG** The torque applied to the fastener has reached the snug torque setting.
- OK** The fastener has been tightened correctly in the selected tightening mode.
- FAULT** One or several of the following fault conditions has occurred:
- Operator Error
 - Low Battery
 - Torque Overage
 - System Failure
 - Wrench not held steady enough during calibration (Reset)
 - Wrench is being pulled too slowly.
 - The mode or parameter adjustment knob has been changed since last reset.
 - Ratchet head has been indexed since last reset.

2. Mode Selector Switch

Selects the particular tightening mode: Torque Control, Dynamic Audit, Yield Control and Angle Control. This switch also allows you to select the Setup mode to adjust communications parameters, setup and restore custom modes, and perform diagnostics

3. Reset Button

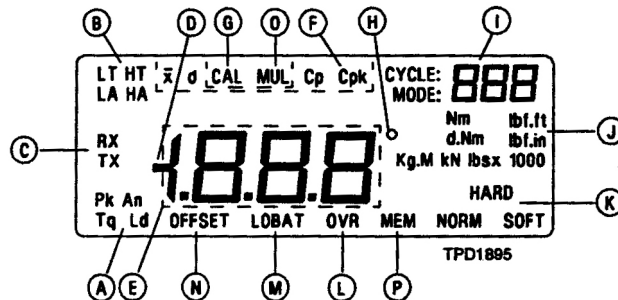
Used to power up the wrench, reset the wrench before every new tightening procedure, to set torque and angle values, and to clear certain fault conditions. When the **Reset** button is held in, the top functions on the membrane key pad can be selected.

4. Parameter Adjustment Knob

When the **Reset** button is held in, this knob adjusts the value of the parameter being displayed.

5. Digital Display

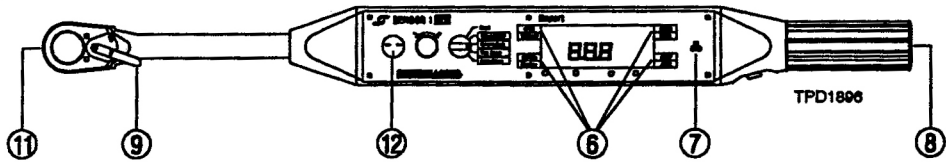
Provides a digital readout of parameters selected:



- A) These segments show the item being displayed on the main display:
Pk is peak torque
An is angle
Ld not used
Tq is dynamic torque
- B) These segments indicate limits:
LT is low torque limit
HT is high torque limit
LA is low angle limit
HA is high angle limit
- C) These segments will light when serial data during tightening or serial data at the end of tightening are selected. They will also flash when data is being sent through the serial port.
RX = receiving, **TX** = transmitting
- D) This segment will light when CCW ("-LEF") has been selected.
- E) These segments display the values of torque and angle.
- F) These segments light when statistical information is being shown on the display.

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- G) This segment will light when the wrench is in calibration mode for torque or angle.
- H) This segment indicated that degrees of angle are being displayed on the screen.
- I) These segments indicate the cycle number for the tightening or the mode number when in setup mode.
- J) These segments indicate the units for torque.
- K) These segments indicate the joint type selection for yield control.
- L) This segment lights when the torque applied to the wrench is over the maximum allowable limit.
- M) This segment indicated a low battery condition.
- N) This segment lights when torque and angle offsets are being calculated.
- O) This segment will light when a torque multiplier is programmed for use with a particular fastening mode.
- P) This segment will flash when a particular tightening mode has reached its limit of 1,000 tightenings. This segment will light continuously when the wrench has reached its limit of 2,500 total tightenings for all the tightening modes.



6. Membrane Keys

Each membrane key has two functions. To access the lower function, simply press the key. The upper function can be accessed by holding in the **Reset** button and then press the membrane key.

- xCp** When this key is pressed (with the **Reset** button held in), the Mean Value is displayed for approximately 1.5 seconds, then the Cp Value is displayed until the **Reset** button is released. Repeatedly pressing this key with the **Reset** button held in, will display Mean and Cp values for Torque or Angle.
- Window** Press this key to display and edit the Torque and Angle high and low limits for a particular tightening mode. Press this key again to go back to the tightening mode.
- s/Cpk** When this key is pressed (with the **Reset** button held in), the Standard Deviation is displayed for approximately 1.5 seconds, then the Cpk Value is displayed until the **Reset** button is released. Repeatedly pressing this key with the **Reset** button held in, will display Standard Deviation and Cpk values for Torque or Angle.
- Display** Pressing this key changes the value that is being displayed on the screen. Each press toggles the display between Peak Torque (Pk), Angle (An), Ld (not used), and Dynamic Torque (Tq).
- Units** Pressing this key will change the torque units displayed for the selected mode. All stored data will also be converted.
- Clear** Pressing this button (while **Reset** is held in) clears custom tightening modes. This key also clears tightening data stored in memory.
- Joint** This button changes the joint type for Yield Control tightening.
- Store** Press this button (while **Reset** is held in) to store Curve Trace Data.

7. Audible Alarm

Signals the completion of a tightening procedure by continuous tone and signals a fault by an intermittent tone. The audible alarm will only sound while torque is being applied to the wrench handle.

8. Charger/Data Port

The battery charger inserts into this connector to charge the wrench. The serial port cable provided with the wrench also plugs into this connector. This port is located in the end of the handle for models 125, 250 and 400. For model 40, it is located on the rear of the Control Unit.

9. Toggle Lever

Selects the direction of the ratcheting mechanism; markings "ON" and "OFF" apply to right-hand threaded fasteners.

10. Power Switch

Located under the cap on the back of the wrench body (models 125, 250 and 400 not shown) or Control Unit (model 40), this switch turns power on and off to the wrench.

11. Angle Reference Arm Connector (EA-models)

Provides a fixed reference for angle measurement while operating the wrench. It is attached to the work piece by a magnet base and spring arm.

12. [ITEM NO LONGER IN USE]

13. Control Unit Pivot (model 40 only)

The pivot separates the upper portion of the Control Unit from the lower portion and allows the upper portion to be pivoted back for belt-mounted mobile use and pivoted forward for bench top use.

14. Belt Clip (model 40 only)

Allows the operator to attach the Control Unit to a belt with the upper portion of the Control Unit pivoted back.

15. Battery Access (model 40 only)

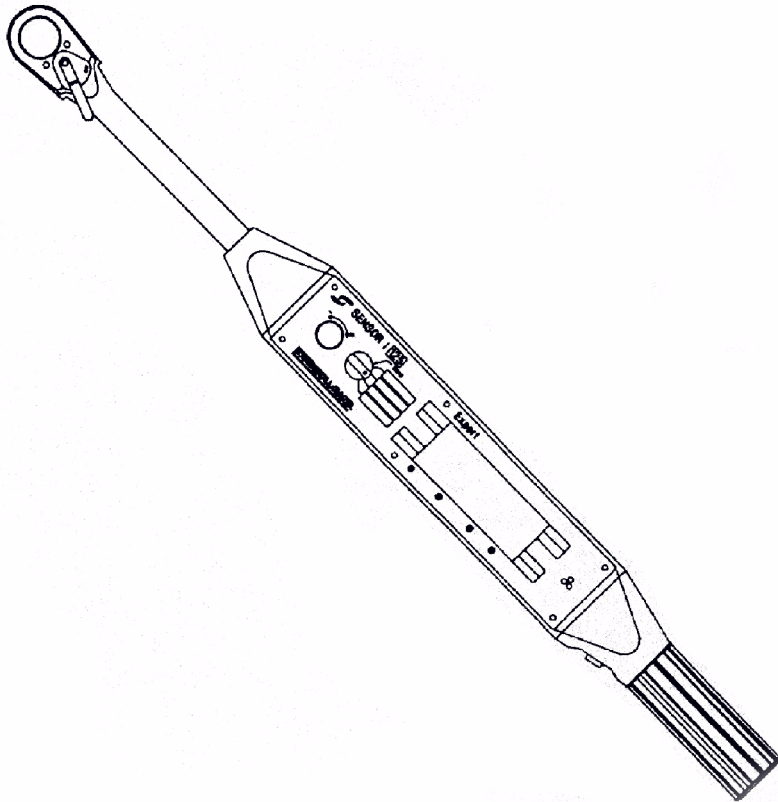
The portion of the Control Unit below the pivot houses the battery. An access door secured with four screws allows access to the battery when the battery needs replacing. Simply pull the battery from both sides to dislodge the battery from the harness.

16. Tool Cable (model 40 only)

The tool cable is integral with the Handheld Tool and serves as the means of communication between the Control Unit and the Handheld Tool. The plug at the end connects to the receptacle on the lower portion of the Control Unit.

CHAPTER 3

Operation Instructions



WRENCH OPERATION INSTRUCTIONS

General Information



Exceeding maximum torque rating may cause damage to wrench or loss of calibration.

The wrench should only be used for its intended purpose, i.e., for tightening, loosening and auditing procedures. It should be operated using a smooth steady pull at moderate speed on the wrench handle with feet firmly placed on floor.

The use of extensions to the handle, or application of force to other parts of the wrench may cause damage or result in personal injury, or may result in inaccurate tightenings.

If the wrench fails to operate using the recommended procedures described in this manual, the cause of malfunction should be corrected by an authorized **Ingersoll-Rand** technician. For a list of authorized **Ingersoll-Rand** service centers, see Appendix D.

Operation

Ensure the Power Switch is in the ON position and press the **Reset** button.

Primary Operation Modes

Throughout all the tightening modes there are some common features. At any time during or at the end of a tightening the screen can be toggled to display the following; Peak Torque (PK), Angle (An), and Dynamic Torque (Tq). The present item displayed is indicated in the lower left hand portion of the screen. This can be changed by pressing the **Display** key.

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At the top right-hand section of the screen is the cycle count indicator. It displays the number of completed tightenings for that mode (up to 999 tightenings). The counter increments by one at the end of each tightening once the **Reset** button has been pressed.

For the most accurate results, the wrench should be pulled at a speed between 10 and 80 degrees per second. The wrench should be held steady while the **Reset** button is pressed.

Setting Torque Units

The units of displayed torque can be toggled between Metric and English units by pressing the **Units** key on the front panel. The current units selected are indicated in the center right-hand section of the screen.

The wrench can also display torque in units of different sizes. The following procedure toggles the wrench units between Nm (or lb.ft.) and dNm (or in.lb.).

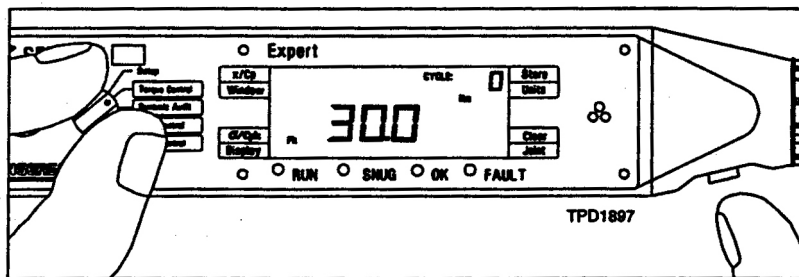
1. Press the **Reset** button to power up the wrench.
2. Move the Mode Selection switch to Setup.
3. With the **Reset** button held in, use the Parameter Adjustment Knob to select the Custom Setup Mode #107. The main display shows "---", and the torque units are displayed in the center right-hand section of the screen.
4. Hold the **Reset** button and press the **Units** button to choose units of Nm and lb.ft. Press the **Joint** button to choose units of dNm and in.lb.
5. Press and hold the **Reset** button and rotate the Parameter Adjustment Knob counterclockwise until the Custom Setup Mode number is below 20.

