



WDS 4004

Web Deflection System

Operator's Manual

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1. Unpacking the System

The WDS, Web Deflection System, is normally supplied in a rigid carrying case containing all items including:

Display Unit (Figure 1)

Deflection Measuring Head with connecting cable (Figure 2)

Extensions and locking rings (Figure 2)

End Points

Angle Measuring Head (Figure 2)

“Y” cable for connecting the Display Unit to the Measuring Heads

RS-232 cable for connecting the Display Unit to a laptop (PC)

Power Pack for charging the battery

Verify that you have received everything before proceeding.

2. WDS Quick Start Instructions

The system was shipped with a fully charged internal lithium ion battery and should be ready for use. The unit will not turn on until the “Y” cable is attached to the unit. Refer to Figures 1 and 2 for connection information.

- Connect the “Y” cable to the Display/Processing Unit. Once connected, the unit may take up to 10 seconds to power up.
- Connect the Deflection Measuring Head and the Angle Measuring Head to the “Y” cable.
- The DEFLECTION display should flash “oL” and the CRANK ANGLE will display digits.
- Rotate the Angle Measuring Head and the “CRANK ANGLE” degrees should rise or fall depending on rotational direction. If not, ensure that it is properly oriented when rotating.
- Hold or place the Angle Measuring Head so an angle is displayed and press the “ANGLE PRESET” button. The displayed degrees revert back to zero. (If a different preset value is needed, refer to the Angle Preset Setup mode later in the manual.)
- Attach Display/Processing Unit to the computer with the RS-232 cable if using WEBMAP2®. Open WEBMAP2® to connect to the Display/Processing Unit.
- Refer to the EXTENSION CHART (Appendix A) for selecting the correct size extensions before placing in web opening. Attach extensions to Deflection Measuring Head.
- Position Deflection Measuring Head into web opening by placing points into center marks, and attach Angle Measuring Head to crank shaft or fly-wheel. Refer to Section 7.1 for web preparation. Adjust Deflection Measuring Head until both lights are out, and then press the Deflection Reset and Angle Preset buttons.

The WDS is now ready for use and data collection.

3. WEBMAP2® Software Installation

WEBMAP2® Software Installation

WEBMAP2® software provides powerful data analysis of web deflection data enabling the user to diagnose and correct potential problems that may lead to premature failure. The software can be used to record deflection and angle data automatically in real-time when connected to the WDS. Whether the data is acquired automatically or manually entered, the data is always available in the software for animations, 3-D views, graphs, and reports of the stresses on shaft.

If you purchased **WEBMAP2®** software from INDIKON, The following steps will allow you to download and register your copy of the software.

- Contact Lauren or her designated representative at Anderson Consulting, Training, and Testing (ACTT), Office: (713) 633-1805.
- ACTT will walk the customer through the download and installation of the program.
- The ACTT representative will give the customer a serial number to enter into the program and the Program will return a corresponding key code that you will need to read back to the ACTT representative.
- After verification of the serial number ACTT will give you a second key code to enter into the program. Once entered, the registration will be complete and allow full access to the software's capabilities.

Customers who wish to try the program may download a *free trial version* of the software program at www.classact.com/actt/webmap/webmap.htm.

This will allow you access to some functions of the program. If you like the program and wish to take advantage of the power of the full program, contact the INDIKON Co.

4. WEBMAP Quick Start

Download and register your software at www.classact.com/actt/webmap/webmap.htm.

Connect the serial cable between the WDS and the COM port on the PC.

Open the WEBMAP2® program.

Open an existing file for the machine being measured. Or create a new English or Metric file.

5. Description

The WDS is a measuring and analysis tool that will help detect stress points on the crank shaft webs. When coupled with the WEBMAP® software you can collect and analyze data using 3D and graphical representation of the Shaft. The WDS comes with a rechargeable lithium Ion battery, an integrated charger, and an external 12VDC power pack. The unit has a sleep mode to conserve battery life that will activate after 30 minutes of inactivity. The "Y" cable provides connectivity to the Deflection Measuring Head and the Angle

Measuring Head. The “Y” cable needs to be connected to the unit in order to power the WDS.

The Deflection Measuring Head is used to measure the web deflection and the Angle Measuring Head indicates the rotational angle of the surface it is attached to.

