

## Evaluation of “Quick-Fire” Clips

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Quick-Fire clips are a product of Martinez Specialties<sup>[1]</sup> and come in two varieties. One is the “VF” clip, which is primarily intended to couple to and ignite visco-like<sup>[2]</sup> fuse products using an electric match. The other is the “LC” clip, which is primarily intended to ignite the lift charge of aerial shells using an electric match.<sup>[3]</sup> (However, both clip types have other useful applications as well.) Supplies of both types of Quick-Fire clips were provided by Martinez Specialties for an evaluation of their effectiveness.<sup>[4]</sup> This article is a brief report of those product evaluations.

### Quick-Fire VF Clips

With the wide spread use of large cake items in firework displays, many with visco fuse as the point of ignition, there is need for a reliable means of igniting those item using electric matches. Based on the testing reported here, the Quick-Fire VF clip (connector) should effectively fill that need. The clip and its attachment to a small cake item are illustrated in Figure 1. The upper most photograph shows two views of the clip as supplied (i.e., without an electric match installed in it). The first step in the process of attachment to the firework is to install a non-shrouded electric match into the left half of the clip.<sup>[4]</sup> This process requires only a few seconds, is well described in the literature supplied with the clips, but is not illustrated in Figure 1. The upper-middle photograph shows the visco fuse of the firework after the ignition end was uncovered and freed from its attachment to the firework. The lower-middle photograph is after the Quick-Fire VF clip has been secured to the visco fuse. Again, this process requires only a second or two, is well described in the literature supplied with the clips, but is not illustrated in Figure 1. The lower most photograph is with the Quick-Fire VF clip and visco fuse secured to the firework using tape.

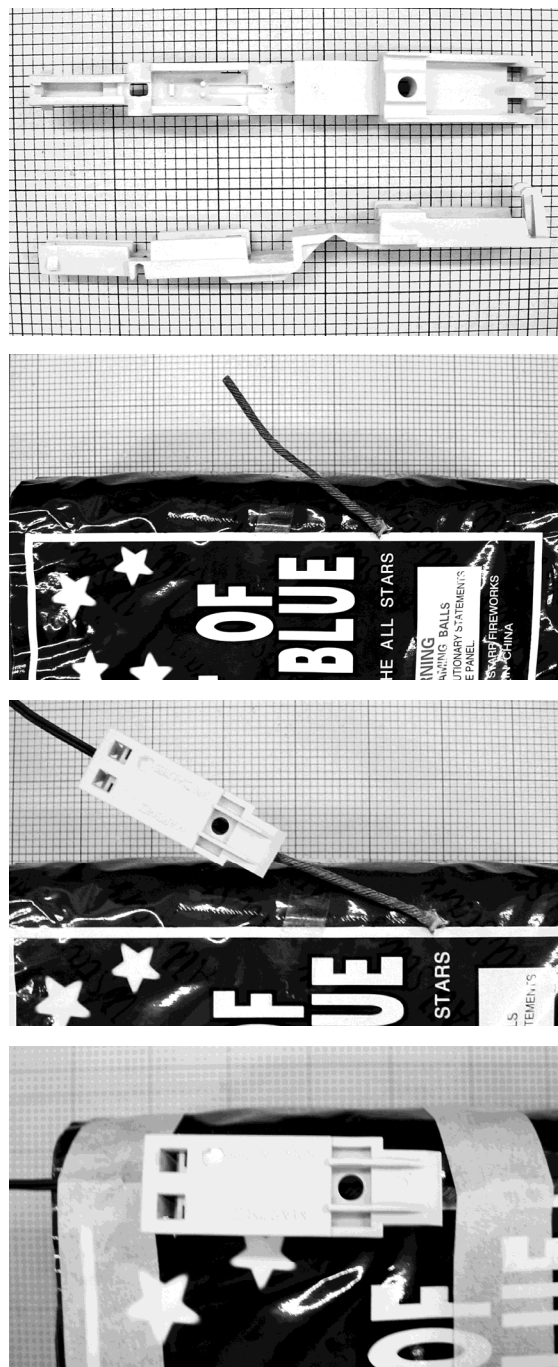


Figure 1. Photos of the Quick-Fire VF clip and its attachment to a small firework cake item.<sup>[4]</sup> (Each square in the background is 0.1 inch.)

In the course of the evaluation a total of 30 test ignitions of visco-like fuse were conducted. This included 10 each of ignitions of: a) high quality visco fuse, b) low quality visco fuse, and c) the fast burning visco-like fuse commonly used on reloadable consumer firework aerial shells. All 30 ignitions were successful. Further, it was found that the process of loading the electric match into the clip and installing the clip onto the visco fuse was quick and relatively easy to accomplish.<sup>[4]</sup>

During the course of evaluating the effectiveness of the Quick-Fire VF clips a limited number of trials of their utility in initiating Lightning Thermo Tube were conducted. (Lightning Thermo Tube is an interesting new product, somewhat similar to shock tube, that is being introduced to the firework trade.<sup>[5]</sup>) It was found that the Quick-Fire VF clip provided an effective means to couple an electric match to Thermo Tube and accomplish its initiation.

