



## **CASCOPHEN® RF-325, RF-350 and RF 375 with CASCOSET® FM-6310L Hardener For Radio Frequency Bonding of Timber Laminates**

### **Description**

CASCOPHEN® Resins RF-325, RF-350 and RF-375 with hardener CASCOSET® FM-6310L are two component phenol resorcinol-formaldehyde adhesives that are formulated for use in radio frequency cure applications. The conductivity of these resins is closely controlled. The resin is less conductive than typical phenol-resorcinol formaldehyde adhesives, but is significantly more conductive than resorcinol-formaldehyde adhesives. These resins are recommended for the manufacture of structural laminated timbers made from soft wood lumber such as Douglas fir and Southern Yellow Pine. Prerequisites for the use of this adhesive include closely controlled, uniform adhesive spreading, kiln dried lumber with equilibrium moisture content in the range of 8-12% and uniform distribution of radio frequency energy across the entire platen area. The radio frequency curing equipment may be batch or continuous.

Because of the rapid cure speed of these resins with FM-6310L, they must be meter mixed. They are not recommended for cold set applications.

### **Storage Conditions**

RF-325, 350 and 375 resins should be stored in a closed container or tank at 21°C (70°F). At these conditions, the resin will remain in satisfactory, usable condition for at least nine months. Containers must be kept tightly closed to prevent loss of solvent.

Hardener FM-6310L is a tan, free flowing liquid that will remain usable for at least 2 ½ months when stored at 21°C (70°F) in a sealed container. Adequate ventilation to remove vapors should be provided in the storage area. The oldest inventory should be used first.

### **Mixing Containers and Equipment**

All mixing and spreading equipment should be clean and free from acids or alkalies. Containers that have been used to prepare other types of adhesive, such as urea-formaldehyde, melamine-urea formaldehyde and polyvinyl acetate, should be thoroughly cleaned because contamination may affect the usable life of the adhesive or cause premature gelation.

### **Use of the Liquid Hardener**

The ready-to-use hardener usually comes in drums or totes. Some settling of the filler components may occur during shipment. It is advisable, therefore, that the contents of drums and totes be transferred to a day-use container with enough capacity to hold all the contents of a drum of tote. The day-use reservoir should be equipped with mild agitation capability so that settled contents may be stirred back into suspension. FM-6310L can be continuously agitated, but does not have to be. A stirring schedule of 10 minutes every 3 hours will be enough to keep the mixture homogeneous. To reduce formaldehyde emissions, maintaining the temperature of the liquid hardener at 60-65°F is recommended.

## Adhesive Mixing

The flow rate of the resin and hardener streams should be monitored and adjusted to ensure that the mix ratio is 2.2-2.6 parts resin to 1 part hardener. A lower proportion of resin to hardener will moderately decrease reactivity, or gel time, of the mix. A higher proportion will lengthen the gel time. The ratio range is intended to allow for adjustments in assembly time in response to seasonal changes. The total flow rate of the mixed adhesive should be checked periodically. This will confirm that the resin and hardener pumps are functioning properly in the running mode. Also, the reactivity of the mixed adhesive should be monitored by an accelerated gel time test. This will give additional assurance that the adhesive is properly mixed.

## Radio Frequency Cure

Cascophen<sup>®</sup> RF- 325, 350 and 375 with Hardener FM-6310L are recommended for structural adhesive applications where the adhesive is cured with radio frequency equipment comprised of a generator, electrodes, a matching network of electrical leads connecting the electrodes to the generator and a hydraulic press to apply pressure during cure. Experience has shown that RF gluing is influenced by many factors, including adhesive composition; adhesive spread rate, adhesive squeeze-out, wood species, moisture content, joint design and RF equipment. The following factors must be closely controlled in order to maintain optimum performance.

The frequency of the load, the electrodes and the electrical leads must be tuned to the frequency of the generator.

