

Technical Information

SYSTEM[®] 659

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under development

SYSTEM 659 is recommended for production of laminates with glass, basalt and carbon fibres by infusion and hand laminating methods.

EPIDIAN[®] 659 is a clear liquid and low viscosity composition of epoxy resin which is made of Bisphenol A as well as Bisphenol F as well as reactive diluent.

SPECIFICATION

Parameter	Unit	Value
Epoxy number	[mol/100g]	0.555 – 0.588
Viscosity at 25°C	[mPas]	600 – 700

HARDENERS[®] 659x are a transparent colourless or yellowish liquids with low viscosity and different reactivity.

HARDENERS SPECIFICATION – SUMMARY

Curing agent	Amine number [mg KOH/g]	Viscosity at 20°C [mPas]	Density at 20°C [g/cm ³]
6591	510±10	18.7±1.0	0.946
6592	550±15	15.8±0.8	0.938
6593	640±15	19.9±1.0	0.938
6594	750±20	16.5±0.8	0.981
6595	770±20	18.0±1.0	0.984

APPLICATION

SYSTEM 659 is a universal epoxy composition, which is used in production of laminates with glass, basalt and carbon fibres. System is recommended for hand laminating and infusion methods.

Use of different curing agent gives moderate pot life and curing time of materials and thermal and mechanical properties.

Weight ratio is 100 phr of EPIDIAN[®] 659 and 30 phr of each hardeners.

SYSTEM SPECIFICATION – SUMMARY

Curing agent	Initial viscosity at 30°C [mPas]	Pot life (100g, 30°C) [-]	Gel time at 30°C for 1 mm layers [-]
6591	180±5	9 h 10 min	11 h 35 min
6592	170±4	7 h 00 min	8 h 52 min
6593	185±5	2 h 40 min	5 h 3 min
6594	145±8	30 min	3 h 21 min
6595	155±7	27 min	2 h 53 min

CURING PROCESS

In one stage:

7 days at the room temperature.

In two stages:

- 24 hours at room temperature and 8 hours at temperature 80°C,
- 24 hours at room temperature and 16 hours at temperature 60°C,
- 24 hours at room temperature and 24 hours at temperature 40°C,

Depending on individual production capabilities, other curing times and temperatures are possible.

SHELF LIFE

12 months from the manufacture date for epoxy resin and 6 months for curing agents.

OHS INFORMATION

Information on the safe handling of epoxy composition is available in „Instruction for the epoxy resins use”.

CLEANING TOOLS

All tools used for making the epoxy coating shall be cleaned regularly with a solvent, e.g. acetone, preventing from curing the residues of the epoxy compositions on the tools.

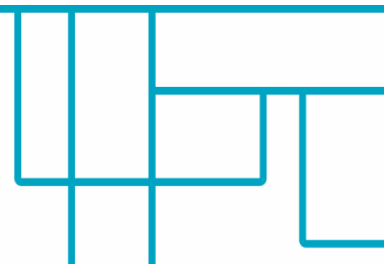
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CURING AGENTS – PROPERTIES

Parameter \ Hardener		6591	6592	6593	6594	6595
Viscosity, mPa·s	15°C	26.2±0.5	21.5±0.5	28.2±1.3	23.5±0.9	24.3±0.4
	20°C	18.7±0.5	15.8±0.2	20.9±0.9	16.5±0.2	18.0±0.7
	25°C	14.3±0.5	12.8±0.4	14.8±0.5	12.8±0.0	13.3±0.2
	30°C	11.3±0.5	10.1±0.2	11.4±0.2	10.2±0.1	10.5±0.2
Refractive index at 22°C, -		1,4650 ±0.0005	1.4715 ±0.0005	1.4863 ±0.0005	1.4884 ±0.0005	1.4920 ±0.0005
Density, g/cm ³		0.946	0.938	0.938	0.981	0.984
Hazen scale, -		<5	<5	<5	<65	<70

UNCURED COMPOSITION – PROPERTIES

Parameter \ Hardener		6591	6592	6593	6594	6595
Initial viscosity, mPa·s	20°C	426±5	404±10	437±5	323±5	329±15
	30°C	178±2	170±2	184±2	146±5	158±6
	40°C	86±1	83±1	88±2	77±3	77±4
Pot life (water bath, 130g of mixture),	30°C	9 h 10 min	7 h 00 min	2 h 40 min	30 min	27 min
	40°C	3 h 32 min	2 h 35 min	1 h 10 min	16 min	15 min

