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To:	FGC; Bonham, Chuck@Wildlife; Carion, Mike@Wildlife
Subject:	Dr. Thomas Proposal for Design and Identification of Nonlead Bullet
Date:	Tuesday, October 21, 2014 12:21:34 PM
Attachments:	NONLEAD Bullet Design Proposal for CA VGT October 2014.pdf

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Dear Mr. Mastrup, Bonham and Carion:

I was a presenter at the July meeting of the CA Fish and Game Commissioners in Sacramento, where the topic of implementing AB 711 was examined. At that meeting, members of the NRA indicated that a barrier to this Bill's implementation was the current inability of Conservation Enforcement Officers to discriminate between lead-core and nonlead bullets in the field, unless destructive methods were used. Accordingly, I have attached a short, 5-page, account of a method that could resolve this problem at no great cost. Let me say that I am no stranger to developing non-toxic ammunition, having been part of the team that developed, successfully, Tungsten Matrix and Tungsten Bronze shotgun ammunition, plus the reliable testing of it in the field. I am also a rifle shooter and I handload my own cartridges with nonlead bullets.

I would appreciate your reviewing this short document and letting me know your impressions as to this technique's utility in California.

Sincerely yours, Vernon G. Thomas, Professor Emeritus.

PROPOSED DESIGN OF NONLEAD RIFLE BULLET TO ALLOW INSTANT IDENTIFICATION

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September 5, 2014.

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1: Rationale for design:

The state of California will require in 2019 under AB711 that all rifle hunters use nonlead bullets. In enforcing the regulations under AB711, it is necessary that state enforcement personnel be able to determine in the field that the bullets in a hunter's ammunition be made of nonlead material. To date, there is no portable, effective, and low-cost device that allows for the instantaneous checking of rifle bullets' composition under field conditions. Because state enforcement officers will have to do the verification of hunters' ammunition, it has been assumed that the onus is placed on the California Fish and Game Department to devise and deploy such technology. This would be similar to enforcement agents having to determine that shotshells used to hunt migratory birds be made of nonlead shot, using the HotShot meter. The shot inside a shotshell should not be removed to conduct such a test. However, the bullet of a rifle cartridge is largely exposed for direct examination.

An alternate approach would be to have the makers of nonlead bullets incorporate a physical feature into the exterior of the exposed bullet that would indicate its nonlead composition. In this case, the manufacturers would provide the cue that enforcement personnel would use to determine that a hunter's bullets were legal.

2: Assumptions behind the design:

- Any physical feature should not detract from the ballistic properties of the bullet
- The physical feature could be incorporated readily into the bullet structure during conventional manufacturing stages
- The feature would not add extra cost to the bullet or to its subsequent manufacture
- The feature would be used to denote only nonlead bullets
- The feature would have to endure normal transport, hunting, and storage conditions, and persist across years
- The feature would have to be instantly recognizable to both hunters and enforcement personnel
- The feature could be applied to all bullet calibers, bullet weights, and bullet shapes. The feature should be in the tip region of the bullet so as to allow verification of loaded cartridges.
- The specific feature would have to have to be agreed upon by different bullet makers and used in their own bullet manufacturing
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3: Possible physical features to be incorporated into a nonlead bullet

3:1. Longitudinal flutes in the tip region of the bullet

There could be 4-8 flutes, each of the depth of 1/100 inch, pressed symmetrically into and around the leading tip of a bullet. Each flute would have a 'V' shape, and be about 1/8 to ¼ inch in length, depending on the bullet caliber and size. The flutes would begin just behind the plastic tip if present (Figure 1). Such flutes would be visible to the naked eye, and could be felt with the finger or finger nail. This would be the cue to assign the bullet to a legal, nonlead, category. It is suggested that these symmetrical flutes would not interfere with the ballistic properties of the bullet and its ability to expand.

The flutes would be made in the anterior part of the bullet when the bullet was being pressed to its designated size in a die. Ridges in the die would produce the "V-shaped" flutes in the copper when the bullet was being made. The "V" shape of the flutes would not cause the bullet to stick in the shaping die. The 4-8 flutes would not likely alter the anterior sectional density of the bullet in a significant way, nor add to the weight and overall length of the bullet. It is realized that prototypes of this design would have to be tested for consistent accuracy, especially in bullets of smaller caliber and bullet weight.

A hunter could, in theory, mark a lead core bullet in such a way as to appear to be nonlead. However, it would be difficult to match the consistency of appearance of flutes made by pressing through a die. Furthermore, there would not be a financial incentive to do so, given the existing costs of nonlead bullets and their lead core equivalents.

