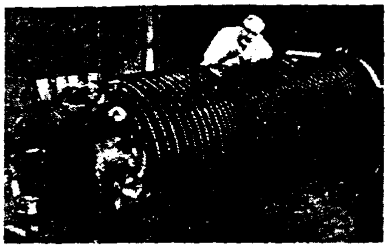
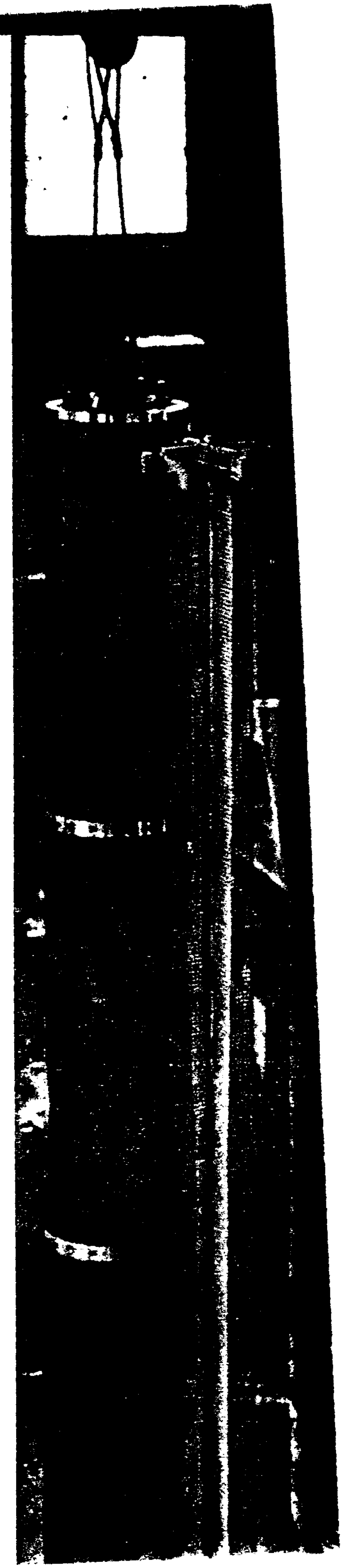
RADIOACTIVE FUEL
— a "packaging" problem





The average package designer usually has only one overriding requirement to meet. It may be preserving freshness, maintaining sterility, or preventing damage to delicate goods. In contrast, the engineer who has to design a shipping cask for radioactive fuel elements is faced with a staggering list of "packaging" requirements.

This is the story of the evolution of a shipping container for radioactive fuel elements for the new Dresden reactor built by General Electric Co. The engineers at Knapp Mills Inc. who designed and built the casks had to thread gingerly through a set of requirements which conflicted with one another and which permitted no compromise. Moreover, the resulting container had to be right the first time.

Radioactivity, of course, was the most obvious factor. The case was specifically called upon to carry greater than 1,-000,000 curie load (gamma activity) of fuel while holding radiation levels outside the cask below the AEC requirement of 200 mR/hr at the cask surface and 10 mR/hr at a distance of one meter. But not only was the cask called upon to contain the radioactive fuel dependably during shipment but it had to continue to do so during and after any "credible" accident.

A loss of shielding around the fuel could create a radiation hazard in the area. More seriously, if some of the radioactive material escaped, say, in transit, the resulting contamination could be very widespread and dangerous.

The cask also had to be designed so that not enough fuel could get together to form a critical mass and start a runaway reaction. Personnel also had to be protected from radiation and contamination while the cask is being loaded, unloaded and handled.

Heat — The second family of design problems is concerned with dissipating the considerable heat generated in the fuel through the cask walls. Circulating coolant, continuous metal construction and external cooling fins are all used in the Dresden design to maintain a safe operating temperature.

The final main design goals are to construct a cask that is as economical, compact, and lightweight as possible.

Essentially, the Dresden cask consists of a stainless steel inner container and a stainless clad carbon steel outer shell. The space between the container and shell is filled with lead, metallurgically bonded and integral to both steel surfaces by Knapp's patented directional shrink cooling process.

Metallurgically bonding lead to the steel shells provides a continuous metal composition for high physical strength, maximum heat transfer and uniform shield density. In unbonded construction, the molten lead when installed may shrink away from the steel during cooling, thereby drastically decreasing the efficiency of the cask design.

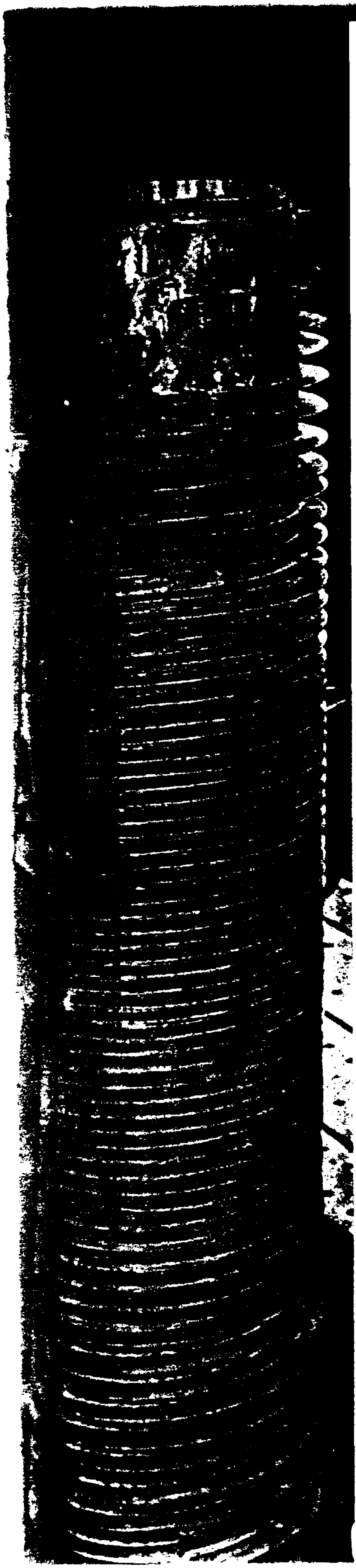
Size — Engineers designed the cask to carry only four fuel rods so that it would be small enough to be shipped by truck and not restricted to railroad transportation. This is an important advantage for versatile application of a basic cask design.

