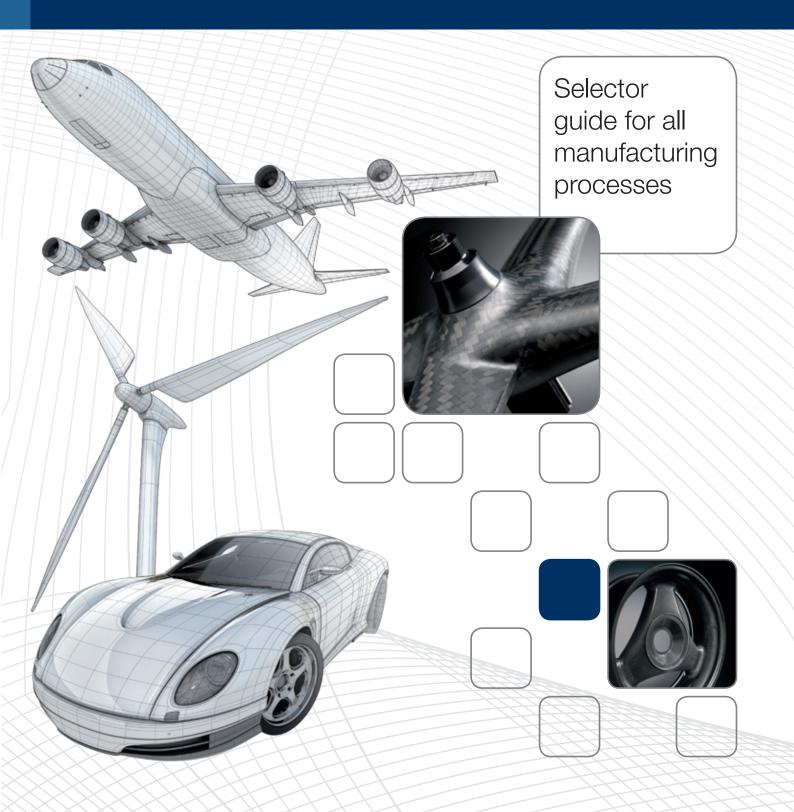


## **Advanced Materials**

## Composite resin systems







### A global partner

As a global partner and innovator working in close collaboration with all major industries using fiber reinforcement: we offer our customers a unique range of innovative high value thermosetting formulated systems combined with a strong technical support. This comprehensive range is used throughout the world's manufacturing industries but particularly in the automotive, aerospace, marine, wind energy, sport and leisure and consumer electronics.

#### We deliver more than just products

Our process know-how and over 60 years expertise help us to develop standard products as well as custom-made solutions formulated to answer project requirements.

Huntsman Advanced Materials has a worldwide team of experts

- > To identify with you the best system meeting your needs
- > To develop when needed new material solutions
- > To reduce manufacturing and production costs through process time reduction based on shorter cure cycles
- > To help you to improve the quality, the durability and the performance of your products such as lightness but also mechanical, temperature, fire, chemical or corrosion resistance and more
- > To quickly bring your product to market through material and process optimization.

## **Araldite**

The original brand serving worldwide composite industry for more than half a century.

















## Proven solutions for all major industries

Huntsman leverages its core strengths in synthesis and formulation to produce high performance materials that deliver improved mechanical and thermal performance in the area of composites.

Our application engineers can support you with advice and practical recommendations on how to optimize the use of Huntsman's products in your chosen manufacturing process.

- > Wet lay-up
- > RTM
- > High pressure RTM
- > Infusion
- > Filament winding
- > Pultrusion
- > Compression molding
- > Prepreg





## Germanischer Lloyd statement of approval

"Rules for Classification and Construction, II-Material and Welding technology – Part 2 Non-Metallic materials"

Huntsman's GL approved resin systems received approval for the construction of FRP laminate components in wind and marine applications on condition that the selected fibre reinforcement both complies with Germanischer Lloyd's requirements and is compatible with the resin. Huntsman Advanced Materials (Switzerland) **GmbH Material Testing** is accredited by DN International standard ISO/IEC 17025:2005.



# Lloyd's Register certificate of approval

"Rules and Regulation for Classification of Special Service Craft"

Huntsman's resin systems with this logo are certified for the construction of composite components on special service crafts including yachts, pleasure crafts, etc.