3.2. A concentric ring in the tip region of the bullet

One or two rings very close together and "V-shaped" could be pressed into the bullet during its passage through the sizing die. Each ring could be about 1/100 inch in depth, and placed just behind the bullet tip or plastic tip, when present. The depth would be adequate for a visual confirmation or a finger nail confirmation of the bullet's being made of nonlead material. It is suggested that such a pair of rings of that dimension would not impede the ballistic properties of the bullet and its ability to expand in the tissues of game animals. It is suggested that this identification feature be used for small caliber bullets of short length as well as for other, larger caliber, bullets.

A precedent exists for this type of external modification of a bullet. Cannalures are pressed into the mid-posterior part of some bullets to allow the neck edge of the cartridge case to fit securely around the bullet when seated. The ring of the cannalure is usually serrated to enhance the grip of the case on the bullet.

A hunter could in theory mimic such concentric rings by placing a lead core bullet in a lathe and making the rings. Serration of the rings added to a nonlead bullet could further act to identify it as nonlead and to deter attempts to counterfeit lead core bullets.

4: Manufacturing & production considerations

Assuming that the addition of shallow flutes or rings did not affect the ballistic properties of bullets, the manufacturing considerations have to be addressed. The most important of these is that the forming dies used to make ALL nonlead bullets of all calibers, shapes, and weights would have to be modified. This modification would entail cutting recesses in to each die to produce the flutes or concentric rings, which ever was decided on. This will be associated with costs and time within each bullet making factory. It is possible for California to compensate (in part) the bullet makers for this cost because the makers would be certifying their product as nonlead and so sparing the State the high costs of inventing, producing, and deploying field technology to do the same. It is suggested that the latter would be far more expensive and time consuming than a maker's identity mark on each bullet. Furthermore, implementation of AB711 in a timely manner requires that such a bullet verification system be in place before 2019. For

bullet makers, it is reasonable to suggest that as they begin to increase production of nonlead bullets across all calibers that they also engineer the identification features into new production.

The development of a nonlead identification feature into rifle bullets will be of benefit to other states that might adopt them for hunting in the future. Thus there is reason to ask for federal assistance to companies making nonlead bullets because the advantages extend across other states and their wildlife, and not California alone.

A number of large, well-established companies make nonlead and lead core rifle bullets in the USA. They are located in different states and all sell to hunters in California. Thus, assuming that a flute or ring identification feature were adopted, all makers should adopt a common identification system for their ammunition. This would not only apply to the cartridge box container, but more importantly, the bullets. Thus an agreement would have to be reached on the type of the identity used across all US makers' products.

Nonlead ammunition is made by foreign companies and imported into the USA. In 2019, California regulations would require that their bullets also be readily identifiable as nonlead. Were American nonlead bullet makers to agree on a common manner of identifying their bullets, it would be advisable for foreign makers of nonlead bullets to adopt the same identification features. This would require a conference among the makers and an international agreement on this identification process. Again, a precedent exists for this agreement. All 20 gauge shotgun shells are made with a yellow color case that identifies them as uniquely 20 gauge, regardless of their country or maker of origin. This is a visual coding that enables hunters to see them and prevent their being loaded into 12 gauge guns ahead of 12 gauge shotshells with disastrous consequences.

5: The next step in the process

1: The idea presented in this paper has to be supported by the California Department of Fish and Game.

2: With that support, the various leading bullet makers in the US have to be approached and their opinion received.

3: If positive, it is vital for some prototype bullets of several common calibers and weights to be made with either the flutes or concentric serrated rings. They must be tested for both their ballistic performance and their ability to be identified as nonlead bullets by enforcement personnel.

A possible testing scenario could be conducted as follows:

- First select a given bullet caliber, bullet weight and shape, e.g. Barnes .270 Winchester, in 130 grain Spitzer profile.
- Obtain 150 nonlead bullets to be used as the control.
- Obtain 150 bullets from the same manufacturer's production run, but with flutes pressed into the leading tip, as indicated in Figure 1.

- Test the ballistic performance of the fluted and control bullets at distances of 100, 200, and 300 yards. Ballistic performance is here measured as the diameter of bullet groupings on target paper.
- At each distance, conduct 10 separate firings of 5 bullets each from the control and fluted bullets, using a target-style bench-rest rifle. Alternate between control and fluted bullet types for each consecutive firing. Conduct the firings using bullets loaded into the chamber from the rifle magazine. Use appropriate time intervals among consecutive firings to control for the effects of raised barrel temperature. Make sure that the shooter is unaware of which bullet type is being fired at a given target to control for attitudinal bias.
- After completion of the 10 replicates of each 5-shot group for the control and fluted bullets at all three distances, measure the diameter of the target bullet hole spread for every target. This measures the ballistic grouping of the two bullet types.
- When completed, this initial, simple, test would give a robust sample for a paired testing in a statistical manner.

