CARE OF THE 2100 SENSOR
with the Model 3000 Indicator

The 2100 Sensor and propeller rotor assembly used with the *Model 3000* Current Meter is the single most important part of the instrument and great care must be observed for its continued accurate output.

Keep the Sensor/Propeller assembly above the streambed when taking readings and avoid rocks and other hazards when moving from one measuring site to another. This prevents damage to the Rotor, Rotor Shaft, Propeller and the Sensor Body.

Never transport or store the sensor wand with the propeller and rotor and shaft installed. *Use the 1/16" hex screwdriver to loosen the setscrew and remove the entire rotor assembly when not using the Model 3000.*

1. During rough use check the propeller frequently for frayed leading edges and for cracks. Chipped or cracked props should be replaced. Frayed leading edges can be brought back to acceptable levels of operation by reshaping them with 220-150 grit sandpaper. Propellers that show signs of being bent or misshapen should be discarded.

2. Rotational friction is by far the biggest cause of erroneous data especially at velocities below 2 feet per second. Check the freedom of rotation frequently especially in turbid water or after rough handling. In some measuring situations it may be necessary to completely disassemble the rotor and clean the parts with clear water after each immersion. Use spare rotor assemblies and interchange them often. ***Never leave the rotor assembly attached to the sensor after taking readings. Even a small amount of damage to a propeller rotor can seriously effect its calibration, making your readings inaccurate.***

3. Water is the lubricant for the *2100-A21* rotor. "Canned air" and spray type degreasers may be used to regularly clean the "bore" of the Rotor (**2100-A27**) and the polished surfaces of the Rotor Shaft (**2100-A26**). Avoid oil & grease. Cleaning the rotor and its parts may be accomplished by using soap and water , alcohol, distilled water, etc. Avoid using any chlorinated solvents or strong alkalies. And remember whatever you use also needs to be cleaned off enough to satisfy environmental requirements.

4. The Rotor Assembly (**2100-A21**) should spin very freely when held in the vertical position (propeller pointing up) and simply blow lightly on the propeller. If it does not, clean the bore of the Rotor and the surface of the Rotor Shaft thoroughly.
One method to determine an acceptable level of low-velocity performance by a particular Rotor Assembly is to perform a "Spin Test":
Install the Rotor on the sensor, connect the sensor to the Indicator, and place the Indicator in the **COUNT** mode. With the propeller pointing up blow very hard straight down on the propeller. *At the instant you stop blowing* hit the **COUNT** key on the indicator and allow the rotor to coast to a stop. A rotor that will perform to the low velocity limits of its design produces counts on the indicator of at least 300-350.

5. If the Rotor begins to "buzz" when spun by hand it means that the bore diameter of the Rotor (**2100-A27**) and the outside diameter of the Shaft (**2100-A26**) are too far apart. In this case it is strongly advised to replace the Rotor with a new one. If the shaft shows visible signs of wear replace it also. Severe buzzing indicates that the rotor is bouncing off the shaft as it rotates around it. This slows the rotor significantly especially at velocities above 3 FPS and will cause readings to be slower than actual. **Note:** Some slight buzzing may be heard in the later versions of the rotor when it is spun "dry". This buzzing should cause no significant loss of efficiency.

6. Periodically examine the Thrust-Bearing Nut (**2100-A23**) and check inside on the bottom (the bearing surface). If a pronounced "cup" begins to form (wear from the ball-shaped end of the Rotor Shaft) the **2100-A23** should be replaced. This is especially necessary when using the *Model 3000* in low-flow situations, 2 FPS or lower.

7. The Photo-Optics in the sensor body must be kept clean. Use soap and water and a soft toothbrush to keep the "eyes" clean if necessary. *Be careful and do not scratch the Photo-optics as this could cause unwanted light scattering and therefore erroneous readings.* Likewise the Fiber optics "eyes" in the base of the Rotor (**2100-A27**) should also be kept clean.

Treat the *2100-A21* Rotor Assembly and Sensor with care and it will continue to produce accurate data with minimum maintenance.

CALIBRATION OF THE MODEL 3000 CURRENT METER

The *Model 3000* Current Meter is designed to be easily calibrated by the user. This calibration must be done with each Rotor you use. *The calibration numbers recommended by SWOFFER INSTRUMENTS, INC. are not necessarily correct for all measuring situations, therefore for optimum accuracy you should calibrate the rotors before use and at or near to the velocities expected to be encountered.*

If very accurate velocity measurements are required then you must calibrate your *Model 3000* system and check the calibrations often. The instructions below should be followed very carefully for reliable measurements using the *Model 3000*.

IMPORTANT NOTE: "Calibrating a sensor" is actually calibrating a particular propeller rotor assembly for use with the *Model 3000* Indicator. If you use more than one rotor assembly you must check the calibration for *each rotor* assembly and change the Indicator Calibration Numbers accordingly as you switch from one propeller assembly to another. Use the PROP key to change calibration numbers.

