Quick Startup Guide for Nut Welding Applications
Sensotec Weld SensorGroup • p/n 008-0614-00 rev. -

Overview
The Sensotec Weld Nut Monitoring and Control system can perform four functions:
- Detect missing nuts
- Detect upside-down or tilted nuts
- Signal fully-retracted cylinder
- Measure weld set-down

The standard equipment used for nut welding applications includes a displacement measuring transducer (LVDT), a WeldMeter, and a relay option cable. There are two common types of LVDTs depending on your application (spring loaded and rod-end).

Installation
Install the LVDT sensor according to the installation sketch below. Be sure the sensor is electrically isolated from any weld current. Piece parts may inadvertently touch the sensor, so isolating both ends is recommended. Do not use set screws or other sharp-edged clamps for mounting. Do not side load LVDT shafts.

Connect the sensor to the WeldMeter by plugging the connector into the port labeled “transducer”. Plug the WeldMeter into a 120VAC supply.

Initial Setup
There are two basic types of weld nuts (piloted and unpiloted) and the Sensotoc system can work with either. (Projection welded studs are similar in application to unpiloted nuts.)
Install the exact weld tooling you plan to use. Your tooling should include a retractable centering pin to align the nut with the hole in the stamping. If welding a “piloted” nut your electrodes may be larger in diameter than the nuts. If welding an “unpiloted nut” you must select an electrode diameter that transmits adequate force and current to the nut but is small enough to fit inside the projections when the nut is upside down and correctly centered. See sketch below.

Determine the weld force you plan to use. Set the regulator to achieve this weld force and check it with a Sensotec WeldProbe force calibrator.

Bring the weld cylinder down manually under full force so that the electrodes are “face to face”. Some adjustment to the centering pin or the upper electrode may be needed to get the electrode faces flat together.

With the electrodes “face to face” under full force, press the “zero” button on the meter.

Move the weld cylinder up and down a few times making sure the meter registers “zero” at the bottom of the stroke each time.

**Note:** Setting the correct “zero” position is very important. Performing this step correctly will insure that you can change or dress electrodes with only a simple “rezero” procedure afterwards. Failing to set a correct zero may result in system malfunction or may require frequent parameter adjustments during operation.

Look at the meter and determine the range of values displayed during the cylinder stroke. It should be zero at the bottom and some positive value (e.g. 1.345 inch) at the top.
Programming

Review the quick limits programming guide (attached). You’ll need to be able to program the meter for the next few steps to set limit values that will trigger the relay outputs to achieve the four functions of the nut checking system. The figure below outlines the four limit positions that you can program.

1. Detect a Missing Nut (Limit 4)
Select a low limit (Lo) of 0.100 inch so that all ram positions lower than this will activate the limit L4 relay and therefore detect a missing nut. Use 0.002 inch for the hysteresis amount.

2. Signal Fully-Retracted Cylinder (Limit 1)
Select a high limit (Hi) with a value approximately 0.100 inch below the uppermost stroke of the ram (and a hysteresis of 0.002 inch). This activates the limit L1 relay to indicate that the ram is in the up and clear position ready for the next weld. This feature can eliminate the need for a micro switch to perform this function.

3. Perform a Dimensional Study for Limits 2 and 3
Obtain 30 fresh nuts and fresh stampings. (Note: fresh parts are important because there is always some amount of cold work (or deformation) of the projections and stampings when placed in a welder under full force conditions. Reusing parts can skew the measurement readings.)

Conduct a dimensional study using the results to set both Limit 2 and 3. For each nut and stamping in place on the lower electrode, bring the head down under full force and manually record the dimension displayed on the meter (setup height). Then make a good weld and record the dimension displayed on the meter after the weld (setdown height).
Calculate the average setup height and determine the range of setup heights. In the following example, average measured setup height = 0.585 inch with a range from 0.583 to 0.587 inch.

Calculate the average setdown height and determine the range of setdown heights. In this example, average measured set-down height = 0.555 inch with a range from 0.552 to 0.558 inch.

