INSTRUCTION MANUAL
MICROPROCESSOR-BASED CONSISTENCY TRANSMITTER
MODEL TMC6000
Rev. 1.9

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The information contained in this manual is intended to assist you in providing a safe working environment. The manual is by no means intended to be all inclusive, nor is it intended to suggest that other unsafe working practices not included in this manual are acceptable to Thompson Equipment Company. While Thompson Equipment Company has put forth its best effort to cover all information in this manual, we disclaim liability for any injuries or damages which might be caused by particular unsafe acts not specifically covered by way of this manual.

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INTRODUCTION

(TECO Stockrite™ Consistency)

The TECO Stockrite™ Consistency System is a member of the TECO Stockrite™ family of pulp and paper stock instrumentation and control equipment. The consistency measurement and control members of this family consist of:

- TMC6000 — Microprocessor-based transmitter with graphical operator displays, DCS communication, computer-assisted set-up and calibration, optional embedded dilution controller, and optional multi-variable compensation.
- C4005B — Analog transmitter with flow input and velocity compensation circuitry.
- C4002B — Analog transmitter similar to C4005, but with no flow input, for those applications where velocities are very low, or compensation is performed in a distributed control system (DCS) or other computer.
- C9000 SwingWing™ — Retractable wing assembly consisting of a pivoted wing on a rugged sensor, bushing, slide valve, extraction chamber and other hardware to facilitate insertion and removal with stockline in full production
- C9700 FixedWing™ — Non-Retractable wing assembly consisting of a fixed wing on a rugged sensor, bushing and other hardware for installations not requiring service during normal production, and for vertical flow installations.
- C5000 — Retractable sensor assembly consisting of extended probe, angle bushing, ball valve, extraction chamber, and other hardware to facilitate insertion and removal with stockline in full production.
- C3000 — Sensor assembly consisting of probe, angle bushing, and other hardware, for installations not requiring service during normal production.

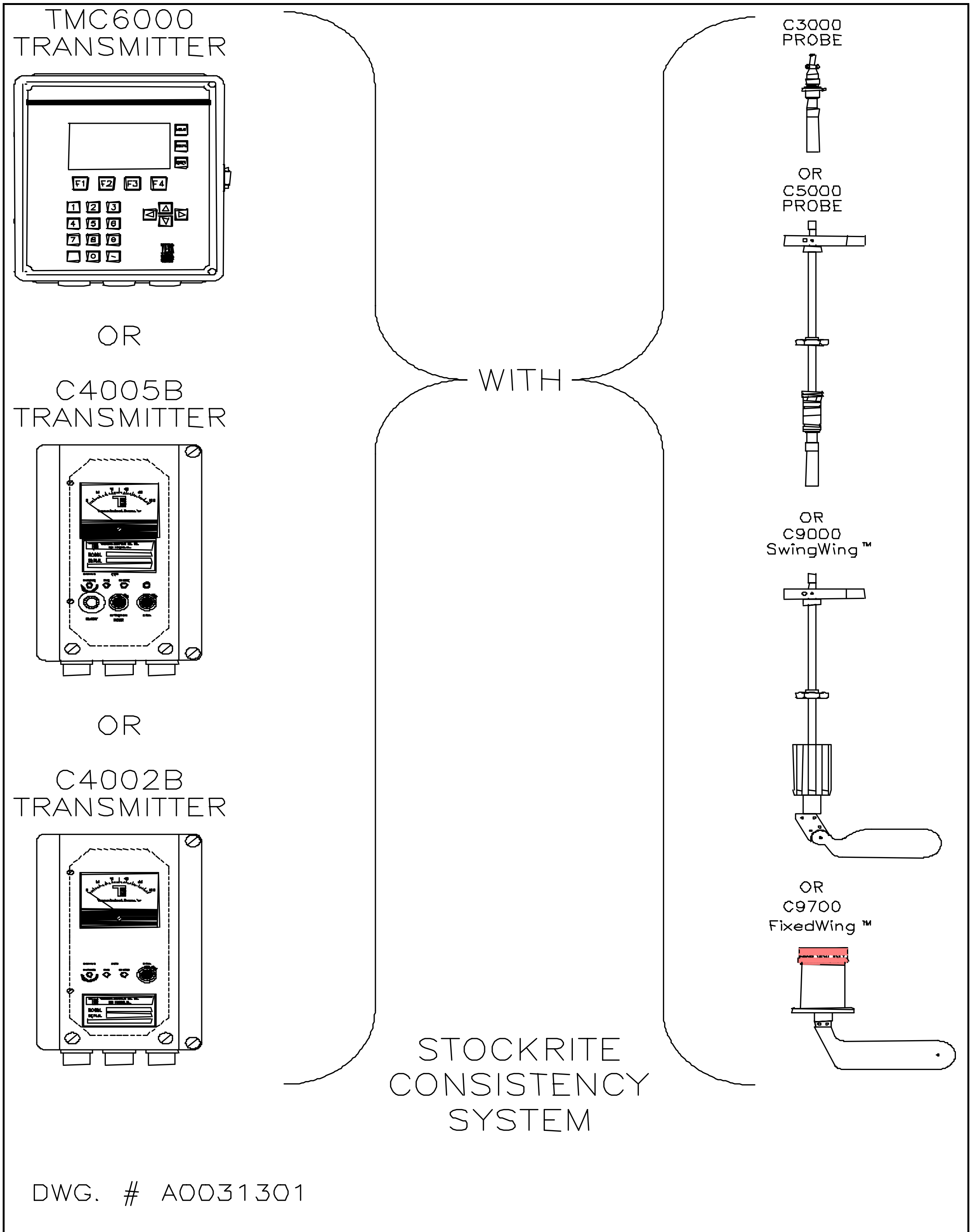


Figure 1 Stockrite™ Consistency System

A basic Stockrite™ Consistency System consists of one transmitter (TMC6000, C4005, or C4002) mated with one sensor (C9000, C9700, C5000 or C3000), and accessory hardware based on the requirements of the application (breaker bar(s), junction box, etc.). This manual covers the installation, start-up, calibration, operation, maintenance, and troubleshooting of any system which includes the TMC6000 transmitter.

THEORY OF OPERATION

Depending on the sensor, the TECO Stockrite™ Consistency System utilizes the measurement principal of shear force or of sliding friction. These forces can be dependably correlated with consistency when properly applied and carefully measured.

What Is *Consistency*?

The term *consistency* is defined as the ratio of solids to total stock expressed as a percentage. A more commonly used definition is the ratio of fiber to total stock, again expressed as a percentage.

What Is ***Shear Force***?

The term *shear force* refers to the force required to untangle or "shear" apart a mass of fiber in a slurry in order for it to pass by an obstruction in its path. A wood fiber's surface is covered with tiny fibrils or rough curls of the fiber itself. In a water slurry of wood fibers, adjacent fibers tend to mechanically bind themselves together by the gripping and tangling of these fibrils on their surfaces. The total force required to break these bonds is referred to as the shear force.

What Does This Have To Do With Consistency Measurement?

The more fibers there are in a volume of water, the more likely it is for two or more fibers to find themselves in contact. The greater the number of fibers that are binding together, the greater the force required to shear them apart. This is the basis for correlating consistency (concentration of fibers) with the measurement of shear force.

How Do the Stockrite™ Sensors Sense Shear Force?

The C5000 and C3000 sensors are identical in their method of sensing the shear force. The sensor consists of a smooth, round machined rod, referred to as the probe. The wetted services of the probe are 316 SS, Titanium and or Hastelloy C. This probe is inserted into the stockline through a bushing which positions it at about a 22^{o} angle with a line perpendicular to the flow direction, and angled downstream. Since this probe is partially obstructing the stock flow, the fiber must be sheared apart by the sensor for it to flow by. As the fiber exerts its force on the probe, internal strain gages sense this force. The transmitter measures the strain, providing a sensitive, rugged detection of variation of shear force on the probe.

How Does The C9000 SwingWing™ Sense The Stock?

While there is a small component of shear force on the SwingWing™, the primary mechanism for exerting force on the sensor is through sliding friction of the stock on the surfaces of the wing.

What is <u>Sliding Friction</u>?

Sliding friction is exerted between two materials with passing contact and relative velocity. Forces are imparted to the wing surfaces of the C9000 SwingWing™ via sliding friction of the fibers in the stock in contact with the two plane faces of the wing element.

What Does This Have To Do With Consistency Measurement?

The more fibers there are in a volume of water, the more total contact there is between fibers and wing surface. Thus, the force due to this contact will vary with the variation of fiber concentration, i.e., consistency.

How Does The C9000 SwingWing™ Sensor Sense The Force From Sliding Friction?

The same rugged force sensor used in the C5000 is used in the C9000 SwingWing™. This force signal, when input to the TMC6000 transmitter can be readily correlated with consistency

MODEL NUMBERING SYSTEM

The following is a breakdown of the model numbering system used on TMC6000 transmitters:

Consistency Transmitter TMC6000 model number: C6 _ _ _ B _ _

Functionality:
- 0 = Standard
- 1 = Embedded control
- 2 = Multivariable
- 9 = Special Function

Power:
- 0 = 117 V.A.C. 50/60 Hz
- 1 = 220 V.A.C. 50/60 Hz

Communications:
- 0 = RS-232
- 1 = RS-232/422/485

Design Level: B

Special Descriptor (if Functionality = 9)

The model number for TECO Stockrite™ sensors are developed as follows:

Consistency Sensor C _ _ 0 _ _

- 3 = Non retractable Probe
- 5 = Retractable probe
- 9 = Wing

- 0 = Retractable Wing
- 7 = Non-Retractable Wing

Length:
- 4 = 4" probe
- 6 = 6" probe
- 8 = 8" probe
- 0 = SwingWing™

Material:
- S = 316SS
- T = Titanium

QUICK START GUIDE

After the TMC6000 has been properly installed and wired to a sensor this guide should: 1.) Get you started measuring deviations in consistency; 2.) Provide familiarization with the keypad and LCD display; 3.) Provide a tutorial on configuration of the instrument.

1. Activation of AUTO SETUP mode.

a) Press the [CONFIG] button. This puts you into CONFIGURATION mode, which is where AUTO SETUP becomes accessible. If the unit requests a password, the proper one will have to be entered to continue.

b) Press the [F3] button (sub-labeled AUTO SETUP).

2. Sensor Setup.

Once AUTO SETUP is entered, you will see a list of steps for setting up a new probe.

a) Press the [F1] button (sub-labeled "CONT.") to enter the first step "SET PROBE LENGTH & MATL." (For the C9000 series select either SwingWing™, FixedWing™, or 6" probe length and SS material). Manipulate the probe length "NEW VALUE:" with the [◁] and [▷] arrow keys until it matches the length of the probe. Press [ENTER] to set the current value equal to the new value. The current value is the value in use. Once the correct value is set as the current value, press [F1] to continue. **No matter what the new value reads when you press the [F1] button, the current value will be used.** Adjust the material "NEW VALUE:" the same way you did the length, and press [F1] when finished.

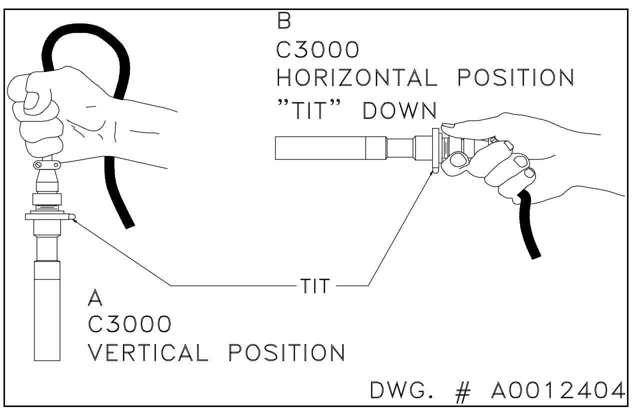


Figure 4 C3000 Calibration Positions

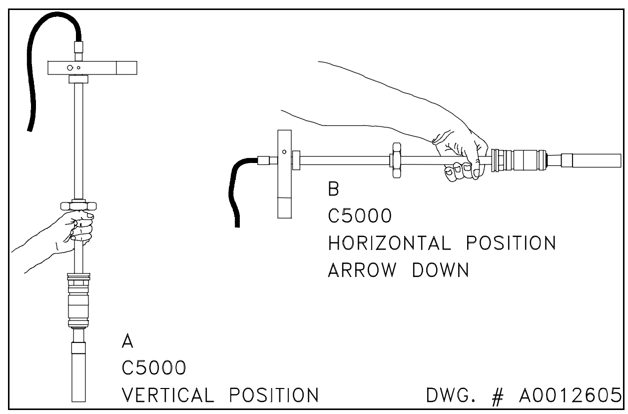


Figure 3 C5000 Calibration Positions

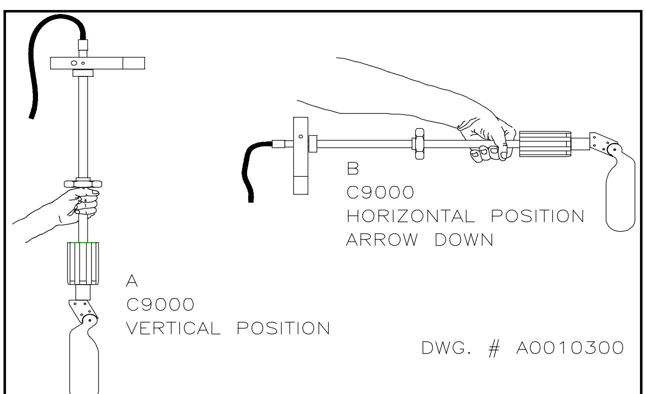


Figure 5 C9000 SwingWing™ Calibration Positions

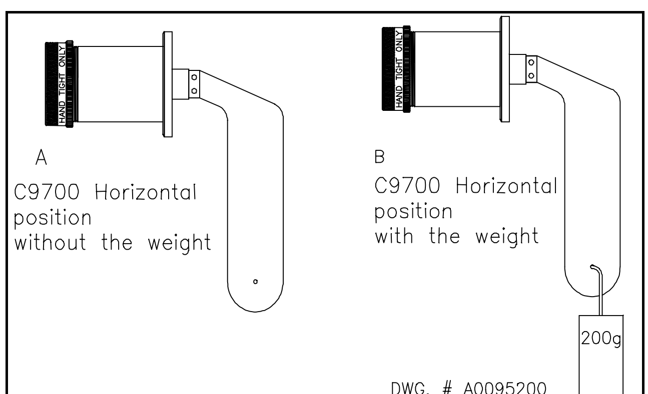


Figure 2 C9700 FixedWing™ Calibration Positions

b) Remove the sensor from the line and hold it in your hand. Press [F1] to enter the "AUTO-CAL" step. Follow the screen prompts to perform the calibration. Note the positions for holding the sensor vertically and horizontally, with or without a weight in the preceding illustrations. "AUTO CAL" will prompt you through calibrating the probe and return you to "AUTO SETUP MODE" automatically.

c) Press [F1] to enter the third step "AUTO-ZERO". With the sensor in the same physical orientation as it will be the final installation, the probe should be zeroed. In the case of a C500x or C9000 sensor, this can be in the retraction chamber. In the case of a C300x or C9700 probe, the probe can be mounted in the bushing if the stockline is empty. The criteria here is that there be no strain on the probe from anything other than gravity. "AUTO ZERO" will prompt you through zeroing your sensor and return you to "AUTO SETUP MODE" automatically.

d) Press [F1] to enter the “SET STOCK (STRAIN FACTOR)” step. This step adjusts the transmitter output relative to strain based on stock type. The default stock type is “SOFTWOOD UN”, or unbleached softwood. Adjust the stock type with the [◁] and [▷] keys and press [ENTER] to record choice. See Appendix F for details.

On all TMC6000 units software revisions .2x and later, the AUTOCAL routine will check for sufficient signal change from the probe. If sufficient change does not occur, AUTOCAL will alert the operator via user interface and will not allow calibration.

If during AUTOCAL you see "PROBE OR CABLE ERROR! CALIBRATION NOT COMPLETE. PRESS ENTER TO CONTINUE"; it could mean any one of the following:

1. Sensor wiring error.
   The sensor cable could be bad. Check terminal connection hookup.
2. Sensor over-strained.
   The sensor itself is damaged.
3. Sensor was not in the correct orientation during AUTOCAL.

3. Velocity Compensation

If you are using a unit where the velocity at the sensor is above 2 feet per second, velocity compensation should be set up. Answering "YES" to the question starts "VELOCITY COMP. SETUP" while answering "NO" will disable velocity compensation.

a) Press [F1] to enter the "SET FLOW SPAN" step. Enter the span on your flowmeter in GPM. Press [F1] once you have the current value set to the proper span.

b) Press [F1] to enter the "SET FLOW ZERO" step. Enter the flowmeter zero in GPM. Press [F1] once you have the current value set to the proper zero.

c) Press [F1] to enter the "SET PIPE ID" step. The inner diameter should be entered for the pipe section where the sensor is located. Enter the proper diameter in inches. If you don't know the pipe diameter, note that the F2 button is sub-labeled PIPE DATA. This will give you access to a set of pipe data tables for common pipe from 4 to 20 inches nominal diameter. After hitting the PIPE DATA button, adjust the nominal pipe diameter with the [◁] and [▷] arrow keys. Press the [▽] arrow to highlight the pipe schedule. Adjust the pipe schedule with the [◁] and [▷]arrow keys. Press ENTER, and the proper diameter will be entered as the current value. You may now continue by pressing [F1].

d) Press [F1] to enter the "SET VELOCITY FACTOR" step. This sets the sensitivity of the velocity correction. The default is 6.0. See APPENDIX G for details.

4. Return to Display Mode

When "AUTO SETUP" is completed, you will find yourself in "CONFIGURATION MODE". Press the [DISPLAY] button to return to normal operation.

QUICK OPERATION/MAINTENANCE GUIDE

The following are commonly used procedures. Refer to Appendix H for detailed explanations.

1. To change the ***Password*** (refer to p.54):

   [CONFIG] [▷] [▷] [▽] [▽] [*] . . [*] [ENTER], Where the [*]'s represent the password. See full discussion on password limitations on p.54.

2. To change the ***Time Base*** for a graphical trend:

   [DISPLAY] Until the appropriate display ("CONSIS." or "FLOW") appears on the screen, then [F1] ("TRND MENU"), and either [F3] ("DECR TIME") or [F4] until the time base is at the desired value.

3. To change the ***Contrast*** of the display:

   [F2] ("CNTR MENU") and either [F3] ("DECR CNTR") or [F4] ("INCR CNTR") until readability is good. If you go too far, [F2] ("CNTR MID") will return the contrast to mid-range.

4. To save a set of ***Calibration Constants*** as a recipe:

   [CONFIG] [◁] [▽] [▽] [*] [ENTER] [F1] ("SAVE CONF"), where the [*] represents the recipe number to be saved. See full discussion on recipes on p.54.

5. To load a previously saved set of ***Calibration Constants*** into the active instrument:

   [CONFIG] [◁] [▽] [▽] [*] [ENTER] [F2] ("LOAD CONF"), where the [*] represents the recipe number to be loaded. See full discussion on recipes on p.54.

6. To change the value of the ***Consistency Strain Factor*** after making the necessary lab tests and calibration calculations:

   [CONFIG] [◁] [◁] [▽] [▷] [▷] [▽] [*] [ENTER], Where the [*] represents the new Strain Factor. See p.41.

7. To change the ***Consistency Bias*** value to make the reading match the lab result (after the Consistency Strain Factor has been set):

   [CONFIG] [▷] [▷] [▽] [◁] [◁] [▽] [*] [ENTER], Where the [*] represents the new bias value. See p.42.

8. To change the ***Display Range*** of the transmitter:

   [CONFIG] [▽] [▽] [*] [ENTER], Where the [*] represents the new span label value.

   Then:

   [△] [▷] [▽] [*] [ENTER], Where the [*] represents the new zero label value.

INSTALLATION

The TECO Stockrite™ Consistency system consisting of a TMC6000 transmitter, and a C3000, C5000, C9700 or C9000 sensor is typically integrated into a stockline as shown in **Figure 6**. This section expands on the installation guidelines illustrated in this figure.

