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USATECOM PROJECT NO. 4-5-7491-05
YPG PROJECT NO.
TEST SPONSOR PROJECT NO.
USACDC AC NO.

YPG REPORT NO. 8027

ENGINEERING TEST OF

GANTRY, LIGHTWEIGHT, AIRDROP RIGGING

FINAL REPORT

BY

TERRY W. PUCKETT, 1LT
NOVEMBER 1968

YUMA PROVING GROUND
YUMA, ARIZONA

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DEPARTMENT OF THE ARMY
Headquarters, U.S. Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland 21005

AMSTE-BG 30 December 1969

SUBJECT: Final Report of Engineering and Service Test of Gantry, Lightweight, Airdrop Rigging, USATECOM Project Nos. 4-5-7491-05 and 4-ES-655-035-001

Commanding General
US Army Materiel Command
ATTN: AMCRD-FS
Washington, D. C. 20315

1. References:

a. Preliminary Report of Engineering Design Test of Modified Gantry, Lightweight, Airdrop Rigging, DA Project No. 1F141812D183, Task 22.

b. Letter, AMSTE-BG, USATECOM, 20 December 1968, subject: Engineering Test Report of Gantry, Lightweight, Airdrop Rigging, RDT&E Project No. 1M141812D18322A, USATECOM Project No. 4-5-7491-05.

2. Approval Statement: Subject reports are approved except as stated herein.

3. Background:

a. Presently field units employ several types of materiel handling equipment not specifically designed for lifting loads being rigged for airdrop. To provide a single standard item, US Army Natick Laboratories developed the subject gantry system.

b. The complete gantry system has a lifting capacity of 35,000 pounds and consists of four "A" frame structures, two power packs and four accessory beams. This system can also be used as two separate lifting devices with each having a capacity of 17,500 pounds and consisting of two "A" frames, one power pack and two accessory beams. The gantries have an internal vertical clearance of 14 feet and a horizontal clearance of 12 feet. These clearances enable the gantry system to lift a nine foot high load five feet for placement onto transport vehicles ten feet wide.

Each gantry is provided with two suspended lift hooks of adjustable height to accommodate the various locations of lift fittings on various type cargoes. These gantries are equipped with caster wheels, incorporating a locking and unlocking device to allow manual positioning at the rigging site or for relocating the gantries. Screwtype legs (feet) of sufficient size are provided on each gantry to enable lifting of loads on soft unprepared ground or on hard snow. The total weight of the 35,000-pound system is approximately 7,500 pounds and can be disassembled into component parts to permit manhandling by four personnel. The disassembled system is suitable for transport in air or ground vehicles.

c. The engineer design test of the gantry was completed in May 1966. At that time engineering tests (ET) were waived and the system was submitted for service testing. The results of this service test (ST) indicated that the gantry system was not suitable for Army use. As a result of the ST In-Process Review in December 1967, it was determined that the gantry system would be modified and would undergo both engineering and service tests.

d. The ET of the modified gantry was completed by Yuma Proving Ground in November 1968, the ST was completed by the US Army Airborne, Electronics and Special Warfare Board in September 1969 and the arctic winter service test is scheduled to be conducted beginning in September 1971.

4. Test Results:

a. The gantry met 34 of 50 requirements of the SDR. Six deficiencies and ten shortcomings were reported by the test agencies on the modified gantry system. After analysis and appropriate reclassification, no deficiencies and 15 shortcomings remain. One requirement of the SDR, operation and storage at -65°F, will be evaluated during the arctic winter service test.

b. Deficiencies - None.

c. Shortcomings (15)

(1) It was very difficult for four men to carry the power pack assembly and load it onto a military vehicle. However, if the hydraulic oil was drained from the power pack, the weight would be reduced by

65 pounds and, at this reduced weight, the test item will meet the requirements of the SDR. Further, the draining of the hydraulic oil (No. 10 engine oil) is a simple operation.

(2) The draft technical manual 5-3950-205-14 for the gantry system was not clear, concise, or complete. Eighty-eight recommended changes to this manual were proposed, 80 are classified as administrative, seven recommend that an operation is within the operator's capability (now assigned to other than the gantry operator), and one recommends that gloves be worn when operating the gantry in the manual mode. All of the proposals can be incorporated into an updated manual without being verified by retesting, and this item can be maintained under field conditions.

(3) Auxiliary equipment required for lifting loads was not included with the test system. Since MB-2 tiedowns, FSN 1670-545-9063, were found to be adequate during this test program and are available within the supply system, the addition of MB-2 tiedowns to the test system is considered acceptable.

(4) Spare parts for the power pack engines were not available through normal supply channels at the service test agency. Since these 3-HP gasoline engines are military standard items with hydraulic pumps and control valves, the lack of spare parts within the supply system should not be considered as a failure of the test item to meet the technical specification.

(5) During the ST this system demonstrated a 90 percent reliability with a 90 percent confidence level of completing a daily mission. (Requirement - 95 percent) However, prior to the ST (during ET) the same system demonstrated the necessary capability of 95 percent reliability. Seven of the reported failures cited in the ST report (Appendix IV, Table 1) are not failures as defined in the SDR. These reported failures did not prevent the test system from completing its assigned mission and could be repaired by the operator with the tools and materials provided within 30 minutes. Revised reliability computations, utilizing the data from the ET and the revised data from the ST, are provided as Inclosure 1. These combined results indicate that the test item demonstrated a reliability of 94 percent with a 90 percent confidence level. This difference (one percent) between the requirement (95 percent) and that demonstrated (94 percent) by the test item is considered minor.

(6) The remaining shortcomings were found in the areas of physical characteristics, maintenance, operational performance/technical characteristics and human factors.

d. The test agency stated (deficiency) that the test system/device is not capable of immediate effective employment. The revised approved technical characteristics stated that the assembly time for a device (17,500-pound capacity) must be less than one hour. This was demonstrated during the ST (actual 47 minutes). Although the parameter for assembly of the system was not defined in the revised technical characteristics, the assembly of the system did take 94 minutes.

e. The test item met the requirements for maintainability.

f. The test item is safe to operate; however, potential operational hazards are noted below in paragraph 4g.

g. During this test program the following improvements/actions are suggested relative to the test item.

(1) That hydraulic hose(s) or hydraulic fitting(s) not be repaired but replaced as necessary.

(2) The cable ends be soldered in lieu of being taped. Tape falls off the cable ends in a short period of time and the loose ends are exposed.

5. Conclusion: The gantry system is suitable for Army use under intermediate environmental conditions.

6. Recommendation: As many of the shortcomings as feasible be corrected.

FOR THE COMMANDER:

/s/ William H. Hubbard
/t/ WILLIAM H. HUBBARD
Colonel, GS
Deputy Chief of Staff

2 Incl
1. as
2. ST Report

AMSTE-BG 30 Dec 1969

SUBJECT: Final Report of Engineering and Service Test of Gantry, Lightweight, Airdrop Rigging, USATECOM Project Nos. 4-5-7491-05 and 4-ES-655-035-001

CF:
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Reliability Computations for Engineering and Service Tests

1. BASIC DATA:

   a. Lift Cycles: 4102

   b. Number of Failures: 2

   c. Mission Day: 50 cycles

2. Computation of Point Estimate of Reliability:

   a. Computation of point estimate of Mean Time Between Failures (MTBF):

   $$MTBF = \frac{NT}{}$$

   $$MTBF = \frac{4102}{2} = 2051$$

   MTBF = 2051 cycles or 5.56 mission days, where:

   NT = Test duration in terms of lift cycles, and

   = Number of failures

   b. Computation of Reliability:

   $$R(x) = \frac{-x}{MTBF}$$

   $$R(50) = 2.73^{\frac{-50}{2051}}$$

   $$R(50) = 2.73^{-024}$$

   R = .976 or 98 percent is a point estimate of reliability where:

   R = Point estimate of reliability

   x = One mission day = 50 cycles

   = Natural log base = 2.73

   MTBF = 2051 point estimate of Mean Time Between Failures

Inclosure 1

3. Computation of Reliability with 90 percent Confidence Level Assumed:

a. Computation of MTBF:

$$MTBF = \frac{2\,x_T}{x^2\ ,2\ +2}$$

$$MTBF = \frac{2(4102)}{X^2.1,2(2)+2}$$

$$MTBF = \frac{8204}{10.645}$$

MTBF = 770 cycles where:

x_T = Test Duration = 41 2 cycles

= Number of Failures (2)

x^2 = Chi square factor (from Table H-3b, AMCP 702-3) and is given by 100(1-)% = 90 percent confidence.

b. Computation of Reliability:

$$R(x) = \frac{-x}{MTBF}$$

$$\frac{-50}{770}$$

R(50) = 2.73

-0649

R(50) = 2.73

R(50) = .937 or 94 percent reliability at a 90 percent confidence level where:

R = Reliability

x = Mission Day = 50 cycles

= Natural log base = 2.73

MTBF = Mean Time Between Failures = 770 cycles

4. Results:

a. The test system demonstrated a point estimate reliability of 98 percent.

b. The test system demonstrated a reliability of 94 percent with a confidence level of 90 percent.

USATECOM PROJECT NO. 4-5-7491-05

ENGINEERING TEST OF

GANTRY, LIGHTWEIGHT, AIRDROP RIGGING

TEST REPORT

BY

TERRY W. PUCKETT, 1LT
NOVEMBER 1968

YUMA PROVING GROUND
YUMA, ARIZONA

ABSTRACT

The ergineer test of the Gantry, Lightweight, Airdrop Rigging, was conducted by Yuma Proving Ground from 20 May 1968 to 30 August 1968.

The purpose of the test was to determine the suitability of the test gantry for service testing.

All testing was conducted under natural environmental conditions. The approved technical characteristics of the test item were used as criteria to determine test item reliability. The power pack was too heavy for four men to carry and load onto a military vehicle (deficiency). The manual chain hoists corroded, the winch broke, and the hydraulic cylinder leaked oil (shortcomings).

It was concluded that the shortcomings were readily correctible, that the Gantry, Lightweight, Airdrop Rigging, is suitable for lifting loads up to 17,500 pounds when used as a device and 35,000 pounds when used as a system. It was recommended that the Gantry, Lightweight, Airdrop Rigging be subjected to service testing.

FOREWORD

Yuma Proving Ground was responsible for test execution, and preparation of the test report.

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

In rigging and preparing airdrop loads, field units presently must employ several types of materials handling equipment such as mobile warehouse and rough-terrain forklift vehicles, heavy ordnance wreckers, construction cranes, and field fabricated A-frame gantries with manually operated hoists to accomplish necessary lifting. These devices are inadequate for rigging loads up to the required weight of 35,000 pounds and are not readily available for use at remote outloading sites.

To remedy this situation, an SDR was approved in July 1964 for a Gantry, Lightweight, Airdrop Rigging (GLAR) to provide a single item with a wide range lifting capability to replace the various materials handling equipment now in use (Ref 4, App VI).

A prototype gantry was designed and fabricated, and testing was initiated at U.S. Army Natick Laboratories (USANLABS) on 1 November 1965. The prototype gantry was unsatisfactory from the viewpoint of safety and human factors engineering.

Testing of a redesigned and modified gantry was resumed by USANLABS on 15 March 1966. This engineer design test was completed on 30 May 1966. At that time, it was recommended that the gantry be submitted for service testing (Ref 2, App VI).

Engineering tests on the GLAR were waived. The U.S. Army Airborne, Electronics and Special Warfare Board (USAAESWBD) conducted a service test of the GLAR at Fort Bragg, North Carolina, from 9 January through 20 April 1967. Because the GLAR did not meet several requirements of the SDR, the service test was terminated prior to completion. The USAAESWBD recommended that the Gantry, Lightweight, Airdrop Rigging be considered not suitable for Army use and that consideration be given to the development of a device employing a lifting means which would eliminate the excessive maintenance and training requirements.

As a result of a Pre-In-Process-Review Conference on 2 November 1967 and a formal In-Process-Review Meeting on 6 December 1967, it was decided that the gantry should be modified and submitted to USATECOM for conduct of engineering and service tests beginning 1 April 1968. Yuma Proving Ground was designated to conduct the engineering tests.

