TECHNICAL NOTES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 930

TENSILE TESTS OF ROUND-HEAD, FLAT-HEAD, AND BRAZIER-HEAD RIVETS

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SUMMARY

An investigation was conducted to determine the tensile strength of round-head (AN430), flat-head (AN442), and brazier-head (AN455 and AN456) aluminum-alloy rivets because of the scarcity of information on the tensile strength of rivets. The results of the investigation are presented as curves that show the variation of the ratio of the tensile strength of the rivet to the tensile strength of the rivet shank with the ratio of the sheet thickness to the rivet diameter for the different types of rivet.

INTRODUCTION

Information on the tensile strength of rivets is scarce, although it is known that, in many applications, rivets are under tensile load. An investigation was therefore conducted to determine the comparative tensile strengths of round-head (AN430), flat-head (AN442), and brazier-head (AN455 and AN456) rivets. The tests were made with special fixtures designed to simplify the testing procedure.

SPECIMENS AND TEST PROCEDURE

The specimens used in the tests each consisted of two sheets of 24S-T aluminum alloy of equal thickness, riveted together with a single A17S-T aluminum-alloy rivet, as shown in figure 1. Round-head (AN430), flat-head (AN442), and brazier-head (AN455 and AN456) rivets

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were used. In the driving operation, a vibrating gun was applied to the manufactured head of the rivet while the shank end was bucked with a bar.

The specimens were mounted for test in the fixtures shown in figure 2. The small rods on each of the fixtures pass through the holes in one of the sheets of the specimen and bear against the other sheet. When load is applied, the rods push the sheets of the specimen apart. Loads were applied to the specimens in a hydraulic testing machine accurate within one-half of 1 percent. Maximum load and type of failure were recorded for each test.

RESULTS AND DISCUSSION

A comparison of the tensile strengths of round-, flat-, and brazier-head rivets is presented in figure 3. Some points are missing from figure 3 because rivets of sufficient length to form full driven heads in certain sheet thicknesses were not available. Figure 4 illustrates the types of failure that were observed.

The variation in the ratio of the tensile strength of the rivet to the tensile strength of the rivet shank with the ratio of the sheet thickness to the rivet diameter is shown in figure 5. The curves faired through the points in figure 5 are presented again separately in figure 6. The values of the ratio of the tensile strength of the rivet to the tensile strength of the rivet shank were obtained by dividing the maximum load for each specimen by the average of the maximum loads of those specimens that failed by tension of the shank.

Figures 3 and 6 indicate that, for ratios of sheet thickness to rivet diameter greater than 0.5, the round-head (AN430) rivets developed the full tensile strength of the rivet shank, the brazier-head (AN455) rivets carried only slightly less load than the round-head rivets, and the flat-head (AN442) and brazier-head (AN456) rivets failed at loads approximately nine-tenths and seven-tenths, respectively, of loads at which the round-head rivets failed. The tensile strength of all four types of rivet decreased in thinner sheet; the strength of the round-head rivets decreased more than

that of the other rivets, probably because of the greater tendency of the small diameter heads to tear through the sheet.

CONCLUSIONS

The following conclusions may be drawn from the results of the tension tests of round-head (AN430), flat-head (AN442), and brazier-head (AN455 and AN456) rivets:

1. When the ratio of the sheet thickness to the rivet diameter was greater than 0.5, the round-head (AN430) rivets developed the full tensile strength of the rivet shank, the brazier-head (AN455) rivets carried only slightly less load than the round-head rivets, and the flat-head (AN442) and brazier-head (AN456) rivets failed at loads approximately nine-tenths and seven-tenths, respectively, of loads at which the round-head rivets failed.

2. The tensile strength of all four types of rivet decreased in thinner sheet; the strength of the round-head rivets decreased more than that of the other rivets, probably because of the greater tendency of the small-diameter heads to tear through the sheet.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., September 25, 1943.

