

Minerals Yearbook 1972

Volume I

METALS, MINERALS, AND



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Lead

By J. Patrick Ryan

World production and consumption of lead reached record levels and achieved a near balance in 1972. Free world mine production increased about 1% with most of the net gain coming from the United States and Peru. Refined lead production was up nearly 2% with most of the major producing countries contributing to the increase. Consumption of metal rose 4%, the largest annual increase since 1969. The near balance between metal production and consumption brought relatively stable world market prices, particularly in the London Metal Exchange (LME) quotation. The average LME cash price published by Metals Week in terms of U.S. currency increased from 11.40 cents per pound in January to 14.51 cents in March, and generally declining thereafter to 13.98 cents in December. The average equivalent LME price in 1972 was 13.68 cents. The average U.S. producers' price after rising 1.6 cents to 15.60 cents in the first 5 months trended lower thereafter to 14.50 cents in December. The average domestic price of lead on a nationwide delivered basis in 1972 was 15.03 cents per pound.

The domestic lead industry again achieved significant gains in both mine production and consumption. Refinery production also increased continuing the rising trend of recent years after a falloff in 1971, which was attributed to a reduction in imports of crude materials for processing at domestic plants. Both mine and refinery production of lead reached the highest levels since 1929 with respective gains of about 7% over 1971 output. The 40,360-ton net increase in domestic mine output was achieved as gains in Missouri and Colorado more than offset declines in Idaho and Utah. Secondary lead output of 616,600 tons, representing about 39% of the market supply, was nearly 20,000 tons more than the 1971 output. The apparent domestic supply of lead consisting of pri-

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Actual drawdown of government stocks during 1972 was 44,738 tons, leaving a total of 1,085,871 tons remaining in the stockpile on December 31. Of the total uncommitted inventory at yearend 547,615 tons was in excess of the 530,000-ton objective.

GSA concluded contracts in May with primary producers for the disposal of 575,000 tons of surplus stockpile lead. Under terms of the contracts producers were obligated to purchase metal at the rate of 50,000 tons per year subject to suspension during quarters when producers' stocks exceed one-tenth of the preceding year's shipment of primary metal. The long-term contracts were amended at year-end by reducing the point of suspension to one-twelfth of the preceding year's shipments and increasing the purchase requirement to 55,000 tons per year. The new rates were to become effective January 1, 1973.

A bill (H.R. 16388) to provide for an adequate supply of lead and zinc for consumption in the United States from domestic and foreign sources was introduced in August and referred to the Committee on Ways and Means. The bill included a proposal to increase tariffs on lead in imported concentrates, lead and zinc unwrought and wrought metals, lead and

zinc waste and scrap, and manufactures of these metals when exceeding specified limiting quantities. The bill also provided for revising the quotas for lead and zinc in concert with changes in the annual consumption. The proposed act was designed to implement the Mining and Minerals Policy Act of 1970 by encouraging private enterprise. No further action was taken on the bill by the 92d Congress. Bills (S. 3136, H.R. 12958) were introduced in the 2d Session, 92d Congress to regulate the amounts of lead and cadmium that may be released from glazed ceramic or enamel dinnerware; other bills introduced in the Congress relating to the use of lead included the following: S. 607—which would reduce the amount of lead contained in lead-based paints for residential use and establish procedures to minimize hazards of lead-based paint in any existing housing; H.R. 15937—which would provide performance standards for emission control devices to reduce air pollution from used vehicles, which could affect the use of lead in gasoline. The enactment of the Noise Control Act of 1972, which sets limits on noise emission, could stimulate the use of lead as a noise suppressing material in construction and other equipment.

On February 23 the Environmental Protection Agency (EPA) published guidelines

in the Federal Register calling for a staged reduction in the lead content of gasoline and requiring that major oil companies provide at least one grade of unleaded gasoline—actually, 0.05 gram per gallon—by July 1, 1974. The proposed timetable for

the reduction for a maximum per gallon per gallon per gallon grams per

Table 1.—Salient lead statistics
(Short tons unless otherwise specified)

	1968	1969	1970	1971	1972
United States:					
Production:					
Domestic ores, recoverable lead content.....	359,166	509,013	571,767	578,550	618,915
Value.....thousands.....	\$94,908	\$151,635	\$178,609	\$159,679	\$186,046
Primary lead (refined):					
From domestic ores and base bullion.....	349,039	513,931	528,086	573,022	592,658
From foreign ores and base bullion.....	118,271	124,724	138,644	76,993	103,001
Antimonial lead (primary lead content).....	19,494	16,250	11,655	16,116	8,185
Secondary lead (lead content).....	550,879	603,905	597,390	596,797	616,697
Exports of lead materials excluding scrap.....	8,281	4,968	7,747	5,925	8,876
Imports, general:					
Lead in ore and matte.....	87,836	109,252	112,406	65,998	101,514
Lead in base bullion.....	8	1,993	296	41	896
Lead in pigs, bars, and old.....	344,601	285,342	251,480	198,970	245,625
Stocks December 31 (lead content):					
At primary smelters and refineries.....	90,427	101,860	192,985	121,660	145,573
At consumer plants.....	78,900	126,404	133,502	125,577	118,544
Consumption of metal, primary and secondary.....	1,328,790	1,389,358	1,360,562	1,431,514	1,485,254
Price: Common lead, average, cents per pound ¹	13.21	14.93	15.69	13.89	15.08
World:					
Production:					
Mine.....	3,314,992	3,566,061	3,741,546	3,771,879	3,848,582
Smelter.....	3,250,514	3,553,458	3,628,422	3,500,868	3,725,584
Price: London, common lead, average, cents per pound.....	10.88	13.09	13.76	11.62	13.68

¹ Quotations for 1968-71 at New York and for 1972 on a nationwide, delivered basis.

