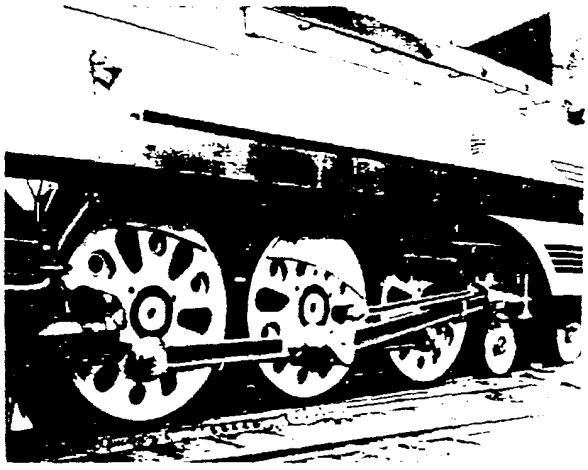
# Lead And The Railroads

IT may seem strange that lead, the heaviest of the common metals, figures so prominently in lightening the task of transporting ourselves and our goods. American railroads and their dependence upon lead for safe and efficient operation is an excellent example of this paradox. Lead base bearings, lead-acid storage batteries and lead paints are used in large quantities by all railroads. In turn, the lead industry depends on the railroads for the safe delivery of millions of tons of lead ores, concentrates, bullion, pig lead and a multiplicity of lead products.

Lead hardened and strengthened with small amounts of tin, antimony and arsenic, or even smaller percentages of the alkaline earth metals is a standard anti-friction material for many types of bearings, and the largest consumer of lead for this purpose is our vast railroad system. Many years ago the Association of American Railroads standardized on lead base bearings for freight cars used in interchange. Like the cars themselves, these railroad bearings must be completely interchangeable. They must provide dependable all-weather performance with simple maintenance and minimum standby inventories.



*Each pair of steam locomotive drive wheels are counterbalanced with as much as 2,500 lb. of lead enclosed in the solid sections of the wheels shown.*

