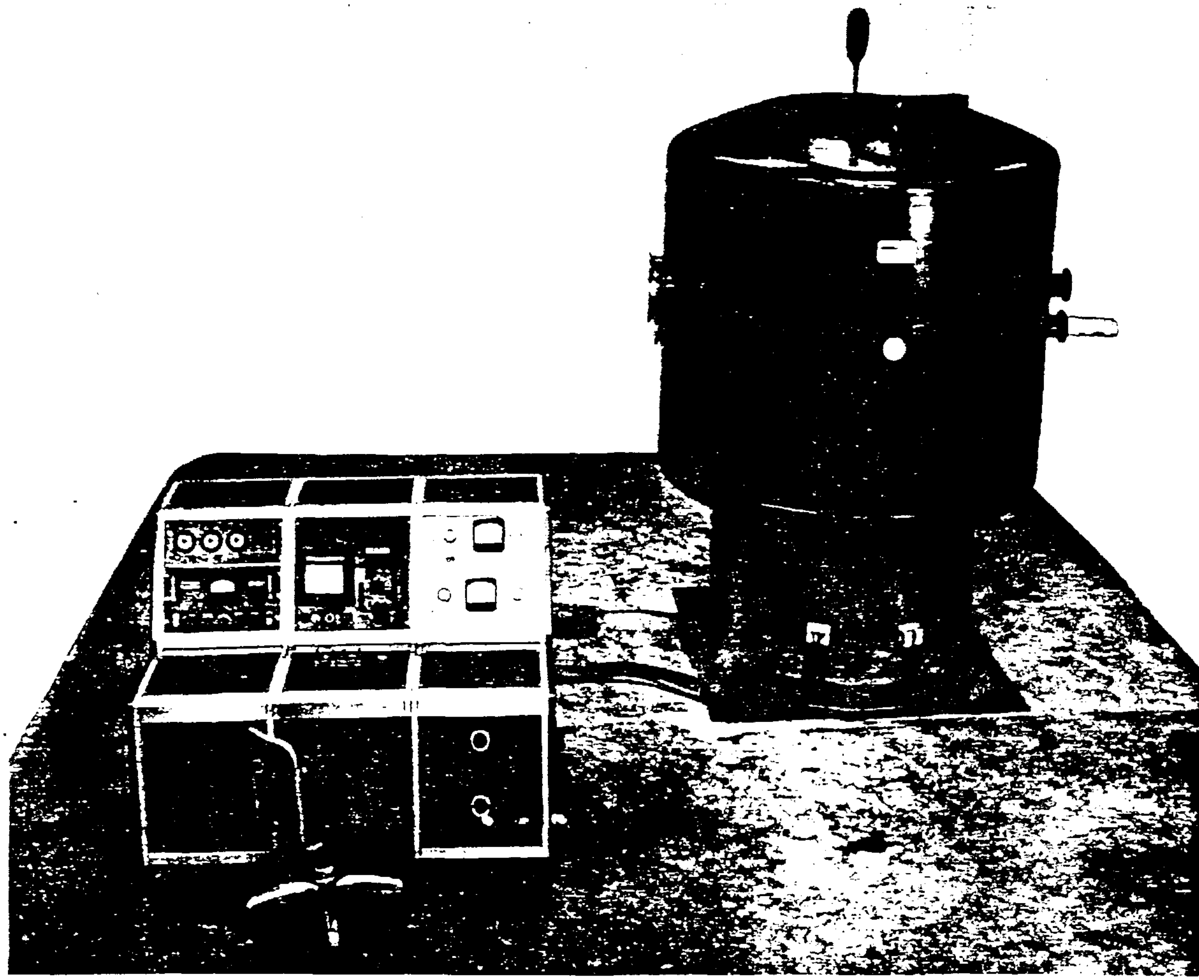
Lead

VOLUME TWENTY-ONE 1957 NUMBER ONE



The world's first mass produced nuclear reactor, 9 ft. high, and control console produced by Aerojet-General Nucleonics utilizes 7,500 lb. of lead for gamma shielding. *See story page 2.*

Lead Shielding In Mass-Produced Nuclear Reactors

THE world's first mass-produced reactors, which are the first to be conceived, designed, constructed and started up with private venture capital from a profit-motivated American industrial organization, have been announced by Aerojet-General Nucleonics of San Ramon, Cal. Three reactors have been completed and put into operation, nine reactors have already been committed and 21 more reactors (based upon a production schedule of one reactor every two weeks) are in the construction or planning stage.

