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Magnetic Arc Shaper and
Molten Puddle Stirrer:
Phase III. Weld Evaluation

Seventh Monthly Report
First Monthly Report of Phase III

Contract No. NAS8-11954

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MURRAY HILL, NEW JERSEY

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Magnetic Arc Shaper and
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Phase III. Weld Evaluation

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to

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Huntsville, Alabama 35812
Attention: Purchasing Office
PR-RC

Contract No. NAS8-11954
Control No. DCN 2-5-04-11537

P. Beischer

June 8, 1966

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ABSTRACT

This report summarizes the work directed toward evaluation of welds made with molten puddle stirrer and arc shaper devices during the month of May.

Welding equipment and instrumentation has been set up, and in the absence of the contract specified aluminum alloy, preliminary weld tests have been conducted on available material (6061 or 2024). During the coming month weld level parameters will be finalized and testing will begin with the arc shaper.

1. INTRODUCTION

This is the First Monthly Report of Phase III of the subject contract, representing the effort directed toward evaluation of welds made with the molten puddle stirrer and arc shaper devices. Work during this period has consisted of assembling the welding equipment in a suitable area, connecting instrumentation and establishing calibration procedures, and conducting preliminary welding tests.

2. DESCRIPTION OF ACTIVITY

2.1 WELDING TEST EQUIPMENT

An overall view of the test equipment is shown in Fig. 1. The travel mechanism chosen is a skate, which is part of the Airco Sampak Welding System. It features a smooth positive drive and feedback control of speed. The skate speed is adjustable from 0 - 60 i.p.m., ± 1%. Coupled to the skate is an Airco Model HMH Automatic Head which will be moved over a stationary work piece.

It has been decided to provide proximity control to maintain constant separation between the coils and the workpiece. This has been accomplished by modifying the automatic head to accept a control voltage from a linear potentiometer which is in contact with the work. The potentiometer senses height changes and the head positions the electrode holder and coils to maintain fixed spacing. Positioning sensitivity thus obtained is 0.001 in. Arc voltage control has not been used for this purpose since the application of stirring and shaping magnetic fields may modify the arc voltage. This would result in arc length changes, thus introducing another variable. In order to use the automatic head it was necessary to change from an M50B Heliweld Holder to an M50A. These holders differ in overall length but are identical in rating.

The welding power supply that will be used is an Airco 600 amp. Function Controlled Welding Supply. This is a precision constant current source with line and load regulation capability. Use of this supply will aid in maintaining constant energy input into the weld in the presence of these variables.

2.2 INSTRUMENTATION

The basic welding parameters, arc current, arc voltage and travel speed, will be measured with a recording oscillograph. This instrument, shown in Fig. 1, is a Consolidated Electrodynamics Corp. Model 524.

Through the use of auxiliary amplifiers, having a zero suppression feature, the following sensitivity and resolution is provided:

Parameter	Sensitivity	Resolution
Arc current	10 amp./in.	1 amp.
Arc voltage	1 v./in.	0.1 v.
Travel speed	1 in./min./in.	0.1 in./min.

A calibration procedure has been established using a certified Leeds and Northrup Type K3 Potentiometer as a standard, and the instrument calibration will be checked periodically throughout the program.

Measurement of the stirrer and oscillator coil excitation frequency will be made with a Hewlett Packard Model 5233L Electronic Counter, while the coil current will be measured with panel meters existing on the power supply.

2.3 PRELIMINARY TESTS

Initial welding tests were made using a standard ceramic nozzle to check out the instrumentation. An indication of the weld bead uniformity and heat storage effect of the plate was obtained by limited bead-on-plate tests using 6061. The weld bead width and penetration resulting from such a test is given in the following table:

Section (in. from start of weld)	Penetration (in.)	Width (in.)
1	0.195	0.459
2	0.232	0.468
3	0.253	0.499
4	0.256	0.506
5	0.263	0.512
6	0.262	0.511
7	0.263	0.500
8	0.261	0.512
9	0.264	0.502
10	0.257	0.510
11	0.257	0.515
12	0.260	0.517

Welding Conditions	
Current	245 amp.
Travel speed	10 i.p.m.
Arc voltage	19.8 v.
Gas	100 c.f.h. He
Work	6061-T65, 1/2 in. thick
Electrode	1/8 in. 2% Thoriation Tungsten; 0.1 in. electrode to work gap
Nozzle	Ceramic, 5/8 in. ID
Power supply	D.C. Bumblebee

For this amount of energy input (29.1 kilojoules/in.), 4 in. of weld are required to reach steady state heat flow. From this point on good weld bead uniformity is obtained, with penetration being maintained to within about 2.3%. Additional tests are in progress to determine the current and travel speed levels to be used during the tests. Based on present data the probable current range will be 225 - 275 amp. and travel speed range from 10 - 12 i.p.m. This will be finalized upon testing of the actual alloys to be furnished by NASA.

