Title
STRENGTH OF PLASTIC WINDOWS AT 20|K



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March 30, 1955

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# STRENGTH OF PLASTIC WINDOWS AT 20°K

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Since the introduction of the ether bubble chamber by Glaser (Phys. Rev. 91, 762 (1953)), the technology has developed to the point where construction of a liquid hydrogen chamber 20 in. x 20 in. x 50 in. seems desirable for the study of reactions such as $\pi^- + p \rightarrow \theta^0 + \Lambda^0$ from 2 to 6 Bev.

Plexiglas has been suggested as a suitable material through which to photograph the tracks. It must be emphasized that the following tests are not extensive, but fulfill the purpose of determining whether or not Plexiglas at 20°K can be given design consideration.

Impact tests (Fig. 1) were made with an Izod hammer with 4-lb weights. The samples were smooth-machined to a cross section of 1/2 in. x 1/2 in. and were not notched. Samples were immersed in various cold media, removed, and broken within 10 seconds. There is no great difference between annealed and unannealed Plexiglas. (Curve A ) A total of 64 samples was broken. Comparative curves were run on laminated bullet-resistant glass (Curve B ) and Pyrex (Curve C ).

Plexiglas tensile test specimens were prepared according to Rohm and Haas specifications:

(1) round stock annealed; (2) rough machined; (3) annealed; (4) finish machined; (5) annealed. Results are shown in Fig. 2.

A total variation of the order of 20 percent in tensile strength may be obtained by applying the load at a higher or lower rate. A lower rate results in lower tensile-strength readings. Pulling time for these samples was of the order of 1 minute to reach the peak values of 21,000 lbs/in$^2$. A total of 50 samples was broken.

Curve A is the average for annealed specimens of various types of Plexiglas. There is no appreciable difference between these various types. Curve B is the average for various types of cemented joints. Cement CD-1a appears to be about 20 percent lower than average in ultimate strength at room temperature, but also appears 20 percent above average at 20°K. All samples were actually immersed in the cold media during these tests.

Fatigue tests were run on the same machine and under the same conditions as the tensile tests. Samples were pulled to a given value, then released, at the rate of about 10 cycles per minute. A total of 15 samples was broken. The results are given in Fig. 3. It is not understood why Curve B is steeper than the others. Check points were run and came along this curve. One sample was run at 77°K and 5,500 lbs/in$^2$ for 107,000 cycles without failure.

Assuming that Plexiglas acts similarly to metals under fatigue, there should be a tensile value at which the material will never break, and cycling the tension will give a similar result. It would appear that a Plexiglas port at 20°K designed for 2,000 to 3,000 lbs/in$^2$ tension could last for a million cycles, and might actually never break.

This work was done under the auspices of the U. S. Atomic Energy Commission.

## Figure Captions

Fig. 1. Results of impact tests on Plexiglas (A), laminated bullet-resistant glass (B), and Pyrex (C).

Fig. 2. Results of tensile-strength tests on Plexiglas. A, averages for annealed specimens. B, averages for cemented joints.

Fig. 3. Results of fatigue tests on Plexiglas. Curve A is at 293°K. Curve B is at 188°K. Curve C is at 77°K. Curve D is extrapolated for 20°K.

