ɀh an anne
pered and
ıg is fuse

ıntil, as
ıt about
·lts and
e plates
·eatment
strength-
structure
ce than

l-bearing
neet spe-
user as
table.

to
the

·ing red lead
ıtely.)
ecommended
eel for Red

ting Highway

PAINT: RED-
TT-P-86a
aints including
ntended appli-

painted, the
given, and the
·ed. Reprinted
Maintenance."

E
ERY CORRO-

ı for the petro-
. How to avoid
ced with lead-
in detail. Re-
April, 1958.
ND FLASHING
he new 2½ and
n detailed draw-
alog," 1958.

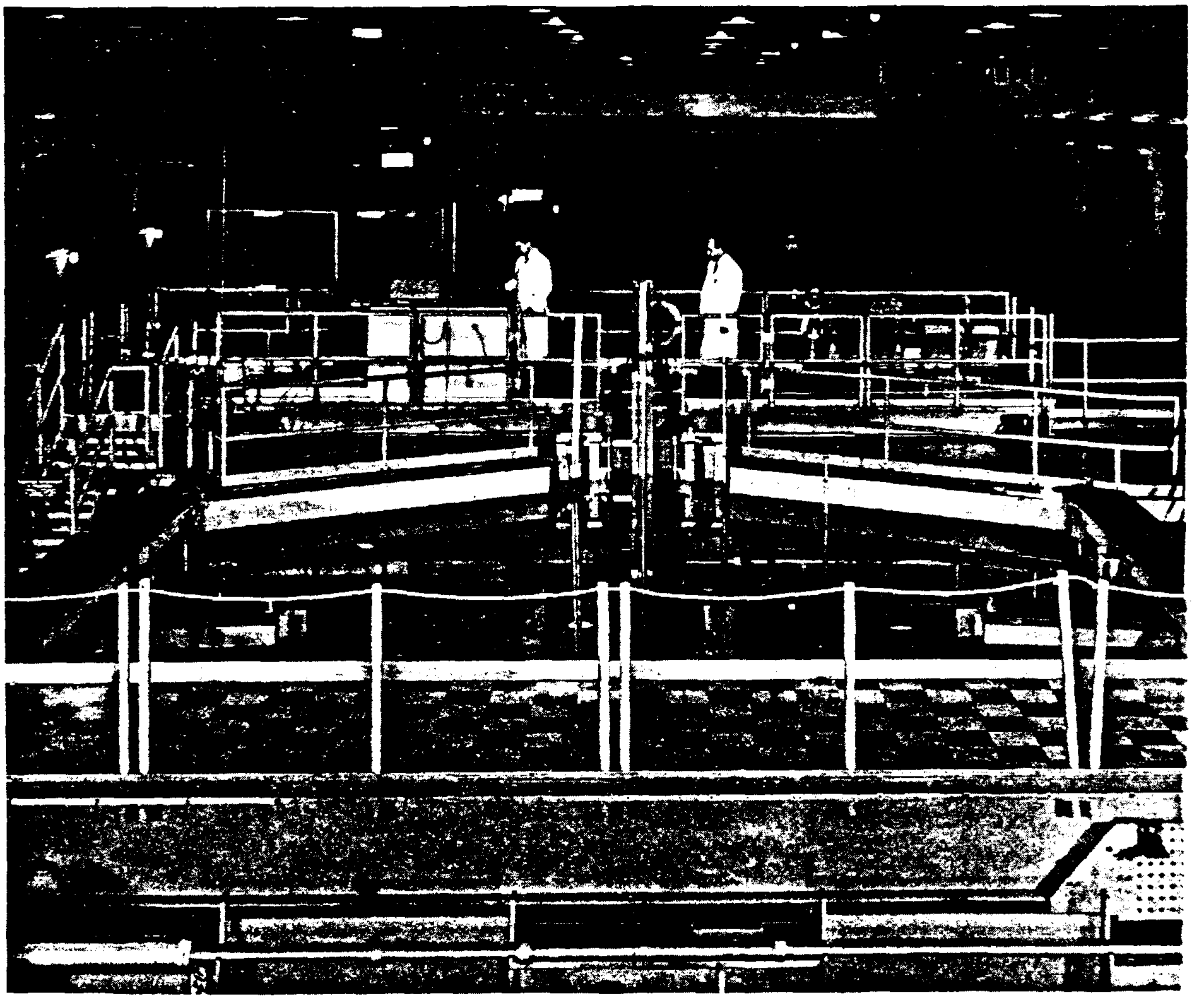
lead pipe and
f today's indus-
etailed drawing
weet's Catalog."

ARGE,
LEMS.

N U. S. A.
N COMPANY, INC
RK CITY

Lead

VOLUME TWENTY-TWO 1958 NUMBER THREE



Over 20 tons of lead are included in the shield of the "Modified Swimming Pool" research reactor at the Naval Research Laboratory, Washington, D. C. *See story page 7.*

INDUSTRIES ASSOCIATION
STREET, NEW YORK 17, N. Y.

