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AUTHOR

R. F. MANESS

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CORROSION OF 304-L STAINLESS STEEL AND HAPO-20 IN ACID-FLUORIDE SYSTEMS

BY

R. F. Maness
Chemical Development Operation
HANFORD LABORATORIES

January 31, 1964

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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CORROSION OF 304-L STAINLESS STEEL AND HAPO-20 IN ACID-FLUORIDE SYSTEMS

INTRODUCTION

Interest continues at Hanford in materials of construction suitable for containing HNO_3-HF solutions. These solutions are or may be used as dissolvents for PuO_2 and ThO_2, as an etchant for zircaloy, and as an elutriant in certain ion exchange columns. Acid -fluoride corrosion data on 304-L stainless steel, the material of construction most commonly used for process equipment at Hanford, are sparce and scattered. This report summarizes 304-L and HAPO-20 corrosion rate data in HNO_3-HF, HNO_3-HF-$Al(NO_3)_3$, and HNO_3-HF-$Th(NO_3)_4$ systems. Corrosion data for HAPO-20 are included because of its comparitively excellent resistance to acid-fluoride solutions.

EXPERIMENTAL

Specimens of 304-L and HAPO-20 were prepared for testing by heat treating at 1250 F for one hour and water quenching. The specimens were then ground to a 120 grit finish, passivated in nitric acid, dried with acetone and weighed. Exposures were made in Teflon bottles equipped with Teflon condensers. Most specimens were exposed for three 24-hour periods. Longer exposure periods were not used because end grain attack becomes the predominate mode of attack in the more aggressive solutions after about 100 exposure hours.

DISCUSSION

The data shown in Figures 1 through 15 are for specimens exposed to the liquid phase. Specimens exposed to the vapor phase or to the liquid-vapor interface were present in about 75 percent of the tests. In all cases the greater attack occurred on specimens exposed to the liquid phase. No preferential attack occurred on specimens exposed to the liquid-vapor interface. The

reported data are useful for comparative purposes but should not be used to estimate the life of plant equipment for a given process utilizing acid-fluoride solutions. Such an estimation requires a more detailed investigation under conditions dictated by the particular system.

