

**PART I - DESCRIPTION**

**I-A GENERAL INFORMATION**

Comptrol loadcells are force transducers especially designed to measure and control web tension on continuous strip processing lines. Loadcells are normally installed in matched pairs under the pillow block bearing at each end of a measuring roll. (See Figure 1)

A loadcell consists of a unique combination of two integral systems (one mechanical, the other electrical) for converting the mechanical force of strip tension into an electrical signal which is directly proportional to the strip tension.

**I-B THE MECHANICAL SYSTEM**

The mechanical system consists of a patented "C-Flexure Pivot Assembly" which includes a Load Table, a frictionless elastic pivot or "hinge" and a rugged base plate. (See Figure 2 ). This assembly allows the deflection of the Load Table to move toward or away from the base plate. Deflection toward the Base Plate is defined as the "Compression Mode", while deflection opposite is defined as the "Tension Mode". An integral adjustable Mechanical Stop is provided to limit the amount of deflection in either mode.

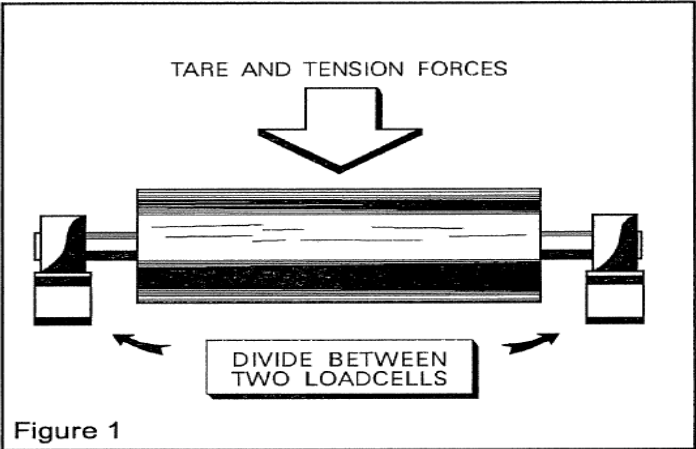


Figure 1

**I-C THE ELECTRICAL SYSTEM**

The electrical system consists of a Linear Variable Differential Transformer (LVDT) which converts the mechanical deflection of the load table into a useful electrical output signal. (See Figure 3) The movable core of the LVDT is mechanically coupled to the Load Table by means of a core wire and crossbar assembly, and a spring loaded zero adjusting assembly.

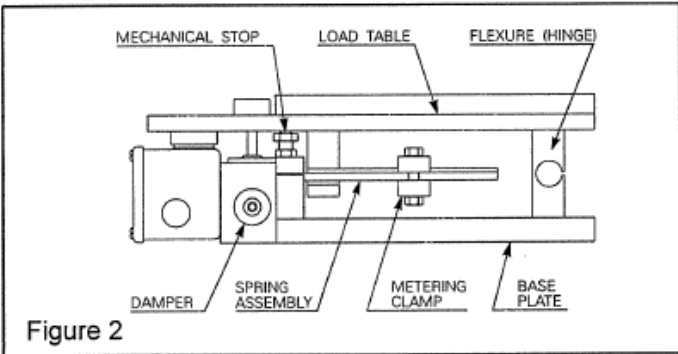


Figure 2

The mechanical system also includes an adjustable Cantilever Spring Assembly mounted between the Load Table and the Base Plate in such a manner as to oppose deflection in either mode. A Metering Clamp allows the adjustment of the effective length of the Cantilever Springs.

An adjustable Viscous Damper is incorporated in the mechanical system to allow control of the loadcell's response to rapid changes in apparent signal fluctuations resulting from such conditions as slight roll imbalance, variations in the strip material, or the operation of the machine. The damper is designed to provide a wide range of stepless, infinitely small adjustments.

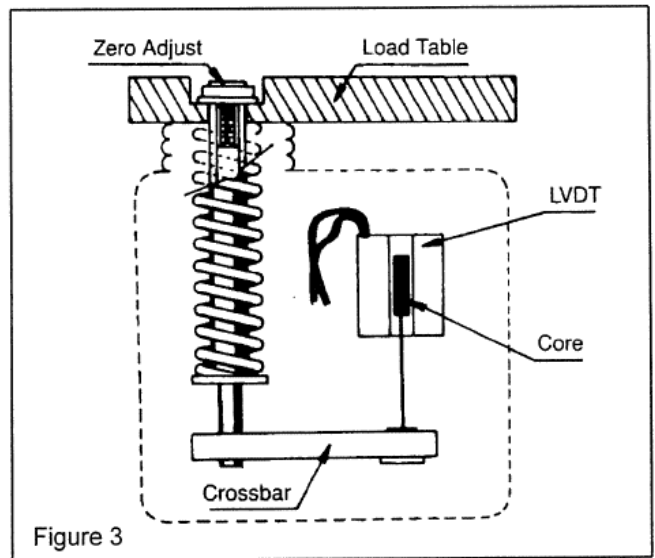


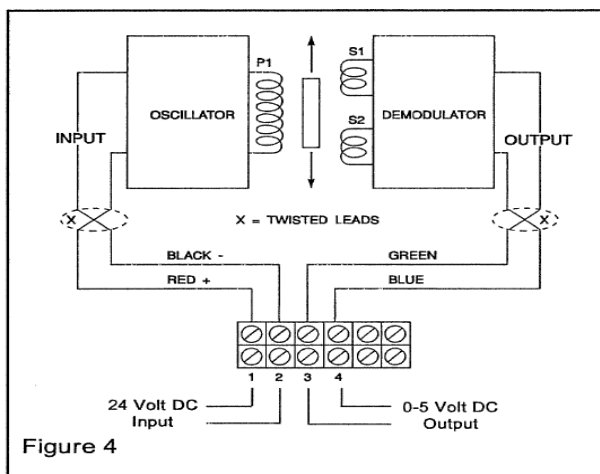
Figure 3

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## I-D TYPE "C" DC LVDT

As illustrated in Figure 4, a DC LVDT consists of the following components:

- A temperature compensated oscillator network, which converts the DC input voltage into a high frequency alternating current for exciting the Primary Coil ( $P_1$ ).
- A Primary Coil ( $P_1$ )
- A movable, permeable metallic core.
- Two Secondary Coils ( $S_1$  and  $S_2$ ).
- A demodulator and summing network to rectify and integrate the currents from the secondary coils.