Low Velocities. Calibration numbers correctly matching a rotor assembly to a 3000 indicator are especially important at the lower velocities (1.5 FPS and lower) and can vary greatly depending on many factors; bearing surface condition in the rotor, make-up of the water being measured (amount of suspended particulates), any damage to the propeller, rotor, shaft, thrust-bearing nut, etc.

What a calibration number is:
The 2100-A21 rotors produce four pulses per revolution. Each of the four fiberoptic “eyes” in the rotor triggers an electrical pulse from the sensor. These pulses are called “Counts” and are read by the Model 3000 Indicator. The Indicator uses these counts, measuring the number of them against an internal timer to determine velocity. The calibration numbers in the Model 3000 therefore represent the number of counts a specific rotor produces as it travels through 10 feet and 10 meters of still water. When the sensor is *stationary* and water is moving past the propeller, a specific number of counts produced in a specific amount of time determines velocity when you know how many counts are produced per foot or meter (pitch). The calibration numbers then can also be referred to as Pitch.

Although rotor/propeller combinations are “similar” they are not necessarily “identical” and therefore each may have a slightly different Calibration Number. Always remember that a Calibration Number shown on the Indicator’s display represents the Calibration Number for a specific rotor assembly only. Double check all rotor assemblies used for any measuring job and make sure that each is within your accepted tolerance for calibration variation. Each rotor assembly may have a different calibration number. Only go out into the field with specific knowledge of each rotor assembly’s calibration number, making sure that the calibration number in the 3000 Indicator matches the rotor that is attached to the sensor before relying on readings.

CHECKING AND CHANGING CALIBRATION OF THE MODEL 3000

MODEL 3000 CALIBRATE MODE

a: Automatic Entry of Prop Pitch by *Model 3000* calculation:

<<< WARNING>>> Make sure that the Model 3000 Indicator is in the correct units mode (feet or meters) when calibrating a sensor. I.e. do not input "metric" data while the instrument is in the "feet" mode. Your velocity measurements as well as the discharge measurements (as calculated by the Model 3000) will be in error. Back out using the ESC key to the initial display screen and toggle the "0" key for desired units selection.

To determine the pitch of a propeller by actual field calibration trials use the Calibrate mode. Calibration is then accomplished by towing the propeller through a course of known length of quiet water while the Model 3000 counts the number of sensor pulses produced. The prop pitch is then calculated:

Pitch = number of pulses
pulses in 10 feet (or meters)
course length

To calibrate a propeller, first select the propeller number to be used (press PROP until the desired prop no. is displayed then press ENTER to select it. Press ESC twice to return to the main screen. Next enter the Calibrate mode by pressing *shift* then CALIBRATE. Display will read:

0 = Calculate
1 = Manual Entry

To do an actual field calibration, you will press 0. (see IN PRACTICE below)

To determine a reliable calibration number for your *Model 3000* (something you <u>must</u> do if you are working with slow flows [below about 1.5 FPS] and for measurements taken in very shallow streams) perform the following:

SUGGESTED METHOD OF COURSE LAYOUT AND PROCEDURE FOR FIELD CALIBRATION (IN FEET)

Accurately mark a straight course of 10 to 20 feet in length in a body of calm, current-free water along which the sensor can be towed while walking the course. A swimming pool or dock into a quiet lake serves well.

Place the sensor in the water a few feet before the beginning of the course, 6 to 12 inches below the surface. The propeller must face into the direction of travel. Walk the sensor through the course at a rate close to that which you will be measuring. Use the *wand* or wading rod rather than the sensor as a guide, press and release **COUNT** at the instant the wand enters the course. The *Model 3000* indicator counts the number of sensor pulses generated as you walk through the length of the course. At the instant the wand leaves the course press and release **COUNT** again. The displayed figure is the number of sensor pulses counted in the course length. Several passes through the course in *both directions* will develop a reliable average calibration figure for the rotor-propeller assembly being calibrated.

IN PRACTICE

Following the in-water placement of the sensor and the walking procedure just described:
Pressing the 0 (0=calculate) key will prompt the *Model 3000* display to ask you for the course length.
Enter the length of the course to be used by pressing digits followed by ENTER. Any accurately measured course length will do since the Model 3000 adjusts the number to equal counts in 10 feet/10 meters, but the longer the distance and the quieter the water the better.
NOTE: Be very sure which units mode the Model 3000 is in before entering figures. (Don’t enter feet as the course distance while the Model 3000 is in the METERS mode for instance!).
Display will read:

Course length? 00.000

Press ENTER again and the display will read:

Count = _ Pass number = 1

Begin walking the sensor several feet before course start mark and at the instant the sensor wand enters the actual course press the COUNT button. Display will begin counting up sensor pulses generated through the length of the course. At the instant the wand reaches the course end, press COUNT again. Counting will stop and the *Model 3000* will automatically calculate a pitch, converting the pulses into a figure in 10 feet (or 10 meters). Display will read:

Pitch = ppp.pp ENTER or REJECT

This pitch is entered in the memory if accepted and it is expressed as the number of sensor output pulses generated in ten feet or meters. It is strongly advised to take four to six passes through the course in both directions to determine a reliable average count for the pitch. The model 3000 keeps track of the number of "passes" back and forth and you may accept or reject any pass as necessary by aborting mid-way (press ESC anytime during the pass) or *shift* REJECT at the end of a pass. Press ENTER after a successful pass to save the count. Press COUNT again to begin another pass and COUNT to stop counting at the end of the next pass. ENTER to accept.