Lead Superconducting Connections

Another case where lead's fabricability and one or more of its intrinsic properties have been employed in solving a problem is exemplified by International Business Machine Corp.'s utilization of lead's superconductivity (the transition temperature for zone refined lead is 7.175 ± 0.005 deg. K in zero magnetic field). As first reported by researcher J. A. Kurtz in a recent issue of IBM Journal, lead for making superconducting connections to thin films of vapor-deposited metal in cryogenic circuits has been found useful.

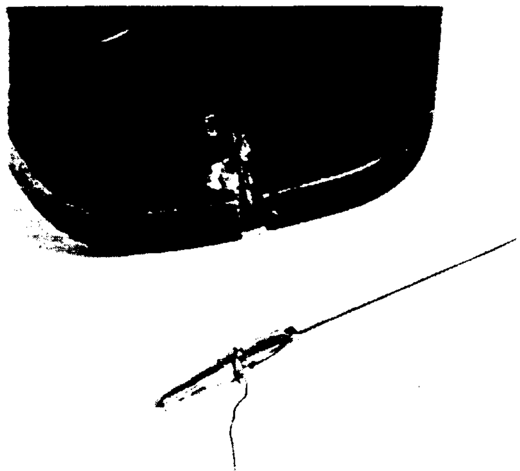
Because the resistance of the circuits immersed in liquid helium must be exactly zero, compressed lead powder of the smallest commercial particle size is used as an intermediate superconducting contact between the film and external circuitry. In making such contacts, two methods were tried, the first making use of a specially prepared plug, and the second, supporting the wire on a plastic base which remains permanently attached to the sample. Of the two methods tried for affixing the solder-covered wire to the film-covered wire, the second was better.

In the first method, the film coating is easily damaged by flexing the unsupported wire. (A fractured film would give a lower critical current.) In it the prongs of the plug are flattened down, a solder-covered wire is soldered to the tapered end, and the whole is covered with a surface coating of solder. The film-coated wire is inserted into the hole at the end of the plug, the cavity is filled with lead powder and a crimper is used to compact the lead in an amount determined by eye after a few trials, Figures 1 and 2.

The second method is easier to apply than the first and reduces the strain by supporting the wire on the plastic base. A small amount of powdered lead is put into the cavities at the ends of the block and the film-coated wire is inserted in the slots. Solder-coated copper wires are also put into each cavity through the same slots, whereupon the cavities are filled with lead powder. A punch is used to compact the lead under a pressure of about 5,000 psi, Figures 3, 4, and 5.

For the intended application, the current at which the self-field transition out of the superconducting state takes place is determined by passing successively greater known currents through the test specimens. Switching is taken as destruction of the superconducting state resulting from the critical self field. The appearance of voltage across a specimen, as detected by a voltmeter with 10 microvolt full scale sensitivity serves to identify the onset of the transition.

Contacts made to vapor deposited tin films by the first method have car-



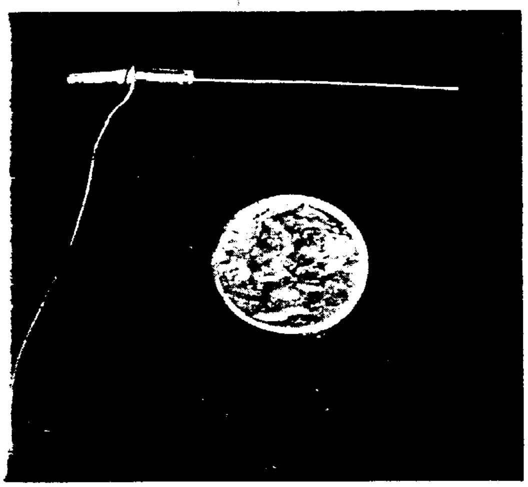


Fig. 1. top. Specially prepared Aircraft Marine Products tapered plug. The film is on the straight wire. The crooked wire is the external lead. The crimping tool head is above the plug.

Fig. 2, bottom. Completed compressed lead powder connection.

Fig. 3. Plastic supported arrangement with external leads.

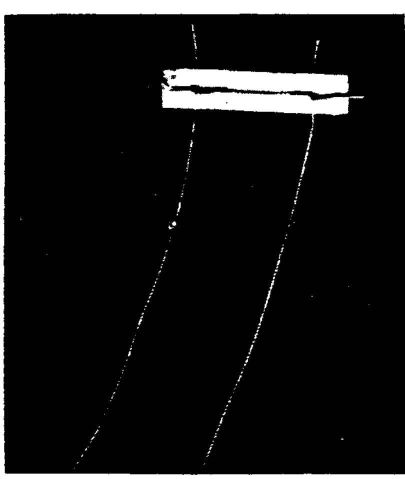
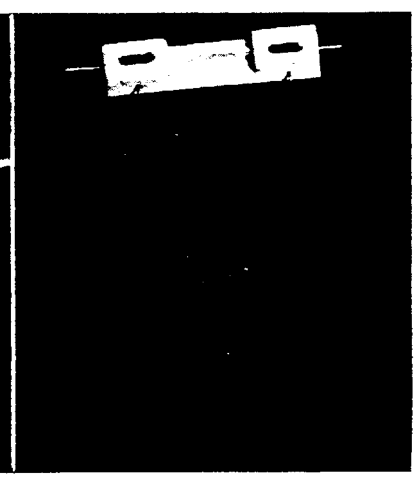


Fig. 4. Compression of lead powder in hydraulic press.

