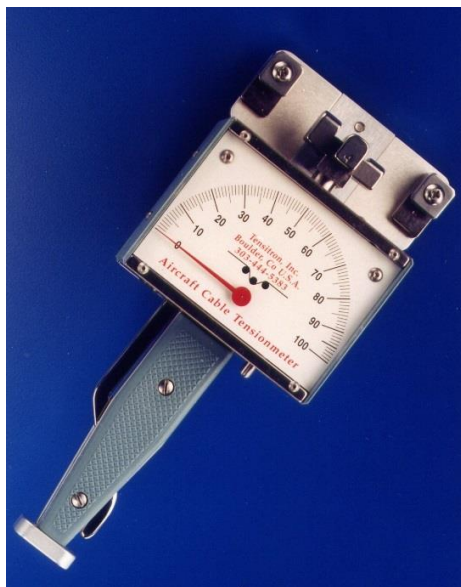



TENSITRON



Operating Instructions ACM and CWT Series Mechanical Aircraft Cable Tension Meters

TABLE OF CONTENTS

| | | |
|----|---|----|
| 1. | WARRANTY POLICY | 3 |
| 2. | SPECIFICATIONS | 4 |
| 3. | SAFETY AND MAINTENANCE | 5 |
| 4. | INSTRUMENT DETAILS..... | 5 |
| • | Standard Instruments, cable diameters, accuracy | 5 |
| • | Features of all Instruments | 6 |
| 5. | BASIC OPERATION..... | 6 |
| • | Before Use..... | 6 |
| • | Selecting the Riser | 6 |
| • | Engaging Instrument onto Cable..... | 7 |
| • | Saving a Reading Using Memory Lock Feature..... | 8 |
| • | Converting Readings to Tension Values with Calibration Chart | 9 |
| • | Maintaining Your Meter..... | 9 |
| 6. | ADVANCED OPERATION | 10 |
| • | Checking Accuracy..... | 10 |
| • | Recalibrating | 10 |
| 7. | APPENDICES | 12 |
| • | Appendix 1: RISER USAGE CHARTS Note: ACM-150-CWT was formerly known as CWT-150, and ACM-300-CWT was formerly known as CWT-300. | 12 |
| • | Appendix 2: BLANK CALIBRATION CHARTS..... | 12 |
| ○ | ACM-100..... | 12 |
| ○ | ACM-200..... | 13 |
| ○ | ACM-300..... | 13 |
| ○ | ACM-600..... | 14 |
| ○ | ACM-150-CWT (formerly CWT-150) | 14 |
| ○ | ACM-300-CWT (formerly CWT-300) | 15 |
| • | Appendix 3: TROUBLESHOOTING | 15 |

Proprietary Notice

This document contains proprietary information which may not be reproduced in whole or in part without the written permission of Tensitron, 733 South Bowen Street, Longmont, CO 80501.

Tensitron reserves the right to make instrument changes and improvements which may not be reflected in this document. Portions of this document may have been updated to include the latest hardware or firmware version, if applicable. We recommend that this document be read in its entirety before any attempt is made to operate the instrument.

Thank You . . .

For purchasing another fine product from Tensitron.

If you have any questions or need assistance, please call us at 303-702-1980 or find us online at www.tensitron.com

1. WARRANTY POLICY

STANDARD EQUIPMENT WARRANTY

Tensitron warrants that all Tensitron-manufactured equipment will be free of any defect in materials or workmanship for the period of (1) year. Warranty begins from the date of shipment from a Tensitron facility. The warranty is extended to customers and applies to all Tensitron-manufactured equipment purchased, installed, and used for the purpose for which such equipment was originally designed. The above warranties cover only defects arising under normal use and do not include malfunctions or failures resulting from misuse, abuse, neglect, alteration, problems with electrical power, usage not in accordance with product instructions, acts of nature, or improper installation or repairs made by anyone other than Tensitron or a Tensitron-authorized, third-party service provider. Shipping costs to and from Tensitron are not included in the warranty coverage.

