An earlier version appeared in *Fireworks Business*, No. 233, 2003.

Report on the Initial Testing of Suspect Tiger Tail Comets

K. L. and B. J. Kosanke

It was previously reported that two out of forty 5-inch White Tiger Tail comet shells had explosively malfunctioned upon firing, destroying their mortars and the racks that contained them.[1] While traveling to conduct display safety training, it was arranged to visit the display company that experienced the problem with the comet shells. During that visit, the damaged mortars were inspected, photographed and sampled for pyrotechnic residues; the problem shells and some similar items were dissected, their components weighed and photographed; and fifty of the comet shells were test fired while being video taped. This article reports on that work.

The two mortars that had been damaged previously by the malfunctioning tiger tail comet shells are shown in Figure 1. The photos document that the explosions were powerful, most especially that which occurred in the second of the two mortars.

When the photograph of the suspect 5-inch White Tiger Tail comet shells was published,[1] one reader called to comment that there must have been a mistake, because the item was fairly obviously a pasted shell as opposed to being a normally constructed tiger tail comet. The astute reader was correct, at least to the extent that the construction of these so-called tiger tail comet shells was not normal. The construction of the item is illustrated in Figure 2. It was constructed somewhat similar to a star shell; however, there was a relatively small number of outer wraps over a normal pair of shell hemispheres, a hole was left where the time fuse would normally have been installed, a small amount of rice hull break powder was around the comet, and inside the shell was a relatively small cylindrical comet and the balance of the shell was filled with a large amount of cotton seeds as inert filler. As expected, based on the shell design and confirmed by the test firings, the shell explodes relatively weakly while still inside the mortar or shortly after leaving it. After the shell bursts, the comet proceeds upward, producing an ascending trail of sparks.

During daylight, a series of 50 of the 5-inch White Tiger Tail comet shells were test fired from HDPE mortars staked above ground. Most of the shells burst weakly while they appeared to still be inside the mortar (although apparently near the top) and produced no damage to the mortars. Some of the shells burst just after leaving the mortars, obviously without damaging the mortar. The exact number of shells bursting inside or outside the mortars could not be accurately determined. Because of the fire exiting the muzzle of the mortar, it was essentially impossible to determine whether they were just inside or

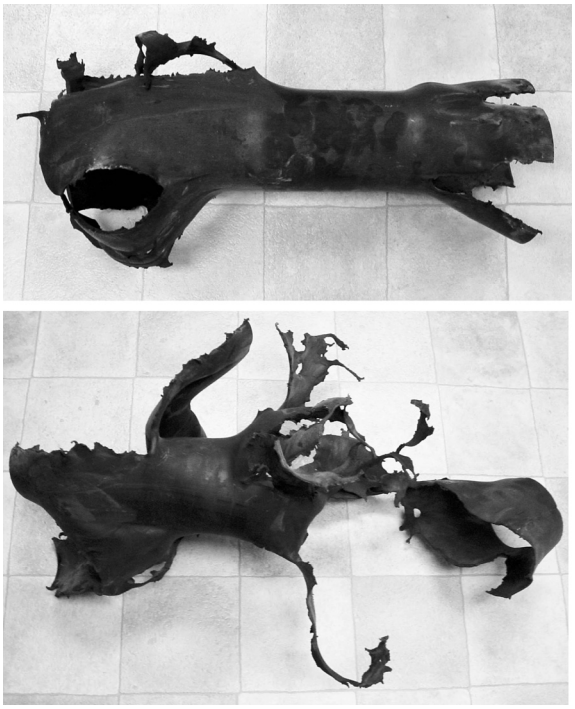

Figure 1. Photographs of the two mortars that had been damaged previously when 2 of 40 5-inch White Tiger Tail comet shells exploded within them upon firing.