Depending on the position of the movable core within the body of the LVDT, the integrated DC output signal will be positive (+) or negative (-) with respect to common. (i.e., The Blue lead will be negative with respect to the Green with the loadcell in the Compression Mode, and positive with respect to the Green with the loadcell in the Tension Mode.)

Regardless of the polarity of the output signal, it will be directly proportional to the amount of deflection of the load table. When the core is positioned at the electrical center of the LVDT (i.e., with no deflection) the output signal will be zero.

With Comptrol LVDT's the input and output circuits are electrically isolated from each other and from the mechanical structure of the loadcell. Thus, they may be used in "floating ground" or "ground return" systems.

In operation, the output signal from both loadcells (one at each end of the measuring roll) are summed to provide a single output. This output maybe used to drive a digital or analog indication meter, or as a "feedback" signal for "close loop" tension controls

## PART II - INSTALLATION AND OPERATION

### II-A INSPECTION UPON DELIVERY

Comptrol loadcells are carefully packaged in sturdy reinforced cartons or wooden boxes and are securely blocked or bolted in place.

1. Upon receipt, examine the exterior of the container for obvious damage or tampering.
2. Check the contents against the packing list.
3. Promptly report any damage or shortage to both the carrier and Comptrol Incorporated.

### II-B HANDLING

Most loadcells can be handled manually. Those that cannot (Models 600, 601, 602) should be lifted by a hoist or other means using ropes placed around the Base Plate.

### II-C LONG TERM STORAGE

While Comptrol loadcells are plated, exposure to weather, dirt, or moisture should be avoided when they are stored.

### II-D MECHANICAL INSTALLATION

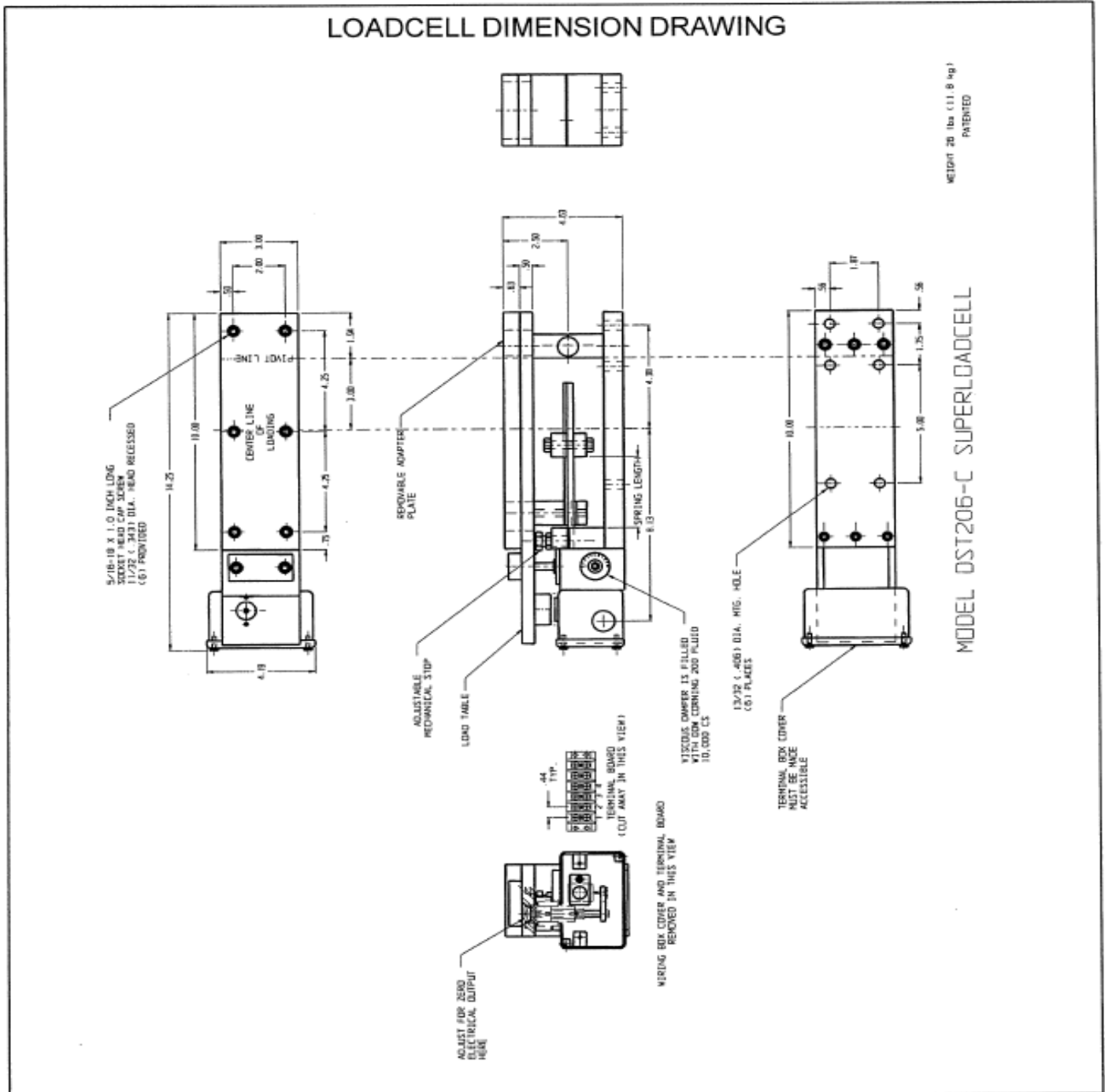
NOTE: The following procedures assume that two loadcells, one at each end of the measuring roll are being installed. Refer to the Dimension Drawing on Page 3 of this manual for detailed identification of all parts.

