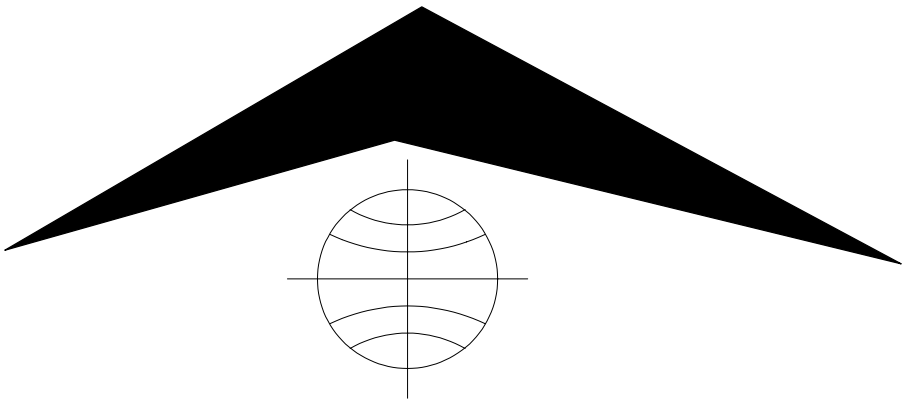
2PCA-1000 PolyCaliper Probe
and
2CAA-1000 Caliper Probe



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General Information

Overview

The 2CAA-1000 Caliper and the 2PCA-1000 PolyCaliper probes measure borehole diameter with three linked arms operating a single resistive sensor. The 3 Arm Caliper data can be scaled and calibrated in inches or in centimeters. The output of the caliper has been optimized with a microprocessor generated linearization scheme to improve the accuracy of the probe over the full range of motion. The output from the probe is an anti-coincidence pulse train that has been a Mount Sopris single conductor standard for many years. The 2CAA-1000 Caliper probe requires 60-65 volts D. C. at 85 mA max. and the 2PCA-1000 requires 80-85 volts D. C. at 85 mA max. The probe can be operated with an MGX or MGXII series logger. The MGX requires operator selection of probe power. The MGX II manages the power requirements automatically.

Options

The 2PCA-1000 PolyCaliper probe can be equipped with a fluid resistivity - temperature extension (2SFB-1000) allowing the tool to be logged down measuring the fluid resistivity and temperature and then logged up measuring caliper and gamma using the 2PGA-1000 PolyGamma probe. The PolyCaliper probe can also be run without the gamma probe by using the 2ADP-1000 Poly probe to MSI single conductor adapter. Without this adapter, the PolyCaliper probe can only be run with the PolyGamma probe on the MGXII logging system. Using the 2ADP-1000 adapter the 2PCA-1000 can be operated on the older MGX logging systems.

The 2CAA-1000 Caliper probe can also be equipped with a fluid resistivity temperature extension (2SFB-1000). This system can be run with the older MGX version or the newer MGXII logging systems.

The fluid resistivity - temperature extension is a factory-installed option. Contact factory for details.

Caliper arm extensions are available for measuring holes larger than 17”. The caliper arm can be unscrewed from the short pivot arm and can be replaced with an extension. The arms are then screwed on to the end of the extension. This will allow the caliper to measure up to 30 inches. The minimum hole diameter in which the caliper can be run with the extension arms is 2.25”.

Theory of Operation

The caliper measurement is made with arms attached to a mechanical assembly that drives a linear potentiometer. A constant reference voltage is applied across the potentiometer. The D. C. output voltage from the wiper of the potentiometer is converted to a frequency. A microprocessor applies a quadratic correction to this frequency so that the frequency is linearly related to borehole diameter. Depending on the polarity of the probe power, the microprocessor selects two frequencies to be transmitted up the cable line. The frequencies correspond to the caliper and natural gamma measurements (when 2PGA-1000 is attached), or the temperature and fluid resistivity measurements (when the 2SFB-1000 is attached). The processor controls the pulse driver circuit that sends positive pulses up the cable line for the first frequency, and negative pulses for the second frequency. An anti-coincidence circuit insures that a positive and negative pulse will not occur simultaneously. The microprocessor also controls the motor that opens and closes the caliper mechanism. The mechanism opens or closes as appropriate when power is applied.

