Laser Strip: A Portable Hand-Held Laser Stripping Device for Reducing VOC, Toxic and Particulate Emissions

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ABSTRACT

Paint stripping formulations and methods used today result in emissions of Volatile Organic Compounds (VOCs), toxic air contaminants, particulate matter and various metals. The techniques also lead to generation of a substantial amount of hazardous waste. Water use and contamination and high energy use for controls can also result from use of some of the methods.

An alternative method of stripping paint that minimizes air emissions, waste, water pollution and energy use has been developed by Laser Strip. The company assembled a portable hand-held carbon dioxide laser stripping device. Laser Strip partnered with the Institute for Research and Technical Assistance (IRTA), a small nonprofit technical environmental organization, and Southern California Edison, a large electric utility, to conduct an Innovative Clean Air Technology (ICAT) project. This project involved conducting four demonstrations of the laser stripping device in applications where it might offer an environmental and cost advantage. The applications included aircraft and aircraft parts stripping, water storage tank stripping, ground vehicle stripping and Navy parts and hull paint stripping.

The laser prototype device had low power and was designed to demonstrate the feasibility of the concept. Laser Strip is building two larger lasers, one a portable laser and the other a fixed laser which will have a much higher strip rate. The cost of stripping with one of these larger laser stripping devices was compared with the cost of stripping with the method that is used conventionally in the four applications where the prototype was demonstrated. The results indicate that the cost of using a laser for stripping is lower than the cost of using alternative technologies except in cases where a substantial amount of surface area must be stripped or the coating to be stripped is very thick. The laser offers a number of advantages over conventional stripping methods. It has lower energy requirements, it is easy to use, it minimizes air emissions of VOCs, toxics and particulate matter and it generates a much lower volume of waste. A conference that involved demonstrating the prototype device was held to communicate the project findings to interested parties.

I. INTRODUCTION AND TECHNOLOGY DESCRIPTION

For several years, there have been attempts to develop a portable laser system that could cost effectively strip paint, coatings and other contaminants of various kinds from surfaces. Such a technology could reduce or eliminate the use of chemical and abrasive strippers that generate Volatile Organic Compound (VOC), toxic and particulate emissions, generate large quantities of hazardous waste and often pollute water bodies.

This project involved testing and demonstrating a portable laser device in four stripping applications where such a laser system could be used. The laser successfully stripped a variety of different paints applied to a range of substrates. The project also involved performing a cost analysis of using a laser for stripping in the four applications and comparing the cost of using the device to the cost of using the most commonly used conventional stripping method. The results indicate that the laser stripping technology holds promise for some applications.

Description of Laser Technology

A portable hand-held pulsed carbon dioxide laser has been developed by Laser Strip Corporation for stripping paints or contaminants from surfaces of various kinds including metals, composites and concrete. The laser generates pulses in the 10.6 micron infra-red wavelength range. The light is absorbed by paints or other contaminants and the high peak power results in a small explosion of the paint or contaminant which is vaporized. The light is not absorbed by the substrate and the laser can be tuned to remove coatings or contaminants one at a time. The paint or contaminant is drawn through a High Efficiency Particulate Arrestor (HEPA) filtration system as it is blown from the surface, removing it from the airflow and the air is returned to the atmosphere.

Pulsed carbon dioxide lasers have been around since the 1960s. Although these lasers could deliver high peak power and high energy per pulse, they could not be pulsed at a high enough rate to economically strip paint. The problem was known as thermal bottlenecking. Even though the efficiency of the carbon dioxide laser is high compared to other types of lasers, it is still only in the neighborhood of 10 percent. A huge amount of energy must go into heating the gas mixture and this heat must be removed or the gas must be replaced before the laser can be pulsed again.

Previous approaches utilized large blowers designed to operate at low pressure (usually less than $1/40^{th}$ of atmospheric pressure) to circulate the gas through the cavity and heat exchangers to remove the heat. These devices were the size of a room. One innovation of the Laser Strip system is the resolution of the cooling problem. The gas in the laser is moved by an internal fan and is alternatively pulsed and cooled in alternating chambers. Resolution of the cooling problem made it possible to develop a compact laser which delivers the required pulse characteristics for stripping paint and other contaminants. The prototype device can easily be moved around an aircraft or inside enclosures and it can be

held in a worker's hand for stripping. It is small enough to fit in a pickup truck and has its own trailer for transport.

Another innovation of the Laser Strip system is a new method of exciting the laser's plasma. It involves a technique for generating and applying a string of nanosecond time scale, ultra high voltage pulses to the plasma. No other laser is capable of meeting the same physical requirements and operating reliably for extended periods of time.

There is one major patent, US6,771,684 B2, that describes in detail the features of the laser stripping system that was used during this project. The patent is assigned to Dr. Alan Hill and he has licensed the technology to Laser Strip.

Advantages of the Laser Strip System

Many different types of technologies are used today to strip paint or contaminants from surfaces. They include:

- Manual removal techniques like sanding with sand paper or abrasive discs and scraping with wire brushes
- Abrasive blasting methods using sand, steel shot, plastic media, wheat starch media, sodium bicarbonate and water
- Thermal methods like steam or burn-off ovens
- Chemical methods using methylene chloride or VOC solvent based strippers

Manual removal methods are obviously very labor intensive and therefore costly and slow. In aircraft stripping, this method is not selective. It not only removes the coating, it also removes the aluminum clad and/or anodizing as well. Stress cracks can also be created and can remain undetected by a buildup of paint dust.

Abrasive blasting methods all rely on a medium to abrade the paint or contaminant from the surface of the substrate. The paint residue and the stripping medium residue together account for a very large volume of material that is emitted to the atmosphere, is discharged to the wastewater treatment system or is disposed of as waste. This large volume of material has to be controlled or treated at a high cost. Generally, blasting technologies require a very high capital investment. Sand and steel shot blasting can damage some substrates and the particulate emissions must be captured. Plastic media and wheat starch blasting can harm substrates if they are not controlled carefully and cracks in the substrate may be masked by the dust. Medium pressure water blasting and sodium carbonate blasting also require large capital investments.

Steam stripping, like water blasting, creates a large volume of wastewater that must be treated and/or disposed of, again at a high cost. This process must also be carefully controlled so that substrate damage does not occur. Use of burn-off ovens for stripping is energy intensive and generates large amounts of NOx emissions.

Methylene chloride has been used for paint stripping for many years. The chemical is a carcinogen and is classified as a Toxic Air Contaminant (TAC) in California. Stripping

with methylene chloride strippers generates air emissions and a large volume of hazardous waste that requires disposal. Other chemical strippers based on n-methyl pyrrolidone have been used more recently. They are not very effective and the chemical is a VOC and a reproductive and developmental toxin. Again, the material is emitted and a large volume of waste is generated.

A major advantage of the Laser Strip system over these other technologies is that, because light is the stripping medium, no emissions or waste material other than the ablated coating residue is generated during the stripping process. The ablated coating remains on the surface of the substrate and looks like char. The vacuum system attached to the laser collects the particulate coating residue which is small in volume. Previous work indicates that the organic content of the paint film is largely converted to carbon dioxide and water (Head and Niedzielski) but this issue may have to be pursued in more detail if large scale systems are used. Another advantage of the system is that it does poses a minimal health hazard to workers or community members from emissions of particulates, carcinogens or reproductive toxins. Still another advantage of laser stripping is that it has significantly lower energy use than the other conventional technologies. Finally, because the laser is portable and hand-held, it provides a convenience in use that other technologies generally do not.

Companies that use chemical strippers containing methylene chloride or VOC solvents are generally required to have control devices installed in their facilities. Companies stripping with blasting media are required to use control devices like bag houses. Use of the laser technology would not require a control device. Users could meet emission standards without the need for a control device and this would reduce capital and operating costs. Use of the laser technology would also reduce energy use and costs for the users compared with some of the technologies used today. Use of the laser would significantly reduce the generation of waste and cost of waste disposal.

Potential Applications for Laser Stripping

There are a variety of possible applications for the Laser Strip technology. One of these is aircraft stripping. There are a number of companies, small and large, that perform aircraft maintenance which can involve stripping and painting corporate jets and various types of commercial and military aircraft. Historically, methylene chloride based strippers have been used for stripping the coatings from aircraft. Many aircraft stripping operations still rely on methylene chloride and others have converted to less effective VOC strippers or abrasive media blasting of different types. Methylene chloride based strippers have also been used by wheel manufacturers to strip polyester coatings from wheels.

Other potential applications for the technology include stripping various metal substrates like large storage tanks, bridges, oil platforms, ship hulls, ship internal tanks and ground vehicles of various types. Hundreds of companies in California that perform these operations use abrasive blasting processes of various types. Steel shot is used by many companies including engine rebuilders. Sand blasting is used routinely for stripping

metal parts or vehicles. All of these types of operations are potential candidates to adopt the Laser Strip technology.

Many companies use water blasting to strip paint and graffiti from buildings and other structures. These companies could potentially use the Laser Strip device as an alternative.

All of these possible customers could realize a cost savings from adopting the laser technology. Companies that do chemical stripping generally have control devices that are expensive to purchase and operate and are energy intensive. Disposal of the chemical strippers is also costly. Companies that use media to strip have baghouses for control. These control methods, again, are very costly to purchase and operate and have high energy requirements. Again, disposal of the media is an additional expense. Companies that use water blasting do not require controls for air emissions but they may be required to collect the effluent from the operation. They would then need to treat the effluent before discharging it or ship it off-site for disposal. The laser technology would make it unnecessary to have control devices or effluent collection and treatment and waste disposal costs would be reduced substantially. Some companies with permit limits on their control devices could increase their throughput through use of the laser.

Business Model

Laser Strip plans to build portable hand-held units that could be leased to California companies that would perform stripping services. Laser Strip also plans to perform the service themselves in the early years. In some cases, military bases in California for example, the customer might want to purchase a unit. Laser Strip also plans to build large fixed lasers based on the same technology. In principle, hundreds and perhaps thousands of facilities in California could either purchase the device or lease the service and use the laser for stripping.

Project Approach

A project team was assembled for this project to conduct the testing and evaluate the results. The team consisted of Laser Strip, the technology developer, the Institute for Research and Technical Assistance (IRTA), a technical nonprofit organization and Southern California Edison (Edison), a large electric utility interested in finding new technologies for their customers. A 100 watt portable hand-held prototype was tested in four applications during the project. These included:

- stripping aircraft components at Aero Pro, an aircraft maintenance facility located at the San Bernardino Airport
- stripping a large steel water storage tank at the San Bernardino Airport
- stripping ground vehicles at the Barstow Marine Base
- stripping ship components and panels at the Navy Southwest Regional Maintenance Center, located in San Diego

Laser Strip is currently building a more powerful portable laser that is designed to have the same footprint as the prototype tested during this project. The new laser will have a power level of 3,000 watts, 30 times that of the laser used during the project. The strip rate is roughly proportional to the power and the new laser should be able to strip 30 times faster than the prototype. Laser Strip is also building a much larger fixed laser that will have a power level of 6,000 watts and plans to offer fixed lasers for sale to customers with greater stripping needs.

Structure of Document

This document focuses on the results of the testing conducted during the project. Sections II, III, IV and V present the results of the aircraft parts stripping, the water storage tank stripping, the ground vehicle stripping and the ship component and panel stripping respectively. In all cases, the project team conducted a cost analysis for the laser and a comparison of the cost of using the laser technology in place of the technology most commonly used currently. Cost information on the stripping processes was obtained from the facilities where the demonstrations were conducted or from contractors who offer stripping services. Cost information on the laser stripping process was provided by Laser Strip. The cost analysis assumes that the more powerful portable 3,000 watt laser will be available for the stripping and that a larger fixed laser will also be available for certain potential users. All assumptions used for the analysis are presented clearly. Section VI describes a conference and demonstration that were held to disseminate the results of the research. Section VII summarizes the results of the project. Finally, Section VIII provides a list of references.