1. Remove the adapter plates from the loadcells.
2. Drill and tap the adapter plates to accept the selected pillow block bearings.

NOTE: THE CENTERLINE OF THE PILLOW BLOCK BEARING MUST COINCIDE WITH THE CENTERLINE OF LOADING ( $\epsilon$ ) OF THE LOADCELL. Refer to the appropriate Dimension Drawing on Pages 3.

3. Check that the mounting surfaces to which the loadcells are to be mounted are flat to within 0.002-inch T.I.R.
4. Refer to the loadcell Dimension Drawing on Page 3 for the size, location and orientation of the base plate mounting holes to be drilled and tapped in the stands or base structures. (NOTE: When the loadcells are mounted, the conduit box cover or electrical connector must be accessible.)

5. Drill and tap the holes in the stand or base mounting structure to accept the loadcell mounting bolts. (See the appropriate Dimension Drawing on page 3)
6. Assemble the loadcells to the stands or base mounting structure.
7. Assemble the adapter plates to the loadcell.
8. Assemble the pillow block bearings onto the measuring roll.
9. Assemble the measuring roll and pillow block bearings onto the loadcell adapter plates.



**II-E MECHANICAL ALIGNMENT**

1. Align measuring roll and pillow block bearings to avoid any mechanical binding or friction. The measuring roll must be level and perpendicular to the path of the strip material for accurate tension measurement.
2. Using a open end wrench and a dial indicator or feeler gauge, adjust the Mechanical Stop for the required clearance between the Load Table and the Mechanical assembly (Refer to Figure 5 & 6). This is accomplished by having the Tare applied and the Load Table not in contact with the Mechanical Stop.
3. Thread the strip material on the measuring roll and check to make sure the wrap angle is the same as the wrap angle specified on the calibration sheet. If the wrap angle is not the same, contact Comptrol.

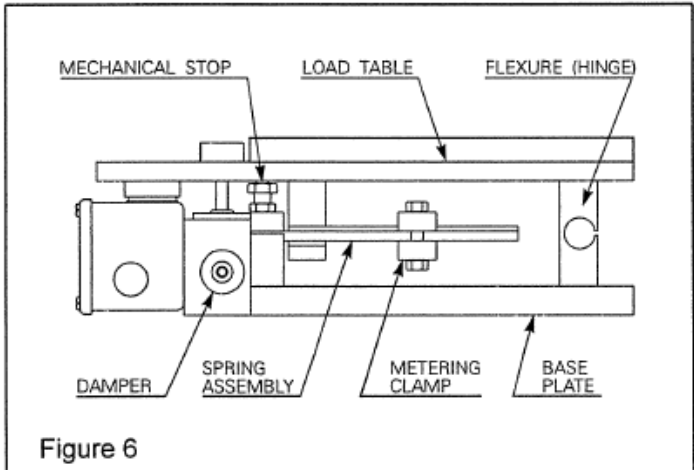


Figure 6

**II-F ELECTRICAL INSTALLATION**

(Read the entire electrical wiring procedure before proceeding.)

1. Turn off all electrical power to the loadcell.
2. Remove the conduit box cover and hole plugs to gain access to the LVDT terminal boards.
3. Use twisted four conductor signal cable, Belden 9402, or equivalent in grounded steel conduit, from the LVDT to the control panel.

4. Observing correct polarity, connect the input power leads to bottom Terminal 1 and 2 on the Terminal Board. (For correct polarity refer to Figure 7)
5. Connect the output signal leads to the bottom Terminals 3 and 4 on the Terminal Board.
6. Make certain all wires and leads are dressed away from the core wire and crossbar assembly. The LVDT may be inoperative if movement of the crossbar is restricted in any way.
7. Repeat Steps 1 through 6 of the electrical wiring procedure for the loadcell mounted on the opposite end of the measuring roll.

