

Prefere 4546

Liquid melamine urea adhesive for the wood industry

Use

Prefere 4546 is a liquid melamine urea adhesive which is used together with the liquid hardeners Prefere 5020, Prefere 5021, Prefere 5022 or Prefere 5093 in the manufacture of load bearing timber structures. Prefere 4546 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 4546 gives water- and weather proof bonds, conforming to Adhesive Type 1 of the European standards for adhesives for load bearing timber structures (EN 301:2013).

Prefere 4546 has been tested by TUM, (Technische Universität München) with hardener Prefere 5020 and 5093, by MPA (Otto-Graf-Institut, Stuttgart) with hardener Prefere 5021 and 5022 as well as by NTI (Norsk Treteknisk Institutt, Oslo) according to the DIN 68141 and EN 301:2013 and fulfils the requirements for the gluing of load bearing wooden structures according to EN 14080:2013, EN 16351:2015 and EN 15497:2014.

Prefere 4546 has been approved for finger jointing with separate application with the hardeners Prefere 5020, Prefere 5021, Prefere 5022 and Prefere 5093.

The adhesive system fulfils herewith the requirements according to EN 301:2013 and is classified as a general purpose, gap filling 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), Birch (*Betula pendula* / BTXX) with the following class designations as specified in the below table.

Designation	Approved hardeners	Approved wood species ^{1), 3)}
EN 301-I-90-GP-0,6-M	5020	PCAB, PNSY, ABAL, PSMN, LADC
EN 301-I-90-GP-0,3-S	5021 ²⁾	PCAB, PNSY, ABAL, LADC, LASI, PSMN
EN 301-I-90-FJ-0,1-M		
EN 301-I-90-FJ-0,1-S	5093	PCAB, PNSY, ABAL, LADC, PSMN, BTXX
EN 301-I-90-GF-1,5-M	5022	PCAB, PNSY, ABAL, LADC, LASI, PSMN
EN 301-I-90-GP-0,3-S		
EN 301-I-90-FJ-0,1-M		
EN 301-I-90-FJ-0,1-S		

¹⁾ Nomenclature according to EN 13556:2003 "Round and sawn timber Nomenclature of timbers used in Europe"

²⁾ With addition of colour. For detailed information regarding addition of colour please see "Glue mix preparation".

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

Prefere 4546 with the hardener Prefere 5093 conforms to the requirements for face gluing and finger jointing in exposure condition B and C according to JAS MAFF, Notification No. 1587.

Prefere 4546 with the hardener Prefere 5021 is approved for finger jointing according to JAS MAFF exposure condition C.

Prefere 4546 with the hardeners Prefere 5020 and Prefere 5021 has been tested by TECO (USA) according to ASTM D2559-04 and D3535 and fulfils the requirements in ANSI/AITC A190.1-1992 part 4.4.1.2 for the gluing of Scots pine, Norway spruce and Silver fir in the manufacture of load bearing timber structures.

Prefere 4546 is classified as Type 1 adhesive according to AS/NZS 4364:2010 for Australia and New Zealand.

Prefere 4546 is tested and approved by NTI for the gluing of impregnated pine (*Pinus sylvestris*) with Wolmanit CX-8 (with hardeners Prefere 5021 or Prefere 5022), Scanimp KF (with hardener Prefere 5021) and Wolsit KD-10 (with hardener Prefere 5022). For details please contact Dynea's technical service department.

Provided that Prefere 4546 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)	63-64 %
Viscosity at 25°C	3000-10000 mPa.s *
pH at 25°C	8,5-10,0
Density at 25°C/4°C	1,27±0,02 g/cm ³

*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.

Temperature (°C)	Storage stability (months)
10	1
15	2
20	3
25	2
30	1

Customers who receive bulk supplies of Prefere 4546 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 4546 is not flammable.

