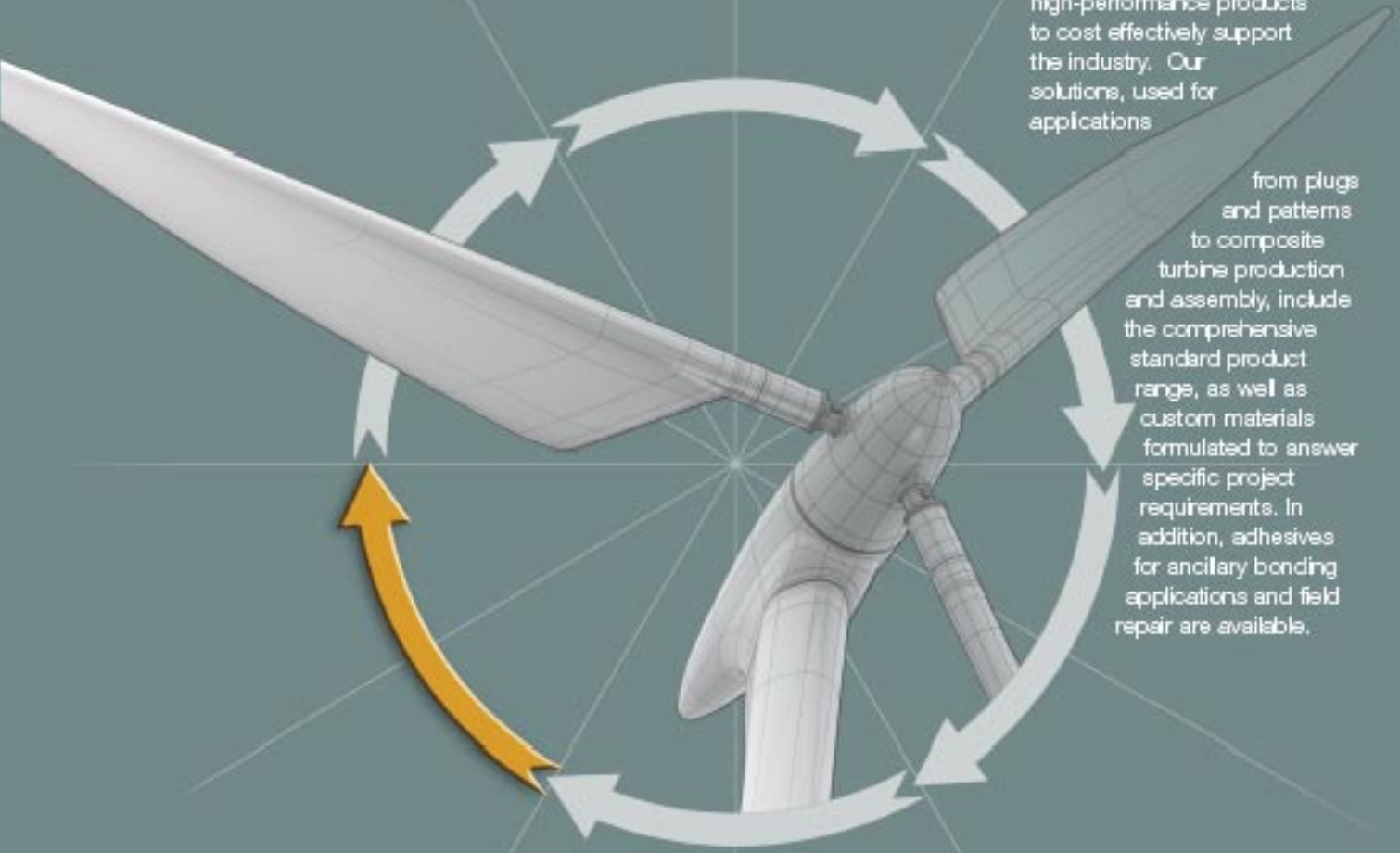
WIND TURBINE INDUSTRY
Advanced Materials
SELECTOR GUIDE

Wind turbines are becoming larger and increasingly sophisticated, to operate under highly demanding conditions in locations offshore and in cold/warm climates.