1.2 DESCRIPTION OF MATERIEL

The gantry device (two gantries, Fig. 1) has a lifting capacity of 17,500 pounds and consists of two A-frame structures and a power pack. The gantry system (four gantries, Fig. 2) can provide a lift capability of 35,000 pounds. Each gantry has a clearance of 14 feet vertically and 12 feet horizontally, to allow lifting 9-foot-high loads up to 5 feet for placement onto transport vehicles 10 feet wide.

FIGURE 1. Two gantry devices lifting separate loads.

FIGURE 2. One gantry system lowering 35,000-pound load onto aircraft loader.

The total weight of the 17,500-pound capacity gantry device, suitable for both mechanical and manual operation, is approximately 3840 pounds. Disassembly into component parts is possible to permit manhandling.

Each power pack consists of the standard military gasoline engine with hydraulic pump and control and safety valves. Valves are arranged so that the gantries may be operated individually or in pairs. Lifting is achieved by a combination of two hydraulic cylinders with a pulley and cable arrangement on each gantry.

Gantries are equipped with caster wheels to allow manual positioning at rigging sites. Adjustable leveling feet are provided for support during lifting. Screw-type legs are raised and lowered by reversible ratchet wrenches on the gantries. Feet are of sufficient size to enable lifting on soft, unprepared ground surfaces.

Hand operated winches are provided for manual erection of the gantries. Also, manually operated chain hoists are included for lifting of the load in the event of power failure or as the only means of lifting.

Components of the disassembled system are suitable for transport in Army ground vehicles and aircraft.

1.3 OBJECTIVE

To determine the technical performance and safety characteristics of the gantry in accordance with the SDR and the advanced data package.

1.4 SUMMARY OF RESULTS

a. The Gantry, Lightweight, Airdrop Rigging, had the following deficiency and shortcomings:

(1) Deficiency. The power pack was too heavy for four men to carry and to load onto a military vehicle (Para. 2.2.3 and App III).

(2) Shortcoming. The manual chain hoist chains corroded while exposed to the desert environment (Para. 2.2.3 and App III).

(3) Shortcoming. A wrench lever would not lock and had to be held in position so that the baseplate could be lowered (Para. 2.3.4 and App III).

(4) Shortcoming. The hydraulic oil cylinders were seeping oil which could not be stopped (Para. 2.4.3 and App III).

b. The following safety hazards, not covered in the safety criteria established by the USAAESWBD, were encountered:

(1) Cable ends of the winch hoist cable are clamped and the loose ends taped. After 3 or 4 weeks the tape falls off and the wire cable is exposed.

(2) Lifting loads with the manual chain hoist for 1 hour will cause blisters and open wounds on a man's hands (Para. 2.3.4d and App III).

(3) Shipping tape can become wedged between the winch hoist handle washer and the winch hoist causing the safety brake to slip (App III).

(4) When the angle from the accessory beam center fitting to the load connection point exceeds 3.6 degrees it is possible for the cable to jump out of the sheave when lifting the load. The load will drop approximately 8 inches when this occurs (Para. 2.5.3b).

(5) If failure occurs within the area of the hydraulic hose and the fittings located between the flow control valve and the cylinder, the load will fall. No attempt should be made to repair the referenced hose or flare the flange portions of the swivel nuts (Para. 2.5.3 and 2.5.4).

1.5 CONCLUSIONS

a. The above deficiencies and shortcomings are readily correctible.

b. The Gantry, Lightweight, Airdrop Rigging, is suitable for lifting loads up to 17,500 pounds when used as a device and 35,000 pounds when used as a system.

1.6 RECOMMENDATIONS

The Gantry, Lightweight, Airdrop Rigging be subjected to service testing.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

The Gantry, Lightweight, Airdrop Rigging, hereafter referred to as the test item, was tested by Yuma Proving Ground during May through August 1968.

The Approved Technical Characteristics of the test item were used as criteria to determine test item reliability.

The requirements that the system be capable of statically supporting twice the rated load without evidence of permanent deformation and that the system demonstrate sufficient reliability and durability to lift 150 percent of its rated load to a height of 60 inches for 50 cycles were deleted from the test (Ref 5, App VI).

Testing to determine if test item met criteria listed in Paragraph 2.3.1.1c was not conducted due to satisfactory completion of the test during the USAAESWBD service test conducted in June 1967.

2.2 TEST NO. 1 - PHYSICAL CHARACTERISTICS

2.2.1 Objective

To determine the physical characteristics of the test item.

2.2.1.1 Test Criteria.

a. Individual components of the system shall be sufficiently lightweight to enable carrying for short distances and loading by four men onto a military vehicle (Para. 1, App II).

b. No component or group of components of the system shall be of such a size as to prevent air transport by cargo aircraft in accordance with applicable portions of Appendices A and B of AR 705-35. Component parts of the system must comply with the requirements of approved specifications (federal, military, and/or industry), and be made corrosion resistant through use of applicable methods and materials (Para. 3, App II).

2.2.2 Method

The test item components were examined, measured, weighed, carried 25 yards by four men and loaded onto a military vehicle. Technical characteristics were reviewed and checked against AR 705-35. A weight comparison was made between a test item having a hydraulic system and a test item having a manual chain hoist.

2.2.3 Results

a. Weights of the test item and its components are contained in Table 1, Appendix I.

b. No components or group of components of the test item exceeded 15 feet in length, 70 inches in width, and 60 inches in height.

c. Individual components of the system (as listed in Table 1, App I), with the exception of the power pack assembly with hydraulic oil, were carried 25 yards by four men, and loaded onto an M35A1, 2-1/2 ton truck. The power pack assembly could be carried with extreme effort but could not be loaded onto the M35A1 truck.

d. The chains on the manual chain hoist rusted while exposed to the desert environment.

2.2.4 Analysis

All components of the test item are within the size limitations for air transport by cargo aircraft.

The power pack assembly with hydraulic oil cannot be carried and loaded onto a military vehicle by four men without complete disregard for the safety and physical well being of the men involved. However, if the hydraulic oil were drained from the power pack the weight would be reduced by approximately 65 pounds; at this reduced weight the test item can be carried by four men.

After exposure to the climatic conditions of the test site for 3 weeks, rust began to appear on the manual chain hoist chains. This occurred under no rain, low humidity conditions.

2.3 TEST NO. 2 - OPERATIONAL TEST

2.3.1 Objective

To determine the operational suitability of the test item.

2.3.1.1 Test Criteria.

a. The system must be cabable of manual assembly, from shipping to operational condition, without special tools or materials handling equipment. Assembly time for a device (17,500-pound capacity) from removal from shipping skids to erection must be less than 1 hour, when using four men.

b. The device must have a lifting capacity of 17,500 pounds and when used in pairs as a system must be capable of lifting a load measuring 108 inches high, 110 inches wide, and 336 inches long, weighing 35,000 pounds, to a height which will provide a 60-inch ground clearance and will permit placement onto a ground transport vehicle up to 120 inches in width.

c. The system must have mechanical leveling provisions to insure stability in all directions for all loads up to rated load on sloping terrain up to and including 5-degree slopes.

d. The device, when assembled, must be capable of being man-propelled short distances over unsurfaced and non-trafficked areas in the vicinity of forward airfields.

e. The system must be capable of raising the rated load to a 60-inch height in approximately 120 seconds, using self-contained gasoline engine operated power packages, together with hydraulic control and lift components.

f. The device shall be operable from a single control station.

g. The system must be capable of manual operation if power is not available. With manual operation, the lift rate requirement listed for mechanical operation is not mandatory.

h. The system must meet the requirements of the current revision of Specification MIL-T-11748 (Signal Corps), "Interference Reduction for Electrical and Electronic Equipment."

2.3.2 Method

a. Time required for manual assembly of the test item from shipping to operational conditions was recorded. Four men, one NCO who was given on-the-job training for approximately 4 hours, and three enlisted men who were given a 15-minute briefing on the erection of the gantry device, assembled the test item.

b. The test items were used for a period of 3 months to lift various loads within the stated weight and dimensional limitations. Lift and lowering times were recorded.

c. The test item was man-moved for short distances when assembled and disassembled. It was man-moved when assembled as both a manual and a mechanical device. The areas in which these tests were conducted were composed of rock alluvium, the dominant features of gravelly deserts, the most common desert type, made up of gravel stratum mixed with sands and silts.

d. The test item was tested manually and mechanically and the results were recorded.

e. Manpower necessary to operate control stations was observed.

f. A radio interference test was conducted on the test item and the results recorded. Specifications MIL-STD-461 and 462 were used in place of MIL-T-11748 as it was not available during testing.

g. Still pictures were taken and analyzed.

h. Engineering data were recorded as necessary.

i. A test load weighing 35,000 pounds was modified to simulate a load measuring 110 inches wide and 336 inches long. Height measurements were taken to determine height limitations. A ground transport vehicle (aircraft loader) measuring 120 inches in width was then driven between the gantries to permit load placement.

2.3.3 Results

a. The gantry device was manually assembled from shipping to operational condition, without special tools or materials handling equipment, in 58 minutes.

b. Operational data are contained in Table 2, Appendix I.

c. The test item was man-moved a distance of 300 feet when assembled for manual operation and when assembled for mechanical operation.

d. The test item was manually operated with loads up to 17,500 pounds using one device. A 35,000-pound system could not be tested due to the nonavailability of enough chain hoist during testing. Operational data are contained in Table 3, Appendix I.

e. One control station is required when operating a gantry device. Two control stations are required when operating a gantry system.

f. The test item met the "Interference Production for Electrical and Electronic Equipment" requirements. Data are contained in Table 4, Appendix I.

g. A ground transport vehicle up to 120 inches wide can be driven between a gantry system and pick up a load which is 110 inches wide, 336 inches long, and 108 inches high (Fig. 1, App V).

2.3.4 Analysis

Criteria were met with the following exceptions:

a. During erection of the test item, a wrench lever would not lock and had to be held in position so that the baseplate could be lowered.

b. Although the test item was assembled from shipping to operational condition by four men in less than 1 hour, it must be noted that the cart assembly was received with the cylinders and hydraulic hose connected. Had the cylinders been shipped as separate units in the shipping containers constructed by the U.S. Army Natick Laboratories, the time

requirement would not have been met. Also, both ends, as well as the top of the shipping container must be removed if no materials handling equipment is utilized. (Future shipping procedures should be determined.) Since the test item was shipped from Natick, Massachusetts, to Yuma, Arizona, with the cylinders mounted and no damage was incurred, it is our opinion that special cylinder crates are unnecessary. It was also noted that the shipping skids used were nailed down in a kite box shaped crate. If the shipping skids were constructed in the shape of a solid rectangular box with a fold back lid, the time required to remove the test item from the shipping skids would be considerably less (Ref 3.5, App III).

c. The gantry was moved a distance of 300 feet in 1 minute and 50 seconds without difficulty when assembled for manual operation. When assembled for mechanical operation the gantry became stuck in the sand on two occasions (movement time 2 minutes and 20 seconds) and although movement was continued with added effort, extreme caution had to be taken to prevent the gantry from toppling. It is also noted that since there are numerous types of soil groups in forward airfield areas, only one of which was available at this testing area, satisfaction of the requirement cannot be determined.

d. Although the test item may be manually operated with loads up to 35,000 pounds, the physical stress on a man's hands creates numerous blisters and open wounds (Fig. 2, App V). Therefore, gloves to eliminate this situation should be standard issue with test item.

2.4 TEST NO. 3 - MAINTENANCE AND RELIABILITY

2.4.1 Objective

To determine if the test item meets maintenance and reliability requirements as defined by the Operational and Technical Characteristics.

2.4.1.1 Test Criteria:

a. The system, when operated by its hydraulic power package, shall demonstrate with 95 percent reliability the capability of performing a daily mission. A daily mission is defined as a total of 50 cycles (lifts of various load weights within the rated capacity. This implies 20 mission days as Mean Time Between Failures (MTBF). A failure is defined as that which prevents the unit from completing its assigned mission and cannot be repaired by the operator with the tools and materials provided within 30 minutes. Unscheduled organizational maintenance should not exceed 30 minutes during the performance of a daily mission. The total maintenance manhours will not exceed 10 percent of the operating hours on the basis of 8 hours of operation equal to 1 mission day. Total maintenance will include scheduled and unscheduled maintenance from operator level through direct support level.

b. The system must be easily maintained under field conditions. Components must be interchangeable between like items of the system. Maintenance costs must be a minimum for systems of this type.

c. The system must be capable of operation and storage in temperatures from -65°F to +125°F.