5.1 Outputs and Controls (See Figure 1)

Momentary DEFLECTION RESET button

Once the measuring head is in place in the web of the throw, auto zero can be applied providing that the measuring head is within 5 mils (63.5 microns) of its mechanical zero range. The measuring head has two lights; when not lit, they indicate that the measuring head is within auto zero range. However, if the red or yellow lights are lit, adjust the length of the measuring head assembly until both lights go out.

If the red light is lit, the measuring head assembly is too long and must be shortened. The processing/display unit will also display red “oLL” for over-limit long. Likewise, if the yellow light is lit, the measuring head assembly is too short and must be lengthened. The processing/display unit will also display orange “oLS” for over-limit short.

Momentary ANGLE PRESET button

Angle sets to the preset number (starting angle).

If data acquisition needs to begin at an angle other than zero, a preset angle can be programmed into the WDS. When the angle is “zeroed”, it will set the angle at that preset angle. (Ref section 6.1)

Momentary DISPLAY ON/OFF button

Manually places WDS into and out of sleep-mode. When awakened, previous data will redisplay and data acquisition may resume. Any angle change will also awaken the WDS.

Momentary DEFLECTION RESET and ANGLE PRESET buttons

Changes deflection units between mils and microns. Deflection units can be changed during normal or programming modes.

Momentary ON/OFF and ANGLE PRESET buttons

Enters into the set angle programming mode. Programming mode will time-out returning to normal operation if no input is received within 10 seconds.

Momentary ON/OFF and DEFLECTION RESET buttons

Enters into the deflection limit programming mode. Programming mode will time-out returning to normal operation if no action is received within 10 seconds.

6. Setup Modes

6.1 Set Angle Mode

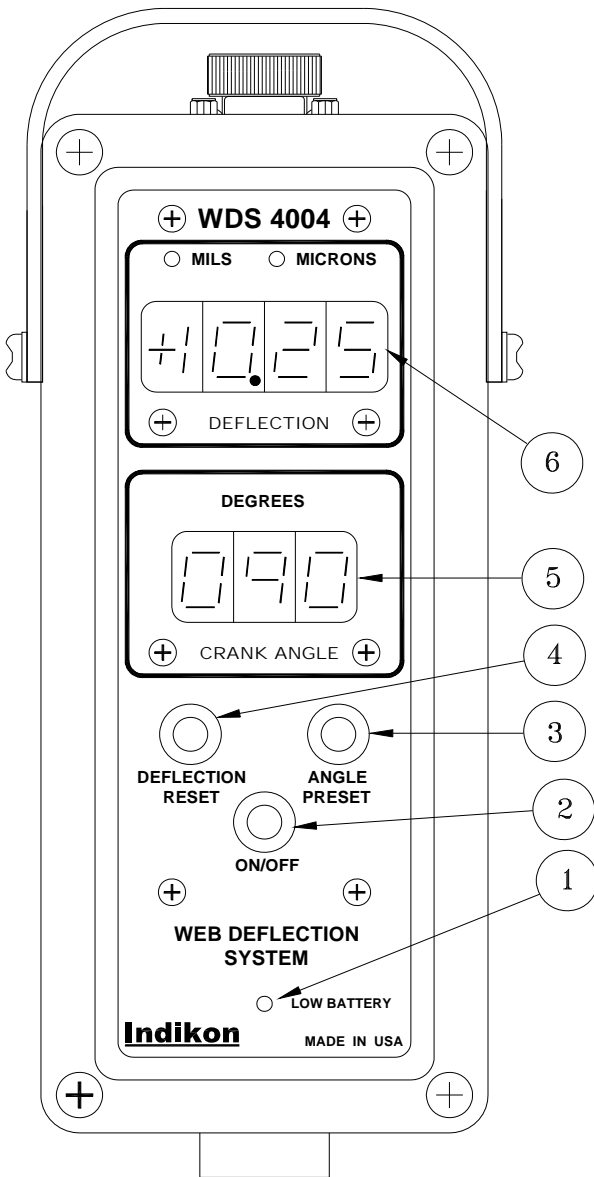
To set the Angle depress the ON/OFF and Angle Preset buttons together. The current “angle preset” value will be shown in red in the CRANK ANGLE display and “**SEt**” will be shown in orange in the DEFLECTION display indicating the unit is in setup mode.

Use the DEFLECTION RESET button or ANGLE PRESET button to increase or decrease the angle preset value. When the desired number is reached, press ON/OFF to save the value. If there is no activity for 10 seconds, the unit will exit setup mode exits without saving the new angle preset value.

