Westlake Epoxy

Technical Data Sheet

EPIKOTE™ Resin MGS LR635
EPIKURE™ Curing Agent MGS LH633, -635, -635LV, -636, -6367, -637

CHARACTERISTICS

Approval	DNV
Application	Rotor blades for wind turbines, boatbuilding, general composites like sporting goods, molds, tools, and other devices
Operational temperature	-40 °C up to +70 °C after appropriate cure
Processing	At temperatures between 15 °C and 50 °C With appropriate application, the LH633 curing agent can deliver cold cure performance at temperatures as low as 5°C
Features	Pot life from approx. 10 min. up to more than 5 hours Curing agents can be mixed for intermediate reactivity
Storage	Shelf life of 36 months in originally sealed containers

APPLICATION

Laminating resin EPIKOTE™ MGS LR 635 is an epoxy-based laminating resin system with a wide range of applications. It contains neither solvents nor fillers and is used for processing of glass, carbon, and aramid fibers.
The available curing agents cover a wide reactivity range from very fast to very slow. Additionally, mixing of curing agents (e.g. LH633 and LH637) is possible to adjust reactivity to individual needs. After precuring at room temperature, the manufactured components are workable and demoldable, only for the very slow curing agent LH637 the manufactured component eventually will be a bit brittle. The final properties, however, will only be reached after postcure at temperatures of more than 40°C.

Due to the chemical characteristics of this system we do not expect any problems concerning compatibility (e. g. blistering, tearing or changes in color), when it is processed with gelcoats. However, comprehensive tests are indispensable.

For epoxy resins crystallization is immanently possible. In an early stage, crystallization is visible as a clouding, and can progress to a stage, where the resin becomes a wax- like solid. Crystallization can be reversed by slow heating of the product to approx. 40 - 60 °C. without restriction to quality after removal, in fact a high purity of material will increase a tendency for crystallization. Although LR 635 is very unlikely to crystallize at low temperatures, storage conditions of 15-30 °C are recommended.

After dispensing material, the containers must again be closed carefully, to avoid contamination or absorption of water. All amine hardeners show a chemical reaction when exposed to air, known as „blushing“. This reaction is visible as white carbamide crystals, which could make the materials unusable.

Curing agents are colored to facilitate an easier identification of a homogenous mixture. The color is only a visual aid and is therefore not exactly specified. Therefore, variations from batch to batch are possible. Furthermore, the color is not stable and can change over time. This can be especially observed for high reactive curing agents like LH633 or LH635 and in addition for all curing agents due to UV radiation. Accordingly, the color can change over time depending on reactivity of curing agent and

storage conditions (like exposure to sunlight), but this has no effect on the overall performance and does not constitute a quality complaint.

The materials have a shelf life of minimum 3 years, when stored in their originally sealed containers.

The relevant industrial safety regulations for the handling of epoxy resins and hardeners are to be observed.

TYPICAL PROPERTIES

Property	Unit	Resin	Curing agent	
		LR635	LH633	LH635
Density[1)]	g/cm³	1,15	1,03	1,06
Viscosity[1)]	mPa·s	3200	170	185
Pot life[2)]	min		9	15
Ultimate T_G[3)]	°C		87	87

Property	Unit	Curing agent			
		LH635LV	LH636	LH6367	LH637
Density[1)]	g/cm³	1,01	1,03	0,96	0,94
Viscosity[1)]	mPa·s	100	80	12	10
Pot life[2)]	min	12	25	130	310
Ultimate T_G[3)]	°C	88	90	88	86

These are typical values and should not be construed as specifications.

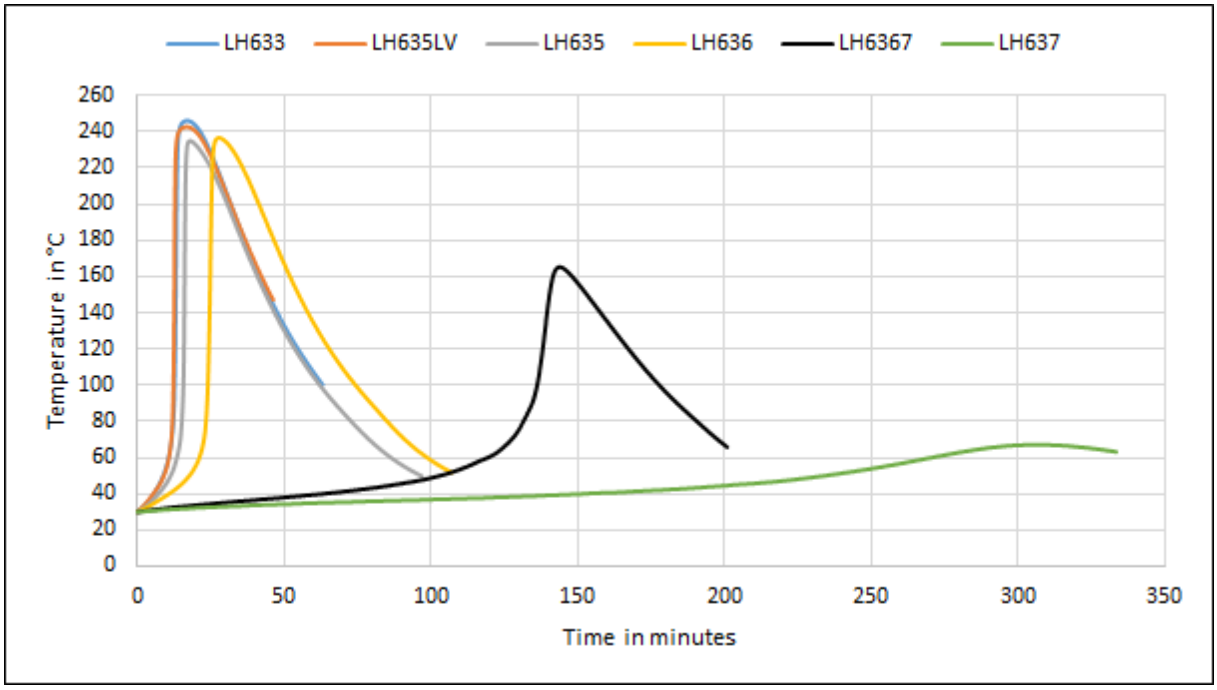
Measuring conditions:
1) measured at 25°C
2) 100g mixture of LR635 and curing agent in water bath at 30°C
   Pot life is a standardized lab test under fixed conditions which does not necessarily reflect real process conditions. The usage or working time varies depending on real processing conditions (environmental temperature, lay-up thickness)
3) After full cure, DSC 20K/min, midpoint

MIXING RATIO

	Parts curing agent per 100 parts resin LR635					
	LH633	LH635	LH635LV	LH636	LH6367	LH637
Parts by weight	30 ± 2					
Parts by volume	34 ± 2	33 ± 2	34 ± 2	34 ± 2	36 ± 2	37 ± 2