Specifications

	2CAA-1000		2PCA-1000 w/2ADP adapter (no Gamma)	
Length:	59.5”	151 cm	60.5"	153 cm
Diameter:	1.5"	38.1mm	1.5"	38.1mm
Weight:	13.0 lbs.	5.9 Kg	13.0lbs	5.9 Kg

The PolyGamma probe adds about 6 lbs (2.72Kg) and 24” (61cm)
The temperature - fluid resistivity extension adds 3 lbs (1.36Kg) about 12.25” (31cm)

Caliper measurement: 1.5" to 17"
38.1mm to 431.8mm

Operating Procedure With the MGX logger

Operation

> **Caution!** Never lower the probe in the hole with the arms open. Caliper logs must be made while logging up, as moving the probe in the down direction with the arms open can damage the caliper mechanism.

Probe File (driver) selection

Name	Measurement	Reference
2CAA-1000 Caliper	3-Arm Caliper	4.55 Ft (or 1.39M) from Top

If the probe is to be operated with a system other than the MGX series loggers consult the factory for proper operating procedures. If the fluid resistivity-temperature extension has been installed, and you wish to make these measurements while descending, select the **2CAA-1000/F Temp. F. Res** probe file. Apply power to the probe by moving the probe select switch to Pulse 2 and the probe power to - (Closed). A startup cycle time of 2 minutes must elapse before the probe will be ready to log. Log the probe. Reference the Logshell documentation for additional information.

To log the caliper up the hole select the proper probe file **2CAA-1000 Caliper**. Follow the LOGSHELL instructions to execute the logging program, and either calibrate the probe (see below) or proceed to the bottom of the hole. The system must be in the log acquisition mode to be able to measure depth while descending. When bottom is reached, move the MGX Probe Select to the Pulse 2 (MOTOR) position and put the Probe Power switch in the OPEN position. This will open the caliper arms, which will take approximately 2 minutes. Notice the Probe Current light is on while the arms are opening or closing until the arms are fully opened or closed. When the Probe Current light dims or goes out, a confirmation frequency will be sent for a few seconds. This frequency will be 500 Hz after opening and 1000 Hz after the arms are closed. The probe will then begin sending caliper data as the probe is logged up the hole. Recommended logging speed is 15-20 fpm (4-6 mpm). Always slow down when entering casing to avoid possible damage to the casing shoe or the caliper.

Once logging has been completed turn off the data acquisition recording capabilities and exit the file. Place the Probe Power switch to the CLOSE position. This will close the caliper arms in about a minute and a half, indicated by the Probe Current becoming dimmer.

Calibrations

The 2CAA-1000 calibrations should be checked through the LOGSHELL software before logging. Follow the procedure above for opening the caliper, and see the section in the LOGSHELL manual for calibrations. Calibration rings should be selected which bracket the range for the log. The normal operating mode of the MGX system updates data each time the probe moves past a given depth interval. When calibrating a caliper on the surface, it is not necessary to operate the winch to update the data, as this is automatically done every 5 seconds, the default, whether the probe is moving or not. In LOG mode (as if you were getting ready to log the hole), place the small ring on the caliper and allow the arms to centrally locate within the ring. Wait about 15 seconds for the reading to stabilize. Move the cursor in the ACQSBC status screen to LftOut and type in the value (in inches or mm) that corresponds to the small ring diameter. Press F3 to copy the current value from the A/D into the LftInp column. This sets the low-end calibration value in real units to the low-end frequency generated by the probe. Next place the

large ring on the probe, center the arms, and wait about 15 seconds for the reading to stabilize. Move the cursor to RgtOut, type in the value for the large ring, and press F4 to copy the current A/D value into the RgtInp column. You may wish to repeat this a few times to check the calibration. When you are satisfied that the calibrations are accurate and repeatable, Press F2 to save the cal values in the probe file. This file will be saved in the current directory, and after logging you will need to copy it to the ACQ directory to update the original probe file values that came with the LOGSHELL program. The fluid resistivity measurements should not need to be calibrated. They can be checked with fluid of known resistivity & temperature. Note that the resistivity of the fluid changes as a function of temperature.