IMPORTANT NOTE: Pressing ENTER a second time after accepting any count will total and average the counts up to that point and will assign the average as the calibration number for that prop pitch. Once done, you have three choices: accept the figure, enter a different figure manually, or start the passes sequence over again for a new set of data.

b: Manual entry of Prop Pitch:

If the pitch of a propeller is known and it is desired to enter it, the manual Calibration mode is used:

<<< WARNING>>> Make sure that the Model 3000 Indicator is in the correct units mode (feet or meters) when manually inputting calibration numbers for a sensor. I.e. do not input "metric" data while the instrument is in the "feet" mode. Your velocity measurements as well as the discharge measurements (as calculated by the model 3000) will be in error. Back out using the ESC key to the initial display screen and toggle the "0" key for units selection.

First, select the sensor (Prop No.) to be used by scrolling through the menu then pressing ENTER. ESC to the main screen and enter the calibrate mode by pressing *shift* CALIB. Display will read:

0 = Calculate 1 = Manual Entry

Press 1. Display will read:

Prop # N
Pitch = PPP.PP

Enter the digits necessary to display the known calibration number (pulses per 10 units of measure). Then press ENTER to put this calibration in the memory.

Manual Calibration mode may be used when changing optic rotor assemblies. New designs may have more (or fewer) pulses per revolution, for instance the AA meter can have an upgraded optics rotor that has four pulses instead of the original 2 pulses per revolution, effectively doubling the calibration number.

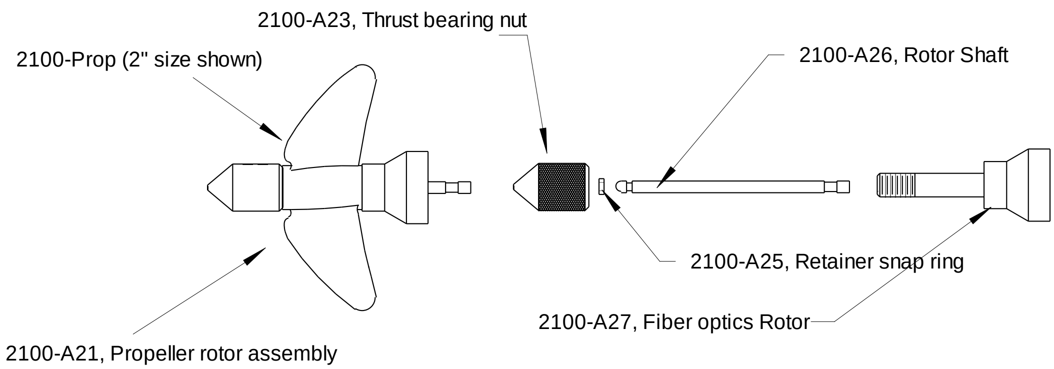
This method may also be used if you have calibrated propeller rotor assemblies using a different meter (Model 3000 or 2100) and you know what the calibration numbers for the propeller rotors are. A calibration number therefore is good for a particular propeller rotor assembly regardless of what sensor and Indicator it is installed on.

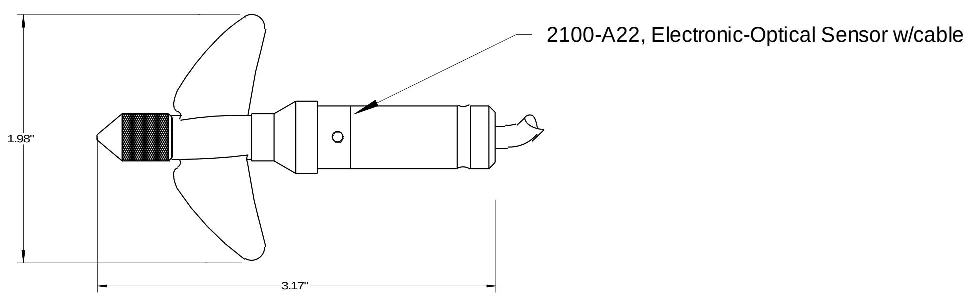
It is important to note that errors in measurements due to Calibration Number variation will be in direct percentage proportion to the difference *between the ideal (correct) Calibration Number for a Prop or rotor and the number that the indicator displays for the rotor.*

Example: If the ideal number is 186 and the displayed number is 184 then the velocity error due to calibration error will be about 1%.

Approximate Calibration Nos. for propellers

PROP	***feet***	***meters***
2" (50 mm) prop	186	610.27
3" (70 mm) prop	130	426.53
1 $^{3}/_{8}$" (35 mm) prop	217	711.98





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