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Aluminum Stocks in Use in Automobiles in the United States

The U.S. Geological Survey estimated the quantity of aluminum stocks in use in the United States to be 142 million metric tons as of 2002 (Sullivan, 2005). Stocks in use include the aluminum in airplanes, automobiles, bridges, buildings, household appliances, machinery, and many other applications and exclude aluminum in solid-waste facilities. Continuous use of aluminum through recycling, remanufacturing, and reuse allows stocks in use to be considered a resource in place.

This Fact Sheet compares all aluminum stocks in use with the aluminum contained in automobile stocks in use in the United States. Automobiles in use in the United States include domestic and imported passenger cars, sport utility vehicles (SUVs), trucks, light trucks, vans, and minivans in commercial (taxicabs and limousines), government, and private use. Data on vehicles with an average vehicle curb weight greater than 8,500 pounds are not included in the Fact Sheet. The curb weight (CW) is the total weight of a vehicle without passengers or cargo.

Aluminum has a unique combination of properties, including strength, light weight, crash-energy absorption, corrosion resistance, and high thermal and electrical conductivity; these qualities are highly valued by the automotive industry. Approximately 60 percent of the aluminum used in making new automobiles comes from recycled aluminum. Approximately 90 percent of aluminum contained in retired automobiles is recovered and recycled (Aluminum Association, Inc., 2001, p. 2–5; Lackey, 2002, p. 14).

The automotive industry has a long history of aluminum use. The 1897 Clark had an aluminum crankcase, the 1903 Gordon Bennett Napier had an aluminum cylinder block, and the 1904 Lanchester had an aluminum rear-axle housing unit (Aluminum Association, Inc., 2001, p. 3, 4). Since the 1950s, automakers have added aluminum to their mass-produced vehicles. Aluminum pistons have been standard in U.S.-made automobiles since 1955; by the mid-1960s, most U.S.-made vehicles had aluminum grilles. Aluminum bumpers were introduced in the early 1970s, and aluminum intake manifolds, in 1977. In the 1980s and 1990s, automakers used improved aluminum bumper reinforcements and suspension parts, drive shafts, engine blocks and cylinder heads, steering shafts, and wheels, along with hoods and trunk lids. Aluminum has become the metal of choice for many manufacturers of automobile body mainframes, underbody frames, and body panels (Aluminum Association, Inc., 2001, p. 2–5). As aluminum was in competition with other automobile materials, it secured some market niches and lost others.

During the past 30 to 35 years, the use of aluminum in automobiles has increased in terms of (1) the average amount by weight used per vehicle and (2) aluminum's percentage of the average vehicle curb weight (table 1). From 1970 through 2001, the number of automobiles in use increased by more than 120 percent, and the estimated average aluminum content per vehicle increased by more than 260 percent (table 2). Figure 1 compares aluminum stocks contained in automobiles in use with all aluminum stocks in use and the average curb weight of automobiles in the United States for the years 1970 through 2001.

In 1970, the average aluminum content per vehicle was about 53.3 pounds, 98.1 million vehicles were in use, and the aluminum stocks in use within automobiles in the United States were about 2.4 million metric tons (2.4 Mt), which were about 5.9 percent of all aluminum stocks in use (40.2 Mt). During the next 31 years, the aluminum contained in automobile stocks in use increased to about 19.1 Mt, which was about 14 percent of all aluminum stocks in use (139 Mt). The average aluminum content of automobiles in use in 2001 increased to about 195 pounds per vehicle. The average CW of an automobile decreased to about 3,150 pounds in model year 2001 from 3,620 pounds in 1970 (National Highway Traffic Safety Administration (NHTSA), 2005b).

Concerns about automobile exhaust emissions and fuel efficiency led to emission controls (Clean Air Act, enacted in 1970) and increased mileage-per-gallon standards expressed as corporate average fuel economy (CAFE) standards (Energy Policy Conservation Act, enacted in 1975). First established in 1978, fuel-efficiency requirements have been changed since then in 1979, 1980, 1981, 1985, 1986, and 1990 (NHTSA, 2005a). As CAFE and emission laws became more stringent in the late 1970s through the mid-1980s, automakers needed to improve fuel economy. This goal was achieved in part by reduc-

Table 1. Aluminum content of automobiles built in the United States, averaged for selected model years.