Operating Procedure With the MGXII logger

Operation

> **Caution!** Never lower the probe in the hole with the arms open. Caliper logs must be made while logging up, as moving the probe in the down direction with the arms open can damage the caliper mechanism.

Probe File (driver) selection

Select the appropriate probe file for the configuration to be operated as listed below. The required Probe files need to have been previously installed via the Logshell Configuration Menu.

To measure caliper

Name	Measurement	Reference
2PCA-1000 PolyCaliper w/ Gamma	Caliper, Gamma	Probe Top
2PCA-1000 Caliper*	Caliper	Probe Top
2CAA-1000 Caliper	Caliper	Probe Top

To measure Fluid resistivity

Name	Measurement	Reference
2PCA-1000/F PolyCaliper*	Temp, F_Res	Probe Top
2PCA-1000/F PolyCaliper w/ Gamma	Temp, F_Res	Probe Top
2CAA-1000/F Caliper	Temp, F_Res	Probe Top

- *Requires 2ADP-1000 Polyprobe to MSI single conductor adapter.

Follow the LOGSHELL instructions to execute the logging program, and either calibrate the probe (see below) or proceed to the bottom of the hole. Refer to the Logshell documentation for procedures on opening the probe (see Special Functions section). After the arms are open the probe may be logged.

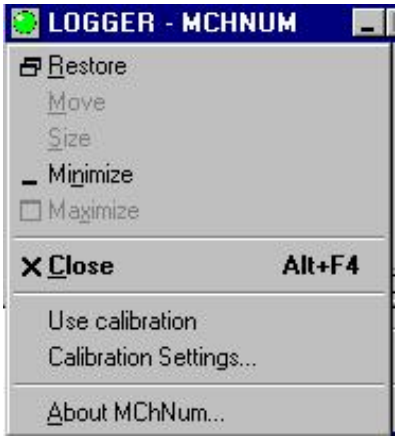
Calibrations

The 2PCA-1000 will need to be calibrated through the LOGSHELL or MSLog software before logging. Follow the procedure above for opening the caliper, and see the sections in either the LOGSHELL or MSLog manuals for calibrations. The normal operating mode of the MGX II system updates data each time the probe moves past a given depth interval. When calibrating a caliper on the surface, it is not necessary to operate the winch to update the data, as this is automatically done when using Logshell every 1 second, which cannot be changed, whether the probe is moving or not. If MSLog is used the user will need to place the acquisition in the Time Mode.

The probe is shipped with a small and a large diameter calibration ring available for calibrating the caliper. **For Logshell users;** In LOG mode (as if you were getting ready to log the hole), place the small ring on the caliper and allow the arms to centrally locate within the ring. Select the Calibrate menu item on the Main PolyLog Menu. Select the EDIT VALUES menu item and enter the values for the Low Reference and High Reference in their respective fields. These values should represent the size of your calibration rings in the engineering units you have chosen (usually inches or centimeters). You move between fields using the TAB key (Shift TAB to move back). Place the small ring on the caliper and center it between the three arms. Press F3 to write the current value of the A/D into the Low Input field. Replace the small ring with the larger ring, and Press F4 to write the current value of the A/D into the High Input field. You may wish to check each ring a few times to verify the calibration. It will take 1 second for the data to update in this mode, so be sure to wait long enough for the value to stabilize. When you are satisfied that the calibrations are accurate and repeatable, Press <Control Enter> to exit the menu and Select the SAVE VALUES bar to save the cal values in the probe file. This file will be saved in the current directory, and after logging may want to copy it to the LS directory to update the original probe file values that came with the LOGSHELL program.