2.4.2 Method

a. An updated Draft Technical Manual, Manufacturers' Maintenance and Operating Manual, and TM 5-2805-203-14 were the only guides available in performing all maintenance during the conduct of this test.

b. A preoperational inspection was performed in accordance with pretesting procedures. However, preoperational inspection time was not recorded as it is not considered a portion of maintenance time. Technical inspections were conducted by maintenance personnel as required. Daily inspections and preventive maintenance operations were performed as directed in Draft Technical Manual and TM 5-2805-203-14.

c. Unscheduled and scheduled maintenance was performed as required. Records were maintained for all maintenance operations to include time required and reasons for actions performed.

d. Soil and ambient air temperatures and relative humidity were recorded during the operation of the test item.

e. Four individual test items were used as a device (two gantries used in unison) and as a system (four gantries used in unison). Each individual gantry was operated a total of 50 cycles per day for 20 working days.

2.4.3 Results

a. The test items, four each, which were used as two devices and as one system during testing, were operated for a total of 91.2 engine hours. During these operations, 1.7 manhours of scheduled and unscheduled maintenance were performed. The scheduled maintenance consisted of 0.5 manhours for the 25-hour organizational maintenance of the gasoline engine.

For details of scheduled and unscheduled maintenance, see Table 1, Appendix IV. In addition, operator daily inspection and servicing were performed requiring approximately 5 minutes per day.

Daily preventive maintenance was performed by test personnel without difficulty.

b. Eleven unscheduled maintenance actions occurred during engineer testing, requiring a total of 1.2 manhours to accomplish (Table 1, App IV).

c. Table 2, Appendix IV, shows gantry operating hours, active maintenance time, maintenance rates, and mean time between failures. The maintenance ratio, based on scheduled and unscheduled maintenance actions but exclusive of operator daily preventive maintenance, and initial inspection was 0.019 for the entire engineering test period.

d. A limited amount of repair parts were furnished with the test item; however, most replacement parts were either locally obtained or fabricated. Parts which could not be obtained in this manner were taken from like items of the system. Components are interchangeable.

e. Some of the unscheduled maintenance was of a serious nature and required a high degree of maintenance skill. However, the test NCO, who carries an MOS of 62E40 (Heavy Equipment Supervisor), and other test personnel were able to correct all unscheduled maintenance without outside assistance with the exception of oil leaks which came from the cylinder seals and could not be corrected.

f. Soil temperatures ranged from 73°F to 109°F. Ambient air temperature ranged from 68°F to 107°F. Relative humidity ranged from 17 to 64 percent. For daily meteorological readings refer to Table 2, Appendix I.

2.4.4 Analysis

a. The amount of maintenance required and the number of parts consumed during engineering testing were within stated criteria.

b. The system, when operated by its hydraulic power package, will perform a daily mission with 95 percent reliability.

c. One failure, Item L, Table 1, Appendix IV occurred due to attempted repair. It has been established that this item should be replaced and repair should not be attempted for safety reasons. Replacement time is 15 minutes.

d. Oil seepage from the cylinder seals (Fig. 3, App V) could not be stopped by tightening. Although oil seepage was very slight, it could cause damage to the parachutes of a rigged load. The seals should be replaced with a higher grade seal to avoid leakage.

e. Since the gantry was tested under desert environmental conditions for over 20 days of operation, it can be assumed that the test item will operate under extreme high temperatures. Although ambient temperatures did not reach 125°F the system is capable of operation under such conditions.

Test item operation at low ambient temperatures could not be determined at this test site.

f. Pressure gage failures (four each) were not considered either a deficiency or shortcoming; however, correction of these failures required 15 minutes of active maintenance time. Of the four failed gages, three were furnished by this installation and had brass movements. One failed gage, which was an initial component of the test item, contained a bronze movement (Para. 3.1, App III, and Fig. 4, App V).

2.5 TEST NO. 4 - HUMAN FACTORS AND SAFETY

2.5.1 Objectives

To determine if the test item conforms to the principles of human factors engineering.

2.5.1.1 Test Criteria. The test item must be safe for its intended use.

2.5.2 Method

The safety criteria as established by the USAAESWBD after service testing in June 1967 was reviewed and followed. Any safety hazards which were not discovered during the service test were recorded.

2.5.3 Results

During the 20-day reliability test of the gantry system, one device had performed the following:

50 lifts of 12,000 pounds each
40 lifts of 12,500 pounds each

Total operating time was 3 hours and 25 minutes. After 67 lifts a small oil leak was noticed which was coming from Items A and B of Figure 3.

The leak was very small at the time (3 or 4 drops of oil per lift). Testing was continued and the leakage kept under observation. At the completion of 90 lifts the leak had increased (10 to 12 drops of oil per lift) and operation was ceased. An attempt was made to tighten the left bolt (Item A). When this was done the separation around the flange (Item B) increased due to the tautness of the manifold line (Item C, Fig. 3).

The entire assembly (Items A through D, Fig. 3) was then removed. Teflon tape was placed around Item A, Figure 3, and a flaring kit was used to flare the flange out on Item B, Figure 3. The assembly was then reinstalled. The motor was started and the load lifted to approximately 36 inches off the ground. The position valves were then pushed down so that the load would begin to descend.

At this time the flange "blew out" of its fitting, spraying oil approximately 30 feet in both directions, and the load suspended by the gantry dropped to the ground.

Further investigation disclosed that the clamp connections (Items E and F, Fig. 4) failed to restrain the manifold hose in its proper location. The hydraulic "hammer action" over the period of 3-1/2 hours of operation and 90 lifts pulled the manifold hose in a direction away from the fitting and through the clamps approximately 1 inch. This,

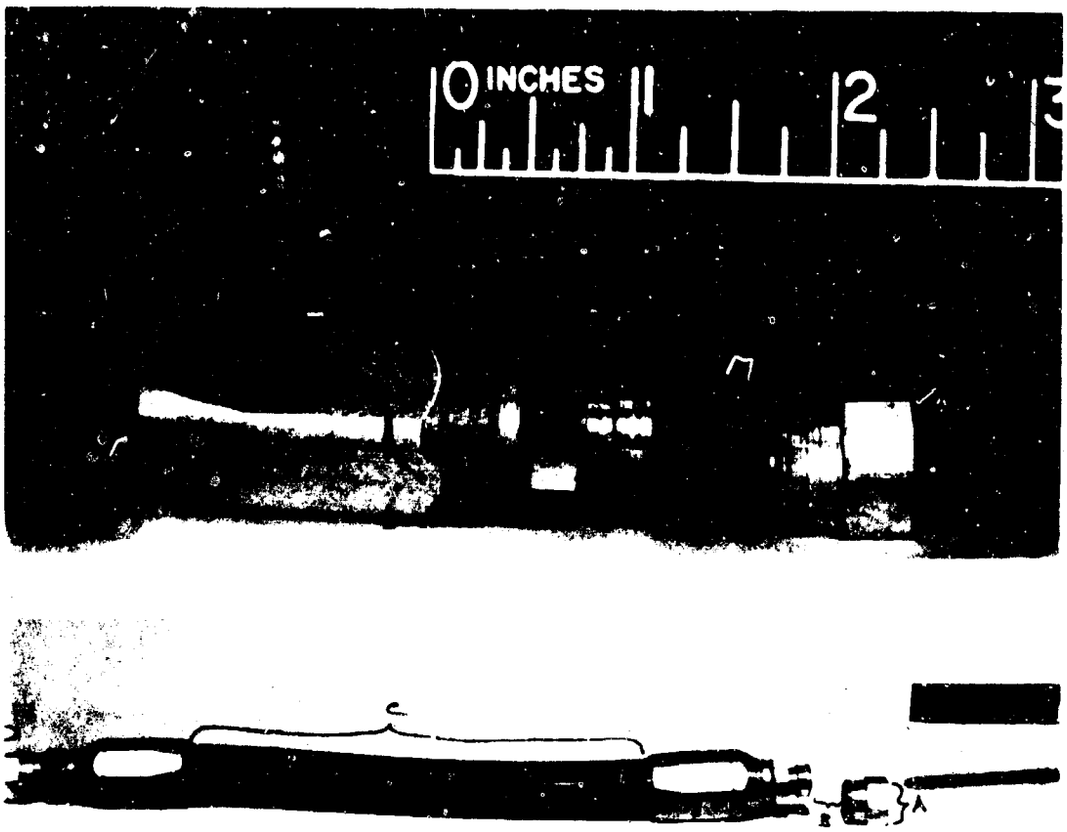

FIGURE 3. Hydraulic hose and fittings.

in turn, pulled the hose so taut that all force was being exerted on the final connection (Items A and B, Fig. 3). The continuing "hammer action" could have been the reason the fittings loosened and the leakage started. Hydraulic oil temperature at this point is 165°F with a maximum oil pressure of 2300 psi.

b. When the angle from the accessory beam center fitting to the load connection point exceeds 3.6 degrees it is possible for the cable to jump out of the sheave when lifting the load. The load will drop approximately 8 inches when this occurs (Fig. 5, App V).

c. Safety hazards (Para. 3.2 and 3.3, App III) should be corrected (Fig. 2 and 6, App V).

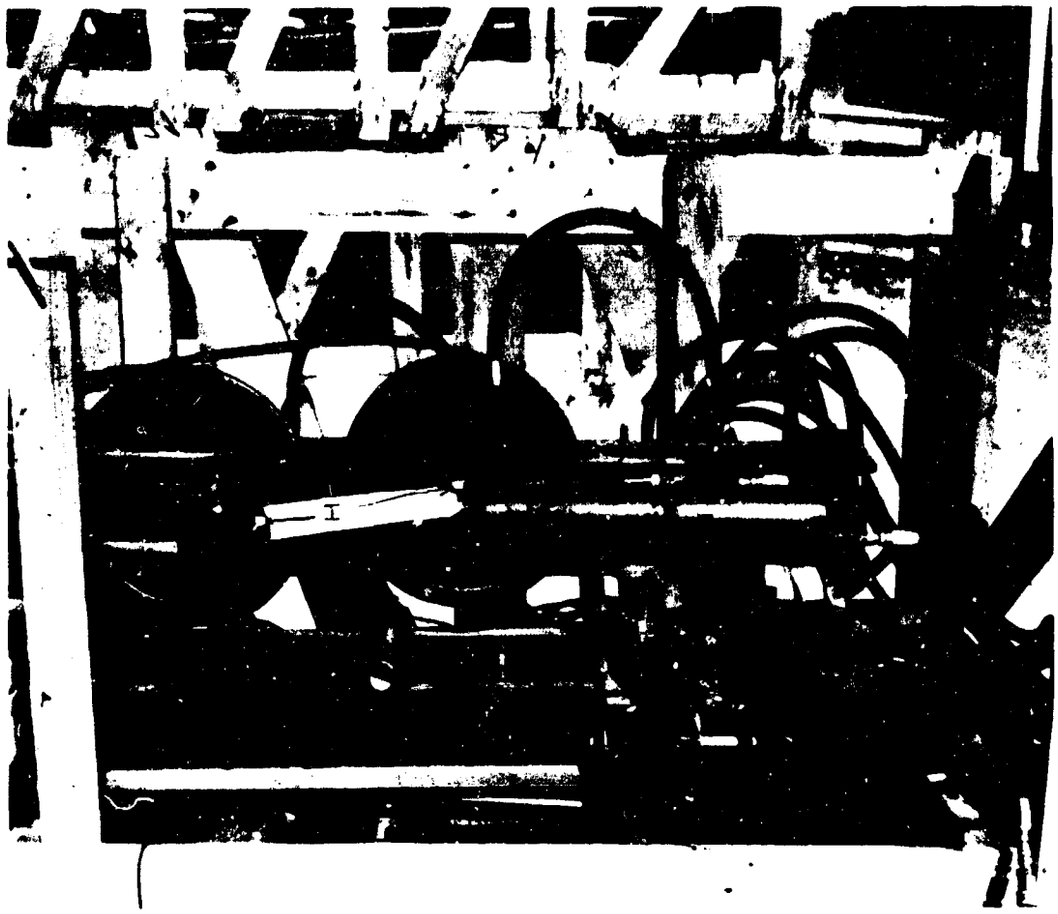

FIGURE 4. Cart assembly.