Production of these small, portable, self-contained, nuclear reactors utilizing lead for shielding, 157,500 lb. total so far, rests on an ingenious method of core fabrication with radiation stabilized polyethylene moderator. The reactor resembles a liquid homogeneous type but actually has a solid homogeneous core. Of further significance is the quadruple sealing of the core which locks in the fission products and eliminates the problem of waste disposal and the escape of radioactive contaminants. Along with the normal reactor safety interlocks a thermal safety fuse built into the core enhances over-all reactor safety. Reactor safety and control rods are activated from the reactor control console which also provides continuous reactor monitoring.

Included in this emphasis on safety is the use of lead 10 cm. thick to protect personnel against gamma rays. The lead shield comprises only 7,500 lb. of the over-all reactor weight, with water for neutron shielding, of 11 tons.

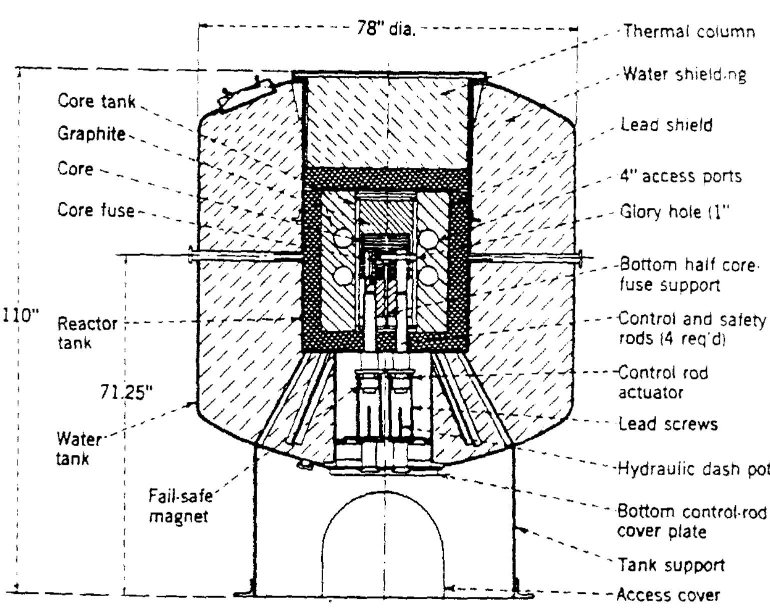
Thus the safety system combined with low cost derived from mass production, portability, low power, and small comparative size allow the AGN 201 to be placed in an ordinary room for a multitude of applications. Early tests indicate many fields. The immediate field aimed for is education and training although the long-range field is for industrial process control. There are indications that a reactor offers an excellent analytical tool for industry, particularly for danger coefficient testing and pile oscillator testing. For example, by the use of danger coefficient testing one can determine 10 mg. of boron in a 50 c.c. sample, and in activation analysis, vanadium content in gasoline can be determined to one part in 10 million.

Those using these reactors will doubtless find many other applications for lead shields in the radioisotope laboratories in industry which the reactors will create. Lead, because of its density, has the advantages of comparative low-weight—small space requirements, together with easy fabrication and portability. Lead is readily obtainable from manufacturers throughout the country as brick, storage safes, sheet, and in other forms.