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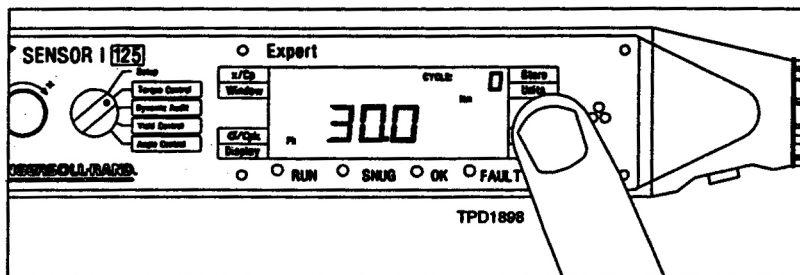
6. Release the **Reset** button. The units choice is now saved.
7. Move the Mode Selection switch to one of the tightening modes and use the **Units** button to choose between Metric or English units.

Torque Control Tightening Procedure

1. Press and release the **Reset** button to power up the wrench. If the wrench is left idle for one minute (adjustable) the wrench will turn off to save battery power.
2. Move the Mode Selection switch to Torque Control. See graphic below

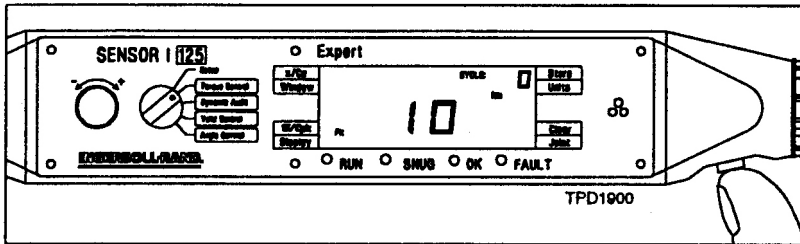


3. Press the **Units** key to select the desired Torque units. See graphic below.

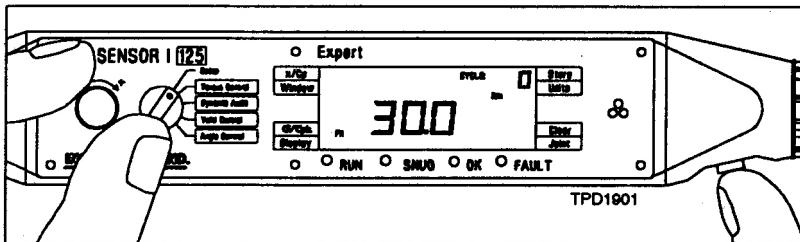


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- Press and hold in the **Reset** button. (Initially the snug torque will be shown, then after a few seconds the target torque will be shown). See graphic below. Note the snug torque in Torque Control mode is not adjustable and set to the minimum snug allowable as a default. The default snug values for all models are listed in the TOOL DESCRIPTION Technical data table in Chapter 2.

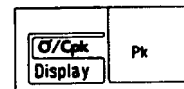
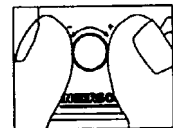
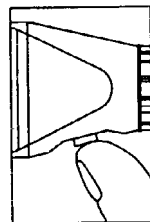
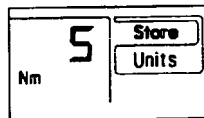
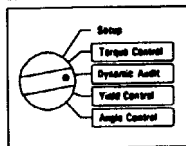
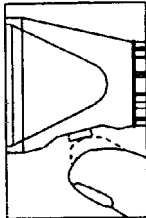


- With the **Reset** button held in, use the Parameter Adjustment Knob to adjust the target torque to the desired value. See graphic below.



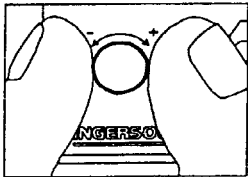
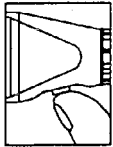
- Release the **Reset** button. If the Fault light is lit then press and hold the **Reset** button again, while holding the wrench steady. Continue to hold in the **Reset** button until the RUN light appears and the FAULT light goes off. Release **Reset**.
- Commence tightening with moderate speed steady pulls. Stop as soon as the OK light comes on and the alarm sounds.

Dynamic Audit

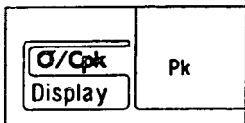
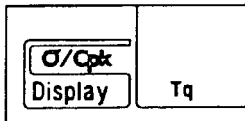


TPD1899

1. Press and release the **Reset** button to power up the wrench (if the wrench is left idle for one minute the wrench will turn off to save battery power).
2. Move the Mode Selection switch to Dynamic Audit.
3. Press the **Units** key to select the desired Torque units.
4. Attach the angle reference arm (EA-models only) to the wrench, and place the magnet on a magnetic surface.
5. Press and hold in the **Reset** button. The capture angle will be displayed.
6. With the **Reset** button held in, use the parameter adjustment knob to adjust the capture angle to the desired value (see the application guide for details). Release the **Reset** button.
7. Press the **Display** key until "Pk" is displayed on the lower left-hand side of the screen.



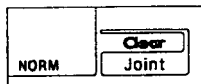
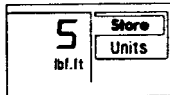
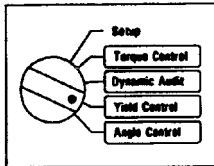
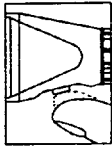
TPD1902



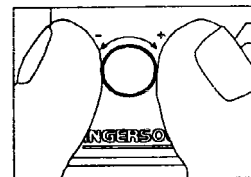
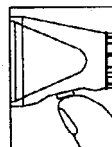
TPD1903

8. Press and hold in the **Reset** button. The snug torque will be displayed.
9. With the **Reset** button held in, use the Parameter Adjustment Knob to adjust the snug torque to the desired value (approx. 50% of expected torque).
10. Release the **Reset** button. If the **FAULT** light is lit, then press and hold the **Reset** button again while holding the wrench steady. Continue to hold in the **Reset** button until the **RUN** light appears and the **FAULT** light goes off. Release **Reset**.
11. Commence tightening with a steady pull at moderate speed. Stop as soon as the **OK** light comes on and the alarm sounds.
12. When audit is complete, press the **Display** key until "Tq" appears in the lower left-hand corner to display the dynamic torque reading.
13. Press the **Display** key until "Pk" appears in the lower left-hand corner to display the peak (or static) torque reading. This is usually the last torque value "seen" by the wrench.

Yield Control



TPD1904



TPD1905

1. Press and release the **Reset** button to power up the wrench.
2. Move the Mode Selection switch to Yield Control.
3. Press the **Units** key to select the desired Torque units.
4. Selects the joint hardness by pressing the **Joint** key on the front panel (the joint hardness currently selected is displayed in the lower right corner of the screen).
5. Attach the angle reference arm (EA-models only) to the wrench, and place the magnet on a magnetic surface.
6. Press and hold in the **Reset** button. The snug torque will be displayed.
7. With the **Reset** button held in, use the Parameter Adjustment Knob to adjust the snug torque to the desired value. The snug torque value should be 30% to 50% of the proof load torque expected for that bolt.

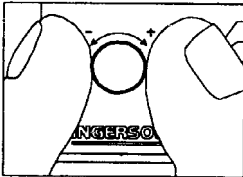
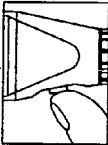
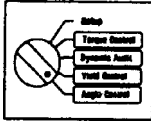
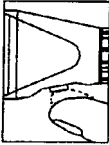
8. Release the **Reset** button. If the FAULT light is lit, then press and hold the **Reset** button again while holding the wrench steady. Continue to hold in the **Reset** until the RUN light appears and the FAULT light goes off. Release **Reset**.

9. Commence tightening with moderate speed steady pulls. Stop as soon as the OK light comes on and the alarm sounds.

 **NOTE**

When using EVS-models, avoid ratcheting when the torque is in the vicinity of the snug torque and between snug and the yield point.

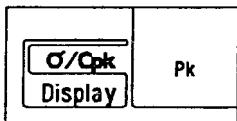
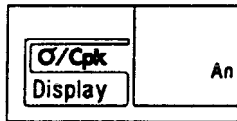
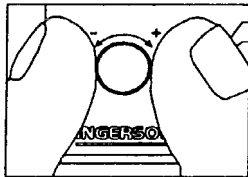
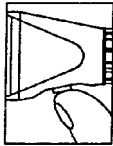
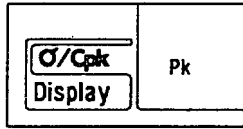
Angle Control



TPD1906

1. Press and release the **Reset** button to power up the wrench.
2. Move the Mode Selection switch to Angle Control.
3. Attach the angle reference arm (EA-models) to the wrench, and place the magnet on a magnetic surface.
4. Press and hold in the **Reset** button. "An" will be displayed in the lower left corner and the angle control point will be shown).
5. With the **Reset** button held in, use the Parameter Adjustment Knob to adjust the angle control point to the desired value. Release the Reset button.

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TPD1907

6. Press the **Display** key until "Pk" is displayed on the lower left-hand side of the screen.
7. Press in the **Reset** button. The snug torque will be displayed.
8. With the **Reset** button held in, use the Parameter Adjustment Knob to adjust the snug torque to the desired value.
9. Release the **Reset** button. If the FAULT light is lit, then press and hold the **Reset** button again while holding the wrench steady. Continue to hold in the **Reset** until the RUN light appears and the FAULT light goes off. Release **Reset**.
10. Press the **Display** key until "An" appears in the lower left-hand corner if angle values must be displayed during tightening.
11. Commence tightening with moderate speed steady pulls. Stop as soon as the OK light comes on and the alarm sounds.
12. When tightening is complete, press the **Display** key until "Pk" appears in the lower left-hand corner. This will display the peak (or static) torque reading.

CYCLE COUNTER

The cycle counter is displayed in the upper right-hand corner of the digital display (see Functions of Components). The counter indicates the number of completed tightenings stored in memory. The cycle counter will increment once the **Reset** button is pressed after a tightening. A tightening cycle is started or initiated once snug torque has been reached. The cycle counter will also increment if a tightening has been completed and the wrench has powered down. Each tightening mode, including the 20 custom stored modes has its own independent cycle counter. The wrench can store a total of up to 2500 readings in memory and up to 1000 readings in any one tightening mode. When this limit is exceeded, the oldest reading in memory is overwritten and "MEM" will flash on the display.

Resetting the Cycle Counter

The cycle counter can be reset by either

1. Changing a control parameter, i.e., Torque, Angle or a window limit.
2. By holding in the **Reset** button and pressing the **Clear** key simultaneously.



Both these operations will clear all data and statistics associated with the tightening mode for which the cycle counter was cleared.