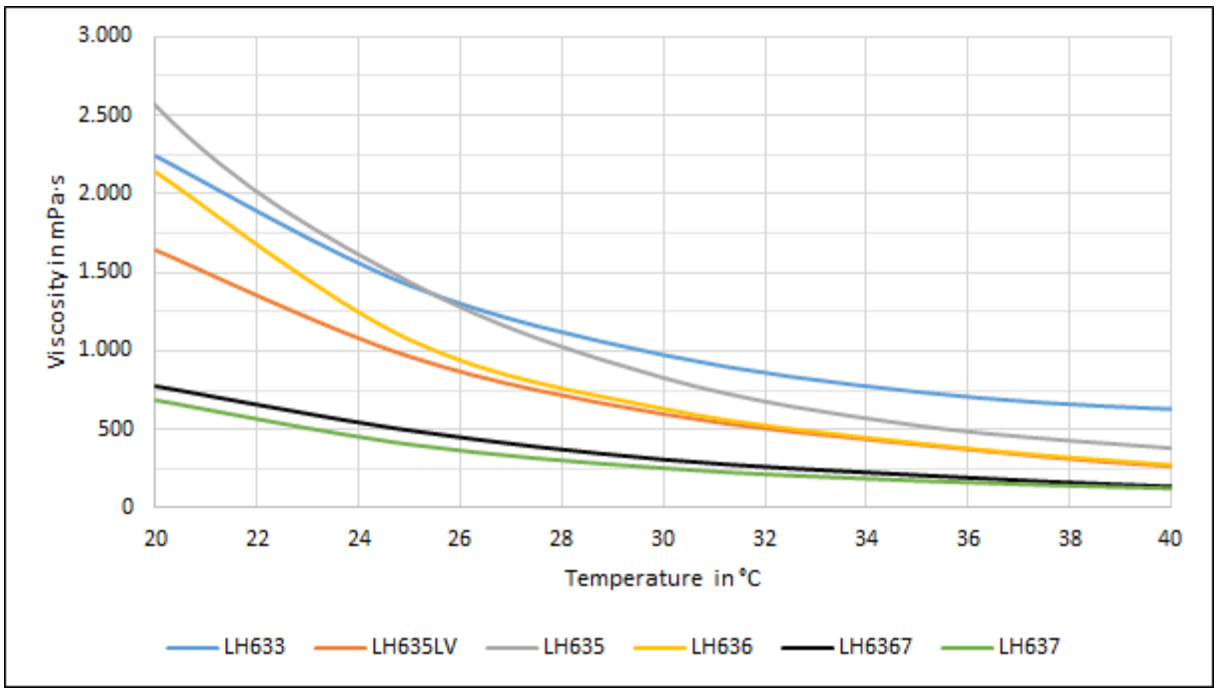
The mixing ratio stated must be observed very carefully. Adding more or less curing agent will not result in a faster or slower reaction, but in incomplete curing which can't be corrected in any way. Resin and curing agent must be mixed very thoroughly. Pay special attention to the walls and bottom of the mixing container.

TEMPERATURE DEVELOPMENT



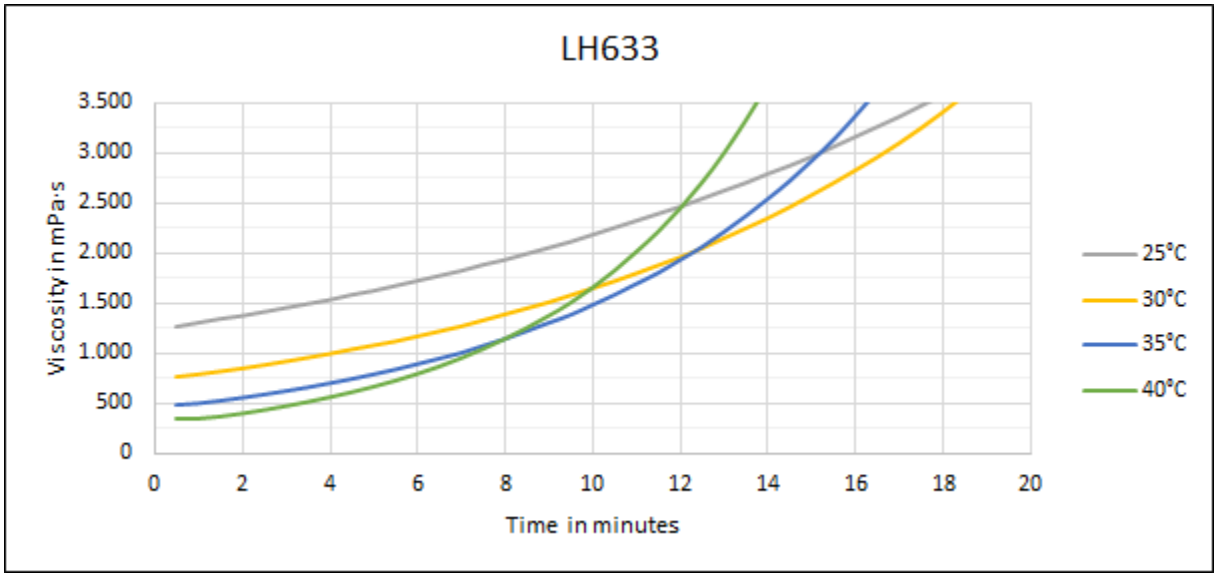
Measuring conditions: measured 100g in a paper cup isolated in a water bath at 30°C