6.2 Deflection Limit Setup Mode

To set the Deflection Limit depress the ON/OFF and Deflection Reset buttons together. The current “deflection limit” value will be shown in red in the DEFLECTION display and “**SEt**” will be shown in orange on the CRANK ANGLE display.

Use the DEFLECTION RESET button or ANGLE PRESET button to increase or decrease the deflection limit value. When the desired number is reached, press ON/OFF to save the value. If there is no activity for 10 seconds, the unit will exit setup mode exits without saving the new deflection limit value.



- 1 Low Battery Indicator
- 2 ON/OFF Button
- 3 ANGLE PRESET Button
- 4 DEFLECTION RESET Button
- 5 Crank Angle Display
- 6 Deflection Display
- 7 RS-232 DB-9 CONNECTOR
- 8 Power Supply Connector
- 9 Protective Cap
- 10 "Y" CABLE PLUG

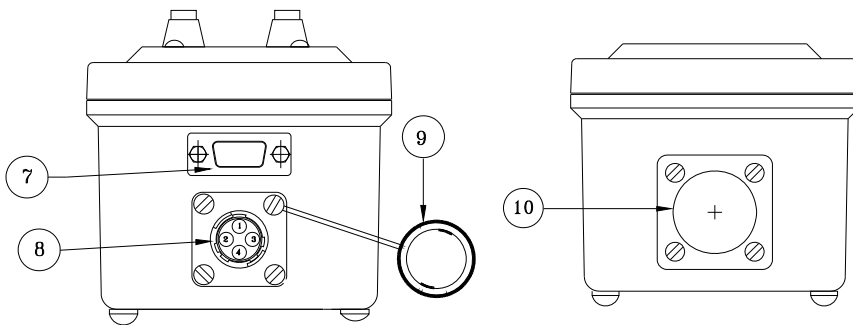


Figure 1

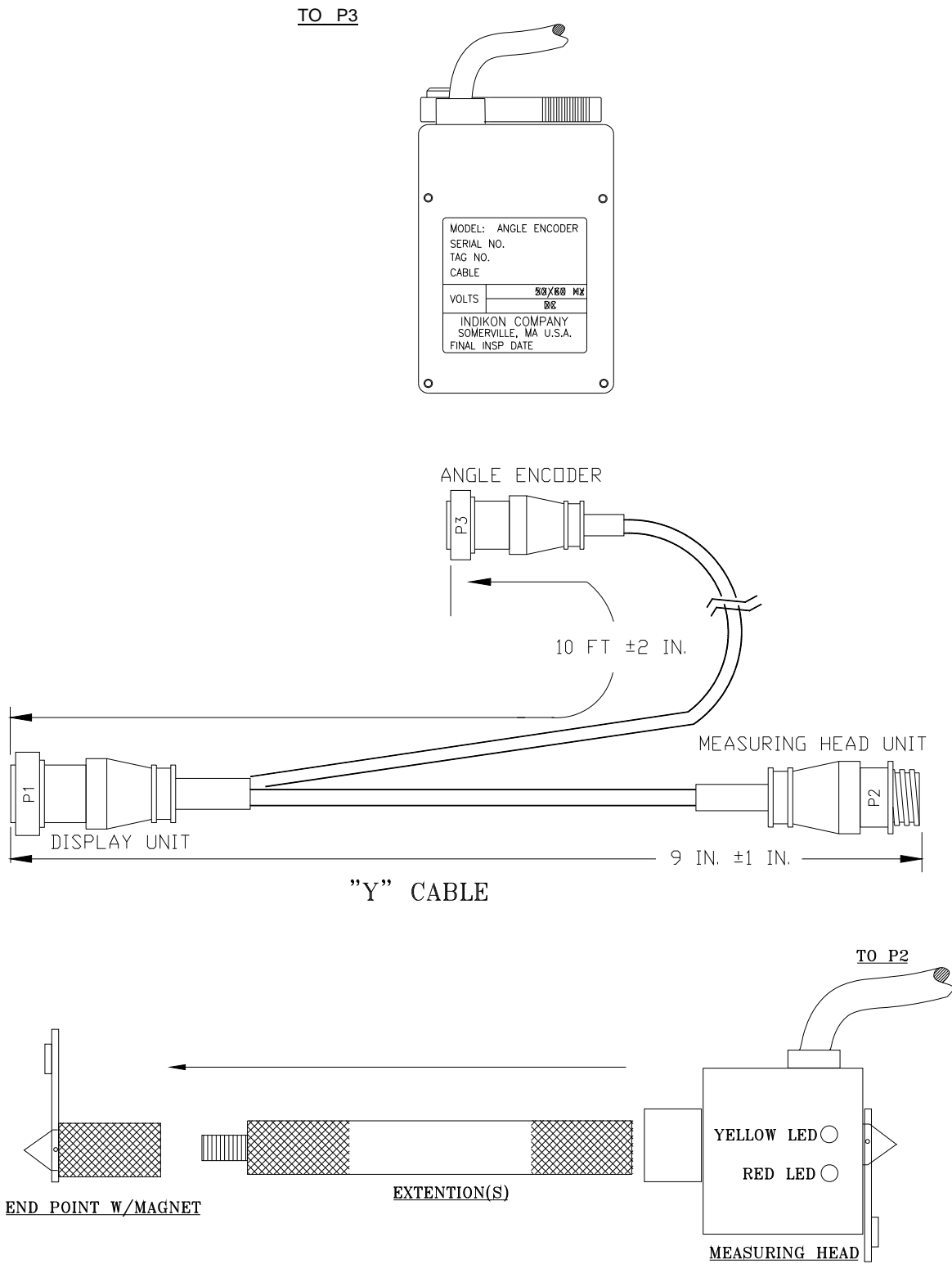


Figure 2

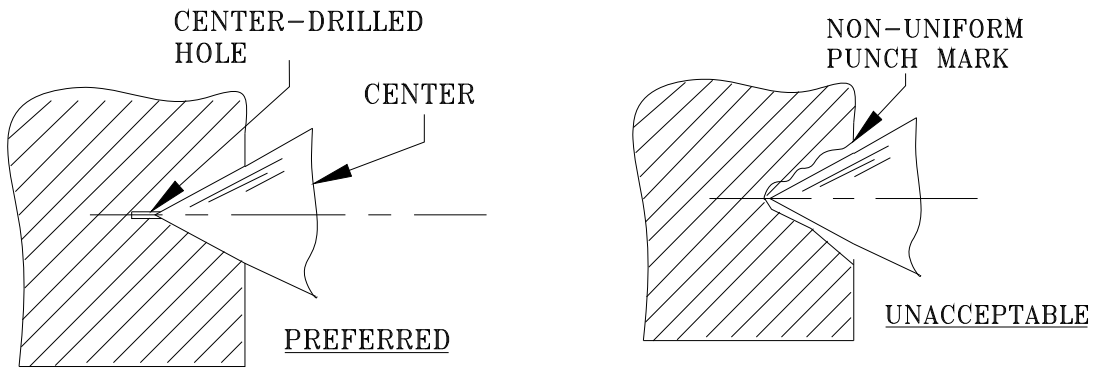
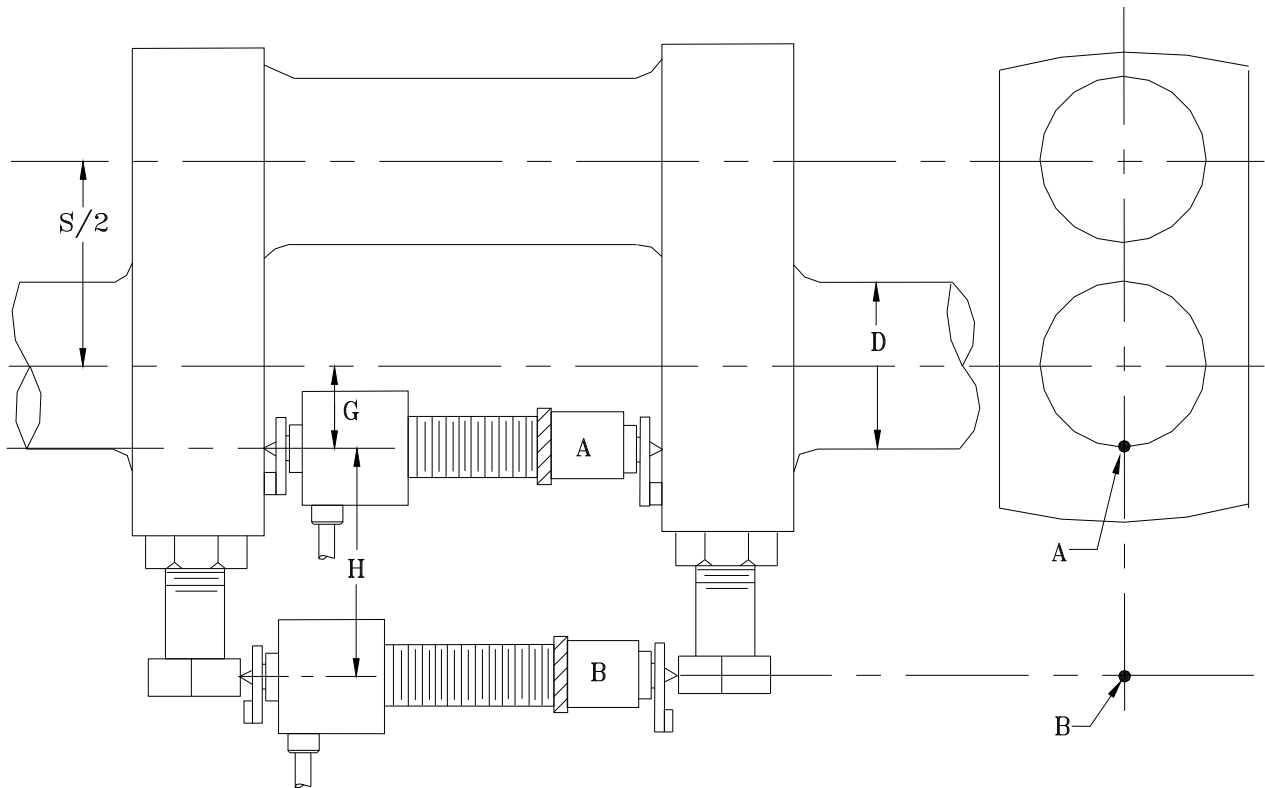