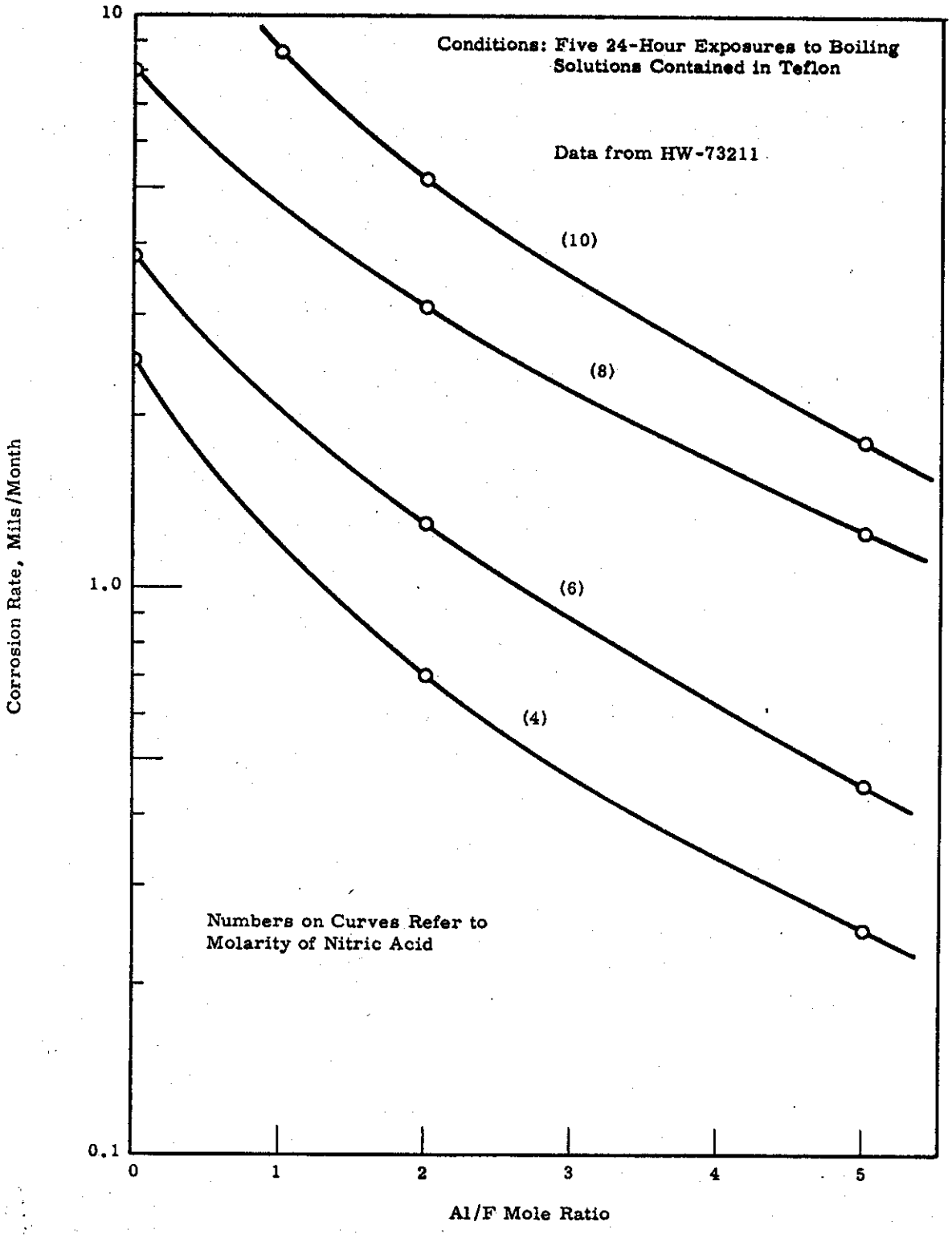

FIGURE 1

304-L Corrosion Rates, 0.01M HF-HNO_3-$Al(NO_3)_3$ System

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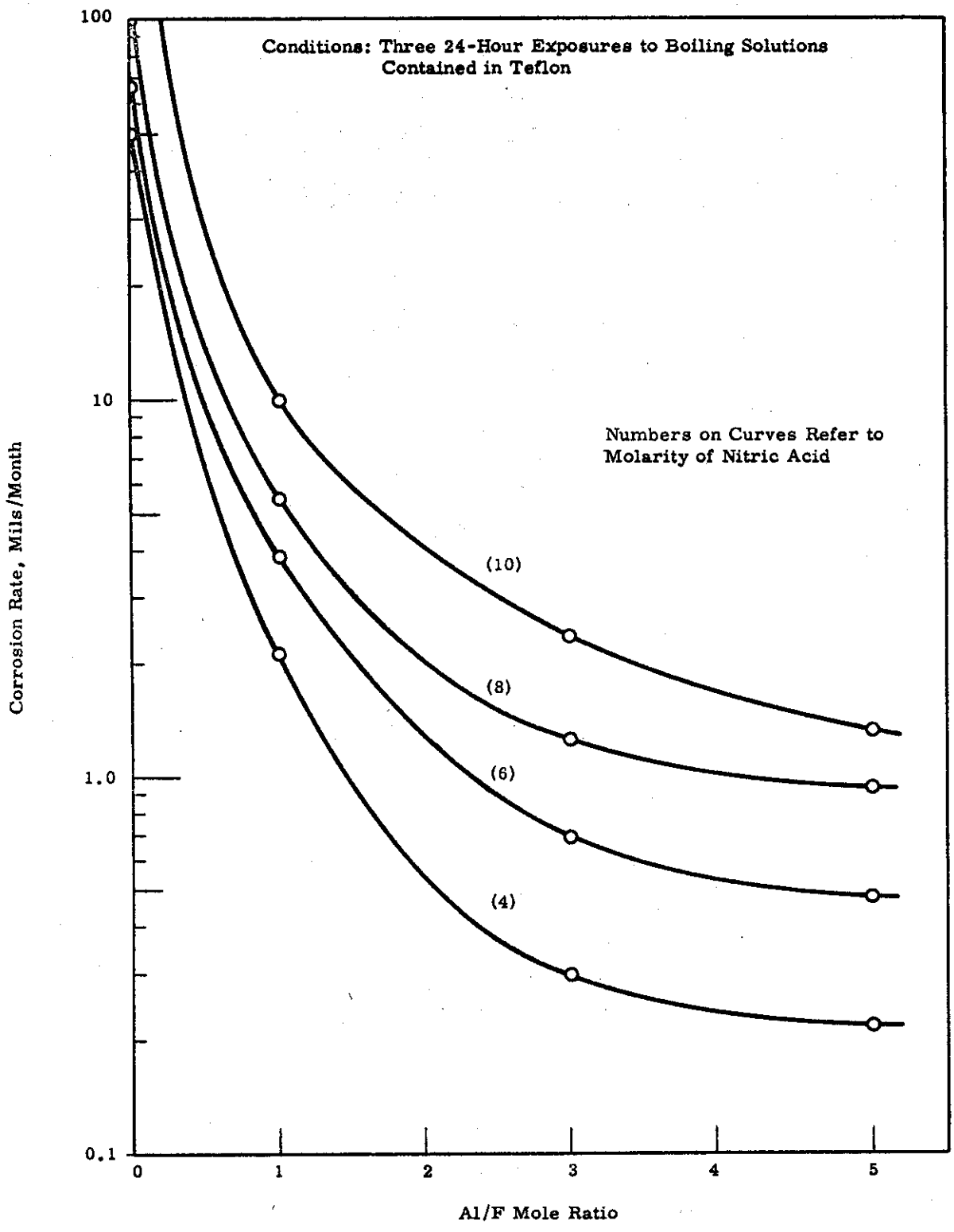