II. AIRCRAFT COMPONENT STRIPPING AT AERO PRO

This section focuses on the testing that was conducted at Aero Pro, the aircraft maintenance facility, on several different aircraft components. The company, like most other aircraft stripping companies, uses methylene chloride based strippers currently. The section provides background on the paints used on aircraft and also includes a cost analysis and comparison of using the laser technology in place of the methylene chloride stripping used today.

Background on Aircraft Stripping

Aircraft coatings generally consist of an epoxy primer and a polyurethane topcoat. Material Safety Data Sheets (MSDSs) for a typical coating system are shown in Appendix A. The first three MSDSs represent an epoxy primer system consisting of the HS Epoxy Yellow Primer, a Solvent Catalyst SC-11 and Epoxy Hardener, High Solids EH-12. The next two MSDSs show a high fill polyurethane topcoat system that is sanded during application. These include the Conventional Urethane Surfacer Primer SP-11 and the Polyurethane Curing Solution PH-20. After this polyurethane system is sanded, another polyurethane topcoat system is applied. This system consists of High Solids Matterhorn White Polyurethane Topcoat PG-6-W83 and Polyurethane Curing Solution PH-34. MSDSs for these coatings are also provided in Appendix A.

Laser Stripping Demonstration for Aircraft Parts

For the aircraft stripping demonstration, the project team used the prototype laser stripping device to strip the coatings systems described above from three types of substrates. These include:

- a 727 engine cowling made of aluminum
- a Krueger flap made of magnesium
- an aileron made of graphite and aluminum

Composite materials like honeycomb glass and graphite cannot be stripped with conventional methylene chloride stripping formulations because of incompatibility. The same is true of the Krueger flaps which are made of magnesium. As aircraft are increasingly made of composite, other technologies will be needed. It is important to include such materials in the stripping tests. The project team did not expect to be able to strip the radome or the graphite portion of the aileron because of the long pulse rate of the 100 watt laser prototype. The long pulse duration causes the laser to dwell on the composite material for a substantial period of time and it is destroyed in the process. The larger laser which is under development has a very short pulse rate. The dwell time is minimized and the composite can be effectively stripped without being destroyed.

A picture of the laser system used during the aircraft parts stripping is shown in Figure 2-1. A picture of the generator used to power the laser is shown in Figure 2-2. A picture of the arm connected to the laser is shown in Figure 2-3.

Figure 2-1. Laser System

Figure 2-2. Generator Used with Laser

Figure 2-3. Laser Arm Connected to Laser

For the aircraft parts stripping, portions of three items were stripped. The first item was an engine cowling made of aluminum which was removed from the aircraft for the test. The cowling contained a Chemical Agent Resistant Coating (CARC) which had an average thickness of 3.9 millimeters. CARC is a very hard paint and is difficult to strip. A section of the cowling was taped off and stripped. The section included a seam. The taped section of the engine cowling is shown in Figure 2-4. A picture of the Laser Strip owner, Joe Ermalovich, stripping the section is shown in Figure 2-5. Figure 2-6 shows the stripped portion of the cowling; the rivets in the cowling are clearly visible.

Figure 2-4. Engine Cowling Taped Off

Figure 2-5. Cowling Being Stripped

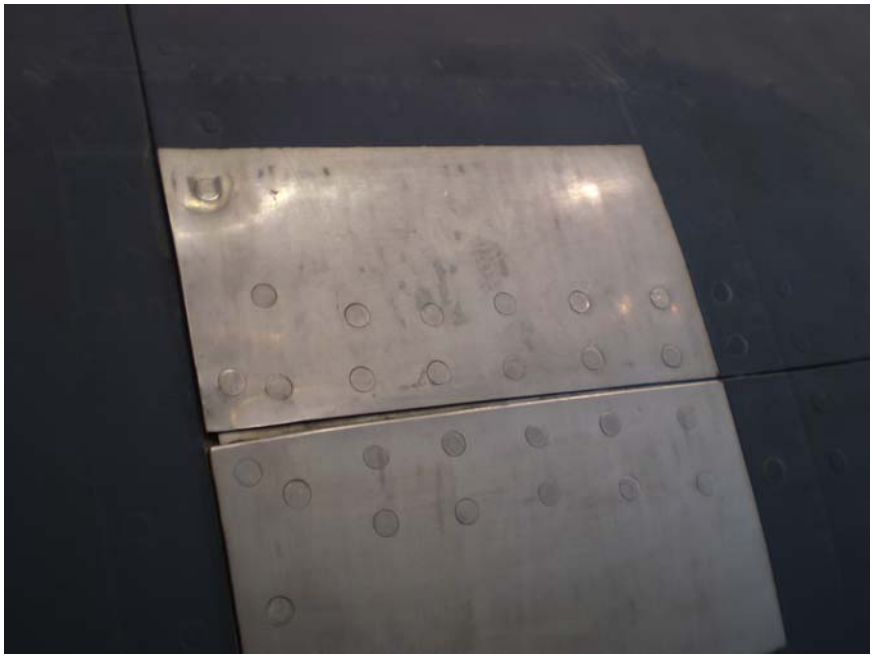

Figure 2-6. Cowling after Stripping

The second item stripped during the demonstration was a Krueger Flap made of magnesium on a 727 aircraft that was being worked on at the hanger. A picture of a section of the Krueger Flap containing a window is shown in Figure 2-7. The thickness of the coating combination (a primer and a topcoat) on the Krueger flap was measured at 14.5 millimeters. A picture of the Krueger flap being stripped is shown in Figure 2-8. A close-up view of the stripped portion of the Krueger flap is shown in Figure 2-9; the laser was able to strip the sealant between the window and the flap, as shown in this picture.

Figure 2-7. Krueger Flap Taped Off

Figure 2-8. Krueger Flap Being Stripped

Figure 2-9. Krueger Flap after Stripping

The third item stripped was an aileron made of graphite and aluminum on the same 727 aircraft. A picture of the taped off portion of the aileron is shown in Figure 2-10. The thickness of the coating on the aileron averaged 2.35 millimeters (the coating is thinner on ailerons for weight reduction). The raised portion of the aileron is made of graphite and it was not successfully stripped by this laser. As discussed above, the laser used in the demonstration is not suitable for stripping composite materials. A larger laser with a short pulse rate capable of stripping composite is currently under development by Laser Strip. The aluminum portion of the aileron was stripped successfully as shown in Figure 2-11.

Figure 2-10. Aileron Taped Off

Figure 2-11. Aileron after Stripping

Cost Analysis for Aircraft Parts Stripping

The costs for the current stripping process using methylene chloride were provided by Aero Pro. Prior to stripping an aircraft, the portions of the aircraft that will not be stripped with the chemical stripper are masked off with four to six millimeter polyethylene plastic and barrier paper. The stripping process first involves applying the methylene chloride stripper to an aircraft and agitating the surface with brushes. The workers then apply a second application of the stripper. A tarp is placed on the floor and the stripped coating residue and stripper residue is pulled off the aircraft onto the tarp. The waste material is shoveled into a drum. The aircraft is then rinsed down with high pressure low volume heated water and the water is collected and placed in a storage tank for waste disposal.

The case study used for the cost analysis is a 727-200 fuselage and vertical stabilizers. The wings are not stripped. The area of surface required to be stripped is 5,400 square feet. The plane is masked and six workers perform the stripping operation which requires a total of 415 labor hours. The elapsed time for the stripping is 36 hours. At a labor rate of $65 per hour, the total labor cost is $26,975. The cost of the masking materials used in the stripping operation amounts to $1,620. Six drums of methylene chloride stripper are used during the stripping at a cost of $3,960. Hazardous waste disposal of four drums of waste coating and stripper residue generated in the process has a cost of $2,475. Some 1,200 gallons of water waste are generated during the operation; at a disposal cost of 40 cents per gallon, the disposal cost amounts to $480. The hanger where the stripping is conducted has a high air flow during the stripping to protect the workers. Three motors with 75 horsepower each are used for the fan. The energy use during the stripping operation amounts to 6039 kWh, assuming a stripping time of 36 hours. At an electricity

rate of 12 cents per kWh, the total energy cost is $725. Taking into account all these costs, the total cost of stripping the 727 aircraft with methylene chloride stripper is $36,235.

The laser tested during this project has very low power, about 100 watts when it is operating optimally. During the testing, this laser had a very low strip rate. Laser Strip is currently building a portable laser with substantially higher power, about 3 kW or 3,000 watts. Assuming the strip rate is proportional to the power output, this new laser could be expected to strip 30 times faster than the laser used during the testing. Laser Strip indicates that the strip rate for this laser will be 600 square feet per hour per millimeter of coating stripped. To be conservative, the strip rate was assumed to be somewhat lower, about 500 square feet per hour per millimeter of coating stripped. The cost analysis described below assumes this strip rate.

Laser Strip's commercialization plan involves locating four lasers each at six different locations. Laser Strip has arrived at an overall service fee of $500 per hour per machine that customers would pay. This fee includes all labor, overhead, administrative, maintenance, energy and materials costs as well as a profit for the company. Laser Strip would use a generator for the stripping operation so the host facility would not be responsible for the electricity used by the laser. Assuming that one machine is used, the $500 per hour cost of the service and the 500 square feet per hour per millimeter thickness of coating stripped leads to an overall stripping cost of $1 per square foot per millimeter of coating. Assuming 5,400 square feet of aircraft requires stripping and assuming an average thickness of coating of 4.5 millimeters based on measurements and contract requirements, the total cost of leasing the laser is $24,300.

The laser stripping, like the methylene chloride stripping, requires masking of the aircraft. The cost of the masking materials, $1,620, must be included in the laser stripping cost. The total stripping cost with the laser amounts to $25,920.

Table 2-1 summarizes and compares the costs of stripping with the methylene chloride formulation and the laser. The laser stripping cost is significantly lower than the cost of using the methylene chloride stripping process. Each of the processes would require masking of the aircraft. In the current chemical stripping process, workers must manually hand clean the skin laps and seam joints prior to resealing. The laser demonstration showed that it was capable of removing sealant. Thus the hand removal would not be necessary in the case of the laser which would reduce the labor cost. It is also not necessary to wash down the aircraft with water after stripping and very little hazardous waste is generated in the stripping process. The only waste product is the HEPA filters that capture particulate emissions.

Laser Strip's overall stripping cost of $500 per hour for the laser includes many cost components. The laser stripping rate includes the cost of leasing space for the laser operation, the administrative cost and the overhead cost of administering the laser stripping service, the materials cost (HEPA filters, gloves, etc.) and maintenance costs. The cost of stripping with the methylene chloride also includes these overhead costs; the

cost is representative of what Aero Pro routinely charges for stripping. Thus the cost elements are comparable and should be representative of the cost of stripping a 727 with methylene chloride versus the cost of stripping with a 3,000 watt laser stripping device. The cost of stripping with the laser is 28 percent lower than the cost of stripping with methylene chloride.

Table 2-1
Cost of Stripping Options for Aero Pro

	Methylene Chloride Stripping	Leasing Laser Stripping Service
Labor Cost	$26,975	-
Masking Materials Cost	$1,620	$1,620
Stripper Cost	$3,960	-
Hazardous Waste Disposal Cost	$2,475	-
Water Waste Disposal Cost	$480	-
Energy Cost	$725	-
Laser Leasing Cost	-	$24,300
Total Cost	$36,235	$25,920

III. WATER STORAGE TANK STRIPPING AT THE SAN BERNARDINO AIRPORT

This section focuses on the stripping tests that were performed on the water storage tank. The stripping method generally used for large storage tanks is sand blasting. The section includes background information on the coatings used for storage tanks and a cost analysis and comparison of using the laser technology in place of the sand blasting operation used conventionally.

Background on Water Storage Tank Stripping

The coatings that are used for applications like water storage tanks are classified as Industrial Maintenance (IM) architectural coatings. These materials generally consist of two sets of coatings. In cases where the surface is blasted, the first coating is a zinc rich primer; the zinc is used to provide a galvanic surface. The second coating is a polyurethane topcoat to seal the zinc primer. In cases where the surface is chemically stripped, the first coating is an epoxy primer and the second coating is a polyurethane or a polysiloxane topcoat.

