

## Prefere 4535

Liquid melamine urea adhesive  
for the wood industry

### Use

Prefere 4535 is a liquid melamine urea adhesive which is used together with the liquid hardeners Prefere 5035 or Prefere 5046 in the manufacture of load bearing timber structures. Prefere 4535 is well suited for radio frequency curing as well as for hot and cold curing. The glue lines of this adhesive system are light-coloured and will not darken over time.

When the gluing is carried out in accordance with the instructions in this Technical Data Sheet, Prefere 4535 gives water- and weather proof bonds, conforming to Adhesive Type 1 of the European standards for adhesives for load-bearing wooden structures (EN 301:2013).

Prefere 4535 has been tested by MPA (Otto-Graf-Institut, Stuttgart) as well as by NTI (Norsk Treteknisk Institutt, Oslo) according to DIN 68 141 and EN 301:2013, and fulfils the requirements for the gluing of load-bearing wooden structures, structural finger jointing and Cross laminated timber (CLT) according to DIN 1052, EN 14080:2013, EN 15497:2014 and EN 16351:2015.

The adhesive system fulfils herewith the requirements according to EN 301:2013 and is classified as a general purpose and finger jointing adhesive for mixed in and separate application use, for the gluing of Norway spruce (*Picea abies* / PCAB), Scots pine (*Pinus sylvestris* / PNSY), Silver fir (*Abies alba* / ABAL), European larch (*Larix decidua* / LADC), Siberian larch (*Larix sibirica* / LASI), Douglas fir (*Pseudotsuga menziesii* / PSMN), Beech (*Fagus sylvatica* / FASY), Birch (*Betula pendula* / BTXX) with the following class designations as specified in the below table.

Designation	Approved hardeners	Approved wood species <sup>1, 2</sup>
EN 301-I-90-GP-0,6-M EN 301-I-90-GP-0,3-S	5035	PCAB, PNSY, ABAL, BTXX
EN 301-I-90-FJ-0,1-M EN 301-I-90-GP-0,6-M <sup>3)</sup>	5046	PCAB, PNSY, ABAL, LADC, LASI, PSMN, FASY

<sup>1</sup> Nomenclature according to EN 13556:2003 "Round and sawn timber Nomenclature of timbers used in Europe"

<sup>2</sup> For the gluing of wood species other than PCAB, PNSY and ABAL please contact Dynea's technical service department.

<sup>3</sup> With addition of colour in the hardener. For details please see the chapter "Glue mix preparation".

Prefere 4535 with hardener Prefere 5046 is approved for the gluing of load bearing timber structures made of beech (Allgemeine bauaufsichtliche Zulassung nr Z-9.1-679). For detailed information about this process please contact Dynea's market service department.

Prefere 4535 with hardener Prefere 5035 is tested and approved by NTI for the gluing of load bearing timber structures made of birch (*Betula pendula*).

Prefere 4535 with hardeners is tested and approved for the gluing of Wolmanit CX-8, Scanimp KF, Wolsit KD-10 and Permawood ACQ 1900 impregnated pine (*Pinus sylvestris*). For details about impregnation and suitable substances please contact Dynea's technical service department.

Provided that Prefere 4535 is used according to the instructions in this technical data sheet, the end-products will exhibit minimal emissions.

### Technical data for the adhesive

Appearance	Light grey/white viscous liquid
Solids content (2 h at 120°C)	63-65 %
Viscosity at 25°C	3000-6000 mPa.s *
pH at 25°C	8,5-10,0
Density at 25°C/4°C	1,26 ±0,02 g/cm <sup>3</sup>

\*The viscosity is measured by Brookfield, RVT, spindle 4 at 20 rpm.

### Storage of the adhesive

The storage stability of the adhesive is temperature dependent. The adhesive can be stored at a temperature of 10°C for up to 6 months.

Temperature (°C)	Storage stability (months)
10	6
15	5
20	4
25	3
30	2

Customers who receive bulk supplies of Prefere 4535 to their own storage tank are referred to our Technical Information Leaflet No. 5E "Bulk storage and handling of liquid resins" which contains useful advice on storage of resins and operation of storage tanks. Prefere 4535 is not flammable.

### Technical data for the hardeners

	Prefere 5035	Prefere 5046
Appearance	White viscous liquid	White viscous liquid
Viscosity at 25°C	2500-5000 mPa.s *	2500-5000 mPa.s *
pH at 25°C	0,7-1,3	1.5-2,5
Density at 25°C/4°C	1.30±0,02 g/cm <sup>3</sup>	1.12±0,02 g/cm <sup>3</sup>

\*The viscosity is measured by Brookfield, RVT, spindle 4 at 20 rpm.

### Storage of the hardeners

The optimal storage temperature is 10-25°C. At these temperatures Prefere 5035 may be stored for up to 6 months and Prefere 5046 for up to 4 months. The hardeners must not be allowed to freeze.

