

®

# High Temperature Aging Cell Instruction Manual

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## **SECTION 1**

### **GENERAL INFORMATION**

Experience shows that some drilling fluids, and especially lime-treated drilling fluids, tend to thicken and in some cases to solidify when left under static conditions in a deep hot hole. This thickening impairs and sometimes prevents drilling and completion operations such as logging, perforating, etc. Fann High Temperature Aging Cells have been developed to aid in predicting the performance of a drilling fluid under static, high temperature conditions. Recent drilling fluid research has indicated the desirability of applying pressure before heating samples to elevated temperatures in aging tests. For this purpose, Fann has available aging cells which can be pressurized with nitrogen or carbon dioxide to a desired pressure to prevent boiling and vaporization of the drilling fluid before it reaches the test temperature. Temperatures and the resulting vapor pressures up to approximately 350°F (177°C) can be accommodated in aluminum bronze aging cells which have been equipped with a valve for pre-pressuring. Fig. 4 illustrates pressurizing using nitrogen and Fig. 3 illustrates the CO<sub>2</sub> assembly.

#### **CAUTION**

**ALLOW SUFFICIENT VOID SPACE FOR THE EXPANSION OF THE FLUID WHEN FILLING THE CELL. SEE TABLE 1.**

For temperatures up to 500°F (260°C), and pressures up to 1000 psi (6895 kPa), a 500 ml stainless steel aging cell is available. It can accommodate a 350-400 ml sample with adequate room for expansion. Shear tests can be run on the sample from this cell. Refer to Section 6.

Cell assemblies made of aluminum bronze, Type 303, Type 316 stainless steel, and other corrosion resistant materials are available to be pressurized from the Fann High Pressure High Temperature Filter Press manifolds as shown in Fig. 3 and 4.

Glass liners with Teflon lids are available for use with either the 260 ml or the 500 ml Aging Cells. These liners are used to separate the sample from the cell. They can be used in cases where the sample could cause corrosion of the cell or where a reaction is possible which would contaminate the sample. The glass liners are made of pyrex glass and can be heated. They do not form a seal. A cell using them can be heated and pressurized as without the liner. It must be kept upright and cannot be rolled.

## SECTION 2 SAFETY CONSIDERATIONS

Safe operation of the High Temperature Aging Cells requires the operator understand and practice the correct assembly and operation of the equipment. This pertains not only to the Aging Cells but also to oven used to heat them. It is imperative that the oven have reliable controls to insure the maximum temperature as listed in Section 7, Specifications, is not exceeded. Improper assembly, operation, or the use of defective parts poses the possibility of cell leakage or a failure which could result in serious injury and damage.

The sample cell and the oven are hot during operation. The operator should be aware of the hot areas and avoid contact with them. Burns can result from touching hot parts of the equipment during normal operation.

Following is a list of suggestions that should be observed to assure safe operation and maintenance of the High Temperature Aging Cells.

### A. Safe Pressurization

Certain Aging cells are designed to be pressurized while still cold to prevent boiling of the sample when heated. Details of the proper pressurization procedure is described in Section 4.

1. Always use either Nitrogen or Carbon Dioxide. Never connect the Aging Cell to compressed Oxygen or other non-recommended or flammable gas. If Nitrogen is used it must be supplied in an approved Nitrogen gas cylinder or the nitrogen supply system must be built into the laboratory. Nitrogen Cylinders must be secured to meet all safety standards. Carbon Dioxide is normally supplied in small cartridges which contain about 900 psi (6206 kPa) pressure. They are primarily used for field operations. Do not allow these cartridges to be heated or exposed to fire. They can explode if overheated.
2. Maintain pressure regulators in good condition. Never use oil on pressure regulators. Leaking pressurization systems should be repaired or replaced. Gauges, fittings and hoses should be kept in good condition and leaks should be found and corrected. Periodically test the safety relief valves on the pressurization manifolds to verify they will relieve if excessive pressure should occur. Never plug or bypass these safety valves.

3. When pressurizing the Aging Cell always open the supply pressure first, then adjust the regulator. Do not attempt to pressurize higher than the equipment is rated or above the relief valve settings. Follow the procedure as outlined in Section 4-E. When de-pressurizing, shut off the supply pressure, bleed the system of pressure, then back out the regulator Tee screw following the procedures in Section 4-E.

B. Safe Heating

1. Caution should be exercised when operating ovens to avoid accidental injury by touching the inside of the oven or the cell assembly while these are hot. The oven and cells are still dangerously hot even after the test has ended and the oven has been turned off.
2. It is not recommended that the cells be removed from the heating chamber or oven until they have cooled to a temperature where they can be safely handled.

**CAUTION**

**HOT CELLS CAN CAUSE SEVERE BURNS**

**DO NOT ATTEMPT TO HANDLE HOT CELLS  
WITH BARE HANDS.**

**THE CELL TEMPERATURE SHOULD BE LESS THAN  
130°F (55°C) BEFORE PRESSURE IS RELEASED  
AND THE CELL OPENED.**

3. The practice of removing the cell and cooling it under water is a very dangerous procedure. This practice is not recommended because of the danger of severe burns. If the cell must be cooled quickly, be extremely careful and use approved pads or gloves.
4. Use extreme caution when placing a hot cell in water. Hot steam generated when the water contacts the hot cell can cause severe burns.
5. A cell removal tool is available for assisting in handling hot cells. Use pads or gloves even with this tool. Refer to Section 4F.