CHARACTERISTICS OF THE AGN-201 REACTOR

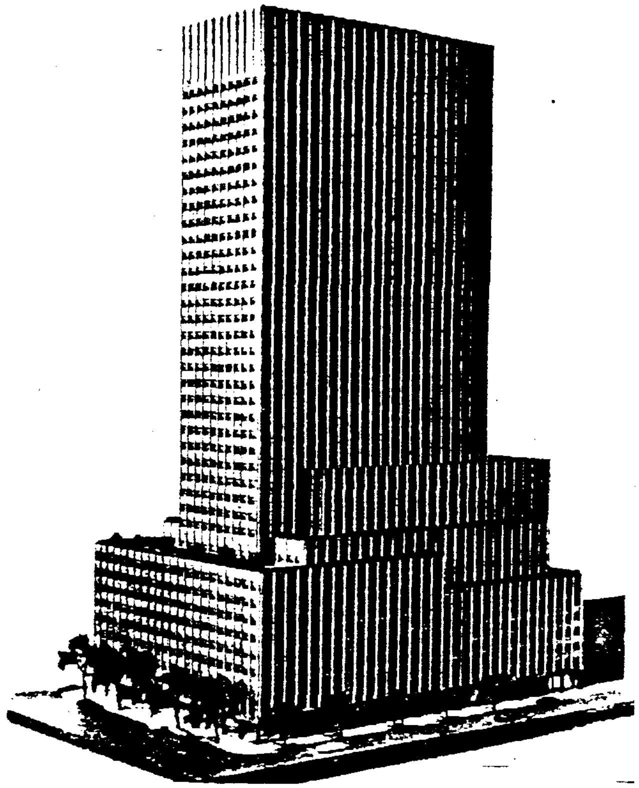
Power, Licensed	100 mw
Power, with special provisions	5 watts
Maximum thermal flux	2.5 X 10^8 n/cm^2/sec
Critical mass	656 gm of U^{235} (20% enriched)
Core size (cylinder)	10 in. dia, 9½ in. high
Moderator	11 kgm polyethylene
Impregnation density (U^{235})	50 mg/cm^3
Reflector (graphite)	20 cm thick (1.70 gm/cm^3)
Shield (lead)	10 cm thick (7,500 lb)
(water)	55 cm thick (8,700 lb)
Over-all diameter	6½ ft.
Over-all height	9 ft.
Over-all weight of reactor unit	22,000 lb
— with water shielding drained	13,300 lb
Temperature coefficient of reactivity	—2.5 X 10^{-4}/°C

Cross section of the AGN-201 nuclear reactor. The lead shield is 10 cm. thick.



LIA26100

White Strips Of Porcelain Enameled Aluminum On New Skyscraper



An architect's model of the new 38-story aluminum and porcelain-enameled aluminum sheathed skyscraper now under construction in New York City by the Tishman Realty and Construction Co.

THE growing importance of prefabricated metal curtain wall panels in skyscraper construction was sharply highlighted recently by the decision of the Tishman Realty & Construction Co. to use this type of facade on their now-under-construction 38-story office building at 666 Fifth Avenue, New York City.

The structure, when completed, will be the world's largest aluminum and porcelain enameled aluminum-faced office building with a facade area of more than eight acres, enclosing better than 1,000,000 square feet of air-conditioned office space. Carson & Lundin of New York City are the architects.

The over-all design of the facade will include aluminum panels, 12 feet high by 7½ feet wide, each to contain a window and spandrel, and separating these will be gleaming white strips of 20 inch wide leaded porcelain enameled aluminum extending the entire height of the building. The total weight of the facade is just over 375 tons.

Lead compounds are a major constituent of the white porcelain enamel on the aluminum strips on this New York City skyscraper, the first two of which are shown in place, just above the scaffolding.

Contributing to the decision to use modern panel wall construction, according to the architects and contractors, was the new developments in aluminum panel production, including improved die design and stamping techniques, plus the new method of placing enamel on aluminum. This last named development includes the use of lead compounds which are a major constituent of the porcelain enamels used on aluminum. The lead imparts greater smoothness and brilliance to the enamel as well as improving its elasticity and increasing its chemical resistance.

Of particular importance to the use of porcelain enameled metal curtain wall construction is the increased resistance to chipping provided the enamel by the addition of lead. As a result, porcelain enameled panels can be sheared, sawed, punched or drilled on the job with little or no chipping of the enamel.

The Reynolds Metals Co. is fabricating the aluminum panels and Hamlin-Stevens, Inc. is applying the leaded porcelain enamels to the aluminum strips.

Red Lead Pri
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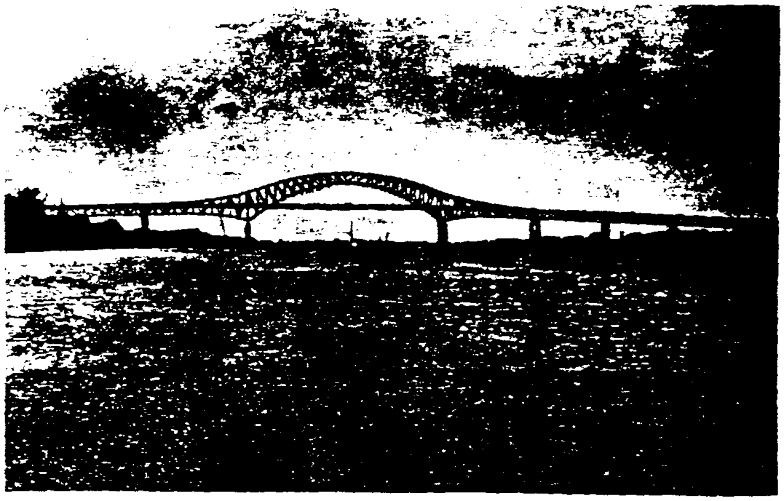


