

AutoCalcimeter Model 442

Instruction Manual



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AutoCalcimeter Model 442 Instruction Manual

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Houston, Texas, USA

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1 Introduction

The AutoCalcimeter Model 442 is an automated tool used to determine the amount of calcium carbonate and magnesium carbonate (dolomite) in a sample of alkaline earth carbonates (such as oil well cores or drilled cuttings). Calcite builds up during drilling and water treatment processes, causing scaling problems. Data from the automated calcimeter can easily help determine the most appropriate chemical treatment.

This instrument complies with the ASTM D 4373-84

Using the Fann AutoCalcimeter, the calcium carbonate (CaCO_3) and magnesium carbonate (MgCO_3) are reacted with 10 percent hydrochloric acid (HCl) to form carbon dioxide (CO_2). This is done in a sealed reaction cell and the pressure build up due to the CO_2 is measured using either a pressure gauge or a pressure recorder. The use of a Calibration Curve, determined through the use of pure CaCO_3 reagent, allows the pressure developed to be related to the weight of CaCO_3 in the calibration sample. Several weights of sample are suggested to assure an accurate curve. These tests can be conducted using either the pressure gauge or recorder with the reaction cell. The sample can be weighed on a portable balance (10 mg precision or better). The CaCO_3 content of soil [ASTM Procedure D 4373] is determined by treating a 1 gm dried soil specimen with HCl in an enclosed reactor vessel. CO_2 gas is generated during the reaction between the acid and carbonate fraction of the specimen. The resulting pressure increase in the closed reactor is directly proportional to the carbonate content of the specimen.

1.1 Document Conventions

The following icons are used as necessary in this instruction manual.



NOTE. Notes emphasize additional information that may be useful to the reader.



CAUTION. Describes a situation or practice that requires operator awareness or action in order to avoid undesirable consequences.



MANDATORY ACTION. Gives directions that, if not observed, could result in loss of data or in damage to equipment.



WARNING! Describes an unsafe condition or practice that if not corrected, could result in personal injury or threat to health.



ELECTRICITY WARNING! Alerts the operator that there is risk of electric shock.



HOT SURFACE! Alerts the operator that there is a hot surface and that there is risk of getting burned if the surface is touched.



EXPLOSION RISK! Alerts the operator that there is risk of explosion.

2 Safety

The Calcimeter test depends on reacting CaCO_3 or CaMgCO_3 with 1 Normal HCl.



WARNING! Hydrochloric acid may be corrosive and may cause chemical burns. Use care in handling so that no acid is spilled on either skin or clothing or splashed into eyes.

If acid contacts skin or eyes, immediately flush with large quantities of water for at least 15 minutes. Do not inhale vapors. Process HCl beneath a laboratory hood or in a well-ventilated area to reduce the inhalation of fumes. Wear appropriate safety equipment.

Do not ingest. Get medical attention immediately if accidentally contacted by the acid.



Do not attempt to open the cell until all pressure has been dissipated as indicated by the pressure reading on the display. Always use the pressure bleed function of the AutoCalcimeter by pressing and holding "0" button for 5 seconds.

The Fann AutoCalcimeter uses an electronic pressure transducer and data acquisition system to record the pressure in the reaction cell. The following safety considerations should be practiced:

1. Make sure the Power switch is OFF before connecting power cable to electrical outlet.
2. Verify the power cable and the outlet receptacles are three wire grounding type plug and receptacle.

3 Features and Specifications

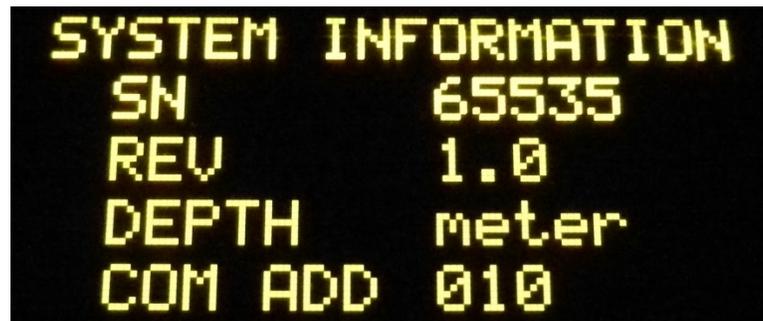
Table 3-1 AutoCalcimeter, Model 442 Specifications

Category	Specification
Dimensions (Width x Depth x Height)	16 in. x 9 in. x 9.5 in.
Weight	15 Lb.
Power Supply	100 to 250 VAC, 50/60 Hz, 75 Watts
Ports	Power, RS485 Serial, USB
Data Port	USB flash drive

4 Startup

Power on the unit using the power switch. Upon startup, the system displays following information:

- Serial number of the machine
- Revision of the firmware
- Depth units
- Communication address of the machine