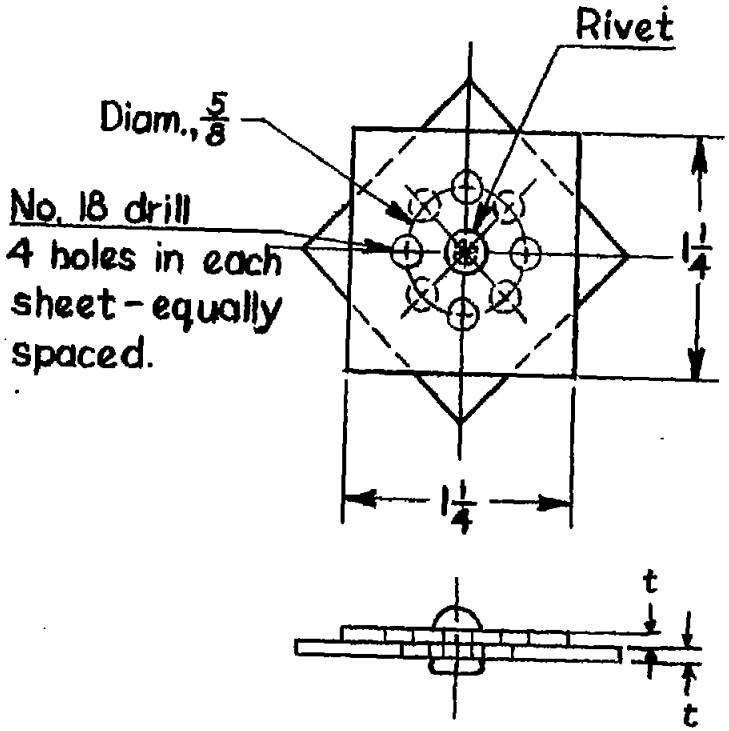

Figure 1.~ Test specimen.

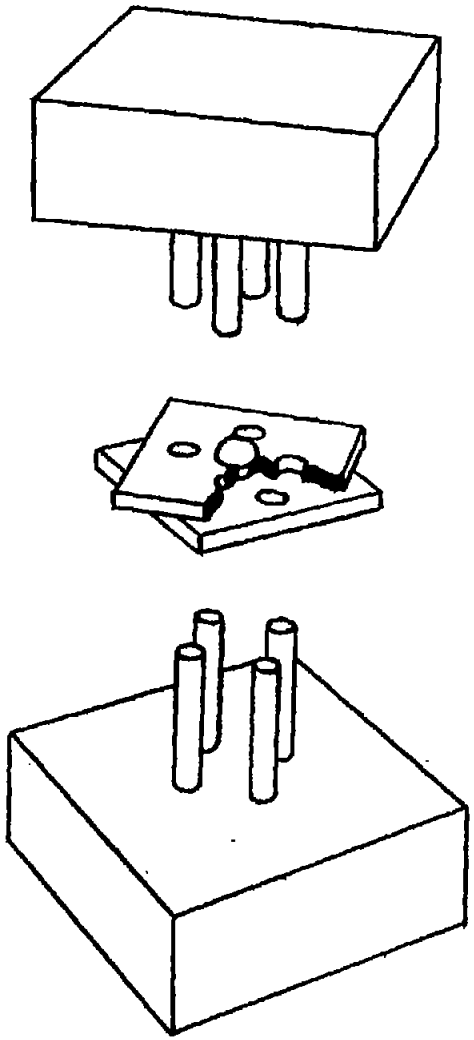

Figure 2.~ Fixtures and specimen for tension tests of rivets.