## Formulated systems for direct liquid processes

|                   | Product designation  | Wet lay-up       | Compression molding | RTM               | Infusion | Filament<br>winding | Pultrusion | Pot life   | Gel time            | Mix viscosity        |  |
|-------------------|--|------------------|---------------------|-------------------|----------|---------------------|------------|------------|---------------------|----------------------|--|
|                   | Conditions   |                  |                     |                   |          |                     |            | RT, 100ml  | 80°C                | 25°C                 |  |
|                   | Norm   |                  |                     |                   |          |                     |            |            |                     |                      |  |
|                   | Unit   |                  |                     |                   |          |                     |            | min        | min                 | mPa.s                |  |
|                   | Araldite® LY 1564 /<br>Hardener XB 3403                                  | •••              |                     |                   | •••      | ••                  |            | 870 - 1050 | 40 - 50             | 150 - 230            |  |
|                   | Araldite® LY 1564 /<br>Aradur® 3405                                      |                  | •••                 | •••               |          |                     |            | 47 - 57    | 6 - 9               | 420 - 520            |  |
|                   | Araldite® LY 3508 /<br>Hardener XB 3403                                  | •••              |                     | ••                |          |                     |            | 600 - 720  | 30 - 36             | 650 - 800            |  |
| loyd's<br>egister | Araldite® LY 1568 /<br>Aradur® 3489                                      | ••               |                     | ••                | •••      | ••                  | ••         | 850 - 950  | 43 - 46             | 200 - 300            |  |
| NV•GL             | Araldite® LY 1568 /<br>Aradur® 3492                                      | ••               | ••                  | ••                | •••      |                     |            | 300 - 350  | 23 - 25             | 250 - 350            |  |
| NV-GL             | Araldite <sup>®</sup> LY 3505 /<br>Hardener XB 3404-1                    | •••              |                     |                   |          |                     |            | 80 - 100   | 11 - 18             | 550 - 800            |  |
| loyd's<br>egister | Araldite® LY 3505 /<br>Hardener XB 3403                                  | •••              |                     |                   |          |                     |            | 600 - 720  | 36 - 48             | 300 - 400            |  |
| NV-GL             | Araldite <sup>®</sup> LY 3505 /<br>Aradur <sup>®</sup> 3405              | •••              |                     |                   |          |                     |            | 26 - 36    | 5 - 11              | 1 000 - 1 200        |  |
| loyds<br>egister  | Araldite <sup>®</sup> LY 1564 /<br>Aradur <sup>®</sup> 3486              | ••               |                     | ••                | •••      | ••                  | ••         | 560 - 620  | 33 - 43             | 200 - 300            |  |
|                   | Araldite® LY 3598 /<br>Aradur® 3498                                      |                  | •••                 | •••               | •••      |                     |            | 40 - 70    | 7 - 10              | 400 - 900            |  |
|                   | Araldite <sup>®</sup> LY 3297 /<br>Aradur <sup>®</sup> 3298              | •••              | •••                 | •••               | ••       |                     |            | 120 - 135  | 18 - 26             | 850 - 950            |  |
|                   | Araldite® LY 3508 /<br>Aradur® 3486                                      | •••              |                     | •••               | ••       | ••                  | ••         | 380 - 480  | 9 - 14<br>at 100°C  | 720 - 860            |  |
|                   | Araldite <sup>®</sup> LY 3585 /<br>Aradur <sup>®</sup> 3475 <sup>2</sup> | ••               | •••                 | HP <sup>3</sup>   |          |                     | •••        | 25 - 35    | 1 - 2<br>at 115°C   | 900 - 1 100          |  |
|                   | Araldite <sup>®</sup> LY 3031 /<br>Aradur <sup>®</sup> 3032 <sup>2</sup> | ••               | •••                 |                   |          |                     |            | -          | <15 sec<br>at 140°C | 1 700 - 1 900        |  |
|                   | Araldite® LY 1564 /<br>Aradur® 5003-1                                    | ••               | •••                 | •••               |          |                     |            | 42 - 52    | 6 - 8               | 200 - 260<br>at 40°C |  |
|                   | Araldite® LY 1564 /<br>Aradur® 3474                                      | ••               | •••                 | •••               | ••       | •••                 | ••         | 260 - 280  | 25 - 35             | 350 - 450            |  |
|                   | Araldite <sup>®</sup> LY 5052 /<br>Aradur <sup>®</sup> 5052              | •••              | ••                  | ••                | ••       |                     |            | 110 - 160  | 14 - 17             | 500 - 700            |  |
|                   | Araldite® LY 3585 /<br>Aradur® 5003-1                                    | •••              | ••                  | ••                |          |                     |            | 40 - 48    | 6 - 8               | 440 - 500<br>at 40°C |  |
|                   | RenLam® LY 113 /<br>Ren® HY 98   | •••              | •••                 | •••               | •••      |                     |            | 90 - 100   | 18 - 20             | 300 - 320            |  |
|                   | Continued on next page  Adjustable reactivity with DY 07                 | O and Accelerate | 060 1 rotic         | ••• Highly recomm | and ad   |                     |            |            |                     |                      |  |
|                   |  |                  |                     |                   |          |                     |            |            |                     |                      |  |

<sup>&</sup>lt;sup>1</sup> Adjustable reactivity with DY 070 and Accelerator 960-1 ratio





<sup>&</sup>lt;sup>2</sup> Measured with internal release agent (1-2 phr)