LEAD

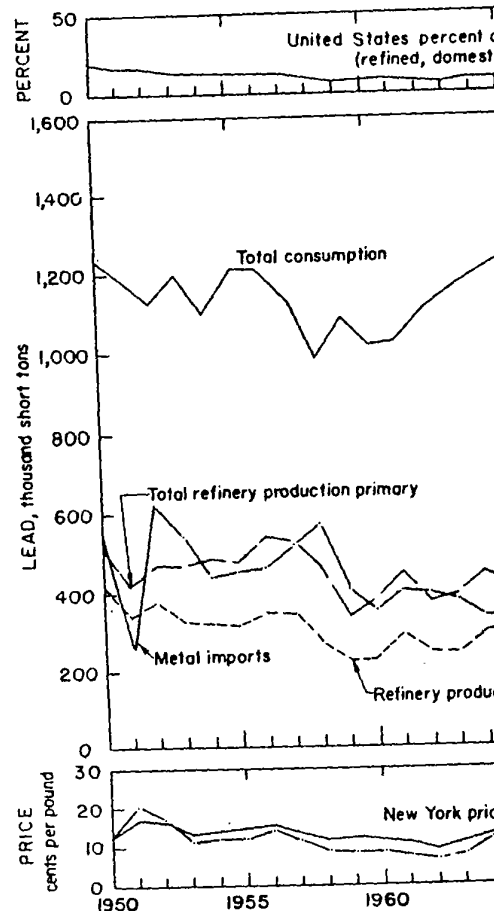


Figure 1.—Trends in the lead industry

Table 2.—Lead statistics, 1931-72
(Short tons unless otherwise specified)

Year	United States						World production (mine)
	Mine production	Refinery production (primary sources)	Secondary production	Imports (refined)	Exports	Consumption	
1931.....	404,622	442,764	234,700	10	21,665	567,700	4.24 1,461,000
1932.....	292,968	281,941	198,300	44	23,516	416,700	3.18 1,315,000
1933.....	272,677	263,676	224,500	109	22,835	449,500	3.87 1,304,000
1934.....	287,339	311,236	208,400	283	5,909	488,000	3.86 1,447,000
1935.....	331,103	324,560	270,400	1,322	6,982	538,900	4.06 1,523,000
1936.....	372,919	399,156	262,900	2,590	18,313	633,600	4.71 1,556,000
1937.....	464,892	467,317	275,100	4,903	46,866	646,000	4.74 1,942,000
1938.....	369,726	383,669	224,900	7,139	74,892	687,000	5.06 1,902,000
1939.....	413,979	484,035	241,500	151,548	23,765	782,000	5.18 1,936,000
1940.....	467,392	533,179	260,346	397,416	14,359	1,060,000	6.79 1,784,000
1941.....	461,426	570,967	397,416	274,189	1,940	1,043,000	6.48 1,793,000
1942.....	496,289	566,839	323,001	366,497	2,003	1,113,000	6.50 1,591,000
1943.....	463,313	469,612	342,094	244,510	15,523	1,118,600	6.50 1,458,000
1944.....	416,861	464,763	331,416	222,758	1,408	1,051,600	6.50 1,302,000
1945.....	390,821	443,586	363,039	227,469	598	956,500	8.11 1,268,000
1946.....	335,475	338,197	392,787	116,503	1,523	1,172,000	14.67 1,498,000
1947.....	384,221	441,010	511,970	169,513	399	1,133,895	17.49 1,890,000
1948.....	390,476	406,694	500,071	247,116	969	957,674	15.36 1,709,000
1949.....	409,908	477,338	412,183	275,240	2,735	1,237,981	13.30 1,860,000
1950.....	430,827	508,314	482,276	441,788	1,281	1,184,793	16.47 2,030,000
1951.....	388,164	417,693	518,110	179,032	803	1,201,604	13.48 2,100,000
1952.....	390,162	472,852	471,294	510,720	596	1,094,871	14.05 2,270,000
1953.....	325,644	467,891	486,737	385,071	403	1,212,644	15.14 2,430,000
1954.....	325,419	479,157	480,925	276,286	4,628	1,209,717	16.01 2,490,000
1955.....	338,025	542,908	506,755	262,654	4,339	1,138,115	14.66 2,640,000
1956.....	352,826	538,533	489,229	324,279	1,359	986,387	12.21 2,590,000
1957.....	338,216	470,156	401,787	263,416	2,766	1,091,149	12.21 2,570,000
1958.....	267,377	340,931	451,387	206,033	1,967	1,021,172	11.96 2,620,000
1959.....	265,586	382,436	469,903	266,852	2,133	1,027,216	10.87 2,640,000
1960.....	246,669	376,063	444,202	257,201	2,108	1,109,635	9.83 2,775,267
1961.....	261,921	449,566	462,792	222,613	1,088	1,163,358	11.14 2,775,267
1962.....	236,956	394,732	493,471	207,844	10,175	1,202,138	13.62 2,779,182
1963.....	253,369	449,429	541,682	222,613	7,811	1,241,482	16.00 2,966,508
1964.....	286,010	418,249	572,834	285,389	6,436	1,323,877	15.12 3,138,779
1965.....	301,147	440,735	563,772	363,598	5,536	1,260,516	14.00 3,169,343
1966.....	327,368	479,810	550,879	278,380	8,251	1,328,790	13.21 3,314,992
1967.....	316,931	467,314	507,390	244,623	4,968	1,389,358	14.93 3,566,061
1968.....	359,156	638,655	603,906	278,380	7,747	1,360,552	15.69 3,741,546
1969.....	509,013	666,730	597,390	244,623	5,926	1,431,514	13.85 3,771,879
1970.....	571,767	666,730	597,390	244,623	8,376	1,485,254	15.03 3,848,582
1971.....	578,550	650,015	596,797	195,587			
1972.....	618,916	695,659	616,597	242,390			

¹ 1931-39 includes a small quantity of scrap.

