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LITTLEJOHN TECHNICAL MEMORANDUM 971
DA 517-07-035

LITTLEJOHN

ROAD TRANSPORTATION TESTS STRAIN INVESTIGATION OF LITTLEJOHN XM-449 TRAILER

March 1962

ORDNANCE MISSION

WHITE SANDS MISSILE RANGE
NEW MEXICO

COPY 27

LITTLEJOHN

ROAD TRANSPORTATION TESTS

STRAIN INVESTIGATION

OF LITTLEJOHN XM-449 TRAILER

BY: CHARLES F. FALKENBACH

DA 517-07-035
OMS CODE NR 5520.12.418

TECHNICAL MEMORANDUM 971

MARCH 1962

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WHITE SANDS MISSILE RANGE
NEW MEXICO

ABSTRACT

THE LITTLEJOHN XM-449 TRAILER WAS MONITORED FOR STRAIN DURING ROAD TRANSPORTATION TESTS CONDUCTED AT WHITE SANDS MISSILE RANGE, NEW MEXICO, DURING THE PERIOD OCTOBER THROUGH DECEMBER 1960.

THE TEST OBJECTIVE WAS TO ACQUIRE QUANTITATIVE DATA REGARDING THE STRUCTURAL INTEGRITY OF THE LITTLEJOHN XM-449 TRAILER DURING ROAD TRANSPORTATION.

THE MAXIMUM STRAIN LEVEL RECORDED WAS 872 MICRO-INCHES PER INCH. THE STRUCTURAL MEMBERS OF THE TRAILER ARE CAPABLE OF WITHSTANDING TRANSPORTATION WITHIN THE LIMITS OF THIS INVESTIGATION.

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INTRODUCTION

THIS REPORT DESCRIBES A STRAIN INVESTIGATION OF THE LITTLEJOHN XM-449 TRAILER WHICH WAS CONDUCTED AT WHITE SANDS MISSILE RANGE, NEW MEXICO, DURING THE PERIOD OCTOBER THROUGH DECEMBER 1960. THE TEST WAS PERFORMED UNDER THE PROVISIONS OF "LITTLEJOHN (PHASE II) XM-51 CONSOLIDATED ENGINEER-SERVICE TEST PLAN" (REVISION 2), WHITE SANDS MISSILE RANGE, NEW MEXICO, DATED AUGUST 1960.

OBJECTIVE

THE OBJECTIVE OF THIS TEST WAS TO ACQUIRE QUANTITATIVE DATA REGARDING THE STRUCTURAL INTEGRITY OF THE LITTLEJOHN XM-449 TRAILER DURING ROAD TRANSPORTATION. THE TEST WAS NOT INTENDED TO RESULT IN A COMPLETE STRUCTURAL ANALYSIS, BUT TO OBTAIN QUANTITATIVE DATA ONLY. IT IS BELIEVED THAT DATA OBTAINED FROM USER REPORTS AND EXTENDED FIELD USE WILL FURNISH MORE INFORMATION RELATED TO TRAILER METAL FATIGUE DAMAGE AND DAMAGE CAUSED BY IMPACT LOADS THAN WOULD DATA OBTAINED FROM A LABORATORY TEST.

DESCRIPTION OF TEST

FOR THE CONDUCT OF THIS TEST, THE FOLLOWING ENVIRONMENTAL QUALIFICATIONS WERE APPLIED TO THE TRAILER:

THE TRAILER WAS TOWED BY A 3/4-TON MILITARY TYPE TRUCK ONLY.

