

LEAD INDUSTRIES ASSOCIATION

202 MADISON AVENUE

NEW YORK 17, N. Y.

October 16, 1961

SUBJECT: LEAD IN FALLOUT
SHELTERS

To Members of the Lead Industries Association:

As a result of the innumerable requests we have received for information on the use of lead in the construction of fallout shelters, we have prepared the attached report to answer such inquiries. We hope that the information it contains will be of assistance to you in answering similar inquiries.

If you need additional copies of this mimeographed letter please let us know.

Very truly yours,

David M. Borcina
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LEAD IN FALLOUT SHELTERS

Among the many commonly available materials for use in the construction of fallout shelters, lead, in terms of weight and space, provides the most efficient shield against gamma rays -- the prime dangerous radiation to be expected in fallout.

For example, 1-in. thick lead weighing approximately 60 lb. per sq. ft. is equivalent to 9.7 in. of concrete weighing approximately 115 lb. per sq. ft. or steel 2.7 in. thick weighing about 110 lb. per sq. ft. Therefore, where weight and space requirements are critical, lead is the obvious choice. However, where weight and space requirements are not critical and cost is the major consideration, then materials other than lead may be selected. Lead has a further advantage, uniform density, not always enjoyed by concrete or earth.

The following table taken from the Atomic Energy Commission's manual entitled "CEX-58.8" indicates the thickness of various materials required for shielding against penetrating residual radiations, fallout:

Approximate Attenuation Factors for Gamma Rays from Fission Products as a Function of Shield Thickness for Indicated Materials

Shield thickness for indicated materials, in inches

Attenuation factor	Lead (710 lb cu ft)	Iron & Steel (490 lb cu ft)	Concrete (144 lb cu ft)	Earth (100 lb cu ft)	Water (62.4 lb cu ft)	Wood (Fir) (34 lb cu ft)
2	0.28	0.7	2.5	3.5	4.8	9.2
4	0.64	1.8	6.6	8.9	13	25
10	1.0	2.7	9.7	13	19	36
50	1.6	4.2	14	20	29	55
100	1.9	4.8	16	23	33	62
1,000	2.7	6.8	22	32	45	88
10,000	3.5	8.8	27	39	56	110
100,000	4.3	11	32	46	70	140

LEAD IN FALLOUT SHELTERS (CONT.)

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The Office of Civil and Defense Mobilization, OCDM, has recommended 8 in. of concrete for house fallout basement shelters which added to the protection afforded by the materials in the floors above provide an attenuation factor, see above table, in the neighborhood of 10, which is probably adequate for most conditions. However, it has been pointed out that an attenuation factor of 1,000 is minimum for those areas subject to heaviest fallout. As to the location of the areas that will be subjected to heaviest fallout, this question may well be relegated to the "How high is up?" category.

It is important to note, again referring to the table, that the concrete used in building fallout shelters should have a density of 144 lb. per cubic foot. This means an 8 in. concrete wall will weigh approximately 56 lb. per sq. ft. and a wall 8 ft. high will weigh roughly 770 lb. a running foot.

The construction of the concrete walls may not pose a serious problem but the ceiling is another matter. The concrete for the ceiling of a shelter 10 x 10 ft. will weigh roughly 10,000 lb. Lead on the other hand will weigh roughly 6,000 lb. and require only 1 in. of head room rather than the 8 in. required if concrete is used.

Lead also offers advantages for use in doors, hatches, window coverings, atop shallow underground shelters and other critical areas.

Composite materials such as lead and concrete, lead and earth, or lead and steel are other structural possibilities. The necessary thickness of the various materials making up the composite is not a straight extrapolation of the figures given in the table and it is therefore suggested that AEC or OCDM be contacted for advice on such construction.

Lead for gamma shielding is available in a number of forms, such as sheet, brick, shot or wool. Lead shot can be cold poured into difficult to protect areas or contained in a steel shell for use in doors, hatches etc. Lead wool is an ideal caulking material for joints in whatever material or materials are selected for the shelter. Lead glass, which can contain more than 50% lead by weight is available and can be used for viewing ports where desirable.