Lead Tanks, Valves and Piping Used in Plant for Manufacture of Catalyst for Oil Refining

THE catalyst which is used in the Thermofor catalytic cracking process for manufacturing high octane gasoline is a synthetic material. It is made from sodium silicate and an acid solution of alum. A considerable portion of the process involves the handling of solutions which are highly corrosive in character. In the Paulsboro, N. J. plant of Socony Vacuum Oil Co., Inc., which produces this catalyst in the form of small spheres or beads, many of the process vessels and much of the piping are lead.

The very first process in the production of the bead catalyst* is the reaction of aluminum trihydrate with sulphuric acid to form an alum solution. This is done in a tank lined with 3/8-in. tellurium lead held in place by vertical steel straps spaced 2 ft. on centers. The reaction heats the tank to 240° F. and though the heating-cooling cycle is repeated two or three times a day the 3/8-in. lead lining shows no signs of deterioration after more than a year of use.

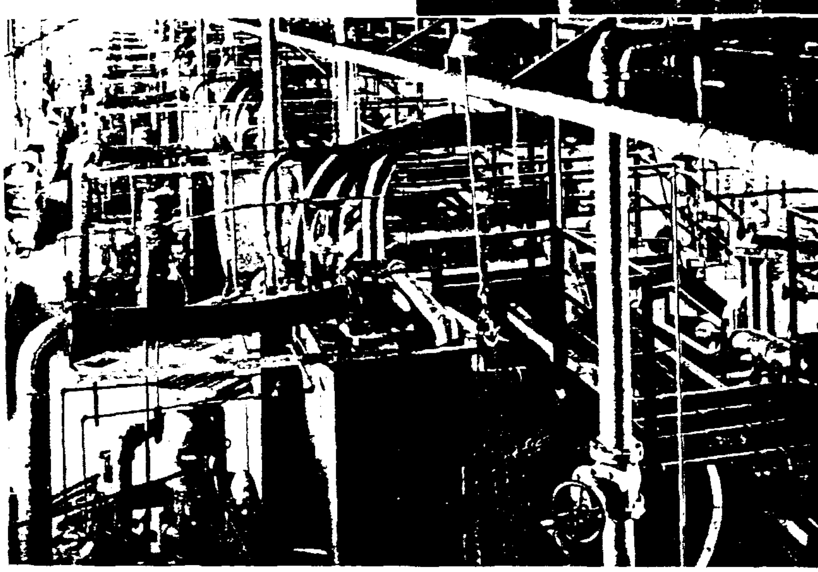
Also of lead lined steel are four storage tanks of 42,000 gal. capacity each. In two of these tanks the acid alum solution diluted to 20 percent strength is held in storage. In the other two the solution is further diluted for use in making and treating the catalytic material. All of the pipes, valves and fittings used to convey the acid-alum solution are of lead.

The acid-alum solution and the sodium silicate solution are brought together at the forming towers which are also of lead lined steel. There are 32 of these towers 3 ft. in diameter and 10 ft. high. Each tower contains a deep layer of light oil floating on a comparatively shallow layer of water. The solutions mix and form a gel in a mixing head above the surface of the oil and the gel is caused to separate into small particles by an ingenious dividing device. As these particles descend through the oil they form spherical beads about 1/3 in. in diameter. The beads are removed from the tower through a lead discharge pipe by the underlying layer of water which is kept in circulation by pumps.

Treatment and washing tanks through which the beads are passed on their way to the dryer are of other materials but lead pipe is used extensively for conveying them up to the point where they enter the dryer.

The extensive use of lead in the plant for the production of the catalyst for the catalytic cracking process gives lead a double role in the production of high octane gasoline. In this case it is a passive part in producing gasoline with the highest octane rating yet obtained without the addition of anti-knock agents. In the form of tetraetheyl lead it serves further to increase the rating of the very best untreated gasoline that can be produced. The combination of calalytic cracking and tetraetheyl lead treatment produces extremely high octane gasolines.

Part of the battery of 32 lead lined forming towers where the gel is formed and divided into spherical beads.



Part of the piping serving the treating tanks. The risers at the left, all of the long radius bends, the large pipes in the right foreground and many others are lead.

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*For a complete description of the manufacturing process see "Chemical and Metallurgical Engineering" April, 1946.