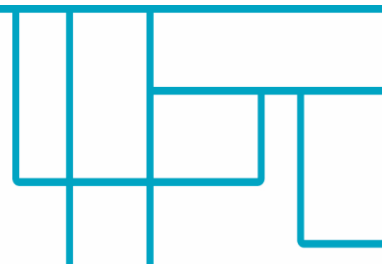


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UNCURED COMPOSITION – CURING PROCESS (START at RT)

Parameter \ Hardener		6591	6592	6593	6594	6595
Pot life,	130 g of mixture	5 h 05 min	4 h 50 min	1 h 45 min	25 min	22 min
	500 g of mixture	2 h 21 min	1 h 54 min	57 min	21 min	20 min
Maximum temperature, °C	130 g of mixture	35.7	52.6	164.9	219.1	220.5
	500 g of mixture	183.0	206.5	233.5	239.2	252.0
Peak time,	130 g of mixture	5 h 30 min	5 h 08 min	1 h 51 min	26 min	23 min
	500 g of mixture	2 h 32 min	2 h 00 min	1 h 01 min	22 min	22 min

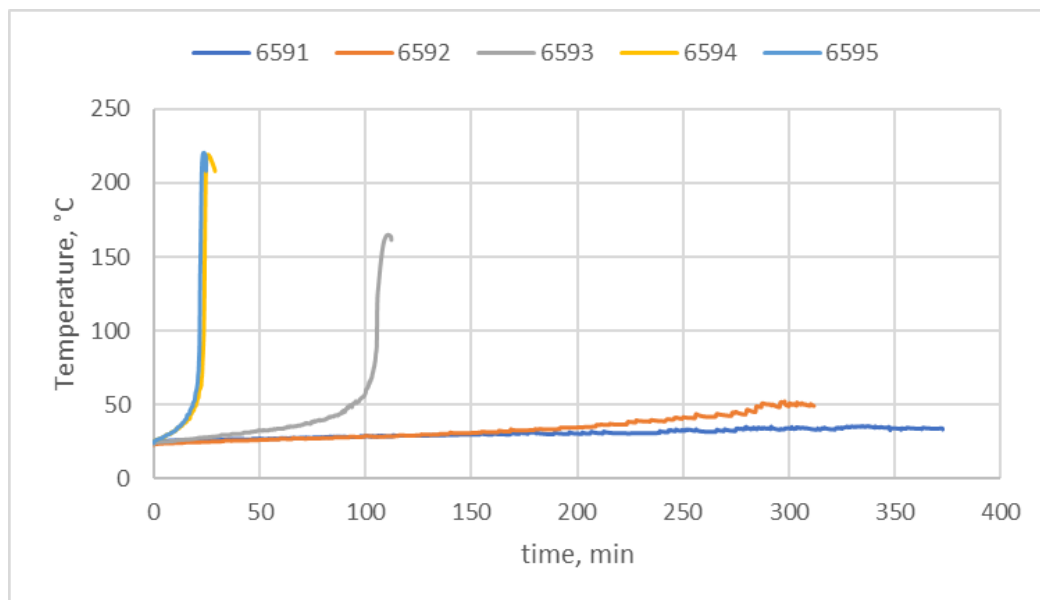


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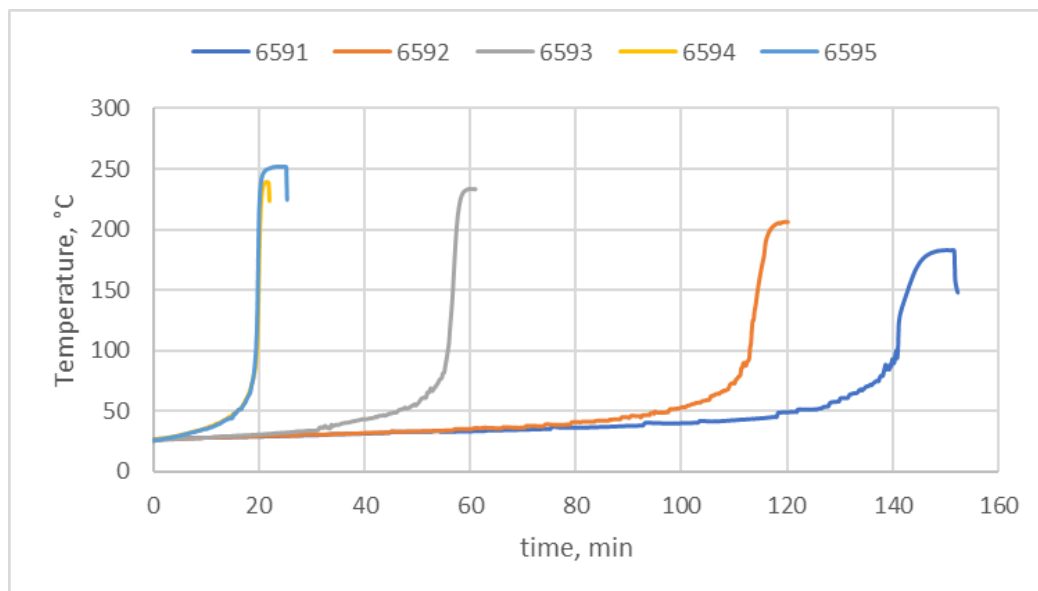
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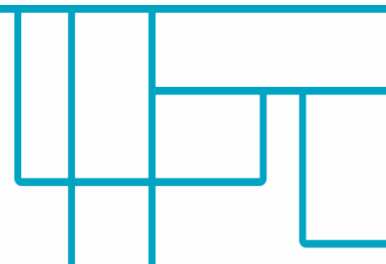
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Reactivity for 130g of mixture (start at RT)