2. SPECIFICATIONS

Dimensions (L x W x D)

All ACM models except ACM-600: 8.24" x 3.38" x 1.56"

ACM-600 only: 8.24" x 5.20" x 1.56" (See Figure 1)

Full Scale Accuracy

ACM-100, ACM-200 and ACM-150-CWT: **4%**

ACM-300, ACM-400 and ACM-300-CWT: **6%**

ACM-600: **8%**

Accuracy for custom calibrations is material specific

Operating Temperature

32° F to 120° F.

Storage Temperature

20° F to 158° F.

Ambient Humidity

10% to 90% non-condensing

Weight

1.5 lb

Environment:

Indoor or outdoor use, dust-free environment.

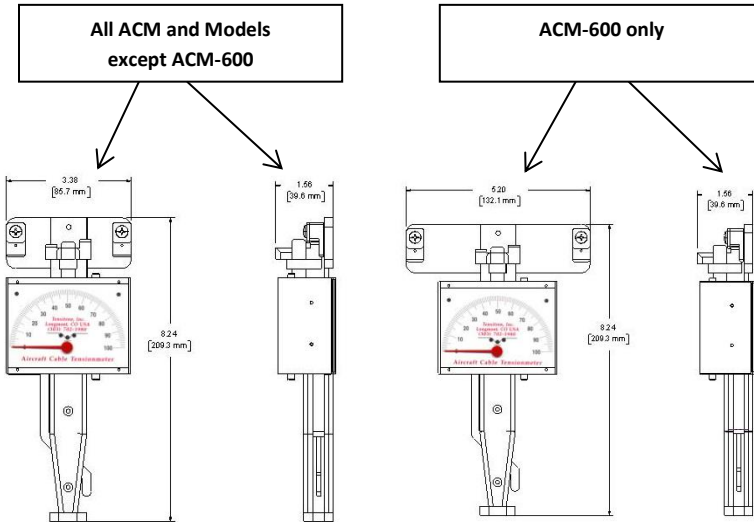


Figure 1: ACM Dimensions

3. SAFETY AND MAINTENANCE

READ AND SAVE ALL INSTRUCTIONS FOR FUTURE USE. Before use, ensure all users read and understand this manual, as well as any labels packaged with or attached to the instrument.

- Know your instrument. Read this manual carefully to learn your tension meter's applications and limitations, as well as the potential hazards associated with this type of instrument.
- Use the right tool or instrument. Do not use this instrument to do a job for which it is not recommended.
- Check for damaged parts. Inspect instrument before use. Check for any binding of moving parts, improper mountings, broken parts and any other condition that may affect operation. Do not use a damaged instrument. Tag damaged instrument "DO NOT USE" until repaired.
- Maintain instrument carefully. Protect meter from exposure to water. Keep instrument dry, clean and free from oil and grease. **Do not lubricate.** All roller bearings are sealed.
- To check this meter's accuracy, see "Check Accuracy" on page 10. If meter is out of calibration, return it to Tensitron for repair.
- Tensitron recommends calibration by the manufacturer at one-year intervals, or sooner if the meter is worn, damaged, or reading incorrectly. However, it is the responsibility of the user to establish a suitable calibration interval, considering such factors as the user's accuracy requirements, requirements set by contract or regulation, and environmental factors such as frequency and conditions of the meter's use.
- Do not use instrument if it has received a sharp blow or been dropped or damaged in any way. Do not disassemble. Incorrect reassembly may damage the instrument.
- If instrument has been dropped or damaged return it to Tensitron for repair.

