S-8 4pgs

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We have reviewed the proposed shipping container for structural integrity. Unfortunately, there are no firm regulations to follow, such as Part 72 for shipment of irradiated fuel elements. The Bureau of Explosives' requirements (File No. 25-16-17h, Revised Sept. 1, 1960) are not very specific; however, they specify that the container "must be so designed that it will maintain its efficiency even if subject to the effects of rather severe fire or impact". It is generally believed that railroad switching operations in classification yards cause the most severe damage to lading during rail shipment. Instrumented switching speed observations collected from a representative number of classification-yard operations indicated a mean impact velocity of 7 mph and a maximum as high as 10 mph. The corresponding impact forces on the container may be assumed, based on attached chart, to be about 23 G's and 35G's respectively for the 7 and 10 mph impact speeds. It is suggested that an impact force of 30 G's be used in analyzing the important elements of these types of containers to insure required safety during shipment.

The following detailed comments are made regarding the structural integrity of subject shipping container assembly:

a. The framework (birdcage) has sufficient strength to resist an impact force of about 100 G's without any appreciable yield and is, therefore, assumed entirely satisfactory, even for a corner impact.

b. The strap attachment of the band to the angle frame will resist an impact force of about 2 G's if only the toes of the strap are welded. The detail as shown on the drawing of this connection is not clear. If the sides of the strap are also welded, the strength of the connection, in combined bending and shear, is calculated to resist an impact force in excess of the 30 G's.

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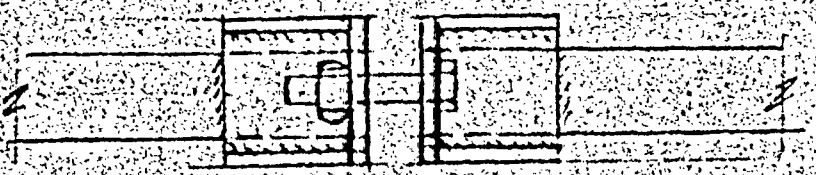
c. The real weak part of the whole assembly is the clamp design. An impact force of less than 3 G's (in terms of the loaded drum) would tend to open up the flanged clamp. It is expected that due to a slightly higher impact force the strap would slip away from the wing-nut causing the drum to fly out of its hold. It is suggested that the design be improved and greatly strengthened.

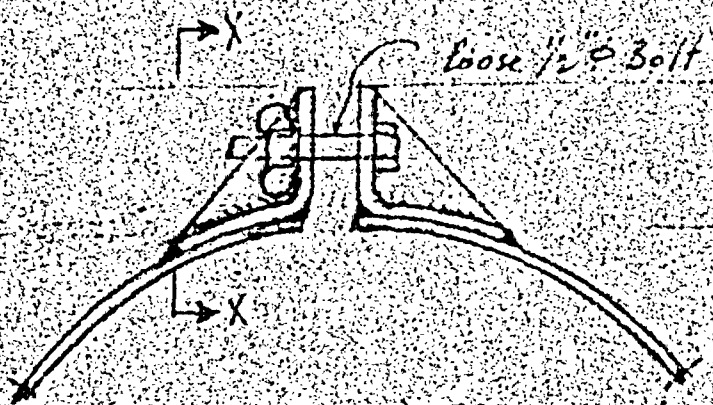
d. The hinges (HAGER #1814) are also considerably weaker in strength than desired. The hinge pin is calculated to fail in shear at only 7 G's, the strap in tension at about 13 G's. A stronger hinge should be used.

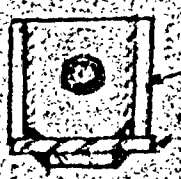
Attachment:
Copy of Chart I

Bcc: A. E. Aikens, Jr.
G. Orosch

Suggested Improved Clamp Design





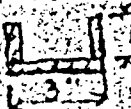


SECTION X-X

$F = \frac{820}{4} \times X$ (X in ½ G's)

$M = F \times 2" = \frac{820}{4} \times 2 \times X = 410X$ "#

at root of Corner Brace



(¼" thick material)

C. of Grav.: 3 × ¼ = .75 × ⅛ = .09

2 × ½ × ¼ = .62 × ⅞ × .57

1.37 .63

$c = \frac{.63}{1.37} = .46"$; $c' = 1.5 - .46 = 1.04"$

$I = (.75 \times (.34)^2) + (.5 \times (1.25)^3 \times 1/12) + (.62 \times (.41)^2) = .086 + .095 + .104 = .285$

