



January 14, 2022

RE: Force Majeure Silicone-Based Thermal Management Products | Alternative raw material source qualification lead products: TGF 3600

Dear valued Customer,

Reference is made to our Force Majeure letter for Silicone-Based Thermal Management Products dated October 4th, where we informed you of certain raw material shortages affecting certain of our products. As previously indicated, we have taken efforts to identify equivalent alternatives from additional suppliers to best serve our customers to the extent possible. Today, we are pleased to inform you that we have successfully qualified alternatives raw material suppliers for the affected raw material for the Silicone-Based Thermal Management products listed in the table below (the "Products"). According to our tests, to the best of our knowledge, such alternatives do not present relevant changes to form, fit, nor function, following our agreed upon specification. Please refer to the respective Henkel White Paper attached for qualification data.

Due to the significant disruption in the silicone market, Henkel will start using chemically equivalent alternative raw material suppliers as of March 1st, 2022, for the TGF 3600. To improve our ability to supply these Products, we will utilize raw materials from qualified alternative sources interchangeably in the future.

Please note that results of our long-term testing will however most probably not be available before Mid of May 2022. Understanding the urgency of the current situation, we nevertheless can offer to supply you with Products manufactured with the raw material of our qualified alternative suppliers beforehand, however, explicitly subject to the condition that we cannot accept any responsibility for any long-term effects. Unless notified by you to the contrary within two weeks of the date of this letter, we will assume your acceptance of the above changes and your waiver of any claims for long-term effects. However, should you not yet be able or willing to receive the Products manufactured with qualified alternative suppliers or before availability of our long-term test results, please cancel your orders and re-submit at a later point in time once you wish to order products utilizing qualified alternative suppliers.

Please note that all applicable lead times, SDS and TDS will remain unchanged.

We regret any inconvenience this situation may cause, and we appreciate your patience and understanding during this challenging period.



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We at Henkel appreciate your business.

Sincerely,

A handwritten signature in black ink that reads "George Thomas".

George Thomas
Vice President
Regional SBU Head, Industrials Americas

A handwritten signature in black ink that reads "Jeremy Hammond".

Jeremy Hammond
Global Product Line Manager Thermal
Electronics & Industrials

Table of products

Product Overview


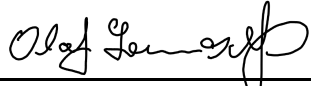

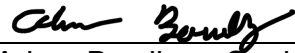
Lead Product

BERGQUIST GAP FILLER TGF 3600

Customer White Paper

Qualification of a chemically equivalent silicone polymer from a new vendor, and an alternate alumina filler production site.

Change Owner:
Lead Site: Brandon
Date: January 5th, 2022

Approval:		January 11, 2021
Alan Kandel - Head of Quality Network (HMTR)		Date
		January 7th, 2022
Olaf Lammerschop - Product Development Head EIMEA		Date
		January 6th, 2022
Cristopher Naida - Vice President, Automotive Electronics and eMobility, NAMEX		Date
		January 6th, 2022
Adam Bowlby – Senior Product Development Engineer		Date



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Title of the Change

Qualification of a chemically equivalent silicone polymer from a new vendor, and an alternate alumina filler production site.

1. Products Affected

BERGQUIST GAP FILLER TGF 3600

2. Change Description

- Change of vinyl silicone polymer "C1" to an alternate vinyl silicone polymer "C2" with the same CAS# at a 1:1 ratio.
 - No change to current silicone hydride crosslinker "F".
 - Product with the alternate vinyl silicone and silicone hydride crosslinker pair denoted as "C2/F".
- Utilizes existing grade of alumina filler from an alternate production site denoted as raw material "G4".

3. Reason for Change

- Supplier of original silicone polymer has declared Force Majeure due to inability to source raw materials.
- Supplier of alternative silicone polymer is being qualified as an alternative to enable continued production.
- Supplier of alumina filler "G" requires a change in production site to continue to supply the raw material. Alumina filler "G4" is being qualified from an alternate production site without a change in grade or supplier to enable continued production.

4. Change/Implementation Timetable

Immediate implementation for all materials as indicated in 1. Products Affected.

5. Change Type

The change does not impact the product properties/performance as specified in the agreed Customer product specifications.

6. Henkel Sites Affected

Brandon, SD USA
Cannon Falls, MN USA



7. Customer Impact

INDICATOR:	Expected Henkel Impact	Expected Customers Impact
Process Capability	No Change	No Change
Yield	No Change	No Change
Output Quality	No Change	No Change
Reliability	No Change	No Change
Productivity	No Change	No Change
Safety/Ergonomics	No Change	No Change
Availability	Increase	No Change

8. Qualification Plan

- All processing and testing equipment are equivalent to the process of record.
- Time scale of the mixing step was increased.
- BERGQUIST GAP FILLER TGF 3600
 - 3 batches of silicone polymer from the new vendor were used to create part A and part B mixes of TGF 3600. This resulted in six total batches being evaluated (three part A's and three part B's).