Figure 3



- A = Measured deflection at point A
- B = Measured deflection at point B
- D = Crank shaft diameter
- H = Offset distance of point B to Point A
- G = Distance from point A to crank centerline
- S = Stroke

$$A = \frac{B \times M}{H + M}$$

WHERE

$$M = S/2 + G$$

Figure 4

7. Setup

7.1 Web Preparation (see Figure 3 & 4)

There are three methods that may be used to mount the Deflection Measuring Head between the webs to be measured. The preferred method is to drill and countersink centering marks (Figure 3) for the points to set in. The next best method is to use punch marks as long as they are crisp and properly aligned (Figure 3). The final option is to just mount the Deflection Measuring Head between the webs.

A combination drill and countersink with a 60° angle (commonly known as a “center drill”) is the preferred method to produce the center marks. Drill bit sized No. 0 or No. 1 is recommended and will provide an appropriate center mark.

Punch marks should be as sharp and as well defined as possible. A hollowed-out or out-of-round mark may allow movement and error. It is recommended for historical comparisons that these marks be readily identifiable for future web deflection measurement in order to accurately determine changes over time.

While the sharp points help insure that the Measuring Head does not shift in a punch marks, proper seating is important. A center mark with an irregular recess, as depicted in Figure 3, should be avoided. The weight of the Measuring Head or other forces may cause the Measuring Head to shift and cause inaccurate readings if not seated properly.

The most accurate readings are achieved by reading from a “hot web” at a stable temperature. The machine needs adequate run time to achieve normal operating temperatures. As a result, complete thermal expansion occurs, leaving the web “hot”, which is ideal for accurate web deflection measurements.

7.2 Measuring Head Extension / Installation

The Measuring Head incorporates a linear displacement transducer to measure the web deflection. Measure the distances between the throws of the machine and assemble the proper extension length (see Appendix A). The Measuring Head should always be mounted between the webs, ensuring that the points are secure in the center marks.

Since temperature changes of 9°F cause an error of 0.1 mil per 10” in web length, the Measuring Head and extensions should be at or near the same temperature as the web to achieve the greatest accuracy. If the Measuring Head is “cold” and its temperature will change significantly while taking a measurement on a single web, place the Measuring Head and extension assembly inside a sealed heat-resistant plastic bag and submerge it in the engine oil for a period of at least 5 minutes to warm it.

If the 2”, 4”, or 8” extensions are required, thread them on to the ¾” threaded stub on the other end of the measuring head. Tighten, firmly, by hand. Place a lock ring and the long center at the other end of the extension assembly.

The three (3) shortest stubs and the short center provide 0.35" adjustment ranges with approximately 0.1" of overlap.