QUALITY CONTROL LIMITS AND STATISTICS

Setup and Viewing Quality Control Limits

1. Press and release the **Reset** button on the side of the wrench.
2. Move the Mode Selection switch to the tightening mode required.
3. Press the **Window** key. You will see "--.-" on the display along with "LT" (low torque limit) flashing in the top left hand corner.
4. Press and hold in the **Reset** button. The present low torque limit will be shown.
5. While holding in the **Reset** button, use the Parameter Adjustment Knob to adjust the low torque limit to the desired value. Release the **Reset** button and press the **Window** key.
6. To adjust the high torque limit (HT), low angle and high angle limits, (LA, HA), press the **Window** key until the desired limit is flashing. Then hold in the **Reset** button and adjust as in step 5 above.
7. When all adjustments have been made, press the **Window** key until all indicators (LT, HT, LA, HA) have stopped flashing on the display.
8. Press the **Reset** button until the RUN light appears and commence tightening.

 **NOTE**

In Yield Control, LA and HA must be greater than or equal to 12° for hard joints, 16° for normal joints, or 24° for soft joints. LT and HT limits must be greater than the snug torque for all modes.

Deleting Quality Control Limits

1. Press and release the **Reset** button to power the wrench.
2. Move the Mode Selection switch to the tightening mode required.
3. Press the **Window** key. You will see "--.-" on the display along with "LT" flashing in the top left hand corner.
4. Press and hold in the **Reset** button. The present low torque limit will be shown.
5. While holding in the **Reset** button, use the Parameter Adjustment Knob to adjust the low torque limit to the torque value (target torque value for Torque Control). Release the **Reset** and press the **Window** key.
6. To delete the torque high limit (HT), press the **Window** key until "HT" is flashing. Then hold in the **Reset** button and adjust this to the snug torque value (target torque value for torque control). Release the **Reset** button and press the **Window** key.
7. To delete the angle low limit (LA), press the Window key until "LA" is flashing. Then hold in the **Reset** button and adjust this value to zero. Release the **Reset** button and press the **Window** key.
8. To delete the angle high limit (HA), press the **Window** key until the "HA" is flashing. Then hold in the **Reset** button and adjust this value to zero. Release the **Reset** button and press the **Window** key.
9. When all adjustments have been made, press the **Window** key until all indicators (LT, HT, LA, HA) have stopped flashing on the display.
10. Press and hold the **Reset** button until the RUN light appears and commence tightening.

Exceptions for angle low and high limits:



While in Angle Control:

- To delete high and low angle settings, HA and LA must be adjusted to the target angle.
- To delete high and low torque settings, HT and LT must be adjusted to the snug torque.

Use of Quality Control Limits

1. After the **Reset** button is pressed any limits that have been set will be indicated on the display with the corresponding segments lit (LT, HT, LA, HA).
2. Once snug torque is reached, the torque/angle lower limit indicators (LT, LA) will flash on the screen until their respective values are reached.
3. Once the lower limit values are reached, the indicators LT, LA will become solid.
4. If a high limit is exceeded HT or HA will begin flashing.
5. All limits that have been set will be indicated on the display with the corresponding segments lit (LT, HT, LA, HA).

Statistics

The following statistical information is available for each custom and primary tightening mode:

Mean	\bar{x}
Standard Deviation	σ
Process Capability Index	Cp
Process Capability Index	CpK

 **NOTE**

Cp and CpK are not available for angle in Dynamic Torque Audit mode as the control limits for low angle (LA) and high angle (HA) are not used.

The statistical calculations are based on all stored final tightening data points for that tightening mode. Lower and upper control limits used for the calculation of the Process Capability Indices, Cp and CpK, use the values of low torque (LT), high torque (HT), low angle (LA) and high angle (HA) entered for each custom and primary tightening mode.

The statistics can be viewed as follows:

1. Select desired custom or primary tightening mode and confirm that the cycle count is a number above zero.
2. While holding in the **Reset** button, press \bar{x} the x key. The display will show \bar{x} the x symbol on the top of the display and the Pk symbol on the bottom of the display. The main display will show the mean value of the torque which is shown for approximately 1.5 seconds, after which the process capability, Cp, is shown until the **Reset** button is released.
3. Repeat the above process to display the \bar{x} mean, x, and process capability, Cp, for angle (An).

4. To read the standard deviation, σ , and process capability, CpK, repeat the above procedure, but press the σ key in place of the x key. The standard deviation and CpK will be displayed for torque (Pk), and angle (An).

CUSTOM TIGHTENING MODES

The Sensor I[®] Expert wrench has the capacity to store up to 20 custom configurations of the primary tightening modes. These modes are numbered 1 through 20 and are stored and accessed through the Setup Mode.

Setup and Storage of Custom Tightening Modes

1. Use the Mode Selection switch to select the primary tightening mode from which the Custom Mode is to be setup, i.e., Torque Control, Dynamic Audit, Yield Control or Angle Control.
2. Program all required control points and window limits.
3. Turn the Mode Selection switch to Setup. Hold in the **Reset** button, and use the Parameter Adjustment Knob to select an empty custom mode. Empty modes will be indicated by a flashing mode number between 1 and 20.
4. With the **Reset** button still held in, move the Mode Selection switch to the primary tightening mode required and press the **Store** key.
5. Release the **Reset** button.

Retrieving Custom Tightening Modes

1. Move the Mode Selection switch to the Setup position.
2. Hold in the **Reset** button until mode appears in the upper right-hand corner of the digital display.
3. With the **Reset** button still held in, use the Parameter Adjustment Knob to select the Custom Mode number desired. Note: Empty modes will be flashing.
4. Release the **Reset** button.
5. Press in the **Reset** button again if the FAULT light appears. Hold until the green RUN light appears and the FAULT light goes off.
6. Commence tightening.



Once Custom Modes are stored, these control values cannot be changed. To change values in a Custom Mode first delete the mode and then store the new configuration.

Identifying Custom Tightening Modes

Once in a particular custom tightening mode, the primary mode from which it came can be identified by pressing the **Reset** button and looking at the values being displayed on the screen.

If two numbers are displayed on the screen with the "Pk" segment lit, the Custom Mode is a Torque Control strategy. The first number indicates the snug torque, the last indicates the target torque.

If the segment "Tq" lights on the screen with the first number, and An lights with the second number, then the Custom Mode is a Dynamic Audit strategy.

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The first number indicated the snug torque value (50% of the expected torque), the last number is the capture angle in degrees.

If only one number is displayed on the screen and the "Pk" segment is lit, the Custom Mode is a Yield Control strategy. The number displayed is the snug torque value (50% of the expected torque at yield).

If the segment "Pk" lights on the screen with the first number, and "An" lights with the second number, then the custom mode is Angle Control. The first number is the snug torque and the second number is the target angle.

Clearing Custom Tightening Modes

Custom tightening mode can be cleared by following the procedure below:

1. Press the **Reset** button to power the wrench.
2. Move the Mode Selection switch to the Setup position.
3. Hold in the **Reset** button and use the Parameter Adjustment Knob to select the Custom Mode to be cleared.
4. With the **Reset** button held in, move the Mode Selection switch to the primary mode from which the Custom Mode was based (i.e., Torque Control, Dynamic Audit, Yield Control or Angle Control. If you no longer know which mode your strategy came from, refer to the previous section.
5. With the **Reset** button still held in, press the **Clear** key.
6. Release the **Reset** button.

DATA STORAGE AND RETRIEVAL

The charger/data port (item 8 in Chapter 2: Tool Description) has an integral RS232 serial port. This can be connected to a PC, and with the InterLink software or a terminal program, the data can be uploaded to the computer. Examples of all outputs can be found in Appendix A. The communication parameters on the PC must be set as follows in order to transmit any data from the wrench.

Data Bits:	8
Stop Bit:	1
Parity:	None
Handshake:	None

The baud rate must match the current baud rate of the wrench. Valid baud rates can be 19200, 9600, 4800, 2400, 1200 & 600.

For use with the InterLink software, the wrench must be set to 2400. Instructions for use of this program are located in the CD jacket and the Help file of the software.

Setup of Wrench for Data Upload

1. Connect the serial cable from the charger/data port to the serial port of the computer.
2. Setup parameters in a computer terminal program.
3. Press the **Reset** button to turn on the wrench.
4. Move the Mode Selection switch to Setup.
5. With the **Reset** button held in, use the Parameter Adjustment Knob to select Custom Setup Mode #110 (the present baud rate will be shown, divided by 100 to fit on the display).
6. Move the Mode Selection switch to Torque Control.

7. Press in the **Reset** button and adjust the baud rate to the desired value (valid baud rates are 19200, 9600, 4800, 2400, 1200 & 600).

 **NOTE**

The last two numerals are not shown on the wrench display.

8. Move the Mode Selection switch to Setup.
9. Press in the **Reset** button and adjust the Custom Setup Mode number below 20.
10. Release the **Reset** button and move the Mode Selection switch to the desired tightening mode.

Data Out During Tightening

Once this function is activated, a torque data point will be transmitted via the serial port for every degree increment of the tightening angle beyond snug.

1. Connect the serial cable from the charger/data port to the serial port of the computer.
2. Press the **Reset** button to turn on the wrench.
3. Move the Mode Selection switch to Setup.
4. With the **Reset** button held in, use the Parameter Adjustment Knob to select Custom Setup Mode #101. Note: A symbol "RX" appears on the left-hand side of the digital display and the main display shows "--.-".
5. Rotate the mode select switch to the tightening mode for which the option is to be enabled. The display will show "OFF".

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6. While holding the **Reset** button, press the Units key to select the option. The display will show "ON". To deselect this option press the **Joint** key deselects it.
7. Rotate the Mode Select switch back to the Setup position. The display should now show "---" with TX on.
8. Holding in the **Reset** button, adjust the Custom Setup Mode number below 20.
9. Release the **Reset** button and move the Mode Selection switch to the desired tightening mode.

Data Out at End of Tightening

Once this function is activated, the final tightening data will be transmitted to the PC via the serial port when Reset button is pressed at the completion of tightening.

1. Connect the serial cable from the charger/data port to the serial port of the computer.
2. Press the **Reset** button to power up the wrench.
3. Move the Mode Selection switch to Setup.
4. With the **Reset** button held in, use the Parameter Adjustment Knob to select Custom Setup Mode #100. Note: A symbol "TX" appears on the left hand side of the digital display and the main display shows "---".
5. Rotate the mode Select switch to the tightening mode for which the option is to be enabled. The display should show "OFF".
6. While holding the **Reset** button, press the **Units** key to select the option. The display will show "ON". Pressing the **Joint** key deselects it.
7. Rotate the Mode Select switch back to the Setup position. The display should now show "---" with TX on.

8. Holding in the **Reset** button, adjust the Custom Setup Mode number below 20.
9. Release the **Reset** button and move the Mode Selection switch to the desired tightening mode.

Parameter Dump

Once initiated the parameter dump function will dump out settings for a particular tightening mode. A parameter dump can be performed on any primary or custom tightening mode. It is recommended that once custom modes have been setup that a parameter dump be initiated so there is a permanent record of the wrench's settings. This is not necessary if the wrench was programmed via the InterLink software.