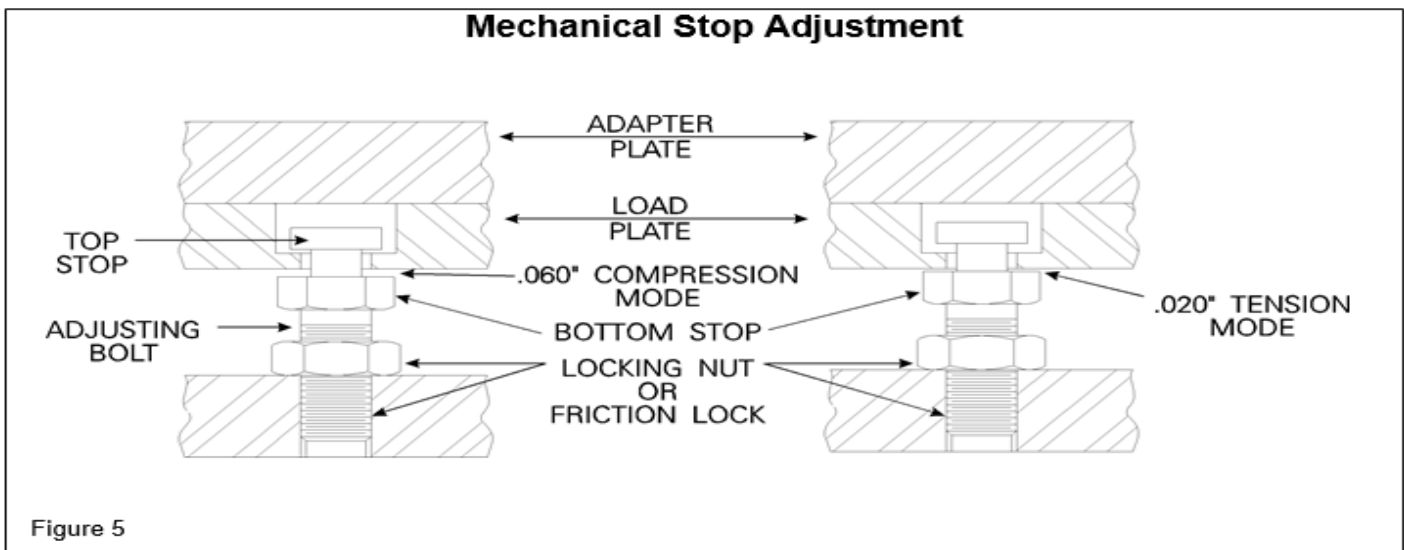


Figure 5

**II-G ELECTRICAL ZERO ADJUSTMENT**

(Read the complete Electrical Zero Adjustment procedure before proceeding with the adjustment.)

**TYPE 'C' 24 VOLT DC LVDT SPECIFICATIONS**

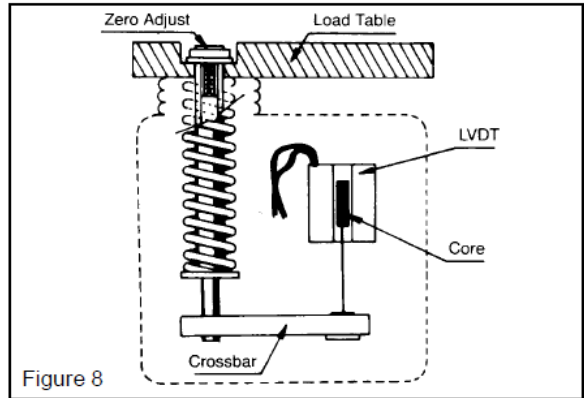
Input .....	6-30volts DC
Output .....	5 volts DC (nominal, open circuit)
Output impedance .....	2.5K ohms
Current Consumption .....	40mA
Recommended Load .....	100K ohms or greater
Maximum Temperature: .....	250°F

Note: Comptrol loadcells are calibrated for 24-volt DC input voltage to provide a 5 volts DC output signal. Output voltage will vary proportionally to input voltage.

1. Disengage strip from the measuring roll so that no tension force is applied to the loadcell.
2. Connect a voltmeter to Terminal 3 and 4 at the top of the Terminal Board (See Figure 7).
3. Apply 24-volt DC electrical power to the loadcell observing the correct polarity. [Plus (+) to Terminal 1 and minus (-) to Terminal 2]. Do not exceed the maximum rated input voltage.

NOTE: Allow 20 minutes for the loadcell to warmup before taking first readings to insure accurate readings.

4. Measure the output voltage of the LVDT between the Green and Blue leads with a voltmeter with a sensitivity of at least 100,000 ohms per volt. The output voltage should be between zero.



5. If the output is not zero, remove the dust cap located on the load table to gain access to the zero adjustment screw. (See Figure 8)
6. Using a 7/64-inch hex key, turn the zero adjusting screw several turns counter clockwise (CCW). Then, slowly turn the adjusting screw clockwise (CW) until a zero reading is obtained on the voltmeter. If the zero position is passed, turn the adjusting screw counter clockwise (CCW) pass the zero point. Then turn the adjusting screw back in a clockwise (CW) direction until the meter reads zero volt.
7. Deflect the Load Table of the loadcell by applying pressure in the direction the tension force will be applied. This may be done manually or with a lever. A change in the output voltage signal should be noticed.

NOTE: The polarity of the output signal will be positive (+) for deflection in the Compression Mode, and negative (-) for deflection in the Tension Mode.

8. Release the force applied to the Load Table should allow the output signal to return to zero.

If the output signal does not return to zero, make sure the measuring roll rotates freely. Check for improper alignment of the measuring roll and for friction or binding with the pillow block bearing. Also check that the LVDT crossbar assembly is free of any interference. Repeat Steps 1 through 8.

If the output signal still does not return to zero, contact Comptrol.

9. Repeat Steps 1 through 8 for the loadcell mounted on the opposite end of the measuring roll.

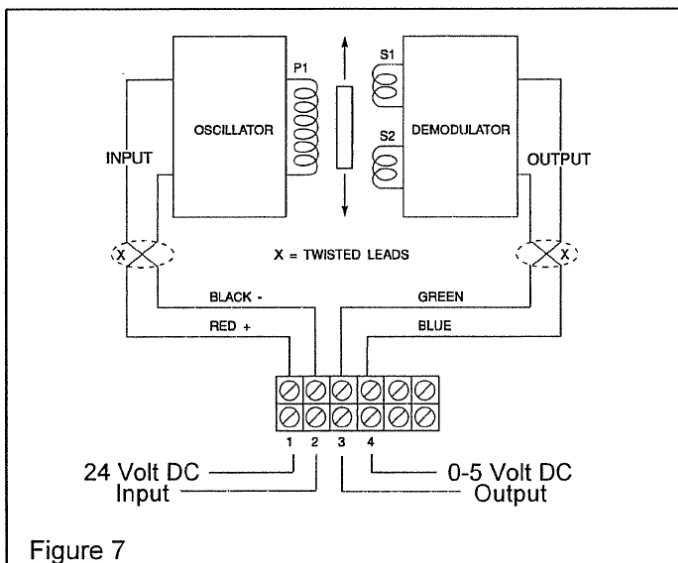


Figure 7



## II-H FULL LOAD ADJUSTMENT

After the loadcell has been zeroed, a pull test can be made to check the output voltage of the loadcell at full load. (See calibration sheet for voltage output)

