Hexcel Research
Reference: 6065

September 24, 1964

Picatinny Arsenal
Dover, New Jersey

Attention: Procurement and Production Directorate
SMUPA - PBI

Subject: Contract No. DA-04-200-AMC-477(A)
Development and Evaluation of a Lightweight Aluminum Honeycomb Case
Monthly Progress Report No. 8

Gentlemen:

Enclosed is the report describing the work done on the subject contract during the month of August, 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 - August, 1964, (2) Schedule Showing Current Progress - August, 1964, and (3) Schedule Showing Program of Ensuing Activities - September, 1964.

Yours very truly,

E. C. Vicars
Research Director

ECV:skw

Enclosures

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

REPORT OF PROGRESS

AUGUST 1964

1. CASE HXL-6-477

1.1 Design Modification: See Progress Report No. 7.

1.2 Testing: Tests on Case HXL-6-477 were performed in the following order.

1.2.1 Hydrostatic Pressure Test of 5 psi: See Progress Report No. 7.

1.2.2 Drop Tests: A summary of the drop tests is given in Table 2. The drops were performed in the order of (1) rear end drop, (2) flat drops, and (3) edge drop.

It is noted that the accelerometers were attached to the payload by mounting brackets (see Figure 1) for all the flat drop testing on Cases 6, 7, 6a, and 8, except where specified.

1.2.3 Hydrostatic Pressure Tests - 22 psi: The case was twice subjected to an external pressure of 22 psi for a duration of five (5) minutes. The hydrostatic cylinder was completely filled with water after finishing the test. The leakage was a result of the following deficiencies:

(1) Insufficient support for the O-ring,

(2) Splits at the joints caused by drop testing,

(3) Poor bonding at the joints and between the core and skin.

2. CASE HXL-7-477

2.1 Modification of Design: In addition to the design described in Progress Report No. 7, an O-ring supporting groove was provided by bonding a 1/16" aluminum ring (13" O.D., 12-1/2" I.D.) to the open end of the hydrostatic cylinder.

2.2 Testing: Case 7 was tested as follows:

2.2.1 Hydrostatic Pressure of 12 psi: See Progress Report No. 7.

2.2.2 Drop Tests: A summary of the test is given in Table 3. The drops are listed in the sequence in which they were performed.

2.2.3 Hydrostatic Pressure Test - 22 psi: The case was subjected to a pressure of 22 psi for five (5) minutes. The hydrostatic pressure cylinder was filled with water to a depth of twelve (12) inches. The leakage was a result of the following items:

(1) Splits at the joints between the end plates and hydrostatic pressure cylinder resulting from

4.1.3 Changing the Thickness and Shape of End Caps: The end caps are in the shape of a frustum of a right cone formed by two layers of core 2.5" thick. Eight 1.5" diameter holes were drilled through the outside layer of core.

4.1.4 O-ring Groove: To provide better sealing against hydrostatic pressure, a deeper O-ring groove was fabricated at the open end of the hydrostatic cylinder.

4.2 Testing: Case 8 was tested as follows:

(1) Temperature shock test,

(2) Vibration test,

(3) Drop tests (one end drop, one flat drop),

(4) Hydrostatic pressure test - 22 psi,

(5) Drop tests.

4.2.1 Temperature Shock Test: The Case was tested with the prototype locking device (described in Progress Report No. 7, Figure 2), dummy payload, and a Buna-N O-ring, .125" diameter.

The temperature cycle consisted of 6-1/4 hours at 155° F. followed immediately by 15 hours at -65° F. When the case was removed from the cold chamber, there was a pattern of longitudinal skin wrinkles extending around the cylinder. These wrinkles disappeared when the temperature of the Case rose to room temperature.

the drop tests.

(2) Part of the hydrostatic pressure cylinder was damaged during the drop tests (flat drop and edge drop in the same position).

(3) Poor bonding at the joints and between core and the skin.

(4) Leakage past the seal ring on the locking device.

3. CASE HXL-6a-477

3.1 Design Modification: An extra Case HXL-6a-477 was fabricated from the hydrostatic cylinder of Case HXL-6-477. The design changes were:

(1) Reduction of energy absorption core from 20 to 17 lineal inches on the longitudinal axis.

(2) The mylar skin was replaced by 0.012 2024 aluminum skin.

3.2 Testing: The only tests conducted on Case 6a were drop tests. A summary of these is given in Table 4.

4. CASE HXL-8-477

4.1 Design of Case HXL-8-477: The design changes are listed below (also see Figure 2 for details):

4.1.1 Energy Absorption Core: The energy absorption core was slit around the circumference.

4.1.2 Installation of Electrical Connector: An electrical connector was installed near the front end of the cylinder.

Splits occurred in several places in most of the circumferential skin joints in the cylinder and caps. There was no indication that this damage had any adverse effect on the functioning of the Case during the remainder of the tests.