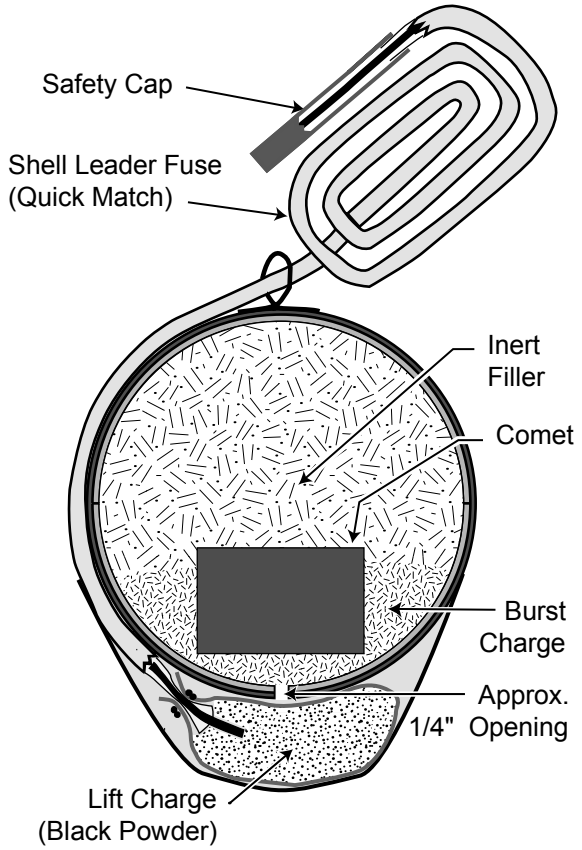

Figure 2. An illustration of the style of construction used for the "Tiger Tail" comet shells.

just outside the mortar. On three occasions, based on the sound produced, the comets themselves seemed to explode in the air above the mortars. On one of those occasions, the explosion was fairly powerful, but it did not seem to be powerful enough to have produced serious damage to a mortar. On a few occasions, based on observing the comet having fragmented into a number of pieces, it seemed that the comet may have exploded while still within the mortar, but so weakly as not to damage the mortar. (It was difficult to say whether those comets exploded weakly or if they simply broke apart because of insufficient structural strength of the comets.) The most important result of the test firings was that none of the 50 shells exploded sufficiently powerfully within their mortar when being fired to cause damage to the mortar.

Some additional work was performed in an attempt to determine the cause of the previous mortar explosions (see Figure 1). A preliminary analysis of the pyrotechnic reaction residue has been done and those initial results seem to be consistent with having been produced by the comet shells. However, at the time of writing this article, final conclusions needed to be deferred. (Further reporting on the mortar explosions was published.[2] The preliminary results in the current article were reported to help put concerns regarding the use of these suspect comet shells into better perspective.)

Normally (traditionally) tiger tails are made by forming a thick layer of comet composition on the outside of an aerial shell, which is then covered with a single loose wrap of paper. The purpose of this type construction is to produce a comet with a much greater burning surface (i.e., one producing a much more dense trail of sparks) than would be possible by simply attaching one or more comets to the outside of a shell. To that extent the so called "Tiger Tail" comets suspected of producing the powerful in-mortar explosions are not really tiger tail comets in the normal sense. To determine the manner of construction of some other tiger tail comets in stock at the

Table 1. Characteristics of Some "Tiger Tail" Comet Shells.

	Shell				Comet								
	Size		Mass			Diameter		Height		Mass		Surface Area	
Mfg. / Brand	(in.)	(mm)	(oz)	(g)	Shape	(in.)	(mm)	(in.)	(mm)	(oz)	(g)	($in.^2$)	(cm^2)
Flower	5	125	18	457	Cylindrical	1.8	45.7	1.2	30.5	2.8	79	12	77.4
Basket	4	100	9.8	249	Cylindrical	1.6	40.6	1.2	30.5	2.2	62	10	64.5
Formex	5	125	18	457	Cylindrical	2.4	61.0	1.5	38.1	6.5	184	27	174.2
Lidu	4	100	18	457	Spherical	3.6	91.4	n/a	n/a	18[(a)]	510[(a)]	39	251.6

a) Because of the lack of equipment, this comet could not be safely broken apart to determine how much of the total mass was comet and how much was from a core of some other material.

display company, those shells were also dissected. The results are summarized in the Table 1.

Of the four shells dissected, only the Lidu was constructed as normal for a tiger tail comet. Note that the surface area for the Lidu 4-inch comet is more than three times greater than that of the 5-inch Flower Basket comet shell. Given the shape and mass of the Lidu comet, it will also have a higher ballistic coefficient. Thus, all else being equal, the 4-inch Lidu comet would produce a much denser tail and would reach a greater altitude than the 5-inch Flower Basket comet.

Reference

1) K. L. and B. J. Kosanke, "WARNING: Serious Product Malfunction", *Fireworks Business*, No. 232, 2003; also in *Selected Pyrotechnic Publications of K. L. and B. J. Kosanke, Part 7 (2003 and 2004)*, Journal of Pyrotechnics, 2006.

2) K. L. and B. J. Kosanke, "Further Report on the Testing of Suspect Tiger Tail Comets", *Fireworks Business*, No. 237, 2003; also in *Selected Pyrotechnic Publications of K. L. and B. J. Kosanke, Part 7 (2003 and 2004)*, Journal of Pyrotechnics, 2006.