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PUBLICLY RELEASABLE
LANL Classification Group
J. O. Hirschfelder

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973

VERIFIED UNCLASSIFIED

August 14, 1948

JA Brown SS & DGL 1/7/88

FINAL DETERMINATION
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L. M. Redman
FEB 5, 1981

To: Dr. Charles Critchfield
From: Joseph O. Hirschfelder
Subject: Design of High Pressure 5-inch Gun.

The 5-inch gun which you originally designed for use with a 60 lb. projectile is considerably larger in chamber and travel than you will need for use with a 55 lb. projectile. I believe that this is clear from the enclosed figures. The characteristics of the gun which you propose is indicated by the point marked A. The dotted curves show the required volume of chamber as a function of either travel or effective length of gun (length of gun if cross section of powder chamber were equal cross section of projectile) using FHM-M1 powder (which has about the same ballistic properties as the Navy powders). The full curves indicate the dimensions required of guns using double base, FHM-M2 powder. I made the calculations for the maximum pressure (as averaged throughout the gun), $P_m = 80,000$ as this was particularly convenient for making my calculations. If you prefer $P_m = 75,000$ it is only necessary to multiply the effective length, volume of chamber, and travel by 80/75.

It is evident that a considerably smaller gun is required if a hot double-base powder is used. There are a number of powder compositions which would be readily available in the required web thickness.

1. Mortar sheet or hot ballistite manufactured by Hercules Powder Company. I understand that any desired web in the range we are interested in could be furnished in approximately a month after ordering.
2. FHM-M2 (manufactured by Hercules Powder Company). I think we require a larger web than they could readily furnish. FHM-M2 is used as a standard powder in many small army cannons.

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3. Cordite WM (manufactured by Nobel Powder Company, Canada). This powder is available in a large assortment of webs and in both cord and tube granulation. It is used as standard for many Canadian guns.

4. Cordite MD. This powder is considerably hotter than the Cordite WM. While it is not manufactured at present in Canada, the Nobel Powder Company is equipped to make small lots of any desired web.

5. Cordite SC or HSC. These powders are available in England. The SC would have no particular advantage over the WM except that its standard granulation is the slotted tube which has particularly nice ballistic and ignition properties. The HSC is the hottest standard powder used at the present time by either the British or Americans. Unfortunately, I believe it is only available in the smaller webs.

The higher the density of loading the smaller gun is required. The limits to the practical density of loading are the ignition difficulties which lead to pressure waves, etc. I want to investigate these ignition difficulties further, but the following is my present understanding:

1. Of all powders, cords are least likely to cause ignition difficulties. It is possible to pack cords with a density of loading up to .9. Cords with a density of loading of .9 give the same ballistic performance as a constant burning surface grain packed at a loading density of .8. Because of their very regular performance, the British use cords even at the sacrifice of about 100 ft/sec in muzzle velocity (for the same weight of powder of a different granulation).

2. Slotted tubes are the next easiest powder to ignite. They have effectively constant burning surface and give good ballistic efficiency. I believe that densities of loading considerably above .8 can be realized.

3. Sheet or flake powder should be quite satisfactory at high densities of loading. However, I would like to study some firing records at Aberdeen before recommending its use.

4. Seven perforated powder would be satisfactory provided that the grains are stacked. This may involve a considerable amount of practical difficulty for the small grain sizes which will be used. (I do not believe that seven perforated powders for guns smaller than

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Dr. Charles Critchfield

the 8" are ever stacked. Even the powder for the 8" gun is tedious to stack. Unstacked seven perforated powder is likely to lead to unpredictable pressure waves, etc., at the high densities of loading and high pressures contemplated.

In designing a gun there are usually a number of factors to be considered. Usually the powder chamber is made fairly small, as this can be done without appreciably increasing the weight of the gun. This has the advantage of giving a smaller muzzle pressure and using smaller cartridge cases. Also it probably makes it easier to secure good ignition. We like to draw volume of chamber versus effective length of gun curves and let the gun designers pick out the dimensions they desire therefrom. Please let me know what you would like me to do along these lines.