White Lead and Sheet Lead Help A Farmer Solve His Housing Problem

BULLETIN P78 of the Agricultural Experiment Station of Iowa State College outlines one solution for a troublesome but seldom discussed phase of the current housing problem — that of the obsolescent farm house. Little consideration has been given to farm housing and it seems to be up to the farmer to solve his problems unaided. Bulletin P78 is a lively and interesting account of how one Iowa farmer did just that, even to the extent of doing nearly all of the work himself.

The success of the project was due primarily, of course, to thoughtful preliminary planning but was assisted in no small measure by the choice of materials of high quality and which could be handled and applied by the owner and his neighbors. Plastering and papering, two skills which are not possessed by most householders, were not required for the erection and finishing of plywood partitions finished with pure white lead paint. This produced a durable, serviceable surface which is slow to collect dirt and easy to clean.

The exterior walls also were painted with pure white lead paint applied to new shingles which were nailed directly to the old siding. All of the painting, both exterior and interior, was done by the owner and his wife using paint mixed and tinted by themselves. The exterior painting was done by the spray method which has been found to be entirely satisfactory for pure white lead paint.

Another means of simplifying the work was the use of sheet lead for flashing in the rebuilding of the chimney. Sheet lead is easily cut and formed to the shapes and contours of masonry with the tools ordinarily found in the farmer's shop. A cap or coping of sheet lead was also placed at the top of the chimney to keep moisture out of the masonry and thus eliminate one of the most troublesome sources of leakage.

There are many times when a little white lead or a piece of sheet lead can be used to advantage on the farm. White lead in the joints of wood construction, such as a wagon bed, will protect them from the weather. Applied to the threads of a pipe or bolt, it will prevent leakage and insure easy removal. Sheet lead is useful for gaskets as well as flashings and it is also handy for fishing line weights in an emergency. The householder who makes use of lead in his construction work or remodeling will be wise to save some of both white lead and sheet lead for use in general property maintenance.

The completed remodeling. The white lead painted shingles are a pleasing and durable finish for an attractive design.

The fresh white lead paint of the kitchen will be durable and easy to clean.

The owner-builder cutting sheet lead strips to make durable, weather-tight flashings for the chimney.

Chemical Corrosion Resistance of Lead

LEAD may be economically employed with many of the chemicals used in the process industries. The following partial list of such chemicals with brief comments on the reactions they may be expected to have with lead is intended as a general guide in the selection of materials of plant construction. Because of the broad range of chemicals and the wide variation of operating conditions existing in modern industry a more complete and more specific list would be impractical.

ACETIC ACID—Moderately corrosive to lead but corrosion is greatly accelerated by high concentrations and temperatures. Acetic anhydride and glacial acetic acid are handled in lead.

ACETONE—Lead may be used satisfactorily.

ACETYLENE—Little effect on lead.

ALCOHOL, ETHYL—No effect on lead.

ALCOHOL, METHYL—No effect on lead.

ALUMINUM SULPHATE OR ALUM—Lead may be used satisfactorily.

AMMONIA—Lead is unaffected by the dry gas, and by liquid unless sodium or potassium are dissolved in it.

AMMONIUM AZIDE—No effect on lead.

AMMONIUM CHLORIDE—Lead may be used at ordinary temperatures with concentrations up to 10 per cent.

AMMONIUM HYDROXIDE—Lead satisfactory with liquid or gas at practically all temperatures and concentrations.

AMMONIUM PHOSPHATE — Lead may be used satisfactorily.

AMMONIUM SULPHATE — Lead may be used satisfactorily.

ANTIMONY CHLORIDE — Lead is somewhat corroded, but is used with comparative economy for chlorinating the tri-chloride to the pentachloride.

BENSYL CHLORIDE—Lead may be used satisfactorily.

BORIC ACID—Lead may be used satisfactorily.

BRINE—(see Sodium Chloride).

BROMINE—Lead may be used when cold and acid free.

CALCIUM CARBONATE—Found in natural waters and forms a good protective coating on lead. Added to water to reduce plumbo-solvency.

CALCIUM HYDROXIDE—Presence in green cement corrodes lead in presence of moisture and oxygen. However, added to soft waters reduces plumbo solvency.

CARBONATES, SOLUBLE — Act as a protection to lead in natural waters unless present in excess, when it increases solubility. Lead is used in acid carbonate systems for generating CO_2.

CHLORINATED HYDROCARBONS—Action on lead varies from slight to severe depending upon breakdown to HCl and presence of organic acids.