Throughout the cure cycle, the output of the RF generator must be controlled to prevent arcing. An RF generator set to cure urea or urea modified melamine adhesives may require adjustments in the electrical output in order to run resorcinol containing adhesives.

Adhesive spread rate and assembly time must be regulated and closely controlled to minimize squeeze-out and maintain adequate adhesive in the glue line.

Electrode configuration with respect to the glue lines is critical.

There are many methods for estimating RF cure requirements. These methods are dependent upon relative position of the glue lines with respect to the electrodes and at best give a rough estimate and of the cure cycle. Most radio frequency laminated beam presses heat parallel to the glue line. In this equipment, the glue lines are placed between the electrodes parallel to the RF field. The glue lines have a higher dielectric loss factor than the wood and selectively receive the RF energy. For this reason, the glue lines heat faster than the wood



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and cure rapidly. It has been estimated that 100 square inches of glue line will cure within 60 seconds at 1 kilowatt of RF power. However, some energy is lost in heating the mass of wood between the electrodes. As the size of the member to be cured increases, more energy is lost heating the lumber and longer cure cycles will be required.

Although arcing in the glue line can virtually be eliminated, occasional arcs may occur. When arcing with carbonization occurs, the damaged lumber must be removed from the press and all carbon deposits must be removed from the electrodes.

## **General Lamination Information**

### **Lumber Preparation**

The moisture content of the lumber to be bonded should be in the range of 8-16%, preferably 10-12%. Moisture contents above 16% may lead to starved glue joints due to over-penetration of the adhesive. Moisture contents below 8% will limit the permissible assembly period, especially when the ambient temperature is above 80°F. Moisture contents outside the ranges specified may cause checks and dimensional changes both during the curing process and when the laminate is in service. It is desirable to use lumber having lower equilibrium moisture content than that likely to be attained in service. The moisture content of adjacent laminations should not vary by more than 3% and the range of moisture content of all laminations in a beam should not exceed 5%.

For best results the wood to be bonded should be surfaced within 24 hours before gluing so that smooth, clean, accurately fitting surfaces are provided. Surfaces should be free from raised or torn grain, skips, burns, glaze or other imperfections that will prevent good contact. Lumber that is cupped or warped so much that it cannot be straightened when pressure is applied should not be used.

The temperature of the lumber should be at least 50°F. The plant should be equipped to raise the glue line temperature to at least 70°F while pressure is applied.

### **Spreading**

The adhesive can be applied with roll spreading equipment or by ribbon extruder. When an extruder is used, the adhesive is normally applied to only one surface. Spreads of 40-60 pounds of adhesive per thousand square feet of glue line are recommended for radio frequency cure applications.



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## Assembly Period

Open assembly time is the time between spreading the adhesive and placing the surfaces to be bonded in contact with each other. Closed assembly time is the time the surfaces are in contact until application of full pressure. Total assembly time is the time between spreading the adhesive and the application of final pressure, the sum of both open and closed assembly time.

The size of the package that can be bonded is governed by the assembly limits of the adhesive mix. The permissible assembly time with a given adhesive will vary depending on the ambient and wood temperatures, relative humidity, moisture content of the lumber, amount of adhesive spread, and the method of application. The assembly time is also affected by the age of the mix when spread. In any event, the package should be clamped and under full pressure before the spread surfaces become dry to the touch. A slight "squeeze out" or bead of adhesive along the edge of all joints when the pressure is applied is a good indication that the spread is adequate and the permissible assembly time has not been exceeded. Excessive "squeeze out" may indicate too short an assembly time, too heavy a spread, excessive pressure, or combinations of these three factors. A starved joint with poor bond quality may result.

These resins catalyzed with the hardener FM-6310L can withstand 15 minutes of open and 30 minutes of total assembly time when spread at a rate of 45 pounds while stock temperatures are in the ranges listed below.

Cascophen<sup>®</sup> RF-325 with FM-6310L hardener can withstand 15 minutes of open and 30 minutes of total assembly time when spread at a rate of 45 pounds while stock temperatures are 75-85°F.

