

AD609871

Hexcel Research
Reference: 6065

August 26, 1964

Picatinny Arsenal
Dover, N. Y.

Attn: Procurement and Production Directorate
SMUPA - PBI

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Subject: Contract No. DA-04-200-AMC-477 (A)
Development and Evaluation of a Lightweight Aluminum Honeycomb Case
Monthly Progress Report #7

Gentlemen:

Enclosed is the report describing the work done on the subject contract during the month of July 1964. The report was prepared by the Advanced Structures Group, Research Division, Hexcel Products, Inc., Berkeley 10, California.

Included as attachments are (1) Statement of Man Hours Expended - July 1964, (2) Schedule showing Current Progress - July 1964, and (3) Schedule showing Program of Ensuing Activities - August and September 1964.

Yours very truly,


J. C. Vicars
Research Director

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Attachments (3)

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REPORT OF PROGRESS
JULY 1964

1. TESTING OF CASE HXL-5-477

1.1 Vibration Tests

The set-up for the tests was the same as that used during the vibration testing on Case HXL-4-477 with the following exceptions. Accelerometers #2 and #4 were moved from the internal payload web (subject to oil canning) to the edge of the more rigid plate which is attached to the front end of the adapter ring. The tie rods on the fixture used to support the Case for the vibration along the longitudinal axis were changed from 6061-T6 aluminum to cold rolled steel.

The Case was placed with the longitudinal axis in a horizontal position and tested by vibrating it along the vertical axis. The Case was then placed with the longitudinal axis in a vertical position and vibrated along the longitudinal axis. Peak acceleration values are summarized in Table 1. No damage occurred to the Case during either test.

1.2 Evaluation of Vibration Test Results

A comparison of the peak accelerations occurring during the testing on Cases HXL-4-477 and HXL-5-477 is shown in Table 1. All of the significant peaks on both Cases were recorded either on Accelerometer #2 or #4. Therefore, values recorded from the other accelerometers were not listed in Table 1. The differences

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in the acceleration magnitudes for peaks which occurred at similar frequencies on the two Cases were apparently the result of moving Accelerometers #2 and #4 from the internal payload web to the plate attached to the front end of the adapter ring. For all but two peaks, the acceleration magnitudes were lower for Case HXL-5-477 than for Case HXL-4-477. This indicates that there was less magnification on the adapter ring plate than on the internal web.

2. DESIGN OF CASE HXL-6-477

No drop tests were performed on Case HXL-5-477 so there was no basis for modifying the core design on Case HXL-6-477. The primary change was in the use of Mylar for the skin of the energy absorption cylinder and Butyrate Cellulose Acetate for the skin of the front and rear energy absorption end caps. A diagram of the Case is shown in Figure 1. The dimensions of the core cutouts are the same as those on Case HXL-5-477 which are shown in Figure 4 of Progress Report #6.

3. TESTING OF CASE HXL-6-477

3.1 Hydrostatic Pressure Test - 5 psi

A diagram of Case HXL-6-477 is shown in Figure 1. The bond between the plastic faces and the energy absorption core of the end caps was very poor in that large areas remained unbonded after fabrication.

A prototype locking device was used in the front end cap in place of the aluminum seal plate which was used in previous

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pressure tests. The locking device was fastened to the head of the dummy payload by a machine screw. Details are shown in Figure 2.

Strips of blotter paper were placed inside of the hydrostatic cylinder to serve as a method of detecting water leakage. One piece was placed on the inside of the removable front end cap around the opening for the locking device. A second piece was placed on the inside of the rear end cap. Two additional pieces were placed around the circumference of the inside of the cylinder, one immediately above the adapter ring and one immediately below it.

The gage pressure was cycled from zero to 5 psi twice. The pressure was held at 5 psi for 5 minutes at the end of each cycle. No noticeable pressure drop occurred at any time during the test.

