HT_2C High Temperature Tooling Compound

DESCRIPTION

HT_2C is a strong, lightweight, fiber reinforced paste epoxy system designed for preparing tools and fixtures that will be exposed to elevated service temperatures. HT_2C is a high temperature epoxy novolac system that has excellent heat resistance. The cured material exhibits very good toughness for stable, durable tools. When used in the sandwich panel construction method described here, HT_2C provides lightweight, strong, stable tools that will give long service in a variety of high temp applications. HT_2C is a syntactic paste that has lightweight micro spheres incorporated to give the cured product lighter weight for easier handling. The resin and hardener components have very smooth consistencies. They combine easily to a creamy, workable paste that is easy to handle and apply. The system is color coded to insure a uniform, consistent mix. The curing exotherm of HT_2C is very low, so shrinkage is negligible. HT_2C is a non-toxic product, for improved safety in the work place. Clean-up is easily accomplished with soap and water. Tools fabricated with HT_2C are easy to handle, have a very high strength-to-weight ratio, are very stable, and easily machined.

PRODUCT SPECIFICATIONS

	HT_2C Resin	HT_2C Hardener	ASTM Method
Color	Off-White	Black	Visual
Viscosity,	Smooth Paste	Smooth Paste	D2392
Specific Gravity, gms./cc	0.86	0.77	D1475
Mix Ratio	100 : 25 By Weight	3.6 to 1 By Volume	PTM&W
Pot Life, 4 fl.oz. Mass @ 77°F	60 minutes		D2471

DIRECTIONS for USE

Construction Method:

For general tooling applications, a sandwich construction method is recommended as follows: Apply 2 layers of epoxy surface coat to a properly prepared pattern using standard techniques. Follow with 2 or 3 layers of Style 7500 type glass cloth impregnated with high temperature laminating resin. *(See Page 4 of this bulletin for recommended surface coat and laminating systems for use in this construction method.)* A ¼ to ½ inch thick layer of HT_2C is then applied to the back of the high temp laminate. The HT_2C layer is allowed to stand until it is firm enough to proceed. Finally, an additional 2 or 3 ply layer of cloth and high temp laminating resin is applied to the back of the HT_2C.

Mixing and Applying HT_2C:

(1.) Mixing - HT_2C resin and hardener are color coded to give a visual indication of a uniform, thorough mix. Small quantities of HT_2C can be mixed by hand, but mechanical mixing is much more efficient for larger batches. Either a dough mixer or a stationary paddle 5-gallon pail mixer will do a good job of mixing HT_2C. A uniform gray color, free of light or dark streaks indicates complete mixing.

(2.) Preparing The HT_2C for Transfer To The Tool

(a.) Method 1 - Roll Out The HT_2C - A constant and uniform thickness is always desirable in a composite tool, no matter what the construction method. This approach yields the most consistent performance as well as the most efficient use of materials. A good way to achieve this with HT_2C is to utilize a "roll-out" board. This is a board 1 to 1.5 feet wide, about 3 feet long. Thickness spacers are attached to the surface so that HT_2C can be rolled out like bread dough to a uniform thickness. First, a layer of waxed kraft paper or plastic film is placed on the board. Then a quantity of mixed HT_2C is placed onto the waxed kraft paper or plastic film, and a second layer of paper or film is placed on top of the HT_2C. A large diameter PVC pipe is then used to roll the HT_2C to a uniform thickness, determined by the thickness of the spacers.

(b.) Method 2 - Hand Application To The Tool – Instead of the roll out method of application, some prefer to apply the mixed HT_2C to the tool by hand. In this instance, the mixed HT_2C is molded into a ball shape approximately the size of a softball or grapefruit. The HT_2C "ball" is then applied to the tool as described below.