1. Run a non-stretchable rope over the center of the tension roll simulating the web path. (NOTE: the rolls should be free to turn)
2. With one end of the rope secured, hang a known weight, equally over the roll so that the total tension is equal to the maximum strip tension specified on the calibration sheet, at the other end. (See Figure 9A)

For larger tension where dead weights would be too large, a crane scale can be used to simulate maximum strip tension (See Figure 9B)

3. With a voltmeter connected to the bottom Terminals 3 and 4 of the Terminal Board, maximum output voltage will be observed.
4. Repeat Step 3 for the loadcell mounted on the opposite end of the measuring roll.
5. Recheck to make certain that all leads are dressed away from the LVDT crossbar assembly on both loadcells and replace both conduit box covers.

Comptrol loadcells instrumentation provides the required signal conditioning and a reliable high level output signal for use as feedback control of a tension drive system. The feedback signal is directly proportional to the strip tension applied. If a Comptrol control is used, refer to the control manual for further calibration.

Although the electrical output of Comptrol loadcells are sufficient to drive most electrical indicators, substantial signal conditioning is normally required for effective tension instrumentation system control. Refer to the documentation available from the instrumentation supplier for more information.

## II-J VISCOUS DAMPER ADJUSTMENT

The Viscous Damper allows for adjustment of the loadcell output signal for signal fluctuations resulting from such conditions as slight roll imbalance, variations in the strip material, or the operation of the machine.

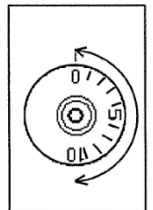
The calibrated dial is graduated from "0" to "10". The damping effect is minimum at "0" and maximum at "10". Adjustment between these two points is stepless.

Because the need for damping becomes apparent only under dynamic conditions, damper adjustment must be made while the strip is moving through the process at normal speed.

NOTE: For best performance the Viscous Damper should be set as close to zero as possible without the mechanical stop contacting the load plate.

### To Adjust the Viscous Damper:

1. Connect a chart recorder to the Terminal 3 and 4 on the bottom of the Terminal Board.
2. Record the loadcell output signal while the line is running. The chart will show the frequency and amplitude of the oscillation of the top plate.
3. Using a 3/16-inch hex key, rotate the adjustment dial clockwise or counter clockwise along the calibrated scale, until the variation of the fluctuation of the output signals minimal.



NOTE: Rotating the dial beyond the "0" or "10" markings on the scale has no effect on the damper adjustment.