 **NOTE**

Tightening parameters of torque that are downloaded and uploaded in units of Nm or lb.ft. are rounded to the nearest Nm or lb.ft. If higher resolution or greater precision is required in the parameters that are transmitted, use units of dNm or in.lb. Actual data points transmit with a resolution of 1/10th of the units.

1. Connect the serial cable from the charger/data port to the serial port of the computer.
2. Press the **Reset** button to power up the wrench.
3. Move the Mode Selection switch to Setup.
4. With the **Reset** button held in, use the Parameter Adjustment Knob to select Custom Setup Mode #109. Note that an "A" appears on the main display.
5. Move the Mode Selection switch to Torque Control.

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6. With the **Reset** button held in, use the Parameter Adjustment Knob to select the desired tightening mode. Select from:

A-	Angle Control
J-	Yield (joint) Control
b-	Dynamic Audit
t-	Torque Control
1 through 20-	Custom tightening modes 1-20

7. Release the **Reset** button once the tightening mode has been selected.
8. Press the **Display** button and the tightening parameters will be transmitted.
9. Move the Mode Selection switch to Setup.
10. Press the **Reset** button and adjust the Custom Setup Mode number below 20.

End of Tightening Data Dump

The Sensor I[®] Expert wrench stores end of tightening data for up to 1000 tightenings for each tightening mode. This final tightening data (Torque, Angle and optional External Channel) can be uploaded to a PC by completing the following:

1. Connect serial cable from the charger/data port to the serial port of the computer.
2. Press the **Reset** button to power up the wrench.
3. Move the Mode Selection switch to Setup.
4. With the **Reset** button held in, use the Parameter Adjustment Knob to select Custom Setup Mode #109. Note that an "A" appears on the main display.

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5. Move the mode selection switch to Torque Control.
6. With the **Reset** button held in, use the Parameter Adjustment Knob to select the tightening mode for which the end of tightening data is to be transmitted over the serial interface. Select from:

A-	Angle Control
J-	Yield (joint) Control
b-	Dynamic Audit
t-	Torque Control
1 through 20-	Custom tightening modes 1-20
7. Release the **Reset** button once the tightening mode has been selected.
8. Press the **Joint** button and the tightening parameters, end of tightening data and statistics will be transmitted.
9. Move the Mode Selection switch to Setup.
10. Press in the **Reset** button and adjust the Custom Setup Mode # below 20.

Tightening Curve Storage

Up to 10 tightening curves can be stored in the Sensor I[®] Expert Wrench for later retrieval via the serial port. Tightening curves can be stored provided the following conditions have not occurred: wrench has powered down, has been switched to another tightening mode or another tightening has commenced.

The following procedure shows how to store a tightening curve.

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1. Complete a tightening.
2. Hold in the **Reset** button.
3. With the **Reset** button held in press the **Store** key.
4. Starting at zero, the screen will then indicate the storage position where the curve will be stored.
5. Release the **Reset** button.

Tightening Curve Data Dump

The following procedure shows how to initiate a curve data dump.

1. Connect serial cable from the charger/data port to the serial port of the computer.
2. Press the **Reset** to power up the wrench.
3. Move the Mode Selection switch to Setup.
4. With the **Reset** button held in, use the Parameter Adjustment Knob to select Custom setup Mode #111. NOTE: The main display shows an integer from 0 to 9.
5. Release the **Reset** button.
6. Move the Mode Selection switch to Torque Control.
7. Hold in the **Reset** button and rotate Parameter Adjustment Knob to select the curve buffer number to be transmitted.
8. Press the **Display** key. The main display will show the number of sample points in the selected curve buffer to be transmitted. The "Tx" will flash while the serial data is being sent. When all the data, parameter and

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samples have been sent, the display reverts to showing the selected curve number.

9. Rotate the Mode Select switch back to the Setup position.
10. Holding in the **Reset** button, adjust the Custom Setup Mode number below 20.

TORQUE MULTIPLIER FUNCTION

The Sensor I[®] Expert wrench may be used with a torque multiplier to increase its effective torque output up to a maximum multiplication factor of ten times (x 10) the capacity of the wrench.

Enabling this custom mode, the wrench can be enabled to select four levels of multiplication for each primary tightening mode. These are as follows:

1. Multiplication Factor = x 1 (default value)
2. Multiplication Factor = x 5
3. Multiplication Factor = x 4
4. Multiplication Factor = x .01 (selectable upto x 10.00 maximum)

Setup of a Torque Multiplier

A multiplier should be used when tightening in that mode if the "MUL" symbol is indicated. All torque parameters, (i.e., snug, target torque, and torque QC limits) are now scaled by the multiplier value. Similarly, any angle parameter, (i.e., target angle or angle QC limit) is divided by the multiplier value. It is a good idea to check that your parameters for the tightening mode are as desired by reviewing the QC limits with the **Window** key. The snug and target torque can also be checked by selecting the display of peak torque (Pk) and holding in the **Reset** button.

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If while in a primary or custom tightening mode, the MUL symbol is on but the user is unsure of the multiplier value, it can be checked by following the procedure described in steps 2 and 3.

To disable a multiplier in a primary mode, follow the step by step procedure to set the multiplier, but select 1.00 as the multiplier value.

1. Turn Mode Select switch to Setup mode.
2. Press and hold in the **Reset** button and rotate Parameter Adjustment Knob until Custom Setup Mode #104 is indicated in the top right hand corner of the display. Note the symbol "MUL" is indicated in the top center of the display and the main display shows "---".
3. Rotate the Mode Select switch to the tightening mode for which the multiplier is to be enabled. This display should show 1.00.
4. While holding in the **Reset** button, press the **Units** key to step through the multiplier values above. Pressing the **Joint** key will reset the multiplier value to 1.00.
5. To adjust the programmable value, begin with the display at "10.00" and ensure that the **Reset** button is released. Rotate the Parameter Adjustment Knob until the display shows the desired value. Increments are in 0.01 steps.
6. Rotate the Mode Select switch back to the setup position. The display now should show "---" with "MUL" indicated.
7. Holding in the **Reset** button, adjust the Custom Mode number below 20.

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8. Release the **Reset** button and rotate the Mode switch to the tightening mode position for which the multiplier was enabled. The multiplier is now enabled for that primary tightening mode.

 **NOTE**

It is only possible to have one programmable multiplier value in operation at any time.

 **NOTE**

Entering the multiplier set mode for a particular tightening mode resets the cycle count and flushes the data buffer for that mode.

Use of a Torque Multiplier

The torque multiplier can be used when the capacity of the Expert wrench is below that required for the tightening application.

Once setup as described in Setup of a Torque Multiplier, the wrench is then used in any of the primary modes as previously described. The joint selection setting should be set at "soft" joints for Yield Control Tightening. This is done by using the **Joint** key.

 **NOTE**

Users should be aware of any torque reaction requirements or capacity restrictions on the torque multiplier being used.

LEFT HAND FASTENERS

Custom Setup Mode #103 allow the user to select tightening direction (CW or CCW).

1. The wrench display shows "---".

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2. Press the **Reset** to power up the wrench.
3. Move the Mode Selection switch to Setup.
4. With the **Reset** button held in, use the Parameter Adjustment Knob to select Custom setup Mode #103. NOTE: The main display shows an integer from 0 to 9.
5. Rotate the mode select switch to select the mode for which the tightening direction is to be changed. The display will indicate "-rit" for CW tightenings or "-LEF" for CCW tightenings.
6. Press and hold the **Reset** button. Depress the **Units** key to select CW tightenings ("-rit") or the **Joint** key to select CCW tightenings ("-LEF").
7. Rotate the mode select switch back to the Setup position. With the **Reset** button held in, use the Parameter Adjustment Knob to set the Custom Setup Mode number below 20.
8. Release the **Reset** button. The tightening direction is set for the mode selected in step 5 above.

NOTE

After the first time a tightening is performed, changing the tightening direction will increase the amount of time required to find the optimum offset point. While the offset is being determined, the display will show a flashing "OFFSET". The wrench is ready for use when the flashing ceases.

RESET ADJUSTMENT (EVS-models only)

Some tightening applications do not require accurate angle measurement. Custom Setup Mode #214 allows the user to decrease the sensitivity of reset of the wrench at the expense of angle measurement accuracy. Angle accuracy will depend on the elapsed time during which the wrench is moved

and stillness of the wrench when it is reset. The shorter the tightening period, the smaller the error will be. The more stable the wrench is at reset, the smaller the error. See the **Application Guidelines** at the front of this manual for additional guidelines.

1. Press the **Reset** button to power up the wrench.
2. Move the Mode Selection switch to Setup.
3. With the **Reset** button held in, use the Parameter Adjustment Knob to select the Custom Setup Mode #214. The main display shows a number between 4 and 10.
4. Release the **Reset** button and turn the Parameter Adjustment Knob to increase shown if the reset is to be made less sensitive. Turn the Parameter Adjustment Knob to decrease the number shown if increased measurement accuracy is required making wrench reset more sensitive.
5. Press and hold the **Reset** Button and rotate the Parameter Adjustment Knob counterclockwise until the Custom Setup Mode number is below 20.
6. Release the **Reset** button. The reset adjustment is now saved.
7. Move the Mode Selection switch to one of the tightening modes and test the reset.

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- Repeat until the angle accuracy and reset of the wrench are suitable to the application.

⚠ NOTE

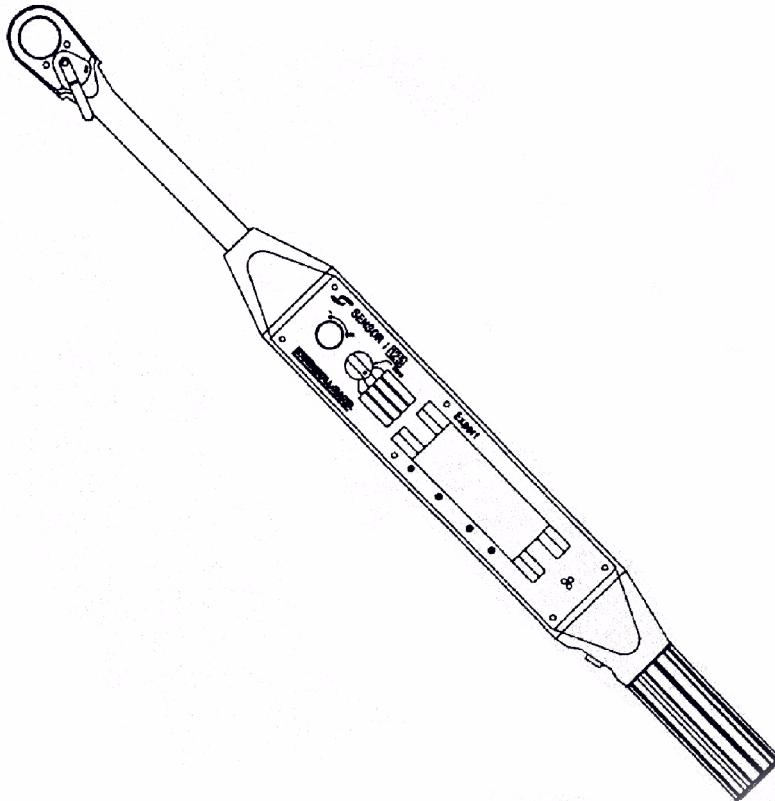
The default reset adjustment value for models 125, 250 and 400 is 4. The default reset adjustment value for model 40 is 6. This has been set on the basis of a balance between wrench reset sensitivity and angle accuracy. Increasing the Reset Adjustment value will increase the probability of angle error as well as the maximum allowable angle error. The maximum allowable error will occur if the wrench is moving and allowed to reset and the minimum speed is used during the tightening. The table below shows the effect of increasing the Reset Adjustment value on maximum angle error.