### C. Safe Electrical Operation

1. Make sure the electrical source is fused and grounded. Verify the power cord on the oven is in good condition and has the proper ground connection.
2. Electrical problems in the wiring or heaters of the oven may not be obvious by looking at the equipment. Always disconnect the power cable before attempting any repair.

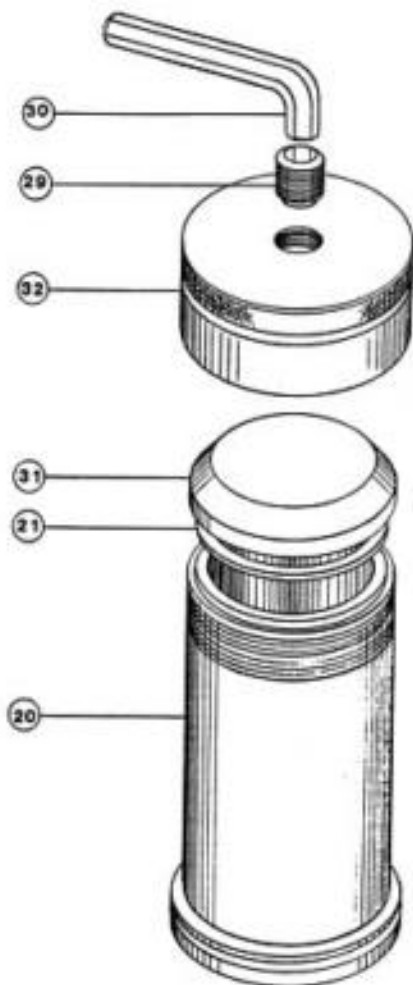
A malfunction should be suspected and electrical repair may be indicated by:

- a. Blows fuses or trips the breaker.
- b. The heating time seems too long.
- c. The thermostat control does not repeat,

### D. Safe Test Cell Maintenance

The Aging Cell Assembly constitutes a PRESSURE VESSEL. The Safety Precautions listed should be followed to assure their safe operation.

1. Aging Cell material should be compatible with the test sample.
2. Aging Cell bodies that show signs of stress cracking, severe pitting, or have damaged Acme threads must not be used.
3. Aging Cell Outer Caps that show damage of the Acme thread or the set screw holes must not be used.
4. Damaged or set screws made of low strength, not heat treated, steel must not be used.



**Fig. 1 - UN-PRESSURIZED CELL ASSEMBLY**  
(For parts list Refer to Section 8)

## SECTION 3 UNPRESSURIZED TESTING PROCEDURE

*(Refer to Fig. 1)*

- A. Determine the safe volume for the cell (350 ml or 500 ml) being used and for the temperature the sample is going to be aged by using the chart shown in Table 1. Pour the safe volume of drilling fluid sample into the aging cell.

### CAUTION DO NOT OVERFILL CELL

- B. Make sure the sealing edge of the cell (20) is clean and put the inner cap (31), with the gasket (21) seal already installed in the groove, in place. Screw the outer cap (32) onto cell hand tight. With the 5/16 Allen wrench (30), tighten the center set screw (29) in the middle of the outer cap. If the cell is to be rolled, install one "O" ring (L4579) in the groove on the outer cap and one "O" ring on the flange near the bottom of the cell.
- C. Place the cell in the Fann Roller Oven or other suitable aging oven, and adjust to the desired aging temperature.

### NOTE

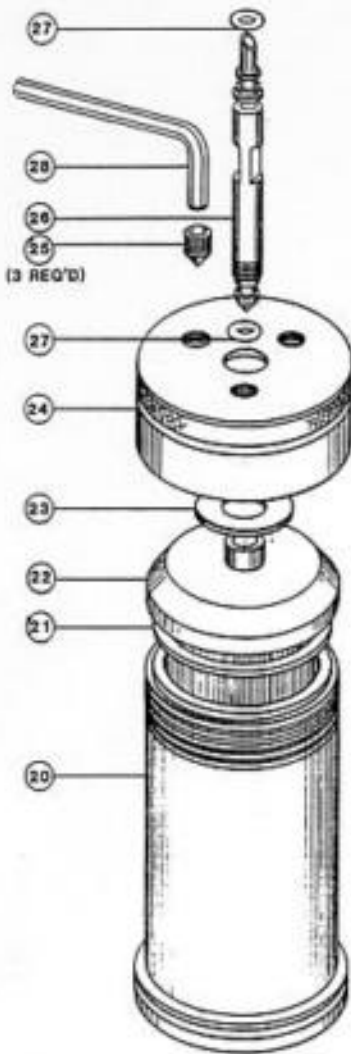
A hot air oven may also be used, provided a constant overall temperature can be maintained as in Fann Roller Ovens.

- D. After the desired aging time has elapsed, remove the cell from the oven and cool the cell to a temperature below

### CAUTION

**CELL TEMPERATURE MUST BE LESS THAN 150°F (65°C). BEFORE ATTEMPTING TO OPEN. DO NOT HANDLE CELLS WITH BARE HANDS. ANY CELL TEMPERATURE ABOVE 130°F (55°C) WILL RESULT IN BURNS.**

- E. To open the cell, loosen the set screw, unscrew the outer cap, and remove the inner cap.
- F. Determine the condition of the aged drilling fluid and report as fluid, gelled, plastic, or hard.
- G. If shear strength is desired, determine as described in Section 6 "SHEAR STRENGTH TEST".