4. INSTRUMENT DETAILS

- **Standard Instruments, cable diameters, accuracy**

| Model # | Cable Selection | Full Scale Accuracy (+/-) | Total error allowed (+/-) |
|-----------------------------------|---|---------------------------|---------------------------|
| ACM-100 | 1/16", 3/32", 1/8", 5/32" | 4% | 4 lbs. |
| ACM-200 | 1/16", 3/32", 1/8", 5/32", 3/16", 1/4" | 4% | 8 lbs. |
| ACM-300 | 3/32", 1/8", 3/16", 1/4" | 6% | 18 lbs. |
| ACM-400 | 3/32", 1/8", 5/32", 3/16" | 6% | 24 lbs. |
| ACM-600 | 1/8", 5/32", 3/16", 1/4" | 8% | 48 lbs. |
| ACM-150-CWT (formerly CWT-150) | 5, 10, 15, 20 & 25 CWT cables | 4% | 6 lbs. |
| ACM-300-CWT (formerly CWT-300) | 10, 15, 20 & 25 CWT cables | 6% | 18 lbs. |

• Features of all Instruments

- Memory Lock feature on all models.
- All models are typically available from stock.
- All models are factory calibrated and ready for use.
- All calibration values are traceable to National Standards.
- Calibration certificate is included.
- Durable, lightweight carrying case with protective foam inserts included. (See Figure 2)

*Figure 2:
Carrying case
with
instrument and
calibration
certification*



5. BASIC OPERATION

• Before Use

1. Verify that the serial number on the instrument and the calibration chart are the same, since readings may vary among instruments.
2. Check that the calibration and certification are current.
3. The Memory Lock feature should be OFF (pushed down). (See “Memory Lock Feature” below.)
4. The pointer must be resting at 0 on the dial. If it is not, the calibration should be checked. (See “Checking Accuracy” in Section 6 below.)

• Selecting the Riser

1. Determine the diameter of the cable to be checked. (See Figure 3)

| Cable Dimensions | |
|--------------------------|---------------------|
| Standard Aircraft Cables | CWT Aircraft Cables |
| 1/16" = .0625" | 5-CWT = .076" |
| 3/32" = .0938" | 10-CWT = .106" |
| 1/8" = .1250" | 15-CWT = .141" |
| 5/32" = .1562" | 20-CWT = .155" |
| 3/16" = .1875" | 25-CWT = .170" |
| 7/32" = .2188" | |
| 1/4" = .2500" | |

*Figure 3:
Cable
Dimensions*

2. Determine the correct riser for your cable by referring to the Calibration Chart on the back of the meter. (See also Riser Usage Chart in Appendix 1)
3. Rotate the riser so the correct setting faces the front (dial side) of the meter and clicks into place.

Example: Selecting Riser

Assuming your cable diameter is 1/8”:

If the meter is an ACM-100, rotate the riser so the number 1/8 faces front

If the meter is an ACM-200, rotate the riser so the number 2 faces front

If the meter is an ACM-300, rotate the riser so the number 2 faces front

If the meter is an ACM-400, rotate the riser so the number 2 faces front

If the meter is an ACM-600, rotate the riser so the letter A faces front

• **Engaging Instrument onto Cable**

Warning:

Do not force the engagement lever or exceed the maximum tension range of the instrument or you will damage your meter!

1. To engage the instrument on the cable, first rotate the engagement lever away from the instrument, raising the outer cable contacts. Next position your cable so it rests on top of the (center) riser and beneath the outer cable contacts. (See Figure 4)

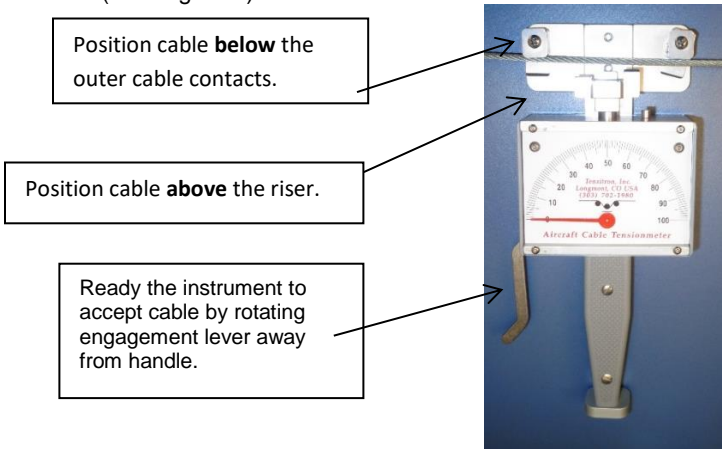


Figure 4: Instrument ready to engage cable

2. Once the cable is in place, squeeze the engagement lever shut until it locks into position parallel with the instrument handle. (See Figure 5) **Note: Do NOT try to force the lever closed, or damage may occur. If the lever does not close easily, STOP, and refer to the Troubleshooting Guide at the end of these instructions**



Note the routing of the Cable.

