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MANUFACTURE OF EXHAUST COLLECTOR RINGS FOR AIRPLANE ENGINES FROM NICKEL-CHROME-IRON ALLOYS
A. C. Specification No. 10082–A

(ENGINEERING SHOPS BRANCH REPORT)
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MANUFACTURE OF EXHAUST COLLECTOR RINGS FOR AIRPLANE ENGINES FROM NICKEL-CHROME-IRON ALLOYS. AIR CORPS SPECIFICATION NO. 10082-A

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PURPOSE

1. The purpose of this report is to explain the processes and the technique of annealing, forming, and welding the following materials:

A. C. Specification #10082-A:
- Type III, Class B (sheet stock).
- Type IV, Class B (welding rod).
- Type V, Class B (seamless tubing).

The processes discussed herein are the results of extended efforts at the Matériel Division, Wright Field, Dayton, Ohio, to make use of the above materials because of satisfactory performance, their heat resisting and noncorrosive characteristics for engine exhaust ducts.

2. Scope.—This report will deal with the processes of annealing, forming, and welding of 0.043-inch materials, now recommended for the manufacture of engine collector rings. This type and class of material is recommended because it can be worked and is most satisfactory for the use intended.

It must be annealed before working. Annealing is accomplished by heating the material in a closed oven for approximately 20 minutes at 1,800° F. After this period of heating, it should be removed from the furnace and allowed to aircool. It should not be quenched in water or oil for cooling.

The material may be worked with considerable ease and with a minimum of "spring out" if formed shortly after this annealing process. However, it has been found that the metal will still have a slight "spring out", which may be compensated for, when the required stamping dies are being built. This "spring out" will be approximately \( \frac{1}{6} \) inch to 1 inch in diameter. For example—-to form a stack 4 inches in diameter would require a stamping die of the proportions shown on a cross sectional view of the die (drawing no. S-36A-132), figure 1.

3. Sheet Stock Materials, Type III, Class B.—The die stamping should be completed in one operation. Repeated stamping blows will have no effect unless the material is re-annealed after each forming operation. Repeated annealing increases scaling, thus rendering the material less suitable for the finished article.

4. Welding.—Seams can be satisfactorily welded with \( \frac{1}{8} \) -inch welding rods (type IV, class B, specification no. 10082-A), by using an excess of acetylene gas so that a carburizing flame will result instead of an oxidizing flame. The following welding fluxes are recommended to obtain satisfactory welds:

a. Three parts of sodium fluoride (NaF), and one part made of equal parts of borax (Na,B,O,.10H,0) and boric acid (HBO,). mixed and formed into a paste. Both the material to be welded and the welding rod will require a coating with the flux before welding.

b. Forty-three percent sodium chloride (NaCl), 57 percent sodium fluoride (NaF), mixed with water to form a paste. To this mixture add approximately one-thousand by volume, Chromally welding flux. A satisfactory weld may be made by coating only the welding rod with the flux.

Fumes arising from the above fluxes are poisonous during the welding operations. Care should be taken so that none of the fumes are inhaled.

5. Tubing—Specification No. 10082-A, Type V, Class B.—Tubing as received from the manufacturer may vary slightly in the degree of hardness. It can be worked cold, but better and more uniform results will be obtained if the material is annealed before working. The same annealing procedure as recommended for sheet stock should be followed.

Fumes arising from the above fluxes are poisonous during the welding operations. Care should be taken so that none of the fumes are inhaled.

As an example of the work that may be accomplished with the above materials, see figures 2 and 3.

The forming dies were cast with the tolerances as indicated in figure 1, and consisted of a male die, female die, and a hold-down plate as shown in figures 2 and 3. The template, after annealing, as shown in figure 1, was bolted in place between the hold-down plate and the female die in order to force the metal to stretch at the abrupt bends rather than wrinkle or tear at these points. If a machine press, equipped with mechanical, hydraulic, or compressed air clamping devices is used to make the stampings, bolting of the template in place will not be necessary.

One sixty-fourth of an inch to one thirty-second of an inch should be left at all joints to be welded to take care of shrinkage. The exact amount of shrinkage will depend upon the skill of respective welders.
Figure 1.—Cross section of stamping die for nickel-chromium-iron alloy.