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EFFECT OF NORMAL PRESSURE ON THE CRITICAL  
COMPRESSIVE STRESS OF CURVED SHEET

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EFFECT OF NORMAL PRESSURE ON THE CRITICAL  
COMPRESSIVE STRESS OF CURVED SHEET

By Norman Rafel

In order to study experimentally the effect of normal pressure on the critical compressive stress for thin curved sheet, two specimens were constructed, as shown in figures 1 and 2. These specimens are designated by their respective rib spacings of 10 inches and 30 inches.

As shown in figure 3, each specimen was tested with flat ends in the 1,200,000-pound-capacity testing machine in the NACA structures research laboratory. The loading head of this machine is laterally supported during tests by the heavy side columns of the machine in such a manner as not to affect the accuracy of load measurement. The ends of the specimen were ground flat and parallel in a planer specially adapted for this purpose. The detailed operations of finishing the ends of the specimen and the loading of it were planned so as to give uniform strain distribution throughout the specimen; strain distribution during the test was checked by wire-resistance-type strain gages.

Normal pressure was applied by admitting compressed air into the specimen. A mercury manometer calibrated in pounds per square inch was used to measure the pressure inside the specimen.

The results of the tests are presented in figures 4 to 8, from which the following conclusions are drawn:

1. Loading of the specimen until buckling occurred at any one normal pressure did not appreciably injure the specimen for additional tests at different pressures, as evidenced by the experimental points in figure 4, where the numbers 1, 2, 3, etc. indicate the order in which the tests were made on each specimen. The specimens were completely unloaded after each test.

2. An outward acting normal pressure very appreciably raises the critical compressive stress for unstiffened curved sheet. (See fig. 4.)

3. The absolute increase in critical compressive stress caused by normal pressure is not greatly different for the two rib spacings of 10 inches and 30 inches tested. (See fig. 5.) On a percentage basis, however, the increase in critical compressive stress caused by normal pressure is much greater for the 30-inch rib spacing than for the 10-inch rib spacing. (See fig. 6.)

4. The critical compressive stress seems to be independent of whether the normal pressure is held constant and the compressive stress is increased until buckling occurs or the compressive stress and normal pressure are maintained at a constant ratio during loading. (See fig. 7.)

5. The compressive stress - normal pressure curve at which the buckles disappeared on unloading is always below the compressive stress - normal pressure curve at which the buckles appeared. (See fig. 8.)

6. The relationship between compressive stress and normal pressure at which buckles disappeared is independent of whether the buckles were made to disappear by increase of normal pressure or decrease of compressive stress. (See fig. 8.)

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National Advisory Committee for Aeronautics,  
Langley Field, Va.



$\frac{3}{16}$ " diam. rivets spaced at  $\frac{5}{8}$ " on outside flanges and at 1" on inside ribs.