**Fig. 2 - PRESSURIZED CELL ASSEMBLY**  
(For parts list, Refer to Section 8)

## SECTION 4 PRESSURIZED TESTING PROCEDURE

*(Pressurized Aging Cell - Refer to Fig. 2)*

*(Pressuring Manifolds - Refer to Fig. 3 and Fig. 4)*

- A. Determine a safe volume and safe initial pressuring for the temperature at which the sample will be tested by using the chart shown in Table 1. Place the safe volume of drilling fluid sample into the an aging cell.

### CAUTION

#### DO NOT OVERFILL CELL.

- B. Make sure the sealing edge of the cell (20) is clean and put the inner cap (22), with the gasket (21) already installed in the groove, in place. Slip the pressure plate (washer) (23) over the neck of the inner cap. Screw the outer cap (24) onto the cell hand tight. With the 3/16 inch set screw wrench (28) evenly tighten the three set screws (25) in the outer cap. If the cell is to be rolled, install one "O" ring (L4579) in the grooves on the outer cap and one "O" ring on the flange near the bottom of the cell.
- C. After checking "O" ring (27) in lower groove for abrasions, install the valve stem (26) into the inner cap. (Screw the cone end in all the way, then loosen one half turn.)
- D. Pressurize with nitrogen (Fig. 4), carbon dioxide (Fig. 3), or air, to the pressure shown in Table 1 "SUGGESTED APPLIED PRESSURE" to prevent vaporization. Normally, the CO<sub>2</sub> manifold for the High Temperature High Pressure Filter Press is used for pressuring aging cells. Its adapter (Fig. 3 - #17) will fit on the end of the valve stem. After cell is pressurized, close valve stem (26) by turning clockwise until seated. Bleed pressure from pressuring assembly by opening valve (16) Fig. 3 then disconnect from valve by pulling pin (Fig. 3 - #18).
- E. Place cell in heating chamber and heat to desired temperature and for the desired time interval.
- F. Remove cell from heating chamber and air cool until sample temperature has been reduced to 250°F (121°C) or less. The cell may then be air or water cooled.

## **CAUTION**

CELL TEMPERATURE MUST BE LESS THAN 150°F (65°C) BEFORE PRESSURE IS RELEASED AND THE CELL OPENED. DO NOT HANDLE CELLS WITH BARE HANDS. ANY CELL TEMPERATURE ABOVE 130°F (55°C) WILL RESULT IN BURNS.

- G. Examine the drilling fluid in the open cell and report condition of the aged drilling fluid as fluid, gelled, plastic, or hard.
- H. If shear strength is desired, determine as described in Section 6 "SHEAR STRENGTH TEST".

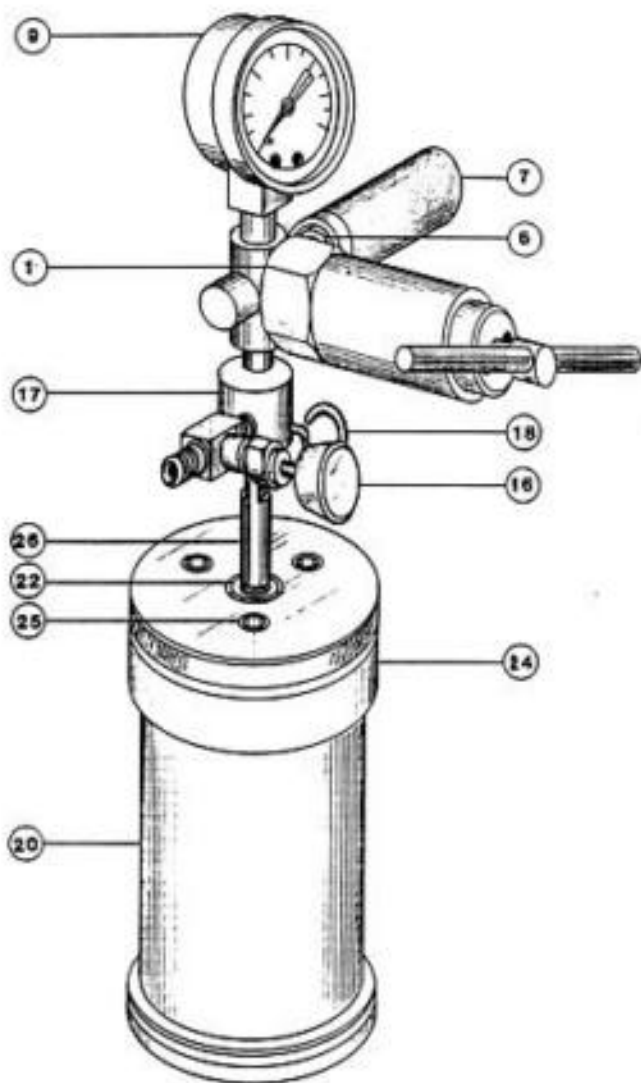
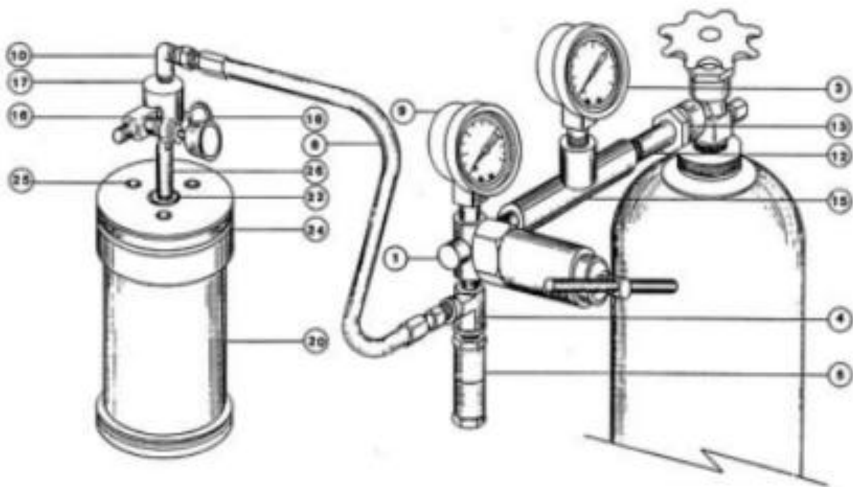