[CW, curb weight of automobile. Sources: National Highway Traffic Safety Administration, 2005b; Naidu S. Madhu, Ducker Research Company, oral and written commun., April 5, 2005]

Auto weight and aluminum content	Model year								
	1970	1975	1980	1985	1990	1995	2000	2001	2004
Average CW, in pounds	3,620	3,730	2,870	2,870	2,910	3,050	3,130	3,150	3,240
Average aluminum content per vehicle, in pounds	82.2	84.0	120	139	165	212	258	265	289
Average aluminum content per vehicle, as a percentage of average CW	2.3	2.3	4.2	4.8	5.7	7.0	8.2	8.4	8.9

Table 2. Automobiles in use and aluminum stocks in use in automobiles and all applications in the United States, averaged for selected years.

[Mt, million metric tons; each metric ton equals 2,204.6 pounds. Sources: Ward's Communication, 1982, p. 121; 1987, p. 147; 2002, p. 227; J.F. Lemons, Jr., U.S. Bureau of Mines, written commun., 1989; Davis, 1997, p. 3–7; Davis and Diegel, 2004, p. 3–5; Sullivan, 2005; D.A. Kramer, U.S. Geological Survey, oral and written commun., January 25, 2005; The Polk Company, oral commun., April 4, 2005; Naidu S. Madhu, Ducker Research Company, oral and written commun., April 5, 2005]

Autos and aluminum stocks	Calendar year								
	Mid-1960s	1970	1975	1980	1985	1990	1995	2000	2001
Automobiles in use, in millions of units	90.6	98.1	120	140	157	179	193	213	217
Average aluminum content per vehicle in use, in pounds	51.0	53.3	67.9	80.5	108	130	153	187	195
Aluminum stocks contained within automobiles in use, in Mt	2.1	2.4	3.7	5.1	7.7	10.6	13.5	18.1	19.1
All aluminum stocks in use, in Mt	22.4	40.2	55.9	72.1	86.4	100	115	135	139
Aluminum stocks contained within automobiles in use, as a percentage of all aluminum stocks in use	9.3	5.9	6.6	7.1	8.9	10.6	11.7	13.4	13.8

ing the weight of the automobile by substituting aluminum and plastics for steel.

In the 1990s, demand increased for larger vehicles such as vans, minivans, SUVs, trucks, and light trucks. To keep the increased average CW of these larger automobiles to a minimum, manufacturers used more aluminum. The average CW decreased from 3,620 pounds in model year 1970 to a low of 2,870 pounds in the early and middle 1980s and then gradually rose to 3,240 pounds in model year 2004 (table 1). The quantity of aluminum stocks within automobiles in use increased steadily from 1970 through 2001 (table 2). The trend of increasing use of aluminum in automobiles is expected to continue through the decade.

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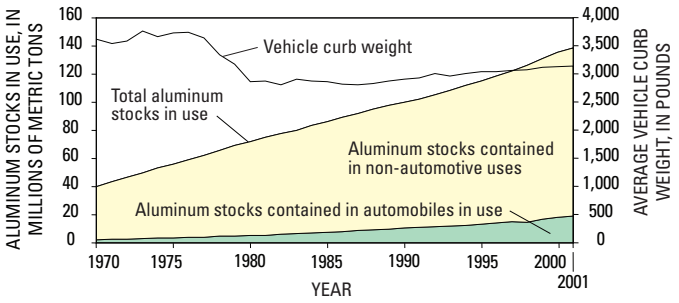

Figure 1. Comparison of aluminum stocks in use contained in automobiles in use with all aluminum stocks in use and the average vehicle curb weight in the United States for the years 1970 through 2001. Sources: Ward's Communication, 1982, p. 121; 1987, p. 147; 2002, p. 227; Davis, 1997, p. 3–7; Davis and Diegel, 2004, p. 3–5; National Highway Traffic Safety Administration, 2005b; Sullivan, 2005; The Polk Company, oral commun., April 4, 2005.

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