### Quick-Fire LC Clips

The greatest precision in the firing time of an aerial shell is accomplished when the electric match is installed directly into its lift charge.<sup>[6]</sup> Probably the best way to accomplish this is to have the electric match installed by the shell's manufacturer. However, it is common for users to install their own electric match, often by simply poking a hole into the shell's lift bag, inserting the electric match (often, but inappropriately, with the safety shroud removed), and taping over the hole. This is somewhat problematic because of the potential for leaking lift powder and the use of electric matches without their safety shrouds.<sup>[7]</sup> Based on the testing reported here, the Quick-Fire LC clip (connector) should effectively solve the problem of a user installed electric match into the lift charge. The Quick-Fire LC clip is shown in Figure 2. The upper photograph is of two views of a clip as supplied. The lower photograph shows the clip after a non-shrouded electric match has been installed.<sup>[4]</sup> This process requires only a few seconds, is well described in the literature supplied with the clips, but is not shown in Figure 2.

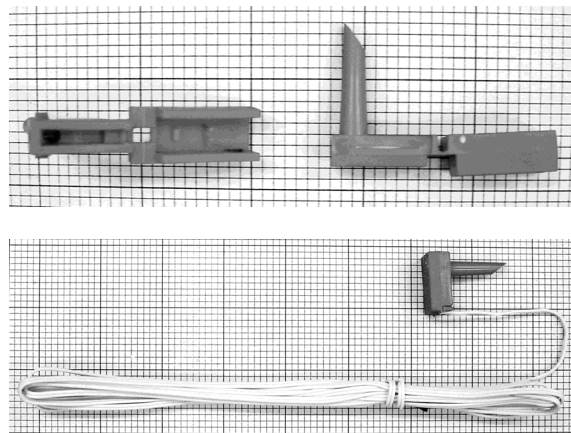
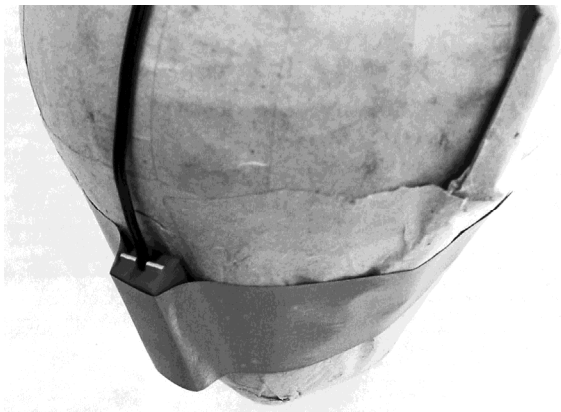
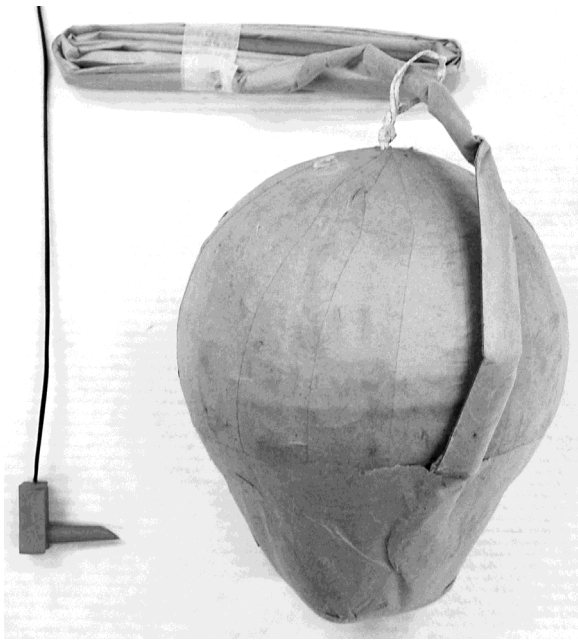


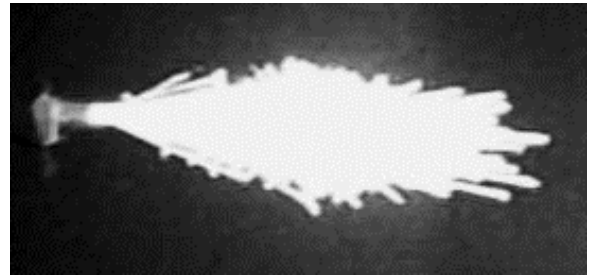
Figure 2. Photos of the Quick-Fire LC clip before and after installation of an electric match.<sup>[4]</sup> (Each square in the background is 0.1 inch.)

