



Circular Cement Expansion Mold

Part No. 122-90

Instruction Manual

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Ver. 1.1

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Intro

The Circular Cement Expansion Mold is designed to measure the expansion or shrinkage characteristics of well cement slurries. In a typical well cementing operation, a cement slurry is pumped into the annulus between the well casing and the bore hole. As the cement slurry hydrates, it undergoes a volume change which translates into bulk expansion or shrinkage. Knowing the amount of expansion or shrinkage allows users to design cement systems which can achieve optimal bonding with the borehole and well casing without sacrificing the integrity of the cement matrix.

The Circular Cement Expansion Mold's external ring has a vertical slit on one side to allow it to expand. Before testing begins, the width of the gap is measured with the included micrometer. The expansion mold is then filled with a cement slurry and cured in a water bath or curing chamber. As the cement cures, the external ring will expand or contract with the cement slurry. At the end of the test, the gap is measured again to determine the expansion factor.

This device conforms to the guide lines in API Recommended Practice 10B-5 (ISO 10426-5:2004).

Components

#122-90 Circular Expansion Mold Kit (Includes mold, micrometer, micrometer stand, and carrying case)

#122-90-010 Circular Cement Expansion Mold

#122-90-011 Base

#122-90-012 Lid

#122-90-013 Internal Ring

#122-90-014 External Ring

#122-90-015 Spacer Block

#122-90-020 Micrometer Stand Assembly

#122-90-021 Base

#122-90-022 Clamp

#700-100-229 Knob

#122-90-030 Micrometer 0" - 1", .00005" accuracy

#122-90-040 Carrying Case with Custom Foam Insert

Preparation

Prepare the mold so that it is watertight to avoid leakage. Line the interior faces of the molds and contact surfaces of the plates with a light coat of release agent. If a release agent is not required, make sure the interior faces of the molds and contact surfaces are clean and dry. To test for shrinkage, insert the spacer block (#122-90-015) inside the split of the external ring.

To prepare the mold, follow these steps. See page 9 for a diagram of parts:

1. Clean the mold thoroughly.
2. Place a bead of grease on the lid and base plates where the internal and external rings touch.
3. If desired, apply a thin film of grease to the internal and external rings and to the surface of the lid and base components that will contact the cement.
4. With the lid inverted, place the internal and external rings on the lid.
5. Place the base over the internal and external rings.
6. Insert the hex socket cap screw into the center hole and tighten it with a $\frac{1}{4}$ " hex wrench to hold the mold together.
7. Confirm that the external ring spins freely and place the larger hole adjacent to the split as shown below.



8. Apply a small amount of grease between the split in the external ring so that the grease seals the split. This will prevent the slurry from leaking before it sets.
9. To test for shrinkage, coat a spacer block with grease and insert the block between the split in the external ring as shown below.



Spacer Block



Note

A micrometer is to be mounted on a block that can be placed on a counter top beside the mold so the measuring contact balls on the expandable ring are centered between the micrometer's measuring contacts as shown below. Using the micrometer without the block mount can cause an inaccurate measurement. See page 6.

Operation



Tip



Tip

1. Mix the test samples in accordance with API RP 10 B2 Clause 5 (ISO 10426-2:2003).
2. Condition the slurry in an atmospheric or pressurized consistometer according to the appropriate conditioning schedule as determined by API RP 10 B2 Clause 5 (ISO 10426-2:2003) or other desired schedule.

To avoid the risk of thermally shocking temperature-sensitive slurries, place the slurry cups in the consistometer at ambient temperature.

The mold can also be preheated to the test temperature in an oven.

3. Once the conditioning period is complete, remove the slurry cup containing the cement slurry from the consistometer.

Stir the slurry with a spatula to ensure the solids are properly dispersed.

4. Fill the mold assembly:
 - a. Pour the slurry into the large fill hole of the top of the mold.
The small hole was designed to allow ventilation while filling the mold.
 - b. Fill the mold until the slurry seeps through the small hole.
For thicker slurries, tap or vibrate the mold while filling to make sure it has been filled completely.
 - c. Use a modified syringe to transfer slurries that are too thick to pour freely. A syringe can be modified by cutting the tip off of a 60 mL syringe and widening the opening to approximately $\frac{1}{4}$ " – $\frac{3}{8}$ " (6.5 mm – 9.5 mm). Use the modified syringe to transfer the thick slurry to the large hole of the mold until the mold is filled completely.
5. Take an initial measurement with a micrometer immediately after the mold is filled with slurry and before placing the mold into a curing bath.
6. Place the filled mold assembly into the atmospheric curing bath.