PENNSYLVANIA TURNPIKE COMMISSION

The Delaware River Bridge and all other steel bridges of the Pennsylvania Turnpike are protected against corrosion by red lead paint. As the motorist travels non-stop across Pennsylvania into

Ohio, the same rust inhibiting pigment — such as on their second largest, the

THE use of red lead for primer paints for exposed steel highway bridges and other structures has long been standard practice among engineers in practically all the state highway departments.

More recently as State Turnpike or Toll Road Commissions have been organized, the same preference for red lead's outstanding rust-inhibiting properties has been shown by the engineers in these agencies. Among the many such semi-public agencies that specify red lead paints are the Pennsylvania Turnpike Commission, the Ohio Turnpike Commission and the Indiana Toll Road Commission, together responsible for the construction and maintenance of almost 1,000 miles of safety engineered dual highway.

The highway traverses each of the states and interconnects at the state lines to make it possible for today's motorist to travel almost a third of the way across the United States without encountering a single traffic light or intersection.

To incorporate these important safety features, the engineers had to design and construct more than 1,500 bridges over this three-state highway system, or about one and one-half bridges per mile of highway.

Controlling the expected corrosion of the exposed steel of these bridges was of course a major consideration, particularly when they would be subjected to varying corrosive influences from rural to highly industrialized atmospheres.

Ohio Turnpike Commission

Shop Primer Paint Specification

		Percent
Pigment:	Red lead (95% Pb_3O_4 grade)	75.0 min.
	Red iron oxide	25.0
		100.0
Vehicle:	Raw or fractionated raw linseed oil	95.2 min.
	Gum Turpentine	0.7
	Drier	4.1
		100.0

Pigment	74.5% (± 1.0%)
Vehicle	25.5% (± 1.0%)
Wt. per gal.	22 lb.
Drying time for recoating	36 hours

ALTERNATE

		Percent (± 2.5%)
Pigment:	Red lead (95% Pb_3O_4 grade)	75.0
	Iron oxide	25.0
		100.0
Vehicle:	Linseed oil and synthetic resin solids	80.6
	Drier and thinner	19.4
		100.0

Pigment	80.0% (± 2.5%)
Vehicle	20.0% (± 2.5%)
Wt. per gal.	23.5 lb.
Drying time for recoating	18 hours

Pennsylvania

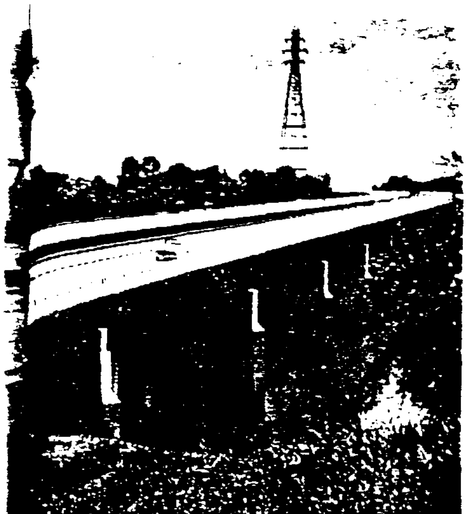
Shop Prim

Pigment:	Red lead (97% P
	Aluminum stearate
Vehicle:	Raw linseed oil
	Pale heat bodied li
	Volatile mineral s