The cask itself is 12.75 ft. long, 38 in. in diameter and weighs 22.5 tons. Special yokes support the cask in its horizontal shipping position and help withstand vibrations and shock.

Strength and cask integrity — The Atomic Energy Commission justly considers the structural integrity of a cask to be the most important factor in determining its invulnerability to a credible accident. In addition to normal strength requirements, they require casks be designed to withstand rigorous puncture and drop tests.

The resilient, shock absorbing properties of the lead mass were perhaps the main factors enabling the cask to be designed to survive the severe punishment.

The puncture test criteria require that a 6-in. diameter area of the cask withstand a blow equal to 30 times the



weight of the loaded cask. In this case, that force is greater than 225,000 psi. AEC sponsored tests on full scale cases showed the bonded lead construction withstood this test without piercing the inner container.

On the same AEC tests a cask was dropped from 15 ft. and then from 30 ft. The mass of lead again absorbed the blows without separation of the steel-lead bonds.

Internal pressure – Another structural requirement was to overcome the raised pressure in the fuel chamber caused by heat. Both the cask itself and the end closure withstood the required 100 psi in the fuel chamber. Maximum permitted operating pressure is 50 psi.

One of the factors that contributes most to the uniformity and effectiveness of the shield is the extreme care taken during fabrication and inspection of the cask to eliminate any voids or spaces between the lead and the steel containers. These steps assure uniform distribution of radiation over the surface of the cask.

The four fuel assemblies carried within each cask are separated from each other by a basket made of stainless steel. In addition to supporting fuel assemblies the basket is designed to be a good thermal conductor to aid in heat dissipation.

Heat is first removed from the radioactive fuel rods by water circulating by natural convection and flowing through perforations in the basket. This heat is absorbed by a black anodized aluminum thermal sleeve positioned around the basket. The sleeve transfers the heat to the stainless steel container wall where it is transmitted through the lead shield and finally dissipated by cooling fins on the cask interior. The cask is designed to remove 25,000 Btu/hr from the fuel while keeping surface temperature of the cask below 180°F.

In designing the cask a special effort was made to achieve a uniform temperature along the length of the cask. This was accomplished by varying the cooling fin spacing from one end to the other.

TESTING OUT COOLING

The cask's heat removal capacity was tested before use by substituting specially designed electrical heaters for fuel elements with the cask filled with water and laid in the transport position. Temperatures were measured with thermocouples at various check points within and outside the cask body and on the cooling fins.

Assurance of no physical imperfections such as voids or irregularities in the cast lead was proven by continuously scanning the length of the cask with penetrating gamma rays from a powerful radium source. Direct read-out recordings of each inspected section would show voids as an excess of gamma rays reaching the detector. Any such flaws in the lead-steel bond were, of course, eliminated.

Lead bonded construction was selected after a careful evaluation of other materials and construction methods. Their appraisal of the shielding characteristics and the practical engineering and economic factors is summarized in the accompanying table. "Practical factors" are weighted three times as heavily as "shielding characteristics" because a material suited in theory (platinum is included as an example) is useful only if it is practical to design and fabricate. In this example, a lead shipping cask could be valued at less than $50,000 but its platinum counterpart would cost more than $35,000,000. The shielding materials are preferred for this design in the following order: lead, cast carbon steel, stainless steel, concrete, tungsten, depleted uranium and platinum.

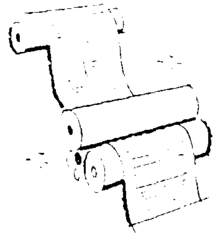
PROPERTY	SHIELD MATERIAL						
Comparison of Shield Characteristics	**Lead**	**Cast Carbon Steel**	**Stainless Steel**	**Concrete**	**Tungsten**	**Depleted Uranium**	**Platinum**
Density	2.6	1.8	1.8	0.8	4.0	4.3	5.0
Corrosion Resistance	5.0	3.0	5.0	5.0	5.0	5.0	5.0
Strength (Tensile)	4.0	5.0	4.0	4.0	4.0	4.0	2.0
Thermal Conductivity	2.4	1.5	0.6	0.01	5.0	2.8	1.2
Specific Heat	1.0	3.5	3.9	5.0	1.0	2.0	1.0
Comparison of Practical Factors							
Availability	15.0	15.0	12.0	15.0	4.5	5.0	1.5
Design Versatility	15.0	10.0	8.0	1.5	1.5	1.5	1.5
Ease of Fabrication	15.0	10.0	10.0	9.0	1.5	1.5	1.5
Ease of Testing	15.0	13.5	13.5	7.5	15.0	15.0	12.0
Lowest Cost of Finished Equipment	15.0	7.0	4.0	5.9	0.3	0.15	0.002
Final Shield Merit	90.0	70.3	62.8	53.7	41.8	41.3	30.7

Shield Material Evaluation For Spent Fuel Shipping Cask by Knapp Mills Engineers

A note on this table – Obviously the details of an evaluation of this sort are subject to debate. Properties of the shield materials themselves were compared first. But, because this was a practical design and construction problem, the materials characteristics were rated as a total of 25 and the practical construction factors totaled 75. Thus, an optimum material would rate 100%.

Of course, some designation might justify a rating of 6 or 4 instead of 5, but these finer distinctions were reserved until a final re-evaluation was made.

"T-..." [illegible] s of 4.0 were assigned to materials that would have to be encased [illegible] eally that of steel. Platinum, for example, would not be encased.



Conventionally molten lead and other metals have been melted where the casting takes place, or the molten metal is carried to the point of use in ladles or a variety of buckets. Such manual methods are, of course, inadequate for high speed operations such as supplying type for large city newspapers. One system now in use conveys the lead to the stereotype casting machines in a closed pipe system so that it does not spill, get dirty or oxidized, and is available when needed at the proper heat.