## PART III - TROUBLE SHOOTING

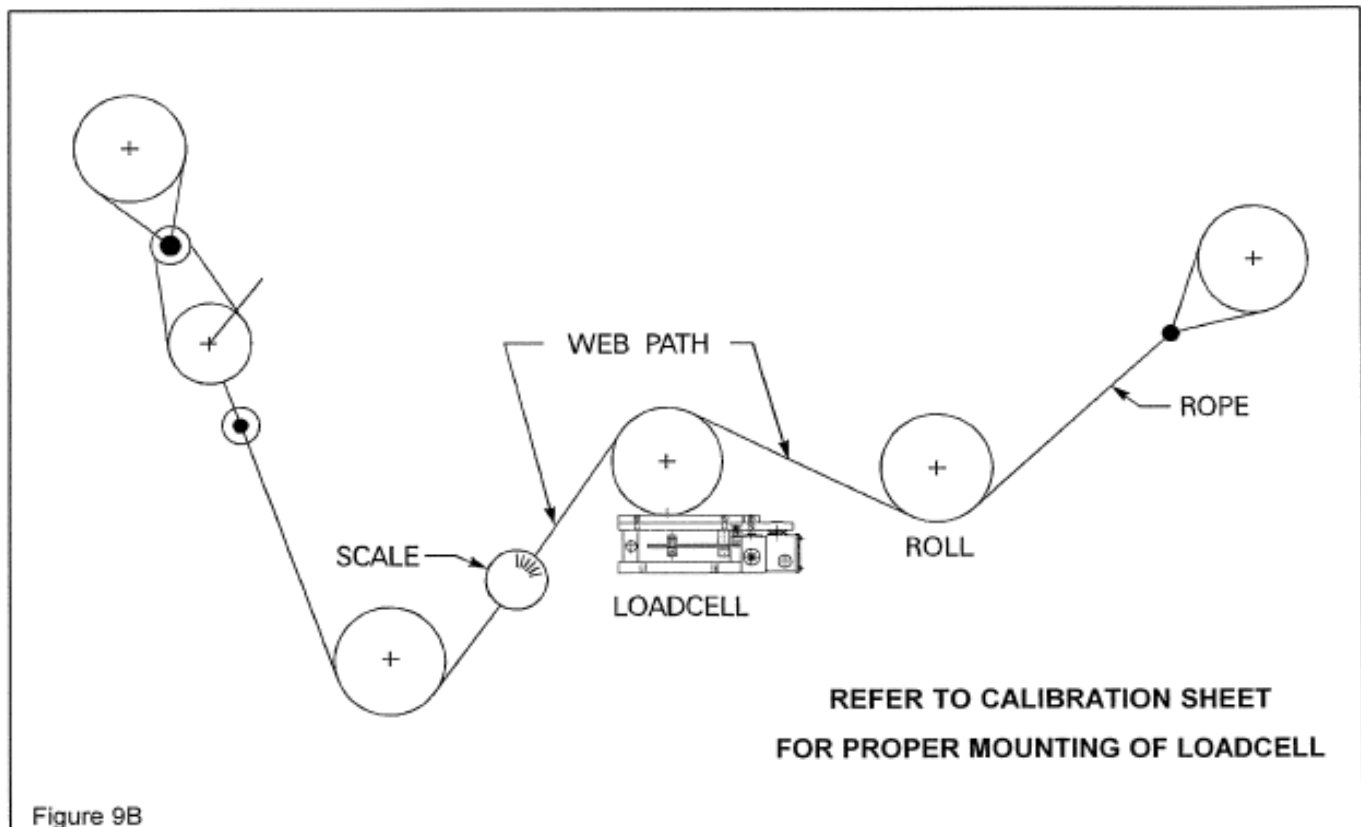
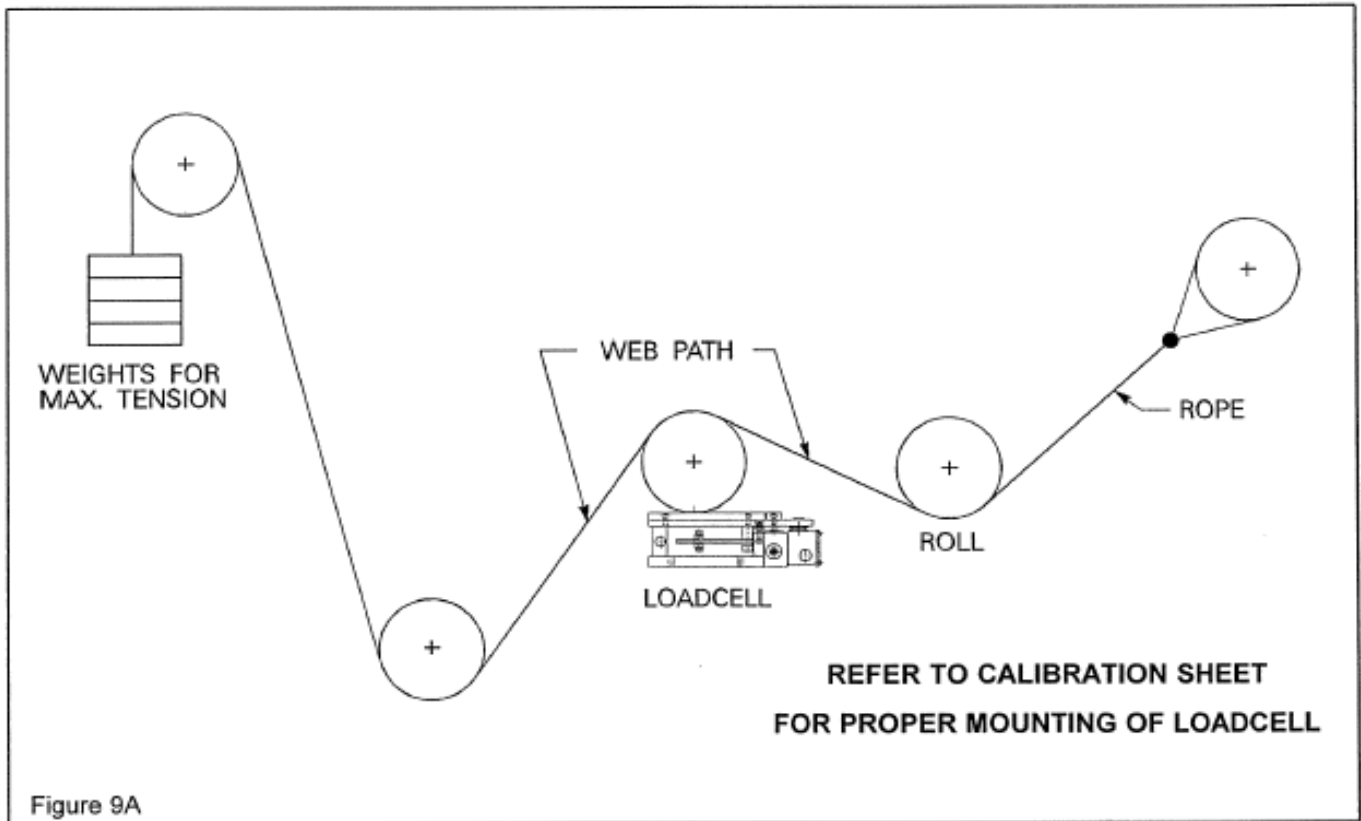
When properly installed in accordance with the original design specifications, Comptrol should require little or no regular maintenance or service.

Certain conditions, however, can impair their inherently accurate and reliable performance. Therefore, if trouble should arise, the following conditions should be checked.

