

## LEAD

### THE PROPERTIES, PRODUCTION AND USES OF LEAD

Compiled by The Arizona Department of Mineral Resources from Reports of U.S.B.M. in May, 1951, and U.S. Tariff Commission in April, 1954.

Lead is one of the most important industrial nonferrous metals used in substantial quantities in the metallic form. It is the softest and heaviest of the common metals. It can be rolled to a foil of less than 0.0005 inch in thickness but is not ductile enough to be drawn into fine wire.

Some of the physical properties of lead are as follows:

|  |             |
|--|-------------|
| Atomic Weight                          | 207.2       |
| Specific Gravity                       | 11.38       |
| Melting Point - Deg. F.                | 621         |
| Boiling Point - Deg. F.                | 2900 - 3600 |
| Heat Conductivity - Silver = 100       | 8.2         |
| Electrical Conductivity - Silver = 100 | 7.6         |
| Tensile Strength - Lbs. per Sq. In.    | 1600 - 2400 |
| Hardness - Moh Scale                   | 2-          |

As shown above, lead has a high boiling point and a low melting point. It is highly resistant to corrosion, especially from sulphuric acid. It has many useful alloying and chemical properties, and its impenetrability to short-wave radiation makes it invaluable for radiation shields (for x-ray equipment and, more recently, in atomic energy applications). These properties of lead account not only for its most important uses but also for the relative ease of its recovery from ores and from scrap, and for its easy workability.

In the United States in the past 5 years the use of lead in the form of chemical compounds (principally in storage-battery oxides, lead pigments, and tetraethyl lead for gasoline) somewhat exceeded its use in alloys (with antimony, tin, copper, bismuth, etc.), and the use of lead in alloys somewhat exceeded the use of unalloyed lead. Requirements in connection with transportation facilities accounted for close to half the total quantity of lead consumed, principally in lead-acid storage batteries (using both antimonial lead and lead oxides) and in gasoline. Large quantities of lead are also used for cable covering, solder, and rolled and extruded products like lead sheet and pipe, for lead caulking, ammunition, bearing metals, type metals, brass and bronze, and for many other uses. Table I gives detailed figures on United States consumption of lead, by uses, for the last four years, 1950 - 1953.

Table II gives Salient Statistics of the U. S. Lead Industry.

Table III gives a Summary of U. S. Lead Production, Imports, Exports and Consumption for the Years 1950 - 1953 inclusive.

A study of these tables indicates that the U. S. mines enjoy their best conditions when they are producing 50% to 60% of the domestic consumption of new lead, or when the mine production plus secondary recovery amounts to better than 75% of total domestic consumption of primary and secondary lead.

Table IV was compiled from the latest available figures to indicate the character of lead and zinc ores mined in Arizona. For the years 1950 and 1951 the average grade of lead-zinc ore treated at mills in Arizona was:

Gold - .05 oz./ton; Silver 3.00 oz./ton; Copper .44%; Lead 4.02%;  
Zinc 8.44%.

The average grade of zinc - copper ore was:

Gold - .05 oz./ton; Silver - 2.08 oz./ton; Copper - 2.65%; Lead -.38%;  
Zinc - 8.43%.

The average grade of lead concentrate shipped to smelters was:

Gold - .37 oz./ton; Silver 24.93 oz./ton; Copper - 2.92 %; Lead - 42.21%;  
Zinc - 8.79%.

The average grade of direct smelting lead ore was:

Gold - .50 oz./ton; Silver - 4.10 oz./ton; Copper - .35%; Lead 15.35%;  
Zinc - .54%.

The average grade of direct smelting lead-zinc ore was:

Gold - .09 oz./ton; Silver 1.93 oz./tons; Copper - .55%; Lead - 17.70%;  
Zinc - 8.08%.

#### LEAD DUTIES

|                            | <u>Rate of<br/>duty under<br/>Tariff Act<br/>of 1930</u> | <u>Rate of<br/>duty under<br/>Trade Agreement<br/>In effect<br/>on 1/1/1954</u> | <u>Maximum<br/>Rate Possible<br/>as result<br/>of "Escape<br/>Clause Action"</u> |
|----------------------------|--|---|--|
| Lead-bearing ores & Mattes | 1½ cts./lb.  | 3/4 cts./lb.  | 1.8 ¢/lb.  |
| Lead pigs, bars, etc.      | 2 1/8 cts./lb.   | 1 1/16 cts./lb.   | 2.55¢/lb.  |

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TABLE I

UNITED STATES CONSUMPTION OF LEAD, BY USES, YEARS 1950-53 INCL.