### The wood

The European production standards EN 14080:2013, EN 15497:2014 and EN 16351:2015 dictate that laminated timber structures consist of one wood species only. The wood material must be strength graded in accordance with EN 14081-1.

All data for assembly time, pressing time and time to full water resistance refers to production using Norway spruce (*Picea abies*). However, Prefere 4535 can be used for a wide range of species. For details, please contact Dynea's Technical Service Department.

To ensure optimum bond quality when producing laminated timber structures or finger jointing the lamellas should be freshly planed or profiled and the moisture content of the wood should be between 6 and 15% with a maximum difference in moisture content between lamellas of 5%.

With Prefere 4535 the moisture content of the timber can be up to 23% for special applications.

### Glue mix preparation

The reactivity of the glue mixture can be adapted to the users production requirements (pot life, assembly time and pressing time). The following glue mixes (in pbw) are approved for laminated timber structures <sup>3)</sup>.

	Prefere 4535	Prefere 5035	Prefere 5046	Water	Colour
EN 301-I-90-GP-0,6-M	100	15-35	15-60	-	-
EN 301-I-90-GP-0,3-S	100	25-35	25-60	-	-
EN 301-I-90-FJ-0,1-M	100	15-60	15-60	-	-
Face gluing and finger jointing, mix-in application with addition of colour	100	20	30	-	2,2 <sup>1)</sup> / 2,0 <sup>2)</sup>

<sup>1)</sup> 2,2 parts by weight of colour can be added to the hardener Prefere 5035 (related to the hardener amount) consisting of 2 pbw Pintosol Oxidrot E-WL 41 and 0,2 pbw Colanyl Schwarz PR 130.

<sup>2)</sup> 2 parts by weight of the colour Flexonyl-Gelb HR-LA01 can be added to the hardener Prefere 5046 (related to the hardener amount).

<sup>3)</sup> For the gluing of wood species other than PCAB, PNSY and ABAL please contact Dynea's technical service department.

It must be demonstrated that automatic metering/mixing equipment to be used to mix Prefere 4535 and hardener is suitable for this special operation.

No fillers or extenders may be added to the glue mixes.

### Glue application

#### Separate application of glue and hardener

Prefere 4535 and hardeners Prefere 5035 and Prefere 5046 are preferably applied with sequential ribbon spreaders especially suited to this purpose. The principle is that the first extruder is used for the hardener and the second for the adhesive. Three ribbon spreaders, ECOTOP T350 from Oest GmbH & Co. Maschinenbau KG, Oest GM-2K (former IFA) and Mixon 2800 series from Mixon AB have proven to work very well. These ribbon spreaders ensure correct ratio between adhesive and hardener and keep the application rate of the two components constant.

By use of the separate application technique no glue mix is made. Consequently the pot life issue is completely removed. But as mixing and blending of the adhesive take place on the surface of the lamellas,

it is very important to have strict control of the planing quality (maximum glue line thickness 0,3 mm) as well as the glue and hardener spread, the assembly time and the final pressure of the press.

### Mix-in application of a glue and hardener

It must be demonstrated that automatic metering/mixing equipment to be used is suitable for this special operation.

If adhesive and hardener are mixed by hand, one should be aware that the adhesive has a different specific gravity than the hardener. In order to obtain a homogeneous glue mix it is therefore advisable to stir from the bottom.

### Pot life

Heat is evolved when adhesive and hardener are mixed. More heat is evolved the higher the initial adhesive temperature is. Once adhesive and hardener are mixed, the curing reaction starts. This reaction will cause increased viscosity and proceeds until the glue mix is cured completely. The reaction rate will increase with temperature and amount of hardener. The pot life (the time to unusable viscosity) for the different glue mixes and both hardeners is given in the table below.

Dosage (pbw)	Pot-life in minutes at			
	15°C	20°C	25°C	30°C
100:15	195	135	80	45
100:20	150	100	60	40
100:25	135	80	45	30
100:30	120	75	45	20
100:35	105	60	30	15
100:60	-	30	-	-

### Glue spread

In the manufacture of laminated timber structures the adhesive should be applied to one surface only at a rate of 200-500 g/m<sup>2</sup> if a ribbon spreader is used, and at a rate of 100-250 g/m<sup>2</sup> (application to both surfaces) if a roller spreader is used. Application to both surfaces is advantageous when bonding difficult-to-bond wood species. Lower glue spread can be sufficient depending on production technique, planing quality, required assembly time and pressing process. This should only be done after seeking technical advice from Dynea.

### Assembly time

Assembly time is the time elapsing between glue application and pressure application. It can be subdivided in open (from glue application until assembly of the adherents) and closed assembly time (from assembly until pressure is established).

