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TWC-1 Tensiometer Wire Counter Operating Manual

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Contents

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0.01	Initial release	21 Feb 2023
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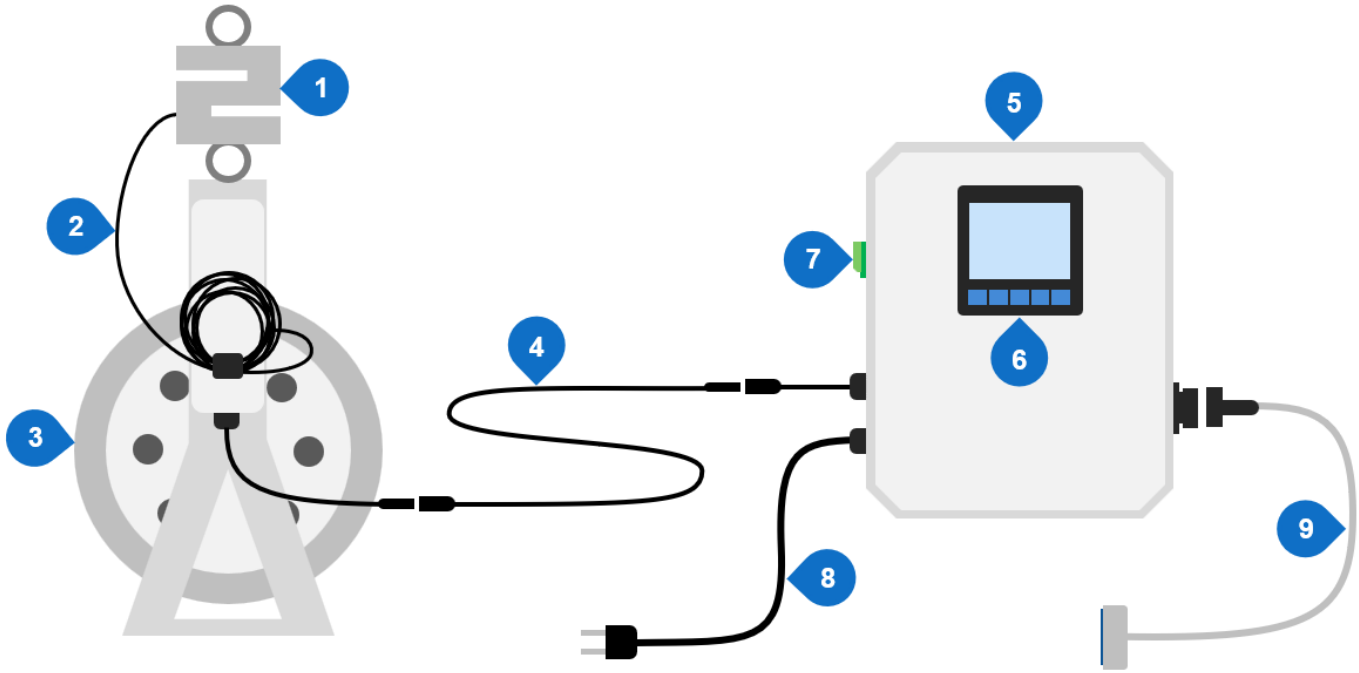
1. Overview

A.G.O.'s TWC-1 is a combined tension and wire payout metering system based on a single instrumented sheave block that can be used with any winch system. The system components include:



1. S-beam load cell with stainless steel eyebolts
2. Load cell cable (**DO NOT CUT OR SHORTEN**)
3. Instrumented magnetically-encoded snatch block sheave
4. Sheave-to-display cable
5. Horner PLC display box
6. Horner PLC
7. Power-on switch
8. Power cable
9. Data-output serial cable

The system will calculate and display tension, line speed, and cable payout length on the Horner PLC display screen based on measurements from the S-beam load cell and magnetic encoding system on the sheave.

This is a somewhat rudimentary system in that it depends on user-inputted site geometry parameters to be able to calculate tension. It is not a system that can be strung up and start measuring tension without any user input. Site geometry parameters must be re-inputted every time the system is used in a new location or the site parameters including A-frame/crane deployment position are changed to maintain measurement accuracy.

