

Moldmaking Silicone: QM 262 with Physical Properties Study

QM 262 introduction

QM 262 is a flowable, blue, high strength, addition (platinum) cure silicone rubber with a 10:1 mix ratio. It is designed for room temperature curing, but like most platinum catalyzed silicones, the cure rate of QM 262 can be accelerated by heating at elevated temperatures, thereby shortening the demold time.

If cure properties need to be modified, CHT offers two additives for that purpose which can be incorporated during the mixing process: The PT Accelerator will speed up the reaction and reduce cure time at room temperature. If one requires longer pot life, QSil PLE can be added to QM 262 to allow longer working time.

Features and benefits

Features	Benefits
Low viscosity, flowable	Easily mixed and de-aired. Will flow thoroughly around complex details.
Fast demold time	The ability to influence cure rate enables reduced production times.
High durometer	Material is hard and does not deflect when casting resin is added in either compression or lateral directions.
Casting resin resistance	Withstands casting resin by-products that outgas from the resin which are absorbed into the silicone.
Excellent dimensional stability	Will not shrink or sag under its own weight.
High strength	For applications such as roller manufacturing, this material is tough enough to withstand the physical demands involved in the grinding process.
Material complies with FDA indirect food contact regulation CFR 177.2600	Can be used for food packaging applications. Does not leach extractables above the FDA limit.

Products in Focus



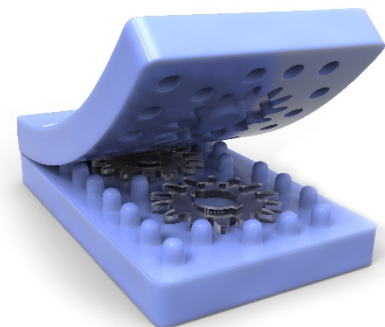
Moldmaking Silicone: QM 262 with Physical Properties Study

Typical applications

QM 262 was specifically designed for moldmaking and industrial applications.

Rapid prototyping

Rapid prototyping is a process using a resin master to quickly produce a scale model to test its design and functionality prior to mass production or for low volume production of complex parts. For example, precise replication of gears' small teeth is crucial so the interface between the replicated gears function smoothly and exactly as designed. The low viscosity of QM 262 enables it to flow throughout the design details.



The fast room temperature cure profile facilitates quick completion of the mold and will allow prototyping to begin within 24 hours. Prototyping can commence in a shorter timeframe if the mold cure is accelerated by the application of heat.

Roller manufacturing

An example application of the utility of QM 262 is in the manufacture of paper or plastic web-handling rollers.

A traditional manufacturing process begins with a heat-cured or thermoset rubber which are obtained as solid sheets or rolls. The High Consistency Rubber (HCR) is pulled and manipulated around a core, commonly aluminum or steel, and a mold is placed around the roll. Then heat at an elevated temperature is typically applied to induce the final cure of the rubber and set its final shape. The roller is then ground down to its final specified diameter and surface texture.



Aside from being energy intensive, these traditional manufacturing methods using solid rubbers result in a final roller having knit lines present – a visible joint or seam –*even after* the grinding process. This knit line then transfers to the film, paper, or other substrate – as if to impart a permanent watermark – as the material wraps or runs over the roller.

QM 262 rebounds instantaneously and does not take a set if the proper cure profile is followed. The surface of HCR and LSR rollers can deform with use over time and must be replaced. Since HCR can contain high levels of filler, traces of filler can be found downstream, which can then be transferred to the film causing a defect.

QM 262 offers many benefits to roller manufacturers. As a liquid, flowable RTV-2 chemistry, the silicone can be transferred via pumping or pouring. Physical handling, alignment, or affixment of a heavy sheet is avoided. The flowability allows for ease of mixing and pouring into molds to produce smaller rollers so equipment is not necessary. QM 262 will cure at room temperature, therefore heat is not required for the cure.

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Moldmaking Silicone: QM 262 with Physical Properties Study

Processing QM 262 to form a liner or coating on a roller core, primed for adhesion, begins with flowing the formulation into a mold containing the core. If porosity from air entrapment is a concern, various techniques can be employed such as feeding from the bottom of the mold or application of vacuum will eliminate bubbles.

