600°F High Temperature Aging Cell

Instruction Manual

Manual No. D00654827, Revision E

Instrument No. 102111608

fann®
Fann Instrument Company

600°F High Temperature Aging Cell Instruction Manual

Houston, Texas, USA

Printed in USA.

Contact FANN

Phone

TELEPHONE: 281-871-4482
TOLL FREE: 800-347-0450
FAX: 281-871-4358

Mail

Fann Instrument Company
P.O. Box 4350
Houston, Texas, 77210 USA

Location

Fann Instrument Company
14851 Milner Road, Gate 5
Houston, Texas, 77032, USA

Online

www.fann.com
fannmail@fann.com

Table of Contents

List of Figures

List of Tables

1 Introduction

Fann's 600°F High Temperature Aging Cell is used in tests that evaluate the performance of drilling fluids or muds under static or dynamic, high temperature conditions.

Some drilling fluids, especially lime-treated drilling fluids thicken or harden when left in a deep hot hole under static conditions. This thickening impairs and sometimes prevents drilling and completion operations, such as logging and perforating.

Recent drilling research indicates that applying pressure before heating samples to elevated temperatures in aging tests is the best approach. Fann has aging cells that can be pressurized with nitrogen or carbon dioxide to a desired pressure, preventing boiling and vaporization of the drilling fluid before it reaches the test temperature.

For temperatures up to 600°F (315°C) and pressures up to 2500 psi (17,237 kPa), a 550 ml stainless steel aging cell is available. This cell can hold a 350 ml sample with adequate room for volume expansion. Shear tests can also be run on this sample.

These cell assemblies are made of Type 316 stainless steel and can be pressurized using the Fann High Temperature High Pressure Filter Press manifolds. This aging cell is certified per the following American Society of Mechanical Engineers (ASME) standard:

ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1: Rules for Construction of Pressure Vessels

1.1 Document Conventions

The following icons are used as necessary in this 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

Safe laboratory practices and procedures should be observed while operating and maintaining the 600°F High Temperature Aging Cell.

Safe operation of the 600°F High Temperature Aging Cell requires the operator understanding and practicing the correct assembly and operation of the aging cell, as well as the oven used to heat them. The Model 802P 600°F Portable Roller Oven is the recommended oven for use with these aging cells.

EXPLOSION RISK! Do NOT heat the oven above the temperature rating of the test cell.

Improper assembly, operation, or the use of defective parts could result in cell leakage or failure, causing serious injury and damage.

The aging 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.

This section lists some precautions for safely operating and maintaining these aging cells.

2.1 Safe Pressurization

Some aging cells are designed to be pressurized before they are heated to prevent boiling the sample when the aging cell is heated.

A detailed pressurization procedure is described in Section 5. Some instructions and recommendations are listed in this section.

- 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 approximately 900 psig (6205 kPa) pressure. They are primarily used for field operations.

Do NOT allow the carbon dioxide cartridges to be heated or exposed to fire. They can explode if overheated.

- 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 that they will relieve excessive pressure. Never plug or bypass these safety valves.
- When pressurizing the aging cell always open the supply pressure first, and then adjust the regulator. Do not attempt to pressurize higher than the equipment's pressure rating or the relief valve settings.
- When de-pressurizing, shut off the supply pressure, and bleed the system of pressure. Then turn the regulator T-screw counterclockwise.

2.2 Safe Heating

Hot cells can cause severe burns.

Do NOT handle hot cells with bare hands.

The cell temperature should be less than 130°F (54°C) before pressure is released and the cell is opened.

- Avoid 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.
- It is recommended that the aging cells be removed from the heating chamber or oven after they have cooled to a temperature in which they can be safely handled.
- When handling hot cells, use approved pads or gloves.
- Removing the aging cell immediately after heat aging and cooling it under running water is very dangerous. This practice is not recommended because there is risk of getting burned.
- Be careful when placing a hot cell in water. The hot steam that is produced can cause burns.

2.3 Safe Test Cell Maintenance

EXPLOSION RISK! Do NOT heat the oven above the temperature rating of the test cell.