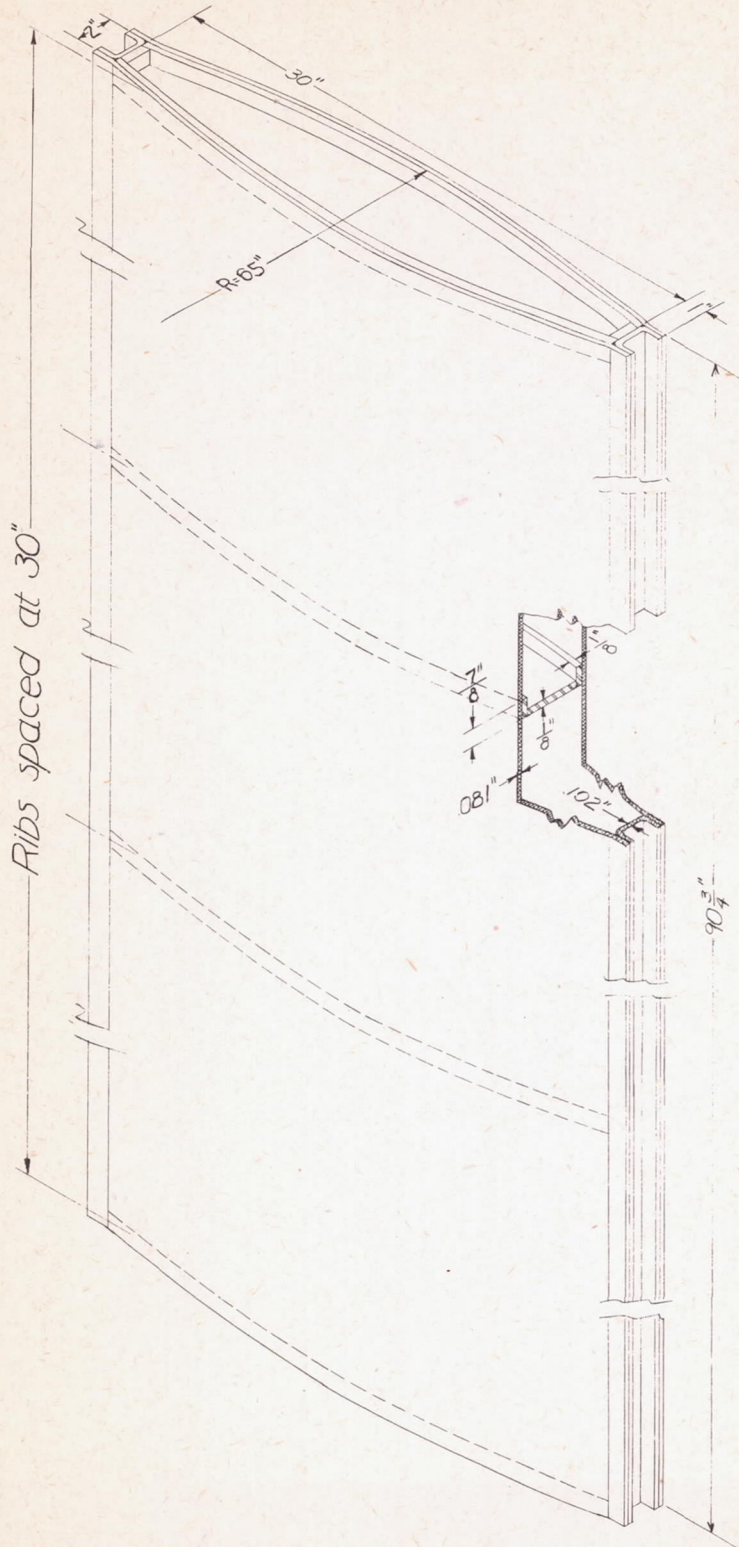


Figure 2.- Specimen with 30-inch rib spacing.