Reset Adjustment Value	Models 125, 250, 400	Model 40
	Additional Maximum Angle Error (% +/-)	Additional Maximum Angle Error (% +/-)
4	---	-4%
5	4%	-2%
6	10%	---
7	13%	2%
8	17%	5%
9	22%	7%
10	26%	9%

For highest angle accuracy results, adjust the Reset Adjustment to the lowest setting possible, reset the wrench while the wrench is resting on a table or other stable surface and maintain a turning speed of between 20 and 80 degrees per second. This will achieve consistent errors within +/-2%. For applications where higher angle accuracy is required, models EA40, EA125, EA250 and EA400 are recommended.

CHAPTER 4

Battery Charging



BATTERY CHARGING

The battery must be recharged as soon as "LO BAT" appears on the display. The charger connects to the charger/data port (item 8 in Chapter 2: Tool Description).

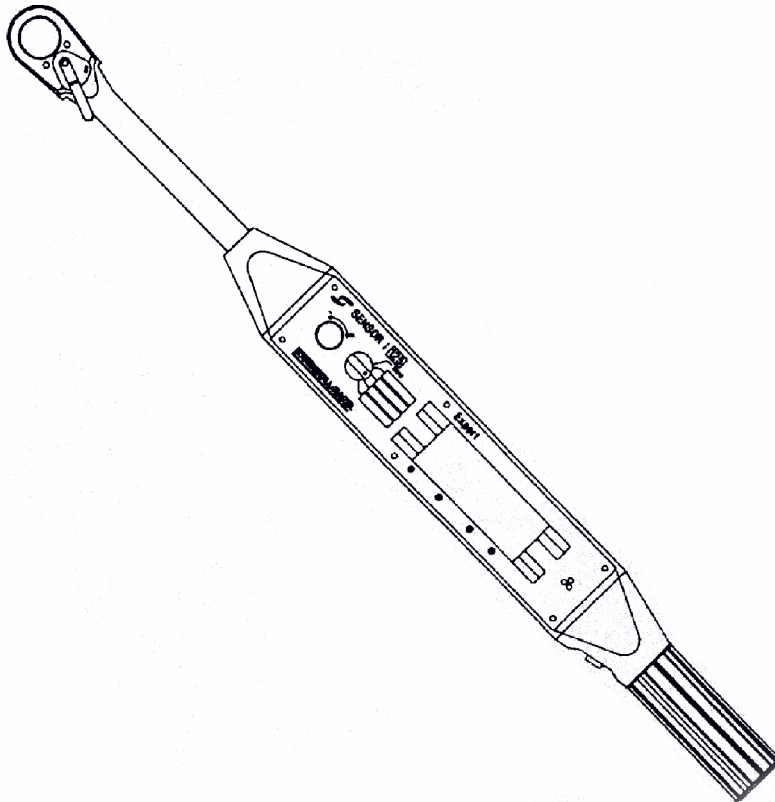
1. Remove the protective cap from the wrench handle (models 125, 250 and 400 only).
2. Insert the battery charger connector into charger/data port and plug the charger into the main AC electric supply. (All models).
3. After the battery is charged, remove the charger connector. (All models.)
4. Reinstall the protective end cap (models 125, 250 and 400 only).

 **NOTE**

- **It takes approximately 14 hours to completely charge a fully discharged battery, resulting in approximately 5.5 hours of continuous use. Shorter charging times may result in reduced hours of continuous use.**
- **The battery should be charged as soon as possible after "LO BAT" appears on the display. The wrench can be operated in the "LO BAT" condition. When it reaches a level where it cannot operate with accuracy, "---" will show on the display and the wrench will not operate.**
- **It is recommended that batteries be fully charged for each work shift.**

CHAPTER 5

Diagnostics & Troubleshooting



DIAGNOSTICS AND TROUBLESHOOTING

Introduction

This chapter provides troubleshooting information using the built-in diagnostic test modes. Tests can be performed by selecting Custom Setup Mode numbers between 200 and 212. When diagnostics are complete, rotate the Mode Selection switch to Setup and turn the parameter adjustment knob to select a Custom Setup Mode number below 20. Then turn the Mode Selection switch to a Primary Mode to reactivate the wrench Timeout feature. If any of the following tests are beyond values listed, go back to the primary mode and reset the wrench. Also make sure the wrench has not had any torque applied. If tests continue to be out of value limits, please contact an authorized **Ingersoll-Rand** service center shown in Appendix D.

Torque Channel A/D Display (Custom Mode #200)

1. The value displayed should be in the range 25-29 when no torque is applied to the wrench. Applying torque in the clockwise (CW) direction will cause this value to increase. Applying torque in the opposite (CCW) direction will cause the displayed value to decrease.
2. If Custom Mode #103 has been set for CCW tightening ("-LEF"), the display will indicate a value between 846 and 853. CW torque then decreases the number, and CCW increases it.

Angle Reference Arm Test Mode (EA - Models, Custom Mode #201)

If the wrench has been calibrated, the display value will be 15 ± 5 at the low end (CW). Rotate the angle reference arm between full CW and full CCW. The change in value as the arm is moved should have no discontinuities. At the high end (CCW), the value will be in the range of 560 ± 5 . For Models 125, 250 and 400, if the values are not correct, loosen the setscrew on the angle reference arm lever and rotate the lever relative to the shaft until the value

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at the low end is correct-the high end should follow. Model 40 should be returned to an authorized **Ingersoll-Rand** Service Center for adjustment.

Battery Level Test Mode (Custom Mode #204)

The display value will be between 100 (fully charged) and zero (depleted).

EZ Angle Test Mode (Custom Mode #207)

1. If Custom Setup Mode #103 has been set for CW ("rit") tightenings, the display should indicate a number between 95 and 105. Moving the wrench in the CW direction should cause the number to increase. Moving the wrench in the CCW direction should cause the number to decrease.
2. If custom Setup Mode #103 has been set for CCW tightenings ("-LEF"), the display should indicate a value between 795 and 805. Moving the wrench in the CW direction should cause the number to decrease.

Membrane Keypad Test Mode (Custom Mode #208)

Pressing any of the membrane keys should toggle an adjacent display legend on and off.

Head Position Test (Models EVS125-, EVS250- and EVS400-, Custom Mode #208)

Index the head. Buzzer should sound when head is in either position off of the center.

Buzzer and LED Test Mode (Custom Mode #209)

The LED's should flash on and off. Pressing any of the membrane keys should cause the buzzer to sound.

Display/Serial Link Test Mode (Custom Mode #210)

1. All display segments should be lit except the "CYCLE" legend.

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2. Connect the serial cable to the charger/data port. Insert the test connector into the end of the serial cable. The buzzer should sound to indicate the Serial Data feature is operating.

Software Version Number Test (Custom Mode #211)

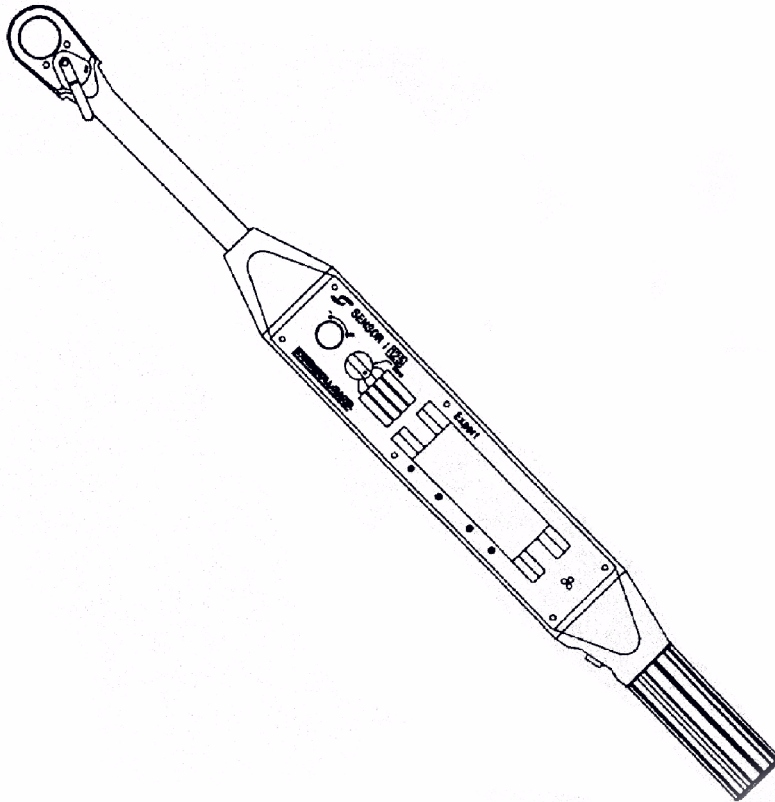
The "SOFT" segment should light, and the main display should display the software version number.

Time-out Adjustment (Custom Mode #212)

This mode allows for adjustment of the wrench time-out feature. The default is 1 minute of non-use time, but this can be adjusted minute by minute.

CHAPTER 6

Calibration



CALIBRATION

General Information

This section describes the calibration method for the torque/angle sensors. Calibration is accomplished by performing tightenings with the wrench and referencing external measuring equipment to compare the results. The Parameter Adjustment Knob on the wrench's front panel is used to match the wrench display readings to that of the reference equipment. Calibration values are stored in nonvolatile memory. Any previously entered setup parameters already stored in tightening modes are scaled to reflect the altered calibration. Performing calibration causes all final tightening data and stored curves to be flushed from memory. Calibration requires torque instrumentation certified to national standards at 0.1% of torque. Currently angle measurements are not traceable to a national standard.

When calibration is complete, rotate the Mode Select switch back to the setup position. Press the **Reset** button and rotate the Parameter Adjustment Knob CCW until the Custom Setup Mode number is below 100. This is necessary to activate the Timeout feature. Update records or label with new calibration information and data.

 **NOTE**

If calibration equipment is not available, it is recommended that the wrench be returned to an authorized Ingersoll-Rand service center for an annual recalibration.

 **NOTE**

If the wrench has an angle reference arm (models EA-), calibrate angle before calibrating torque. If the wrench has an EZ angle non-contact angle sensor (models EVS-), calibrate torque before calibrating angle.

Torque Calibration

Torque calibration procedure described is for the 125 lb.ft. model wrench.