Figure 3 illustrates the process of installing the Quick-Fire LC clip into the lift charge of an aerial shell. The top photograph shows the aerial shell and Quick-Fire LC clip (with an electric match) ready for installation. The middle photograph shows the LC clip pressed partially into the lift charge of the shell. This insertion is facilitated by the relatively sharp point on the LC clip. The bottom photograph shows the Quick-Fire LC clip fully inserted and secured in position using tape. The taper of the LC clip aids in limiting the leakage of lift charge powder. The typical user will probably want to leave the shell leader attached on smaller caliber shells for use in lowering the shell into its mortar.

Only a very limited number of test firings of the Quick-Fire LC clip installed into the lift charge of an aerial shell were carried out. In part this was for the sake of economy, but it was mostly because of the abundant fire and sparks that project from the clip when it fires. Figure 4 is one video field (1/60 second) recorded during the firing of an LC clip using a Martinez Specialties e-max electric match. The LC clip is seen illuminated to the left in Figure 4, and the fire and sparks projecting from the clip extends fully 10 inches to the right. With such a robust projection of fire and sparks, ignition of an aerial shell's lift charge is essentially assured.

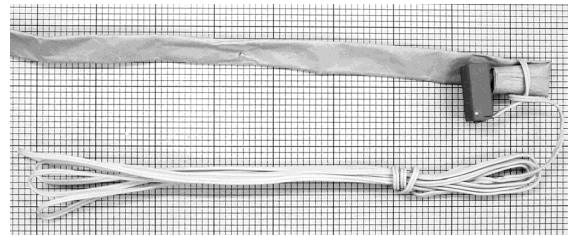


*Figure 3. Photographs illustrating the process of installing a Quick-Fire LC clip into the lift charge of an aerial shell.*



*Figure 4. A photograph documenting the 10-inch jet of fire and sparks projecting from a Quick-Fire LC clip.*

Although Quick-Fire LC clips are primarily intended for use in quickly and safely installing an electric match into a standard aerial shell, it is possible to use the clip to install an electric match into shell's leader fuse. This can be accomplished in at least two ways, one of which is demonstrated in Figure 5. In this case, a portion of the shell leader has been cut off, the LC clip inserted into the quick match between the black match and the match pipe, and clip is held in place by bending over the end of the leader fuse and securing the clip with the electric match leg wire. Another method of installing the Quick-Fire LC clip (not illustrated herein) is to slit the leader fuse, insert the LC clip into the slit alongside the black match, and then secure the clip in place.



*Figure 5. A photograph demonstrating an alternate use of a Quick-Fire LC clip to attach an electric match to an aerial shell's leader fuse.*

## Conclusion

The use of Quick-Fire VF and LC clips is an expedient and effective means of attaching electric matches to visco-fused items and standard aerial shells. In addition, although not specifically investigated in this brief study, use of the clips should provide abundant safety with respect to the installation and removal of electric matches. This is because the electric matches are well encased

and are not in direct contact with other pyrotechnic materials. This virtually eliminates or at least greatly reduces the possibility of their accidental ignition due to impact, friction, and the type of electrostatic discharges of greatest concern.<sup>[8-9]</sup>

### References and Notes

- 1) Martinez Specialties, Inc., 205 Bossard Rd. Groton, NY 13073, 607-898-3053.
  - 2) Visco fuse is also called hobby fuse, cannon fuse and sometimes fireworks safety fuse.
  - 3) "New E-Match Attaching Clip", *Fireworks Business*, No. 262, 2005.
  - 4) The clips supplied for evaluation, and shown in the top photographs of Figures 1 and 2, did not have electric matches preinstalled. However, while Martinez Specialties will supply clips without an electric match already installed, it is intended that the clips will generally be supplied with an electric match preinstalled to save time for the user.
  - 5) Lightning Thermo Tube is a product intended for use in fireworks that was subsequently evaluated by the authors. "An Evaluation of Lightning Thermo-Tube™ as a Pyrotechnic Ignition System", K. L. and B. J. Kosanke, *Journal of Pyrotechnics*, No. 24, 2006; *Selected Pyrotechnic Publications of K. L. and B. J. Kosanke, Part 8 (2005 through 2007)*, 2009.
  - 6) "Firing Precision for Choreographed Displays", K. L. and B. J. Kosanke, *Fireworks Business*, No. 194, 2000; *Selected Pyrotechnic Publications of K. L. and B. J. Kosanke, Part 5 (1998 through 2000)*, 2002.
  - 7) Transporting an aerial shell with a non-shrouded electric match installed in the lift charge would also be a violation of a requirement of the standard APA87-1, incorporated by reference into US DOT regulations.
  - 8) Typical electric matches are far more sensitive to electrostatic discharges that occur through the pyrotechnic composition, rather than those that occur through the bridgewire. Since electric matches installed in LC clips are isolated from close contact with external objects, electrostatic discharges occurring through the composition are very highly unlikely.
  - 9) "Studies of Electric Match Sensitiveness", *Journal of Pyrotechnics*, No. 15, 2002; ; *Selected Pyrotechnic Publications of K. L. and B. J. Kosanke, Part 6 (2001 and 2002)*, 2005.
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