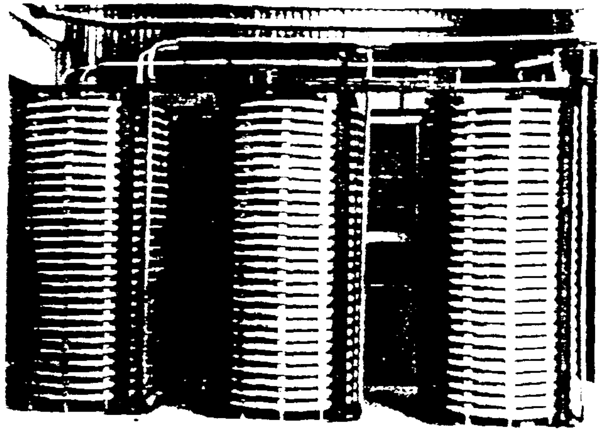
Lead Heat Exchangers

PURE SULPHUR DIOXIDE PRODUCTION UTILIZES UNUSUAL DESIGN

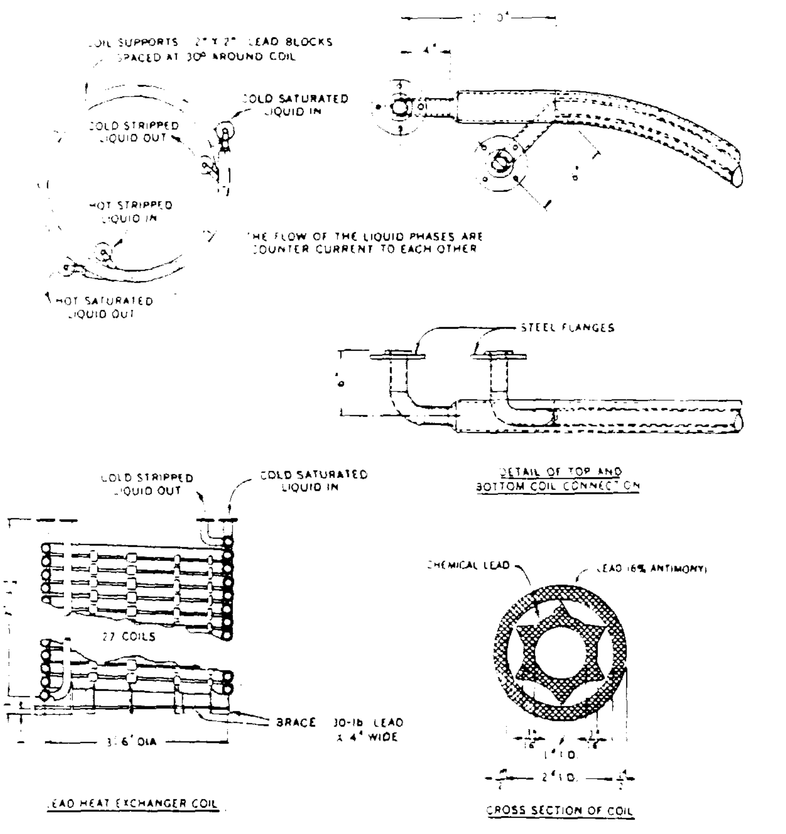
THE nose-tingling smell of burning sulphur has become a modern industrial chemical of far-reaching commercial importance in the form of compressed liquid sulphur dioxide. Though better known as an industrial raw material used in the production of a variety of important chemicals, this acrid gas when purified and in liquid form has found a ready market in a variety of important industries. It is used as an antichlor in bleaching, for refrigeration, as a solvent in petroleum refining, as a disinfectant. For these uses and a host of others sulphur dioxide must be at least 99.997 percent pure. Manufacturing sulphur dioxide to meet such a high degree of purity depends to a surprising degree upon the metal, lead, whose resistance to the corrosive attack of sulphur dioxide has been long established.



