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CONTRACT REQUIREMENTS	CONTRACT ITEM	MODEL	CONTRACT NO.	CONTRACT DATE
Exhibit E, Para. 3.3.3.3	Line Item 27	LM	NAS 9-1100	4 Oct. '65

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PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1 (DOCKED CONFIGURATION)

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PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

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PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

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Figure 2	Test Set-Up
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Figure 4	Vehicle Deflections at $X_c \approx 21$
Figure 5	Vehicle Deflections at $X_c \approx 82$
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Figure 8	LM/CM Ring Relative Movement
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PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

DISTRIBUTION LIST

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This distribution is in addition to the distribution of Report No. LTP 933-00001.

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

LIST OF REFERENCES

1. NASA Contract No. NAS 9-1100
   Exhibit A - Statement of Work
   Exhibit E - Documentation

2. LM Spec LSP470-16, End Item Spec LTA-3

3. GAEC/NAA ICD MH01-05128-116 Rev. B, CSM/LM Structural Interface

4. GAEC/NAA ICD MH01-05050-414 CSM/LM Structural Loads and Bending Moments.

5. GAEC/NAA ICD MH01-05641-416 CM 2S-1/CTA-3 Integrated Static Test

6. NAA ATR 332073 CM 2S-1/LTA-3 Docked Static Test

7. NAA Internal Letter 696-703-110-66-093; October 13, 1966; CM 2S-1 Shipping Configuration

8. NAA Internal Letter APTE/66/186; October 7, 1966; Transport Plan for S/C 2S-1 CM

9. NASA/MSC Letter - BG-54-66-996; November 14, 1966; CCA 418, Additional Testing on LTA-3.

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

1.0 INTRODUCTION

1.1 Purpose of Test

The purpose of the LTA-3/CM2S-1 docked tests are to determine the deflection characteristics of the docked vehicles under the influence of various unit loads.

1.2 Objectives

1.2.1 The first order objective of these tests are to measure the deflection characteristics of the docked vehicles due to various unit loads.

1.2.2 The second order objective of these tests are to measure the CM/LM interface slippage.

1.3 Precedence

These tests are being performed as per direction of NASA/MSC. A C.C.A. (see reference 9)authorized these tests. Therefore, no preliminary test plan has been submitted.

1.4 Failure Reporting

Failure Reports will be prepared for each test article failure incurred during the performance of these tests in accordance with Grumman Procedure D-3, dated 26 October 1964, "Procedure for Preparation, Handling and Distribution of Discrepant Material Tag (DMT) Form G666 6-64 and Government-Owned Material Tag (GOM) Form G667 6-64."

1.5 Constraints

1.5.1 The availability of Command Module 2S-1 and LTA-3 Ascent Stage is a constraint on the start of this test.

1.5.2 The completion of the Docking Structure Tests of LTA-3, LTP933-24006A, is a constraint on the start of these test.

1.5.3 These tests do not relieve any Grumman constraints as defined in Contract NAS 9-1100.

1.6 Responsibilities

1.6.1 Grumman Aircraft Engineering Corporation will be responsible for the implementation and performance of the test program.

1.6.2 NASA/MSC will be responsible for supplying the CM and CM loading fixture to Grumman in accordance with the terms defined in Ref. 5.

1.6.3 North American Aviation/Space & Information Division will be responsible to support these tests with qualified project, test, structures,

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

1.0 INTRODUCTION

1.6 Responsibilities (Cont.)

1.6.3 mechanical, quality control, and shipping engineers as required by Grumman.

1.7 Test Schedule

The test program will begin approximately in March 1967 and continue until April 1967. The detailed schedule is shown in Figure 1.

2.0 DESCRIPTION OF THE TEST ARTICLES

2.1 LM: LTA-3

The LM test article will consist of the structurally complete Ascent Stage of the LTA-3 structural demonstrator, and will basically conform to Grumman drawings LDW280-23002-3. The LTA-3 pressure compartment will be representative of the final LM units with the exception of subsystems and the associated hardware. Equipment bracketry may be installed and dummy equipment used where attachment redundancies exist between the basic structure and the equipment, where pressure closures are necessary for umbilical and ducting, they will be, where practical, representative of the closure configuration.

2.2 CM: 2S-1

The CM test article will be as described in Reference 7 of this test plan. NAA will have performed modifications to the forward access hatch and CM tunnel to accept pneumatic and electrical feedthroughs for the pressurization system of the tunnel and for the instrumentation harness.

3.0 DESCRIPTION OF THE TEST PROGRAM

3.1 Test Conditions

3.1.1 Unit Load Tests

The test loads will be applied to the command module and command module fixture such that the LM/CM interface at X_e 312.50 (X_c 110.25) experiences the unit loads specified in the table below. The test vehicles will be in the nominal orientation as described in Ref. 4 of this test plan.