Logo and Information Screens

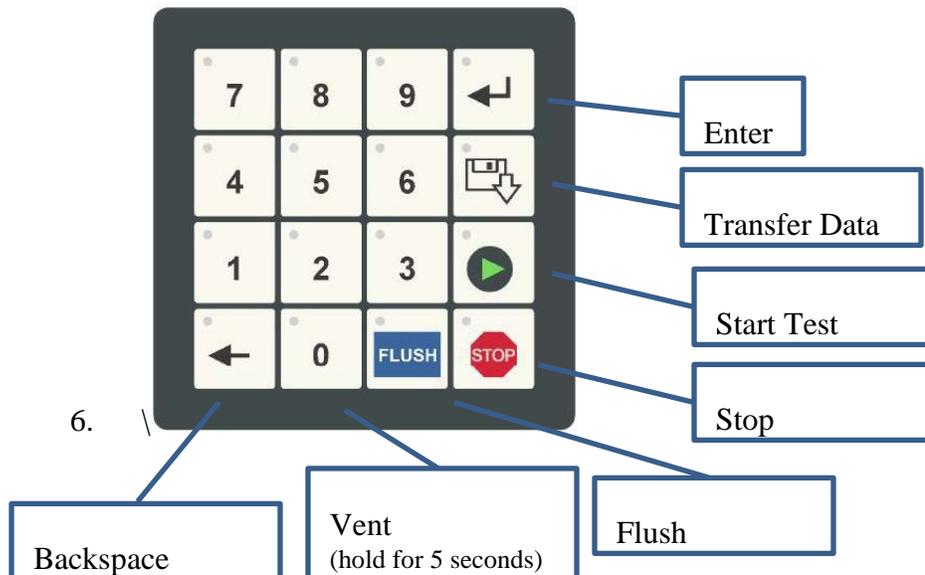
After the logo and information screens above, the main startup screen is displayed.

4.1 Main Startup Screen



Main Startup Screen

1. **TIME:** This is elapsed time of the test in hours, minutes, seconds. If the second counter is updating, then test is running. If it is static, then the test is not running. The time counter retains the information of the last test and only reverts to zero after a subsequent test has been started.
2. **PSI:** This is the actual PSI reading of the instrument. The instrument measures the PSI and converts it to calcite and dolomite percentages based on the topology of the machine, the weight of the test sample, and calibration table stored within the machine.
3. **%Cal:** During the test, the percentage of calcite is calculated and displayed in this field.
4. **%Dol:** At the end of the test percentage of dolomite is calculated and displayed in this field.
5. Machine functions are described below:



5 Setup

To enter Setup mode, start with the AutoCalcimeter powered off. Press and hold the Stop button and power on the machine. The Setup menu will be then visible on the screen. Press the ENTER button to view more setup options on the menu, or the Stop button to exit the setup menu.



Setup Main Menu Screens

The setup menu is comprised of the following sections:

1. Time: Press 1 on the keypad to set the date and time on the machine. This date and time is remembered by the machine on the next power up, and the date and time stamp is used by the instrument to timestamp each test that is run on the device.
2. Depth (meter/foot): Press 2 on the number keypad to toggle the option of entering the units of the depth of the well in “meter” or “foot”
3. Calibration: Press 3 on the menu to bring up the calibration screen. The machine allows entry of calibration values manually, or through automatic calibration. See section 5.2 for more information.
4. Address: Pressing 4 on the keypad will allow the user to change the address. An asterisk (*) will appear at the right of the address, and the user can use the numeric keypad to enter the address of the machine. Once finished, press ENTER to register the value.
5. Firmware Update: Firmware update is on the second screen, which can be accessed by pressing ENTER (More) on the setup screen. After accessing the second screen, press 1 to start the firmware update. Refer to section 12 for firmware updating procedure.

5.1 Time Setup

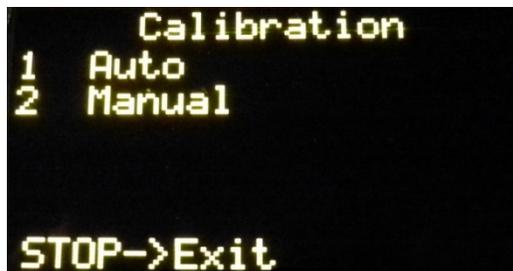


```
Time HH:MM
  10:45
Calendar YY/MM/DD
  15/02/09
STOP->Exit (←)->More
```

Time Menu

To set the time on the machine, enter time setup. The field with a time entry will be highlighted. User can then enter the digits to set the correct time. Press ENTER to accept the new value and jump to the next field (date). Once the information is correct, use the STOP button to exit the menu.

5.2 Calibration Setup



```
Calibration
1 Auto
2 Manual
STOP->Exit
```

Calibration Menu

When the calibration menu is opened, two options are presented: auto and manual.



Before first use, the unit should be calibrated to ensure proper operation. The unit comes with factory default calibration, however each individual machine will have to be calibrated for its specific topology before putting it in use.

5.2.1 Auto Calibration

Press 1 to enter Auto Calibration mode. Using auto calibration, choose the percentage of calcite to calibrate. The machine will run an actual test with the known percentage of calcite. The machine will measure the pressure created from this known calcite, and input these values in respective fields. The calibration process for each percentage of calcite takes 45 minutes.

E.g. If user selects option 2, then provide a sample with 40% calcite or use pure calcite with 0.4 grams weight. The machine will run regular tests and pressure readings are measured and internal calibration table will be populated with the values of pressure at 30 sec and 45 minutes during the test.

```
Select Cal %
1 20%
2 40%
3 60%
4 80%
5 100%
STOP->Exit
```

Auto Calibration Menu

5.2.2 Manual Calibration

In manual calibration, if the pressure readings for particular calcite percentage are known, the value on a particular row of the table can be edited.

E.g. if the value of 60% calcite needs to be edited, press 3 on the keypad. That row will have a "<" at the end corresponding to 30 sec pressure reading. The value of PSI corresponding to 60% calcite at 30 seconds can now be entered. Once value has been adjusted, press "Enter". Now 45 min pressure reading will have the "<" indication. After entering the value, press ENTER to save this value. The "<" will disappear on successful save. Press STOP to exit.

```
PSI at 30sec 45min
1 20% : 02.88 03.18
2 40% : 05.83 06.28
3 60% : 08.28 08.89
4 80% : 11.53 12.44
5 100% : 14.75 15.52
STOP->Exit (←)->Save
```

Manual Calibration Menu

6 Before Starting a Test

Before starting the test procedure, make sure the equipment is clean and in good operating condition. Make sure equipment is calibrated as per Section 5.2.