<sup>&</sup>lt;sup>3</sup> High Pressure RTM

<sup>•••</sup> Highly recommended

<sup>••</sup> Recommended

| Applied cure schedule        | Tg                           | Flexural<br>strength  | Ultimate<br>flexural<br>elongation | Fracture<br>properties<br>K <sub>1C</sub> G <sub>1C</sub> | Key features  |
|------------------------------|------------------------------|-----------------------|------------------------------------|---|---|
|                              | DSC, 10 K/min                |                       |                                    |   |   |
|                              | ISO 11357-2                  | ISO 178               |                                    | ISO 13586   |   |
|                              | °C                           | MPa                   | %                                  | MPa√m J/m²  |   |
| 8h at 80°C                   | 68 - 72                      | 104 - 115             | 10.5 - 11.5                        | 1.0 - 1.1<br>360 - 380                                    | Hardener XB 3403 and Aradur® 3405 can be mixed to adjust > reactivity at constant resin/hardener mix ratio.           |
| 8h at 80°C                   | 68 - 72                      | 116 - 130             | 9.0 - 10.0                         | 1.1 - 1.3<br>460 - 480                                    | High toughness.   |
| 4h at 60°C + 6h at 80°C      | 70 - 75                      | 100 - 125             | 9.0 - 11.0                         | 2.1 - 2.3<br>1 250 - 1 400                                | Latent, very high toughness.  |
| 8h at 80°C                   | 78 - 80                      | 120 - 130             | 9.0 - 10.0                         | 0.7 - 0.8<br>170 - 210                                    | Aradur® 3489 and Aradur® 3492 can be mixed to adjust reactivity at constant resin/hardener mix ratio.                 |
| 8h at 80°C                   | 80 - 85                      | 125 - 135             | 7.0 - 7.5                          | 0.7 - 0.8<br>210 - 230                                    | Aradur <sup>®</sup> 3489 based system provides low exothermic behavior.   |
| 4h at 60°C + 6h at 80°C      | 76 - 81                      | 125 - 145             | 6.5 - 9.5                          | 0.8 - 1.0<br>160 - 200                                    |   |
| 4h at 60°C + 6h at 80°C      | 78 - 83                      | 110 - 130             | 10.5 - 13.0                        | 0.9 - 1.1<br>250 - 280                                    | Hardener XB 3404-1, XB 3403 and Aradur® 3405  can be mixed to adjust reactivity at constant resin/hardener mix ratio. |
| 4h at 60°C + 6h at 80°C      | 87 - 92                      | 135 - 155             | 7.0 - 9.0                          | 0.8 - 0.9<br>150 - 190                                    |   |
| 8h at 80°C                   | 80 - 84                      | 118 - 130             | 10.5 - 12.5                        | 0.9 - 1.1<br>260 - 310                                    | Latent, low viscosity.  |
| 30 min at 100°C              | 87 - 93                      | 100 - 110             | 7.0 - 8.5                          | 1.7 - 1.9<br>900 - 1 100                                  | Laminating system containing nano-technology, offering outstanding toughness.   |
| 8h at 80°C                   | 92 - 98                      | 125 - 130             | 7.0 - 8.0                          | 0.8 - 1.0<br>215 - 245                                    | Good mechanical properties after 23°C curing.   |
| 5h at 100°C                  | 95 - 102                     | 110 - 125             | 10.0 - 12.5                        | 2.2 - 2.4<br>1 500 - 1 700                                | Very high toughness.  |
| 2 min at 115°C               | 105 - 115<br>CFRP DMA Tg     | 75 - 80<br>in tensile | 8.0 - 10.0<br>in tensile           | 0.8 - 0.9<br>220 - 300                                    | Latent, fast cure system for composite mass production.   |
| 30 sec at 140°C              | 95 - 105<br>CFRP DMA Tg      | 70 - 80<br>in tensile | 5.0 - 7.0<br>in tensile            | 0.9 - 1.1<br>320 - 380                                    | Very fast cure system for compression molding mass production.  |
| 30 min at 80°C + 2h at 120°C | 108 - 115                    | 108 - 118             | 7.0 - 9.0                          | 0.9 - 1.0<br>230 - 290                                    | Very fast.  |
| 1h at 80°C + 4h at 120°C     | 115 - 120                    | 120 - 130             | 8.0 - 9.0                          | 0.7 - 0.9<br>200 - 240                                    | Excellent flexibility and high reactivity.  |
| 8h at 80°C                   | 114 - 122<br>(max 120 - 134) | 116 - 122             | 8.5 - 13.5                         | 0.7 - 0.9<br>192 - 212                                    | Very good mechanical properties after 23°C curing.<br>Aerospace qualified.  |
| 30 min at 80°C + 2h at 120°C | 120 - 130                    | 115 - 125             | 6.0 - 9.0                          | 0.8 - 0.9<br>180 - 230                                    | Medium Tg, very fast.   |
| 24h at 23°C + 4h at 120°C    | 120 - 125                    | 127 - 130             | 7.0 - 8.0                          | 0.8 - 0.9<br>220 - 250                                    | Suitable for tooling application: free stand post-cure after 23°C pre-cure conditions.                                |
|                              |                              |                       |                                    |   |   |