Fig. 3 - PRESSURIZING MANIFOLD, CARBON DIOXIDE

(For Parts List, Refer to Section 8)

**TABLE 1  
DRILLING FLUIDS VOLUME AND PRESSURE FOR HIGH  
TEMPERATURE AGING**

| Aging Temperature |     | Water Vapor Pressure |      | Coefficient of Expansion for Water | Suggested Applied Pressure |      | Drilling Fluids Volume, Cell |        |
|-------------------|-----|----------------------|------|------------------------------------|----------------------------|------|------------------------------|--------|
| ° F               | ° C | psi                  | kPa  |                                    | psi                        | kPa  | 260 ml                       | 500 ml |
| 212               | 100 | 14.7                 | 101  | ---                                | 25                         | 172  | 225                          | ---    |
| 250               | 121 | 30                   | 207  | ---                                | 50                         | 345  | 225                          | ---    |
| 300               | 149 | 67                   | 462  | ---                                | 100                        | 689  | 200                          | ---    |
| 350               | 177 | 135                  | 931  | ---                                | 150                        | 1034 | 200                          | ---    |
| 400               | 205 | 247                  | 1703 | 1.16                               | 250                        | 1724 | ---                          | 350    |
| 450               | 232 | 423                  | 2917 | 1.20                               | 300                        | 2068 | ---                          | 350    |
| 500               | 260 | 680                  | 4689 | 1.27                               | 375                        | 2586 | ---                          | 350    |



**Fig. 4 - Cell Pressurizing Manifold, Nitrogen**  
(For Parts List, Refer to Section 8)

## SECTION 5 CARE OF AGING CELLS

After each test, the cell should be completely disassembled and thoroughly cleaned. Periodically, the following maintenance is required:

- A. Replace the gasket, located in the inner cap, whenever it shows distortion. The life of this gasket is greatly reduced when the cells are used at 500°F (260°C) , usually requiring replacement after each test.
- B. Remove, clean and lubricate the outer cap set screws with "Neverseize®".
- C. Clean and lubricate the outer cap and cell thread.
- D. Thoroughly clean the inside of the cell and inner cap. Make sure the rounded corner between the wall and the bottom of the cell is clean and does not show signs of corrosion. Minor corrosion may be removed by sandblasting.

### CAUTION

**CELL CORROSION CAN RESULT IN CORROSION STRESS CRACKING WHICH IMPAIRS THE SAFETY OF THE CELL. DO NOT PRESSURE OR HEAT CELL SHOWING STRESS CRACKS, UNLESS COLD WATER SAFETY TESTED FIRST.**

- E. Check and replace "O" rings on valve stem whenever they are cut or hard. These "O" rings will require frequent replacement if high temperatures (400-500°F) (205-260°C) are being used.
- F. For maintenance of regulators and pressurizing assemblies, see regulator instructions.
- G. Shearometer parts should be cleaned and dried after use.

CALCULATE SHEAR STRENGTH  
FROM NOMOGRAPH OR FORMULA

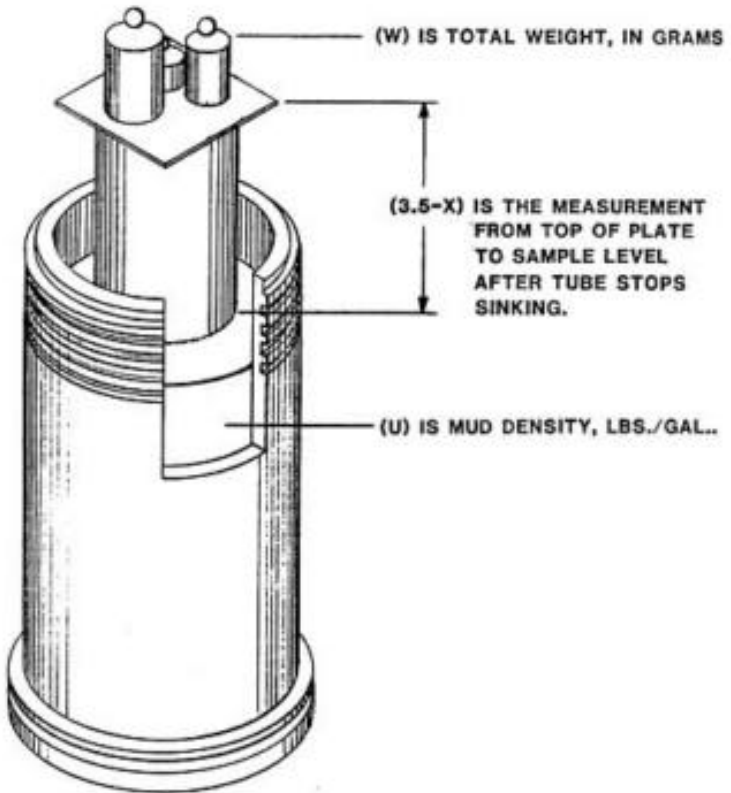
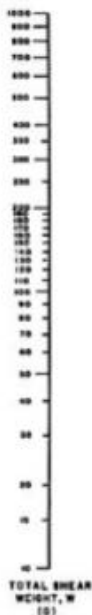