Reactivity for 500g of mixture (start at RT°C)

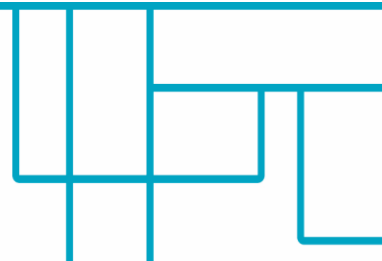


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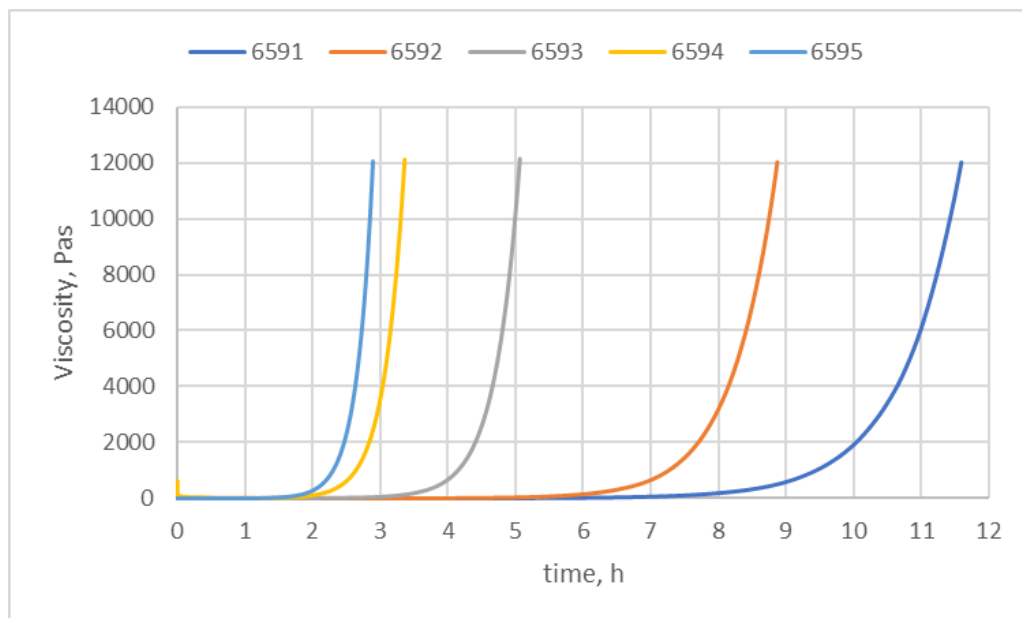
UNCURED COMPOSITION – CURING PROCESS FOR 1 MM LAYER

Parameter \ Hardener		6591	6592	6593	6594	6595
time to reach viscosity at 30°C, min	1 Pa·s	165	151	95	43	38
	10 Pa·s	316	246	124	79	72
	50 Pa·s	407	315	178	107	95
	100 Pa·s	446	344	194	119	106
	500 Pa·s	532	409	233	146	128
	1000 Pa·s	567	436	249	158	138
	5000 Pa·s	650	498	284	186	162
	10000 Pa·s	686	525	300	198	171
time to reach viscosity at 40°C, min	1 Pa·s	105	86	45	26	21
	10 Pa·s	175	141	79	45	34
	50 Pa·s	225	178	101	59	39
	100 Pa·s	243	193	110	66	57
	500 Pa·s	288	228	130	80	69
	1000 Pa·s	307	242	139	87	75
	5000 Pa·s	351	276	158	102	87
	10000 Pa·s	372	292	166	108	93