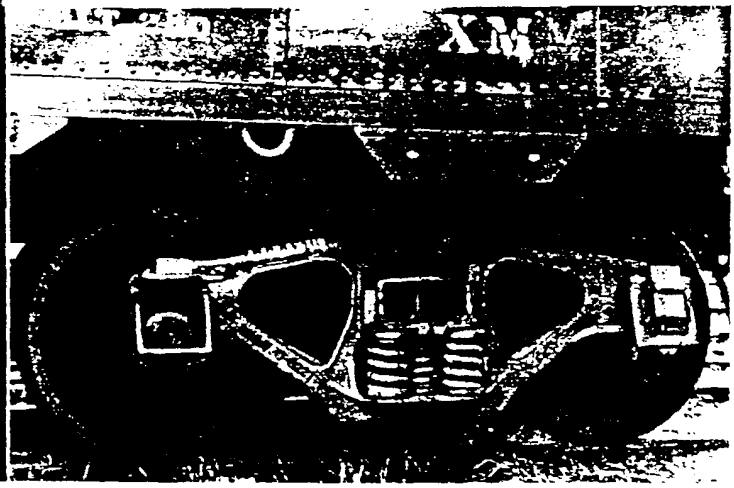
RAILWAY AGE

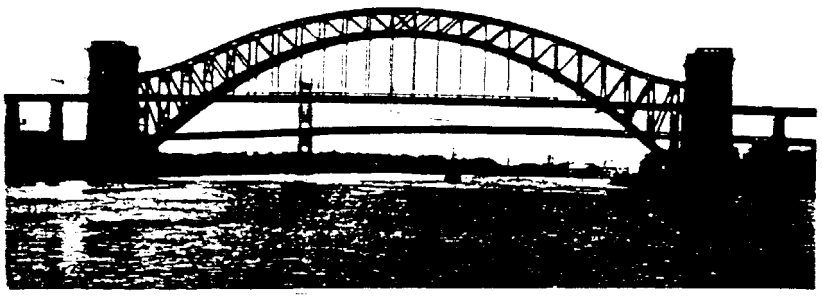
The standard A.A.R. solid bearing assembly, containing about 8 pounds of lead (approximately 4 pounds of lead in the lining and another 4 pounds in the journal shell alloy), more than meets these requirements. Though on any given day only about 40 percent of the approximately 2 million freight cars operated by our railroads may be found on the owner's lines, the more than 16 million solid bearings installed in the cars maintain a daily operating efficiency of better than 99.99 percent. Few bearing installations of any type, in any industry, can match that record.

Solid-type lead base bearings have served the railroads well at a minimum of expense for a number of reasons. They are inexpensive to install, maintain and replace. Like the safety valve on a steam boiler, the comparatively low melting point of a lead alloy becomes a very important safety factor. Should lubrication fail, the bearing will not "freeze" and wreck the unit, or possibly the entire train.

Solid-type bearings can be applied and removed from freight equipment, and wheels changed at any point on the railroad with practically no auxiliary equipment required. Because a solid bearing is essentially "free floating" on the journal, there is at least 1/2 inch of lateral movement available to cushion the effect of lat-

*Left, pouring lead-base bearing metal into a mold consisting of a mandrel and the bearing shell itself. Stacked in the background are the completed bearings. Below, freight car wheels equipped with just two of the 16 million solid type lead base bearings in daily use. Journal box lid is open on left wheel.*





THE NEW HAVEN RAILROAD

*The world famous Hell Gate railroad bridge is protected against corrosion by red lead base primer paint, another form of lead used extensively by the railroads.*

eral shocks thus protecting valuable lading from damage.

Lead base solid bearings figure prominently in maintaining the fast delivery records of "overnighters." Today, 124 overnighters are in operation in the United States and Canada. These fast freight trains travel distances from 300 to 545 miles in 12 to 14 hours and between terminal points must maintain maximum speeds permitted by roadbed and traffic conditions. All these trains are lead base bearing equipped. The cars of one such train, the New York Central system's "Pacemaker" freight, have traveled over 336 million bearing miles without a bearing failure, a record made in a period of slightly more than a year.

Not only freight and passenger cars make use of lead's anti-frictional properties for bearing purposes, but diesel locomotives, electric locomotives and motor unit cars are also equipped with lead base bearings in the form of traction motor support bearings.

Lead base bearing metals offer high resistance to compression yet are soft enough to prevent wear of the more costly and hard to replace axle. They possess the plasticity necessary to absorb foreign particles which normally would score the shaft. Should the axle journal itself become badly scored, the lead bearing installation permits it to be turned down (sometimes as much as 1/2 inch below the original surface!) and reused. When the bearings have served their useful life, their high scrap value makes for economic replacement. Lead base bearing metals also conform and adjust automatically to slight irregularities in the machining and alignment of the shaft.

Other properties of metallic lead are used to advantage by the railroads, for example, there are over 23,000 steam locomotives still in operation and practically all of them use as much as 2,500 pounds of lead per pair of drive wheels in the form of counterbalance weights.

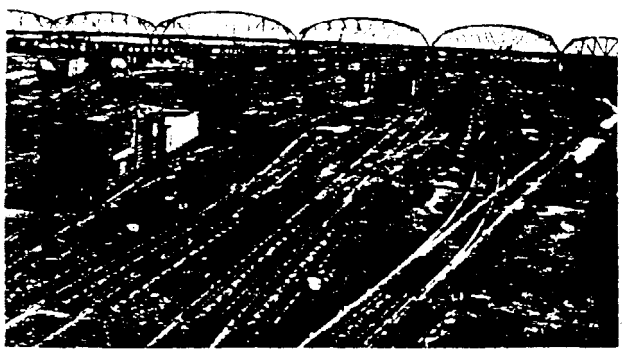
A use of lead familiar to all automobile owners, the lead-acid storage battery, is another important contribution of lead to railroad operation. They are used to crank the engines of diesel-electric locomotives and to operate their control circuits as well as to provide power for passenger car lighting and air conditioning. They are relied upon to safeguard the operation of vitally important railroad signals, switches and communication systems.