Fig. 5 - MEASURING SHEAR STRENGTH

## SECTION 6 SHEAR STRENGTH TEST

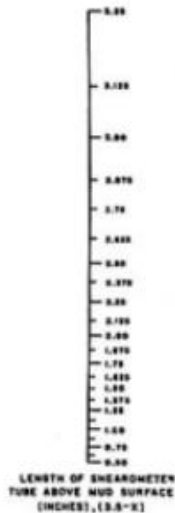
- A. A stainless steel shear tube is placed on the surface of the sample. Refer to Fig. 5.
- B. Place the stainless steel weight platform on top of the shear tube. This weight is 20 grams.
- C. Starting with a small gram weight from the weight set, add gram weights until the tube starts to sink into the sample. The tube will stop its downward motion at the point where the shear strength of the gelled sample against the surface of the tube is sufficient to support the applied weight.
- D. Measure the length of the tube exposed above the sample, (3.5-X in inches). Calculate X if the formula on Fig. 6 is to be used.
- E. The shear strength in pounds per 100 square feet is obtained from the nomograph (Fig. 6) by utilizing the force, in grams, (20 + gram weights) applied to the shear tube and the length of exposed tube after the tube reaches equilibrium, (3.5-X).
- F. This nomograph is based on a sample having a density of 16 lb/gal. Use the equation shown on Fig. 6 to calculate the shear strength for samples of significantly different densities.

NOMOGRAPH FOR CALCULATING SHEAR STRENGTH  
OF A HIGHLY GELLED DRILLING FLUID



$$S = \frac{3.615 W}{L} - 0.238 U$$

THIS NOMOGRAPH WAS DEVELOPED  
FOR USE WITH A STAINLESS STEEL  
SHEARMETER TUBE OF:  
LENGTH = 3.5 IN.  
WEIGHT = TUBE } 20g  
                  PLATE }  
OUTSIDE DIAMETER = 1.4 IN.  
WALL THICKNESS = 0.008 IN.  
A MUD DENSITY U, OF 16 LB/BAL  
WAS ASSUMED.



**Fig. 6 - NOMOGRAPH FOR CALCULATING SHEAR STRENGTH**

## SECTION 7 SPECIFICATIONS

| CELL PART NO.        | CELL MATERIAL   | CELL VOLUME (ml) | MAX. WORKING PRESSURE |       | MAXIMUM <sup>(2)</sup> TEMPERATURE |     |
|----------------------|-----------------|------------------|-----------------------|-------|------------------------------------|-----|
|                      |                 |                  | psi                   | kPa   | °F                                 | °C  |
| 76000 <sup>(4)</sup> | Aluminum Bronze | 260              | 1250                  | 8618  | 350 <sup>(1)</sup>                 | 177 |
| 76001                | Aluminum Bronze | 260              | 1250                  | 8618  | 350 <sup>(1)</sup>                 | 177 |
| 76010                | Aluminum Bronze | 500              | 1250                  | 8618  | 350                                | 177 |
| 76012                | 303             | 500              | 2500                  | 17237 | 500                                | 260 |
| 76013                | 316 SS          | 500              | 2500                  | 17237 | 500                                | 260 |
| 76015                | Aluminum Bronze | 500              | 1250                  | 8618  | 350                                | 177 |
| 76016 <sup>(4)</sup> | 303 SS          | 260              | 2500                  | 17237 | 350 <sup>(1)</sup>                 | 177 |
| 76017                | 303 SS          | 260              | 2500                  | 17237 | 350 <sup>(1)</sup>                 | 177 |
| 76018 <sup>(4)</sup> | 303 SS          | 500              | 2500                  | 17237 | 500                                | 260 |
| 76019                | 316 SS          | 260              | 2500                  | 17237 | 350 <sup>(1)</sup>                 | 177 |
| 76020 <sup>(4)</sup> | 316 SS          | 260              | 2500                  | 17237 | 350 <sup>(1)</sup>                 | 177 |
| 76024 <sup>(3)</sup> | 303 SS          | 500              | 2500                  | 17237 | 500                                | 260 |
| 76051                | 316 SS          | 500              | 2500                  | 17237 | 500                                | 260 |
| 76060                | Inconel (600)   | 500              | 2500                  | 17237 | 500                                | 260 |
| 76061 <sup>(4)</sup> | Incoly 625      | 500              | 2500                  | 17237 | 500                                | 260 |

### NOTES

- (1) These cells are rated at 350°F (177°C) since the allowable sample size becomes less than 200 ml for higher temperatures.
- (2) Cell temperature is limited by gasket.
- (3) Same as 76012 except with corrosion coupon holder and gas injection tube mounted to inner cap.