Once cable is properly routed, gently squeeze the engagement lever back toward the handle until it locks into the engaged position, parallel to the instrument handle.

Don't over torque!

Figure 5: Instrument engaged onto cable

3. Note the reading on the display.

• Saving a Reading Using Memory Lock Feature

Each ACM instrument has a Memory Lock feature. This feature can be used to save readings taken in areas (such as confined spaces or behind obstructions) where the operator cannot see the dial face while engaging the instrument on the cable. To use this feature:

1. Begin by making sure the Memory Lock feature is OFF. Do this by pushing the memory lock shaft all the way DOWN, so the red line is no longer visible. (See Figure 6)



Turn OFF the Memory Lock feature by pushing the memory lock shaft DOWN until the red line is no longer visible.

Figure 6: Memory Lock feature OFF / disengaged

2. Engage the instrument onto the cable as described in "Engaging Instrument onto Cable," above.
3. Save your reading by turning the Memory Lock feature ON. Do this by pushing the memory lock shaft UP as far as possible, so the red stripe on the shaft is visible. (See Figure 7)



Turn ON the Memory Lock feature by pushing the memory lock shaft UP until the red line is visible.

**Figure 7: Memory Lock
ON / engaged**

4. Disengage and remove the meter from the cable. The pointer will remain locked in position so you can note the reading.
5. To clear the reading and return the pointer to zero, turn the Memory Lock feature OFF (see step #1 above).
6. If you engage the Memory Lock with no tension load, you may see the needle move slightly off zero. However, this small amount of travel will not materially affect the accuracy of tension readings taken when the Memory Lock feature is correctly used.
7. Do not try to measure tension with the Memory Lock feature already ON. Only turn the Memory Lock feature on AFTER engaging the meter on the cable.

• **Converting Readings to Tension Values with Calibration Chart**

The number on the dial is NOT the tension. You must convert the reading on the dial to a tension value by using the chart on the back of the meter.

1. Once the meter is engaged onto the cable, note the reading (where the pointer is on the dial).
2. Refer to the calibration chart on the back of the instrument and locate the column for the cable diameter you are testing.
3. Find the number in this column that most closely corresponds to the pointer's reading.
4. Follow this number's row all the way to the left until you reach a number in the "TENSION IN LBS" column. This number is the true tension of the cable.
5. Tensions may differ along the length of an aircraft cable because cable shape and thickness may vary. For greater accuracy, it is best to take multiple readings along the cable and average these readings.

• **Maintaining Your Meter**

Return your meter to Tensitron for service when:

- Pointer does not reset at 0 with memory lock "off."
- Instrument has been dropped or otherwise damaged.

- When using on aircraft, the instrument should be calibrated at intervals not to exceed 12 months.

6. ADVANCED OPERATION

• **Checking Accuracy**

1. To verify the accuracy of your instrument, hang a 5' length of your cable vertically. Suspend a known weight from the end. (Make sure the weight does not exceed the maximum tension range of your instrument.) Engage the instrument on the cable. See if the tension value matches the suspended weight. (See Figure 8)
2. NOTE: Tension on a cable can be defined as the exact value of a suspended weight from the cable. For example, a 100 lb. weight hanging freely from a cable will tension the cable to exactly 100 lbs.
3. When performing this test, use a micrometer to measure your cable diameter and ensure it is dimensionally within tolerance, +/- .003" of size, and not out of round.
4. Only use free-hanging weights which are traceable to National Standards on correctly-sized cables.
5. **Never use any tensioning device that attempts to convert rotational torque values into tension loads**, as these types of systems are highly inaccurate. Also, any load cell system must be routinely checked for accuracy using traceable weights as these types of systems are also highly inaccurate and generally do not meet the minimum repeatable accuracy standards required by ISO-17025.
6. **NEVER SIMULATE TENSION LOADS ON THESE INSTRUMENTS BY USING A CALIBRATION BAR!**

Figure 8:
Simulating
cable tension
using free-
hanging weight



• **Recalibrating**

Tensitron provides prompt turnaround service for its instruments needing repair and/or re-certification. All values tested are traceable to national

standards, and serviced instruments meet or exceed all civilian and military specifications. A calibration certification listing all calibration data and values is included with each instrument.