One of the principal components of the system, now used at the new plant of the *New York Times*, is the electrical impedance heated pipeline which can maintain an internal temperature of 600 to 950°F. This keeps the lead fluid under flow or standby conditions. The pipe is heated by passing a low voltage electric current through the piping itself so that the electrical resistance of the pipe creates the heat.

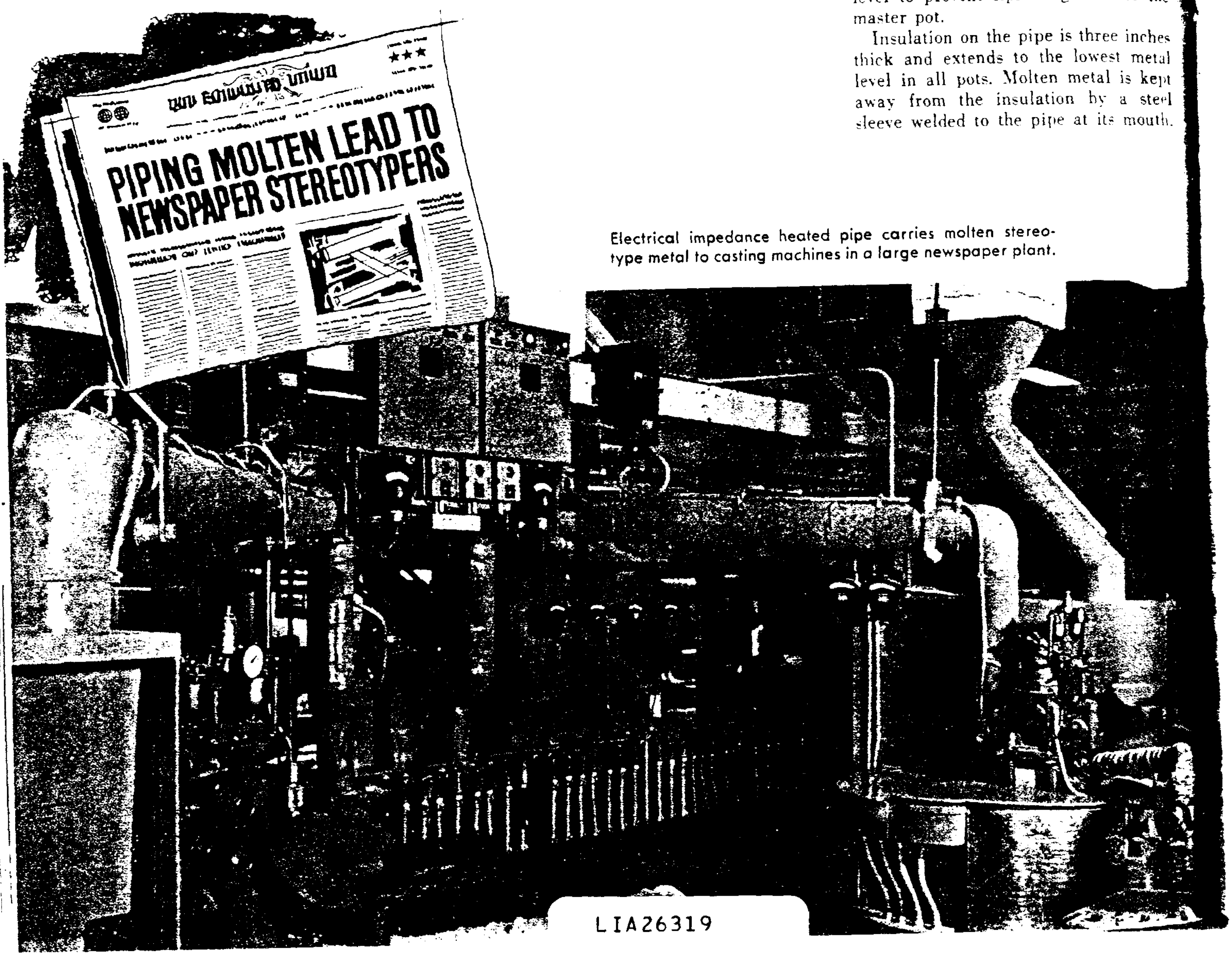
Wattage is only 100 to 120 watts per foot. The actual heat losses are about one third of this and are low enough to preclude overloading the plant air conditioning system. Normally, only enough energy is used to make up heat losses — the reserve capacity is for remelting metal in the line after shutdown.

In the *New York Times* system, designed and built by Electric Pipe Line, Inc., Saddle Brook, N.J., used plates of stereotype metal, each as big as a newspaper spread (about 40 pounds), are automatically conveyed to a 25-ton master melting pot. Molten lead is pumped from this pot through the heated pipe overhead to either of two 8-ton slave pots which feed the type casting machines directly.

The molten lead is driven by immersed impeller pumps located in the master pot. Maximum delivery from each pump is about 700 pounds per minute. Feed rates are arranged to hold the fluid level constant to one inch in the slave pots, letting it vary in the master pot.

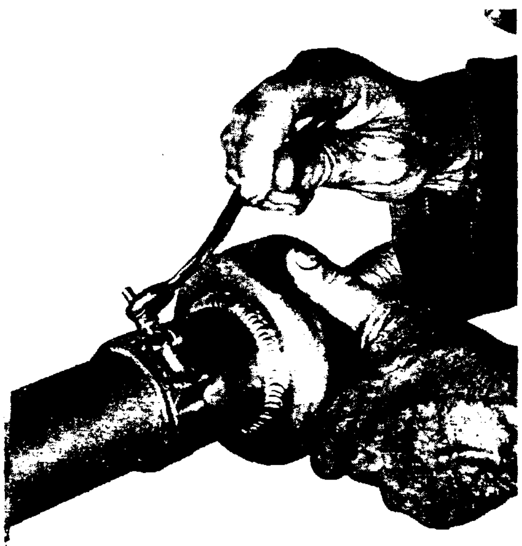
The discharge pipe feeding the slave pots is always immersed in the metal to prevent splashing, air draw, and internal drossing. The horizontal pipe run is over four feet above the highest metal level to prevent siphoning back to the master pot.

Insulation on the pipe is three inches thick and extends to the lowest metal level in all pots. Molten metal is kept away from the insulation by a steel sleeve welded to the pipe at its mouth.