The aging cell assembly constitutes a pressure vessel. These safety precautions should be followed:

- The aging cell material should be compatible with the test sample.
- Aging cell bodies that show stress cracking, severe pitting, or that have damaged threads must not be used.
- Aging cell outer caps with damaged threads or set screw holes must not be used.
- Damaged set screws or low-strength, non-heat treated set screws must not be used.

3 Features and Specifications

This aging cell is designed for heat aging at high temperatures, up to 600°F (315°C). It is composed of Type 316 stainless steel. See Table 3-1 for its specification. Figure 3-1 shows its components. This aging cell assembly includes the valve stem for pressurizing.

Table 3-1 600°F High Temperature Aging Cell Specifications

Category	Specification
Maximum Temperature	600°F (315°C)
Maximum Allowable Working Pressure	2500 psi @ 850°F 17,237 kPa @ 454°C
Weight	16.5 lb (7.48 kg)
Cell Volume	550 ml
Certification	ASME BPV Code Section VIII Division 1

Figure 3-1 600°F High Temperature Aging Cell

When heat aging at 212°F (100°C) and higher, apply the recommended backpressure and add the volume of drilling fluid as shown in Table 3-2.

This cell is rated for 600°F (315°C).

Cell temperature is limited by the O-ring and sample volumetric expansion.

Table 3-2 Suggested Applied Pressure for 550 ml Aging Cell

Desired Aging Temperature		Absolute Water Vapor Pressure		Desired Total Cell Absolute Pressure	Initial Sample Volume (V_1)	Water Density	Water Volume	Total Sample Volume	Gas Volume	Applied Initial Pressure (P_1)	Calculated Final Pressure (P_2)
°F	°C	psia	kPa	psia	ml	1b/ft^3	ml	ml	ml	psig	psig
212	100	15	101	215	350	59.87	364	364	186	25	53
250	121	30	206	230	350	58.86	370	370	180	50	110
300	149	67	462	267	350	57.36	380	380	170	100	243
350	177	135	928	335	350	55.65	391	391	159	150	433
400	204	247	1705	447	350	53.72	406	406	144	200	709
450	232	422	2912	622	350	51.53	423	423	127	250	1113
500	260	681	4692	881	350	49.03	444	444	106	300	1731
520	271	812	5599	1012	350	47.92	455	455	95	250	1811
540	282	962	6634	1162	350	46.74	466	466	84	150	1679
560	293	1133	7810	1333	350	45.46	479	479	71	100	1734
580	304	1325	9138	1525	350	44.08	494	494	56	50	1760
600	316	1542	10635	1742	350	42.58	512	512	38	25	1937

4 Unpressurized Testing Procedure

Refer to Figure 4-1 for this procedure.

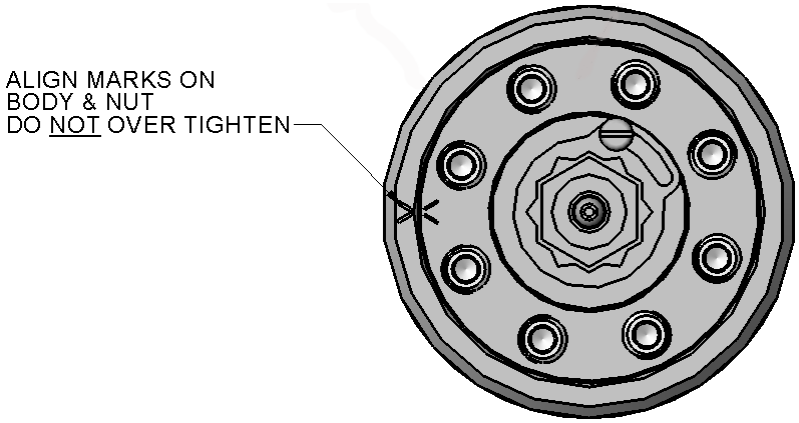
1. The safe sample volume for this cell is 350 ml. Pour 350 ml of drilling fluid into the aging cell.

Do NOT overfill the aging cell.

2. Make sure that the sealing edge of the cell is clean. Install the O-ring in the groove of the cell.

Two O-rings are available. Use the appropriate O-ring for the test temperature. See Table 9-3.