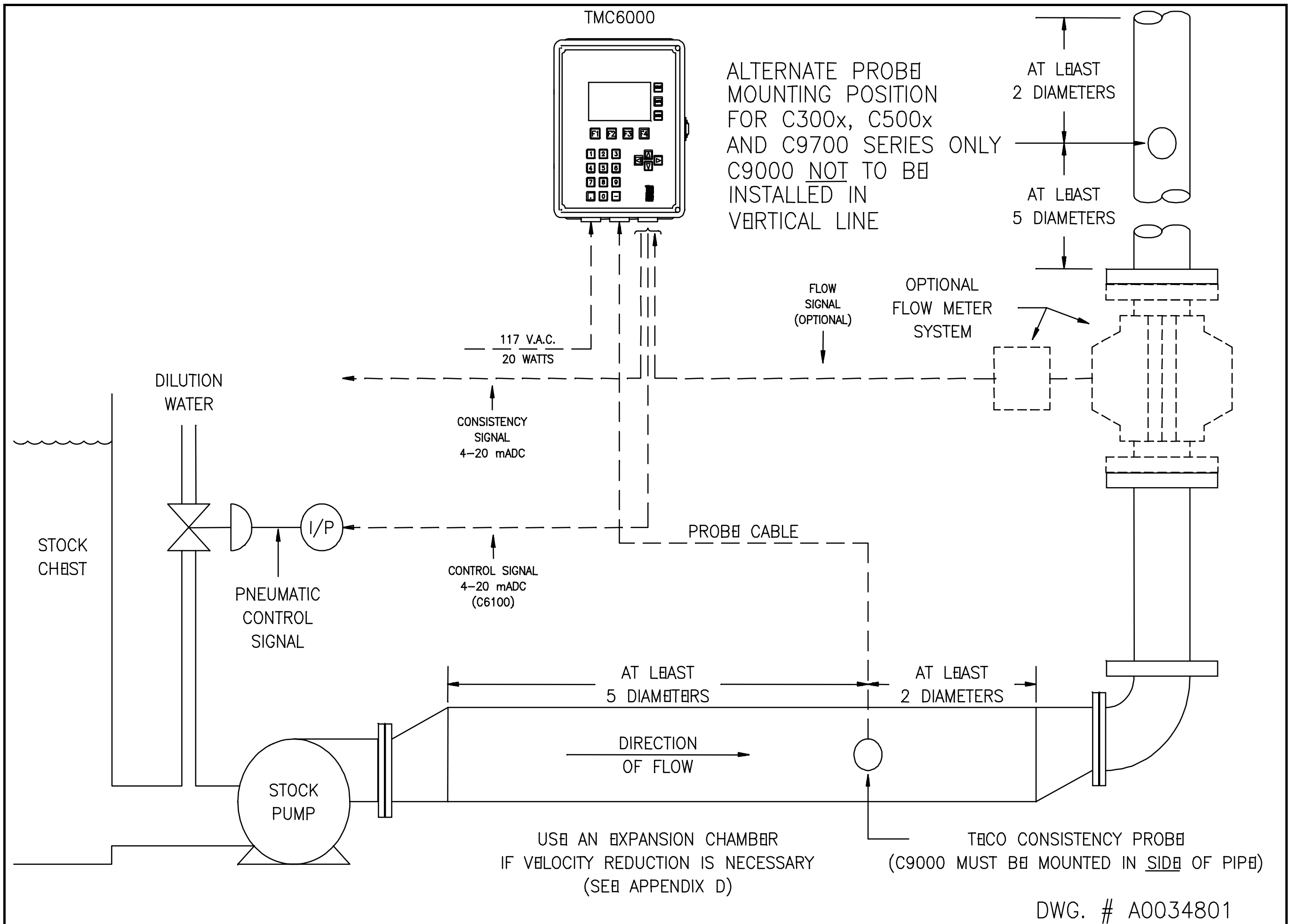


Figure 6 TECO Stockrite™ Consistency System Installation

I. TRANSMITTER

A. TRANSMITTER MOUNTING

Refer to Figure7 for electronic transmitter mounting dimensions and required clearances. The transmitter may be wall-mounted using the molded mounting flanges on the top and bottom of the case, or pipe-mounted on horizontal or vertical pipe using the optional back-plate and pipe saddle.

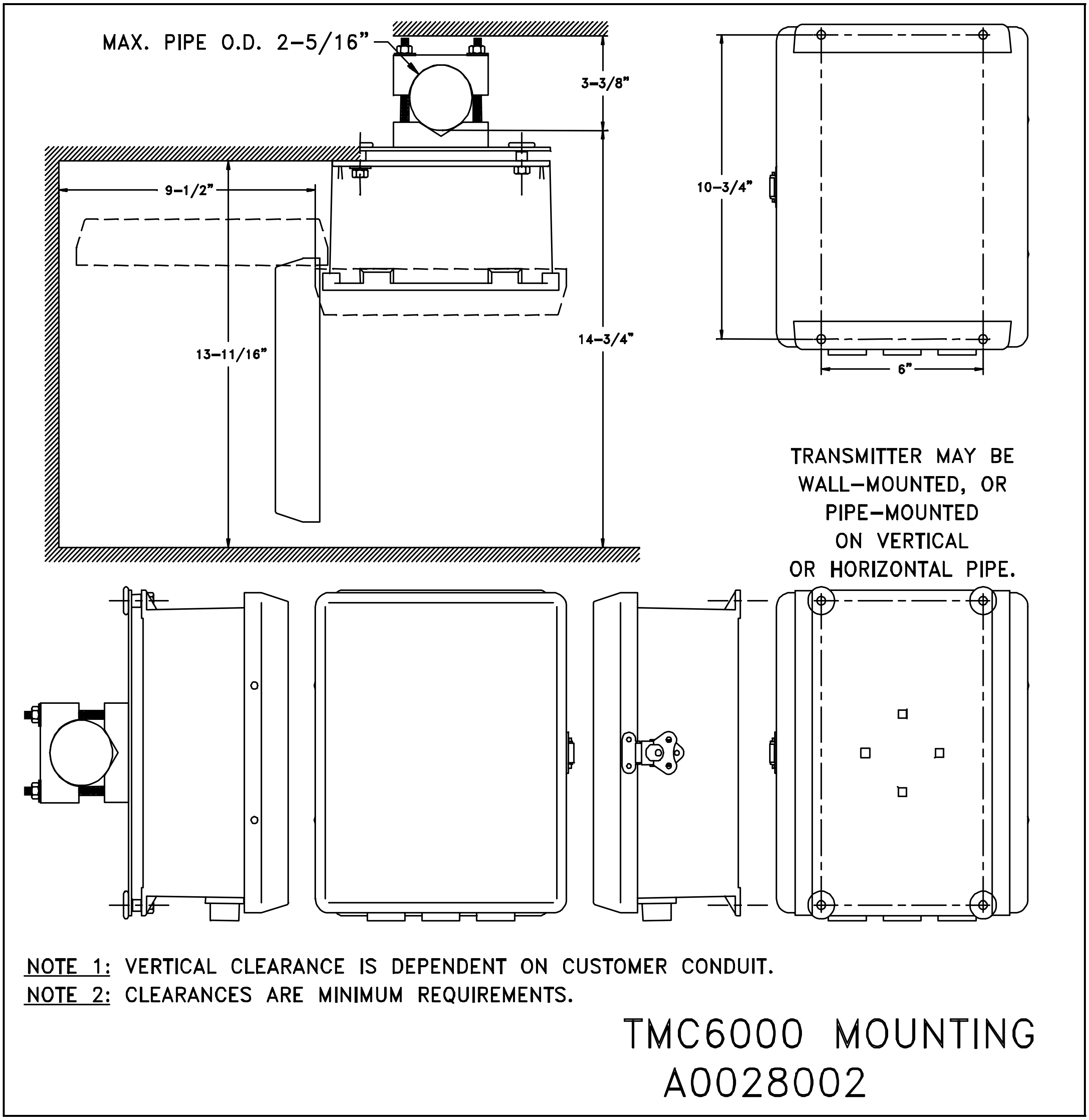


Figure 7 Transmitter Mounting Dimensions

B. POWER CONNECTION

The transmitter requires a 117 V.A.C., 50-60 cycle or a 220 V.A.C., 50/60 cycle electrical supply. Refer to "MODEL NUMBERING SYSTEM" on page 7 if you are unsure which is correct for your instrument.

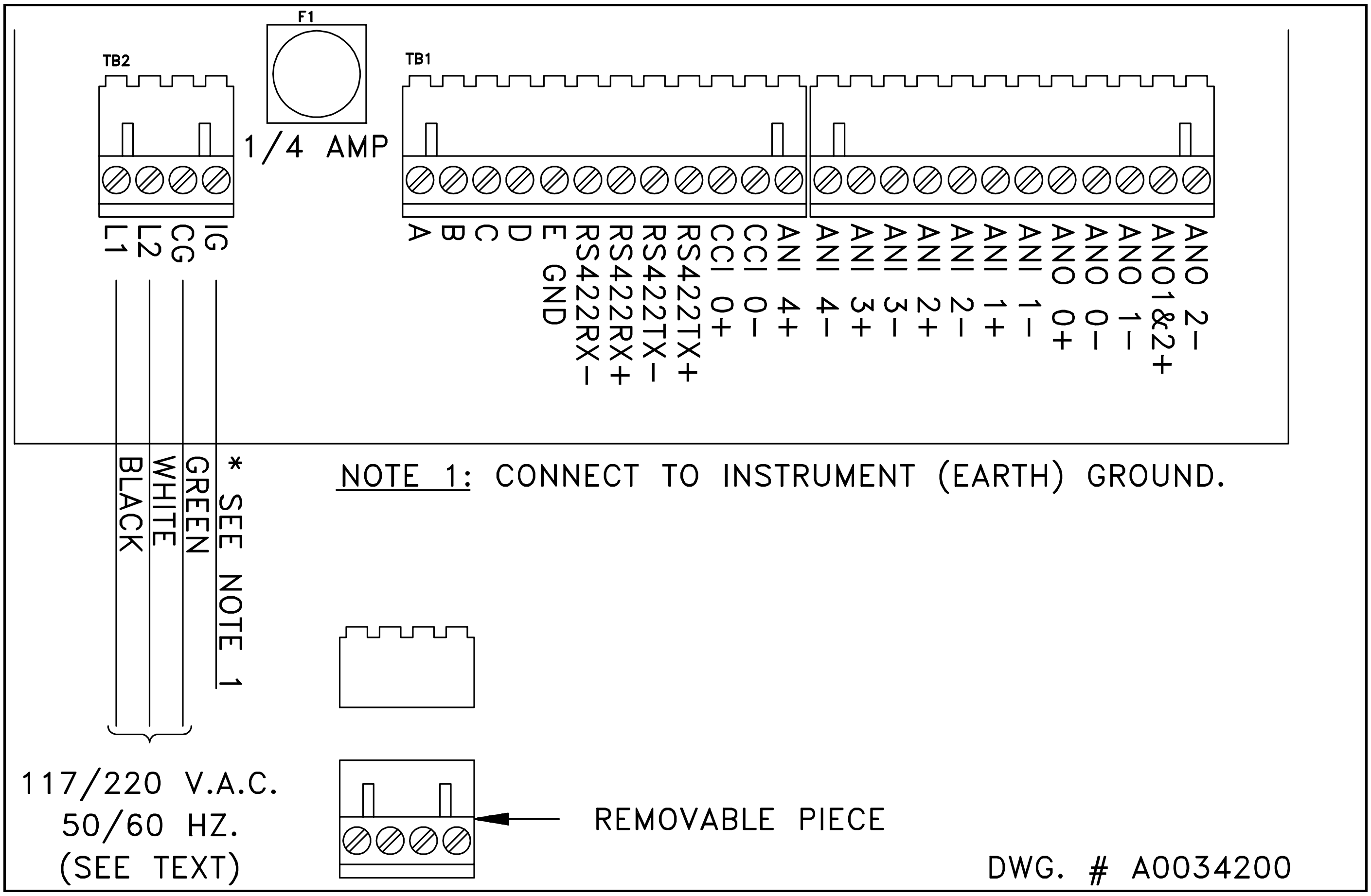


Figure 8 Power Wiring Connections

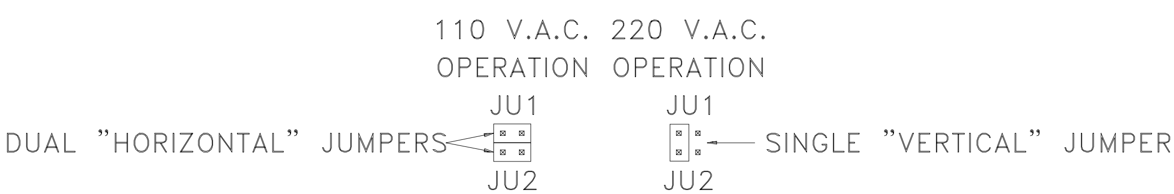


Figure 9 Voltage Select Jumpers

Connect the 117/220 V.A.C. to TB2 as follows:

L1	to TB2-1 (L1)
L2	to TB2-2 (L2)
GND	to TB2-3 (CG)
Earth Ground	to TB2-4 (IG)

Note that terminal strip TB2 separates for ease of wiring.

C. PROBE (SENSOR) CONNECTION

Refer to the following drawings when making terminations.
Connect the Probe cable to TB1 as follows:

Orange	to TB1-1 (A)
Black	to TB1-2 (B)
Clear	to TB1-3 (C)
Red	to TB1-4 (D)
White/shield	to TB1-5 (E GND)

Note that terminal strip TB1 separates for ease of wiring.

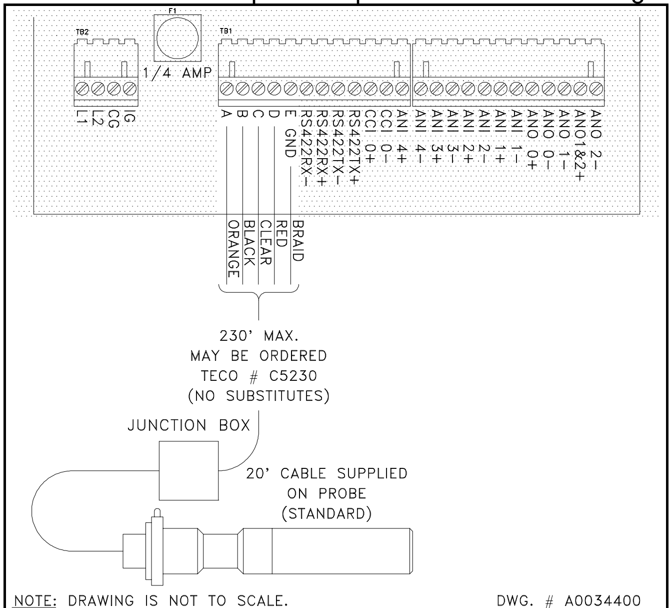


Figure 12 C3000 Wiring

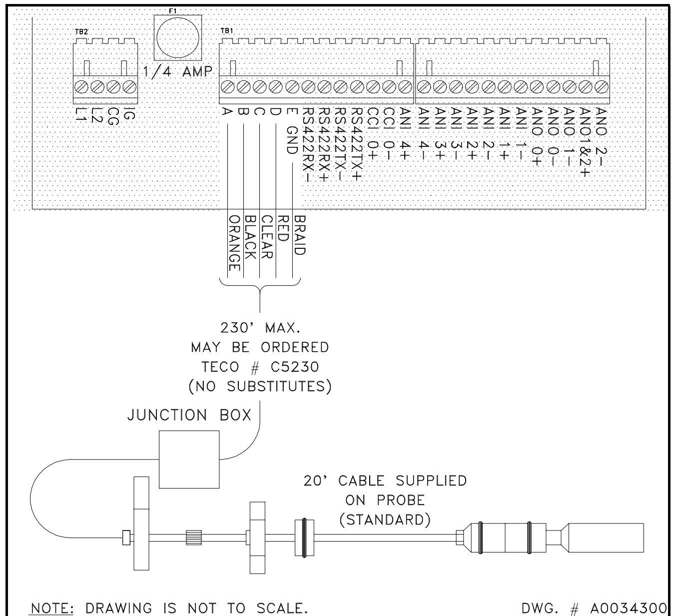


Figure 10 C5000 Wiring

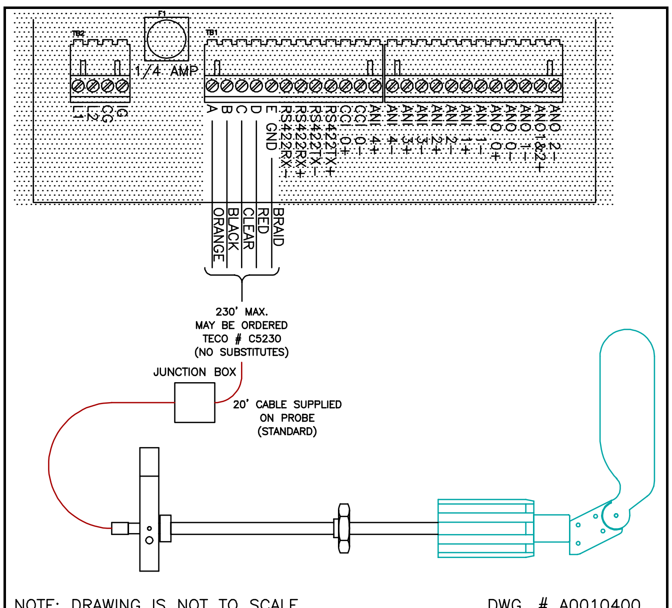


Figure 13 C9000 Wiring

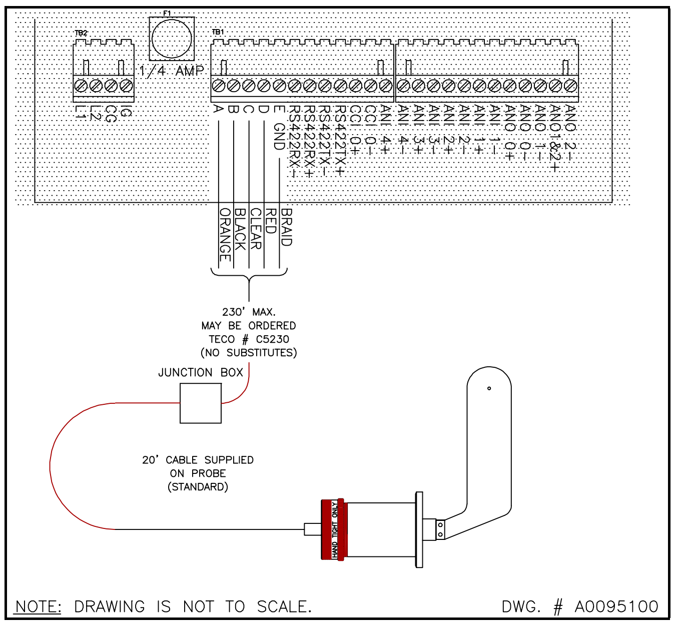


Figure 11 C9700 Wiring

D. ANALOG INPUTS

The TMC6000 can accept (but does not require) one or more analog inputs for various forms of compensation. The Standard version can accept a 4-20 Ma flow signal for flow compensation. The Embedded Control version can also accept a Remote Set Point, Feed Forward, and X-variable input. The Multivariable version substitutes a Z-variable and Y-variable for the Remote Set Point and Feed Forward inputs, respectively. Refer to Figure7 for the location of connections. Connections to these inputs are made on TB1 as follows:

Functionality	Signal	Connection point
Standard	Flow 4-20 Ma (+)	TB1-18 (ANI 1+)
(C6000)	Flow 4-20 mA (-)	TB1-19 (ANI 1-)
Embedded Control	Flow 4-20 mA (+)	TB1-18 (ANI 1+)
(C6100)	Flow 4-20 mA (-)	TB1-19 (ANI 1-)
	Remote Set Point 4-20 mA (+)	TB1-16 (ANI 2+)
	Remote Set Point 4-20 mA (-)	TB1-17 (ANI 2-)
	Feed Forward 4-20 mA (+)	TB1-14 (ANI 3+)
	Feed Forward 4-20 mA (-)	TB1-15 (ANI 3-)
	X-variable 4-20 mA (+)	TB1-12 (ANI 4+)
	X-variable 4-20 mA (-)	TB1-13 (ANI 4-)
Multivariable	Flow 4-20 mA (+)	TB1-18 (ANI 1+)
Compensation	Flow 4-20 mA (-)	TB1-19 (ANI 1-)
(C6200)	Z-variable 4-20 mA (+)	TB1-16 (ANI 2+)
	Z-variable 4-20 mA (-)	TB1-17 (ANI 2-)
	Y-variable 4-20 mA (+)	TB1-14 (ANI 3+)
	Y-variable 4-20 mA (-)	TB1-15 (ANI 3-)
	X-variable 4-20 mA (+)	TB1-12 (ANI 4+)
	X-variable 4-20 mA (-)	TB1-13 (ANI 4-)

Note that terminal strip TB1 separates for ease of wiring.