Lead in an entirely different form, as a paint pigment, also finds extensive use in railroads. Practically all railroads protect and preserve their signal towers, bridges and other right-of-way structures from corrosion by periodically painting them with red lead primers. Besides railway structures, much rolling stock is primed with red lead base paints to guarantee long life free from rusting. Station houses and other modern buildings are generally painted with white lead-containing paints.

In addition to providing bearing surfaces, a source of electricity, and paints for corrosion prevention, the entire lead industry, its miners, refiners and lead product manufacturers, provide the railroads with a fair share of revenue. In a recent year about 1,124,000 net tons of lead ore and concentrates were shipped in a total of 20,000 railroad cars within the borders of this country. More than 8,000 cars shipped over 447,000 tons of lead-containing residues and scrap. About 757,000 tons of lead bullion and pig lead were shipped in 14,500 cars. Thus American railroads in one year used about 42,500 railroad cars to transport more than 2,328,000 tons of lead and lead-containing materials to and from lead smelters and refineries. Since a large portion of this lead is mined in the Rocky Mountain area, and the bulk of it consumed in states east of the Mississippi, the average haul is long.

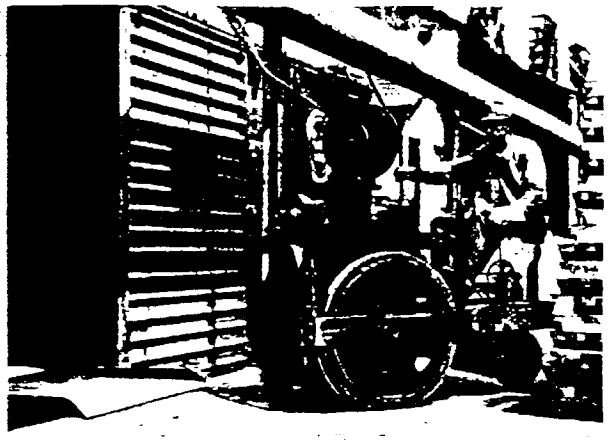
But this is only a part of the total lead actually carried by the railroads. Approximately one-third of the lead used in this country each year comes from foreign sources. The bulk of this tonnage, which amounted to 541,000 tons including scrap in 1950,

*Standard A.A.R. solid type lead base bearings help make possible the fast interchange of freight cars in classification yards such as shown here.*



upon arrival at American ports, is shipped to its ultimate destination by rail. Secondary lead (reclaimed scrap) which supplies one-third of the lead needed each year is also shipped by rail, though to a lesser extent than primary lead. Last year approximately 400,000 tons of secondary lead were consumed.

Shipments of the foregoing forms of lead (pig, scrap and concentrates) are restricted for the most part between lead mines, refineries and the large industrial consumers of pig lead such as manufacturers of paint, batteries, tetraethyl lead, cable sheathing, pipe and sheet. How are these products shipped? In 1950 the total tonnage of finished lead products consumed amounted to 1,212,000 tons of lead content only. While it is difficult to determine how lead in this form is shipped, it may be estimated conservatively that 75 percent of this tonnage moves by rail. This estimate is doubly conservative in the sense that it represents only the actual lead content of the lead products consumed. The figure, 1,212,000 tons, covers only the actual lead content of paint, for instance, and does not take into account the fact that every gallon of white lead mixed pigment paint weighs from 12 to 16 pounds.