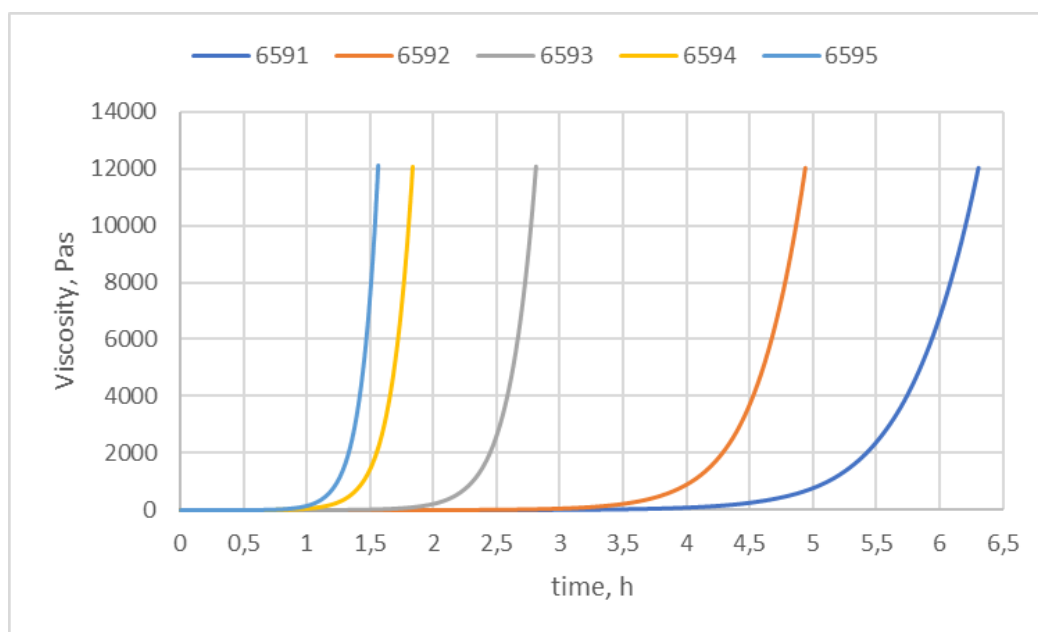


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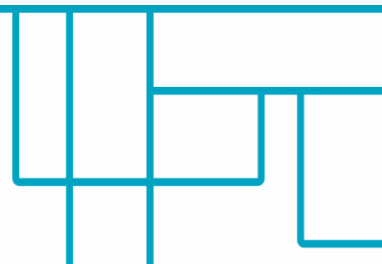
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Viscosity changes vs time at 30°C for 1 mm layer



Viscosity changes vs time at 40°C for 1 mm layer



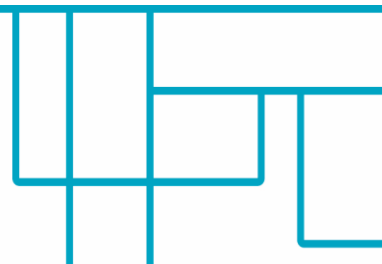
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STRENGTH PARAMETERS

The presented results are for a random batch of resin cured at:24 hours at room temperature (about 21°C) and 8 h at 80°C

Parameter \ Hardener	6591	6592	6593	6594	6595
Flexural strength , [MPa] PN-EN ISO 178:2019	115	123	132	112	111
Flexural modulus , [MPa] PN-EN ISO 178:2019	2910	2910	2950	2810	2780
Deflection , [mm] PN-EN ISO 178:2019	8.8	9.8	11.0	9.2	9.2
Tensile strength , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	68.3	75.2	81.4	70.6	68.2
Tensile modulus , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	2650	2910	3070	2800	2750
Young modulus , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	2790	2990	3060	2850	2880
Elongation at break , [%] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	5.0	6.3	6.6	6.7	6.4
Compression strength , [MPa] PN-EN ISO 604:2006	92.3	97.9	106.0	88.2	83.8
Charpy impact , [kJ/m ²] PN-EN ISO 179-1:2010	58	76	83	65	112
Deflection temperature HDT , [°C] PN-EN ISO 75-1: 2020, PN-EN ISO 75-2: 2013	68.2	82.3	95.3	67.4	67.1
Hardness by the ball indentation method , [MPa] PN-EN ISO 2039-1:2002	163	154	156	156	152
Barcol Hardness , [B] ASTM D2583-95:2007	28	32	34	24	21
Shore Hardness , [°Sh] PN-EN ISO 868:2005P	78.1	78.3	79.1	78.9	79.6
DSC glass transition, mid , 1 st run, [°C] 10K/min,20-200°C	69.5	88.0	95.6	69.7	
2 nd run, [°C]	75.4	90.1	97.2	71.6	
DMA glass transition, tgσ , 1 st run, [°C] 3K/min,40-180°C	90.5	104.0	111.6	87.6	
2 nd run, [°C]	94.5	107.4	114.5	91.2	
Rheometer/DMA glass transition, tgσ , 1 st run, [°C] 3K/min,40-180°C	86.2	96.3	104.6		88.7
2 nd run, [°C]	88.3	99.5	107.8		88,8