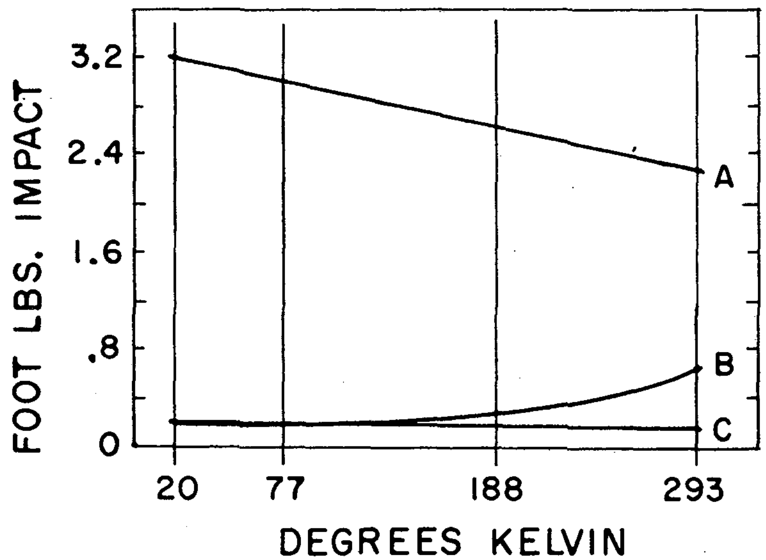



FIG. 1

23302-1

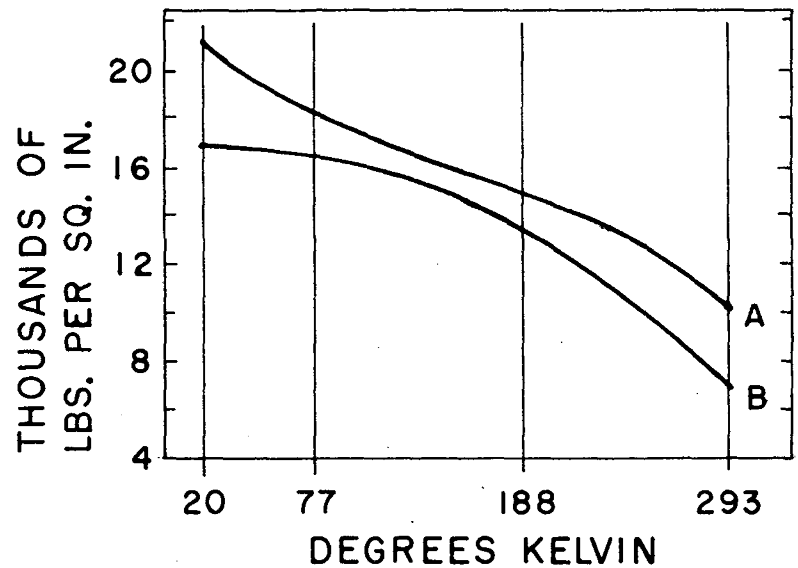
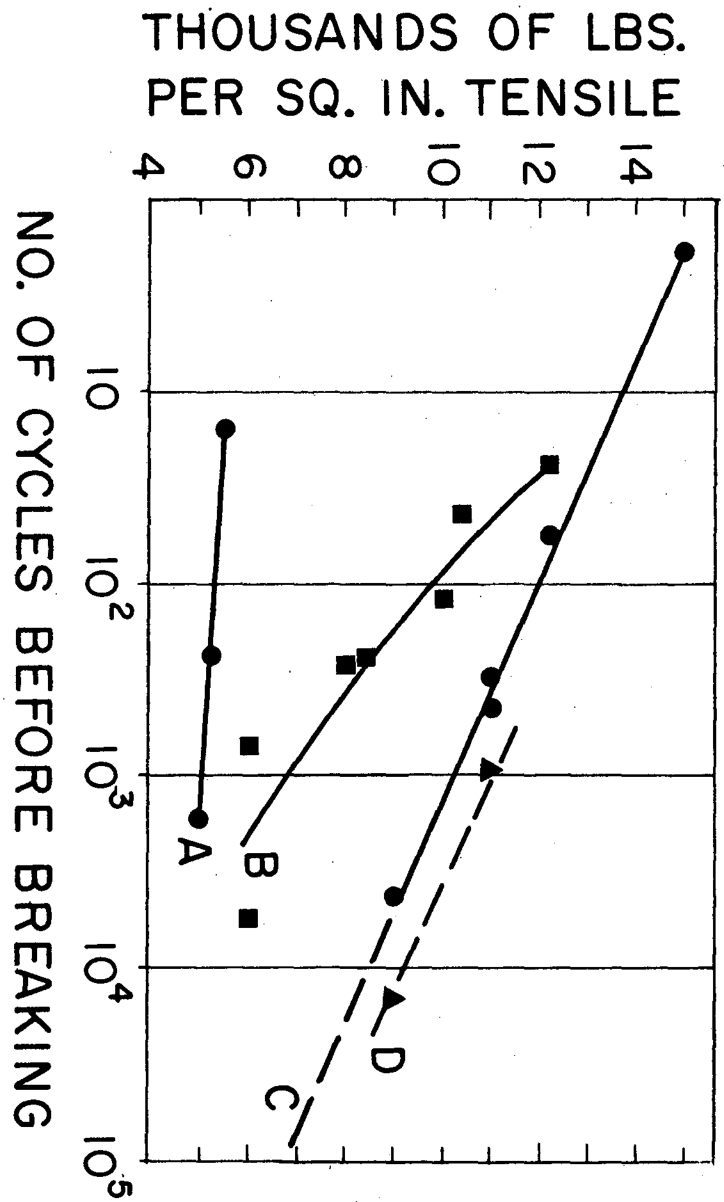

THOUSANDS OF
LBS. PER SQ. IN.
20
16
12
8
4
20
77
188
293
DEGREES KELVIN
A
B

FIG. 2

23303-1


THOUSANDS OF LBS.
PER SQ. IN. TENSILE
4
6
8
10
12
14
NO. OF CYCLES BEFORE BREAKING
10
$10^2$
$10^3$
$10^4$
$10^5$
A
B
C
D

23304-1