DOMESTIC PRODUCTION

MINE PRODUCTION

Domestic mine output of recoverable lead continued its uninterrupted rise since 1967 with an increase of about 7% in 1972 to 618,900 tons. Monthly production reached a maximum of 56,900 tons in August, slightly more than the maximum achieved in 1971. Production from Missouri mines increased 59,800 tons to 489,400 tons, representing 79% of the total domestic mine output. Idaho, the second largest producing State, provided 10%; Colorado, 5%; and Utah, 3%.

The Buick mine of AMAX Lead Co. of Missouri was again the leading lead producer with an output of 189,000 tons of lead concentrate in 1972. The seven leading mines, all in Missouri, contributed

74% of the total domestic mine production of lead. The 10 leading mines produced 84%, and the 25 leading mines contributed nearly 99%.

St. Joe Minerals Corp. closed its Federal mine in October and reported that its new Brushy Creek mine in the New Lead Belt with a production potential of 50,000 tons of lead per year is scheduled to start milling early in 1973. Although St. Joe reported a 3% increase in lead concentrate production to 312,700 tons, output of lead and lead alloy declined 6% to 207,877 tons. Operations at the company's Herculanum smelter were interrupted by a 2-week work stoppage.²

² St. Joe Minerals Corp. 1972 Annual Report, pp. 9, 17.

Ozark Lead Co.'s Ozark mine produced 69,100 tons of lead in concentrates compared with 55,300 tons in 1971. The production gain reflected a return to full-scale operation following a production curtailment in 1971 because of a buildup of concentrates during the period when the Glover custom smelter was closed by a labor strike.

Production of lead in Idaho was 5,200 tons less than in 1971. Increased output at the Bunker Hill and Star mines did not fully offset the loss in output at the Lucky Friday mine. Hecla Mining Co. reported a ore production of 263,595 tons at the Star-Morning mine, owned jointly by Hecla (30%) and Bunker Hill (70%), about 17,000 tons more than in 1971. Hecla's share of the 1972 silver-lead-zinc ore production was 79,079 tons assaying 5.33% lead and yielding 3,854 tons of lead. Extensive deep level development was completed, including deepening of No. 4 shaft to the 7,900-foot level and approximately 4,150 feet of development footage. Hecla's share of computed ore reserves increased 4,000 tons to 265,000 tons at yearend. Hecla's Lucky Friday mine produced 192,020 tons of ore assaying 10.43% lead, compared with 213,390 tons assaying 11.3% lead in 1971. Ore reserves at yearend totaled 584,000 tons, about 32,000 tons more than 1 year earlier. The main shaft was deepened to 30 feet below the 4,250-foot level, and a pilot station crosscut was completed at the 4,250 level. Crosscuts were completed through the vein on the new 4,050 level.

Output of lead in Utah declined about 46% in 1972. The Mayflower mine operated by Hecla Mining Co. produced 114,604 tons of ore yielding 3,586 tons of lead compared with 4,860 tons in 1971. The mine was closed at yearend.

Kennecott Copper Corp. reported that output of lead increased at its Burgin mine in the Tintic District, Utah, in 1972 owing to improved working conditions and the discovery of a new ore zone. The critical shortage of skilled miners continued to hamper mine development and production.⁴

In Colorado lead output, continuing the rising trend since 1968, increased nearly 22% in 1972. As in 1971 the production gain was attributed largely to increased output at the Leadville Unit, an Ameri-

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AMAX Lead Co. of Missouri reported that the smelter at Buick, Mo., jointly owned by AMAX and Homestake Mining Co., produced 133,000 tons of refined lead, compared with 109,000 tons in 1971. Of the total output 67,000 tons were for the account of AMAX-Homestake, and the remainder was processed on toll for other producers.⁷

ASARCO's custom smelting and refining plant at Glover, Mo., operating at less than capacity because of market conditions, produced 86,400 tons of lead compared with 66,500 tons in 1971, a year in which the smelter was shut down for nearly 4 months by a strike. Most of the concentrate treated at the Glover plant came from the Ozark Lead Co. mine at Sweetwater, Mo. Concentrates from 13 other domestic mines in five States and from one mine in Honduras also were treated at Glover. The East Helena, Mont., smelter operated continuously during the year processing crude ores and concentrates from approximately 54 domestic mines and mines in Canada, Peru, and Australia. The El Paso lead smelter processed ores and concentrates from about 28 domestic mines in seven States and from mines in Peru, Canada, Honduras, Nicaragua, Australia, and Mexico. Refined metal output at the company's Omaha refinery, which processed lead bullion from the East Helena and El Paso smelters, totaled 142,700 tons, 20,200 tons more than in 1971 when production was interrupted by a 7-week labor strike.