Heat exchanger coils consisting of one lead pipe within another permitting counter-current flow of a corrosive coolant

The latest and most unique method for refining impure sulphur dioxide into pure liquid form is credited to research engineers at the Selby Plant of the American Smelting and Refining Co. who put into commercial operation an interesting and unique patented process.* The operation of the process depends upon the fact that cold, liquid dimethylaniline (DMA) dissolves impure sulphur dioxide and gives it up when heated, free of impurities and ready to be dried and compressed.

The heat exchanger phase of the system is particularly interesting. The heat exchangers heat the saturated DMA with hot gas-free DMA and at the same time cool the latter. This complicated sounding maneuver is easily accomplished by using two lead coils, one within the other, as illustrated. In one illustration three such coils are shown connected in series. The other is an interior cross-sectional view of the two lead pipes that make up the coil. The larger pipe has an inside diameter of 2 in. with a ¼ in. wall thickness and is made of 6 percent antimonial lead. The inside pipe made of chemical lead is 1 in. in diameter with a wall thickness a little less than ¼ in. at the thinnest section. The exterior of the inner pipe has been extruded in the shape of a six-pointed star to provide support and also to retain concentricity. In addition, the pipes were designed so that the area of the space between the two



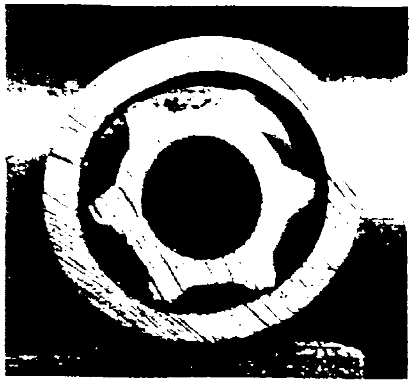
Methods of construction of the lead heat exchangers used in the production of pure sulphur dioxide.

* U. S. Patents No. 2,295,587 and 2,399,013.

is approximately equal to the cross-sectional area of the inner pipe. After extrusion, the smaller pipe is inserted into the larger and both are then coiled into units 11 ft. in circumference and 27 coils high (about 7 ft.). Three hundred ft. of pipe are used in each coil weighing a total of about 5,000 lb.

The saturated DMA containing 15 percent by weight of sulphur dioxide enters the heat exchangers at a temperature of 86 degrees F. and is calculated to leave at about 175 degrees F. The stripped DMA enters the exchangers at a temperature of 198 degrees F. and is calculated to leave at about 110 degrees F.

Because of the corrosive nature of DMA in combination with sulphur dioxide the major portion of the processing equipment which comes in direct contact with these chemicals is constructed of lead. The absorption tower is made of lead with a steel framework for support. Bubble caps are made of antimonial lead as well as the shelves for supporting them. The stripping tower is constructed of steel with a bonded lead lining. This type of lining is necessary because of the higher temperatures encountered. Other materials have been tried in the heat exchanger coils but none have succeeded in providing the long service life obtainable with lead.



Cross-sectional view of the lead heat exchanger coil shows the specially shaped inner lead pipe.

This process is an outstanding example of lead's utility in modern chemical engineering and it serves also as an excellent illustration of the versatility of lead. It may be formed into virtually any extrudable shape. Assembly requires a minimum of effort because of the simplicity of bending and joining by welding ("burning"). It has the highest salvage value of any of the common metals. And of even greater importance in this instance, is lead's unequaled corrosion resistance, the property which governs the high purity of the finished sulphur dioxide.

Lead Alloys in Aircraft Manufacture

THE smooth contours and streamlines of the modern airplane depend, strangely enough, upon lead. In manufacturing airplanes for the Air Force as well as commercial aviation an alloy of lead and antimony is used as the punch casting metal for forming sheet aluminum, magnesium or stainless steel to exacting and complex airflow contours. One reason why lead alloy and not steel or other metal punches are used is because all minor surface irregularities are immediately smoothed out by dropping the punch on to the die.