$S.M. = \frac{I}{c'} = \frac{.285}{1.04} = .275$

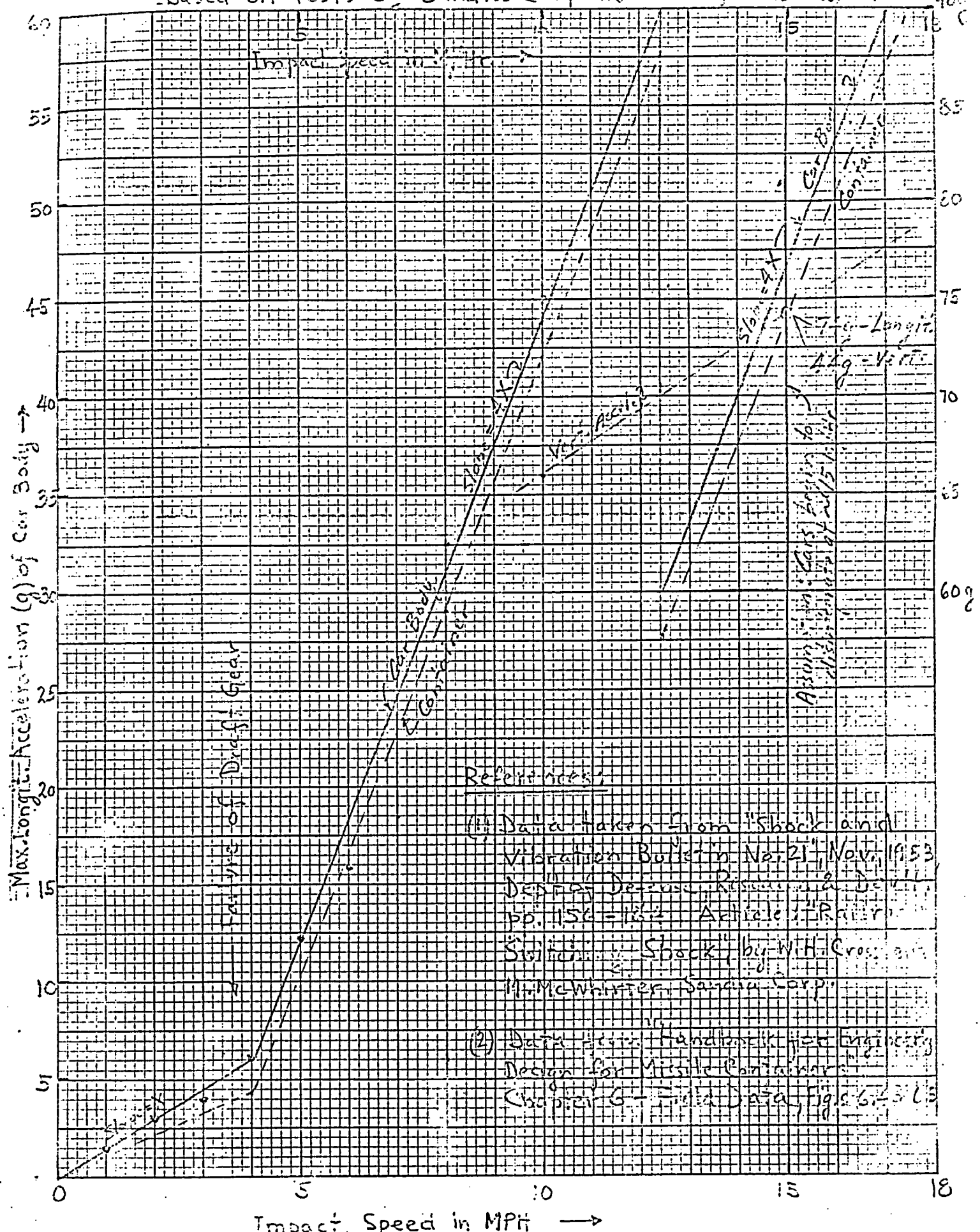
Using stress of 50,000 psi: $M_{max} = 50{,}000 \times .275 = 13{,}800$ "#

$X = \frac{13{,}800}{410} = 33$ G's

CHART 1

Acceleration vs P.R. Impact Speed Curve (up to 16 M/P.H.)

Based on tests by Sandia Corp. (see Ref. Reports)



References:

(1) Data taken from "Shock and Vibration Bulletin No. 21 Nov. 1953 Dept. of Defense, Washington D.C. pp. 156-162 Article "Paper Simulation of Shock" by W.H. Cross & H. McWhirter, Sandia Corp.

(2) Data from Handbook "Environmental Design for Missile Containers" Chapter 6 - Field Data, Fig. 6.4.3.5