Verify that there is no overlap between the setup height range and the set-down height range. In the example above, the maximum set down height is 0.558 inch and the minimum setup height is 0.583 and thus do not overlap at the boundary area.

Using the work sheet attached, establish the tolerance bands required for both setup and set-down values:

a. Select a set point (Set.Pt) equal to the measured average value.

b. Select a deviation (d.tion) value that comfortably includes the measured range defined earlier (+/- 0.005" for this example).

   **Note:** Make sure that the lower range of Limit 2 and the upper range of limit 3 do not overlap.

c. Select a hysteresis (HYS) value (usually 0.002 inch).

   **Note:** The hysteresis value is selected to eliminate relay “chatter” near the outside limit values, but it also reduces the effective limit window and must be accounted for when setting deviation values.
Example Limit Settings

Note: Set hysteresis values (HYS) = 0.002" to eliminate relay chatter. This will reduce limit window by this amount.

HI Limit Type

L1 set pt. 3.571
H1 Limit Type

Retracted Cylinder

Good Setup
Good Setdown
Missing nut

L1

L2

L3

L4

Summary of Limits (L1 - L4)

L4 set pt. 0.100

Lo Limit Type

Zero 0.000

+ Deviation 0.587*

L2 set pt. 0.585

- Deviation 0.580

Deviation Limit
SET sharp = 0.585
dilution = 0.005
Limit range = 0.580 to 0.587*

+ Deviation 0.557*

L3 set pt. 0.555

- Deviation 0.550

Deviation Limit
SET sharp = 0.555
dilution = 0.005
Limit range = 0.550 to 0.557*
4. Detect Good Setup/Upside-Down Nut (Limit 2)

Select the deviation (d.tion) style limit. Use the average set up height as the set point (SEt.Pt). Use a deviation tolerance (d.tion) that overlaps the measured range. Use 0.002inch for the hysteresis (HYS) amount.

**Limit 2 -- Correct Setup Height**
5. Detect Good Setdown (Limit 3)

Select the deviation (d.tion) style limit. Use the average set down height as the set point (SEt.Pt). Use a deviation tolerance (d.tion) that overlaps the measured range.

Use 0.002inch for the hysteresis (HYS) amount.

6. Setup Relay Outputs

Refer to the WeldMeter Manual and the drawing to the right.

Adjust the relay contact selection switches in the back of the meter (inside the case):

Relay 1 = NO contacts, (+) right switch pos.
Relay 2 = NC contacts, (0) left switch pos.
Relay 3 = NC contacts, (0) left switch pos.
Relay 4 = NO contacts, (+) right switch pos.

Attach the relay option cable (AW990) to the Weld Meter. The wiring code is:

<table>
<thead>
<tr>
<th>PIN#</th>
<th>Function</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Relay 1 (NO/NC)</td>
<td>Red</td>
</tr>
<tr>
<td>2</td>
<td>Relay 1 Common</td>
<td>Grey</td>
</tr>
<tr>
<td>3</td>
<td>Relay 2 (NO/NC)</td>
<td>Yellow</td>
</tr>
<tr>
<td>4</td>
<td>Relay 2 Common</td>
<td>White</td>
</tr>
<tr>
<td>5</td>
<td>Relay 3 (NO/NC)</td>
<td>Orange</td>
</tr>
<tr>
<td>6</td>
<td>Relay 3 Common</td>
<td>Blue</td>
</tr>
<tr>
<td>7</td>
<td>Relay 4 (NO/NC)</td>
<td>Black</td>
</tr>
<tr>
<td>8</td>
<td>Relay 4 Common</td>
<td>Brown</td>
</tr>
</tbody>
</table>

If interfacing to a simple weld controller only, series the limit L3 contact into the “pressure switch interlock” circuit on the weld controller. This will insure correct nut placement before welding. If interfacing to a PLC, use each contact L1, L2, L3, and L4 as a separate input and program your ladder logic according to your required results.
**Limit Setting Worksheet**

*Note:* Set hysteresis values \( (HYS) = 0.002" \) to eliminate relay chatter. This will reduce limit window by this amount.