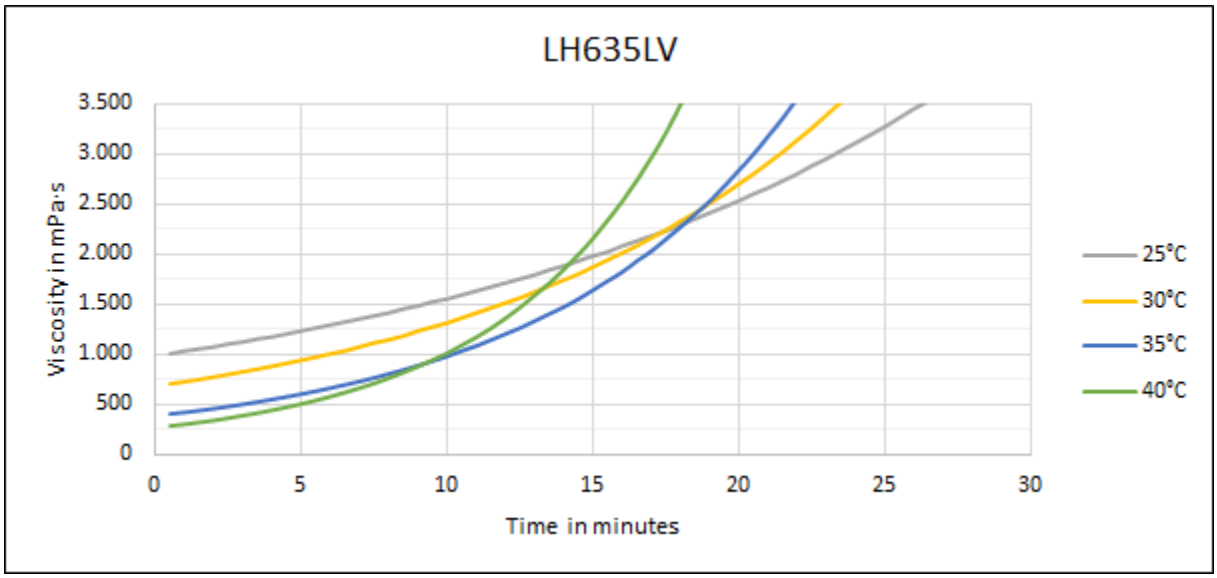
VISCOSITY OF MIXTURE

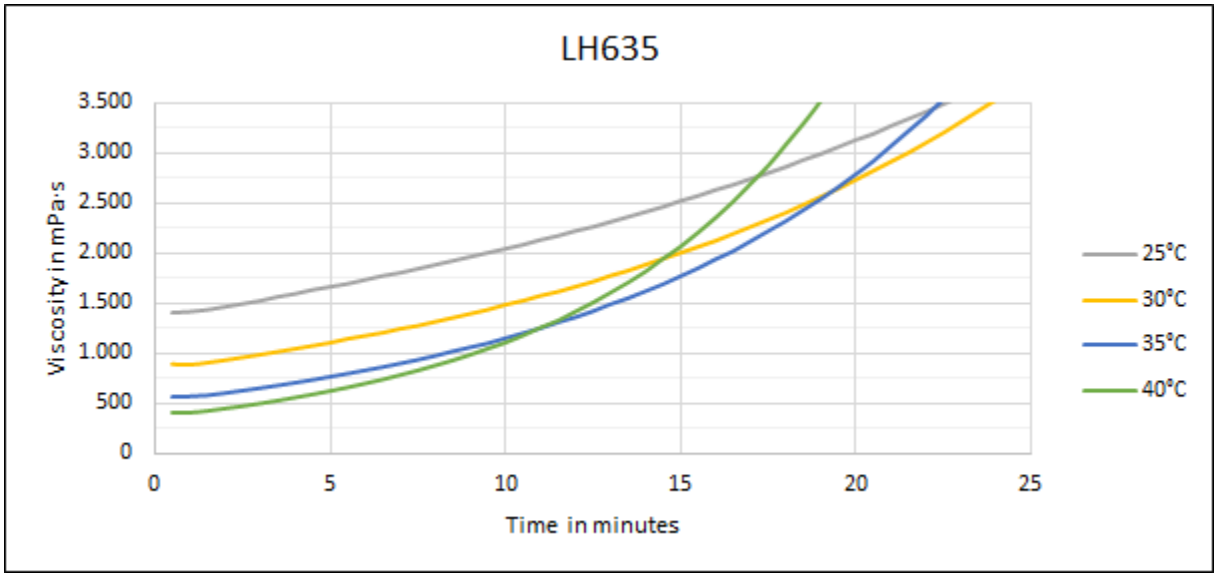


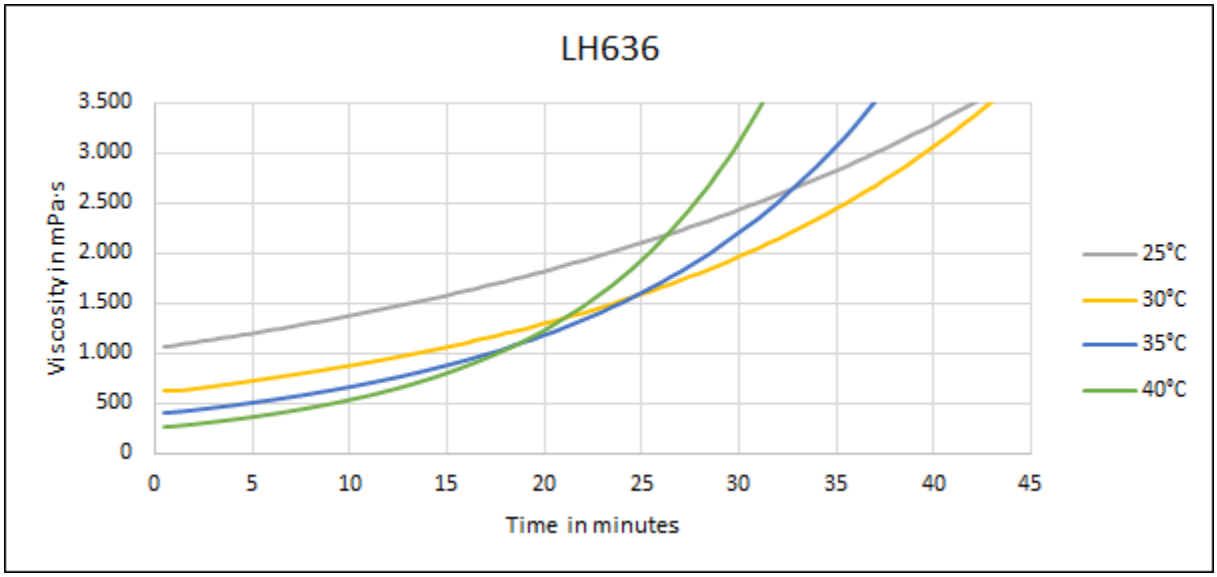
Measuring conditions: Viscometer, cone-plate configuration, diameter 50 mm, gap 0.1 mm