2.5.4 Analysis

a. The clamp connections, Items E and F (Fig. 4) should be checked daily to insure that they secure and that the manifold hose is restrained in its proper location.

b. The load will fall if the referenced hose assembly or fittings fail. These items are located between the flow control valve and cylinder, and should be checked daily for oil leaks. No attempt should be made to repair referenced hose or to flare the flanged portions of the swivel nuts. Operation should be ceased and the faulty items replaced.

c. Caution should be used during rigging to avoid connecting the gantry to the load at more than a 3.6-degree angle as this can damage the gantry cable and presents a possible safety hazard.

NOTE: Figure 4 is not a photograph of the gantry on which the incident occurred and is for reference only. Clamp E is normally located at Point G and Clamp F at Point H. Point I is the normal location for the hose shown in Figure 1.

APPENDIX I. TEST DATA

TABLE 1. Gantry Components

Nomenclature of Component	Unit of Issue	Unit Wt (lb)	Number of Units	
			Per Device (2 gantries)	Per System (4 gantries)
Left hand column assembly with winch	Ea	190	4	8
Right hand column assembly with stay bar	Ea	170	4	8
Main beam assembly with hinge pins and rods	Ea	290	2	4
Cart assembly with cylinders and hydraulic hose	Ea	365	2	4
Accessory beam	Ea	100	2	4
Power pack assembly with hydraulic oil	Ea	421	1	2
Manual chain hoist	Ea	93.5	4	8
Tie-down chain assembly	Ea	10.5	4	8
5-gallon jerry can with gas and gas line	Ea	53.5	1	2

Total weight of gantry device (2 each gantries) for manual operation only: 2636.0 pounds.

Total weight of gantry device (2 each gantries) for mechanical operation only: 3478.5 pounds.

Total weight of gantry device (2 each gantries) for manual and mechanical operation: 3840.5 pounds.

TABLE 2. Mechanical Operation Data

Gantry No. 1 and 2
Load Weight: 8060 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 78; Low, 74

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	41	45	1300	1100	2100
2	42	44			
3	41	45			
4	41	45			
5	41	46			
6	45	46			
7	40	47			
8	42	47	1100		1800
9	41	47			
10	40	47			
11	43	47			
12	42	49			
13	42	48			
14	42	48			
15	43	48			
16	45	51			
17	42	50			
18	42	51			
19	42	50			
20	39	51			
21	40	51			
22	40	51			
23	42	51			
24	40	51			
25	40	51			
26	40	50			
27	42	52			
28	40	51			
29	42	50			
30	42	51			
31	40	51			
32	41	52			
33	40	52			
34	42	52			
35	40	51			
36	40	52			
37	40	51			
38	42	52			
39	42	51			
40	40	51			
41	46	52			
42	41	51			1700
43	40	51			
44	42	52			
45	40	51			
46	40	51			
47	40	51			
48	42	51			
49	42	52			
50	42	52			

Remarks: Cycle No. 42. Hose connectors were disconnected from the power pack assembly and reversed so that the four-way control valve levers would lift and lower in conjunction. Upon replacing the connectors a heavy leak started in connection No. 3. No visual damage to the interior positions of the connectors was noted and leakage was stopped by trial and error adjustment of the hose fitting (EPR 15-2).

Gantry No. 3 and 4
Load Weight: 12,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 78; Low, 74

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	49	49	1200	1000	2000
2	47	50			
3	47	52			
4	47	51			
5	47	51			
6	47	51			
7	47	51			
8	47	51			
9	47	51			
10	47	51			
11	47	51			
12	47	51			
13	47	51			
14	47	52			
15	48	52			
16	44	54			
17	46	54			
18	46	54			
19	46	54			
20	45	54			
21	46	54			
22	46	54			
23	46	54			
24	46	55			
25	45	54			
26	45	56			
27	45	55			
28	45	55			
29	45	54			
30	46	54			
31	46	55			
32	45	55			
33	46	54			
34	46	55			
35	46	55			
36	47	47		950	
37	46	48			
38	45	49			
39	45	51			
40	46	50			
41	45	52			
42	47	51	1100		
43	46	51			
44	46	51			
45	47	52			
46	49	49			
47	48	52			
48	47	51			
49	47	51			
50	47	49			

Remarks: After 5 minutes of test life operation one of the manifold hose connectors which was connected to the power pack began to leak. The fitting was tightened and held for around 5 minutes. The fitting began leaking again and although tightened to its capacity the oil leakage increased and developed into a heavy spray. Operation was ceased and the connector was disconnected for repair. The connector had not been filled with "white lead" during production and was repaired by placing teflon tape between the fittings (EPR 15-4). Cycle No. 19. Manifold hose "jumped" out of the manifold hose support (EPR 15-5).

Gantry No. 1 and 2
Load Weight: 7500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 78; Low, 74
Humidity (%): High, 55; Low, 55

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	43	45	1300	1300	1800
2	42	46			
3	41	46		1100	
4	42	44	1200		
5	46	47			
6	41	47	1900		
7	41	48			
8	41	47			
9	46	48			
10	46	48			
11	45	47			
12	43	50			
13	42	48			
14	42	50			
15	39	50			
16	46	49			1700
17	46	49			
18	46	50			
19	46	50			
20	46	49			
21	46	50			
22	41	50			
23	43	50			
24	46	50			
25	46	52			
26	42	50			
27	46	49			
28	42	51			
29	39	49			
30	42	51			
31	Not Recorded				
32	↓				
33					
34					
35					
36					
37					
38					
39					
40	Not Recorded				
41	42	49			
42	39	49			
43	39	49			
44	39	51			
45	39	51			
46	39	51			
47	46	51			
48	39	51			
49	38	50			
50	39	51			

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 3 and 4
Load Weight: 12,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 76; Low, 74
Humidity (%): High, 55; Low, 55

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	50	49	1200	1000	2000
2	49	48			
3	49	48			
4	48	46			
5	49	49			
6	49	49			
7	49	49	1100		
8	47	50			
9	47	50			
10	49	50			
11	47	49			
12	48	52			
13	47	52			1800
14	48	51			
15	47	50		900	
16	47	50			
17	47	50			
18	47	51			
19	47	51			
20	47	50			
21	49	50			
22	49	50			
23	48	51			
24	48	51			
25	47	52			
26	47	50			
27	48	50			
28	50	52			
29	47	50			
30	47	52			
31	Not Recorded				
32					
33					
34					
35					
36					
37					
38					
39					
40	Not Recorded				
41	48	50			
42	47	50			
43	47	51			
44	47	51			
45	47	49			
46	47	50			
47	48	50			
48	47	51			
49	46	50			
50	49	51			

Remarks: Manifold hose "jumped" out of the manifold hose support approximately 50 percent of the cycles when the load was starting to be lowered from its suspended position (EPR L5-5-2). Cycle No. 17. Oil leak at connection of cylinder and hydraulic hose (EPR L5-6).

Gantry No. 1 and 2
Load Weight: 7060 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambien Temperature (°F):
High, 78; Low, 72
Humidit, (%): High, 21; Low, 18
Soil Temperature (°F): High, 82; Low, 75

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	43	47	1200	1000	1800
2	42	48			
3	42	48			
4	42	48			
5	41	49	1000		
6	41	49			
7	41	49			
8	41	49			
9	41	50		1100	
10	41	50			
11	41	49			
12	41	49			
13	40	49			
14	41	49			
15	41	49			
16	40	49			
17	40	50			
18	40	49			
19	40	49			
20	41	49			1700
21	41	49			
22	40	49			
23	40	50			
24	40	50			
25	40	50			
26	40	50			
27	40	50			
28	40	50			
29	40	50			
30	40	50			
31	Not Recorded				1800
32					
33					
34					
35					
36					
37					
38					
39					
40	Not Recorded				
41	40	50			
42	40	50			
43	40	51			
44	40	50			
45	40	50			
46	40	50			
47	40	51			
48	40	50			1700
49	40	50			
50	40	50			

Remarks: No problems were incurred.

Gantry No. 3 and 4
Load Weight: 13,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 78; Low, 72
Humidity (%): High, 21; Low, 18
Soil Temperature (°F): High, 75; Low, 72

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	53	47	1200	0900	2100
2	51	48			
3	51	49			
4	49	48			
5	50	49	1100		
6	50	49			
7	51	49			
8	50	49			
9	50	50			
10	48	50			
11	49	50			
12	48	50			
13	49	51			
14	49	50			
15	48	50			
16	49	50			
17	49	51			
18	49	51			
19	48	51			2000
20	48	51			
21	48	51			
22	48	51			
23	48	51			
24	49	51			
25	48	51			
26	Not Recorded				
27					
28					
29					
30					1900
31					
32					
33					
34					
35					
36					
37					
38					
39					
40	Not Recorded				
41	48	51			
42	48	51			
43	48	51			
44	49	52			
45	50	52			
46	50	52			
47	50	52			2000
48	50	51			
49	48	52			
50	47	52			

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 1 and 2
Load Weight: 6560 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 79; Low, 74
Humidity (%): High, 21; Low, 17
Soil Temperature (°F): High, 81; Low, 77

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	41	46	1200	1100	1700
2	41	46			
3	41	47			
4	41	47		1000	
5	41	48			
6	41	48			
7	41	48			
8	41	49			
9	40	50			1800
10	Not Recorded				
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25	Not Recorded				
26	39	51			
27	40	50			
28	40	52			
29	41	49			
30	40	49			
31	40	49			
32	40	50			
33	39	50			
34	40	49			
35	40	50			
36	41	51			
37	40	50			
38	41	51			
39	40	50			
40	Not Recorded				
41					
42					
43					
44					
45					
46					
47					
48					
49					
50	Not Recorded				

Remarks: No problems were incurred.

Gantry No. 3 and 4
Load Weight: 13,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 79; Low, 74
Humidity (%): High, 21; Low, 17
Soil Temperature (°F): High, 81; Low, 77

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	49	47	1300	0900	1900
2	50	46			
3	50	49			
4	50	47	1200		
5	50	48			
6	50	48			2000
7	50	48			
8	50	49			
9	49	50			
10	49	50			
11	Not Recorded				
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25	Not Recorded				
26	49	50			
27	50	50			
28	49	50			
29	49	48			
30	49	49			
31	49	50			
32	49	50			
33	49	49			
34	49	50			
35	48	51			
36	49	50			
37	50	51			
38	49	50			
39	Not Recorded				
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50	Not Recorded				

Remarks: No problems were incurred.

Gantry No. 1 and 2
Load Weight: 6060 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 84; Low, 68
Humidity (%): High, 40; Low, 20
Soil Temperature (°F): High, 82; Low, 73

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	41	48	1100	1300	1700
2	40	49			
3	40	48			
4	40	49			
5	39	48			
6	40	48			
7	39	48			
8	39	49	1000		
9	39	48			
10	39	48			1800
11	39	48			
12	39	48			
13	38	48			
14	38	48			
15	39	48		1100	
16	39	48			
17	39	48			
18	39	49			
19	39	49			
20	38	48			
21	37	50			
22	39	50			
23	39	50			
24	40	49			
25	38	51			
26	37	49			
27	39	50			
28	39	51			
29	38	50			
30	39	50			1700
31	37	51			
32	40	50			
33	37	51			
34	38	51			
35	38	52			
36	37	50			
37	38	52			
38	38	51			
39	38	52			
40	37	50			1800
41	38	51			
42	37	52			
43	38	51			
44	38	52			
45	37	51			
46	37	52			
47	38	50			
48	38	50			
49	38	51			
50	38	50			

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 3 and 4
Load Weight: 14,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 84; Low, 68
Humidity (%): High, 40; Low, 20
Soil Temperature (°F): High, 82; Low, 73

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	51	50	1200	1000	1900
2	50	50			
3	51	50			
4	50	49			
5	50	51			
6	52	49			
7	52	[illegible]			
8	52	51			
9	50	52			
10	50	50			
11	51	51			2100
12	51	50			
13	52	51			
14	53	51			
15	51	52			
16	50	50			
17	52	52			
18	52	51			
19	51	52			
20	51	50			
21	52	51			
22	51	52			
23	51	51			
24	50	52			
25	51	51			
26	52	52			
27	51	50			
28	52	51			
29	51	50			
30	50	53			1900
31	51	48			
32	50	49			
33	49	48			
34	50	49			
35	50	48			
36	50	48			
37	50	48			
38	51	49			
39	50	48			
40	50	48			
41	50	48			
42	50	48			
43	50	48			
44	50	48			
45	50	48			
46	50	48			
47	50	48			
48	51	49			
49	50	49			
50	50	48			

Remarks: No problems were incurred.