*Loading pig lead into a railroad car—a few of the millions of tons of lead, lead ore and lead products shipped yearly by rail.*

but contains only from 1 to 4 pounds of lead. Nor have we considered the total number of times a given pound of lead is shipped before it is consumed. For instance, lead concentrate is first shipped to a refinery whence it is shipped to a white lead pigment manufacturer and then to a paint manufacturer who finally ships the finished can of white lead paint to his dealer. At any rate, the tonnage of lead products moved by rail is, by all means, a substantial figure.

It is interesting to note that another characteristic of lead, its high density, eases the railroad's job of hauling, for when lead or any of its products are shipped, their high weight-to-volume ratio reduces the bulk of the shipments. Cars for shipping lead and lead products can nearly always be loaded to their rated capacity. Obviously a freight car is not operating efficiently and providing proper return to its owners if it cannot be loaded to its rated capacity.

Indeed a cooperative venture—the lead industry contributes in many ways toward maintaining the safe operation and welfare of our railroad systems upon which the lead manufacturing and consuming industries depend to insure delivery of their goods when and where needed.

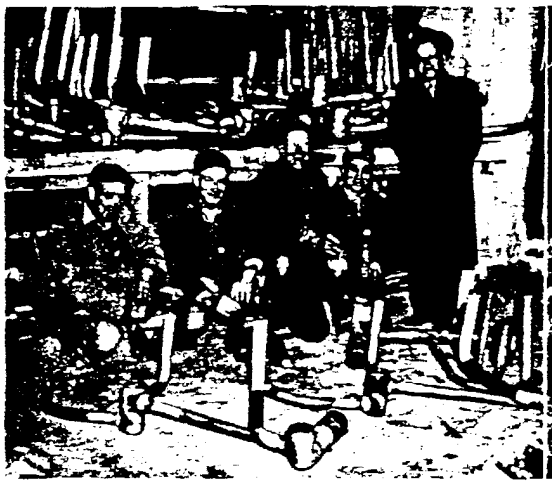
# Lead In Modern Plumbing Systems

LEAD in modern plumbing systems offers far more advantages than those customarily attributed to this most versatile of all the common metals. To its customary advantages in plumbing systems, such as non-rusting and non-clogging, can be added its space saving and time saving qualities.

Modern day construction costs are such that architects and builders are constantly striving to reduce the amount of space required for services and utilities and at the same time maintain safety and quality. In plumbing waste and vent systems, lead pipe and fittings do this remarkably well. Lead, because of its flexibility and the absence of bulky joints can be installed in less space between wall or floor than any of the other materials used for this purpose.

Its time-saving qualities can be attributed to the ease with which lead waste and vent systems can be prefabricated long in advance of their need

*These space-saving lead wastes and vents for back-to-back bathrooms were prefabricated in the plumber's shop located on the site of the Kansas City apartment project, Summit House on the Plaza.*



*The plumbers along with some of the prefabricated lead work installed in the 202-unit apartment project, Summit House on the Plaza, located in Kansas City.*

*Approximately half the lead fittings, wastes and vents installed in a Beaumont, Texas, apartment project. In the foreground, note how little space is required to make a 180 degree change of direction.*

on the job. This means that work can go on in the plumbing shop while other construction is delayed by weather or other reasons. Also, such shop work is usually done under the most ideal working conditions resulting in workmanship that is most satisfactory from the standpoint of cost and quality. Because lead is flexible, slight miscalculations that may occur in the preparation of the roughing-in are easily overcome at the time of actual connection to the stack and fixtures.

These space and time-saving qualities of lead plumbing can be and have been applied to practically all types of construction. Recent examples are two large private apartment projects, a low-rent housing project and a hospital. These all reveal that no matter how complicated the layout, the saving of space and time as a result of prefabrication is possible with lead.

