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DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

Ottawa, February 11, 1947.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2176.

Welding Experiments on R.C.A.F. Qualification Tests.

(Copy No. 7.)

Bureau of Mines

Mineral Dressing and
Metallurgy Division

Physical Metallurgy
Research Laboratories

CANADA

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OF
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Mines and Geology Branch

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Origin of Investigation:

On December 4, 1946, Flying Officer G. W. E. Brown, R.C.A.F. Inspection Staff, Maintenance Command, Uplands Airport, visited the Laboratories to discuss specifications for the qualification of Aircraft Welders; particularly test specimen #3, R.C.A.F. Drawing 3284. Objections had been received from a leading Canadian manufacturer of aircraft that this test was too difficult.

Test specimen #3 is designed to test an operator's ability to weld light sections to heavy sections. It consists

(Origin of Investigation, cont'd) -

of a cluster of three pieces 1.00" x 0.065" wall tubing welded to a plate 6" x 6" x ¼", using the oxyacetylene method (see Figure 1). It is reported that operators attempting to weld this test-piece registered the following objections:

1. Because of the thickness of the plate, it was impossible to supply sufficient heat input without the aid of auxiliary heating.

2. The heat radiated by the plate caused the edges of the tubing to melt.

3. The heavy input of heat resulted in "burning and crystallization of the weld".

Object:

It was decided to attempt to weld some of these test pieces in the laboratory in an effort to work out a suitable welding sequence.

Procedure:

Samples of tubing already machined were supplied by R.C.A.F. Maintenance Command, and plates of the required dimension were prepared in the Bureau of Mines workshops.

A standard Purox Aircraft torch (tip #6, Drill size 50) was used. Pressure readings were: Oxygen, 9; Acetylene, 8. D.O.C. #1 H.T. welding rod, 1/8" diameter, was used for filler metal.

The parts to be welded were insulated from a steel table by a double layer of 3/16" asbestos sheet. The plate was preheated to a dark, cherry red (approx. 1200-1400° F.).

Figures 1 and 2 illustrate the welding sequence. The numbers designate the order in which welds were made; the arrows point in the direction of welding. Points (T) are tack welds used to hold the tubing in position.

Figure 3 is a photograph of the finished test pieces.

Discussion:

Aircraft welding is recognized as a trade in itself. Great experience is necessary to meet the demands of this type of welding. This specialized skill is not available in these Laboratories.

The problem is essentially one of heat control. Very careful preheating is required to raise the plate to the necessary temperature. This can be accomplished, using #6 tip (Drill size 50), in approximately fifteen minutes.

The tubes should be placed in position and welded singly to avoid overheating their thin walls. Care must be taken to avoid melting the edge of the tubing by heat radiation from the base plate. During welding, the tubing edge was protected by holding the filler rod against the tubing, slightly ahead of the weld puddle.

Some difficulty was encountered in maintaining the plate at welding temperature. This was partially overcome by additional heating of the plate before each weld and by using tack welds in the positions indicated (see Figures 1 and 2).

It was necessary to direct the flame of the torch away from the tubing. This resulted in large, flat fillets. As can be seen from Figure 3, the welds were uniform in structure and free from pinholes and porosity.

When these specimens were sectioned, it was found that penetration into the base plate did not meet the required 15 per cent minimum. Although the operator failed to obtain sufficient penetration in the welds, it is felt that an experienced aircraft welder should be able to meet the specified penetration.

(Continued on next page)

(Discussion, cont'd) -

A similar test is mandatory in Army-Navy Aeronautical Specification Tests, Aircraft Welding Operator's Certification in the United States.

Conclusions:

1. No auxiliary heat is required to maintain welding temperature in the base plate.

2. The edges of the tubing can be shielded from heat radiation by the filler rod.

3. No burning was encountered in the welding of these test pieces.

4. Test specimen #3, R.C.A.F. Drawing 3284, is a thorough test of the operator's ability to weld light sections to heavy sections.

Recommendation:

Any action to facilitate the welding of this test piece, such as the use of a lighter plate, would result in lowering the standard of aircraft welding in Canada. Such action is not warranted.