3. REVIEW OF ANTICIPATED WORK

The aluminum material to be supplied by NASA was not received until June 3 due to a delay during shipping. This represents a three week delay in initiating weld tests on the specified material. All attempts will be made to make up this time lost. Because of this a limited number of welding tests have been under way since May 18, using 6061 or 2024 alloys, because they were the only alloys available. Some of these tests will have to be repeated with the specified alloys. During the coming month welding parameter levels will be finalized and welding tests will begin.

P. Beischer

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Approved:

N. J. Normando

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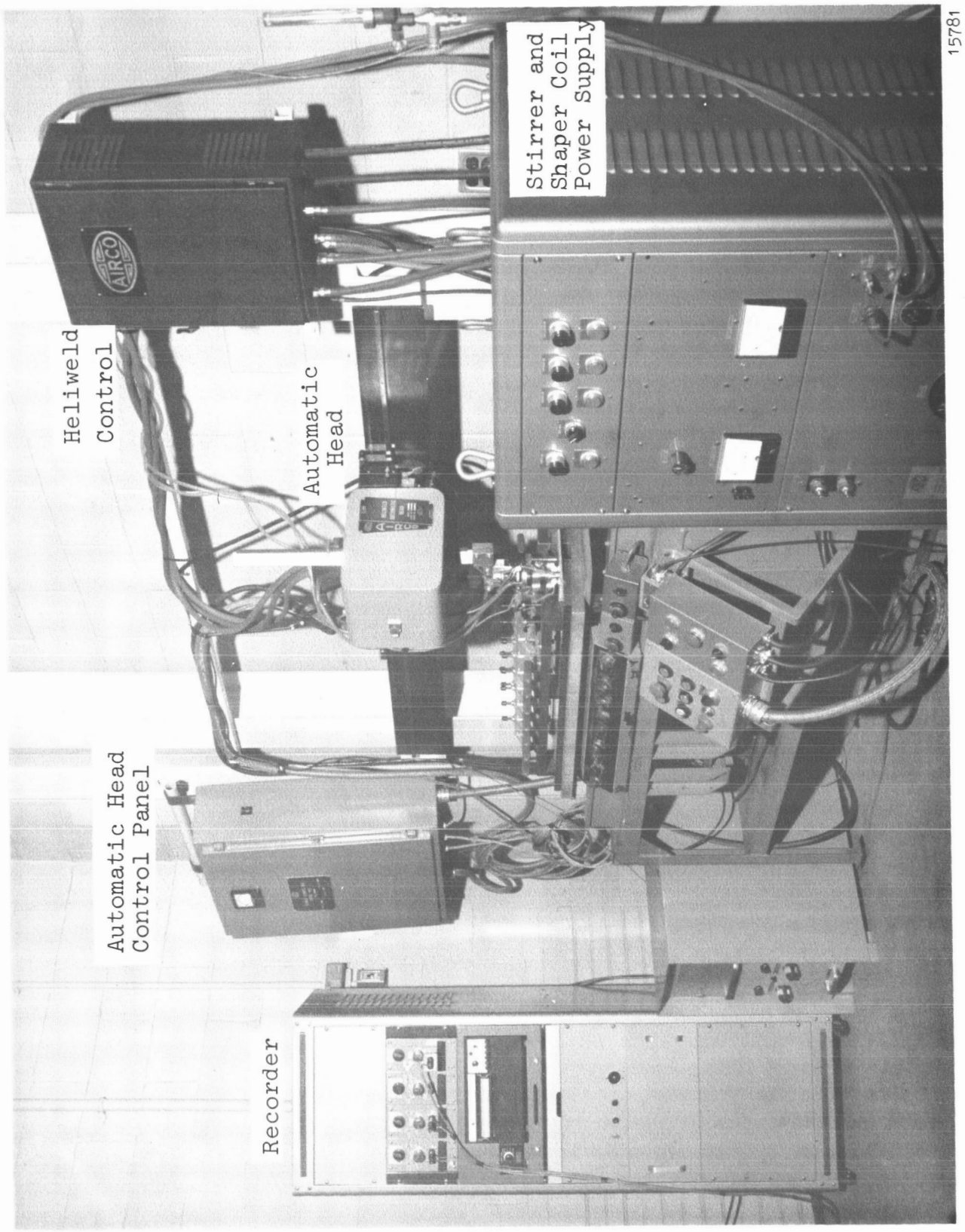
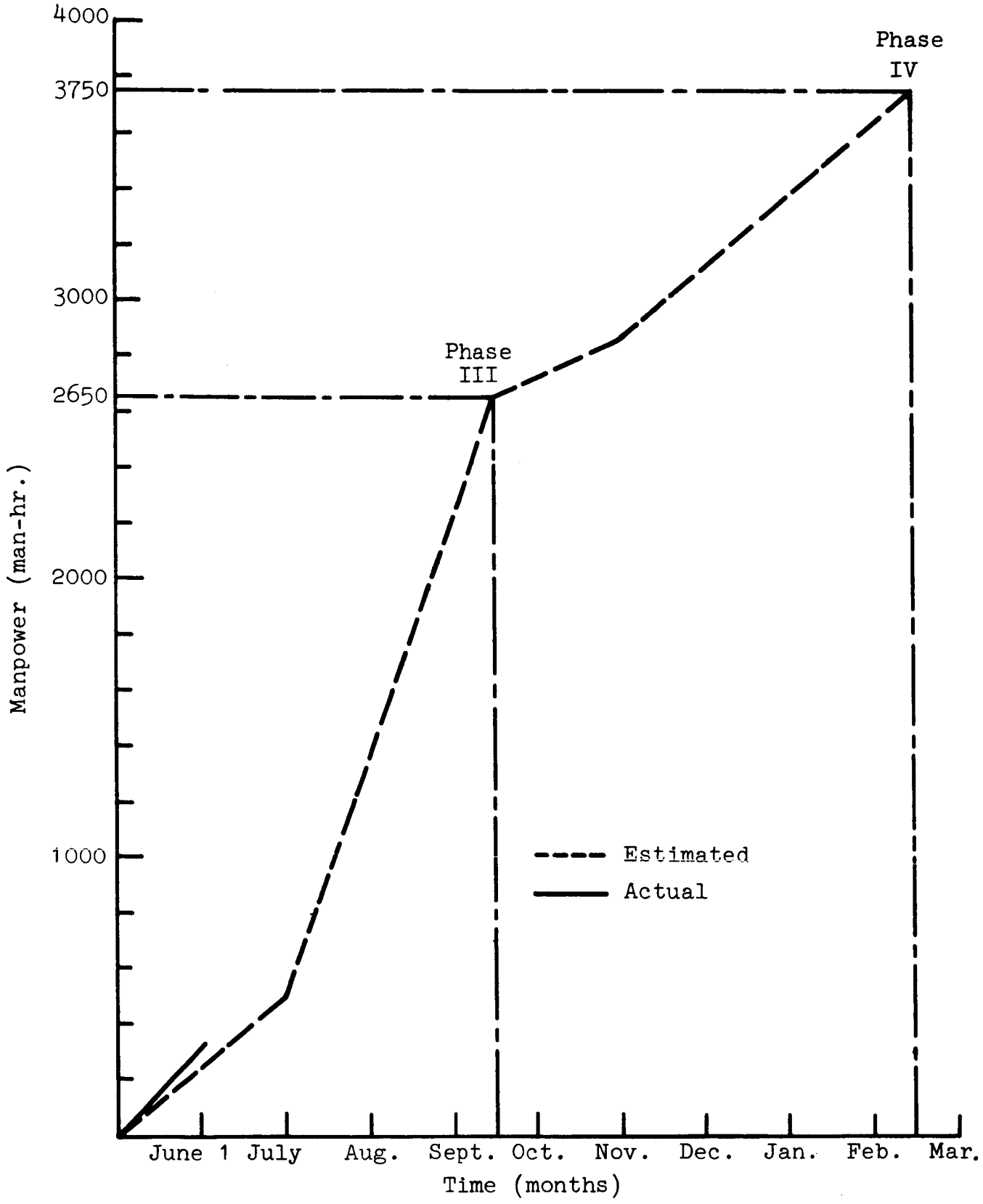


Fig. 1. TEST EQUIPMENT



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