During the test, the front and rear end caps became partially filled with water. The energy absorption core filled with water to a level of from 7 to 11 inches from the rear end of the energy absorption cylinder (excluding the rear end cap).

After the specimen was removed from the pressure tank, the front end cap was removed. There was approximately one inch of water at the bottom of the hydrostatic cylinder. All blotter paper used in the cylinder was damp.

The edges of the front end cap buckled inward $1/4$ " to $3/8$ " all around the circumference. The core was crushed inward (and pulled away from the skin) approximately one inch at two points on the

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circumference. There was very little permanent deformation in the skin of the rear end cap or the cylinder other than a slight waviness.

3.2 Evaluation of Hydrostatic Pressure Test Results

Part of the water in the hydrostatic cylinder probably entered the cylinder while the front end cap was being removed. There was no way to tell what proportion of the water came from this source. The remainder of the water could have leaked in (1) through the joint between the hydrostatic cylinder and rear hydrostatic end cap, (2) through the joint where the threaded I-section is bonded into the hydrostatic cylinder, (3) past the O-ring at the front end cap, (4) past the seal ring between the locking device and the front hydrostatic end plate, (5) past the bolt and washer which attach the locking device to the dummy payload, or (6) through the longitudinal seam in the wall of the hydrostatic cylinder.

It was concluded that the primary source of the leakage into the hydrostatic cylinder occurred by way of the locking device seal ring.

4. DESIGN OF CASE HXL-7-477

This Case is basically the same as Case HXL-5-477. Aluminum skin was used throughout. The circumferential cutouts in the energy absorption core extend completely through the core as with Case HXL-5-477, and the core cutout dimensions are the same as those on Case HXL-5-477. A diagram of the Case is shown in Figure 3.

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The primary design differences between Cases HXL-5-477 and HXL-7-477 are summarized below.

- 4.1 The skin gage was changed from .012 to .0043 in the following places: inner and outer faces and edges of front energy absorption cap; outer face of rear energy absorption cap; inner edge of rear energy absorption cap.
- 4.2 The .012 Alclad 2024-T3 skin on the inner face of the rear energy absorption cap was omitted.
- 4.3 The skin around the edge of the rear energy absorption cap was overlapped onto the cylinder 1/2".

5. TESTING OF CASE HXL-7-477

5.1 Hydrostatic Pressure Test - 12 psi

A diagram of Case HXL-7-477 is shown in Figure 3. The prototype locking device was used in the front end cap. See Figure 2 for details.

Strips of blotter paper were placed inside of the hydrostatic cylinder as was done on Case HXL-6-477.

The gage pressure was cycled from zero to 12 psi* twice. The pressure was held at 12 psi for 5 minutes at the end of each cycle.

*The pressure reached 13 psi during one cycle.

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No noticeable pressure drop occurred at any time during the test.

The front and rear end caps and the cylinder energy absorption core became partially filled with water during the test. After the specimen was removed from the pressure tank, the front end cap was removed. There was no water in the bottom of the hydrostatic cylinder and no dampness in any of the pieces of blotter paper.

There was no indication of skin buckling or damage to the seams or joints on the inside of the hydrostatic cylinder. A pattern of longitudinal wrinkles occurred in the energy absorption cylinder skin over each circumferential core cutout. The wrinkles were approximately uniformly spaced around the circumference of the cylinder. The edges of the front and rear end caps had similar patterns of longitudinal wrinkles extending around the circumference of the caps. The circumferential skin joints opened intermittently.