The Bunker Hill smelter-refinery of Gulf Resources & Chemical Corp. at Kellogg, Idaho, produced 131,000 tons of lead in all forms, 2% more than in 1971 and a new record. The corporation attributed the increase in lead production to improved operating techniques at the smelter.⁸

CONSUMPTION AND USES

Lead consumption in the United States increased nearly 4% in 1972 to a new record of 1.48 million tons. Monthly requirements were higher than those of 1971 in every month except July and September. All major product categories required greater quantities of lead than in 1971. In the metal products category, the 46,800-ton

RAW MATERIAL SOURCE

Domestic mines delivered 619,000 tons of recoverable lead in concentrates to domestic primary smelters in 1972. This represents 88% of the plant production of 703,800 tons of primary refined and antimonial lead compared with 87% in 1971 and 84% in 1970. Lead recovered from imported concentrate smelted during the year amounted to 105,000 tons, about 24,100 tons more than in 1971. The 7,000 tons of lead recovered from lead scrap processed at primary plants was nearly double the 1971 total but constituted only 1% of the total lead from primary plants. Raw material stocks at the beginning of the year at primary plants totaled 165,500 of which 84,400 tons was in process and 1,800 tons was in secondary materials. Total stocks trended upward from a low of 163,800 tons at the end of January to a high of 204,000 tons at the end of November. At yearend, stocks of primary materials awaiting processing contained 92,900 tons of lead, material in process 101,900 tons, and secondary materials 2,500 tons, making a total of 197,300 tons.

Scrap materials consumed in 1972 totaled 814,400 tons, nearly 30,000 tons more than in 1971. New scrap in the form of purchased drosses and residues from a wide variety of sources aggregated 158,900 tons, about 19% of the total input. The remainder, old scrap, was predominantly battery scrap with small amounts of cable lead, type metal, solder, babbitt, and soft and hard lead. The scrap processed was essentially all from domestic sources. General imports of reclaimed scrap, mainly from Australia, totaled 3,200 tons (lead content), slightly less than in 1971, but exports of lead scrap totaling 35,200 tons were about double those in 1971. Stocks of scrap at smelters at yearend were nearly 66,300 tons, about 7,300 tons less than at yearend 1971.

(7%) increase in battery requirements more than offset decreases in the quantity of lead used in ammunition, cables, calking, tubes, sheet lead, and other products. The growth in battery lead requirements

largely reflected continued increase in the population of both on-the-road and off-the-road motor vehicles using battery power for starting, lighting, ignition, and propulsion. A total of 55.5 million automotive batteries were produced in 1972, about 43.2 million of which were required for replacement and the remainder for new car production. The growth in antiknock requirements was resumed in 1972 after a 5% decrease in 1971. The quantity of lead used in gasoline antiknock compounds increased 5% to 278,340 tons, only slightly less than the record consumption in 1970. The gain in lead antiknock additives reflected continuing growth in gasoline production and an increase in the average lead content per gallon of gasoline, from 2.59 grams per gallon in 1971 to 2.63 grams per gallon in 1972.

Soft refined lead represented 65% of the total consumption, antimonial lead 29%, and lead in other alloys, mainly solder and bearing metals, accounted for 5%. Lead in copper-base scrap accounted for 1% of consumption.

The domestic supply of lead metal from all sources—production, imports for consumption, stock changes, and stockpile releases—totaled about 100,000 tons more than reported consumption and exports. The unaccounted for supply in 1972, amounting to about 7% of reported consumption compares with an annual average of approximately 64,000 tons for the 1963-72 period. The difference in totals is attributed to unreported consumption and stock buildup, especially by small users and dealers that do not report to the Bureau of Mines.

The compound annual growth rate in lead consumption during the 10-year period 1963-72 averaged about 2.5% owing largely to the increased demand from the transportation sector for batteries and gasoline additives, which together showed an annual growth of 4.8% and accounted for approximately 68% of the total domestic consumption in 1972, but only 54% in 1963.

Pigments and weights and ballast uses also showed significant growth, but lead consumption in most other metal products was less than in 1971. In 1963 the use of lead in various products in terms of percent of total was as follows: Batteries 39%,

⁷ AMAX, 1972 Annual Report. P. 17.

⁸ Gulf Resources & Chemical Corp. 1972 Annual Report. P. 23.

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18.75-18.90 cents. The price quotation of commercial-grade litharge, powdered, in carload lots, at works, ranged between 17.75-18.00 cents per pound and 19.25-19.50 cents during the year and was 18.00 cents at yearend, the same as at the beginning of the year.

The value of shipments of white lead, red lead, and litharge amounted to \$61.1 million, an average of \$344 per ton compared with \$57.1 million and \$325 per ton, respectively, in 1971.

Foreign Trade.—Exports of pigment-grade lead oxides total 1,866 tons valued at \$818,400 and exports of lead oxides other than pigment grade amounted to nearly 500 tons valued at \$455,600. Ship-

ments went to about 36 countries. Canada, South Vietnam, West Germany, Italy, Japan, and Trinidad were the leading importers of pigment-grade lead oxide, accounting for 80% of the total. Canada, West Germany, Japan, and Netherlands received nearly 85% of the nonpigment-grade oxide exported.

Imports for consumption of lead pigments and compounds decreased 5% in quantity but increased 21% in value to \$9.2 million. Litharge which comprised 58% of the total imports increased 4%, but imports of red lead decreased 74%. Mexico supplied nearly all of the 15,360 tons of litharge and 1,290 tons of red lead imported.