### Continued

| Product designation  | Wet lay-up         | Compression molding | RTM               | Infusion | Filament<br>winding | Pultrusion | Pot life  | Gel time            | Mix viscosity   |
|--|--------------------|---------------------|-------------------|----------|---------------------|------------|-----------|---------------------|-----------------|
| Conditions   |                    |                     |                   |          |                     |            | RT, 100ml | 80°C                | 25°C            |
| Norm   |                    |                     |                   |          |                     |            |           |                     |                 |
| Unit   |                    |                     |                   |          |                     |            | min       | min                 | mPa.s           |
| Araldite® LY 1564 /<br>Aradur® 917-1 /<br>Accelerator 960-1 1            |                    |                     |                   | ••       | •••                 | •••        | 80 - 90h  | 30 - 40             | 450 - 700       |
| Resin XB 6469 /<br>Aradur® 2954  | ••                 | •••                 | •••               | •••      | ••                  | ••         | 740 - 810 | 38 - 42             | 220 - 240       |
| Resin XB 3518 /<br>Aradur® 22962   | ••                 | •••                 | •••               | ••       |                     |            | 210 - 290 | 15 - 20             | 400 - 500       |
| Araldite® LY 1564 /<br>Aradur® 22962                                     | ••                 | •••                 | •••               | •••      |                     |            | 110 - 150 | 20 - 30             | 400 - 600       |
| Araldite® LY 1135-1 /<br>Aradur® 917-1 /<br>Accelerator 960-1 1          |                    |                     |                   | ••       | •••                 | •••        | 56 - 62   | 15 - 21<br>at 100°C | 600 - 1 000     |
| Araldite® LY 1135-1A /<br>Aradur® 1135-1B                                |                    | EES <sup>3</sup>    |                   |          |                     |            | -         | 1 - 2<br>at 110°C   | 3 200           |
| Araldite® LY 556 /<br>Ren® HY 5212                                       |                    | ••                  | ••                |          | ••                  | •••        | 260 - 280 | 110 - 120           | 11 500 - 12 500 |
| Araldite® LY 1564 /<br>Aradur® 2954                                      | ••                 |                     | •••               | ••       | ••                  | ••         | 480 - 600 | 35 - 45             | 500 - 700       |
| Araldite <sup>®</sup> LY 3508 /<br>Aradur <sup>®</sup> 22962             | ••                 |                     | •••               |          |                     |            | 90 - 150  | 24 - 40             | 1 800 - 2 100   |
| Araldite® LY 1564 /<br>Ren® HY 5211                                      | •••                | ••                  | ••                | •••      | ••                  | ••         | 27 - 31h  | 200 - 220           | 1 350 - 1 550   |
| Araldite® LY 556 /<br>Aradur® 917-1 /<br>Accelerator DY 070 <sup>1</sup> |                    |                     |                   | ••       | •••                 | •••        | 95 - 105h | 140 - 160           | 600 - 900       |
| Araldite® LY 556 /<br>Aradur® 22962                                      | •••                | ••                  | ••                |          |                     |            | 120 - 180 | 18 - 22             | 1 800 - 2 000   |
| RenLam® LY 120 /<br>Ren® HY 99   | •••                |                     | •••               | •••      |                     |            | 210 - 230 | 20 - 25             | 300 - 350       |
| Araldite® LY 3508 /<br>Aradur® 2954                                      | ••                 |                     | •••               | ••       |                     |            | 320 - 380 | 9 - 14<br>at 100°C  | 2 600 - 3 300   |
| Araldite® LY 1564 /<br>Hardener XB 3473                                  | •••                | ••                  | ••                | •••      | •••                 | ••         | 84 - 88h  | 410 - 430           | 1 000 - 1 200   |
| Araldite® LY 556 /<br>Aradur® HY 906 /<br>Accelerator DY 070 1           |                    |                     |                   | ••       | •••                 | •••        | 50 - 55h  | 200 - 280           | 1 900 - 2 100   |
| Araldite® LY 556 /<br>Hardener XB 3473                                   |                    |                     | ••                | ••       | ••                  | ••         | 32 - 37h  | > 600               | 5 200 - 6 000   |
| Resin XB 3292 /<br>Hardener XB 3473                                      | ••                 | ••                  | •••               |          | ••                  |            | 78 - 86h  | 360 - 420           | 1 600 - 2 000   |
| Araldite® CY 179 /<br>Aradur® 917-1 /<br>Accelerator DY 070 <sup>1</sup> |                    |                     |                   | ••       | ••                  | ••         | > 48h     | 60 - 80             | 100 - 200       |
| Araldite® LY 8615 /<br>Hardener XB 5173                                  |                    | ••                  | •••               | •••      |                     |            | 300 - 400 | 24 - 28             | 270 - 370       |
| Continued on next page   | 70 and Accelerator |                     | ••• Highly recomm |          |                     |            |           |                     |                 |