Electrical impedance heated pipe carries molten stereotype metal to casting machines in a large newspaper plant.

1. Tin the joint area of the cable sheath.

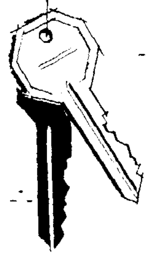


2. Compress reducer with clamp to close fit over sheath.

3. Wrap insulated electrical heater over the joint. Apply voltage until the joint is hot enough to solder. Finally, clean off excess solder to finish joint with a fillet.

JACKETING & JOINING . . .

keys to top performance of industrial power cable



"The plant electrical engineer who today is faced with the problem of selecting a high voltage cable for a plant distribution system . . . should review the characteristics and records of available materials to determine which have shown merit of consideration. If such a review considered service reliability and good experience, two characteristics certainly not to be overlooked for an industrial installation, paper-insulated lead-covered cable (PILC) cable would present an outstandingly good record."

This quotation* coupled with the low cost of lead-sheathed paper-insulated cable raises the question of why the cable is not used exclusively for high voltage circuits in industrial application. A survey of industrial plant electrical engineers showed that lead-sheathed paper-insulated cable is, in fact, widely used. However, two disadvantages are reported by the users. They are, sheath corrosion in certain environments and difficulty with splicing and terminating.

The survey showed that although corrosion was reported as a problem, "sheath corrosion had been eliminated by the addition of non-metallic jackets over the lead sheath on installations where this design was adopted. Fabric reinforced neoprene jackets have been completely successful in eliminating corrosion of lead sheath. No corrosion of lead sheath protected by a neoprene jacket has been reported on over 30 years of operating experience." Polyethylene jackets are also in use.

Splicing and terminating difficulties arose with lead sheathed cable principally because of the unavailability of skilled lead wipers to make the universally used hand wiped joint. Now there is a joining method available to meet this need.

The "pressed electrical wipe" joint does not reduce the need for good workmanship but it does provide a sealed joint as good or better than a hand wiped joint. The technique involves solder 'sweating,' rather than a hand wipe requiring considerable skill and experience.

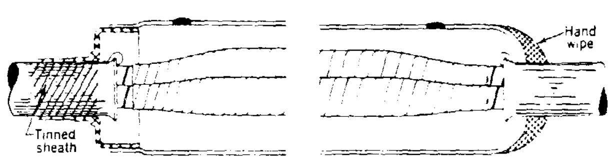
The electric wipe joint, originated by the Consolidated Edison Company of New York, has now been modified and is being offered commercially in kit form under the trade name 'Electro-Lap Seal' by The Okonite Company, manufacturers of electrical cables. The new technique is compared with the hand wipe construction on the accompanying diagrams.

In the standard splice, two heavy hand wipes are necessary to seal the splice sleeve to the cable sheath. In the electrical wipe four solder-sealed joints are used instead. The sheath area to be soldered is first tinned. Tools required for this are a torch and a solder stick. A loose-fitting lead reducer is slid over the sheath and tightened to induce capillary flow of the solder. A heater wire wrapped around the lapped joint raises the temperature evenly to the melt point of the solder. This step should take only about three minutes. Solder is then fed into the hot joint until it accepts no more. While the joint is cooling, excess solder is wiped away. This also finishes the joint with a solder fillet between the sheath and reducer. A splice sleeve is sealed to the reducer in the same way.

Joint for joint the pressed electrical wipe is probably more expensive than the hand wipe splice. However, the pressed joint offers the infrequent installer great advantages in that he need not call on skilled craftsmen.

An accelerated service test of a conventional hand wiped joint and a pressed electrical wipe joint showed that the standard joint failed after 8280 expansion and contraction cycles while the electric wipe continued to 8640 cycles. In both cases failure was in the sheath outside the joint.

*From "Power Cable for Industrial Plant Electrical Systems," by Thomas F. Loraditch, electrical engineer, The Okonite Co. *Iron and Steel Engineer*, July, 1963.



sed electrical wipe (left) and conventional
l wipe (right) on a three-conducto. cable

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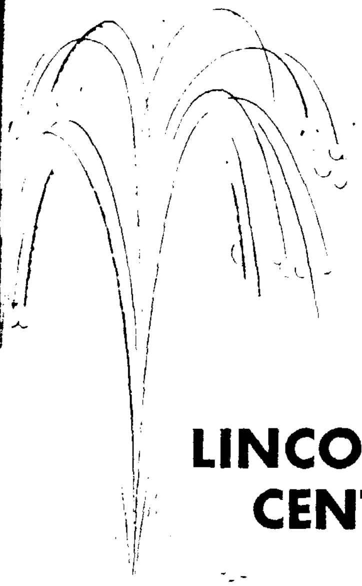
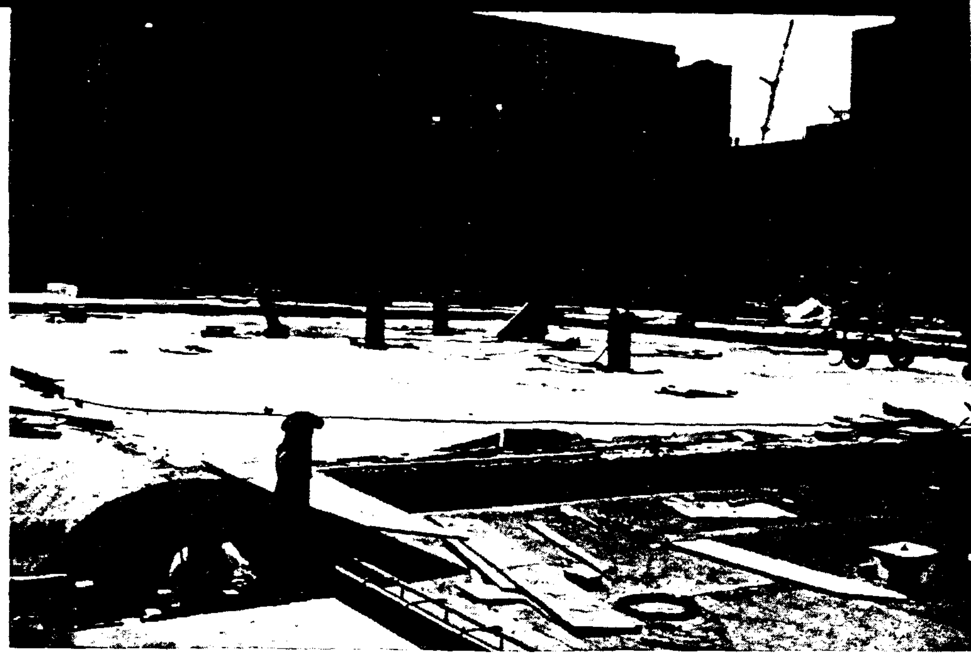


