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Allowable External Pressures for Zircaloy-2
Cylindrical and Spherical Vessels

Introduction

Recently available mechanical property data ⁽¹⁾ for zircaloy-2 in compression and at various elevated temperatures have made it possible to calculate allowable external working pressures for zircaloy-2 cylindrical and spherical vessels designed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. Results are in the form of a standard ASME Code chart for determining allowable external pressures and curves representing several typical reactor cores being considered at this time.

The results presented here apply strictly to complete cylinders and spheres only, not to composite vessels composed of two or more different shapes. For the latter cases a much more thorough analysis must be made. However, the information presented here will be satisfactory for approximate estimations, when such are needed in preliminary design.

Method of Using ASME Chart

One method of using the chart is to enter a predetermined number on the ordinate at the left hand end. From the intersection of this horizontal line with the proper D_o/t for cylinder or sphere diagonal line construct a vertical line to intersect with the material property line for the desired temperature. The value of B horizontally opposite the last intersection will give the allowable pressure as indicated on the chart. The curves in Fig. 1 were obtained in this manner for a zircaloy-2 sphere at 600°F.

Nomenclature

D_o = Outside diameter of cylinder

L = Length of cylinder (see ASME Code)

L_1 = Inside radius of sphere

t = Wall thickness of cylinder less corrosion allowance

t_h = Wall thickness of sphere less corrosion allowance

P = $B(t/D_o)$ for cylinders

P = $B(t_h/L_1)$ for spheres

where P = allowable working pressure

References

1. Morris, R. E., "Tests of Special Materials, Final Report,"
Auburn Research Foundation, March 20, 1957.

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CHART FOR DETERMINING SHELL THICKNESS OF CYLINDRICAL AND SPHERICAL VESSELS UNDER EXTERNAL PRESSURE — WHEN CONSTRUCTED OF ZIRCALOY II

ZIRCALOY 2 DATA ADDED TO CHART FROM ASME BOILER AND PRESSURE VESSEL CODE
PUBLISHED IN UNFIRED PRESSURE VESSELS, SECTION VIII

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FIG. 1. Allowable external pressures for zircaloy 2 spheres at 600°F.