(4) These cells cannot be pressurized

## SECTION 8 PARTS LIST

### A. AGING ASSEMBLIES AND THEIR PARTS

| PART NO. | DESCRIPTION   |
|----------|---|
| 76000    | Cell, Aging, Aluminum Bronze, 260 ml, Non-pressurized |
| 76032    | Cell Body, 260 ml, Aluminum Bronze                    |
| 76002    | Gasket  |
| 76038    | Inner Cap, Brass                                      |
| 76036    | Outer Cap, Aluminum Bronze                            |
| 76004    | Set Screw, 5/8 - 18 x 5/8 Long                        |
| 76003    | Set Screw Wrench, 5/16, for 76004 Set Screw           |
| 76001    | Cell, Aging, Aluminum Bronze, 260 ml, Pressurized     |
| 76032    | Cell Body, 260 ml, Aluminum Bronze                    |
| 76002    | Gasket  |
| 76005    | Inner Cap, Brass                                      |
| 76006    | Outer Cap, Aluminum Bronze                            |
| 76007    | Set Screw (3) 3/8-16 x 5/8 Long                       |
| L4332    | Set Screw Wrench, 3/16, for 76007 Set Screws          |
| 76008    | Valve Stem for Pressurized Cells                      |
| L4503    | "O" Rings for Valve Stem (2), 3/16 x 5/16, Viton      |
| 76011    | Washer, 3/4 inch, Flat                                |

|       |  |
|-------|--|
| 76010 | Cell, Aging, Aluminum Bronze, 500 ml, Pressurized          |
| 76034 | Cell Body, 500 ml, Aluminum Bronze                         |
| 76002 | Gasket   |
| 76005 | Inner Cap, Brass   |
| 76006 | Outer Cap, Aluminum Bronze                                 |
| 76007 | Set Screw (3) 3/8-16 x 5/8 Long                            |
| L4332 | Screw Wrench, 3/16, for 76007 Set Screws                   |
| 76008 | Valve Stem for Pressurized Cells                           |
| L4503 | "O" Rings for Valve Stem (2), 3/16 x 5/16, Viton           |
| 76011 | Washer, 3/4 inch, Flat                                     |
| 76012 | Cell, Aging, Type 303 Stainless Steel, 500 ml, Pressurized |
| 76044 | Cell Body, 500 ml, Type 303 Stainless Steel                |
| 76002 | Gasket   |
| 76009 | Inner Cap, Type 303 Stainless Steel                        |
| 76046 | Outer Cap, Type 303 Stainless Steel                        |
| 76007 | Set Screw (3) 3/8-16 x 5/8 Long                            |
| L4332 | Screw Wrench, 3/16, for 76007 Set Screws                   |
| 76008 | Valve Stem for Pressurized Cells                           |
| L4503 | "O" Ring for Valve Stem (2), 3/16 x 5/16, Viton            |
| 76011 | Washer, 3/4 inch, Flat                                     |

|       |   |
|-------|---|
| 76013 | Cell, Aging, Type 316 Stainless Steel, Pressurized    |
| 76045 | Cell Body, 500 ml, Type 316 Stainless Steel           |
| 76002 | Gasket  |
| 76048 | Inner Cap, Type 316 Stainless steel                   |
| 76047 | Outer Cap, Type 316 Stainless Steel                   |
| 76007 | Set Screw, (3) 3/8-16 x 5/8 Long                      |
| L4332 | Screw Wrench, 3/16, for 76007 Set Screws              |
| 76008 | Valve Stem for Pressurized Cells                      |
| L4503 | "O" Ring for Valve Stem (2), 3/16 x 5/16, Viton       |
| 76011 | Washer, 3/4 inch, Flat                                |
| 76015 | Cell, Aging, Aluminum Bronze, 500 ml, Non-pressurized |
| 76034 | Cell Body, 500 ml, Aluminum Bronze                    |
| 76002 | Gasket  |
| 76038 | Inner Cap, Brass                                      |
| 76036 | Outer Cap, Aluminum Bronze                            |
| 76004 | Set Screw, 5/8-18 x 5/8 Long                          |
| 76003 | Set Screw Wrench, 5/16, for 76004 Set Screw           |

|       |  |
|-------|--|
| 76016 | Cell, Aging, Type 303 Stainless Steel, 500 ml, Non-pressurized |
| 76042 | Cell Body, 260 ml, Type 303 Stainless Steel                    |
| 76002 | Gasket   |
| 76041 | Inner Cap, Type 303 Stainless Steel                            |
| 76040 | Outer Cap, Type 303 Stainless Steel                            |
| 76004 | Set Screw, 5/8-18 x 5/8 Long                                   |
| 76003 | Set Screw Wrench, 5/16, for 76004 Set Screw                    |
| 76017 | Cell, Aging, Type 303 Stainless Steel, 260 ml, Pressurized     |
| 76042 | Cell Body, 260 ml, Type 303 Stainless Steel                    |
| 76002 | Gasket   |
| 76009 | Inner Cap, Type 303 Stainless Steel                            |
| 76046 | Outer Cap, Type 303 Stainless Steel                            |
| 76007 | Set Screw (3) 3/8-16 x 5/8 Long                                |
| L4332 | Screw Wrench, 3/16, for 76007 Set Screws                       |
| 76008 | Valve Stem for Pressurized Cells                               |
| L4503 | "O" Ring for Valve Stem (2) 3/16 x 5/16 Viton                  |
| 76011 | Washer, 3/4 inch, Flat   |