STOCKS

Inventories of refined and antimonial lead at primary smelters and refineries declined through the first 4 months as shipments exceeded production then increased steadily through September falling off again at yearend. Metal stocks totaling 52,100 tons at the start of the year increased to 64,500 tons at yearend. Stocks of base bullion declined about 2,300 tons during the year, but ore and matte stocks increased 13,800 tons.

Stocks of lead in all forms at consumer and secondary smelting plants totaled 118,500 tons at yearend, which reflects a 7,000-ton reduction during the year. Refined soft lead constituted 62% of the total compared with 65% of the total in 1971.

Stocks of lead at producers and consumers plants totaling about 264,000 tons, represented slightly more than 2 months' domestic consumption.

PRICES

Although the quoted price range of common-grade lead on a nationwide delivered basis was 14.0 to 14.3 cents, the producer price based on the weighted average of domestic sales as reported by Metals Week remained unchanged through January at 14.0 cents per pound. Two price changes in February raised the price to 15.5 cents, which held until mid-April when a split quotation of 15.5 to 16.0 cents again developed because some producers raised their price. The average price in April and May was 15.6 cents. Thereafter an average price of 15.5 cents held until late in August when one major producer lowered its price 0.5 cent to 15.0 cents and the split quotation became 15.0 to 16.0 cents. In mid-October the quoted price range became 14.5 to 16.0 cents when one producer reduced its price 0.5 cent to 14.5 cents. The price reduction reflected an increased supply situation attributed to

gains in imports, metal inventories, and GSA releases. The split price quotation of 14.5-16.0 cents per pound continued unchanged through December; however, virtually all sales were made at 14.5 cents. Hence the weighted average producers' price of lead at yearend was 0.5 cent more than at the beginning of the year. The spread between the average domestic price of lead and the average equivalent London Metal Exchange (LME) spot quotation narrowed during the year from 2.6 cents in January to 1.4 cents in September and 0.5 cent in December. The average weighted domestic price for the year was 15.0 cents per pound.

The LME average spot quotation trended upward from a low of £97.80 per metric ton in January to £123.79 in September and to £131.39 in December. The equivalent price in terms of U.S. dollars was 11.40 cents per pound in January,

13.71 cents in September, and 13.98 cents in December; the average for the year was 13.68 cents (using a Sterling exchange average of 250.08 cents) compared with an average price of 11.52 cents in 1971.

The relative stability in the domestic price of lead in 1972 was attributed largely to the near balance between supply and

demand during the year. The relative stability in the domestic price of lead in 1972 was attributed largely to the near balance between supply and

FOREIGN TRADE

Exports of lead materials during 1972 aggregated 43,600 tons valued at \$8.8 million, compared with 23,000 tons valued at \$6.2 million in 1971. Wrought and unwrought metal constituted 19% of the total exported; the remaining 81% was contained in scrap materials, most of which was shipped to Canada.

Reversing the declining trend since 1967, general imports of lead materials increased 31% in 1972 to a total of 348,000 tons valued at \$84.5 million. Receipts of lead in concentrates and other crude materials were about 36,000 tons more than in 1971

and metal demand during the year. The relative stability in the domestic price of lead in 1972 was attributed largely to the near balance between supply and

WORLD REVIEW

In 1972 mine production of lead in non-Communist countries (including Yugoslavia), depending on the reporting base and source, and scope of estimating, ranged from 2.89 million tons based on data compiled by the Bureau of Mines, through the International Lead and Zinc Study Group preliminary total of 2.82 million tons to the American Bureau of Metal Statistics (ABMS) total of 2.73 million tons. Bureau of Mines data, which indicate the basis used insofar as possible, depend largely on government information, as do those of the Study Group, although a somewhat different basis is used by the Study Group. ABMS relies largely on company and industry association sources. The Bureau of Mines estimated production in Communist countries (excluding Yugoslavia) at 0.96 million tons and the world total at 3.85 million tons, an alltime record high. Smelter output of lead is reported by the Bureau of Mines as primary output, insofar as possible, whereas the Lead and Zinc Study Group reports metal output from both primary and secondary sources. Thus, smelter output in 1972 in

non-Communist countries (including Yugoslavia), depending on the reporting base and source, and scope of estimating, ranged from 2.89 million tons based on data compiled by the Bureau of Mines, through the International Lead and Zinc Study Group preliminary total of 2.82 million tons to the American Bureau of Metal Statistics (ABMS) total of 2.73 million tons. Bureau of Mines data, which indicate the basis used insofar as possible, depend largely on government information, as do those of the Study Group, although a somewhat different basis is used by the Study Group. ABMS relies largely on company and industry association sources. The Bureau of Mines estimated production in Communist countries (excluding Yugoslavia) at 0.96 million tons and the world total at 3.85 million tons, an alltime record high. Smelter output of lead is reported by the Bureau of Mines as primary output, insofar as possible, whereas the Lead and Zinc Study Group reports metal output from both primary and secondary sources. Thus, smelter output in 1972 in

The U.S. Bureau of Mines reported that in 1972, according to the world total, Australia produced 100,000 tons, seven countries produced a total of 100,000 tons. The U.S. Bureau of Mines reported that in 1972, according to the world total, Australia produced 100,000 tons, seven countries produced a total of 100,000 tons. The U.S. Bureau of Mines reported that in 1972, according to the world total, Australia produced 100,000 tons, seven countries produced a total of 100,000 tons.

zinc-silver ore, respectively. In 1972 about 47% of Cerro-Peru's refined lead production came from purchased ores, 40% came from purchased ores in 1971.

Yugoslavia.—Trepča Corp. expansion and modernization of production facilities

at its Stari Trg mine continued during the year. When completed in 1975, the expansion program will increase ore production capacity to 440,000 tons per year and metal production to 184,000 tons of lead per year.