Pigm M
Vehic M
Wt. p M

LIA26102

...nts Preferred ... Commissions

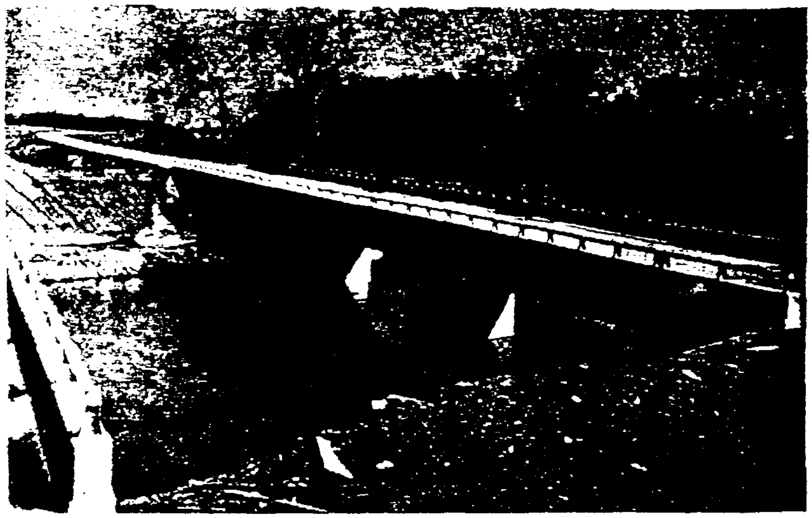


... the Ohio Turnpike Commission bridges, ...bridge near Toledo. As the motorist

The one rust-inhibiting paint pigment specified for the all-important shop or primer coat of paint on the structural steel by all three Commissions was red lead, whether or not the exposure was rural or industrial.

One of the reasons for this unanimous agreement on the use of red lead paints is its outstanding performance record under almost all types of exposure. Contributing to this outstanding performance record is the fact that red lead is an active pigment, rather than a passive one, and has the ability to combine with linseed oil to form lead soaps in the paint. These lead soaps strengthen the film, which is tough and elastic when dry, so that it can expand and contract with temperature changes, in harmony with the surface on which it is applied.

As a direct result of research, recent developments in the field of red lead paint formulations include paints that are faster drying, such as those shown in the primer paint specifications accompanying this article. Also, red lead paint formulations have been developed that will meet other exacting requirements to meet specific conditions, and a list of these will be found under the heading "Red Lead Technical Letters" in "The Lead Library" section appearing on the last page.



INDIANA TOLL ROAD COMMISSION

Indiana, red lead paint is protecting the steel bridges of the Indiana Toll Road Commission. The bridge across the Pigeon River, above, is one of the 312 bridges in this highway system which has been primed with red lead paint.

...e ...ommission

...ecification

Min.	Percent	Max.
	99.5	
	0.5	
	100.0	
35.0		50.0
15.0		30.0
—		35.0
	100.0	

Min.
Max.
Min.

Indiana Toll Road Commission

Shop Primer Paint Specification

ALTERNATE "A"

		Percent
Pigment:	Red lead (95% Pb_3O_4 grade)	75.0 min.
	Red iron oxide	25.0
		100.0
Vehicle:	Fractionated raw linseed oil	95.2 min.
	Gum turpentine	0.7
	Drier	4.1
		100.0

Pigment	74.5% (± 1.0%)
Vehicle	25.5% (± 1.0%)
Wt. per gal.	22.0 lb.
Drying time for recoating	36 hours

ALTERNATE "B"

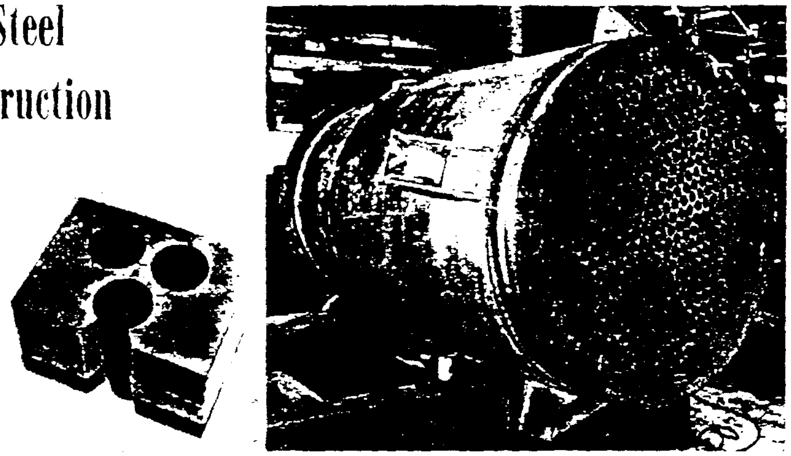
		Percent (± 2.5%)
Pigment:	Red lead (95% Pb_3O_4 grade)	75.0
	Iron oxide	25.0
		100.0
Vehicle:	Linseed oil and synthetic resin solids	80.6
	Drier and thinner	19.4
		100.0