For other wrench models, use the following information for calibration:

Model 40: 45-450 dNm Range, 170 dNm +/-1 dNm Calibration point

Model 250: 115-330 Nm Range, 220 Nm +/-0.5 Nm Calibration point

Model 400: 140-530 Nm Range, 330Nm +/-0.5 Nm Calibration point

1. Make sure the wrench has been set to operate in the clockwise ("rit") direction (see Chapter 3, Left Hand Fasteners, for additional instructions).
2. With no force on the wrench, press the **Reset** button while in Torque Control mode and hold until the yellow RUN light illuminates. Release **Reset**. Select Setup position with the Mode Select switch.
3. Hold in the **Reset** button, select Custom Setup Mode #114, and turn the mode switch to the Torque Control position.
4. Press the **Window** key while holding in the **Reset** button. "CAL" will display on the screen.
5. Release the **Reset** button and apply torque to the wrench equal to approximately 100Nm. Make sure the external torque meter is showing the dynamic torque rather than peak hold torque.
6. Wait until the meter stabilizes.
7. Turn the Parameter Adjustment Knob until the reading on the wrench matches within $\pm 0.1\text{Nm}$ of the reading on the meter.
8. Apply torque to the wrench equal to approximately 165Nm and check that the torque readings match within the specified tolerance.

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9. Apply torque to the wrench equal to approximately 25Nm and check that the torque readings match within specified tolerance.
10. After checking the low end and high end torque, use the Parameter Adjustment Knob to balance throughout the specified torque range (20 Nm-170 Nm).
11. Press the **Display** key to complete calibration in the CW direction. A scale factor and offset will display for approximately 3 seconds.
12. Release the torque on the wrench. Set the Mode Select switch to the Setup position.
13. Press the **Reset** button and adjust the Mode number below 20. This saves the CW calibration value.
14. Be sure you are in Setup. With the **Reset** pressed, adjust the mode number to #103 and turn the Mode Selector switch to Torque Control. Select CCW ("-LEF") by pressing **Reset** and the **Joint** key simultaneously.
15. Set Mode Select switch to Setup, press the **Reset** button, and adjust the mode number below 20. Release **Reset**.
16. Move the mode switch to Torque Control and wait for the wrench to adjust the offset.
17. After the flashing OFFSET disappears (this may take several seconds), press and release the **Reset** button.
18. Repeat steps 2 through 12 to calibrate the wrench in the CCW direction.
19. Press in the **Reset** button and adjust the Mode number below 20. This will save the CCW calibration value.
20. At this point, it is recommended that the scale factor and offset are checked and recorded with the calibration records. To check these, set

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Cal Mode and press **Display** to cancel. Number will cycle. To save Cal scale factor, select Setup, hold in **Reset** and adjust the Mode below 20.

21. Go to Setup Mode #103 and turn the Mode Select switch to Torque Control. Press **Reset** and the **Units** key simultaneously to return the wrench CW ("rit") direction. Select Setup, hold in Reset and adjust the Mode below 20.

Angle Reference Arm Calibration (EA - models)

1. Hold in the **Reset** button and select Custom setup Mode #119. The wrench should display "0.0°".
2. Rotate the Mode Select switch to the Angle Control position.
3. Press the **Reset** button and **Window** key simultaneously. "CAL" should appear on the wrench display. Calibration is now enabled.
4. Release the **Reset** button and rotate the angle reference arm to the full CW position. Apply torque until SNUG light illuminates. Maintain torque, and rotate the angle reference arm from the full CW to the full CCW position. The displayed value will be 219 ± 1 . If not, use the wrench's parameter knob to bring the displayed value within specification. Release torque from the wrench.



For model 40, use $234 \pm 1^\circ$ for the full sweep angle calibration. For models 250 and 400, use $217 \pm 1^\circ$.

5. Press the **Display** key to exit calibration mode.
6. Select Setup, hold in **Reset** and adjust the Mode below 20.

EZ Angle Calibration (EVS - models)

1. Before entering the calibration mode it is necessary to zero the wrench's angle sensor offset voltage. This is accomplished by setting the wrench

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on a flat surface, selecting Angle Control and pressing the **Reset** button until the front panel's FAULT light is extinguished and the green RUN light appears. Then proceed as follows:

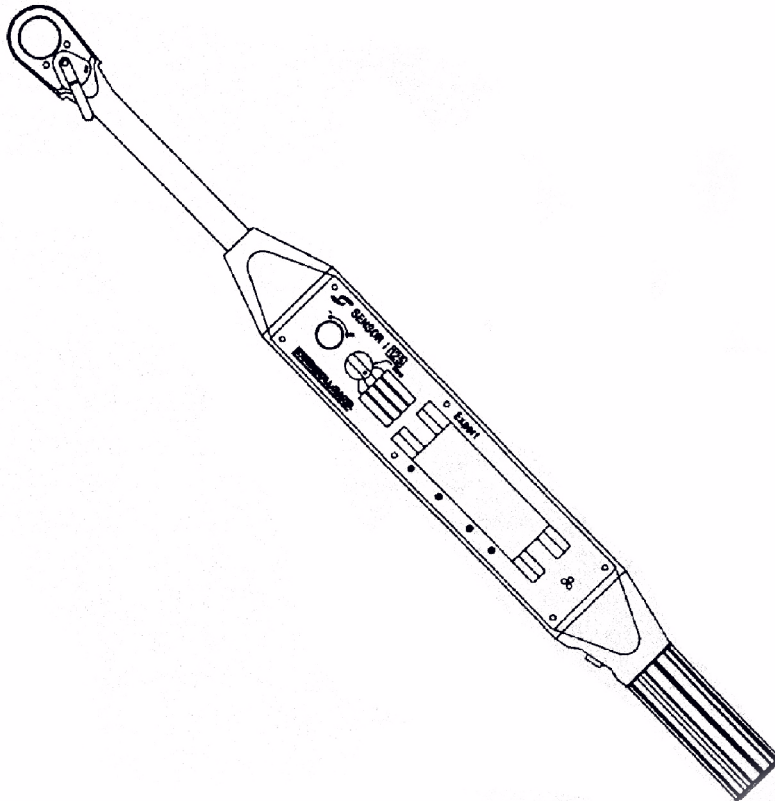
 **NOTE**

If this calibration procedure takes longer than 10 minutes or the wrench ambient temperature changes more than 5° Celsius, step 1 should be repeated.

2. Hold in the **Reset** button and select Custom Setup Mode #120. The wrench display will read "0.0°".
3. Rotate the Mode Select switch to the Dynamic Audit position.
4. Press the **Reset** button and **Window** key simultaneously. A CAL legend should appear on the wrench display. Calibration is now enabled. Release **Reset**.
5. Set the external monitoring equipment's snug torque to match the Torque Control Mode default snug torque of the wrench. The default snug values for all models are listed in the TOOL DESCRIPTION Technical Data table in Chapter 2.
6. Apply more than the snug torque to the wrench and rotate it through a known angle at a rate of between 20 and 45 degrees/second (**do NOT ratchet the wrench**). The wrench's displayed angle value will be the same as that shown on the external monitoring equipment6 ($\pm 2^\circ$). If not, turn the wrench's Parameter Adjustment Knob until they match.
7. Press the **Reset** button, and repeat step 6 to verify calibration.
8. Press the **Display** key to exit calibration.
9. Select Setup, hold in **Reset** and adjust the Mode below 20 to save.

Appendix A

Sample of Data Reports



Appendix A

These reports are accessed by the methods noted in "Data Storage and Retrieval". The information provided by the optional InterLink software will have a different format.

Sample Reports

Parameter Dump

Tightening Configuration No	: Torque Control Mode
Torque Units	: Nm
Load Units	: kN
External channel	: Load Cell
Angle Transducer	: Non Contact Angle Measurement
Multiplier	: 1.00
Serial data during tightening	: Off
Serial data at end of tightening	: Off
Tightening Direction	: Clockwise
Control Strategy	: Torque Control
Target Value	: 0020
Snug Torque	: 0010
Low Torque Limit	: 0020
High Torque Limit	: 0020
Low Angle Limit	: 0000
High Angle Limit	: 0000

End of Tightening Data Dump

Tightening Configuration No : Torque Control Mode
Torque Units : Nm
Load Units : kN
External channel : Load Cell
Angle Transducer : Non Contact Angle Measurement
Multiplier : 1.00
Serial data during tightening : Off
Serial data at end of tightening : Off
Tightening Direction : Clockwise

Control Strategy : Torque Control
Target Value : 0020
Snug Torque : 0010
Low Torque Limit : 0015
High Torque Limit : 0025
Low Angle Limit : 0020
High Angle Limit : 0040

End of Tightening data :
T,0020.4 A,0029 E,0000
T,0020.7 A,0032 E.0000
T,0020.9 A,0032 E,0000
T,0020.1 A,0032 E,0000
T,0020.9 A,0035 E,0000

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End of Tightening Data Dump (cont.)

TORQUE

Mean	: 0020.6
Sigma	: 000.34
Cp	: 004.60
Cpk	: 004.02

ANGLE

Mean	: 0031.9
Sigma	: 001.87
Cp	: 001.84
Cpk	: 001.50

EXTERNAL

Mean	: 0000.1
Sigma	: 000000
Cp	: N/A
Cpk	: N/A

Tightening Curve Data Dump

Torque Units: Nm

Load Units: kN

Multiplier: 1.00

Tightening Direction: Clockwise

Control Strategy: Angle Control

Target Value: 0030

Snug Torque: 0020

Low Torque Limit: 0020

High Torque Limit: 0020

Low Angle Limit: 0030

High Angle Limit: 0030

T,0021 A,0001 E,0000

T,0022 A,0002 E,0000

T,0023 A,0003 E,0000

T,0024 A,0004 E,0000

T,0025 A,0005 E,0000

T,0026 A,0007 E,0000

T,0027 A,0008 E,0000

T,0028 A,0009 E,0000

T,0029 A,0010 E,0000

T,0030 A,0011 E,0000

T,0031 A,0012 E,0000

T,0032 A,0014 E,0000

T,0034 A,0015 E,0000

T,0035 A,0016 E,0000

T,0035 A,0017 E,0000

T,0036 A,0018 E,0000

T,0038 A,0019 E,0000

T,0039 A,0021 E,0000

Data Out at End of Tightening

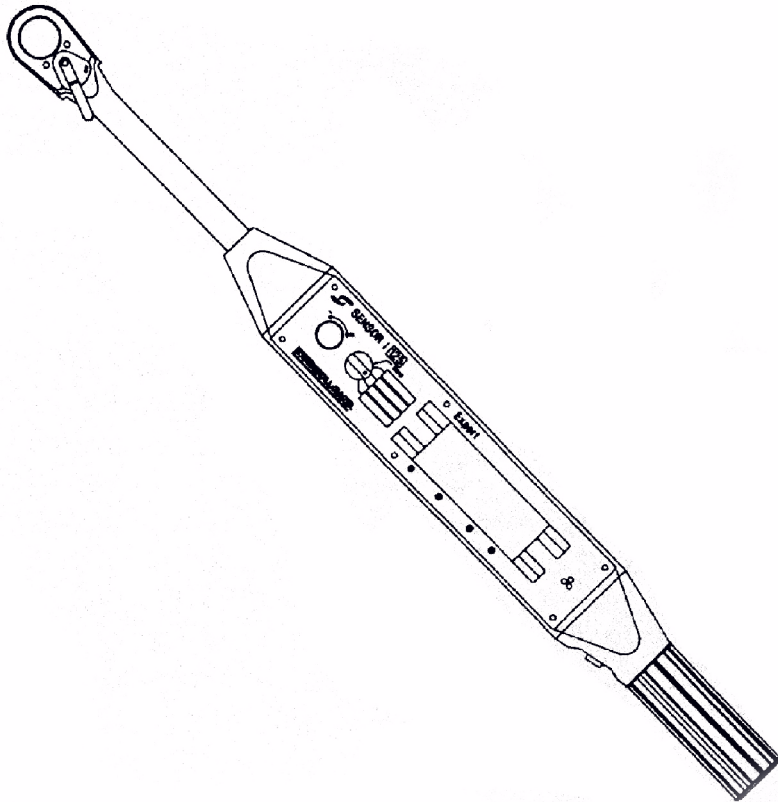
T,0020.5,-,A,0015,a,E,0000,-
T,0017.8,t,A,0010,a,E,0000,-
T,0013.8,t,A,0008,a,E,0000,-
T,0020.5,-,A,0013,a,E,0000,-
T,0027.0,-,A,0017,-,E,0000,-
T,0026.8,-,A,0018,-,E,0000,-
T,0030.5,T,A,0017,-,E,0000,-
T,0020.2,-,A,0000,A,E,0000,-
T,0013.8,t,A,0001,a,E,0000,-
T,0020.5,-,A,0000,a,E,0000,-
T,0017.8,t,A,0000,a,E,0000,-
T,0013.8,t,A,0001,a,E,0000,-