If you would like to calibrate your instrument yourself, follow the procedure below.

***IMPORTANT: This procedure should only be performed by a qualified calibration facility using certified and traceable dead weights.**

Do not use this procedure for a simple accuracy check.

1. **Prepare blank charts:** Photocopy the blank calibration chart to use for the new values you will be collecting. (See Appendix 2 for blank calibration charts that are correctly sized to fit on the back of your instrument.)
2. **Adjust zero:** If the pointer is not resting at the 0 position on the dial, unscrew the socket plug located on the bottom left of the instrument body. Using a small screwdriver, gently adjust the zero adjust screw until the pointer indicates 0. After adjustment apply torque-seal or paint to lock the screw head.
3. **Perform a Dead Weight Calibration:**
 - a. For each cable to be tested:
 - i. Set the correct riser for the cable diameter as described in “Selecting the Riser” above.
 - ii. Simulate a tension load on the cable with a dead weight by following the procedure in step #1 under “Checking Accuracy” above.
 - iii. On the calibration chart, in the column for that cable, record the pointer reading so it lines up with the corresponding weight in the CABLE TENSION LBS column.
 - iv. Repeat this process with different weights.
 - b. **Do not attempt to measure cable diameters larger than those for which the meter was designed.** See Appendix 1, Riser Usage Charts, for the appropriate cables for each instrument.
 - c. If a tension value for a particular cable is considered “critical”, remove the cable from the aircraft and perform this dead weight calibration procedure on that cable, rather than relying on a comparable sample.
 - d. Repeat this process for each cable.
4. **Complete Chart:** Make sure to sign and date your new calibration chart, and attach it to the back of the instrument.

7. APPENDICES

Appendix 1: RISER USAGE CHARTS

Note: ACM-150-CWT was formerly known as CWT-150, and ACM-300-CWT was formerly known as CWT-300.

| | | RISER USAGE & CABLE DIAMETER - Inch | | | | | | |
|---------|---------|-------------------------------------|-------------|-------------|------------|-------------|----------|----------|
| | | DIAMETER | 1/16" | 3/32" | 1/8" | 5/32" | 3/16" | 1/4" |
| | | Use Riser #: | | | | | | |
| MODEL # | ACM-100 | | 1/16 | 3/32 | 1/8 | 5/32 | | |
| | ACM-200 | | 1 | 2 | 2 | 3 | 3 | 4 |
| | ACM-300 | | | 1 | 2 | | 3 | 4 |
| | ACM-400 | | | 1 | 2 | 3 | 3 | |
| | ACM-600 | | | | A | B | C | D |

| | | RISER USAGE & CABLE DIAMETER - Carat Weight (CWT) | | | | | |
|---------|-------------|---|----------|-----------|-----------|-----------|-----------|
| | | DIAMETER | 5 | 10 | 15 | 20 | 25 |
| | | Use Riser #: | | | | | |
| MODEL # | ACM-150-CWT | | 5 | 10 | 15 | 20 | 20 |
| | ACM-300-CWT | | | 10 | 15 | 20 | 20 |