<sup>&</sup>lt;sup>1</sup> Adjustable reactivity with DY 070 and Accelerator 960-1 ratio

<sup>•••</sup> Highly recommended

<sup>&</sup>lt;sup>2</sup> Measured with internal release agent (1-2 phr)

<sup>••</sup> Recommended

<sup>&</sup>lt;sup>3</sup> Expandable Epoxy System

| Applied cure schedule                                    | Тд            | Flexural<br>strength | Ultimate<br>flexural<br>elongation | Fracture<br>properties<br>K <sub>10</sub> G <sub>10</sub> | Key features  |
|--|---------------|----------------------|------------------------------------|---|---|
|  | DSC, 10 K/min |                      |                                    |   |   |
|  | ISO 11357-2   | ISO 178              |                                    | ISO 13586   |   |
|  | °C            | MPa                  | %                                  | MPa√m J/m²  |   |
| 4h at 80°C + 4h at 120°C                                 | 122 - 130     | 140 - 150            | 6.0 - 7.0                          | 0.6 - 0.7<br>100 - 125                                    | Low temperature cure anhydride curing system.   |
| 90 min at 80°C + 1h at 150°C                             | 125 - 135     | 100 - 110            | 6.5 - 7.5                          | 0.95 - 1.0<br>350 - 390                                   | Low viscosity, long pot life. Alternative to anhydride for filament winding and pultrusion when hot/wet performance is key. |
| 1h at 100°C + 2h at 140°C                                | 128 - 138     | 120 - 135            | 8.5 - 10.0                         | 0.6 - 0.8<br>160 - 180                                    | Medium Tg, high elongation at break.  |
| 15 min at 120°C + 2h at 150°C                            | 130 - 140     | 124 - 132            | 9.0 - 11.0                         | 0.8 - 1.0<br>200 - 260                                    | Medium Tg, high elongation at break.  |
| 4h at 80° + 4-8h at 140°C                                | 132 - 138     | 150 - 162            | 6.5 - 8.0                          | 0.57 - 0.65<br>90 - 115                                   | Medium Tg, very latent anhydride curing system.   |
| 2 - 3 min at 150°C - 160°C                               | 135 - 145     | -                    | -                                  | -   | Expandable EP system. High Tg, low density.   |
| 2h at 80°C + 2h at 120°C<br>+ 4h at 150°C                | 140 - 150     | 130 - 140            | 6.0 - 7.0                          | 0.6 - 0.65<br>140 - 150                                   | Good chemical resistance.<br>Ren® HY 5212: faster version of Ren® HY 5211.  |
| 1h at 80°C + 8h at 140°C                                 | 143 - 148     | 120 - 124            | 6.5 - 7.5                          | 0.7 - 0.8<br>150 - 180                                    | Medium Tg, alternative to anhydride for filament winding and pultrusion when hot/wet performance is key.                    |
| 1h at 80°C + 2h at 150°C                                 | 144 - 154     | 120 - 135            | 8.0 - 10.0                         | 0.9 - 1.2<br>340 - 380                                    | Medium Tg, toughened.   |
| 30 min at 130°C + 12h at 160°C                           | 145 - 155     | 120 - 130            | 7.0 - 8.0                          | 0.6 - 0.7<br>120 - 130                                    | Good chemical resistance.<br>Ren® HY 5211: faster version of XB 3473.   |
| 4h at 80°C + 8h at 140°C                                 | 148 - 153     | 125 - 135            | 6.0 - 8.5                          | 0.5 - 0.6<br>85 - 95                                      | Medium Tg, very latent anhydride curing system.   |
| 15 min at 120°C + 2h at 150°C                            | 148 - 158     | 130 - 136            | 7.5 - 10.0                         | 0.7 - 0.8<br>140 - 175                                    | Good balance between Tg and elongation at break.  |
| 8h at 40°C + 8h at 150°C                                 | 150 - 155     | 120 - 126            | 6.5 - 7.5                          | 0.6 -0.7<br>170 - 185                                     | Suitable for tooling application: free stand post-cure after 40°C pre-cure conditions.                                      |
| 1h at 80°C + 8h at 160°C                                 | 150 - 158     | 125 - 135            | 7.0 - 8.0                          | 0.8 - 1.0<br>250 - 290                                    | High Tg, toughened.   |
| 30 min at 130°C + 12h at 160°C                           | 165 - 175     | 100 - 110            | 5.5 - 6.5                          | 0.7 - 0.8<br>170 - 190                                    | Good chemical resistance.   |
| 2h at 120°C + 8h at 160°C                                | 165 - 175     | 100 - 140            | 4.0 - 7.0                          | 0.6 - 0.8<br>100 - 125                                    | High Tg, very latent anhydride curing system.   |
| 2h at 120°C + 4h at 180°C                                | 185 - 194     | 110 - 120            | 5.5 - 6.5                          | 0.7 - 0.9<br>190 - 220                                    | High chemical resistance.   |
| 2h at 100°C + 1h at 140°C<br>+ 1h at 180°C + 2h at 200°C | 195 - 203     | 98 - 108             | 4.0 - 4.5                          | 0.5 - 0.6<br>70 - 75                                      | Very high Tg, high chemical resistance.   |
| 1h at 100°C + 6h at 180°C                                | 200 - 205     | 75 - 95              | 2.0 - 3.5                          | 0.4 - 0.5<br>65 - 75                                      | Very high Tg, very latent anhydride curing system.  |
| 90 min at 80°C + 1h at 150°C<br>+ 1h at 180°C            | 200 - 207     | 113 - 117            | 4.0 - 5.0                          | 0.5 - 0.7<br>130 - 165                                    | Suitable for tooling application: free stand post-cure after 40°C pre-cure conditions.                                      |