The project team stripped and applied a known coating to a portion of a ground level water storage tank at the San Bernardino Airport. It was necessary to strip and apply coating to the tank since the project team did not know what coating system is currently on the tank. The characteristics of the coating must be known for the testing.

The project team obtained the coating from a local supplier and the Aero Pro painters stripped a 20 square foot area of the tank with a chemical stripper. Ameron (PPG), a supplier of IM coatings, provided coatings at no cost to the project team for the stripping test. Appendix B shows MSDSs for the coatings used on the storage tank. The epoxy IM coating, called Amerlock Sealer Cure Res, was applied to the area after stripping. It also requires a curing material; the MSDS for the curing agent, called Amerlock Sealer Cure, is also shown in Appendix B. The MSDS for the polysiloxane topcoat, called PSX 700 Montu Tan, was applied over the epoxy primer. The MSDS for the curing material for this topcoat is called PSX 700 Cure.

Laser Stripping Demonstration

A picture of the tank on which the laser was tested is shown in Figure 3-1. The stripping demonstration was conducted at night. The storage tank demonstration involved placing the laser on a lift, transporting it to the storage tank and stripping a small portion of the industrial maintenance coating on the tank. The project team did one stripping test where both the primer and the topcoat were removed. The team did a second stripping test where only the topcoat was stripped from the tank. The second test was performed to show the capability of the laser to strip one coating and leave the other intact. Potential users would often need this feature. The third test was designed to demonstrate that the laser could strip rust and a small rust spot was stripped effectively.

Figure 3-1: Ground Level Water Storage Tank

The strip rate is related to the laser power. During this demonstration, the electrodes in the laser were not functioning properly and the laser was operating at about 20% of its full power potential. As a result, the power was very limited. For the first demonstration, the strip rate was about one square inch per minute. This rate was doubled during the second demonstration test as one of the team members ramped up the power.

Figure 3-2 shows the lift and Figure 3-3 shows the laser system. Figure 3-4 shows the laser being loaded onto the lift with a fork lift. Figures 3-5 and 3-6 show views of the laser positioned at the water storage tank. Figure 3-7 shows the laser stripping the coating. Figure 3-8 shows the section stripped of both topcoat and primer (the larger section) and the section stripped of topcoat only (the smaller section).

Figure 3-2. Lift for Laser

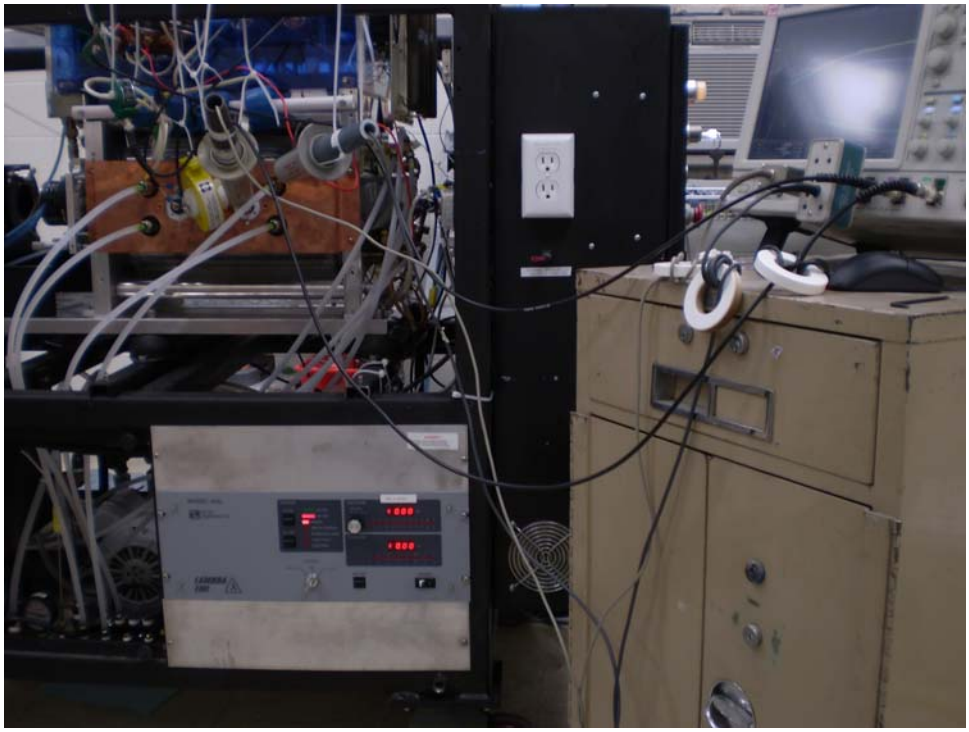

Figure 3-3. Portable Laser System

Figure 3-4. Laser Loaded on Lift

Figure 3-5. Laser Positioned at Water Tank

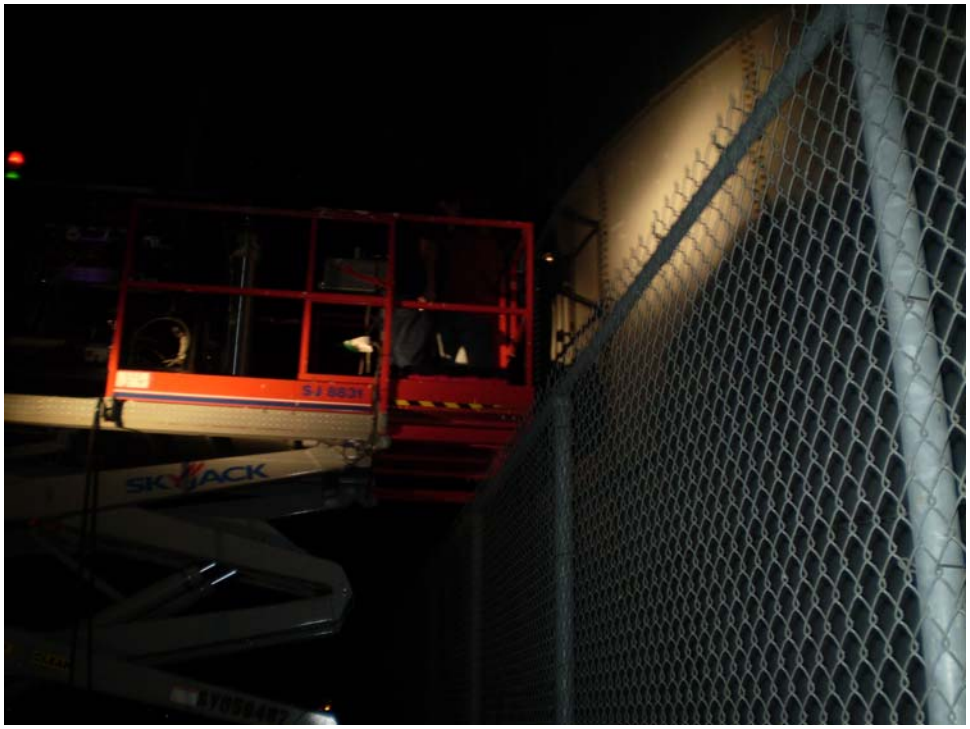

Figure 3-6. Another View of Laser Positioned at Water Tank

Figure 3-7. Laser Stripping Coating

Figure 3-8. Sections Stripped by Laser

Cost Analysis for Water Tank Stripping

Several nationwide companies offer stripping services for tanks of various kinds. IRTA obtained a cost estimate from one such company for sand blast stripping. This estimate was compared to the cost of stripping with the 3,000 watt laser stripping device currently under development by Laser Strip.

The water storage tank located at the San Bernardino airport is 50 feet in diameter and 40 feet high. The sides and the top of the storage tank must be stripped. This translates into 8,243 square feet of surface that must be stripped. The storage tank is within the jurisdiction of the South Coast Air Quality Management District (SCAQMD). SCAQMD regulations require the tank to be shrouded if it could impact any other facility over the fence line of the airport. Since there is a golf course located next to the property, the cost analysis assumes that the water storage tank must be shrouded for the stripping operation.

The cost of the shrouding and the sand blasting stripping is based on the square footage of the item to be stripped. The shrouding involves encasing the item (in this case, the water storage tank) in shrink-wrap and leaving a work zone between the shrink-wrap and the tank for workers doing the stripping. It also involves erecting three foot wide scaffolding around the water tank to act as an outside perimeter for the shrink-wrap. Additional frames are required along the top rim and top of the tank since stripping is required there as well. The shrink-wrap has a thickness of 9 millimeters and it is fire rated.

Industrial maintenance coatings are used for painting metal structures like the water storage tanks. The primers used for this purpose contain a substantial amount of zinc. Some of the zinc from the primer will end up in the sand residue that remains after the stripping operation. The California Department of Toxic Substances Control (DTSC) has regulations on disposal of hazardous waste. The waste will be classified as hazardous waste if the waste contains a certain concentration of zinc. It is not possible to know the concentration of the zinc in the waste before the sand blasting operation. Hazardous waste hauling companies partner with the sand blasting company and the scaffolding company in stripping operations of this type. These companies build a secondary containment plastic sheeting structure under the shrink-wrap in which the waste is generated. They haul off the waste on a daily basis as the stripping progresses. They dismantle the plastic sheeting and secondary containment material at the end of the process and dispose of it. If the waste is classified as hazardous, then the plastic sheeting must also be disposed of as hazardous waste.

In this case, the sand blasting company estimates that it would require five to seven days to strip the 8,243 square foot storage tank, assuming an eight hour day. The sand blasting company estimates the cost for stripping the tank on a rule of thumb at $2 per square foot. On this basis, the sand blasting company's cost for stripping the tank would amount to $16,486.

The shrouding company also provided an estimate based on the square footage of the tank. The shrouding company's cost for erecting the scaffolding is $6,080 and the cost of the shrink-wrap containment is $10,240. The total cost of the operation is $16,320.

The waste hauling company provided two estimates, one assuming the sand blast and coating residue is hazardous waste and one assuming it is not hazardous waste. The cost estimates involve setting up containment inside of shrink-wrapped scaffolding provided by others. The company would set up containment, clean blast media from the containment, bag the waste, profile the waste and properly dispose of the waste. Assuming six shifts (six days) are required for the operation, the company estimates that the total amount of waste that would be generated is about 10 tons. If the waste is classified as hazardous waste, the cost would amount to $24,990; if it is not hazardous waste, the cost would be $22,100.

The cost of using the laser is based on a strip rate of 500 square feet per hour per millimeter of coating stripped and a price for the service of $500 per hour. This indicates a cost of $1 per square foot stripped per millimeter of coating stripped. In this case, the storage tank surface area is 8,243 square feet and the average coating thickness on the tank is 3.5 millimeters based on measurement. On this basis, the cost of the stripping operation using the laser amounts to $24,729.

Table 3-1 summarizes and compares the cost of the blasting and laser stripping operations. The first column provides the costs of the sand blasting operation assuming the waste is not hazardous waste. The second column presents the costs assuming the waste is hazardous waste. The values show that the cost of stripping with the laser is less than half the cost of using sand blasting.

Table 3-1
Cost of Stripping Options for San Bernardino Airport

	Sand Blasting Operation (Non-Hazardous)	Sand Blasting Operation (Hazardous)	Leasing Laser Stripping Service
Stripping Service Cost	$16,486	$16,486	$24,729
Shrouding Cost	$16,320	$16,320	-
Waste Disposal Cost	$22,100	$24,990	-
Total Cost	$54,906	$57,796	$24,729

IV. GROUND VEHICLE PARTS STRIPPING AT BARSTOW MARINE BASE

This section describes the testing that was conducted at the Barstow Marine Base on portions of several different ground vehicles and components of ground vehicles. Barstow currently uses various types of blasting operations to strip the vehicles. The section describes the coatings encountered at the base and also includes a cost analysis and comparison of using the laser technology in place of the blasting operations.