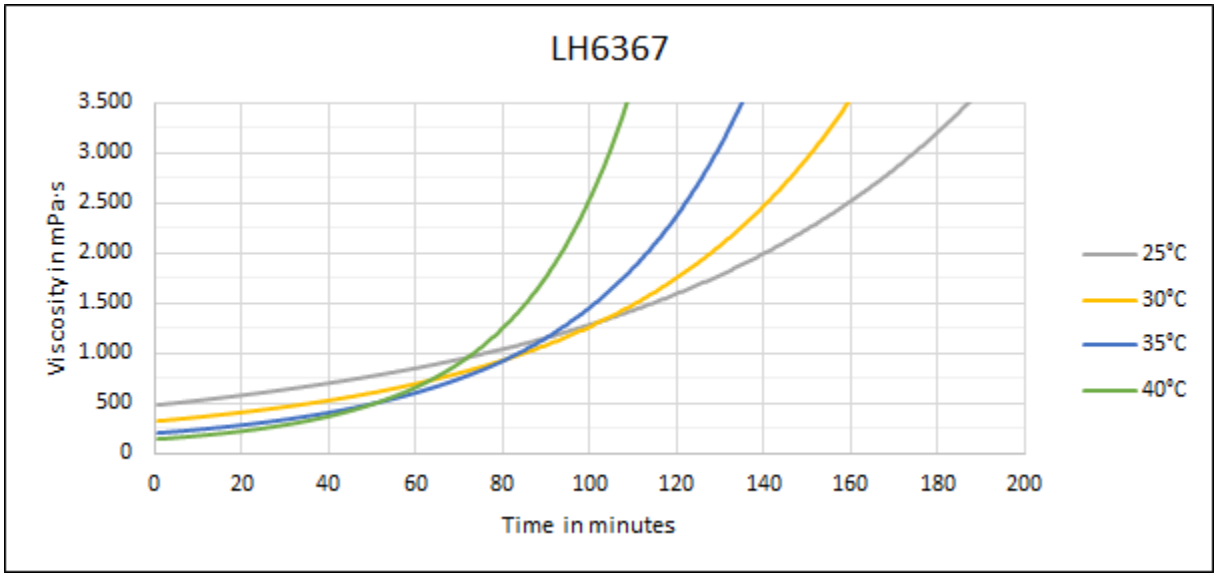
VISCOSITY DEVELOPMENT

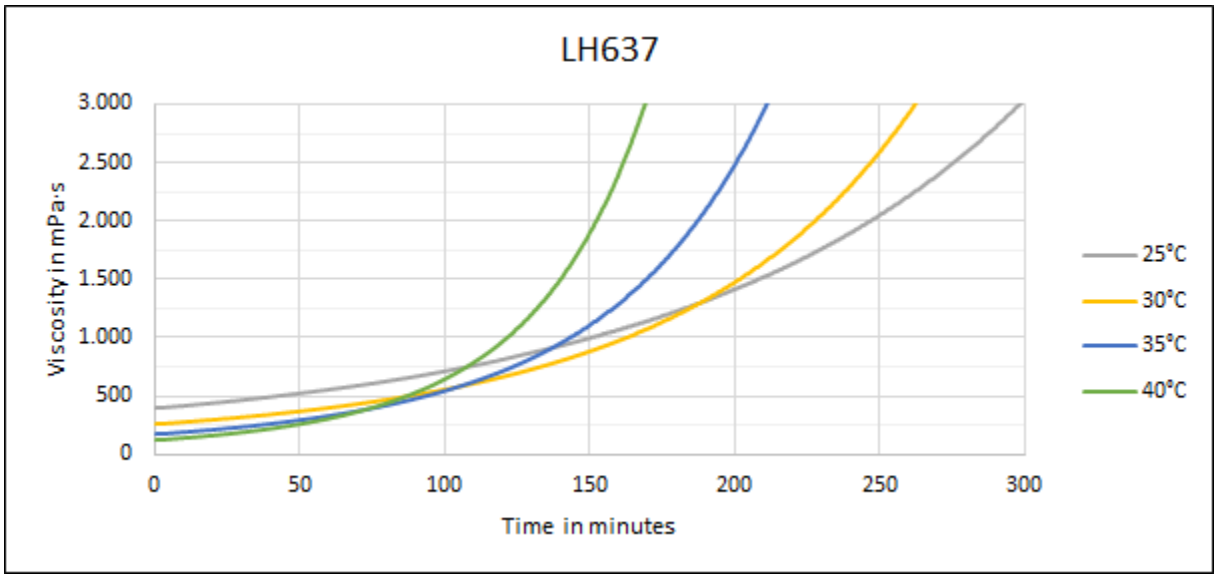


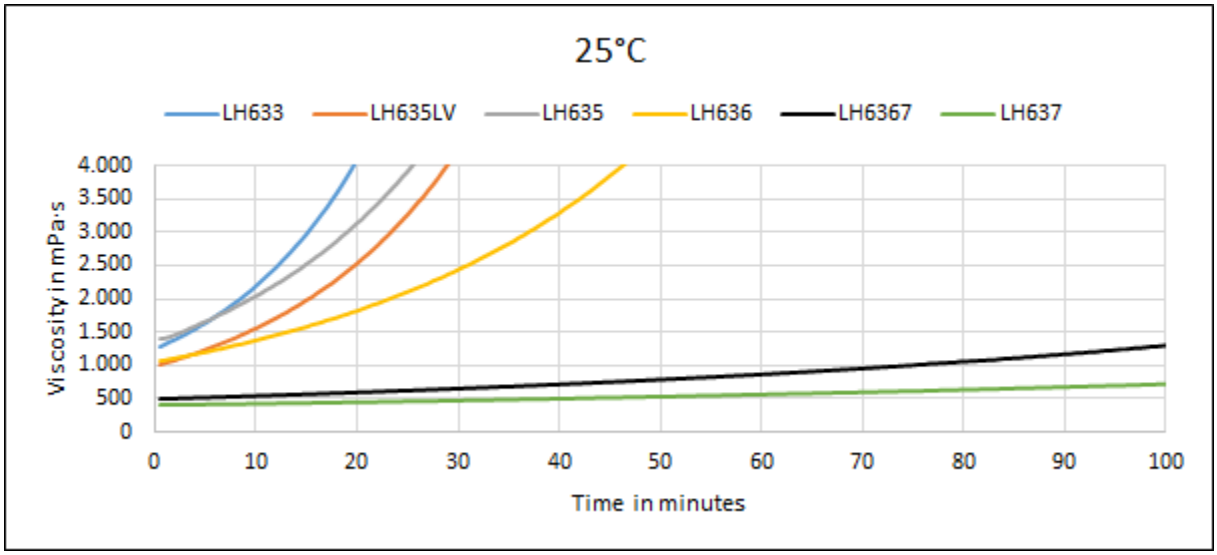


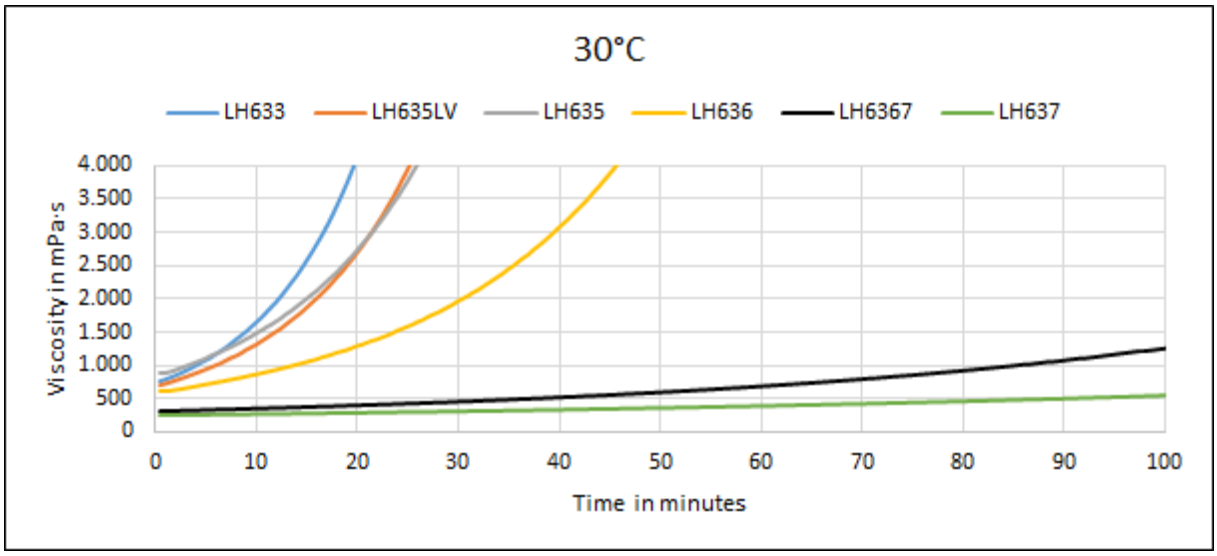


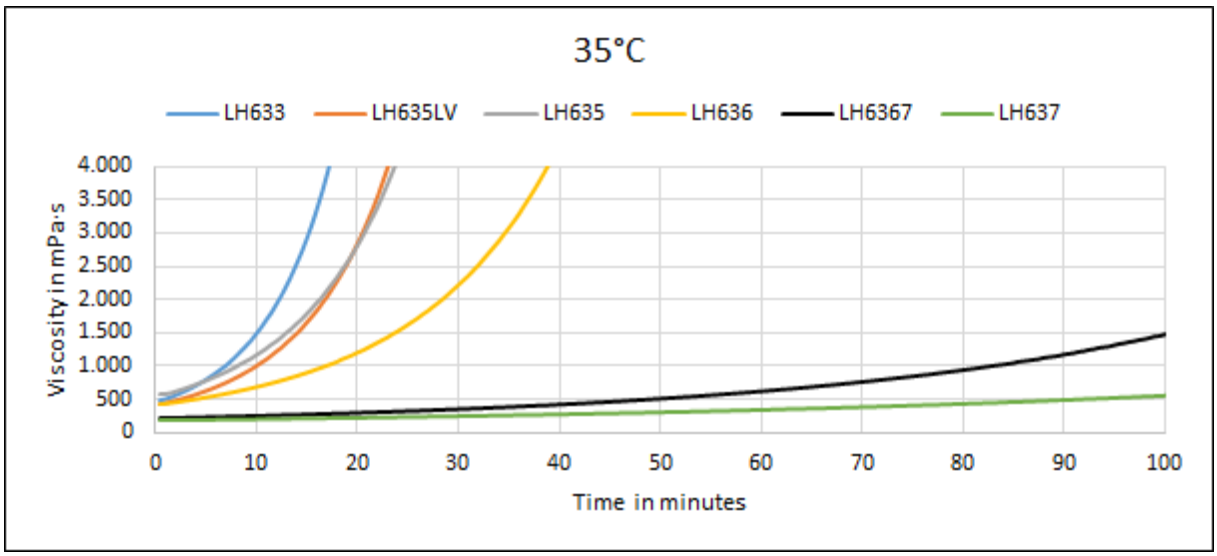

LH636
Viscosity in mPa·s
3.500
3.000
2.500
2.000
1.500
1.000
500
0
0
5
10
15
20
25
30
35
40
45
Time in minutes
25°C
30°C
35°C
40°C

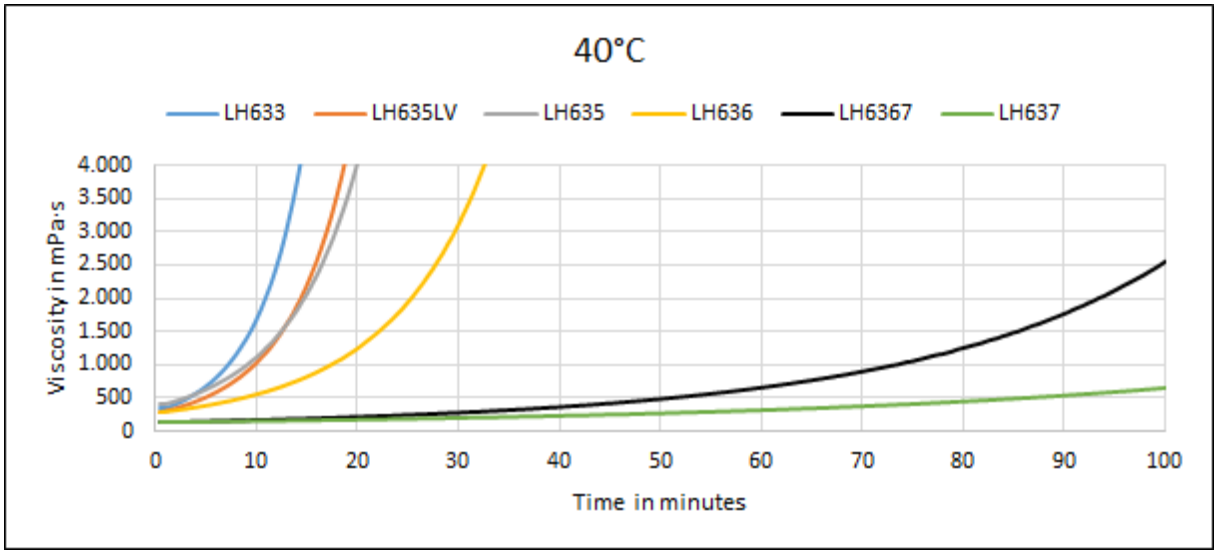

LH6367
Viscosity in mPa·s
3.500
3.000
2.500
2.000
1.500
1.000
500
0
0
20
40
60
80
100
120
140
160
180
200
Time in minutes
25°C
30°C
35°C
40°C


LH637
Viscosity in mPa·s
3.000
2.500
2.000
1.500
1.000
500
0
0
50
100
150
200
250
300
Time in minutes
25°C
30°C
35°C
40°C


25°C
LH633
LH635LV
LH635
LH636
LH6367
LH637
Viscosity in mPa·s
4.000
3.500
3.000
2.500
2.000
1.500
1.000
500
0
0
10
20
30
40
50
60
70
80
90
100
Time in minutes