| Continued   |            |                     |     |          |                     |            |            |                      |                 |
|---|------------|---------------------|-----|----------|---------------------|------------|------------|----------------------|-----------------|
| Product designation   | Wet lay-up | Compression molding | RTM | Infusion | Filament<br>winding | Pultrusion | Pot life   | Gel time             | Mix viscosity   |
| Conditions  |            |                     |     |          |                     |            | RT, 100ml  | 80°C                 | 25°C            |
| Norm  |            |                     |     |          |                     |            |            |                      |                 |
| Unit  |            |                     |     |          |                     |            | min        | min                  | mPa.s           |
| Araldite® LY 8615 /<br>Aradur® 8615   | ••         | ••                  | ••  | •••      | ••                  | ••         | 14 - 16h   | 34 - 38              | 480 - 580       |
| Araldite® LY 8615 /<br>Ren® HY 5212   |            |                     | ••  |          | ••                  | •••        | 460 - 480  | 58 - 62              | 2 000 - 2 100   |
| Resin XB 9721 /<br>Aradur <sup>®</sup> 917-1 /<br>Accelerator DY 070 <sup>1</sup> |            |                     |     |          | ••                  | •••        | 110 - 130h | 6 - 9<br>at 120°C    | 550 - 750       |
| Resin XB 9721 /<br>Hardener XB 3473   |            | ••                  | ••  |          | ••                  | ••         | 80 - 95h   | 80 - 100<br>at 120°C | 14 000 - 17 000 |
| Araldite® FST 40002 /<br>FST 40003  |            | ••                  | ••• | •••      |                     | •••        | > 24 h     | see data<br>sheet    | 600 - 800       |
| Araldite® FST 40004 /<br>FST 40005  |            | ••                  | ••• | •••      |                     | •••        | > 24 h     | see data<br>sheet    | 400 - 500       |

<sup>&</sup>lt;sup>1</sup> Adjustable reactivity with DY 070 and Accelerator 960-1 ratio

## Formulated systems for pre-impregnation (Prepregs)

| Product designation | Mix viscosity | B-Staging | Shelf-life | Gel time <sup>1</sup> | Applied cure schedule |  |
|---------------------|---------------|-----------|------------|-----------------------|-----------------------|--|
| Conditions          | 25°C          | 23°C      | 23°C       | 120°C                 |                       |  |
| Norm                |               |           |            |                       |                       |  |
| Unit                | mPa.s         | h         |            | min                   |                       |  |

### Chemical B-stage process

|        | •   | •             |         |           |        |             |  |
|--------|---|---------------|---------|-----------|--------|-------------|--|
| DNV-GL | Araldite® LY 1556 /<br>Aradur® 1571 /<br>Accelerator 1573 /<br>Hardener XB 3403 | 4 000 - 6 000 | 24 - 48 | > 6 weeks | 6 - 11 | 2h at 120°C |  |
|        | Araldite® LY 3508 /<br>Aradur® 1571 /<br>Accelerator 1573 /<br>Hardener XB 3403 | 6 650 - 7 450 | 24 - 48 | > 4 weeks | 4 - 12 | 4h at 120°C |  |

## **Hot-melt process**

| Araldite® LY 3514 /<br>Aradur® 1571 /<br>Accelerator 1573 | 14 000 - 15 000 at 70°C | n.a. | > 5 weeks | 17 - 21 | 30 min at 90°C + 2h at 120°C |  |
|---|-------------------------|------|-----------|---------|------------------------------|--|
| Resin XB 3515 /<br>Aradur® 1571 /<br>Accelerator 1573     | 24 000 - 28 000 at 55°C | n.a. | > 5 weeks | 10 - 13 | 1h at 120°C + 2h at 140°C    |  |