Background on Ground Vehicle Stripping

The Barstow Marine Base in Barstow, California strips, repairs and refurbishes many different types of ground vehicles and ground vehicle parts including engines and assembled radar systems. The Base must strip mild aluminum, hard aluminum, cast iron, steel, composite and fiberglass. These parts are coated with a variety of different paints including chemical agent resistant coating (CARC), epoxy and latex. The type of paint that the Base routinely strips is:

- a primer that meets MIL-P-53030
- a topcoat that meets MIL-DTL-64159

The primer is a waterborne, air dry, corrosion inhibiting, epoxy primer. The topcoat is a waterborne CARC aliphatic polyurethane for use on military tactical equipment. An MSDS for the topcoat is shown in Appendix C.

Laser Stripping Demonstration

The project team stripped portions of ground vehicles at Barstow Marine Base. The laser was transported on a trailer to the Base and this was the first time it was transported such a long distance.. It was not damaged and it performed very well. This demonstrates the portability of the laser device. A picture of the laser at the Base is shown in Figure 4-1.

A ground vehicle called a Light Armored Vehicle (LAV) was stripped. A picture of the LAV is shown in Figure 4-2. Portions of the top and the side were stripped during the demonstration. A picture of one of the project team stripping the top of the LAV is shown in Figure 4-3. A picture of the side of the LAV after stripping is shown in Figure 4-4. The LAV had a chemical agent resistant coating (CARC) that was very thick, between 27 and 30 millimeters. Figure 4-4 shows the surface of the side of the vehicle after stripping the CARC and an adhesive tape that was on the vehicle. A close-up picture of the LAV side is shown in Figure 4-5.

The project team also stripped a steel front plate for an armored humvee. It contained an epoxy primer and a CARC topcoat which was 14 to 15 millimeters thick. A picture of the front plate is shown in Figure 4-6. Figure 4-7 shows one of the project team stripping a portion of this part. A closer view of the stripped area is shown in Figure 4-8.

Figure 4-1. Laser at Barstow Marine Base

Figure 4-2. Light Armored Vehicle (LAV)

Figure 4-3. Stripping Top of LAV

Figure 4-4. LAV Surface after Stripping

Figure 4-5. LAV Close-up after Stripping CARC and Tape.

Figure 4-6. Front Plate for Armored Humvee

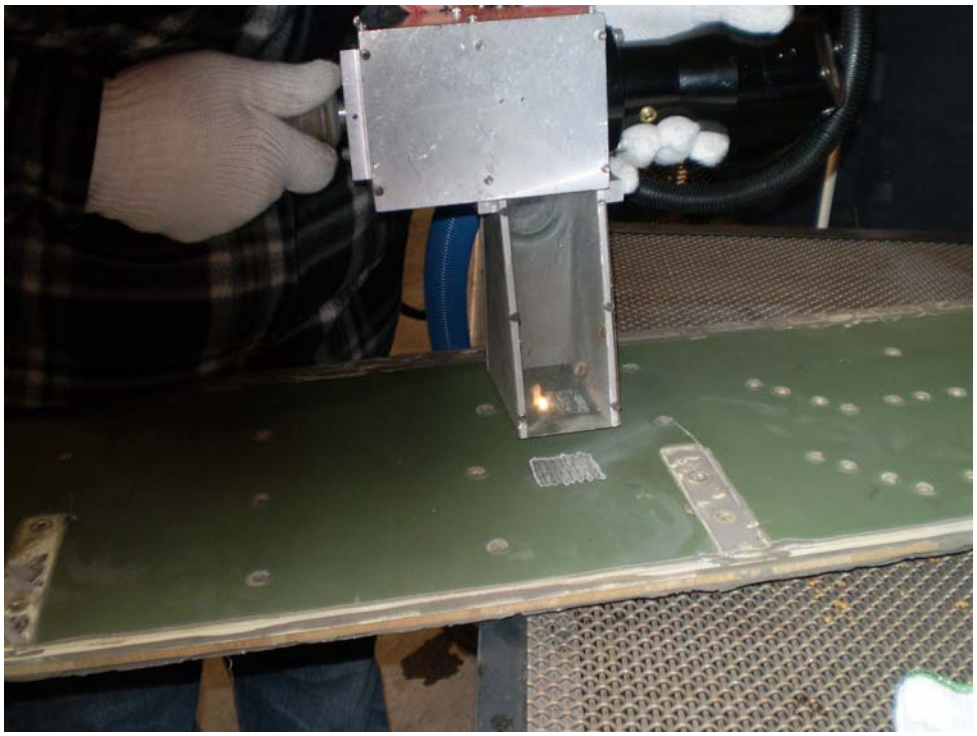

Figure 4-7. Stripping Humvee Front Plate

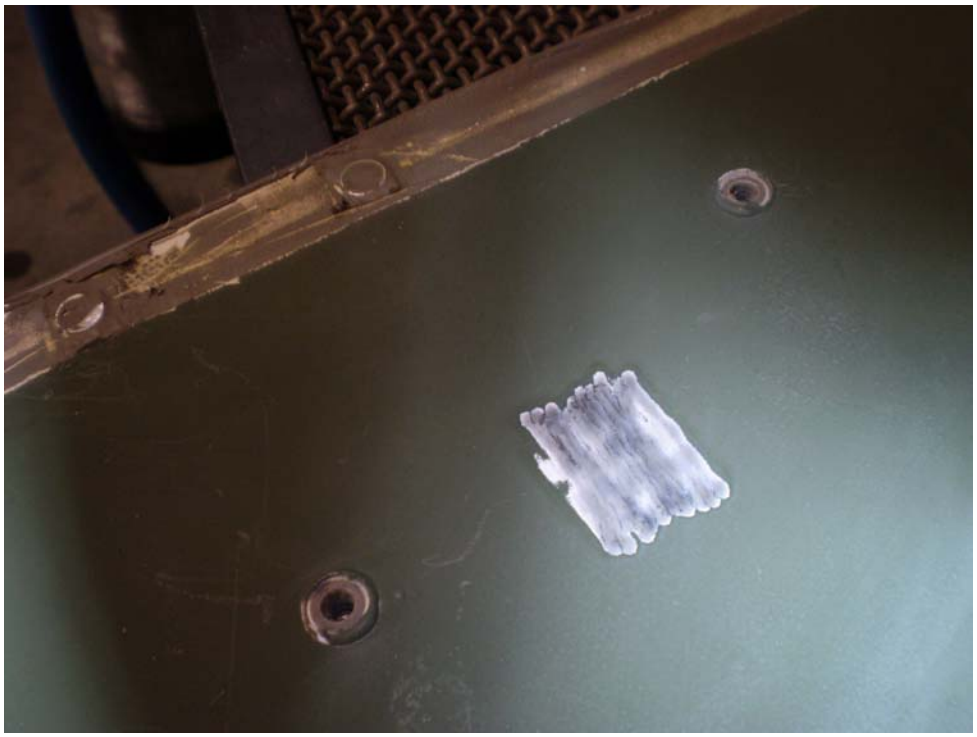

Figure 4-8. Close-up of Humvee Front Plate after Stripping

Another set of parts that were stripped comprised a tool kit for the P7 made of steel and aluminum. The coating on these parts was seafoam green enamel which ranged in thickness from about 1 millimeter to 17 millimeters. These parts are shown in Figure 4-9. Figures 4-10, 4-11 and 4-12 show each of the parts during stripping. Figure 4-13 shows the stripped portion of one of the parts.