The longest stubs (1.70", 2.70") and the long center give 1.00" adjustment ranges with 0.2" overlap.

If extensions are not required, place a lock ring and appropriate center directly on the $\frac{3}{4}$ " threaded stub.

The web deflection should be measured at points A (Figure 4), if possible. Position B can be used at the discretion of the operator if interference problems prevent the proper setup of the measuring head at position A. If position B is used, measurements are taken between the bolts or counter weights, and then converted to position A dimensions using the formula shown on Figure 4. Webmap2® should be set up to automatically perform the calculation at Position B for automatic data collection and manual data collection.

7.3 Angle Measuring Head Installation

Connect the Angle Measuring Head (AMH) to P3 of the "Y" cable.

Position the AMH on the suitable side of the web for a clockwise rotation. Before data collection, verify the direction of the angle measuring head is correct by turning AMH in the desired direction by a few degrees. As shaft position changes during data acquisition, the angle measuring head detects change in degrees and is displayed in the CRANK ANGLE display on the unit

For accurate angle measurements, care should be taken to ensure there is no added tension on the cable other than the cable itself, to prevent shifting of the Angle Measuring Head and acquiring unreliable angle data.

7.4 WEBMAP2®

Download and register your software at www.classactt.com/actt/webmap/webmap.htm.

Connect the serial cable between the WDS and the COM port on the PC.

Open the WEBMAP2® program.

Open an existing file for the machine being measured. Or create a new English or Metric file. Add the correct number of bearings and throws to the machine configuration, then save configuration.

Select Data Entry in the pull-down menu.

Select Acquire button.

WEBMAP2® is ready to receive data.

Press the Help button for further information.

8. Normal Operation

8.1 Normal Startup

Verify the “Y” cable is properly connected to the Display Unit and Measuring Heads. Once the “Y” cable is plugged in the Processing/display unit will turn on within 10 seconds.

If using the WEBMAP2® software, verify proper connection of the serial communications cable between the Display Unit and the COM port of the laptop.

Press the DEFLECTION RESET button to zero the deflection reading.

Press the ANGLE PRESET button to initialize the crank angle reading.

Start rotating the crankshaft to begin automatic data acquisition per section 8.3.

8.2 Manual Data Collection

The WDS facilitates the manual collection of data with a few simple steps.

Choose a default angle interval, possibly 45°.

Record the deflection and the angle at the initial position.

Rotate the crankshaft by the selected angle interval.

Record the deflection and the angle at the new position.

Repeat the process of rotation and data collection until the crankshaft has been rotated 360°.

Verify that the initial deflection reading is close to the final reading after 360° of rotation.

Collect data at each web (or each position on the crankshaft).

If using the WEBMAP2® program, proceed as follows. Select Data Entry from the pull-down menu. Click on the Tabular button and enter the data obtained from the manual readings into the Data Entry window.

Click on the Help button for further information on entering the data.

8.3 Automatic Data Collection

Use the WEBMAP2® software to automatically collect all the data as follows.

Select Data Entry from the pull-down menu. Click on the Acquire button.

Select the proper COM port (in WEBMAP2®) and wait for the software to establish communications with the Display Unit.

If WEBMAP2® fails to establish communications, try a different COM port.

Rotate the crankshaft and the software will automatically collect data every 10° of rotation.

The r^2 value (correlation coefficient) reflects accuracy and consistency of the readings. A good set of data has been collected when the r^2 value is higher than 0.94 and the curve generated shows a smooth path.

Collect data at each web (or each position on the crankshaft).

Once the data is collected on all the webs, a printout of the data in both graph and report form is available. The WEBMAP2® software furnishes a quick analysis and projection of the data for all of the webs and displays it on a 'virtual crankshaft'. See the software instructions for more details.

The on-screen manipulation of the crankshaft and magnification of the points of stress and bends in the shaft will allow the user to develop the strategies necessary to correct any problems (i.e. shims, alignment, bearing change, etc.) and compensate for the deflection.

9. Battery Charging

The Low Battery LED illuminates indicating that the battery is low and should be recharged. If use is continued, "Lo bAt" will flash in the display, recharge immediately. Finally, if use is still continued, the unit will be forced into the sleep mode. The unit will also sleep after inactivity of the buttons or angle measurement after 30 minutes.