FIGURE 2

304-L Corrosion Rates, 0.1M HF-HNO_3-$Al(NO_3)_3$ System

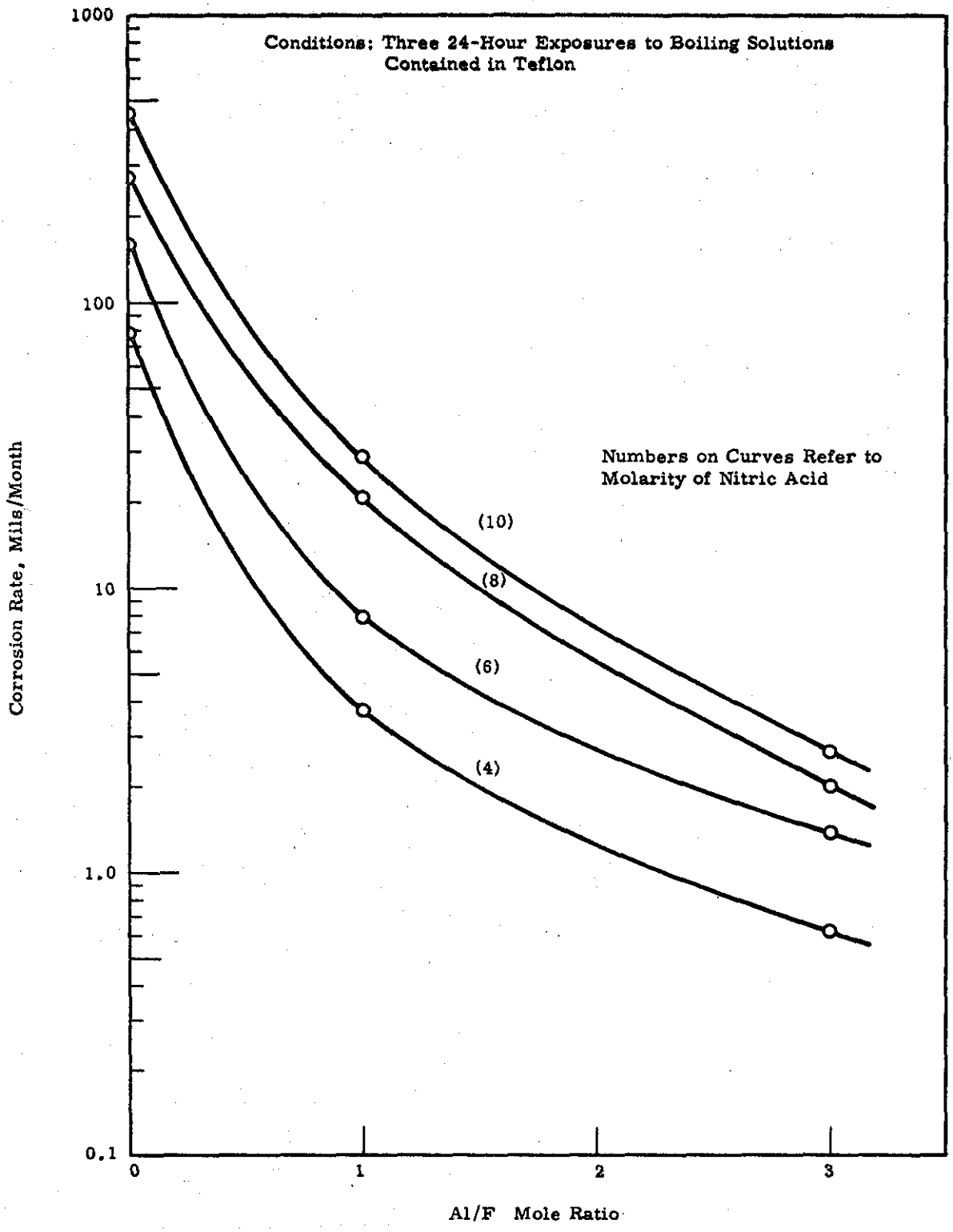

FIGURE 3

304-L Corrosion Rates, 0.25M HF-HNO_3-$Al(NO_3)_3$ System

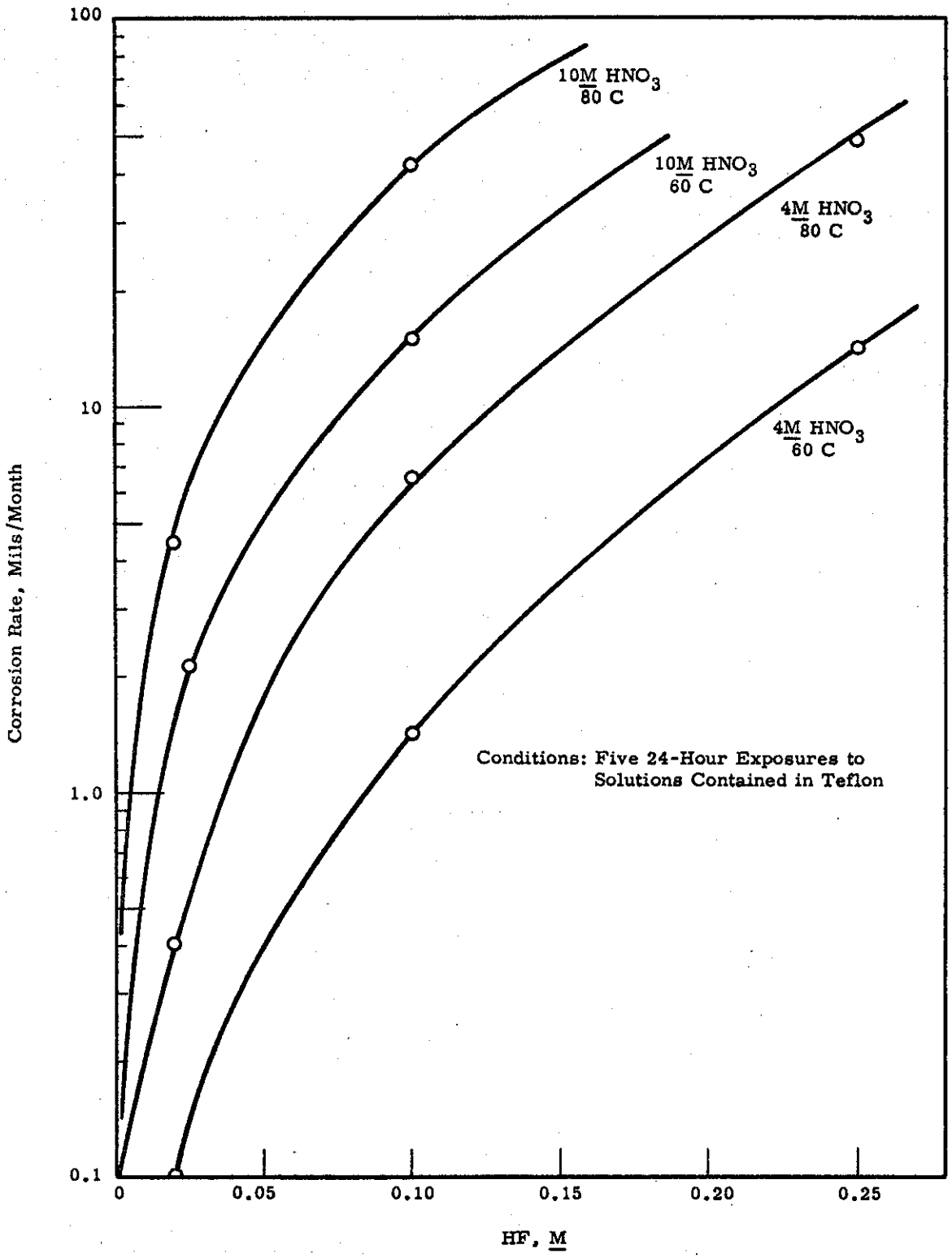

FIGURE 4

304-L Corrosion Rates, HNO_3-HF System

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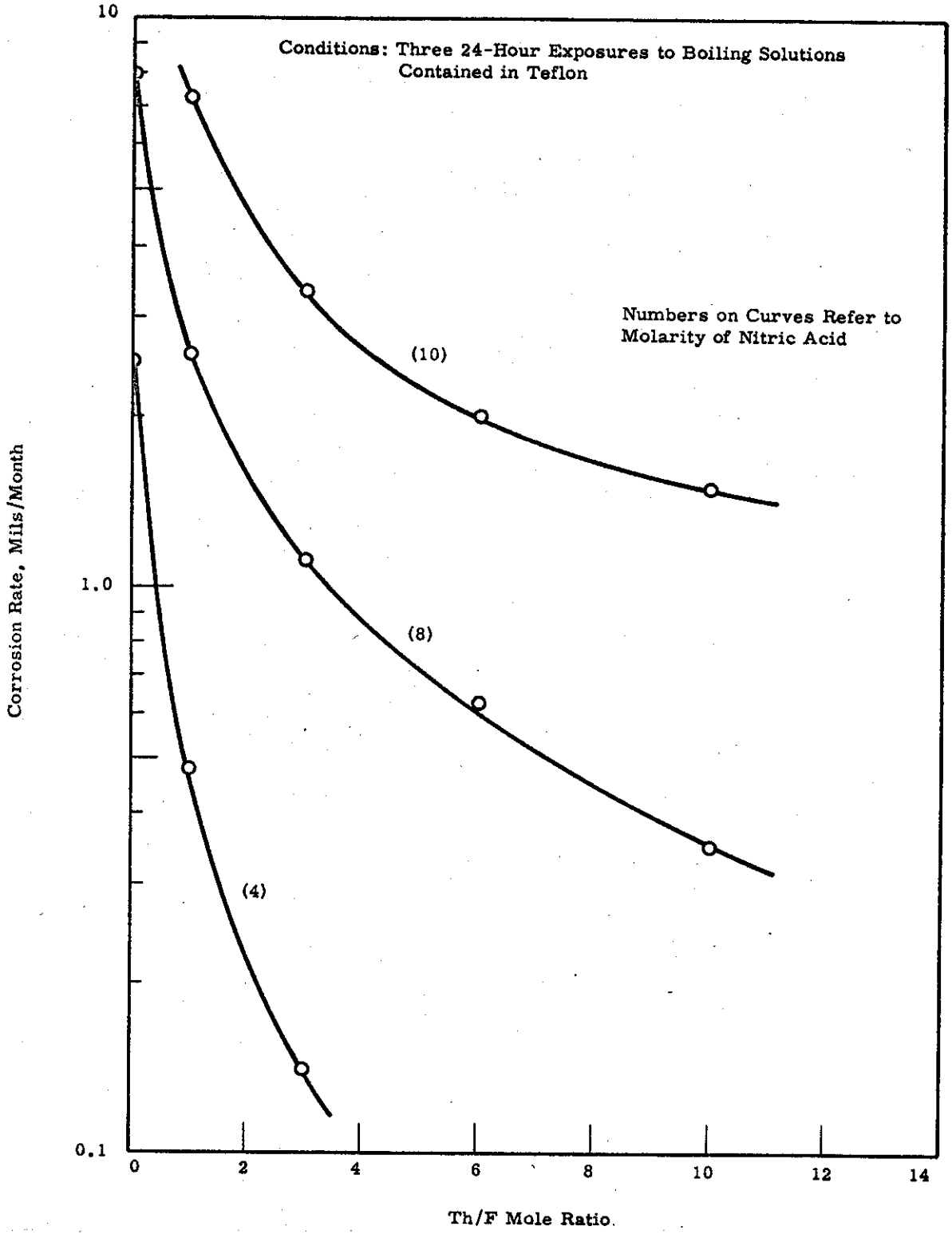