|       |  |
|-------|--|
| 76018 | Cell, Aging, Type 303 Stainless Steel, 500 ml, Non-pressurized |
| 76044 | Cell Body, 500 ml, Type 303 Stainless Steel                    |
| 76002 | Gasket   |
| 76041 | Inner Cap, Type 303 Stainless Steel                            |
| 76040 | Outer Cap, Type 303 Stainless Steel                            |
| 76004 | Set Screw, 5/8-18 x 5/8 Long                                   |
| 76003 | Set Screw Wrench, 5/16 for 76004 Set Screw                     |
| 76019 | Cell, Aging, Type 316 Stainless Steel, 260 ml, Pressurized     |
| 76039 | Cell Body, 260 ml, Type 316 Stainless Steel                    |
| 76002 | Gasket   |
| 76048 | Inner Cap, Type 316 Stainless Steel                            |
| 76047 | Outer Cap, Type 316 Stainless Steel                            |
| 76007 | Set Screw (3) 3/8-16 x 5/8 Long                                |
| L4332 | Screw Wrench for 76007 Set Screws                              |
| 76008 | Valve Stem for Pressurized Cells                               |
| L4503 | "O" Ring for Valve stem (2) 3/16 x 5/16 Viton                  |
| 76011 | Washer, 3/4 inch, Flat   |

|       |   |
|-------|---|
| 76020 | Cell, Aging, Type 316 Stainless Steel, 260 ml, Non-Pressurized      |
| 76039 | Cell Body, 260 ml, Type 316 Stainless Steel                         |
| 76002 | Gasket  |
| 76050 | Inner Cap, Type 316 Stainless Steel                                 |
| 76049 | Outer Cap, Type 316 Stainless Steel                                 |
| 76004 | Set Screw, 5/8-18 x 5/8 Long  |
| 76003 | Screw Wrench, 5/16, for 76004 Set Screw                             |
| 76024 | Cell, Corrosion Test, Type 303 Stainless Steel, 500 ml, Pressurized |
| 76044 | Cell Body, 500 ml, Type 303 Stainless Steel                         |
| 76002 | Gasket  |
| 76023 | Inner Cap, Corrosion Test Cell, Type 303 Stainless Steel            |
| 76046 | Outer Cap, Type 303 Stainless Steel                                 |
| 76007 | Set Screw (3) 3/8-16 x 5/8 Long                                     |
| L4332 | Screw Wrench, 3/16, for 76007 Set Screws                            |
| 76008 | Valve Stem for Pressurized Cells                                    |
| L4503 | "O" Rings for Valve Stem (2) 3/16 x 5/16                            |
| 76011 | Washer, 3/4 inch, Flat  |
| 63611 | Screws & Grommets for Coupon holder (Pkg of 10)                     |

|       |  |
|-------|--|
| 76051 | Cell, Aging, Type 316 Stainless Steel, 500 ml, Non-Pressurized |
| 76045 | Cell Body, 500 ml, Type 316 Stainless Steel                    |
| 76002 | Gasket   |
| 76050 | Inner Cap, Type 316 Stainless Steel                            |
| 76049 | Outer Cap, Type 316 Stainless Steel                            |
| 76004 | Set Screw 5/8-18 x 5/8 Long                                    |
| 76003 | Set Screw Wrench, 5/16 for 76004 Set Screw                     |
| 76060 | Cell, Aging, Inconel 600, 500 ml, Pressurized                  |
| 76057 | Cell Body, 500 ml, Type 600 Inconel                            |
| 76002 | Gasket   |
| 76058 | Inner Cap, Type 600 Inconel                                    |
| 76059 | Outer Cap, Type 600 Inconel                                    |
| 76007 | Set Screw (3) 3/8-16 x 5/8 Long                                |
| L4332 | Screw Wrench, 3/16, for 76007 Set Screws                       |
| 76065 | Valve Stem for Pressurized Cells, 600 Inconel                  |
| L4503 | "O" Rings for Valve Stem (2) 3/16 x 5/16, Viton                |
| 76011 | Washer, 3/4 inch, Flat   |

|       |  |
|-------|--|
| 76061 | Cell, Aging, Incoloy Type 625, 500 ml, Pressurized |
| 76062 | Cell Body, 500 ml, Incoloy Type 625                |
| 76002 | Gasket   |
| 76063 | Inner Cap, Incoloy Type 625                        |
| 76064 | Outer Cap, Incoloy Type 625                        |
| 76007 | Set Screw (3) 3/8-16 x 5/8 Long                    |
| L4332 | Screw Wrench, 3/16, for 76007 Set Screws           |
| 76066 | Valve Stem for Pressurized Cells,                  |
| L4503 | "O" Rings for Valve Stem (2) 3/16 x 5/16, Viton    |
| 76011 | Washer, 3/4 inch, Flat                             |

**B. SHEAROMETER TEST PARTS**  
**(Refer to Fig. 5)**

| PART NO. | DESCRIPTION  |
|----------|--|
| 24205    | Shear Tube, Stainless Steel with weight support plate, 20 gram |
| 25500    | Gram weights, Set  |