Figure 4-9. Tool Kit Parts for P7

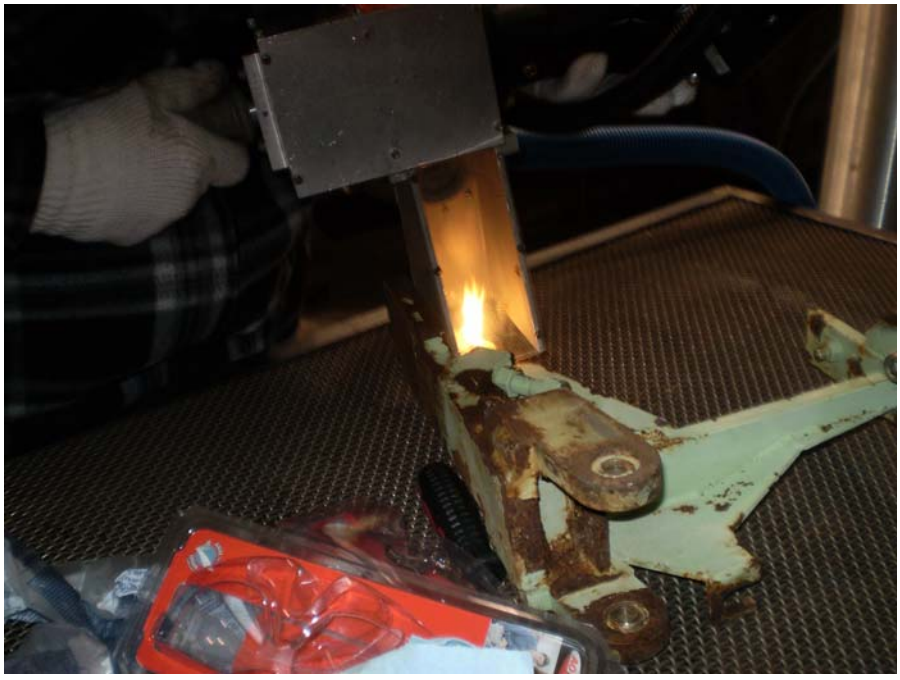

Figure 4-10. P7 Toolkit Part #1

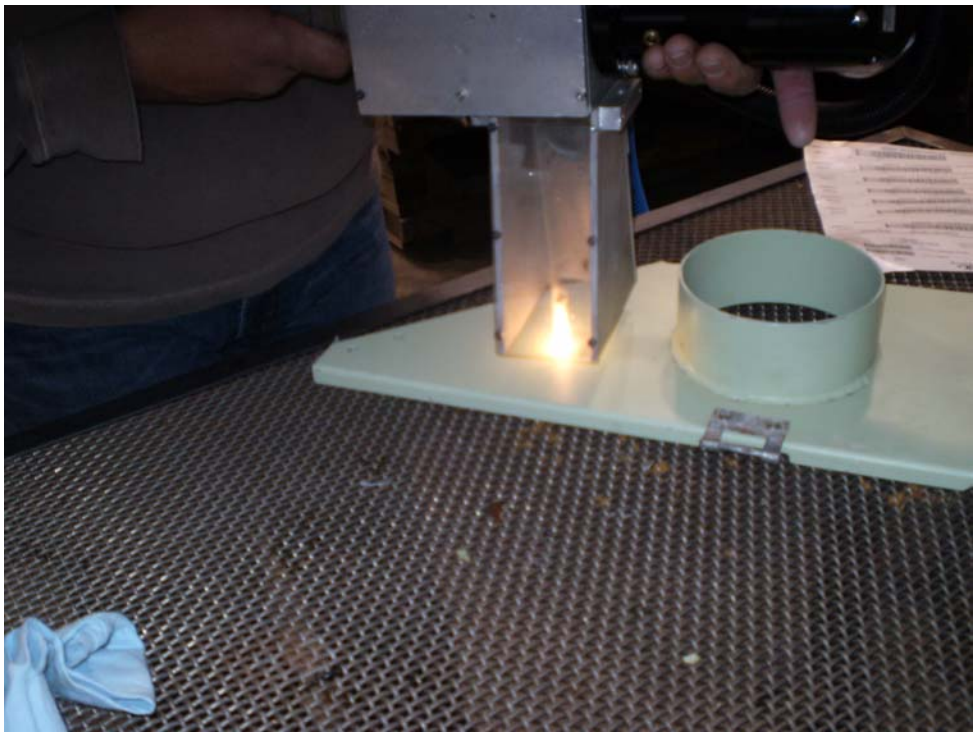

Figure 4-11. P7 Toolkit Part #2

Figure 4-12. P7 Toolkit Part #3

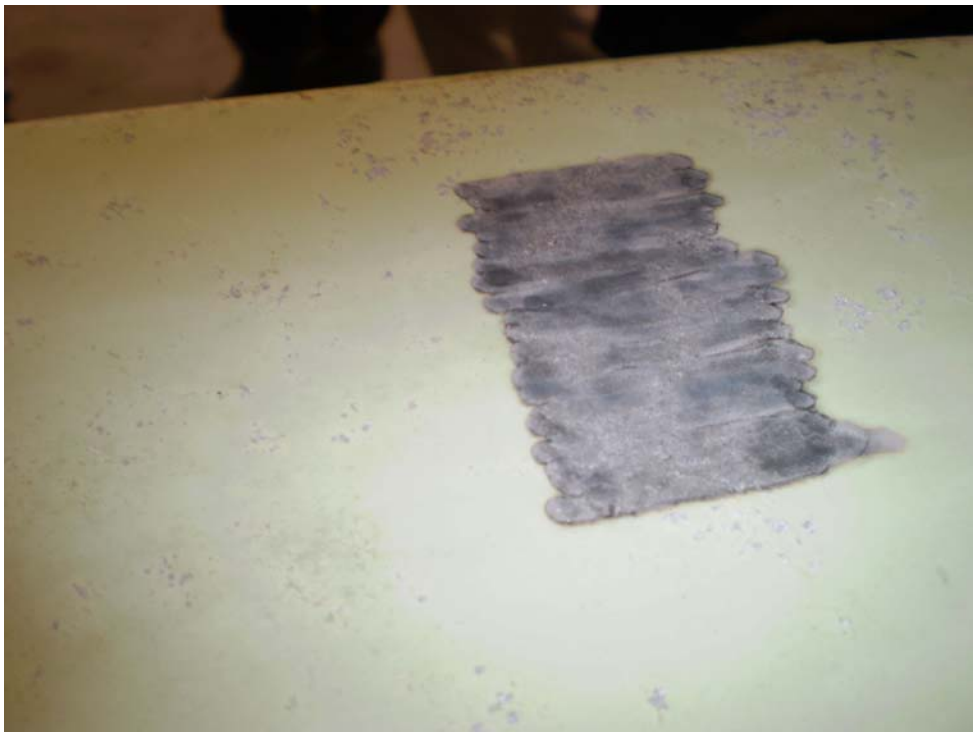

Figure 4-13. Stripped Portion of P7 Toolkit Part

The project team successfully stripped corrosion and sealant from an electrical plug shown in Figure 4-14. An anodized aluminum part with an epoxy coating, shown in Figure 4-15, was also stripped. The coating thickness was 3 millimeters.

Figure 4-14. Electrical Plug after Stripping


Figure 4-15. Anodized Aluminum Part after Stripping

Cost Analysis for Ground Vehicle Stripping

IRTA obtained information from the Barstow Marine Base and conducted a cost analysis of the stripping. The stripping is currently performed in four booths using garnet media. An MSDS for a typical garnet media is shown in Appendix D. The vehicles and vehicle parts are placed on pallets and stripped in the four booths during the day shift. Two of the booths are used for stripping during a night shift.

Barstow pays 49 cents per pound for the garnet and, in 2007, purchased and used 85,400 pounds of the media. The cost for purchasing the media amounted to $41,846.

The media is recycled but eventually requires disposal at a cost of 29 cents per pound. Assuming 85,400 pounds requires disposal, the cost is $24,766. The Base also must use drums for the disposal. The density of the garnet is 145 pounds per cubic foot. A 55 gallon drum has a volume of seven cubic feet. On this basis, 84 drums would be required for the disposal. Assuming the Base would require 21 drums four times a year, the cost of the drums each time is $200 plus a $45 delivery fee and tax of 8.25 percent. This amounts to $1,069. The labor required for disposal is estimated at 30 minutes per drum or 42 hours. The Base did not provide a labor rate for proprietary reasons so IRTA obtained a labor rate from a contract stripping company. For Monday through Friday operations, this company charges $30 per hour. Assuming this labor rate for the Barstow personnel, the annual labor cost for disposal is $1,260. The total disposal cost for the media is $27,095.

Maintenance costs for the stripping operation are estimated by the base at $20,000 per year for safety equipment and between $35,000 and $50,000 per year for general maintenance. Assuming the midpoint of $42,500 for the general maintenance, the total annual maintenance cost is $62,500.

IRTA used the labor rate provided by the contract stripping company to estimate the labor cost of the stripping. Four booths are operated for nine hours per day and two of them are operated for nine hours during a night shift. Assuming there are six workers who perform the stripping and that each works an eight hour shift five days per week for 52 weeks a year and assuming the labor rate of $30 per hour, the total annual labor cost for the stripping amounts to $374,400.

The energy costs were estimated using the hours of operation for the booths provided above. Two of the booths have 12 three horsepower auger motors, one 20 horsepower elevator motor and one 200 horsepower primary exhaust fan. These booths each have one 150 horsepower compressor. The booths are operated for nine hours during the day shift and nine hours during the night shift. The other two booths have eight three horsepower auger motors, one 20 horsepower elevator motor and one 125 horsepower primary exhaust fan. There is also one 100 horsepower compressor in each of these booths. The two booths are operated for nine hours during the day shift. The load factor for the compressors is 50 percent. Using these assumptions, and an efficiency of 95 percent, the total energy use for the booth operations is 3,246,750 kilowatt hours per year. The base pays a rate of 13 cents per kilowatt hour which leads to an annual energy cost of $422,076.

Summing the media cost, the media disposal cost, the maintenance cost, the labor cost and the energy cost leads to a total cost for the stripping operations of $927,017 per year.

IRTA analyzed two different scenarios to compare the cost of using the laser stripping method with the garnet media blasting method used by the base currently. The first scenario is that the base would lease the stripping service from Laser Strip which would require using several different portable handheld lasers. The second scenario is that the base would purchase a large fixed higher powered laser from Laser Strip to do all of the stripping. This fixed system, which has a nominal power of 6,000 watts, is currently being assembled by Laser Strip.

For the first scenario, the cost of leasing the lasers is $1 per square foot of surface area stripped per millimeter of paint removed. The paint stripped by the Base is between eight and 12 millimeters thick with an average thickness of 10 millimeters. The Base could not provide the square footage stripped in a year but did provide the number of large and small vehicles stripped each month and gave examples of small and large vehicle types. During one year, 144 large vehicles and 525 small vehicles were stripped. IRTA assumed the Light Armored Vehicle (LAV) was typical of the large vehicles stripped. Using the dimensions of the LAV (a length of 29.96 feet, a width of 8.20 feet and a height of 8.83 feet), the typical large vehicle has a surface area of about 859 square feet. Assuming there are 144 large vehicles stripped, the square footage of large vehicles

stripped in a year is 123,696. IRTA assumed that the M105 1.5 ton cargo trailer was typical of the small vehicles stripped. This vehicle has a length of 9.17 feet, a width of 6.17 feet and a height to the top of the side panels of 1.5 feet. On this basis, taking into account that there are 525 small vehicles stripped, the square footage of small vehicles stripped annually amounts to 83,475 square feet. The base also strips pallets used to support the vehicles. An average of 400 pallets are stripped per month. Typical pallet dimensions are 48 inches by 40 inches. Assuming the base strips only the top of the pallets, the surface area square footage of the pallets amounts to 63,840. The total of the square footage stripped taking into account the small vehicles, the large vehicles and the pallets is 271,011.

Assuming the average coating thickness is 10 millimeters and using the square footage number for the vehicles and pallets, the cost of using the service would amount to $2,710,110 annually. This is substantially higher than the cost of using the garnet blasting operation which is a little less than $1 million per year.

The second option, purchasing a large fixed laser, is a more reasonable one for Barstow since they have such a large stripping operation. The fixed laser currently under construction by Laser Strip would have a sales price of $3 million. Assuming a four percent cost of capital and a 20 year useful life for the laser, the annualized capital cost of the laser is $156,000.

This laser was used for several years at Hill Air Force Base for stripping radomes which are made of composite. Laser Strip purchased the laser components from Hill and is modernizing some of the components and modifying it so it will be able to strip a range of different parts. The Hill Air Force Base personnel indicate that the strip rate of the laser is 162 square feet per hour for a five millimeter coating thickness. For the 10 millimeter average coating thickness routinely stripped at Barstow, the strip rate would be half the value or 81 square feet per hour. Assuming Barstow needs to strip 271,011 square feet per year, the laser would be operated for 3,346 hours annually. The labor hours used for stripping currently at Barstow amount to 12,480 annually, more than three times the laser stripping hours that would be required. Assuming three workers would be required during the hours of operation of the laser (half the number required for the garnet blasting operation) and that the labor rate is $30 per hour, the annual labor cost of using the laser would amount to $290,340.

The maintenance cost of the laser is likely to be high because it is a fairly new technology. IRTA estimates this cost at $50,000 per year.

The fixed 6 kW laser is used for 1,673 hours per year. The electricity use is 100,380 kilowatt hours per year. Again, assuming a cost for the electricity of 13 cents per kilowatt hour, the annual energy cost of using the large fixed laser is $13,049.

Summing up the capital cost of the laser, the labor cost, the maintenance cost and the energy cost, the total annualized cost of using the fixed laser amounts to $509,389. This cost is substantially lower than the cost of the current stripping operation.

Table 4-1 summarizes and compares the three different options. The first option is the garnet blasting used currently. The second option is leasing the service of laser stripping from Laser Strip. The third option is for the base to purchase the large fixed laser from Laser Strip.

Table 4-1
Annualized Cost of Stripping Options for Barstow Marine Base

	Garnet Blasting	Leasing Laser Stripping Service	Purchasing Fixed Laser
Capital Cost	-	-	$156,000
Media Cost	$41,846	-	-
Media Disposal Cost	$27,095	-	-
Maintenance Cost	$62,500	-	$50,000
Labor Cost	$374,400	-	$290,340
Electricity Cost	$422,076	-	$13,049
Total Cost	$927,917	$2,710,110	$509,389

The lowest cost option in Table 4-1 is purchasing the large fixed laser. The major reason this option is lower cost is that the hours of operation for the laser stripping are much lower than the hours of operation for the garnet blasting operation. The hours of operation influence the labor cost and the electricity cost. The electricity cost for the laser system is much less than the electricity cost of the garnet blasting operation.

The highest cost option is leasing the laser stripping service. This is a loaded cost that includes many variables and these same variables are not quantified in the garnet blasting operation or the option of purchasing the fixed laser. The variables include the cost of leasing or owning space and many indirect costs.

V. NAVY SHIP PARTS STRIPPING AT NAVY MAINTENANCE CENTER

This section describes the testing that was conducted at the San Diego Navy maintenance center on a common type of part the center strips and on panels brought to the site by another Navy group. The part is commonly stripped in a burn-off oven and with sand blasting. The ship hull coatings on the panels are commonly stripped with sand blasting. The section provides a discussion of the coatings and a cost analysis and comparison of the laser stripping process and the processes that are used today.

Background on Navy Parts and Panel Stripping

The Navy's maintenance center, located in San Diego, is responsible for stripping and recoating various types of navy ship parts. The operation processes 80,000 pieces per year. Currently the parts are stripped in a burn-off oven. They are then sand blasted to clean the surface and etch it for the coating application. The parts are coated first with thermal spray aluminum paint and then a polyester powdercoat. The coating used by the Center is polyester Triglycidyl Isocyanurate (TGIC). An MSDS for the powdercoat is shown in Appendix D.

Another Navy group brought panels containing several different types of ship hull coatings. This group did not know the exact types of coatings that were on the panels but some qualitative information on these paints is provided below.

Laser Stripping Demonstration

The laser was transported to San Diego to the Navy maintenance center for the stripping tests. This demonstration showed the portability of the laser for a long 2-hour driving trip. At the center, portions of powder coated ship parts and panels painted with ship hull coatings were stripped. A picture of the laser at the shipyard is shown in Figure 5-1.

Figure 5-1. Laser Stripping Device at Navy Maintenance Center

The Navy commonly paints a part called a stanchion that is a component of the railing on ships. A picture of two stanchions is shown in Figure 5-2. They are made of steel and contain a metallized aluminum coating and then a powder topcoat. Figure 5-3 shows one of the stanchions prior to stripping and Figure 5-4 shows a close-up view of a portion of the stanchion that was stripped.

