Technical data sheet

OptiPLUS®

040-8079 and 040-8091
High Performance Low Shrink Tooling Resin for Infusion

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Description

OptiPLUS® 040-8079 and 040-8091 are pre-promoted resins containing reactive monomers. They are formulated for the fabrication of composite tooling using the vacuum infusion process at ambient conditions. *OptiPLUS*® tooling resins are shrink controlled resins that provide dimensional stability as well as exceptional surface quality. Infused *OptiPLUS*® tools also result in high fiber content laminates (65-70% typical), excellent strength, and very high heat resistance.

OptiPLUS® 040-8079 and 040-8091 are candidates to replace isophthalic, vinyl ester, and epoxy resins in tooling applications for both ambient and elevated temperature processes including:

- Conventional molds for hand lay-up, spray-up and infused processes
- RTM (Resin Transfer Molding) and VARTM (Vacuum Assisted Resin Transfer Molding)
- RIM (Reaction Injection Molding)
- Thermoplastic Vacuum Forming
- Elevated temperature curing of epoxy prepreg and infused epoxy resin matrix parts.

Features and Benefits

OptiPLUS® infusion grade resins offer the following features:

- Dimensional control for nearly perfect mold or master replication
- Exceptional surface quality
- Excellent heat resistance
- Superior laminate mechanical properties
- Low viscosity for excellent fiber wet out

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Typical Liquid Properties (77ºF, 25^{0}C)

Liquid properties of *OptiPLUS*® 040-8079 and 040-8091 are shown below. These values may or may not be manufacturing control criteria. They are listed as a reference guide only. Particular batches will not conform exactly to the numbers listed because storage conditions, temperature changes, age, testing equipment (type and procedure) can each have a significant effect on testing. Products with properties outside of these readings can perform acceptably. Final suitability of the product is in the end use performance.

Test	*OptiPLUS*® 040-8079	*OptiPLUS*® 040-8091
Viscosity[(1)]	105 cps	105 cps
Gel Time[(2)]	15 minutes	30 minutes
Weight per Gallon	8.7 lbs	8.7 lbs

[(1)]Brookfield LVT, spindle #2 at 60 rpm
[(2)]50 g mass, 1.5% Syrgis NOROX® MEKP-9

Physical Properties

The physical properties of *OptiPLUS*® 040-8079 and 040-8091 are shown below. Properties are shown for both neat resins casting and for a glass fiber reinforced laminates. These are typical values and are provided for reference only. Note: The physical properties of thermoset resins evolve as the resin cures. The properties given below are for well cured castings and laminates. Resin and laminates at different stages of cure will have varying properties.

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Test	Test Method[1]	Neat Resin Casting[2]	Laminate[3]
Tensile Strength	ASTM D638	7,900 psi	40,300 psi
Tensile Modulus		506,000 psi	2,677,000 psi
Tensile Elongation		2.05%	2.44%
Flexural Strength	ASTM D790	12,300 psi	51,100 psi
Flexural Modulus		472,000 psi	2,404,000 psi
Compression Strength	ASTM D695	--	34,100 psi
Compression Modulus		--	1,808,000
Inter-laminar Shear Strength	ASTM D2344	--	3,470
Glass Transition Temperature, Tg[4]	Dynamic Mechanical Analysis	345ºF (174ºC)	--
CTE[5]	ASTM E289-04	---	0º - 9.4x10^{-6} in./in.ºC 45º - 10.4x10^{-6} in./in.ºC 90º - 10.3x10^{-6} in./in.ºC Z - 61.2x10^{-6} in./in.ºC

[1]All tests run per internal CCP test methods. These methods are similar to the ASTM Method listed above.
[2]Neat resin casting catalyzed with 1.5% Syrgis NOROX® MEKP-9. The casting cured and post cured at 150ºF (66^{0}C). Total cure time was 4 hours.
[3]Laminate - Resin was initiated with 2.0 % Syrgis Anodox SHP-90. Laminate schedule was 7 plies of VECTORPLY® E-QX 3600 (36.0 oz, 0°/+45°/90°/-45° Quadraxial). Laminate thickness was 0.26 in. thick. Glass content was 69.8%. The panel was cured at room temperature.
[4]Test conducted per CCP internal test method, CCP-22-TAS-TM-3008
[5]See example 2 under application for laminate schedule. Temperature range is 72^{0}F – 399^{0}F (22ºC -204ºC).

