LC-235
3rd revision
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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

WWC:AEH

IV-5/

Subject: Ultra-violet Transmission of Glasses.

1. Replying to your inquiry of , we are enclosing our Letter Circular No. 235, 3rd revision, which gives the Bureau's findings on this subject.

Respectfully,

George K. Burgess

George K. Burgess, Director.
CAS

Enclosure:

LC 235 (3rd Revision).

WWC:AEH

DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

Letter
Circular
235
(Third Revision)

January 14, 1928.

THE ULTRA-VIOLET TRANSMISSION OF VARIOUS NEW GLASSES AND WINDOW GLASS SUBSTITUTES AS COMPARED WITH THAT OF COMMON WINDOW GLASS

This letter circular is issued in response to numerous inquiries for information on the transmissive properties of new glasses and organic substitutes for window glass for use in solariums, sun parlors, schools, homes, office buildings, animal houses, and green houses.

The visible rays of light are comprised between the approximate wave lengths of 760 mμ in the red and 400 mμ in the violet. Wave lengths longer than 760 mμ are called infra-red, and those shorter than 400 mμ, ultra-violet. Though the average eye is not sensitive to wave lengths shorter than 400 mμ such rays actually exist in the light of the sun, extending down to a wave length a little more or a little less than 300 mμ, depending on the time of day, season of year, latitude, altitude and clearness of atmosphere.

Since ordinary window glass shuts out the ultra-violet rays below about 310 mμ, much attention has been given of late to the production of special glasses, transparent to the shortest wave lengths which the atmosphere permits the sun to furnish us. This letter circular gives the results of ultra-violet transmission tests which have been made at the Bureau of Standards upon a number of such special glasses and common window glass.

TOTAL TRANSMISSION OF VARIOUS GLASSES FOR THOSE ULTRA-VIOLET SOLAR RAYS TO WHICH COMMON WINDOW GLASS IS OPAQUE

Using a filter method, direct measurements with sunlight as source, have been made during the noon hours of especially clear days from April to December, 1927.

These measurements covered the solar spectral region to which common window glass is opaque (below about 310 mμ). Table 1 gives for that region the total transmission found for the following specimens:

TABLE 1. Total Transmissions of Various Glasses, when new, for the Ultra-violet Solar Rays to which Common Window Glass is Opaque.

Trade Name	Per Cent Transmission
Fused quartz	93
Corex	92
Helioglass (Vioray[1])	50
Vita glass	50
Cel-o-glass[2]	20
Quartz-lite	5
Flexoglass[3]	1
Common Window Glass	0 to 5

(1) Vioray is the foreign trade name for Helioglass.

(2) This consists of a fine wire screen whose interstices are covered with cellulose acetate.

(3) This is a loosely woven fabric usually covered with paraffin.

SPECTRAL TRANSMISSIONS OF VARIOUS GLASSES FOR THE ULTRA-VIOLET RAYS

A second and more reliable method of measuring the relative transparency of a specimen of glass to ultra-violet light is to determine its spectral transmission curve, wave length by wave length. Curves of this description are shown in the accompanying illustration. These curves were obtained by means of an artificial source of light (quartz mercury arc) giving a line spectrum richer in ultra-violet than the solar spectrum.

By means of these spectral transmission curves an estimate of the relative transmissions of the various specimens for rays shut out by common window glass, may be obtained by reading from the curves the values of the transmission at 302 mμ-- the wave length of an intense mercury line, of convenient value for making such tests. Table 2 gives transmission values for this wave length. These are our most recent findings for new specimens.

TABLE 2. Per Cent Transmission of Various Glasses at 302 mμ, when new.

Trade Name	Number of Samples Tested	Average Thickness	Average Per Cent Transmission at 302 mμ
Fused quartz	1	4.7 mm	92
Corex	4	2.8	89
Helioglass	15	2.3	56
Vitaglass	15	2.5	44
Cel-o-glass	5	.1 (about)	30
Quartz-lite	16	1.9	0.5
Common Window Glass	14	3.3	0.0

SOLARIZATION:

Helioglass, Vitaglass and Col-o-glass have been found to decrease in transmission at 302 mμ and neighboring wave lengths (295 to 310 mμ) by exposure to ultra-violet radiation from the sun, quartz mercury arc, and carbon arc. The rate of change is much more rapid with the arc than with the sun and varies also with the different glasses.

Vitaglass has been on the market the longest, hence concerning this glass we are able to give the most information on solarization. A sample which had been in a hospital window in Rhode Island for a year was found to have a transmission of 25 per cent at 302 mμ (for thickness = 2.3 mm). Further exposure to the quartz mercury arc reduced the transmission but little, showing that solarization was complete.

Exposure in Washington of a sample (t = 2.35 mm) of Vitaglass directly to the sun for 123 hours (between 9 A.M. and 3 P.M. during June, July, and August) decreased the transmission from 47 to 35 per cent. Our tests show that the greatest decrease in transmission occurs during the first few weeks exposure. The average transmission of Vitaglass at 302 mμ after complete degeneration by the mercury arc is about 25 per cent for a thickness of 2.3 mm.

Helioglass has not been on the market for a sufficient length of time to obtain a complete solarization test. Two samples each of Helioglass and Vitaglass, exposed simultaneously to the sun in October to December, were found to have decreased in transmission at about the same rate. The average transmission of Helioglass

at 302 mμ, after complete degeneration by the mercury arc is about 30 per cent for a thickness of 2.3 mm.