Obtain a sample of core, drilled cuttings, or other solids that are to be analyzed. The sample should be dry and free of contaminants. Grind sample using a mortar and pestle to 150 micron size particles or finer measured with a 100 mesh sieve. If it is unknown whether the sample has been dried, it is recommended to heat the sample in an oven at 220°F (105°C) for an appropriate time.

Test sample should be 1.0 g (± 0.01 g).



CAUTION. Do not attempt to run larger than 1.0 g sample with the Autocalcimeter. This could lead to over pressurization and damage the equipment.

- A. Load the Test Sample in the CO₂ reaction chamber.
1. Unscrew and remove the reaction chamber from the unit.
 2. Inspect chamber to make sure it is clean and dry.
 3. Make sure that reaction chamber and O-Ring seal in the top cap, are in good condition. Use a light coating of Vacuum Grease on O-Ring seals.
 4. Check the level of HCl in the acid reservoir. Fill with Acid if the acid level is less than quarter of the reservoir,. Make sure all pipe or tubing connections to the acid reservoir are tight and do not leak.
 5. Put the sample to be tested to the bottom of the reaction chamber.



Any piece of paper can be used to lower the sample to the bottom of the chamber by placing the sample on the paper and inserting it horizontally in the cell, then tilting the chamber to vertically upright position.

6. Carefully place the stirring magnet bar inside the reaction chamber.
7. Hand tighten reaction chamber on to the cell cap which is fixed on the unit.

8. Raise the stirring base to be flush with the reaction chamber and lock it in place.
9. Follow Section 7 to start the test on the machine



Ensure that pre-test procedures are followed carefully, to avoid inaccurate test results.

7 Starting a Test

Press the  button. Options for starting the test will be displayed on the screen.



AutoCalcimeter Keypad

1. Verify all procedures are complete as per Section 6; press ENTER to continue



Start Test Menu: Verify and Start Test

2. Enter Depth: The user is prompted to enter depth of the well from which sample, was obtained.. Use the number keypad to enter this value. Press “Enter” to continue.

**Start Test Menu: Enter Depth**

3. Enter Sample Weight: Enter the weight (in grams) of the sample under test. Use the keypad to enter the weight.

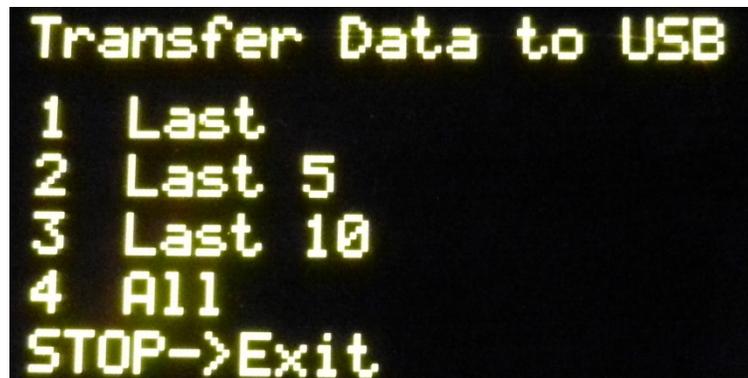
**Start Test Menu: Enter Weight**

4. Press ENTER to Start the test.

8 Recording Test Data

The AutoCalcimeter has a USB port to record test data. If the user has a USB flash drive connected, then the machine will record the test data onto the USB drive in CSV file format. If the USB Flash drive is not present the data is still recorded in the internal memory. The unit records maximum of last 20 tests and keeps them in the memory. If 21st test is run, then it deletes the oldest test data to make room for the latest test.

The user can get any of the archived test data by using the Transfer button on the keypad. The user can transfer last test, last 5 tests, last 10 or all tests to USB drive by selecting appropriate options from the transfer menu.



```
Transfer Data to USB
1 Last
2 Last 5
3 Last 10
4 All
STOP->Exit
```

USB Data Transfer Options

9 Interpreting Test Data

For interpretation of the pressure readings, refer to Figure 9-1, Figure 9-2 and Figure 9-3. These are representative of pressure versus time graphs as they would appear on a Time vs Pressure graph. Figure 9-1 is representative of the CaCO_3 only. Figure 9-2 is representative of dolomite only. Figure 9-3 is representative of combined CaCO_3 and dolomite.