FIGURE 5

304-L Corrosion Rates, 0.01M HF-HNO_3-$Th(NO_3)_4$ System

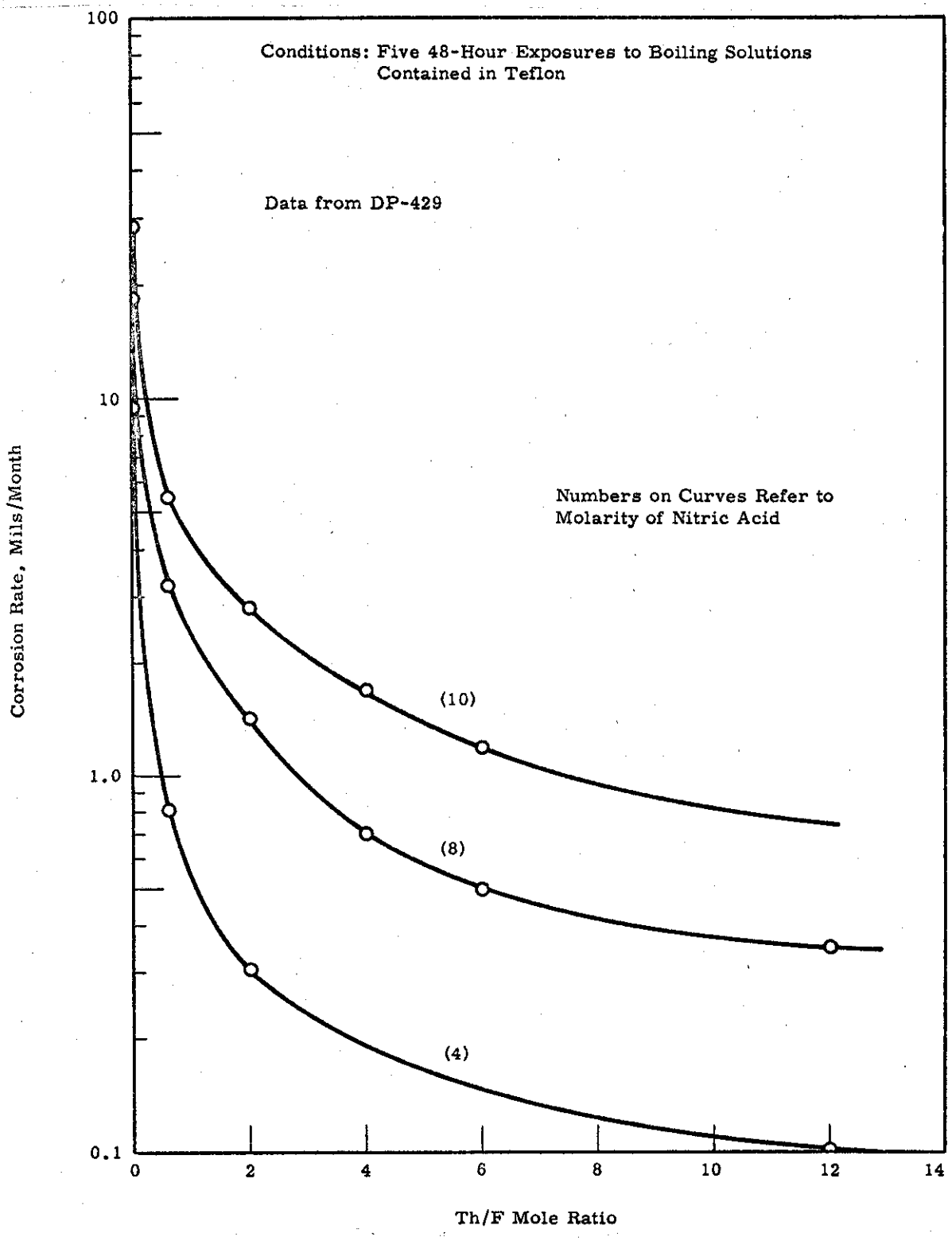

FIGURE 6

304-L Corrosion Rates, 0.05M $HF-HNO_3-Th(NO_3)_4$ System

AEC-GE RICHLAND, WASH.