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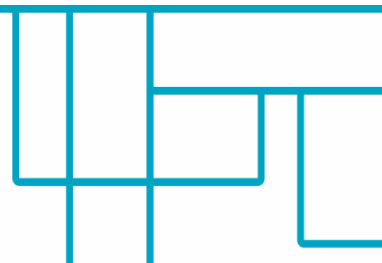
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STRENGTH PARAMETERS

The presented results are for a random batch of resin cured with curing agent 6591 with different curing programs

Parameter \ Hardener	7 days RT	24h/RT/ 24h/40°C	24h/RT/ 16h/60°C	24h/RT/ 8h/80°C
Flexural strength , [MPa] PN-EN ISO 178:2019	115	108	123	115
Flexural modulus , [MPa] PN-EN ISO 178:2019	3130	2920	3070	2910
Deflection , [mm] PN-EN ISO 178:2019	7.6	8.0	9.0	8.8
Tensile strength , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	69.2	65.1	73.6	68.3
Tensile modulus , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	3390	3000	3000	2650
Young modulus , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	3420	3060	3150	2790
Elongation at break , [%] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	4.2	5.8	5.6	5.0
Compression strength , [MPa] PN-EN ISO 604:2006	101.0	93.7	96.7	92.3
Charpy impact , [kJ/m ²] PN-EN ISO 179-1:2010	45	65	73	58
Deflection temperature HDT , [°C] PN-EN ISO 75-1: 2020, PN-EN ISO 75-2: 2013	47.3	53.5	66.9	68.2
Hardness by the ball indentation method , [MPa] PN-EN ISO 2039-1:2002	165	151	162	163
Barcol Hardness , [B] ASTM D2583-95:2007	24	26	27	28
Shore Hardness , [°Sh] PN-EN ISO 868:2005P	80.3	77.4	78.9	78.1
DSC glass transition, mid , 1 st run, [°C] 10K/min, 20-200°C	52.1		69.3	69.5
2 nd run, [°C]	75.1		74.8	75.4
DMA glass transition, tgσ , 1 st run, [°C] 3K/min, 40-180°C	68.2		87.9	90.5
2 nd run, [°C]	95.2		95.3	94.5



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STRENGTH PARAMETERS

The presented results are for a random batch of resin cured with curing agent 6592 with different curing programs

Parameter \ Hardener	7 days RT	24h/RT/ 24h/40°C	24h/RT/ 16h/60°C	24h/RT/ 8h/80°C
Flexural strength , [MPa] PN-EN ISO 178:2019	119	124	128	123
Flexural modulus , [MPa] PN-EN ISO 178:2019	3250	3150	3050	2910
Deflection , [mm] PN-EN ISO 178:2019	7.5	8.6	9.5	9.8
Tensile strength , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	74.7	77.1	79.8	75.2
Tensile modulus , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	3230	3200	3150	2910
Young modulus , [MPa] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	3250	3200	3150	2990
Elongation at break , [%] PN-EN ISO 527-1:2019, PN-EN ISO 527-2:2012	3.4	5.1	5.3	6.3
Compression strength , [MPa] PN-EN ISO 604:2006	105	103.0	102.0	97.9
Charpy impact , [kJ/m ²] PN-EN ISO 179-1:2010	31	76	94	76
Deflection temperature HDT , [°C] PN-EN ISO 75-1: 2020, PN-EN ISO 75-2: 2013	54.0	60.3	77.7	82.3
Hardness by the ball indentation method , [MPa] PN-EN ISO 2039-1:2002	160	153	153	154
Barcol Hardness , [B] ASTM D2583-95:2007	28	26	31	32
Shore Hardness , [°Sh] PN-EN ISO 868:2005P	78.5	77.2	78.1	78.3
DSC glass transition, mid , 1 st run, [°C] 10K/min,20-200°C	58.7	64.6	76.5	88.0
2 nd run, [°C]	89.9	88.3	88.6	90.1
DMA glass transition, tgσ , 1 st run, [°C] 3K/min,40-180°C	72.5	80.7	94.2	104.0
2 nd run, [°C]	107.8	107.8	106.3	107.4

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