3. Put the cell cover in place.
4. Add the thrust washer.
5. Screw the nut on the body. See the instructions in the following drawing.



Aging Cell Top View

6. Use the 7/32-in. Allen Wrench to tighten the center set screws into the nut.

Tighten the set screws to a torque of 5 to 10 ft-lb (7 to 14 N-m).

7. Place the cell into a Fann roller oven or other suitable aging oven, and then set the oven to the desired aging temperature.

A hot air oven may also be used if it can maintain a constant, uniform temperature like the Fann roller ovens.

8. After the desired aging time has elapsed, remove the cell and cool the cell to less than 130°F (54°C).

The cell temperature must be less than 130°F (54°C) before the cell is opened.

Do NOT handle hot cells with bare hands. If the cell temperature is greater than 130°F (54°C), there is danger of being burned.

9. To open the cell, loosen the set screw and unscrew the nut. Then remove the cover.

10. Examine the aged drilling fluid and report the condition as gelled, plastic, or hard.

11. For shear strength testing, see the procedure in Section 6.

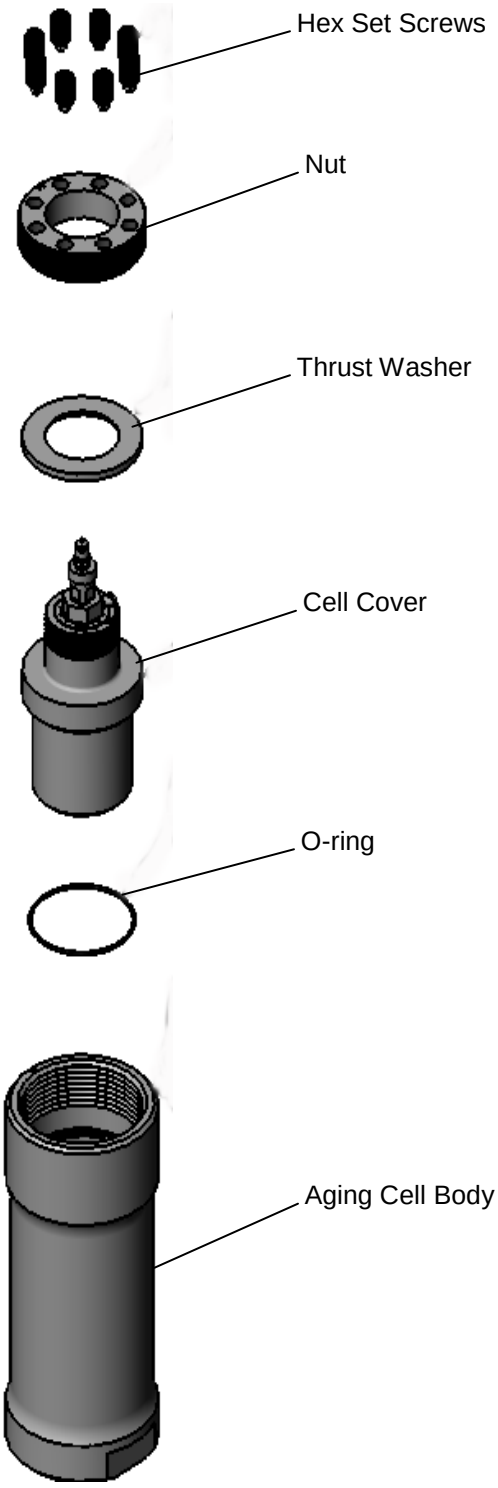


Figure 4-1 Unpressurized Aging Cell Assembly

5 Pressurized Testing Procedure

EXPLOSION RISK! Do NOT heat the oven above the temperature rating of the test cell.