CHLORINATION PROCESSES—Lead is slowly corroded at temperatures usually used, but has satisfactory life and greater economy compared with other common metals.

CHLORINE—Dry does not effect lead and lead may be used with moist chlorine up to about 110 deg. C. with slight corrosion. Amounts of chlorine used in water treatment do not affect lead.

CHROMIC ACID—Since chromates form a good protective coating on lead, lead may be used with fairly high concentrations of this acid. Antimonial lead is widely used in electroplating.

CINDERS—Lead embedded in cinders should be protected.

COAL TAR—Lead used in refining and recovery of many by-products.

CONCRETE, CEMENT OR MORTAR—When green, free lime present attacks lead. Aging to carbonate lime or applying asphalt coating on lead recommended to prevent such corrosion.

COPPER SULPHATE—Lead is used for anodes and tank linings in electroplating.

ETHER—Little or no effect on lead. Lead used in its manufacture.

FERROUS SULPHATE — Lead used for tank linings and coils in production and use.

FORMALDEHYDE (FORMIC ACID)—Action on lead similar to that of acetic acid.

HYDROCHLORIC ACID—Use of lead is not generally recommended but it has been used with some corrosion in concentrations up to 30 per cent at normal temperatures and 20 per cent at 100 deg. C. Antimonial lead shows better resistance than ordinary lead.

HYDROFLUORIC ACID—Lead is commonly used and has fair resistance to dilute acid.

HYDROGEN CHLORIDE (ANHYDROUS HYDROCHLORIC ACID)—Little effect on lead.

HYDROGEN PEROXIDE— Not likely alone to affect lead, but accelerates acid corrosion.

KOCH ACID REDUCTION MASS—Lead may be used satisfactorily.

MAGNESIUM CHLORIDE—Corrodes lead as it does other metals.

MALACHITE GREEN MOTHER LIQUOR—No appreciable effect on lead at 80 deg. C.

MIXED ACIDS—Mixtures of sulphuric and nitric acids can be used with lead at ordinary temperatures if water present is less than 30 per cent.

NAPHTHALENE — No effect on lead.

NITRATION MIXTURE OF H-ACID—Lead is used with rather high corrosion.

NITRIC ACID—Lead is not generally recommended with this acid, but is used with little corrosion when concentrations are above 80 per cent at normal temperature.

NITRO-BENZOL AND NITRO-CHLOR-BENZOL—Corrosive to lead.

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NITROCELLULOSE—Lead widely used as in all rayon manufacturing processes.

NITROGLYCERINE — Lead used to handle spent acid.

NITROSYL - SULPHURIC ACID —Action on lead is least at specific gravity of about 1.5 to 1.6. Close control thus minimizes corrosion.

ORGANIC ACIDS—In general, accelerate the corrosion of lead, but their presence in solutions does not always preclude the use of lead.

OXYGEN — Dry gas merely tarnishes lead. In presence of water, initial attack is usually followed by formation of protective coating formed by salts such as carbonates, sulphates and silicates in the water. In absence of these salts, aeration may be employed to remove oxygen because of its action on all metals.

OXY-L ACID—Lead is corroded to some extent but is about the only economical metal that can be used with satisfaction.

PHENOL—Lead may be used satisfactorily.

PHOSPHORIC ACID—Lead may be used with concentrations up to 80 per cent below 200 deg. C. Impure acid has even less effect on lead and can be used up to 85 per cent concentration.

PHOTOGRAPHIC SOLUTIONS—Lead is satisfactory generally.

POTASSIUM PERMANGANATE —Attacks lead.

PYRIDENE—Does not affect lead.

SILICATES—Form protective coatings on lead and thus can be recommended for treating natural waters if necessary.

SODIUM BISULPHATE—Can be handled in lead when highly concentrated.

SODIUM CARBONATE — Dilute solutions do not affect lead; in natural waters forms protective coating on lead.

SODIUM CHLORIDE—Lead satisfactory for dilute solutions at ordinary temperatures. Sea water and brine are commonly handled in lead or antimonial lead.

SODIUM HYDROSULPHITE—Lead may be used satisfactorily.

SODIUM HYDROXIDE — Lead can be used with concentrations up to 25 per cent and temperatures of 80 deg. C.

SODIUM HYPOSULPHITE—Lead can be used satisfactorily.

SODIUM HYPOCHLORITE—Attacks lead.

SODIUM SULPHATE—Lead can be used satisfactorily with solutions up to 10 per cent concentration boiling.