4.2.2 Vibration Test: Only the vertical axis vibration test was conducted on this case (see Progress Report No. 6 for test procedure). The accelerometers were mounted as shown on Figure 4. A comparison of the results of the vibration test completed on Cases HXL-5-477 and HXL-8-477 is given in Table 1.

4.2.3 Drop Tests: The first flat drop and the first rear end drop were performed prior to the hydrostatic pressure test. A summary of the drop testing on Case HXL-8-477 is given in Table 5. The drops are listed in the sequence in which they were performed.

4.2.4 Hydrostatic Pressure Test - 22 psi: The Case was subjected to 22 psi for five (5) minutes. Examination of the case after completing the pressure test revealed a small amount of dampness in the area adjacent to the electrical connector. The leakage in the hydrostatic cylinder appeared to come entirely from the electrical connector. However, it was not possible to determine whether the water leaked past

the connector O-ring or whether it leaked into the core of the hydrostatic cylinder and then past the connector.

TABLE 1

COMPARISON OF VIBRATION TEST RESULTS
ON CASES HXL-5-477 & HXL-8-477

LOCATION OF ACCELEROMETER	CASE HXL-5-477		CASE HXL-8-477	
	FREQUENCY (CPS)	ACCEL. (g's)	FREQUENCY (CPS)	ACCEL. (g's)
Free end of payload	20	4.2	5	1.8
	42	9.5	40	8.6
	58	12.0	58	10.0
Adapter ring	35	5.6	40	5.0
	115	18.0	75	6.0

TABLE 2

SUMMARY OF DROP TESTS ON CASE HXL-6-477

Case Weight: 17.5 lb.
Drop Weight: 205.6 lb.
Drop Height: 36. in.

**See Figure 3 for details.
*Each position is 90° apart.

Type of Drop	*Location of Drop	**Location of Accelerometer on Payload	Deceleration (g)	Remarks
End	Rear end	Fixed end	49.6	1. 3.1 lb. of water was in the energy absorption core.
				2. Accelerometer was mounted with double backed tape.
Flat	Position #1	Fixed end	23.8	3. Accelerometers were mounted with double backed tape at both ends of the payload.
		Free end	25.6	
	Position #2	Fixed end	38.4	4. #2 position was dropped on the 1.5" wide seam where the core was continuous along the longitudinal axis.
	Position #3	Fixed end	30.5	
		Free end	35.9	
	Position #4	Fixed end	36.2	-
		Free end	32.6	

TABLE 3

SUMMARY OF DROP TESTS ON CASE HXL-7-477

Case Weight: 19.8 lb.
Drop Weight: 207.3 lb.
Drop Height: 36. in.

*See Figure 3 for details.

Type of Drop	Location of Drop	*Location of Accelerometer on Payload	Deceleration (g)	Remarks
Flat	Position #1	Fixed end	38.4	1. 2.5 lb. water was in the energy absorption core.
		Free end	42.	2. Accelerometer was mounted with double backed tape.
	Position #2	Free end	42.8	3. Accelerometer was mounted with double backed tape.
	Position #3	Adapter ring	33.9	
		Free end	42.5	
	Position #4	Adapter ring	40.	4. Accelerometer at fixed end of payload was mounted with double backed tape.
		Free end	41.	
		Fixed end	38.1	5. #4 position was dropped twice; first for flat drop, then for the edge drop
Edge	Front cap	Fixed end	28.3	6. 5" thick for front cap.

TABLE 4

SUMMARY OF THE DROP TESTS ON CASE HXL-6a-477

Case Weight: 19.76 lb.
Drop Weight: 206.1 lb.
Drop Height: 36. in.

*See Figure 4 for details.

Type of Drop	Location of Drop	*Location of Accelerometer on Payload	Deceleration (g)	Remarks
End	Rear end	Adapter ring	---	1. No data was recorded. 2. Rear end cap was made movable as front cap.
	Front end	Adapter ring	31.2	3. Core was crushed only under the end plate for the hydrostatic cylinder, the remainder of core pushed into the energy absorption cylinder for both end drops.
Flat	Position #1	Adapter ring	26.4	4. Payload was blocked by hard rubber pads at free end of the payload.
		Free end	39.8	
	Position #2	Adapter ring	27.3	5. Payload was not blocked for Position #2.
		Free end	44.5	
	Position #3	Adapter ring	---	6. The trace on the scope was not clear enough to determine the G level.
		Free end	38.4	7. Same as Remark 4.