TECHNOLOGY

Most of the research and development effort in the lead industry continued to be market-oriented with emphasis on maintaining growth in established uses and in developing new applications that will offset a declining trend in some areas where substitution and environmental restrictions have become significant factors. Further progress was made in developing automotive emission control technology and equipment that will be effective in reducing lead and other exhaust pollutants in compliance with standards established under the Clean Air Act of 1970.

A dual-bed catalytic device designed by Gould, Inc., to meet auto exhaust emission control standards for carbon monoxide, hydrocarbons, and nitrogen oxides was undergoing tests by leading automobile and antiknock-additive manufacturers to determine the catalysts effectiveness and compatibility with leaded gasoline. The company stated that the first catalyst in the dual-bed system not only is effective in reducing nitrogen oxides but facilitates the action of the second oxidation catalyst which removes most of the carbon monoxide and hydrocarbons to meet emission standards.

The National Academy of Sciences (NAS) in a report to Congress and the Environmental Protection Agency stated that the Honda dual-carburated, stratified charge system, which is not sensitive to leaded gasoline, was the most promising of the five systems under evaluation by automobile manufacturers. The Honda system was reported by NAS to be clearly superior to the noble metal catalyst system. NAS also stated that the Honda system offers the promise of lower initial costs, greater durability in service, and significantly greater fuel economy compared with the catalyst system. The stratified charge engine achieved well over the 90% reduction in hydrocarbon and carbon monoxide emissions, called for in the Clean

Air Act, after 50,000 miles of durability testing. Some uncertainty exists as to whether the same degree of emission control achieved in smaller engine sizes could be mass produced for larger conventional engines by 1976.

The International Lead Zinc Research Organization (ILZRO) continued to sponsor and conduct research programs on a worldwide basis with emphasis in those areas that will have a strong impact on markets. The shortage and steeply rising price of lumber coupled with increasing labor costs has prompted strong efforts by ILZRO to produce lower cost prefabricated all-metal housing units in which lead and zinc will have major roles. The ILZRO house is designed to provide a basic moderately priced core unit that can be expanded as required, and will include such new developments as lead-plastic composites and lead sheet for sound attenuation in conjunction with galvanized steel building panels and wrought zinc roofing systems. ILZRO in cooperation with the lead battery industry has augmented research efforts to improve and increase the efficiency and power density of the lead-acid battery as a source of electrical energy for general use in addition to its primary use in automotive vehicles, particularly in response to demands of environmentalists for a totally nonpolluting vehicle.

A comprehensive study of battery manufacturing process fundamentals, sponsored by ILZRO, identified the conditions for casting calcium-lead grids in top-filled molds, using a reducing gas to prevent loss of calcium by oxidation. Battery manufacturers report that tests by auto companies indicate that maintenance-free, calcium-lead batteries may last 50,000 miles and they require no water and are permanently sealed. They can be placed out of the way to make room under the hood for pollution control devices. ILZRO participated in research directed to designing and con-

structing a prototype electric delivery truck powered by lead-acid batteries. Road tests indicated that operation of the battery-powered delivery vehicle under typical multistop, limited range and speed conditions was technically feasible. ILZRO also reported the development of lead-plastic composite materials combining light weight, corrosion resistance, and ease of forming suitable for such applications as fuel containers and military packaging.

The lead and zinc industry continued to sponsor extensive research into the medical, biological, and environmental aspects of these metals. A cooperative research study on the effect of airborne lead, the Seven-Cities Survey, was sponsored by the American Petroleum Institute and the Environmental Protection Agency. The data collected in this project disclosed that within the range of air-lead concentrations found in the major U.S. cities, airborne lead has no effect on the blood-lead level of the population. This finding was an important factor in the decision to defer implementation of proposed restrictions on the use of lead in gasoline. An ILZRO-sponsored project to determine the possible role lead plays in biological processes also was begun. The project may provide further conclusive data on the human health aspects of lead.

The NAS also reviewed the scientific knowledge on the biologic effects of lead on human health and welfare and issued an evaluation report¹⁵ to help guide EPA decisions on establishing air-quality criteria. NAS concluded that the average lead content of the air over most major cities apparently has not changed greatly over the last 15 years and that little change in the character and magnitude of the effects of atmospheric lead on biologic systems will likely occur for some years to come. The NAS study also found the transfer of lead from the atmosphere to the soil is directly related to the density of automobile traffic with heavy contamination in cities and major roadways and little evidence of contamination in rural areas attributable to lead alkyls. Similarly, the waters of streams and lakes have about the same concentration of lead today as in 1940. Furthermore, there was no evidence to indicate that the amount of lead in diets of people has changed substantially since 1940.

Lead Industries Association, Inc., re-

achieved and metallic lead of 99.9% purity was produced. Other Bureau of Mines investigations included strengthening lead-antimony alloys by modified rolling tech-

niques, improving fatigue resistance of lead and lead alloys by surface coatings, and developing lead composites for noise control.