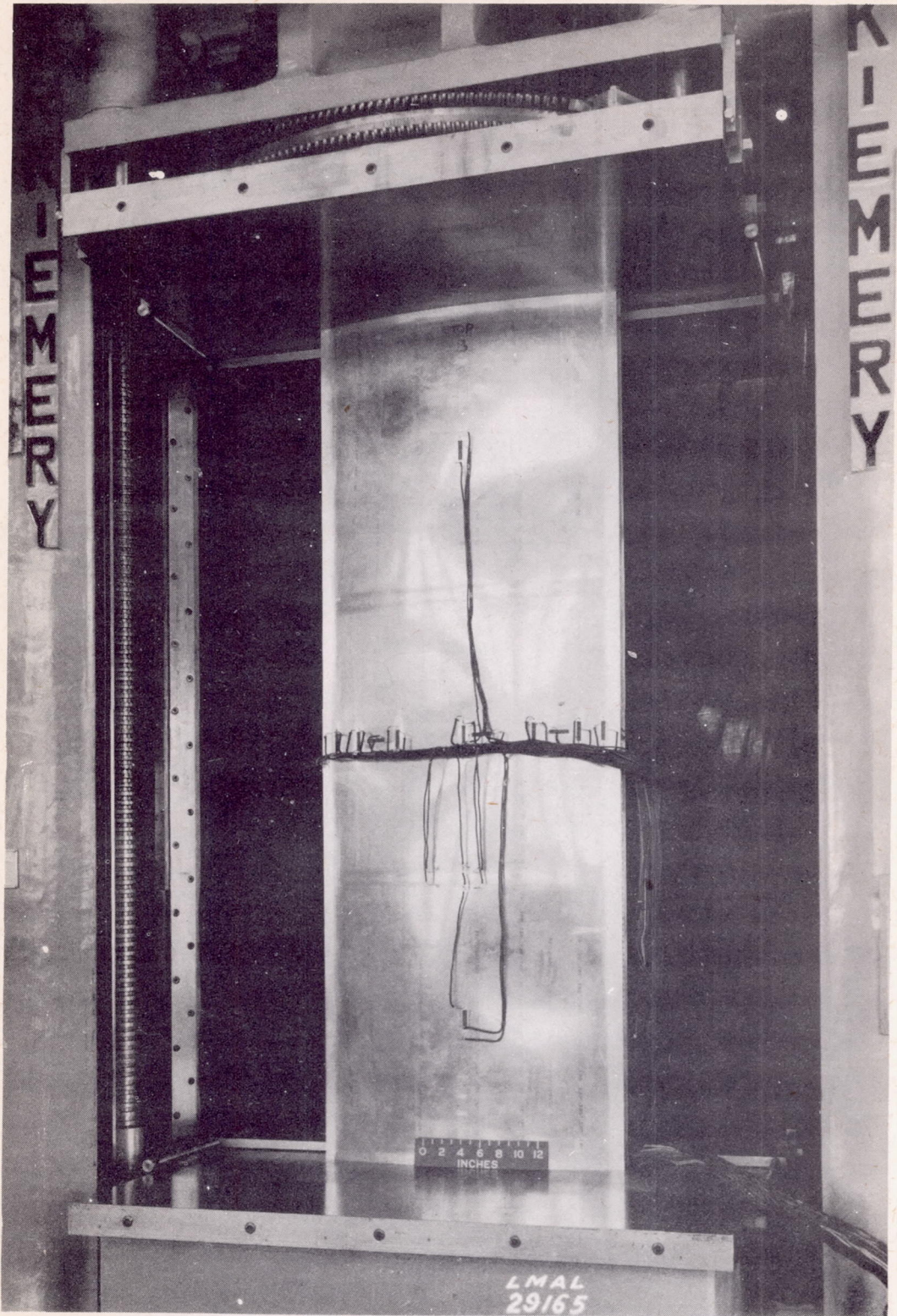


Figure 3.- Specimen with 30-inch rib spacing buckled in 1,200,000 - pound capacity testing machine.

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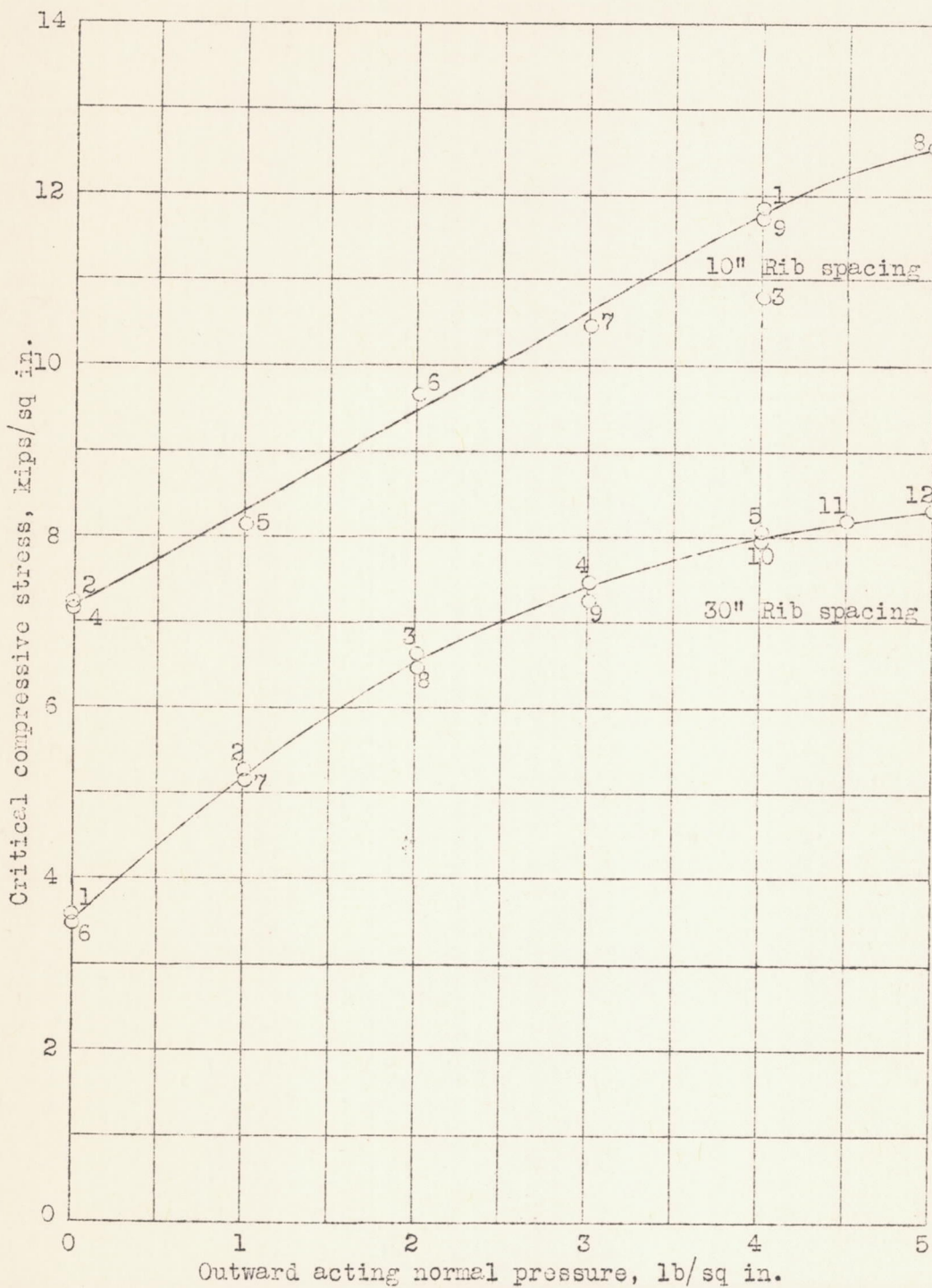