E. ANALOG OUTPUTS

The TMC6000 provides an Analog Output signal for transmission to a recorder, controller, or dilution valve. Connections to these outputs are made on TB1 as follows:

Functionality	Signal	Connection point
Standard	Process Variable 4-20 mA (+)	TB1-20 (ANO 0+)
(C6000)	Process variable 4-20 mA (-)	TB1-21 (ANO 0-)
Embedded Control	Process Variable 4-20 mA (+)	TB1-20 (ANO 0+)
(C6100)	Process variable 4-20 mA (-)	TB1-21 (ANO 0-)
	Dilution Valve 4-20 mA (+)	TB1-23 (ANO 1+)
	Dilution Valve 4-20 mA (-)	TB1-22 (ANO 1-)

NOTE:

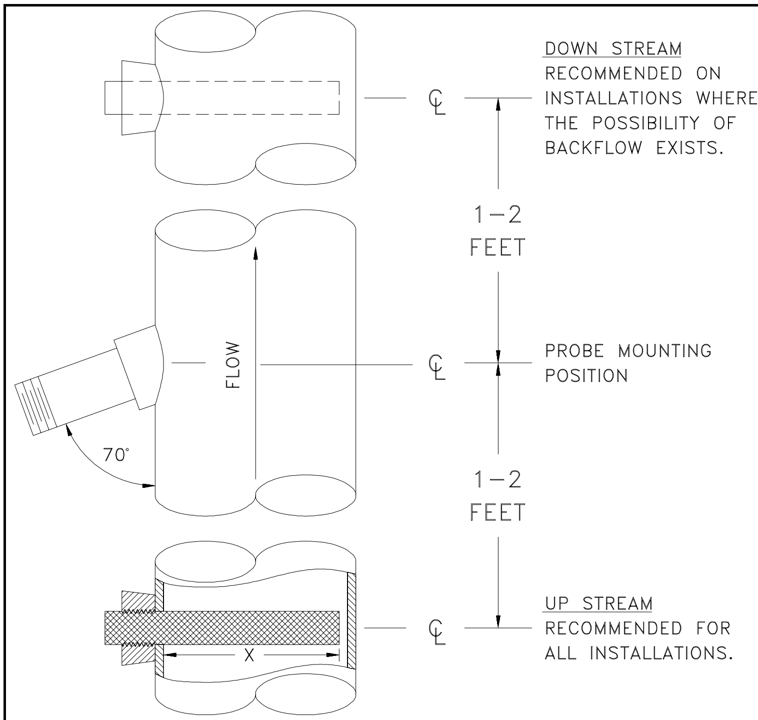
The Dilution Valve Output (ANO 1) is <u>not</u> isolated from the instrument ground. If isolation is required between the TMC6000 and the dilution valve actuator, a current isolator must be used.

Multivariable	Process Variable 4-20 mA (+)	TB1-20 (ANO 0+)
Compensation	Process variable 4-20 mA (-)	TB1-21 (ANO 0-)
(C6200)		

NOTE:

The Process Variable Output (ANO 0) is isolated from the local ground.

II. DEFLECTOR ELEMENT (BREAKER BAR) INSTALLATION



IMPORTANT:
WHEN INSTALLING IN HORIZONTAL STOCKLINES, THE PROBE AND BREAKER BAR(S) ARE TO BE MOUNTED IN THE SIDE OF THE STOCKLINE.

NOTE:
THE TERMS "BREAKER BAR" AND "DEFLECTOR ELEMENT" ARE INTERCHANGEABLE.

SIZE OF STOCKLINE	"X" LENGTH OF BREAKER BAR
6" STOCKLINE	6"
8" STOCKLINE	8"
10" STOCKLINE	10"
12"–UP STOCKLINE	12"

RECOMMENDED BREAKER BAR INSTALLATION
DWG. # A0000603 03/24/1993

Figure 14 Breaker Bar Installation

Installing a deflector element will protect the Sensor from damage due to "logs" or foreign matter in the line. The recommended method is to weld a 1" weldolet to the line approximately 1 to 2 feet upstream from the Sensor, in the same plane as the sensor, and screw a 1" stainless steel rod (breaker bar), slightly longer than the Sensor, into the weldolet. A similar rod downstream from the Sensor (approximately 1 to 2 feet) is recommended to prevent Sensor damage during shut downs when de-watered stock moves backwards in the line. These can be furnished by TECO if desired.

III. PROBE SELECTION CRITERIA

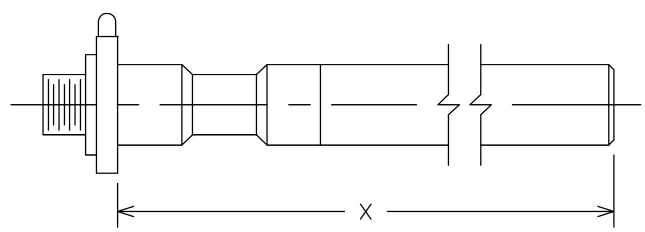
The length of the Probe is determined by stock consistency, not by line size. There are no hard and fast rules for selecting probe size, but the following may be used as guidelines:

CONSISTENCY	PROBE LENGTH	SwingWing™	FixedWing™
2.5% < C < 4.5%	8"	1.5% < C < 12%	1.5% < C < 12%
4.5% < C < 8%	6"		
C > 8%	4"		

MINIMUM LINE SIZE	PROBE LENGTH	SwingWing™	FixedWing™
6"	8"	MINIMUM LINE SIZE FOR C9000 IS 6"	MINIMUM LINE SIZE FOR C9700 IS 6"
4"	6"		
4"	4"		

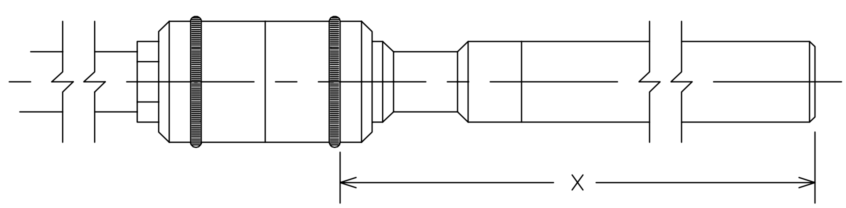
C-3000 PROBE

PROBE SIZE (INCHES)	X DIMENSION (INCHES) FRACTIONAL	X DIMENSION (INCHES) DECIMAL
4	3-15/16"	3.938"
6	6-5/32"	6.156"
8	7-11/32"	7.344"
10	9-3/32"	9.094"



C-5000 PROBE

PROBE SIZE (INCHES)	X DIMENSION (INCHES) FRACTIONAL	X DIMENSION (INCHES) DECIMAL
4	3-23/32"	3.719"
6	5-15/16"	5.938"
8	7-1/8"	7.125"



Dwg. A0082301

Figure 15 Probe Identification

III. C3000 PROBE INSTALLATION

The Consistency Probe is shipped as two separate items: a bushing assembly and the Probe itself. **Figure 16**-A illustrates the bushing assembly that is installed in the pipeline during plant construction. This assembly seals the pipeline opening for preliminary washout and pressure tests. **Figure 16**-B illustrates the installation of the Probe in the bushing.

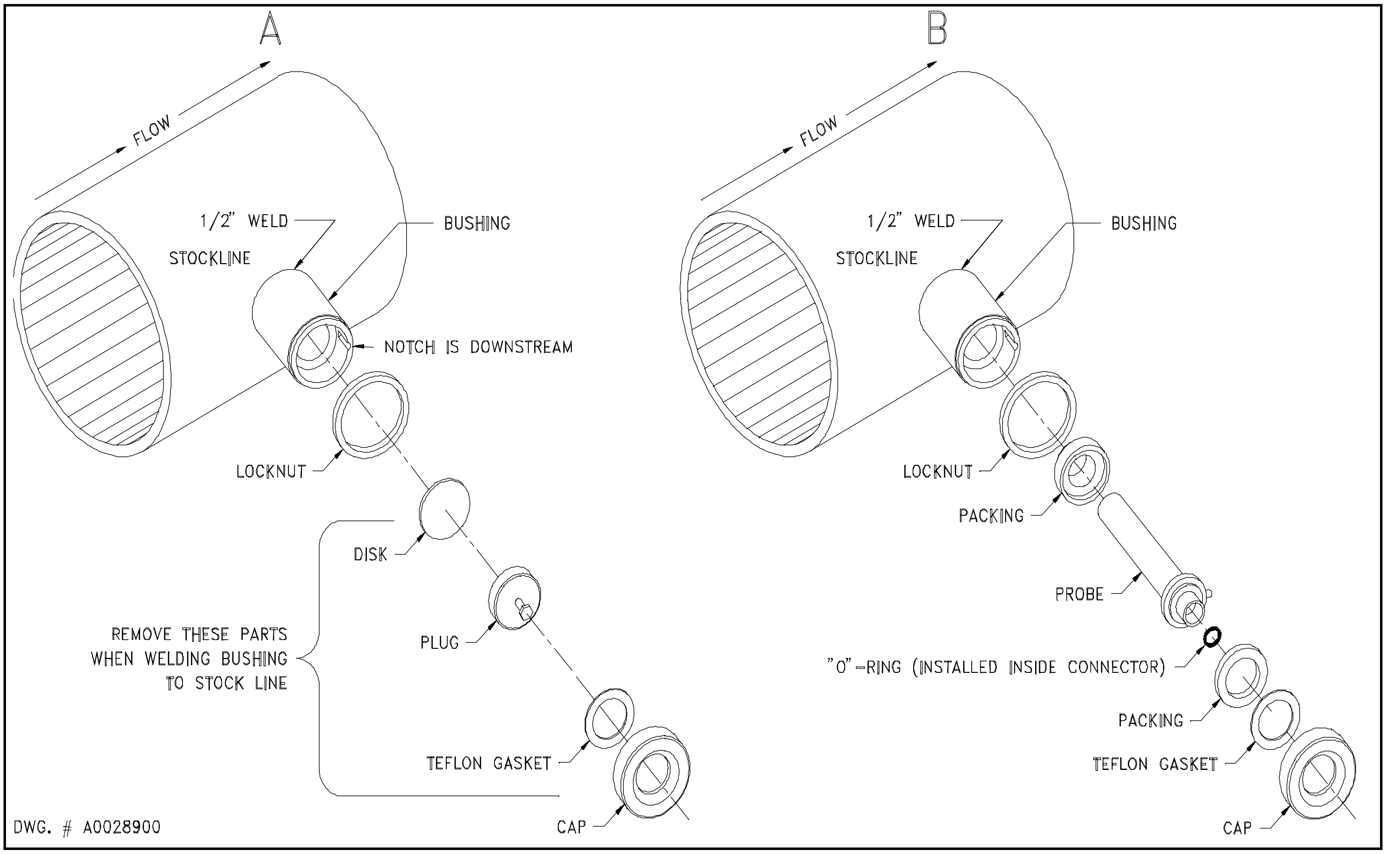


Figure 16 C-3000 Bushing & Probe Installation

CAUTION

The strain gages in the Probe can be damaged by sharp impact. Avoid mechanical contact of the Probe with other objects. Once installed in the pipeline, the Probe is no longer subject to damage from shock, although it is still subject to damage from foreign objects in the stockline.

A. BUSHING INSTALLATION

Refer to 16-A.

1. Drill a 1-1/2" diameter hole in the side of the main pipeline where the bushing is to be mounted. The Probe can be installed in a horizontal or vertical pipeline. In horizontal piping, the Probe must be installed in the <u>side</u> of the pipeline (<u>never</u> in the top or bottom). In a vertical pipe installation, the flow should always be upward.

2. Center the bushing on the hole, with notch facing down stream and weld in place.

3. If the Probe is to be installed later, install the rubber disk and PVC plug to seal the opening.

B. INSTALLING PROBE

Refer to 16-B.

1. Be sure the Probe has a new "O" Ring in the female terminal connection. This "O" Ring protects the terminal from moisture.

CAUTION

When installing the Probe in the bushing, do not allow the Probe to strike the bushing.

2. Remove the rubber gasket and PVC plug from the bushing assembly.

3. Install the Probe and gaskets. When installing the Probe in the bushing, do not allow the Probe to strike the bushing.

4. Hand-tighten the nut.

5. Securely tighten the lock nut.

6. It is suggested that the plug on the 4-wire cable be fastened to the Probe receptacle immediately after installation. This covers the exposed prongs and prevents loss of the "O" Ring. Moisture on the pins will affect the output of the Probe.

IV. C5000 REMOVABLE PROBE INSTALLATION

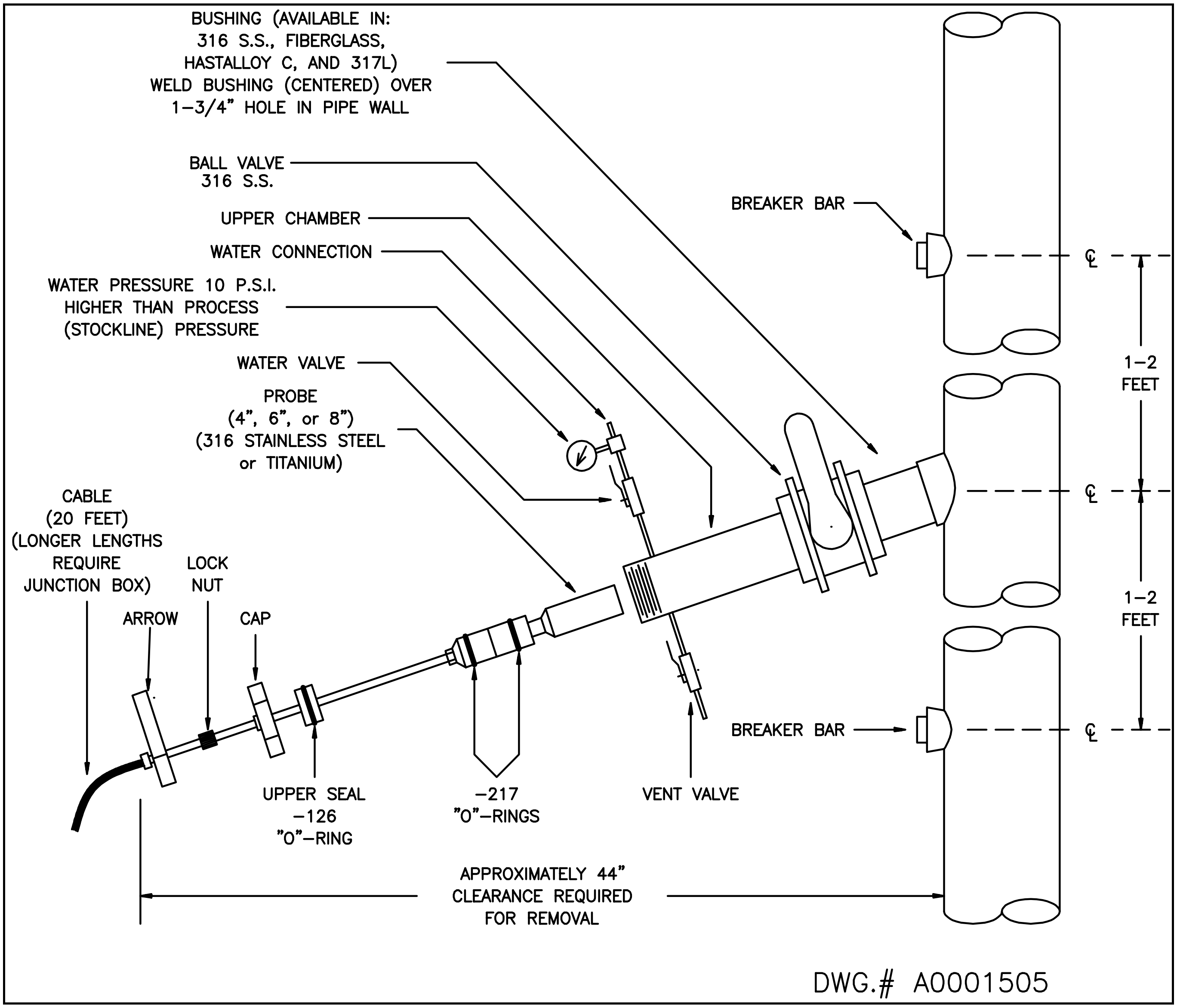


Figure 17 C5000 Removable Probe Installation

A. SLANTED BUSHING AND BALL VALVE INSTALLATION

1. Drill a 1-3/4" hole in the side of the main pipe. Center the bushing over the hole and tack. The Probe can be installed in a horizontal or vertical (the only exception to this is the C9000 probe it can not be installed in a vertical line) pipe line. In horizontal piping, the Probe must be installed in the side of pipeline (never in the top or bottom). In a vertical pipe installation, flow should always be upward.

2. Weld the neck of the bushing to the main pipe.

3. Screw the ball valve and the upper chamber onto the bushing.

4. Close the water valve and do not open it until instructed to do so. Connect a water line, with pressure higher than the line pressure, to the water valve at the top of the upper chamber. This water is necessary to balance the pressure on the

Probe when installing against line pressure. In addition, this water pressure prevents leakage of paper stock into the upper chamber during operation. Stock in the upper chamber would prevent withdrawal of the Probe during operation.

5. Close the ball valve

B. PROBE INSTALLATION

1. Insert the Probe until the bottom touches the ball valve.

2. Screw the cap assembly on the upper chamber, thus sealing the upper chamber.

3. Close vent valve.

4. Open ball valve.

CAUTION

The Probe may "self-insert" <u>rapidly</u> if the water purge pressure is much higher than the stock line pressure. Observe the following precautions when turning on the water pressure:

Do not hold on to the Probe. Keep fingers away from the large cap nut that holds the Probe in the insertion chamber. Fingers could be caught between the nut and the pointer as the Probe moves into the pipeline.

---

5. See "CAUTION" above. Slowly open the water pressure valve referred to in step 4.

6. Push the Probe into the line through the ball valve as far as possible.

7. Screw the locknut on the Probe shaft to the cap assembly. When installing the C5000 probe, align the pointer with the direction of stock flow. Use a 1-1/4" open-end wrench or adjustable-end wrench to tighten the locknut until the shaft can no longer be rotated in the cap.

The locknut locks the Probe down in case of water pressure failure.

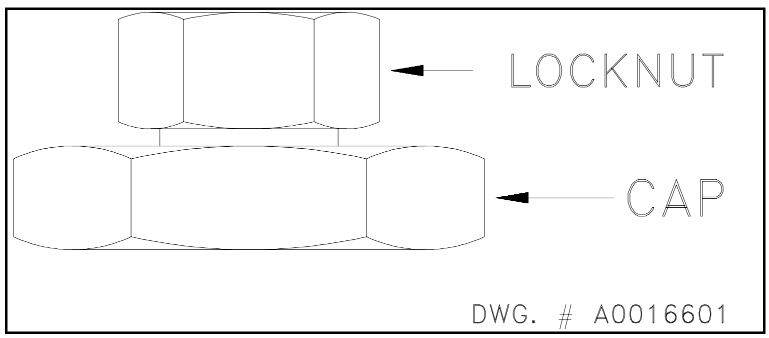


Figure 18 C5000 or C7000 Locknut

8. Rotate the Probe so that the arrow on the Probe extension points downstream. Note: The Probe is directionally sensitive and the regulator will not function properly unless the arrow is pointing downstream. Do not rotate the arrow on the Probe extension, as the relationship between the Probe and the arrow is critical.

9. Connect the cable from the C5000 insertion Probe to the junction box. Then connect the cable from the junction box to the TMC6000 transmitter. The junction box can be eliminated when cable lengths are less than 20 feet.

C. PROBE REMOVAL

CAUTION

The Probe may be ejected rapidly when performing steps 1, 2 or 3. This is due to the water pressure in the pipeline pushing the Probe out. Do not stand behind the Probe or hold on to the Probe when performing these steps.

1. Unscrew the lock nut (See caution above).
2. Turn off the water purge valve (See caution above).
3. Open the vent valve SLOWLY (See caution above).
4. Withdraw the Probe to stop.
5. Close the ball valve.
6. Unscrew the cap.
7. Withdraw the Probe.