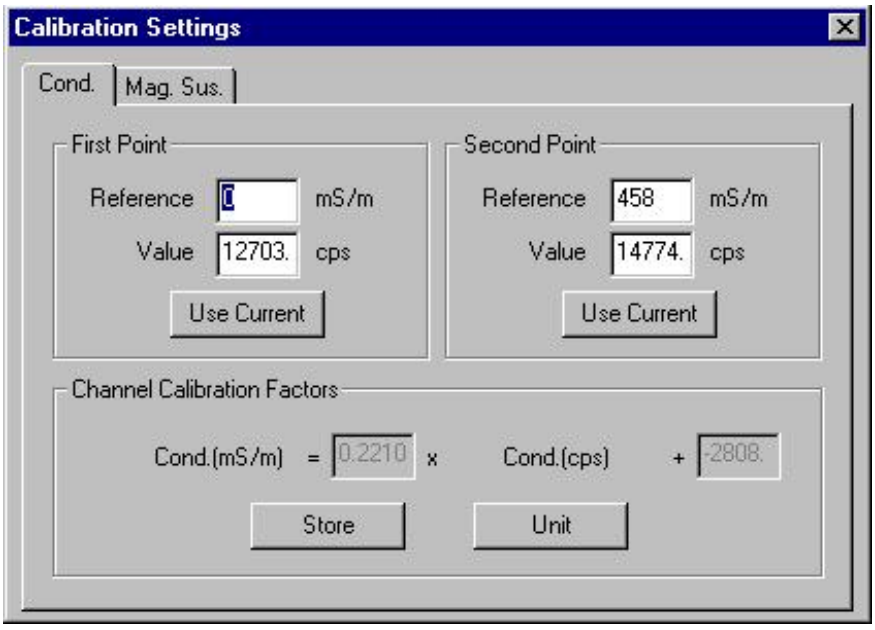
The fluid resistivity and temperature measurements can be calibrated as described in the users manual for this probe extension. They can be checked with fluid of known resistivity & calibrated thermometer. Note that the resistivity of the fluid changes as a function of temperature.

Calibration Settings for MSLog Users



Be sure that the Use Calibration ✓is OFF before proceeding! Click on the Calibration Settings line. In this dialog box, the user can select the channel to calibrate, enter the appropriate calibration values, and then store the entered values in the TOL file. The example on the following page shows a screen for an EM probe calibration, where the user placed the probe in a zero conductivity medium and pressed the button marked “Use Current Value” to set one end of the calibration, and then placed the calibration ring on the probe with a 458 mS/m response and pressed the “Use Current Value” button to set the other end of the calibration. Similar calibrations can be performed for a caliper probe, using two different known calibration ring sizes. When finished with a channel, the user should press the Store button. After finishing the calibration, the user should close the window, and **CLICK on Use Calibration, so the ✓is checked.** If another browser, like MCHCURVE, is running, the user will have to Stop and Start the browser again to make it read the new calibrated values.

Sample Calibration Screen



Caution: The user must follow the above procedures to the letter to ensure accurate and correct calibrations. Pay close attention to the reference to the check mark (✓) setting in front of USE Calibrations. It is OFF during calibration and ON during logging.

Preventive Maintenance

The 2CAA-1000 should provide long life with only minor maintenance required to the mechanical end of the probe. Before and after each usage of the probe, using a standard automotive grease gun and M6 x 1thread fittings (replacement P.N. 28-957-001), apply grease to the two grease ports. These are located immediately above and below the arm pivot point. Close the arms to apply grease to the upper fitting and open the arms to apply grease to the lower fitting. Remove the two grease fittings and install M6 X 6 SS Set Screws (replacement P.N. 28-185-549) as plugs in the holes before operating the probe in a well. After each log, when possible, clean and flush mud and or contaminants out of the caliper arm assembly. When the caliper arms are open inspect the mechanism on the arms to see if there is adequate grease for lubrication. If not re apply grease.

We recommend Dow Corning DC-111 silicone grease for use in water wells. DC-111 is approved for incidental contact with food. There are a number of other greases that will work. High resistance to water washout and temperature range being the prime considerations in their selection. Any grease used should be compatible with the Buna N o-rings. Buna N o-rings are recommended for: Petroleum oils and fluids, cold water, silicone greases and oils, Di-ester base lubricants (MIL-L-7808), Ethylene glycol base fluids (Hydrolubes). It is not recommended for: Halogenated hydrocarbons (nitrobenzene, aniline), Nitro hydrocarbons (nitorbenzene, aniline), Phosphate ester hydraulic fluids (Skydrol, Fyrquel, Pydraul), Ketones (MEK, acetone), strong acids, ozone, and automotive brake fluid.