As a global leader and innovator in working with wind energy equipment manufacturers, Huntsman Advanced Materials has the technologies and high-performance products to cost effectively support the industry. Our solutions, used for applications from plugs and patterns to composite turbine production and assembly, include the comprehensive standard product range, as well as custom materials formulated to answer specific project requirements. In addition, adhesives for ancillary bonding applications and field repair are available.



HUNTSMAN

Tooling materials for blade

Master model / Plug

Product	Colour	Mix Ratio (pbw)	Minimum Cure Schedule	Density (g/cm^3)	Hardness Shore D ISO 868	Coef. of Thermal Exp. ISO 11359 (10^{-6} K^{-1})	Deflection Temp. ISO 75 (°C)	Compres. Strength ISO 604 (MPa)	Flex. Strength ISO 178 (MPa)
Seamless modeling paste									
RenPaste® 4503-1 / Ren® HV 4503-1	Brown	100:100	Machinable after 1 day (RT* curing)	0.75-0.8	55-60	101 (3 days @ RT*)	42 (3 days @ RT*)	11.5 (3 days @ RT*)	11 (3 days @ RT*)
XD 4618-1 R/H	Light Grey	100:50	Machinable after 2 days (RT* curing)	0.95-1.0	65-75	45-50 (7 days @ RT*)	47 (7 days @ RT*)	51 (7 days @ RT*)	29 (7 days @ RT*)

* Room Temperature = 25 °C

Mould production with RTM and wet lay-up processes • Heat resistant up to 120°C

Product	Colour	Mix Ratio (pbw)	Pot Life 250 ml at 25°C (min)	Density (g/cm^3)	Hardness Shore D ISO 868	Deflection Temp. ISO 75 (°C)
Surface coat						
XD 4615 / Ren® HY 5159	Black	100:15	25-30	1.3	80-90	120
XD 4623 / Ren® HY 5159	Pastel green	100:16.5	30	1.2	80-90	120

Product	Colour	Mix Ratio (pbw)	Pot Life 250 ml at 25°C (min)	Demoulding Time (hr)	Density (g/cm^3)	Hardness Shore D ISO 868	Deflection Temp. ISO 75 (°C)
Coupling layer							
Coupling Coat P99 / Ren® HY 5159	Grey	100:11	30	12	1.5	90	120

Product	Colour	Mix Ratio (pbw)	Pot Life 500 ml at 25°C (min)	Demoulding Time (hr)	Density (g/cm^3)	Deflection Temperature ISO 75 (°C)
Back construction						
RenLam® LY 113 / Ren® HY 97-1	Pale yellow	100:30	80	24	0.95	121
RenLam® LY 113 / Ren® HY 98	Clear to pale yellow	100:30	190	24	0.95	120

Mould production with prepreg process • Heat resistant up to 180°C

Product	Colour	Mix Ratio (pbw)	Pot Life at 25°C (hr)	Demoulding Time (hr)	Density (g/cm^3)	Hardness Shore D ISO 868	Tg** (°C)
Surface coat							
RenGel® SW 5200 / Ren® HY 5212	Black	100:20	10 (500 ml)	_	1.5	90	200
RenGel® SW 5200 / Ren® HY 5213	Black	100:16	4.5 (250 ml)	7 days @ RT* or 14 @ 40°C	1.6	90	185

* Room Temperature = 25 °C • ** IEC 1006, DSC, 10 K/min

Product	Colour	Mix Ratio (pbw)	Viscosity at 25°C (mPas)	Pot Life 500 ml at 25°C (hr)	Demoulding Time (hr)	Density (g/cm^3)	Tg** (°C)
Back construction							
RenLam® LY 5210 / Ren® HY 5212	Amber	100:40	2 000	12	-	1.1	238
RenLam® LY 5210 / Ren® HY 5213	Amber	100:32	1 800	3.0-3.5	3-4 days @ RT* or 14 @ 40°C	1.1	180