Pigment	80.0% (± 2.5%)
Vehicle	20.0% (± 2.5%)
Wt. per gal	23.5 lb.
Drying time for recoating	18 hours

LIA261C

Lead Bonded Steel Tube Sheet Construction

THE use of lead in a rather unique application is illustrated by the tube sheets incorporated into the "Shell and Tube" type heat exchanger, manufactured by the Swenson Evaporator Company, a Division of Whiting Corporation. This novel approach to handling of corrosives is illustrated by the accompanying detailed photos of the heating element for a phosphoric acid evaporator combining both the strength of steel and lead's corrosion resistance in tube sheet construction.



Detail of the Karbate tubes installed in a homogeneously bonded lead covered steel tube sheet and the entire Swenson heating element for a phosphoric acid evaporator.

On the acid or tube side lead is exposed to the liquor-box or chamber while on the steam or shell side steel is exposed. Each component in the evaporator, therefore, is performing its design function; Karbate tubing, heat exchange surface; steel, structural support for lead covered tube sheets; and lead for resistance to phosphoric acid. Another feature of bonded lead is its increased resistance to creep and buckling and resultant increased service life where high or fluctuating temperatures are involved, thus expanding lead's field of usefulness.

In the accompanying detail of the Karbate tubing as installed, one inch of steel supplements 1½ in. of homogenous bonded lead, giving an overall sheet thickness of 2½ in. Note recesses in the lead for retention of three neoprene ring gaskets for sealing and flexible anchorage (patented) of the tubes which avoids difficulty connected with expansion. This assembly is capable of functioning at 10 to 15 psi. steam pressure, or even higher for special applications.

This same type of bonded lead equipment is also offered for service with such other corrosives as may be found in industrial chemical operations, with sulphuric acid, phosphoric acid, and spin bath for viscose rayon manufacture being typical.

Colorful And Permanent Lead Glass Labels

HIGHLY decorative and permanent are the leaded glass labels now found on many bottles, ranging all the way from those containing expensive perfumes to returnable "pop" bottles.

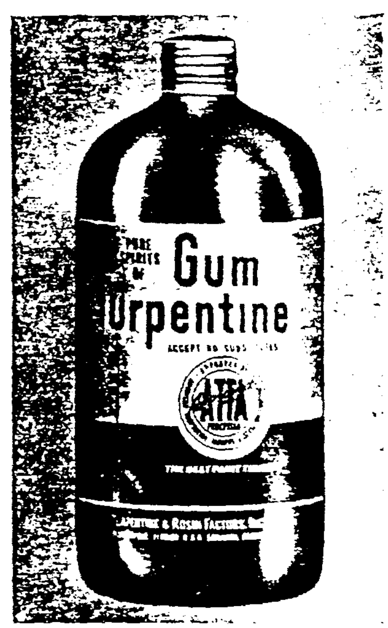
These colorful permanent labels add sales appeal to all kinds of glass packages. In the case of the perfume bottles, the labels are applied because of the richness and glamor this type of label imparts to the product. On the "pop" bottles, the clean, crisp appearance of the label is a decided advantage as is the cost-saving made possible by elimination of delabeling and relabeling each time the bottle is refilled.

A glance at any super market's shelves of glass containers will reveal the wide range of colors that are available in applied color labels, a name the ceramic industry has given this expanding application of glass technology.

The base glass with which practically all glass decorating colors are made is essentially a lead boro-silicate glass, having the comparatively low melting temperature of 900 - 1000 deg. F.

Lead oxide, which is a major constituent of these glasses, has a dual role in that it is responsible for its low melting characteristics as well as providing the proper coefficient of thermal expansion so as to be compatible with other glassware on which the glass colors are applied.

General procedure for making the glass colors involves first, the mixing



Glass container with permanent ceramic color label. This was one of the first outside of dairy and beverage bottles to use such labels.

TYPICAL FLUX FOR GLASS COLOR

(Percent)

PbO	58.6
SiO_2	26.6
B_2O_3	2.5
ZrO_2	3.5
Na_2O	5.1
TiO_2	3.7

Pigment to be added.

of the raw batch components which are indicated in the accompanying table. Next the mix is melted, water quenched and placed in a ball mill for wet grinding. At this point the color pigment is added in amounts varying from 10 to 20 percent and with the other ingredients is ground down to pass through a 325 mesh screen. What is now a glass color is then removed, dried and pulverized.