5.2 Evaluation of Hydrostatic Pressure Test Results

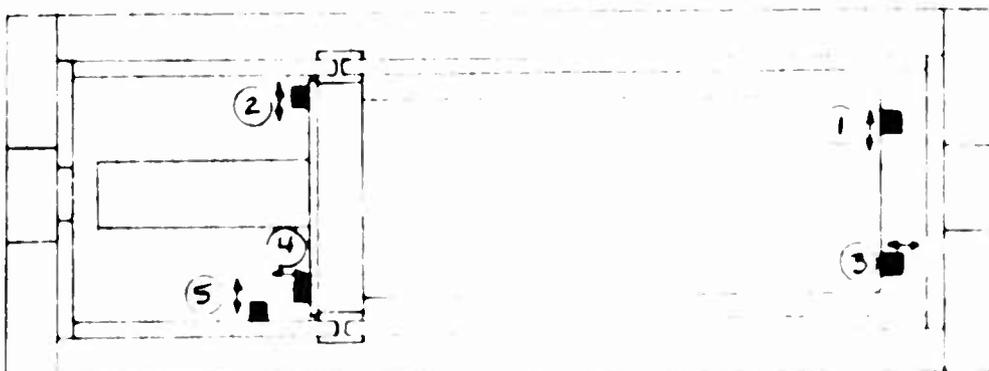
No leakage into the inside of the hydrostatic cylinder occurred during this test. However, leakage past the seal ring occurred during the test on Case HXL-6-477. The probable cause of the different results of the two tests is that the plastic seal ring used during the test on Case HXL-6-477 appeared to be faulty and was replaced prior to the test on Case HXL-7-477.

TABLE I
COMPARISON OF VIBRATION TEST RESULTS ON CASES
HXL-4-477 AND HXL-5-477

TEST **	PEAK NUMBER *	CASE HXL-4-477		CASE HXL-5-477		
		FREQUENCY (CPS)	ACCEL. (g's)	FREQUENCY (CPS)	ACCEL. (g's)	
VERTICAL AXIS VIBRATION TEST	a) Parallel to vibration axis - Accelerometer #2	1	124	12	115	18
		2	194	18	-	-
	b) Perpendicular to vibration axis - Accel #4	1	122	38	115	12
		2	194	54	-	-
LONGITUDINAL AXIS VIBRATION TEST	a) Parallel to vibration axis - Accel. #4	1	42	30	-	-
		2	60	25	-	-
		3	121	46	-	-
	b) Perpendicular to vibration axis - Accel. #2	1	125	12	94	23

*Peak #1 on each set of data has similar frequencies for the two Cases.

**Accelerometers for Case HXL-5-477 were located as shown below. The arrows indicate the direction along which each accelerometer measured g values. See Progress Report #6 for accelerometer locations for Case HXL-4-477.