## APARTMENT PROJECTS

In Kansas City, Mo., prefabricated lead plumbing for an 11-story, 202-apartment building was prepared in advance of need in the temporary shop of the A. D. Jacobsen Plumbing & Heating Co. located on the job site. The extent of prefabrication of the lead work is shown in the accompanying shop photograph of the complicated lead assemblies just after being completed. Other photographs show these assemblies in place and the amount of space saved can be easily noted in the absence of bulky joints and special fittings that would have been necessary with other materials. Winn Senter is the general contractor for this apartment project that will be known, when completed, as the Summit House on the Plaza.

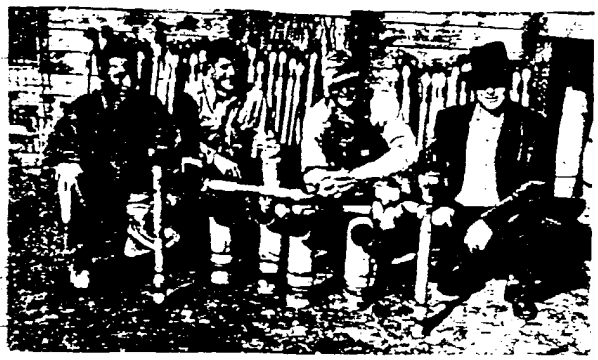
In Beaumont, Texas, the prefabricated lead plumbing for another large apartment project was prepared in the plumbing shop on the construction site and installed by the Chas. Keisling Plumbing Co. of Houston, Texas. Here again, the entire underfloor plumbing has been prefabricated of lead. In the foreground of the accompanying photograph of this job note how little space is required for the 180 degree bend in the lead waste outlet of the lead trap into which the bathtub will waste. Approximately half the lead pipe and fittings required for this installation is shown.

## LOW-RENT PROJECT

Prefabricated lead plumbing can be applied to low-cost construction as well, as shown by the plumbing installed in a 150-unit, low-rent project in Fort Smith, Ark., by the L. D. Burris Heating and Plumbing Co. Lead bends for water closets, lead drum traps for baths with connecting lead wastes and vents were all prefabricated in the temporary shop on the site. Over 1,700 wiped joints, requiring little more space than the pipe itself were used in connecting up the more than 12 tons of lead pipe and fittings necessary for this plumbing installation.

## HOSPITAL PROJECT

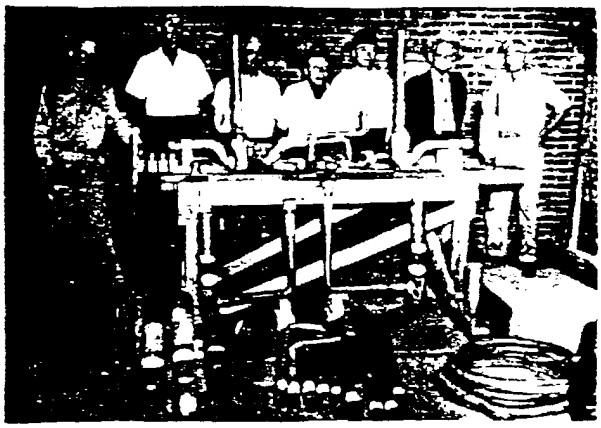
The plumbing system of a hospital is probably more varied and extensive



*Fort Smith, Ark. plumbers and some of the lead plumbing prefabricated for installation in a low-rent apartment project.*

than any other building of comparable size. The new 12-story, 750-bed Shreveport Charity Hospital, Shreveport, La., for example, has 1,500 plumbing fixtures, including 228 water closets.

Some of these fixtures required unusual connections, a few of which are shown in the accompanying photograph. Included are double 1¼ in. lead waste arms, shown in the center on the table, for back-to-back lavatories, wasting into a single connection to the stack. This was accomplished by connecting the two waste arms to a ferrule with a single wiped joint. Also shown are shower wastes entering the top of lead drum traps and several of the extremely long lead closet connections required. Poe Plumbing and Heating Co., of Greenville, S. C., are the contractors.