Gantry No. 1 and 2
Load Weight: 5560 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 96; Low, 93
Humidity (%): High, 24; Low, 20
Soil Temperature (°F): High, 94; Low, 94

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	36	49	1100	1100	1700
2	37	50			
3	36	49			
4	36	49			
5	37	50			
6	37	50			
7	36	52			
8	36	51			
9	36	51			
10	36	51			
11	35	50			
12	36	50			
13	36	51			
14	35	49			
15	36	49			
16	36	50			
17	37	49			
18	36	50			
19	36	50			
20	37	50			
21	37	50			
22	36	49			
23	37	49			
24	37	49			
25	36	49			
26	36	50			
27	36	50			
28	36	50			
29	36	50			
30	37	50			1000
31	37	50			
32	37	50			
33	37	50			
34	37	50			
35	37	50			
36	36	50			
37	36	50			
38	36	50			
39	36	50			
40	36	50			
41	36	50			
42	36	50			
43	36	50			
44	36	50			
45	36	50			
46	36	50			
47	36	50			
48	36	50			
49	36	50			
50	36	50			

Remarks: No problems were incurred.

Gantry No. 3 and 4
Load Weight: 14,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 96; Low, 93
Humidity (%): High, 24; Low, 20
Soil Temperature (°F): High, 94; Low, 94

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	53	49	1200	1000	1800
2	53	50			
3	51	49			
4	52	49			
5	51	50			
6	52	50			
7	51	52			
8	52	51			
9	52	51			
10	52	51			
11	52	50			
12	52	50			
13	52	51			
14	52	49			
15	52	49			
16	51	50			
17	51	49			
18	50	50			
19	51	50			
20	52	50			
21	52	50			
22	52	49			
23	51	49			
24	52	49			
25	52	49			
26	51	50			
27	52	50			
28	51	50			
29	52	50			
30	51	50	1400	1100	
31	51	50			
32	52	50			
33	51	50			
34	52	50			
35	52	50			
36	51	50			
37	52	50			
38	51	50			
39	51	50			
40	52	50			
41	52	50			
42	52	50			
43	52	50			
44	52	50			
45	52	50			
46	51	50			
47	52	50			
48	52	50			
49	52	50			
50	51	50			

Remarks: Cycle No. 13. Pressure gage broke. Item was replaced (Ref App III) (KPR L5-7).

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 1 and 2
Load Weight: 5060 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1

Cycle No.	Time (sec)		Pressure Variation		
	Up	Down	Up	Down	Idle
1	38	50	1000	1100	1700
2	37	49			
3	37	49			
4	36	49			
5	36	49			
6	36	49			
7	36	49			
8	36	49			
9	36	50			
10	35	49			
11	36	49			
12	35	50			
13	35	49			
14	35	50			
15	35	49			
16	35	49			
17	35	49			
18	35	49			
19	35	49			
20	35	50			
21	36	50			
22	35	49			
23	35	49			
24	35	50			
25	35	50			
26	35	50			
27	35	50			
28	35	49			
29	35	50			
30	35	50			
31	36	50			
32	36	49			
33	35	49			
34	35	49			
35	35	50			
36	35	50			
37	35	50			
38	36	50			
39	35	50			
40	35	51			
41	35	50			
42	35	49			
43	35	50			
44	35	50			
45	35	50			
46	36	51			
47	35	51			
48	35	50			
49	35	56			
50	35	51			

Remarks: No problems were incurred.

Gantry No. 3 and 4
Load Weight: 15,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2

Cycle No.	Time (sec)		Pressure Variation		
	Up	Down	Up	Down	Idle
1	51	50	Not valid		
2	52	49			
3	52	49			
4	53	50			
5	53	50			
6	52	50			
7	53	49			
8	53	49			
9	52	49			
10	53	49			
11	53	49			
12	52	50			
13	53	49			
14	53	50			
15	53	49			
16	52	49			
17	53	49			
18	52	49			
19	52	49			
20	53	50			
21	53	50			
22	52	49			
23	52	49			
24	53	50			
25	52	50			
26	52	50			
27	52	49			
28	52	49			
29	53	50			
30	53	50			
31	52	50			
32	53	49			
33	53	49			
34	52	49			
35	53	50			
36	52	50			
37	53	50			
38	53	50			
39	53	50			
40	53	51			
41	52	50			
42	52	49			
43	52	50			
44	52	50			
45	52	50			
46	53	51			
47	52	51			
48	53	50			
49	52	50			
50	52	51			

Remarks: No problems were incurred.

Gantry No. 1 and 2
Load Weight: 4560 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1

Cycle No.	Time (sec)		Pressure Variation		
	Up	Down	Up	Down	Idle
1	36	49	1000	1200	1700
2	35	49			
3	35	49			
4	35	49			
5	35	49			
6	35	49			
7	35	49			
8	35	49			
9	35	49			
10	35	49			
11	35	49			
12	35	49			
13	35	49			
14	35	49			
15	35	49			
16	35	49			
17	35				
18	35	50			
19	35	50			
20	35	50			
21	35	50			
22	35	49			
23	35	50			
24	35	49			
25	35	49			
26	35	49			
27	35	49			
28	35	49			
29	35	50			
30	35	49			
31	35	49			
32	35	50	900	1100	
33	35	50			
34	35	50			
35	35	50			
36	35	50			
37	35	50			
38	35	50			
39	34	50			
40	34	50			
41	35	50			
42	35	50			
43	35	50			
44	34	50			
45	34	50			
46	34	50			
47	34	50			
48	34	51			
49	34	51			
50	34	50			

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 3 and 4
Load Weight: 15,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	52	49	Incorrect readings		
2	51	49			
3	51	49			
4	52	49			
5	51	49			
6	52	49			
7	52	49			
8	52	49			
9	52	49			
10	52	49			
11	52	49			
12	53	49			
13	52	49			
14	53	49			
15	53	49			
16	53	49			
17	53	49			
18	53	50			
19	54	50			
20	52	50			
21	52	50			
22	53	49			
23	53	50			
24	53	49			
25	53	49			
26	52	49			
27	52	49			
28	53	49			
29	53	50			
30	53	49			
31	53	49			
32	54	50			
33	53	50			
34	54	50			
35	54	50			
36	54	50			
37	54	50			
38	54	50			
39	54	50			
40	54	50			
41	54	50			
42	54	50			
43	54	50			
44	54	50			
45	54	50			
46	54	50			
47	54	50			
48	54	51			
49	54	51			
50	54	50			

Remarks: Pressure gage worn and giving faulty pressure readings. Item was replaced (EPR L5-7-2).

Gantry No. 1 and 2
Load Weight: 4660 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 93; Low, 81.7
Humidity (%): High, 47; Low, 18
Soil Temperature (°F): High, 91; Low, 79

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	36	49	1200	1100	1700
2	35	49			
3	35	48			
4	34	49			
5	34	49			
6	34	49			
7	34	49			
8	34	49			
9	35	49			
10	34	49			
11	34	50			
12	34	50			
13	35	50			
14	35	50			
15	34	50	1000		1600
16	35	49			
17	34	50			
18	34	50			
19	34	50			
20	34	50			
21	34	50			
22	34	50			
23	34	50			
24	34	50			
25	34	50			
26	34	50			
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46			0900		1700
47					
48					
49					
50	34	50			

Remarks: No problems incurred.

Gantry No. 3 and 4
Load Weight: 16,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 93; Low, 81.7
Humidity (%): High, 47; Low, 18
Soil Temperature (°F): High 91; Low, 79

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
1	51	49	Incorrect readings		
2	51	49			
3	52	48			
4	51	49			
5	51	49			
6	51	49			
7	52	49			
8	51	49			
9	52	49			
10	53	49			
11	52	50			
12	53	50			
13	54	50			
14	53	50			
15	54	50			
16	All readings				
17	approximately				
18	the same.				
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48	All readings				
49	approximately				
50	the same.				

Remarks: Pressure gage worn and giving faulty readings. Item was replaced.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 1 and 2
Load Weight: 3560 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 100; Low, 98
Humidity (%): High, 34; Low, 28

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	34	48	1000	1100	1600
2	35	46			
3	34	49			
4	35	48			
5	34	49			
6	34	49			
7	34	49			
8	34	49			
9	34	49			
10	34	49			
11	34	49			
12	34	49			
13	34	49			
14	34	50			
15	34	49			1700
16	33	49			
17	34	50			
18	34	50			
19	34	50			
20	34	50			
21	33	50			
22	33	50			
23	33	50			
24	33	50			
25	33	50			
26	34	50			
27	34	50			
28	34	50			
29	33	50			
30	33	50			
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					

Remarks: No problems were incurred.

Gantry No. 3 and 4
Load Weight: 16,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 100; Low, 98
Humidity (%): High, 36; Low, 28

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	54	51			
2	54	50			
3	54	50			
4	55	50			
5	55	50			
6	55	50			
7	55	50			
8	55	50			
9	55	50			
10	55	51			
11	54	50			
12	54	51			
13	54	51			
14	55	51			
15	55	51			
16	55	51			
17	55	51			
18	55	51			
19	55	50			
20	55	50			
21	55	50			
22	55	50			
23	55	50			
24	55	50			
25	55	50			
26	All same as above				
27	within 1 second.				
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49	All same as above				
50	within 1 second.				

Remarks: Between Cycle No. 17 and 25. Slight oil leak began on Gantry No. 4. Leak was coming from upper cylinder at fitting connection point. Leak could not be repaired (EPP 15-8). Pressure gage were sad giving faulty readings. Item was not replaced.

Gantry No. 1 and 2
Load Weight: 3050 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 101; Low, 98
Humidity (%): High, 38; Low, 16

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	33	50	1000	1100	1700
2	33	49			
3	33	48			
4	33	50			
5	33	50			
6	33	50			
7	33	50			
8	33	50			
9	33	50			
10	33	50			
11	34	48			
12	34	48			
13	34	49			
14	34	49			
15	34	49			
16	34	49			
17	34	49			
18	34	50			
19	33	50			
20	33	50			
21	33	50			
22	33	50			
23	33	50			
24	33	50			
25	33	50			
26	34	50			
27	34	50			
28	34	50			
29	33	50			
30	33	50			
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 3 and 4
Load Weight: 17,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 107; Low, 98
Humidity (%): High, 38; Low, 18

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	54	50			
2	54	48			
3	54	48			
4	54	50			
5	54	50			
6	54	50			
7	54	50			
8	54	50			
9	54	50			
10	54	50			
11	54	48			
12	52	48			
13	53	49			
14	54	49			
15	54	49			
16	54	49			
17	54	49			
18	54	50			
19	54	50			
20	54	50			
21	55	50			
22	54	50			
23	55	50			
24	55	50			
25	54	50			
26	54	50			
27	54	50			
28	55	49			
29	55	50			
30	55	50			
31	55	50			
32	55	50			
33	55	50			
34	55	49			
35	55	50			
36	55	50			
37	54	50			
38	54	49			
39	55	49			
40	56	49			
41	56	49			
42	56	50			
43	57	50			
44	58	50			
45	58	50			
46	56	50			
47	56	50			
48	56	50			
49	56	50			
50	56	50			

Remarks: No problems were incurred.