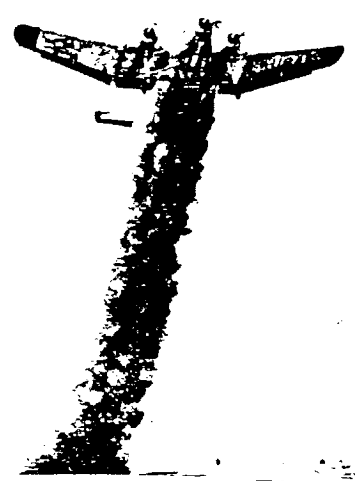
An advantage from the safety viewpoint is that lead punches are not subject to fracture. In an operational life test, one punch formed 3,500 parts from ¼ inch aluminum sheet before it had to be discarded. In general practice punches are usually re-cast after 100 or so parts are made because the high pressure areas are crowded out of contour. The safe operating properties of lead alloy are further indicated by the practice of holding dies in position on the drop hammer platen with lead alloy corner blocks, as shown in the illustration. All other possibilities for holding dies in position have been rejected because of the excellent safety record established by the lead alloy corner blocks.

Drop hammer forming practice at Northrup Aircraft, Inc., Hawthorne, California, is to first cast a punch and form the initial order requirements and then re-strike the formed parts on a new punch. When forming channel sections the average punch will produce 100 stainless steel parts or 200 aluminum parts. With simple shapes, a punch will often produce up to 300 stainless steel parts or 1,000 aluminum parts.

Standard foundry practice at Northrup is to cast hard lead (6 to 7 percent antimony) punches directly on to zinc alloy dies. The dies are boxed in with asbestos coated wooden sideboards and a thick mixture of water and fire clay is used to seal all openings to prevent run-out. Then the contact surfaces of the dies are sprayed with a thin mixture of water and fine fire clay or water and titanium dioxide. After this, the surface is dried and pre-heated between 300 degrees and 400 degrees F. before pouring the lead alloy punch metal.

Hard lead punch metal is poured in a stream about ¼ in. in diameter and quickly distributed over the surface of the zinc die to start shrinkage uniformly. The pouring rate is important in preventing cold shuts and folds besides assuring uniform shrinkage and freedom from distortion. Asbestos covers are placed over the casting directly after pouring and are removed as soon as the casting

The Northrup Raider C-125 equipped with six JATO rocket units. Lead punches are used in fabricating parts for such airplanes.



LIA25973

Above, lead alloy punches and zinc alloy dies in the storage area at Northrup Aircraft, Inc., Hawthorne, Calif.

Right, typical drop hammer using lead alloy punch to form a section for the Northrup C-125 light assault transport plane.

cools to about 500 degrees F. The shrinkage cavity is then filled with molten metal.

Iron bolt holders are cast into the bottom of the lead punch to aid in attaching it to the platen.

Chief among the factors contributing to successful foundry practice are the alloys used for making the casting. Thus the first step in insuring quality control is the procurement of metal to proper specifications. Antimonial lead punch metal has a special advantage here because it is not required to conform to rigid procurement standards. It is capable of tolerating a total of 0.4 percent impurities and may vary in antimony content from 6 to 7 percent.

When the percentage of antimony drops to below 3 percent as the metal is used over and over again it is rejected and sold for salvage thus reducing, in effect, the initial metal cost. A decrease in antimony content below 3 percent lowers the tensile strength to less than 5,000 psi and the elongation below 19 percent in 2 inches. Analysis checks are taken on only a few heats every 6 months to check the antimony content. However, it is interesting to note that after 10 years of foundry operations at Northrup, their lead alloys are still satisfactory and have never been replaced.

New Concepts Explain Why "Lead" Paints are Better

THE importance of the chemical properties of paint pigments to durability and other characteristics of paint films is often overlooked or underestimated. This is partly due to the fact that at least some of the chemical reactions that take place are not widely understood and, in fact, knowledge of them is relatively new.