Among pourable products in the marketplace, a key benefit of QM 262 is the cured durometer (60, Shore A) which is among the highest in comparison to similar products. With a low catalyzed viscosity of approximately 35,000 cP, QM 262 enables processing techniques that reduce air entrapment and finished rollers that are free of knits lines. QM 262 is compatible with and suited for use with a number of primers to ensure a good bond to a variety of core materials. Finally, the overall strength and toughness of QM 262 also allows a completed roller to undergo grinding to achieve the desired thickness and surface finish. If needed, CHT can customize filler particle size of RTV-2 silicones to mediate final surface finish of the roller.

Architectural reproduction

QM 262 also finds utility in architectural reproductions where it is used to replicate simple structures such as brick or stone, to more intricate ornamental items such as lattice, custom wood molding, and sculptures.

Being lighter in weight than masonry material, sizeable molds can be created allowing for large columns and walls to be replicated. The cured silicone is very durable, and in many cases, hundreds of replicas can be created from the same mold. The casting process is time and cost efficient for producing and installing decorative accents in either residences or commercial sites.



There are numerous materials that architectural replicas can be made from such as fiberglass-filled resin, polyurethane, polyester, acrylic resin, concrete and even silicone. The chemical make-up of QM 262 positions it as a prime silicone rubber for use with fiberglass filled resin – one of the most preferred in large architectural reproductions.

Moldmaking Silicone: QM 262 with Physical Properties Study

Physical properties lab study

The objective of this lab study is to determine the physical properties of QM 262.

The instruments used in this study include:

- Testometric™ M350-AX5 Tensile Tester
- Brookfield Viscometer DVII,
- Shore A Scale Durometer Gauge Procedure
- TA Instruments Discovery HR-3 Hybrid Rheometer

Physical properties of cured QM 262 were studied using two popular cure schedules.

Tensile strength, Elongation, Young's modulus, Tear strength

QM 262 was mixed with 10 parts A and 1 part B, by weight, de-aired, and then poured into a mold with dimensions of 6" X 6" X 0.075". The first sample sheet was cured in a heated press for 150 °C for 30 minutes and then allowed to cool for 30 minutes. For comparison, a second sheet was created in a similar manner, but cured at room temperature for 24 hours.

ASTM D412 cutting die was used to cut the test specimens which were tested according to ASTM D412 to measure the tensile strength, elongation and Young's modulus. For tear resistance, an ASTM D624B cutting die was used to cut the test specimens and which were tested according to ASTM D624B.

The average values were calculated and shown in the table below.

The viscosity of part A and part B were measured, separately, at 24 °C using a Brookfield DV-II+PRO Viscometer. Spindle #6 at 5 RPM was used for QM 262 A, which resulted in a viscosity of 42,000 cP. Spindle #3 at 20 RPM was used for QM 262 B, which resulted in a viscosity of 2,100 cP.

Durometer/hardness

The durometer of QM 262 was measured according to ASTM D2240 on four samples cured under differing regimens. Approximately 40 grams of catalyzed material were poured into each of the four 57mm aluminum dishes. Samples are a minimum of 0.25 inches thick per the standard.

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Two samples were cured at 23 °C – one for 24 hours, and the other for seven days. The third sample was cured at 150 °C for 30 minutes while the fourth sample was cured at 200 °C for 94 hours. The hardness was measured using a Shore A durometer gauge. All results are shown in the table below:

QM 262 Room Temperature and Heat Aged	Cured Puck	Cured Sheet			
	Durometer, Shore A	Tensile, psi	Elongation, %	Young's Modulus, psi	Tear, ppi
30 minutes at 150 °C	68	888	235	176	95
24 hours at 23 °C	56	835	248	183	100
7 days at room temperature	62				
94 hours at 200 °C	66				

Cure profile

The cure profile of QM 262 was collected on a TA Instruments HR-3 hybrid rheometer. The data in Chart 1 and Chart 2 below illustrate QM 262 remains flowable for up to 1.5 hours. This allows time for de-airing and pouring to make the mold or final part. After 24 hours, QM 262 is highly crosslinked and can be used as a mold within 24 hours.