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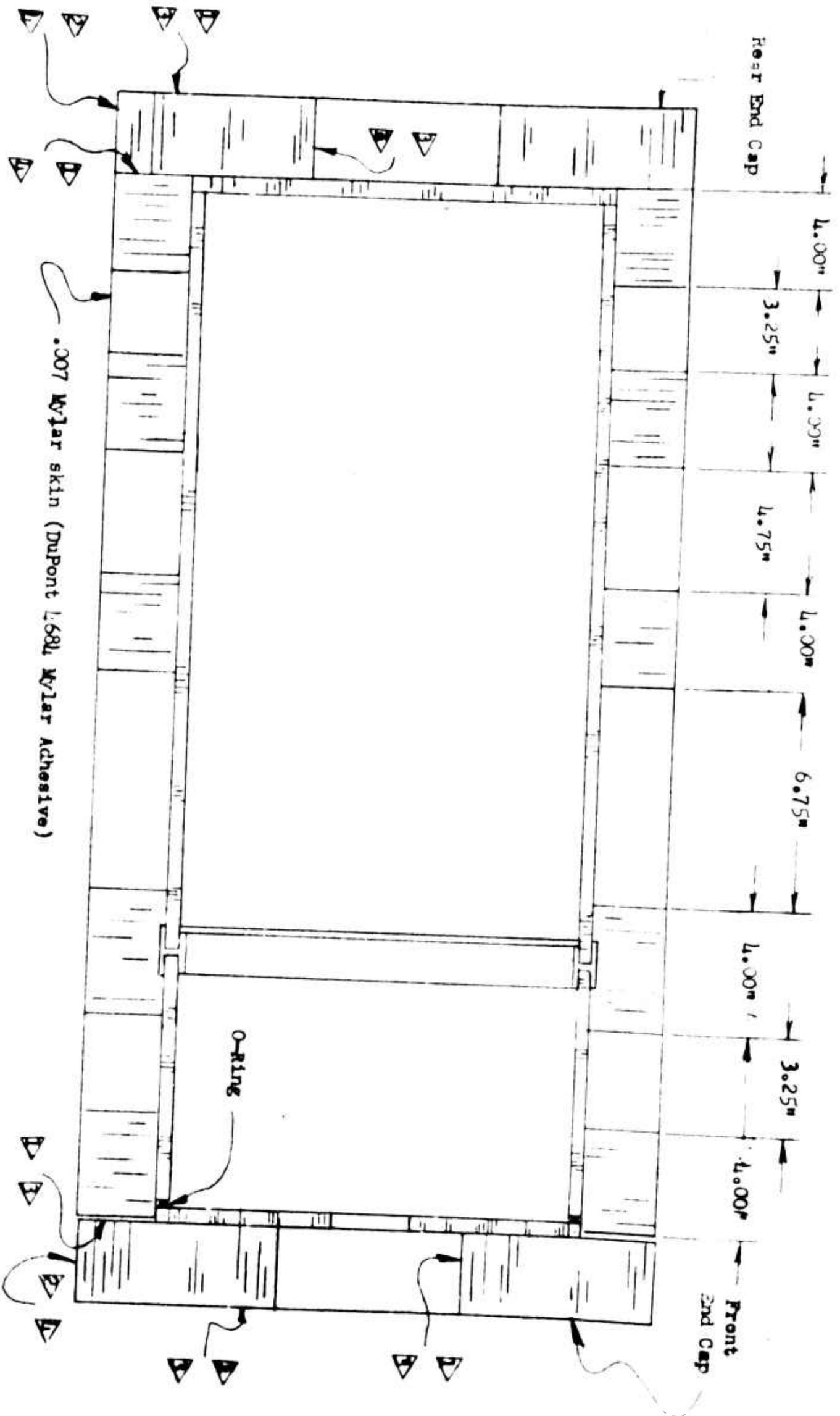
CONTRACT NO. DA-04-200-AMC-477(A)

ATTACHMENT #1

ATTACHMENT #1

STATEMENT OF MAN HOURS EXPENDED - JULY 1964

	<u>MAN HOURS</u>
Engineering:	
Sr. Professional	55.0
Professional	181.5
Technician:	
Drafting, fabrication, & testing	118.5
Other:	
Clerical	<u>4.0</u>
TOTAL HOURS EXPENDED	359.0



- 1 Vacuum formed from 20 MI Butyrate Cellulose Acetate. Vacuum forming reduced thickness of sheet at ends.
- 2 2 thicknesses of
- 3 Stabond C-III Adhesive.
- 4 3M BC-2218 Adhesive