Note on tension metering accuracy:

Tension measurement accuracy is dependent on accuracy of user-inputted site geometry measurements. It is not recommended for use as a precision tension measurement device, but is suitable for detecting changes in tension e.g. due to a payload reaching the sea floor.

2. Menus and settings quick reference

Setting	Menu navigation from the Home screen
Cable size parameters	F4 (Menu) → Winch Parameters → More…
Display units	F4 (Menu) → Winch Parameters → F1 (Units)
Main menu	F4 (Menu)
Serial communications parameters	F4 (Menu) → Comms Parameters
Sheave angle orientation	F4 (Menu) → Tension Parameters → Angle +/-
Winch drum parameters	F4 (Menu) → Winch Parameters → More…
Wire payout orientation	F4 (Menu) → Winch Parameters → More… → Count +/-
Zeroing/unzeroing the displayed cable payout length	F1 (Offset) = Zero F3 (Un-Ofs) = Un-zero

3. Set-up and use

To set up and use the TWC-1 system, you will need:

- Power source – the TWC-1 is rated to run on 85-264 VAC single-phase input power
- A tape measure

Setting up the components

1. Connect the sheave to the Horner PLC display box using the sheave-to-display cable.
2. Plug the Horner PLC display box into a compatible 220VAC 1-ph power supply.
3. Hang the sheave assembly, including the S-beam load cell and its eyebolts, from the A-frame or crane that will be used during payload deployment and operation.

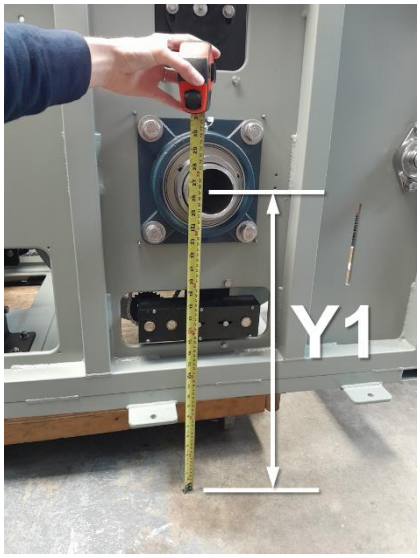
Taking the site parameter measurements

4. Measure and record parameters L and Y1.

   L is the full, total length between the sheave's axle and the ultimate hanging point from which it swings on the A-frame or crane.

   Y1 is the winch's drum axle's height above the deck.

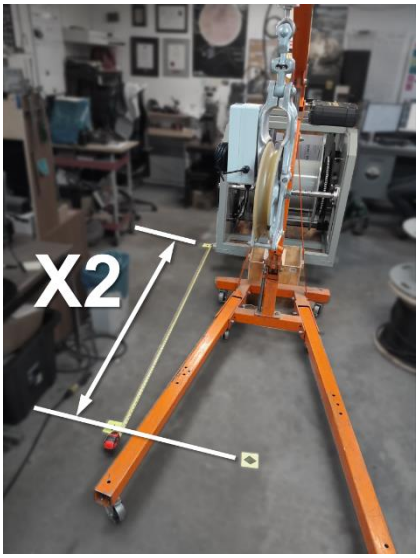
   

5. Prepare the winch and payload for payload deployment (i.e. loading the cable into the sheave, etc.) and deploy the A-frame or crane to its operational position that it will remain in for the duration of the deployment while measuring tensions.