Gantry No. 1 and 2
Load Weight: 2560 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1
Ambient Temperature (°F):
High, 105; Low, 97
Humidity (%): High, 50; Low, 36
Soil Temperature (°F): High, 103; Low, 95

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	32	49	1000	1100	1700
2	32	48			
3	32	49			
4	32	49			
5	32	50			
6	33	50			
7	32	50			
8	33	50			
9	33	50			
10	32	50			
11	32	49			
12	33	49			
13	33	49			
14	33	50			
15	33	50			
16	33	50			
17	33	49			
18	33	49			
19	32	50			
20	32	50			
21	32	49			
22	32	49			
23	33	50			
24	33	50			
25	33	50			
26	33	49			
27	33	49			
28	33	50			
29	32	50			
30	32	50			
31	32	50			
32	33	49			
33	33	49			
34	32	50			
35	32	50			
36	32	50			
37	32	49			
38	33	50			
39	33	49			
40	33	49			
41	32	50			
42	33	50			
43	33	50			
44	32	49			
45	33	49			
46	33	50			
47	33	49			
48	32	50			
49	33	50			
50	32	50			

Remarks: No problems were incurred.

Gantry 3 and 4
Load Weight: 17,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 2
Ambient Temperature (°F):
High, 105; Low, 97
Humidity (%): High, 50; Low, 36
Soil Temperature (°F): High, 103; Low, 95

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
1	52	47	1700	1200	1700
2	52	48			
3	52	48			
4	52	48			
5	53	48			
6	53	48			
7	55	48			
8	54	48			
9	54	49			
10	54	48			
11	53	49			
12	54	52			
13	57	52			
14	55	51			
15	55	50		1100	
16	54	51			
17	56	51			
18	55	51			
19	55	51			
20	57	51			
21	58	51			
22	56	51			
23	56	51			
24	55	52			
25	55	51			
26	56	51			
27	54	51			
28	55	52			
29	54	51			
30	54	50	1500		
31	56	49			
32	55	51			
33	55	51			
34	54	50			
35	54	50			
36	55	51			
37	55	31			
38	54	47			
39	53	50			
40	54	51	1600	1200	
41	53	48			
42	55	47			
43	54	46			
44	54	47			
45	54	48			
46	55	47			
47	54	49			
48	55	49			
49	56	48			
50	55	49			

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 1, 2, 3 and 4
Load Weight: 18,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2
Ambient Temperature (°F):
High, 102; Low, 96
Humidity (%): High, 32; Low, 28
Soil Temperature (°F): High, 109; Low, 94

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
Readings from Power Pack No. 2 only					
1	42	48	1300	1200	1700
2	42	48			
3	42	48			
4	42	48			
5	42	48			
6	43	48			
7	42	47			
8	42	50			
9	42	50			
10	42	50			
11	42	50			
12	42	50			
13	43	50			
14	42	50			
15	42	50			
16	42	50			
17	42	50			
18	42	51			
19	42	50			
20	42	51			
21	43	51			
22	43	51			
23	42	50			
24	42	51			
25	42	51			
26	42	51			
27	42	52			
28	42	52			
29	42	51			
30	43	52			
31	42	52			
32	42	52			
33	43	51			
34	43	52			
35	42	51			
36	41	52			
37	41	52			
38	42	52			
39	42	52			
40	42	52			
41	43	53			
42	42	53			
43	43	52			
44	42	52			
45	43	53			
46	43	52			
47	42	52			
48	43	52			
49	42	52			
50	43	53			

Remarks: No problems were incurred.

Gantry No. 1, 2, 3 and 4
Load Weight: 20,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2
Ambient Temperature (°F):
High, 96; Low, 92
Humidity (%): High, 71; Low, 54
Soil Temperature (°F): High, 97; Low, 85

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
Readings from Power Pack No. 2 only					
1	43	48	1200	1200	1700
2	42	48			
3	42	50			
4	42	50			
5	42	50			
6	43	48			
7	43	48			
8	43	48			
9	43	50			
10	43	49			
11	43	50			
12	44	50			
13	43	50			
14	43	50			
15	43	50			
16	43	50			
17	43	50			
18	43	50			
19	44	50			
20	44	50			
21	41	49			
22	44	50			
23	43	50			
24	43	50			
25	43	51			
26	43	51			
27	43	50			
28	43	51			
29	43	51			
30	43	51			
31	43	52			
32	43	51			
33	44	50			
34	44	51			
35	44	51			
36	44	52			
37	44	53			
38	43	54			
39	44	53			
40	43	53			
41	43	52			
42	44	52			
43	44	52			
44	43	52			
45	44	52			
46	44	52			
47	43	52			
48	44	52			
49	43	52			
50	43	52			

Remarks: No problems were incurred.

Gantry No. 1, 2, 3 and 4
Load Weight: 22,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2
Ambient Temperature (°F):
High, 93; Low, 84
Humidity (%): High, 64; Low, 60
Soil Temperature (°F): High, 88; Low, 80

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
Readings available from Power Pack No. 2 only					
1	45	48	1300	1200	1700
2	45	49			
3	45	50			
4	45	50			
5	45	49			
6	44	49			
7	44	50			
8	44	49			
9	44	50			
10	44	50			
11	44	48			
12	44	49			
13	45	50			
14	44	49			
15	44	49			
16	45	50			
17	44	49			
18	44	49			
19	45	50			
20	44	50			
21	45	50			
22	46	48			
23	44	48			
24	44	49			
25	45	49			
26	45	48			
27	45	48			
28	45	48			
29	45	48			
30	46	48			
31	45	48			
32	45	48			
33	45	48			
34	47	49			
35	44	50			
36	45	50			
37	46	50			
38	46	51			
39	48	51			
40	46	51			
41	47	51			
42	47	51			
43	48	51			
44	47	52			
45	47	52			
46	47	51			
47	47	52			
48	47	52			
49	46	52			
50	46	52			

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Continued)

Gantry No. 1, 2, 3 and 4
Load Weight: 25,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2
Ambient Temperature (°F):
High, 96; Low, 90
Humidity (%): High, 62; Low, 54

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
Readings available from Power Pack No. 2 only					
1	49	50	1400	1200	1700
2	48	50			
3	46	49			
4	47	50			
5	47	50			
6	47	50			
7	48	50			
8	47	50			
9	46	50			
10	45	51			
11	46	50			
12	46	50			
13	47	51			
14	48	50			
15	47	51			
16	48	51			
17	49	51			
18	49	52			
19	49	51			
20	49	50			
21	47	48			
22	48	48			
23	47	49			
24	48	50			
25	47	49			
26	47	50			
27	47	50			
28	47	50			
29	48	50			
30	47	50			
31	48	50			
32	47	50			
33	47	51			
34	49	50			
35	48	50			
36	47	49			
37	49	50			
38	47	50			
39	47	50			
40	48	50	1300	1100	
41	48	50			
42	49	50			
43	48	49			
44	48	49			
45	47	50			
46	47	50			
47	47	50			
48	48	50			
49	47	51			
50	46	50			

Remarks: No problems were incurred.

Gantry No. 1, 2, 3 and 4
Load Weight: 27,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2
Ambient Temperature (°F):
High, 101; Low, 87
Humidity (%): High, 54; Low, 50

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
Readings available from Power Pack No. 2 only					
1	48	50	1500	1200	1800
2	49	50			
3	49	50			
4	49	50			
5	49	49			
6	50	50			
7	52	50			
8	52	50			
9	53	49			
10	53	50			
11	53	51			
12	53	51			
13	53	50			
14	53	50			
15	54	50			
16	53	51			
17	53	50			
18	52	50			
19	52	50			
20	53	50	1400	1100	1700
21	53	51			
22	54	51			
23	54	51			
24	54	52			
25	54	51			
26	53	51			
27	53	51			
28	53	50			
29	53	51			
30	54	51			
31	54	51			
32	54	52			
33	54	52			
34	54	52			
35	54	52			
36	54	51			
37	54	51			
38	54	51			
39	54	52			
40	54	51			
41	54	51			
42	54	52			
43	54	51			
44	54	51			
45	54	51			
46	54	51			
47	54	51			
48	54	51			
49	54	51			
50	54	51		1200	

Remarks: No problems were incurred.

Gantry No. 1, 2, 3 and 4
Load Weight: 30,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2
Ambient Temperature (°F):
High, 94; Low, 92
Humidity (%): High, 66; Low, 62
Soil Temperature (°F): High, 89; Low, 88

Cycle No.	Time (sec) Up	Down	Pressure Variation Up	Down	Idle
Readings available from Power Pack No. 2 only					
1	52	49	1600	1200	1800
2	52	49			
3	52	49			
4	53	49			
5	51	49			
6	52	50			
7	52	49			
8	52	50			
9	53	50			
10	53	50			
11	52	50			
12	53	50			
13	53	50			
14	52	50			
15	53	50			
16	53	50			
17	54	50			
18	53	50			
19	54	50			
20	54	50	1400		1700
21	54	50			
22	54	50			
23	54	50			
24	54	50			
25	53	50			
26	53	50			
27	53	50			
28	53	50			
29	53	50			
30	53	51			
31	53	51			
32	53	51			
33	53	51			
34	53	52			
35	53	51			
36	53	52			
37	54	52			
38	55	51			
39	54	51			
40	54	52			
41	54	52			
42	54	52			
43	53	51			
44	53	51			
45	53	51			
46	53	51			
47	54	51			
48	54	51			
49	54	50			
50	54	51			

Remarks: No problems were incurred.

TABLE 2. Mechanical Operation Data (Concluded)

Gantry No. 1, 2, 3 and 4
Load Weight: 32,500 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
Readings available from Power Pack No. 2 only					
1	53	50	1600	1200	1800
2	53	50			
3	53	50			
4	53	50			
5	53	50			
6	52	51			
7	52	50			
8	53	50			
9	53	51			
10	53	50			
11	52	51			
12	53	51			
13	53	50			
14	53	50			
15	53	50			
16	52	50			
17	53	51			
18	53	50			
19	54	50			
20	53	50	1500	1100	
21	54	51			
22	54	50			
23	54	51			
24	54	50			
25	54	50			
26	54	50			
27	54	50			
28	54	50			
29	54	51			
30	53	50			
31	54	50			
32	54	[illegible]			
33	54	50			
34	54	50			
35	54	50			
36	54	52			
37	54	51			
38	54	52			
39	54	50			
40	54	50	1400		1700
41	55	50			
42	55	51			
43	55	50			
44	54	50			
45	54	50			
46	55	51			
47	54	50			
48	55	51			
49	55	52			
50	55	51			

Remarks: No problems were incurred.

Gantry No. 1, 2, 3 and 4
Load Weight: 35,000 lb
Maximum Height Load Lifted: 62 in.
Power Pack No. 1 and 2
Ambient Temperature (°F):
High, 96; Low, 94
Humidity (%): High, 44; Low, 41
Soil Temperature (°F): High, 91; Low, 88

Cycle No.	Time (sec) Up	Time (sec) Down	Pressure Variation Up	Pressure Variation Down	Pressure Variation Idle
Readings available from Power Pack No. 2 only					
1	54	49	1700	1100	1700
2	54	51			
3	54	51			
4	54	50			
5	53	50			
6	53	51			
7	54	51			
8	54	51			
9	54	51			
10	53	51			
11	54	51			
12	54	51			
13	54	51			
14	54	50			
15	53	50			
16	54	50			
17	54	51			
18	54	50			
19	54	50			
20	54	51	1400		
21	54	50			
22	53	51			
23	53	51			
24	54	51			
25	54	51			
26	54	51			
27	54	50			
28	54	51			
29	53	51			
30	54	50			
31	54	51			
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33	53	50			
34	53	50			
35	54	51			
36	54	51			
37	54	51			
38	54	51			
39	54	51			
40	54	51			
41	55	50			
42	55	50			
43	54	50			
44	55	51			
45	55	51			
46	54	51			
47	54	51			
48	54	51			
49	55	51			
50	55	51	1600		

Remarks: No problems were incurred.