FIGURE 1

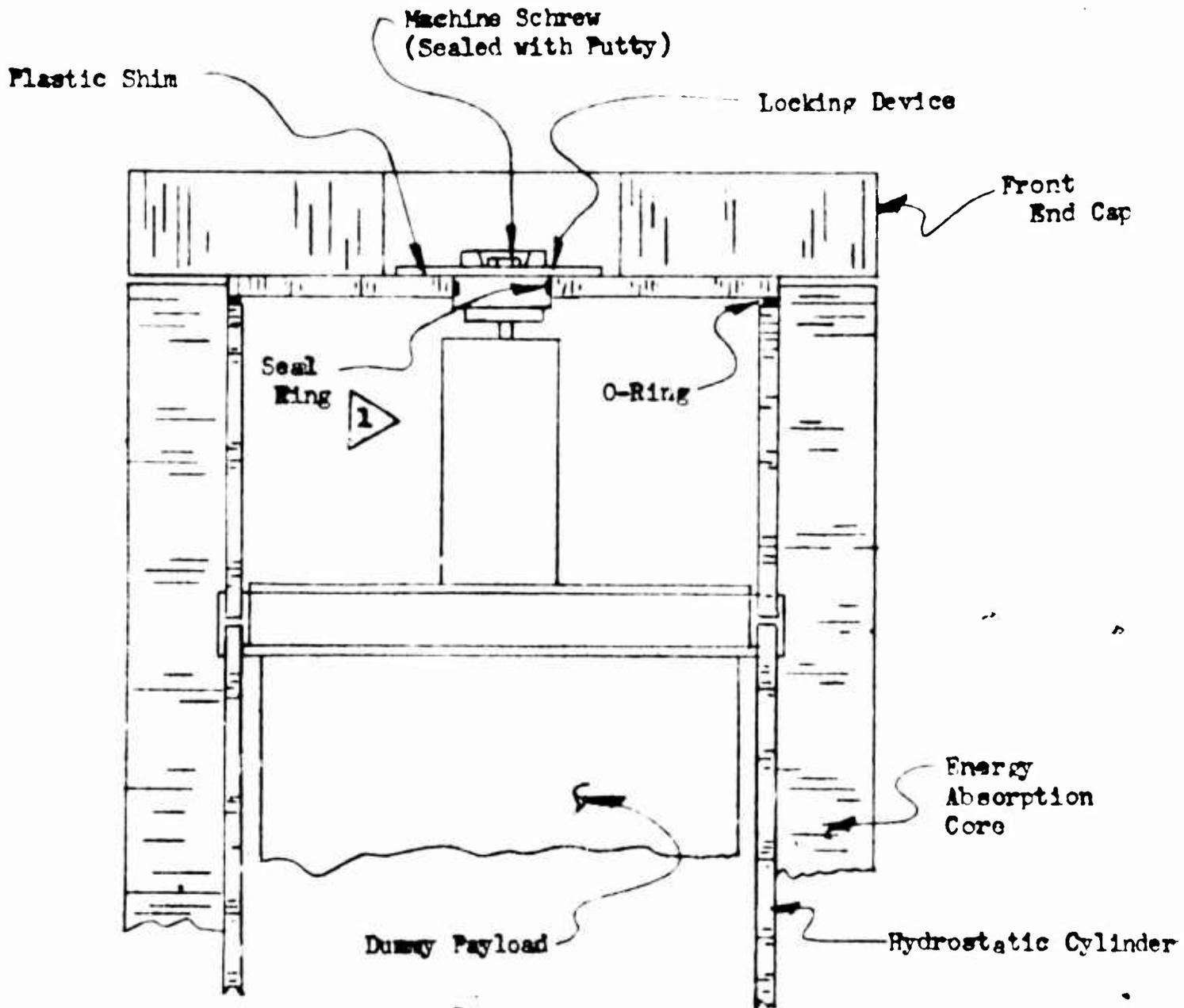


FIGURE 2

HYDROSTATIC PRESSURE SEALING CASES HXL-6-477 AND HXL-7-477

The seal ring consists of a Plastic Ring of rectangular cross-section and a rubber back-up ring.

Not to Scale

8/21/64 P.P.