SODIUM SULPHIDE — Lead can be used satisfactorily with these solutions at temperatures up to 100 deg. C.

SODIUM SULPHITE — Lead can be used with solutions up to 20 per cent concentration at 25 deg. C.

SULPHUR CHLORIDE—Has little effect on lead.

SULPHUR DIOXIDE — Has little effect on lead when dry and can be used moist up to about 200 deg. C.

SULPHURIC ACID—Lead is the standard material for handling this acid. It can be used with concentrations up to 96 per cent at room temperature and 85 per cent up to 220 deg. C. It is sometimes used satisfactorily even up to 250 deg. C.

SULPHUROUS ACID — Lead is satisfactory up to about 220 deg. C.

TANNIC ACID — Somewhat similar to acetic acid.

TARTARIC ACID — Somewhat similar to acetic acid.

THIONYL CHLORIDE — Lead is used satisfactorily up to 220 deg. C. and sometimes higher.

TITANIUM SULPHATE — Solutions can be handled satisfactorily in lead.

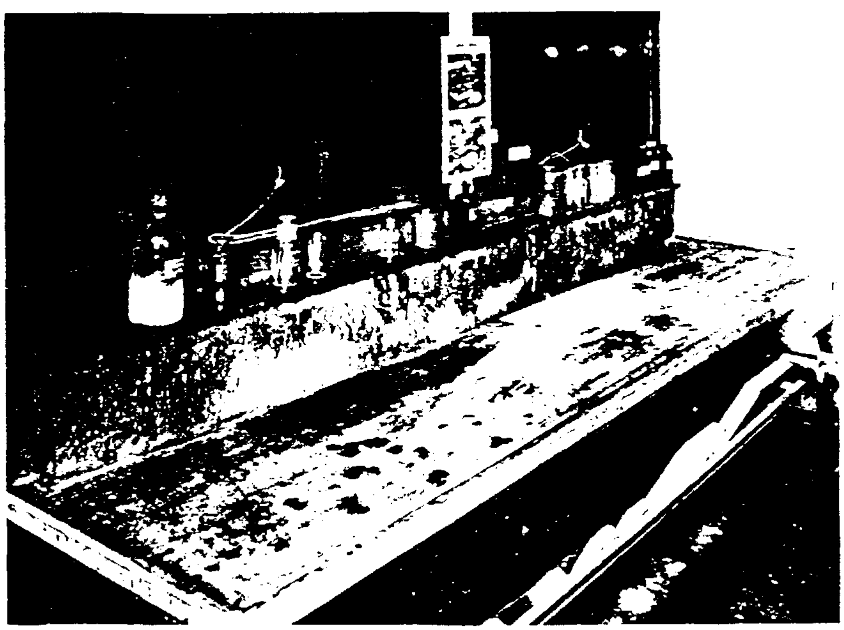
VICTORIA GREEN MOTHER LIQUID—Lead may be used satisfactorily up to 80 deg. C.

WATER, DISTILLED — Dissolves lead very slowly in proportion to amount of dissolved oxygen.

WATER, NATURAL—Usually no effect on lead because of protective coating formed from dissolved salts. Very soft waters or those of peaty origin may dissolve lead slightly, as they do other metals, and such action can be prevented by treatment of the waters with lime or sodium silicate.

WOOD—Most wood has little or no corrosive effect on lead. A few instances of corrosion by wood containing organic acids, such as green oak, have been reported. Wood to be lined with lead should be inspected for presence of borers.

ZINC CHLORIDE — Lead can be used satisfactorily.



The sheet lead table top illustrated above is in excellent condition after seven years service in a western university laboratory under exposure to a variety of corrosive chemicals.

Lead Shows Long Record of Service In Sulphuric Acid Plant

THE simplicity of fabricating methods for lead, as well as the high resistance of this metal to the action of many corrosive elements, make it an indispensable construction material in the chemical industry. An illustration of both corrosion resistance and ease of fabrication is provided in the accompanying photographs of the work in progress of replacing a large lead duct in the sulphuric acid plant of a southern chemical company.

The old duct had been in place and in constant service since the plant was constructed in 1917. It was located between the Glover Tower and the nitre pot and therefore was conveying heavy vapors of sulphuric acid, but the lead was in excellent condition after nearly thirty years of continuous exposure.