LINCOLN CENTER



– waterproofing a reflecting pool

One of the dramatic changes of the twentieth century in the United States has been the growth of the big city. In fact "big" takes on a meaning far beyond that which it had when the phrase "big city" was coined back in the gaslight era. Today's urban attractions – shopping, entertainment, recreation – bring such hordes of automobiles into urban centers that city planners have to work hard to keep their cities functioning at all.

Consider what is happening at the new Lincoln Center for the Performing Arts in New York City. At a typical performance, thousands of people, many of them in their own cars, will be arriving in a short time. Parking these cars takes space. Yet the entire effect of the graceful buildings of the Center, its landscaped walkways, plazas, reflecting pools and fountains would be utterly spoiled if the grounds were to be turned into one huge parking lot. With space at such a premium, the architects for the Center simply located the garage *under* the plazas and pools. Of course the major problem arising from this arrangement was the important matter of providing reliable waterproofing to protect materials and automobiles in these below ground spaces: The most reliable of the choices was sheet lead. Accordingly, a total of 55 tons of 8 lb. chemical lead was used to line a fountain and a reflecting pool.

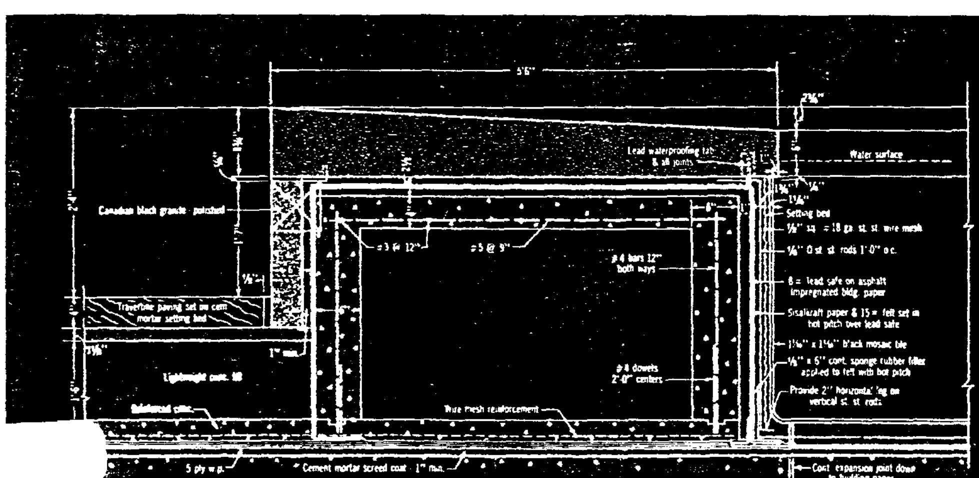
The fountain, located between Philharmonic Hall and the New York State theater, was designed by Philip Johnson Associates of New York City. It will provide a constantly changing kaleidoscope of form and color through regulation of a series of water jets and the play of colored light upon them. Ten tons of lead were used to line this unit. The circular form of the fountain and the many penetrations required through the waterproofing necessitated special handling. In order to provide the most economical and practical layout, the Andrews-Knapp Construction Co. of Long Island City, New York, who installed the lead work, devised a unique plan. It consisted of 36 pie shaped sheets of lead laid out in a radial pattern with careful regard for placement and location of the many jets. Pipe for all these jets, plus others for overflow and drain lines, were homogenously bonded to the lead pan to form a permanent, watertight barrier against leakage.

The reflecting pool in front of the Vivian Beaumont Theater was the design of Harrison and Abramovitz, Architects of New York City. Though not as complex as the fountain, its handling presented problems of sheer size. A total of 45 tons of 8 lb. lead was used by Andrews-Knapp to line this pool which measured 122 feet by 80 feet. Sheets were roughly 7 feet by 18 feet on the bottom with smaller sections for the sides. All sheets were lapped 2 inches and burned. Standard details were followed including protection of the lead against the temporary hazard of free lime in fresh concrete through the use of asphalt impregnated papers.

Both the fountain and the pool were built by the New York City Department of Parks which is also responsible for construction of the plazas, pedestrian bridge and underground garage at the Center.

Credits:

Architects: Philip Johnson Associates (Fountain)
Harrison and Abramovitz
(Reflecting Pool)
General Contractor: Slattery C...
Mechanical Engineers: Syskc...
Plumbing: Eugene Duklauer, ...
Lead Work: Andrews-Knapp ...