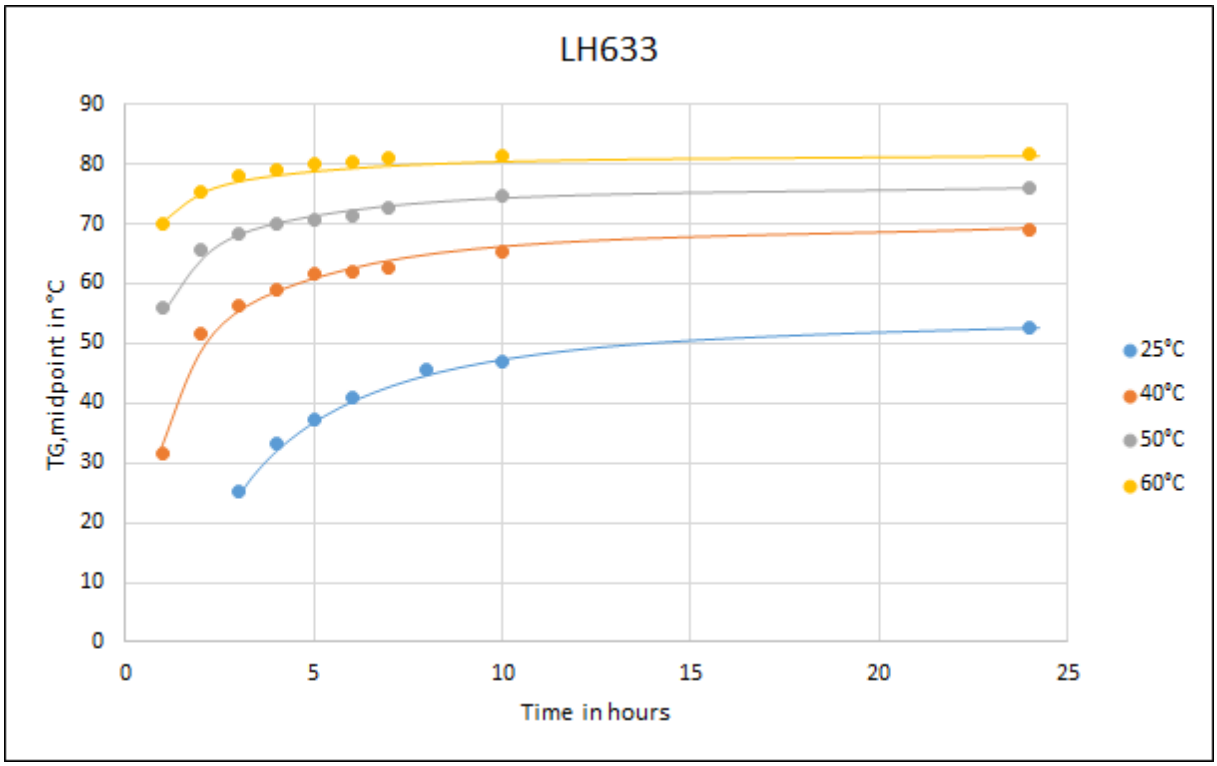

30°C
LH633
LH635LV
LH635
LH636
LH6367
LH637
Viscosity in mPa·s
4.000
3.500
3.000
2.500
2.000
1.500
1.000
500
0
0
10
20
30
40
50
60
70
80
90
100
Time in minutes

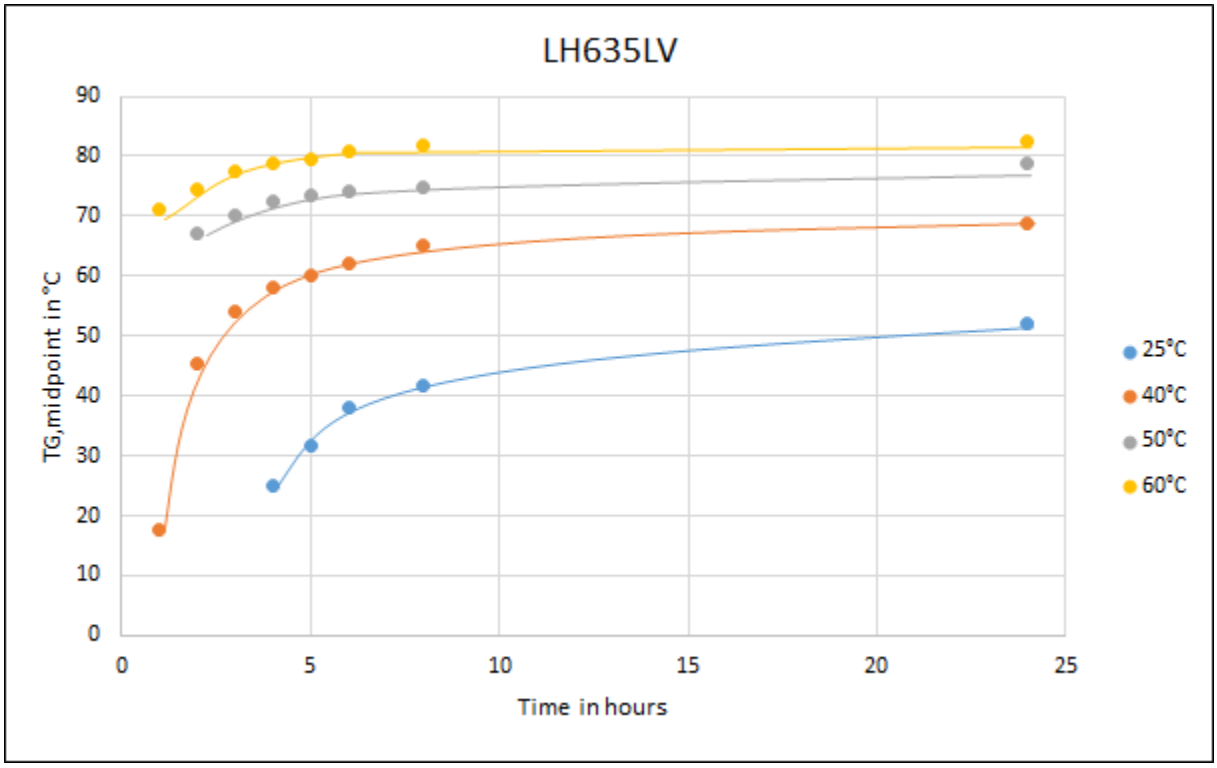

35°C
LH633
LH635LV
LH635
LH636
LH6367
LH637
Viscosity in mPa·s
4.000
3.500
3.000
2.500
2.000
1.500
1.000
500
0
0
10
20
30
40
50
60
70
80
90
100
Time in minutes