Fig. 5. Completed connections in plastic base.



ried up to 200 ma. at a temperature of 3.67 deg. K without switching. Contacts made by the second method to similar tin films carried up to 1.25 amp. at 3.67 deg. K.

Lead's normally high resistivity coupled with the superconducting transition has made lead and certain lead alloys attractive in other application areas as well, in flip-flop circuits, gates, counters and other computer circuitry. In summary, the advantages of lead in superconducting (or cryogenic) circuits are:

1. It has a high critical field so that it does not switch into the normal state by self-field when a gate strip of tin switches.

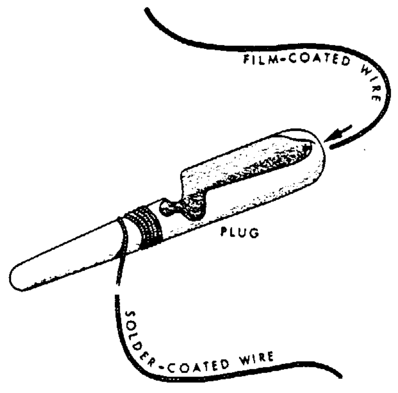
2. It is readily available in the purity and type (granules, powders, bars, etc.) desired and is not too expensive.

3. It vaporizes easily so that flat film cryotrons can be made up by vacuum evaporation techniques.

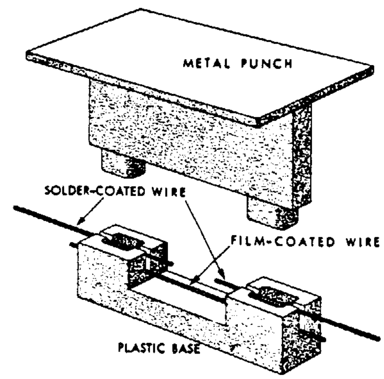
4. When used in powder form to make the connections described, no heat is required and only moderate pressure need be used.

Full exploitation of superconductive phenomena is yet to be had but startling developments are in the offing. Investigations are now being made into alloying and the effects of hydrostatic pressure on lead's transition to the superconducting state.

METHODS FOR MAKING LEAD SUPERCONDUCTING CONNECTIONS



Modified AMP taper plug for compressing lead powder.



Plastic base and metal punch for compressing lead powder.

Another Record-Breaking Bridge Primed With Red Lead Paint

THE Quinnipiac River Bridge at New Haven, Conn., with its central three-span continuous plate-girder unit, is the largest structure on the 129 mile half-billion dollar Connecticut Turnpike. Two of the span lengths are 258 ft. with a center span of 387 ft., the longest for this type of construction in the Western Hemisphere.

This record-breaking bridge, carrying six lanes of Turnpike traffic is nine-tenths of a mile long. Included in this distance are the three-span continuous unit, 903 ft. long, 2,541 ft. of simple-span girders varying from 125 to 175 ft. in span length and 1,290 ft. of simple-beam spans varying in length from 57 to 93 ft. In addition, the west end of the structure is widened at two locations to accommodate ramp structures of simple-beam construction. At the east abutment, the roadway is widened to 120 ft. to provide access and exit ramps to city streets.

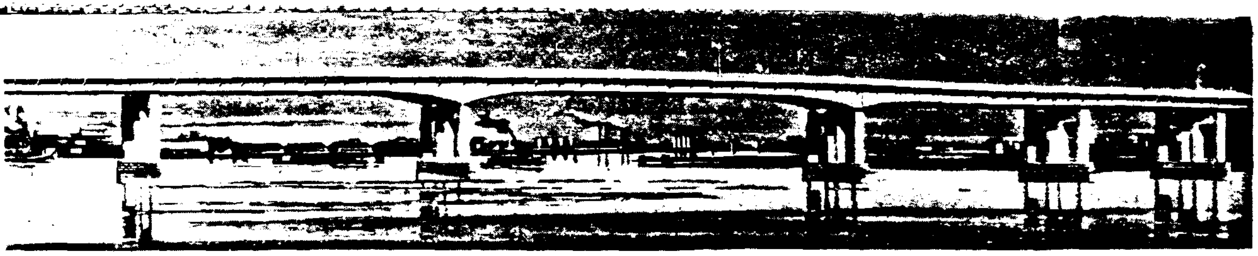
This bridge joins with another record breaker, the Mackinac Bridge (Lead, Volume 21, No. 2) in the selection and use of red lead paint to

TABLE I
SPECIFICATION
for
PRIMER AND FIRST FIELD COAT
QUINNIPIAC RIVER BRIDGE AND
INTERCHANGE

Pigment:	Per Cent by Wt.
Red Lead (95% grade)	75.0 min.
Red Iron Oxide (80% Fe_2O_3 min.)	25.0 max.
	100.0
Vehicle:	
Fractionated Linseed Oil	95.2 min.
Driers and Turpentine	4.8 max.
	100.0
Pigment (per cent by weight)	73.5-75.5
Vehicle (per cent by weight)	24.5-26.5
Weight per gallon (lb.)	22.0
Drying time (hours to dry through)	24 max.