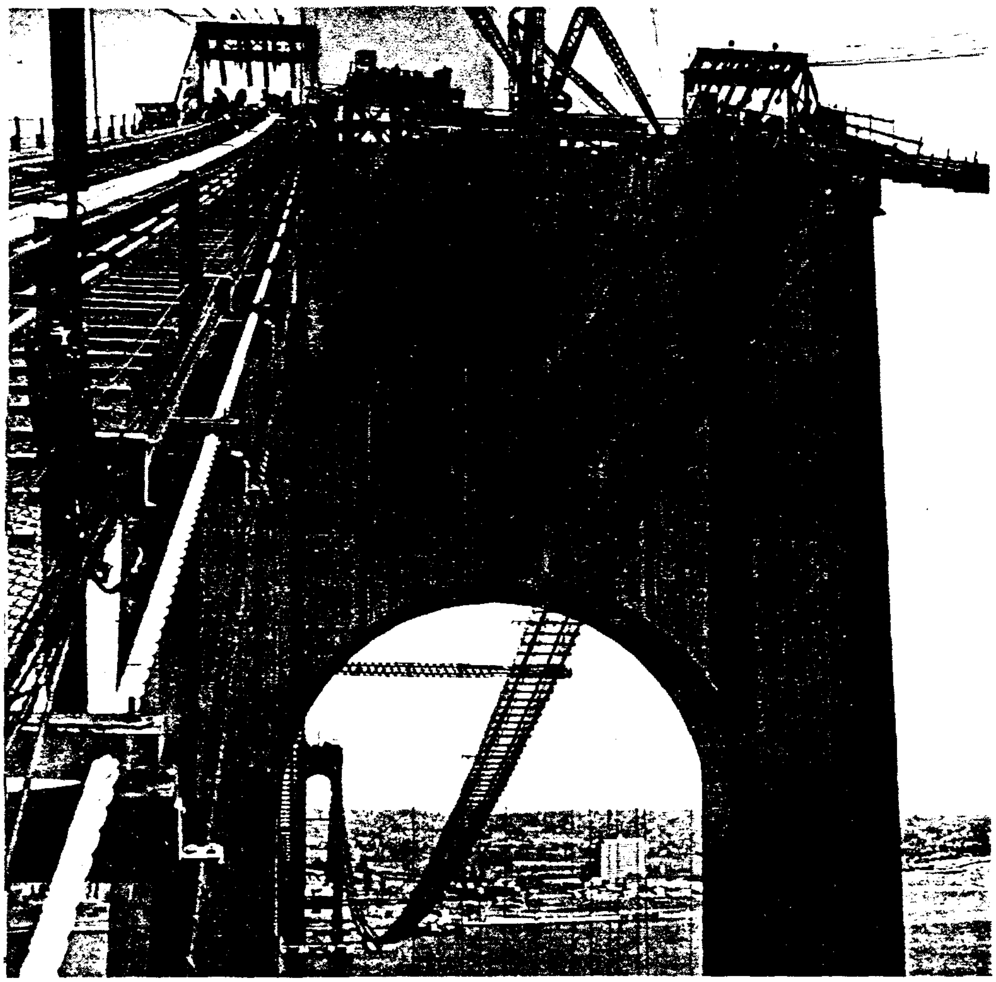
DETAIL SECTION AT FOUNTAIN

LEAD over and under the new Verrazano-Narrows Bridge

From the top to the bottom of the Verrazano-Narrows Bridge is a long way. To be more specific, its towers are nearly the height of a 70-story building. And lead in several forms will be used for its corrosion inhibitive properties from the tip of the bridge's twin towers right down to the waters of New York's Upper Bay.

Every bit of structural steel going into this $325,000,000 giant – more than 160,000 tons of it – will be covered not just once but a minimum of three tim with lead pigmented paints to check co rosion. A fourth coat has been added the interior of the towers, and all oth box sections will get one too because their inaccessibility for repainting late

In all, more than 140,000 gallons paint containing basic lead silico chr mate pigment will be required. Th rust-inhibitive lead pigment will be pre ent in every coat to fight he corrosio of salt spray, water, weather and fume And lead pigmented paints stand u well against the elements because lead's ability to make metallic soap out of the organic acids which ordinaril form in the film – thus neutralizing thei corrosive powers. It is these acids tha break down a paint's film and expos the metal underneath to attack; how ever, the "active" lead pigment prevent this and extends film life from a matter of months into years.



Paint for the Verrazano Bridge is being applied by three different contractors: Harris Structural Steel Co., New York, N.Y.; Bethlehem Steel Co., Bethlehem, Pa.; and The American Bridge Div., U.S. Steel Co., Pittsburgh, Pa.

Contractors laying the granite pier blocks which sheathe the concrete supports at the base of the two 690 ft. towers found lead very useful also. The Albert R. MacInnis Co. Inc., of Manhattan, used 35,000 lb. of "lead wool" to calk the spaces between each granite block as a simple means of water-proofing the mortar joints. Since these piers are battered constantly by waves (the tower foundation on the Staten Island side is 300 ft. offshore, while the Brooklyn tower is 700 ft.), the use of lead calking assures long life of the mortar with minimum maintenance.

Workmen merely hammered the "wool," which contains many tiny strands intertwined to form a mass about the size and shape of a large rope, into the joints with a chisel. The lead strands cold weld under such pressure to form a permanent, waterproof seal.

The Verrazano-Narrows Bridge is being financed and built, and like all others in New York City, will be operated by the Triborough Bridge and Tunnel Authority. Consulting Engineers for the project were Ammann and Whitney. Anticipated completion date is the end of 1964 – in time to help lighten the traffic load through mid-Manhattan en route to the World's Fair.

Primer Specification — Verrazano-Narrows Bridge*

Pigment (64.5%)	Min.	Max.
Basic lead silico chromate	94.0	
Silicious red iron oxide	5.0	6.0
Organo montmorillonite	0.5	0.6

Vehicle (35.5%)

Raw linseed oil and alkyd resin combined in 4:1 proportions by weight, with a minimum of 4.6% phthalic anhydride.

Drier — a combination of 0.15% zirconium + 0.03% manganese metals.

Weight: 15.2 lb/gallon

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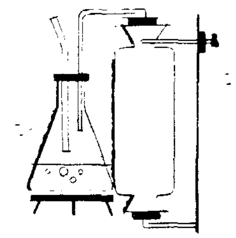
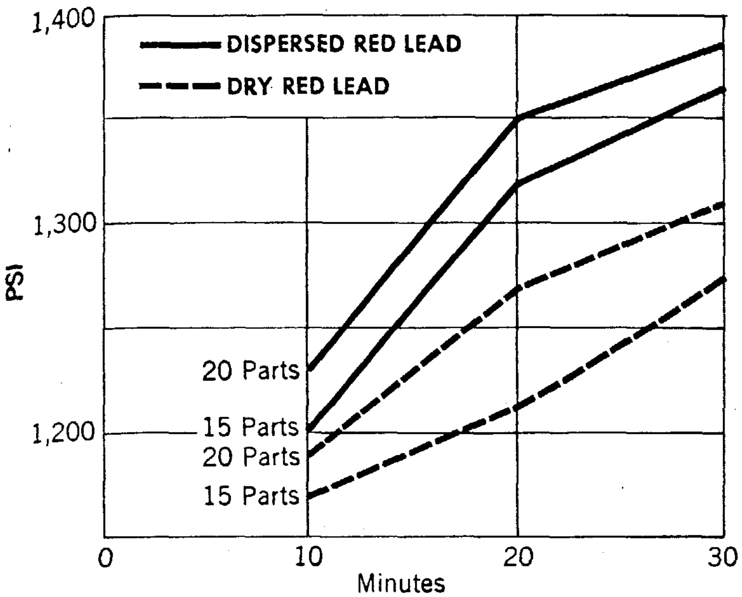
* Specifications for the intermedi... ...ined by writing the Lead Industries Association, Inc.