Technical data for the hardeners

	Prefere 5020	Prefere 5021	Prefere 5022	Prefere 5093
Appearance	White viscous liquid	White viscous liquid	White viscous liquid	White viscous liquid
Viscosity at 25°C	3000-4000 mPa.s	3000-4000 mPa.s	1800-2800 mPa.s	1800-4000 mPa.s
pH at 25°C	1,5-2,5	1,5-2,5	1,5-2,5	1,5-2,5
Density at 25°C/4°C	1,10±0,02 g/cm ³	1,12±0,02 g/cm ³	1,08±0,02 g/cm ³	1,12±0,02 g/cm ³

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

Storage of the hardeners

The optimal storage temperature is 5-25°C. At this temperature the storage time is 3 months. Higher and lower storage temperatures will result in a faster viscosity increase.

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 4546 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%.

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 and finger jointing ²⁾.

	Prefere 4546	Prefere 5020	Prefere 5021	Prefere 5022	Prefere 5093	Water	Colour
EN 301-I-90-GF-1,5-M	100			10		-	
EN 301-I-90-GP-0,6-M	100	30-100	10-100 ³⁾	10-100	20-100	-	100 ³⁾
EN 301-I-90-GP-0,3-S	100	30-100	20-100	20-100	20-100	-	
EN 301-I-90-FJ-0,1-M	100	30-100	10-100	10-100 ⁴⁾	20-100	-	10-100 ⁴⁾
EN 301-I-90-FJ-0,1-S	100	70-100	70-100	70-100	70	-	
Finger-jointing with addition of water	100	-	70-100	20-100	-	5 ¹⁾	

- 1) The total amount of water can be varied up to 5 parts. The respective amount can be added to one of the components, divided between the components or added to the glue mix prior to mix in or separate application.
- 2) For the gluing of wood species other than PCAB, PNSY and ABAL please contact Dynea's technical service department.
- 3) 1 part by weight of colour Colanyl Gelb HR 130 can be added in total to the adhesive Prefere 4546 and / or the hardener Prefere 5021.
- 4) 1 part by weight of colour Colanyl Gelb HR 130 can be added in total to the adhesive Prefere 4546 and / or the hardener Prefere 5022.

It must be demonstrated that automatic metering/mixing equipment to be used to mix Prefere 4546 and hardener is suitable for this special operation. No fillers or extenders may be added to the glue mixes.

Glue application

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

Separate application of glue and hardener

Prefere 4546 and hardeners 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 (earlier IFA) and Type Mixon 2800 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 glue and hardener

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 is given in the table below.

Dosage (pbw)	Pot-life at 20°C in minutes			
	Prefere 5020	Prefere 5021	Prefere 5022	Prefere 5093
100:10	-	130	130	-
100:20	-	95	95	90
100:30	45	65	65	60
100:50	30	40	40	35
100:100	15	20	20	22

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/m² if a ribbon spreader is used, and at a rate of 100-250 g/m² coated surface (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 AS.

In the manufacture of laminated timber structures such as for block gluing, where thicker glue lines might occur, the glue application should be homogeneous and the amount must be high enough to ensure sufficient gap filling. In cases where thicker glue lines are expected the minimum recommended application amount M_k can be calculated as follows:

$$M_k = 400 + ((t_f - 0,2) * 1000) \quad [g/m^2]$$

where

M_k minimum recommended application amount in g/m²

t_f glue line thickness in mm.

Under all circumstances the application amount must be high enough to ensure adhesive being squeezed out of the glue line when the pressure is applied.

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. 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 in the table below.

Separate application	Maximum closed assembly time in minutes								
	Prefere 5020		Prefere 5021			Prefere 5022		Prefere 5093	
Dosage (pbw)	250 g/m ²	350 g/m ²	250 g/m ²	350 g/m ²	400 g/m ²	250 g/m ²	400 g/m ²	250 g/m ²	400 g/m ²
100:20	-	-	90	110	120	90	120	90	120
100:30	55	75	90	110	110	88	110	88	110
100:50	50	70	85	100	100	85	100	85	100
100:75	45	65	75	85	85	75	85	75	85
100:100	35	60	55	60	60	55	60	55	60