Keep all thread and o-ring surfaces clean and dry. Re-apply grease or silicone compound (o-rings) on a regular basis. If 2SFB-1000 is attached always flush and clean the fluid resistivity/temperature sensor section after each use, and dry thoroughly before storage to insure accurate measurements.

If electronic troubleshooting becomes necessary it should only be performed by qualified persons or someone that is comfortable with the task.

To access the inside of the probe, the probe top can be removed from the main housing. For the 2CAA-1000, three screws are removed by rotating them counter (anti) clockwise using an M3 hex wrench. For the 2PCA-1000, the three captive screws are rotated clockwise, using an M4 hex head wrench, until they clear the outer housing.

WARNING: The three screws in the 2PCA-1000 Poly top are tight when they are fully counter (anti) clockwise. If they are turned to far clockwise the 2PCA-1000 probe housing will disconnect from the Poly top and can then fall off. **Before disassembling the probe, contact the factory for assistance.**

Next the housing can be unscrewed from the lower section of the probe. The PCB is located at the top end of the inner housing with the motor just below the PCB. In the middle of the PCB are rods, which drive measurement circuits and sensors for control switches that control the open and close positions. Just above where the housing threads are located is the linear potentiometer. When required, feed through wiring is then carried to the bottom of the probe for the 2SFB-1000.

Common electronic problems are a broken or shorted wire. A visual inspection of the wiring should be performed before further testing is done.

If electronic testing is to be done a copy of the schematics is highly recommended before proceeding any further. Depending on the nature of the problem checking things like regulator voltages and pulse outputs is recommended to locate the problem.

Schematics

Drawing Number	Title
0500S-2097 - 1	Poly Caliper power supply
0500S-2097 - 2	Poly Caliper limit switch & v/f
0500S-2097 - 3	Poly Caliper processor & driver circuit

Appendix

Suggested QA Procedure

Regular calibration of the caliper response will provide accurate, high quality hole diameter information. Be sure to use calibration standards which are rigid and whose dimensions can be traced to a high degree of precision. The caliper mechanism will normally have some "play" due to mechanical tolerances, but the spring tension will provide for accurate measurements with a minimum of maintenance. Cleaning and greasing the mechanical section on a routine basis will insure repeatable results.

General notes for Quality Assurance are presented here for users who need to utilize these techniques when collecting data. These users will need to periodically calibrate their equipment using equipment whose calibration is traceable to an approved standard. Details of these calibrations must be recorded.

When an instrument is calibrated, records need to be kept regarding the calibration standard(s) used and what was changed on the instrument to calibrate it. Typically, the corrections made to the instrument, involve changing constants that are used to scale the raw instrument reading so that the proper value is reported. The constants must be recorded during a calibration procedure. The Mt. Sopris acquisition software provides records of calibration constants. This aids the QA process, but does not replace the need for recording these constants at the time of calibration. The reason for this is that the length of time since the last calibration is unknown with only this information.

The device providing the standard must be traceable to an accepted standard. Examples of organizations providing standards for measuring instrumentation are: The U. S. National Bureau of Standards; The American Petroleum Institute; and the American Society for Testing Materials. For example, if the voltmeter or the density standard used for calibration is not traceable to an approved organization, such as those listed above, the calibration should not be considered valid. Records should be kept indicating the last time that standard being used for calibration was calibrated or checked against an approved standard. The QA procedure necessary for some programs mandate that the calibration standards be periodically checked against a standard approved by a proper agency.

A QA procedure may dictate that data taken from a given locale be associated with records indicating the exact time and location that the data was collected. The data itself may have to be collected in a certain format to meet requirements. Often, QA procedure specifies that surveys must be repeated and the data from the successive surveys compared. This technique is used to eliminate poor or invalid data.