Temperature	T-10 ¹ , minutes	T-50 ² , minutes	T-90 ³ , minutes
25 °C	279.3	430.9	818.8
75 °C	4.6	6.9	10.5
100 °C	2.4	3.4	4.7

1. T-10, time to reach 10 % of the complete cure
2. T-50, time to reach 50 % of the complete cure
3. T-90, time to reach 90 % of the complete cure

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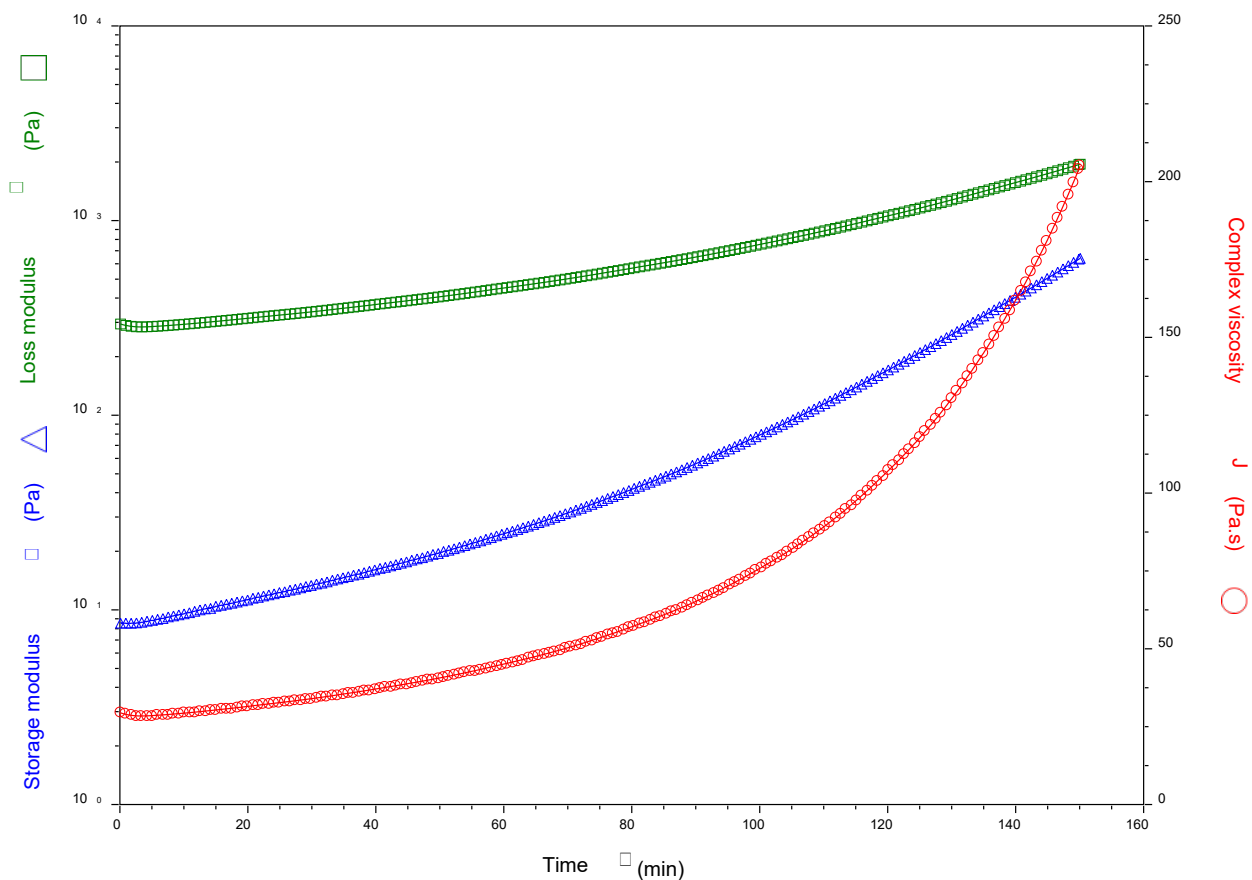
For the cure profile at room temperature, 25 °C, see **Chart 1** and **Chart 2** below.
Test conditions: 25 mm parallel plate, strain rate 1.25 %, frequency 10 rad/s.

For the cure profile at 70 °C, see **Chart 3** below.
Test conditions: 25 mm parallel plate, strain rate 1.0 %, frequency 12 rad/s.

For the cure profile at 100 °C, see **Chart 4** below.
Test conditions: 25 mm parallel plate, strain rate 1.0 %, frequency 12 rad/s.