TABLE 4
SUMMARY OF THE DROP TESTS ON CASE HXL-6a-477
(Continued)

Type of Drop	Location of Drop	*Location of Accelerometer on Payload	Deceleration (g)	Remarks
Flat	Position #4	Adapter ring	34.4	3. Same as Remark 4.
		Free end	44.6	2. Outside skin of the case was removed

TABLE 5

SUMMARY OF DROP TESTS ON CASE HXL-8-477

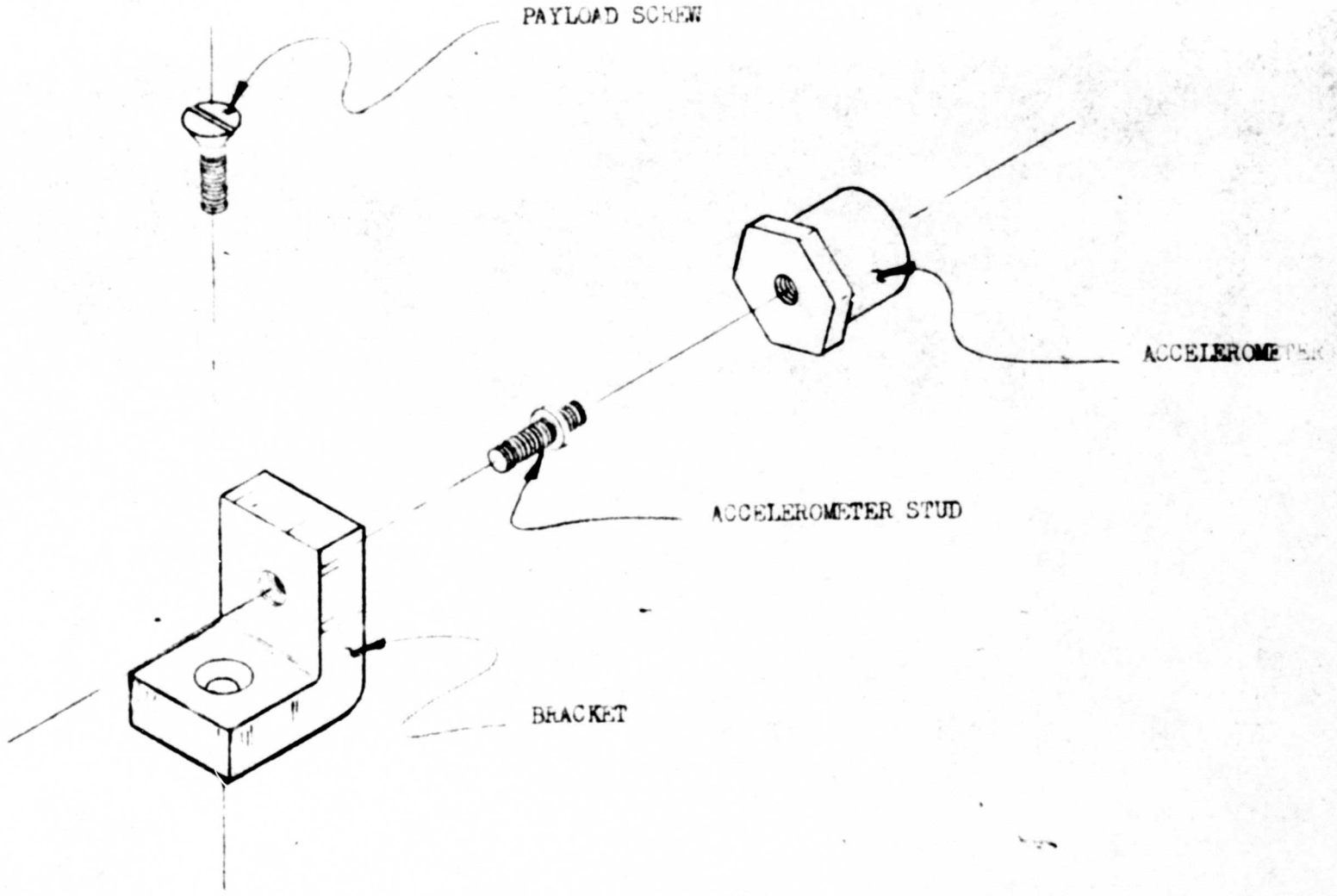
Case Weight: 20 lb.
Drop Weight: 206 lb.
Drop Height: 36 in.

*See Figure 4 for details.

Type of Drop	Location of Drop	*Location of Accelerometer on Payload	Deceleration (g)	Remarks
End	Rear end #1 drop	Adapter ring	38.	1. The case rebounded after it hit the ground.
Flat	Position #1	Adapter ring	32.2	2. Drop height was 24 inches.
		Free end	31.3	
	Position #2	Adapter ring	38.3	
		Free end	34.4	
	Position #3	Adapter ring	41.	3. Case was dropped without outside skin and the end caps. The ends of hydrostatic cylinder were supported by end plates.
		Free end	51.	4. The core was completely crushed.