The web for Navy powder for use in your proposed gun at a density of loading of .75 and $P_p = 75,000$ psi is changed to approximately .08" when you change from $M = 60$ lb. to $M = 53$ lb.

Sincerely yours,

JON:ml

Joseph O. Hirschfelder

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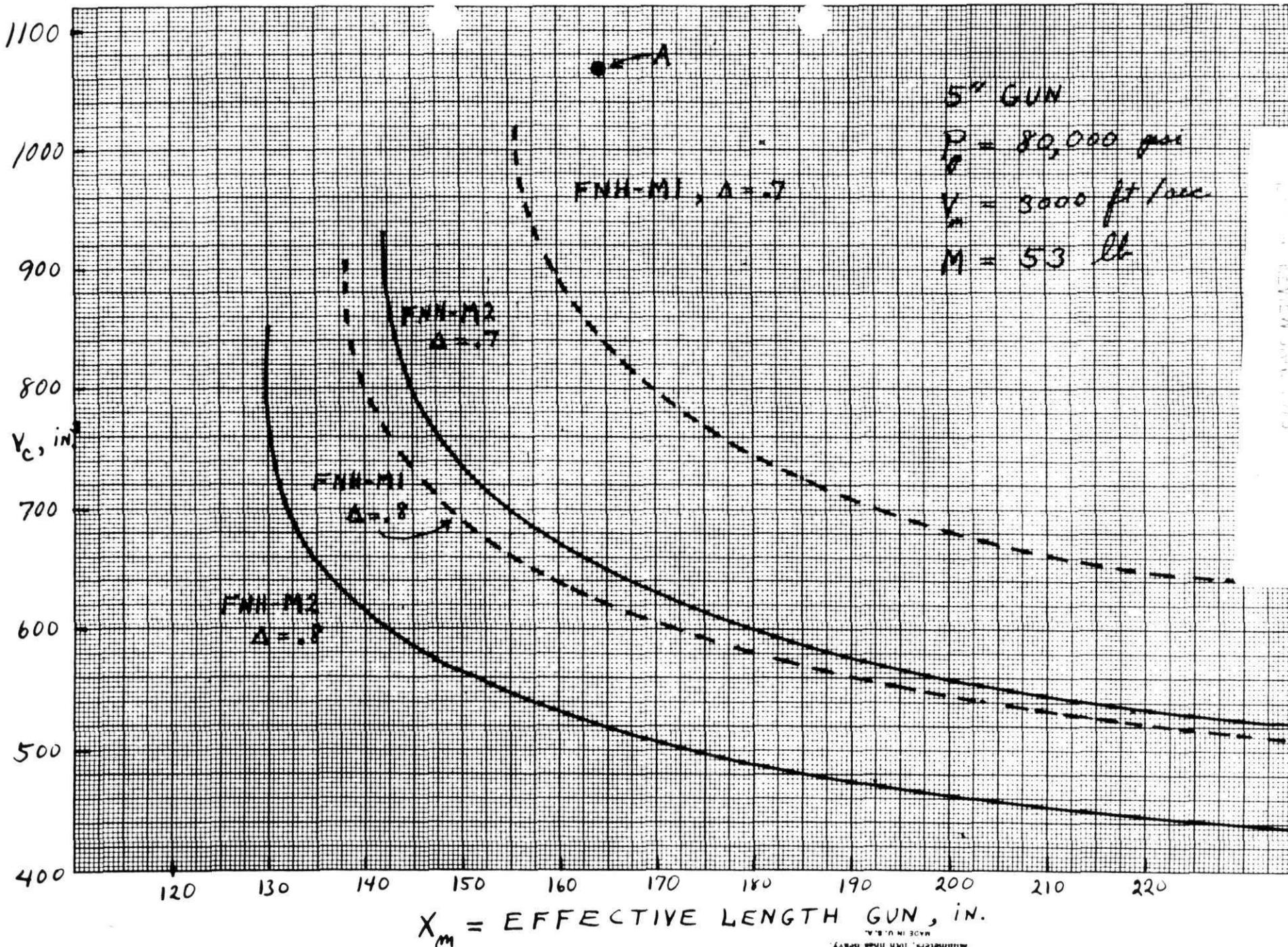
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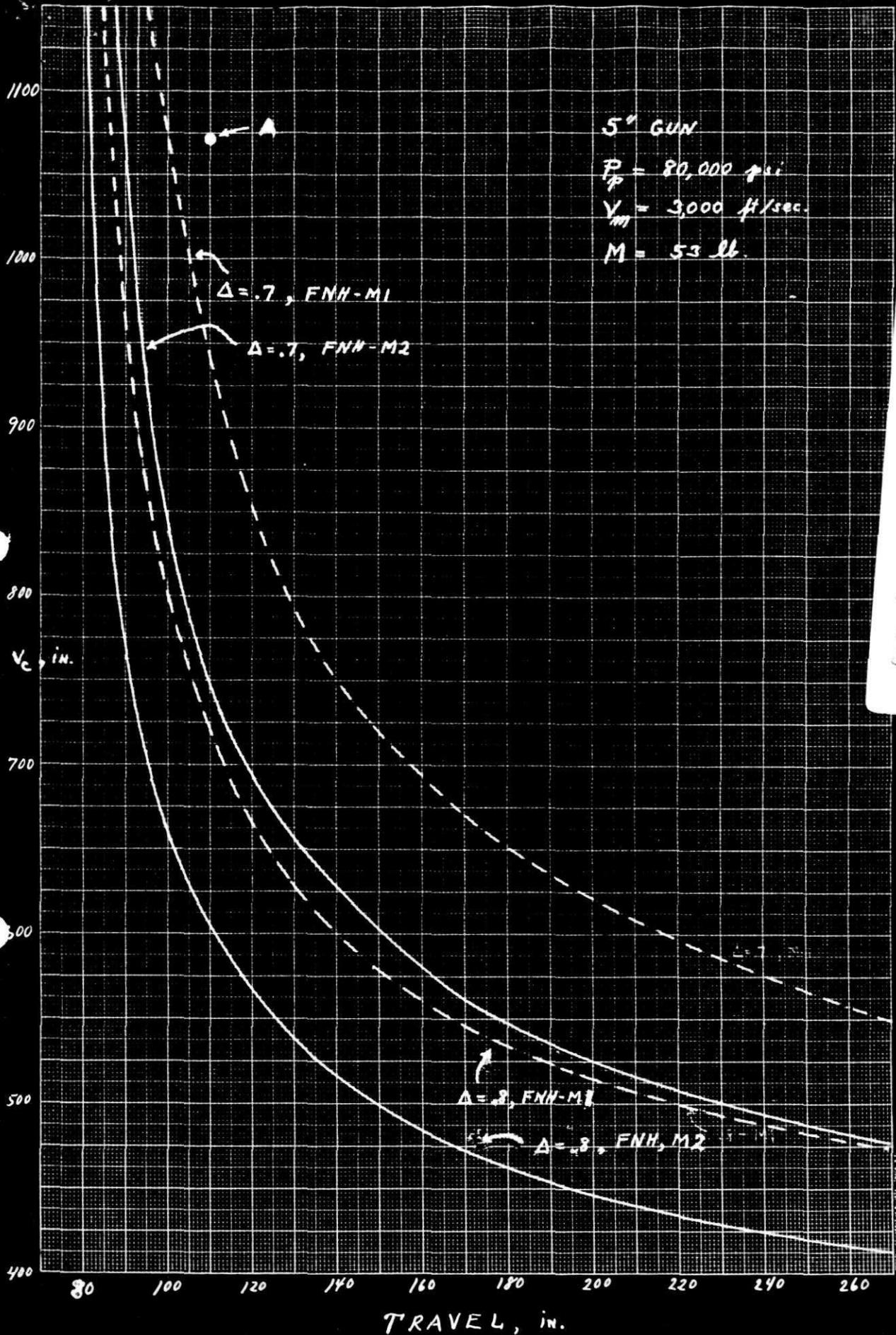
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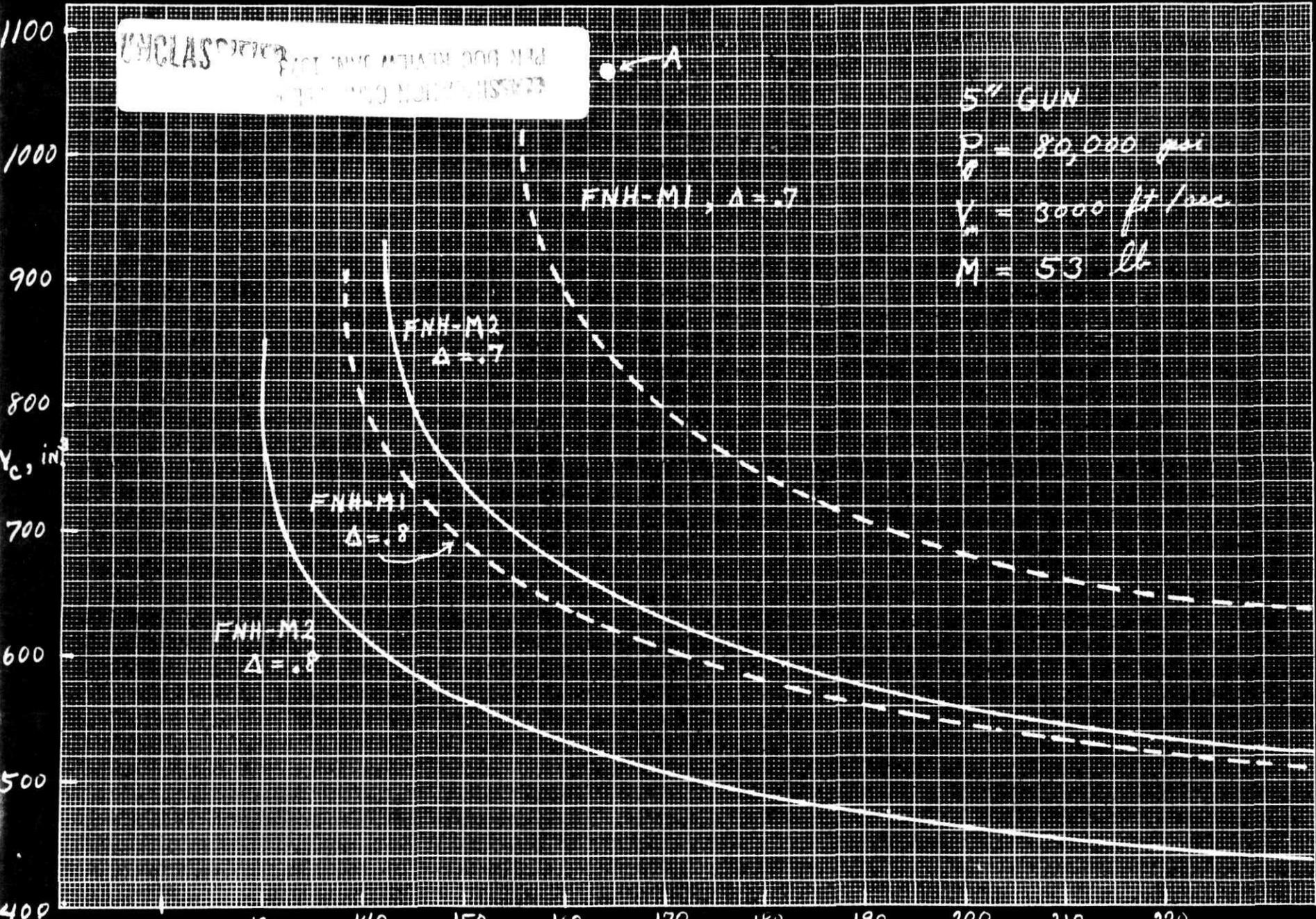
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5" GUN

$P = 80,000$ psi

$V_m = 3000$ ft/sec

$M = 53$ lb



$X_m =$ EFFECTIVE LENGTH GUN, IN.

KEUFFEL & ESSER CO., N. Y. NO. 589-14
MILWAUKEE, WIS. U.S.A.
Both lines heavy.