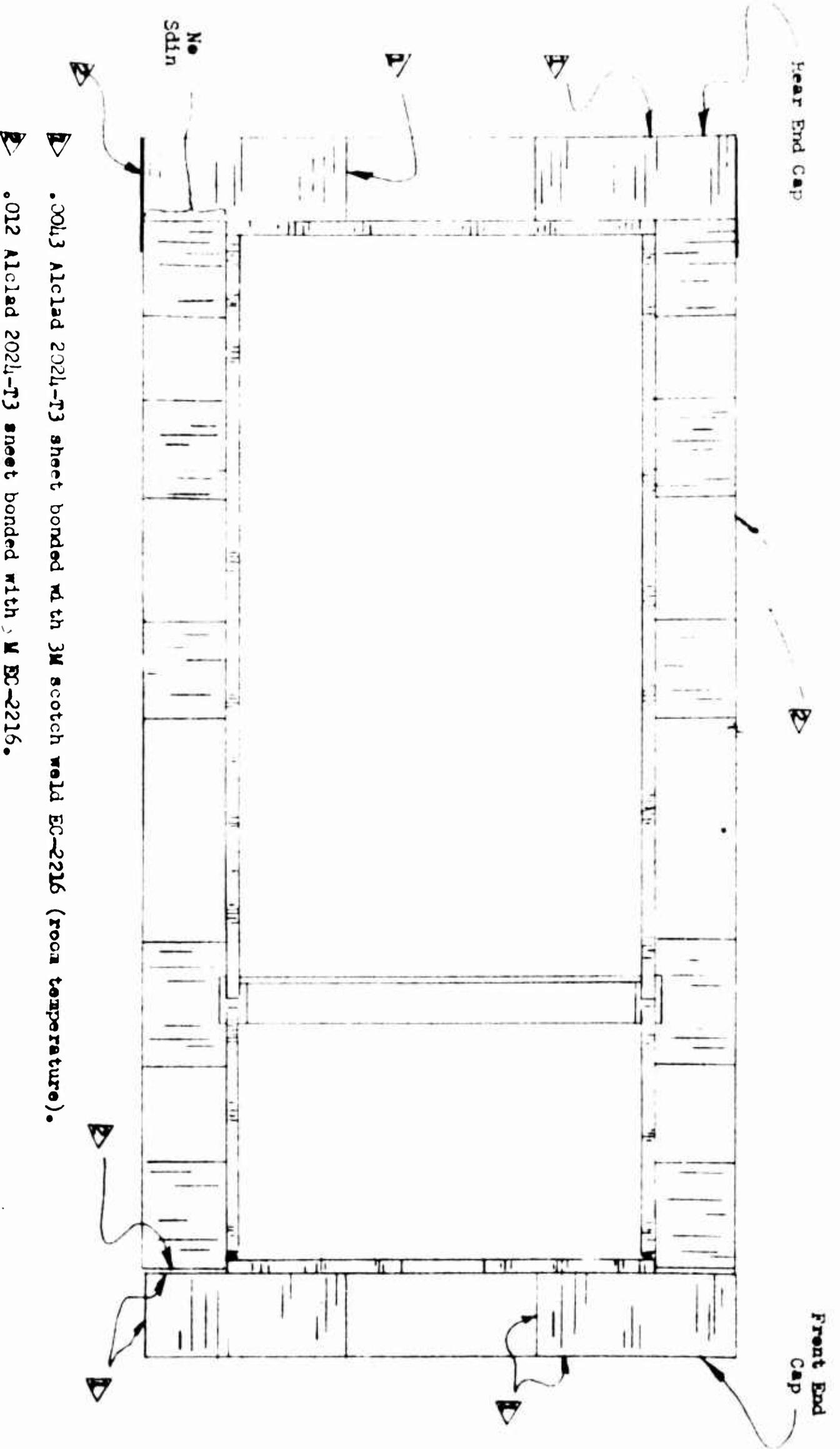


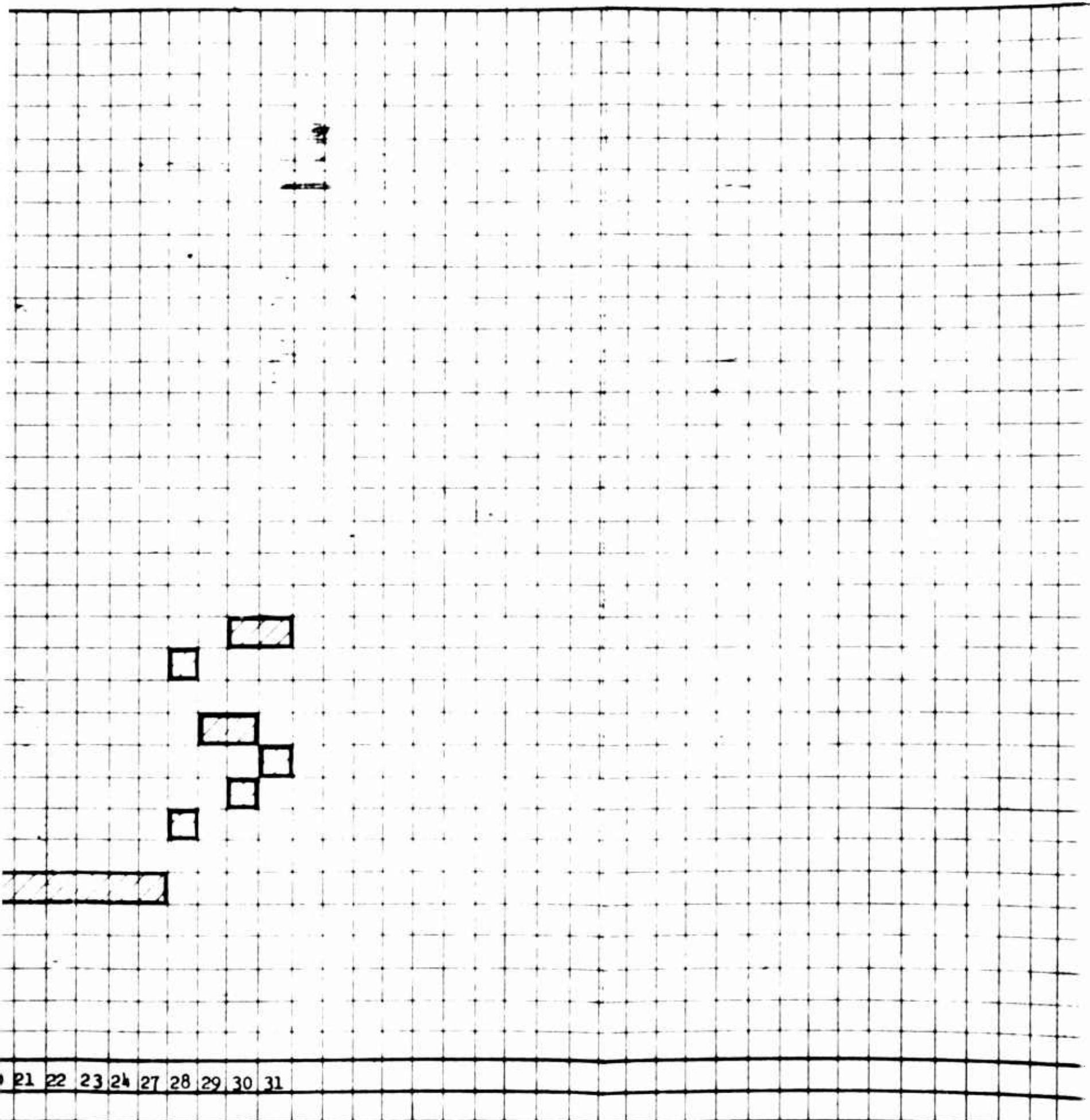
FIGURE 3 CASE HXL-7-477

Not to Scale 8/21/64 R.P.