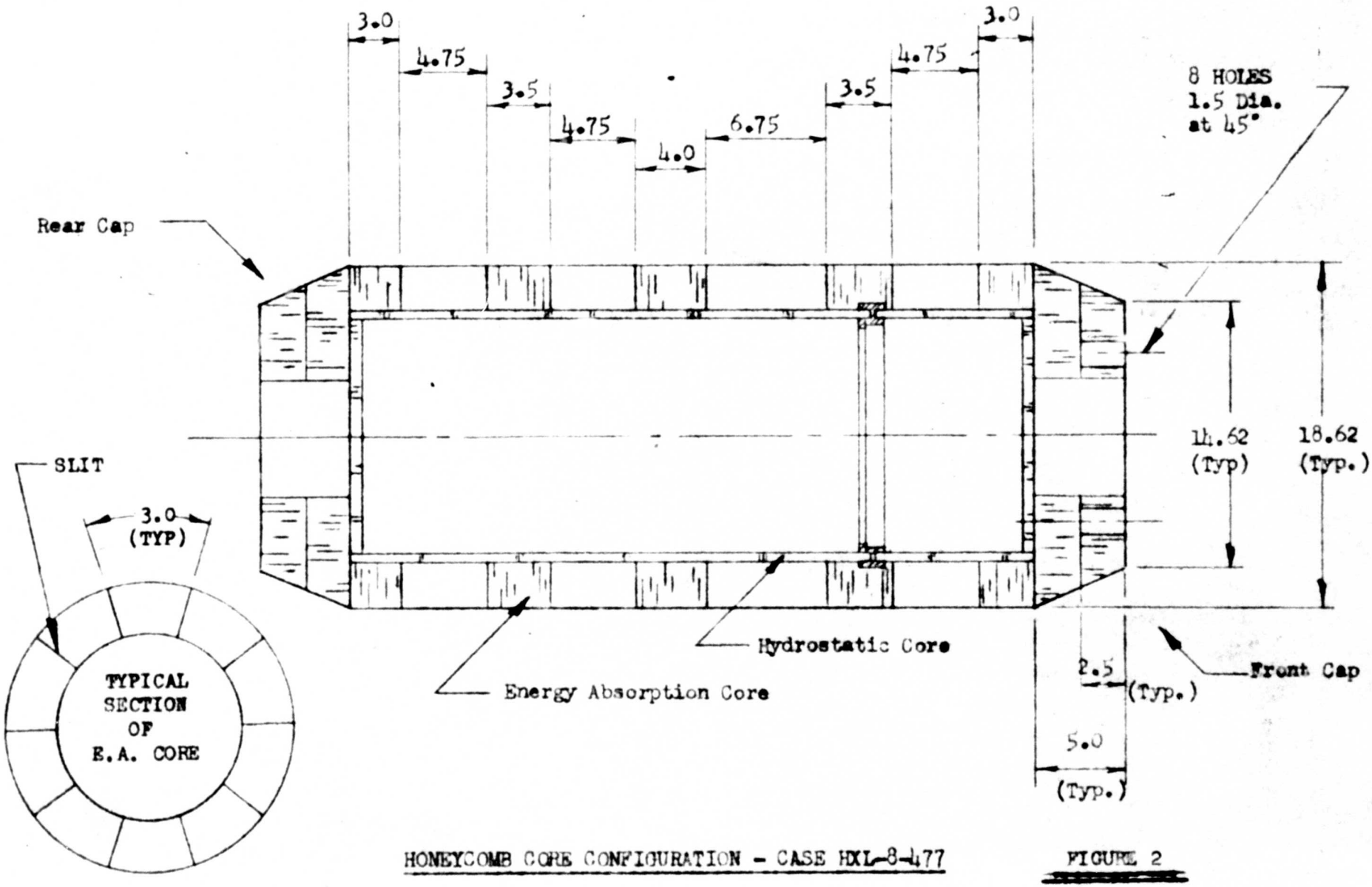
TABLE 5
SUMMARY OF DROP TESTS ON CASE HXL-8-477
(Continued)

Type of Drop	Location of Drop	*Location of Accelerometer on Payload	Deceleration (g)	Remarks
Flat	Position #4	Adapter ring	21.1	5. See Remark 3.
		Free end	23.8	6. Drop height was 24 inches.
End	Rear end #2 drop	Adapter ring	22.5	
	Rear end #3 drop	Adapter ring	---	7. The trace was not clear enough to determine the G level.



ACCELEROMETER BRACKET

FIGURE 1



HONEYCOMB CORE CONFIGURATION - CASE HXL-8-477

FIGURE 2

Scale: 3/8 = 1 9/21/64 F.P.