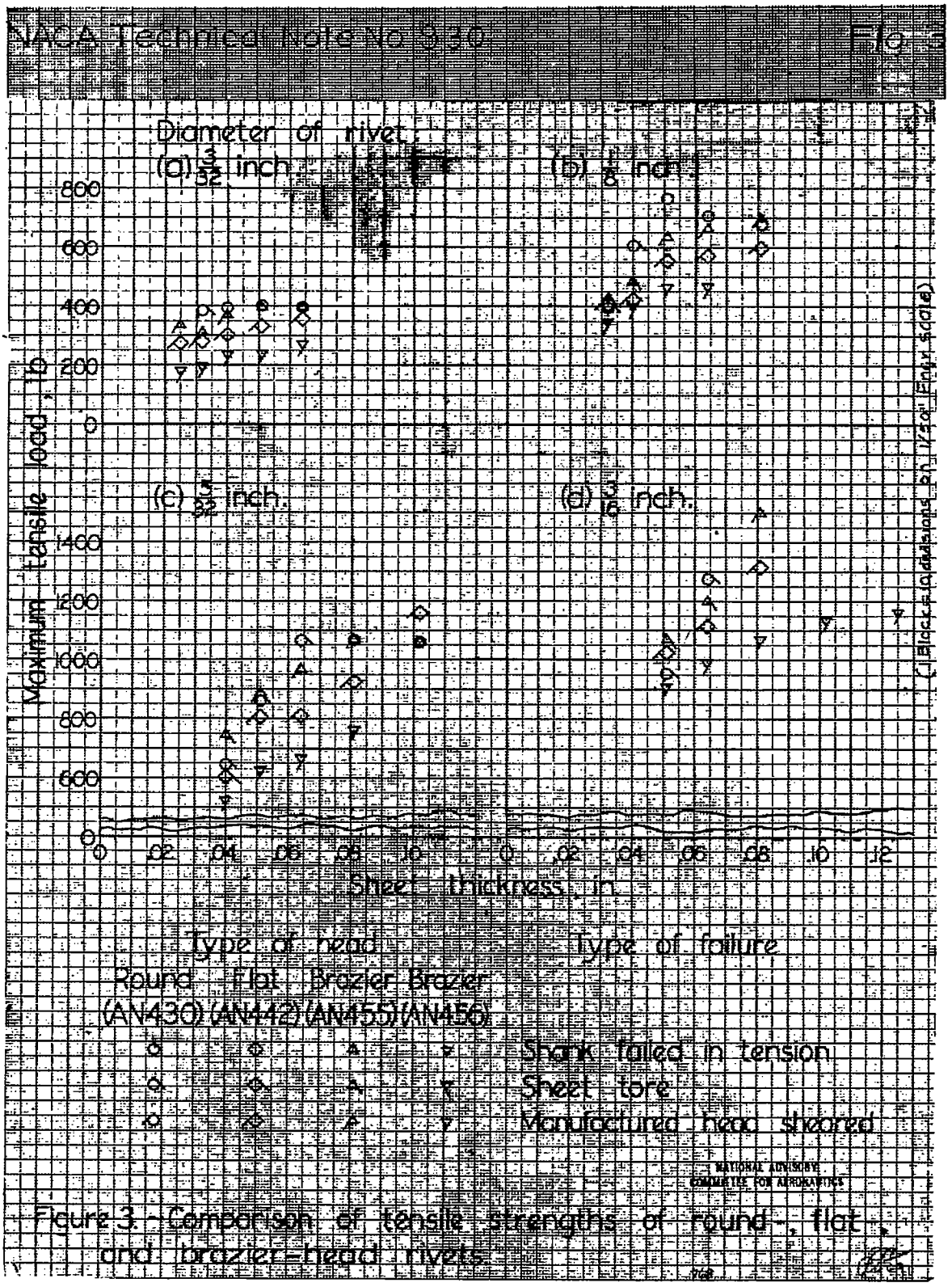

Figure 3.- Comparison of tensile strengths of round-, flat-, and brazier-head rivets.

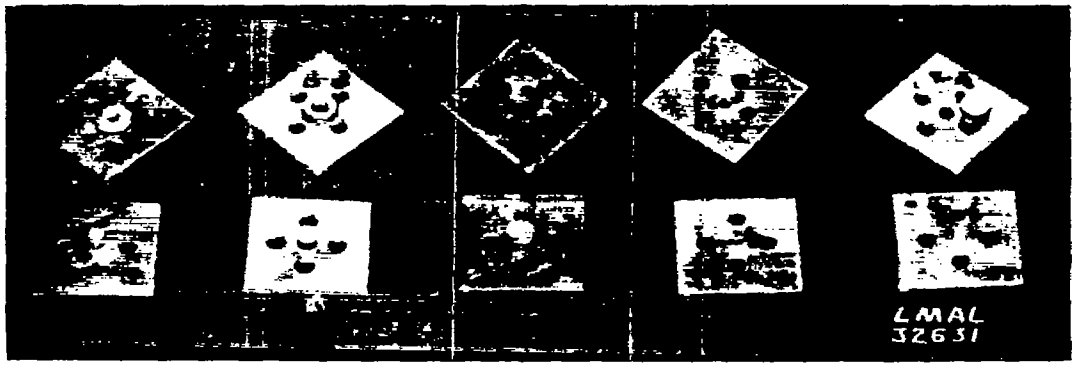

Figure 4.- Typical specimens after failure. Left to right: Brazier-head (AN455) rivet, 3/32 inch, and flat-head (AN442) rivet, 3/16 inch - manufactured head sheared; round-head (AN430) rivets, 3/16 and 3/32 inch - sheet tore; and round-head (AN430) rivet, 1/8 inch - shank failed in tension.