Plug the 12VDC Power Pack into a wall outlet and into the display unit's charging connector, Item 8 in Figure 2. The unit and battery are both protected and can not be overcharged. When the unit is charging, the Low Battery LED will periodically flash. When the battery is at 100% capacity, "bAttFuL" will flash in the ANGLE and DEFLECTION displays.

10. MAINTENANCE

10.1 Inspection and Cleaning

Inspect and clean exterior surfaces on all components after each use. Electrical connections should be clean and checked for bent or damaged pins. The battery is internal in the Display Unit and should only be serviced or replaced by the factory.

10.2 Calibration

Calibration can only be performed at the factory. Since this is a relative measuring system, meaning that the deflection and angle are both reset/preset during use, only the relative readings and linearity are checked during calibration.

Please contact Customer Service for any required calibration or repair.

11. Specifications

Deflection Measuring Head

Type	LVDT
Web Opening Range	3.9" to 20.8" (99 to 528mm)
Differential Measuring Range	±19.9 mils or ±505 microns
Resolution	0.05 mils or 1.27 microns
Viewable Resolution	0.1 mils or 3 microns
Absolute Accuracy	N/A – This is a relative measuring device
Relative Accuracy	1% error full scale
Thermal Expansion Error	0.1 mils per 10" of length per 9°F change

Angle Measuring Head

Type	Optical Encoder
Measuring Range	0° to 359°
Resolution	1°
Absolute Accuracy	N/A – This is a relative measuring device
Relative Accuracy	3°

Adjustments

Deflection Reset	Sets deflection to zero
Deflection Limit Indicator	DEFLECTION displayed orange when value exceeded
Deflection Limit Range	0.0 – 19.9 mils or 0 – 505 microns
Deflection Limit Resolution	0.1 mils or 3 microns
Angle Preset	Sets angle to a preset value
Angle Preset Range	0° to 355°
Angle Preset Resolution	5°

Interface Connectors

Y Cable	
Deflection Measuring Head	
Angle Measuring Head	
PC Communications	Female DB-9
12v Power Pack	Battery charging

Operating Power

Battery	Lithium Ion with internal protection
Voltage	7.2 VDC nominal
Power Consumption	1 watts
Operating Time	12 Hours on a fully charged battery

Charging Power Pack

Input Voltage	100VAC to 120VAC, 47-63Hz
Output Voltage	12VDC nominal
Power Consumption	2.4 watts
Charging time	16 Hours

Mechanical – Display/Processing Unit

Enclosure	Fiberglass
Dimensions	3.5" x 8.5" x 3.5" (89mm x 203mm x 102mm)
Weight	3.8lbs (1.7kg)

Mechanical – Deflection Measuring Head

Enclosure	Aluminum
Dimensions	1.75" diameter x 3.9" L (44mm x 99mm)
Weight	1.4lbs (0.6kg)

Mechanical – Angle Measuring Head

Enclosure	Aluminum
Dimensions	2" x 2.75" x 1.5" (50mm x 63mm x 37mm)
Weight	0.8lbs (0.4kg)

Mechanical – Carrying Case with Contents

Material	ABS Plastic
Dimensions	17" x 12" x 6" (432mm x 305mm x 153mm)
Weight	12lbs (5.4kg)

Environmental

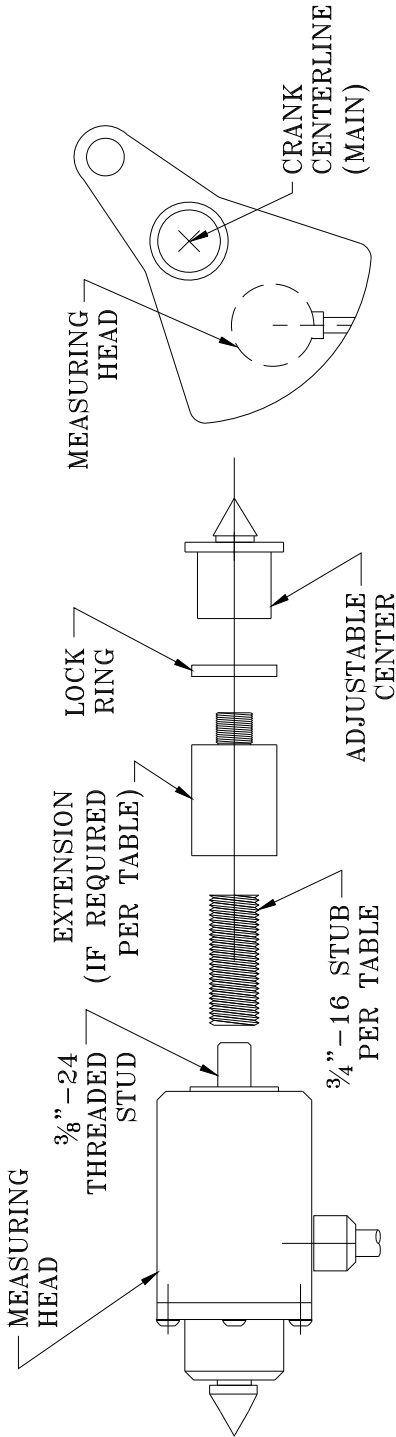
Display/Processing Unit	
Ambient Storage Temperature	32°F to 125°F (0°C to 52°C)
Ambient Operation Temperature	32°F to 125°F (0°C to 52°C)