<sup>&</sup>lt;sup>1</sup> Adjustable reactivity with Accelerator 1573 ratio

n.a.: not applicable / n.m.: not measured



<sup>•••</sup> Highly recommended

<sup>&</sup>lt;sup>2</sup> Measured with internal release agent (1-2 phr)

<sup>••</sup> Recommended

| Applied cure schedule                                    | Tg            | Flexural<br>strength   | Ultimate<br>flexural<br>elongation | Fracture<br>properties<br>K <sub>1C</sub> G <sub>1C</sub> | Key features  |
|--|---------------|------------------------|------------------------------------|---|---|
|  | DSC, 10 K/min |                        |                                    |   |   |
|  | ISO 11357-2   | ISO 178                |                                    | ISO 13586   |   |
|  | °C            | MPa                    | %                                  | MPa√m J/m²  |   |
|  |               |                        |                                    |   |   |
| 90 min at 80°C + 1h at 150°C<br>+ 1h at 180°C            | 200 - 210     | 82 - 86                | 2.5 - 4.0                          | 0.6 - 0.8<br>130 - 165                                    | Suitable for tooling application: free stand post-cure after 40°C pre-cure conditions.  |
| 90 min at 80°C + 1h at 150°C                             | 205 - 215     | 135 - 140              | 5.5 - 6.0                          | 0.6 - 0.65<br>125 - 135                                   | Very high Tg, good chemical resistance.<br>Ren® HY 5212: faster version of Ren® HY 5211.  |
| 2h at 120°C + 2h at 160°C<br>+ 2h at 200°C + 4h at 220°C | 205 - 215     | 85 - 100               | 2.5 - 3.0                          | 0.4 - 0.5<br>45 - 60                                      | Very high Tg, very latent anhydride curing system.  |
| 2h at 120°C + 2h at 160°C<br>+ 2h at 200°C + 4h at 220°C | 232 - 238     | 105 - 125              | 3.0 - 4.5                          | 0.6 - 0.7<br>95 - 100                                     | High chemical resistance.   |
| 1h at 100°C + 1h at 120°C<br>+ 2h at 180°C               | 250 - 260     | 90 - 110<br>in tensile | 4.0 - 6.0 in tensile               | 0.85 - 0.95<br>250 - 300                                  | FST (Fire, Smoke & Toxicity) unfilled inherently flame retardant. High mechanical performance. Meets FST according to FAR 25.853. |
| 1h at 100°C + 1h at 120°C<br>+ 2h at 180°C               | 260 - 270     | 40 - 50<br>in tensile  | 1.0 - 2.0<br>in tensile            | 0.55 - 0.65<br>100 - 150                                  | FST (Fire, Smoke & Toxicity) unfilled inherently flame retardant. Meets HL1 / HL2 according to EN 45545-2 R1/R7.                  |

| Тд            | Flexural strength | Ultimate flexural elongation | Fracture properties $K_{1c}$ $G_{1c}$ |
|---------------|-------------------|------------------------------|---------------------------------------|
| DSC, 10 K/min |                   |                              |                                       |
| ISO 11357-2   | ISO 178           |                              | ISO 13586                             |
| °C            | MPa               | %                            | MPa√m J/m²                            |
|               |                   |                              |                                       |
| 105 - 115     | 125 - 140         | 7.0 - 10.0                   | 0.7 - 0.9<br>130 - 250                |
| 115 - 125     | 110 - 120         | 5.5 - 8.0                    | 1.4 - 1.7<br>850 - 1 000              |
|               |                   |                              |                                       |
| 120 - 130     | 135 -150          | 6.0 - 9.0                    | 0.8 - 0.9<br>280 - 320                |
| 140 - 145     | 120 - 140         | 4.5 - 6.5                    | 1.2 - 1.3<br>400 - 440                |

## Preforming epoxy binders for RTM process

| Product designation | Softening point | Tg            | Typical preforming cycle   |
|---------------------|-----------------|---------------|--|
| Conditions          |                 | DSC, 10 K/min |  |
| Norm                | DIN 51920       | ISO 11357-2   |  |
| Unit                | °C              | °C            |  |
|                     |                 |               |  |
| Araldite® LT 3366   | ca. 150         | 75 - 85       | $20 \pm 10$ sec at $180 \pm 20^{\circ}\text{C}$ + cold stamping. |
|                     |                 |               |  |