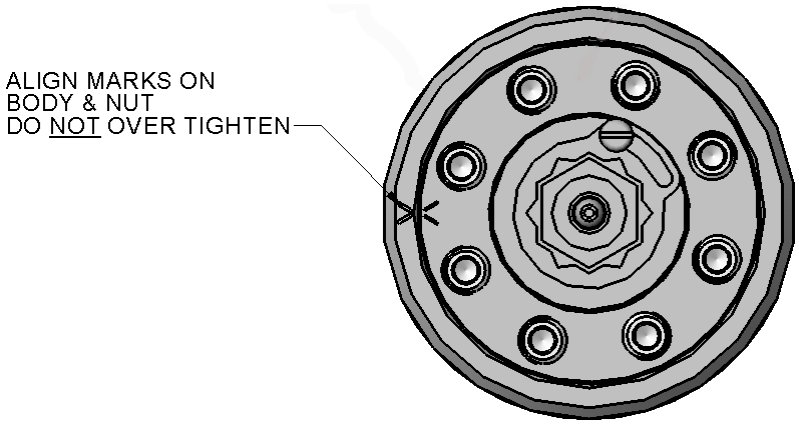
1. Use the chart shown in Table 3-2 to determine a safe volume and initial pressure for the aging test temperature.
2. Pour the drilling fluid into the aging cell.

Do NOT overfill the aging cell.

3. Make sure that the sealing edge of the cell is clean. Install the O-ring in the groove of the cell.

Two O-rings are available. Use the appropriate O-ring for the test temperature. See Table 9-3.

4. Put the cell cover in place.
5. Add the thrust washer.
6. Screw the nut on the body. See the instructions in the drawing below.



7. Use the 7/32-in. Allen wrench to tighten the center set screws into the nut.

Tighten the set screws to a torque of 5 to 10 ft-lb (7 to 14 N-m).

8. Pressurize with carbon dioxide, nitrogen, or air to the pressure that will prevent vaporization. Refer to Table 3-2.

   Usually, the carbon dioxide manifold for a high temperature, high pressure filter press is used for pressurizing aging cells. Its adapter will fit on the end of the valve stem. Figure 9-4 shows the carbon dioxide manifold assembly.

   Refer to Figure 9-3 for the nitrogen manifold assembly.

9. After the cell is pressurized, turn the valve stem clockwise until seated in order to close the valve stem.

10. Open the valve to bleed pressure from the pressuring assembly, and then pull the locking pin to disconnect the pressuring assembly.

11. Place the cell into the heating chamber and heat to desired temperature for the desired time.

12. Remove the cell from the heating chamber and let the cell cool until the sample temperature reduces to 130°F (54°C) or less. The cell may be cooled with or without water.

The cell temperature must be less than 130°F (54°C) before the cell is opened.

Do NOT handle hot cells with bare hands. If the cell temperature is greater than 130°F (54°C), there is danger of being burned.

13. Open the cell and examine the aged drilling fluid. Report its condition as fluid, gelled, plastic, or hard.

14. For shear strength testing, see the procedure in Section 6.

6 Shear Strength Test Procedure

The references for this procedure are as follows:

- API Recommended Practice for Field Testing Water Based Drilling Fluids, API RP 13B-1
- API Recommended Practice for Field Testing Oil Based Drilling Fluids, API RP 13B-2

Refer to Figure 6-1.

1. Place the stainless steel shear tube on the surface of the sample.
2. Place the stainless steel weight platform on top of the shear tube. This platform weighs 20 grams.
3. Add gram weights (small gram weights first) until the shear tube starts to sink into the sample. The shear tube will stop sinking when the shear strength of the gelled sample against the surface of the tube is sufficient to support the applied weight.
4. Measure the length of the tube exposed above the sample surface.
5. Calculate the length of the tube below the sample, X, as follows:

   3.5 in – X = Length of tube above sample surface

6. Calculate the shear strength as follows:

$$S = \frac{3.61W}{X} - 0.256U$$

where

S is shear strength in lb/100ft^2

W is the total shear weight in grams

U is the fluid density in lb/gal

X is the submerged length of shear tube in inches

7. For a 16 lb/gal sample, you can use the nomograph shown in Figure 6-2.

   Use the total shear weight and the length of the tube above sample surface to find the shear strength (lb/100ft^2) on the nomograph.