Figure 5-2. View of Typical Stanchions

Figure 5-3. Stanchion Before Stripping

Figure 5-4. Close-up View of Stanchion after Stripping

The project team also stripped part of two panels that contained copper antifouling paint topcoat with a significant (50 to 75%) copper content and probably a high zinc oxide content as well. These panels also contained an epoxy primer. The coating thickness ranged from 23 millimeters to 27 millimeters which is very thick. One of the panels had a sprayed on coating and the other had a rolled coating. Figure 5-5 shows the laser stripping one of the copper panels. Figure 5-6 shows the stripped sections of the copper panel. Even though the coating is very thick and contains substantial quantities of metal, the laser did a reasonable job in stripping.

Figure 5-5. Laser Stripping Copper Paint Panel

Figure 5-6. Copper Coated Panel after Stripping

Sections of two other panels, one coated with a blue coating and the other coated with a yellow coating, were also stripped. The blue coating may be an epoxy foul release coating that has a thickness of 7 millimeters. The yellow coating, which has an oil layer, is almost certainly silicon based foul release coating; this coating was extremely thick, 27 millimeters. Figure 5-7 shows the blue panel during stripping and Figure 5-8 shows the blue panel after stripping. Figure 5-9 shows the yellow coating after stripping.

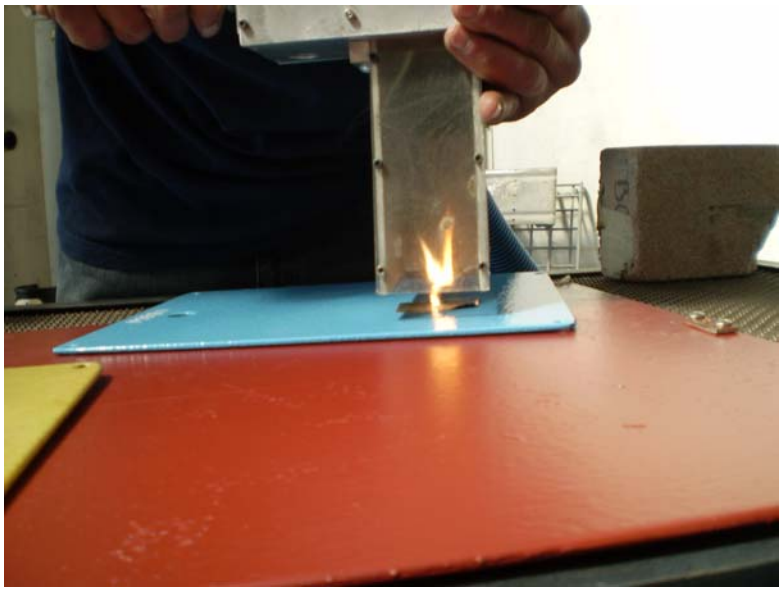

Figure 5-7. Laser Stripping Blue Coated Panel

Figure 5-8. Blue Coated Panel after Stripping

Figure 5-9. Yellow Coated Panel after Stripping

The laser also stripped the rust from a threaded part. The part after stripping is shown in Figure 5-10.

Figure 5-10. Threaded Rusted Part after Stripping

Cost Analysis for Stanchion Stripping

The stanchions are currently stripped and repainted at the Navy maintenance facility in San Diego. As discussed earlier, two coatings are used on the stanchions. The first coating that is applied is a metalized coating and the second coating is a powder coating. When the stanchions are repainted, the Navy only removes the powder coating which is about 7 millimeters thick.

The stanchions are 36 inches tall and 3.5 inches in diameter. Based on this information, the cylindrical surface area of each stanchion is 2.75 square feet. The Navy strips about 150 of the stanchions per day which leads to a coating surface area of 413 square feet. The operation involves using a burn off oven to remove the coatings. The manager of the operation estimates that the cost of stripping the stanchions is $178 per hour or $1,424 per day. This cost excludes the labor cost and does not take into account overhead.

Two people are responsible for the stripping operation. Using a labor rate of $21.60 per hour, the cost of stripping is $43.20 per hour or $346 per day assuming an eight hour day. The manager of the operation does not know what the overhead and indirect costs are for the operation. IRTA investigated this issue and used the results of a paper (Raffi and Swamidase) indicating that the overhead rate in an average U.S. manufacturing firm is about two and one-half times the direct labor cost. On this basis, adding in this overhead rate, the labor cost and the overhead cost of stripping at the Navy maintenance facility is $865 per day. Adding in the non-labor cost, the total cost of the stripping operation is $2,289 per day.

For the laser, the strip rate is assumed to be 500 square feet per hour per millimeter of paint stripped. The cost charged by Laser Strip is $500 per hour. On this basis, the laser would cost $1 per square foot per millimeter stripped. Taking into account the area of

413 square feet that needs to be stripped and a coating thickness of 7 millimeters, the total cost of stripping the stanchions with the laser amounts to $2,891.

Table 5-1 summarizes and compares the stripping options for the stanchions. The cost of stripping with the laser is 26 percent higher than the cost of using the burn off oven. The cost of the operation will vary depending on the cost of gas. As the cost of gas increases, the laser stripping process might be competitive with the current process.

Table 5-1
Cost of Stripping Options for San Diego Navy Maintenance Center

	Burn-Off Oven	Leasing Laser Stripping Service
Stripping Cost	$1,424	-
Labor Cost	$346	-
Overhead Cost	$865	-
Total Cost	$2,289	$2,891

VI. CONFERENCE AND DEMONSTRATION

On October 21, 2009, the project team held a conference at Southern California Edison's Customer Technology Applications Center (CTAC) in Irwindale, California. Attendees included representatives from commercial and military operations involved in aircraft maintenance. Personnel from commercial vehicle maintenance facilities, an electric motor rebuilder and representatives from several government agencies also attended.

At the conference, the project team presented the results of the project. The four demonstrations were described and the cost analysis results were presented and discussed. A demonstration of the 100 watt prototype laser used for the four applications was performed by Laser Strip. Videos of the larger 3,000 watt portable laser and the 6,000 watt fixed laser under development by Laser Strip were also presented. A picture of the Laser Strip owner demonstrating the prototype unit at the conference is shown in Figure 6-1 and a picture of several attendees in the demonstration room is shown in Figure 6-2.

Figure 6-1. Laser Strip Owner Joe Ermalovich Demonstrating Prototype Unit

Figure 6-2. Attendees in the Demonstration Room

VII. RESULTS AND CONCLUSIONS

This project involved performing tests and demonstrations of a portable hand-held laser paint stripping device developed by Laser Strip. The prototype device used for the demonstrations had a power of about 100 watts. Laser Strip is developing a larger 3,000 watt hand-held stripping laser that is much more powerful. The company is also developing a stationary laser stripping system with a power of about 6,000 watts.

Four demonstrations were conducted with the small 100 watt laser prototype in the course of the project. First, the small laser was used to strip paint from various components of an aircraft at Aero Pro, an aircraft maintenance facility. Second, it was used to strip a small portion of an industrial maintenance coating on a large water storage tank at the San Bernardino Airport. Third, it was used to strip paint from sections of a wide variety of ground vehicles at Barstow Marine Base. Fourth, it was used to strip portions of stanchions and panels containing marine coatings at a San Diego Navy maintenance facility. The analysis focused on these four diverse activities that span the range of paint stripping applications encountered today.

IRTA conducted a cost analysis which compares the cost of stripping the paints with the technology that is used currently in each case with the cost of stripping with the larger lasers under development by Laser Strip. The cost comparison is summarized in Table 7-1.

Table 7-1
Cost Comparison of Currently Used Technology and Laser Stripping Technology

Stripping Application	Current Stripping Technology	Cost of Stripping With Current Technology	Cost of Stripping With Laser
Aircraft	Chemical Stripping	$36,325	$25,920
Storage Tank	Sand Blasting	$54,906 to $57,796	$24,729
Ground Vehicles	Media Blasting	$927,917	$509,389
Navy Parts	Burn-Off Oven	$2,289	$2,891

Many aircraft maintenance facilities use chemical strippers for removing the primer and topcoat from aircraft and aircraft parts. These chemical strippers are often based on methylene chloride which is a carcinogen and is classified as a TAC in California. Other aircraft maintenance facilities use chemical strippers based on VOC solvents which contribute to photochemical smog. The values of Table 7-1 show that the cost of using the methylene chloride stripper at Aero Pro for stripping a large 727 aircraft is higher than the cost of using the larger portable laser under development by Laser Strip.

Water storage tanks and other large metal structures are often stripped using sand or other blasting media. These operations generate particulate matter emissions which can cause lung damage and will increasingly be regulated by EPA and air regulatory agencies in

California in the future. The cost of using sand blasting is higher than the cost of using the large portable laser that is being developed by Laser Strip for stripping the metal water storage tank as shown in Table 7-1.

Ground vehicles constructed of various metal substrates are commonly stripped with media blasting of various types. Again, these operations generate large quantities of particulate matter emissions. Table 7-1 shows that the cost of using the media blasting operation at the Barstow Marine Base is almost twice as costly as using the larger fixed laser under development at Laser Strip.

Stanchions used on Navy craft are currently stripped using a burn-off oven at the Navy maintenance facility in San Diego. Such ovens have high energy use and generate nitrogen oxide emissions. The values of Table 7-1 illustrate that the cost of using the burn off oven for stripping is somewhat lower than the cost of using the larger portable laser under development at Laser Strip for the stripping.

In the case of three of the four applications discussed in the document, the cost of using the laser technology for stripping is lower than the cost of using current technology. In a particular application, the cost of using the portable laser technology is heavily influenced by the area that requires stripping and the thickness of the coating. The higher the square footage that requires stripping and the thicker the coating that needs to be stripped, the higher the cost is of using the portable laser. Cases where a very thick coating needs to be stripped are likely to be very costly to strip with the portable laser. The Barstow Marine Base cost comparison demonstrates this point. It would be much more cost effective for the Base to purchase the larger fixed laser under development at Laser Strip than to use the service of stripping with the portable laser. That cost comparison shows that using the large fixed laser is actually much lower in cost than stripping with the current media blasting operation.

A notable advantage of using the laser for stripping is that the energy requirements of stripping with the laser are much lower than the energy requirements for stripping with the other technologies. In the case of the aircraft stripping case study analyzed here, the electricity requirement for using the methylene chloride stripping process for a 727 is 6039 kWh whereas the electricity requirement for the laser is only 147 kWh. In the case of the Barstow Marine Base case study, the annual electricity requirement for stripping with the garnet blasting is 3,246,750 kWh. The annual electricity requirement for stripping with the large fixed laser is 100,380 kWh which is substantially less.

Laser Strip is in the development phase of the higher power hand-held portable device. The company plans to commercialize the high power laser within the next few years. Laser Strip will offer a stripping service to potential customers or will sell the lasers to other companies that offer stripping services. Laser Strip is also developing a very large stationary laser stripping system. Potential customers for purchasing such stationary systems would include very large commercial operations that perform stripping and military operations that strip routinely.

The results of the project were presented at a conference held at Southern California Edison's CTAC facility in Irwindale, California. Parties interested in laser stripping as an alternative method attended. They included representatives from private companies, military bases and government.

VIII. REFERENCES

Head, J.D. and J. Peter Niedzielski, “Laser Paint Stripping,” WL-TR-91-4026, Wright Laboratory, Materials Directorate, Air Force Systems Command, Wright-Patterson Air Force Base, June 1991.

- MIL-DTL-53072 “The CARC System”, page 5.

- Raffi, Farshad and Paul M. Swamidase “Towards a Theory of Manufacturing Overhead Cost Behavior: A Conceptual and Empirical Analysis,” ScienceDirect.