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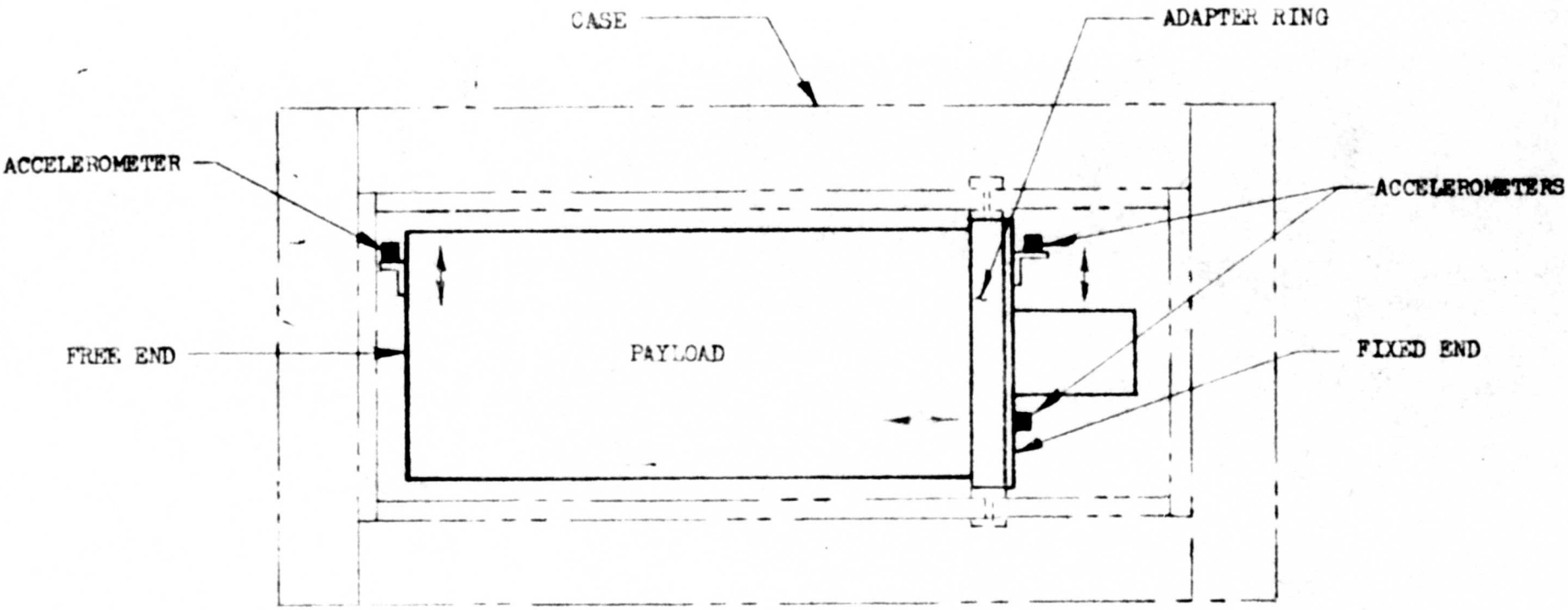