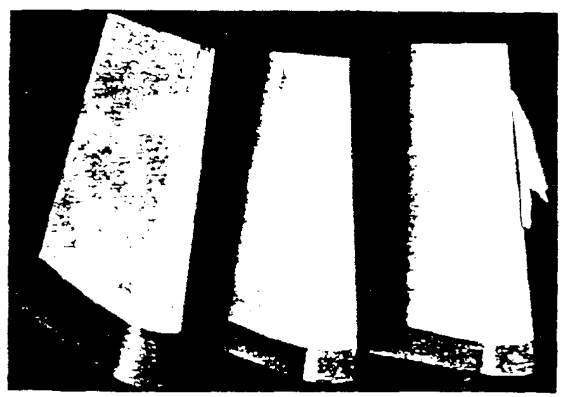
Many pigments are employed for their hiding power, color or other characteristics that are readily and widely understood. But it is only recently that chemical reactivity of certain pigments has become fully recognized for its essentiality in providing film forming characteristics.

The white lead pigments are unique for their film forming properties, at the same time adding other desirable characteristics and not detracting from still others. In fact no other pigment contributes so many desirable properties to a paint film. Lead pigments are not the only reactive pigments but their reactivity is of such a nature and rate that it results in a film having the most desirable combination of properties.

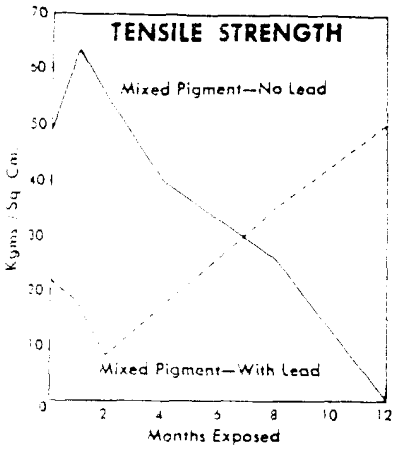
Briefly outlined here are four reasons why white lead pigments make multiple pigment paints last longer.

White lead stabilizes paint, retarding its decomposition. Without a reactive pigment, a house paint film would have a relatively short life in outdoor service. Why? Because as it slowly weathers, the vehicle breaks down to form acidic compounds such as formic, hydroxyacetic, propionic and related destructive acids. These

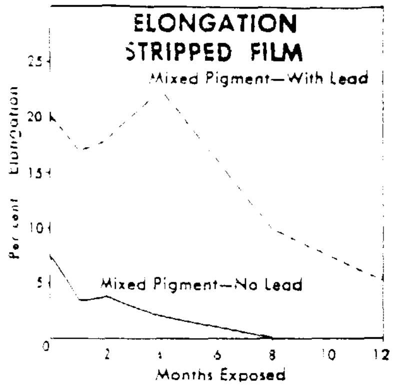
Mandrel test demonstrates high flexibility of paint plasticized with lead shown in center and non-leaded paints, left and right, cracking and flaking as a result of the bending.



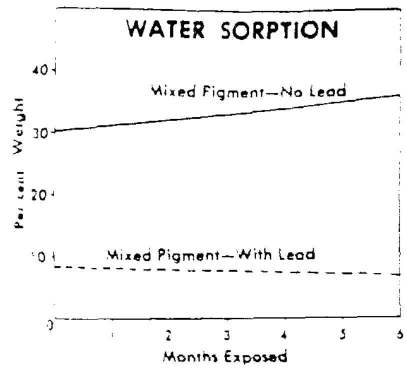
LIA25974



Strength-age graph shows how mixed pigment paint containing white lead increases in tensile strength as it ages.



Elongation graph shows how the flexibility of a paint film is improved by the incorporation of white lead.



Water sorption graph shows how white lead decreases the water pick-up of mixed pigment paints.

acids liquefy or soften the paint film causing early disintegration of the protective paint film.

Active lead pigments in a paint neutralize these products of decomposition as the film ages and form stable insoluble lead salts. In this way, the film is stabilized and its durability greatly improved.

White lead plasticizes paint, increasing its flexibility. In reality a paint film is a plastic, although it is not generally referred to as such. And, like many plastics, it would become hard, brittle and inflexible if it did not contain a plasticizer. Such a paint would crack easily under normal stresses, not only spoiling its appearance but also greatly reducing its protective value.

White lead pigments permit the proper formulation of paints that provide flexible films not only after application, but throughout the life of the paint. Lead soaps, formed by the reaction of a lead pigment with the vehicle, act as plasticizers. Their effect is supplemented by other soaps which are usually present in the film.