Application

Use of proper application procedures is critical to obtaining the full benefits of *OptiPLUS*® Infusion resins. Crucial process parameters include temperature, peroxide type and level, reinforcement content and laminate thickness. Prior to any large scale mold making, sample laminates should be made varying these parameters until laminate exotherm temperatures over 135ºF (57^{0}C) are achieved. Laminates with exotherm temperatures below 135ºF (57^{0}C) will have poor cure and shrinkage control. High exotherm temperatures may damage master molds. Exotherm temperatures above 160ºF (71^{0}C) should be avoided for masters made of wood, body patch, low temperature foams or other “soft” materials. The use of CCP Composites’ VSXH 2210 skin coat materials is also highly suggested with either “soft” plug materials or in extremely complex parts where glass bridging may occur. Specific tooling gel coats, such as CCPs 945 series and

barrier coat material such as CCP Composites' 965BK150 should also be considered for maximum surface profile and long term performance. Please call on your CCP technical representative or distributor for assistance with this process.

OptiPLUS® Infusion resins turn from clear amber liquid to a creamy white when it cures. This color change is a leading indicator that the product has been applied and is working properly. Temperature extremes above 200ºF (93^{0}C) should be avoided and can be controlled by passing compressed air over the backside mold surface if 200ºF (93^{0}C) temperatures are observed.

Temperature – The recommended temperature range for use of *OptiPLUS*® Infusion resin is 70-95ºF (21^{0}C-35^{0}C). Temperatures above and below this range are discouraged. However *OptiPLUS*® Infusion resins can still be processed if laminate thickness and initiator levels are adjusted and tested for the "ambient" condition.

Catalyst – *OptiPLUS*® Infusion resins are quality control tested using Syrgis NOROX® MEKP-9. Other 9% oxygen MEKP catalysts such as Arkema's Luperox™ DDM-9, and CADOX D-50 are expected to yield similar performance.

While Syrgis NOROX® MEKP-9 is used for QC purposes, alternate catalyst types may be needed to reach the required laminate exotherm. Acetylacetone peroxides (AAP) such as Syrgis Norox® Azox or AAP blends such as Syrgis Anodox SHP-90 should be considered for thin, high glass content laminates or in cool temperatures. Cumene hydoperoxide/MEKP peroxide blends may be considered for thick, lower glass content laminates or in high temperatures. Recommended CHP catalysts are those that have less than 30% CHP such as Syrgis Norox® MCP-21. The laminate schedules below are for examples only. The use of either 040-8079 or 040-8091 in these examples is fine, but realizes gel times will be different.

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Process Parameter	Example 1 (high strength)	Example 2 (thick laminate)	Example 3 (best for surface quality)
Ambient Temperature	77ºF (25^{0}C)	77ºF (25^{0}C)	77ºF (25^{0}C)
Resin Matrix	*OptiPLUS*® 040-8091	*OptiPLUS*® 040-8091	*OptiPLUS*® 040-8079
Laminate Schedule	7 plies of VECTORPLY® E-QX 3600 (36.0 oz, 0º/+45º/90º/-45º Quadraxial)	See table below for laminate schedule	See table below for laminate schedule
Catalyst	Syrgis Anodox	75% Syrgis NOROX® MEKP 925	Syrgis Anodox
	SHP-90	25% Syrgis NOROX® CHP	SHP-90
Catalyst Level	2.0%	2.25% blend	1.75%
Laminate Gel Time	40 minutes	50 minutes	20 minutes
Laminate Peak Exotherm	160ºF (71^{0}C)	165^{0}F (74^{0}C)	165^{0}F (74^{0}C)
Laminate Time to Peak	35 minutes after gel	45 minutes after gel	35 minutes after gel
Laminate Thickness	0.26 inches	0.51 inches	0.28 inches
Laminate Glass Content	69.8%	65%	67%