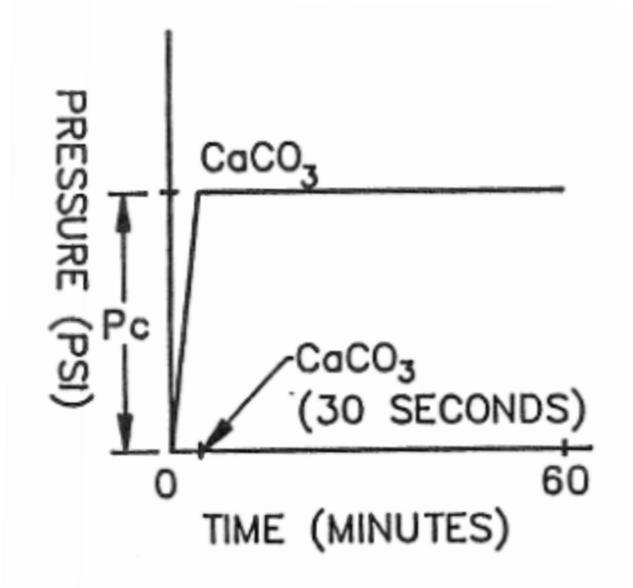


Figure 9-1 CaCO_3 Pressure

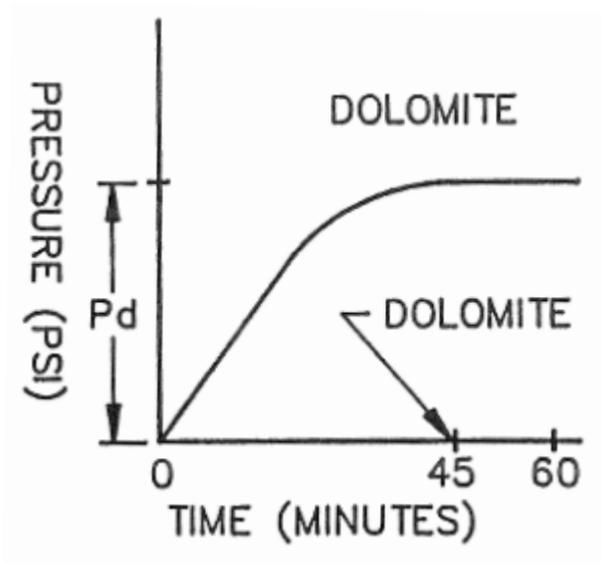


Figure 9-2 Dolomite Pressure

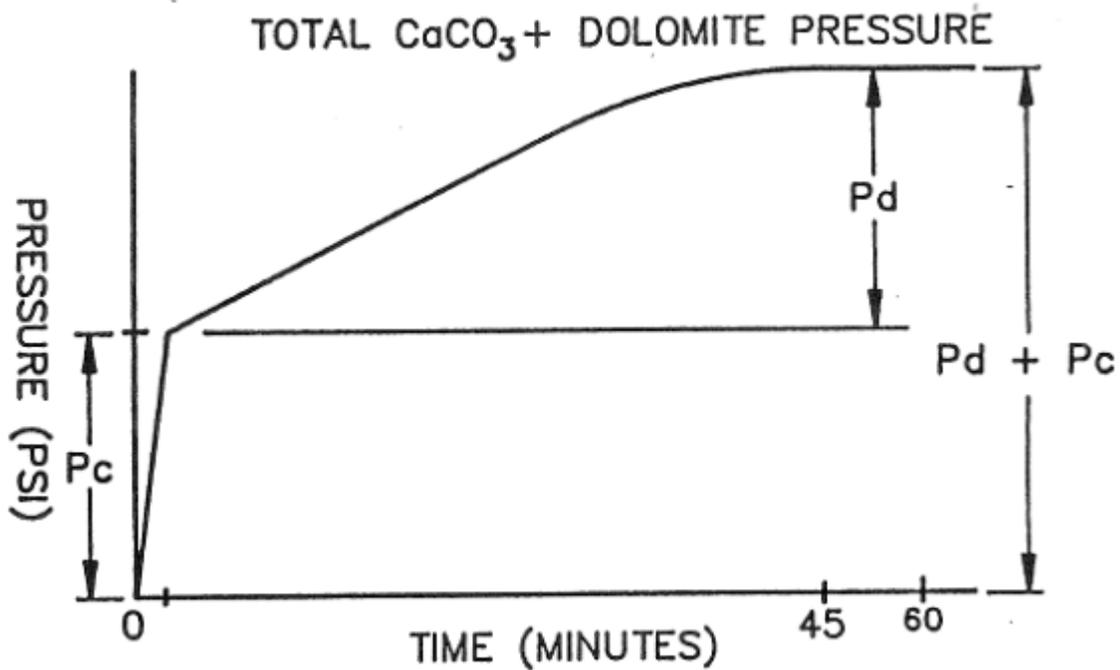


Figure 9-3 Total Pressure of CaCO₃ + Dolomite

Use equations [1] and [2] below for calculation of the percentages of CaCO₃ and dolomite.

$$[1] \quad \% \text{CaCO}_3, \text{ as recorded} \\ = \frac{(\text{Pressure Reading, PSI}) (100)}{(\text{Sample Weight}) (\text{Average Slope})}$$

$$[2] \quad \% \text{ Dolomite, as recorded} \\ = \frac{(\text{Total Press.} - \text{Press. CaCO}_3) (100) (.92)}{(\text{Sample Weight}) (\text{Average Slope})}$$

10 Post-Test Procedures

After test is complete the pressure in the chamber should be released by pressing and holding “0” button for 5 seconds. The Chamber should be removed after this pressure release.

Dispose of test residue from the chamber. Use water to clean and dry before running a new test.

To prepare the unit for transportation, the fluids should be evacuated from the unit. Press the FLUSH button (shown below) to pump acid back into the reservoir from the dispensing system. The reservoir can be emptied of the acid and then cleaned with water for transport. The chamber should be cleaned with water in the same way. See section 14 for safe practices when handling HCl.



Flush Start Screen



WARNING! Hydrochloric acid is corrosive and may cause chemical burns. Use care in handling so that no acid is spilled on either skin or clothing or splashed into eyes. See section 14 for safe practices when handling HCl.