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

3.0 DESCRIPTION OF THE TEST PROGRAM

3.1.1 Unit Load Tests (Cont.)

Test No.	Description	Unit Load Ref. LM Axes	Pressure* (PSIG)
1	Unit Pressure		5.8
2	Unit Axial Tension Load	$+P_x$ = 20,000 lbs	0
3	Unit Axial Tension Load with Pressure	$+P_x$ = 20,000 lbs	5.8
4	Unit Axial Compression Load	$-P_x$ = 25,000 lbs	0
5	Unit Axial Compression Load with Pressure	$-P_x$ = 25,000 lbs	5.8
6	Unit Shear Load	$+S_y$ = 1000 lbs	0
7	Unit Shear Load with Pressure	$+S_y$ = 1000 lbs	5.8
8	Unit Shear Load	$+S_z$ = 1000 lbs	0
9	Unit Shear Load with Pressure	$+S_z$ = 1000 lbs	5.8
10	Unit Torsion	$+M_x$ = 26,000 in-lbs**	0
11	Unit Torsion with Pressure	$+M_x$ = 26,000 in-lbs**	5.8
12	Unit Moment	$+M_y$ = 174,000 in-lbs**	0
13	Unit Moment with Pressure	$+M_y$ = 174,000 in-lbs**	5.8
14	Unit Moment	$+M_z$ = 174,000 in-lbs**	0
15	Unit Moment with Pressure	$+M_z$ = 174,000 in-lbs**	5.8

* Pressure means: CM cabin vented to atmosphere; pressure in tunnel and LM; LM docking hatch open.

** Moment definition - When looking along an axis in a negative toward positive direction, clockwise moments are positive.

3.1.2 CM-LM Interface Slippage Determination

The data obtained for this condition will be obtained during the Docking Structure Tests of LTA-3, LTP933-24006A, paragraph 3.1.2.2.

3.2 Test Description

In order to precludecatastrophic damage to the test article and also for reasons of personnel safety, the LTA-3 Ascent Stage will be submerged in water in the hydrostatic tank.

The LTA-3 Ascent Stage will be positioned in the hydrostatic tank, (Plant 31, Grumman, Bethpage) as shown in Figure 2. Command Module 2S-1 will be affixed in a hard docked position to the test article and will be counterbalanced to allow the initial X-axis loading on the vehicle to be zero. External loads will then be applied to the NAA loading fixture which is attached to the base of the CM2S-1. In this manner, the correct interaction of the test vehicles and load paths are assured. The loads applied to the NAA loading fixture are calculated by knowing the desired interface loads (paragraph 3.1.1

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

3.0 DESCRIPTION OF THE TEST PROGRAM

3.2 Test Description (Cont.)

and 3.1.2) and the geometrical relationship of the loading points on the NAA loading fixture and the CM/LM interface.

3.3 Test Procedure

The test articles will be assembled as described in the preceding section and shown in Figure 2. The tank and the LM cabin will be filled with water and the test pressures applied as required. The test loads will be incrementally applied until the maximum loading condition is reached. Each test condition may consist of more than one test run.

The following parameters will be monitored and recorded during the performance of the test (Appendix 1):

1. Vehicle Strains
2. Vehicle Deflections
3. Applied Loads
4. Applied Pressures

The above data will be taken directly from the instrumentation on recording systems and presented in graph or tabular form, as required, in a report.

During the performance of these tests, the cognizant NAA test director will have the sole authority to deviate from the procedures when deviations are required.

A test log will be furnished for each test and will include all pertinent information relating to the performance of the test and the test article.

A sample data sheet and test log are included as appendices 2 and 3 respectively.

Photographic coverage of the test will be provided.

4.0 SUPPORT REQUIREMENTS

4.1 Instrumentation

Instrumentation to be provided on the test articles are specified in the table on the next page and in Figures 3 thru 8.

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

4.0 SUPPORT REQUIREMENTS

4.1 Instrumentation (Cont.)

	Unit Loads (Para. 3.1.1)	CM-LM Interface Slippage Determination (Para. 3.1.2).
GAEC		
Vehicle Strain*	0	68
Vehicle Deflection*	0	2
NAA		
Vehicle Strain	12	12
Deflections:		
1. At $X_c \approx 21$	8	0
2. At $X_c \approx 82$	8	0
3. At $X_c \approx 110.25$	12	0
4. At LM Interstage	8	0
5. At Interface (closed loop)	8	8
APPLIED LOADS	10	6

* Defined in LTP933-24006A

The data acquisition system to be utilized for these tests consists of B&F strain recorders, direct writing oscillographs, and dial indicators as required.

4.2 Fixturization and GSE

4.2.1 The test fixturization will include those used to support the LTA-3 hydrostatic test program as well as fixtures designed for the docking structure test.

4.2.2 GAEC GSE will include but not be limited to: slings, hydraset, interstage fittings, transporter and leak rate test unit.

4.2.3 NAA GSE will include but not be limited to: CM handling frame, vehicle slings and vehicle covers.

5.0 TEST REPORTING

The results of these tests will be presented in Report No. LTR933-24007, "Report of Unit Load Tests of LTA-3 and CM2S-1."

6.0 SAFETY REQUIREMENTS

No special personnel safety requirements are necessary for the per-

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

6.0 SAFETY REQUIREMENTS (Cont.)

formance of these tests other than those normally implemented and considered to be a part of the standard Grumman safety program.

7.0 DISPOSITION OF TEST ARTICLES

7.1 After completion of the test program, the LTA-3 Ascent Stage will be turned over to manufacturing for refurbishment for the LTA-3 Drop Tests.