Open assembly time should be kept as short as possible and should not exceed 5 min. On the other hand, 5 -15 minutes closed assembly is beneficial, in particular when dense wood is being bonded.

Maximum closed assembly time depends first of all on the glue spread rate and hardener dosage, further on wood species, temperature and moisture content of the wood, temperature, relative humidity and air circulation in the workshop. The lower the spread rate, the higher the temperature and the drier the air, the

shorter will the assembly time be. Provided the lamellas are assembled immediately after glue application, the maximum assembly times for given hardener dosages are stated in the tables below.

Maximum closed assembly time in minutes at 20°C for **separate application**

Dosage (pbw)	Prefere 5035		Prefere 5046	
	250 g/m <sup>2</sup>	350 g/m <sup>2</sup>	250 g/m <sup>2</sup>	350 g/m <sup>2</sup>
100:25	60	90	80	120
100:30	60	80	75	110
100:35	45	75	75	110
100:60	-	-	75	110

Maximum closed assembly time in minutes at 20°C for **mix-in application**

Dosage (pbw)	Prefere 5035		Prefere 5046	
	250 g/m <sup>2</sup>	400 g/m <sup>2</sup>	250 g/m <sup>2</sup>	400 g/m <sup>2</sup>
100:15	90	120	80	150
100:20	90	120	80	150
100:25	60	90	75	120
100:30	60	90	75	105
100:35	45	75	70	90
100:60	-	-	45	55

Maximum closed assembly time in minutes at 25°C with 400 g/m<sup>2</sup> **mix-in application**

Prefere 5046	
Dosage (pbw)	
100:15	100
100:20	100
100:25	80
100:30	75
100:35	60

The times apply to softwood at a relative air humidity of 65% and a room temperature of 20°C.

Under all circumstances the adhesive must still be tacky when the pressure is applied. Adhesive being squeezed out of the glue line when the pressure is applied is an indication that the assembly time is not exceeded.

## Pressure

The pressure is dependent on the wood species (softwood or hardwood) and on the type of bonding operation.

In the manufacture of laminated timber structures the pressure should be 0.6-1.0 N/mm<sup>2</sup> with softwoods and 0.8-1.2 N/mm<sup>2</sup> with hardwoods. In other bonding operations a lower pressure may be sufficient.

In finger jointing the end (longitudinal) pressure should be adapted to the joint profile, wood species, the moisture content and the cross section of the timber, thus it should therefore be determined accordingly. For most softwoods an end pressure of the order of 5-8 N/mm<sup>2</sup> will be sufficient for finger joints over 25 mm in length. For shorter joints an end pressure of 8-12 N/mm<sup>2</sup> is necessary. If pre-heated wood is used, there is a risk that the pressure may cause compression fracture of the wood, in particular if the moisture content of the wood is high. In such cases the pressure must be reduced.

## Pressing properties

### a) Laminated timber structures

#### Cold and hot bonding

In the tables below, the minimum pressing times when manufacturing straight beams with a maximum glue line thickness of 0,1 mm are given.

Dosage (pbw)	Pressing time in minutes with 0,1mm glue line thickness			
	20°C		30°C	
	Prefere 5035	Prefere 5046	Prefere 5035	Prefere 5046
100:60 <sup>1</sup>	-	180	-	90
100:35	240	180	105	90
100:25	360	270	120	120
100:15 <sup>2</sup>	735	345	240	150

Dosage (pbw)	Pressing time in minutes <sup>3</sup>					
	50°C	60°C	70°C	80°C	90°C	100°C
100:60 <sup>1</sup>	6:00	2:00	1:45	1:00	0:45	0:30
100:35	6:00	2:00	1:45	1:00	0:45	0:30
100:30	8:00	3:00	2:00	1:15	0:45	0:30
100:25	10:00	4:00	2:00	1:30	0:45	0:30
100:20	15:00	5:00	2:30	2:00	1:00	0:30
100:15 <sup>2</sup>	20:00	6:00	3:00	2:30	1:15	0:30

<sup>1)</sup> Only valid for hardener Prefere 5046

<sup>2)</sup> Only for mix-in application

<sup>3)</sup> At pressing temperatures from 50°C the hardeners Prefere 5035 and Prefere 5046 can be considered equal in reactivity

If the bonding is accomplished at elevated temperature in curing chambers, the time to reach the desired temperature in the glue line must be added to the pressing times above. This additional time depends on the chamber temperature, the initial temperature of the wood and, in particular, on the width of the

laminations. Prefere 4535 also works perfectly with the *Dynea Curesafe* system to determine the correct pressing and assembly times at different temperatures.

In the case of thicker glue lines additional pressing time is required. Curved structures require extended pressing times. The smaller the radius of curvature, the longer pressing times are required. Our Technical service Department will assist in calculating the necessary pressing time.

### Radio frequency curing

Prefere 4535 is very well suited for curing under radio frequency heating conditions.