White lead increases the elastic strength of a paint film. Lead pigments reinforce a paint film mechanically as a result of chemical reactions. As the films containing the reactive lead pigments age, they increase in toughness to an optimum degree, because the lead soaps, that are formed improve the coherence, the flexibility, the distensibility and the other factors that contribute to long life and improved protective ability of the paint film.

Lead soaps are made up of flexible crystals with a long spiney structure. Under a microscope, they look like cockleburs, with the spines of adjacent crystals intermeshed. This intertwining or meshing forms a felted mat which reinforces the film and increases its elastic strength.

White lead increases the water resistance of a paint film. Water attempts to dissolve and emulsify portions of a paint film causing it to swell and soften. This tends to break its cohesive bond and is probably the greatest single cause of loss of adhesion. Paints containing lead pigments, are highly resistant to water; they absorb only a fraction as much water as non-lead paints. Lead supplies this essential resistance to water and its destructive action.

White lead pigmented paints possess high water repellency. This fact is vividly illustrated in practice by the formation of distinct water droplets on "lead" pigmented paints and the complete wetting of non-"lead" paint films.

Photomicrograph of lead soaps formed from lead pigments in paint. These intermeshing crystals reinforce the paint film structure.

Experimental paint films with varying lead pigmentation after stripping, soaking and drying. As the lead content increases from left to right, disintegration is materially reduced.

LIA25975

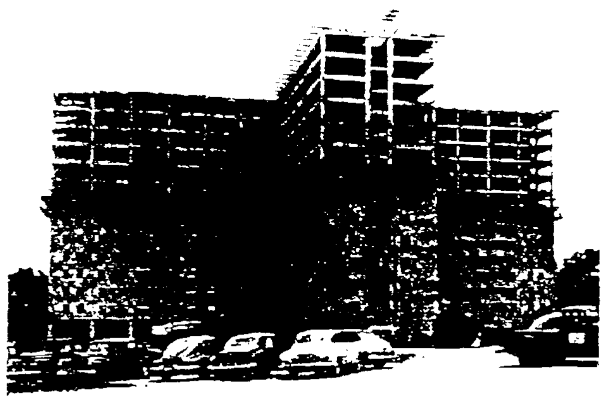
Flexible Lead Connections in Modern Plumbing Systems

ONE of the most practical advantages offered by lead in any plumbing system is the flexibility of the metal itself which is sufficient to take up, without failure, differential movement between the rigid pipe system and the kitchen and bathroom fixtures.

This unique ability of lead to serve in effect as an expansion and contraction joint between materials of different coefficient of expansion has been long recognized by the building industry. It is one of the primary reasons why lead connections are preferred and required by so many plumbing codes. As a matter of fact, it is one of the few materials used in plumbing systems that are permitted by practically every plumbing regulatory code in the country.

Among the many areas of the country that require lead connections between rigid piping and kitchen and bathroom fixtures is Fulton County, Ga., which includes the City of Atlanta. This requirement has benefitted the public as well as the building industry in this area by providing a flexible connection between rigid materials that unquestionably adds years of trouble-free life to the entire plumbing system.

A general view of the 14-story 612-unit Darlington Apartments now under construction just outside the city limits of Atlanta, Ga.



BATES CAMERA

A fine example of this type of plumbing installation has just been installed in the new 14 story, 612-unit Darlington Apartment project designed by architect William G. Tyler, Bissett, Carlisle and Wolff, of Columbia, S. C. This project located on famed Peachtree Road, in Fulton County, just outside the city limits of Atlanta, will have every fixture connected to the cast-iron soil and waste lines with lead pipe, bends and stubs.