Appendix A
MSDSs for Aircraft Coatings

MSDS for HS Epoxy Yellow Primer

MATERIAL SAFETY DATA SHEET

24-hour Emergency Phone: 1-800-424-9300
PRODUCT CODE: EP-2-Y1

PRODUCT NAME: HS EPOXY YELLOW PRIMER **HMIS CODES:** H C F R P
PRODUCT CODE: EP-2-Y1 2 3 1 G

========== SECTION I - MANUFACTURER IDENTIFICATION ==========

MANUFACTURER'S NAME: **Axon Products Inc**
ADDRESS : 307 Echelon Road
Greenville, SC,
INFORMATION PHONE : 864 299-2819 **DATE PRINTED** : 12/7/2006

========== SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION ==========

REPORTABLE COMPONENTS	CAS NUMBER	VAPOR PRESSURE mm Hg	@ TEMP	WEIGHT PERCENT
METHYL NORMAL AMYL KETONE ACGIH TLV: 50 PPM SSHA 100 PPM TWA	110-43-0	2.80	68 F	1% to 10%
ACETONE OSHA PEL: 750 PPM, ACGIH TLV: 750 PPM	67-64-1	186	68 F	1% to 10%
CYCLOHEXANONE OSHA VPEL: 25 PPM TWA ACGIH TLV: 25 PPM TWA	108-94-1	2	68 F	1% to 10%

*** Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.**

========== SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS ==========

BOILING RANGE: 132.0 F TO 313.0 **SPECIFIC GRAVITY (H2O=1):** 1.5888
BOILING POINT: 132.0 F
VAPOR DENSITY: HEAVIER THAN AIR **EVAPORATION RATE:** SLOWER THAN ETHER
COATING V.O.C.: 287.24 G/L **MATERIAL V.O.C.:** 253.65 G/L
SOLUBILITY IN WATER: INSOLUBLE
APPEARANCE AND ODOR: OPAQUE WITH ODOR OF SOLVENT

========== SECTION IV - FIRE AND EXPLOSION HAZARD DATA ==========

FLASH POINT: -4.00 **METHOD USED:** CC
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.1 **UPPER:** 12.8

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Water spray may be ineffective. If water is used, fog nozzles are preferred. Water may be used to cool closed containers to prevent pressure build-up and possible auto-ignition or explosion when exposed to extreme heat.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep containers tightly closed. Isolate from heat, sparks, electrical equipment and open flames. Closed containers may explode when exposed to extreme heat. Application to hot surfaces requires special precautions. Self-contained breathing apparatus should be worn by firefighters.

========== SECTION V - REACTIVITY DATA ==========

STABILITY: STABLE

CONDITIONS TO AVOID

Temperatures above maximum storage temperature. Avoid exposure to heat, sparks, or open flames.

INCOMPATIBILITY (MATERIALS TO AVOID)

Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS
By fire - CO, CO2, nitrogen oxides.
HAZARDOUS POLYMERIZATION:
WILL NOT OCCUR

========== SECTION VI - HEALTH HAZARD DATA ==========

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Persons with asthmatic type conditions, chronic bronchitis or other chronic respiratory diseases or recurrent skin eczema or sensitization should be excluded from working with this product.
SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Can cause irritation to skin, eyes and respiratory tract. Symptoms may be watering of eyes, dryness of throat, coughing, headache, tightness in chest or burning sensation.
SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Allergic reactions may occur in some individuals. Headache, dizziness or nausea may be experienced by some as a result of exposure to solvents.
INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Drink water to dilute. Do not induce vomiting. Consult a physician.
HEALTH HAZARDS (ACUTE AND CHRONIC)
During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.
CARCINOGENICITY: NTP CARCINOGEN: No **IARC MONOGRAPHS:** No **OSHA REGULATED:** No
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
Asthmatic type conditions, chronic bronchitis, other chronic respiratory disease or recurrent skin eczema/sensitization.
EMERGENCY AND FIRST AID PROCEDURES
Eye Contact: Flush with water for 15 minutes. Consult a physician. Skin Contact: Wash affected area with soap and water. Remove contaminated clothing. Consult a physician. Inhalation: Remove to fresh air. Consult a physician. Ingestion: Drink water to dilute. Do not induce vomiting. Consult a physician.

========== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE ==========

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Evacuate non-essential personnel. Remove all sources of ignition. Ventilate the area. Equip clean-up crew with self-contained breathing apparatus. Dike spill. Cover with sawdust, vermiculite or Fuller's earth. Collect in open containers.
WASTE DISPOSAL METHOD
Conform to Federal, State and Local regulations. Empty containers must be handled carefully due to product residue and flammable solvent vapor.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Do not store above 100 degrees F. Store in large quantities only in buildings designed to comply with OSHA 1910.106. Keep containers closed and upright to prevent leakage. Do not store or use near heat, sparks or flames.
OTHER PRECAUTIONS
Avoid prolonged or repeated contact with vapor or spray mist during application or curing.

========== SECTION VIII - CONTROL MEASURES ==========

RESPIRATORY PROTECTION
In outdoor or open areas, use NIOSH approved mechanical filter respirator. In restricted ventilation areas, use NIOSH approved chemical/mechanical filters to remove vapors and particulates. In confined areas, use NIOSH approved air line type respirators or hoods.
VENTILATION
Must be sufficient in volume and pattern to keep contaminant concentration below TLV (NIOSH) or PEL (OSHA). Exhaust air may need to be cleaned by scrubbers or filters to reduce environmental contamination.
PROTECTIVE GLOVES
Required, butyl rubber recommended.
EYE PROTECTION
Required. Use goggles, face shields or safety eyewear with side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Protective creams where skin contact is likely.

WORK/HYGIENIC PRACTICES

Wash hands before eating or using bathroom. Remove and wash contaminated clothing before reuse. Wear chemical resistant boots.

========== SECTION IX - DISCLAIMER ==========

The information contained herein is based on data considered accurate, but no warranty is expressed or implied. Users assume all responsibility and liability for loss or damage arising from the handling and use of our products, whether used alone or in combinations. Although hazardous materials are listed, we cannot guarantee these are the only ones that exist.

MSDS for Solvent Catalyst SC-11

MATERIAL SAFETY DATA SHEET

24-hour Emergency Phone: 1-800-424-9300
PRODUCT CODE: SC-11

PRODUCT NAME: SOLVENT CATALYST **HMIS CODES:** H C F R P
PRODUCT CODE: SC-11 2 3 1 G

========== SECTION I - MANUFACTURER IDENTIFICATION ==========

MANUFACTURER'S NAME: **Axon Products Inc**
ADDRESS : 307 Echelon Road
Greenville, SC,
INFORMATION PHONE : 864 299-2819 **DATE PRINTED** : 12/7/2006

========== SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION ==========

REPORTABLE COMPONENTS	CAS NUMBER	VAPOR PRESSURE mm Hg	@ TEMP	WEIGHT PERCENT
*TOLUENE	108-88-3	22.00	68 F	25% to 40%
OSHA PEL: 100 PPM -TWA OSHA PEL: 150 PPM - STEL ACGIH TLV: 50 PPM - TWA (SKIN) ACGIH TLV 150 PPM - STEL (SKIN)				
METHYL NORMAL AMYL KETONE	110-43-0	2.80	68 F	10% to 25%
ACGIH TLV: 50 PPM SSHA 100 PPM TWA				
*METHYL ISOBUTYL KETONE	108-10-1	16	68 F	1% to 10%
OSHA VPEL: 50 PPM - TWA OSHA VPEL: 75 PPM - STEL ,ACGIH TLV: 50 PPM - TWA ,ACGIH TLV: 75 PPM - STEL				

*** Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.**

========== SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS ==========

BOILING RANGE: 232.0 F TO 304.0 **SPECIFIC GRAVITY (H2O=1)**: 0.9489
BOILING POINT: 232.0 F
VAPOR DENSITY: HEAVIER THAN AIR **EVAPORATION RATE**: SLOWER THAN ETHER
COATING V.O.C.: 511.99 G/L **MATERIAL V.O.C.**: 511.99 G/L
SOLUBILITY IN WATER: INSOLUBLE
APPEARANCE AND ODOR: CLEAR WITH ODOR OF SOLVENT

========== SECTION IV - FIRE AND EXPLOSION HAZARD DATA ==========

FLASH POINT: 45.00 **METHOD USED**: TCC
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.1 **UPPER**: 8.0 %

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Water spray may be ineffective. If water is used, fog nozzles are preferred. Water may be used to cool closed containers to prevent pressure build-up and possible auto-ignition or explosion when exposed to extreme heat.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep containers tightly closed. Isolate from heat, sparks, electrical equipment and open flames. Closed containers may explode when exposed to extreme heat. Appplication to hot surfaces requires special precautions. Self-contained breathing apparatus should be worn by firefighters.

========== SECTION V - REACTIVITY DATA ==========

STABILITY: STABLE

CONDITIONS TO AVOID
Temperatures above maximum storage temperature. Avoid exposure to heat, sparks, or open flames.
INCOMPATIBILITY (MATERIALS TO AVOID)
Avoid contact with strong oxidizing agents.
HAZARDOUS DECOMPOSITION OR BYPRODUCTS
By fire - CO, CO2, nitrogen oxides.
HAZARDOUS POLYMERIZATION:
WILL NOT OCCUR

========== SECTION VI - HEALTH HAZARD DATA ==========

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Persons with asthmatic type conditions, chronic bronchitis or other chronic respiratory diseases or recurrent skin eczema or sensitization should be excluded from working with this product.
SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Can cause irritation to skin, eyes and respiratory tract. Symptoms may be watering of eyes, dryness of throat, coughing, headache, tightness in chest or burning sensation.
SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Allergic reactions may occur in some individuals. Headache, dizziness or nausea may be experienced by some as a result of exposure to solvents.
INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Drink water to dilute. Do not induce vomiting. Consult a physician.
HEALTH HAZARDS (ACUTE AND CHRONIC)
During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.
CARCINOGENICITY: NTP CARCINOGEN: No **IARC MONOGRAPHS:** No **OSHA REGULATED:** No
MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
Asthmatic type conditions, chronic bronchitis, other chronic respiratory disease or recurrent skin eczema/sensitization.
EMERGENCY AND FIRST AID PROCEDURES
Eye Contact: Flush with water for 15 minutes. Consult a physician. Skin Contact: Wash affected area with soap and water. Remove contaminated clothing. Consult a physician. Inhalation: Remove to fresh air. Consult a physician. Ingestion: Drink water to dilute. Do not induce vomiting. Consult a physician.

========== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE ==========

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Evacuate non-essential personnel. Remove all sources of ignition. Ventilate the area. Equip clean-up crew with self-contained breathing apparatus. Dike spill. Cover with sawdust, vermiculite or Fuller's earth. Collect in open containers.
WASTE DISPOSAL METHOD
Conform to Federal, State and Local regulations. Empty containers must be handled carefully due to product residue and flammable solvent vapor.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Do not store above 100 degrees F. Store in large quantities only in buildings designed to comply with OSHA 1910.106. Keep containers closed and upright to prevent leakage. Do not store or use near heat, sparks or flames.
OTHER PRECAUTIONS
Avoid prolonged or repeated contact with vapor or spray mist during application or curing.

========== SECTION VIII - CONTROL MEASURES ==========

RESPIRATORY PROTECTION
In outdoor or open areas, use NIOSH approved mechanical filter respirator. In restricted ventilation areas, use NIOSH approved chemical/mechanical filters to remove vapors and particulates. In confined areas, use NIOSH approved air line type respirators or hoods.
VENTILATION
Must be sufficient in volume and pattern to keep contaminant concentration below TLV (NIOSH) or PEL (OSHA).
PROTECTIVE GLOVES

Required, butyl rubber recommended.

EYE PROTECTION

Required. Use goggles, face shields or safety eyewear with side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Protective creams where skin contact is likely.

WORK/HYGIENIC PRACTICES

Wash hands before eating or using bathroom. Remove and wash contaminated clothing before reuse. Wear chemical resistant boots.

========== SECTION IX - DISCLAIMER ==========

The information contained herein is based on data considered accurate, but no warranty is expressed or implied. Users assume all responsibility and liability for loss or damage arising from the handling and use of our products, whether used alone or in combinations. Although hazardous materials are listed, we cannot guarantee these are the only ones that exist.

MSDS for Epoxy Hardener, High Solids EH-12

AXON Products, INC.

