UNCLASSIFIED 9-14-56

OAK RIDGE NATIONAL LABORATORY

Operated By
UNION CARBIDE NUCLEAR COMPANY

UCC

POST OFFICE BOX P
OAK RIDGE, TENNESSEE ORNL
CENTRAL FILES NUMBER

CF-56-8-149

DATE: August 23, 1956

SUBJECT: EXAMINATION OF TWO 347 SS DIAPHRAGMS FROM
PULSE-FEEDER PUMPS

TO: C.H. Gabbard

FROM: Bertram Fleischer

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission to the extent that such employee or contractor prepares, handles or distributes, or provides access to, any information pursuant to his employment or contract with the Commission.

Photostat Price \$ 1.80

Microfilm Price \$ 1.80

Available from the
Office of Technical Services
Department of Commerce
Washington 25, D. C.

418 001

UNCLASSIFIED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

EXAMINATION OF TWO 347 SS DIAPHRAGMS FROM PULSE-FEEDER PUMPS

Introduction

Two 347 SS pump diaphragms (20 mils thick) from pulse-feeder pumps were submitted to metallography for examination. One of the diaphragms had failed after 2800 hrs in the HRT mock-up. This diaphragm was exposed to 0.04 molar UO_2SO_4 on one side and water on the other. The temperature was approximately 150°F. The other diaphragm was exposed (700 hrs.) to water on both sides in a pulse-feeder test loop. No failure had occurred.

Procedure

The diaphragms were examined macroscopically before sections were removed. Photographs were made of the cracked area and impression areas. The diameters of some of the impressions were also measured. Sections were taken from the test loop diaphragm so as to get a cross-section of some of the impressions. Sections of the failed diaphragm were taken at the cracked area (Fig. 1 and 2). Hardness tests were made in the areas surrounding the impressions and the crack. Measurements were also made to determine the amount of thinning out around the impressions and crack.

Results

Visual examination of the diaphragms showed that both sides of the lower halves of the diaphragms contained many impressions. These impressions were examined macroscopically and were found to range in size from 1 to 25 mils. The impressions were of irregular shape and varying depths. Also present on the diaphragms were elongated, worm-like impressions. Figure 3 is a magnified photograph of one of the worm-impressions. It can be seen from this picture that the impression is merely a series of overlapping impressions caused by the same particle.

Hardness tests were made in the areas surrounding a shallow and a deep impression, and in the cracked area of the failed diaphragm. The hardness range for this material is approximately 145 through 200 DPH, according to the ASM Metals Handbook. The hardness in normal areas of the diaphragms ranged from 141 through 207 DPH. The hardness in the areas surrounding the impressions and crack ranged from 143 through 330 DPH. In the cracked area all of the hardness tests were above 200 DPH. In the deep impression area all but one test were above 200 DPH.

Measurement of the shallow impression (Fig. 4) shows the impression to be about 0.3 mils deep. Figure 5, a cross-section of a deep impression, shows the impression to have a depth of approximately 3 mils.

Macro-examination of the cracked area of the failed diaphragm reveals a Y-shaped crack (Figs. 1 and 2). The area has been highly deformed on both sides. A cross-section of this area taken at A (Fig. 1) is shown in Fig. 6. The impression areas, being located almost exactly opposite each other in this cracked area, have set up somewhat of a sheer and have considerably cold worked the metal. The crack originated in this stressed area. Micro-examination revealed this crack to be transgranular and straight, except for a jag in the middle (Fig. 7). The diaphragm has been thinned considerably in this area, but the actual amount of thinning can not be determined because the angle of cross-section is not perpendicular to the diaphragm surface.

Summary and Conclusions

Cold work hardening is quite apparent in the locality of the impressions. The impression areas, where the crack originated, were located almost exactly opposite each other and much cold work hardening and thinning were apparent. These factors are believed to have made the area more susceptible to fatigue fracture, and this is probably the type of failure that occurred. The absence of necking-down at the crack implies that failure was not due to tensile stress. It is possible that corrosion may also

CONFIDENTIAL

EXAMINATION OF TWO 347 SS DIAPHRAGMS FROM PULSE-FEEDER PUMPS

have been present in this locally stressed region, and failure may have been due to corrosion-fatigue, but no definite evidence of corrosion was noticed on the mounted specimens or the diaphragm surface.

Bertram Fleischer

418 003

CONFIDENTIAL

EXAMINATION OF TWO 347 SS DIAPHRAGMS FROM PULSE-FEEDER PUMPS

T-10632 Mag 7X

Figure 1: Cracked Area of Failed Diaphragm (Soup Side)
Note : Y-Shaped Crack and Impression Area Inside Triangle)

T-10631

Figure 2: Cracked Area of Failed Diaphragm (Water Side)

418 004

EXAMINATION OF TWO 347 SS DIAPHRAGMS PULSE-FEEDER PUMPS

T-10640 Etch: Gly-Regia
Figure 5: Deep Impression Area and Hardness Tests

418 006

~~T-10635~~ T-10800 Mag 20X
Figure 6: Cross-Section Made at A (Fig. 1) Showing Deformation in Cracked Areas

T-10641 Etch: Gly-Regia 8 007
Figure 7: Cracked Area of Failed Diaphragm (Section A, Fig. 1) and Hardness Tests