Since the necessary pressing times depend on a number of factors, such as the shape of the adherents, the position of the electrodes, the effect of the generator, etc. it is recommended to optimise the pressing times by trials.

Our Technical service department can advise on establishing press times and how to make glue line temperature measurements when radio frequency heating is employed. A typical glue line temperature will be in the range 65-80°C in combination with a wood temperature of 35-40°C. It can be either higher or lower depending on the type and settings of the press.

### Post curing

After expiration of the above pressing times the adhesive is sufficiently cured to allow for machining. Full water resistance of the bonds will however only be reached after some time. The necessary time for post curing depends on the glue mix, glue line thickness, pressing time and the temperature during pressing and post curing. The following table shows minimum post curing times for a glue line thickness of 0,1 mm at an application amount of 250 g/m<sup>2</sup> and at a storage temperature of 20°C.

Dosage (pbw)	Time to water resistance at 20°C in hours
100:15	72
100:35	36
100:60	12

If the curing takes place by means of radio frequency curing, in curing chambers at elevated temperatures or by hot curing, the post curing time will be reduced. Our technical service department will assist in establishing the necessary post curing times. During the post curing period the structures should not be exposed to strains which may weaken the glue bond.

### b) Finger jointing

Finger joints can either be cured in a heated workshop, or the curing can be accelerated by means of hot dies, radio frequency heating or pre-heating of the wood. The curing is dependent on the achieved temperature in the glue-line.

The following table shows the time to full bending strength.

Glue line temperature in °C	Curing time to full bending strength in hours	
	20 pbw hardener	50 pbw hardener
20	16	5
25	6,5	2,5
30	3,5	1



At higher curing temperatures the time to full bending strength and the time to full water resistance can be considered as equal. The following table shows the time to full water resistance from 20 to 80°C.

Glue line temperature in °C	Curing time to full water resistance in hours / minutes	
	20 pbw hardener	50 pbw hardener
20	72 h	12 h
25	15 h	4 h
30	7 h	2 h
35	3,5 h	1 h
40	1,5 h	0,5 h
45	50 min	18 min
50	30 min	12 min
55	17 min	8 min
60	10 min	5 min
65	7 min	4 min
70	5 min	3,5 min
75	3,5 min	2,5 min
80	2,5 min	1,75 min

With radio-frequency pre-heating of the ends, the temperature in the glue-line will drop with 5-10°C/minute depending on the temperature of the materials and the achieved glue-line temperature. Experiments have shown that with a glue-line temperature of 75-80°C when pressure is applied the time to 100% water resistance will be 10 minutes. At 55-60°C the curing time will be 2 hours.

With RF pre-heating of the ends the lowest recommended temperature when pressure is applied is 55°C. With RF curing of the glue the glue-line temperature should be at least 60-70°C.

## Cleaning

With Dynea Washless System the need for cleaning is reduced significantly compared to mixed application systems since there is no glue-mix and the system is protected from dry-out. If the application equipment needs to be cleaned, the individual components can easily be washed with warm water (40-60°C).

With mixed application systems, the mixing and application equipment must be cleaned at the end of each working day. If the glue mix thickens in the application equipment, the equipment must be immediately emptied and cleaned because otherwise there is a risk that the glue will cure. Cured glue is insoluble and must be scraped off.

For easier removal of cured glue, it is recommended to cover exposed metal parts with Dynea's release agent Dynoadd R-1001 or with self-attaching plastic foil prior to gluing.

Cleaning of the glue mix is most easily done with warm water (40-60°C). Before flushing of the equipment is started, the water pipes should be drained of cold water.

Advice on safe handling of glue remainders and wash water can be found in our Technical Information Leaflet No. 2E "Waste handling".



## Safety precautions

Reference is made to the Safety Data Sheet for Prefere 4535 and hardeners Prefere 5035 and Prefere 5046.

When the adhesive and the hardener are mixed a chemical reaction will start. The pH of the mixture will be in between the value for the adhesive and the hardener. The free formaldehyde content for the adhesive will be reduced. The acid/salt concentration of the hardener will be diluted.

When handling the adhesive, the hardener and the glue mix, it is recommended that certain precautions normally taken when handling chemicals is observed. Skin contact with the uncured glue should be avoided, since people with particularly sensitive skin may be affected. It is recommended to wear protective gloves, likewise eye protection where there is a risk of splashes. Hands and forearms should be thoroughly washed with soap and warm water at the end of the working day.

Adequate ventilation of the workshops should be maintained.

## Notice

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The manufacture of laminated timber structures normally is subject to control procedures implemented by the authorities or other regulatory bodies. To satisfy these requirements, certain guidelines have to be followed in the production. These guidelines vary from country to country. They may, on some points, differ from the instructions given above. In such cases the manufacturer must obey the regulations applicable.

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