Appendix 2: BLANK CALIBRATION CHARTS

o ACM-100

| ACM-100 | | Serial No. | | |
|--------------------------|---|------------|-----------|------------|
| If Cable Size is: | 1/16" | 3/32" | 1/8" | 5/32" |
| USE → | RISER 1/16 | RISER 3/32 | RISER 1/8 | RISER 5/32 |
| CABLE TENSION LBS = ↓ | ← | ← | ← | ← |
| 5 | | | | |
| 10 | | | | |
| 15 | | | | |
| 20 | | | | |
| 25 | | | | |
| 30 | | | | |
| 35 | | | | |
| 40 | | | | |
| 45 | | | | |
| 50 | | | | |
| 55 | | | | |
| 60 | | | | |
| 65 | | | | |
| 70 | | | | |
| 75 | | | | |
| 80 | | | | |
| 85 | | | | |
| 90 | | | | |
| 95 | | | | |
| 100 | | | | |
| TENSITRON, INC. | | | | |
| CAL. BY: | 733 S. Bowen St., Longmont, CO 80501 | | | |
| Date: See Cal Sticker | TEL: (303) 702-1980 FAX: (303) 702-1982 | | | |

○ **ACM-200**

| Model ACM-200 | | | | Serial No. | | |
|-----------------------------|---------|---------|---------|---|---------|---------|
| If Cable Size is: | 1/16" | 3/32" | 1/8" | 5/32" | 3/16" | 1/4" |
| USE → | RISER 1 | RISER 2 | RISER 2 | RISER 3 | RISER 3 | RISER 4 |
| Actual Tension on | | | | | | |
| Cable in LBS = ↓ | ← | ← | ← | ← | ← | ← |
| 20 | | | | | | |
| 30 | | | | | | |
| 40 | | | | | | |
| 50 | | | | | | |
| 60 | | | | | | |
| 70 | | | | | | |
| 80 | | | | | | |
| 90 | | | | | | |
| 100 | | | | | | |
| 120 | | | | | | |
| 140 | | | | | | |
| 160 | | | | | | |
| 180 | | | | | | |
| 200 | | | | | | |
| | | | | TENSITRON, INC. | | |
| CAL. BY: _____ | | | | 733 S. Bowen St. - Longmont, CO 80501 | | |
| Date: See Cal Sticker _____ | | | | TEL: (303) 702-1980 FAX: (303) 702-1982 | | |

○ **ACM-300**

| Model ACM-300 | | | Serial No. | |
|-----------------------------|---------|---------|---|---------|
| If Cable Size is: | 3/32" | 1/8" | 3/16" | 1/4" |
| USE → | RISER 1 | RISER 2 | RISER 3 | RISER 4 |
| CABLE TENSION | | | | |
| LBS = ↓ | ← | ← | ← | ← |
| 40 | | | | |
| 50 | | | | |
| 60 | | | | |
| 70 | | | | |
| 80 | | | | |
| 90 | | | | |
| 100 | | | | |
| 120 | | | | |
| 140 | | | | |
| 160 | | | | |
| 180 | | | | |
| 200 | | | | |
| 220 | | | | |
| 240 | | | | |
| 260 | | | | |
| 280 | | | | |
| 300 | | | | |
| | | | TENSITRON, INC. | |
| CAL. BY: _____ | | | 733 S. Bowen St., Longmont, CO 80501 | |
| Date: See Cal Sticker _____ | | | TEL: (303) 702-1980 FAX: (303) 702-1982 | |

○ **ACM-600**

| ACM-600 | | Serial No. | | | |
|------------------------------------|---------|---|---------|---------|--|
| If Cable Size is: | 1/8" | 5/32" | 3/16" | 1/4" | |
| USE → | RISER A | RISER B | RISER C | RISER D | |
| Actual Tension on Cable in LBS = ↓ | ← | ← | ← | ← | |
| 40 | | | | | |
| 60 | | | | | |
| 80 | | | | | |
| 100 | | | | | |
| 120 | | | | | |
| 140 | | | | | |
| 160 | | | | | |
| 180 | | | | | |
| 200 | | | | | |
| 220 | | | | | |
| 240 | | | | | |
| 260 | | | | | |
| 280 | | | | | |
| 300 | | | | | |
| 320 | | | | | |
| 340 | | | | | |
| 360 | | | | | |
| 380 | | | | | |
| 400 | | | | | |
| 420 | | | | | |
| 440 | | | | | |
| 460 | | | | | |
| 480 | | | | | |
| 500 | | | | | |
| 520 | | | | | |
| 540 | | | | | |
| 560 | | | | | |
| 580 | | | | | |
| 600 | | | | | |
| TENSITRON, INC. | | | | | |
| CAL. BY: _____ | | 733 S. Bowen St., Longmont, CO 80501 | | | |
| Date: See Cal Sticker | | TEL: (303) 702-1980 FAX: (303) 702-1982 | | | |