Commercially the pigmented glasses are known as glass colors, or in case of those used for applied color labels as A.C.L. colors

These glass colors are then applied to the outer surface of the glass bottle or other containers to be decorated by one of several means such as hand painting, spraying or by the screen stencil process. For hand painting, the leaded glass color is mixed with a suitable mixing oil such as turpentine and fat oil. For spraying, the glass colors are mixed with 3 parts water and 1 part alcohol. Glass colors applied by the screen process are mixed with a special oil called squeegee oil in the approximate ratio of 4½ parts color to 1 part oil.

Fusing of the leaded glass colors is accomplished by passing it through a continuous decorating lehr. Going into the lehr cold, the ware is gradually heated to a point where, as it enters the firing zone, the color melts and fuses to the glass. Later it passes on through the tempering section and the glass is cooled and annealed.

One of the many returnable beverage bottles on which leaded glass labels are applied to eliminate delabeling and relabeling costs.

Lead For Plumbing Fixture Connections On Small Homes

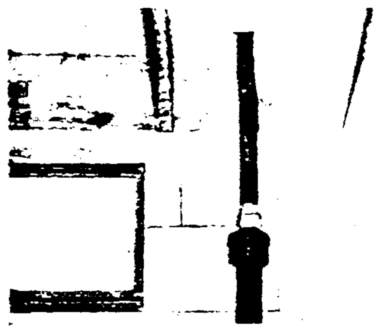
LEAD pipe and fittings are widely accepted materials for use in today's plumbing installations. Wherever sound, sanitary practices are followed in installing plumbing, lead will be found among the materials used and often required and more important, most often required in those areas of the system that are subjected to the severest conditions.

An example would be the water closet connection, subjected as it is to the differential expansion and contraction of the rigid piping system and the building itself. A lead connection at this point provides the flexibility to absorb the expansion and contraction, plus any vibration or uneven building settlement that may occur without damage to itself, the fixture or the rigid piping.

As a matter of fact, wherever a connection between a rigid piping system and a fixture is made, such as for the water closet, a bathtub, sink, urinal and the like, lead's flexibility can be used to decided advantage. This is true of lead whether it is used in the plumbing system of office skyscrapers, large apartment buildings or single-family homes.

A group of small Cape Cod type residences now under construction in

The plumbing roughing-in for Cape Cod type homes in Canton, Ohio, includes lead connections for all fixtures. Below, the lead P-trap for the bathtub.



Lead pipe sink wastes connected to vertical and horizontal drainage lines installed by the J. P. Roth Plumbing Co. in homes in Canton, Ohio.

Canton, Ohio. exemplifies the use of lead in the plumbing systems of single-family homes. Each of these homes will have two bathrooms and all fixtures will have lead connections to the cast-iron drainage lines.

The J. P. Roth Plumbing Co. of Canton, Ohio, is installing 4-in. lead bends for the water closet connections, flexible lead P-traps for the bathtub waste connection and 1½-in. lead pipe for the waste connection from the kitchen sink.

Another of the advantages inherent in lead's flexibility is the ease with which changes of direction can be made without the use of expensive joint fittings that can add immeasurably to the cost of a plumbing installation. Typical examples of this feature of lead pipe are shown in the accompanying photographs.

Lead connections have a number of other desirable qualities that enhance its value in the vital sections of the plumbing system and these are its resistance to corrosive mediums, such as hydrogen sulphide gas commonly found with sewage, its smooth inner bore that offers no obstructions to which solids can cling and cause clogging, and bonded wiped joints that are as strong, if not stronger than the pipe itself.

THE *Lead* LIBRARY
of Technical Information

The following articles and reprints contain information, drawings and specifications on the use of lead products helpful to architects, engineers and others interested. They are available, free of charge, except where otherwise indicated, upon request to the LEAD INDUSTRIES ASSOCIATION, 60 EAST 42nd STREET, NEW YORK 17, N. Y.

MATERIALS OF CHEMICAL CONSTRUCTION ANNUAL REVIEWS — LEAD AND LEAD ALLOYS

Up-to-date reports on new developments in the uses of lead and lead alloys in chemical construction including research progress, engineering applications, and technological advancements. With bibliography. 1956, 1955 and 1954 reviews (editions are not cumulative) available. Reprinted from "Industrial and Engineering Chemistry," September, 1956, October, 1955, and October, 1954.

