Button/Plate Yielding

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Approved

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An aluminum button and plate were yielded to compare the experimental and calculated button to plate stress ratios. Using the fact that compressive stress is directly proportional to area and load, the calculated button to plate stress ratio is equal to the plate to button area ratio for a constant load.

Button and Plate Sample:

Button diameter (D_b) = 0.415 in.

Plate thickness (t_p) = 0.2615 in.

Button Area (A_b) = $D_b^2 * (\pi/4) = 0.135 \text{ in.}^2$

Plate bearing area (A_p) = $(D_b + t_p/2)^2 * (\pi/4)$
= 0.234 in.^2 (See D-Zero Eng. note #57)

$\text{Stress}_b / \text{Stress}_p = A_p / A_b = 1.73$

The loads that caused the button and plate to yield were estimated from a load test cell graph obtained from the materials testing facility. The button was simply compressed, but the plate was compressed with a steel cylinder of the same diameter as the aluminum button.

Load @ yield (plate) = 12100 lb.

Load @ yield (button) = 7920 lb.

Since the button and the steel cylinder had the same diameter;

$\text{Stress}_b / \text{Stress}_p = \text{load @ yield (plate)} / \text{load @ yield (button)}$
= 1.53

Conclusion

The experimental and calculated stress ratios for the button and plate are the same within experimental error. The equation for the plate bearing area is therefore correct.