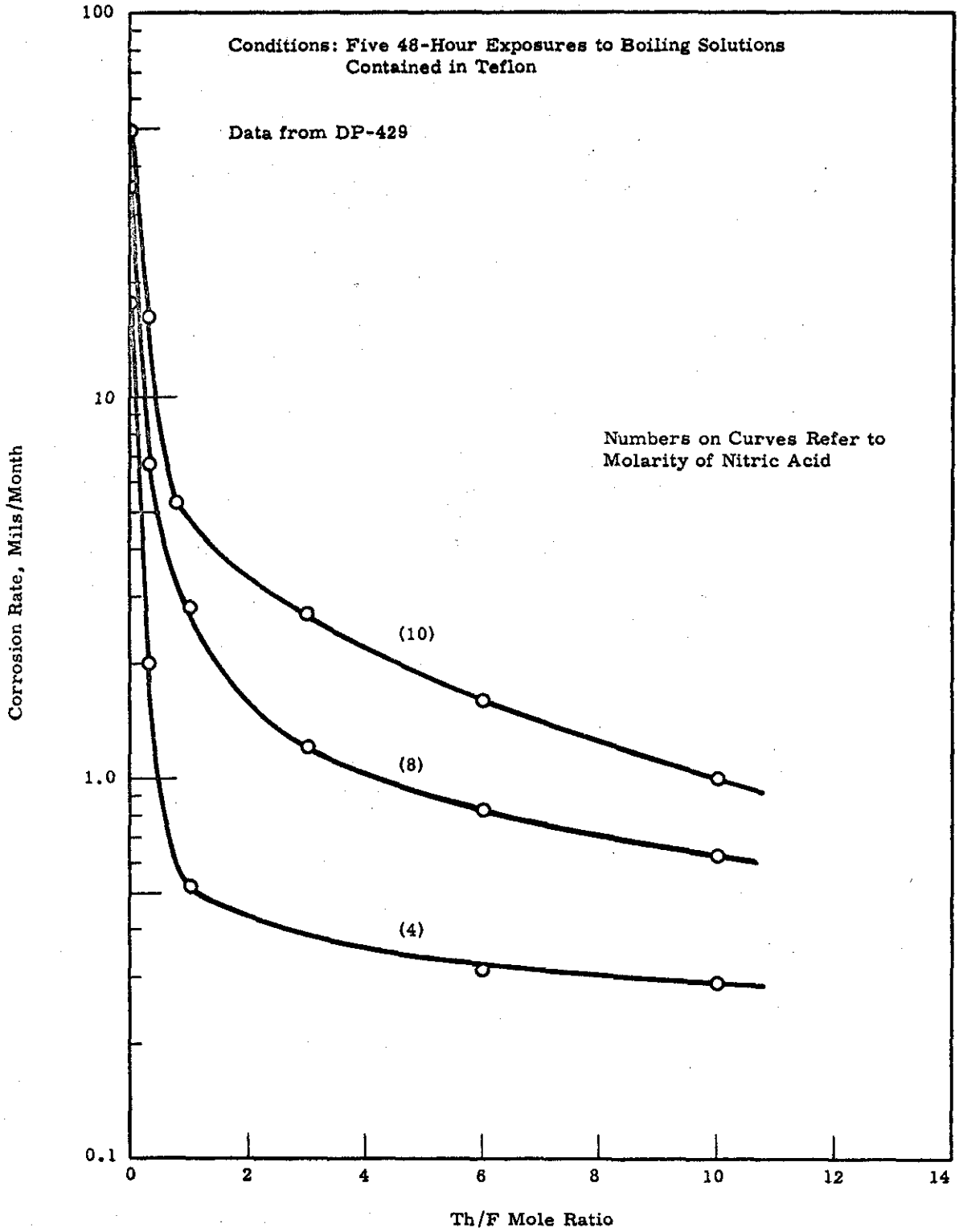

FIGURE 7

304-L Corrosion Rates, 0.10M $HF-HNO_3-Th(NO_3)_4$ System

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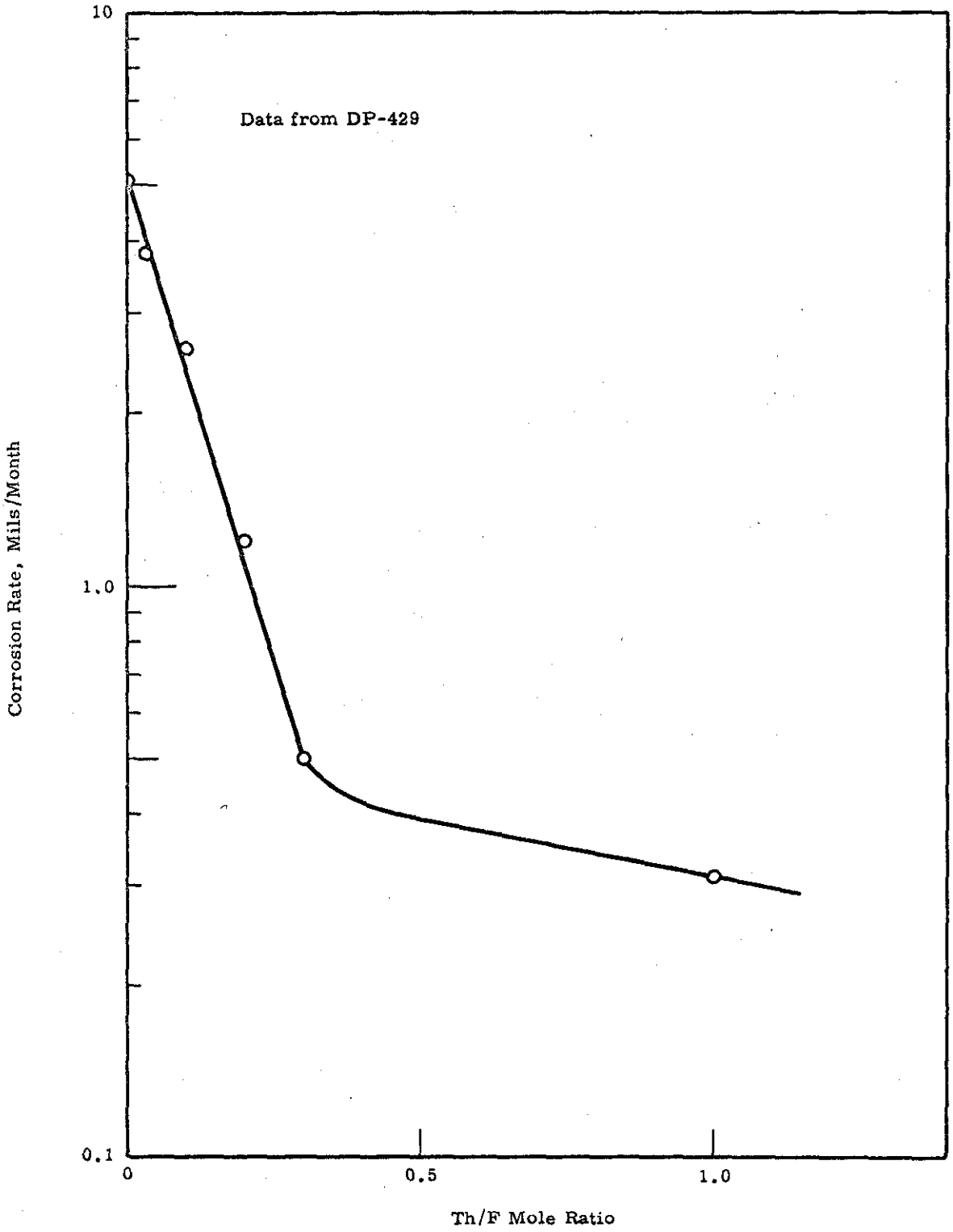

FIGURE 8

304-L Corrosion Rates, 0.1M HF-10M HNO_3-$Th(NO_3)_4$ Systems - 60 C

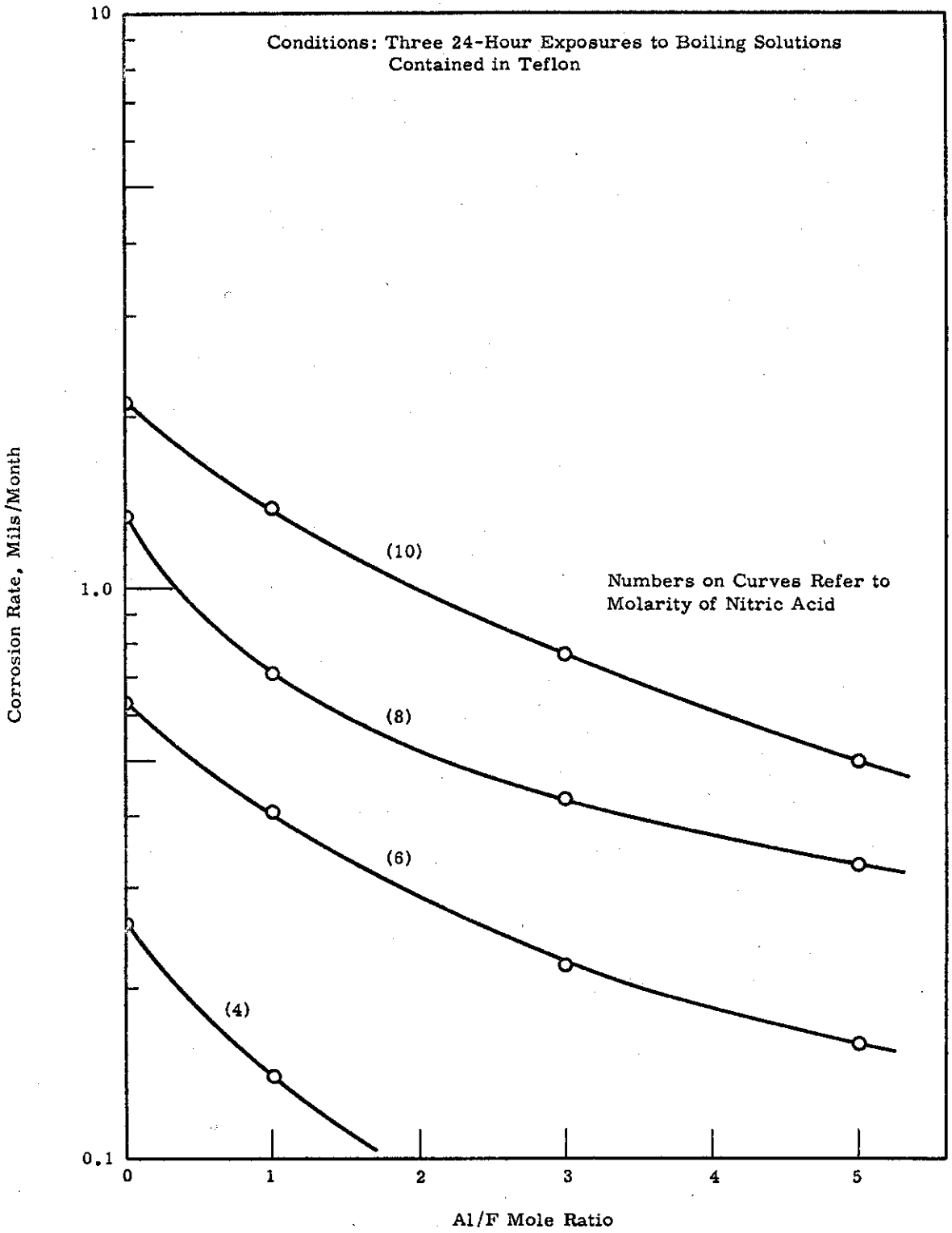

FIGURE 9

HAPO-20 Corrosion Rates, 0.01M HF-HNO_3-$Al(NO_3)_3$ System

AEC-GE RICHLAND, WASH.