V. C9000 SwingWing™ INSTALLATION

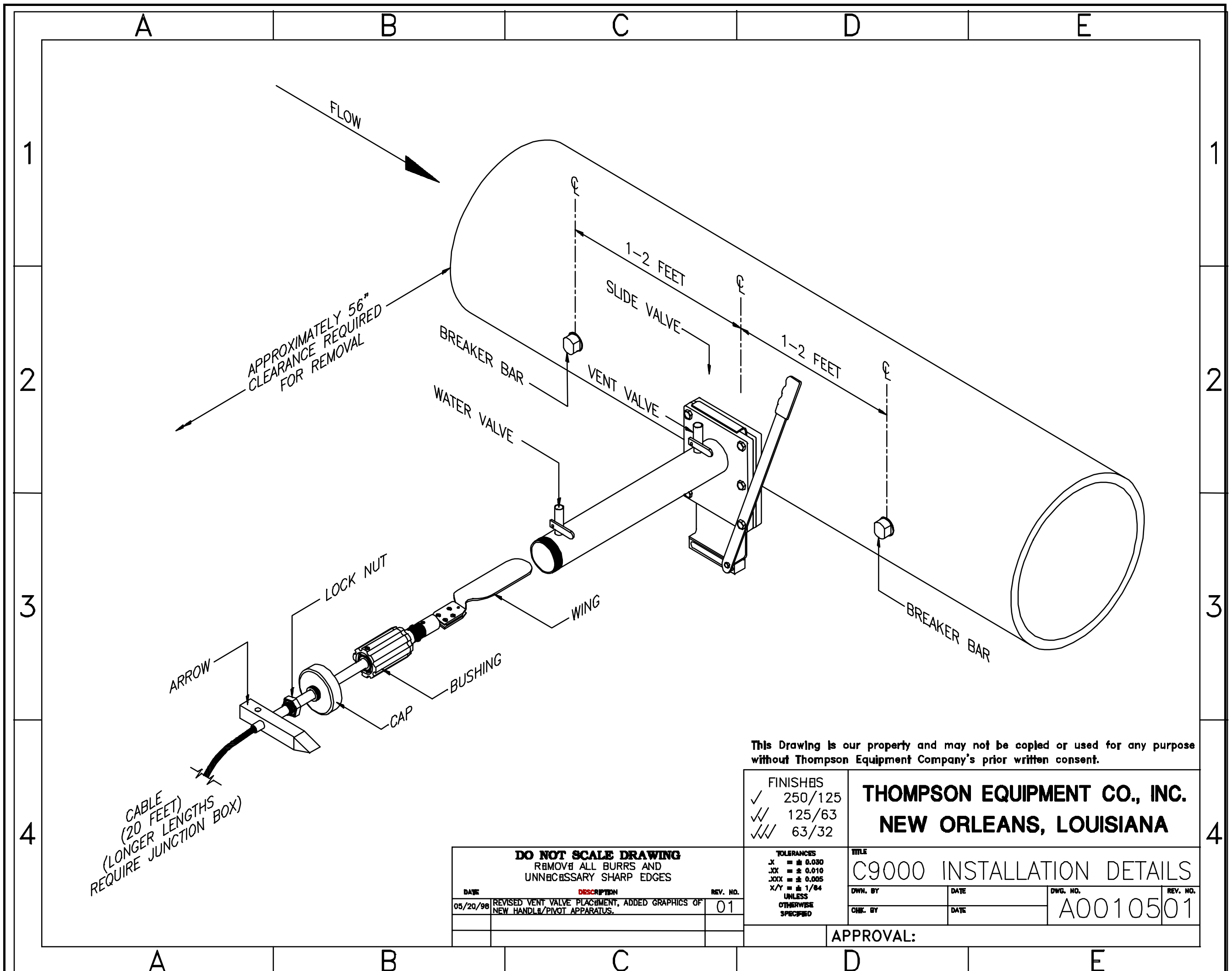


Figure 19 SwingWing™ Installation Drawing

NOTE:

The C9000 can only be installed in a horizontal line. It can not be installed in a vertical line.

A. SwingWing™ BUSHING AND SLIDE VALVE INSTALLATION

1. Shape the bushing so that it fits the pipe surface. Drill a 3" hole in the <u>side</u> of the main pipe -- The C9000 must be installed in the side of pipeline, <u>never</u> in the top or bottom. Center the bushing over the hole and weld ensuring that the top edge of the bushing is parallel to the pipe.

2. Clamp the chamber and slide valve to the bushing, aligning it with the flow direction, and close the valve.

3. Connect a water line, with pressure higher than the line pressure, to the water valve at the top of the chamber. This water is necessary to purge the chamber of stock to facilitate removal of the probe.

B. SwingWing™ INSTALLATION

1. Orient the sensor with the arrow in the correct direction (This sensor cannot be turned once it is in the line). Insert the Sensor until the bottom of the wing touches the slide valve.

2. Screw the cap assembly on the upper chamber, thus sealing the upper chamber.

3. Close both water valve and vent valve.

4. Open slide valve and insert the sensor

5. Insure the arrow is inline with flow direction (Note: The Sensor is directionally sensitive and the regulator will not function properly unless the arrow is pointing downstream. Do not rotate the arrow on the Sensor extension as the relationship between the Sensor and the arrow is critical) and tighten locknut see 19

C. SwingWing™ REMOVAL

1. Open water purge valve. Open vent valve and allow the chamber to purge about 30 sec.

Caution: Do not stand near vent valve during venting, Stock will flow from the vent valve and may be hot.

2. Close vent and then close water purge valve.

3. Loosen the lock nut (Figure18) and pull the wing out as far as it will go.

Note: If the wing will not come all the way out repeat steps 1&2 as you pull the wing out.

4. Close the slide valve.

5. Open the vent valve to ensure the chamber is vented.

6. Unscrew the cap and remove the sensor.

VI. C9700 FixedWing™ INSTALLATION

1. Shape the bushing so that it fits the pipe surface. Drill a 3" hole in the main pipe -- The C9700 can be installed in the side or top of the pipe. Center the bushing over the hole and weld ensuring that the top edge of the bushing is parallel to the pipe.

2. Clamp the probe/bushing assembly to the pipe bushing after calibration, aligning it with the flow direction.

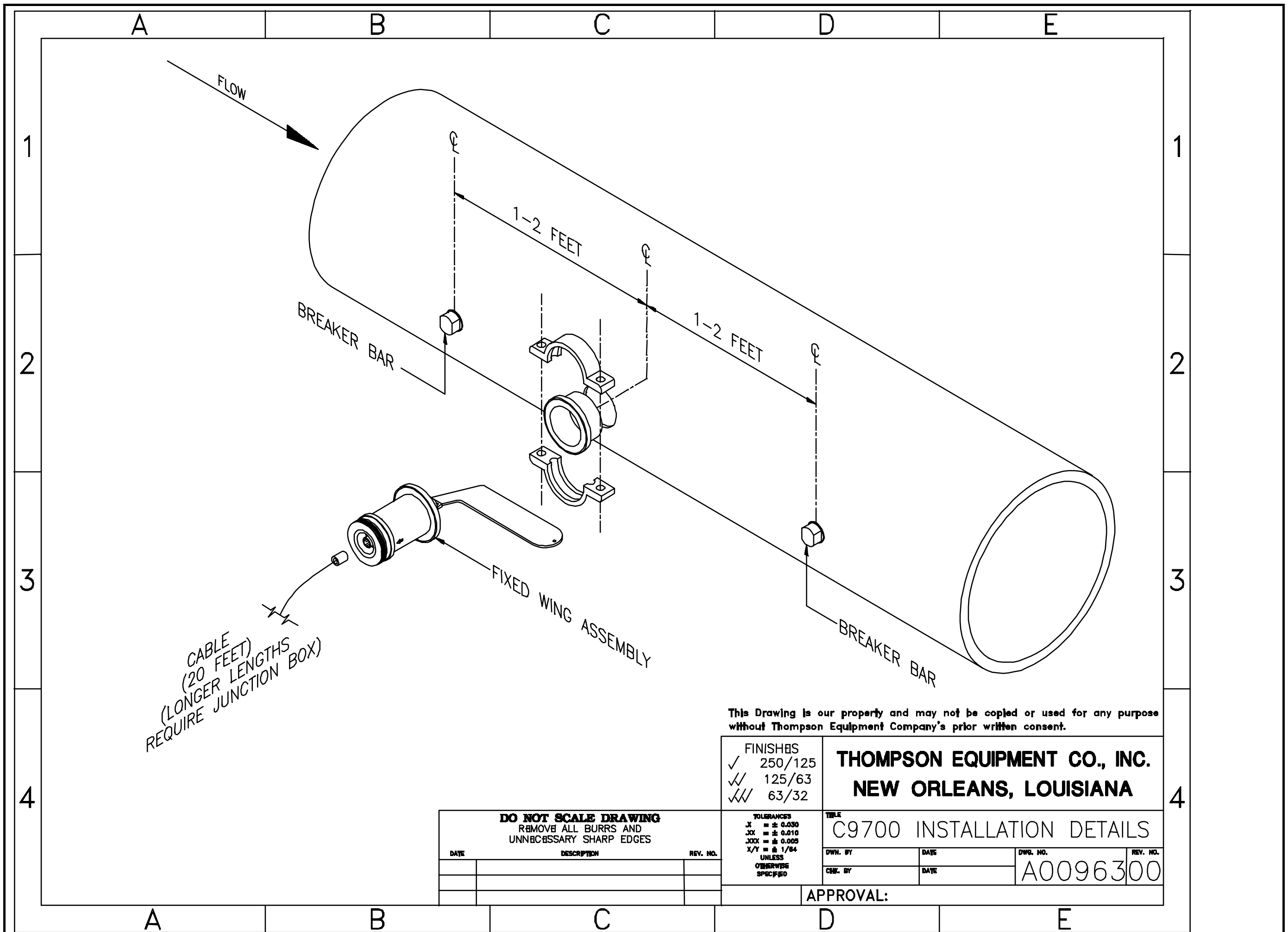


Figure 20 C9700 FixedWing™ Installation

VII. INSTALLATION CHECKLIST

A. GENERAL CHECKLIST FOR C3000 and C5000 PROBES

The flow rate past the sensor must be less than 3.5 ft./sec. (see Specifications on p. 28). With a properly calibrated TMC6000 unit with flow input to it, the velocity can be increased to 6 ft./sec. If the velocity is greater than this, the instrument will be flow-sensitive and will not measure consistency. The only answer to such an installation is to move the Probe to a larger section of the pipeline or enlarge the pipe section for about 7 diameters where the Probe is installed, such that the maximum velocity is less than 3.5 ft/sec, or less than 6 ft/sec if a flow input is provided to the TMC6000.

The breaker bar upstream from the Probe is to break up any "logs" in the line and to divert wire, strapping material and other metal objects around the Probe. When a mill shuts down there is frequently a reverse flow of stock, with some de-watering, which may damage the Probe. Where this occurs, a second breaker bar should be installed downstream from the Probe, oriented in the same direction as the upstream breaker bar. See **Figure 14**

This series of probes can be installed in a horizontal or vertical pipeline. In horizontal piping, the Probe must be installed in the side of the pipeline (never the top or bottom). In a vertical pipe installation, the flow should always be upward.

If cable lengths longer than 20 ft. are required, a junction box will be necessary. If a junction box is used to splice the cable, be sure the box is sealed from the atmosphere to prevent moisture from condensing on the terminal strip.

B. ADDITIONAL CHECKLIST FOR C3000 ONLY

The cap of the bushing on the sensor should not be tightened with a wrench. This can cause it to be insensitive to consistency changes.

The bushing must be welded in the line so that the notched inner face is downstream. This notch orients the Probe's strain gage bridge.

Moisture in the Probe cable connector will short out the signal. An "O" Ring is furnished in the Probe connector. The connector on the cable should be screwed onto the Probe tightly.

C. ADDITIONAL CHECKLIST FOR C9000 ONLY

The flow rate past the sensor must be less than 10 ft./sec. With a properly calibrated TMC6000 unit with flow input, the velocity can be as high as 10 ft./sec. If the velocity is greater than this, the instrument will be flow-sensitive and will not measure consistency. The only answer to such an installation is to move the Sensor to a larger section of the pipeline or enlarge the pipe section for about 7 diameters where the Sensor is installed, such that the maximum velocity is less than 10 ft/sec. A flow input provided to the TMC6000 will permit active and accurate compensation for flow variation.

If cable lengths longer than 20 ft. are required, a junction box will be necessary. If a junction box is used to splice the cable, be sure the box is sealed from the atmosphere to prevent moisture from condensing on the terminal strip.

APPENDICES

APPENDIX A: SPECIFICATIONS

I. TRANSMITTER

Power Requirements	....	117 Volts AC ± 10% 50/60 Hz 20 Watts, 220 Volts AC ± 10% 50/60 Hz 20 Watts.
Output Signal Analog ANO0	....	4-20 mA DC into 0-1000 ohms (isolated)
Output Signal Analog ANO1	....	4-20 mA DC into 0-500 ohms (not isolated)
Flow Signal Input	....	4-20 mA DC input representative of flow at sensor.
Temperature Limits	....	0^{o} to 60^{o}C (32^{o} to 140^{o}F) operating -20^{o} to 85^{o}C, (-4^{o} to 185^{o}F) storage.

PERFORMANCE CHARACTERISTICS

Accuracy Current Output.................. ± 1% of max scale.

Accuracy Rate Display Meter .... ± 1% of max scale.

Repeatability .... ± .25% of max scale.

Transient Response .... Field-configurable.

Sensitivity .... ± .1% bone dry, consistency.

II. SENSOR

OPERATING CHARACTERISTICS

Flow Rate Requirements.................. For the C3000 and C5000 0.1 to 2 FPS (feet per second) preferred. 0.1 to 3.5 FPS acceptable. 0.1 to 6.0 FPS with flow compensation.
For the C9000, C9700, 0.5 to 10 FPS, flow compensation advised.

Consistency Regulation Requirements .... For the C3000 and C5000 any range from 2.5% to 18% bone dry long fiber or 3% to 18% bone dry short fiber. These are nominal limits; actual limits depend upon the nature of the stock.
For the C9000, C9700, 1.5% to 12%

Upper Temp Range	....	250^{o} F Max
Distance from Transmitter	....	250 Feet maximum

APPENDIX B: KEYPAD AND DISPLAY OPERATIONS

A. Overview

The TMC6000 has two primary modes of operation, display mode and configuration mode. Display mode manages the presentation of data such as consistency, flow and all other available features. Configuration mode provides a way to set-up and maintain the TMC6000. Display and Configuration functions are accessed through the front panel keypad. The keypad is a pressure sensitive panel that provides tactile feedback to indicate a successful key contact.

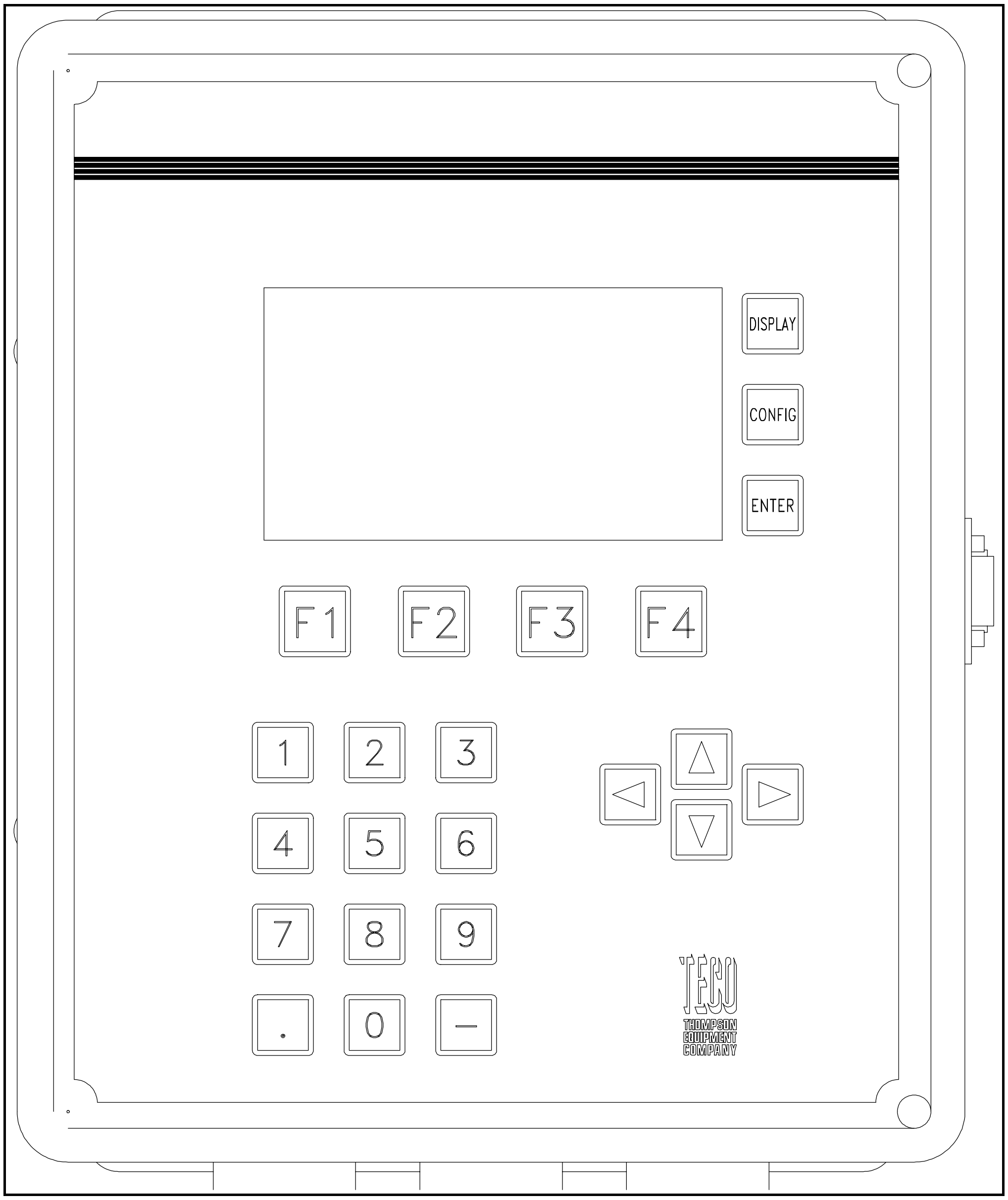


Figure 21 TMC6000 KEYPAD

B. Display Mode

Display mode is the primary mode of operation. The display mode function keys are the F-keys (F1, F2, F3, and F4). Each F-key function changes with respect to the screen being displayed. A description of each key function appears on the display directly above each "F" button. Located to the right of the display is a button labeled "DISPLAY" that may be used to advance to the next display.

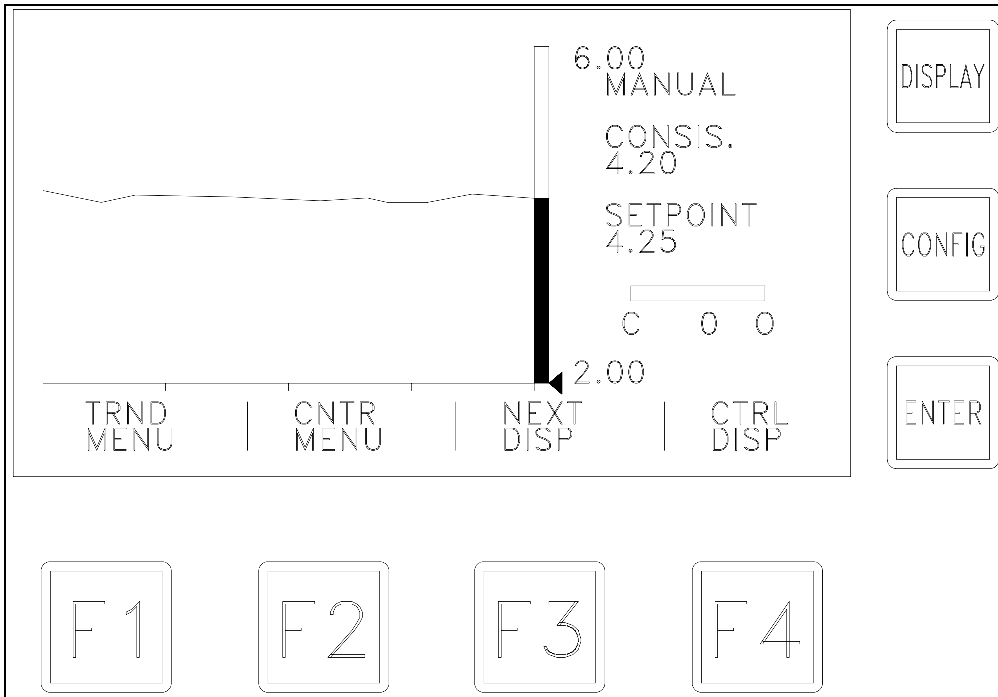
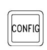


Figure 22 TYPICAL DISPLAY SCREEN

C. Configuration Mode

Configuration mode is used to setup and maintain system attributes, such as calibration parameters, display scaling parameters, etc. As a security feature this mode can be protected by a password which must be entered to access configuration mode. A period of four minutes of inactivity is allowed before the password must be re-entered. The time period allows toggling between modes in order to view the results of configuration changes. The password is defined as a floating point number with a maximum of three digits to the right of the decimal. A password of "0" means that no password is set.

Configuration mode is entered by pressing the 

button. If a non-zero password has been entered, a prompt will appear requesting the password. An incorrect password will place the instrument in DISPLAY mode. If correctly entered the screen will indicate that it is in configuration mode.