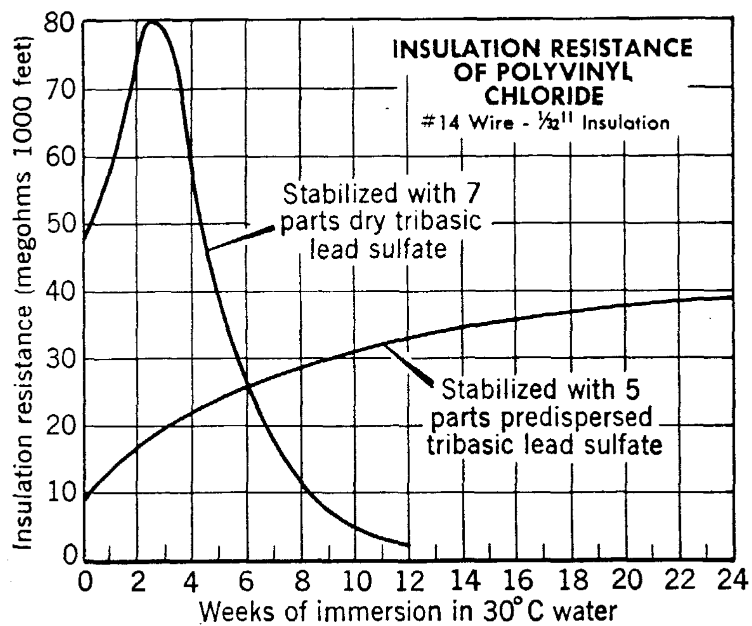
LEAD CHEMICALS



— with the mixing built in



Effects of dry and dispersed red lead versus cure time (at 307°F) on the 200 per cent modulus of a neoprene rubber.



Comparison of dry and predispersed tribasic lead sulfate stabilizer in a polyvinyl electrical wire insulation after immersion in hot water.

The new bride's problem of making a seven-minute frosting is not far different from that of the rubber chemist or plastics technologist trying to work out a new formulation. All the ingredients may be right but the product doesn't behave the way they'd like. The new bride may have to spend years learning exactly when to stop beating her frosting so that it sets without getting gritty. The rubber chemist, though, has a simpler solution available to him.

Suppose his problem is to introduce red lead into a rubber compound as the curing agent. Red lead is a fine dry powder. Rubber, tough and gooey, waits to receive it on the moving rolls of a rubber mill. Understandably, it is hard to get an intimate mixture of two such materials. Dry powders like red lead tend to be spilled or puffed out into the air. Even when they are "wet" by the rubber it is difficult to be sure that they've been thoroughly dispersed. If the milling is continued for a long time to force dispersion, heating and mechanical breakdown of the rubber may start.

One solution to the problem lies in a collection of patented pre-dispersed rubber and plastic chemicals. Lead chemicals are listed frequently in this collection. One of the unlisted ingredients is the premixing which puts the chemicals in an easily compounded, intimately dispersible form. These are the Prespersion® materials made by Ware Chemical Corp., of Westport, Conn.

A typical Prespersion red lead would have a composition as follows:

Red lead	90%
Naphthenic oil	6.5%
Paraffin (mp 130°F)	2.7%
Polyisobutylene	0.8%

The material is packaged in bulk and is also available in pre-weighed batches ready for addition to rubber in the mill or Banbury.

Another benefit derived from the predispersed chemicals is the performance achieved in the final formulation — as shown by the performance tests plotted here.

QUIET ELEGANCE . . .

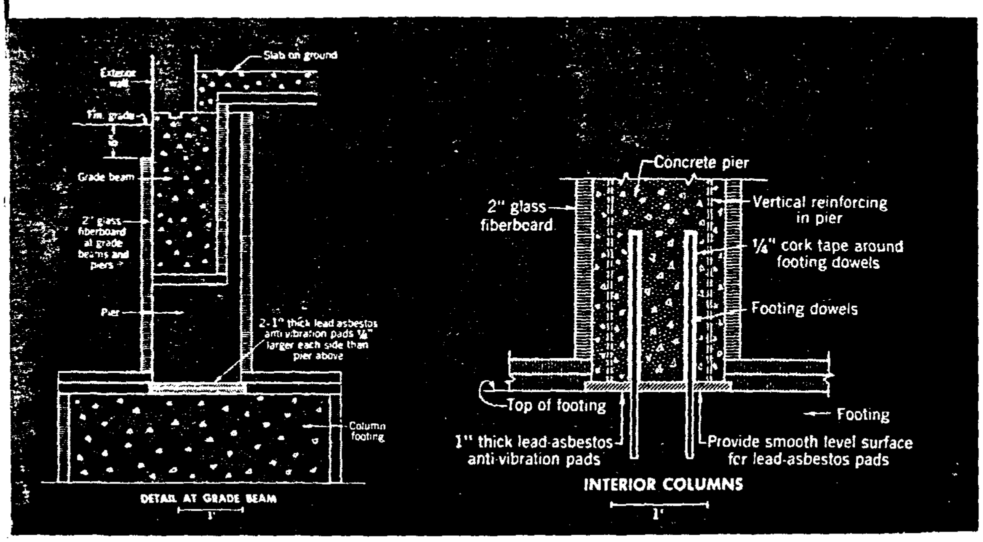
Hahne & Company, Westfield, N. J.