- **Full Cyl Retraction**
- **L1 set pt.**

**HI Limit Type**

- **Retracted Cylinder**
- **L1**
- **Good Setup**
- **Good Setdown**
- **Missing nut**
- **L2**
- **L3**
- **L4**

**Summary of Limits (L1 -- L4)**

- **L4 set pt.**
- **Zero**

**Lo Limit Type**

- **+ Deviation**
- **L2 set pt.**
- **- Deviation**

**Deviation Limit**

- **+ Deviation**
- **L3 set pt.**
- **- Deviation**

**Deviation Limit**
<table>
<thead>
<tr>
<th>ACTION</th>
<th>DISPLAY RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power up meter by connecting 120VAC</td>
<td>Startup sequence display = E725, 1.04, AC-4.00.0.4</td>
</tr>
<tr>
<td></td>
<td>Display ends with transducer value = 2.560</td>
</tr>
<tr>
<td>Press and hold SETUP button 1 sec.</td>
<td>UL1 (user menu for setting limits)</td>
</tr>
<tr>
<td>Press ENTER</td>
<td>00000 (password prompt)</td>
</tr>
<tr>
<td>Press ▲</td>
<td>00001 (default password for menu 1)</td>
</tr>
<tr>
<td>Press ENTER 5 times to accept</td>
<td>Filt (Please bypass this feature)</td>
</tr>
<tr>
<td>Press ▼</td>
<td>L  1-4</td>
</tr>
<tr>
<td>Press ENTER</td>
<td>L1 (menu for limit 1)</td>
</tr>
<tr>
<td>Press ENTER (or ▲ ▼ for other limits)</td>
<td>OFF (or some other previously selected limit type)</td>
</tr>
<tr>
<td>Press ▲ or ▼ to choose limit type</td>
<td>OFF limit is off all the time</td>
</tr>
<tr>
<td></td>
<td>Hi limit is on when signal is higher than set point</td>
</tr>
<tr>
<td></td>
<td>Lo limit is off when signal is lower than set point</td>
</tr>
<tr>
<td></td>
<td>d.tion limit is on when signal deviates from set point by +/- more than selected deviation amount</td>
</tr>
<tr>
<td>Press ENTER to accept</td>
<td>Funct flashes and then n-IP (or previously set input type)</td>
</tr>
<tr>
<td>Press ENTER to accept</td>
<td>SEt.Pt flashes then 0.0000 (or previous set-point value)</td>
</tr>
<tr>
<td>Press ▲ or ▼ to change first digit</td>
<td>0.002</td>
</tr>
<tr>
<td>Press ENTER to accept</td>
<td>1.232 (desired set point)</td>
</tr>
<tr>
<td>Press ▲ or ▼ to change each digit</td>
<td>d.tion flashes and then 0.007 (or other previously set deviation value)</td>
</tr>
<tr>
<td>followed by ENTER to accept</td>
<td>0.007 (deviation value)</td>
</tr>
<tr>
<td>Press ENTER (this selection occurs when d.tion type is chosen above)</td>
<td>After last ENTER HYS flashes, then 0.000 (or previous set hysteresis value)</td>
</tr>
<tr>
<td>Press ▲ or ▼ to change each digit</td>
<td>0.002 (hysteresis value)</td>
</tr>
<tr>
<td>followed by ENTER to accept</td>
<td>After last ENTER LAt-n (or LAt-Y)</td>
</tr>
<tr>
<td>Press ▲ or ▼ to select mode</td>
<td>LAt-n limit does not latch after being triggered</td>
</tr>
<tr>
<td></td>
<td>LAt-Y limit stays latched after being triggered until reset</td>
</tr>
<tr>
<td>Press ENTER to accept</td>
<td>L2 (or next limit in sequence)</td>
</tr>
<tr>
<td>Press RESET</td>
<td>run</td>
</tr>
<tr>
<td>Press ENTER</td>
<td>- - - - - - followed by 0.1234 (actual value of transducer)</td>
</tr>
</tbody>
</table>