Table 3.—Mine production of recoverable lead in the United States, by State
(Short tons)

State	1968	1969	1970	1971	1972
Alaska.....	W	2	--	--	--
Arizona.....	1,704	217	285	859	1,763
California.....	4,001	2,518	1,772	2,284	1,163
Colorado.....	19,778	21,767	21,855	25,746	81,348
Idaho.....	54,790	65,597	61,211	66,610	61,407
Illinois.....	1,467	791	1,582	1,238	1,336
Kansas.....	1,227	896	80	--	--
Kentucky.....	W	--	--	--	--
Maine.....	--	--	--	--	85
Missouri.....	212,611	355,452	421,764	429,634	489,397
Montana.....	1,870	1,753	996	615	287
Nevada.....	863	1,420	364	111	(¹)
New Mexico.....	1,363	2,368	3,550	2,971	3,582
New York.....	1,396	1,686	1,280	877	1,089
Oklahoma.....	2,387	805	797	--	--
Oregon.....	W	(¹)	(¹)	--	--
South Dakota.....	--	1	3	--	--
Utah.....	45,205	41,332	45,377	38,270	20,706
Virginia.....	3,573	3,858	3,356	3,386	3,441
Washington.....	5,655	8,649	6,784	5,777	2,587
Wisconsin.....	1,126	1,102	761	752	757
Other States.....	140	--	--	20	--
Total.....	369,156	509,018	571,787	578,550	618,915

W Withheld to avoid disclosing individual company confidential data; Included in "Other States."
¹ Less than 1/2 unit.

Table 4.—Production of lead and zinc in the United States in 1972, by State and class of ore,
from old tailings, etc., in terms of recoverable metal
(Short tons)

State	Lead ore			Zinc ore			Lead-zinc ore		
	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content
Alaska.....	--	--	--	--	--	--	--	--	--
Arizona.....	--	--	--	--	--	--	--	--	--
California.....	--	--	--	--	--	--	--	--	--
Colorado.....	256,793	25,237	2,273	114,560	1,553	1,010	2,817	600	192
Idaho.....	--	--	--	249,098	3,183	25,456	509,694	16,721	25,350
Illinois.....	--	--	--	50,850	85	3,783	683,401	35,166	35,821
Kansas.....	8,485,752	489,397	61,923	--	--	--	--	--	--
Maine.....	119	19	--	--	--	--	--	--	--
Missouri.....	--	--	--	--	--	--	--	--	--
Montana.....	--	--	--	210,768	--	83,086	138,273	3,571	12,421
Nevada.....	--	--	--	--	--	--	--	--	--

Table 13.—Lead consumption in the United States, by product
(Short tons)

Product	1971	1972	Product	1971	1972
Metal products:			Pigments—Continued:		
Ammunition.....	87,567	84,899	Pigment colors.....	13,916	16,264
Bearing metals.....	16,285	15,915	Other ¹	773	387
Brass and bronze.....	20,044	19,805	Total.....	81,258	89,214
Cable covering.....	52,920	45,930			
Calking lead.....	29,993	22,483	Chemicals:		
Casting metals.....	7,281	7,139	Gasoline antiknock		
Collapsible tubes.....	10,041	4,020	additives.....	264,240	278,340
Foil.....	4,417	4,592	Miscellaneous chemi-		
Pipes, traps, and bends.....	18,174	17,780	icals.....	401	849
Sheet lead.....	27,607	29,687	Total.....	264,641	279,189
Solder.....	70,013	71,289			
Storage batteries:			Miscellaneous uses:		
Battery grids, posts, etc.	322,236	347,225	Annealing.....	4,068	4,329
Battery oxides.....	357,567	379,367	Galvanizing.....	1,995	1,997
Terne metal.....	1,409	504	Lead plating.....	582	638
Type metal.....	20,812	19,944	Weights and ballast.....	17,453	21,802
Total.....	1,046,366	1,064,859	Total.....	23,498	27,666
Pigments:			Other, unclassified uses.....	15,751	24,826
White lead.....	4,731	2,814	Grand total².....	1,431,514	1,485,254
Red lead and litharge.....	61,838	69,799			

¹ Includes lead content of leaded zinc oxide and other pigments.

² Includes lead that went directly from scrap to fabricated products.

Table 14.—Lead consumption in the United States, by month
(Short tons)

Month	1971	1972	Month	1971	1972
January.....	118,676	122,272	August.....	129,174	127,368
February.....	113,197	123,671	September.....	130,568	125,984
March.....	126,579	132,311	October.....	127,763	132,241
April.....	120,660	122,867	November.....	121,126	131,438
May.....	120,104	129,012	December.....	117,346	120,500
June.....	116,548	126,651	Total¹.....	1,431,514	1,485,254
July.....	95,773	91,439			

¹ Includes lead that went directly from scrap to fabricated products and lead contained in leaded zinc oxide and other pigments.

Table 15.—Lead consumption in the United States in 1972,
by class of product and type of material
(Short tons)

Product	Soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
Metal products.....	175,115	81,924	66,520	14,207	337,767
Storage batteries.....	390,728	335,864	--	--	726,592
Pigments.....	89,214	--	--	--	89,214
Chemicals.....	278,890	299	--	--	279,189
Miscellaneous.....	13,398	14,216	62	--	27,666
Unclassified.....	23,092	906	828	--	24,826
Total.....	970,438	433,209	67,400	14,207	1,485,254

¹ Includes lead that went directly from scrap to fabricated products and lead contained in leaded zinc oxide and other pigments.