TABLE 3. Manual Operational Data

Load Wt (lb)	Max. Height Load Lifted (in.)	Time Required (min/sec)					
		Cycle 1		Cycle 2		Cycle 3	
		Up	Down	Up	Down	Up	Down
3,000	76	3/14	2/5	3/35	2/20	3/30	2/15
6,000	76	4/40	3/15	4/25	3/10	4/50	3/20
9,000	76	5/45	3/0	6/20	3/10	6/10	3/5
12,000	76	6/0	3/35	6/14	3/20	6/25	3/38
15,000	76	9/20	3/48	9/40	3/55	9/25	3/50
17,500	76	10/15	4/30	10/20	4/45	10/18	4/20

TABLE 4. Radio Suppression Data

Item: Gantry Crane Power Pack
Model: YAC32-1
USA Reg No.: G000055
Manufacturer: Continental Motors Corp

Specification: MIL-STD-461/462
Test Date: 15 August 1968
Test Area: 60 Percent Slope
Test Equipment: AN/URM 85

Radiation Test - DB* Class III C

Freq Mcs	A	P	a	Freq Mcs	A	P	a
0.15	71+	89	71+	110	25	58	47
0.35	71+	85	71+	120	27	57	49
1.5	71+	78	71+	130	28	57	54
3	71+	75	71+	140	31	56	58
5	57	72	59	150	34	56	52
8	58	70	61	160	35	56	58
12	63	68	63	170	34	56	54
16	65	67	65	180	34	55	45
20	40	66	53	190	33	55	44
23	43	65	49	200	31	55	48
27	51	64	51	220	30	55	53
30	33	64	51	240	20	56	71+
35	38	63	49	260	20	57	71+
38	35	63	51	280	23	58	71+
40	33	62	51	300	35	58	71+
45	30	62	52	350	26	60	71+
50	28	61	59	400	23	61	71+
55	31	61	53				
60	36	61	44				
65	33	60	39				
70	46	60	45				
75	45	59	57				
80	39	59	46				
85	33	59	48				
90	32	58	52				
95	32	58	49				
100	31	58	48				

*Decibels above one microvolt per megacycle of bandwidth
A - Ambient noise level
P - Passing limit
a - Interference noise level at ambient

Remarks: As specified in MIL-STD-461; the limit for class IIIC items in the applicable frequency range of 0.15 to 400 MHz shall be relaxed by 20 db.

APPENDIX II. FINDINGS

Requirements	Source	Degree of Compliance
Individual components of the system shall be sufficiently lightweight to enable carrying for short distances and loading by four men onto a military vehicle.	Paragraph 2c, AMCTCM Approved TC	Did not meet requirement (Test No. 1 and Para. 1.1 App III).
No component or group of components of the system shall be of such a size as to prevent air transport by cargo aircraft in accordance with applicable portions of Appendices A and B of AR 705-35.	Paragraph 2m, AMCTCM Approved TC	Met requirement (Test No. 1).
Component parts of the system must comply with the requirements of approved specifications (federal, military and/or industry), and be made corrosion resistant through use of applicable standard methods and materials.	Paragraph 2o, AMCTCM Approved TC	Did not meet requirement (Test No. 1 and Para. 2.1, App III).
The device must have a lifting capacity of 17,500 pounds and when used in pairs as a system must be capable of lifting a load measuring 108 inches high, 110 inches wide, and 336 inches long, weighing 35,000 pounds, to a height which will provide a 60-inch ground clearance and will permit placement onto a ground transport vehicle up to 120 inches in width.	Paragraph 2a, AMCTCM Approved TC	Met requirement (Test No. 2).
The system must be capable of manual assembly from shipping to operational condition, without special tools or materials handling equipment. Assembly time for a device (17,500-lb capacity) from removal from shipping skids to erection must be less than 1 hour, when using four men.	Paragraph 2b, Approved TC	Met requirement (Test No. 2).

Requirement	Source	Degree of Compliance
The system must have mechanical leveling provisions to insure stability in all directions for all loads up to rated load on sloping terrain up to and including 5-degree slopes.	Paragraph 2c, AMCTCM Approved TC	Met requirement (Test No. 2).
The device, when assembled, must be capable of being man-propelled short distances over unsurfaced and non-trafficked areas in the vicinity of forward airfields.	Paragraph 2f, AMCTCM Approved TC	Requirement compliance could not be determined (Test No. 2).
The system must be capable of raising the rated load to a 60-inch height in approximately 120 seconds, using self-contained gasoline engine operated power packages, together with hydraulic control and lift components.	Paragraph 2g, AMCTCM Approved TC	Met requirement (Test No. 2).
The device shall be operable from a single control station.	Paragraph 2h, AMCTCM Approved TC	Met requirement (Test No. 2).
The system must be capable of manual operation if power is not available. With manual operation, the lift rate requirement of above is not mandatory.	Paragraph 2i, AMCTCM Approved TC	Met requirement (Test No. 2).
The system must meet the requirements of the current revision of Specification MIL-T-11748 (Signal Corps), "Interference Reduction for Electrical and Electronic Equipment."	Paragraph 2p, AMCTCM Approved TC	Met requirement (Test No. 2).
The system, when operated by its hydraulic power package, shall demonstrate with 95 percent reliability the capability of performing a daily mission. A daily mission is defined as a total of 50	Paragraph 2b15, AMCTCM, Approved Operational Characteristics and verbal request by Natick Labs.	Met requirement (Test No. 3).

Requirement	Source	Degree of Compliance
cycles (lifts of various load weights within the rated capacity. This implies 20 mission days as Mean Time Between Failures (MTBF). A failure is defined as that which prevents the unit from completing its assigned mission and cannot be repaired by the operator with the tools and materials provided within 30 minutes. Unscheduled organizational maintenance should not exceed 30 minutes during the performance of a daily mission. The total maintenance manhours will not exceed 10 percent of the operating hours on the basis of 8 hours of operation equal to 1 mission day. Total maintenance will include scheduled and unscheduled maintenance from operator level through direct support level.		
The system must be capable of statically supporting twice the rated load without evidence of permanent deformation, when loaded at an attitude to 3 degrees in any direction from the vertical.	Paragraph 2j, AMCTCM Approved TC	Not tested.
The system must demonstrate sufficient reliability and durability to lift 150 percent of its rated load to its fully raised height of 60 inches, for 50 cycles, with all overload safety devices rendered inoperable for duration of test.	Paragraph 2k, AMCTCM Approved TC	Not tested.
The system must be easily maintained under field conditions. Components must be interchangeable between like items of the system. Maintenance costs must be a minimum for systems of this type.	Paragraph 2l, AMCTCM Approved TC	Met requirement (Test No. 3).

Requirement	Source	Degree of Compliance
The system must be capable of operation and storage in temperatures from -65°F to +125°F.	Paragraph 2r, AMCTCM Approved TC	Not completely determined (Test No. 3).

APPENDIX III. DEFICIENCIES AND SHORTCOMINGS

1. Deficiencies

Deficiency	Suggested Corrective Action	Remarks
1.1 One of the basic components of the gantry, the power pack, was too heavy to enable carrying for short distances and loading by four men onto a military vehicle.	None	If hydraulic oil were drained from power pack, weight would be within criteria.

2. Shortcomings

Shortcoming	Suggested Corrective Action	Remarks
2.1 The manual chain hoist chains corroded during testing.	Coat chains with non-corrosive material.	None
2.2 Baseplate wrench failed to operate properly.	Closer quality control be observed.	None
2.3 Oil seepage from hydraulic oil cylinder seals.	Better grade seals be used.	None

3. Suggested Improvements

Quality/Performance	Suggested Action	Remarks
3.1 Broken pressure gages.	Observe gages during service testing. If gages continue to fail, investigate possibility of replacement with a gage which will withstand high transient oil pressure.	None
3.2 Cable ends of the winch hoist cable are clamped and the loose ends taped. After 3 or 4 weeks the tape falls off and the wire cable is exposed which is a safety hazard.	Solder loose ends of cable.	None
3.3 Lifting loads with the manual chain hoist for 1 hour will cause blisters and open wounds on a man's hands.	Issue protective gloves to be worn when operating the manual chain hoist.	None

Quality/Performance	Suggested Action	Remarks
3.4 Shipping tape was wrapped around the winch hoist crank handles during shipment. During assembly of the test item, a small piece of tape was not removed between the winch hoist handle washer and the winch hoist, causing the safety brake to slip.	As small pieces of tape are easy to overlook and may create a safety hazard it is suggested that all loose ends be tied (rather than taped) to the frame for shipment.	None
3.5 Shipping containers are poorly constructed.	Redesign shipping containers.	None

TABLE I. Maintenance Data

Gantry No.	Components and Related Operations	Active Maintenance Time	Life Operation	Type Maintenance	Remarks
1 & 2	Manifold hose, quick fit disconnects (adjusted)	10 min	2 hr	Unscheduled	Oil leak (EPR L5-2)
1 & 2	Org maintenance	15 min	25 hr	Scheduled	Lubrication and inspection of power pack.
3 & 4	Manifold hose quick fit disconnects (tightened)	3 min	5 min	Unscheduled	Oil leak (EPR L5-4).
3 & 4	Manifold hose quick fit disconnects (tightened)	3 min	10 min	Unscheduled	Oil leak (EPR L5-4).
3 & 4	Manifold hose quick fit disconnects (repaired)	5 min	15 min	Unscheduled	Oil leak (EPR L5-4).
3 & 4	Hose assembly (adjusted)	3 min	1 hr	Unscheduled	Hose off shelves (EPR L5-5).
3 & 4	Hose assembly (adjusted)	12 min	2 hr to 3 hr 25 min	Unscheduled	Hose off shelves - Replaced 8 times - then disregarded (EPR L5-5-2).
3 & 4	Hose assembly (repaired) NOTE: Repair created a hazardous condition - item was then replaced.	1 hr 30 min (NOTE: Replacement time - 15 min)	3 hr 25 min	Unscheduled	Oil leak (EPR L5-6).
3 & 4	Pressure gage (replaced)	5 min	11 hr 7 min	Unscheduled	Broken pressure gage (EPR L5-7).

TABLE 1. Maintenance Data (Concluded)

Gantry No.	Components and Related Operations	Active Maintenance Time	Life Operation	Type Maintenance	Remarks
3 & 4	Pressure gage (replaced)	5 min	18 hr 2 min	Unscheduled	Broken pressure gage (EPR L5-7-2).
3 & 4	Pressure gage (replaced)	5 min	20 hr 32 min	Unscheduled	Broken pressure gage (EPR L5-7-2).
3 & 4	Cylinder fitting connections (tightened, could not be repaired).	8 min	20 hr	Unscheduled	Oil leak (EPR L5-8).
3 & 4	Org maintenance	15 min	25 hr	Scheduled	Lubrication and inspection of power pack.

TABLE 2. Maintenance Times

Nomenclature	Gantry 1 and 2	Gantry 3 and 4	Total System
Operating hours	44.5	46.7	91.2
Active maintenance hours*	0.4	1.3	1.7
Maintenance ratio	0.009	0.028	0.019
Mean time between failures	44.5	46.7	91.2

*Includes unscheduled and scheduled inspection time.