### III-A MECHANICAL

1. Has the tension measuring system been changed?
  - a. An increase or decrease in web tension. (Refer to A on the calibration sheet for specified web tension)
  - b. An increase or decrease in the wrap angle. (Refer to B on the calibration sheet for the specified wrap angle)

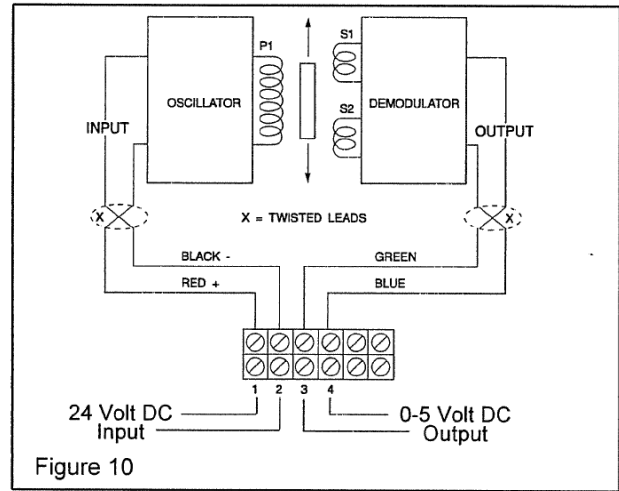
If any of the above parameters have been changed, recalibration may be required. (Refer to Recalibration Procedure, Page 8)



2. Are the loadcells mounted securely?
  - a. Base plate to Mounting Stand?
  - b. Adapter Plate to Load Table?
  - c. Pillow Block bearing to Adapter Plate?
3. Is tension measuring roll in proper alignment and does it turn freely?
4. Are Pillow Block bearings and seals free of all binding and stickiness? Are they worn?
5. Are the Metering Clamps on the loadcell securely tightened?
6. Are the Mechanical Limit Stops correctly adjusted? (Refer to Mechanical Alignment on Page 4)
7. Are the Viscous Dampers correctly adjusted? (Refer to Viscous Damper Adjustment, Page 6)

**III-B ELECTRICAL**

1. Are LVDT's receiving correct input voltage?  
Check line voltage, fuses or circuit breakers, and power switches. Check power supply output and voltage to LVDT's.
2. Are all connections secure?  
Check for continuity. Retighten all connections. Recheck operation.
3. Are LVDT's mechanically secure in their mounting and clamps?  
If loose, recenter, tighten, and readjust electrical zero.
4. Are electrical zero adjustments, correct?  
Readjust electrical zero. (See Electrical Zero Adjustment on Page 5)
5. Are LVDT's open or shorted?  
To check, turn off power and disconnect the input and output leads. Check coil continuity and resistance.
  - a. Red (Terminal 1) to Black (Terminal 2) should be in excess of 2 megohms.
  - b. Red (Terminal 1) or Black (Terminal 2) of LVDT should be in excess of 5 megohms.



- c. Green (Terminal 3) to Blue (Terminal 4) should be approximately 20,000 ohms.
- d. Green (Terminal 3) or Blue (Terminal 4) to LVDT should be in excess of 5 megohms.

If LVDT circuits are open or shorted, replace LVDT. Replacement units are available from the factory. Contact Comptrol with loadcell model number and serial number.

**PART IV- RECALIBRATION PROCEDURE**

All Comptrol loadcells are factory calibrated before shipment, as specified in the purchase order. However, if any of the following parameters vary from the original design specifications, recalibration will become necessary.

1. Strip Tension (Refer to A on calibration sheet for specified strip tension)
2. Wrap Angle (Refer to B on calibration sheet for specified wrap angle)
3. Inclination of the Passline (Refer to C on calibration sheet for specified Passline)
4. Mounting Angle (Refer to N on the calibration sheet for specified mounting angle)

Should recalibration become necessary, it is strongly recommended that the loadcell be returned to the factory with complete specifications.

When this is impractical or impossible, recalibration can be performed after installation in strict accordance with the following procedure.



**IV-A RECALIBRATION AFTER INSTALLATION**

Loadcell recalibration involves changing the spring length which in effect changes the calibrated operating load capacity of the unit. This is accomplished by increasing or decreasing the spacing between the opposing faces of the front spring clamp and the metering blocks. (Refer to Figure 11)

Increasing the spring length decreases the operating load capacity of the unit. Decreasing the spring length increases the operating load capacity.

NOTE: The operating load capacity must not exceed the maximum load rating of the unit.

Before making any adjustments, calculate the new spring length required to obtain the desired operating load capacity using the following formula:

- Where: J = old capacity  
 Jnew = desired new capacity  
 L = measured spring length  
 Lnew = new spring length

Note: The spring length should not be less than 3 inches.

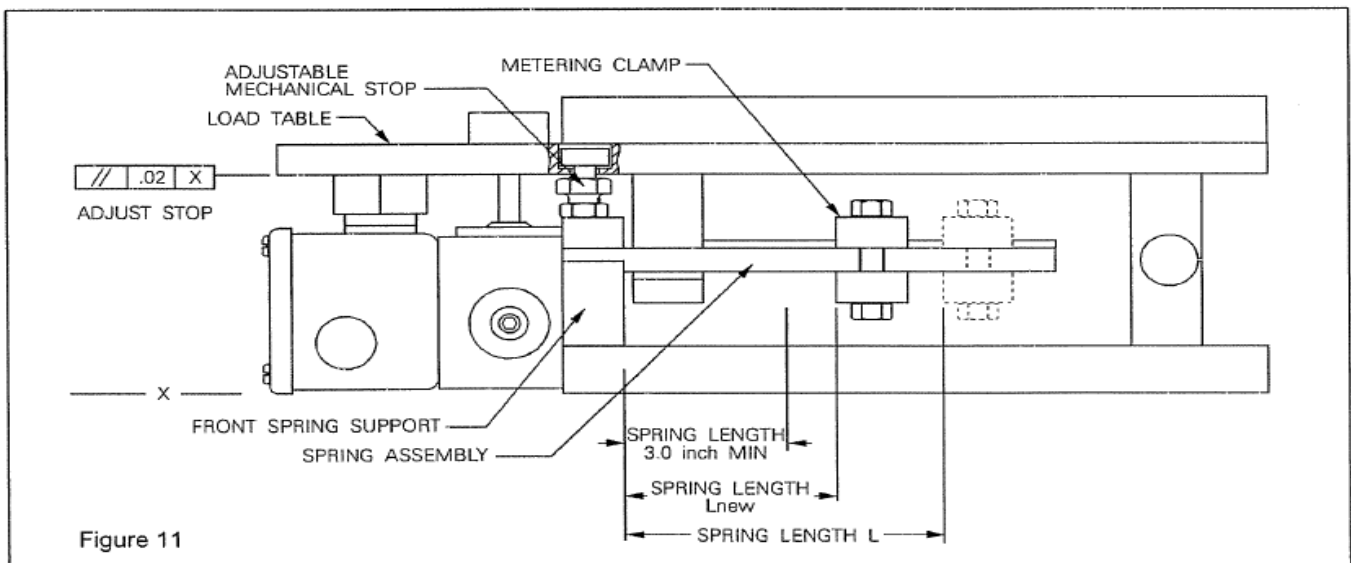
$$L_{new} = \sqrt[3]{J \times L^3 / J_{new}}$$