Cascophen<sup>®</sup> RF-350 with FM-6310L hardener can withstand 15 minutes of open and 30 minutes of total assembly time when spread at a rate of 45 pounds while stock temperatures are 65 - 75°F.

Cascophen<sup>®</sup> RF-375 with FM-6310L hardener can withstand 15 minutes of open and 30 minutes of total assembly time when spread at a rate of 45 pounds while stock temperatures are 55 - 65°F.

Different spread rates and stock temperatures will alter these general guidelines.



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Mixes of these resins described in this bulletin are thixotropic and ideally suited for single spread bead application. Longer open assembly or lower adhesive spread are generally permissible with single spread, bead application because the surface area of the adhesive exposed to air is significantly less than when double spread roll coating is the means of application. Extrusion is an excellent method of adhesive application for the fabrication of laminated members. This technique permits lower volume, uniform adhesive spread. However, care must be exercised to select the proper spread level, which should be dictated by the time required to apply, assemble and clamp the member, taking into consideration lumber temperature and moisture content, as well as ambient conditions of temperature and relative humidity.

## Pressure

Pressures in the range of 125-150 psi are recommended for Northwest softwoods. 150-175 psi is recommended for Southern Yellow Pine. The glue line thickness should be 0.002-0.010 inches.

## Curing Temperature

These resins with FM-6310L have a recommended, 190°F inner glue line temperature, coming out of the radio frequency press for adequate cure. The mixed adhesive will post-cure, or pick up strength after the glue line begins to cure. If adequate temperature has not been achieved, or if the temperature is marginal, care should be taken to handle the beams gently after they come out of the press so that the glue line is not disturbed during the post-cure period. Lower inner glue line temperatures may be, used with supporting in-plant quality tests, verifying shear and delamination performance.

## Precautions

When Cascophen® RF-325, 350 and 375 are handled with proper protective equipment; worker exposure to hazardous components should remain within permissible limits. See the Material Safety Data Sheet for both resin and hardener for a description of potential health hazards. High standards of cleanliness will minimize health risks.

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Before using any Hexion Inc. product, please be sure to read the Safety Data Sheet, which was included with the shipment.

For more information contact your local Hexion Sales Representative or Customer Service Center (866) 443-9466.



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Attached Technical Data Sheet

## CASCOPHEN<sup>®</sup> RF-325 WITH CASCOSET<sup>®</sup> FM-6310L

Cascophen RF-325 is a phenol, resorcinol formaldehyde resin formulated for structural applications. Cascoset FM-6310L is a paraformaldehyde, hardener powder that is mixed with water at the customer's plant. RF-325 with FM-6310L hardener has met the requirements of ASTM D 2559 accelerated weatherization testing. These specifications should be understood as applicable to components and mixes at time of manufacture.

### Typical Physical Properties (at time of manufacture) using RF325:

PROPERTY	SPECIFICATION	UNITS	TEST METHOD
Viscosity – Resin	4,500-8,000	cps	(Brookfield <sup>1</sup> #3/spindle/20 rpm/25°C/1 min)
– Hardener	2,000-5,000	cps	(#4/20/21°C/5 min)
Mix Ratio	2.2-2.6/1	by weight	resin/hardener
Mix Viscosity	4,000-8,000	cps	(#4/20/21°C/1 min)
Gel Time	100 - 130	min.	<sup>2</sup> 50 gram controlled exotherm
Storage Life – Resin	9	months	@21°C
Screening – Resin	50	mesh	American National Standard
– Hardener Powder	22	mesh	American National Standard
Specific Gravity – Resin	1.148 ± .01		21°C ambient/21°C resin
– Hardener Mix	1.140± .01		21°C ambient/21°C hardener mix
Density – Resin	9.676	lbs.	/US Gal, (Gardner Wt/Gal Cup)
– Hardener Mix	9.46-9.76	lbs.	/US Gal, (Gardner Wt/Gal Cup)
Flash Point – Resin	61	°C	Pensky-Martin, closed cup