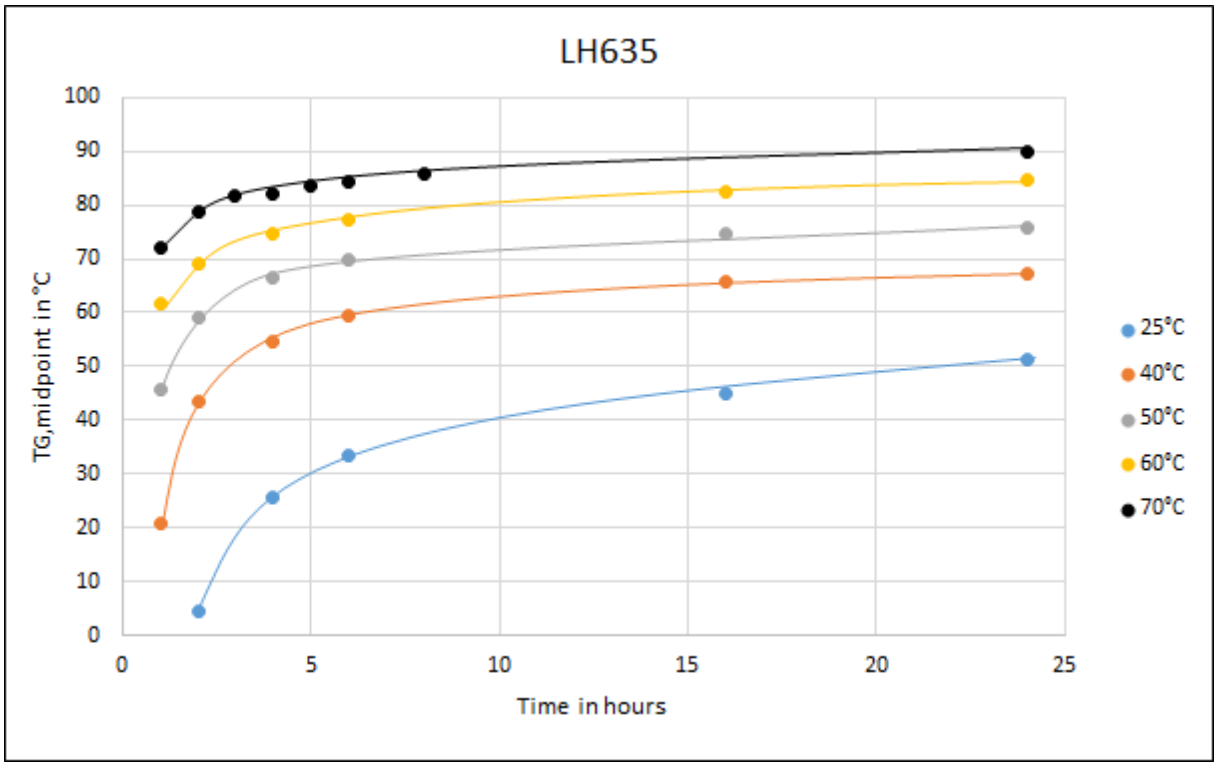


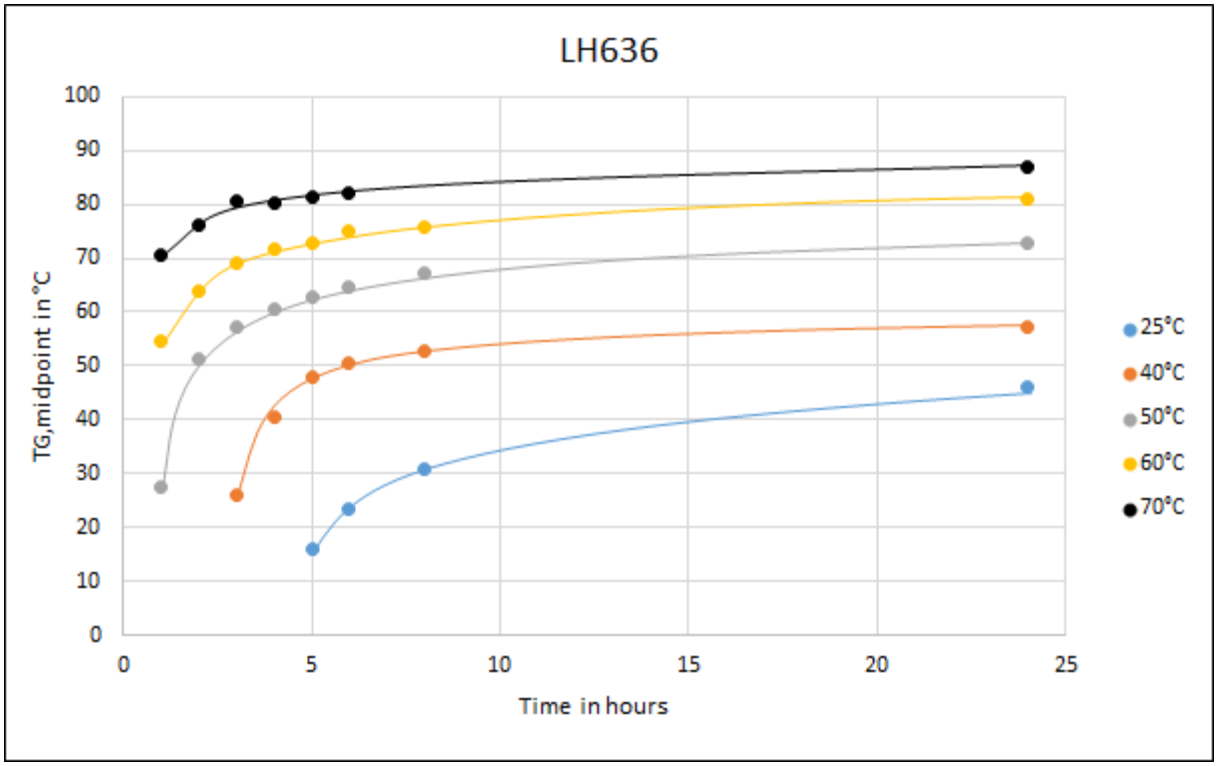
Measuring conditions: Viscometer, cone-plate configuration, diameter 50 mm, gap 0.1 mm