LIA26150

The steel work of the Quinnipiac River Bridge and triple interchange, called a "can of worms" by the contractors, has two coats of rust-inhibiting red lead paint.

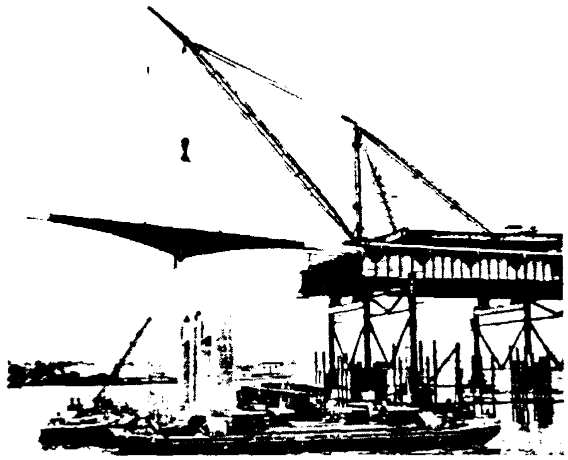


protect the structural steel against corrosion. Both of these outstanding bridges were designed in the offices of D. B. Steinman, consulting engineer of New York.

The formulation for the red lead paint used on the Quinnipiac Bridge for the primer and first field coat appears in the accompanying table.

A "can of worms" is what the contractors have so aptly named the triple interchange located within downtown New Haven, see accompanying photograph. The eastbound and westbound roadways within this interchange are at different levels and as much as 350 ft. apart to provide necessary underclearance and sufficient space for multitudinous roadways. The total length of paved roadway within the 1.48 miles of this particular part of the Connecticut Turnpike is 5.36 miles, of which 2.19 miles are on steel structures that have been protected against corrosion by a primer and field coat of lead paint.

An engineer's rendering of the completed Quinnipiac Bridge, the largest structure on the 129-mile Connecticut Turnpike, and at right, during construction. All steel received two coats of red lead paint.



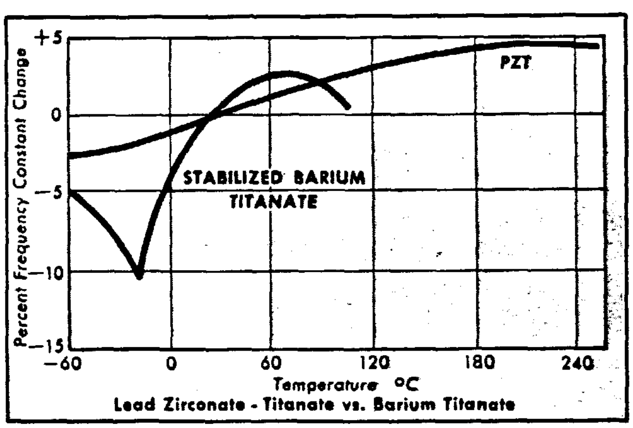
Bethlehem Steel Co. fabricated the steel work and R. M. Boynton, associate engineer with D. B. Steinman, was in charge of the project.

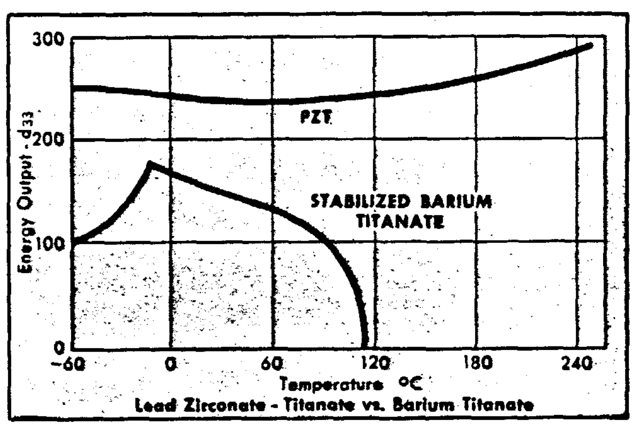
Lead — The Standard In Stereophonic Sound

One of the latest and most exciting new uses for lead is in the field of stereophonic sound. Two lead zirconate-titanate elements comprise the heart of a new series of pickup cartridges capable of transforming the vibrations in the groove of a stereophonic record into the wonder of stereophonic sound.