The individual sections of the duct were constructed on the site by the simple expedient of rolling 10-lb. sheet lead around a mandrel consisting of three wood discs of proper diameter attached to a simple framework. The longitudinal joint was then welded and two steel bands spaced 4 ft. on centers were put in place and covered with 10-lb. lead which was welded to the duct metal to protect the straps from any stray acid vapors.

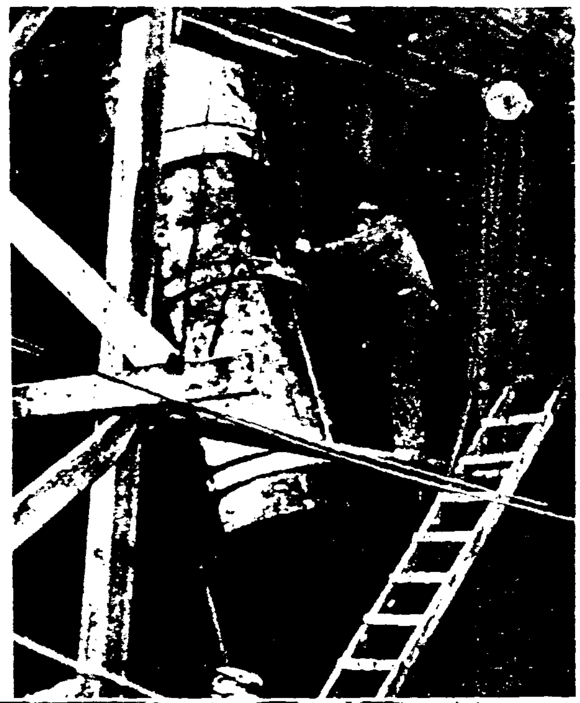
The mandrel was then removed and each section was hoisted to its place and bolted securely to the wood supporting framework. Welding the transverse joints and the connections to the Glover Tower and the nitre pot completed the job and the plant was ready to go back into operation.

The entire length of the duct is 28 ft. and the diameter 42 in. It operates at temperatures of from approximately 235 deg. F. at the top where it leaves the Glover Tower to 205 deg. F. at the bottom where it enters the nitre pot carying SO_2 and SO_3 gasses.

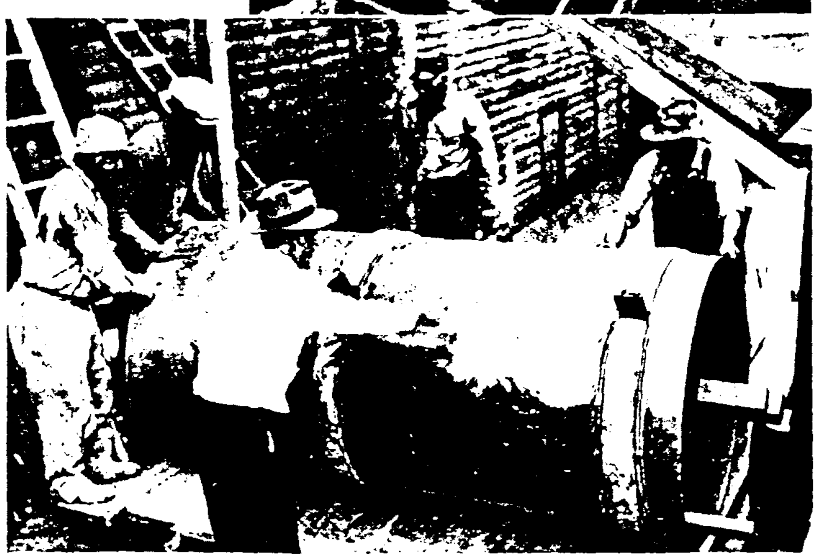
The plant is a box chamber type with four chambers 40 ft. high and 30 ft. wide and from 90 ft. to 120 ft. long. The chambers are of sheet lead with floors and the lower 30 in. of the walls of 20-lb. lead and the remainder of the walls and the ceiling of 7-lb. lead.

This is the first time the plant has been shut down since 1938 and only the second time since its construction in 1917. Very few process plants producing much less destructive materials than sulphuric acid can boast such lengthy periods of continuous operation.

The proved resistance of lead to sulphuric acid vapors and the acknowledged fact that sulphuric acid vapors exist in heavy industrial atmospheres would indicate that lead roofing and flashing materials and lead coated sheets and hardware can be of assistance in solving troublesome corrosion problems.



Setting an 8-ft. section of the 42-in. diameter lead duct in place on the wood supporting beams.

