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HW-25285

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By JH Wells - 11-19-94

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V. R. Cooper
Chief, Process
Separations Technology Unit
Engineering Department

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● SERVICE OF REDUCTION BOMBS, PLUTONIUM PURIFICATION
AND FABRICATION 234-5 BUILDING

- References: 1. HW-25042, Service of Reduction Bombs, Plutonium Purification and Fabrication, 234-5 Building, July 16, 1952.
2. Drawing No. E-2-15284, April 1, 1952.

This letter will confirm discussion of July 28 on the service life of reduction bombs in elaboration of reference 1.

The relation between life to rupture under steady state conditions and life to rupture under cyclic heating and loading has not been well established. A limited amount of experimental data indicate that cyclic heating increases creep rates and, it may be inferred, decreases life to rupture. Since no good conversion factor exists a simplifying assumption will be used that the cumulative time at maximum temperature and maximum stress during cyclic heating and loading is equivalent to the same time at constant temperature and stress. This assumption is a first approximation sufficiently accurate for a small number of cycles and relatively short total time. The available data show that the maximum time at maximum temperature during a single reduction is not more than ten minutes. Therefore, the life to rupture value divided by ten minutes per reduction will be used as the number of permissible reductions.

SPECIAL RE-REVIEW
FINAL DETERMINATION
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BY J.P. Macarini DATE 5-19-81
BY AC Barber DATE 5-27-81

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The carbon steel used in the present reduction bomb, (ref. 2), has an average life to rupture of two hours at 750°C and 4400 psi. This time is equivalent to 12 reductions. For a normal reduction, in which the internal pressure does not exceed 100 psig, the maximum calculated hoop stress is 720 psi and a rupture strength of 4400 psi is therefore equivalent to a design factor of 600 per cent. For an abnormal reduction, where the pressure is 450 psig, the design factor is 135 per cent. In view of the fact that the extreme service pressure of 450 psig has been measured only on reduction of off-standard material, it is felt that the present bomb can safely be used provided each bomb is used for no more than 12 reductions and is not used for reduction of sweepings or off-standard material. It is recommended however that carbon steel be discontinued as soon as practicable in favor of higher strength, longer life material. Specifically it is recommended that reduction bombs, (ref. 2), be made of material conforming to ASTM Specification A-158, Grade TP5a. Bombs of this material will have a useful life of six hours (equivalent to 36 reductions) at a stress of 6500 psi. This stress is 200 per cent of the calculated maximum hoop stress of 3250 psi which is obtained under an internal pressure of 450 psig.

Bombs fabricated by welding of Grade TP5a steel should be preheated to 750°F, maintained above 650°F during welding, transferred without cooling to a furnace and post heated at 1600°F for 1/2 hour, then furnace cooled. Type E502-15 American Welding Society classification welding electrode should be used.

R Ward

Head, Metallurgy
Applied Research Unit
ENGINEERING DEPARTMENT

R Ward:dh

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