Layer		Example 2	Example 3
1	90^0	7500 E-Glass Fiberglass cloth	Alcan D7760 Finishing Mat
2	45^0	7500 E-Glass Fiberglass cloth	VECTORPLY® E-BXM 1715-6VC
3	90^0	VECTORPLY® E3LTi 10800	VECTORPLY® E-TLYA 3612
4	-45^0	VECTORPLY® E3LTi 10800	VECTORPLY® E-3LTi 10800
5	45^0	VECTORPLY® E3LTi 10800	
6	90^0	VECTORPLY® E3LTi 10800	
7	45^0	7500 E-Glass Fiberglass cloth	
8	90^0	7500 E-Glass Fiberglass cloth	

The catalyst level for MEKP type catalysts should not exceed 2.4% or fall below 0.9% for proper cure. Recommended range is 0.9% to 2.4% with 1.5% at 77°F (25^{0}C) being ideal. Refer to catalyst manufacturers guidelines for appropriate levels of other types of catalysts.

Glass Content – A target glass content should be determined in the laminate design stage based on the types of glass used in the laminate schedule and the amount of glass needed to achieve strength requirements. However, the glass content obtained in actual laminate fabrication will vary as process parameters vary. Decreases in glass content will increase laminate exotherms. Increasing glass content will lower laminate exotherm. Infused laminates are typically in the 60-70% glass by weight range.

Laminate Thickness – The required laminate thickness should also be determined during laminate design and is largely controlled by the laminate schedule. *OptiPLUS*® 040-8079 and 040-8091 can be used to infuse wide range of laminate thicknesses (0.25 – 2.0 inches) provided the other critical factors (temperature, catalyst type and level and glass content) are adjusted and controlled properly. Thicker laminates will reach higher exotherm temperatures than thinner laminates.

Any molds that include secondary bonding to laminates infused with *OptiPLUS*® 040-8079 and 040-8091 should be evaluated for adhesion. In some cases use of FRP adhesion promoters will be required.

Properly applied *OptiPLUS*® 040-8079 and 040-8091 cures thoroughly when processed under appropriate ambient conditions. To reach ultimate heat resistance and dimensional stability, molds can be post cured. The post cure temperature should be slightly above the maximum temperature of the process in which the mold will be used. See CCP Composites Application Guide for further information.

Caution

Do not add any material, other than peroxide catalyst to this product without the advice of a representative of CCP Composites US.

Storage

OptiPLUS® 040-8079 and 040-8091 has a shelf life of three months from date of shipment from CCP when stored at 73°F (23^{0}C) or below in a closed, factory-sealed, opaque container, and out of direct sunlight. The usage life is cut in half for every 20°F over 73°F.

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CCP COMPOSITES US
WARRANTIES, DISCLAIMERS AND LIMITATION OF LIABILITY (Rev. 10/11)

Seller warrants that: (i) Buyer shall obtain good title to the product sold hereunder, (ii) at Shipment such product shall conform to Seller's specifications; and (iii) the sale or use of such product will not infringe the claims of any U.S. patent covering the product itself, but Seller does not warrant against infringement which might arise by the use of said product in any combination with other products or arising in the operation of any process. **SELLER MAKES NO OTHER WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, EVEN IF THAT PURPOSE IS KNOWN TO SELLER. ANY APPLICATION INFORMATION OR ASSISTANCE WHICH SELLER MAY FURNISH TO BUYER IS GRATUITOUS AND SHALL IN NO WAY BE DEEMED PART OF THE SALE OF PRODUCT HEREUNDER OR A WARRANTY OF THE RESULTS OBTAINED THROUGH THE USE OF SUCH PRODUCT.**