Table 16.—Lead consumption in the United States, by State
(Short tons)

State	Refined soft lead	Lead antimonial
California.....	90,682	8
Colorado.....	1,042	1
Connecticut.....	10,579	1
District of Columbia.....	114	--
Florida.....	5,751	--
Georgia.....	55,810	2
Illinois.....	87,616	5
Indiana.....	99,403	4
Kansas.....	11,104	1
Kentucky.....	6,017	--
Maryland.....	1,042	1
Massachusetts.....	2,219	--
Michigan.....	14,597	1
Missouri.....	32,032	1
Nebraska.....	3,186	--
New Jersey.....	134,018	2
New York.....	45,905	--
Ohio.....	12,089	--
Pennsylvania.....	61,056	4
Rhode Island.....	1,481	--
Tennessee.....	7,244	1
Virginia.....	644	--
Washington.....	15,479	--
West Virginia.....	17,301	--
Wisconsin.....	5,281	--
Alabama and Mississippi.....	4,634	--
Arkansas and Oklahoma.....	5,742	--
Hawaii and Oregon.....	4,682	--
Iowa and Minnesota.....	4,426	1
Louisiana and Texas.....	211,962	8
Montana and Idaho.....	697	--
New Hampshire, Maine, Vermont, Delaware.....	11,583	1
North and South Carolina.....	4,985	--
Utah, Nevada, Arizona.....	35	--
Total.....	970,438	43

¹ Includes lead that went directly from scrap to fabricated products and other pigments.

Table 17.—Production and shipments of lead pigments

Product	1971			
	Production (short tons)	Shipments		
		Quantity (short tons)	Value ¹	
			Total	Average per ton
White lead:				
Dry.....	7,505	5,466	\$2,348,721	\$440
In oil ²	1,297	1,315	868,893	668
Total.....	8,802	6,781	3,217,614	468
Red lead.....	23,548	20,989	7,587,104	363
Litharge.....	138,271	147,844	46,301,521	314
Black oxide.....	283,032	--	--	--

¹ Excludes basic lead sulfate, figures withheld to avoid disclosure.

² At plant, exclusive of container.

³ Weight of white lead only, but value of paste.

Table 18.—Lead content of lead and zinc pigments¹ and lead oxides produced by domestic manufacturers, by source
(Short tons)

Product	1971				1972			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Ore		Pig lead		Ore		Pig lead	
	Domestic	Foreign			Domestic	Foreign		
White lead.....	--	--	7,042	7,042	--	--	6,492	6,492
Red lead.....	--	--	21,346	21,346	--	--	21,908	21,908
Litharge.....	--	--	128,692	128,692	--	--	130,014	130,014
Black oxide.....	--	--	270,097	270,097	--	--	292,492	292,492
Leaded zinc oxide	W	W	--	W	W	W	--	W
Total.....	W	W	427,077	427,077	W	W	450,906	450,906

W Withheld to avoid disclosing individual company confidential data.

¹ Excludes lead in basic lead sulfate.

Table 19.—Distribution of white lead (dry and in oil) shipments,¹ by industry
(Short tons)

Industry	1968	1969	1970	1971	1972
Paints.....	6,681	5,969	4,460	4,896	6,788
Ceramic.....	124	67	26	34	31
Other.....	4,823	4,323	4,152	2,951	3,267
Total.....	11,634	10,359	8,638	6,781	10,066

¹ Excludes basic lead sulfate (figures withheld to avoid disclosing individual company confidential data).

Table 20.—Distribution of red lead shipments, by industry
(Short tons)

Industry	1968	1969	1970	1971	1972
Paints.....	11,347	9,191	7,848	8,717	4,909
Storage batteries.....	W	9,302	W	W	W
Other.....	12,464	3,684	11,596	12,272	14,864
Total.....	23,811	22,177	19,444	20,989	19,773

W Withheld to avoid disclosing individual company confidential data; included with "Other."

Table 21.—Distribution of litharge shipments, by industry
(Short tons)

Industry	1968	1969	1970	1971	1972
Ceramic.....	24,123	21,670	24,578	24,337	23,188
Insecticides.....	W	W	W	W	W
Oil refining.....	1,849	1,603	2,016	1,413	1,262
Paints.....	1,787	1,511	1,315	3,085	7,316
Rubber.....	1,986	1,794	1,663	2,081	2,162
Other.....	101,433	109,241	116,771	116,928	113,694
Total.....	131,178	135,719	146,343	147,844	147,622

¹ Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Other."

LEAD

Table 22.—U.S. imports for consumption of lead

Kind	Quantity (short tons)
White lead.....	1,238
Red lead.....	4,895
Litharge.....	14,700
Chrome yellow.....	6,220
Other lead pigments.....	20
Other lead compounds.....	63
Total.....	27,886

¹ Revised.

Table 23.—Stocks of lead at primary smelters, United States, December
(Short tons)

Stocks	1968
Refined pig lead.....	11,490
Lead in antimonial lead.....	8,852
Lead in base bullion.....	11,471
Lead in ore and matte.....	68,614
Total.....	90,427

Table 24.—Consumer stocks of lead in the United States
(Short tons, lead content)

Year	Refined soft lead	Lead in antimonial lead
1968.....	48,983	25,000
1969.....	67,804	49,600
1970.....	82,828	42,400
1971.....	81,984	85,700
1972.....	74,161	86,100

Table 25.—Average monthly and yearly lead prices
(Cents per pound)

Month	St. Louis	New York
January.....	18.80	18.80
February.....	18.80	18.80
March.....	18.80	18.80
April.....	18.80	18.80
May.....	18.80	18.80
June.....	18.80	18.80
July.....	14.05	14.05
August.....	14.05	14.05
September.....	14.05	14.05
October.....	14.05	14.05
November.....	14.05	14.05
December.....	--	14.05
Average.....	18.66	18.80

¹ St. Louis: Metal Statistics, 1972. New York: Metal Statistics, 1972.
² Metals Week. Quotations for United States on a nationwide basis.
³ Eleven-month average.