

## Chapter 3. Lead and Lead Compounds

### High Priority Ammunition for Shooting Ranges Alternatives

The following alternative ammunitions were selected for assessment:

- Bismuth
- Copper
- Iron
- Tungsten
- Zinc

### 3.3.2 Alternatives Associated with Wheel Weights

#### Available Alternatives

The following were identified as potential alternatives to lead wheel weights:

- Zinc and ZAMAC (an alloy of zinc, aluminum and copper)
- Steel
- Plastic
- Copper
- Steel
- Tin
- Tungsten
- Iron
- Internal balancing systems, including plastic beads or other material inserted into the tire

Several European and Japanese automobile manufacturers have already switched to zinc or steel wheel weights. While auto manufacturers are making some progress to switch to lead-free wheel weights, the Institute noted that 80% of wheel weights are used by aftermarket businesses such as tire retailers and service stations and very few of these businesses use lead-free wheel weights.

#### Alternatives Prioritization

Alternatives that appeared likely to meet the following performance criteria were given a higher priority for assessment:

- Should meet automotive industry standards and specifications established for lead wheel weights
- Should be made of a dense material to minimize size
- Should be corrosion resistant
- Should be resistant to high temperatures
- Should be recyclable

#### Copper

Copper has several properties that match the requirements of wheel weight applications. It is relatively dense (8.9 g/cm<sup>3</sup>), it is ductile and it is corrosion resistant. One manufacturer states that

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copper is ideal for high quality adhesive weights where small size, appearance and balance accuracy are important. One major UK manufacturer produces copper adhesive weights; copper wheel weights are not manufactured in Massachusetts.

### Steel

Steel weights are susceptible to corrosion and therefore must be coated. One manufacturer uses a sacrificial zinc corrosion protection plus a plastic coating. Steel is not ductile and therefore it is more suited for adhesive weights than clip-on weights. Steel wheel weights are currently manufactured in Tennessee, Japan, UK, and Austria. Steel is a relatively inexpensive metal and it is possible that steel weights would cost less than lead weights. Steel is currently used for a wide range of products including automobile wheels and other automotive components.

### Tin

One wheel weight manufacturer states that tin offers a high quality appearance with a good color match to alloy wheels and does not require corrosion protection. Tin wheel weights are currently manufactured by companies in India and the UK. No tin wheel weight manufacturers are located in Massachusetts. Based on the higher cost of tin, it is expected that tin wheel weights would cost more than lead weights.

### Zinc and zinc alloy (ZAMAC – ZnAl<sub>4</sub>Cu<sub>1</sub>)

Zinc has a density of 7.05 g/cm<sup>3</sup> which is 62% of the density of lead and therefore zinc wheel weights will have the disadvantage of being larger than lead weights. Zinc is successfully being used for both clip-on and adhesive type wheel weights.

Zinc and/or zinc alloy wheel weights are manufactured by companies in Tennessee, Austria, Germany, Thailand, and the UK. No zinc wheel weight manufacturers are located in Massachusetts. Zinc clip-on weights are typically more expensive than uncoated lead clip-on weights but zinc weights are likely to be comparable in price to higher quality coated lead weights. Unless zinc weights are clearly marked or labeled, they are not easily distinguishable from lead weights and therefore will likely cause contamination problems for lead smelters during the recycling of lead wheel weights.

Based on the previously listed criteria, alternatives based on the following materials were given a lower priority for assessment

1. Tungsten: Tungsten has the advantage of being more dense than lead and could be used as a pure metal, as an alloy with other metals, or as a filler for plastic weights. A study by Okopol Institute for Ecology and Political Affairs concluded that tungsten was not a realistic alternative for lead wheel weights due to the high price of tungsten, which could be 100 times the price of lead. The study also stated that world-wide production of tungsten is only 31,500 tons per year while demand for wheel weights is 12,000 tons per year.
2. Iron: Iron was not found to be used for wheel weights, most likely because iron is not corrosion resistant.
3. Plastic (Polypropylene): A European study on the use of heavy metals in vehicles (Lohse, 2001) identified talc filled polypropylene as an alternative material for wheel weights but additional information on the use of polypropylene was not located. Polypropylene has the disadvantages of being a low density material and having a low melting point. The European study indicated

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that talc filled wheel weights have a density of less than 5.2 g/cm<sup>3</sup>, which is less than half the density of lead, and that they would fail at temperatures above 120° C.

4. Internal Balancing Systems: Internal balancing systems incorporate the weights, such as plastic beads, inside the tire. One advantage of internal balancing systems is that the weights will not fall off of the wheel since they are contained within the tire. These systems are also likely to be dynamic balancing systems, providing balancing even as the tire wears. A major barrier to adopting internal balancing systems is that they are not drop-in replacements to lead wheel weights. They are likely to require changes to tire balancing equipment and/or tire designs.

### High Priority Alternatives for Lead Wheel Weights

The following alternative materials were selected for assessment:

- Copper
- Steel
- Tin
- Zinc and Zinc Alloy (ZAMAC)

### 3.3.3 Alternatives Associated with Fishing Sinkers

#### Available Alternatives

The following were identified as potential alternatives to lead fishing sinkers:

- Bismuth and bismuth/tin
- Brass
- Tin
- Copper
- Iron
- Ceramic
- Zinc
- Steel
- Tungsten, tungsten/nickel alloy and tungsten/polymer composite

#### Alternatives Prioritization

Alternatives that appeared likely to meet the following performance criteria were given a higher priority for assessment

- Adequate density to minimize size
- Smooth finish to reduce line wear
- Corrosion resistance
- Durability
- Scent absorption (some applications)
- Coloring (some applications)