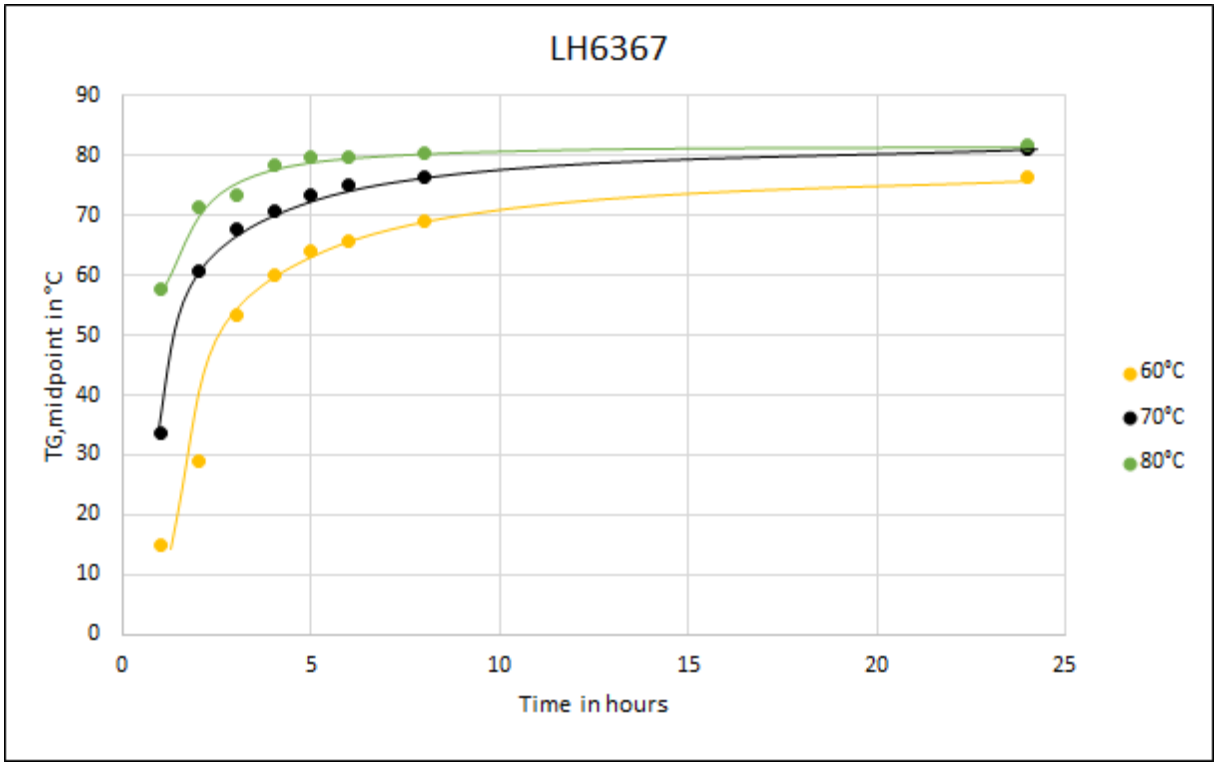
T_G DEVELOPMENT

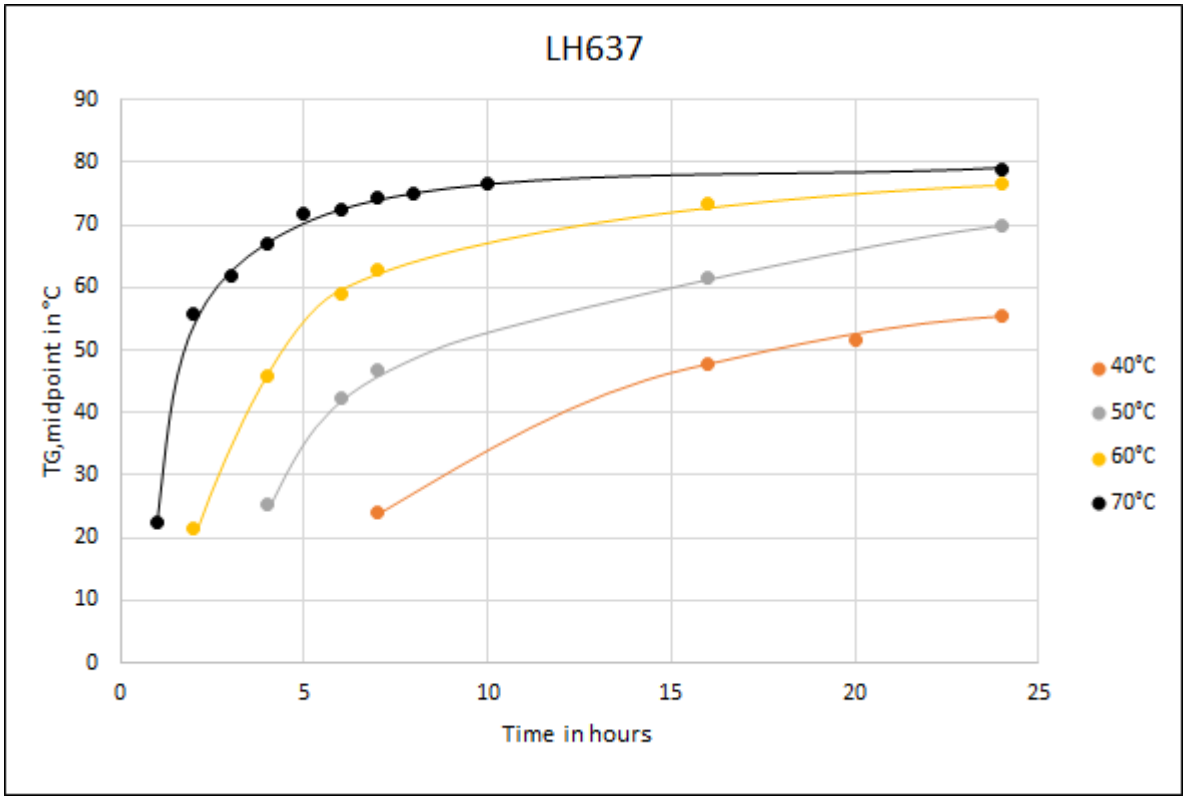


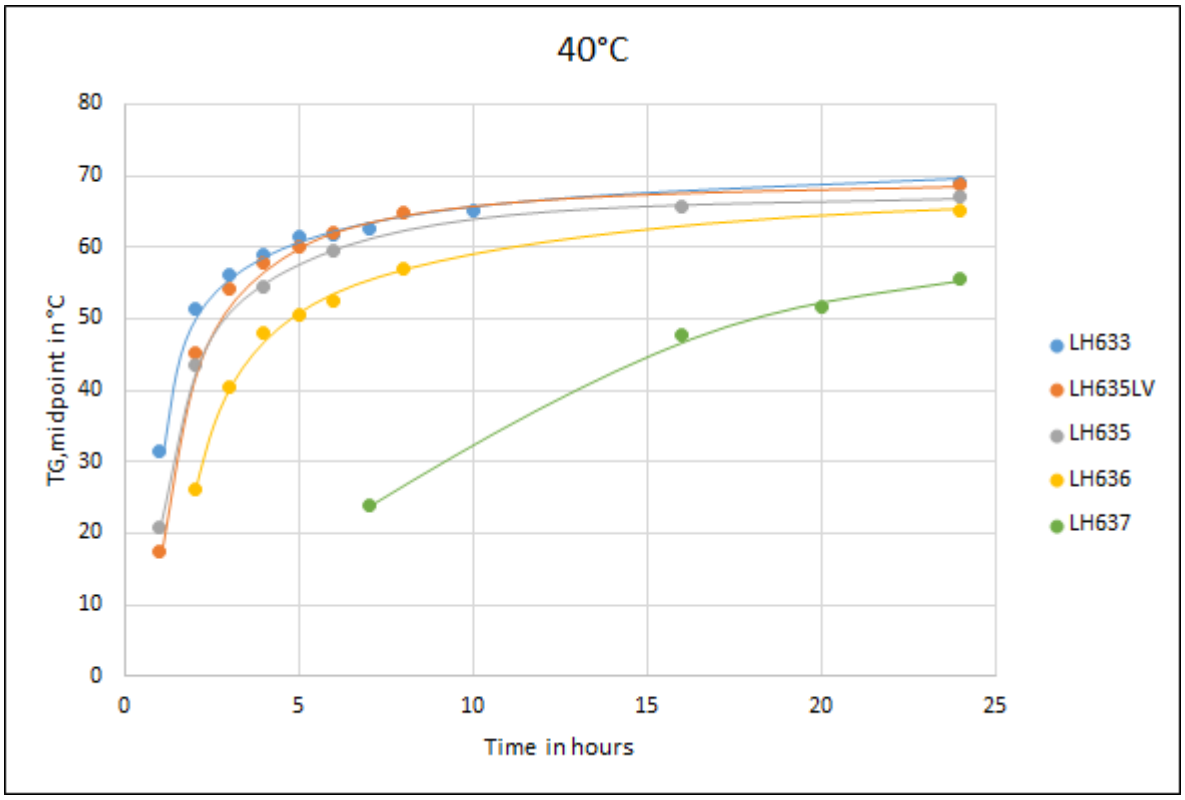

LH635LV
TG,midpoint in °C
Time in hours
0
10
20
30
40
50
60
70
80
90
0
5
10
15
20
25
25°C
40°C
50°C
60°C

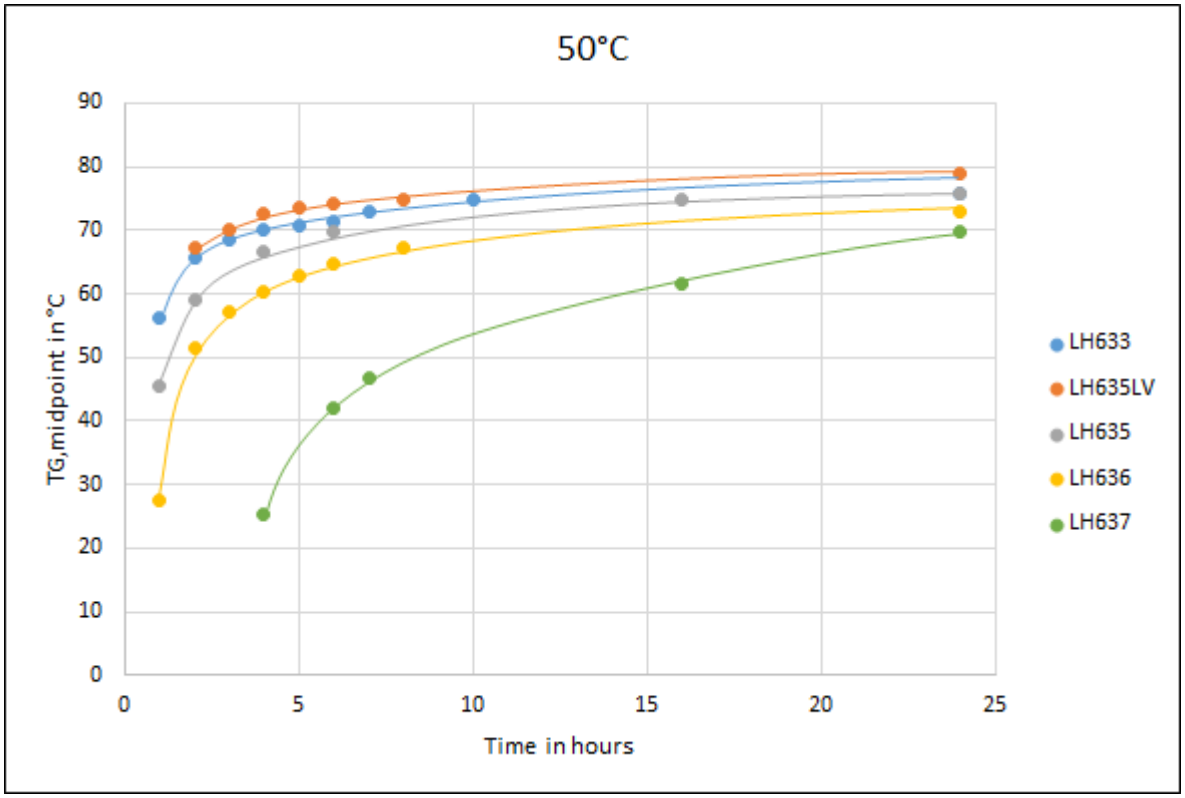

LH635
TG,midpoint in °C
Time in hours
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
25°C
40°C
50°C
60°C
70°C