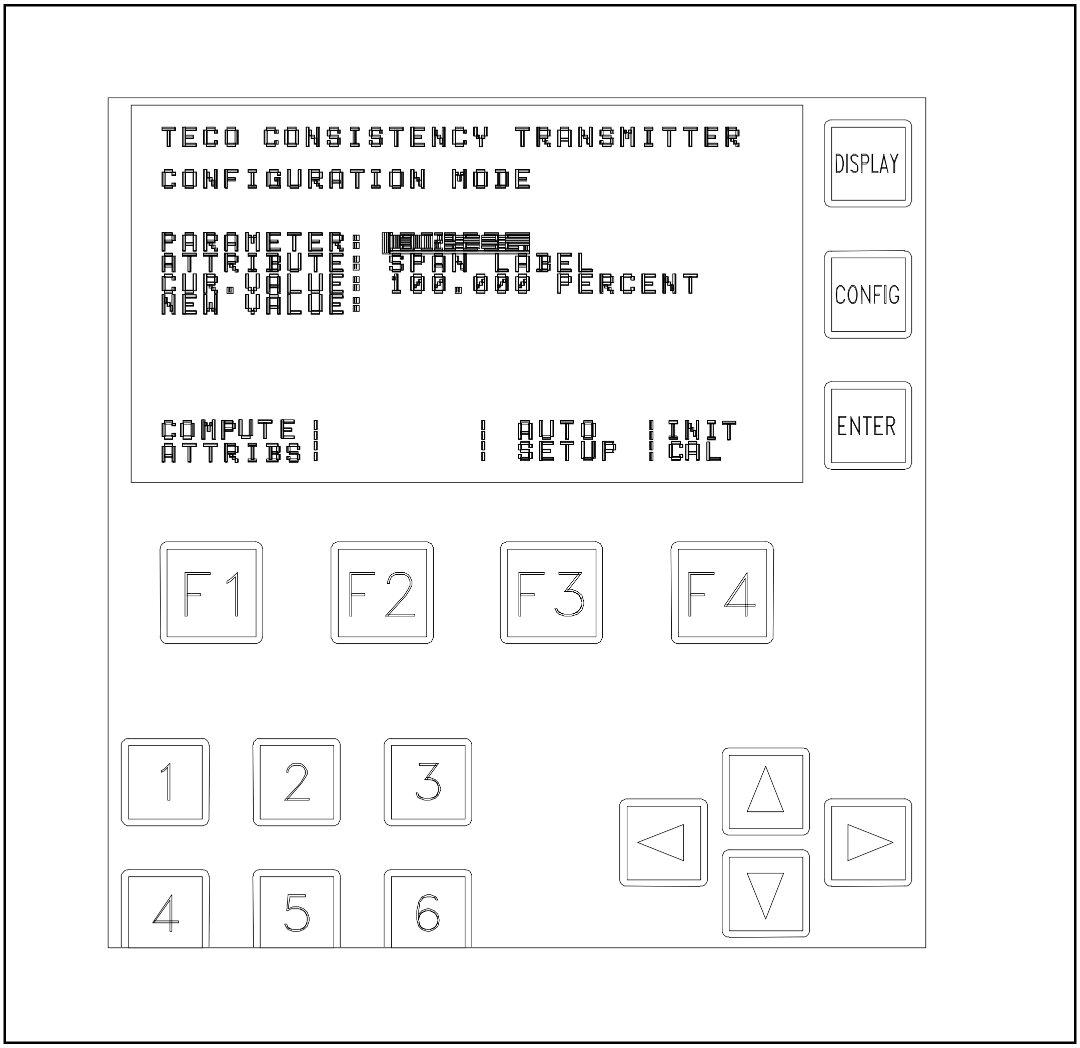


Figure 23 TYPICAL CONFIGURATION SCREEN

The first parameter will appear highlighted. The ▷ (right arrow key) advances to the next parameter and the ◁ (left arrow key) will page back to the previous parameter. Each parameter will have related attributes that can be changed as needed. Selecting an attribute is similar to selecting a parameter. Once the desired parameter has been found, press the ▽ (down arrow key) once to highlight the attribute. ▷ will advance to the next attribute and ◁ will page back to the previous attribute. To change the attribute, press ▽ so that the cursor is in the "NEW VALUE:" field. Using the numeric keys, enter the desired value. If an error is made, use ◁ to delete the entry and re-enter the correct value. Pressing the ENTER key will place the new value in the "CUR. VALUE:" field, which stands for current value. Once the new value appears in the current value field, the attribute change has been successfully achieved. At this point, △ can be used to highlight the attribute field or the parameter field, so the next attribute can be changed or the next parameter selected. In some cases, the attribute is limited to a set of pre-determined values. For these attributes, the new value field will have a value present. When it is selected with ▽, it will appear highlighted and the word "ADJUST" will appear. Use the ◁ and ▷ to move through the available values. When the appropriate value is found, press the ENTER key to register the change. The F-keys functions will be described as applicable.

APPENDIX C: COMMUNICATIONS INTERFACES

1. RS422/485

The TMC6000 offers the RS-422/485 interface standard in Full Duplex Mode. The communications parameters are:

Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1

Terminating resistors are required across the receivers at each end of the communications cable. The TMC6000 provides an internal resistor that can be connected with jumper J16. Intermediate stations must not be terminated. A second terminating resistor is provided across the transmitter for short runs to instruments that do not have a terminating resistor. This second resistor is enabled with jumper J18.

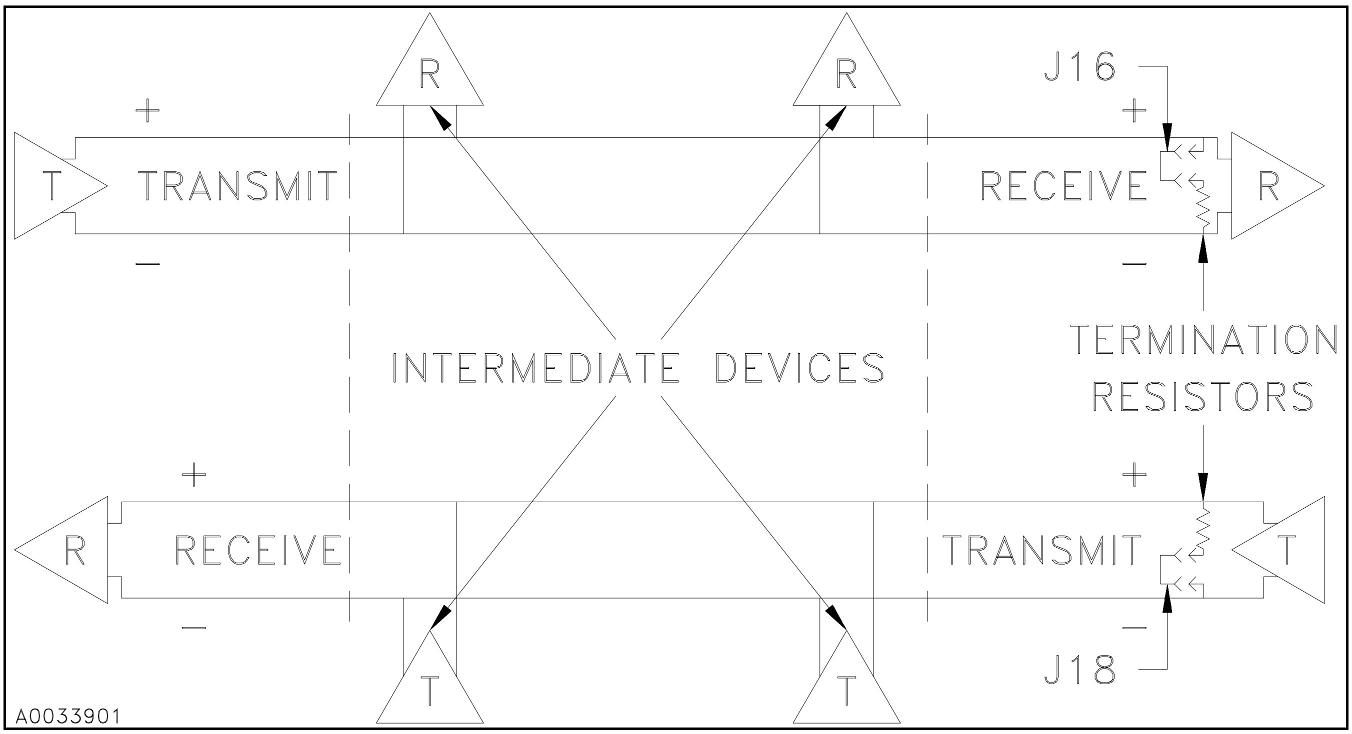


Figure 24 RS422/485 Communication Block Diagram

The jumpers are located on the digital board. Access to the jumpers requires the removal of the LCD display. Remove the 4 4-40 Phillips-head screws from the corners of the LCD display and gently pull it straight out from the supporting standoffs. The jumpers are located in the lower left side of the digital board, about one third of the way up from the bottom

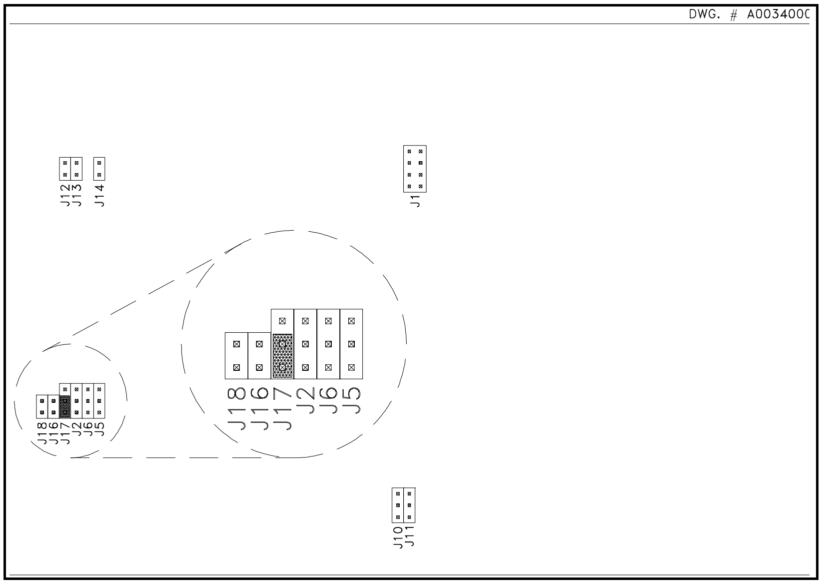


Figure 25 RS422/485 Jumper Settings

edge.

The following jumper configuration defines the setup for this interface. Jumper J17 should only be installed when RS-422 communication will be implemented.

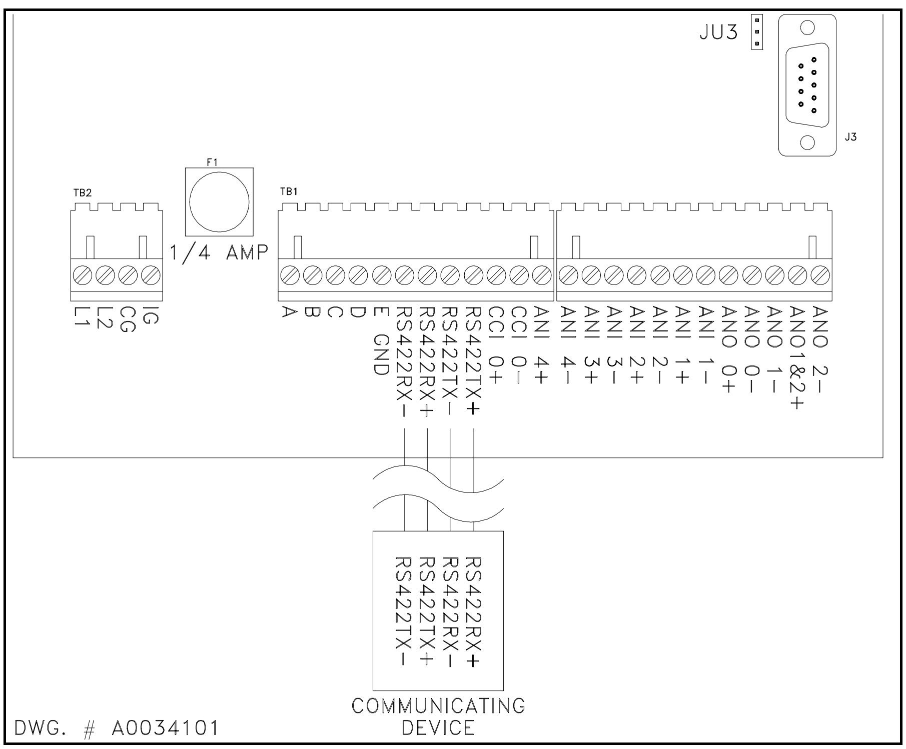


Figure 26 RS422/485 Wiring Configuration

Note: Terminating resistor jumpers J16 and J18 should be used as required.

Instrument Addressing for RS-485 multi-drop communications:

The TMC6000 can be configured with an instrument address between 1-32. If multiple instruments are installed on a RS-485 communications link, each instrument must have a unique address. If no address is desired, this value should be set to zero. The instrument address is set by entering the value in the parameter PASSWORD/INSTRUMENT ADDRESS, attribute INSTRUMENT ADDRESS from the configuration mode.

2. RS-232

The TMC6000 is equipped with an RS-232 interface. A hand-held configurer or Personal Computer communicating in ASCII may be used to communicate with the TMC6000. Communications parameters are:

Baud Rate	9600
Parity	None
Data Bits	8
Stop Bit(s)	1

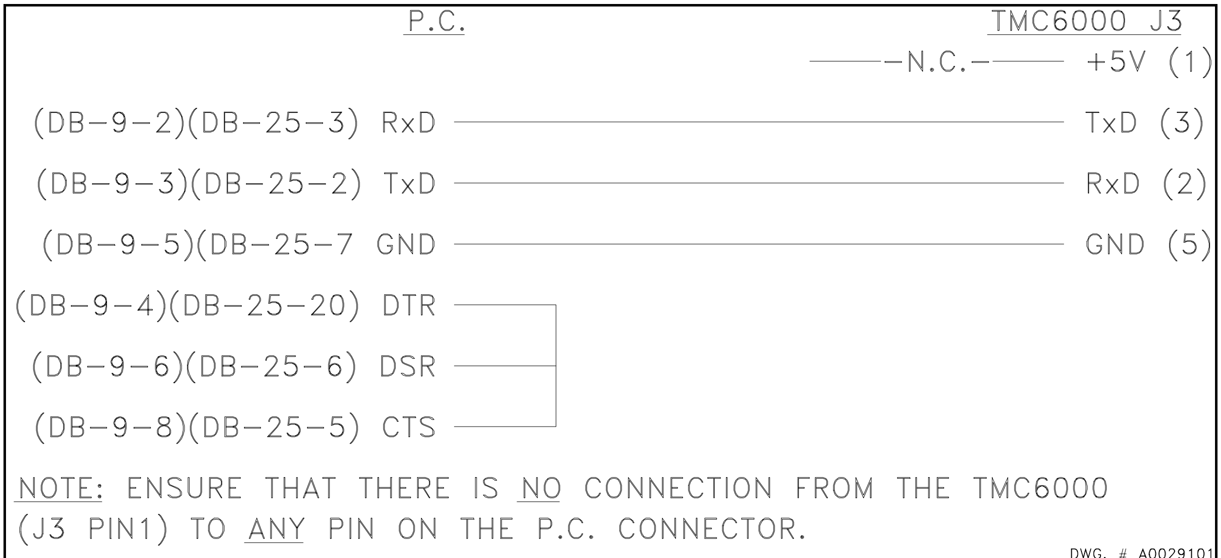


Figure 27 Wiring a P.C. to the TMC6000

<u>Note:</u> The TMC6000 J3 Pin 1 does <u>NOT</u> conform to standard RS-232 signal definition. It is used to provide power for a hand-held configurer and <u>MUST NOT</u> be connected to <u>ANY</u> pin in a P.C. Damage to either the TMC6000 serial interface or the P.C. serial interface may occur.

3. COMMAND SUMMARY

The following is the command summary for the TMC6000 transmitter:

NOTE:
The command set for RS-485 communications is identical to the RS-232 command set. If an instrument is configured with a non-zero address, each command must be preceded by the instrument address value and separated by a space. An address value does not need to precede the command if the instrument's address is set to zero, or if it is the only instrument on the communications link.

Computing Consistency Attributes for Direct-Reading Indicating Transmitter:

Non-addressed instrument:

Take Test Strain Sample	SAMPLE x ↵
Set Consistency Lab Result	RESULT x f1 ↵
Compute & update attribute settings	COMPSET f2 f3 ↵

Addressed instrument:

Take Test Strain Sample	ia SAMPLE x ↵
Set Consistency Lab Result	ia RESULT x f1 ↵
Compute & update attribute settings	ia COMPSET f2 f3 ↵

where:

ia	is an integer value of the instrument address
x	is an integer number of the Test # requested
f1	is a floating-point value of a consistency lab result
f2	is a floating-point value of the desired span
f3	is a floating-point value of the desired zero

EXAMPLE 1:

In order to take the strain sample for test #1, the command from the P.C. would be SAMPLE 1 ↵ .

EXAMPLE 2:

To set the consistency result of test #2 to 15%, the command would be RESULT 2 15.0 ↵ .

EXAMPLE 3:

To compute the attribute settings for a desired span of 100.0 and a desired zero of 10.0 the command would be COMPSET 100.0 10.0 ↵ .

EXAMPLE 4:

To take the strain sample for test #2 on an instrument with an address of 12 the command would be 12 SAMPLE 2 ↵

Configuring Parameters and Attributes:

Non-addressed instrument:

Request Parameter	RP n ↵	
Request Attribute	RA n I ↵	
Set Attribute	SA n i nval ↵	
Load Recipe	LR n ↵	
Save Recipe	SR n ↵	
Get Control Parameter	GETCP x ↵	* For embedded control options only.
Set Control Parameter	SETCP x f ↵	* For embedded control options only.

Addressed instrument:

Request Parameter	ia RP n ↵	
Request Attribute	ia RA n I ↵	
Set Attribute	ia SA n i nval ↵	
Load Recipe	ia LR n ↵	
Save Recipe	ia SR n ↵	
Get Control Parameter	ia GETCP x ↵	* For embedded control options only.
Set Control Parameter	ia SETCP x f ↵	* For embedded control options only.

where:

ia	is an integer value of the instrument address
x	is an integer number of a Control Parameter
f	is a floating-point value of a Control Parameter
n	is the number of the Parameter,
i	is the number of the Attribute,
nval	is the new value to be entered, and
↵	indicates a CARRIAGE RETURN character.

Note that the spaces between commands and parameters are MANDATORY.

EXAMPLE 1:

In order to interrogate the instrument for the current setting of FLOW FILTER, the command from the P.C. would be RA 1 2 ↵ (Request Attribute Parameter 1 Attribute 2).

EXAMPLE 2:

To change the setting for FLOW FILTER to 2.3 seconds, the command would be SA 1 2 2.3 ↵ (Set Attribute Parameter 1 Attribute 2 2.3).

EXAMPLE 3:

To interrogate the instrument for the current feed-forward value, the command would be GETCP 3 ↵

EXAMPLE 4:

To change the setpoint to 3.36, SETCP 1 3.36 ↵

EXAMPLE 5:

To load Recipe #2 on an instrument with an address of 5, the command would be 5 LR 2 ↵

Control Parameters are:

0 Process Variable
1 Setpoint
2 Output
3 Feed-forward Value

Parameters and Attributes with their sequential numbers are:

0 STRAIN
- 0 CAL. FACTOR
- 1 CAL. BIAS
- 2 FILTER

1 FLOW
- 0 SPAN
- 1 ZERO
- 2 FILTER
- 3 PIPE I.D.

2 CONSIS.
- 0 SPAN LABEL
- 1 ZERO LABEL
- 2 STRAIN FACTOR
- 3 VEL. FACTOR
- 4 VEL. SQ. FACTOR
- 5 BIAS
- 6 FILTER

3 PROBE
- 0 LENGTH
- 1 MATERIAL

4 PASSWORD/INSTRUMENT ADDRESS
- 0 PASSWORD
- 1 INSTRUMENT ADDRESS

5 CONTROL
- 0 PROP. BAND
- 1 RESET
- 2 CTRL ZONE
- 3 CTRL ACTION
- 4 OUT HIGH
- 5 OUT LOW
- 6 MAN RESET
- 7 RSP GAIN
- 8 RSP BIAS
- 9 FF GAIN
- 10 FF BIAS
- 11 FF LAG
- 12 FF LEAD

6 I/O CALIBRATION
- 0 ANO 0 FACTOR
- 1 ANO 0 BIAS
- 2 ANO 1 FACTOR
- 3 ANO 1 BIAS
- 4 ANO 2 FACTOR
- 5 ANO 2 BIAS
- 6 ANI 1 FACTOR
- 7 ANI 1 BIAS
- 8 ANI 2 FACTOR
- 9 ANI 2 BIAS
- 10 ANI 3 FACTOR
- 11 ANI 3 BIAS
- 12 ANI 4 FACTOR
- 13 ANI 4 BIAS

7 RECIPE
- 0 NUMBER

8 x VAR
- 0 SPAN
- 1 ZERO
- 2 LINEAR FACTOR
- 3 SQUARED FACTOR
- 4 CUBED FACTOR
- 5 FILTER

9 y VAR
- 0 SPAN
- 1 ZERO
- 2 LINEAR FACTOR
- 3 SQUARED FACTOR
- 4 CUBED FACTOR
- 5 FILTER

10 z VAR
- 0 SPAN
- 1 ZERO
- 2 LINEAR FACTOR
- 3 SQUARED FACTOR
- 4 CUBED FACTOR
- 5 FILTER

11 INITIAL CAL
- 0 STOCK

APPENDIX D: WHAT ELSE AFFECTS THE FORCE ON THE PROBE?