11 Maintenance and Repair

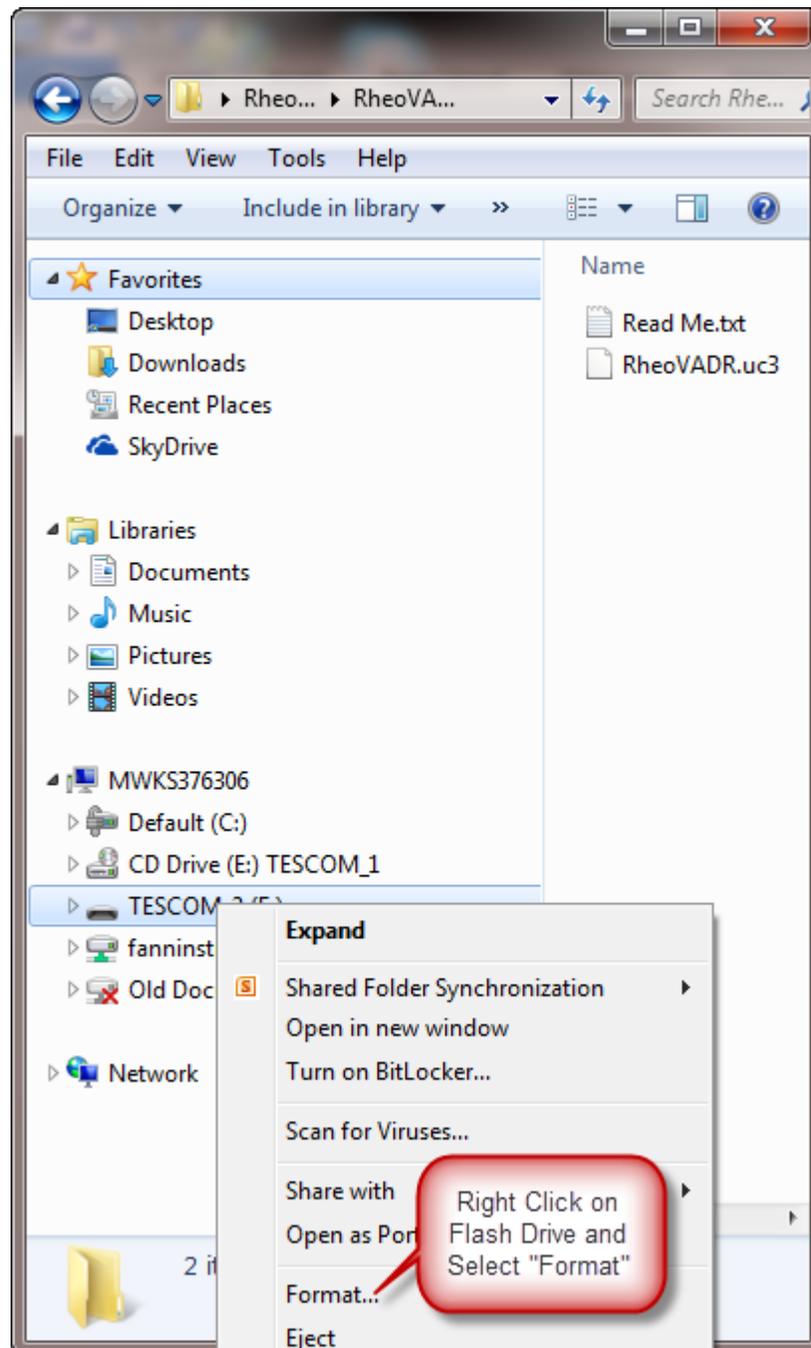
Spare part kits are available for purchase.

Following maintenance points are to be taken care of by the end user.

1. Use to damp cloth to wipe and clean the machine regularly
2. Reaction chamber O-ring. Grease it before starting tests. Inspect and replace monthly.
3. Reservoir O-ring. Inspect and replace every six months.
4. All Tygon tubing in the machine needs to be changed on yearly basis.
5. Tubing for peristaltic pump should be changed every six months.

12 Updating Firmware

1. Insert any USB Flash/Pen Drive in the Computer USB Port. Navigate to Windows Explorer and Invoke the Format Command as shown below.



2. Format the USB Flash/Pen Drive using a Windows computer. Select FAT32 File System.



3. Download/Unzip the update file “M442.uc3”. The file name must not be changed.
4. Copy the “M442.uc3” file to the USB Flash/Pen Drive prepared in Step 2 above.
5. Safely detach the drive from the Computer.
6. Turn OFF the Machine to be updated
7. Insert the USB Flash/Pen Drive into the USB port on the Machine
8. Press and Hold the <STOP> button on the Machine and Power on the machine.
9. Machine will display the SETUP screen.
10. Press <ENTER> button to advance to next screen.
11. Select Option <1> “Firmware Update” to start the update.
12. The screen will go blank and after update is completed, Machine will restart.
13. On Startup, the System Information will display the new Firmware Revision.