7.2 After completion of the test program, NAA will make appropriate arrangements for the shipment of CM 2S-1.

PLAN FOR UNIT LOAD TESTS OF LTA-3 AND CM 2S-1

LTA-3 TEST PROGRAM SCHEDULE

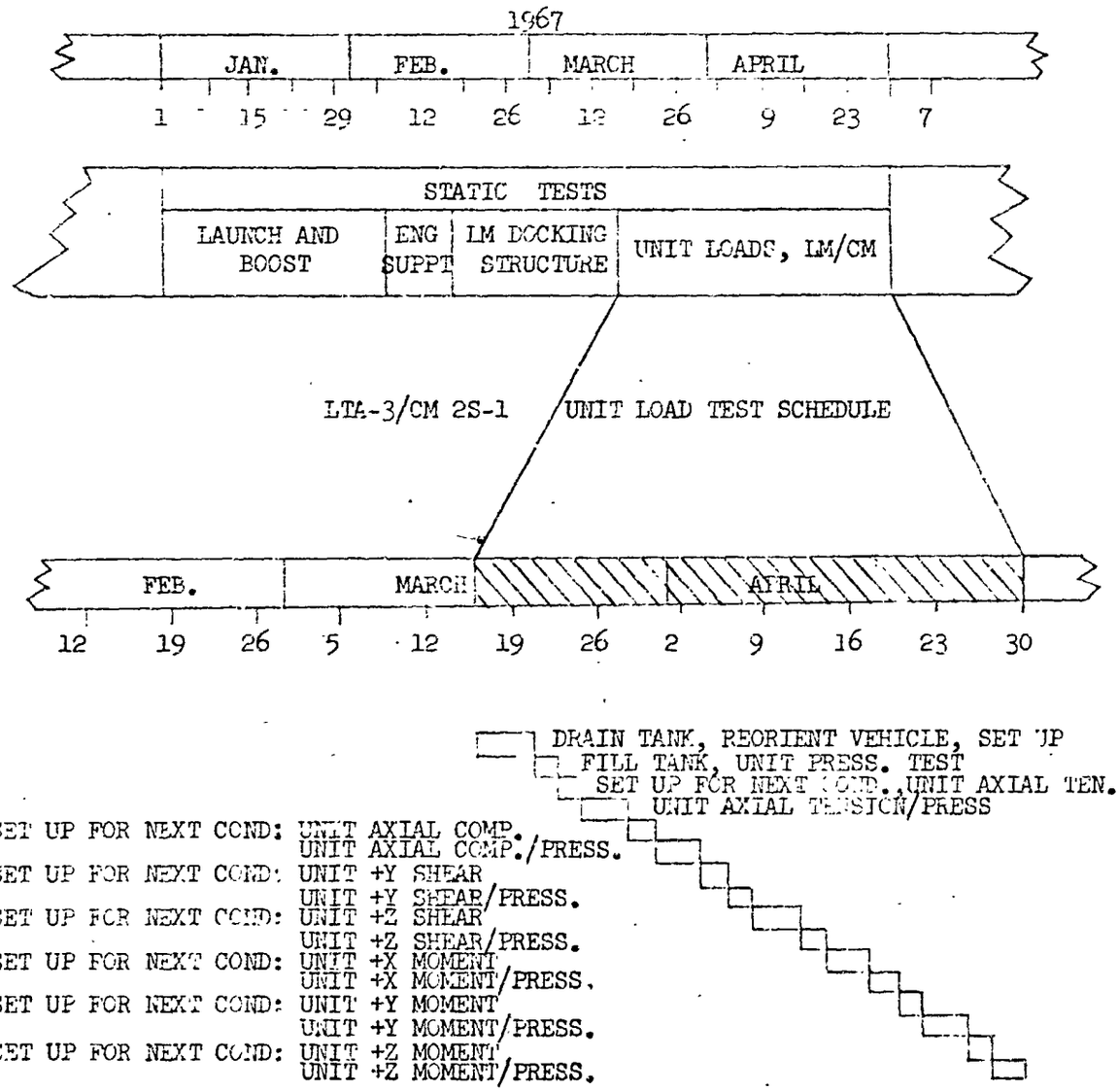


FIGURE 1 - TEST SCHEDULE

PLAN FOR DOCKING STRUCTURE TESTS OF LTA-3

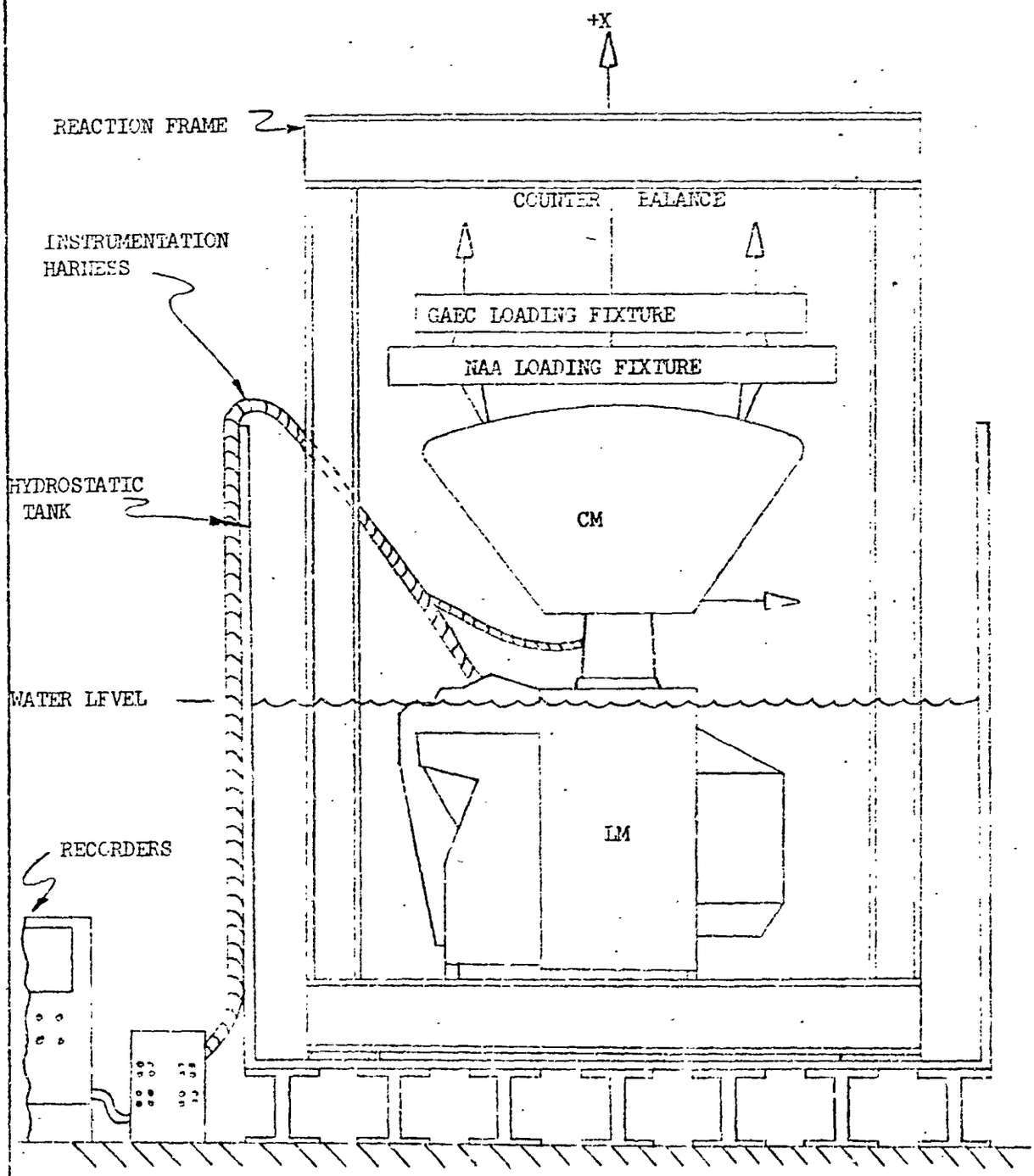
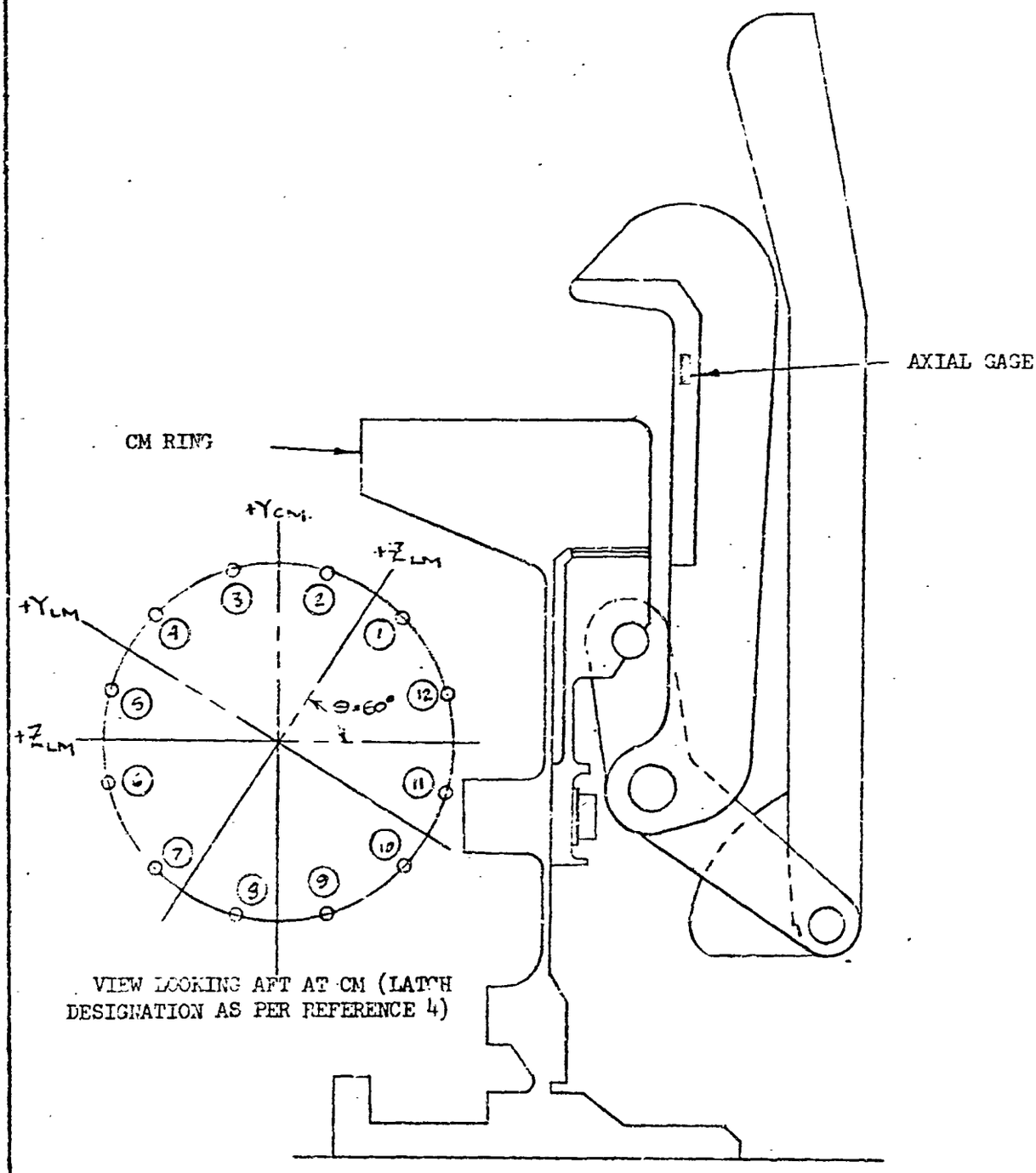