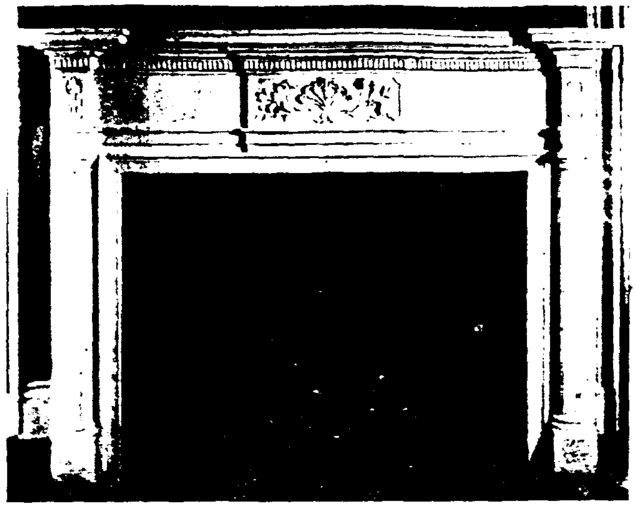


Below, preparing to remove the mandrel from a completed section of the lead duct. Note that steel straps which provide both stiffening and support are secured to the duct and sealed off from corrosive atmosphere by sheet lead covering burned to the duct wall.

A Portfolio of American Landmarks

No. 38

One of the six lovely carved mantels in the house, each of different design. They, along with the rest of the woodwork, in perfect condition after nearly one hundred and fifty years service, are painted with pure white lead paint.



The Parsonage At Glastonbury, Conn.

THE pictures selected for this issue of the Landmarks series are intended to illustrate a landmark in craftsmanship rather than in history although the house from which these details were taken is not without historic interest.

Records of its building have been lost but legend has it that the house was built about 1800 by a wealthy merchant named Benton and given to his daughter as a wedding present. The elegance of detail and extravagance of workmanship apparently did not impress the neighbors favorably since the house was referred to as Benton's folly.

It is difficult in these days to feel that anything as beautiful as the door and mantel shown here are folly and it is evident that the owners of the building have never failed to take the very best of care to see that all perishable features were given ample protection from time and the weather. All of the woodwork, both inside and out has been and still is painted with pure white lead paint. Only by means of the use of the best paint properly applied could the crispness and delicacy of the exceptionally fine carving have been so well preserved.

Right, entrance to the Congregational Parsonage in Glastonbury, Conn. Built about 1800, the exquisite carving and fine detail are sharp and clean, preserved but not coarsened by periodic repainting with pure white lead paint.

Left, interior of the entrance doorway is equally lavish and quite as well protected, also by pure white lead paint.

PHOTOS BY DAYTON SNYDER

THIS IS NO. 38 OF A SERIES REPRESENTATIVE OF THE MANY AMERICAN LANDMARKS IN VARIOUS SECTIONS OF THE COUNTRY THAT ARE PRESERVED FOR THE FUTURE WITH PURE WHITE LEAD AND OIL PAINT. MANY OF THEM HAVE ALWAYS BEEN PROTECTED WITH THIS RELIABLE MATERIAL ACCORDING TO AVAILABLE RECORDS.

Exposed Lead Shielding Makes Attractive Wall Finish For X-Ray Room

THE methods of installing sheet lead on the walls of rooms housing X-ray equipment will, of course, very with conditions and they are governed primarily by the building structure and the weight of the lead. The comparatively light lead shielding required for ordinary medical radiography can usually be very simply applied.

The accompanying photograph shows such a shielding of 4-lb. sheet lead applied with an ordinary lock seam joint which provides a positive unbroken barrier over the entire wall

Exposed lead X-ray shielding in Veterans Administration building in San Antonio, Texas. Neat installation with nailing covered by lock seams allows functional material to become finish material on a specialized wall.

area. In this case the bottom course was applied first and nailed along the top of the sheet about ¾ in. from the edge. The top edge of the lead was then turned out and down ½ in. The bottom edge of the next course was turned up ½ in. and hooked under the turned down edge of the bottom course.

The procedure was repeated with each course up to the ceiling. The seams were then dressed down smooth making a neat, presentable job which required no additional finish. Vertical joints were made in the same manner.

Where thicker lead is required for X-ray shielding more elaborate provision for support may be necessary. Where the lead is to be concealed behind plaster or other finish it may seem that a plain lap joint would be sufficient but the lock seam joint is an excellent means of securely covering all nailing without the use of extra strips attached by soldering or welding.