Source: U. S. B. M.

|  | <u>1950</u>      | <u>1951</u>      | <u>1952</u>      | <u>1953</u><br><u>Preliminary</u> |
|--|------------------|------------------|------------------|-----------------------------------|
| <b>METAL PRODUCTS:</b>                 |                  |                  |                  |                                   |
| Storage Batteries<br>(antimonial lead) | 212,464          | 199,838          | 187,506          | 189,531                           |
| Storage Batteries<br>(oxides)          | 185,945          | 175,546          | 163,424          | 173,331                           |
| Cable Coverings                        | 131,989          | 131,863          | 142,571          | 145,502                           |
| Solder                                 | 94,606           | 82,465           | 72,664           | 77,474                            |
| Caulking Lead                          | 53,450           | 46,544           | 45,150           | 46,205                            |
| Ammunition                             | 38,438           | 40,242           | 36,182           | 43,777                            |
| Bearing Metals                         | 38,241           | 35,410           | 36,545           | 38,534                            |
| Sheet Lead                             | 30,778           | 31,210           | 28,697           | 30,190                            |
| Pipes, Traps & Bends                   | 41,361           | 33,095           | 29,465           | 27,904                            |
| Other uses                             | 86,664           | 99,180           | 85,268           | 82,887                            |
| <b>TOTAL</b>                           | <b>913,936</b>   | <b>875,393</b>   | <b>827,472</b>   | <b>855,335</b>                    |
| <b>CHEMICALS:</b>                      |                  |                  |                  |                                   |
| Tetraethyl Lead                        | 113,846          | 128,407          | 146,723          | 162,983                           |
| Other Chemicals                        | 11,680           | 6,949            | 3,996            | 6,918                             |
| <b>TOTAL</b>                           | <b>125,526</b>   | <b>135,356</b>   | <b>150,719</b>   | <b>169,901</b>                    |
| <b>PIGMENTS:</b>                       |                  |                  |                  |                                   |
| Red Lead & Litharge                    | 101,974          | 88,031           | 76,742           | 78,977                            |
| White Lead                             | 36,181           | 25,578           | 22,943           | 17,307                            |
| Other                                  | 28,232           | 25,895           | 22,614           | 23,433                            |
| <b>TOTAL</b>                           | <b>166,387</b>   | <b>139,504</b>   | <b>122,299</b>   | <b>119,717</b>                    |
| <b>MISCELLANEOUS USES</b>              | <b>32,132</b>    | <b>34,540</b>    | <b>30,305</b>    | <b>31,760</b>                     |
| <b>GRAND TOTAL CONSUMED</b>            | <b>1,237,981</b> | <b>1,184,793</b> | <b>1,130,795</b> | <b>1,176,713</b>                  |

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TABLE II

## SALIENT STATISTICS OF THE U. S. LEAD INDUSTRY

YEARS 1950 - 1953 INCL.

Source: U.S.B.M.