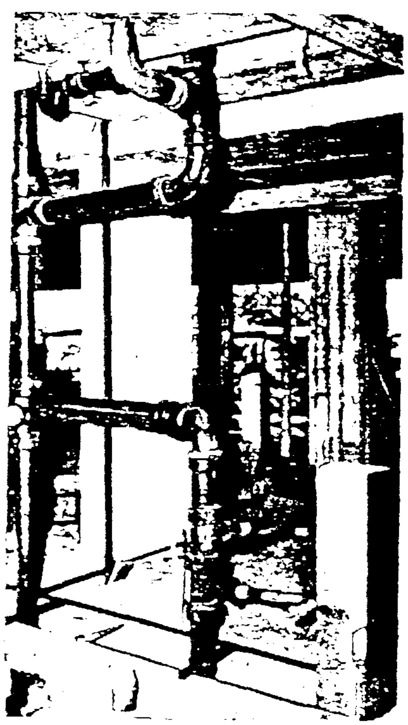
The plumbing contractor, George D. Smith Plumbing and Heating Co. of Atlanta, installed 4-in. lead bends under the water closets and also used 1½ in. manufactured lead bends for the lavatories and kitchen sinks. Lead stubs were used to connect the bath to the soil and waste lines. All joints in the cast iron were calked with lead.

Hub type lead vent stack flashings were used on the 40 vent stacks protruding through the roof. Here again, the flexibility of lead is used to good advantage. Differential movement between the vent stacks and the building itself will be absorbed to a large extent by the lead, thus avoiding failures which would permit water to enter the building interior.

Further evidence of the continued and growing acceptance of lead connections in the plumbing system, particularly between the water closet and cast iron soil stack, are recently enacted plumbing codes requiring that these connections be made with lead.

The city of Spokane, Wash., in its new plumbing code which went into effect January 1, 1950, requires that water closet connections in buildings with wooden flooring or joists must be made with lead.

Under this recently enacted pro-



Left, an example of the type of plumbing used in the Darlington Apartments. All fixtures are connected to the soil lines with lead.

Right, a journeyman plumber preparing the lead stubs for a 200-unit project in Spokane, Wash.

vision, the Standard Plumbing and Heating Co. of Spokane, installed lead stubs under every water closet in the 200-unit Guthrie Housing project located in northeast Spokane.

A point well worth considering in planning plumbing systems is that those recently enacted codes, as well as the older ones in force, do not restrict the use of lead connections but often do require that they be used under certain conditions.

It has been found upon investigation of numerous plumbing codes that "certain conditions" usually apply to types of construction that are most prone to movement or inaccessibility of piping such as under bathroom floors.

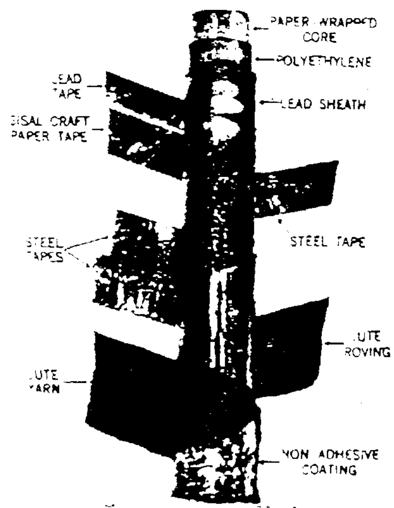
In effect, wherever the most trying conditions are encountered or where replacement would be unduly expensive, lead is the preferred material for plumbing installations.

Lead Tape Protects New Type Cable

AN improved cable protection design known as "Modified Tape Armor" has been developed recently by Bell Telephone Laboratories, Inc., into a covering that is expected to furnish better buried cable protection at less cost. Buried cables, i.e., cables buried directly in trenches covered with earth, are subjected to a variety of hazards which have to be considered in the design of the protective armor. For example, such cable is exposed to accidental physical damage from sharp tools or rocks, to chemical attack by certain soil elements, to electrolytic corrosion, not to mention impairment by rodents or even termite attack. Furthermore, the circuits themselves have to be electrically shielded from power line and static interference, and in many regions a special provision against harm from lightning must be incorporated in the system.