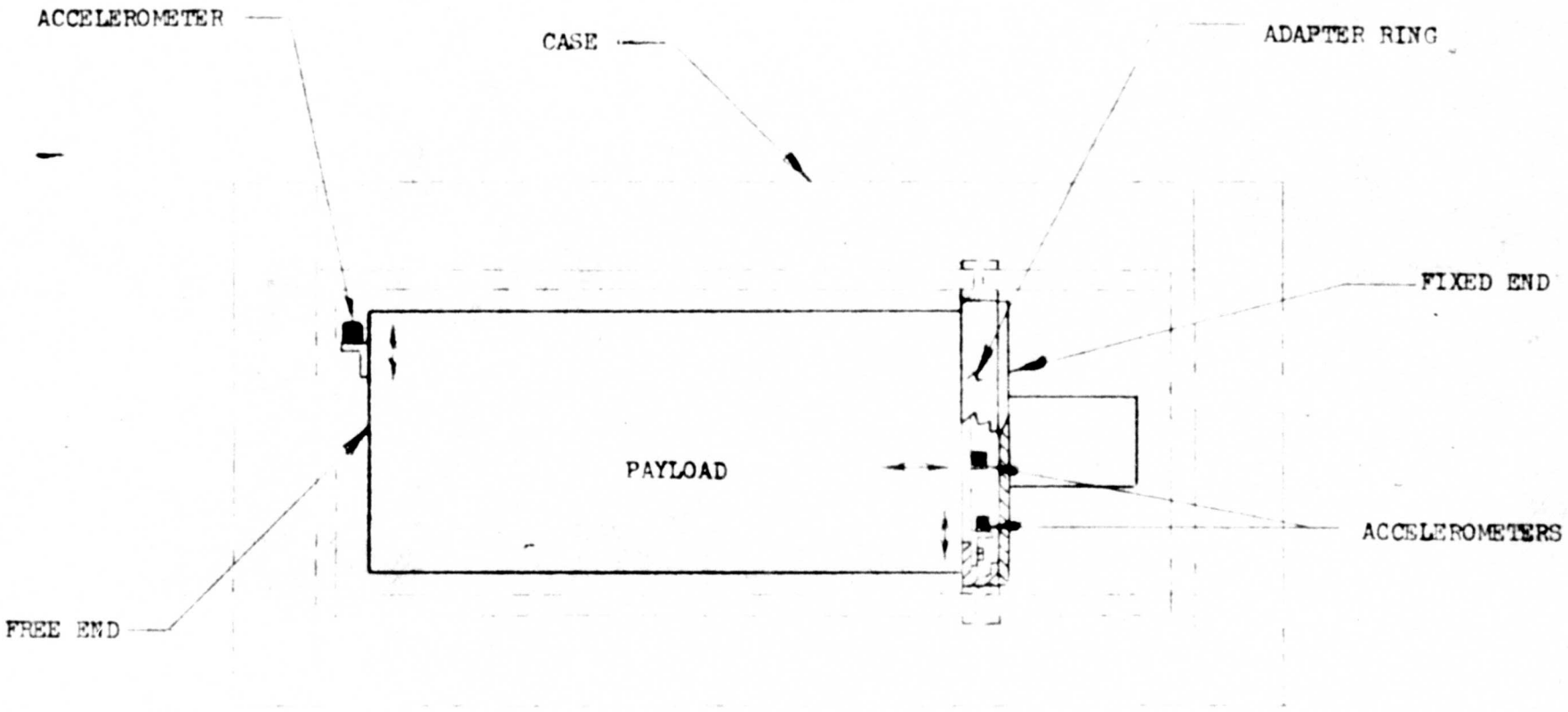
LOCATION OF ACCELEROMETERS (3)
FOR CASES HXL-6-477 & HXL-7-477

FIGURE 3

Not To Scale

Ref: 6065

8/11/64 F. P.



LOCATION OF ACCELEROMETERS (3) FIGURE 4
FOR CASES HXL-6a-477 AND HXL-8-477

NOT TO SCALE

REF: 6065 8/11/64 F.P.

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Reference: 6065

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

ATTACHMENT NO. 1

STATEMENT OF MAN HOURS EXPENDED

JUNE, 1964

	Man Hours
Engineering	
Senior Professional	87
Professional	302
Technician	
Drafting, fabrication, and testing	141
Other	
Clerical	19.5
TOTAL HOURS EXPENDED	549.5

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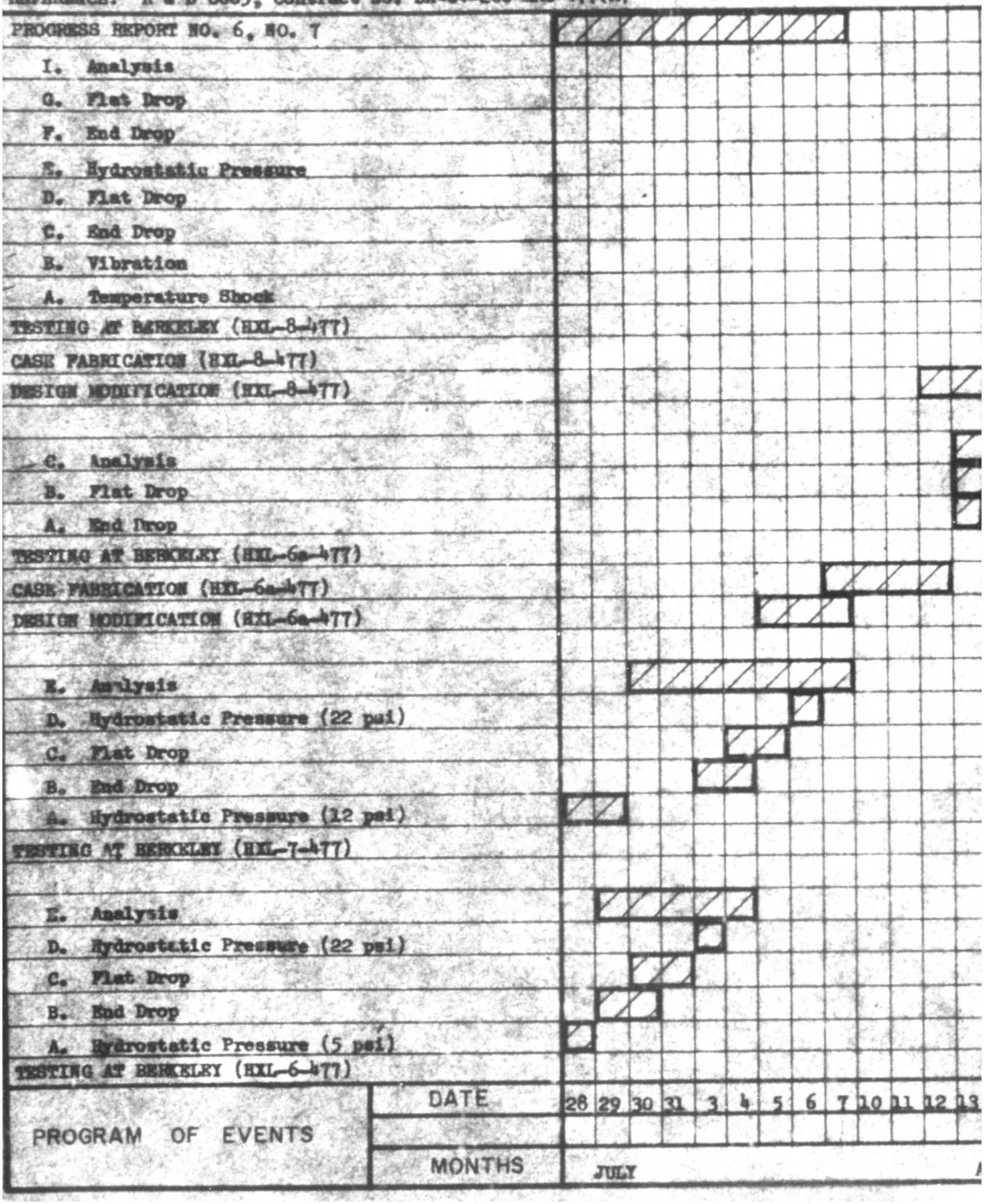