Adjustable Measuring Head	
Ambient Storage Temperature	-10°F to 150°F (-23°C to 65°C)
Ambient Operation Temperature	-10°F to 150°F (-23°C to 65°C)

Humidity	0 to 95% RH, non-condensing
Transportation Vibration	IAW Commercial Handling/Shipping

Warranty

Standard	1 year
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NOMINAL WEB OPENING, INCHES [mm]		Indikon		MODEL 4004		WEB DEFLECTOR INDICATOR	
		MIN	MAX	MIN	MAX	MIN	MAX
4.155	[105.5]	X					
3.665	[93.1]						
4.505	[114.4]		X				
4.015	[102.0]						
4.855	[123.3]						
4.365	[110.9]						
6.000	[154.4]			X			
4.716	[119.8]						
7.080	[179.8]						
5.716	[145.2]						
8.525	[203.8]	X					
6.760	[171.7]	X					
9.025	[229.2]						
7.760	[197.1]	X					
10.030	[254.8]						
8.755	[222.4]						
11.030	[280.2]						
9.755	[247.8]	X					
12.035	[305.7]	X					
10.750	[273.1]	X					
13.035	[331.1]						
11.750	[298.5]	X					
14.030	[356.4]						
12.755	[324.0]						
15.030	[381.8]						
13.755	[349.4]						
16.035	[407.3]	X					
14.750	[374.7]	X					
17.035	[432.7]						
15.750	[400.1]	X					
18.035	[458.1]						
16.750	[425.5]						
19.035	[483.5]						
17.750	[450.9]						
20.040	[509.0]	X					
18.745	[476.1]	X					
21.040	[534.4]	X					
19.745	[501.5]						
2.00	[50.8]						
4.00	[101.6]						
8.00	[203.2]						
0.65	[16.5]						
1.00	[25.4]						
1.35	[34.3]						
1.70	[43.2]						
2.70	[68.6]						
	SHORT CENTER						
	LONG CENTER						

Appendix A

Warranty Statement

Limited Warranty: All products are warranted by the Seller for one year to be free from defects in both materials and workmanship under normal use and service. This warranty is in lieu of and excludes any other warranty, express or implied, including, but not limited to, any implied warranty derived from quote or fitness of purpose. (Manufacturer's liability and Buyer's limited remedies under Manufacturer's warranty shall be limited solely to repair, replacement, credit or refund, at the Manufacturer's option, with respect to products supported by a Return Material Authorization number obtained from the Manufacturer and returned to the Manufacturer. The Manufacturer shall not be liable, under any circumstances, for consequential or incidental damages, including, but not limited to, labor costs or loss of profits arising in connection with the use of or inability to use products purchased from the Seller)

Product Application: The Buyer is solely responsible in determining the suitability of the Manufacturer's products in its application regardless of circumstances.

Manufacturer reserves the right to make future design changes to any of its products without thereby incurring any obligations to make changes to or replacements of this product.

Manufacturer neither makes nor authorizes any person to make on its behalf any other guarantee or warranty concerning its products.

Service

To obtain service under this Limited Warranty call Indikon Customer Service Department in **New Hartford** to obtain an RMA (Return Material Authorization) number.

Pack the item(s) in its original shipping container (or equivalent)

Put the RMA number on the address label

Put the RMA number on the shipping carton

Insure it (or assume the risk of loss / damage during shipment)

Manufacturer is not responsible for damage to inbound product.

Indikon
215 Clinton Road
New Hartford, NY 13413
Voice: 315-624-7171
Fax: 315-624-7173