Data Out During Tightening

T,0020.1,A,0001,E,0000
T,0023.4,A,0002,E,0000
T,0027.4,A,0003,E,0000
T,0029.1,A,0004,E,0000
T,0033.2,A,0005,E,0000
T,0037.1,A,0007,E,0000
T,0039.8,A,0008,E,0000
T,0041.4,A,0009,E,0000
T,0044.0,A,0010,E,0000
T,0047.5,A,0011,E,0000

Appendix B

List of Setup Modes



Appendix B

Custom Modes

Custom Modes 1 through 20 are the Custom Tightening modes. They are memory locations used to store tightening strategies for later recall.

Custom Modes 100 through 120 are the Custom Setup Modes and are used for both advanced option selection performing calibration. The Custom Setup Modes are:

Custom Mode	Function
100	Serial data out at end of tightening.
101	Serial data out during tightening.
102	Not used.
103	Tightening direction.
104	Torque multiplier enable/disable.
105	Not used.
106	Not used.
107	Torque Units selection.
108	Not used.
109	Tightening mode parameter upload via serial port.
110	Serial baud rate selection.
111	Stored tightening curve upload via serial port.
112	Not used.
113	Temperature display/calibration.
114	Torque calibration.
115	Not used.
116	External channel setup/calibration for load cell.
117	External channel setup/calibration for torque cell
118	Not used.
119	Angle Reference Arm setup/calibration.
120	EZ Angle sensor setup/calibration.

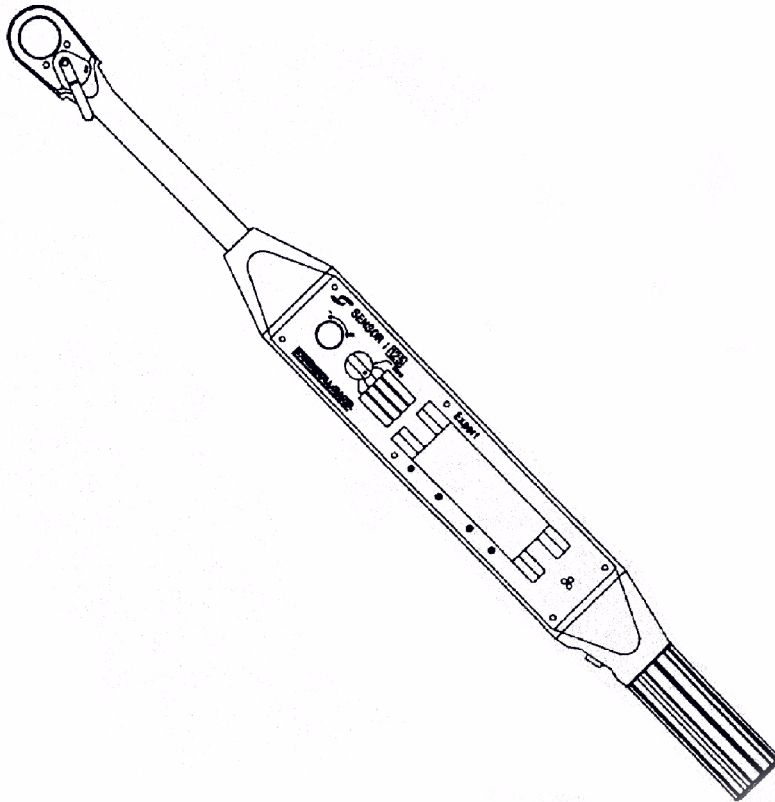
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Custom Modes 200 through 220 are the Custom Diagnostic modes and are used for wrench testing. The Custom Diagnostic modes are:

Custom Mode	Function
200	Display Torque channel A/D converter value/4
201	Display angle reference arm A/D converter value/4
202	Display external channel A/D converter value/4
203	Display Torque Offset D/A channel A/D converter value/4
204	Display Battery channel A/D converter vale/4
205	Display Temperature channel A/D converter value/4
206	Display EZ-Angle Offset D/A channel A/D converter value/4
207	Display EZ-Angle channel A/D converter value/4
208	Membrane keypad test/Ratchet head position test
209	Buzzer test/LED test
210	LCD test/Serial communication test
211	Software version number
212	Time-out adjustment
213	No function implemented
214	Reset Adjustment
215-220	No function implemented.

Appendix C

Spare Parts List



Appendix C**Spare Parts Listing - MODEL 40**

Description	Part #	CPN
*Wrench Assembly, EZ angle	EZS40A-HHT	89934541
*Wrench Assembly, Auditor	EA40A-HHT	89930952
Ratchet Head Replacement Kit	E40HDKIT	89935159
Ratchet Head Assembly (EA-)	EA40A-HD	89930978
Ratchet Head Assembly (EVS-)	EVS40A-HD	89934442
Plastic Overmold Sleeve Grip	TRH-40-135	04683264
Reset Switch Assembly	E40A-RST-SW	89931000
Reset Switch Button Cover	E40-BTTN-CVR	04706370
Tool Cable Assembly (EA- MODELS)	EA40A-CBL	89930960
Tool Cable Assembly (EVS- MODELS)	EVS40A-CBL	89934533
Angle Sensor PCB (EVS- MODELS)	E40A-VS	89931216
Potentiometer cap (EZ- MODELS)	EA40-CAP	89931018
Handle Front cap	E40FRCP	89933618
Handle Back cap	E40RRCP	89931208
Handle decal - warning - English	40HWLBL	89931471
Handle decal - warning - French	40HWLBL-F	89935522
Handle decal - warning - Spanish	40HWLBL-S	89935530
Handle decal - warning - German	40HWLBL-G	89935548
Handle decal - warning - Italian	40HWLBL-I	89935555
Handle decal - logo - English	40HLGLBL	89931455
Handle decal - logo - French	40HLGLBL-F	89935563
Handle decal - logo - Spanish	40HLGLBL-S	89935571
Handle decal - logo - German	40HLGLBL-G	89935589

***NOTE: This component must be recalibrated with its mating unit.**

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Spare Parts Listing - MODEL 40 (cont.)

Description	Part #	CPN
Handle decal - logo - Italian	40HLGLBL-I	89935597
PCB Expert 40 Display	T03710-69	04539516
PCB Expert 40 Control	E40-PCB-MAIN	04705760
Angle Ref. Arm (EA- models only)	T14471-89	04315396
*Control Unit (Both versions)	EXP40A-CU	04706933
Carrying Case	EXP40-CASE	10327054
Shoulder Strap	E40-STRP	89931760
Mode Selector Knob	T14350-01	04313482
Parameter Adjustment Knob	T14337-01	04313474
Tool Receptacle/Wire Assembly	E40A-RCPT	04705653
Recharge Connector and Ribbon Cable Assembly	E40A-RIBBON	04705661
12 Pin Recharge Connector	T25197-01	04313078
2 Pin connector	T25295-01	04313185
Battery Harness	E40A-BAT-TERM	04705604
Battery Access Panel	EXP40-BCAC	10324598
Pivot Indexer Hardware Kit	E40PVKIT	89935167
Belt clip assembly	E40A-BELT-CLIP	04705620
Power switch cap plug (Black)	T28088-01	04313557
NiMH Battery -- 7.2 V 300 mA	T95313-01	04537700
Charger 110V	T95301-110T	04538955
Charger 220V	T95301-220T	04538963
British 3-Conductor 2.5M Right Angle Plug	95301-CORDB	89934269
Euro plug 2.5M	95301-CORDE	89934277
Serial Cable Assembly	T66104-01	04544078

***NOTE: This component must be recalibrated with its mating unit.**

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Spare Parts Listing - MODEL 40 (cont.)

Description	Part #	CPN
Rear Control Unit Decal - English	E40-PR-LABEL	04705786
Rear Control Unit Decal - French	E40-PRLBL-F	89935449
Rear Control Unit Decal - German	E40-PRLBL-G	89935456
Rear Control Unit Decal - Spanish	E40-PRLBL-S	89935464
Rear Control Unit Decal - Italian	E40-PRLBL-I	89935472
Front Control Unit Decal - English	E40-OPER-LABEL	04705752
Front Control Unit Decal - French	E40-OPLBL-F	89935480
Front Control Unit Decal - German	E40-OPLBL-G	89935498
Front Control Unit Decal - Spanish	E40-OPLBL-S	89935506
Front Control Unit Decal - Italian	E40-OPLBL-I	89935514
Front Panel - English (EVS- models)	T21475-69AEE	04539763
Front Panel - German (EVS- models)	T21475-69AEG	04544110
Front Panel - French (EVS- models)	T21475-69AEF	04540415
Front Panel - Spanish (EVS- models)	T21475-69AES	04625992
Front Panel - Italian (EVS- models)	T21475-69AEI	04540423
Front Panel - English (EA- models)	T21475-AEE	04623200
Front Panel - German (EA- models)	T21475-AEG	04629234
Front Panel - French (EA- models)	T21475-AEF	04629218
Front Panel - Spanish (EA- models)	T21475-AES	04629242
Front Panel - Italian (EA- models)	T21475-AEI	04629259

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Spare Parts Listing - MODEL 125

Description	Part #	CPN
PCB Expert Display	T03710-69	04539516
PCB Expert Control	T03711-69	04539524
Angle Ref Arm (EA- models only)	T14154-89	04312732
Carrying Case with Inserts	T53125-89	04313672
Serial Cable Assembly	T66104-01	04544078
Ratchet Head Replacement Kit	T14372-79	04313391
Ratchet Head Assembly (EA-)	T14327-88	04539029
Ratchet Head Assembly (EVS-)	T14327-87	04539367
Rear Panel - English	T19979-125E	04539748
Rear Panel - French	T19979-125F	04540431
Rear Panel - German	T19979-125G	04544094
Rear Panel - Spanish	T19979-125S	04625984
Rear Panel - Italian	T19979-125I	04540449
Spring Rotation Mech	T14338-01	04313540
Mode Selector Knob	T14350-01	04313482
Plastic Molded Hand Grip	T14335-01	04313037
Reset/Power Switch	T51122-02	04313052
Rear Panel Gasket	T14330-EX	04539912
Cap Plugs (Back)	T28088-01	04313557
Circlip	T28653-01	04313128
NiMH Battery -- 7.2V 300 mA	T95313-01	04537700
Battery Replacement Kit	T95313-99	04537718
Charger 110V	T95301-110T	04538955
Charger 220V	T95301-220T	04538963
British 3-Conductor 2.5M Right Angle Plug	95301-CORDB	89934269

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Spare Parts Listing - MODEL 125 (cont.)