13 Parts List

Table 10-1 AutoCalcimeter Model 442 Parts List

Item No.	Part No.	Description
0001	102455989 / C	BASE AUTO-CALCIMETER
0002	102453265 / E	CAP, TEST CELL, AUTO-CALCIMETER
0003	102454208 / A	TUBE ID: 1/8 PIPE SIZE: 1/8 USE WITH FIRM (SHORE A75-A80) PVC AND POLYURETHANE 90 DEGREE ELBOW ADAPTERS, TUBE-TO-MALE THREADED PIPE
0004	102479666 / A	18-8 STAINLESS STEEL SOCKET HEAD CAP SCREW 8-32 THREAD, 7/8 LENGTH
0005	102481695 / A	ORING CHEMICAL-RESISTANT VITON® O-RING AS568A DASH NUMBER 029 OD: 1 5/8, ID: 1 1/2, WIDTH: 1/16
0006	207620 / A	10-32 X 1/2 SHCS BOPL
0007	207871 / A	WASHER FLAT 10 STAINLESS STEEL
0008	208704 / A	WASHER SPLIT 10 STAINLESS STEEL
0009	207599 / D	ROD SUPPORT MODEL 35 VISCOMETER
0010	205654 / A	ORING 9/16 X 3/32 NITRILE B-46 11
0011	102452172 / C	STAGE ASSEMBLY, AUTO-CALCIMETER
0012	207588 / A	KNOB
0013	207598 / C	SPACER CLAMP MODEL 35 VISCOMETER
0014	207597 / B	NUT CLAMP MODEL 35 VISCOMETER
0015	102260460 / C	BASE MODEL RheoVADR
0016	205778 / B	FEET RUBBER 1/2in.
0017	207487 / A	6-32 X 1/4 BHMS STAINLESS
0018	203419 / A	10-32 X 5/8 BHMS STAINLESS
0019	102479300 / A	AUTO-CALCIMETER ELECTRONICS ASSY
0020	102455990 / A	BRACKET FOR PCB, AUTO-CALCIMETER
0021	101652740 / A	4-40 x 1/4 SHCS STAINLESS
0022	102477688 / A	18-8 STAINLESS STEEL MALE-FEMALE THREADED HEX STANDOFF 1/4 HEX, 1/4 LENGTH, 4-40 SCREW SIZE
0023	102333749 / A	18-8 SS Truss Head Phillips, Black-Oxide Plated, 4-40 Thread, 1/4 L
0024	102455993 / A	COVER BACK AUTO-CALCIMETER
0025	102455636 / A	SINGLE DOSE PUMP
0026	102479664 / A	18-8 STAINLESS STEEL SOCKET HEAD CAP SCREW 6-32 THREAD, 5/8 LENGTH
0027	102477682 / A	CHEMICAL-RESISTANT POLYPROPYLENE BARBED FITTING STRAIGHT FOR 1/8 INCH TUBE ID

0028	102455638 / A	LFR SOLENOID VALVE ASSEMBLY, AUTOCALCIMETER
0029	102455996 / A	18-8 STAINLESS STEEL SOCKET HEAD CAP SCREW 2-56 THREAD, 1-1/4 LENGTH
0030	102455994 / A	SENSOR 0-30PSIG 1/4NPT 4-20MA FEATURES: 1) 0.1% Accuracy 2)-40 DEGREE C to +105 DEGREE C OPERATING RANGE
0031	102478054 / A	1/8 ID X 1/4 OD TYGON TUBING
0032	102455998 / A	CRACK-RESISTANT POLYETHYLENE TUBING MODEL AUTOCALCIMETER 1/16 ID, 1/8 OD, 1/32 WALL THICKNESS, WHITE
0033	102455992 / D	MOTOR COVER AUTOCALCIMETER
0034	102479689 / A	BLACK-OXIDE ALLOY STEEL SOCKET HEAD CAP SCREW 8-32 THREAD, 3-1/4 LENGTH
0035	102455991 / A	PUSH-IN GROMMET: 1/4 ID, 3/4 OD, 1/8 THICK FOR 1/2 DIAMETER PANEL HOLE
0036	102452714 / D	RESERVOIR MOUNT, AUTOCALCIMETER
0037	102479637 / A	18-8 STAINLESS STEEL SOCKET HEAD CAP SCREW 6-32 THREAD, 7/16 LENGTH
0038	102479658 / A	BLACK-OXIDE FINISH PAN HEAD PHILLIPS MACHINE SCREW 18-8 STAINLESS STEEL, 6-32 THREAD, 3/8 LENGTH
0039	102452749 / A	HCL RESERVOIR ASSEMBLY, AUTOCALCIMETER
0040	102267850 / D	COVER MODEL RheoVADR
0041	102478111 / A	OVERLAY-KEYPAD ASSEMBLY AUTOCALCIMETER
0042	101729598 / A	SCREW, FLAT HEAD, 4-40 UNC, STAINLESS STEEL, HEX SOCKET, 1/2 LONG, 82 DEGREE
0043	207634 / A	NUT 4-40 HEX REGULAR STAINLESS
0044	102478052 / A	OVERLAY LCD(POLYCARBONATE, 3-COLOR SUBSURFACE, MP468 ADHESIVE)MODEL AUTOCALCIMETER
0045	102454162 / A	BODY, TEST CELL, AUTOCALCIMETER
0046	102478417 / A	MAGNETIC OCTAGON STIRRING BAR LxD: 1x3/8
0050	209933 / C	HYDROCHLORIC ACID 10% 8oz
0051	206690 / C	BALANCE DIGITAL POCKET CAPACITY: 500g X 0.1g
0052	102436956 / A	3 INCH TEST SIEVE, NO. 100 MESH, HALF HEIGHT, BRASS FRAME -STAINLESS CLOTH Model Number: 1638 Sieve Description: 3-HH-BR-SS-US-100 SIEVE Sieve Height: Half Height (Height - 1 1/4, Depth5/8) U.S. Standard: No. 100
0053	205803 / B	MORTAR & PESTLE, 145 ML, SIZE 3
0055	209940 / B	CALCIUM CARBONATE POWDER 2oz
0056	102516344 / A	CASE BLANK PLASTIC 22 X 17 X 8 WITHOUT FOAM
0057	102455997 / B	FOAM INSERT AUTOCALCIMETER
0058	102425065 / A	HIGH-TEMPERATURE VITON® FLUOROELASTOMER TUBING SOFT, 1/8 ID, 1/4 OD, 1/16 WALL X 2 FEET LENGTH, BLACK