The Clevite Corporation produces a variety of lead zirconate-titanate materials, known to the trade as "PZT," for these cartridges and for other purposes. These elements are able to transform record groove vibrations into sound through the unique property of piezoelectricity or "pressure electricity." Since the nineteenth century, piezoelectric materials have been known to have the ability to generate electricity when subjected to stress or pressure. Some crystals have this property in their natural state, some ceramics can be given this property by electrical polarization. Conversely, they will elastically deform independently under the in-

Temperature dependent properties "PZT" vs. barium titanate





LIA26151

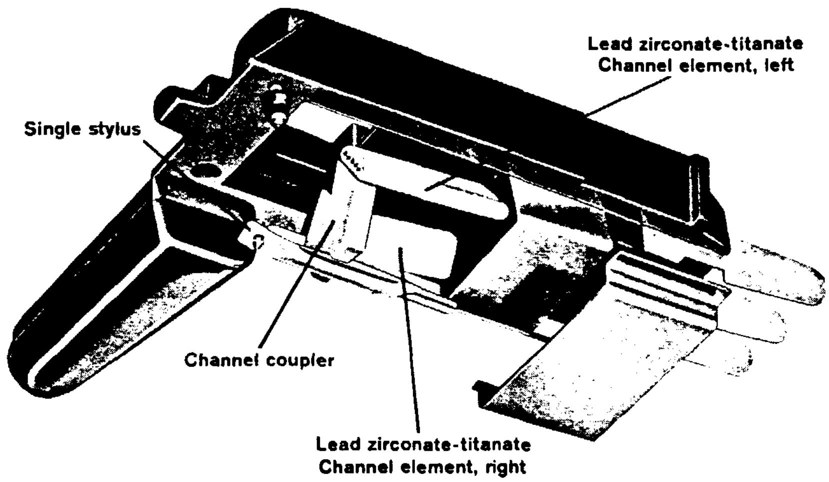
fluence of an electric field. Lead zirconate-titanate is one of the performance leaders in this field.

Stereophonic sound, the exciting new major step in the hi-fi world, requires two separate channels of sound. A unique design of the cutting and playback cartridge has made it possible to combine these two channels on a single record, with a single stylus—hi-fi parlance for needle—in a single groove. The sound channels are picked up and fed separately to the ears to yield the impression of 3-dimensional sound, or a true feeling of "presence". The stylus transmits vibrations picked up from the record groove to two separate "PZT" elements, as shown in the accompanying figures. Each element is oriented so as to be sensitive to motion in only one direction. The elements are placed in the cartridge so that their polarities are at 90° angles to each other. In effect, two channels can be recorded into one groove with each element picking up only the motion in the direction to which it is sensitive.

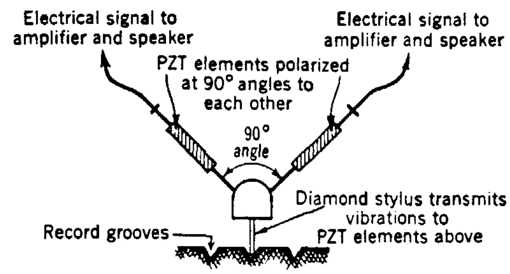
The superior properties of "PZT" which make it so desirable for a stereophonic pickup are principally its higher electromechanical coupling—its electrical output to mechanical input, and its lower modulus of elasticity. A lower modulus of elasticity results in a pick-up element of higher compliance or flexibility. These features are desirable because of the greater complexity and delicacy of the pickup system. The stylus in a stereophonic pickup cartridge has a sharper point than in a standard playback cartridge. Therefore, in order not to cause excessive record wear, it is necessary to reduce the forces between the stylus and the record groove. The higher compliance and greater electrical output of these lead zirconate-titanate elements makes it possible to reduce these forces and yet still obtain a good electrical signal from the cartridge.

Piezoelectric materials have been known for many years. They form the basis of the fields of ultrasonic flaw detection, ultrasonic cleaning, etc. In general, the use of "PZT" greatly increases the reliability and operating range of devices presently using other

Cutaway of PZT Stereophonic Cartridge



Drawing and diagrammatic sketch showing location of lead zirconate-titanate elements on a stereophonic cartridge.