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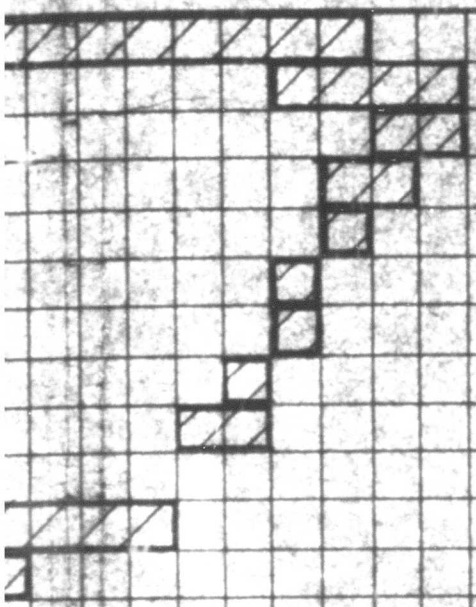
ATTACHMENT #2
CURRENT PROGRESS
AUGUST 1964



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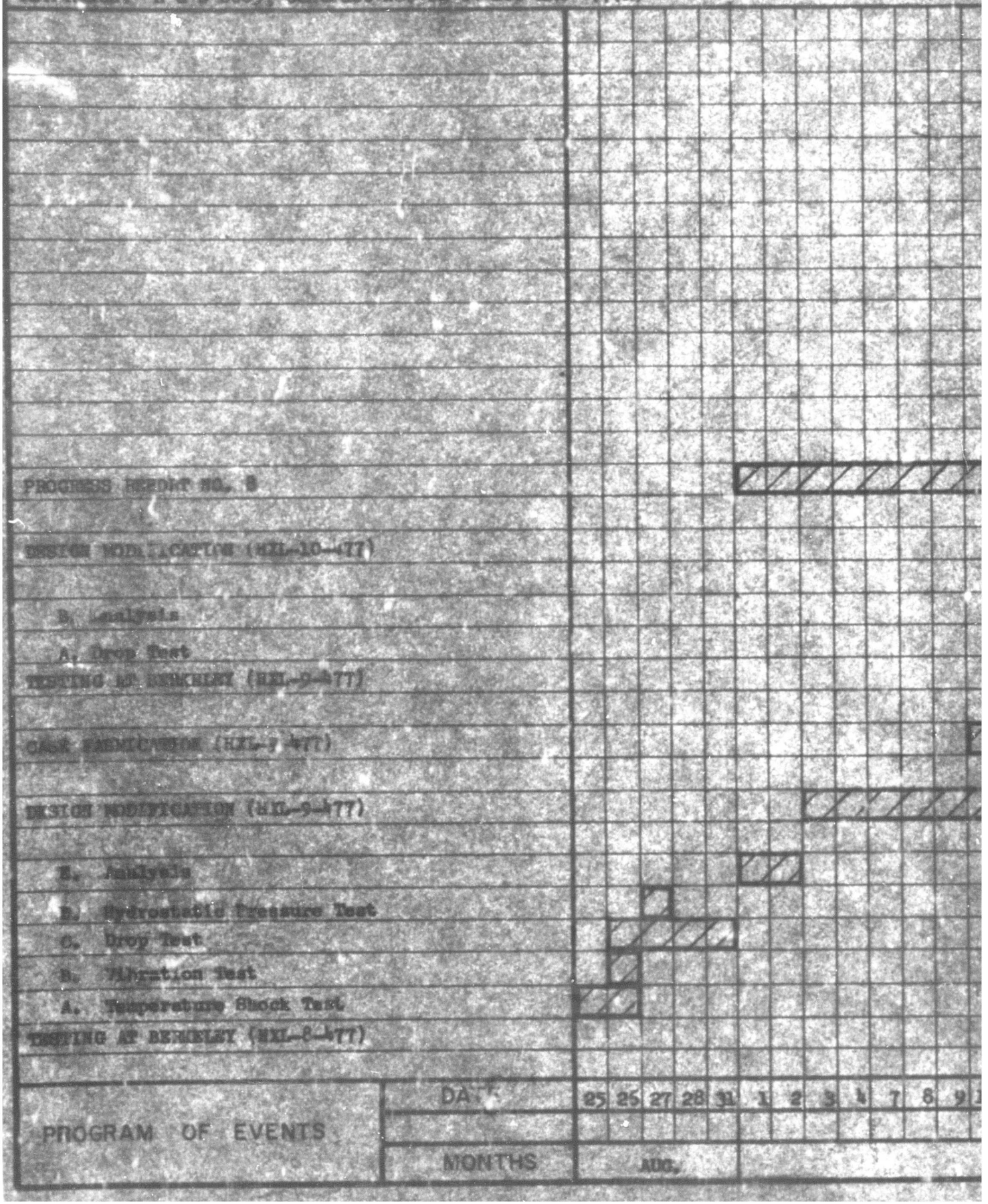
ARMY TRACK: R & D 6065, Contract No. DA-04-200-AMC-477(A)



