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Corrosion Test Cell

#175-40 - 303 Stainless Steel

#175-40-1 - 316 Stainless Steel

#175-40-H - Hastelloy

Instruction Manual

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Ver. 3.0

OFI Testing Equipment, Inc.

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Intro

The OFITE Corrosion Test Cell is a pressure vessel that has been modified to hold a special corrosion coupon suspended inside the cell to accurately analyze corrosion rates under carefully controlled conditions of elevated temperatures and pressures. Corrosion may be defined as the decomposition of the metallic state of an element. It is a process that, if untreated, continues until all of the metal turns to rust or decomposes into the oxide or salt that nature intended it to be. For iron based metals, namely steel, there is no known way of avoiding corrosion and it will happen whether we like it or not. The most we can do is to control it in a way that it does not happen rapidly, or concentrate in any one spot. It is a proven fact that uniform corrosion can and will accelerate if left uncontrolled. The best way to determine if this is occurring is to place a sacrificial surface (coupon) in the fluid path and observe its wear by weight difference.

The OFITE Corrosion Test Cell enables us to accurately monitor the amount of corrosion and also the rate at which it occurs. We also can accurately monitor the effectiveness of corrosion inhibitors under a carefully controlled environment. The amount of metal loss is directly proportional to the corrosivity of the fluid as the central mounting placement of the coupon within the cell ensures there is no erosion (frictional loss) and the coupon mounting effectively eliminates any galvanic corrosion.

The standard OFITE Corrosion Test Cell is manufactured from Stainless Steel in grades 303 (175-40) or 316 (175-40-1). For testing highly corrosive fluids, Hastelloy® and Inconel® cells are available by special order.

Description

The special Corrosion Test Cell Inner Cap may be used with any of the OFITE style 500 mL stainless steel Aging Cells. The cap is designed to hold a flat Corrosion Coupon suspended inside the cell to prevent contact with the cell walls or any other metallic surface. The coupon is attached to the holder with a grommet which prevents galvanic corrosion from occurring. The flow of pressurized air or gas into the cell is directed away from the coupon to prevent erosion and possible injected contaminants which could adversely affect the coupon weight.

Flat Corrosion coupons are typically used in aging cells in a laboratory environment or at select locations within the flow line. Coupons should never be handled without wearing protective gloves. The Corrosion Coupon should be kept inside the cell for a minimum of 16 hours, with time periods of 40 or even 100 hours considered normal. Shorter exposure times should be avoided because initial corrosion rates may be unusually high and can give misleading data. After exposure to the fluid for a period of time the difference between the initial and the final weights (or the weight loss) is attributed to corrosion. The corrosion rate is calculated and reported as lbs/ft²/yr, or mils per year (my). The term “mils per year” refers to the loss of metal in thousandths of an inch per year.

Parts and Accessories



Caps

- #175-13 Outer Cap for Pressurized Aging Cells, 303 Stainless Steel
- #175-45 Inner Cap with Coupon Holder, 303 Stainless Steel
- #175-45-1 Inner Cap with Coupon Holder, 316 Stainless Steel
- #175-45-2 Inner Cap, Hastelloy, C-276

O-rings and Gaskets

For tests below 200°F:

- #175-54 Buna N O-ring for Outside of Aging Cell

For tests up to 400°F:

- #170-17 Viton® O-ring for Valve Stem
- #175-09-2 Viton® O-ring for Inside of Aging Cell Body
- #175-47 Viton® O-ring for Outside of Aging Cell

For tests above 400°F:

- #175-09-1 Teflon® O-ring for Inside of Aging Cell Body
- #175-46 Teflon® O-ring for Outside of Aging Cell
- #175-03 Peek O-ring for Inside of Aging Cell Body

**Buna N O-rings should only be used for temperatures below 200°F.
Viton® O-rings can be used at temperatures up to 400°F.
Teflon® O-rings should be used for temperatures above 400°F.**