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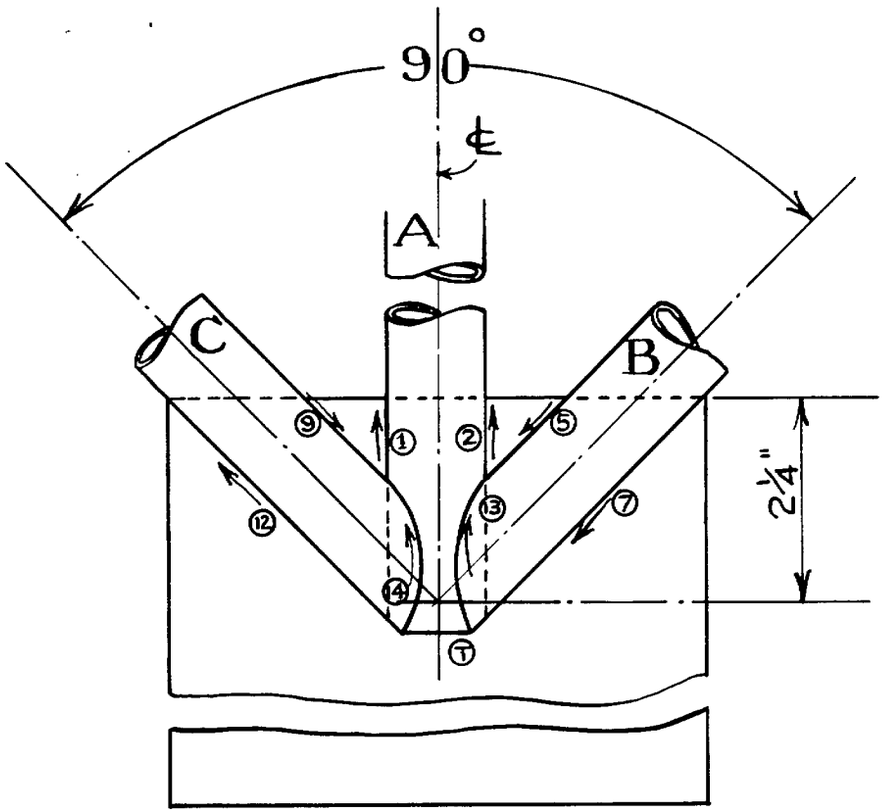
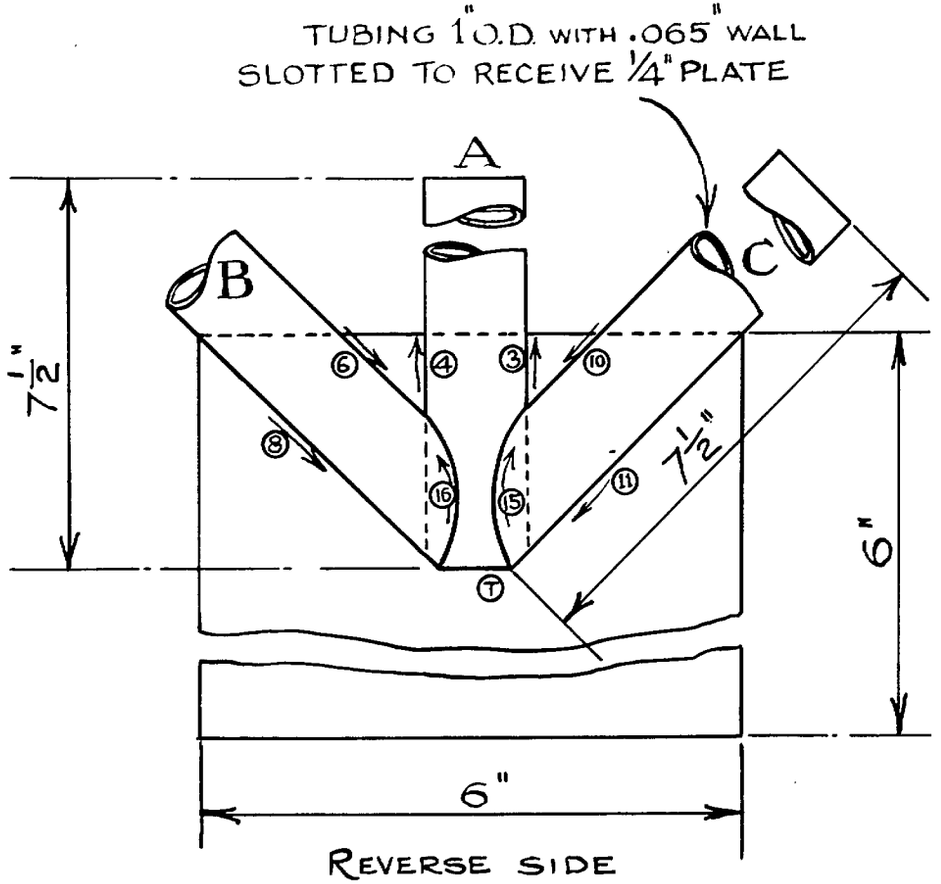
(Figures 1 to 3 follow, on Pages 5 and 6.)



FRONT SIDE

FIG. I



REVERSE SIDE

FIG. II

WELDING SEQUENCE FOR R.C.A.F. WELDERS QUALIFICATION TEST

SCALE ½" = 1"

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Figure 3.

PHOTOGRAPH OF FINISHED TEST PIECES.

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