| Compiled by Arizona Department of Mineral Resources.   | 1950      | IN SHORT TONS OF 2000 LBS. |           |           |
|--|-----------|----------------------------|-----------|-----------|
|  |           | 1951                       | 1952      | 1953      |
| Consumers' stocks at beginning of year.  | 97,267    | 139,884                    | 102,760   | 122,530   |
| Producers' stocks " " " "  | 201,526   | 137,669                    | 124,080   | 149,778   |
| Refined primary lead produced.   | 508,314   | 417,693                    | 472,852   | 474,000   |
| Secondary lead recovered from old & new scrap.   | 482,275   | 518,110                    | 471,294   | 435,000   |
| Imported pigs and bars.  | 441,798   | 178,907                    | 510,720   | 385,000   |
| Imported reclaimed scrap.  | 20,085    | 9,082                      | 12,339    | -         |
| Imported misc. products - lead content.  | 13,128    | 9,648                      | -         | -         |
| Total Supply   | 1,764,393 | 1,410,993                  | 1,694,045 | 1,566,308 |
| Consumers' stocks at end of year.  | 139,884   | 102,760                    | 122,530   | 113,518   |
| Producers' stocks " " " "  | 137,669   | 124,080                    | 149,778   | 196,340   |
| Exported lead (pigs, bars and anodes)  | 2,735     | 1,281                      | 1,762     | 803       |
| Sub-total  | 280,288   | 228,121                    | 274,070   | 310,661   |
| Net apparent consumption.  | 1,484,105 | 1,182,872                  | 1,419,975 | 1,255,647 |
| REPORTED consumption.  | 1,237,981 | 1,184,793                  | 1,130,795 | 1,176,713 |
| Unaccounted for *  | 246,124   | -                          | 289,180   | 78,934    |
| Mine production of recoverable lead (Arizona)  | 26,383    | 17,394                     | 16,520    | 9,300     |
| " " " " " (U. S.)  | 430,827   | 388,164                    | 390,161   | 335,412   |
| " " " " " (World)  | 1,841,000 | 1,857,000                  | 2,006,000 | 1,900,000 |
| Production of refined primary lead:  |           |                            |           |           |
| From domestic ores & base bullion.   | 418,809   | 342,644                    | 383,358   | 330,000   |
| " foreign " " " "  | 89,505    | 75,049                     | 89,494    | 140,000   |
| Recovery of secondary lead from old scrap.   | 427,520   | 441,658                    | 411,831   | 385,000   |
| " " " " " new "  | 54,755    | 76,452                     | 59,463    | 50,000    |
| Imported lead in ores and matte.   | 76,520    | 67,651                     | 104,515   | 163,200   |
| Imported lead in base bullion.   | 3,488     | 2,281                      | 389       | 892       |
| Imported lead in reclaimed scrap, etc.   | 20,039    | 9,082                      | 12,339    | -         |
| U. S. Mine production % of reported U. S. consumption.   | 34.80     | 32.76                      | 34.50     | 28.50     |
| U. S. Mine production plus U. S. secondary lead from old scrap - as % of reported U. S. consumption. | 69.33     | 70.21                      | 70.92     | 61.22     |
| Average price of lead (N.Y.) (E. & M. J.)  | 13.296    | 17.500                     | 16.467    | 13.489    |

\* Mostly in strategic stockpiles.

TABLE III

SUMMARY OF U. S. LEAD PRODUCTION, IMPORTS, EXPORTS,  
AND CONSUMPTION - YEARS 1950 - 53.

Source: U. S. B. M.

| <u>LEAD</u>   | <u>1950</u> | <u>1951</u> | <u>1952</u> | <u>1953<br/>Preliminary</u> |
|---|-------------|-------------|-------------|-----------------------------|
| Stocks at smelters and re-<br>fineries beginning of year.                         | 201,526     | 137,669     | 124,080     | 149,778                     |
| Mine Production of<br>recoverable Lead.   | 430,827     | 388,164     | 390,161     | 335,412                     |
| Imported in ore,matte, base<br>bullion,pigs,bars & reclaimed.                     | 541,835     | 257,921     | 627,963     | 549,185                     |
| Secondary Lead recovered<br>from scrap.   | 482,275     | 518,110     | 471,294     | 435,000                     |
|   | 1,656,463   | 1,301,864   | 1,613,498   | 1,469,375                   |
| Exported Lead pigs,<br>bars and anodes  | 2,735       | 1,281       | 1,762       | 803                         |
| Stocks at smelters and<br>refineries at end of year.                              | 137,669     | 124,080     | 149,778     | 196,340                     |
| Apparent domestic consumption.  | 1,516,059   | 1,176,503   | 1,461,958   | 1,272,228                   |
| Reported consumption  | 1,237,981   | 1,184,793   | 1,130,795   | 1,176,713                   |
| Unaccounted for *   | 278,078     | -           | 331,163     | 95,515                      |
| Mine production plus secondary<br>recovery as percent of<br>apparent consumption. | 60.23       | 77.03       | 58.92       | 60.56                       |
| Mine production as % of apparent<br>consumption of new lead.                      | 41.67       | 58.96       | 39.38       | 40.06                       |

\* Principally in strategic stockpiles - and changes in stocks held by importers.

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TABLE IV  
LEAD - ZINC  
STATE OF ARIZONA  
TONNAGES AND ASSAYS OF CONCENTRATING ORES, DIRECT SMELTING ORES,  
AND CONCENTRATES IN 1950 and 1951.