This installation is in a building which is being remodeled for the Veterans' Administration in San Antonio, Texas. The opening in the wall is the entrance to the dark room and is backed up by a baffle wall also covered with lead.

The erection of the lead shielding was done by A. J. Monier, plumbing contractor of San Antonio, whose men, justly proud of their job, are shown in the foreground.

The following articles and reprints contain information, drawings and specifications on the use of lead products helpful to architects, engineers and others in the construction industry. They are available, free of charge, upon request to the Lead Industries Association, 420 Lexington Avenue, New York 17, N. Y.

PROPERTY PROTECTION WITH WHITE LEAD PAINT

A 28 page booklet on the protective value, durability and beauty of pure white lead paint with quantity estimating tables, formulas and mixing and tinting instructions for exterior and interior use.

RED LEAD FOR STRUCTURAL WORK
By Dr. L. L. Carrick, Director, Red Lead Research, Lead Industries Association

A discussion of the rust inhibitive qualities of red lead paint and the best means of making use of those qualities for the protection of structural metal. Reprinted from *Engineering News Record*, April 6, 1943.

LEAD CARRIES ITS WEIGHT
By Fred P. Peters

An interesting resume of many of the long established uses of lead plus information on a number of recently developed adaptations of the properties of lead to special purposes. Reprinted from *Scientific American*, June, 1944.

SOME PAINTING PROBLEMS AND THE ANSWERS
By Dr. F. L. Browne, Senior Chemist, Forests Products Laboratory, Madison, Wis.

Reprinted from the *National Real Estate Journal*, Sept., 1939.

NEW LEAD COATING PROCESS ELIMINATES USE OF ZINC ALLOYS
By W. Yonkman, Engineer, Western Electric Co.

A description of a successful hot dip lead coating process with complete instructions for changing over from hot dip galvanizing using the same equipment. Reprinted from *Product Engineering*, May, 1944.

LEAD COATINGS ON STEEL
By Harold A. Knight, News Editor, Metals and Alloys

A thorough discussion of hot dip and electroplated coatings on steel sheet, wire and fabricated products including the technique of application, thickness of coatings, uses and advantages. Reprinted from the November, 1944 issue of *Metals and Alloys*.

COMMERCIAL STANDARDS:
Calking Lead, CS94-41
Lead Pipe, CS-95-41
Lead Traps and Bends, CS96-41

Official publications by the Government Printing Office of the above Commercial Standards as promulgated by the U. S. Department of Commerce through the National Bureau of Standards, effective June 25, 1941.

FEDERAL SPECIFICATION WW-P-325
For Pipe, Bends and Traps, LEAD

Part 5 of Section IV of the Federal Standards Stock Catalog, official publication by the Government Printing Office.

STAMFORD'S DOUBLE LIFETIME HOME

A complete analysis of hard lead flashing, white *lead paint, lead plumbing, plywood and red cedar* Certigrade shingle details and installation methods. Reprinted from *American Builder*, July, 1939.

LEAD X-RAY SHIELDING

Graphic chart based on recommendations of the International Commission on X-Ray and Radium Protection giving thicknesses of lead for respective voltages in millimeters, inches and pounds per square foot.

MATERIALS AND METHODS OF X-RAY PROTECTION
By George Singer, Acting Chief Radiation Section, National Bureau of Standards, Washington, D. C., and George C. Lawrence, Ph.D., National Research Council of Canada

A discussion of the materials suitable for use in shielding X-ray installations giving methods of and graphs for computing required thickness of barriers, based on tube current and distance as well as tube voltage. Reprinted from *Industrial Radiography* Vol. IV, No. 2, Fall, 1945.

LEAD, A METAL OF MANY USES IN THE THEATRE
By J. Leland Benson

A discussion of the many ways, both utilitarian and decorative, in which lead is or can be used in the theatre. *Reprinted from Theatre Catalog 1945 Edition.*

SPECIFY SEAL OF LEAD INDUSTRIES APPROVAL MATERIAL

UPON REQUEST, THE LEAD INDUSTRIES ASSOCIATION WILL BE GLAD TO MAIL "LEAD" REGULARLY, FREE OF CHARGE, TO THOSE INTERESTED, AND WILL COOPERATE WITHOUT OBLIGATION IN THE SOLUTION OF YOUR LEAD PROBLEMS

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