Figure 4.- Effect of normal pressure on critical compressive stress.

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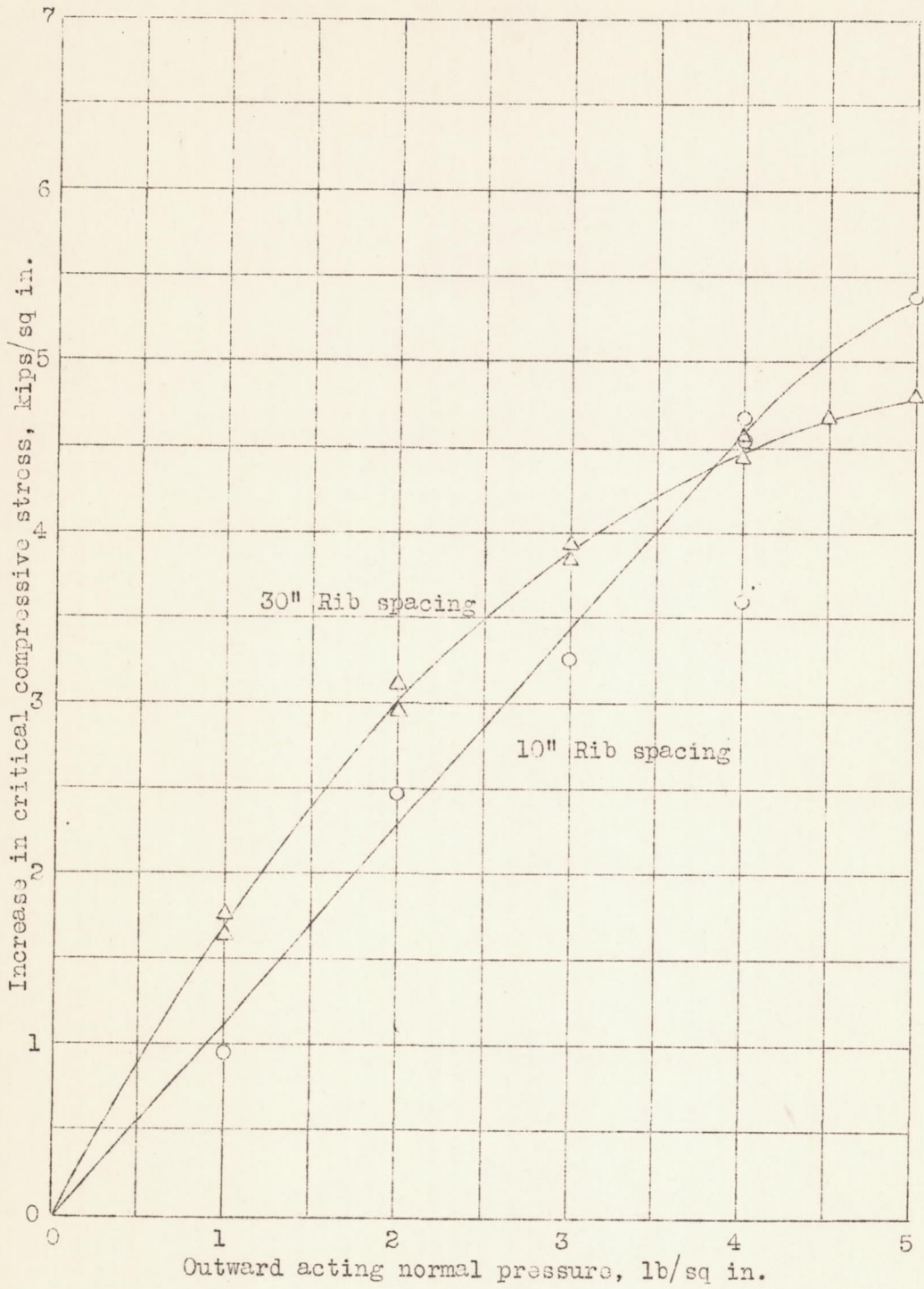