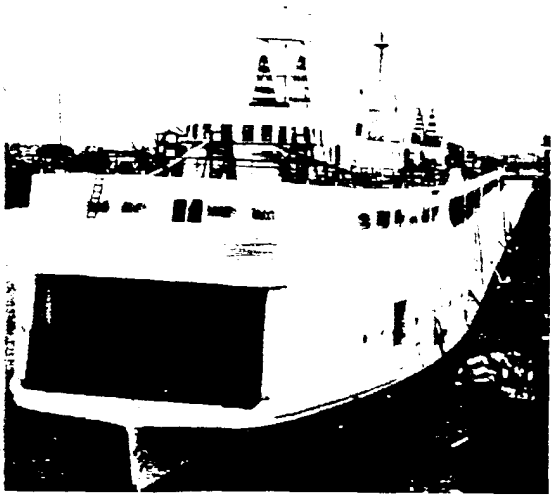
*Some of the unusual plumbing connections, all easily prefabricated with lead, installed in the new 12-story 750 bed Shreveport Charity Hospital, Shreveport, La.*

This installation, as well as the others herein described, all make use of lead's versatility as a waste and vent material in the hands of plumbing craftsmen. It will be noted that all of these intricate assemblies, pictured and described, were made with a minimum number of joints without any special fittings. What other material could have met the exacting requirements of some of these connections as easily as lead?

# Great Lakes Ice-Breaker Ferry Protected By Red Lead Specification Paint

A NEW ice-breaker ferry, the Vacationland, was recently completed at the Great Lakes Engineering Works Shipyard in River Rouge, Michigan for the Michigan State Ferry service across the Straits of Mackinac and was put in service this winter.

The Vacationland, 360 feet long and 75 feet wide, is protected from keel to mast against the ravages of corrosion by two coats of a fast drying red lead paint meeting the requirements of Federal Specification TT-P-86a, Type IV, which says "Type IV paint is intended for use as a primer on iron and steel surfaces particularly, as those subjected to severe humid conditions or fresh water immersion. In addition to its excellent water impermeability, the paint film exhibits good resistance to acid and alkaline environments. Water storage tanks, structural work on dams, structural metal and equipment in bottling plants, laundries, and mines are typical of the steel surfaces for which this paint is particularly effective as a protective coating."



*The new ice-breaker ferry, the Vacationland, latest addition to the Michigan State Ferry service across the Straits of Mackinac. All steel surfaces have been primed with two coats of fast-drying red lead paint.*

The new State Ferry with its four huge diesel engines delivering 10,000 horsepower will be one of the two most powerful vessels on the Great Lakes. The other is the U. S. Coast Guard icebreaker, the Mackinaw. The Vacationland with a speed of 15 knots and its powerful hull construction will be able to move through the formidable ice jams of the Straits without difficulty. There will be space on the main deck for some 150 vehicles, about 50 more than the largest ferry currently in service. Radar and ship-to-shore phones will assure safe navigation through treacherous waters during all seasons.

Construction of the Vacationland required the building of a new slip at Mackinaw City as well as the installation of another fuel line system. This fuel line will carry oil from ship tankers to storage tanks on shore

and then back to the end of the dock to refuel the new ferry.

Complete new docking facilities were built on the St. Ignace side of the Straits of sufficient size to handle the new ship. These docks will permit four of the State Ferries to load at one time as compared to only two at the old St. Ignace docks. The new dock construction alone will cost approximately $4.000.000.