* Room Temperature = 25 °C • ** IEC 1006, DSC, 10 K/min

Resin systems for blade parts production

With wet lay-up process

Product	Pot Life 100 gr at 23°C (min)	Gel Time at 80°C (min)	Mix Viscosity at 25°C (mPas)	Recommended Cure Schedule (°C)	Flexural Strength ISO 178 (MPa)	Ultimate Flexural Elongation (%)
Araldite® LY 3505 / Hardener XB 3403	600-720	36-48	300-400	4 hr @ 60 + 6 hr @ 80	110-130	10.5-13.0
Araldite® LY 3505 / Hardener XB 3404-1	80-100	11-18	550-800	4 hr @ 60 + 6 hr @ 80	125-145	6.5-9.5
Araldite® LY 3505 / Aradur® 3405	26-36	5-11	1000-1200	4 hr @ 60 + 6 hr @ 80	135-155	7.0-9.0
Araldite® LY 1556 SP / Hardener XB 3461	320-360	30-34	800-1100	4 hr @ 60 + 6 hr @ 80	95-110	8.5-10.5
Araldite® LY 1556 SP / Aradur® 3405	40-50	6-9	1500-1800	4 hr @ 60 + 6 hr @ 80	110-125	9.0-11.0
Resin XB 3585 / Hardener XB 3403	700-950	40-55	300-500	8 hr @ 80	118-132	10.5-12.5
Resin XB 3585 / Hardener XB 3404-1	100-130	10-20	550-800	8 hr @ 80	128-135	8.0-9.5
Resin XB 3585 / Aradur® 3405	30-50	4-11	1000-1400	8 hr @ 80	140-155	9.0-10.5

Epoxy resin systems with low sensitisation potential, long pot life and fast curing at elevated temperatures • Tg level : 80-90°C

With infusion process

Product	Pot Life 100 gr at 23°C (min)	Gel Time at 80°C (min)	Mix Viscosity at 25°C (mPas)	Recommended Cure Schedule (°C)	Flexural Strength ISO 178 (MPa)	Ultimate Flexural Elongation (%)
Araldite® LY 1564 / Hardener XB 3485	970-1050	40-55	200-320	-	120-135	9.0-10.0
Araldite® LY 1564 / Aradur® 3486*	560-620	33-43	200-300	8 hr @ 80	118-130	10.5-12.5
Araldite® LY 1564 / Hardener XB 3416	290-340	20-27	200-320	8 hr @ 80	118-130	10.0-12.0
Araldite® LY 1564 / Aradur® 3487*	130-160	18-25	220-320	8 hr @ 80	118-130	10.0-12.0

Low viscosity systems for fast infusion and reduced production cycles • Tg level : 80-90°C • * GL approved

With prepreg process

Product	Description	Mix Ratio (pbw)	B-Staging	Shelf Life at 23°C (°C)	Recommended Cure Schedule (°C)	Tg ** (°C)
Araldite® LY 556 / Aradur® 5021 / Hardener XB 3403	Easy B-staging	100:25:12	Chemical B-Stage 24 hr @ RT*	> 6 weeks	90 min @ 120	115-125
Araldite® LY 556 / Aradur® 5021 / Hardener XB 3471	Sharp B-staging	100:25:14	Chemical B-Stage 3 min @ 80-90°C	> 3 weeks	90 min @ 120	115-125
Resin XU 3508 / Aradur® 5021 / Hardener XB 3403	Toughened prepreg with easy B-staging	100:22:12	Chemical B-Stage 24 hr @ RT*	> 6 weeks	90 min @ 120	110-120
Resin XU 3508 / Aradur® 5021 / Hardener XB 3471	Toughened prepreg with sharp B-staging	100:22:14	Chemical B-Stage 3 min @ 80-90°C	> 3 weeks	90 min @ 120	110-120