While the shear force can be correlated with consistency, the total force acting on a probe is the sum of the shear force and the force due to the flow of the water in the stock. The shear force is constant as velocity increases, changing only with fiber concentration or fiber characteristics. The flow-related force, however, is proportional to the square of the velocity of the stock **Figure 28** shows three zones of interest concerning the velocity of the stock.

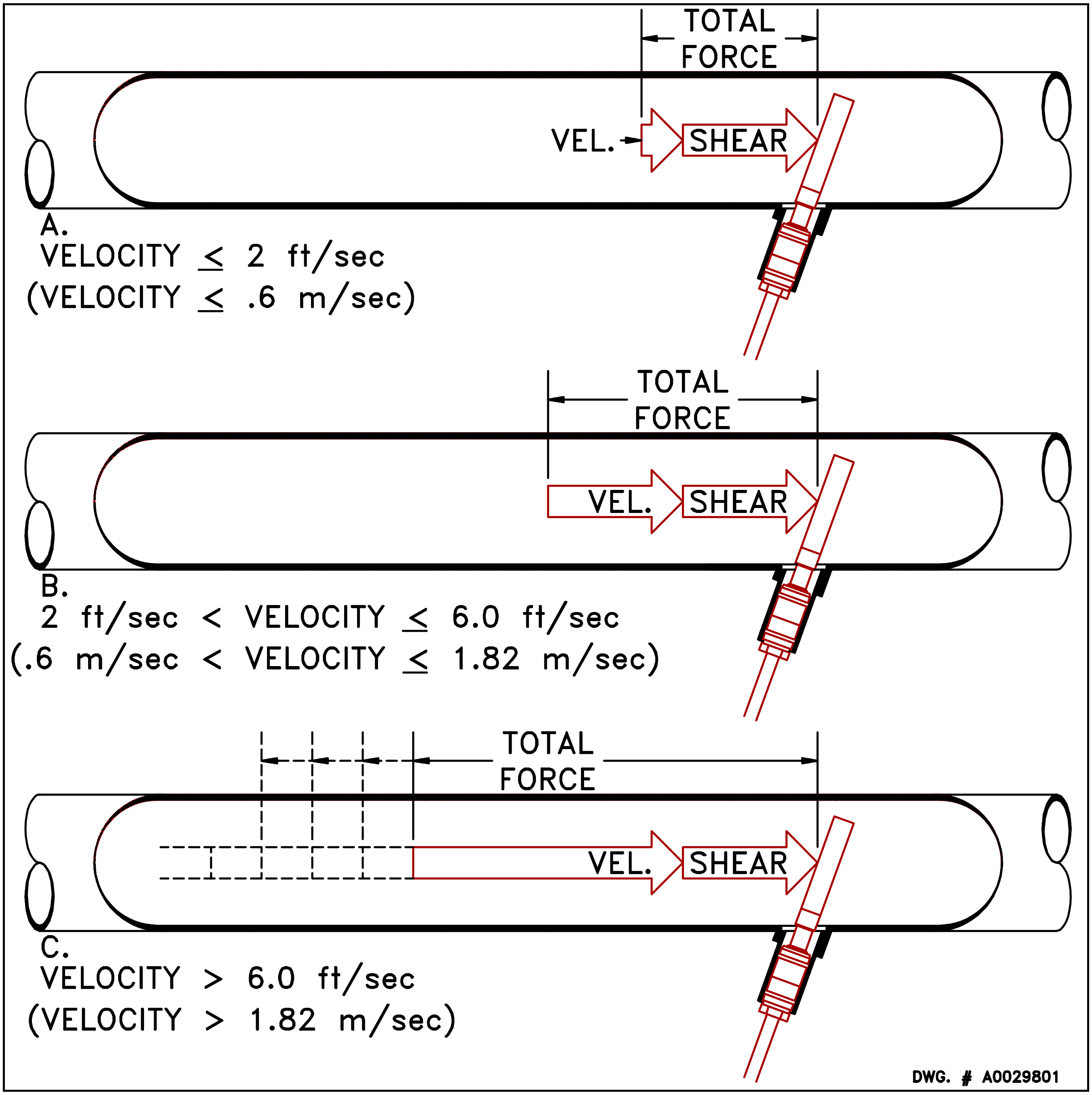


Figure 28

28A:

Below approximately 2 ft/sec (.6 m/sec) the shear force is so large relative to the velocity force that the latter may be ignored.

28B:

Beyond 2 ft/sec (.6 m/sec) and up to approximately 6.0 ft/sec (2 m/sec), the velocity force is of the same order of magnitude as the shear force. Use of the TMC6000 or the C4005 permits using a flow signal to calculate the velocity force and subtract it from the total force.

28C:

Beyond approximately 6.0 ft/sec (2 m/sec) the velocity force rapidly becomes many times larger than the shear force. For a shear force method of measurement to be used requires the installation of larger diameter pipe, sized to locally reduce the velocity to under 6 ft./sec.

Can The Output Signal Be Interpreted As Consistency?
The force required to shear apart the fiber, while related primarily to the concentration of fiber in the stock, is affected by other characteristics of the stock.

• Fiber length - Each species of wood has a characteristic range of fiber lengths, from the long fibers of softwood varieties to the short fibers of the hardwoods. Since longer fibers have more surfaces to bind together, the shear force associated with a softwood stock will be higher for the same consistency than a hardwood stock. Stocks blended of different proportions of different species add further to the variability of the consistency/shear force relationship. The TMC6000 has the ability to hold several sets of calibration constants, each tailored to a particular product blend.

• Temperature - Stock temperature affects the strength of the mechanical bond between the fibers. As temperature increases, less force is required to break the bond. Since the magnitude of this effect is also species and blend dependent, the exact relationship is unique to each stock. If the process engineer can characterize the relationship for his various product stocks, the TMC6000 can accept an input from a thermocouple or RTD transmitter and compensate for temperature variation.

• pH - The lubricity of the fiber varies with pH of the stock, thus varying the force required to break the mechanical bond between the fibers. Again this is very stock dependant, but if the process engineer can characterize the relationship for his various product stocks, the TMC6000 can accept an input from a pH transmitter and compensate for pH variations.

Please refer to the sections associated with each piece of equipment for the guidelines, installation procedures, suggested maintenance, and other detailed information.

APPENDIX E: STANDARDIZATION

1. INTRODUCTION

2. N.I.S.T. TRACEABILITY

Consistency measurement is not a measurement that can be traced to a nationally recognized standard, therefore the portion of the ISO 9000 standards which states "- where no such standards exist, the basis used for calibration shall be documented" would apply.

Using laboratory samples as the basis for comparison, calibrate the TECO Consistency Transmitter to the calibration procedure (See APPENDIX F) at documented regular intervals. The following is an important consideration in this process:

a) Document your consistency sampling procedure and laboratory processing procedure.

b) Ensure your laboratory scale is traceable to N.I.S.T.

Use the password protection system of the TMC6000 to safeguard the equipment from adjustments, which would invalidate the calibration setting.

Use a calibration sticker on the instrument indicating Calibration date and Calibration Due date. Document and record all calibrations as evidence that the calibration procedure has been done.

3. STATISTICAL CORRELATION

Statistical techniques may be used to improve this calibration procedure.

APPENDIX F: CONSISTENCY PARAMETER

I. Overview

Two basic ways that the TMC6000 may be used are as a relative consistency deviation-indicating transmitter, and as a direct-reading consistency transmitter.

In the case of a deviation transmitter, the user is not concerned with the actual value of consistency, but only the fact the value is changing from a normal operating point. This is very common when the unit is used as a feedback element to a dilution controller. In this application, under desired stock conditions a user might set the consistency bias to give a reading of 50%, set the setpoint of the controller to 50%, and put the controller in automatic. The user is not concerned with the actual consistency, but only that it is being controlled to a constant value over a limited time interval (between lab measurements).

Sometimes it is desired that the output of the consistency transmitter be correlated to laboratory results. The transmitter can then be set up to continuously give direct-reading consistency indication over the tested range. The unit should be set up as a deviation transmitter first, and then correlated to actual laboratory results if desired.

II. Explanation of Consistency Parameter Attributes

A. Span Label

Span label adjusts the "span" of the calculated consistency variable. All consistency calculations are done on a 0-100% full scale basis internally, and the span label is used to span the consistency information provided by the LCD and data-link.

Note: Changing the consistency "SPAN" after 2-point lab calibration has been performed, will render the "STRAIN FACTOR" inaccurate.

B. Zero Label

Zero label adjusts the "zero" of the calculated consistency variable.

Example:

> It is desired that at 100% output (20 ma), the LCD and data-link report 6% and at 0% output (4ma), the LCD and data-link report 2%. The span label setting should be set to 4, and the zero label should be set to 2.

C. Strain Factor

Strain factor is a gain adjustment to the probe. A value of 1.0 should work well for most deviation indication applications. A value of 0.5 would make the unit half as sensitive as a value of 1.0. A value of 0 removes the probe completely and the bias is the only setting that affects the output. If the unit is to be used as a deviation sensing device for dilution control purposes, the strain factor should be set to give good response to changes in the dilution valve position while not being overly sensitive to noise and other disturbances.

If it is desired that the unit transmit data representative of consistency, the strain factor should be set by one of two methods. The first method configures the unit with an estimate of the strain factor based on selection of a stock type. This method is provided as a means to get a unit on line quickly and functioning near its optimal accuracy without having to manipulate the process and perform lab tests. The stock type may be selected by any of three different means while in configuration mode.

- Access the "STOCK" attribute through the “Auto Setup” utility (see page 8)
- Depress the “INIT CAL” button [F4] while at the PARAMETER level of the configuration menu. This positions the user at the INITIAL CAL parameter, where the STOCK attribute may be modified.
- Scroll through the parameter list using the [◁] or [▷]. key until the “INITIAL CAL” parameter is displayed, with its attribute, “STOCK“.

In all cases, the desired stock type is selected by use of the or . keys, followed by pressing the key. Stock types are:

SOFTWOOD UN	unbleached softwood
SOFTWOOD BL	bleached softwood
HARDWOOD UN	unbleached hardwood
HARDWOOD BL	bleached hardwood
HW>SW BLEND	hardwood/softwood blend (hardwood > 50%)
SW>HW BLEND	softwood/hardwood blend (softwood > 50%)
OCC	old corrugated containers
MOW	mixed office waste
NEWSPRINT	newsprint
MAGAZINE	magazine
GROUNDWOOD	groundwood
TMP	thermomechanical pulp
CTMP	chemi-thermomechanical pulp

The second method for setting the strain factor is used when it is desired to transmit data representative of consistency relative to test data derived from measured lab results. The procedure for doing this is described in Section IV of this appendix.

D. Velocity Factor

Velocity compensation allows the transmitter to eliminate the effect of variation of total force on the probe due to corresponding variation in flow rate. Velocity compensation is typically only needed at velocities above 2 ft/sec. Velocity factor is a linear correction factor providing correction that varies directly with velocity. If it is seen that a flow increase causes an increase in the reading, the velocity factor should be increased. If it is seen that a flow increase causes a decrease in the reading, the velocity factor should be decreased. Note that after a change is made in the velocity factor, a change in bias will be required to bring the reading back to its original position.

Example:

A technician notices from the trend displays that the reading of a transmitter goes up from 40% to 50% of full scale when the flow goes up by 2 ft/sec. Assuming that the velocity factor was previously set to 0, he should set the velocity factor to 5%/ft/sec since this would have the effect of decreasing the output by 10% for a 2 ft/sec increase in velocity. After making the change, he notices that the reading has dropped by 10% and he would like it to read 50%. He would then need to increase the bias by 10%.

E. Velocity Squared Factor

Velocity squared factor provides correction based on the square of the velocity. For most applications, velocity factor should be used and velocity squared factor should be set at zero. Some low consistency applications might work better with velocity factor set to zero, and velocity squared factor set at a positive number on the order of 1.0. The same method should be used in setting this number and the bias as in the above example on velocity factor.

F. Bias

The bias can be set to give a desired reading at an operating point. It should be noted that bias is in percentage of <u>full scale</u>.

Example:

The unit is ranged to read 2-6% at the LCD via the span label and zero label settings. With the bias set at 30%

full scale and all other settings properly set, the unit reads 4%. It is desired that the unit read 3%. Since a -1% reading change represents -25% full scale (1 is 25% of the span label setting of 4), the bias should be adjusted to 5%.

G. Filter

Filtering should be used to dampen the response of the reading. The filter should be set at the smallest value that eliminates unwanted noise. Typical values for filtering are on the order of .1 to 7 seconds. Care should be taken not to over-dampen the signal, since the unit will respond poorly to changes in consistency.

III. Setting The Consistency Attributes For Use As A Deviation Indicating Transmitter.

To set up the transmitter as a deviation transmitter, the user would follow these basic steps:

1) Follow the procedure outlined in the Quick-Start guide of this manual. When prompted, set the span label to 100 and set the zero label to 0.

2) Insure that the probe is in a flowing line with the arrow pointing downstream, and the stock is at desired operating conditions.

3) Adjust the bias to give the desired reading (usually mid scale).

If the unit is found to be too sensitive to changes in dilution valve position, decrease the strain factor and readjust the bias to give the desired reading.
If the unit is found not to be sensitive enough to changes in dilution valve position, increase the strain factor and readjust the bias to give the desired reading.

IV. Setting the Consistency Attributes for Use as A Direct-Reading Indicating Transmitter.

Caution

It should be noted that many factors could cause a change in the force vs. consistency characteristic of stock, such as variations in temperature, flow, fiber species, stock blend, pH, etc. Care should be taken that these conditions are kept constant for the direct reading data to be meaningful. If they cannot be held constant, they should be accommodated with the optional C6200 Multivariable Compensation Transmitter.

```
  SPAN LBL:     100.000  PERCENT
  ZERO LBL:       0.000  PERCENT
STRAIN FCT:       1.000  %FS/F.
      BIAS:      40.000  PERCENT
 - - - - - - - - - - - - - - - - - -
        DESIRED LABELS.
SPAN:       100.000
ZERO:         0.000
- - - -- - - - - - - - - - - - - - -
        LAB RESULT   STRAIN SAMPLE
TEST1:  [  EMPTY  ]  [  EMPTY  ]
TEST2:  [  EMPTY  ]  [  EMPTY  ]

TEST #1 | TEST #2 | COMPUTE  | CNCL
SAMPLE  | SAMPLE  | SETTINGS | QUIT
  F1        F2        F3        F4
```

Figure 29 Typical Lab Cal Screen

This portion of the manual covers setting the unit assuming that these other factors are held constant. To set up the unit for direct reading, the following basic steps <u>should be followed in order</u>.

1) Set up the unit as a deviation sensor as described in Section III of this appendix. Note that the transmitter should be set up so that it does not saturate over the desired operating range (never reads more than 100% or less than 0 %).

2) While operating at a thicker than normal consistency value, go to the "COMPUTE ATTRIBS" screen. Press the "F1" key to take the Test #1 strain sample. The unit will respond with "OVERWRITE READING #1?". Press “CONTINUE” to proceed or “CNCL” to cancel the function. Simultaneously take a stock samples for lab analysis. It is recommended to use methods described by TAPPI standard T-240 to take several lab samples and get average.

3) Modulate the dilution valve to get the consistency well below the normal operating consistency but within the desired calibration range. Allow the transmitter to settle to a new value within its range. If saturation occurs, change the valve position to bring the reading within range.

4) On the "COMPUTE ATTRIBS" screen, press the "F2" key to take the Test #2 strain sample. The unit will respond with "OVERWRITE READING #2?". Press “CONTINUE” to proceed or “CNCL” to cancel the function. Simultaneously take a stock samples for lab analysis.

5) Do laboratory analyses on the lab samples as described in TAPPI test methods T-240.

6) When the consistency lab results are complete from the two samples, return to the "COMPUTE ATTRIBS" screen. Use the arrow keys to highlight the "TEST1" value under "LAB RESULT". Press "ENTER" to select the position desired. Enter the actual consistency percentage of the first stock sample. Press "ENTER" a second time for the value to be accepted.

7) Repeat the procedure in step 6 to enter the second “LAB RESULT” value in the "TEST2" position.

8) Enter values for desired span and zero labels if they are different from the current settings.

Note: Span label must not be changed after the following step (9) is performed. Changing the consistency "SPAN" after 2-point lab calibration has been performed, will render the "STRAIN FACTOR" inaccurate.

9) With the strain samples, stock consistency lab results, and desired labels entered press "COMPUTE SETTINGS". The unit will respond with "COMPUTE & UPDATE SETTINGS?". Press "CONTINUE" to proceed or “CNCL” to abort the function. The unit should accept the values and calculate the new consistency attribute settings. (Strain Factor and Bias)

10) Before calculating new settings the TMC6000 checks to make sure that, the two strain samples and consistency lab result values have a large enough deviation to allow an accurate calculation of the strain factor and bias values. If the strain values are too close, the unit will respond with "STRAIN DIFF. MUST BE > 5". If the stock sample consistency values are too close, the unit will respond with "RESULT DIFF. MUST BE > 5".

11) To return to operating display press F4 to quit and then press the DISPLAY key.

12) To fine-tune the unit after calibration, allow the process to stabilize at a normal consistency and do a final lab sample. Then adjust the bias to bring the reading on the TMC6000 as close as possible to the final lab sample.

V. Explanation of the formulas to follow if the, TMC6000 program is not used.

Definition of Variables

Part 1, Data to be recorded

S_1 = span label during test
Z_1 = zero label during test
S_2 = desired span label
Z_2 = desired zero label
SF_1 = strain factor during test
B_1 = Bias during test
R_1 = first transmitter reading
L_1 = first lab results
R_2 = second transmitter reading
L_2 = second lab results

Part 2, Data to be calculated

PR_1 = percent full scale of reading at test point 1
PL_1 = percent full scale of result at test point 1
PR_2 = percent full scale of reading at test point 2
PL_2 = percent full scale of result at test point 2
ST_1 = probe strain at test point 1
ST_2 = probe strain at test point 2
SF_2 = calculated new strain factor
B_2 = calculated new bias

Calculations

Part 1, Convert data to percent full scale

$$PR_1 = \frac{100(R_1 - Z_1)}{S_1}$$

$$PL_1 = \frac{100(L_1 - Z_2)}{S_2}$$

$$PR_2 = \frac{100(R_2 - Z_1)}{S_1}$$

$$PL_2 = \frac{100(L_2 - Z_2)}{S_2}$$

$$ST_1 = \frac{PR_1 - B_1}{SF_1}$$

$$ST_2 = \frac{PR_2 - B_1}{SF_1}$$

$$SF_2 = \frac{(PL_2 - PL_1)}{(ST_2 - ST_1)}$$

$$B_2 = \frac{(PL_2 ST_1 - PL_1 ST_2)}{(ST_1 - ST_2)}$$

Part 2, Calculate probe strain at test points
Part 3, Compute new strain factor and bias

Enter the following into the transmitter
Set consistency span label to S_2.
Set consistency zero label to Z_2.
Set consistency strain factor to SF_2.
Set consistency bias to B_2.

Alternate Output Calibration

If you purchased your TMC6000 as a system, you will have received an IBM compatible diskette with the instruction kit. If you did not receive your disk call, TECO and we will supply you with one free of charge. This program is also available from TECO's web site by sending your request by e-mail to Support@Tecon.com The following manual calibration should be used to get a good average over a long period of time on an IBM compatible PC.

1) Insert the TECO supplied configuration disk containing the program TMC6000.exe in drive A:.

2) a) In DOS type A:TMC6000<Return>.
b) In Windows 3.11 in the program manager go to "File" select "Run" and type A:TMC6000<Return>
c) In Windows 95 from the start Menu select "Run" and type A:TMC6000<Return>

3) When the program prompts "CURRENT SPAN LABEL", enter the setting in SPAN LABEL when the calibration tests are being made.