Corex glass appears to undergo no appreciable change in transmission when exposed to solar radiation. For example, a sample of cathedral finish Corex which had been in a greenhouse roof in New York for 14 months was found to have, as nearly as could be measured on that kind of surface, the same transmission as a new sample. It was then polished plane and found to have a transmission of 89.5 per cent at 302 mμ, while the average transmission for new samples as given in Table 2, is 89.

On the other hand, exposure to a quartz mercury arc causes a very marked decrease in the transmission.

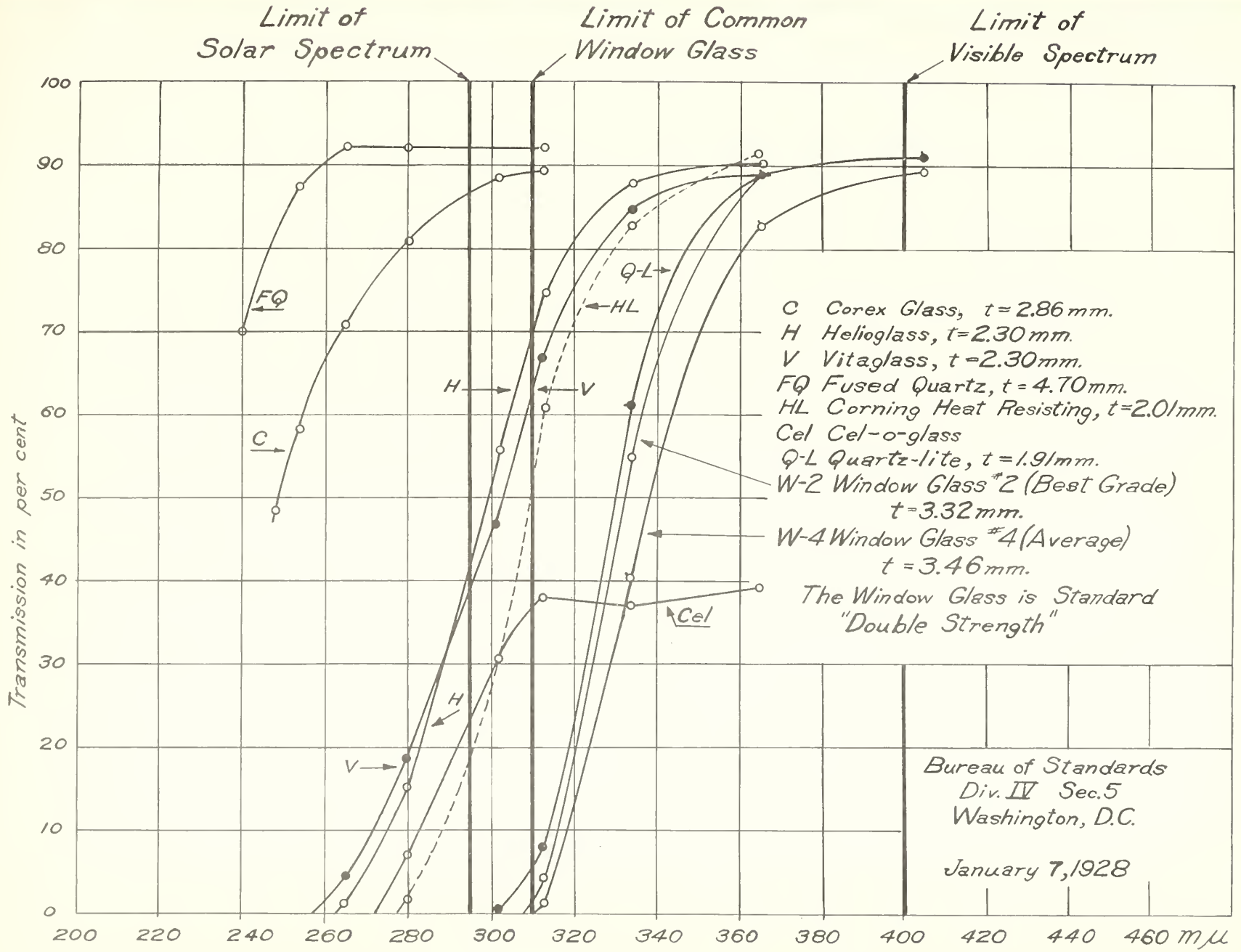
Cel-o-glass (cellulose acetate) becomes opaque at 302 mμ, and shorter wave lengths, after 25 hours exposure to the quartz mercury arc. A sample that was exposed to the sun for 400 hours during the months of April to October, decreased but little in transparency at 302 mμ. On the other hand, samples that transmitted 30 per cent at 302 mμ, when new, transmitted only 5 to 10 per cent at this wave length after being exposed on the side of a building continuously day and night for 8 months, April to December, showing that the change in transparency may be owing to the varying conditions of the weather.

Quartz-lite is not appreciably affected by sunlight. Exposure to the quartz mercury arc decreases its transmission slightly (measured at 313 mμ).

Common Window Glass is also slightly decreased in transmission by exposure to the quartz mercury arc but changes inappreciably in sunlight.

THICKNESS

The thinner the glass, the greater in general will be its transparency to ultra-violet rays. Considerations of strength, however, set a limit to an indefinite reduction in thickness. Commercial samples have been submitted for test with a thickness of less than 1 mm (1/25 inch). In installing such glass, attention should be given to the proper size of sash to meet safety requirements.



Ultra-violet Spectral Transmission of Various Window Glasses When New.