The State of Michigan has invested $4.700.000 in the Vacationland. This investment is protected against destruction by rust by two coats of the red lead-phenolic primer and a finish coat of a gloss-white enamel. About 4.500 gallons of the red lead specification primer were required for the job. The following is a detailed formulation meeting the requirements of the Federal Specification (F.S. TT-P-86a, Type IV) as published in the Lead Industries Association Red Lead Technical Letter No. 6.

| Composition | Percent | Pounds | Gallons |
|---|---|---|---|
| Red Lead (97% grade) | 85.00 | 950.0 | 12.85 |
| Diatomaceous Silica | 8.00 | 89.6 | 5.36 |
| Magnesium Silicate | 6.60 | 74.0 | 3.10 |
| Aluminum Stearate | 0.40 | 4.4 | 0.53 |
| | 100.00 | | |
| *Phenolic Varnish | 74.00 | 432.0 | 57.70 |
| Aromatic Petroleum Spirits | 22.40 | 129.7 | 17.70 |
| Dipentine | 2.75 | 16.0 | 2.26 |
| Antioxidants | 0.50 | 2.2 | 0.27 |
| Driers | 0.35 | 2.0 | 0.23 |
| | 100.00 | 1699.9 | 100.00 |

Pigment = 65.9% Wt./Gal. = 17 lb.
Vehicle = 34.1% PV = 41

*Phenolic Varnish:

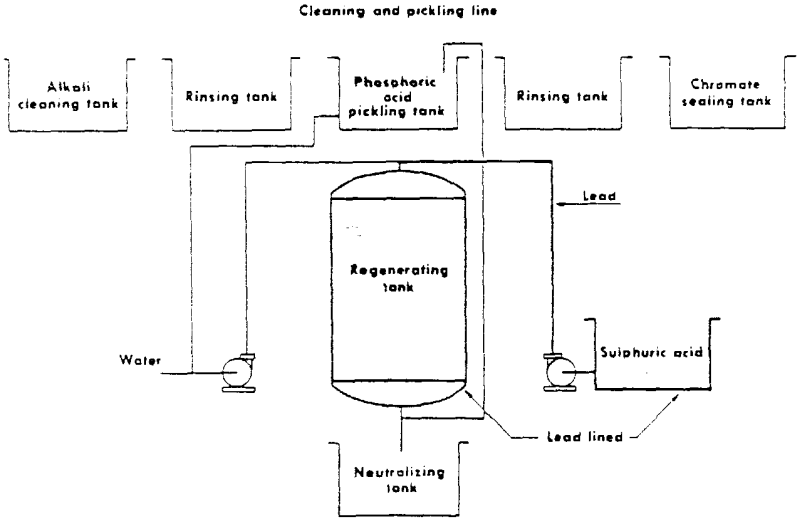
| | |
|---|---|
| Phenolic Resin (100% para tertiary amyl phenol-formaldehyde resin) | 20.25% |
| Tung Oil | 39.75 |
| Mineral Spirits | 40.00 |
| | 100.00% |

NOTE: This paint performs best when applied to surfaces freed of all contaminants by sandblasting or other equally effective means.

# New Pickling Process Uses Lead

MOST steel undergoes pickling at one time or another before it becomes part of a finished product. "Pickling" is a common method of preparing a metal surface prior to plating, galvanizing, enameling or painting by corroding the metal with acid under controlled conditions. While some alloy steels are frequently pickled with muriatic acid, nitric acid or mixtures of acid, the common grades of steel are usually pickled with a 6 to 10 percent sulphuric acid solution. In some instances pickling is done with phosphoric acid at 15 to 50 percent concentration.

*Flow diagram of the new phosphoric acid pickling system.*




PHOSPHORIC ACID PICKLING

Pickling steel with dilute phosphoric acid has one chief advantage over other acids in that the metal acquires an adherent phosphate coating which is rust resistant and forms an excellent base for paint. But despite this and other advantages, phosphoric acid pickling has not been used extensively because the acid itself is so much more expensive than sulphuric acid.