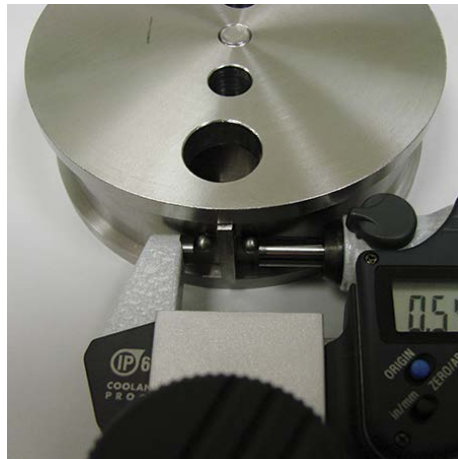
7. Once the sample has been cured, remove the mold from the water bath.
Carefully remove the spacer block (if used). Do not expand the outer ring while attempting to remove the spacer block.
8. Use the provided micrometer to measure the distance between the two steel balls with a precision of 0.02 mm (0.001"). Take this measurement immediately (Less than 5 minutes) after removing the mold from the atmospheric curing bath or the 170°F (77°C) cooling bath to prevent the specimen from cooling significantly, which may cause an inaccurate measurement.



Micrometer and Adapter Pieces



Micrometer Mounted to Adapter



Micrometer Measuring



Micrometer Alignment

Calculations

(API Recommended Practice 10B-5)

1. The percent circumferential change (shrinkage or expansion) is calculated from measurements in SI units as follows:

$$l_{\Delta,SI} = (l_{f,SI} - l_{i,SI}) \times 0.358$$

where

$l_{\Delta,SI}$ – is the circumferential change, expressed in percent, of the cement sample;

$l_{f,SI}$ – is the final distance, expressed in millimeters, after curing;

$l_{i,SI}$ – is the initial distance, expressed in millimeters.

2. Alternatively, the percent circumferential change (shrinkage or expansion) can be calculated from measurements in U.S. Customary units as follows:

$$l_{\Delta,US} = (l_{f,US} - l_{i,US}) \times 9.095$$

where

$l_{\Delta,US}$ – is the circumferential change, expressed in percent, of the cement sample;

$l_{f,US}$ – is the final distance, expressed in inches, after curing;

$l_{i,US}$ – is the initial distance, expressed in inches.



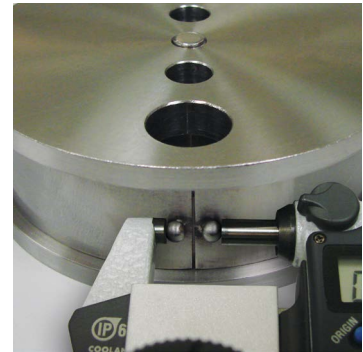
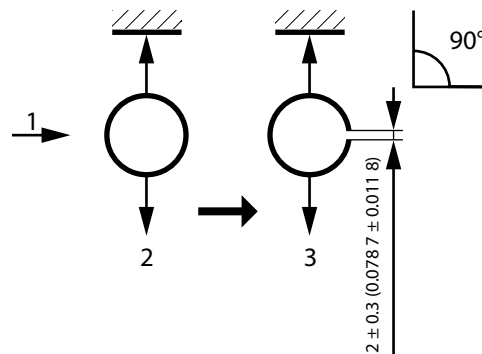
Note

It is possible to measure either shrinkage or expansion with this test, a positive $l_{\Delta,US}$ or $l_{\Delta,SI}$ indicates expansion, a negative $l_{\Delta,US}$ or $l_{\Delta,SI}$ indicates shrinkage.

The expansion is expressed by the change in circumference as measured by the change in distance between the balls. The measurement is actually a chord and not an arc, but because the difference is small, it can be neglected. Because of the small distance between the measurement balls, no correction is needed for extrapolating from the initial measurement of the mould at room temperature to the measurement at the actual test temperature. The theoretical correction for the metal used in the moulds is 0.005% for each 35°C (100°F) above the initial room temperature measurement. The result shall be reported with the corresponding test period.