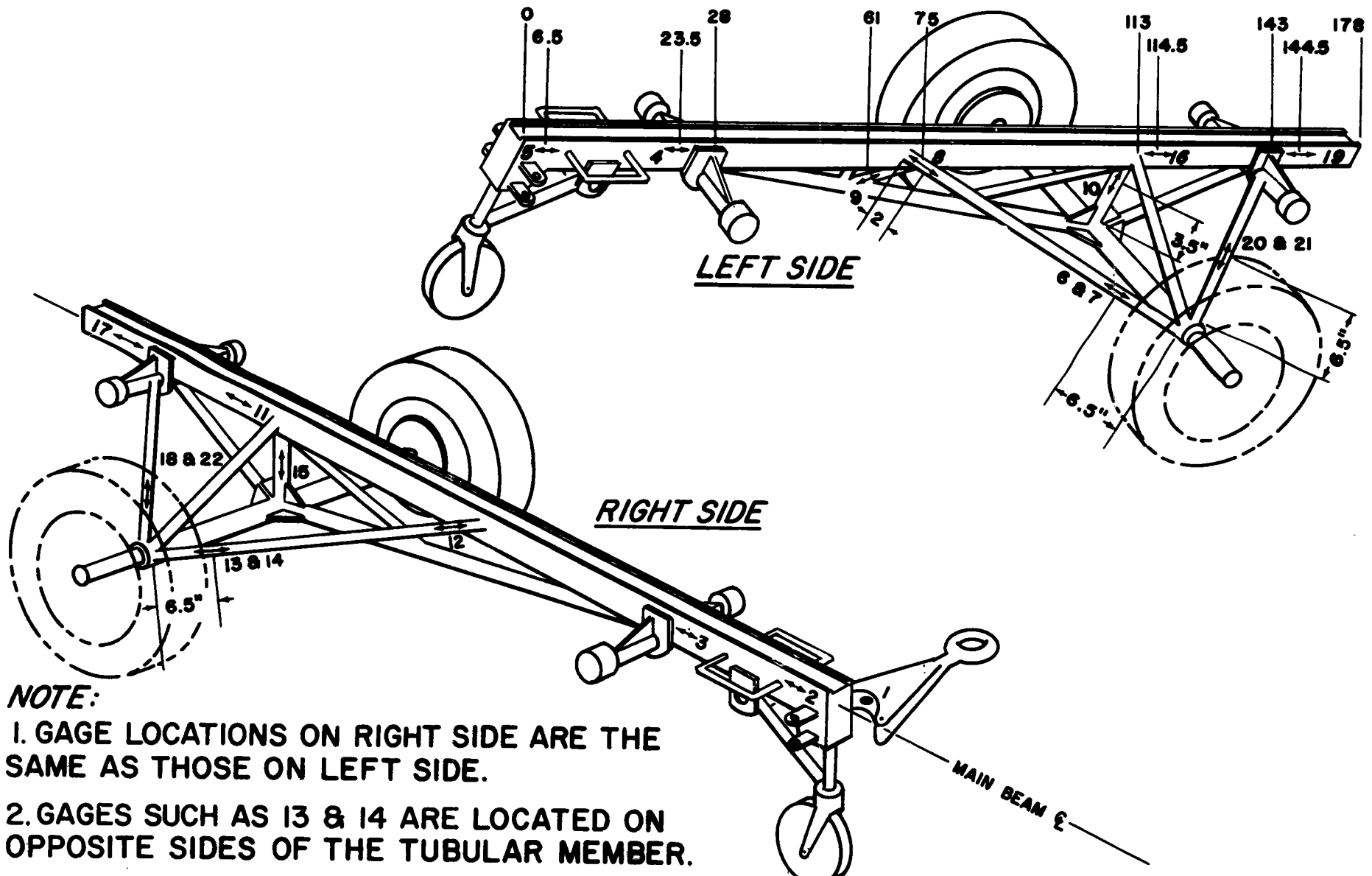
AMBIENT TEMPERATURE WAS BETWEEN 70°F AND 90°F.

VEHICLE SPEEDS VARIED FROM 5 TO 10 MILES PER HOUR OVER CROSS-COUNTRY TERRAIN.

THE MISSILE WAS PROPERLY SECURED TO THE TRAILER.

THE LITTLEJOHN XM-449 TRAILER WAS COATED WITH A BRITTLE LACQUER. THE TRAILER, WITH AN INERT MISSILE, WAS THEN TOWED BY A 3/4-TON MILITARY TYPE TRUCK OVER CROSS-COUNTRY TERRAIN. THE PRINCIPAL AXES OF STRAIN AT SELECTED POINTS WERE DETERMINED BY OBSERVATION OF THE CONDITION OF THE LACQUER AT THE END OF THE TEST.

STRAIN GAGES WERE APPLIED TO THE TRAILER, ALIGNED ALONG THE PRINCIPAL AXES OF STRAIN. FIGURE 1 PRESENTS LOCATION AND ORIENTATION OF GAGES, AND A DESCRIPTION OF THE STRAIN GAGE INSTRUMENTATION IS GIVEN IN APPENDIX A. THE STRAIN GAGE BRIDGE IS SHOWN IN FIGURE A-1.



NOTE:

1. GAGE LOCATIONS ON RIGHT SIDE ARE THE SAME AS THOSE ON LEFT SIDE.

2. GAGES SUCH AS 13 & 14 ARE LOCATED ON OPPOSITE SIDES OF THE TUBULAR MEMBER.

Fig. 1. Strain Gage Location.