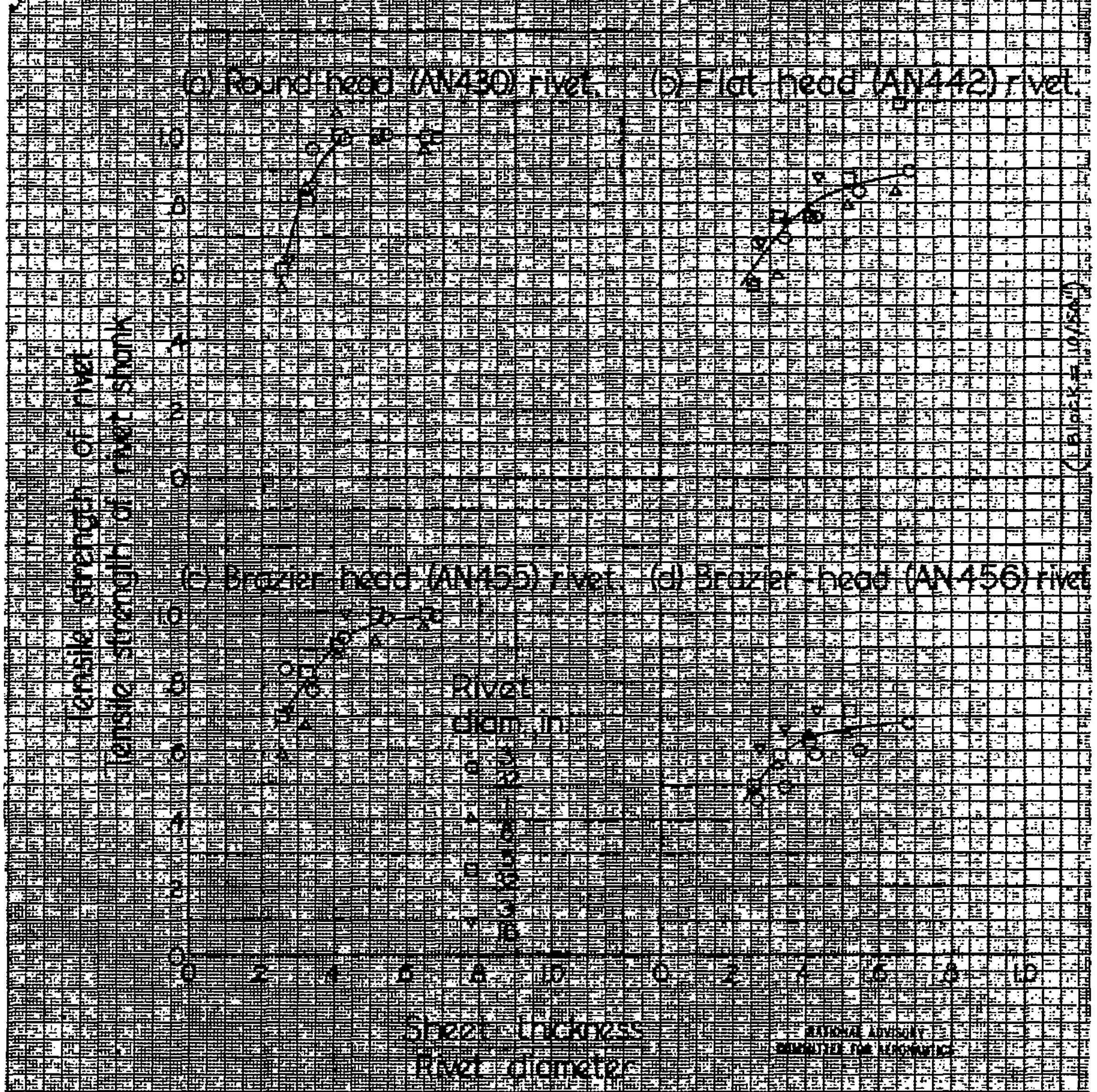

Figure 5.- Variation in the ratio of rivet tensile strength to rivet shank tensile strength with the ratio of sheet thickness to rivet diameter.