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## CASCOPHEN<sup>®</sup> RF-350 WITH CASCOSET<sup>®</sup> FM-6310L

Cascophen RF-350 is a phenol, resorcinol formaldehyde resin formulated for structural applications. Cascoset FM-6310L is a paraformaldehyde, hardener powder that is mixed with water at the customer's plant. RF-350 with FM-6310L hardener has met the requirements of ASTM D 2559 accelerated weatherization testing. These specifications should be understood as applicable to components and mixes at time of manufacture.

### Typical Physical Properties (at time of manufacture) using RF350:

PROPERTY	SPECIFICATION	UNITS	TEST METHOD
Viscosity – Resin	4,500-8,000	cps	(Brookfield <sup>1</sup> #3/spindle/20 rpm/25°C/1 min)
– Hardener	2,000-5,000	cps	(#4/20/21°C/5 min)
Mix Ratio	2.2-2.6/1	by weight	resin/hardener
Mix Viscosity	4,000-8,000	cps	(#4/20/21°C/1 min)
Gel Time	67 - 75	min.	<sup>2</sup> 50 gram controlled exotherm
Storage Life – Resin	9	months	@21°C
Screening – Resin	50	mesh	American National Standard
– Hardener Powder	22	mesh	American National Standard
Specific Gravity – Resin	1.148 ± .01		21°C ambient/21°C resin
– Hardener Mix	1.140± .01		21°C ambient/21°C hardener mix
Density – Resin	9.676	lbs.	/US Gal, (Gardner Wt/Gal Cup)
– Hardener Mix	9.46-9.76	lbs.	/US Gal, (Gardner Wt/Gal Cup)
Flash Point – Resin	61	°C	Pensky-Martin, closed cup



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## CASCOPHEN® RF-375 WITH CASCOSET® FM-6310L

Cascophen RF-375 is a phenol, resorcinol formaldehyde resin formulated for structural applications. Cascoset FM-6310L is a paraformaldehyde, hardener powder that is mixed with water at the customer's plant. RF-375 with FM-6310L hardener has met the requirements of ASTM D 2559 accelerated weatherization testing. These specifications should be understood as applicable to components and mixes at time of manufacture.

### Typical Physical Properties (at time of manufacture) using RF375:

PROPERTY	SPECIFICATION	UNITS	TEST METHOD
Viscosity – Resin	4,500-8,000	cps	(Brookfield <sup>1</sup> #3/spindle/20 rpm/25°C/1 min)
– Hardener	2,000-5,000	cps	(#4/20/21°C/5 min)
Mix Ratio	2.2-2.6/1	by weight	resin/hardener
Mix Viscosity	4,000-8,000	cps	(#4/20/21°C/1 min)
Gel Time	45 - 55	min.	<sup>2</sup> 50 gram controlled exotherm
Storage Life – Resin	9	months	@21°C
Screening – Resin	50	mesh	American National Standard
– Hardener Powder	22	mesh	American National Standard
Specific Gravity – Resin	1.148 ± .01		21°C ambient/21°C resin
– Hardener Mix	1.140± .01		21°C ambient/21°C hardener mix
Density – Resin	9.676	lbs.	/US Gal, (Gardner Wt/Gal Cup)
– Hardener Mix	9.46-9.76	lbs.	/US Gal, (Gardner Wt/Gal Cup)
Flash Point – Resin	61	°C	Pensky-Martin, closed cup

#### Notes:

<sup>1</sup> Brookfield® is a registered trademark of Brookfield Engineering Inc.

<sup>2</sup> A 50 gram sample of fresh adhesive is placed in a circulating water bath controlled to 70°F. A thermometer and a gel stick are inserted into the sample to monitor temperature and distribute exotherm through occasional stirring. The gel is called when the glue mass breaks like toffee as the stick is pulled slowly out of the gel can.



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