Mix-in application	Maximum closed assembly time in minutes							
	Prefere 5020		Prefere 5021		Prefere 5022		Prefere 5093	
Dosage (pbw)	250 g/m ²	400 g/m ²	250 g/m ²	400 g/m ²	250 g/m ²	400 g/m ²	250 g/m ²	400 g/m ²
100:10	-	-	115	150	115	150	-	-
100:20	-	-	75	110	75	110	120	140
100:30	45	50	50	80	50	80	95	110
100:50	35	40	40	60	40	60	60	75
100:100	20	25	20	25	20	25	30	35

The times apply to softwood at a relative wood moisture content of 12%.

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/mm² with softwoods and 0.8-1.2 N/mm² with hardwoods. For special bonding operations e.g. block gluing where thicker glue lines up to 1,5 mm might occur pressures down to 0,01 N/mm² may be sufficient. Under all circumstances adhesive should be squeezed out of the glue line to ensure sufficient pressure is applied.

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/mm² will be sufficient for finger joints over 25 mm in length. For shorter joints an end pressure of 8-12 N/mm² 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

Cold curing

In the table below, the minimum pressing times when manufacturing straight beams with a maximum glue line thickness of 0,1 mm at an application rate of 250g/m² are given. 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.

Dosage (pbw)	Pressing time in minutes					
	Prefere 5020	At 20°C			At 25°C	
		Prefere 5021 or Prefere 5022	Prefere 5093	Prefere 5020	Prefere 5021 or Prefere 5022	Prefere 5093
100:100	60	90	120	40	60	60
100:75	75	120	135	50	75	75
100:50	90	150	150	55	80	80
100:30	105	180	180	60	90	90
100:20	-	240	225	-	120	120
100:10 ¹	-	450	-	-	270	-

¹ Only for mix-in application

In the table below, the minimum pressing times for Prefere 4546 with hardener Prefere 5022 are given when manufacturing straight beams with a hardener dosage of 100:10 and a maximum glue line thickness of 1,5 mm.

Glue line thickness, mm	Pressing time in hours at glue line temperature						
	15°C	18°C	20°C	25°C	30°C	40°C	
0,10 mm	11	8:30	7:30	3:15	2:20	1	
0,50 mm	26	20:45	15:30	7	3:30	1:30	
0,75 mm	31	24:45	18	8	4	2	
1,00 mm	36:30	28:30	21	10	5	2:30	
1,25 mm	43	34	24	12	6	3	
1,50 mm	49:30	39	27	14	7	3:30	
2,00 mm ¹	63	50	36	17	9	4	

¹ According EN 14080:2013 maximum allowed glue line thickness is 1,5mm

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 4546 also works perfectly with the *Dynea Curesafe* online computer based system to control and optimize the pressing and assembly times at different temperatures during production.

Radio frequency curing

Prefere 4546 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 services 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 60-80°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/m² and at a storage temperature of 20°C.

Dosage (pbw)	Time to water resistance in hours at 20°C			
	Prefere 5020	Prefere 5021	Prefere 5022	Prefere 5093
100 : 100	5	5	5	7
100 : 50	10	12	12	12
100 : 30	20	24	24	24
100 : 20	-	30	30	30
100 : 10	-	48	48	-

The following table shows minimum post curing times with the hardener Prefere 5022 for glue line thicknesses up to 2,00 mm at a storage temperature of 20°C.

Glue line thickness, mm	Time to water resistance in days at 20°C
0,10 mm	2
0,50 mm	4
0,75 mm	4,5
1,00 mm	5
1,25 mm	6
1,50 mm	7
2,00 mm ¹	9

¹ According EN 14080:2013 maximum allowed glue line thickness is 1,5mm

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.

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.

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 "Glue waste disposal - Prevention of pollution".

Safety precautions

Reference is made to the Safety Data Sheet for Prefere 4546 and hardeners Prefere 5020, Prefere 5021, Prefere 5022 and Prefere 5093.

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.

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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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Replaces Technical Data Sheet dated 09.2017

RB/TS 06.2018