▪ Table 1: Process Variable Plan

	POR	Control	Experimental
Process Variable			
Equipment Type	Planetary Mixer	Planetary Mixer	Planetary Mixer
Process	N/A	Equivalent to POR	Equivalent to POR
Raw Materials	N/A	Identical raw materials to one experimental batch with the exception of alternate silicone polymer, alumina from original production site	3 unique lots of alternate silicone polymer, and alumina from alternate production site
Sample Selection			
Batch Size	142.9-653.6kg	234.7kg	234.7kg
Number of Batches	300	1	3



Table 2: Testing Plan

	Units
Quality Testing	
SHEAR VISCOSITY @ 1500 /s RATE (Part A)	Pa*s
SHEAR VISCOSITY @ 1500 /s RATE (Part B)	Pa*s
THERMAL CONDUCTIVITY	W/mK
SHORE 00 HARDNESS OF MOLD 200C-20-00	Unitless
SPECIFIC GRAVITY - MOLD	Unitless

9. Success Criteria

The experimental batches were compared to the most recent historical batches.

Multiple Batch Success Criteria (TGF 3600):

Experimental data sets were compared to the historical population. Prior to conducting hypothesis test for equivalence of means, tests for normality and equivalence of variance were completed. This enabled the selection of the appropriate hypothesis tests (2-sample Student t-test). Hypothesis tests were interpreted in the following manner:

1. If the P-value is < 0.05, reject hypothesis of equivalency.
2. If the P-value is ≥ 0.05, do not reject hypothesis of equivalency.
3. Otherwise, the test is inconclusive.

After the hypothesis tests were run, the quality characteristics were given one of the following grades:

1. SE = “Statistically Equivalent” → The t-test passes and the quality characteristic is deemed to be equivalent to the POR
2. TE = “Technically Equivalent” → The t-test fails or is inconclusive and the quality characteristic is deemed technically equivalent to the POR.
3. NE = “Not Equivalent” → The t-test fails and the quality characteristic is deemed not to be equivalent to the POR.

10. Testing Statistics Summary in Cannon Falls

Table 3: BERGQUIST GAP FILLER TGF 3600 Results

Test Name	UOM	POR μ	POR σ	POR N	Qual X	Qual s	Qual n	p-value	Conclusion (Decision)
SHEAR VISCOSITY @ 1500 /s RATE (Part A)	Pa*s	54.34	6.03	300	43.58	1.48	3	0.010	TE
SHEAR VISCOSITY @ 1500 /s RATE (Part B)	Pa*s	54.11	4.17	300	51.29	2.75	3	0.221	SE
THERMAL CONDUCTIVITY	W/mK	3.97	0.14	300	4.13	0.18	3	0.288	SE
SHORE 00 HARDNESS OF MOLD 200C-20-00	Unitless	45.1	6.9	300	48.9	2.9	3	0.275	SE
SPECIFIC GRAVITY - MOLD	Unitless	3.08	0.02	300	3.08	0.01	3	0.485	SE



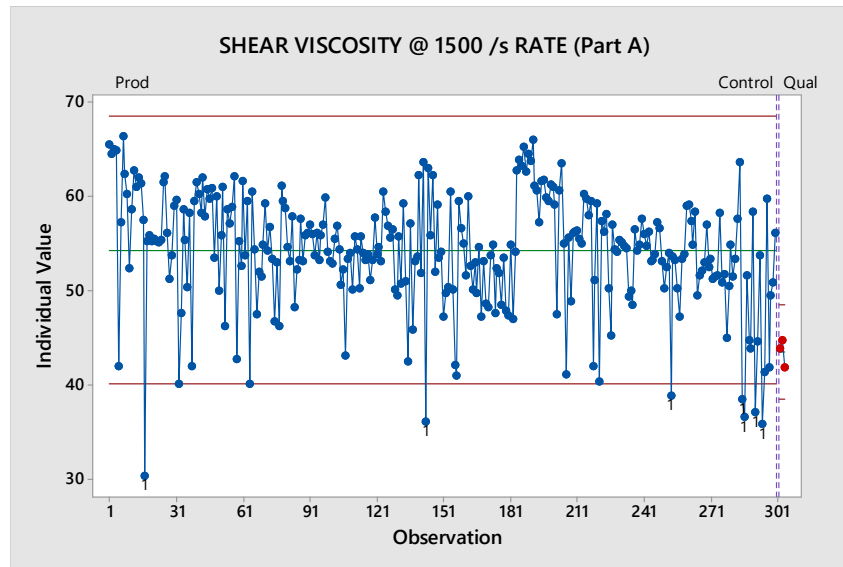
11. Overall conclusion/recommendation from GateKeepers

In our testing, the technical performance of our products using the silicone polymer from the new vendor, and alumina from an alternative production site, was technically equivalent to the historical product.



12. Appendix

Technical Equivalence - SHEAR VISCOSITY @ 1500 /s RATE (Part A)



- SHEAR VISCOSITY @ 1500 /s RATE (Part A) for the qualification batches was deemed technically equivalent to POR. Analysis of qualification batches versus POR indicate a shift in mean from 54.34 Pa*s (POR) to 43.58 Pa*s (Qual), while remaining within control compared to historical production. A decrease in SHEAR VISCOSITY @ 1500 /s RATE (Part A) translates to an increased dispense rate at the designated high shear rate for the Part A. Increased dispense rate at a high shear rate is considered technically better, resulting in a conclusion of technical equivalence. The control batch is indicated in the above chart as observation 301. The three qualification batches are indicated in the above charts as observations 302, 303, and 304.