The problem of what to do if you have a busy railroad not ten feet from your back door is apt to be a serious one. If that back door is planned to be one of the exits from a fine department store, the problem becomes one of even greater proportion.

This was the situation facing executives of Hahne & Company, Newark and Montclair department store owners, when a property in Westfield, N.J., became available for development. It was the desire of the owners to create, not just another unit in a chain of stores, but a new and distinctive member of a line of fine retail establishments. The feeling of quiet elegance, so much a part of this type of enterprise, would therefore need a basic solution to the vibration problem posed by the not infrequent passage of railroad rolling stock along the South wall of the building.

It was therefore on the advice of their architect, Lathrop Douglass of New York City, that Hahne & Company engaged the services of Lewis S. Goodfriend & Associates, Consulting Engineers in Acoustics, to make a study of the existing conditions and to recommend remedial measures. Accordingly, a series of measurements were made of railroad induced vibrations produced at the site by trains of the Central Railroad of New Jersey. From these, certain data were developed which were used as guide lines by the structural engineers, Throop & Feiden of New York City. The possibility of having to isolate entire walls along the railroad right-of-way where they would come to bear on their footings resulted in a decision to use a system of grade beams carrying the exterior wall and spanning from pier to pier. Each pier then is isolated from vibration on the South side of the building by lead-asbestos anti-vibration pads double thick and, on the first interior row of columns, by single thick pads. Additional insulation was afforded by the interposition of two inch thick asphalt coated glass fiber board between the exterior walls and the earth back fill.

A unique solution was necessary where structural requirements dictated use of steel dowels passing through the pads from the footings into the column to be poured above. In order to prevent the passage of vibration through the dowels, thus short circuiting the system, the specification called for the dowels to be wrapped with ¼ inch thick cork tape such as is used to prevent condensate forming on cold water pipes. Pads varied in size from 50 x 20 inches to 20 inches square and all were adjusted in size so that loading ranged from 200 to 500 pounds per square inch. Passage of time since the completion of the job has been sufficient for the owners to gauge the effectiveness of this installation. In the words of Mr. J. C. Buck, President of Hahne & Company: "We have not experienced any vibration or noise problems from the railroad, which was a major concern."



Credits:

Architect: Lathrop Douglass, New York City
General Contractor: Mahony-Troast, Clifton, N.J.
Structural Engineers: Throop & Feiden, New York City
Foundation Contractor: George Peterson, Harrison, N.J.
A ... Goodfriend &
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ODDS & ENDS ABOUT LEAD

International Lead Conference Proceedings available — The edited proceedings of the First International Conference on Lead held in London, Oct., 1962 have been published. The 350-page, illustrated volume contains 23 papers on lead cable sheathing, storage batteries, radiation shielding, research, and lead and lead alloys in the chemical industry. The Proceedings are priced at $6.50 post free from the Lead Development Association, 34 Berkeley Square, London, W1, England, with payment to that organization.

When your French curve doesn't fit, take a tip from reader H. P. Higgs: "I use solder to take the place of a French curve. I straighten it by drawing it across the edge of the desk. It is then easily formed to connect plotted data points." he writes. Considering the cost of flexible curves and the fact that you can never find them when you need them, we think he has a good idea. If you have a tip on a handy way to use lead, let us tell others about it. — The Editors.

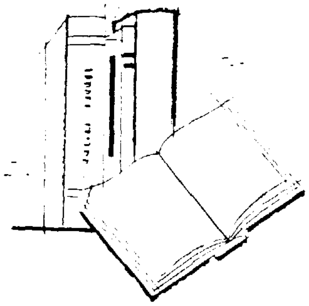
Interurban battery buses? A serious proposal has been made for inter-urban trolley buses whose overhead trolley wires would end at the edge of heavy commercial areas. In the congested areas the buses' self-contained batteries would take over. Electric Storage Battery Company's Monroe G. Smith sees them as offering economy without the clutter of rails and wires on city streets. One problem still to be solved: How to get passengers to move to the rear.

Less bounce to the ounce is the claim to fame for a lead filled plastic made by Fiberfil, Inc., of Evansville, Ind. The injection molding acetal resin, Plaslube AC-80/Pb/50, is used for small parts like carburetor valves. The inertia and low bounce brought about by the lead aids in getting smooth performance.

— Thirty Years Ago —

The last word in interoffice communications was described in a 1933 issue of LEAD. The British Post Office was installing extensions to its pneumatic tube system using lead pipe. This was done in perfect confidence since the existing lead pipe had been giving good service for 52 years previous to 1933!

The golden aura of safety will soon loom at every major intersection in New York City. Convinced that lead chromate yellow had contributed to safety improvement in other cities, New York's new traffic commissioner Henry Barnes is having all traffic lights painted as well as having yellow lane marking lines in the streets. Here a Welsbach Corp. painter is adding the new look to a Brooklyn street light.



LEAD LIBRARY of technical information

NEW LISTINGS

Lead sheathing for power cable
24-page design guide for lead sheathed power cable describes manufacture and evaluates lead sheathing subject to mechanical stresses, corrosive environments and varying electrical loads. Factors governing cable selection are also reviewed.

Transmission loss of leaded building materials
Evaluation of sound-transmission loss characteristics of architectural partition materials and constructions with and without addition of sheet lead to faces. Seven pages.

Lead wall reduces noise
Effectiveness of partition construction in reducing noise is described and evaluated. Partition consists of gypsum board bonded to faces of sheet lead core. One page.

Dielectric behavior of Pb-, Ba-, Sr-hafnate systems
Six page reprint of use in the investigation of ferroelectric materials for ferromagnetic and electronic applications.

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New uses for lead
Design engineering data

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Truck costs in a jiffy
Three nomographs for estimating costs of gas or battery powered industrial trucks.

The choice of battery systems

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Methods of lining lead tanks
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Four page reprint describes shielding requirements for pipe or duct through wall openings.

Thermal expansion data — lead compounds, two papers I, II
PbO-Fe_2O_3 Phase Relations
Lead to control sound and vibration
Anodes for ship protection
Lead glazes for brick
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