CEMENT TEST EQUIPMENT, INC.

Tulsa, Oklahoma, USA

Expansion Mold Instruction Manual

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Expansion Mold User's Manual

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Table of Contents

Chapter 1

Introduction

This chapter contains general information about the expansion mold and its use as well as detailed specifications.

Use of an expansion mold

The expansion mold is designed to simulate the expansion properties of cement compositions placed into the annulus of a well. In a typical well cementing operation, a cement slurry is run into the annulus between the well casing and the bore hole, frequently at more than one location in the bore hole. As the cement slurry hardens to a solid during the setting-up period, it is essential that the cement composition expand sufficiently to provide a good bond with the well casing and also the wall of the borehole. Otherwise, if the cement should shrink during hardening, it can leave channels between the borehole wall and the cement column and between the cement column and the well casing. This "channeling" effect is undesirable for several reasons. One reason is that gas or oil from a producing formation could leak into these channels and thus by-pass the production tubing which carries it to the well head.

Description of the mold

The expansion mold includes a cylindrical sleeve which has a vertical slit on one side to allow the sleeve to expand. On the outside of the sleeve is a set of stainless steel pins located on opposite sides of the slit. A spring is utilized across the pins to keep the sleeve in a closed position before a test has begun. In the test procedure, the sleeve is filled with wet cement, which is then cured to a solid phase. As the cement cures it causes the sleeve to expand along with the spring. The actual expansion of the sleeve represents an expansion factor for the cement. This factor is calculated by measuring the distance across the pins, first by making a measurement when the sleeve is empty and again after the cured cement expands the sleeve. CTE offers two sizes of expansion molds, one to fit CTE curing chamber pressure

vessels and another to fit CTE UCA pressure vessels. Mold units are stackable.

Mold Specifications

CURING CHAMBER SIZE EXPANSION MOLD

MECHANICAL

Height:	1.29in (3.3cm)
Diameter:	3.9in (9.9cm)
Weight:	2.21lbs (1kg)
AVG Inside Diameter	3.35in (8.5cm)*
Sleeve Material	316L Stainless Steel

UCA SIZE EXPANSION MOLD

MECHANICAL

Height:	1.16in (2.95cm)
Diameter:	2.18in (5.5cm)
Weight:	0.51lbs (0.23kg)
AVG Inside Diameter	1.79in (4.55cm)*
Sleeve Material	316L Stainless Steel

* Do not use this number for calculation of linear expansion. Inside radius (R) must be measured separately for each test.

Part # 05-0100-1; For use in a CTE UCA pressure vessel.

Part # 05-0100; For use in a CTE curing chamber pressure vessel.

Side by side size comparison

Chapter 2

Preparation and Calculating Linear Expansion

1. Clean all surfaces of the expansion mold. Removing cement from threads and all metal surfaces.
2. Lightly coat the metal surfaces that will be exposed to the cement slurry with mold grease.
3. Assemble the expansion mold using the shoulder screw provided. Do not overtighten the shoulder screw. Only a sufficient amount of torque should be used that still allows the outer ring to expand freely.
4. Install the tension spring between the two stainless steel pins.
5. Measure the linear distance between the two stainless steel pins in a closed position and at room temperature prior to filling with cement. Record this number (C_1). A digital, outside micrometer is typically used for a precise measurement.
6. Fill the expansion mold with slurry and purge the entrained air. There is a large and small hole on one side of the expansion mold. Fill using the large hole. The small hole is to help remove trapped air. Note: On the curing chamber expansion mold 05-0100, there are two holes in the center-do not fill into these holes. These are present to facilitate heating or cooling.
7. Place the expansion mold into the autoclave and perform a curing test as usual per assignment specifications. An optional bucket can be supplied for use in autoclaves that use oil as its pressure medium. The bucket is filled with water prior to placing into the cylinder.
8. When the curing period is finished, the entire unit is removed from the autoclave. At this point, the cement composition inside the sleeve has solidified and expanded, such that it has caused the circumference of the sleeve to increase in size. The sleeve is then allowed to cool back down to room temperature at atmospheric pressure. The sleeve must be brought back to identical conditions from when the first measurement was made.
9. Measure the expanded linear distance between the stainless steel pins on the expanded sleeve using the micrometer (C_2). The expansion of the cement composition during curing is then calculated from the following equation:

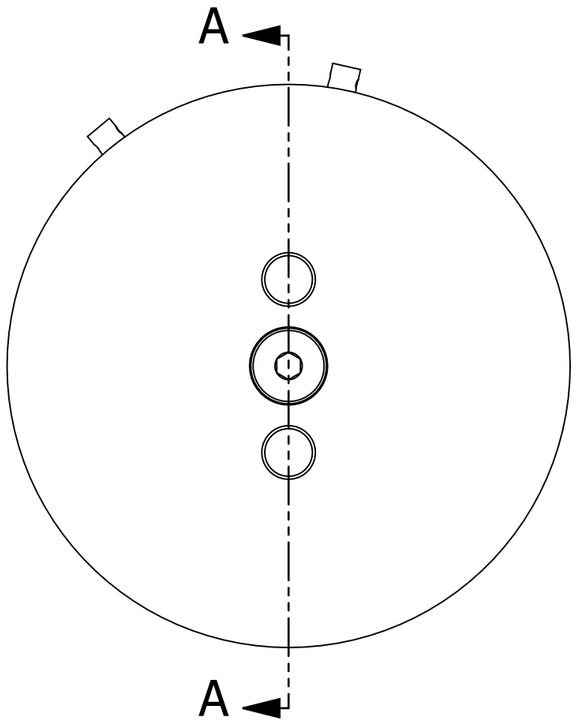
$$100\left[\frac{r}{R}\left(\frac{C_2}{C_1}-1\right)\right] = \%\ Linear\ Expansion$$

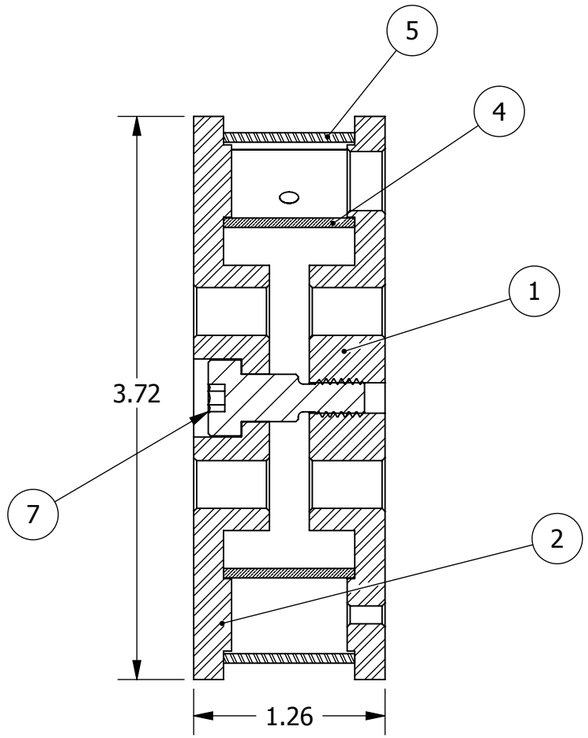
C_1 = distance between stainless steel pins before curing
C_2 = distance between stainless steel pins after curing
R = inside radius of sleeve (Inside Diameter/2)
r = R + center line height of calipers at the point of measurement from the surface of the sleeve + thickness of outer ring.

The equation set out above simplifies the calculation of the change in size of the inside diameter of the sleeve, resulting in percent linear expansion. Some error is introduced by the foregoing, which is an approximation that assumes the expansion is small, for example, on the order of one percent. But in relative terms, the information derived from this device, and the measurements taken, provide useful data when comparing different cement compositions under constant conditions.

Appendix

Drawings





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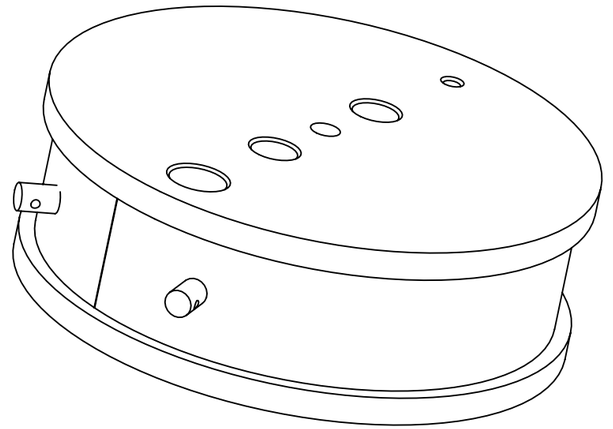


ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	05-0101	TOP	1
2	05-0102	BOTTOM	1
3	05-0106	EXPANSION MOLD TERMINAL	2
4	05-0103	INNER RING	1
5	05-0104	OUTER RING	1
6	C-1412	SPRING, EXPANSION MOLD (NOT SHOWN)	1
7	94035A303	SS Precision Hex Socket Shoulder Screw 5/16" Shoulder Dia, 3/8" L Shoulder, 1/4"-20 Thread	1

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/32
ANGULAR: ± 1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	GRH	05-28-09
CHECKED	GRH	05-28-09
ENG APPR.	GRH	05-28-09
MFG APPR.	GRH	05-28-09
Q.A.	GRH	05-28-09

COMMENTS:

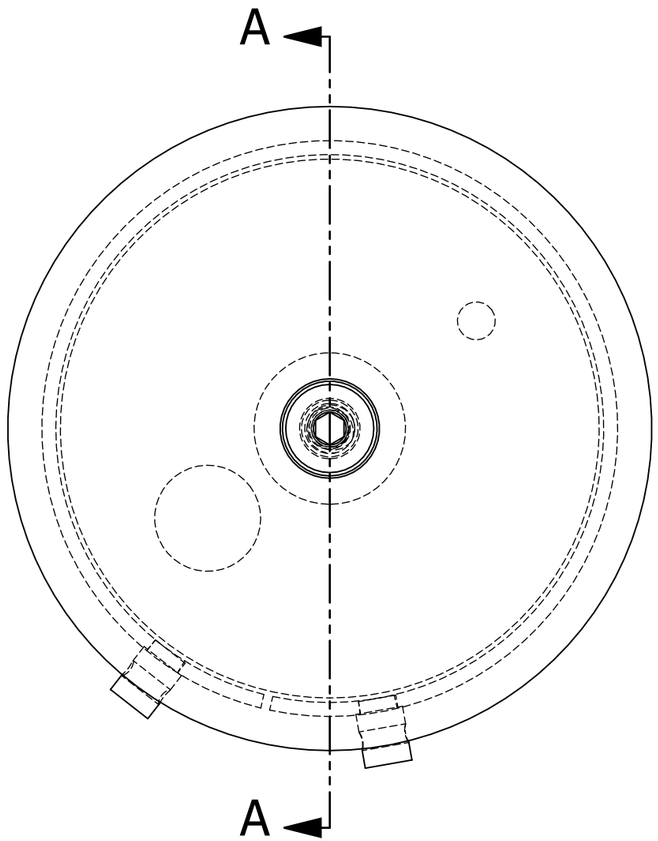
Cement Test Equipment

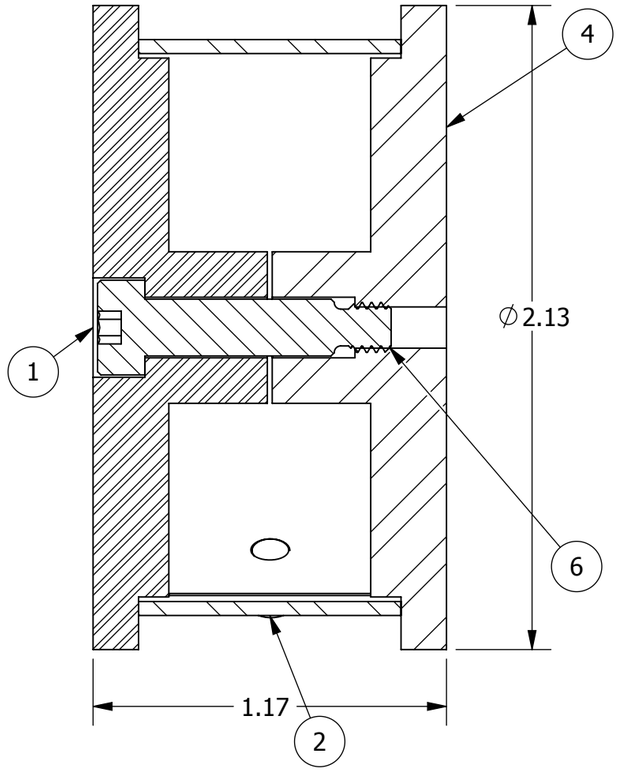
TITLE:

CEMENT EXPANSION CELL MOLD

SIZE	DWG. NO.	REV
B	05-0100	

SCALE:1:2 | WEIGHT: 1.99 | SHEET 1 OF 1





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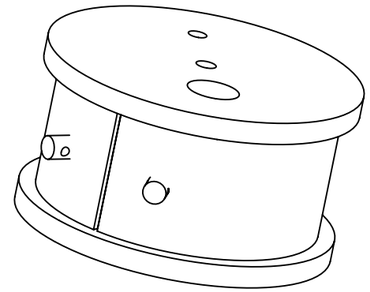

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	05-0102-1	BOTTOM	1
2	05-0104-1	OUTER RING	1
3	05-0107	EXPANSION MOLD TERMINAL	2
4	05-0101-1	TOP	1
5	C-1408	SPRING, EXPANSION MOLD (NOT SHOWN)	1
6	C-1250	PRECISION SHOULDER SCREW SST, 8-32 THREAD, 5/8 SHOULDER LENGTH	1

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MFG APPR.	GRH	06-10-09
Q.A.	GRH	06-10-09

COMMENTS:

Cement Test Equipment

TITLE:

EXPANSION MOLD - UCA

SIZE	DWG. NO.	REV
B	05-0100-1	

SCALE:1:1 | WEIGHT: 0.54 | SHEET 1 OF 1