   - Total Shear Weight

     W (g) = 20 g + gram weights (weight applied to the shear tube)

   - Length of shear tube above sample surface (in)

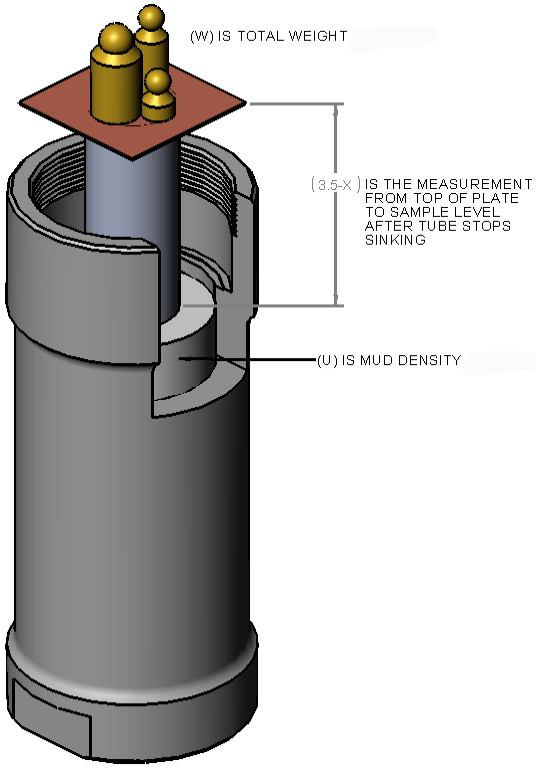


Figure 6-1 Shear Tube on Sample

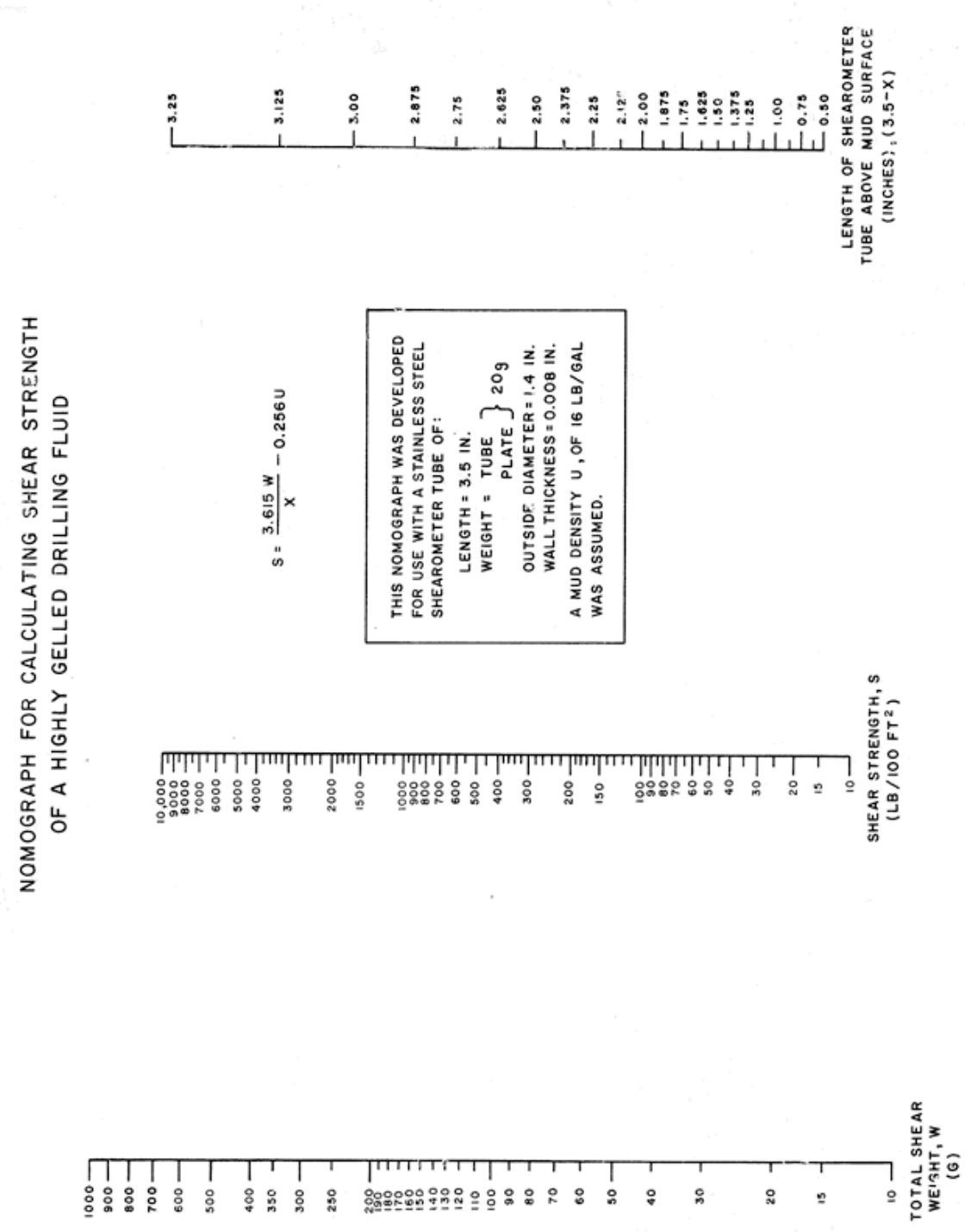


Figure 6-2 Nomograph for Calculating Shear Strength

7 Maintenance of Aging Cells

After each test, completely disassemble and thoroughly clean the aging cell.

Periodically, follow these instructions for maintaining the aging cells:

- Replace the O-ring located between the cover and the body after each test at 600°F (315°C).
- Remove, clean, and lubricate the set screws. Lubricate them with high-quality, high-temperature lubricant suitable for 600°F (315°C) (e.g., an anti-seize lubricant).
- Clean and lubricate the outer cap and cell thread.
- Thoroughly clean the inside of the cell and the inner cap. Make sure that the rounded corner between the wall and the bottom of the cell is clean and that it does not show corrosion. Minor corrosion may be removed by sandblasting.

Cell corrosion can result in corrosion stress cracking, which impairs the safety of the cell. Do NOT pressure or heat a cell showing stress cracks.

- For maintaining regulators and pressurizing assemblies, see the instructions for regulators.
- Shearometer parts should be cleaned and dried after use.

7.1 Replacing Graphite Yarn Packing

The graphite yarn packing material (P/N 102125489) found in the cell cap is shown in Figure 7-1 and 7-2. This material should be replaced within two years.

To find the graphite packing material, disassemble the cell as shown in Figure 7-2.

This part is included in the two year hard goods spare parts kit (P/N 102186520). See Table 8-3.