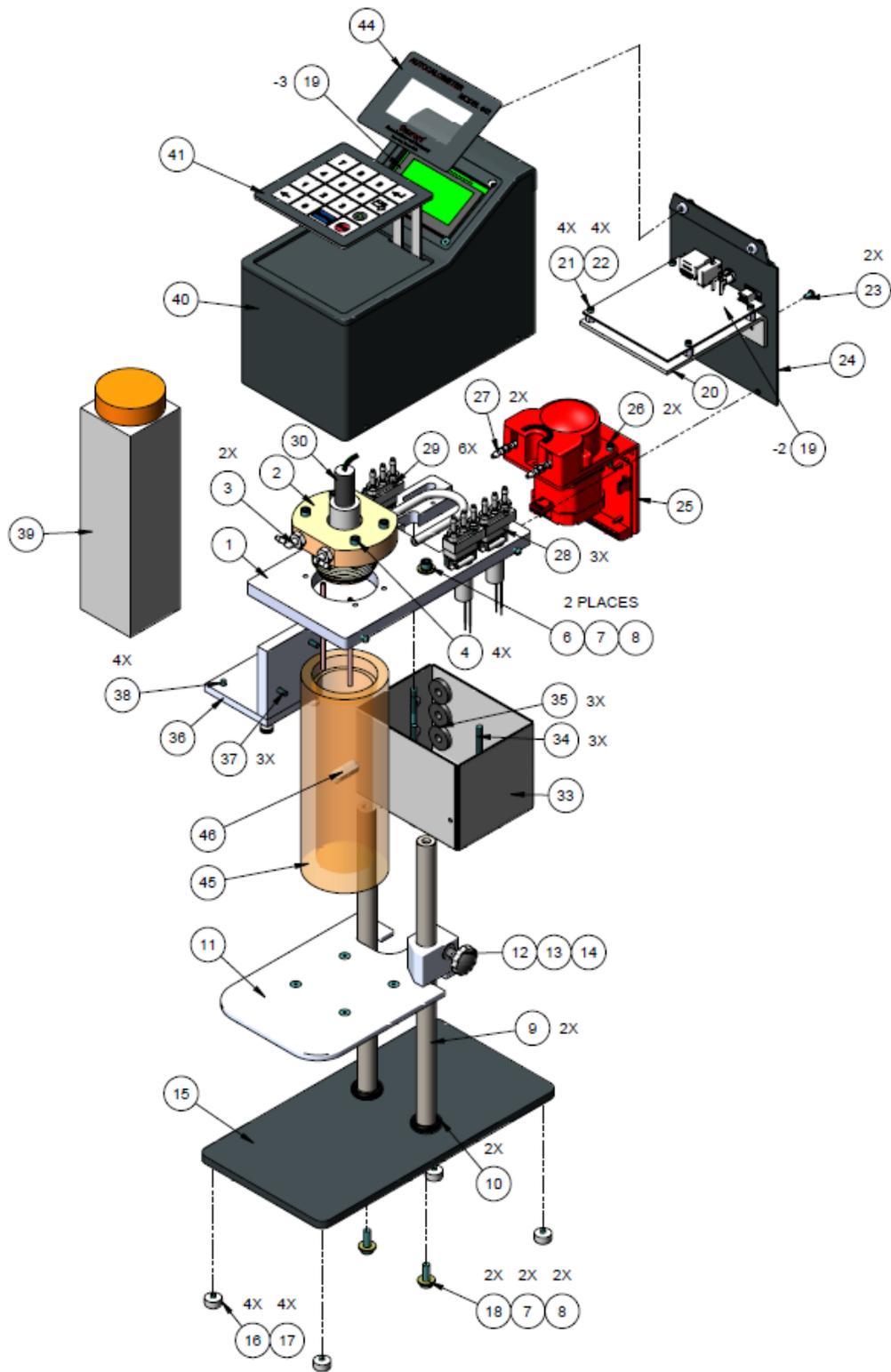


Figure 13-1 Total AutoCalcimeter Components Diagram

14 Safe Handling of HCl

Information in this section is excerpted from the USGS Water Resources Division Memorandum 94.06 “SAFETY--Storage, transportation, handling, and disposal of Hydrochloric Acid”, developed in regulation with OSHA and the EPA.

Hydrochloric acid is a colorless liquid with a sharp and extremely irritating odor. Upon exposure to air, there is an immediate release of toxic hydrogen chloride gas. As a strong corrosive acid, hydrochloric acid reacts with many metals producing flammable hydrogen gas that can become an explosion hazard.

14.1 Health Hazards of HCl

Acute effects of HCl exposure include:

- Ingestion: mucosal as well as severe esophageal corrosive injury, can occur. Chemical burns of the mouth, pharynx and stomach can develop. Injury may be severe and cause death.



Ingestion First Aid - Do not induce vomiting. Dilute the acid immediately by drinking large quantities of water or milk. If vomiting persists, administer fluids repeatedly. Ingested acid must be diluted approximately 100 fold to render harmless to tissues. Get medical attention immediately. If vomiting occurs, keep head below hips to prevent aspiration..

- Inhalation: severe pulmonary edema and pneumonitis can result from inhalation of hydrogen chloride (hydrochloric acid) gas. Pre-existing lung disease may be aggravated by exposure. Ulcerations of nose, throat and larynx are possible.



Inhalation First Aid - Remove from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Administer oxygen, if available. Keep affected person warm and at rest. Get medical attention immediately.

- Dermal - Ulcerations of skin. Hydrochloric acid will probably not be absorbed through skin.



Dermal First Aid - Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of the chemical remains. Get medical attention immediately if chemical burn occurs.