Chart 1:

QM 262 Cure Curve at 25 °C, First 150 minutes



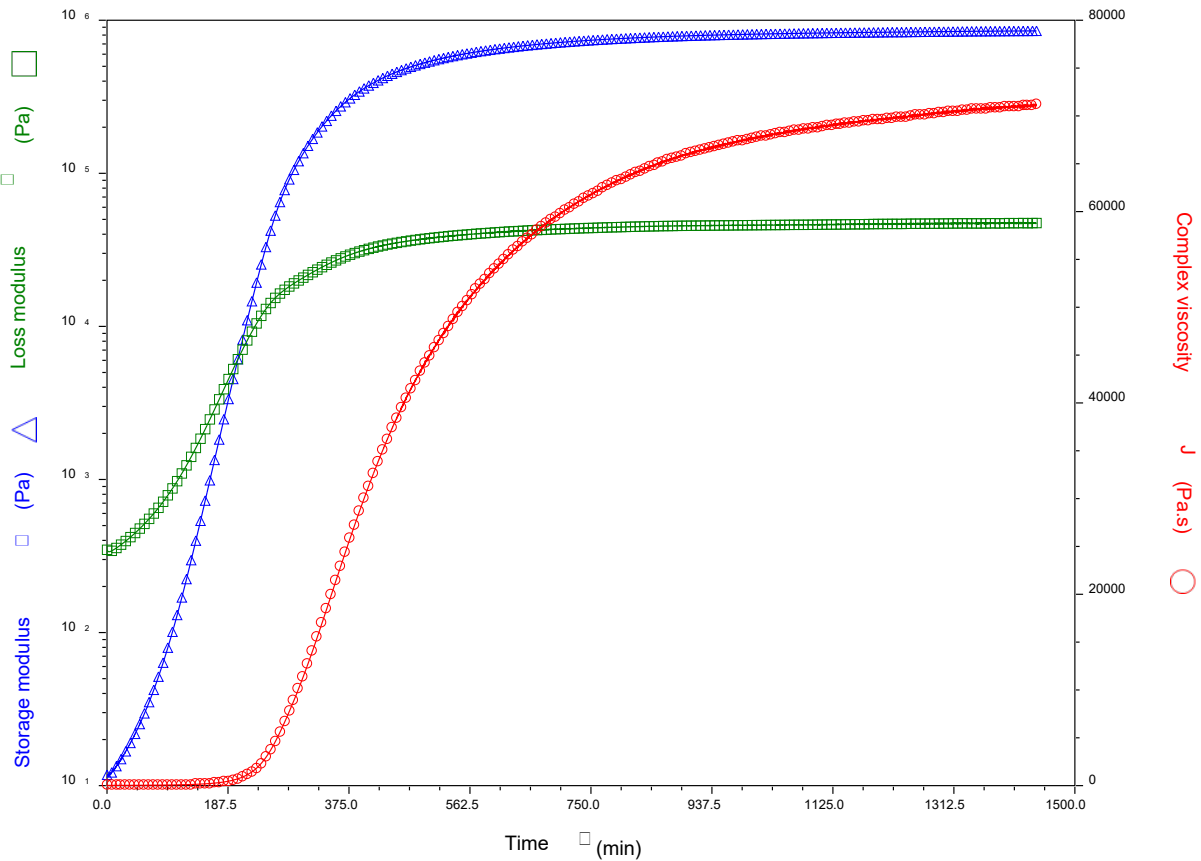
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Chart 2:

QM 262 Cure Curve at 25 °C



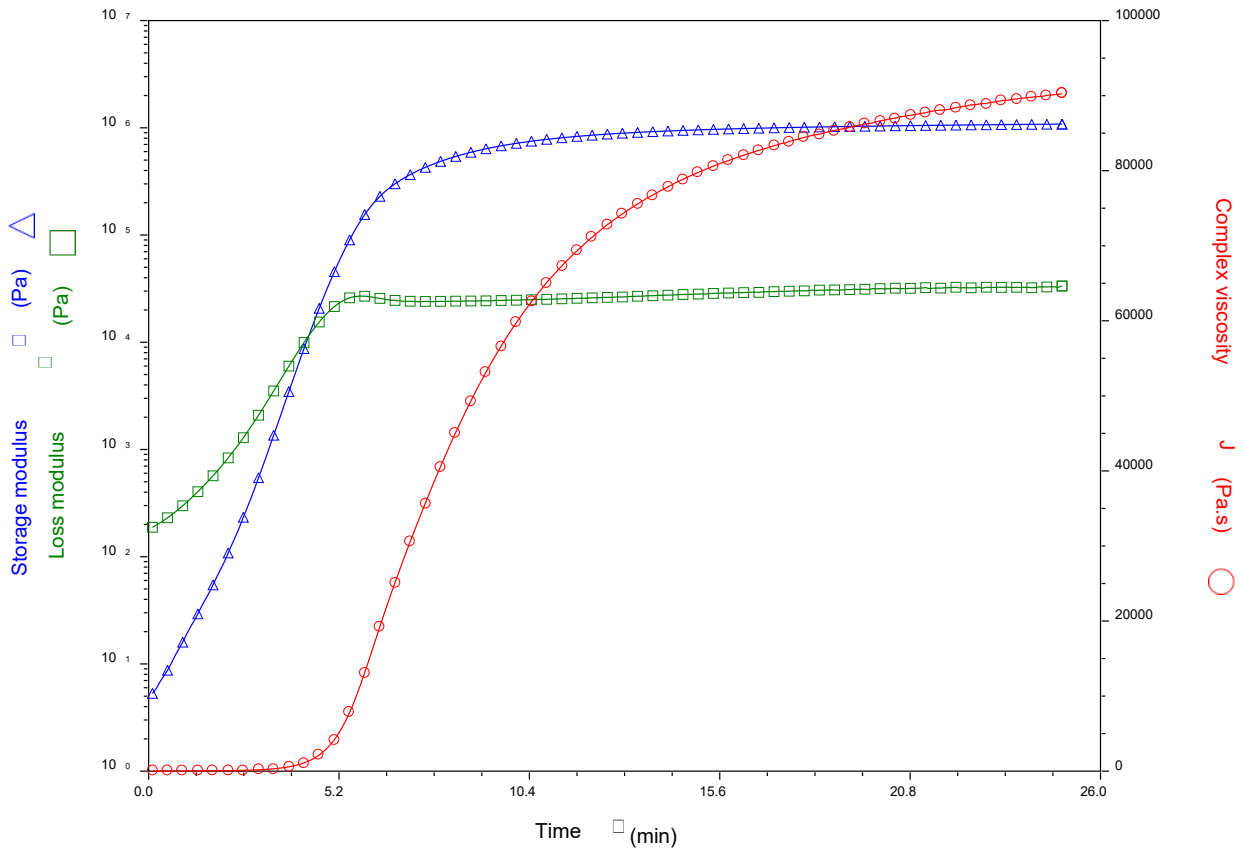
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Chart 3:

QM 262 Cure Curve at 70 °C



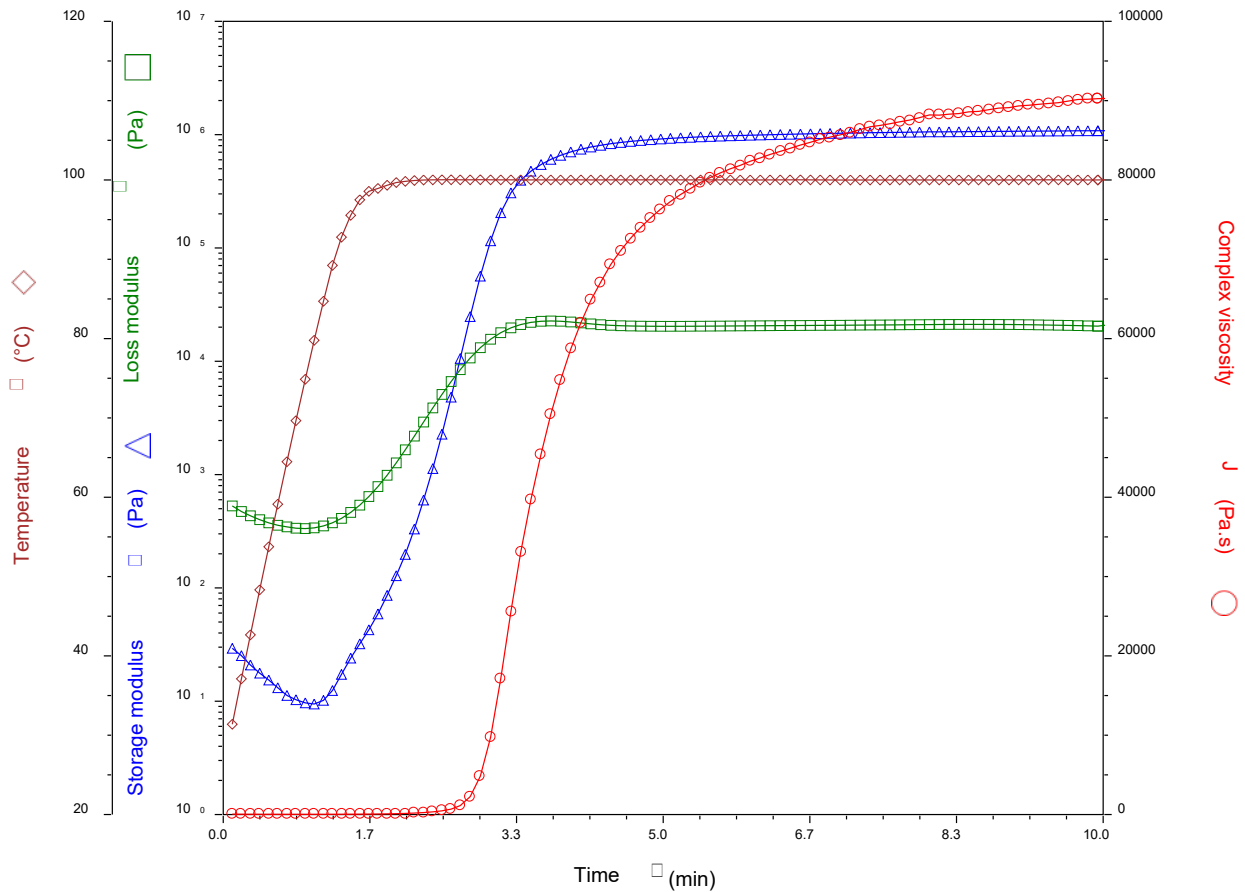
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Chart 4:

QM 262 Cure Curve at 100 °C



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If the mold is to be used at an elevated temperature, then QM 262 should be post cured at that particular temperature. Like all materials, the dimensions of silicone will change with temperature relative to the coefficient of thermal expansion (CTE) of the cured silicone. The post cure procedure ensures the designed dimensions of the part cast in the mold are obtained with each reproduction.

Shrinkage

The shrinkage for QM 262 is 0.02%, measured in the lab. The sample mold with dimensions of 15 x 0.5 x 0.25 inches was measured prior to and post cure. The shrinkage result was evaluated after curing for three days which is the typical time for measuring physical properties of silicone rubber.

Conclusion

QM 262 is an addition cure silicone designed for moldmaking and industrial applications. Having versatile properties, this silicone rubber offers a long open time and controllable cure time. Because of its low viscosity, QM 262 will flow easily throughout intricate details of both small and large parts.

QM 262 features good dimensional stability which is essential for molds when the master model being reproduced is highly detailed and complex, and therefore, will not alter proportions of the final part. QM 262 is designed with a combination of physical properties that contribute to durability and successful use in a number of applications requiring rigorous functionality.

The high durometer (60, Shore A) allows for both large and small rigid molds. The high values for tensile, tear, elongation, and Young's modulus enable the final product to be stretched and manipulated for easy part removal or to undergo the intense physical processing steps involved with roller manufacturing. The excellent dimensional stability and low shrinkage allow parts to be predictably reproduced. The formulation is adaptable to a number of process conditions. End users can control cure rate by varying the temperature or with the use of auxiliary additives and be assured the physical properties will remain consistent under a multitude of conditions.

QM 262 is available amongst a broad range of moldmaking silicones developed by CHT. Finding the right silicone for your application is not limited to CHT's product portfolio. Our technical team will partner with you to either modify specifications in a current product or custom formulate a new one to meet your exact requirements.

To browse CHT's complete product line or request samples, please visit www.silicone-experts.cht.com, or contact us: material@cht.com.