

## Advanced Materials

# Araldite® LY 3505 / Aradur® 5003-1\*

### WARM TO HOT CURING EPOXY SYSTEM

Araldite® LY 3505 is an epoxy resin

Aradur® 5003-1 is a polyamine based hardener

|                     |                                                                                                                                                                                                                                                                                             |                           |                      |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------|
| <b>APPLICATIONS</b> | <ul style="list-style-type: none"> <li>Industrial composites</li> <li>Structural composites</li> </ul>                                                                                                                                                                                      |                           |                      |
| <b>PROPERTIES</b>   | The system exhibits excellent mechanical properties and good thermal resistance. Due to its high reactivity short cure cycles can be realized.                                                                                                                                              |                           |                      |
| <b>PROCESSING</b>   | <ul style="list-style-type: none"> <li>Wet lay-up</li> <li>Resin Transfer Moulding (RTM)</li> <li>Pressure moulding</li> </ul>                                                                                                                                                              |                           |                      |
| <b>KEY DATA</b>     | <b>Araldite® LY 3505</b>                                                                                                                                                                                                                                                                    |                           |                      |
|                     | Aspect (visual)                                                                                                                                                                                                                                                                             | clear liquid              |                      |
|                     | Colour (Gardner, ISO 4630)                                                                                                                                                                                                                                                                  | ≤ 3                       |                      |
|                     | Viscosity at 25 °C (ISO 12058-1)                                                                                                                                                                                                                                                            | 6500 - 8000               | [mPa s]              |
|                     | Density at 25 °C (ISO 1675)                                                                                                                                                                                                                                                                 | 1.15 - 1.20               | [g/cm <sup>3</sup> ] |
|                     | Flash point (ISO 2719)                                                                                                                                                                                                                                                                      | ≥ 200                     | [°C]                 |
|                     | Storage temperature<br>(see expiry date on original container)                                                                                                                                                                                                                              | 2 - 40                    | [°C]                 |
|                     | <b>Aradur® 5003-1</b>                                                                                                                                                                                                                                                                       |                           |                      |
|                     | Aspect (visual)                                                                                                                                                                                                                                                                             | clear light-yellow liquid |                      |
|                     | Viscosity at 25 °C (ISO 12058-1)                                                                                                                                                                                                                                                            | 70 - 120                  | [mPa s]              |
|                     | Density at 25 °C (ISO 1675)                                                                                                                                                                                                                                                                 | 0.98 - 1.08               | [g/cm <sup>3</sup> ] |
|                     | Flash point (ISO 2719)                                                                                                                                                                                                                                                                      | ~ 174                     | [°C]                 |
|                     | Storage temperature<br>(see expiry date on original container)                                                                                                                                                                                                                              | 2 - 40                    | [°C]                 |
| <b>STORAGE</b>      | Provided that the products described above are stored in a dry place in their original, properly closed containers at the above mentioned storage temperatures they will have the shelf lives indicated on the labels.<br>Partly emptied containers should be closed immediately after use. |                           |                      |

\* In addition to the brand name product denomination may show different appendices, which allows us to differentiate between our production sites: e.g., BD = Germany, US = United States, IN = India, CI = China, etc.. These appendices are in use on packaging, transport and invoicing documents. Generally the same specifications apply for all versions. Please address any additional need for clarification to the appropriate Huntsman contact.

**PROCESSING DATA**

| <b>MIX RATIO</b> | <i>Components</i> | <i>Parts by weight</i> | <i>Parts by volume</i> |
|------------------|-------------------|------------------------|------------------------|
|                  | Araldite® LY 3505 | 100                    | 100                    |
|                  | Aradur® 5003-1    | 20                     | 22                     |

We recommend that the components are weighed with an accurate balance to prevent mixing inaccuracies which can affect the properties of the matrix system. The components should be mixed thoroughly to ensure homogeneity. It is important that the side and the bottom of the vessel are incorporated into the mixing process.