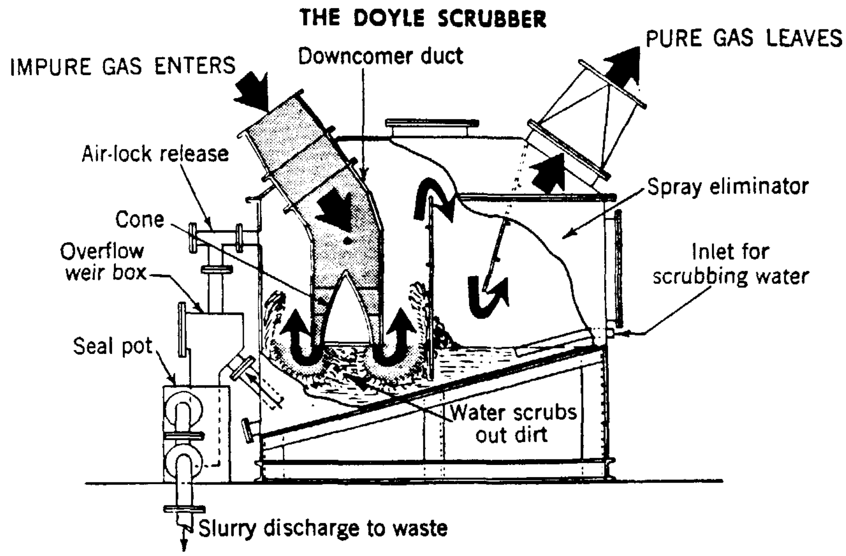


materials. Basically, this is again due to its higher electromechanical coupling and also to its higher Curie temperature. The Curie temperatures of "PZT" materials can range up to 300° C. which compares with a Curie temperature of 110° C. for barium titanate. The result is that not only can these materials be used at substantially higher temperatures, but they can be driven to higher mechanical power outputs at lower ambient temperatures without incurring any loss of power when the temperature of the transducer rises during operation.

An exciting future is seen for this material. It has already found a new use as a transducer material for our Navy's sonar underwater detection equipment. Moreover, "PZT" electromechanical filter devices called "Transfilters"* have been designed by Clevite which can take the place of the intermediate frequency transformers in radio circuits. Other uses in this field are envisaged. This high power output material may very well find a big market for itself in the field of ultrasonic cleaning. There may come a day when the average housewife will have a dishwasher which owes its excellent cleaning powers to lead zirconate-titanate transducers.

* Reg. U.S. Pat. Off. by Clevite Corp.

This cage-constructed Doyle Scrubber is treating gases from crusher and conveyor transfer points for dust recovery at Cominco's smelter feed and sinter plant at Trail, B.C. Over 4,900 lb. of antimonial lead sheet, from 24 lb. at the bottom to 8 lb. on sides above water line are used in the scrubber. An operational detail is shown at right.



New Lead-Constructed Scrubber In Use

A new wet-impingement scrubber has been developed by The Consolidated Mining and Smelting Company of Canada Limited as a more efficient recovery unit for the treatment of dusts and fumes from process gases and ventilating systems. Known as the Doyle Scrubber, it utilizes principles of wet-impingement collection at relatively high gas velocities with high recovery efficiency and low installation and maintenance costs. As indicated in the sketch, the gas stream, laden with fume and dust, enters the downcomer duct, whereupon its velocity is increased by the annular gap provided by the placement of a streamlined cone at the duct bottom. Desired impingement velocities are obtained by use of cones of appropriate base diameters or, if a wide variation in gas volume is anticipated, with an adjustable cone. The impure gas, after entering the liquid undergoes a complete reversal of direction, leaving the impingement tank at the top, then entering the spray elimination section. The clean gas is subsequently exhausted or used in other processes.

Cominco has over 20 lead-constructed Doyle Scrubbers in use to treat exhaust gases from materials transfer points in its metallurgical plants to eliminate atmospheric dust. These scrubbers are of lead-on-steel-cage construction which contributes to low-cost installation and maintenance.

Advantages provided by this mode of construction are:

1. Effective performance of lead in contact with variable concentrations of a wide variety of corrosive process gases and solutions.

2. Repair is made possible from the outside.

3. Where the chamber design calls for extra support for the lead lining, this can be provided externally, with the avoidance of internal strapping and the necessity for piercing the sheets.

4. Lower material and erection costs and easier construction through the elimination of unwieldly steel sheets.

5. Easy leak detection. When steel chambers are lined with lead, it is customary to provide "weep holes" to indicate the development of leaks. However, corrosives do not always follow a detectable path from the point of failure to the weep hole and observed leaks are often merely an indication of their occurrence rather than of location. The cage construction, on the other hand, permits immediate location of any leak and easy accessibility for repair.

The Doyle Scrubber has been made available by Cominco to industry generally through licensed manufacturers.

Table 1

Operating Requirements for Lead-Lined Doyle Scrubber

Power:	2.2 to 3.0 hp./1,000 c.f.m. of gas	**Impingement Velocities:**	**90 to 240 ft./sec., usually 150 ft./sec.**
Scrubbing Liquid:	2 gal. water/1,000 cu. ft. of gas. In some applications, the rate is as low as 0.5 gal./1,000 cu. ft. of gas—discharged to settling tanks for recovery of solids. Liquid is returned to scrubbing system.	**Inlet gas volume:**	**6,000 c.f.m. at 30° C.**
		Inlet dust burden:	**140 to 180 mg. per cu. ft.**
		Outlet dust burden:	**0.1 mg. per cu. ft.**
		Draft across scrubber:	**10 inches w.g.**