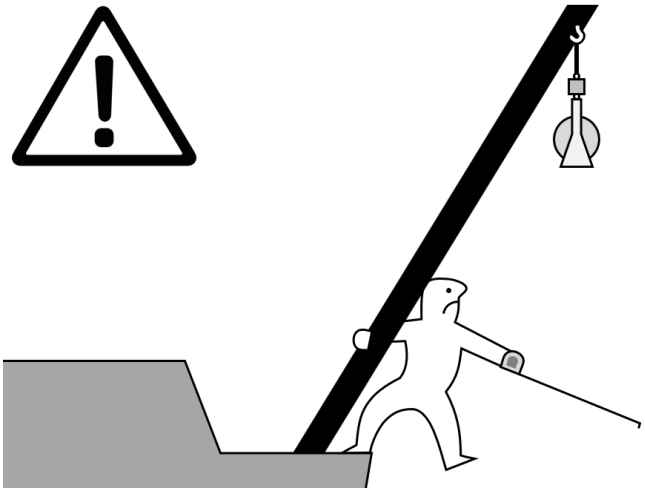
6. Measure and record parameters X2 and Y2.

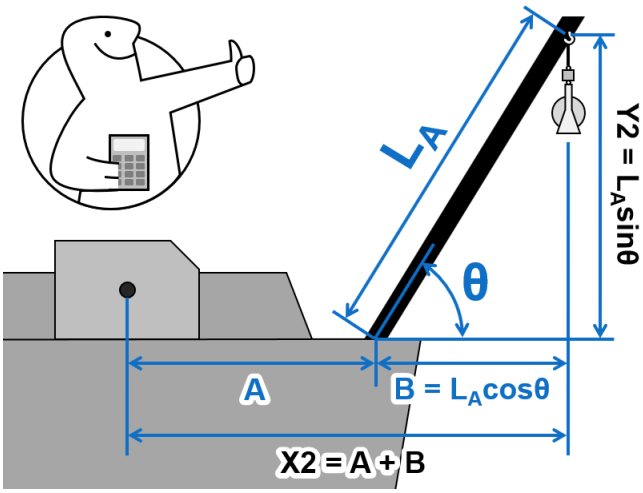
   X2 is the horizontal distance between the winch's drum axle and the sheave's ultimate hanging point on the A-frame or crane.

   Y2 is the sheave's ultimate hanging point height above deck.



If it is not possible to safely measure X2 and Y2 in the A-frame's deployment position, use the A-frame's length and deployment angle to help calculate X2 and Y2.





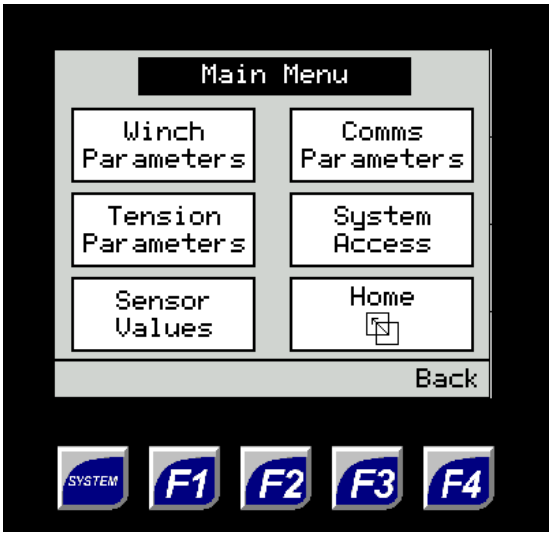
Configuring the Horner PLC

7. Turn on the Horner PLC display box by turning the green power-on switch.

   After a brief start-up sequence, the Horner PLC will display the default “Home” display screen which looks like this:

8. Press the F4 button (corresponding to “Menu” on the screen) to access the PLC’s parameter configuration menus.

   The winch’s main menu screen looks like this:

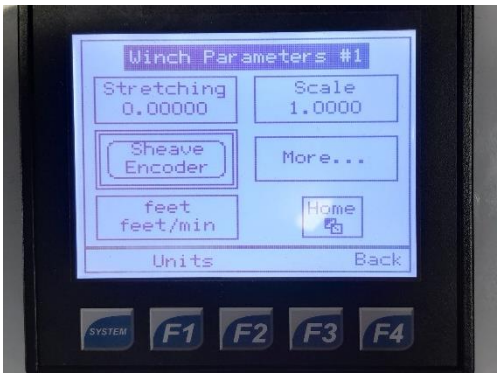


9. Press the “Winch Parameters” button on the Main Menu touch screen.

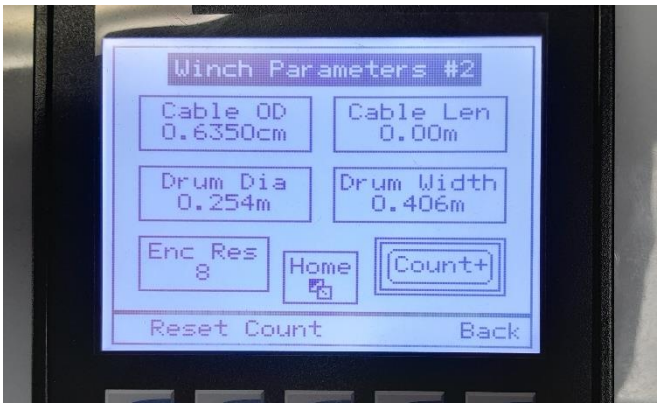
   On the “Winch Parameters #1” screen, ensure that…

   - Scale is set to 1.0000
   - The middle left button says “Sheave Encoder”
   - The units are set to your desired line speed and payout length units.

   Press the F1 “Units” button to cycle through the units setting options.



10. Press “More…” to access the “Winch Parameters #2” screen.



Enter your winch’s drum and cable parameters:

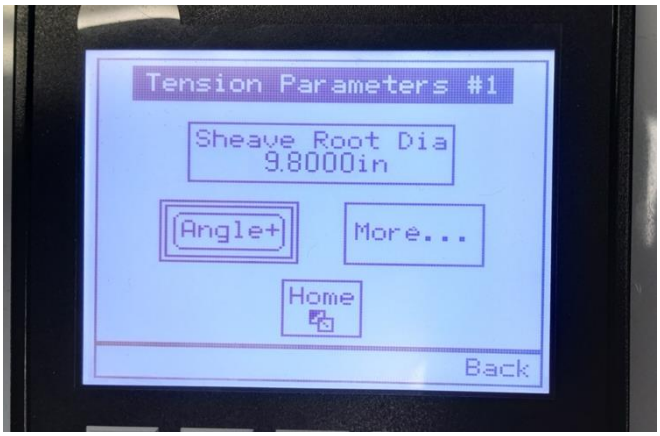
- Cable OD
- Drum core diameter
- Drum width between flanges

“Enc Res” must be set to 8, corresponding to the number of magnets on the sheave.

“Cable Len” is irrelevant for A.G.O.’s sheave-based wire payout systems and can be ignored.

“Count+” can be toggled if needed during operations in case the sheave is counting in the wrong direction.

11. Press “Home” to return to the Main Menu.



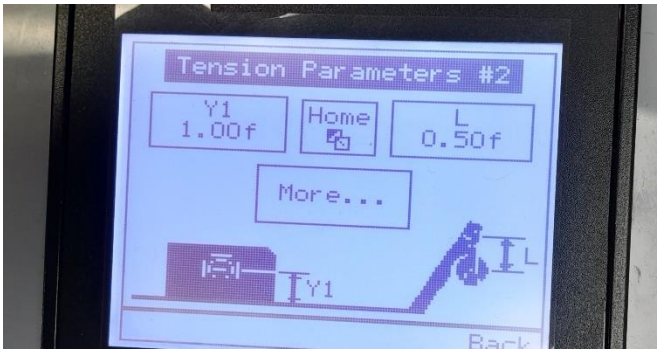
Press the “Tension Parameters” button to access the tension metering parameters screens.

On the “Tension Parameters #1” screen:

- Refer to last page of this manual to find the Sheave Root Diameter measurement for your sheave
- “Angle +/-” can be toggled if, after entering the rest of the parameters, the tension measurements are noticeably nonsensical.

