



## SILICONE TECHNOLOGIES DIVISION

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### **LOW OUTGASSING SILICONE FOR FLEXIBLE HEATERS**

Arlon – Silicone Technologies Division announces the introduction of an advanced silicone compound specifically designed for flexible heater applications. Arlon's new 375CR compound maintains the excellent performance characteristics of other high temperature stable silicone rubber compounds while providing a significant advantage for flexible heater manufacturers – low silicone outgassing.

Silicone outgassing is the release of low molecular weight siloxanes (LMWS) over time. There are two primary sources of LMWS in silicone rubber: 1) LWMS by-products created during the silicone polymerization reaction, and 2) LWMS added as formulation processing aids. Since LWMS may condense on electronics and optical assemblies, flexible heaters used in sensitive environments are scrutinized carefully for LWMS outgassing.

Flexible heater manufacturers are able to reduce LWMS outgassing through extended high temperature post-curing, but these processes are costly and can degrade silicone performance. Post-curing must be carried out as a separate process step after the initial cure cycle, so it significantly increases manufacturing time and decreases throughput. In addition, high temperature post cure cycles can damage or fragment the silicone polymer chains, leading to reduced heater service life. The damaged polymer chains can outgas during heater service, so unless great care is taken post-curing can actually increase outgassing.

Arlon developed 375CR so that heater manufacturers can design and produce low outgassing heaters without extended high temperature post-curing. The data shows that, with just an initial cure, Arlon's 375CR compound outgasses less than standard heater materials. In the industry standard ASTM E595 outgassing test, 375CR yielded a total mass loss (TML) of 1.07% and a collected volatile condensable materials (CVCM) value of 0.28%. This represents a 60% reduction in TML and a 30% reduction in CVCM from industry standard heater compounds. In ASTM E595, TML is measured over 24 hours at 125°C and  $< 5 \times 10^{-5}$  torr, while CVCM is measured at 25°C and less than  $5 \times 10^{-5}$  torr.

While ASTM E595 is a good benchmarking test method, the test temperatures are lower than typical flexible heater service temperatures. Arlon has conducted additional testing at more relevant conditions. Figure 1 compares the TML of Arlon's 375CR to a standard silicone heater compound after initial polymer curing and shows a 62.5% reduction in outgassing levels at 204°C and 75 torr.

The information contained herein is based on laboratory data and should not be used to establish material specifications without customer specific confirmation and validation studies.



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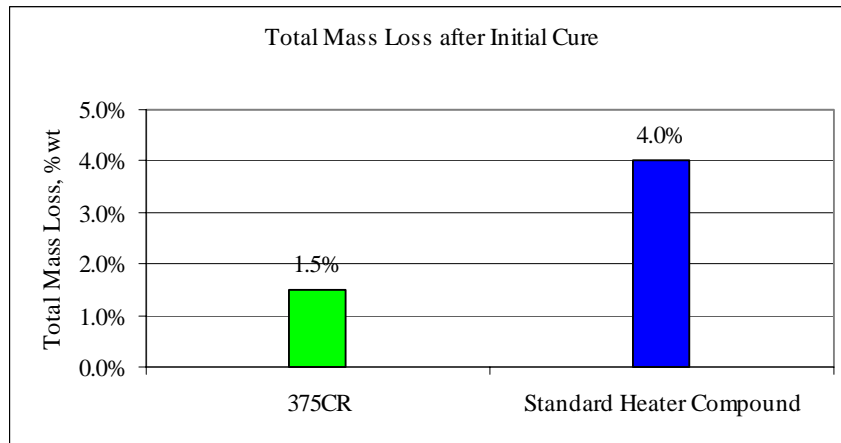


Figure 1 Test parameters (204°C, 24 hrs, 75 torr)

While post curing Arlon’s 375CR is not necessary, in-service performance and stability will be optimized with a post cure cycle of 2 hours at 218°C. Post curing decomposes any remaining peroxide and drives off acidic peroxide by-products. In addition, post curing further reduces the very low outgassing levels of the 375CR. Figure 2 compares in-service TML of Arlon’s 375CR versus a standard flexible heater compound after post curing. Arlon’s 375CR outperforms standard silicone, with a recommended post cure of 2 hours at 204°C, providing a 40% reduction in in-service outgassing. Even after the standard heater compound post cure is increased by two fold, the in-service outgassing level of 375CR is still 21% lower. (Note: The optimized post cure for Arlon’s 375CR compound produces a TML value of 0.34% and a CMCM value of 0.1% per ASTM E595.)

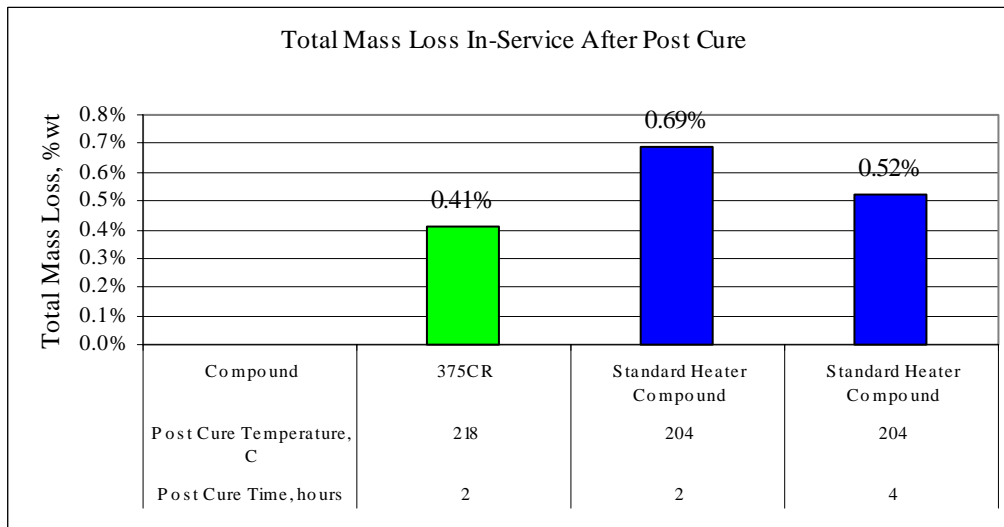


Figure 2 TML after (164°C, 168hrs, 760 torr)

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Arlon's 375CR delivers reduced outgassing without performance tradeoffs in other service attributes. The 375CR compound allows for easy processing of both foil and wire wound heaters. The compound bonds to primed foils easily, and its low plasticity allows for easy embedding and pickup of both resistive wire and foil. Arlon's 375CR is well suited for curing in a hydraulic press, vacuum bag, or open air at temperatures as low as 121°C. Arlon's 375CR has good thermal stability when compared to conventional flexible silicone heater compounds. Accelerated thermal aging studies indicate excellent retention of initial physical properties.

Arlon's 375CR is currently available from Arlon Silicone Technologies Division in either bulk form or calendered onto fiberglass in a number of constructions. Contact your Arlon Sales Engineer to discuss your specific requirements or to request trial samples.

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