When processing large quantities of mixture the pot life will decrease due to exothermic reaction. It is advisable to divide large mixes into several smaller containers.

|                                               |                      |                               |
|-----------------------------------------------|----------------------|-------------------------------|
| <b>INITIAL MIX VISCOSITY</b><br>(ISO 12058-1) | <i>[°C]</i><br>at 25 | <i>[mPa s]</i><br>1800 - 2300 |
|-----------------------------------------------|----------------------|-------------------------------|

|                                                |                      |                         |
|------------------------------------------------|----------------------|-------------------------|
| <b>POT LIFE</b><br>(TECAM, 100 ML,<br>65 % RH) | <i>[°C]</i><br>at 25 | <i>[min]</i><br>42 - 56 |
|------------------------------------------------|----------------------|-------------------------|

|                                |                                                 |                                                        |
|--------------------------------|-------------------------------------------------|--------------------------------------------------------|
| <b>GEL TIME</b><br>(HOT PLATE) | <i>[°C]</i><br>at 40<br>at 60<br>at 80<br>at 90 | <i>[min]</i><br>40 - 58<br>15 - 20<br>4.5 - 7<br>2 - 4 |
|--------------------------------|-------------------------------------------------|--------------------------------------------------------|

The values shown are for small amounts of pure resin/hardener mix. In composite structures the gel time can differ significantly from the given values depending on the fibre content and the laminate thickness.

|                                                               |              |                                    |
|---------------------------------------------------------------|--------------|------------------------------------|
| <b>GELATION AT 23 °C</b><br>(IN THIN LAYERS:<br>0.4 - 0.7 MM) | Start<br>End | <i>[h]</i><br>1.5 - 2<br>2.5 - 3.5 |
|---------------------------------------------------------------|--------------|------------------------------------|

|                            |                                                                                    |
|----------------------------|------------------------------------------------------------------------------------|
| <b>TYPICAL CURE CYCLES</b> | 30 min 80 °C<br>or 30 min 80 °C + 30 min 100 °C<br>or 30 min 80 °C + 30 min 120 °C |
|----------------------------|------------------------------------------------------------------------------------|

The optimum cure cycle has to be determined case by case depending on the processing and the economic requirements.

**PROPERTIES OF THE CURED, NEAT FORMULATION**

|                                                        |                                 |                     |                              |
|--------------------------------------------------------|---------------------------------|---------------------|------------------------------|
| <b>GLASS TRANSITION TEMPERATURE (<math>T_g</math>)</b> |                                 | <i>Cure:</i>        | $T_g$ [°C]                   |
| (IEC 1006,<br>DSC, 10 K/MIN)                           | 4 h 60 °C                       |                     | 77 - 85                      |
|                                                        | 20 min 80 °C                    |                     | 83 - 90                      |
|                                                        | 30 min 80 °C                    |                     | 88 - 95                      |
|                                                        | 2 h 80 °C                       |                     | 95 - 102                     |
|                                                        | 15 min 90 °C                    |                     | 94 - 102                     |
|                                                        | 30 min 90 °C                    |                     | 98 - 106                     |
|                                                        | 1 h 90 °C                       |                     | 100 - 108                    |
|                                                        | 15 min 100 °C                   |                     | 100 - 108                    |
|                                                        | 30 min 80 °C + 30 min 100 °C    |                     | 106 - 114                    |
|                                                        | 30 min 80 °C + 1 h 100 °C       |                     | 108 - 118                    |
|                                                        | 30 min 80 °C + 2 h 100 °C       |                     | 110 - 120                    |
|                                                        | 30 min 80 °C + 1 h 120 °C       |                     | 120 - 126                    |
|                                                        | 30 min 80 °C + 30 min 140 °C    |                     | 118 - 126                    |
| <b>TENSILE TEST</b>                                    |                                 | <i>Cure:</i>        | 30 min 80 °C<br>+ 2 h 100 °C |
| (ISO 527)                                              | Tensile strength                | [MPa]               | 76 - 90                      |
|                                                        | Elongation at tensile strength  | [%]                 | 3.8 - 4.8                    |
|                                                        | Ultimate strength               | [MPa]               | 75 - 88                      |
|                                                        | Ultimate elongation             | [%]                 | 3.8 - 5.0                    |
|                                                        | Tensile modulus                 | [MPa]               | 3150 - 3350                  |
| <b>FLEXURAL TEST</b>                                   |                                 | <i>Cure:</i>        | 30 min 80 °C<br>+ 2 h 100 °C |
| (ISO 178)                                              | Flexural strength               | [MPa]               | 140 - 150                    |
|                                                        | Elongation at flexural strength | [%]                 | 6.5 - 7.5                    |
|                                                        | Ultimate strength               | [MPa]               | 138 - 148                    |
|                                                        | Ultimate elongation             | [%]                 | 7.0 - 8.0                    |
|                                                        | Flexural modulus                | [MPa]               | 3200 - 3400                  |
| <b>FRACTURE PROPERTIES</b>                             |                                 | <i>Cure:</i>        | 30 min 80 °C<br>+ 2 h 100 °C |
| <b>BEND NOTCH TEST</b>                                 | Fracture toughness $K_{1C}$     | [MPa√m]             | 0.90 - 1.05                  |
|                                                        | Fracture energy $G_{1C}$        | [J/m <sup>2</sup> ] | 210 - 280                    |
| <b>WATER ABSORPTION</b>                                |                                 | <i>Cure:</i>        | 30 min 80 °C<br>+ 2 h 100 °C |
| (ISO 62)                                               | 1 day H <sub>2</sub> O 23 °C    | [%]                 | 0.05 - 0.15                  |
|                                                        | 10 days H <sub>2</sub> O 23 °C  | [%]                 | 0.30 - 0.38                  |