Figure 5.- Increase in critical compressive stress caused by normal pressure.



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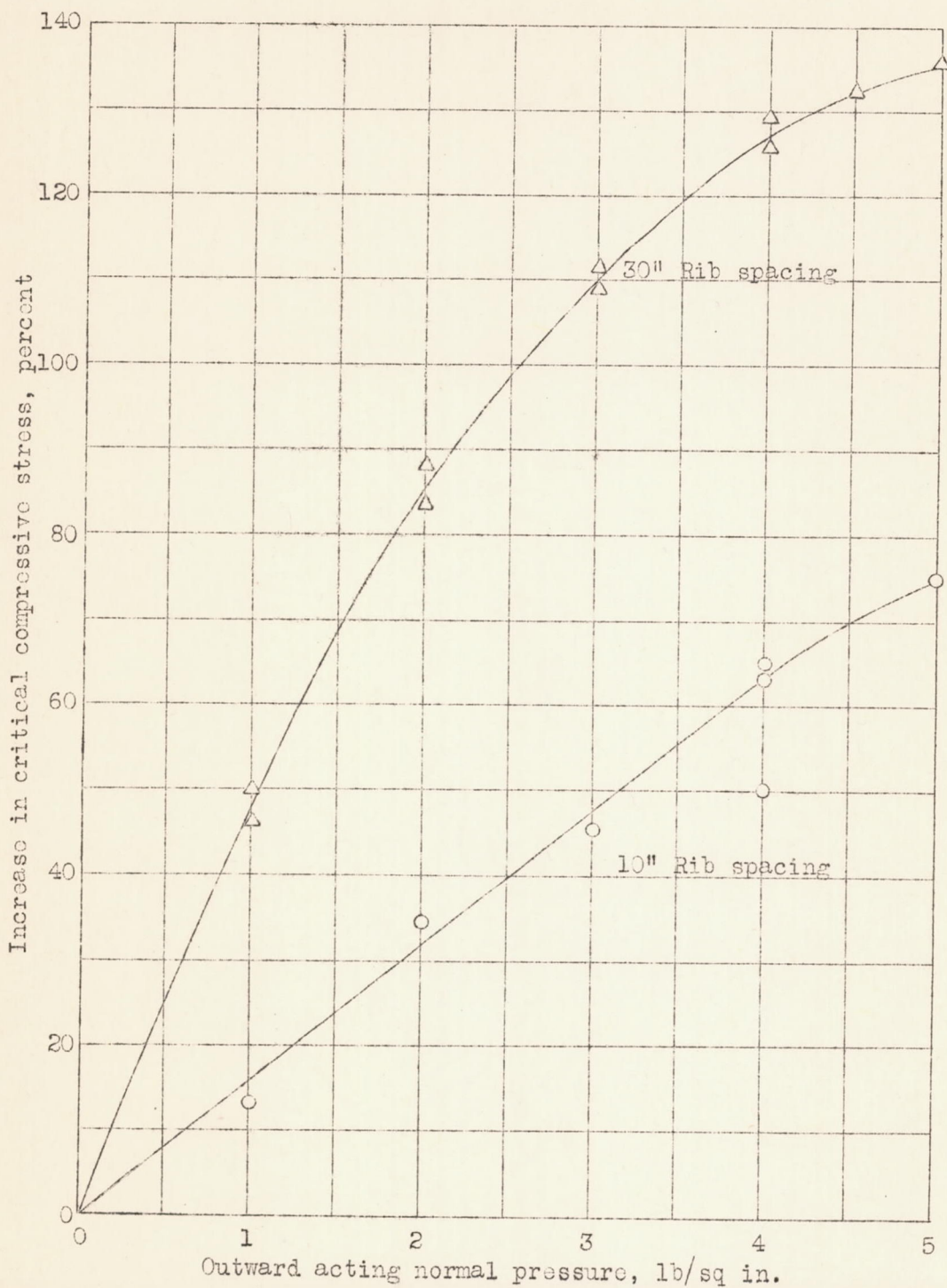