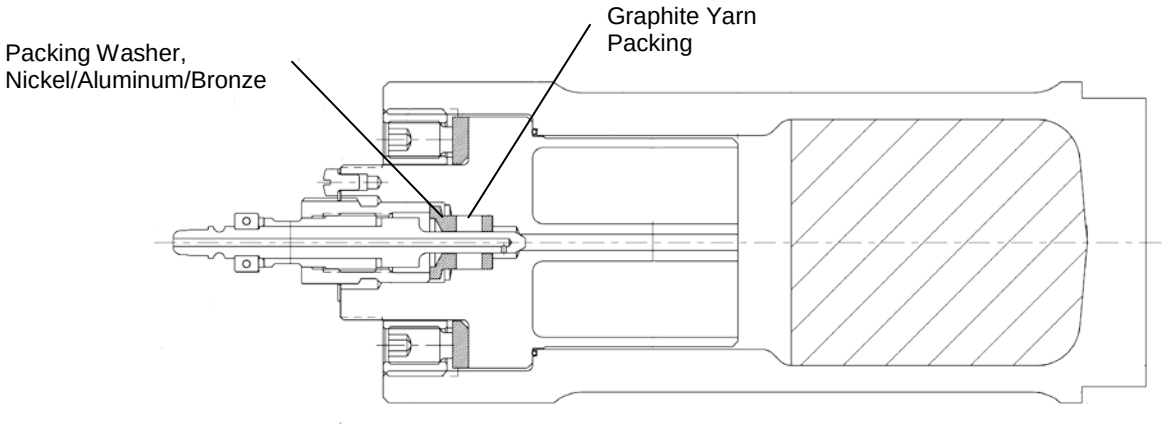


Figure 7-1 Cell Assembly Drawing

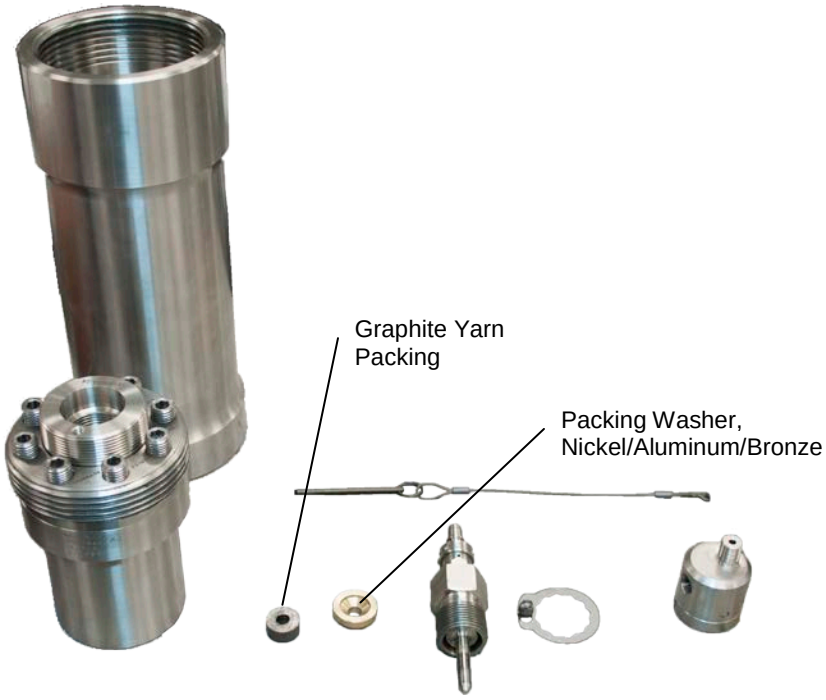


Figure 7-2 Disassembled Cell

8 Accessories and Kits

Table 8-1 Accessories

Part Number	Description
208608	Carbon Dioxide cartridges, 10/box
208654	Adjustable wrench, 6-in. for valve stem
209497	Cell Lifting Tool (pressurized cells only)

Table 8-2 One Year Soft Goods Spare Kit, P/N 102125514

Part Number	Quantity	Description
207455	16	O-ring, Viton®, 5/16 X 7/16
102124946	60	O-ring, Viton® 037 for 600°F Aging Cell
102124947	20	O-ring, Teflon® for 600°F Aging Cell

Table 8-3 Two Year Hard Goods Spare Parts Kit, P/N 102186520

Part Number	Quantity	Description
102125488	1	Thrust Washer
102125489	1	Graphite Yarn, Packing Material
102125490	1	Two-piece Clamp Style Collar
102125501	8	Hex Socket Set Screw, 7/16 -20 x 0.75 in
102125514	2	One Year Soft Goods Spare Kit

9 Parts List

Table 9-1 Aging Cell Assembly, P/N 102111608

Part Number	Description
102186464	600°F Aging Cell Assembly
102125482	Tool Kit Assembly (included)
102125513	Basic Accessories (included)

Table 9-2 Tool Kit Assembly, P/N 102125482

Part Number	Description
205637	Wrench for test ring nut
206718	Hex Key Wrench, 1/4 long arm
208654	Adjustable Wrench
210435	High Temperature Lubricant, 1 oz.
101781172	Screwdriver, Multi-bit
102125475	Open End Wrench, 1/2-in.
102178169	Adjustable Torque Screwdriver
102178170	Socket Adapter
102178171	Hex Bit Socket, 7/32-in.