- Eyes: Hydrochloric acid induces chemical burns on contact with human eyes that can lead to irreversible corneal damage.



Eye First Aid - Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of the chemical remains (at least 15-20 min). Get medical attention immediately.

Chronic effects of HCl exposure include toxicity - prolonged or repeated exposure may result in respiratory impairment and bronchitis. Mucosal membranes severely damaged following repeated exposures.



Hydrochloric acid is a strong corrosive and care should be taken to prevent contact with metals, amines, and alkalis which could cause the release of flammable hydrogen gas and toxic or corrosive fumes.

14.2 Exposure Limits

The airborne permissible exposure limit (PEL) for hydrogen chloride (hydrochloric acid) is 5 ppm in an 8 hour work day. A concentration of 100 ppm is considered to be immediately dangerous to life or health (IDLH).

14.3 Handling and Use

Because of the potential to release toxic vapors, hydrochloric acid should never be opened, mixed, or transferred to other containers at any time while inside a vehicle or in any other small enclosure without a mechanism to vent all fumes to the

outside. A Materials Safety Data Sheet (MSDS) should be in the possession of the user at all times and made available to those working with this chemical. The MSDS for hydrochloric acid is to be in the laboratory and field files containing all pertinent MSDS. The MSDS files should be clearly labeled and readily accessible to all personnel.

14.4 Transportation

Hydrochloric acid should never be transported in other than a plastic coated glass container, accurately labeled, and properly stored within the vehicle to prevent shifting, spillage, or breakage. Containers of hydrochloric acid carried in vehicles in warm climates should be placed in coolers to protect them from excessive heat. Although hydrochloric acid has a boiling point of 110 degrees C (230 degrees F) it should be transported at room temperature to minimize a buildup of gas pressure in the container.

14.5 Contingency Spills and Response

During operational use, transportation, and wherever an accidental spill is likely to occur, each laboratory and field unit should have, as part of their required emergency equipment, sufficient absorbent materials, such as sodium bicarbonate, soda ash or lime, to handle

small spills. Shovel chemical waste into a container and properly label as "used hydrochloric acid." Wash residue from spill are with copious amounts of water. Do not allow run-off to contaminate water supplies or nearby creeks or rivers. Do not attempt cleanup unless wearing skin, eye, and respiratory protection. Since hydrochloric acid has a pH less than 1, discarded material is a hazardous waste (Environmental Protection Agency (EPA) Hazardous Waste No. D002, 40 CFR 261.22) including empty hydrochloric acid containers. Waste material should be stored in a safe area and clearly marked for special disposal by a recycling contractor. Record how much of the chemical was spilled and the method of clean up and proper disposal, as required by hazardous waste regulations.

14.6 Personal Protective Equipment (PPE)

Because hydrochloric acid is a strong corrosive, an acid-resistant apron, gloves, and face shield or protective eyewear should be worn at all times while pouring, mixing, or transferring this chemical.

Handling of hydrochloric acid must be in a well-ventilated area or under a fume hood for approved acids. Because of its nature to induce severe chemical burns, an eyewash station and quick drench shower should be made available within the work area.

14.7 Storage

Hydrochloric acid should be kept in a tightly closed container and stored in chemical area that is compatible with other chemicals. Store in a secure, well-ventilated area, that is well marked, and away from the general work population. Do not store near oxidizing materials.

14.8 Disposal

Spilled or used hydrochloric acid is considered a hazardous waste and must be handled accordingly. It must be properly labeled and disposed of by a hazardous waste contractor. Storage should be in an assigned area that is away from general worker population, and well-marked, well ventilated and not subject to heat cycles. Records must be maintained on the amounts of waste hydrochloric acid, the storage time, and the contractor involved in hazardous waste recycling.

Used hydrochloric acid is considered a hazardous waste because of its corrosive properties. By diluting hydrochloric acid to 5 percent volume to volume or less, and neutralizing it with NaHCO_3 to a neutral pH, the solution is no longer corrosive and can, in some jurisdictions, be disposed of down the drain. Before this is practiced as a means of disposal, permission must be obtained from the local waste water treatment facility and be in compliance with local and state environmental regulations.

15 Warranty and Returns

15.1 Warranty

Fann Instrument Company warrants only title to the equipment, products and materials supplied and that the same are free from defects in workmanship and materials for one year from date of delivery. **THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED OF MERCHANTABILITY, FITNESS OR OTHERWISE BEYOND THOSE STATED IN THE IMMEDIATELY PRECEDING SENTENCE.** Fann's sole liability and Customer's exclusive remedy in any cause of action (whether in contract, tort, breach of warranty or otherwise) arising out of the sale, lease or use of any equipment, products or materials is expressly limited to the replacement of such on their return to Fann or, at Fann's option, to the allowance to Customer of credit for the cost of such items. In no event shall Fann be liable for special, incidental, indirect, consequential or punitive damages. Notwithstanding any specification or description in its catalogs, literature or brochures of materials used in the manufacture of its products, Fann reserves the right to substitute other materials without notice. Fann does not warrant in any way equipment, products, and material not manufactured by Fann, and such will be sold only with the warranties, if any, that are given by the manufacturer thereof. Fann will only pass through to Customer the warranty granted to it by the manufacturer of such items.

15.2 Returns

For your protection, items being returned must be carefully packed to prevent damage in shipment and insured against possible damage or loss. Fann will not be responsible for damage resulting from careless or insufficient packing.

Before returning items for any reason, authorization must be obtained from Fann Instrument Company. When applying for authorization, please include information regarding the reason the items are to be returned.

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