## Structural adhesives (epoxy)

| Product designation                     | Mixing ratio | Pot life   | Recommended cure schedule     | LSS <sup>1</sup> | Tg        | Gap filling | Key features   |
|---|--------------|------------|-------------------------------|------------------|-----------|-------------|--|
| Conditions                              |              | 23°C, 100g |                               |                  |           |             |  |
| Unit                                    |              | min        |                               | MPa              | °C        | mm          |  |
| Araldite® 2029-1 ²                      | 1:1          | 35 - 45    | RT or at elevated temperature | 24               | 25 - 35   | 5           | High elongation at break, high strength.                               |
| Araldite® 2015                          | 1:1          | 45 - 60    | RT or at elevated temperature | 17               | 60        | 10          | Toughened, GL approved, resistant to weathering.                       |
| Araldite® 2031                          | 1:1          | 50 - 65    | RT or at elevated temperature | 18               | 60        | 10          | Toughened, resistant to weathering.                                    |
| Araldite® AV 4858 /<br>Hardener HW 4858 | 2:1          | 150        | RT or at elevated temperature | 38               | 60        | 10          | High peel strength, high toughness.                                    |
| Araldite® 2014-1                        | 2:1          | 50 - 65    | RT or at elevated temperature | 18               | 75 - 85   | 5           | Resistant to temperature, KIWA approved (contact with drinking water). |
| Araldite® AV 4859 /<br>Hardener HW 4859 | 2:1          | 100        | RT or at elevated temperature | 33               | 50 - 120  | 10          | Resistant to high temperature after post cure, high toughness.         |
| Araldite® AW 4510 /<br>Hardener HV 4511 | 2:1          | 85 - 100   | 2h at 110°C                   | 16               | 120 - 125 | 10          | Resistant to high temperature, resistant to chemicals.                 |

 $<sup>^{\</sup>mbox{\tiny 1}}$  On epoxy composites - LSS = Lap Shear Strength

Note: All adhesives are available in different pack sizes including cartridges for easy use in the field  ${\sf Note}$ 

<sup>&</sup>lt;sup>2</sup> Polyurethane chemistry

## Shell bonding adhesive, gap filling

| Product designation                     | Pot life   | Typical cure schedule | LSS <sup>1</sup>                       | Tg      | Gap filling | Key features   |
|---|------------|-----------------------|--|---------|-------------|--|
| Conditions                              | 23°C, 500g |                       |  |         |             |  |
| Unit                                    | min        |                       | MPa                                    | °C      | mm          |  |
|   |            |                       |  |         |             |  |
| Araldite® AW 4856 /<br>Hardener HW 4856 | 240 - 280  | 5h at 70°C            | 25 - 30 on 0.5 mm<br>13 - 16 on 3.0 mm | 80 - 85 | up to 40    | Assembly adhesive for large structures, particularly where thick bond lines may occur. |

 $<sup>^{\</sup>mbox{\tiny 1}}$  On acid etched aluminium - LSS = Lap Shear Strength

## Fast assembly and repair

| Product designation                     | Chemistry  | Pot life   | Fixture time | LSS <sup>1</sup> | Tg      | Gap filling   | Key features   |
|---|------------|------------|--------------|------------------|---------|---------------|--|
|   |            |            |              |                  |         |               |  |
| Conditions                              |            | 23°C, 100g | 23°C         |                  |         |               |  |
| Unit                                    |            | min        | min          | MPa              | °C      | mm            |  |
|   |            |            |              |                  |         |               |  |
| Araldite® 2012                          | EP system  | 6          | 20           | 18               | 40 - 50 | self leveling | Short gel time, multipurpose.  |
|   |            |            |              |                  |         |               |  |
| Araldite® AW 2101 /<br>Hardener HW 2951 | EP system  | 6          | 60           | 20               | 40 - 45 | 5             | Rigid, low shrinkage.  |
| Araldite® 2021                          | MMA system | 3 - 5      | 8            | 20 - 22          | 65 - 80 | 3 - 5         | Very fast setting, tough adhesive for rapid fixing and filling of small voids. |
| Araldite® 2022                          | MMA system | 10         | 18           | 25               | 65 - 80 | 5             | No sagging, toughened.   |
| Araldite® 2048-1                        | MMA system | 10         | 35           | 24               | 65 - 75 | 8             | Flexible, gap filling.   |

 $<sup>^{\</sup>mbox{\tiny 1}}$  On acid etched aluminium - LSS = Lap Shear Strength

Note: All adhesives are available in different pack sizes including cartridges for easy use in the field

EP: Epoxy

MMA: Methacrylate







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#### Europe, Middle East & Africa

Huntsman Advanced Materials (Switzerland) GmbH Klybeckstrasse 200 PO Box 4002 Basel Switzerland Tel. +41 61 299 1111 Fax +41 61 299 1112

Asia Pacific & India Huntsman Advanced Materials (Guangdong) Co., Ltd. Room 4903-4906, Maxdo Centre 8 Xing Yi Road, Shanghai 200336, P.R.China Tel. + 86 21 2325 7888

Fax + 86 21 2325 7808

Huntsman Advanced Materials Americas Inc. 10003 Woodloch Forest Drive The Woodlands Texas 77380 USA

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