4: It is suggested that the costs of this be supported by both California and the federal government despite the jurisdictional issue. The costs incurred would be the purchase of the bullets, the costs of modifying the bullet to include the flutes of rings, the actual testing of the fired bullets, and the statistical analysis of the results. It is opined by the author that this could be conducted for much less than 15,000$. It is in the federal government's interest to have a nonlead bullet that can be used reliably by all hunters in the different states across the entire California Condor range. A possible source of California state funding could be the Pitmann-Robertson Grant in aid to wildlife conservation, with the U.S. Department of Fish and Wildlife being the co-sponsor with matching funds.

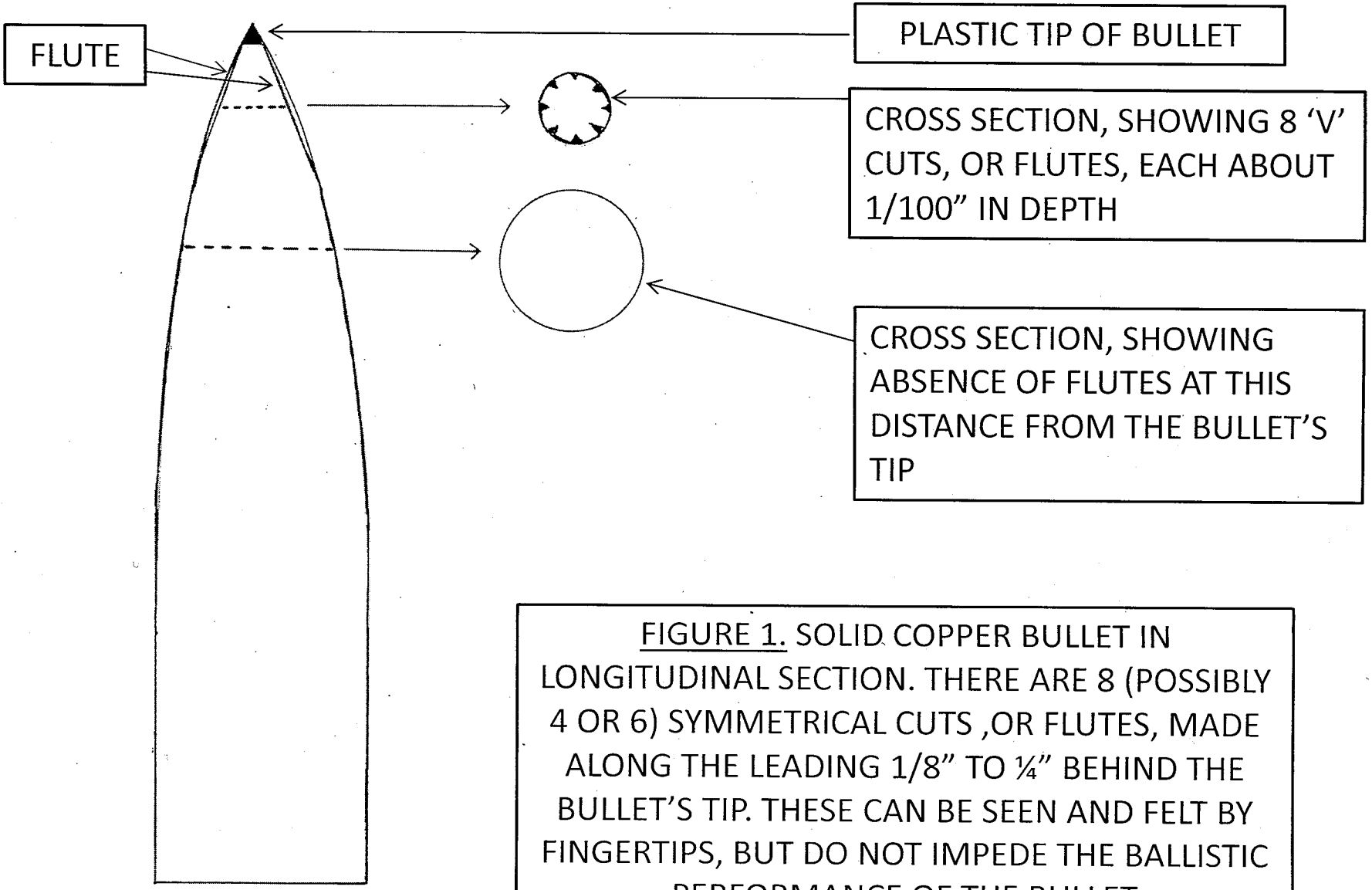

FIGURE 1. SOLID COPPER BULLET IN LONGITUDINAL SECTION. THERE ARE 8 (POSSIBLY 4 OR 6) SYMMETRICAL CUTS ,OR FLUTES, MADE ALONG THE LEADING 1/8" TO ¼" BEHIND THE BULLET'S TIP. THESE CAN BE SEEN AND FELT BY FINGERTIPS, BUT DO NOT IMPEDE THE BALLISTIC PERFORMANCE OF THE BULLET