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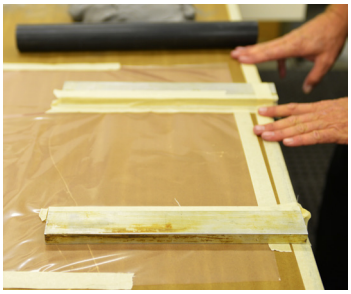
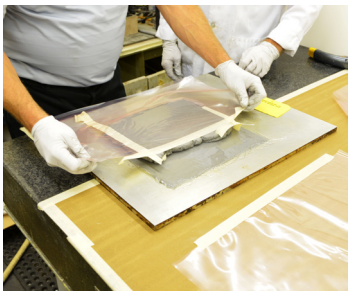
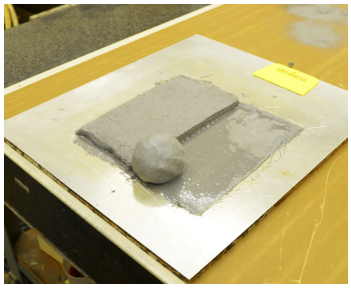
(3.) Transfer to the Tool – **(A.)** If using the roll out method with HT_2C, cut the rolled out material into manageable pieces of approximately 1 square foot. Then transfer the HT_2C to the tool and lay it onto the wet top layer of the laminating resin. The mixed HT_2C has good cohesive properties, and is not crumbly, so the transfer is easy to do. In placing the pieces of HT_2C, be sure to butt the adjoining edges together properly so that there are no voids in the tool, which would cause weak spots. Also, press the HT_2C firmly into the wet resin layer, so that there are no voids just behind the tool surface. A "tie coat" is sometimes used between the laminate and HT_2C layer to provide uniform contact with the laminate and minimize trapped air between the layers. A quantity of mixed HT_2C is diluted with mixed high temperature laminating resin and hardener to yield a thick, paintable consistency, and brushed onto the laminate before the HT_2C pieces are applied. This "tie coat" provides a good bond, and fills any small gaps between the layers, for better cured performance.
(B.) If you prefer to apply the HT_2C to the tool surface by hand, place the HT_2C "ball" onto the wet top layer of the laminating resin. At this point, begin pressing the HT_2C to flatten the ball and spread the material over the surface to a uniform thickness. The very nature of this action will press the HT_2C into the surface, providing good contact with the surface and minimizing trapped air between the layers. Continue to add additional "balls" to the surface to cover the area and complete the application. Again, be sure to butt the adjoining edges together properly so that there are no voids in the tool, which would cause weak spots. As with the roll out method, a tie coat, as described above, can be used when applying HT_2C by hand.

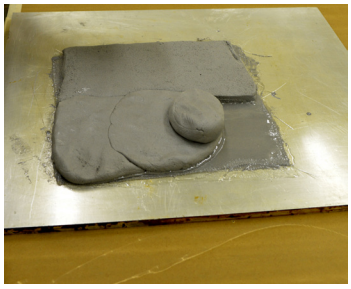
These Pictures Illustrate Both Methods of Preparing The HT_2C for Application To The Tool:
The Roll Out Method:



The Hand Application Method:






(4.) The Backing Laminate - When completing the tool, the HT_2C must be allowed to firm up somewhat before the backing laminate is applied. Thirty to forty minutes is usually sufficient, but the actual time required will depend upon the ambient temperature in the shop. After the HT_2C is firm enough, the top layers of epoxy and fiberglass are applied, and the tool is ready for curing. A "tie coat" is not needed with the backing laminate, as the laminating resin will naturally soak into the HT_2C a little, bonding well.
(5.) Curing The Tool - HT_2C will gel at room temperature, but requires an oven post cure before service. Always allow the HT_2C tools to gel completely at room temperature before post curing - 18 to 24 hours is usually sufficient. After the room temp. cure, HT_2C tools can be post cured either supported on the pattern, or free standing. Whenever possible, a supported post cure is always recommended for that extra margin of insurance against distortion. In either case, post cure the tool as follows:

a. Place the tool in a cold oven and slowly raise the temperature to 150°F, and hold for 3 to 4 hours.**
b. Then, slowly raise the temperature to 250°F, and hold for 3 to 4 hours.
c. Then, raise the temperature to 350°F, and hold for 4 hours.
d. Allow the oven to cool to room temperature. Then the tool can be removed, cleaned up and put into service.

** It should be noted that the post cure temperature stages refer to the temperature of the tool. Thermocouples are typically used to insure that the tool has reached the required temperature at each stage, before the specified time at temperature is begun.