Set Screws and Wrenches

- #175-14 Set Screw for Pressurized Aging Cells; 3/8"
- #175-15 Wrench for 3/8" Set Screw

Other

- #175-05 Thrust Washer
- #175-16 Valve Stem
- #180-04 Grommets, Package of 10

Optional

- #180-12 Corrosion Coupon, 1/16" × 1" × 3"
- #180-34 Corrosion Coupon, 1/16" × 3/4" × 3"

#175-40-SP Spare Parts Kit

- #165-44 High-Temperature Thread Lubricant, 1 oz, Qty: 2
- #170-17 O-ring for Valve Stem, Viton®, 36
- #175-09-1 O-ring for Inside of Aging Cell, Teflon®, Qty: 12
- #175-09-2 O-ring for Inside of Aging Cell, Viton®, Qty: 12
- #175-14 Set Screw, 3/8", Qty: 6
- #175-15 Wrench for Set Screws
- #175-16 Valve Stem, Qty: 6
- #175-46 O-ring for Outside of Aging Cell, Teflon®, Qty: 4
- #180-04 Grommet, Package of 10, Qty: 6

Specifications

Maximum Temperature: 500°F (260°C)
 Maximum Pressure: 2,000 PSI (13.8 MPa)

For tests above 200°F, refer to the chart below for the appropriate pressure.

Mud Volume and Pressure for High-Temperature Aging					
Aging Temp. (°F / °C)	Water Vapor Pressure (PSI)	Coefficient of Expansion of Water	Suggested Applied Pressure (PSI / kPa)	Mud Volume in 260 mL Cell (mL)	Mud Volume in 500 mL Cell (mL)
212 / 100	14.7	1.04	25 / 172	225	450
250 / 121	30	1.06	50 / 345	225	450
300 / 149	67	1.09	100 / 690	200	425
350 / 176	135	1.12	150 / 1,034	200	400
400 / 204	247	1.16	250 / 1,724	-	375
450 / 232	423	1.20	300 / 2,069	-	375
500 / 260	680	1.27	375 / 2,586	-	325



Do not use nitrous oxide cartridges as pressure sources for high-temperature, high-pressure (HTHP) aging. Under high temperature and pressure, Nitrous Oxide can detonate in the presence of grease, oil, or carbonaceous materials. Nitrous Oxide cartridges are to be used only for Garrett Gas Train Carbonate Analysis.



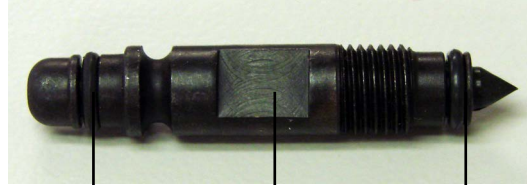
Carbon Dioxide and Nitrous Oxide cartridges are pressurized to approximately 900 PSI at 1 atmosphere (sea level). Therefore, they should never be transported by airplane without proper packing because cabin de-pressurization may cause an explosion.



If the aging cells are going to be rolled in a roller oven during a test, install o-rings on the outer perimeter on the top and bottom of the cells. Failure to do so can damage the rollers in the oven. Teflon (#175-46), Viton® (#175-47), and Buna N (#175-54) o-rings are available.

Procedure

1. Carefully inspect all o-rings for defects. Place one o-ring in the groove inside the cell body and two in the grooves in the valve stems. Replace any o-rings that are hard or have cuts or nicks. Blow air through the valve stem to make sure it is not plugged. Replace all o-rings after any test above 350°F (177°C).