Figure 6.- Percentage increase in critical compressive stress caused by normal pressure.

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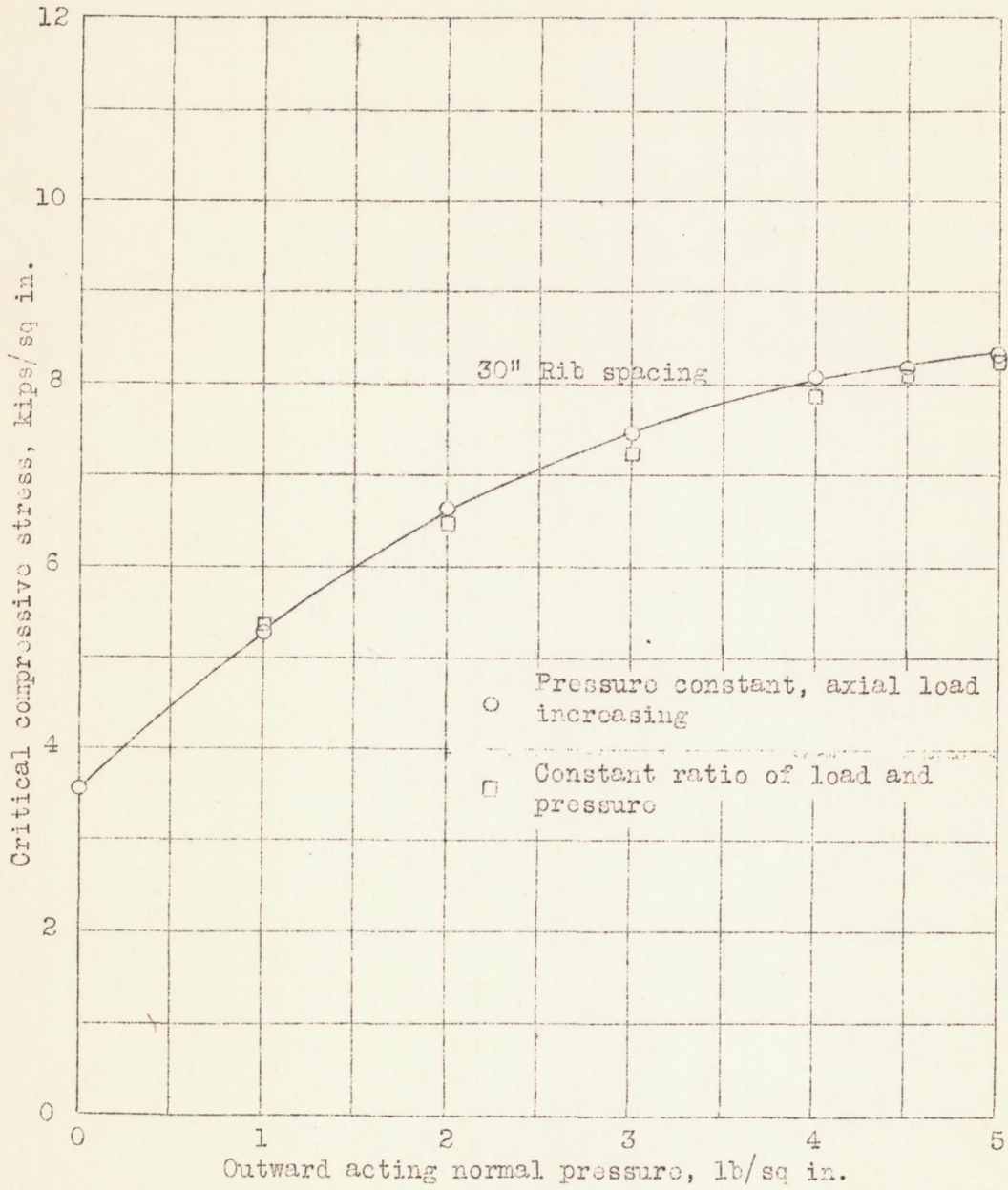


Figure 7.- Effect of methods of load and pressure application on critical compressive stress.

