June 17, 2022

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Mr. Robert Pignato
National Candle Association
529 14th Street NW, Suite 1280
Washington, DC 20045

Re: **Test Report**
Coated and Botanical Candles
Candles Manufactured for Testing Purposes Only
by NCA Member Companies

Note: The names of the companies that made the samples for this review have been redacted by NCA.

Dear Mr. Pignato:

In early May 2022, SEA, Ltd. (S-E-A) received three candles produced specifically for testing purposes by three different NCA member companies. These candles that were produced as test candles, not for sale, by three different NCA members are identified below:

Sample 1: One, 3.5" tall x 3.25" round, filled candle with botanicals produced by the Sample 1 Company
Sample 2: One, 4" tall x 3.125" round, filled candle with botanicals produced by the Sample 2 Company
Sample 3: One, 3.625" tall x 3.875" round, filled candle with botanicals produced by the Sample 3 Company

Exemplar photographs of the candles identified as samples 1 through 3 are shown in **Figures 1 through 3 (attached)**, respectively. These photographs document the candles prior to any testing.

S-E-A was requested to test the three candles following the testing protocol in Fire Safety Design Standard ASTM F-2417, *Standard Specification for Fire Safety for Candles*. The candles were evaluated for flame height and observed for any secondary ignition events. A secondary ignition event is defined as something other than the primary wick on fire. The candles were also evaluated for container integrity (i.e., any glass breakage during testing). This testing was conducted to evaluate how similar candles, currently in the market, might behave when burned by consumers.

Results and Discussion

The candles produced by both the Sample 1 Company and the Sample 3 Company experienced secondary ignition events. The candle supplied by the Sample 2 Company did not experience a secondary ignition event throughout the duration of the test. The most severe incident of secondary ignition was observed from the candle produced by the Sample 1 Candle Company. The secondary ignition event that occurred with this candle was so intense it caused the entire surface of the candle to ignite. This is known as a candle "flashover." This occurred within one hour of the first lighting of the candle. The following is a description of how each candle performed in the test.

Sample 1: This candle was manufactured for "testing only" by the Sample 1 Company. The candle consisted of a filled candle, with dried botanical material on the surface. There were flower petals within close proximity of the candle's wick, such that it was nearly impossible not to light the botanicals when lighting the candle. Figure 1 documents what the candle looked like prior to testing. Shortly after the candle was lit, the botanical features ignited and acted as a secondary ignition source. Within the first hour of the candle burning, the wax had become so hot from the secondary ignition of the botanicals that the wax itself ignited and the candle experienced a flashover event. **Figure 4** shows the beginnings of the secondary ignition of the candle shortly after it was lit. **Figure 5** documents the progression of the secondary ignition event. **Figure 6** documents the candle once it had flashed over and the entire surface of the wax was on fire.

Sample 2: This candle was manufactured for testing only by the Sample 2 Company. The candle was a single-wick candle in a glass container, with botanical material on the surface. This candle was burned in four-hour burn cycles in accordance with ASTM F-2417. No secondary ignition events were observed throughout the candle's burn life.

Sample 3: This candle was manufactured for testing only by the Sample 3 Company and was also a single-wick candle in a glass container, with botanical materials on the surface and imbedded in the candle wax, as seen in Figure 3. This candle experienced a secondary ignition event of the botanical materials the first time the candle was burned. **Figure 7** documents this secondary ignition event. Testing of the candle continued, and the candle was burned in four-hour burn cycles per the ASTM F-2417 test method. The candle continued to experience secondary ignition events as it burned; however, it did not experience a flashover event. The candle's wick eventually drowned, as the secondary ignition of botanicals in the candle created a large melt pool causing the flame on the primary wick to extinguish. **Figure 8** shows the candle when the primary wick was drowned out and only the botanical material remained lit.

Summary

Of the three candles tested, two experienced secondary ignition events where something other than the primary wick supported flaming combustion. These two candles would fail the requirements of ASTM F2417 for candle fire safety.

One of the secondary ignition events, specifically the one observed on the candle produced by the Sample 1 Company for this experiment, was so intense that it caused the candle to experience a flashover event where the entire surface of the wax ignited.

Secondary ignition events can create a potential ignition source for combustible materials that may be near the candle. In the case where the candle experienced a flashover event, the flames from the candle could have easily ignited surrounding combustible materials to create a much larger fire. While neither of the two candles that experienced a secondary ignition event broke their containers, it is possible for the intense heat from such an event to break glass containers. This too could lead to the fire communicating to combustible materials outside the candle container.

It should be further noted that when a candle experiences a flashover event, such as sample 1, the addition of water to extinguish the candle fire can create a much worse situation. When water is added to a candle fire, it is like adding water to a grease fire. When the water hits the flaming hot wax, it vaporizes, which creates large flames that are carried with the steam that is emitted due to the addition of water to the candle fire. Should a candle experience a flashover, the safest way to extinguish the fire is to smother it with a pot or some other device and starve the fire of oxygen. For safety reasons, a candle flashover event should never be extinguished with water.

If S-E-A may be of further assistance or answer any questions, please do not hesitate to contact us at (614) 888-4160. Any samples remaining will be destroyed in seven days, unless S-E-A is otherwise notified.

Report Prepared By:

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Director, Chemical and Candle Laboratories

Tyler S. Collins

RDM:me
Attachments

Issue Date: June 17, 2022

Figure 1: Photograph of candle supplied by Sample 1 Company for testing.

Figure 2: Photograph of candle supplied by Sample 2 Company for testing.

Figure 3: Photograph of candle supplied by Sample 3 Company for testing.

Figure 4: Sample 1 Company candle shortly after lighting. Dried flower has ignited and is supporting combustion.

Figure 5: Sample 1 Company candle with secondary ignition progressing. Wax pool is becoming deep.

Figure 6: Sample 1 Company candle. Within 50 minutes of lighting, candle experienced flashover where entire surface is on fire.

Figure 7: Sample 3 Company candle, with secondary ignition of botanicals, during first four-hour burn cycle.

Figure 8: Thirty minutes after lighting Sample 3 Company candle last time. Only botanicals remain lit and wax pool drowns out flame on wick.