Among the several protective measures which have been developed over the years to suit special cases in specific areas or conditions, one of the more generally used has been "tape armor." Tape armor consists of heavy steel tapes spiraled over a paper or jute bedding, an arrangement that mechanically protects the underlying lead sheath and shields the internal circuit wires against external electrical fields. However, when lightning strikes in the vicinity the current flows along the tapes and sometimes causes potential differences between the steel tape and the lead sheath since these two metals are not in direct contact. Depending upon the magnitude of the lightning stroke and the resistivity of the earth, occasionally an arc develops between the steel tape and lead sheath. This disadvantage has been overcome by establishing electrical contact between steel and lead while still retaining the mechanical and corrosion protection qualities of the earlier types of cables together with their shielding properties.

As illustrated, the modified tape armor consists of 0.010 inch lead tape alternated with 0.012 inch sisalkraft paper tape laid over the sheath, and over them a single 0.010 inch steel tape and an outer protection of two 0.020 inch steel tapes. Since experience had shown that a steel tape directly over a lead sheath sometimes damaged the sheath when the cable was handled, the first layer of lead and paper tapes is provided to protect the sheath against the steel.

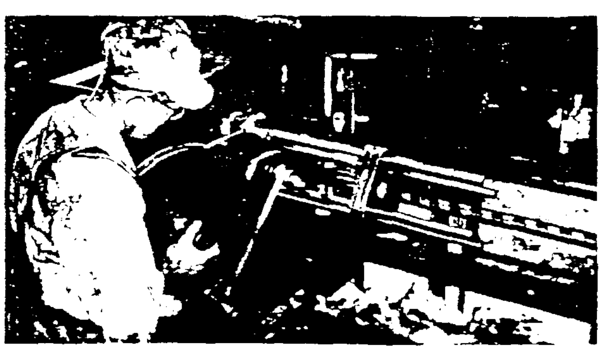


The construction of the "Modified Tape Armor" cable.

Tests conducted by Bell Telephone Laboratories on the modified tape armor have shown that it has excellent handling qualities and will withstand the treatment associated with manufacture and installation with a good margin of safety.

Manufacture of modified tape armored cable is simple, differing little from normal armored cable manufacture. Floodings of asphalt compound are applied over the lead sheath and over each subsequent serving of tape and jute to help preserve these materials. It was determined that this could be done without destroying electrical contact between the metal tape and lead sheath.

This type of armor can be applied to all cables from the very small to the largest size with minor mechanical changes which is an added advantage from the manufacturing standpoint and is reflected in reduced over-all cost of armored type cable.



Method used in applying the lead tape to the modified tape armor cable.

PHOTOS BY BELL LABORATORIES

Lead Paints Protect Steel on Railroad Bridge

THE recently completed 13-track double-deck Long Island Railroad Bridge over the Van Wyck Expressway at Jamaica is a prime example of careful project planning and excellent coordination between the operating division of the railroad and the contractor.

The bridge crosses the recently opened Van Wyck Expressway, a direct link to the new International Airport at Idlewild. This expressway, consisting of six express lanes and four lanes in the service roadways, required lengthening the bridge between abutments from 100 to 194 feet.

The job involved widening Van Wyck Boulevard and lowering its grade. This necessitated constructing a new abutment and wing walls for the bridge, erecting two additional cross bents, and lowering the footings of another bent which was rebuilt because of an increase in the span of the girders. All the substructure was completed before erection of the steel.

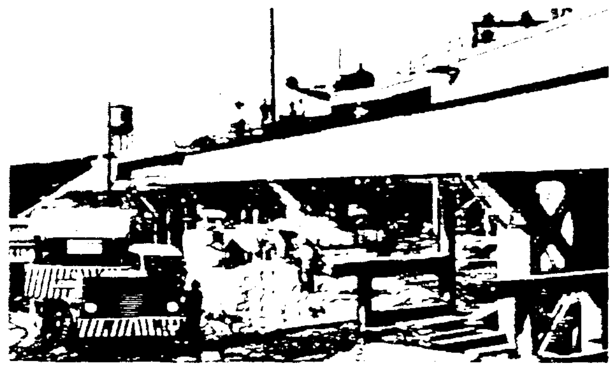
Temporary shoring supported the existing girders while the old steel was being cut out and the new steel set. Only one track was out of service at a time to hold rerouting of trains to a minimum. Approximately two thousand tons of steel were required.