Table 9-3 Basic Accessories, P/N 102125513

Part Number	Quantity	Description
204648	1	Safety Locking Pin
207455	4	O-ring, Viton®, 5/16 X 7/16
102027094	1	Manifold Block
102124946	20	O-ring, Viton® 037, 0°F to 450°F (17.8°C to 232°C)
102124947	5	O-ring, Teflon®, 0°F to 650°F (17.8°C to 343°C)
102125488	1	Thrust Washer
102125489	1	Graphite Yarn, Packing Material
102125490	1	Retaining Ring, Stainless Steel
102125501	8	Hex Socket Set Screw, 7/16 -20 x 0.75 in

Figure 9-1 600°F Aging Cell Assembly

Table 9-4 Shearometer Test Parts

Part No.	Description
206956	Stainless steel Shear Tube with weight support plate, 20 g
206967	Gram weights

Figure 9-2 Shear Tube

Table 9-5 Pressurizing Assemblies

Part No.	Description
102124747	Nitrogen Manifold Assembly
102124782	Carbon Dioxide Manifold Assembly

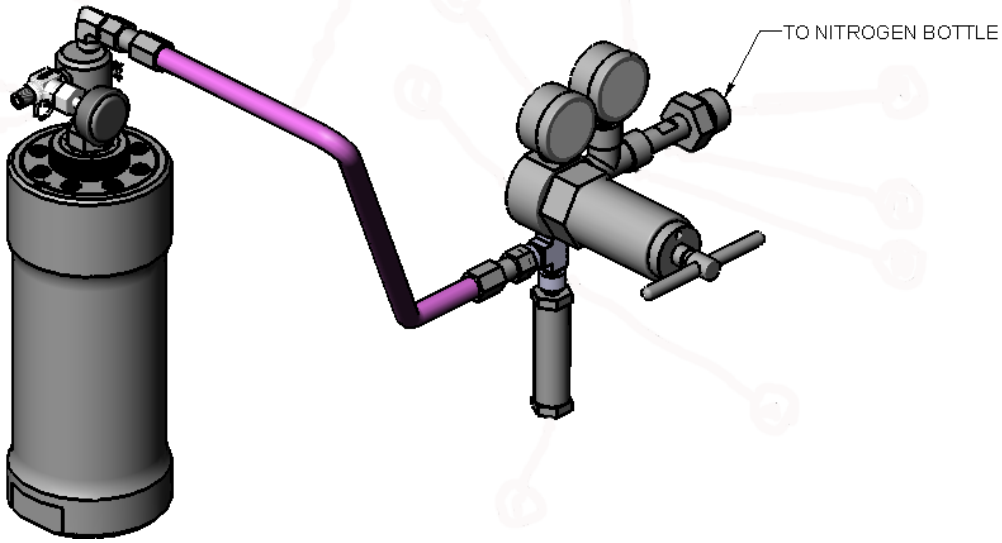


Figure 9-3 Nitrogen Manifold Assembly

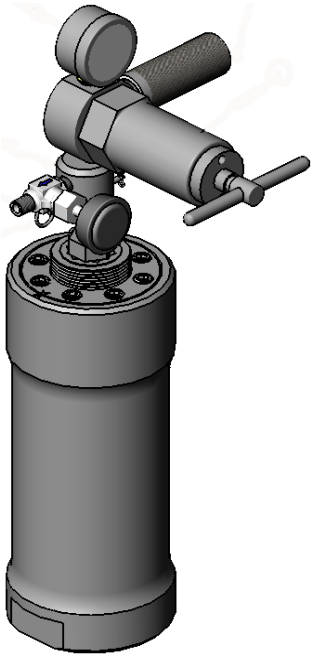


Figure 9-4 Carbon Dioxide Manifold Assembly

10 Warranty and Returns

10.1 Warranty

Fann Instrument Company warrants its products to be free from defects in material and workmanship for a period of 12 months from the time of shipment. If repair or adjustment is necessary, and has not been the result of abuse or misuse within the twelve-month period, please return, freight prepaid, and correction of the defect will be made without charge.

Out of warranty products will be repaired for a nominal charge.

Please refer to the accompanying warranty statement enclosed with the product.

10.2 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.

Our correspondence address is:

Fann Instrument Company
P.O. Box 4350
Houston, Texas USA 77210

Telephone: 281-871-4482
Toll Free: 800-347-0450
FAX: 281-871-4446

Email fannmail@fann.com

Our shipping address is:

Fann Instrument Company
14851 Milner Road, gate 5
Houston, Texas 77032