O-ring (#170-17) Valve Stem (#175-16) O-ring (#170-17)

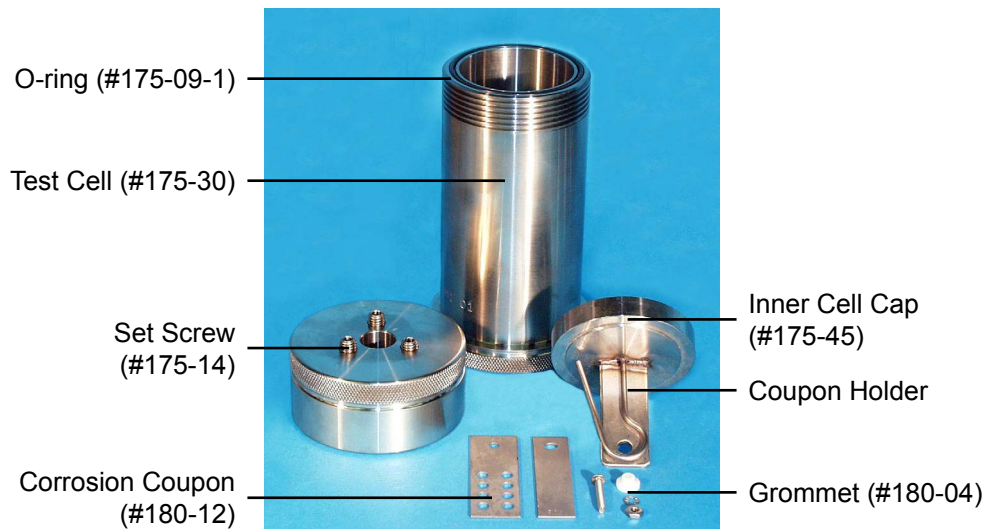
2. Attach the Nylon grommet to the hole in the corrosion coupon. Thread the supplied screw through the grommet and into the hole in the coupon holder on the inner cap. Secure it in place with the washer and nut. Be sure the corrosion coupon does not come in contact with any other metal surfaces.

Always handle the Corrosion Coupon with clean, dry gloves.



Do not throw away or lose the “OFITE Mailer” as this has the original weight (to 4 decimal places) and the serial number for the corrosion coupon.

3. Carefully pour the test fluid into the cell. Clean any spilled fluid from the edge of the cell. Carefully place the special inner cap onto the cell body so that it seats into place. Hand tighten the outer cap into place. With the supplied allen wrench, tighten the three set screws on top of the outer cap. Insert the valve stem into the inner cap and tighten it completely. To pressurize the cell, loosen the valve stem approximately one half turn and initiate pressurization.



4. When the desired pressure is reached, close the valve stem by tightening it with the wrench. To ensure there are no leaks, immerse the cell in water and check for bubbles originating from the valve stem or cell cap.
5. Place the Corrosion Test Cell into a heating oven or chamber and heat to the desired temperature or for the desired time interval.
6. Remove the Corrosion Test Cell from the heating chamber and allow it to cool until the sample has reached ambient temperature. The cell may be either air or water cooled.
7. When the cell has reached ambient temperature, open the valve stem very slowly to release the pressure. When the pressure has been released, open the cell.



Note

If the pressure inside the cell has not been fully released, the outer cell cap cannot be removed. This is a safety measure built into the Aging and Corrosion Test Cells.

8. Remove any fluid residue from the corrosion coupon by carefully wiping it with a cloth. Examine the coupon to determine the severity of the corrosion. If severe corrosion is evident, the cause should be determined and remedial action taken. The Corrosion Test cell is an ideal vessel for this analysis.
9. As soon as possible, the cleaned coupon should be carefully weighed on a precision scale to four decimal places and the number noted as the final weight. This will be entered into the equation on page 6 to determine the amount of corrosive activity present. The OFITE Mailer should be filled out with the final coupon weight and the coupon may then be stored in the mailer for future reference. If no scale is available that is accurate to four decimal places, the coupon may be mailed to OFI Testing Equipment for re-weighing. There will be a nominal charge for this service. Mail the coupon to:

OFI Testing Equipment
11302 Steeplecrest Dr.
Houston, TX. 77065 U.S.A.

Please be sure to include your name, address, phone, and fax number.

10. The Corrosion Test Cell must be thoroughly cleaned after every test. Clean out the valve stem with water and blow out any residual liquid from inside the stem. Clean out the cell body, paying particular attention to the o-ring and o-ring grooves. Carefully inspect the inner cell cap for residual liquid that may be trapped along or inside the air channel on the coupon holder.