Easy B-staging, 85 to 120°C curing, toughened version for high impact performance • Tg level : 100-120°C • * Room Temperature = 25°C • ** IEC 1006, DSC, 10 K/min

Adhesives for structural bonding

Blade assembly • Bonding of main load bearing structures (composite/composite)

Product	Description	Mix Ratio (pbv)	Max. Assembly Time at 20 °C (min)	Recommended Cure Schedule (°C)	Double Lap Shear Strength* (N/mm²)	Typical Cured Tg*** (°C)
Arathane® 4527 PO / Arathane® 3304 IS	PU system	100:45	70	4 hr @ 60	Laminate Failure 13	47
Resin XD 4734 / Hardener XD 4735	EP system GL Approved	100:40-42	120	4 hr @ 70	Laminate Failure 13	70
Resin XD 4734 / Hardener XD 4741-1	EP system GL Approved	100:40	20	4 hr @ 70**	Laminate Failure 11	70
Resin XD 4734 / Hardener XD 4741 S	EP system GL Approved	100:40	30	4 hr @ 70**	Laminate Failure 12	70

* On typical epoxy composite • ** Cured in standard blade cycle after initial fixing of shear webs at 25 °C • *** IEC 1006, DSC, 10 K/min

Assembly of load bearing • Bonding of ancillary structures

Product	Description	Typical Substrates	Mix Ratio	Pot Life 100 gr at 25°C (min)	Recommended Cure Schedule (°C)	Lap Shear Strength (N/mm²)	Typical Cured. Tg* (°C)	Gap Filling (mm)
Arathane® 4497 / Arathane® 3304 IS	Fast curing PU system for workshop finishing operations	Composite / Composite	100:40 pbw 100:45 pbv	8-10	Ambient for 3 hr	20	45-50	15
Araldite® 2027	Rapid curing filler for small voids	Thermoplastic	100:97 pbw 100:100 pbv	10	Ambient or 1 hr @ 60	14	35	3
Araldite® 2014	Bonding tip control shaft components	Metal / Composite	100:50 pbw 100:50 pbv	40	Ambient or 4 hr @ 60	18	85	5
Araldite® AV 138 / Hardener HV 998	Tip control shaft and vibration damper bonding	Metal / Composite	100:40 pbw 100:40 pbv	35	Ambient or 4 hr @ 60	15	85	5
Araldite® 2015	Bonding of lightning conductor / monitor censors	Metal / Composite	100:100 pbw 100:100 pbv	30-40	Ambient or 4 hr @ 60	17	65	10
Resin XB 5047 / Hardener XB 5067	Liquid system for vertical bolt & alu end ring bonding	Metal / Composite	100:30 pbw 100:45 pbv	70	2 hr @ 80	22	85	< 0.5
Araldite® AV 4076-1/ Hardener HV 5309-1	Steel insert bonding	Metal / Composite	100:116 pbw 100:100 pbv	60	Ambient or 4 hr @ 60	24	78	10
Araldite® 2021	Rapid repair and filling of small voids	Metal / Composite / Plastic	100:90 pbw 100:100 pbv	2-3	Ambient for 1hr	22	60	3
Araldite® 2022	Field/workshop repair operations	Metal / Composite / Plastic	100:94 pbw 100:100 pbv	8-10	Ambient for 1-2 hr	25	50	3
Agomet® F347 with Hardener D	Rapid attachment of SS parts	Metal / Plastic / Composite	100:10 pbw 100:10 pbv	9	Ambient for 1 hr	14	No clear transition	3
Resin XD 4510 / Hardener XD 4511	High temperature applications	Composite / Composite / Metal	100:50 pbw 100:50 pbv	75-90	2 hr @ 110	17	125-130	10

* IEC 1006, DSC, 10 K/min

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RESINES AND COMPOSITE MATERIALS