4) When the program prompts "CURRENT ZERO LABEL", enter the setting in ZERO LABEL when the calibration tests are being made.

5) When the program prompts "CURRENT STRAIN FACTOR", enter the setting in STRAIN FACTOR when the calibration tests are being made.

6) When the program prompts "CURRENT BIAS", enter the setting in BIAS when the calibration tests are being made.

7) When the program prompts "DESIRED SPAN LABEL", enter the span label intended after this calibration.

8) When the program prompts "DESIRED ZERO LABEL", enter the zero label intended after this calibration.

9) When the program prompts "TEST 1 READING", enter the value read from the TMC6000 while the first lab sample was being drawn.

10) When the program prompts "TEST 1 RESULTS", enter the results of the lab measurement done on the first sample.

11) When the program prompts "TEST 2 READING", enter the value read from the TMC6000 while the second lab sample was being drawn. Insure that there is a significant change in this value relative to the first lab test. Ideally, these two values would be approximately 25% of span above the desired operating point, and 25% of span below the desired operating point. If you have to wait for a change of stock this program is provided so the data can be entered it when it is convenient.

12) When the program prompts "TEST 2 RESULTS", enter the results of the lab measurement done on the second sample.

13) The program will now compute and display the following:

CONSISTENCY SPAN LABEL __.___
CONSISTENCY ZERO LABEL __.___
CONSISTENCY STRAIN FACTOR __.___

CONSISTENCY BIAS __.___

Enter these values into the TMC6000. For any questions call TECO's Technical support at 504-833-6381 or E-Mail to Support@Tecon.com.

APPENDIX G: FLOW PARAMETER

The TMC6000 provides flow indication and velocity compensation. The flow signal is to be wired to analog input 1 (ANI1). For wiring information see "ANALOG INPUTS", p. 15. This section deals with the configuration of a transmitter for flow input.

The flow signal is indicated and converted to velocity in order to velocity compensate the consistency reading. Refer to APPENDIX F for application of this factor to consistency.

To begin configuration press the CONFIG button (if a password has been configured a prompt will appear requesting the password) and press the right arrow key until the parameter FLOW appears. Below FLOW the first configuration attribute appears. To enter a value press the down arrow key so that the cursor appears in the new value field; the value can now be entered by using the numeric key pad and pressing the ENTER key. Advances to the next flow attribute by pressing the up arrow key until the attribute field is highlighted and then press the right arrow key. The next flow configuration attribute should appear. Following is a list and explanation of each attribute.

1. Span

The flow display indicates the upper range of the analog signal by adding the span and zero. For example if the zero of the flow signal is 500 GPM and the span is 3000 GPM the display will indicate an upper range of 3500 GPM.

Upper Range = Span + Zero

2. Zero

The lower range of the display is the "zero" value.

3. Filter

This is a first order digital filter with the time constant in seconds. The filter should be set at the smallest value, which eliminates unwanted noise. Typical values for filtering are between 0 and 10 seconds. Values above 10 should not be used. A value of 0 provides no filtering. Care should be taken not to over-dampen the signal, since this will cause the unit to respond poorly to changes in flow, adversely affecting velocity compensation.

4. Pipe ID

The inside pipe diameter at the probe location must be entered in inches in order to accurately calculate the flow velocity. A database of pipe ID's can be found by pressing the "PIPE DATA" key. Inside diameters for schedule 10, 20, 40, and 80 pipe can be found. The right arrow key can be used to step through the various pipe nominal sizes. To change the pipe schedule press the down arrow key so that the schedule is highlighted. Then press the right arrow key until the desired schedule appears. If the pipe ID is found using the supplied database, the value can be entered by pressing the ENTER key. If a value of zero exists for a particular nominal size and schedule, data is not available for that size.

Normal Operation of the TMC6000, Model C6000B

Each time DISPLAY is pressed, the display toggles between the Consistency Trend Display, (**Figure 30**) and the Flow Trend Display (**Figure 31**):

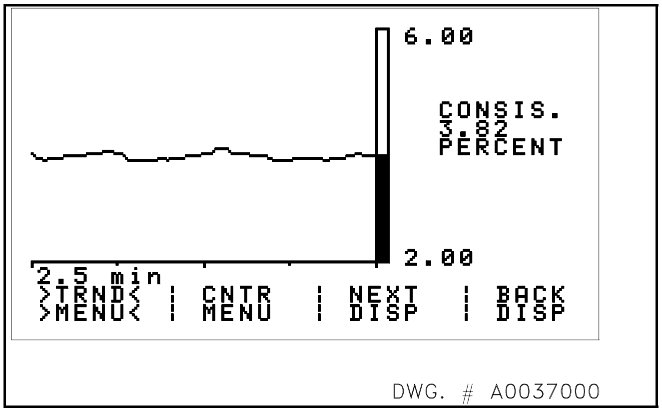


Figure 30 Consistency Trend Display

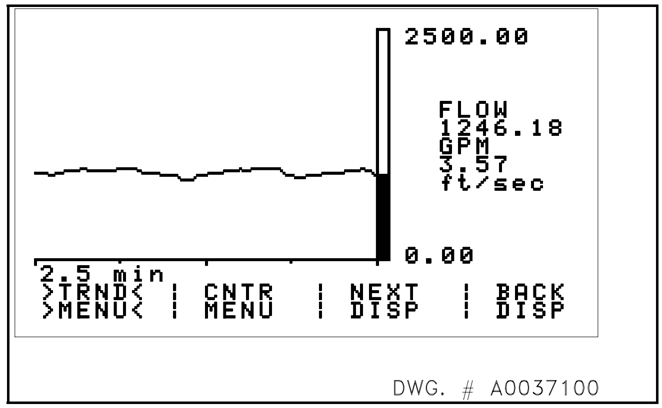


Figure 31 Flow Trend Display

On either of the two normal operating displays of **Figure 30** or **Figure 31**, the variable function keys F1, F2, F3, and F4 may have labels on the display as shown in **Figure 32** or **Figure 33**:

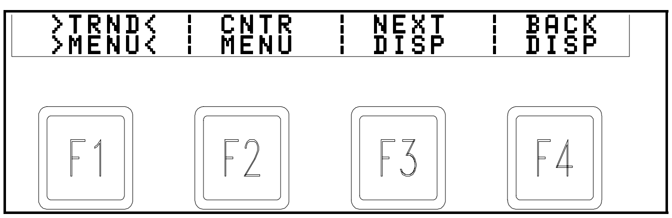


Figure 32 Main Menu

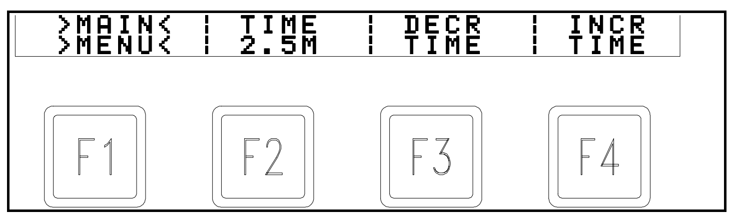


Figure 33 Trend Menu

If the legends over the FUNCTION keys are the Main Menu, pressing F1 ("TRND MENU") will change the legends to the Trend Menu. Conversely, if the legends over the FUNCTION keys are the Trend Menu, pressing the F1 ("MAIN MENU") key will change the legends to the Main Menu.

MAIN MENU

FUNCTION KEY		FUNCTION
F1	TRND MENU	Changes FUNCTION keys to the Trend Menu.
F2	CNTR MENU	Changes FUNCTION keys to Contrast Menu.
F3	NEXT DISP	Toggles between Consistency Trend Display and Flow Trend Display.
F4	BACK DISP	Toggles between Consistency Trend Display and Flow Trend Display.

TREND MENU

FUNCTION KEY		FUNCTION
F1	MAIN MENU	Changes FUNCTION keys to the Main Menu.
F2	TIME 2.5M	Returns the time base to 2.5 minutes from whatever the setting may have been.
F3	DECR TIME	Decreases the trend graph time base in 2.5 minute increments.
F4	INCR TIME	Increases the trend graph time base in 2.5 minute increments.

CONTRAST MENU

FUNCTION KEY		FUNCTION
F1	MAIN MENU	Changes FUNCTION keys to the Main Menu.
F2	CNTR MID	Forces the display contrast to midrange.
F3	DECR CNTR	Gradually decreases the display contrast.
F4	INCR CNTR	Gradually increases the display contrast.

Maintenance Operation of TMC6000, Model C6000B

Data in the TMC6000 is organized into parameters and attributes. A parameter is a category of data, with each parameter being defined by its corresponding set of attributes. The parameters and corresponding attributes of the C6000B are as follows:

PARAMETER	ATTRIBUTE (S)
STRAIN	
	CAL. FACTOR (Read Only) Configurable in tech mode
	CAL. BIAS (Read Only) Configurable in tech mode
	FILTER
FLOW	
	SPAN
	ZERO
	FILTER
	PIPE I.D.
CONSISTENCY	
	SPAN LABEL
	ZERO LABEL
	STRAIN FACTOR
	VEL. FACTOR
	VEL. SQ. FACTOR
	BIAS
	FILTER
PROBE	
	LENGTH
	MATERIAL
PASSWORD/INSTRUMENT ADDRESS	
	PASSWORD
	INSTRUMENT ADDRESS
RECIPE	
	NUMBER
INITIAL CAL	
	STOCK

To change an attribute associated with a parameter, press CONFIG. If no password has been set, the first configuration display will appear. If a password has been set, (See the procedure for setting PASSWORD), enter the password using the numerical keypad, followed by pressing the ENTER key. If the password is entered correctly, the first configuration display will appear. If the password is entered incorrectly, the display will return to the Consistency Trend Display.

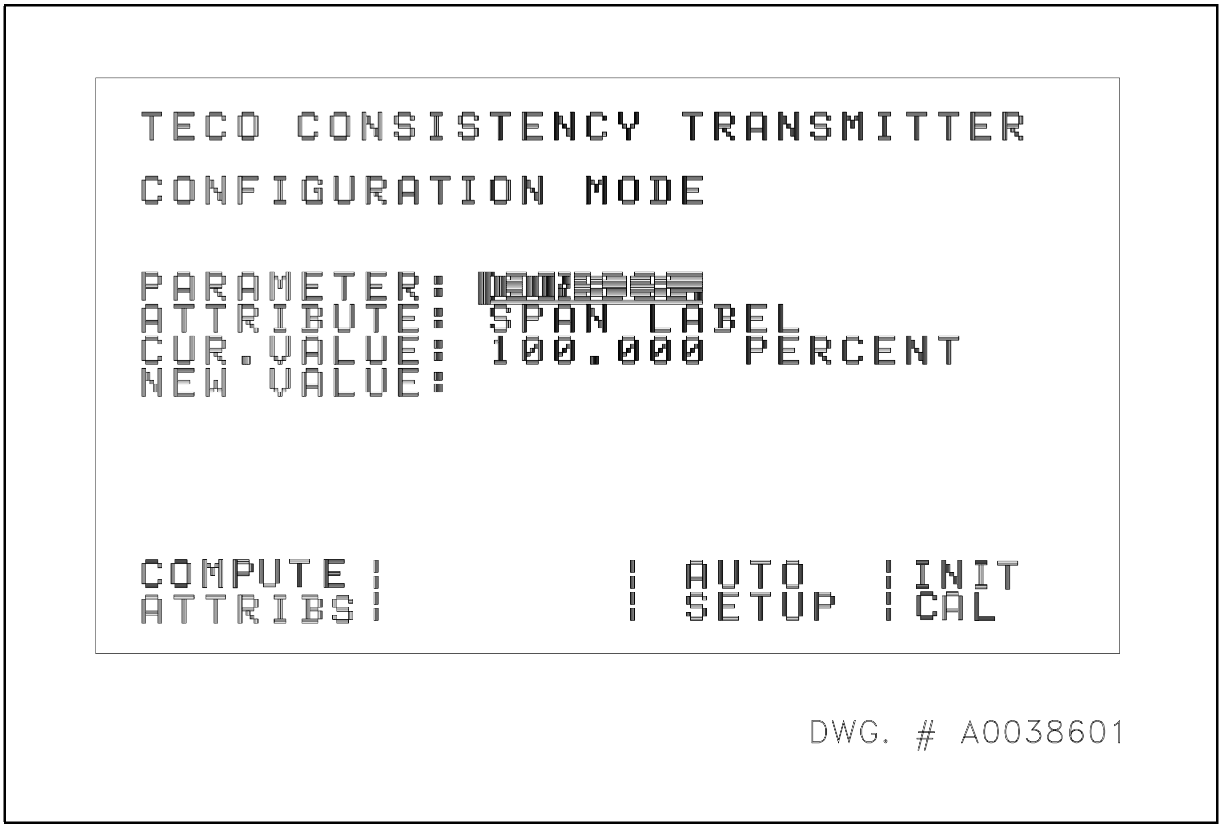


Figure 34 Configuration Display

CONFIGURATION DISPLAYS

The general form of the configuration displays is shown in **Figure 34**.

The [△] and [▽] keys switch the line in the display selected for manipulation. The line selected is indicated as follows:

PARAMETER: Reverse contrast
ATTRIBUTE: Reverse contrast
NEW VALUE: Blinking underline cursor

If the line selected is either PARAMETER or ATTRIBUTE, the choices available are switched with [◁] and [▷]. If the line selected is NEW VALUE, the numerical keypad and [ENTER] are used. At any time, the current value of an attribute for a parameter is shown in CUR. VALUE. When it is to be changed, the [△], [▽], [◁], and [▷] keys are used to get to the parameter and corresponding attribute, and then [▽] is used to put the cursor on NEW VALUE. The desired value is keyed in through the numerical keypad. The number keyed in will appear next to NEW VALUE, but the old value will still be displayed next to CUR. VALUE. When [ENTER] is pressed, the value in NEW VALUE is transferred to CUR. VALUE, and NEW VALUE is cleared.

PARAMETER: STRAIN

ATTRIBUTE	DISCUSSION
CAL. FACTOR	This factor calibrates the known force of a given probe to the strain gage output. The instrument will make the necessary measurements for determining this factor by using F1 ("AUTO CAL."). Note that if the AUTO CAL procedure is performed correctly, this value will always be a negative number, that is, less than 0 and greater than -2. This attribute is only configurable in tech mode.
CAL. BIAS	This factor calibrates the zero offset of the strain gages of a given probe. The instrument will make the necessary measurements for determining this factor by using F2 ("AUTO ZERO"). This attribute is only configurable in tech mode.
FILTER	This setting is the time constant of an exponential filter used to dampen any undesirable noise (such as line vibration) which might affect the strain gage output.

PARAMETER: FLOW

ATTRIBUTE	DISCUSSION
SPAN	This should be set to the flow value corresponding to 100% or 20 mADC output of the flow transmitter.
ZERO	This should be set to the flow value corresponding to 0% or 4 mADC output of the flow transmitter.
FILTER	This setting is the time constant of an exponential filter used to dampen rapidly changing or noisy flow conditions.
PIPE I.D.	This should be set to the I.D. of the pipe at the point where the consistency probe is located. If this value is unknown, use F1 ("PIPE DATA"). See Appendix H submenus for this procedure.

PARAMETER: CONSISTENCY

ATTRIBUTE	DISCUSSION
SPAN LABEL	Set to 100% if the transmitter is being set up as a deviation transmitter, or to the value of the span if it is being set up for direct reading. SPAN = (Reading @ full scale) - (Reading @ minimum scale)

<u>Note:</u> Changing the consistency "SPAN" after 2-point lab calibration has been performed, will render the "STRAIN FACTOR" inaccurate.

ZERO LABEL	Set to 0% if the transmitter is being set up as a deviation transmitter, or to the value of the minimum reading if it is being set up for direct reading.
STRAIN FACTOR	As a deviation transmitter, this is a sensitivity setting, with a value of 1.0 being a good starting point. For a direct reading transmitter, this is the force vs. consistency characteristic gain of a particular stock. Appendix F provides alternate means of determining this factor.
VEL. FACTOR	This linear factor is a gain used to multiply the calculated velocity at the sensor to develop the force to be subtracted from the total force in order to determine the force on the sensor due to fiber shear only. This linear factor works well with plug flow conditions.
VEL. SQ. FACTOR	The square factor is a gain used to multiply the square of the calculated velocity at the sensor to

develop the force to be subtracted from the total force on the sensor in order to determine the force on the sensor due to fiber shear only. This square factor works well with laminar flow conditions.

BIAS — The bias term is used as a final shift of scale once SPAN LABEL, ZERO LABEL, STRAIN FACTOR, VEL. FACTOR, and VEL. SQ. FACTOR have been set. Its units are % of scale; i.e., if SPAN LABEL is set to 6% consistency, and lab tests show an actual consistency of 4.5% when the instrument reads 3.9%,

$$\frac{4.5\% - 3.9\%}{6\%} = \frac{.6}{6} = \frac{1}{10}$$

Adjust bias by $+\frac{1}{10}$ or 10% from its current setting.

FILTER — This setting is the time constant of an exponential filter used to dampen rapidly changing consistency conditions.

PARAMETER: PROBE

ATTRIBUTE	DISCUSSION
LENGTH	Adjustment of this attribute is accomplished by using ◁ or ▷ to select from the available probe lengths. When the correct value appears in NEW VALUE, press ENTER. The value in CUR.VALUE will be replaced by the value in NEW VALUE.
MATERIAL	Adjustment of this attribute is accomplished by using ◁ or ▷ to select from the available material of manufacture. When the correct material appears in NEW VALUE, press ENTER.

PARAMETER: PASSWORD/INSTRUMENT ADDRESS

ATTRIBUTE	DISCUSSION
PASSWORD	If password protection of configuration is not desired, set password to "0" (zero). If password is set to a non-zero value, when CONFIG is pressed, the user will be given a display to enter the proper password. If it is not entered correctly, the display and operation simply returns to the Normal Operation Mode. A valid password may consist of an integer up to seven (7) digits long, or a floating point number up to eight (8) characters long including the decimal and maximum of three (3) digits to the right of the decimal.
INSTRUMENT ADDRESS	Instrument Address is used when the instrument is installed on an RS-485 communications link. (See Appendix C. for setting up communications). A valid address would be a value between 1-32. If no address is desired, this attribute should be set to zero.

PARAMETER: RECIPE

ATTRIBUTE	DISCUSSION
NUMBER	This attribute can be set to a single digit value from 0 through 9. Each retains a set of calibration parameters which may be associated with a different furnish, blend of furnishes, or other variation which has a significant effect on the strain vs. consistency relationship. Settings saved as a recipe are all attributes associated with the CONSISTENCY, X-VARIABLE,

Y-VARIABLE, and Z-VARIABLE parameters.

When this parameter is displayed, a submenu of three assignments appear for the variable function keys: [F1] ("SAVE CONF"), [F2] ("LOAD CONF"), and [F3] ("AUTO SETUP"). Refer to Appendix H submenus for details. [F1] ("SAVE CONF") causes the currently active set of calibration values to be stored as Recipe No. x, according to the value in CUR. VALUE, for this attribute. [F2] ("LOAD CONF") causes the set of calibration values previously stored as Recipe No. x to replace active calibration values. [F3] ("AUTO SETUP") initiates the AUTO SETUP mode. See Appendix H submenus for details.

PARAMETER: INITIAL CAL

ATTRIBUTE	DISCUSSION
STOCK	Adjustment of this attribute is accomplished by using [◁] or [▷] to select from the available stock choices. When the stock type that best represents the mill stock appears in "NEW VALUE", press [ENTER]. The value in CUR. VALUE will be replaced by the value in "NEW VALUE".