Source: U. S. B. M.

| <u>Kind of Ore</u><br><u>1950:</u>                   | <u>Quantity</u><br><u>Treated</u><br><u>Short Tons</u> | <u>Oz.</u><br><u>Gold/ton</u> | <u>Oz.</u><br><u>Silver/ton</u> | <u>%</u><br><u>Copper</u> | <u>%</u><br><u>Lead</u> | <u>%</u><br><u>Zinc</u> |
|--|--|-------------------------------|---------------------------------|---------------------------|-------------------------|-------------------------|
| <u>Ore Treated at Mills</u>                          |  |                               |                                 |                           |                         |                         |
| LEAD   | 1,864  | .05                           | 2.43                            | .24                       | 6.05                    | .26                     |
| ZINC   | 7,159  | .02                           | .78                             | 1.77                      | .82                     | 21.07                   |
| ZINC - COPPER  | 248,391  | .05                           | 2.16                            | 2.74                      | .36                     | 7.85                    |
| LEAD - ZINC  | 613,621  | .05                           | 3.22                            | .50                       | 4.46                    | 9.35                    |
| ZINC-LEAD-COPPER                                     | 2,498  | -                             | 6.40                            | 1.73                      | 4.22                    | 12.44                   |
| <u>Concentrate Shipped to Smelters</u>               |  |                               |                                 |                           |                         |                         |
| LEAD   | 50,073   | .31                           | 24.11                           | 3.09                      | 43.42                   | 9.19                    |
| LEAD- COPPER   | 315  | .61                           | 60.05                           | 14.94                     | 38.45                   | 5.13                    |
| ZINC   | 117,133  | .05                           | 4.01                            | 1.29                      | 3.04                    | 56.09                   |
| ZINC - COPPER  | 759  | .03                           | 1.58                            | 4.24                      | 2.13                    | 44.63                   |
| IRON (Lead-Zinc)                                     | 26,444   | .19                           | 2.87                            | .10                       | 1.47                    | 5.24                    |
| <u>Ore, Old Tailings, Shipped Direct to Smelters</u> |  |                               |                                 |                           |                         |                         |
| LEAD   | 11,278   | .41                           | 4.20                            | .44                       | 15.06                   | .19                     |
| LEAD - ZINC  | 3,926  | .08                           | 2.22                            | .45                       | 18.70                   | 7.72                    |
| <u>1951</u>  | <u>Ore Treated at Mills</u>                            |                               |                                 |                           |                         |                         |
| LEAD   | 857  | -                             | 1.46                            | .04                       | 7.85                    | .88                     |
| ZINC   | 8,859  | -                             | 1.21                            | .69                       | .45                     | 16.71                   |
| ZINC - COPPER  | 433,256  | .04                           | 2.00                            | 2.57                      | .40                     | 7.49                    |
| LEAD - ZINC  | 497,738  | .06                           | 2.72                            | .38                       | 3.58                    | 7.53                    |
| ZINC-LEAD-COPPER                                     | 2,643  | -                             | 2.69                            | 3.29                      | 3.05                    | 8.79                    |
| <u>Concentrate Shipped to Smelters</u>               |  |                               |                                 |                           |                         |                         |
| LEAD   | 35,025   | .43                           | 25.74                           | 2.74                      | 41.00                   | 8.39                    |
| LEAD - COPPER  | 183  | -                             | 35.51                           | 35.69                     | 40.23                   | 6.32                    |
| ZINC   | 106,027  | .05                           | 3.54                            | 1.48                      | 1.68                    | 51.37                   |
| ZINC - COPPER  | 19   | .26                           | 11.60                           | 3.30                      | 6.42                    | 10.87                   |
| IRON (Lead-Zinc)                                     | 28,536   | .16                           | 2.35                            | .11                       | 1.08                    | 4.22                    |
| <u>Ore, Old Tailings, Shipped Direct to Smelters</u> |  |                               |                                 |                           |                         |                         |
| LEAD   | 4,952  | .60                           | 4.00                            | .27                       | 15.63                   | .89                     |
| LEAD - ZINC  | 5,562  | .11                           | 1.64                            | .66                       | 16.71                   | 8.45                    |

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