Without limiting the generality of the foregoing, if any product fails to meet warranties mentioned above, Seller shall at Seller's option either replace the nonconforming product at no cost to Buyer or refund the Buyer the purchase price thereof. The foregoing is Buyer's sole and exclusive remedy for failure of Seller to deliver or supply product that meets the foregoing warranties. Seller's liability with respect to this contract and the product purchased under it shall not exceed the purchase price of the portion of such product as to which such liability arises. Seller shall not be liable for any injury, loss or damage, resulting from the handling or use of the product shipped hereunder whether in the manufacturing process or otherwise. In no event shall Seller be liable for special, incidental or consequential damages, including without limitations loss of profits, capital or business opportunity, downtime costs, or claims of customers or employees of Buyer. Failure to give Seller notice of any claim within thirty (30) days of shipment of the product concerned shall constitute a waiver of such claim by Buyer. Any product credit received by Buyer hereunder, if not used, shall automatically expire one (1) year from the date the credit was granted. Notwithstanding any applicable statue of limitations to the contrary, any action by Buyer relation to a claim hereunder must be instituted no later than two (2) years after the occurrence of the event upon which the claim is based. All the foregoing limitations shall apply irrespective of whether Buyer's claim is based upon breach of contract, breach of warranty, negligence, strict liability, or any other legal theory.

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COMPOSITES SAFETY INFORMATION
(October 2011)

All sales of products manufactured by CCP Composites US (CCP), and described herein, are made solely on condition that CCP's customers comply with applicable health and safety laws, regulations and orders relating to the handling of our products in the workplace. Before using, read the following information, and both the product label, and Material Safety Data Sheet pertaining to each product.

Most products contain styrene. Styrene can cause eye, skin and respiratory tract irritation. Avoid contact with eyes, skin and clothing. Impermeable gloves, safety eyewear and protective clothing should be worn during use to avoid skin and eye contact. Wash thoroughly after use.

Styrene is a solvent and may be harmful if inhaled. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Extended exposure to styrene at concentrations above the recommended exposure limits may cause central nervous system depression causing dizziness, headaches or nausea and, if overexposure is continued indefinitely, loss of consciousness, liver and kidney damage.

Do not ingest or breathe vapor, spray mists or dusts caused by applying, sanding, grinding and sawing products. Wear an appropriate NIOSH/MSHA approved and properly fitted respirator during application and use of these products until vapors, mists and dusts are exhausted, unless air monitoring demonstrates vapors, mists and dusts are below applicable exposure limits. Follow respirator manufacturer's directions for respirator use.

The International Agency for Research on Cancer (IARC) reclassified styrene as Group 2B, "possibly carcinogenic to humans." This revised classification was not based on new health data relating to either humans or animals, but on a change in the IARC classification system. The Styrene Information and Research Center does not agree with the reclassification and published the following statement: Recently published studies tracing 50,000 workers exposed to high occupational levels of styrene over a period of 45 years showed no association between styrene and cancer, no increase in cancer among styrene workers (as opposed to the average among all workers), and no increase in mortality related to styrene.

Styrene is classified by OSHA and the Department of Transportation as a flammable liquid. Flammable products should be kept away from heat, sparks, and flame. Lighting and other electrical systems in the work place should be vapor-proof and protected from breakage.

Vapors from styrene may cause flash fire. Styrene vapors are heavier than air and may concentrate in the lower levels of molds and the work area. General clean air dilution or local exhaust ventilation should be provided in volume and pattern to keep vapors well below the lower explosion limit and all air contaminants (vapor, mists and dusts) below the current permissible exposure limits in the mixing, application, curing and repair areas.

Some products may contain additional hazardous ingredients. To determine the hazardous ingredients present, their applicable exposure limits and other safety information, read the Material Safety Data Sheet for each product (identified by product number) before using. If unavailable, these can be obtained, free of charge, from your CCP representative or from: CCP Composites US, P.O. Box 419389, Kansas City, MO 64141-6389; 816-391-6053.

FIRST AID: In case of eye contact, flush immediately with plenty of water for at least 15 minutes and get medical attention; for skin, wash thoroughly with soap and water. If affected by inhalation of vapors or spray mist, remove to fresh air. If swallowed, get medical attention.

Those products have at least two components that must be mixed before use. Any mixture of components will have hazards of all components. Before opening the packages read all warning labels. Observe all precautions.

Keep containers closed when not in use. In case of spillage, absorb with inert material and dispose of in accordance with applicable regulations. Emptied containers may retain hazardous residue. Do not cut, puncture or weld on or near these containers. Follow container label warnings until containers are thoroughly cleaned or destroyed.

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