THE TRAILER, WITH THE INERT MISSILE, WAS TOWED BY A 3/4-TON MILITARY TYPE VEHICLE OVER CROSS-COUNTRY TERRAIN AT SPEEDS BETWEEN 5 AND 10 MILES PER HOUR. THE SPEED AND TERRAIN WERE SUFFICIENT TO CAUSE THE TRAILER TO REBOUND UP TO 2.5 FEET FROM THE GROUND.

RESULTS

A MAXIMUM STRAIN OF 872 MICRO-INCHES PER INCH WAS MEASURED FROM STRAIN GAGE 15 (FIG. 1). TABLE I SHOWS THE MAXIMUM COMPRESSION AND TENSION LEVELS EXPERIENCED BY THE CORRESPONDING STRAIN GAGE. THE TRAILER DID NOT SUFFER VISIBLE DAMAGE.

TABLE I

MAXIMUM MEASURED STRAINS

GAGE	STRAIN*		BALDWIN-LIMA HAMILTON GAGE TYPE
	COMPRESSION (IN MICRO-INCHES PER INCH)	TENSION (IN MICRO-INCHES PER INCH)	
1	138	288	A-16
2	609	641	A-16
3	505	452	A-16
4	255	59	EBF-13D+
5	336	532	A-16
6	274	217	A-16
7	209	209	A-16
8	162	54	EBF-13D+
9	172	235	EBF-13D+
10	642	345	A-16
11	170	64	A-16
12	262	77	A-16
13	243	144	A-16
14	218	206	A-16
15	454	872	A-16
16	138	148	EBF-13D+
17	142	88	A-16
18	199	220	A-16
19	194	76	CBD-7
20	315	136	CBD-7
21	285	70	CBD-7
22	262	72	A-16

* RESULTANT STRAINS CAUSED BY A COMBINATION OF BENDING LOADS PLUS COMPRESSION AND/OR TENSILE LOADS.

CONCLUSIONS

THE MAXIMUM STRAIN MEASURED WAS 872 MICRO-INCHES PER INCH, WHICH IS EQUIVALENT TO 8,720 PSI OF LOADING.

SINCE THE MINIMUM YIELD STRENGTH OF 6061-T4 OR T6 ALUMINUM (THE TYPE OF ALUMINUM USED IN THE TRAILER) IS 40,000 PSI AT 75°F, IT IS CONCLUDED THAT THE STRUCTURAL MEMBERS OF THE TRAILER ARE CAPABLE OF WITHSTANDING TRANSPORTATION WITHIN THE LIMITS AS STATED HEREIN. NO MEANS WERE AVAILABLE TO DETERMINE THE STRENGTH OF THE WELDS.

APPENDIX A

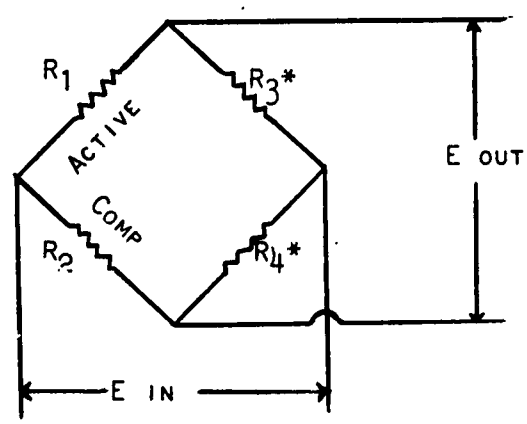
STRAIN GAGE INSTRUMENTATION

STRAIN GAGES WERE MOUNTED ON THE SPECIMEN WITH EASTMAN 910 ADHESIVE. EACH ACTIVE GAGE WAS WIRED INTO A BRIDGE CIRCUIT AS SHOWN IN FIGURE A-1. THE TEMPERATURE COMPENSATING GAGE WAS MOUNTED ON AN ALUMINUM TAB AND ATTACHED TO THE SPECIMEN.

THE BRIDGE CIRCUIT WAS MONITORED WITH A CEC (CONSOLIDATED ELECTRO-DYNAMICS CORPORATION) MODEL 113-B CARRIER AMPLIFIER. NOTE THAT TWO LEGS OF THE BRIDGE CIRCUIT WERE INCORPORATED WITHIN THE AMPLIFIER.

THE AMPLIFIER RESPONSE WAS MONITORED WITH A CEC MODEL 5-114 OSCILLOGRAPH RECORDER.

A 28V D.C.-110V A.C., 400 CPS PORTABLE GENERATOR WAS USED TO SUPPLY THE NECESSARY ELECTRICAL POWER.



* R_3 AND R_4 ARE CONTAINED IN THE AMPLIFIER.

FIG. A-1. STRAIN GAGE BRIDGE.

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