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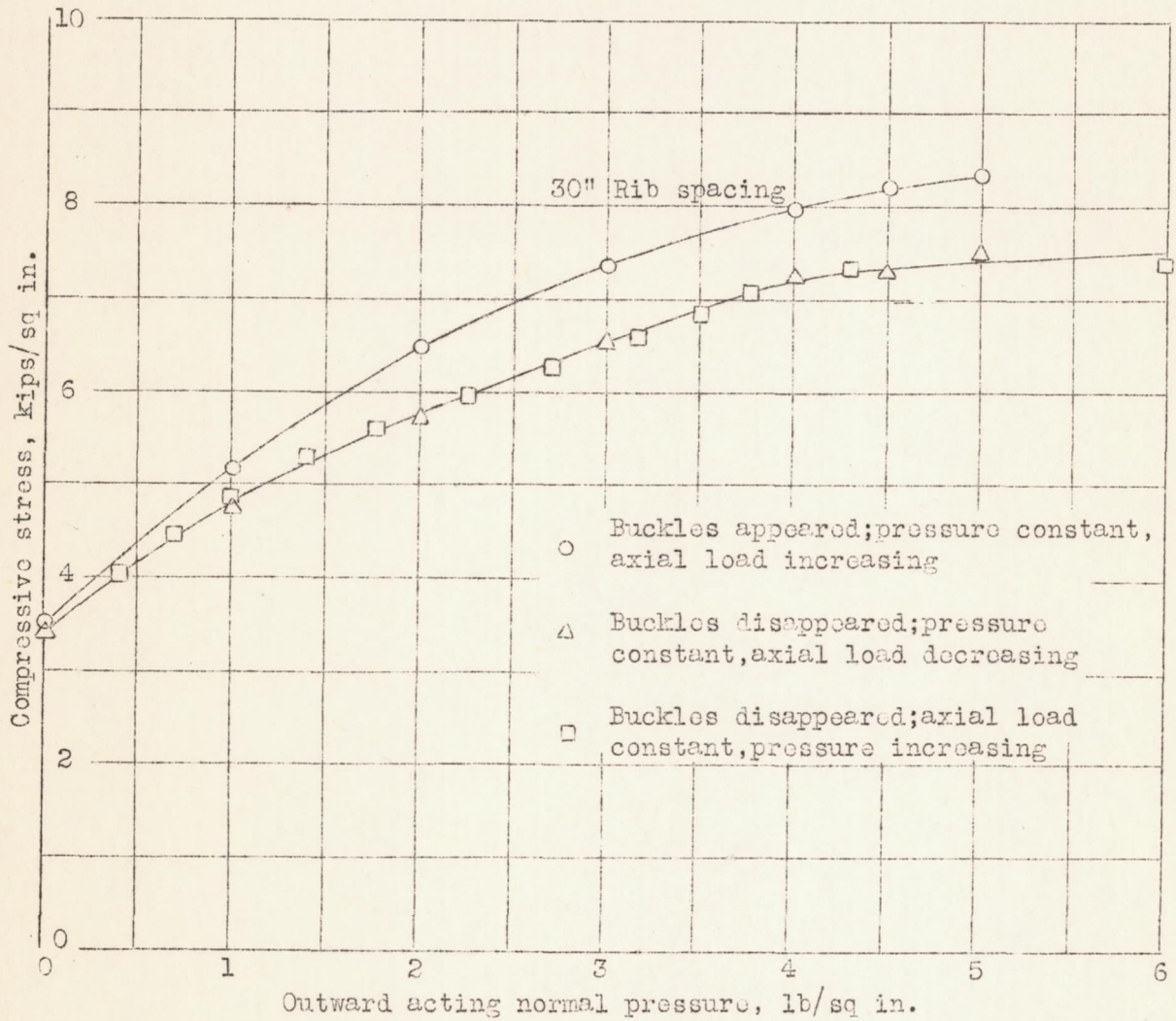


Figure 8.- Comparison of compressive stress at which buckles appeared and disappeared.