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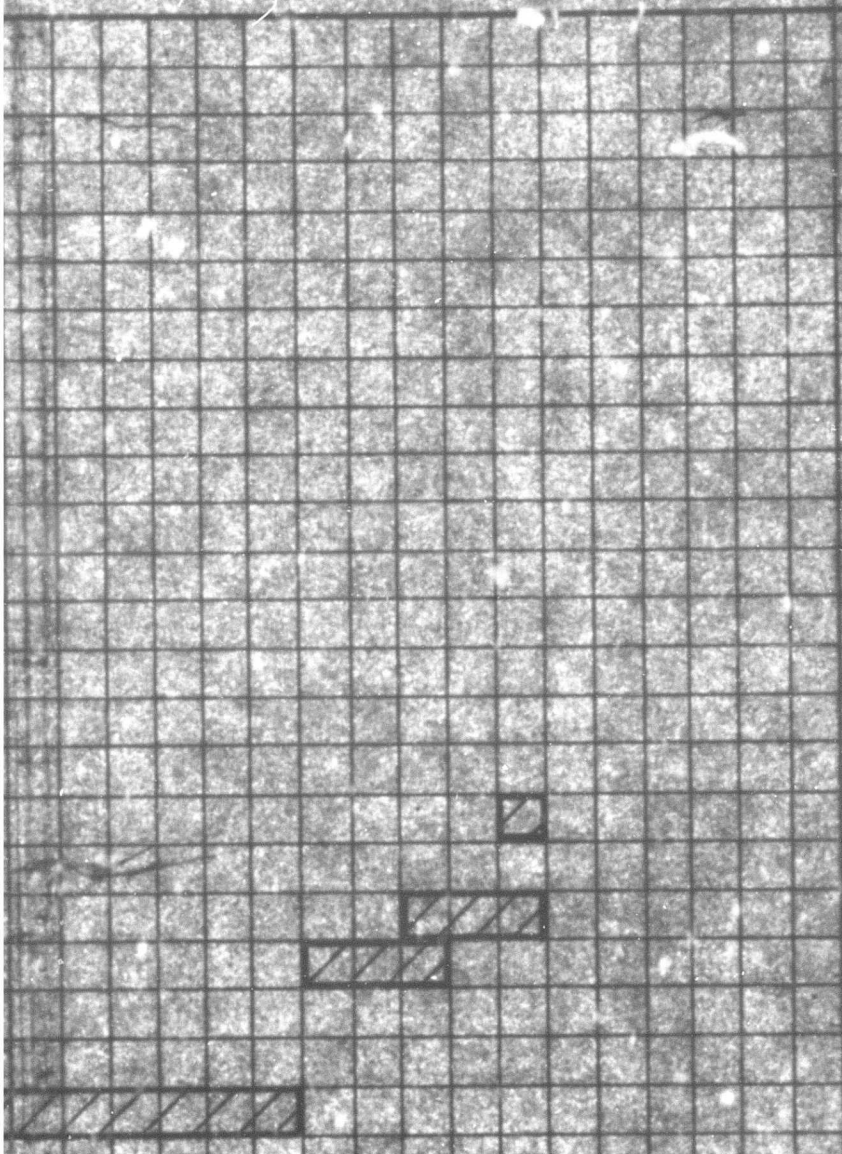
ATTACHMENT #3

PROGRAM OF ENSUING ACTIVI

SEPTEMBER 1964



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