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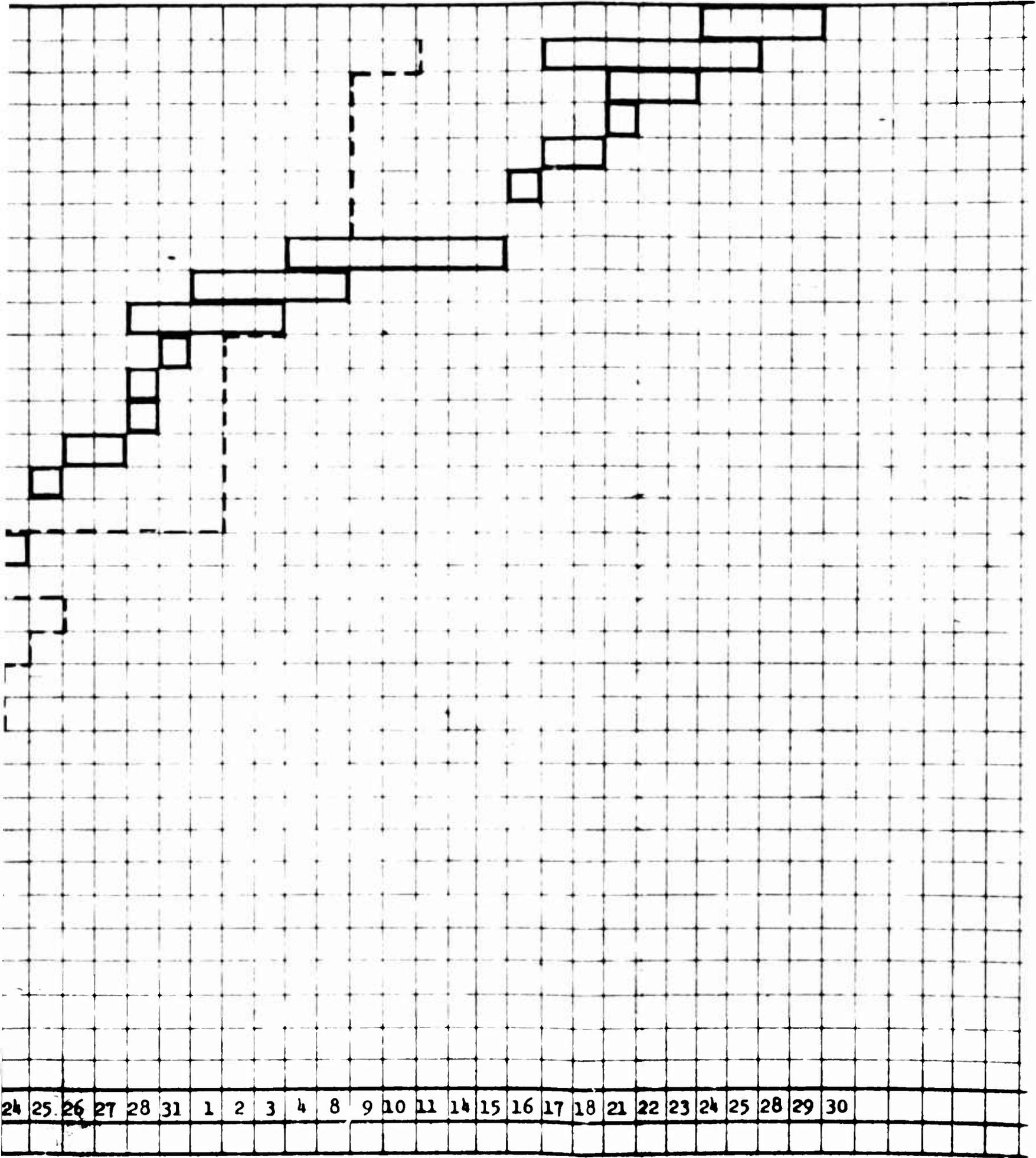
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ATTACHMENT / 2
CURRENT PROGRESS
JULY 1964



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Attachment # 3
PROGRAM OF ENSUING ACTIVITIES
AUGUST & SEPTEMBER 1964



SEPTEMBER 1964