TYPICAL MECHANICAL PROPERTIES

	HT_2C Part A / Part B	ASTM Method
Mix Ratio, By Weight	100 : 25 By Wt. 3.6 to 1 By Volume	PTM&W
Color	Gray	Visual
Mixed Viscosity, centipoise	Smooth Cohesive Paste	D2393
Pot Life, 4 fl. Oz. Mass, @77°F	60 minutes	D2471
Exotherm, 1 Pound Mass	142°F	
Cured Hardness, Shore D	80 Shore D	D2240
Shrinkage, inch/inch, Mold Number, Volume	Nil	D2566
Specific Gravity, grams, cc	0.79	D1475
Density, lb./cu. Inch	.029	D792
Specific Volume, cu. in. / lb.	35.0	
25 lb. Pail Kit Coverage @ 1/2 inch Thickness	12.2 Square Feet	PTM&W
Ultimate Flexural Strength, (Panel), psi	16,000 psi	D790
Flexural Modulus, (Panel), psi	1,073,272 psi	
Compressive Strength, (Panel), psi	8,900 psi	D695
Glass Transition Temperature, Tg (Peak)	315°F	D648
Coefficient of Thermal Expansion, Range 125°F to 300°F	1.620×10^{-5} in./in./ °F	D696

PACKAGING WEIGHTS

	5-GALLON PAIL KIT
HT_2C RESIN	20 lb.
HT_2C HARDENER	5 lb.
KIT	25 lb.
Pail Kit Coverage @ 1/4" Thickness	24.3 Square Feet

SAFETY and HANDLING

PTM&W epoxy products are made from raw materials carefully chosen to minimize or even eliminate toxic chemicals, and therefore offer the user high performance products with minimum hazard potential when properly used. Generally, the PTM&W epoxy resins and hardeners will present no handling problems if users exercise care to protect the skin and eyes, and if good ventilation is provided in the work areas. However, breathing of mist or vapors may cause allergenic respiratory reaction, especially in highly sensitive individuals. As such, avoid contact with eyes and skin, and avoid breathing vapors. Wear protective rubber apron, clothing, nitrile rubber gloves, face shield or other items as required to prevent contact with the skin. In case of skin contact, immediately wash with soap and water, followed by a rinse of the area with vinegar, and then a further wash with soap and water. The vinegar will neutralize the hardener and lessen the chances of long term effects. Use goggles, a face shield, safety glasses or other items as required to prevent contact with the eyes. If material gets into the eyes, immediately flush with water for at least 15 minutes and call a physician. Generally, keep the work area as uncluttered and clean as possible, and clean up any minor spills immediately to prevent accidental skin contact at a later time. Keep tools clean and properly stored. Dispose of trash and empty containers properly. Do not use any of these types of products until Material Safety Data Sheets have been read and understood.

Surface Coats & Laminating Systems

HIGH TEMPERATURE EPOXY SURFACE COATS

PT1540	Black graphite filled surface coat for high temperature service, with a smooth paintable viscosity.
PT1554	Gray general purpose aluminum filled surface coat system with slightly lower viscosity.
PT1995	Black graphite filled surface coat for high temperature service, with thermal expansion characteristics designed for high performance composite tooling

SURFACE COAT PROPERTIES

	PT1540 A/B	PT1554 A/B	PT1995 A/B
Color	Black	Gray	Black
Mix Ratio, By Weight	100 : 15	100 : 12	100 - 12
Pot Life, 4 fl.oz. @ 77°F	20 - 25 minutes	25 - 30 minutes	50 - 60 minutes
Glass Transition Temperature, Peak	271°F	260°F	310°F

HIGH TEMPERATURE EPOXY LAMINATING SYSTEMS

PT2520	Medium viscosity, unfilled, light amber laminating resin that is designed for the construction of tooling and components that will operate in the intermediate high temperature range. Cured structures are durable and have good heat resistance .
PT2846	Amber unfilled high temperature epoxy laminating resin designed specifically for demanding high performance composite tooling. Good handling and fabric penetration, and very high physical properties.

LAMINATING SYSTEMS PROPERTIES

	PT2520 A/B	PT2846 A/B
Color	Amber	Amber
Mix Ratio, By Weight	100 : 16	100 : 19
Viscosity, cps	1900 cps	4,000 - 4,500 cps
Pot Life, 4 fl.oz. @ 77°F	45 - 50 minutes	40 - 45 minutes
Glass Transition Temperature, Peak	272°F	308°F

MIXING EQUIPMENT FOR HT_2C:

Stationary paddle 5-gallon pail mixers do a good job of mixing HT_2C. Available from most industrial supply houses.

Commercial dough mixers work well for mixing larger quantities of HT_2C. Check with restaurant suppliers or used equipment dealers, for a good used machine.

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