Comptrol recommends removing the units from the equipment to gain access to the unit and components during recalibration.

If the units must be recalibrated while installed on the equipment:

1. Turn off electrical power to the loadcell.
2. Remove the strip material from the measuring roll to eliminate any tension load upon the loadcell.
3. Check that the load plate is parallel to the base plate ( $\pm .020"$ ). This in effect removes the tare weight acting on the load plate. Depending on the load capacity of the units and the applied tare weight, the load table may require the use of a prying or clamping device to force the load table parallel to the base plate, and blocking it to maintain the position. (Refer to Figure 11 before proceeding with Step 3a or 3b).
  - a. For units with the tare weight acting in compression on the load plate, adjust the bottom mechanical stop head toward the load plate until the load plate and base plate are parallel.
  - b. For units with the tare weight acting in tension on the load plate, loosen the bottom mechanical stop head away from the load plate until the load plate and base plate are parallel.

If the unit is recalibrated off the machine, remove the pillow block bearing and secure the unit to a bench or fixture to prevent the unit from moving.



**To Adjust the Spring Length:**

1. Measure the spring length.
2. Loosen the two-metering clamp outer hex head bolts (closest to the outer edge of the unit.)
3. Loosen the two inner metering clamp hex head bolts.
4. Clean the spring assembly and metering clamp to remove any debris or contaminants to insure proper clamping.
5. Adjust the metering clamp along the spring assembly to attain the new calculated spring length "L<sub>new</sub>".
6. With the metering clamp square to the spring, tighten all the bolts until each bolt head contacts the metering clamp and the metering clamp contacts all three prongs of the spring assembly.
7. Tighten the two inner bolts on the metering clamp extremely tight.
8. Tighten the two outer bolts on the metering clamp extremely tight.
9. Remove any blocking and/or clamping devices, and adjust the mechanical stop as specified in Mechanical Alignment, (Section II-E, on Page 4).
10.
  - a. If the units are recalibrated off the machine, refer to the procedures in Section II-A through II-J to re-install.
  - b. If the units are recalibrated on the machine, re-adjust the electrical zero as specified in Section II-G, Electrical Zero Adjustment.

## APPLICATION REVIEW

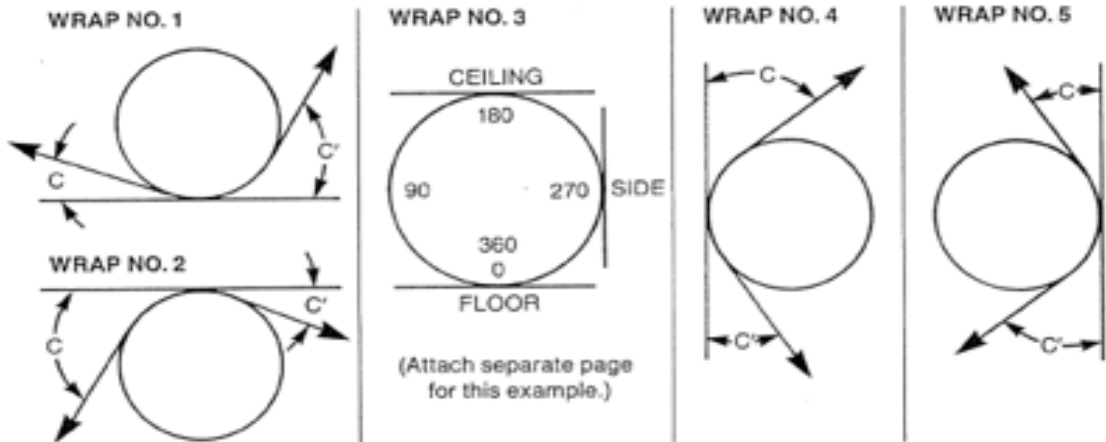
Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Name \_\_\_\_\_  
 Phone \_\_\_\_\_ Email \_\_\_\_\_

### APPLICATION DATA

Wrap No. \_\_\_\_\_ C = \_\_\_\_\_ deg. C' = \_\_\_\_\_ deg.  
 Strip Tension: Max \_\_\_\_\_ lbs. Min. \_\_\_\_\_ lbs.  
 Line Speed: Max \_\_\_\_\_ fpm Min \_\_\_\_\_ fpm Roll Diameter \_\_\_\_\_ in.  
 Mounting:  Side  Under Pillow Block Bearing (specify manufacturer & model)  
 Bearing Mfr. \_\_\_\_\_ Model No. \_\_\_\_\_  
 Roll and bearing weight: \_\_\_\_\_ lbs. Shaft diameter: \_\_\_\_\_ in.

Controller:  Analog  Digital Installation:  New  Existing

**COMPTROL  
STRIP TENSION  
TRANSDUCER  
DATA**



Special Considerations (Environment, temperature, etc.): \_\_\_\_\_

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