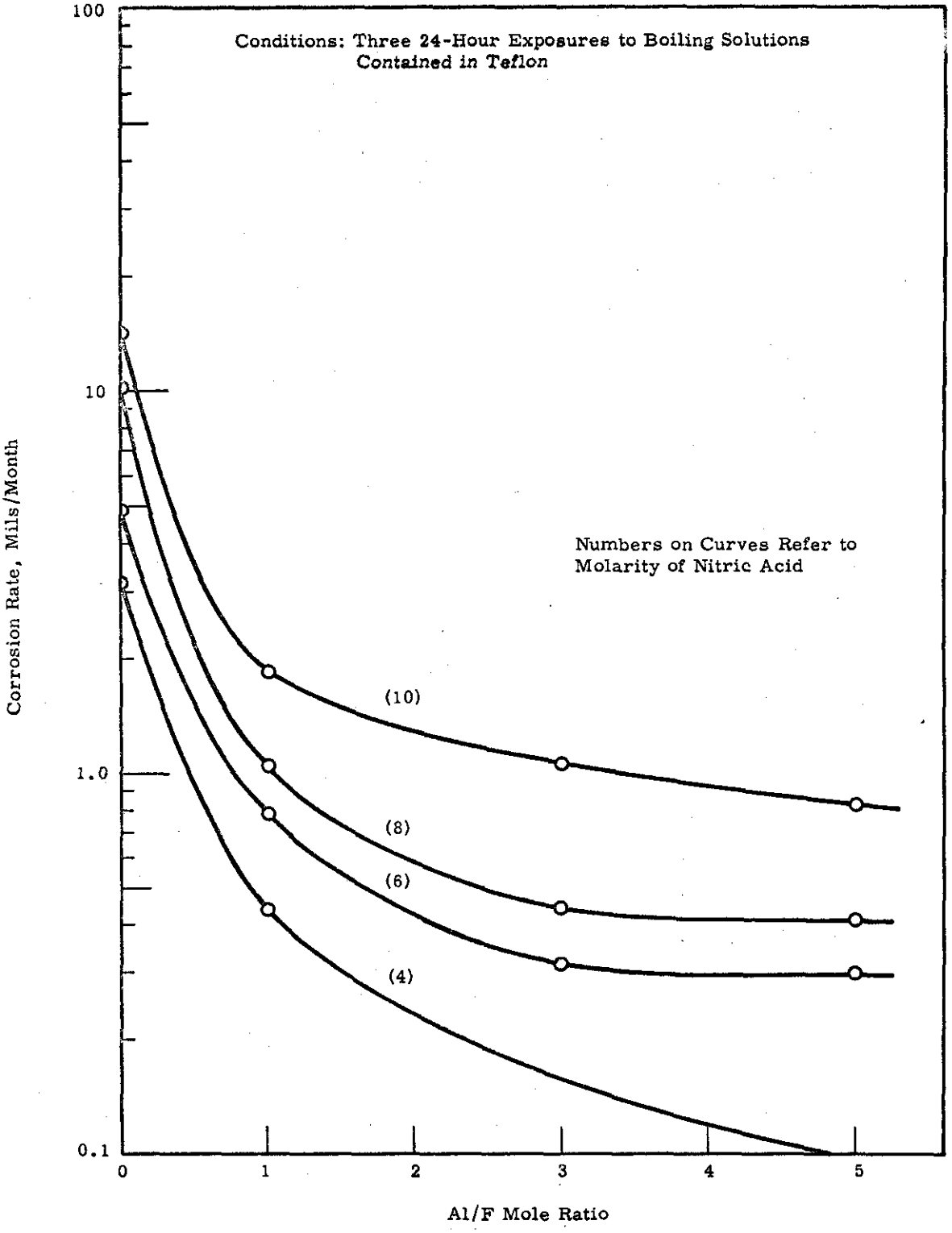

FIGURE 10

HAPO-20 Corrosion Rates, 0.10M HF-HNO_3-$Al(NO_3)_3$ System

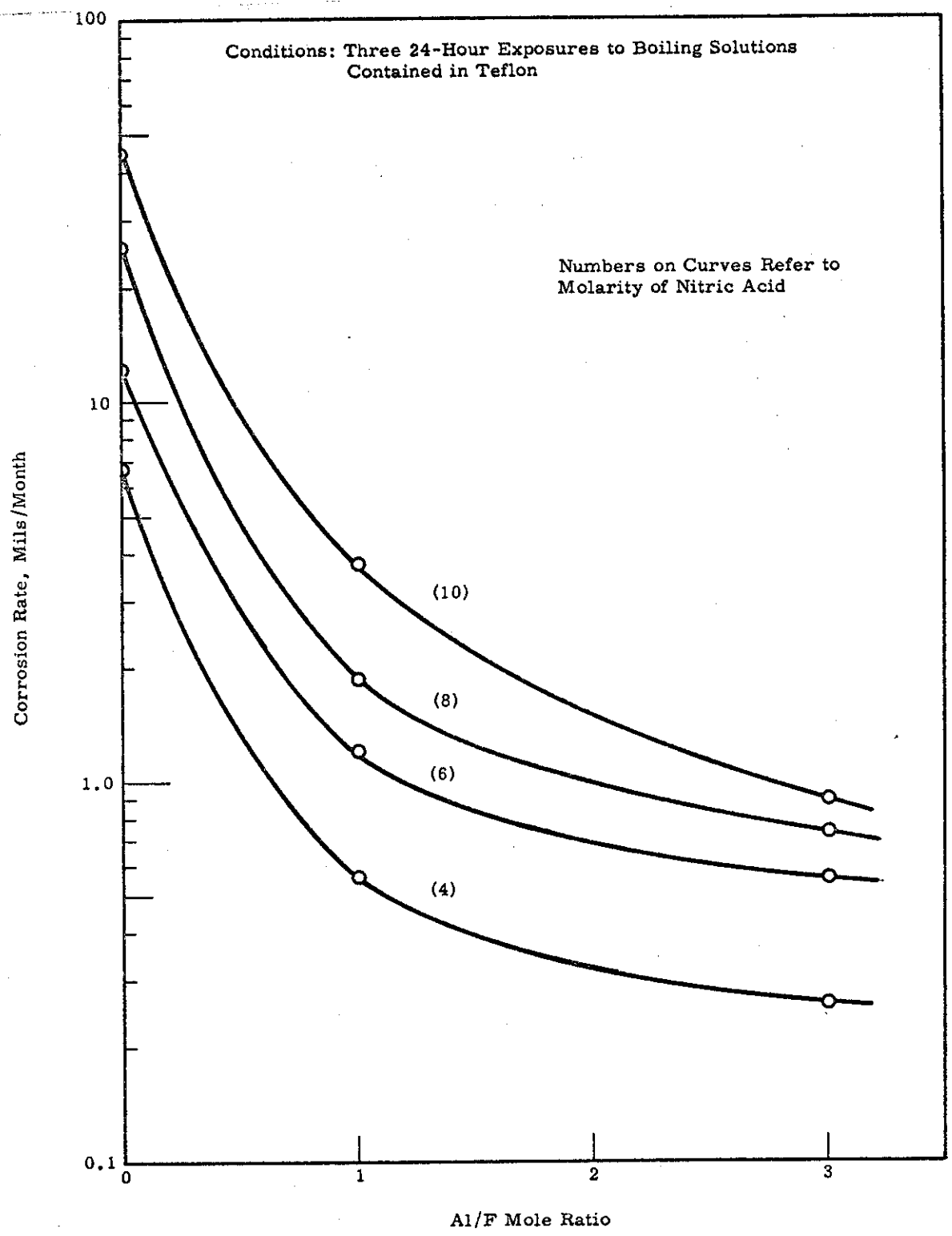

FIGURE 11

HAPO-20 Corrosion Rates, 0.25M HF-HNO_3-$Al(NO_3)_3$ System