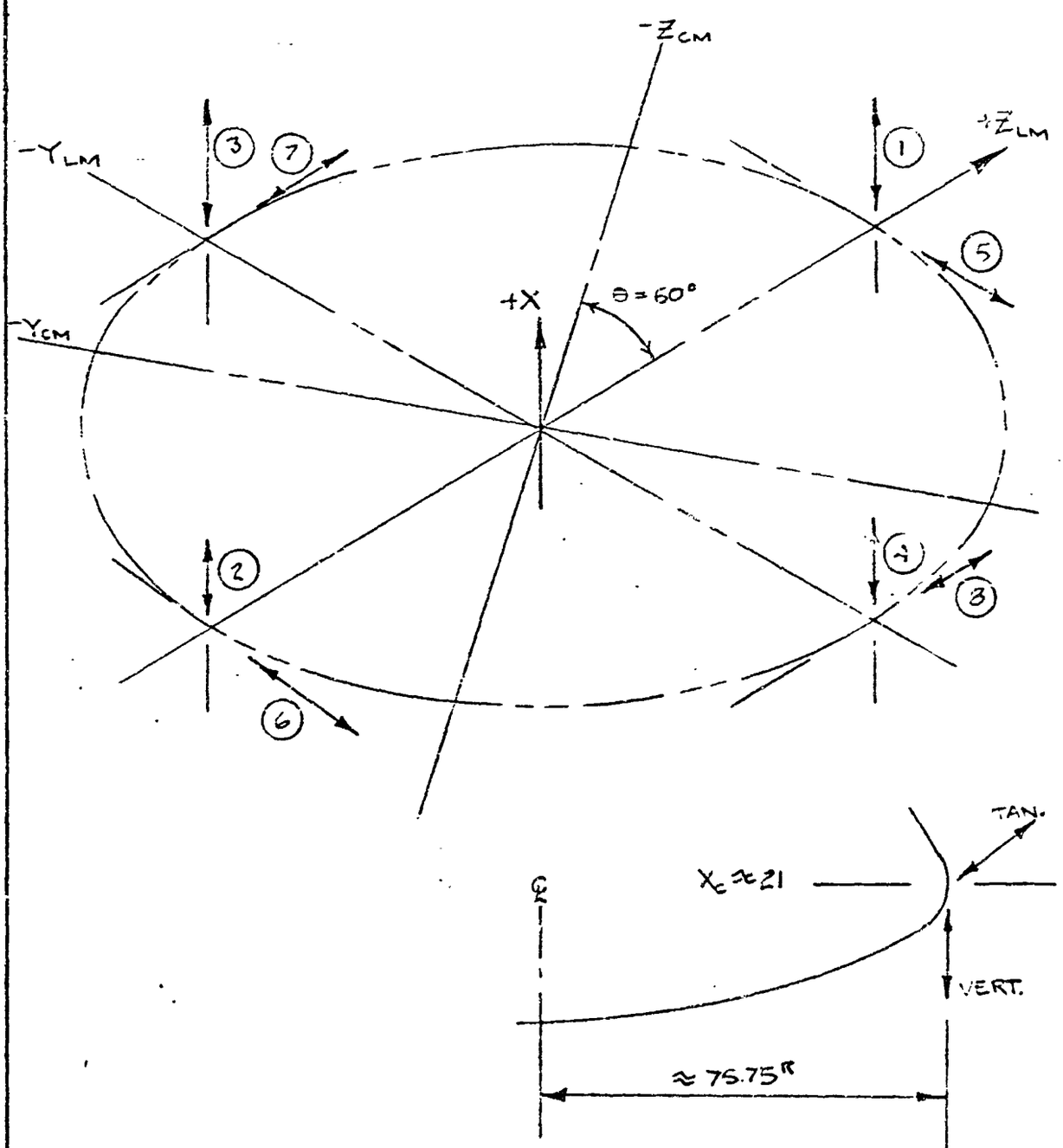
FIGURE 2 - TEST SET-UP

FIGURE 3 - DOCKING LATCHES STRAIN GAGE LOCATIONS



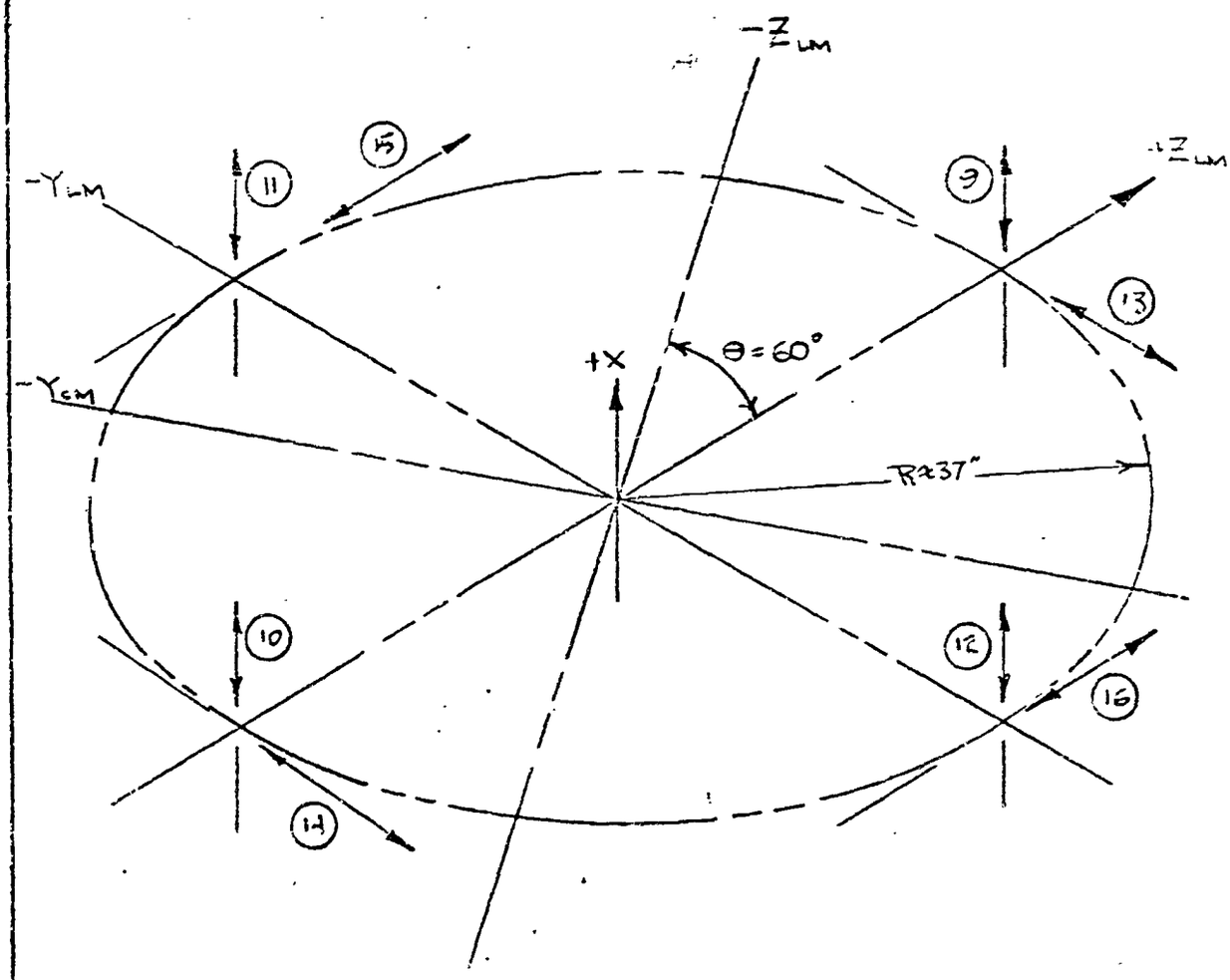
DOCKING LATCH - TYPICAL 12 PLACES

FIGURE 4: VEHICLE DEFLECTIONS AT $X_c \approx 21$



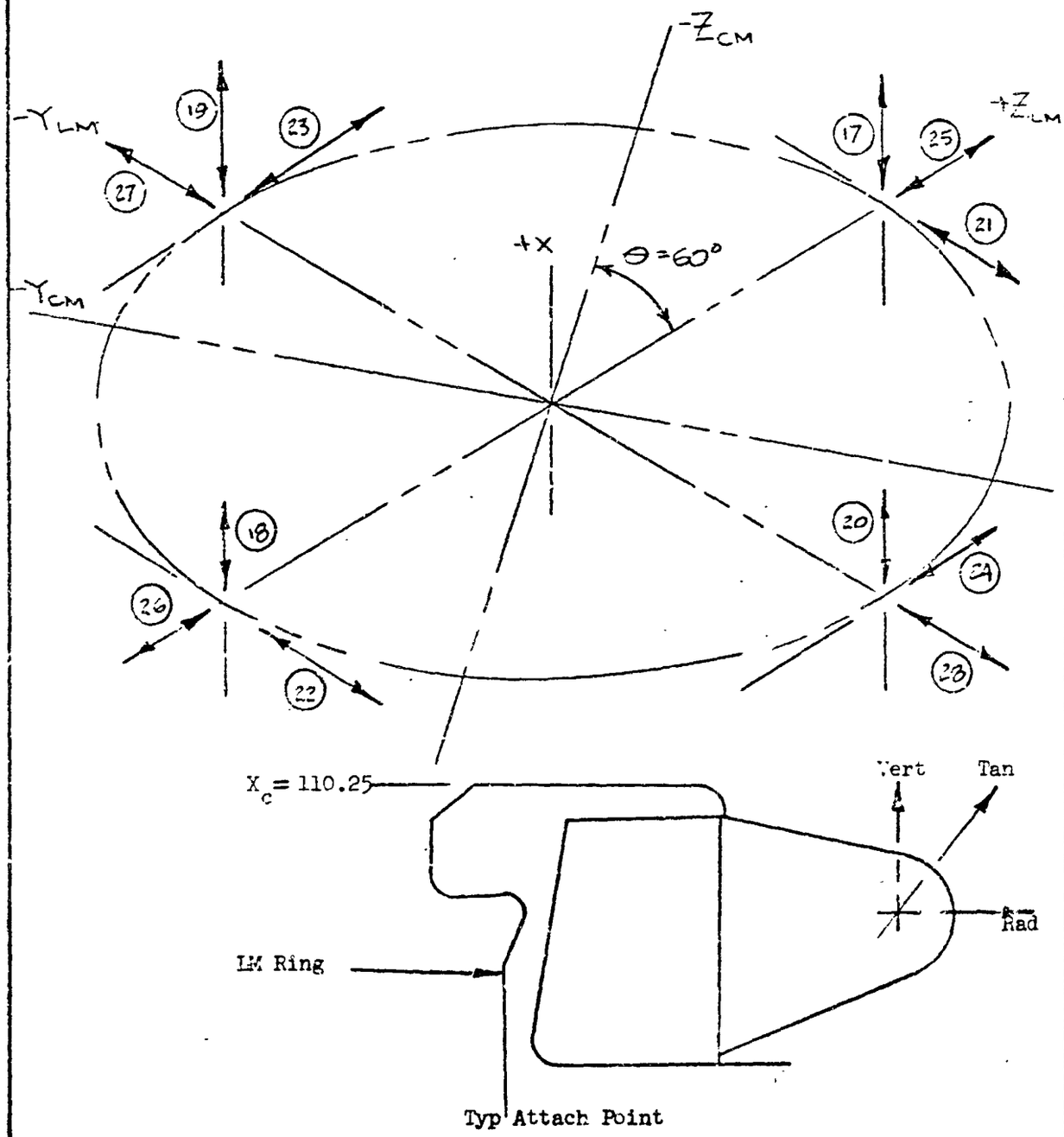
VIEW LOOKING DOWN ON TEST SET-UP

FIGURE 5: VEHICLE DEFLECTIONS AT Xc ≈ 82