Recently a process making phosphoric acid competitive cost-wise with sulphuric acid pickling was proven successful. The new process depends on continuous purification and reclamation of the phosphoric acid pickling solution. In the reclaiming process the acid is pumped directly from the pickling tank through a cation exchange unit of special design developed by the Permutit Company containing a hydrogen zeolite cation exchange resin. The resin absorbs the dissolved iron in the pickling solu-

*Phosphoric acid pickling line in use in the Peoria, Ill. plant of Caterpillar Tractor Co. Regenerating tank is the tall tower at left.*

tion in the form of iron phosphate and converts it back to phosphoric acid. However, as reclamation of the acid proceeds the exchange resin eventually becomes exhausted and no longer removes iron. To regenerate the resin the flow of pickling solution is stopped, and the tank drained, backwashed with water and regenerated with sulphuric acid thus restoring the zeolite to its original condition. This is where lead enters the picture.

Because of the greater corrosiveness of sulphuric acid, lead has proven to be the only practical material of construction. A storage tank for holding the sulphuric acid (30 percent) labeled "dangerous, strong acid" in the illustration is of sheet lead lined steel construction. The tank is 4 ft. in diameter and 2 ft. 6 in. high and consists of a steel shell lined with 8-lb. chemical lead. No strapping is required, the lead being supported from the top by turning over the flange. The lead pipe for conducting the acid from the storage tank to the zeolite tank is made of chemical lead. A lead overflow pipe is provided. Approximately 40 ft. of pipe are required per unit. The tank contains a perforated lead pipe coil through which air is introduced in order to thoroughly agitate the acid.

It is interesting to note that when one of the first commercial installations of the phosphoric acid pickling process was put into operation, the piping for conducting the sulphuric acid from storage to the acid regenerating section was made of a rigid metallic material. This material failed after the first month of service, was replaced with lead piping and since then has given continuous satisfactory service.

While the regenerating unit does not at present utilize lead in its construction, designers at the Permutit Company are contemplating the use of either bonded lead or sheet lead construction in future installations.

The pickling operation in industry almost invariably goes hand in hand with lead especially since the bulk of pickling is done with sulphuric acid. Lead lined tanks for batch pickling, brick and lead lined tanks for continuous pickling and combinations of both are common applications of lead. Added to this, as a result of increased emphasis on water pollution control, are waste pickle liquor recovery systems which also utilize lead where corrosives are encountered and other common materials of construction cannot economically withstand acid attack. To the more familiar pickling techniques, we may now add the new process of phosphoric acid pickling which again depends upon the excellent corrosion resistant properties of lead for safe and economic operation.

**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.**

**THE USE OF LEAD IN THE PULP AND PAPER INDUSTRY**
Detailed description of various applications of lead in the modern pulp and paper mill. Covers all phases of paper pulp manufacture and treatment including sulphite acid manufacture, acid pulping, bleaching and stock handling.
Reprinted from "Paper Trade Journal," Oct. 26, 1950.

**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.

**METAL PROTECTIVE RED LEAD PAINTS**
The versatility of red lead in protective primers to meet a wide range of surface conditions, drying schedules and economic demands is described.
Reprinted from "Paint and Varnish Production," January, 1951.

**A STUDY OF PAINTS FOR ENCLOSED STRUCTURAL MEMBERS IN STEEL HOUSING CONSTRUCTION**
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**
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
- Technical Letter No. 6—Red Lead Paint Formulations

**CORROSION OF LEAD BY SULPHURIC ACID**
Data on lead and lead alloys, including charts, for corrosion by sulphuric acid. The proper test methods and corrosion rates at varying temperatures and concentrations are detailed.
Reprinted from "Industrial and Engineering Chemistry," September, 1951.

**PHYSICAL AND CORROSION CHARACTERISTICS OF LEAD IN THE CHEMICAL INDUSTRY**
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.

**NEW DEVELOPMENTS EXPAND USE OF LEAD CONSTRUCTION**
Improvements in lead fabrication and installation methods are described and illustrated in a reprint from "Materials & Methods" May, 1951. The article shows how lead construction developments have continued to keep pace with developments in the chemical and process industries.

**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, Chromic Acid, Copper Sulphate, Citric 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**



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