Description	Part #	CPN
Euro plug 2.5M	95301-CORDE	89934277
Head Indexing Set Screw	SETSCR-10-24-395	04630059
Insulating Spacer	T14334-01	04313086
Ribbon Cable, 26 AWG	T66103-01	04540050
Ribbon Cable Converter, 10 pin (2x5)	T25728-01	04539656
Connector Mounting Plate	T14333-01	04313110
Connector 12 pin	T25197-01	04313078
Connector 2 pin	T25295-01	04313185
Front Panel - English (EVS- models)	T21475-69AEE	04539763
Front Panel - German (EVS- models)	T21475-69AEG	04544110
Front Panel - French (EVS- models)	T21475-69AEF	04540415
Front Panel - Spanish (EVS- models)	T21475-69AES	04625992
Front Panel - Italian (EVS- models)	T21475-69AEI	04540423
Front Panel - English (EA- models)	T21475-AEE	04629200
Front Panel - German (EA - models)	T21475-AEG	04629234
Front Panel - French (EA - models)	T21475-AEF	04629218
Front Panel - Spanish (EA- models)	T21475-AES	04629242
Front Panel - Italian (EA- models)	T21475-AEI	04629259

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Spare Parts Listing - MODEL 250

Description	Part #	CPN
PCB Expert Display	T03710-69	04539516
PCB Expert Control	T03711-69	04539524
Angle Ref Arm (EA-models only)	T14154-88	04314555
Carrying Case	T14418-01	04314522
Serial Cable Assembly	T66104-01	04544078
Foam Inserts	T14415-01	04314688
Ratchet Head Replacement	T14381-01	04314365
Ratchet Head Assembly (EA-)	T14393-89E	04628145
Ratchet Head Assembly (EVS-)	T14393-89EV	04628350
Rear Panel - English	T19979-250E	04628988
Rear Panel - French	T19979-250F	04628996
Rear Panel - German	T19979-250G	04629002
Rear Panel - Spanish	T19979-250S	04629010
Rear Panel - Italian	T19979-250I	04629028
Spring Rotation Mech	T14395-01	04314498
Mode Selector Knob	T14350-01	04313482
Plastic Molded Hand Grip	T14335-01	04313037
Reset/Power Switch	T51122-02	04313052
Rear Panel Gasket	T14330-EX	04539912
Cap Plugs (Back)	T28088-01	04313557
Circlip	T28653-01	04313128
NiMH Battery -- 7.2V 300mA	T95313-01	04537700
Battery Replacement Kit	T95313-99	04537718
Charger 110V	T95301-110T	04538955
Charger 220V	T95301-220T	04538963

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Spare Parts Listing - MODEL 250 (cont.)

Description	Part #	CPN
British 3-Conductor 2.5M Right Angle Plug	95301-CORDB	89934269
Euro plug 2.5M	95301-CORDE	89934277
Head Indexing Set Screw	SETSCR-10-24-395	04630059
Insulating Spacer	T14334-01	04313086
Ribbon Cable, 26 AWG	T66103-01	04540050
Ribbon Cable Convertor, 10 pin (2x5)	T25728-01	04539656
Connector Mounting Plate	T14333-01	04313110
Connector 12 pin	T25197-01	04313078
Connector 2 pin	T25295-01	04313185
Front Panel - English (EVS- models)	T21475-69AEE	04539763
Front Panel - German (EVS- models)	T21475-69AEG	04544110
Front Panel - French (EVS- models)	T21475-69AEF	04540415
Front Panel - Spanish (EVS- models)	T21475-69AES	04625992
Front Panel - Italian (EVS- models)	T21475-69AEI	04540423
Front Panel - English (EA- models)	T21475-AEE	04629200
Front Panel - German (EA- models)	T21475-AEG	04629234
Front Panel - French (EA- models)	T21475-AEF	04629218
Front Panel - Spanish (EA- models)	T21475-AES	04629242
Front Panel - Italian (EA- models)	T21475-AEI	04629259

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Spare Parts Listing - MODEL 400

Description	Part #	CPN
PCB Expert Display	T03710-69	04539516
PCB Expert Control	T03711-69	04539524
Angle Ref Arm (EA- models only)	T14154-88	04314555
Carrying Case	T14418-01	04314522
Serial Cable Assembly	T66104-01	04544078
Foam Inserts	T14415-01	04314688
Ratchet Head Replacement	T14381-01	04314365
Ratchet Head Assembly (EA-)	T14394-89E	04628228
Ratchet Head Assembly (EVS-)	T14394-89EV	04628368
Rear Panel - English	T19979-400E	04629036
Rear Panel - French	T19979-400F	04629044
Rear Panel - German	T19979-400G	04629986
Rear Panel - Spanish	T19979-400S	04629051
Rear Panel - Italian	T19979-400I	04629069
Spring Rotation Mech	T14395-01	04314498
Mode Selector Knob	T14350-01	04313482
Plastic Molded Hand Grip	T14335-01	04313037
Reset/Power Switch	T51122-02	04313052
Rear Panel Gasket	T14330-EX	04539912
Cap Plugs (Back)	T28088-01	04313557
Circlip	T28653-01	04313128
NiMH Battery -- 7.2V 300mA	T95313-01	04537700
Battery Replacement Kit	T95313-99	04537718
Charger 110V	T95301-110T	04538955
Charger 220V	T95301-220T	04538963

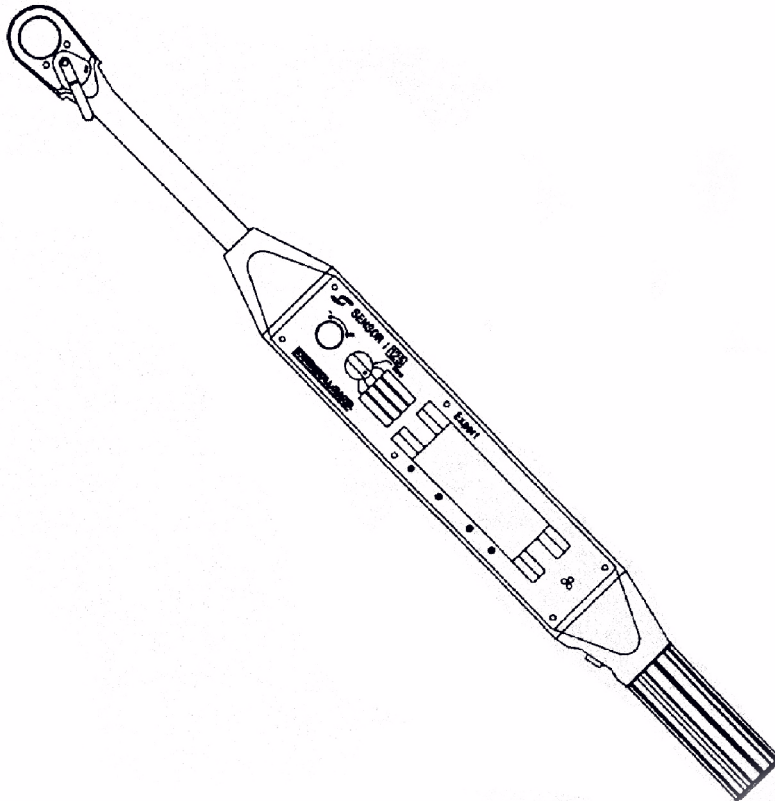
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Spare Parts Listing - MODEL 400 (cont.)

Description	Part #	CPN
British 3-Conductor 2.5M Right Angle Plug	95301-CORDB	89934269
Euro plug 2.5M	95301-CORDE	89934277
Head Indexing Set Screw	SETSCR-10-24-395	04630059
Insulating Spacer	T14334-01	04313086
Ribbon Cable, 26 AWG	T66103-01	04540050
Ribbon Cable Converter, 10 pin (2x5)	T25728-01	04539656
Connector Mounting Plate	T14333-01	04313110
Connector 12 pin	T25197-01	04313078
Connector 2 pin	T25295-01	04313185
Front Panel - English (EVS- models)	T21475-69AEE	04539763
Front Panel - German (EVS- models)	T21475-69AEG	04544110
Front Panel - French (EVS- models)	T21475-69AEF	04540415
Front Panel - Spanish (EVS- models)	T21475-69AES	04625992
Front Panel - Italian (EVS- models)	T21475-69AEI	04540423
Front Panel - English (EA- models)	T21475-AEE	04629200
Front Panel - German (EA- models)	T21475-AEG	04629234
Front Panel - French (EA- models)	T21475-AEF	04629218
Front Panel - Spanish (EA- models)	T21475-AES	04629242
Front Panel - Italian (EA- models)	T21475-AEI	04629259

Appendix D

Service Centers



Appendix D

Service Centers

USA

**Ingersoll-Rand Company
Automation and Integration Center
1872 Enterprise Dr.
Rochester Hills, MI 48309**

Tel: +1 (248) 293-5700

Fax: +1 (248) 293-5800

EUROPE

**Ingersoll-Rand Company
Fastener Tightening System Division
Swan Lane, Hindley Green, Nr.Wigan
Lancashire WN2 4EZ
United Kingdom**

Tel: (44) 01942 502 661

Fax: (44) 01942 502 660

DECLARATION OF CONFORMITY

We _____ **Ingersoll - Rand, Co.**
(supplier's name)

_____ **Swan Lane, Hindley Green, Wigan WN2 4EZ, U.K.**
(address)

declare under our sole responsibility that the product,

_____ **Sensor I[®] Expert Electronic Wrenches**

to which this declaration relates, is in compliance with the provisions of

_____ **98/37/EC, 73/23/EEC, 93/68/EEC, 89/336/EEC and 92/31/EEC** *Directives.*

By using the following Principle Standards: _____ **EN792-1, EN26789, EN60204,
EN60950, EN50081, EN50082**

Serial No. Range _____ **EX-0000-EX-4999**

_____ **B. Seager**
Name and signature of authorised persons

_____ **James Wardlaw**
Name and signature of authorised persons

_____ **November, 2000**
Date

_____ **November, 2000**
Date

NOTICE

SAVE THESE INSTRUCTIONS. DO NOT DESTROY

When the life of the tool has expired, it is recommended that the tool be disassembled, degreased and parts be separated by material so that they can be recycled.



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