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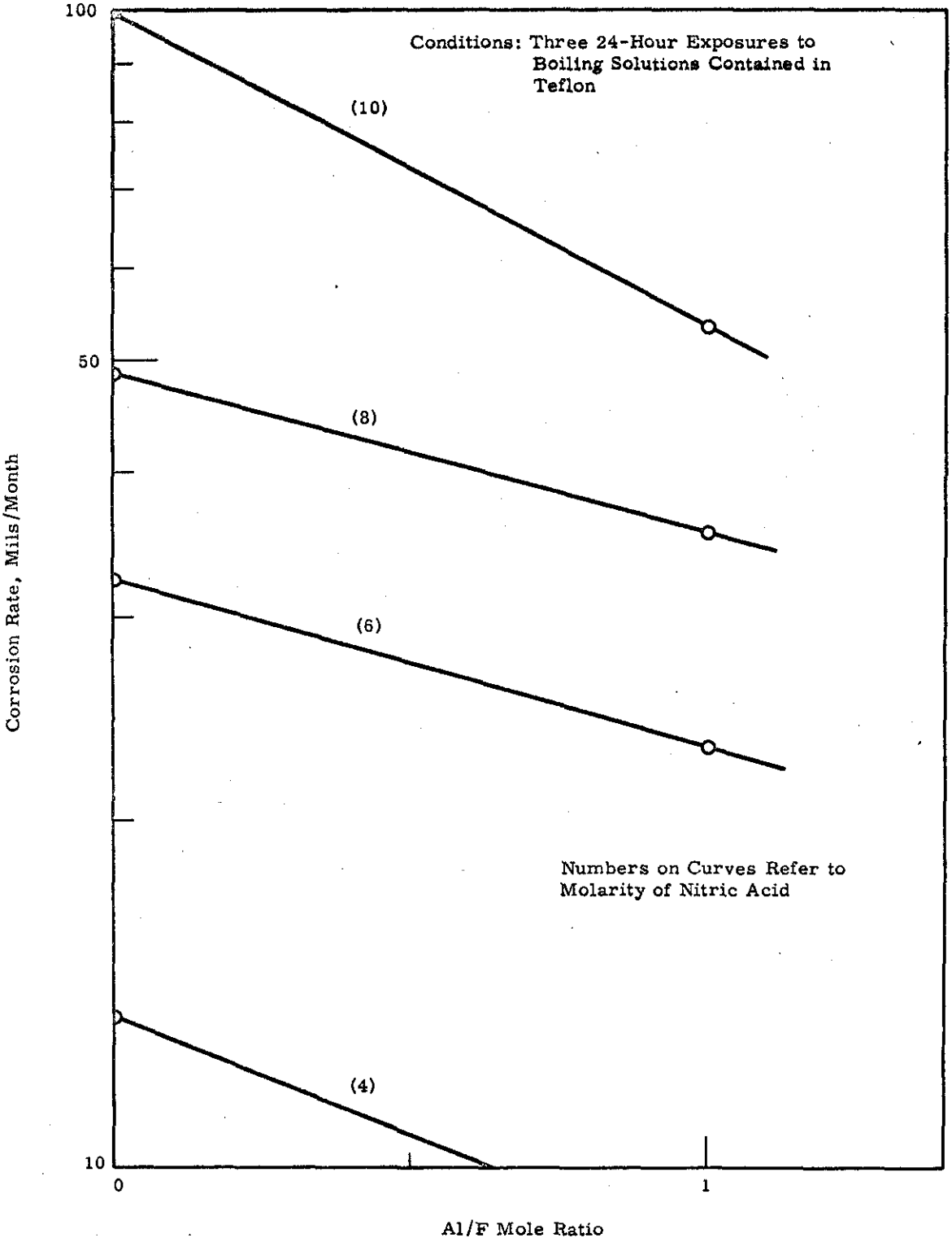

FIGURE 12

HAPO-20 Corrosion Rates, 0.50M HF-HNO_3-$Al(NO_3)_3$ System

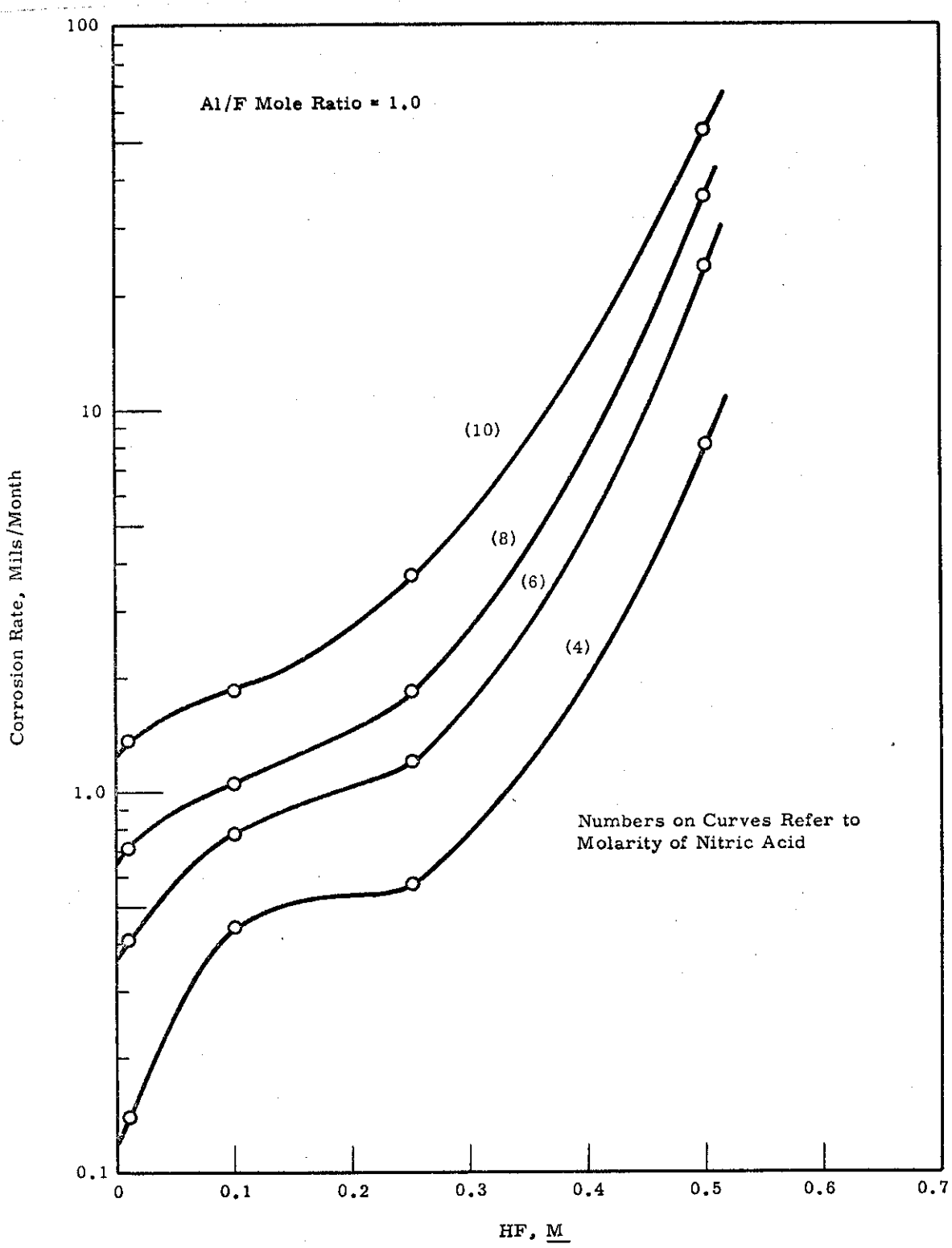

FIGURE 13

HAPO-20 Corrosion Rates, HNO_3-HF-$Al(NO_3)_3$ System (Boiling)