Mold Calibration

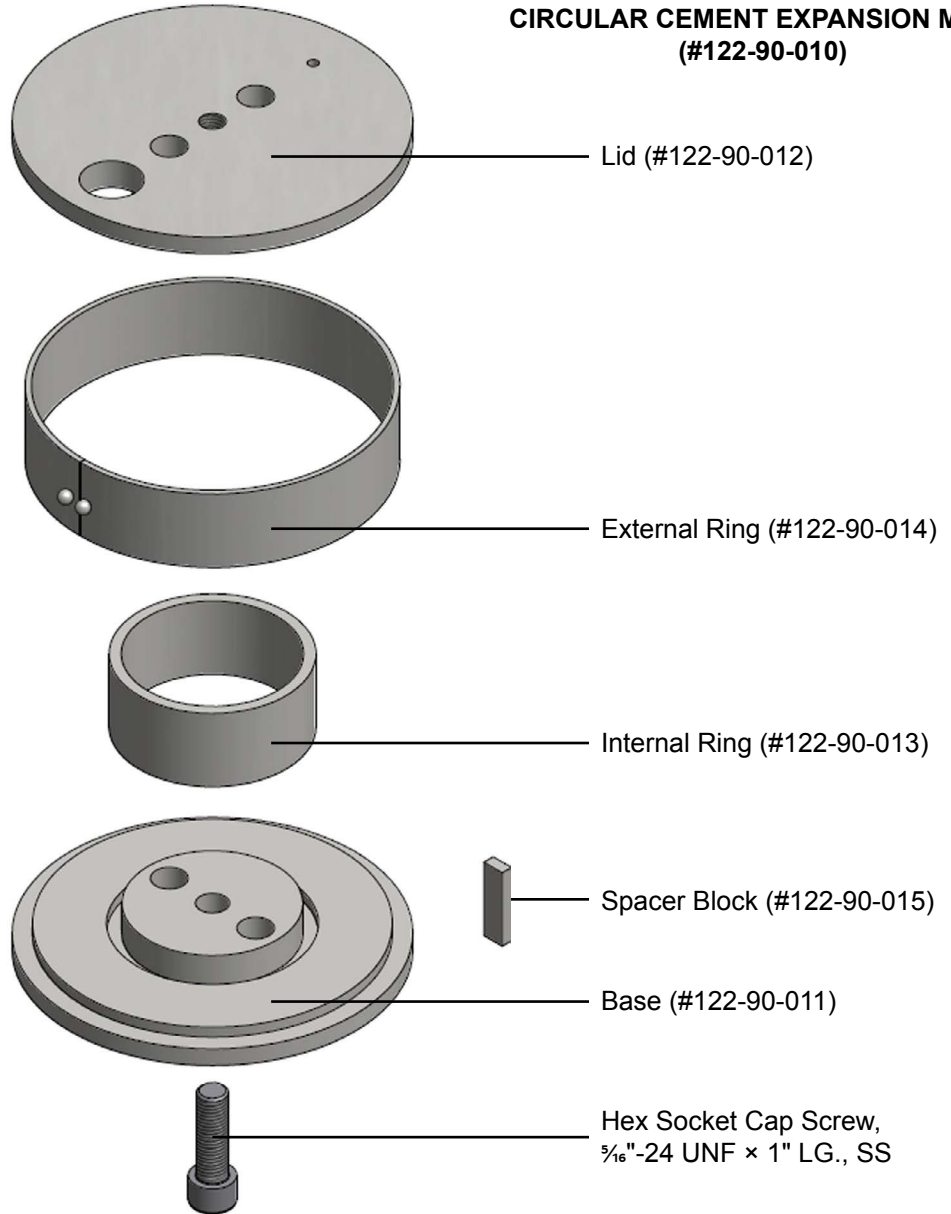
The resilience of the ring of the mold should be calibrated annually. The resilience should be such that the mass of $1,000\text{ g} \pm 1\text{ g}$ ($2.204\text{ lb} \pm 0.002\text{ lb}$) applied as shown below shall increase the distance between the two steel measurement balls by $2\text{ mm} \pm 0.3\text{ mm}$ ($0.0787\text{ in} \pm 0.0118\text{ in}$) without permanent deformation (see diagram below).



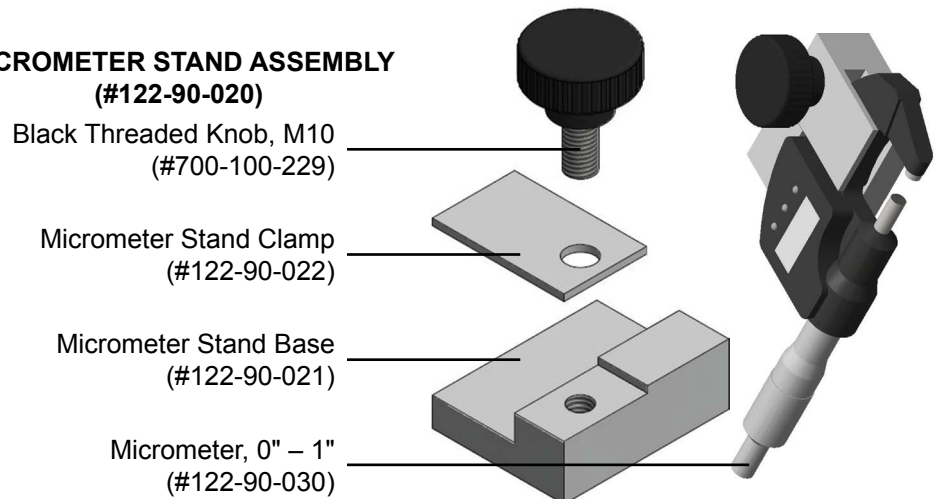
Apply the load perpendicularly to the gap (90°) in order to avoid errors, which can be easily made. Repeat the measurements at least three times to obtain an average value with a standard deviation of 0.05 mm (0.002 in).

Diagrams

CIRCULAR CEMENT EXPANSION MOLD (#122-90-010)



MICROMETER STAND ASSEMBLY (#122-90-020)



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.