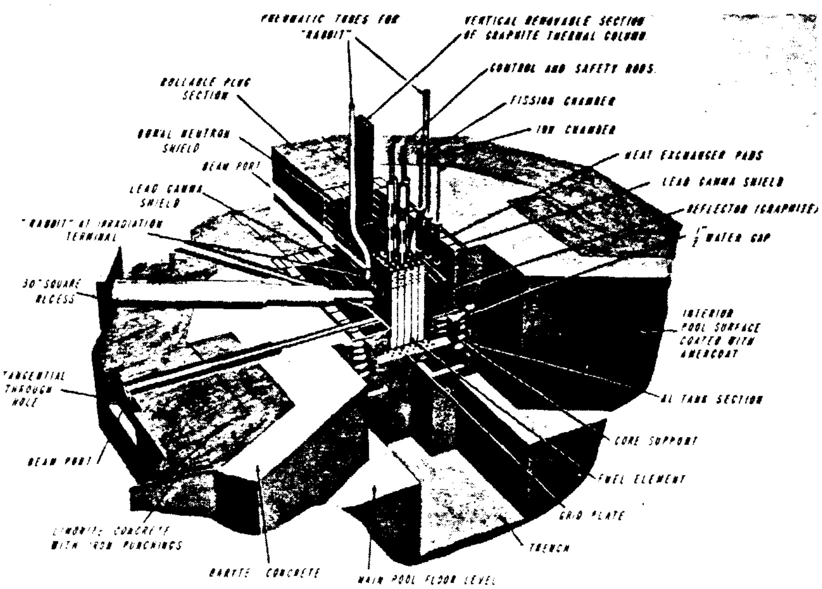
LIA26153

Lead Shield In Naval Nuclear Reactor

Over 20 tons of lead has been included in the shield of the "Modified Swimming Pool" research reactor at the Naval Research Laboratory in Washington, D. C. This reactor and its associated facilities have been designed to meet the needs of a wide variety of investigations in the physical sciences. Its principal function is to provide an intense source of neutrons and gamma rays required in many aspects of the laboratory's research programs. Access to neutrons and gamma rays is provided by seven beam ports which penetrate the concrete and lead shield right to the core of the reactor. These radiations are extremely useful as a research tool in the fields of nuclear physics, solid state physics, metallurgy, chemistry, mechanics, electronics, and reactor technology.

A Modified Swimming Pool reactor with beam ports was chosen because of its flexibility in dealing with varied research problems. The presence of the pool allows the reactor to be used to study radiation shielding design problems of nuclear reactors for ship propulsion and electric power generation. The pool is 40′ long x 26′ wide x 20½′ deep and contains high purity water in order to minimize corrosion of the reactor core and to obviate the possibility of activation of water impurities. This water provides part of the radiation shielding for the reactor; it serves as a coolant to remove the heat formed in the uranium core and; finally, it is a moderator slowing down fast moving neutrons in the core to thermal energies.

One end of the pool consists of a heavy lead and concrete radiation shield including several beam ports with removable plugs. It was necessary to keep the shield thickness to a minimum so that the beam ports would be as short as possible. In order to accomplish this, a shield utilizing lead in conjunction with heavy aggregate concretes was designed. Because of lead's high density, it provides efficient shielding against gamma radiation. The use of lead will substantially reduce the thickness of material required to accomplish a given amount of shielding. Due to the requirements of a compact shield in this reactor, the use of lead was a natural choice.



A cutaway of the "Modified Swimming Pool" research reactor at the Naval Research Laboratory.

The shielding consists of several layers. Immediately outside the uranium core is a layer of carbon blocks whose excellent ability to scatter high energy neutrons makes it useful as a neutron reflector. Surrounding the carbons blocks is a lead brick shield which has been designed to absorb much of the gamma radiation from the core. The lead is followed by heavy barytes concrete which is a strong neutron absorber. The final layer of the shield consists of a concrete containing iron ore and iron punchings which serves as additional gamma ray shielding. Lead performs an additional significant function in this shield. It absorbs a portion of the gamma ray energy and fast neutron energy entering the shield. By absorbing this energy, the temperature in the concrete shield is minimized. In this way, the moisture content of the concrete, which is of major importance in neutron energy degradation, is not driven off.

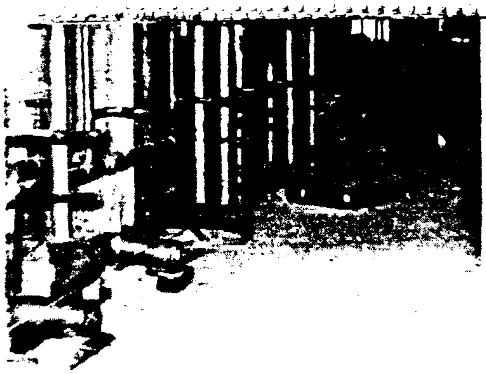
Lead is widely considered in the field of nuclear energy as one of the basic shielding materials. In addition to its use in reactors and portable radiographic equipment where compactness is desired, lead is widely used around atomic laboratories in a variety of experimental applications, in hospitals and, in general, wherever there is a necessity for shielding against gamma rays.