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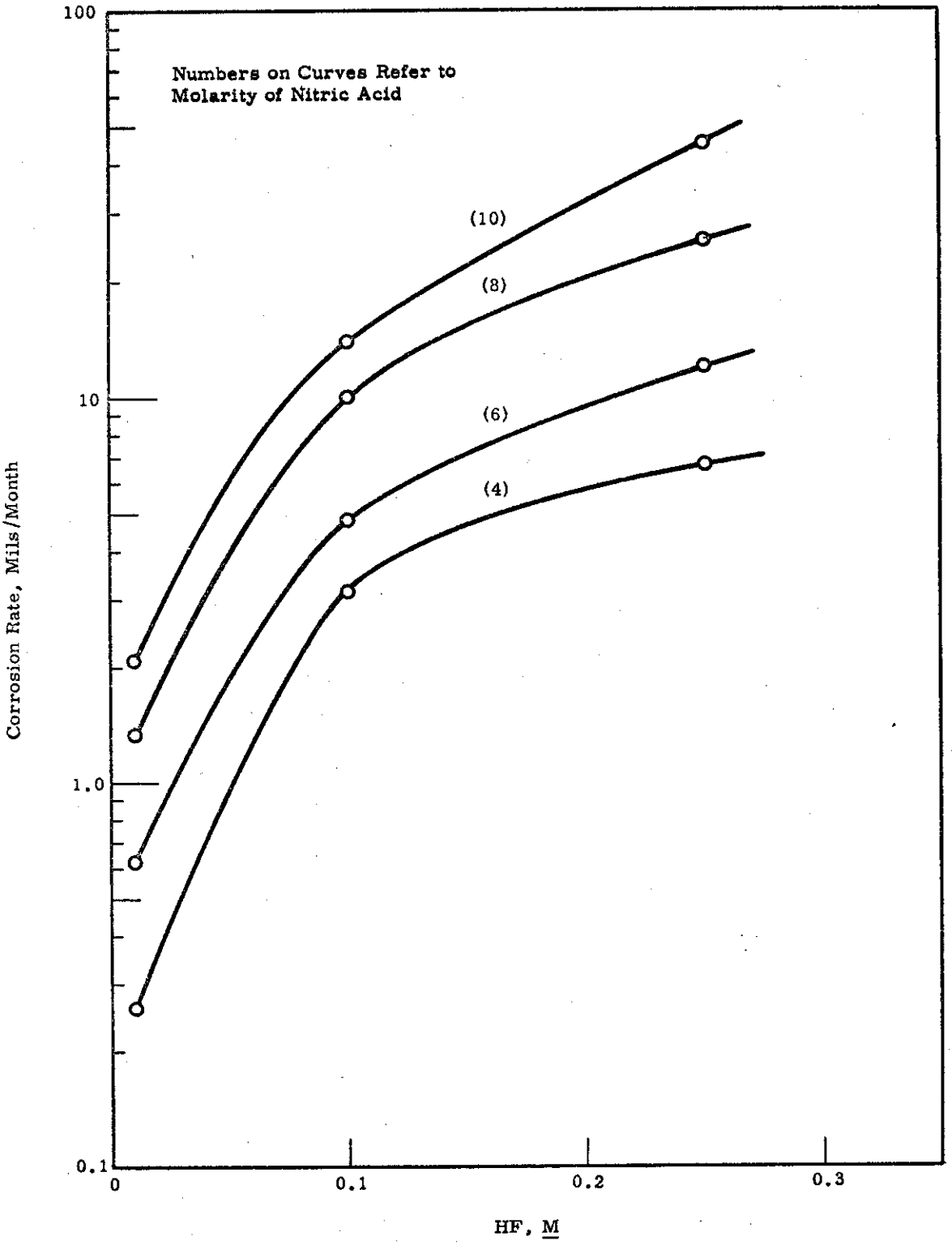

FIGURE 14

HAPO-20 Corrosion Rates, Boiling HNO_3-HF System

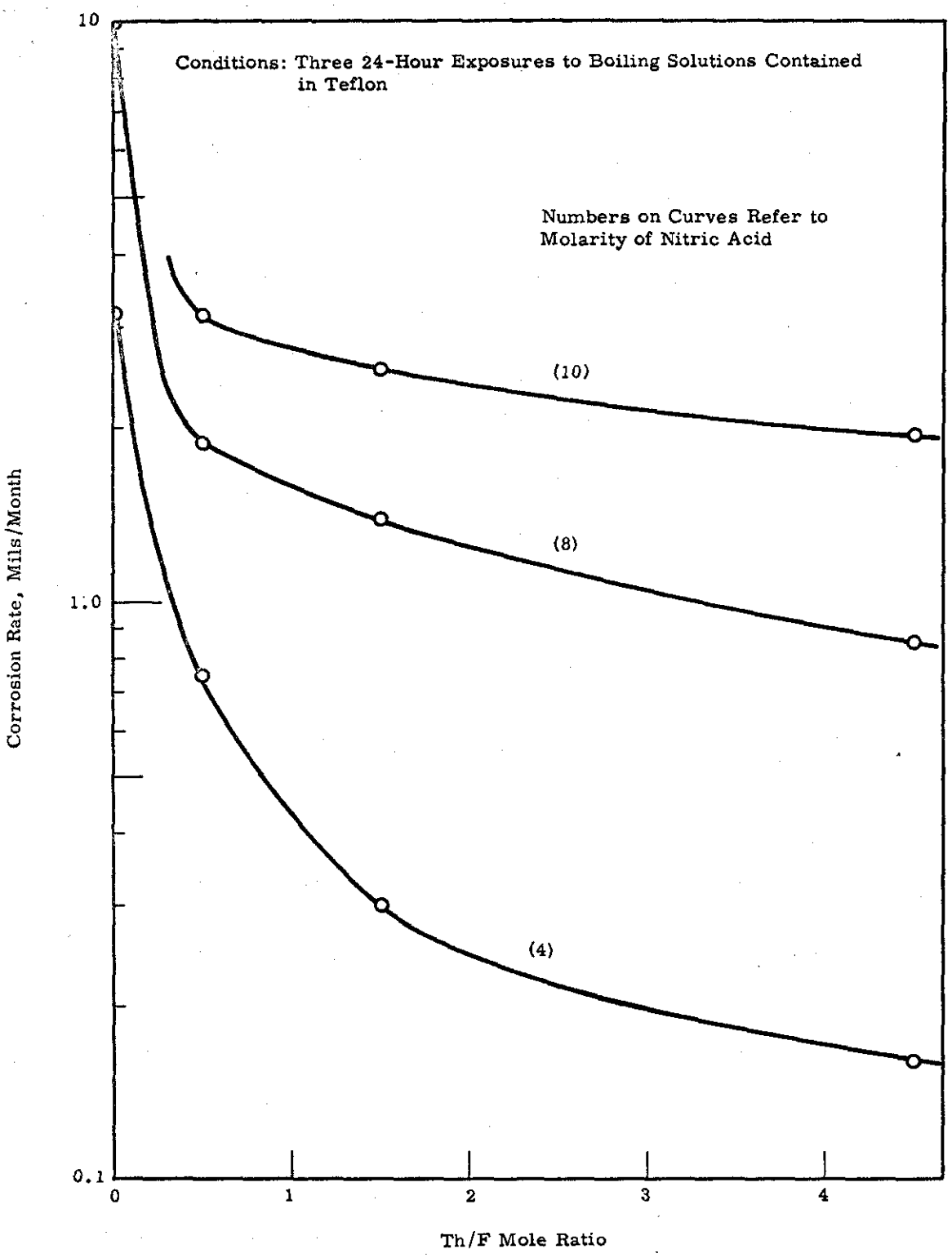

FIGURE 15

HAPO-20 Corrosion Rates, 0.1M $HF-HNO_3-Th(NO_3)_4$ System