Calculations

$$\frac{\text{lbs.}}{\text{ft}^2 \text{ year}} = \frac{\text{Weight Loss (g)}}{\text{Exposure Time (h)}} \times \text{K Factor}$$

$$\text{mils per year (mpy)} = \frac{\text{lbs.}}{\text{ft}^2 \text{ year}} \times 24.6$$

The K Factor is a constant that contains the area and density of the corrosion coupon. The K Factor will be printed on the coupon packaging.

A corrosion rate of 2 lbs/ft²/year or 50 mpy is a reasonable criteria for corrosion rate but this may vary with individual conditions.

Warranty and Return Policy

Warranty:

OFI Testing Equipment, Inc. (OFITE) warrants that the products shall be free from liens and defects in title, and shall conform in all respects to the terms of the sales order and the specifications applicable to the products. All products shall be furnished subject to OFITE's standard manufacturing variations and practices. Unless the warranty period is otherwise extended in writing, the following warranty shall apply: if, at any time prior to twelve (12) months from the date of invoice, the products, or any part thereof, do not conform to these warranties or to the specifications applicable thereto, and OFITE is so notified in writing upon discovery, OFITE shall promptly repair or replace the defective products. Notwithstanding the foregoing, OFITE's warranty obligations shall not extend to any use by the buyer of the products in conditions more severe than OFITE's recommendations, nor to any defects which were visually observable by the buyer but which are not promptly brought to OFITE's attention.

In the event that the buyer has purchased installation and commissioning services on applicable products, the above warranty shall extend for an additional period of twelve (12) months from the date of the original warranty expiration for such products.

In the event that OFITE is requested to provide customized research and development for the buyer, OFITE shall use its best efforts but makes no guarantees to the buyer that any products will be provided.

OFITE makes no other warranties or guarantees to the buyer, either express or implied, and the warranties provided in this clause shall be exclusive of any other warranties including ANY IMPLIED OR STATUTORY WARRANTIES OF FITNESS FOR PURPOSE, MERCHANTABILITY, AND OTHER STATUTORY REMEDIES WHICH ARE WAIVED.

This limited warranty does not cover any losses or damages that occur as a result of:

- Improper installation or maintenance of the products
- Misuse
- Neglect
- Adjustment by non-authorized sources
- Improper environment
- Excessive or inadequate heating or air conditioning or electrical power failures, surges, or other irregularities
- Equipment, products, or material not manufactured by OFITE
- Firmware or hardware that have been modified or altered by a third party
- Consumable parts (bearings, accessories, etc.)

Returns and Repairs:

Items being returned must be carefully packaged to prevent damage in shipment and insured against possible damage or loss. OFITE will not be responsible for equipment damaged due to insufficient packaging.

Any non-defective items returned to OFITE within ninety (90) days of invoice are subject to a 15% restocking fee. Items returned must be received by OFITE in original condition for it to be accepted. Reagents and special order items will not be accepted for return or refund.

OFITE employs experienced personnel to service and repair equipment manufactured by us, as well as other companies. To help expedite the repair process, please include a repair form with all equipment sent to OFITE for repair. Be sure to include your name, company name, phone number, email address, detailed description of work to be done, purchase order number, and a shipping address for returning the equipment. All repairs performed as "repair as needed" are subject to the ninety (90) day limited warranty. All "Certified Repairs" are subject to the twelve (12) month limited warranty.

Returns and potential warranty repairs require a Return Material Authorization (RMA) number. An RMA form is available from your sales or service representative.

Please ship all equipment (with the RMA number for returns or warranty repairs) to the following address:

OFI Testing Equipment, Inc.
Attn: Repair Department
11302 Steeplecrest Dr.
Houston, TX 77065
USA

OFITE also offers competitive service contracts for repairing and/or maintaining your lab equipment, including equipment from other manufacturers. For more information about our technical support and repair services, please contact techservice@ofite.com.