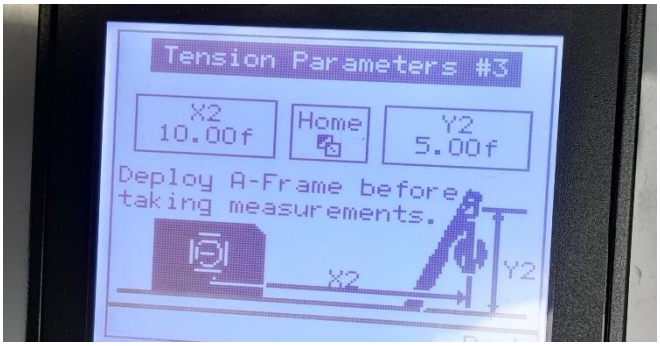
The “Angle +/-” setting just changes which direction of sheave movements is interpreted as a positive angle by the inclinometer installed in the sheave assembly.

12. Press “More…” to access the “Tension Parameters #2” screen.



Tap on the rectangles for Y1 and L to enter your measurements.

13. Press “More…” to access the “Tension Parameters #3” screen.



Tap on the rectangles for X2 and Y2 to enter your measurements.

Press the “Home” button to return to the primary data display screen.

14. Double check the tension measurement on the Home screen to check whether the sheave's angle orientation needs to be toggled per Step 11.

    If the displayed tension is a nonsensically high value relative to the approximate expected tension, it is a good indication that the sheave's angle orientation needs to be toggled.

15. For wire counting, the F1 "Offset" button on the Home screen can be used to "zero" the wire payout at a given position, e.g. when the payload is at the water's surface so that the system only measures the length of cable paid out beneath the surface.

    The F3 "Un-Ofs" button can undo the zeroing to instead display the absolute amount of cable paid out.

4. Data output to a computer

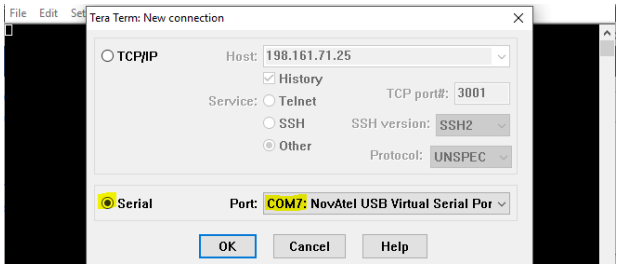
The Horner PLC display box can be connected to a computer with a 9-pin serial D-sub port compatible with the provided serial D-sub data-output cable. Reading the data string requires installing a serial terminal program such as Tera Term on the computer where the data will be read to. The following instructions for setting up the communications parameters are specific to Tera Term, but the process should be similar for other serial terminal programs.

1. From the Home screen on the Horner PLC, press the F4 "Menu" button to access the Main Menu, and select the "Comms Parameters" menu.

   You will reference these values when setting up Tera Term.

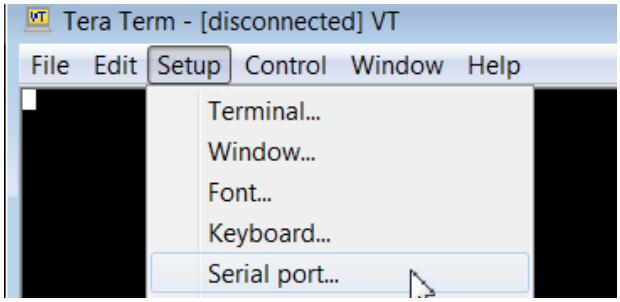
2. Connect the Horner PLC display box to the computer using the provided data-output serial cable. Open Tera Term.

3. When Tera Term opens, it will show a "New connection" window. Select the "Serial" button, and select the COM port corresponding to the winch's serial cable from the drop-down menu. Press the OK button.



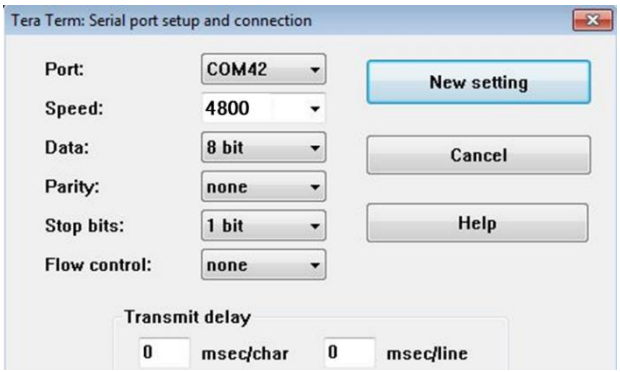
    Now the port connection has been established, but Tera Term likely does not have the right port settings yet, and so it will be displaying the data received from the winch as strings of nonsense. This is normal and will be fixed in the next steps.