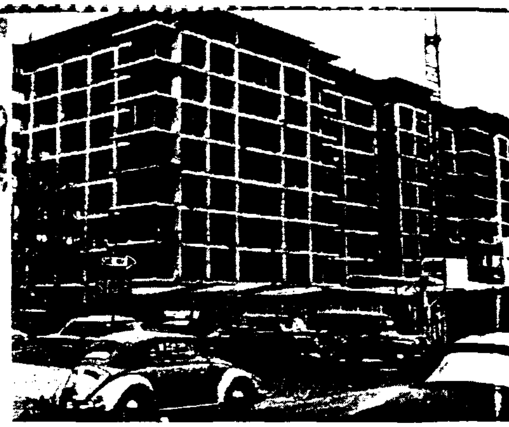
Lead Water Closet Connections

Pratt Housing in Brooklyn, N. Y., a Title I, F.H.A. Slum Clearance Project, and a dormitory building at the Manhattanville College of the Sacred Heart, Purchase, N. Y., are two recent examples of the widespread acceptance of lead water closet connections for all types of construction.

Whether it be for these types of construction, for single-family homes or for commercial-type buildings flexible lead connections have received practically universal acceptance by the building fraternity and there are a number of excellent reasons why this is so.

First, lead connections are flexible enough to permit allowances for slight inaccuracies in construction measurements, an advantage that can result in substantial savings when the fixtures are set in place. Secondly, lead is durable, it will not corrode and rust out under normal operating use.





Flexible lead bends as shown above were installed under more than 1,000 water closets in Pratt Houses, an F.H.A. Title I project under construction at right. At left, lead bends for wall-waste water closets in the Manhattanville College dormitory, Purchase, N. Y.

Finally, lead connections are acceptable to all modern day plumbing codes including those that are national in scope. Among such codes is the National Plumbing Code which was sponsored by the American Public Health Association and the American Society of Mechanical Engineers.

In the Manhattanville College Dormitory Building, flexible lead bends and stubs roughed through the walls were used for the 80 wall-waste, floor-set water closets. The plumbing contractor, Hauxwell and Smith, Portchester, N. Y., also installed 20 6-lb. sheet lead roof drains and 12 4-lb. sheet lead vent stack flashings. The architects were Eggers & Higgins, New York, and Jarros, Baum and Bolles were the mechanical engineers.

In the much larger Pratt Housing project in Brooklyn, N. Y., more than 1,000 lead water closet connections will be installed in three 16-story reinforced concrete structures. The buildings will have 18 apartments with 23 water closets on each floor. This moderate priced F.H.A. Title I project was designed by Kessler & Sons, architects of New York, and the extensive plumbing system was installed by Lipsky & Rosenthal of Brooklyn, N. Y.

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 CONSTRUCTION ANNUAL REVIEWS—LEAD AND LEAD ALLOYS
Lead and lead alloys in design and construction including research progress, engineering applications, and technological advancements. With bibliography. 1957 and 1956 reviews (editions are not cumulative) are available. Reprinted from "Industrial and Engineering Chemistry," September, 1957 and September, 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.

USE LEAD TO CONTROL REFINERY CORROSION
Latest practices in lead construction for the petroleum refining industry are described. How to avoid the difficulties sometimes experienced with lead-lined equipment is also outlined in detail. Reprinted from "Petroleum Refiner," April, 1958.

RADIATION PROTECTION
The place of lead in shielding against radiation in X-ray and atomic energy applications. Principles of lead shielding construction. Reprinted from "Lead In Modern Industry."

PORTABLE RADIATION-SHEILDING 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 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, the textbook presents clearly to the plumbing student the necessary tools, procedures and the methods required for lead work.

LEAD IN MODERN INDUSTRY
$1.00 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 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.
BULLETIN NO. 3
Specification for Lead Chemical Laboratory Drainage Systems.

FEDERAL SPECIFICATION WW-P-325
For Pipe, Bends and Traps: Lead
Dimensions and weights of lead products used in the plumbing and water works fields are given. Published by the Government Printing Office.

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.

SHEET LEAD FOR ROOFING AND FLASHING
Preferred installation methods for the new 2½ and 3-lb. hard lead are given along with detailed drawings. Reprinted from "Sweet's Catalog," 1958.

LEAD FOR MODERN PLUMBING
Preferred installation methods for lead pipe and fittings in the plumbing systems of today's industrial and residential structures. Detailed drawings are included. Reprinted from "Sweet's Catalog," 1958.

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. 11 — Recommended Surface Preparation of Steel for Red Lead Paints.
Technical Letter No. 12—Painting Highway Structural Steel.

FEDERAL SPECIFICATION FOR PAINT: RED-LEAD-BASE, READY-MIXED TT-P-86a
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.

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.

188

PRINTED IN U. S. A.
ISAAC GOLDMANN DIVISION
PUBLISHERS PRINTING—ROGERS KELLOGG CORP.
LONG ISLAND CITY 1, N. Y.