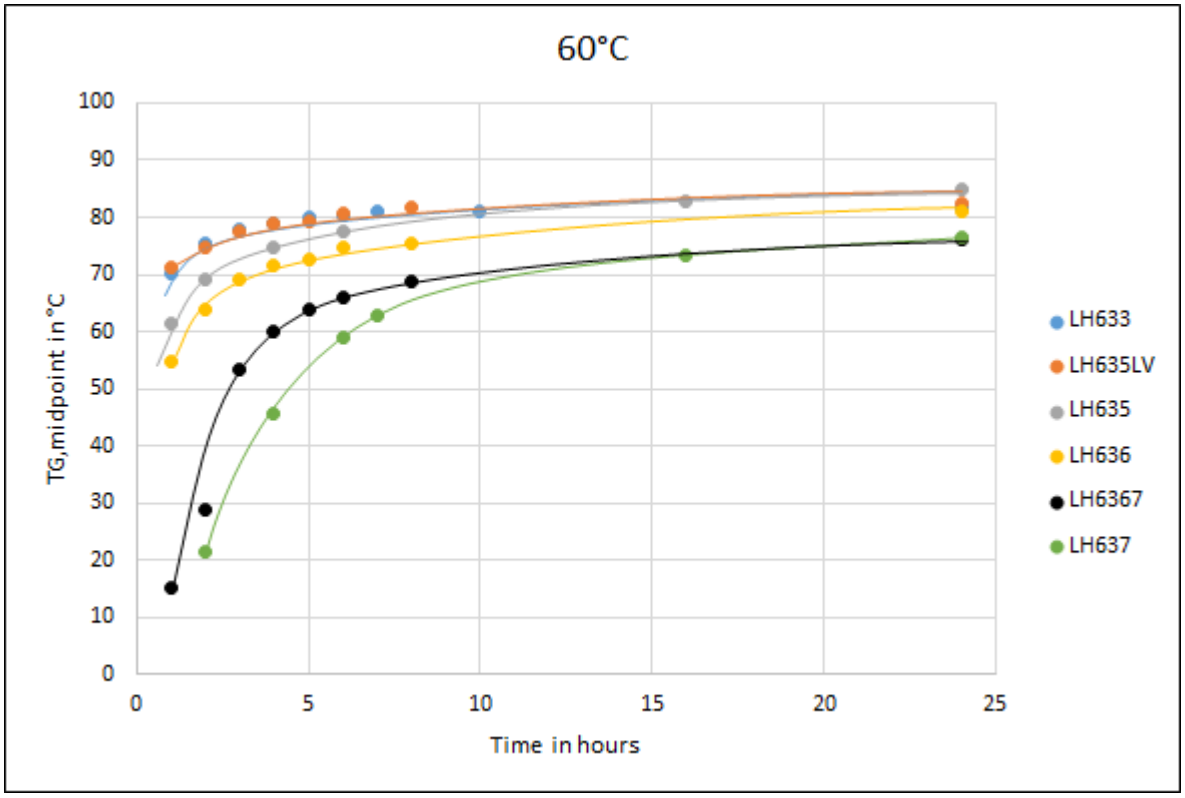

LH636
TG,midpoint in °C
Time in hours
25°C
40°C
50°C
60°C
70°C

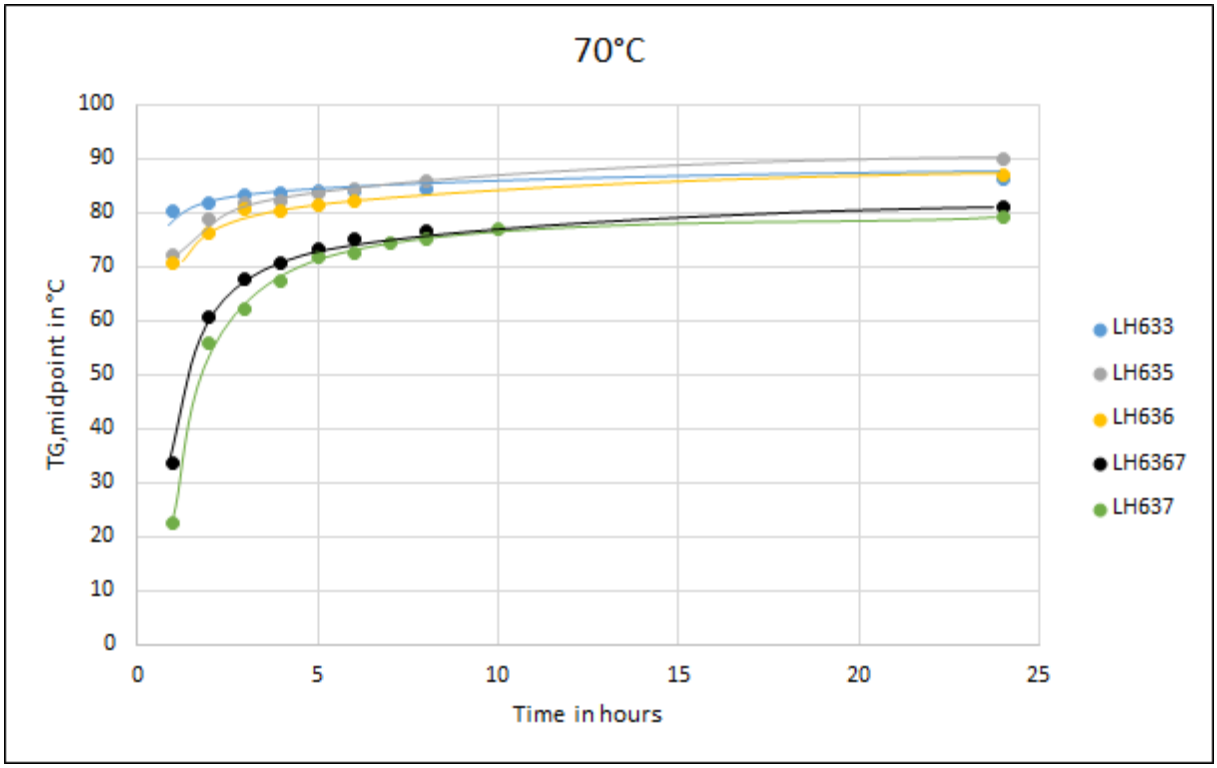

LH6367
TG,midpoint in °C
Time in hours
60°C
70°C
80°C


LH637
TG,midpoint in °C
Time in hours
40°C
50°C
60°C
70°C


40°C
TG,midpoint in °C
Time in hours
LH633
LH635LV
LH635
LH636
LH637


50°C
TG,midpoint in °C
Time in hours
0
10
20
30
40
50
60
70
80
90
0
5
10
15
20
25
LH633
LH635LV
LH635
LH636
LH637


60°C
TG,midpoint in °C
Time in hours
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
LH633
LH635LV
LH635
LH636
LH6367
LH637



Measuring conditions: DSC-measuring heat rate: 20°C/min, sample mass 10-20 mg

PYHISICAL AND MECHANICAL DATA (TYPICAL)

Test	Property	LH633	LH635	LH635LV	LH636	LH637
Cured density DIN EN ISO 1183-1	**Density [g/cm³]**	1,15 – 1,20				
Tensile test DIN EN ISO 527-2	**Tensile strength [MPa]**	80	85	80	85	70
	Tensile modulus [GPa]	3,4	3,6	3,4	3,6	3,2
	Tensile strain at break[1)] [%]	7	6	8	7	8
Flexural test DIN EN ISO 178	**Flexural strength [MPa]**	130	140	125	140	115
	Flexural modulus [GPa]	3,3	3,8	3,3	3,5	3,3

These are typical values and should not be construed as specifications.

[1)] Tensile strain at break results strongly depends on specimen quality, especially void content
All tests accomplished at standard climate; specimens cured up to a T_G midpoint (DSC) of approx. 75°C

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