APPENDIX V. PHOTOGRAPHS

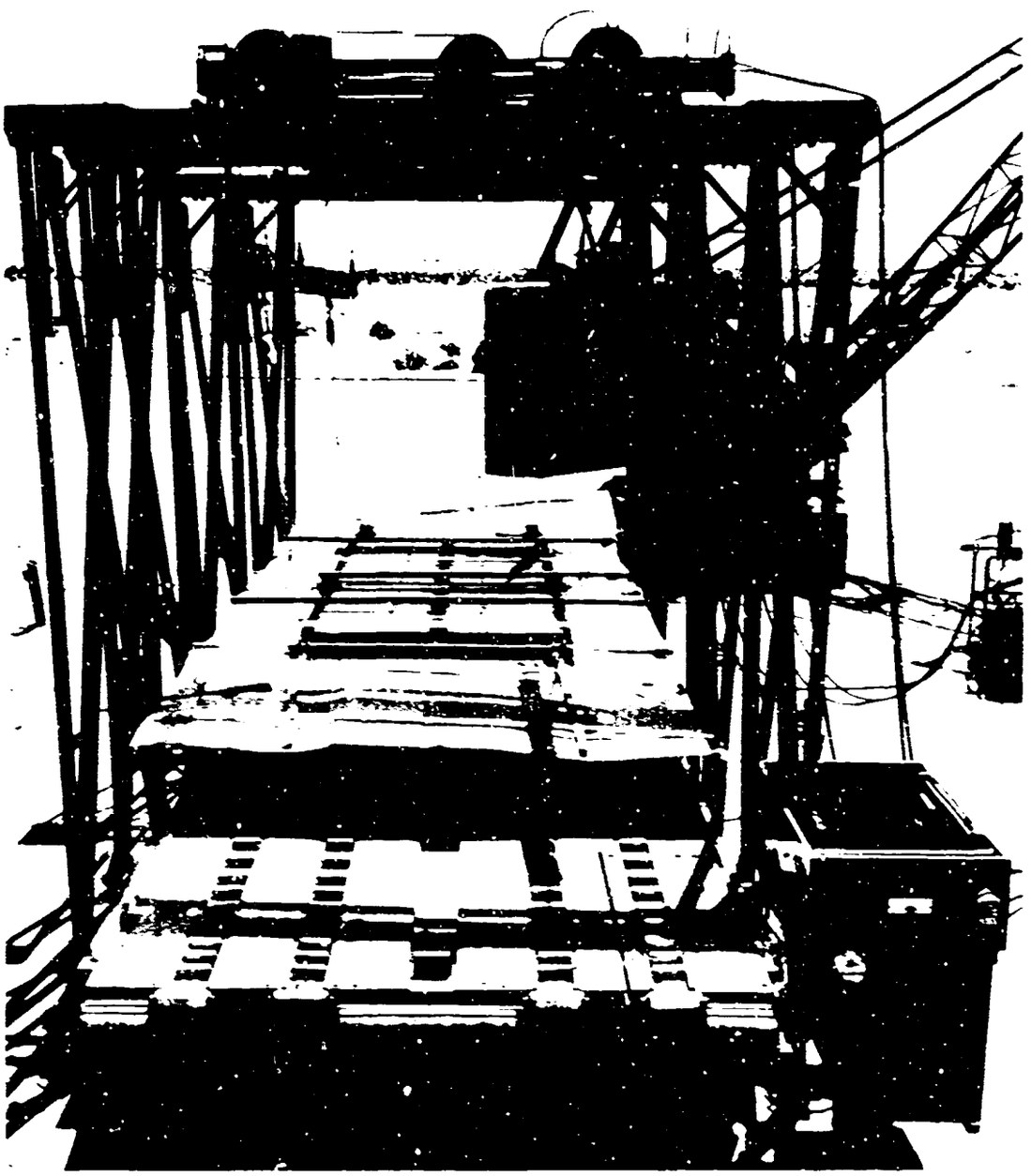

FIGURE 1. Aircraft loader (120 inches wide) driven under gantry system to pick up a 35,000-pound load which was extended to measure 336 inches long and 110 inches wide.

FIGURE 2. Man's hands after operating manual chain hoist for a period of 1 hour. Note blisters and open wounds.

FIGURE 3. Hydraulic cylinder showing oil leakage from seals.

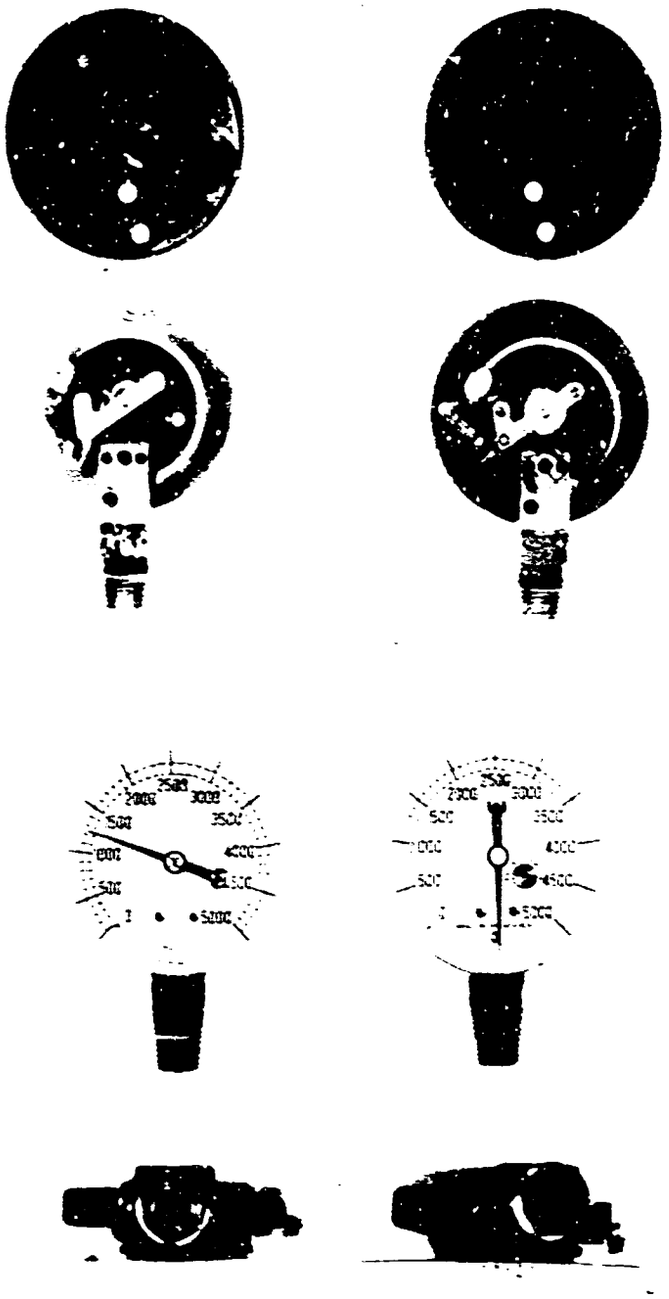

FIGURE 4. Broken gages which were replaced on the power pack during testing. At left, gage with the brass movement (note shavings). Gage wore thin. At right, gage with bronze movement. Gage broke.

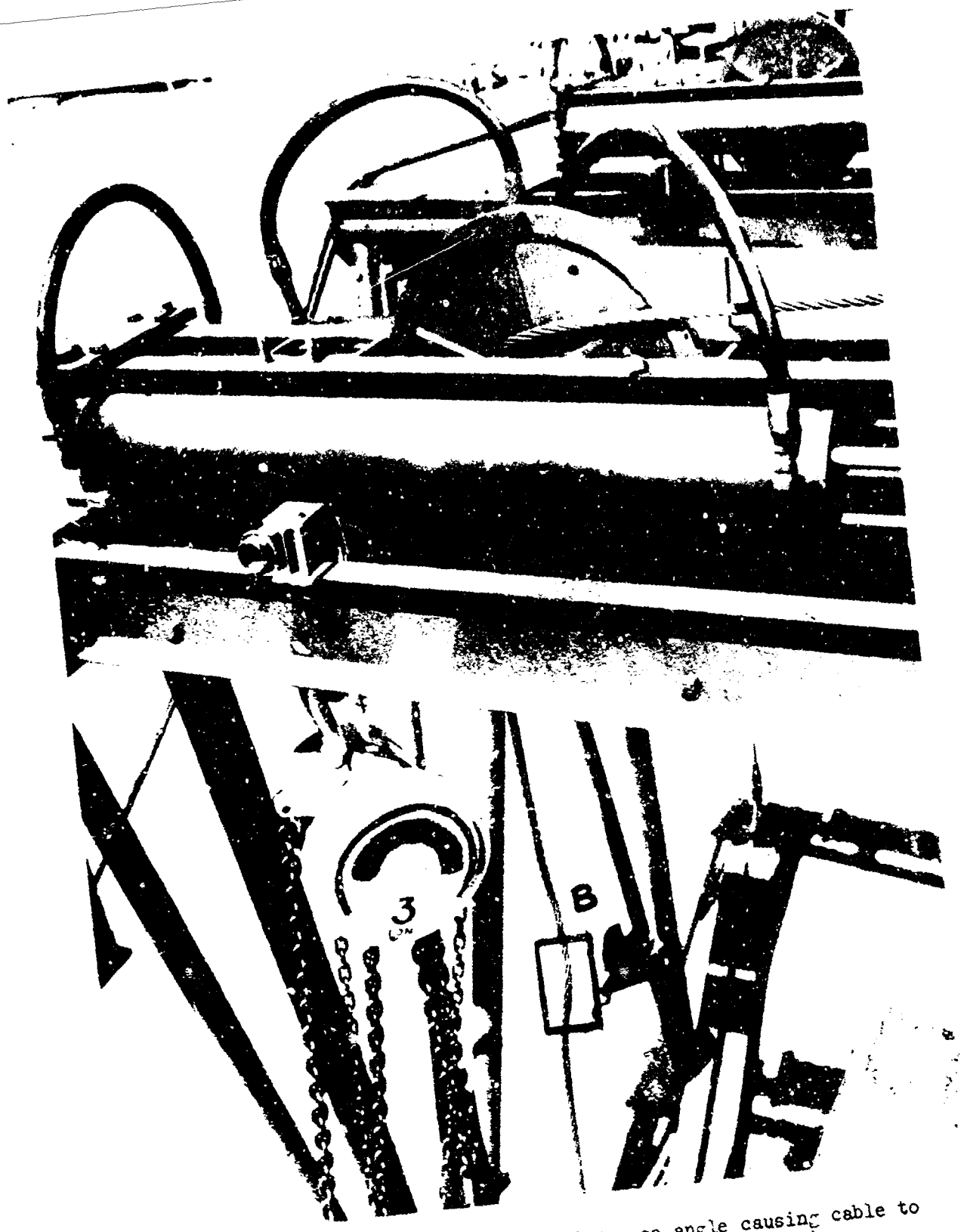

FIGURE 5. Load was lifted at a 3.6-degree angle causing cable to jump off sheave (Item A) and to kink (Item B).

FIGURE 6. Cable ends of winch hoist cable.

APPENDIX VI. REFERENCES

1. Letter, AMSTE-BG, USATECOM, subject "Test Directive for Service Test of Gantry, Lightweight, Airdrop Rigging," 28 July 1966.

2. Letter, U.S. Army Natick Laboratories, subject "Preliminary Report of Engineering Design Test of Gantry, Lightweight, Airdrop Rigging," June 1966.

3. Letter, U.S. Army Natick Laboratories, subject "Revised Copy of Small Development Requirement and Technical Characteristics of Subject Gantry, as Amended by Minutes of In-Process Review Meeting, and as Approved by Indorsement from Hq, DA, OCRD," May 1968.

4. TM 5-2805-203-14, dated April 1965.

5. Letter, U.S. Army Natick Laboratories, subject "Gantry, Lightweight, Airdrop Rigging," 15 August 1968.

6. Maintenance and Operating Manual for the Portable Lightweight Lifting System for Preparation of Airdrop Cargoes, dated 7 March 1966.

7. U.S. Army Mobility Equipment Center, Draft Operator, Organizational, Direct and General Support Maintenance Manual (DTM 5-3950-205-14) for Gantry, Lightweight System for Preparation of Airdrop Cargoes, FSN (None Assigned), Natick Project NL-92.1, updated to March 1968.

8. USATECOM Regulation 385-2, Safety Responsibilities, 18 February 1963.

9. U.S. Army Airborne, Electronics and Special Warfare Board, subject "Service Test of Gantry, Lightweight, Airdrop Rigging, RDTE Project No. 1M141812D18322A, USATECOM Project No. 4-5-7491-01 (AB 767)," June 1967.

10. USATECOM Regulation 385-7, Safety Confirmation, 18 December 1962.

11. USATECOM Regulation 700-1, Value Analysis in Materiel Testing, 18 February 1967.

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13. ABSTRACT

The engineer test of the Gantry, Lightweight, Airdrop Rigging, was conducted by Yuma Proving Ground from 20 May 1968 to 30 August 1968.

The purpose of the test was to determine the suitability of the test gantry for service testing.

All testing was conducted under natural environmental conditions. The approved technical characteristics of the test item were used as criteria to determine test item reliability. The power pack was too heavy for four men to carry and load onto a military vehicle (deficiency). The manual chain hoists corroded, the winch broke, and the hydraulic cylinder leaked oil (shortcomings).

It was concluded that the shortcomings were readily correctible. It was also concluded that if only four men are available the hydraulic oil could be drained from the power pack, thus eliminating the heavy weight deficiency. It was recommended that the Gantry, Lightweight, Airdrop Rigging be subjected to service testing.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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Reliability						
Hoisting						