○ **ACM-150-CWT (formerly CWT-150)**

| Model CWT-150 | | | Ser. No.: | | |
|---------------------------|-----------------------------|-----------------------------|---|-----------------------------|-----------------------------|
| IF CABLE SIZE IS: | | | | | |
| 5 CWT USE ↓ RISER 5 | 10 CWT USE ↓ RISER 10 | 15 CWT USE ↓ RISER 15 | ACTUAL TENSION LBS. | 20 CWT USE ↓ RISER 20 | 25 CWT USE ↓ RISER 20 |
| | | | 10 | | |
| | | | 20 | | |
| | | | 30 | | |
| | | | 40 | | |
| | | | 50 | | |
| | | | 60 | | |
| | | | 70 | | |
| | | | 80 | | |
| | | | 90 | | |
| | | | 100 | | |
| N/A | N/A | | 110 | | |
| N/A | N/A | | 120 | | |
| N/A | N/A | | 130 | | |
| N/A | N/A | | 140 | | |
| N/A | N/A | | 150 | | |
| DATE: SEE CAL STICKER | | | | | |
| CAL. BY: _____ | | | TENSITRON, INC. | | |
| | | | 733 S. Bowen St., Longmont, CO 80501 | | |
| | | | TEL: (303) 702-1980 FAX: (303) 702-1982 | | |

○ **ACM-300-CWT (formerly CWT-300)**

| Model CWT-300 | | | | Serial No. | | 224 |
|-----------------------|---------|----|----|---|----|-----|
| If Cable Size is | 1/16" | 10 | 15 | 5/32" | 20 | 25 |
| USE RISER | RISER 1 | 10 | 15 | RISER 3 | 20 | 20 |
| CABLE TENSION | | | | | | |
| LBS = | | ← | ← | | ← | ← |
| 40 | | | | | | |
| 50 | | | | | | |
| 60 | | | | | | |
| 70 | | | | | | |
| 80 | | | | | | |
| 90 | | | | | | |
| 100 | | | | | | |
| 120 | | | | | | |
| 140 | | | | | | |
| 160 | | | | | | |
| 180 | | | | | | |
| 200 | | | | | | |
| 220 | | | | | | |
| 240 | | | | | | |
| 260 | | | | | | |
| 280 | | | | | | |
| 300 | | | | | | |
| 300 | | | | | | |
| | | | | TENSITRON, INC. | | |
| CAL. BY: _____ | | | | - Boulder, CO St. Longmont, CO 80501 | | |
| Date: See Cal Sticker | | | | TEL: (303) 702-1980 FAX: (303) 702-1982 | | |

• **Appendix 3: TROUBLESHOOTING**

| TROUBLESHOOTING | | |
|---|---|---|
| PROBLEM | POSSIBLE CAUSE | POSSIBLE SOLUTION |
| The engagement lever is difficult to rotate closed. | <ol style="list-style-type: none"> Using the incorrect riser for the cable diameter. Trying to measure excessive tension. | <ol style="list-style-type: none"> See Appendix 1, and use correct riser. Do not exceed meter's maximum tension |
| The tension readings are not as expected | <ol style="list-style-type: none"> Reading chart incorrectly. The meter has been dropped and is damaged | See "Converting Readings to Tension Values with Calibration Chart" above 3. Return to Tensitron for service |
| The instrument needle will not return to zero | The Memory Lock is engaged | Disengage the memory Lock. See "Saving a Reading Using Memory Lock Feature " above |
| The instrument needle will not hold a stable reading. | The meter has been dropped and is damaged | Return to Tensitron for service |