The atmospherically exposed steel contained a shop coat of red lead-in-oil paint and received a touch-up coat of red lead after erection. The red lead coats were followed by two coats of gray tinted white lead base paints. The primer specification calls for a paint consisting of 78% to 81% by weight of dry red lead (not less than 95% Pb_3O_4) and 19% to 22% of a vehicle composed of a mixture of raw and bodied oils in the proportion of one-third boiled oil, the balance being raw oil. All of the paints conformed to the requirements of New York State Department of Public Works, Department of Highways Specifications.

The shop coat was applied by the American Bridge Company and the field coats by the Lewis Hass Painting Company of New York City.

The contract for the work amounted to $2,590,000 and was under the supervision of the New York State Department of Public Works and the Long Island Railroad. For the joint-venture contractors the work was under the direction of Charles B. Molineaux, General Manager, and Alfred C. Maevis, Project Manager. Mr. T. W. Pinard is Chief Engineer and George Patton is Engineer in Charge for the Railroad. J. J. Darcy is District Engineer and P. O. Hale is Resident Engineer for the New York State Department of Public Works.

Section of the red lead protected steel work for a railroad bridge overpass in Jamaica, L. I., N. Y.



Based on an article by Alfred C. Maevis, The Arthur A. Johnson Corp. and Mason & Hanger Co. published in the September, 1949 issue of Contractors and Engineers Monthly.

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.

A STUDY OF PAINTS FOR ENCLOSED STRUCTURAL MEMBERS IN STEEL HOUSING CONSTRUCTION
By H. A. Pray and R. S. Peoples, Battelle Memorial Institute
A reprint of a paper which was read before the General Meeting of the American Iron and Steel Institute, May 25-26, 1949, which sponsored the work. The study included some 34 kinds of paint systems.

AN INVESTIGATION OF PRIMERS FOR MARINE ATMOSPHERIC ENVIRONMENTS
By C. J. Vander Valk, Technical Director, Red Lead Division, Lead Industries Association
Results of an investigation of synthetic vehicles and red lead mixed pigment primers over an exposure period of three and one half years in a rigorous marine atmosphere. Reprinted from "Official Digest" published by The Federation of Paint and Varnish Production Clubs.

RED LEAD TECHNICAL LETTERS
A series of technical letters issued by the Red Lead Division, Lead Industries Association. The numbers and titles follow: (Available separately.)
Technical Letter No. 3—Red Lead Primers for Atmospheric Exposure
Technical Letter No. 4—Red Lead Paints for Marine Exposures
Technical Letter No. 5—Red Lead-Vinyl and Coumarone Type Paints

NEW MARINE PRIMERS
By K. H. Roll and C. J. Vander Valk, Lead Industries Association
An article on newly developed paint primers for metals exposed to marine atmospheres written expressly for the person who is not a paint technologist. Reprinted from "Marine Engineering and Shipping Review," March, 1949.

PHYSICAL AND CORROSION CHARACTERISTICS OF LEAD IN THE CHEMICAL INDUSTRY
By K. H. Roll, Lead Industries Association
A detailed discussion of the use of lead in the chemical industry presented before the National Association of Corrosion Engineers Conference, April 11-14, 1949.

COMPARATIVE CORROSION STUDY OF SOIL, WASTE AND VENT PIPE MATERIALS
By John D. Kane, Chief Plumbing Inspector, Department of Public Works, Fort Worth, Tex.
A study undertaken to determine the relative rates of corrosion of six metallic pipe materials used or suggested for use in the plumbing soil, waste and vent system.
Reprinted from 1949 Yearbook of the American Society of Sanitary Engineering.

CORROSION FORUM
A series of one page articles on the use of lead as a material of chemical construction in contact with the following chemicals (available separately): Chlorine, Hydrochloric Acid, Hydrofluoric Acid, Industrial Alcohol, Sulphuric Acid, Sodium Chloride, Sulphur Dioxide, Phosphoric Acid.
Reprinted from "Chemical Engineering."

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.

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.

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.

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

PRINTED IN U.S.A.
BY PUBLISHERS PRINTING ...
NEW YORK ...