Possible stock choices are:

SOFTWOOD UN	unbleached softwood
SOFTWOOD BL	bleached softwood
HARDWOOD UN	unbleached hardwood
HARDWOOD BL	bleached hardwood
HW>SW BLEND	hardwood/softwood blend (hardwood > 50%)
SW>HW BLEND	softwood/hardwood blend (softwood > 50%)
OCC	old corrugated containers
MOW	mixed office waste
NEWSPRINT	newsprint
MAGAZINE	magazine
GROUNDWOOD	groundwood
TMP	thermomechanical pulp
CTMP	chemi-thermomechanical pulp

SUBMENUS Several of the configuration mode display screens have submenus of assignments to the variable function keys, F1 through F4. These are:

ATTRIBUTE	KEY	SUBMENU	
STRAIN			
	F1	AUTO CAL.	Start procedure to guide user through dry calibration of a probe.
	F2	AUTO ZERO	Start procedure to guide user through in-line, no-flow reference of a probe.
	F3	AUTO SETUP	Start procedure to guide user through initial matching of a probe to a transmitter, and complete AUTO CAL and AUTO ZERO functions.
	F4	INIT CAL	Initial Calibration of STRAIN FACTOR based on stock type selected
FLOW			
	F1	PIPE DATA	Provide for entry of pipe ID information for velocity calculation if flow compensation is to be used.
	F3	AUTO SETUP	Start procedure to guide user through initial matching of a probe to a transmitter, and complete AUTO CAL and AUTO ZERO functions.
	F4	INIT CAL	Initial Calibration of STRAIN FACTOR based on stock type selected
CONSISTENCY			
	F3	AUTO SETUP	Start procedure to guide user through initial matching of a probe to a transmitter, and complete AUTO CAL and AUTO ZERO functions.
	F4	INIT CAL	Initial Calibration of STRAIN FACTOR based on stock type selected
PROBE			
	F3	AUTO SETUP	Start procedure to guide user through initial matching of a probe to a transmitter, and complete AUTO CAL and AUTO ZERO functions.
	F4	INIT CAL	Initial Calibration of STRAIN FACTOR based on stock type selected
PASSWORD			
	F3	AUTO SETUP	Start procedure to guide user through initial matching of a probe to a transmitter, and complete AUTO CAL and AUTO ZERO functions.
	F4	INIT CAL	Initial Calibration of STRAIN FACTOR based on stock type selected
RECIPE			
	F1	SAVE CONF	Store a copy of the currently active Parameter/Attribute setting into a table denoted by Recipe No.
	F2	LOAD CONF	Transfer a previously saved copy of Parameter/Attribute settings from a Recipe

No. to the active operating table.

F3 AUTO SETUP Start procedure to guide user through initial matching of a probe to a transmitter, and complete AUTO CAL and AUTO ZERO functions.

F4 INIT CAL Initial Calibration of STRAIN FACTOR based on stock type selected

STRAIN

F1 AUTO CAL Auto Cal initiates a procedure through which the user can establish or refine the attributes CAL. FACTOR and CAL. BIAS for the parameter STRAIN.

PROCEDURE:

1. This display prompts HOLD PROBE VERTICAL THEN PRESS F1 Suspend the probe so that it is vertical, and press F1.

2. The display prompts HOLD PROBE HORIZONTAL THEN PRESS F1 Support the probe so that it is horizontal with the normal direction of flow downward.

   * For a C300x probe, hold the nylon alignment dimple downward
   * For a C500x probe or the C9000 wing, point the aluminum flow arrow downward
   * For a C9700 attach a 200g weight in the hole provided and press F1.

RESULTS:

The TMC6000 will calculate values for CAL. FACTOR and CAL. BIAS as a result of these two strain measurements.

F2 AUTO ZERO Auto Zero initiates a procedure through which the user can account for the exact plane and angle of installation in the stockline. This refines the setting for CAL. BIAS determined in AUTO CAL.

PROCEDURE:

1. This display prompts INSTALL IN CHAMBER WITH ARROW POINTING DOWNSTREAM THEN PRESS F1. With no stock or water in the stock line, insert the probe in the bushing (C300x), clamp the probe/bushing assembly on to the pipe bushing (C9700), or in the extraction chamber (C500x or C9000). For the C500x or C9000, be sure the flow arrow is oriented with the direction of flow. Now press F1.

RESULT:

The TMC6000 will update the setting for CAL. BIAS, accounting for the exact orientation of the actual installation.

F3 AUTO SETUP Auto Setup assists the user in the complete initial set up procedure for a new system. It starts by providing a PROBE SETUP display that indicates the sequence of steps necessary for a complete set up:

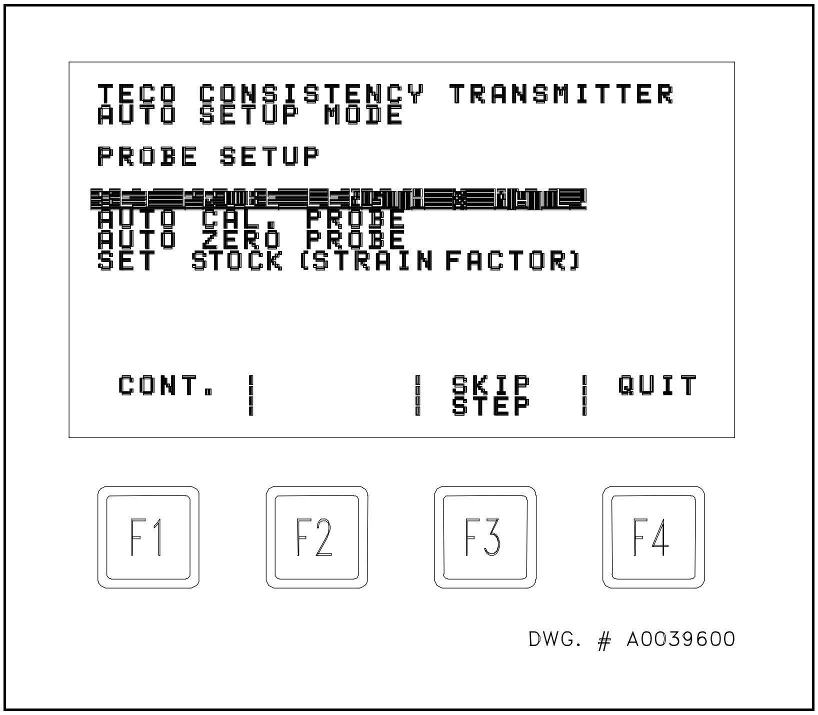


Figure 35

The step selected at any time is indicated by reverse contrast on the line. To perform a step that is selected, press F1 ("CONT."). To skip the step that is selected, and select the next step in sequence, press F3 ("SKIP STEP"). To terminate the Auto Set up mode, and return to the configuration mode press F4 ("QUIT").

On all TMC6000 units software revisions .2x and later, the AUTOCAL routine will check for sufficient signal change from the probe. If sufficient change does not occur, AUTOCAL will alert the operator via user interface and will not allow calibration.

If during AUTOCAL, you see "PROBE OR CABLE ERROR! CALIBRATION NOT COMPLETE. PRESS ENTER TO CONTINUE"; it could mean any one of the following:

1. Sensor wiring error.
   The sensor cable could be bad. Check terminal connection hookup.

2. Sensor over-strained.
   The sensor itself is damaged.

3. Sensor was not in the correct orientation during AUTOCAL.

AUTO SET UP STEPS

SET PROBE LENGTH & MATL. Press [F1] ("CONT.") to execute this step.

PARAMETER: PROBE

ATTRIBUTE

LENGTH — Use [◁] or [▷] to select 4", 6", 8", 10", SwingWing™ or FixedWing™ probe length, then [ENTER] [F1] ("CONT.").

MATERIAL — Use [◁] or [▷] to select STAINLESS or TITANIUM, then [ENTER] [F1] ("CONT.").

AUTO CAL. PROBE — Press [F1] ("CONT.") to execute this step.

PROMPT — HOLD PROBE VERTICAL THEN PRESS F1
Suspend probe so that it is hanging vertically, then press [F1] ("TAKE DATA").

PROMPT — HOLD PROBE HORIZONTAL THEN PRESS F1
Support probe horizontally with nylon alignment knob (C300x) or aluminum flow arrow (C500x or C9000) point downward, then press [F1] ("TAKE DATA").

AUTO ZERO PROBE — Press [F1] ("CONT.") to execute this step.

PROMPT — INSTALL IN CHAMBER WITH ARROW POINTING DOWNSTREAM THEN PRESS F1.
With stockline empty, insert C300x probe in line bushing, or C500x or C9000 probe in extraction chamber. On C500x or C9000, be sure to rotate flow arrow to point in direction of flow. Press [F1] ("TAKE DATA").

SET STOCK (STRAIN FACTOR) — Press [F1] ("CONT.").

PARAMETER: INITIAL CAL

ATTRIBUTE

STOCK — Use [◁] or [▷] to select desired stock. Then press [ENTER] [F1] ("CONT.").

PROMPT — DO YOU WISH TO SET UP VELOCITY COMPENSATION? Press [F1] ("YES") or [F2] ("NO"). If you press [F1] ("YES"), the display becomes

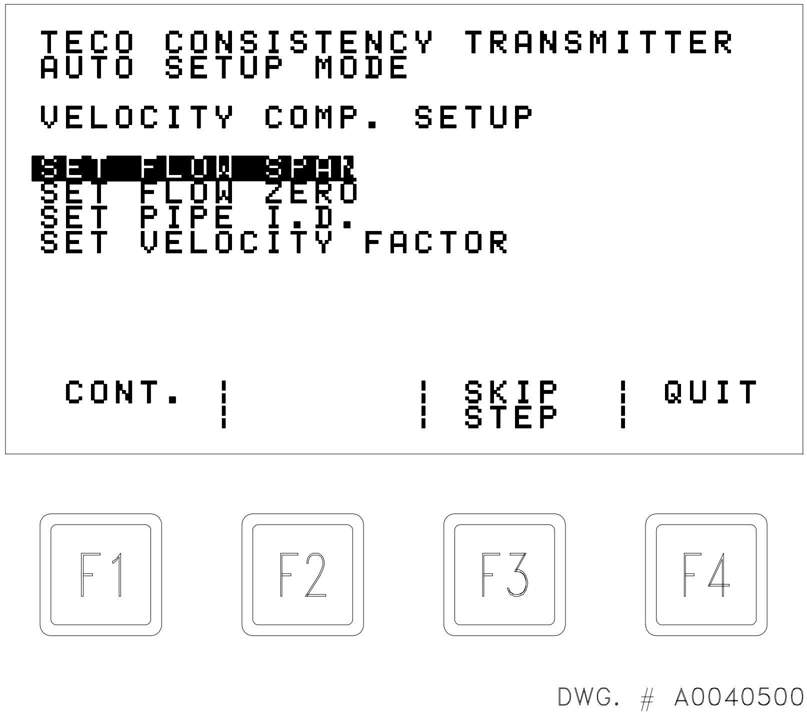


Figure 36

Note: The step selected at any time is indicated by reverse contrast on the line. To perform a step that is selected, press F1 ("CONT."). To skip the step that is selected, and select to next step in the sequence, press F3 ("SKIP STEP"). To terminate the AUTO SET UP mode and return to the CONFIGURATION MODE, press F4 ("SKIP STEP").

VELOCITY COMP. SET UP STEPS

SET FLOW SPAN Press F1 ("CONT.").

PARAMETER: FLOW

ATTRIBUTE
SPAN Using numeric key pad, key in the flow value which corresponds to 100% or 20 mADC output on the flow meter, then press ENTER. Press F1 ("CONT.").

SET FLOW ZERO Press F1 ("CONT.").

ZERO Using numeric key pad, key in the flow value which corresponds to 0% or 4 mADC output on the flow meter, then press ENTER. Press F1 ("CONT.").

ATTRIBUTE
PIPE I.D. Using numeric keypad, enter the inside diameter of the pipe in decimal inches at the location of the consistency probe, and then press ENTER. If the I.D. is not known, press F2 ("PIPE DATA").

Use ◁ or ▷ to select the nominal pipe size from the list, which ranges from 4" to 20".

Press [ENTER] when appropriate line size is selected. Use [▽] to select SCHEDULE, then [◁] or [▷] to select from standard pipe schedules. Note that the inside diameter is filled in automatically as the nominal size and schedule is selected. Any nominal size schedule, which shows to have a 0” inner diameter, is either not a standard combination, or must be entered manually using the ATTRIBUTE: PIPE I.D. When the proper combination is found, press [ENTER] [F1].

SET VELOCITY FACTOR Press [F1] ("CONT.").

PARAMETER: CONSISTENCY

ATTRIBUTE

VEL. FACTOR This factor is used as a linear gain to adjust the amount of correction applied to the strain vs. consistency calculation based on the calculated velocity. A gain of 6 provides a typical mid-range correction. Increasing this value will provide more correction per unit of flow variation, while adjusting it to a smaller value will reduce the amount of correction per unit of flow variation. See Appendix G for more detail. When the desired setting for VEL. FACTOR has been entered with the numeric keypad into NEW VALUE, press [ENTER] [F1] ("CONT.").

AUTO SET UP is now complete. Press DISPLAY to return to normal operation.

NOTE: If by any chance the contrast becomes adjusted such that the display is unreadable, pressing F2 twice will restore the display to the default medium contrast.

Troubleshooting Guide

Symptom: Display is blank.

Action: Check that power is on. There should be current available from ANO0+ to ANO0-. If not,

a.) Check the fuse and replace if necessary.

b.) Check the power wiring.

If correcting any problems found in "a" or "b" doesn't work, call TECO for help.

If power is on, is the contrast adjusted for the operating temperature? Check by:

a.) Resetting the microprocessor (by pulling the fuse and reinstalling).

b.) Hit F2 twice to set the default contrast value.

c.) If you still don't see the display, try holding down F3 or F4 for 7 seconds each while watching for the display to appear.

d.) If there is still no display, call TECO for help.

Symptom: The display appears, but it doesn't update the reading.

Action: Press CONFIG. Does the unit go into CONFIGURATION mode?

If yes, check that there is a reasonable value for STRAIN CAL FACTOR and STRAIN CAL BIAS. STRAIN CAL FACTOR should be between 0.0 and -1.0 STRAIN CAL BIAS should be between 0.0 and +1.0. These are the values set during the probe calibration.

If the values are acceptable reset the processor by pulling and reinstalling the fuse.

If not, enter values of -1.0 and +1.0 and restart the processor.

Re-calibrate the probe as described in the QUICK START GUIDE.

If the unit still does not work, please make a list of all configuration settings, and call TECO for help.

If the unit does not go into CONFIGURATION mode, try resetting the microprocessor as described above. If the unit still does not operate, please consult TECO.

Refer to the troubleshooting flowchart on the next page.

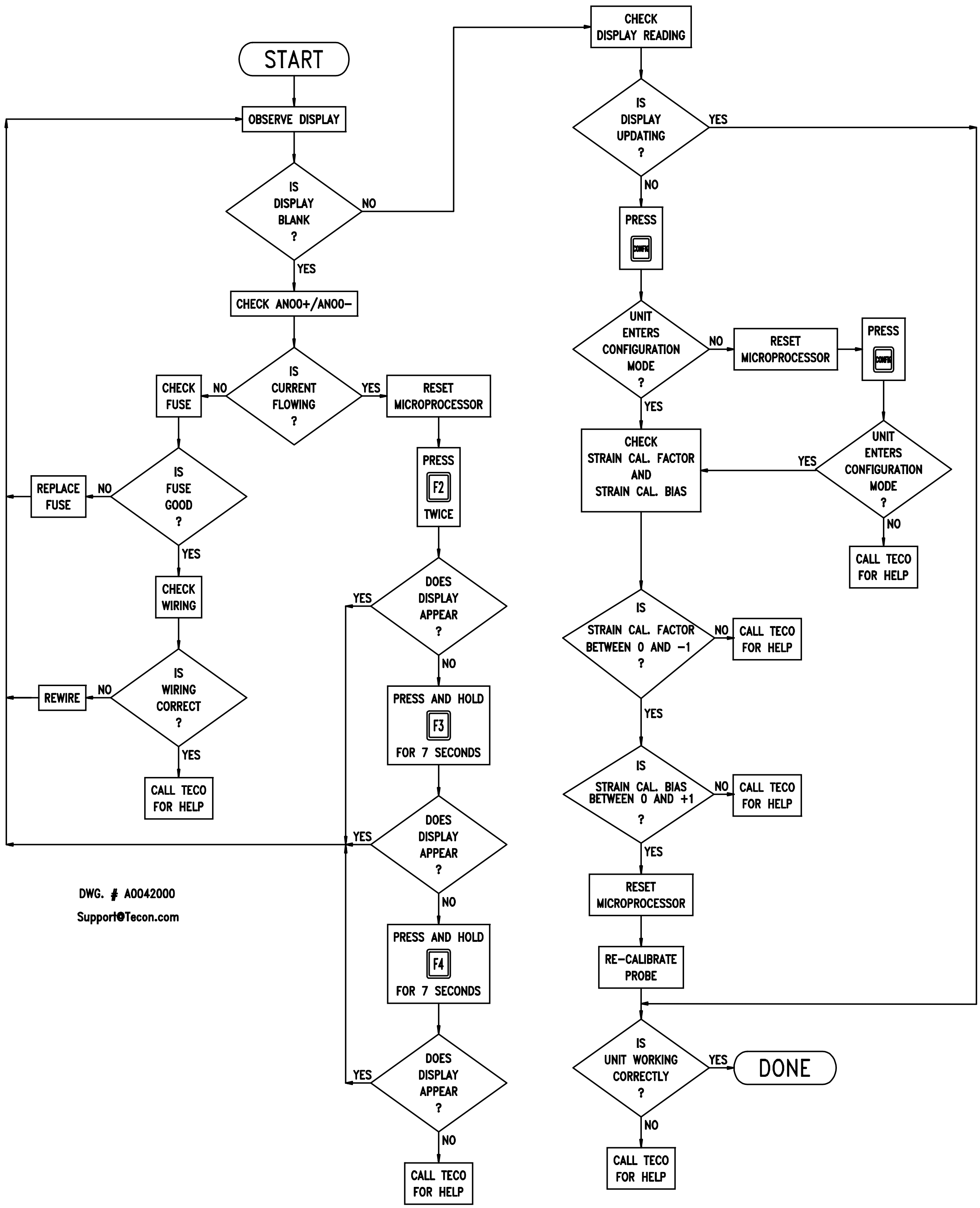

START
OBSERVE DISPLAY
IS DISPLAY BLANK ?
NO
YES
CHECK AN00+/AN00-
IS CURRENT FLOWING ?
NO
YES
CHECK FUSE
RESET MICROPROCESSOR
IS FUSE GOOD ?
NO
YES
REPLACE FUSE
PRESS
F2
TWICE
CHECK WIRING
DOES DISPLAY APPEAR ?
YES
NO
IS WIRING CORRECT ?
NO
YES
REWIRE
PRESS AND HOLD
F3
FOR 7 SECONDS
CALL TECO FOR HELP
DOES DISPLAY APPEAR ?
YES
NO
PRESS AND HOLD
F4
FOR 7 SECONDS
DOES DISPLAY APPEAR ?
YES
NO
CALL TECO FOR HELP
DWG. # A0042000
Support@Tecon.com
CHECK DISPLAY READING
IS DISPLAY UPDATING ?
YES
NO
PRESS
CONFIG
UNIT ENTERS CONFIGURATION MODE ?
NO
YES
RESET MICROPROCESSOR
PRESS
CONFIG
UNIT ENTERS CONFIGURATION MODE ?
YES
NO
CHECK STRAIN CAL. FACTOR AND STRAIN CAL. BIAS
CALL TECO FOR HELP
IS STRAIN CAL. FACTOR BETWEEN 0 AND -1 ?
NO
YES
CALL TECO FOR HELP
IS STRAIN CAL. BIAS BETWEEN 0 AND +1 ?
NO
YES
CALL TECO FOR HELP
RESET MICROPROCESSOR
RE-CALIBRATE PROBE
IS UNIT WORKING CORRECTLY ?
YES
NO
DONE
CALL TECO FOR HELP

TABLE OF REVISIONS - TMC6000 MANUAL		
REVISION NUMBER	DATE PRINTED	NATURE OF REVISION
0	14 JUL 1993	INITIAL DOCUMENT
1	16 JUL 1993	Changed figures: 10, 17, 18, 19 Added copyright notice to cover sheet Added stockrite system drawing (figure 4) Modified model number Added appendix f
1.1		Added "table of contents" page header. Modified model numbering system. Added internal references to quick start guide 1st paragraph. Changed figure 4 teco stockrite consistency system. Adjusted box sizes figs 7,8 to match each other. Separated c6000, c6200 in discussion of wiring analog outputs. Added probe identification drawing. Expanded appendix f. Added appendix h. Added placeholder page for appendix i. Corrected typos and spelling.
1.2		AUTO CAL ECO ADDED
1.3		1) Fixes bug, which caused slow display update on boot-up. 2) Adds a function which computes consistency attribute settings based on strain readings, lab consistency results, desired span, and desired zero labels. (For use as Direct-Reading Indicating Transmitter)
1.4		Added C7000 probe discussion in several areas and made all necessary changes for addressing on a RS-485 communications link
1.5		updated for the C9000 changes text and DWG's
1.6		Added sensor compatibility guide
1.7	1-19-98	Deleted C7000 references and added C9700 references
1.8	4-27-99	Transferred to MSWord and made Y2K compatible
1.8	7-28-99	Added in lab cal screen and 110/220 jumper description – no revision yet hasn't been printed
1.8	11-29-99	Added quick start modifications
1.8	5-22-00	Transferred to PDF format
1.9	10-27-03	Removed 10" probe from selection criteria (Page 17)