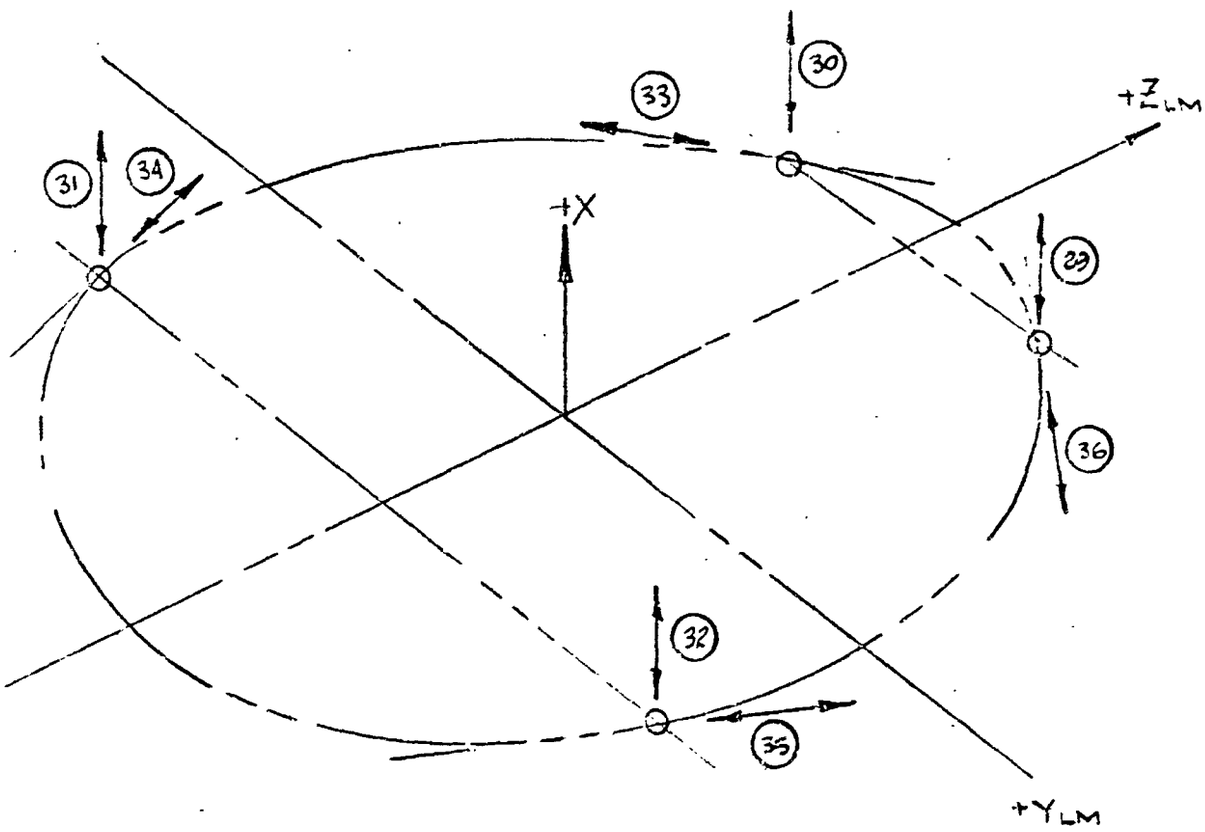
VIEW LOOKING DOWN ON TEST SET-UP

FIGURE 6: VEHICLE DEFLECTION AT $X_c \approx 110$



VIEW LOOKING DOWN ON TEST SET-UP

FIGURE 7: VEHICLE DEFLECTIONS AT LM INTERSTAGE



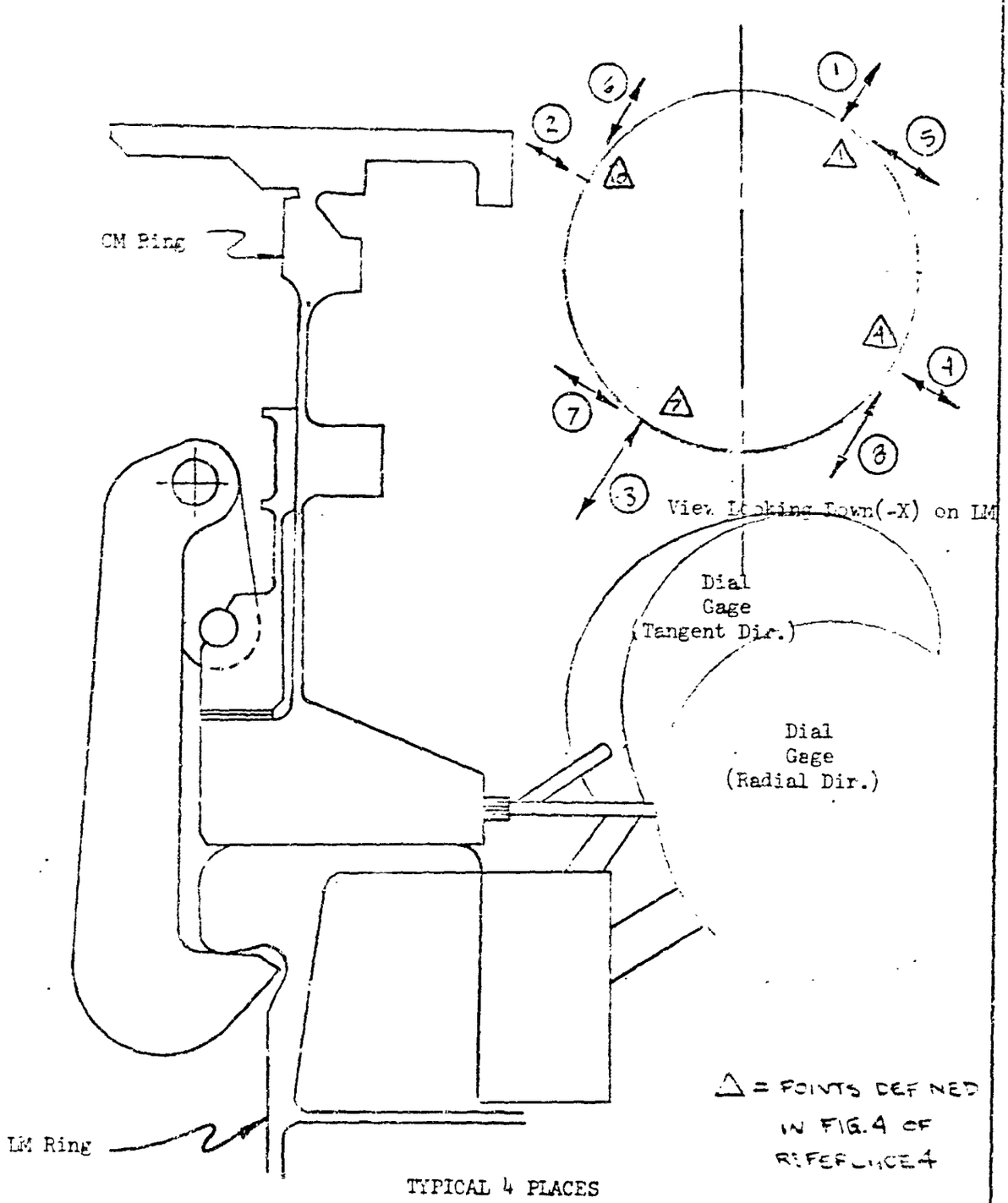


FIGURE 8: LM/CM RING RELATIVE MOVEMENT

APPENDIX 1: INSTRUMENTATION FORM B

TO BE ADDED

APPENDIX 2: DATA SHEET- UNIT LOAD TESTS OF LTA-3 SHEET OF

PART I - GENERAL DATA

TEST CONDITION:

TEST PLAN:

TEST PROCEDURE:

TEST ARTICLE:

TEST DATE:

TEST DIRECTOR: ______________
GAEC - SYSTEMS TEST

WITNESSED: ______________
GAEC - QUALITY CONTROL

WITNESSED: ______________
NASA [illegible]

PART II - TEST DATA

GAGE			MEASUREMENT		REMARKS
NO.	LOCATION	TYPE			

APPENDIX 3: LOG SHEET- UNIT LOAD TESTS OF LTA-3 SHEET OF

PART I - GENERAL DATA

TEST CONDITION:	TEST DIRECTOR: ____________ GAEC - SYSTEMS TEST
TEST PLAN:	
TEST PROCEDURE:	WITNESSED: ____________ GAEC - QUALITY CONTROL
TEST ARTICLE:	
TEST DATE:	WITNESSED: ____________ NASA Q. C.

PART II - TEST LOG

PLAN NO.	% OF LIMIT LOAD	REMARKS