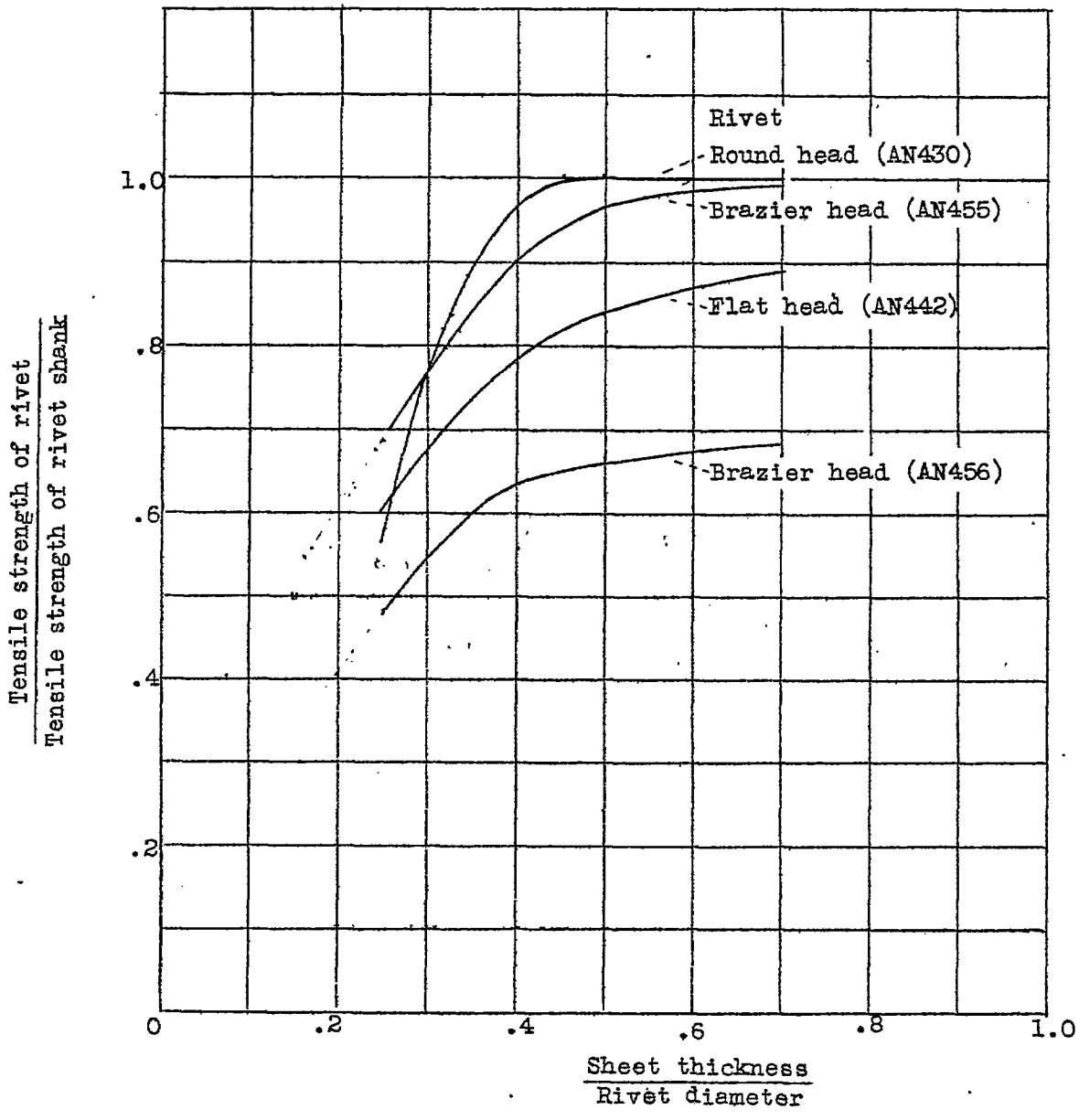

Figure 6.- Average curves for the tensile strength of four types of A17S-T aluminum-alloy rivet in 24S-T aluminum-alloy sheet.