LEAD REFERENCE SHEET (Parts 1 & 2)

A short outline of the types, grades, and chemical and physical properties of lead in chemical construction, with a summary of the corrosion characteristics of lead in use with a large number of common chemicals and solutions used in various industries. Reprinted from "Chemical Engineering Progress," January and February, 1955.

INSPECTING LEAD LININGS

Latest methods of testing and inspecting sheet lead and bonded lead linings used in the chemical process industries are described. Reprinted from "Chemical Engineering," November, 1956.

BEST DESIGNS FOR LEAD INSTALLATIONS

A special report on the applications of lead and lead alloys in the chemical and metallurgical industries. Recommended practice for joining lead sheets, and the construction of wood stave tanks, launders, towers and flues where lead is involved are included. Reprinted from "Chemical Engineering," March, April and May, 1956.

PORTABLE RADIATION-SHIELDING MATERIALS

A special report on commercially available shielding forms that can be used to build readily assembled, hand stacked shielding walls. Prepared by the editors of "Nucleonics," May, 1955.

LEAD IN MODERN INDUSTRY

$1.50 Postpaid

A fully illustrated, 230 page, cloth bound book describing all phases of the production and use of lead, lead alloys and lead compounds.

LEAD WORK FOR MODERN PLUMBING

$1.50 Postpaid, $1.00 per copy in quantities of 10 or more

Profusely illustrated with over 140 photographs and drawings, this textbook presents clearly to the plumbing student the necessary tools, procedures and the methods required for lead work.

LEAD BUILDING CONSTRUCTION BULLETINS

A series of specifications for the use of lead in building construction. (Available separately.)

BULLETIN NO. 1

Specification for Lead Waste Connections for Plumbing Fixtures with Integral Traps (Water Closets—Pedestal Urinals—Service Sinks).

BULLETIN NO. 2

Specification for Lead Shower and Safe Pans.

SUGGESTED SPECIFICATIONS FOR CHEMICAL LABORATORY DRAINAGE SYSTEM

A complete guide to the selection and installation of drainage systems in chemical laboratories. Includes laboratory waste and vent piping, traps, sinks, acid trays, troughs, safe pans, neutralizing basins and other topics.

LEAD IN MODERN PLUMBING— WHY, WHERE, HOW IT IS USED

A 24 page booklet containing descriptive information as well as four pages of detailed drawings for plumbing installations in various type houses.

LEAD WELDING

An informative as well as practical guide to lead welding. Reprinted from the "Welding Handbook, Third Edition" published by the American Welding Society.

LEAD FLASHINGS IN MODERN CONSTRUCTION

Lead flashings as used in an ultramodern house in Randolph, Vt. Reprinted from "National Roofer," October, 1954.

LEAD SUPPLY AND DEMAND IN THE UNITED STATES

A short resume of lead supply and demand in the United States in 1956 and the outlook for 1957. Reprinted from "Engineering and Mining Journal", February, 1957.

THE STORY OF LEAD — MATERIALS THE RAILROADS BUY (Parts 1 and 2)

Lead from mine to finished product with special reference to its uses by the railroads. Reprinted from "Railway Purchases and Stores," December, 1954 and February, 1955.

RED LEAD TECHNICAL LETTERS

A series of technical letters containing red lead paint formulations. (Available separately.)

- **Technical Letter No. 3—Red Lead Primers for Atmospheric Exposures**
- **Technical Letter No. 6 — Red Lead Paint Formulations**
- **Technical Letter No. 8—Primers for Railroad Structures and Rolling Stock**
- **Technical Letter No. 9—Red Lead Paints for Galvanized Steel, Rusted, Weathered or Treated New**
- **Technical Letter No. 10 — L.I.A. Formula 3-7, A Red Lead-Alkyd Vehicle Primer for Industrial and Marine Environments.**
- **Technical Letter No. 11 — Recommended Surface Preparation of Steel for Red Lead Paints.**

FEDERAL SPECIFICATION TT-P-86a
Paint: Red-Lead-Base, Ready-Mixed

Covers four types of red-lead-base paints including two fast-drying formulations. Many intended applications listed.

PAINT GALVANIZED SURFACES?

Why galvanized surfaces should be painted, the kind of pretreatment that should be given, and the correct painting systems are discussed. Reprinted from "Factory Management and Maintenance," April, 1956.

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