**PROPERTIES OF THE CURED, REINFORCED FORMULATION**

|                                                     |                                                                 |       |               |
|-----------------------------------------------------|-----------------------------------------------------------------|-------|---------------|
| <b>Flexural test</b><br>(ISO 178)                   | Samples: 12 layers E-glass fabric UD (425 g/m <sup>2</sup> )    |       |               |
|                                                     | Laminate thickness: 3.1 - 3.25 mm                               |       |               |
|                                                     | Fibre volume content: 61 - 64 %                                 |       |               |
|                                                     | Cure: 30 min 80 °C + 2 h 100 °C                                 |       |               |
|                                                     | Flexural strength                                               | [MPa] | 1050 - 1300   |
|                                                     | Ultimate elongation                                             | [%]   | 2.6 - 3.0     |
|                                                     | Flexural modulus                                                | [MPa] | 38000 - 42000 |
| <b>Interlaminar shear strength</b><br>(ASTM D 2344) | Short beam: 12 layers E-glass fabric UD (425 g/m <sup>2</sup> ) |       |               |
|                                                     | Laminate thickness: 3.1 - 3.25 mm                               |       |               |
|                                                     | Fibre volume content: 61 - 64 %                                 |       |               |
|                                                     | Cure: 30 min 80 °C + 2 h 100 °C                                 |       |               |

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|                |       |         |
|----------------|-------|---------|
| Shear strength | [MPa] | 62 - 68 |
|----------------|-------|---------|

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**HANDLING  
PRECAUTIONS**

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**Personal hygiene**

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*Safety precautions at workplace*

|                        |                                      |
|------------------------|--------------------------------------|
| protective clothing    | yes                                  |
| gloves                 | essential                            |
| arm protectors         | recommended when skin contact likely |
| goggles/safety glasses | yes                                  |

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*Skin protection*

|                      |                                     |
|----------------------|-------------------------------------|
| before starting work | Apply barrier cream to exposed skin |
| after washing        | Apply barrier or nourishing cream   |

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*Cleansing of contaminated skin*

Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents

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*Disposal of spillage*

Soak up with sawdust or cotton waste and deposit in plastic-lined bin

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*Ventilation*

|               |                                                        |
|---------------|--------------------------------------------------------|
| of workshop   | Renew air 3 to 5 times an hour                         |
| of workplaces | Exhaust fans. Operatives should avoid inhaling vapours |

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**FIRST AID**

Contamination of the eyes by resin, hardener or mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted.

Material smeared or splashed on the *skin* should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (see above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately.

Anyone taken ill after *inhaling* vapours should be moved out of doors immediately. In all cases of doubt call for medical assistance.

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