**C. PRESSURIZING ASSEMBLIES**  
**(Refer to Fig. 3 & 4)**

| ITEM NO. | PART NO. | DESCRIPTION   |
|----------|----------|---|
| 1        | 38411    | Regulator w/1500 psi (10340 kPa) gauge, consists of items 1 and 9                   |
| 2        | 38412    | CO <sub>2</sub> Pressuring Assembly, consists of items 1,6,7,9,16,17, and 18 Fig. 3 |
| 3        | 38407    | Gauge, Press 3000 psi, (20682 kPa) 2" (5.08 cm) Dia.                                |
| 4        | L1220    | 1/8 Brass St. Tee   |
| 5        | 38432    | Relief Valve, 1200 psi  |
| 6        | 33620    | Adapter, CO <sub>2</sub>  |
| 7        | 33606    | Barrel CO <sub>2</sub>  |
| 8        | 38420    | Hose, 3000 psi (20682 kPa), 3/16" x 3 ft.(.48 x 91 cm)                              |
| 9        | 38408    | Gauge, Pressure, 1500 psi,(10340 kPa) 2" (5.08cm)Dia.                               |
| 10       | L2579    | 1/8" FNPT X 1/4" Flare Ell  |
| 12       | 38418    | Gland, Nitrogen, Oil Pumped   |
| 13       | 38416    | Nut, Nitrogen, Oil Pumped   |
| 15       | 38409    | Tee 1/4", 3000 psi (20682 kPa)  |
| 16       | 35300    | Valve, 1/8"   |
| 17       | 38733    | Manifold Block  |
| 18       | 38734    | Locking Pin   |

**D. AGING CELL PARTS REFERENCE**  
**(Refer to Fig. 1 & 2)**

| ITEM NO. | PART NO. | DESCRIPTION                                 |
|----------|----------|---|
| 20       | 76032    | Cell Body, Aluminum Bronze, 260 ml          |
|          | 76034    | Cell Body, Aluminum Bronze, 500 ml          |
|          | 76039    | Cell Body, Type 316 Stainless Steel, 260 ml |
|          | 76042    | Cell Body, Type 303 Stainless Steel, 260 ml |
|          | 76044    | Cell Body, Type 303 Stainless Steel, 500 ml |
|          | 76045    | Cell Body, Type 316 Stainless Steel, 500 ml |
|          | 76057    | Cell Body, Inconel Type 600, 500 ml         |
|          | 76062    | Cell Body, Incoly Type 625, 500 ml          |
| 21       | 76002    | Gasket, Teflon                              |

**E. UNPRESSURIZED AGING CELL PARTS**  
**(Refer to Fig. 1)**

| ITEM NO. | PART NO. | DESCRIPTION                              |
|----------|----------|--|
| 29       | 76004    | Set Screw, Hex Socket, 5/8-18 x 5/8 long |
| 30       | 76003    | Wrench, 5/16 Hex for 76004 Set Screw     |
| 31       | 76038    | Inner Cap, Brass                         |
|          | 76041    | Inner Cap, type 303 Stainless Steel      |
|          | 76050    | Inner Cap, Type 316 Stainless Steel      |
| 32       | 76036    | Outer Cap, Aluminum Bronze               |
|          | 76040    | Outer Cap, Type 303 Stainless Steel      |
|          | 76049    | Outer Cap, Type 316 Stainless Steel      |

F. PRESSURIZED AGING CELL PARTS  
*(Refer to Fig. 2)*

| ITEM NO. | PART NO.  | DESCRIPTION   |
|----------|-----------|---|
| 22       | 7600<br>5 | Inner Cap, Brass  |
|          | 7600<br>9 | Inner Cap, Type 303 Stainless Steel                                 |
|          | 7602<br>3 | Inner Cap, Adapted for Corrosion Test Cell Type 303 Stainless Steel |
|          | 7604<br>8 | Inner Cap, Type 316 Stainless Steel                                 |
|          | 7605<br>8 | Inner Cap, Inconel Type 600   |
|          | 7606<br>3 | Inner Cap, Incoly Type 625  |
| 23       | 7601<br>1 | Washer, Flat 3/4 inch   |
| 24       | 7600<br>6 | Outer Cap, Aluminum Bronze  |
|          | 7604<br>6 | Outer Cap, Type 303 Stainless Steel                                 |
|          | 7604<br>7 | Outer Cap, Type 316 Stainless Steel                                 |
|          | 7605<br>9 | Outer Cap, Inconel Type 600   |
|          | 7606<br>4 | Outer Cap, Incoly Type 625  |
| 25       | 7600<br>7 | Set Screw, Hex Socket, 3/8-16 x 5/8 long                            |
| 26       | 7600<br>8 | Valve Stem, Type 416 Stainless Steel, Hardened                      |
|          | 7606<br>5 | Valve Stem, Inconel Type 600  |

|    |           |                                       |
|----|-----------|---------------------------------------|
|    | 7606<br>6 | Valve Stem, Incoly Type 625           |
| 27 | L450<br>3 | "O" Ring 3/16 X 5/16 X 1/16, Viton    |
| 28 | L433<br>2 | Wrench, Hex, 5/16 for 76007 Set Screw |

G. MISCELLANEOUS PARTS AND SUPPLIES

| PART NO. | DESCRIPTION   |
|----------|---|
| 33601    | CO <sub>2</sub> Cartridges, Box of 10                 |
| 34600    | Wrench 6" Adjustable, for valve stem                  |
| 38714    | Cell Lifting Tool, (Pressurized cells only)           |
| 38717    | Valve Seat Refinishing Tool (Pressurized Inner Caps)_ |
| 76053    | Floating Piston, (Separator), Pressurized Cells       |
| 38233    | Removal tool for Floating Piston                      |
| E8022    | "O" Ring for Floating Piston 2-1/8 ID X 3/16 Viton    |
| L4579    | "O" Ring for outside of Cell, 3-5/8 ID X 3/16 Viton   |

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