3. At the top of the main black Tera Term window, select the "Setup" menu and click "Serial port". A "Serial port setup" window will open.



4. Check and set the following settings in the “Serial port setup” window:
   Baud rate/Speed = 4800
   Data = 8 bit
   Parity = none
   Stop = 1 bit
   Flow control = none

   Apply the changes by pressing the “New setting” button.



The main Tera Term terminal window should now be displaying a continuous feed of cable payout data in a readable format.

Data string format

The data string word is arranged in a standard NMEA sentence format like this:

$YXXDR,D,####.#,M,L,S,##.#,M,#####.#,K,R*24[CR][LF]

The sentence parts are defined by the following:

- $ = NMEA sentence delimiter (beginning of sentence)
- YX = talker device type is a transducer
- XDR = the sentence formatter for a transducer measurement
- D = measurement is a linear displacement
- ####.# = actual measurement in meters
- M = units for displacement measurement, where “M” refers to meters
  - If units of feet are selected, this character will be “F” instead of “M”
- L = transducer ID (arbitrary letter, L chosen to signify "length")
- S = speed
- ##.# = actual speed measurement in selected units
- M = units for speed measurement, where “M” refers to meters/min
  - If units of feet/min are selected, this character will be “F” instead of “M”
  - If units of knots are selected, this character will be “K” instead of “M”
- #####.# = tension measurement in selected units
- K = units for tension measurement, where “K” refers to kilograms
  - If units of feet are selected in the wire payout units setup, this character will be “P” for pounds
- R = rate
- * = NMEA sentence delimiter (end of sentence)
- 24 = Checksum (EXOR of all characters between but not including the "$" and "*" characters, reported as a 2-digit hexadecimal number)
- [CR][LF] = Carriage Return and Line Feed characters (decimal 13 followed by decimal 10)

5. Standard AGO Sheave Sizes Reference

Brand	Sheave	Groove root diameter	Max cable size	Safe Working Load[1]	Maximum Load Limit[1]
Sherman & Reilly	**SR12**	10” (254.0mm)	1.10” (28.1mm)	1,625 lbs (737 kg)	6,500 lbs (2,948 kg)
	SR14[2]	12.239” (310.9mm)	1.21” (30.7mm)	1,875 lbs (850 kg)	7,500 lbs (3,401 kg)
	SR16	14” (355.6mm)	1.34” (34.0mm)	2,250 lbs (1,020 kg)	9,000 lbs (4,082 kg)
	SR20	16.25” (412.8mm)	1.51” (38.4mm)	3,000 lbs (1,361 kg)	12,000 lbs (5,442 kg)
	SR22	18.125” (460.4mm)	1.51” (38.4mm)	3,000 lbs (1,361 kg)	12,000 lbs (5,442 kg)
	SR28	24” (609.6mm)	1.86” (47.3mm)	3,000 lbs (1,361 kg)	12,000 lbs (5,442 kg)
	SR35	30.25 (768.4mm)	2.09” (53.2mm)	3,000 lbs (1,361 kg)	12,000 lbs (5,442 kg)
	SR42	36” (914.4mm)	2.09” (53.2mm)	4,250 lbs (1,927 kg)	17,000 lbs (7,710 kg)

1. Load limits refer to the maximum load applied to the sheave as measured at the shackle that supports it. It is the operator’s duty to determine the corresponding tension limit according to their particular site’s geometry and how much the cable is wrapped over the sheave. For a conservative estimate on recommended safe maximum tension for a given sheave, divide the Safe Working Load by 2.
2. This size is not commonly kept in stock and may have longer leadtimes compared to other sizes.