MATERIAL SAFETY DATA SHEET

24-hour Emergency Phone: 1-800-424-9300
PRODUCT CODE: EH-12

PRODUCT NAME: EPOXY HARDENER, HIGH SOLIDS **HMIS CODES:** H C F R P
PRODUCT CODE: EH-12 2 3 1 G

========== SECTION I - MANUFACTURER IDENTIFICATION ==========

MANUFACTURER'S NAME: Axon Products Inc
ADDRESS : 307 Echelon Road
Greenville, SC,
INFORMATION PHONE : 864 299-2819 **DATE PRINTED** : 12/7/2006

========== SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION ==========

REPORTABLE COMPONENTS	CAS NUMBER	VAPOR PRESSURE mm Hg	@ TEMP	WEIGHT PERCENT
EPOXY CURING AGENT		10.34	N/A	25% to 40%
*TOLUENE	108-88-3	22.00	68 F	25% to 40%
OSHA PEL: 100 PPM -TWA				
OSHA PEL: 150 PPM - STEL				
ACGIH TLV: 50 PPM - TWA (SKIN)				
ACGIH TLV 150 PPM - STEL (SKIN)				
EPOXY CURING AGENT		N/A	N/A	10% to 25%
EPOXY CURING AGENT		1	68 F	1% to 10%

* Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.

========== SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS ==========

BOILING RANGE: 232.0 F TO 460.0 **SPECIFIC GRAVITY (H2O=1)**: 0.9603
BOILING POINT: 232.0 F
VAPOR DENSITY: HEAVIER THAN AIR **EVAPORATION RATE**: SLOWER THAN ETHER
COATING V.O.C.: 408.01 G/L **MATERIAL V.O.C.**: 408.01 G/L
SOLUBILITY IN WATER: INSOLUBLE
APPEARANCE AND ODOR: CLEAR WITH ODOR OF SOLVENT

========== SECTION IV - FIRE AND EXPLOSION HAZARD DATA ==========

FLASH POINT: 45.00 **METHOD USED**: TCC
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.2 **UPPER**: 7.0

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Water spray may be ineffective. If water is used, fog nozzles are preferred. Water may be used to cool closed containers to prevent pressure build-up and possible auto-ignition or explosion when exposed to extreme heat.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep containers tightly closed. Isolate from heat, sparks, electrical equipment and open flames. Closed containers may explode when exposed to extreme heat. Appplication to hot surfaces requires special precautions. Self-contained breathing apparatus should be worn by firefighters.

========== SECTION V - REACTIVITY DATA ==========

STABILITY: STABLE

CONDITIONS TO AVOID

Temperatures above maximum storage temperature. Avoid exposure to heat, sparks, or open flames.

INCOMPATIBILITY (MATERIALS TO AVOID)

Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

By fire - CO, CO2, nitrogen oxides.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

========== SECTION VI - HEALTH HAZARD DATA ==========

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Persons with asthmatic type conditions, chronic bronchitis or other chronic respiratory diseases or recurrent skin eczema or sensitization should be excluded from working with this product.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Can cause irritation to skin, eyes and respiratory tract. Symptoms may be watering of eyes, dryness of throat, coughing, headache, tightness in chest or burning sensation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Allergic reactions may occur in some individuals. Headache, dizziness or nausea may be experienced by some as a result of exposure to solvents.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Drink water to dilute. Do not induce vomiting. Consult a physician.

HEALTH HAZARDS (ACUTE AND CHRONIC)

During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

CARCINOGENICITY: NTP CARCINOGEN: No **IARC MONOGRAPHS:** No **OSHA REGULATED:** No

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Asthmatic type conditions, chronic bronchitis, other chronic respiratory disease or recurrent skin eczema/sensitization.

EMERGENCY AND FIRST AID PROCEDURES

Eye Contact: Flush with water for 15 minutes. Consult a physician. Skin Contact: Wash affected area with soap and water. Remove contaminated clothing. Consult a physician. Inhalation: Remove to fresh air. Consult a physician. Ingestion: Drink water to dilute. Do not induce vomiting. Consult a physician.

========== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE ==========

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate non-essential personnel. Remove all sources of ignition. Ventilate the area. Equip clean-up crew with self-contained breathing apparatus. Dike spill. Cover with sawdust, vermiculite or Fuller's earth. Collect in open containers.

WASTE DISPOSAL METHOD

Conform to Federal, State and Local regulations. Empty containers must be handled carefully due to product residue and flammable solvent vapor.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Do not store above 100 degrees F. Store in large quantities only in buildings designed to comply with OSHA 1910.106. Keep containers closed and upright to prevent leakage. Do not store or use near heat, sparks or flames.

OTHER PRECAUTIONS

Avoid prolonged or repeated contact with vapor or spray mist during application or curing.

========== SECTION VIII - CONTROL MEASURES ==========

RESPIRATORY PROTECTION

In outdoor or open areas, use NIOSH approved mechanical filter respirator. In restricted ventilation areas, use NIOSH approved chemical/mechanical filters to remove vapors and particulates. In confined areas, use NIOSH approved air line type respirators or hoods.

VENTILATION

Must be sufficient in volume and pattern to keep contaminant concentration below TLV (NIOSH) or PEL (OSHA).

PROTECTIVE GLOVES

Required, butyl rubber recommended.

EYE PROTECTION

Required. Use goggles, face shields or safety eyewear with side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Protective creams where skin contact is likely.

WORK/HYGIENIC PRACTICES

Wash hands before eating or using bathroom. Remove and wash contaminated clothing before reuse. Wear chemical resistant boots.

========== SECTION IX - DISCLAIMER ==========

The information contained herein is based on data considered accurate, but no warranty is expressed or implied. Users assume all responsibility and liability for loss or damage arising from the handling and use of our products, whether used alone or in combinations. Although hazardous materials are listed, we cannot guarantee these are the only ones that exist.

MSDS for Conventional Urethane Surfacer Primer SP-11

AXON Products, INC.

MATERIAL SAFETY DATA SHEET

24-hour Emergency Phone: 1-800-424-9300
PRODUCT CODE: SP-11

PRODUCT NAME: CONVENTIONAL URETHANE SURFACER PRIMER **HMIS CODES:** H C F R P
PRODUCT CODE: SP-11 0 0 0 0 0

SECTION I - MANUFACTURER IDENTIFICATION

MANUFACTURER'S NAME: Axon Products Inc
ADDRESS : 307 Echelon Road
Greenville, SC,
INFORMATION PHONE : 864 299-2819 **DATE PRINTED :** 4/10/2007

SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION

REPORTABLE COMPONENTS	CAS NUMBER	VAPOR PRESSURE mm Hg	@ TEMP	WEIGHT PERCENT
TERT BUTYL ACETATE ACGIH - 200ppm	540-88-5	34	77 F	1% to 10%
DIBK OSHA PEL: 25 PPM, ACGIH TLV: 25 PPM	108-83-8	1.7	68 F	1% to 10%
*GLYCOL ETHER PM ACETATE	108-65-6	3.7	68	1% to 10%

*** Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.**

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING RANGE: 208.4 F TO 325.0 **SPECIFIC GRAVITY (H2O=1):** 1.7414
BOILING POINT: 208.4 F
VAPOR DENSITY: HEAVIER THAN AIR **EVAPORATION RATE:** SLOWER THAN ETHER
COATING V.O.C.: 305.18 G/L **MATERIAL V.O.C.:** 265.11 G/L
SOLUBILITY IN WATER: INSOLUBLE
APPEARANCE AND ODOR: OPAQUE WITH ODOR OF SOLVENT

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 39.92 **METHOD USED:** CLOSED CUP
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: .8 **UPPER:** 7.1

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Water spray may be ineffective. If water is used, fog nozzles are preferred. Water may be used to cool closed containers to prevent pressure build-up and possible auto-ignition or explosion when exposed to extreme heat.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep containers tightly closed. Isolate from heat, sparks, electrical equipment and open flames. Closed containers may explode when exposed to extreme heat. Application to hot surfaces requires special precautions. Self-contained breathing apparatus should be worn by firefighters.

========== SECTION V - REACTIVITY DATA ==========

STABILITY: STABLE

CONDITIONS TO AVOID

Temperatures above maximum storage temperature. Avoid exposure to heat, sparks, or open flames.

INCOMPATIBILITY (MATERIALS TO AVOID)

Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

By fire - CO, CO2, nitrogen oxides.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

========== SECTION VI - HEALTH HAZARD DATA ==========

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Persons with asthmatic type conditions, chronic bronchitis or other chronic respiratory diseases or recurrent skin eczema or sensitization should be excluded from working with this product.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Can cause irritation to skin, eyes and respiratory tract. Symptoms may be watering of eyes, dryness of throat, coughing, headache, tightness in chest or burning sensation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Allergic reactions may occur in some individuals. Headache, dizziness or nausea may be experienced by some as a result of exposure to solvents.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Drink water to dilute. Do not induce vomiting. Consult a physician.

HEALTH HAZARDS (ACUTE AND CHRONIC)

During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

CARCINOGENICITY: NTP CARCINOGEN: No **IARC MONOGRAPHS:** No **OSHA REGULATED:** No

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Asthmatic type conditions, chronic bronchitis, other chronic respiratory disease or recurrent skin eczema/sensitization.

EMERGENCY AND FIRST AID PROCEDURES

Eye Contact: Flush with water for 15 minutes. Consult a physician. Skin Contact: Wash affected area with soap and water. Remove contaminated clothing. Consult a physician. Inhalation: Remove to fresh air. Consult a physician. Ingestion: Drink water to dilute. Do not induce vomiting. Consult a physician.

========== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE ==========

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate non-essential personnel. Remove all sources of ignition. Ventilate the area. Equip clean-up crew with self-contained breathing apparatus. Dike spill. Cover with sawdust, vermiculite or Fuller's earth. Collect in open containers.

WASTE DISPOSAL METHOD

Conform to Federal, State and Local regulations. Empty containers must be handled carefully due to product residue and flammable solvent vapor.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Do not store above 100 degrees F. Store in large quantities only in buildings designed to comply with OSHA 1910.106. Keep containers closed and upright to prevent leakage. Do not store or use near heat, sparks or flames.

OTHER PRECAUTIONS

Avoid prolonged or repeated contact with vapor or spray mist during application or curing.

SECTION VIII - CONTROL MEASURES

RESPIRATORY PROTECTION

In outdoor or open areas, use NIOSH approved mechanical filter respirator. In restricted ventilation areas, use NIOSH approved chemical/mechanical filters to remove vapors and particulates. In confined areas, use NIOSH approved air line type respirators or hoods.

VENTILATION

Must be sufficient in volume and pattern to keep contaminant concentration below TLV (NIOSH) or PEL (OSHA). Exhaust air may need to be cleaned by scrubbers or filters to reduce environmental contamination.

PROTECTIVE GLOVES

Required, butyl rubber recommended.

EYE PROTECTION

Required. Use goggles, face shields or safety eyewear with side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Protective creams where skin contact is likely.

WORK/HYGIENIC PRACTICES

Wash hands before eating or using bathroom. Remove and wash contaminated clothing before reuse. Wear chemical resistant boots.

SECTION IX - DISCLAIMER

The information contained herein is based on data considered accurate, but no warranty is expressed or implied. Users assume all responsibility and liability for loss or damage arising from the handling and use of our products, whether used alone or in combinations. Although hazardous materials are listed, we cannot guarantee these are the only ones that exist.

MSDS for Polyurethane Curing Solution PH-20

MATERIAL SAFETY DATA SHEET

24-hour Emergency Phone: 1-800-424-9300 **Page 1**
PRODUCT CODE: PH-20

PRODUCT NAME: POLYUETHANE CURING SOLUTION **HMIS CODES:** H C F R P
PRODUCT CODE: PH-20 2 3 1 G

SECTION I - MANUFACTURER IDENTIFICATION

MANUFACTURER'S NAME: **Axon Products Inc**
ADDRESS : 307 Echelon Road
Greenville, SC,
INFORMATION PHONE : 864 299-2819 **DATE PRINTED** : 4/10/2007

SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION

REPORTABLE COMPONENTS	CAS NUMBER	VAPOR PRESSURE mm Hg	@ TEMP	WEIGHT PERCENT
TERT BUTYL ACETATE	540-88-5	34	77 F	25% to 40%
ACGIH - 200ppm				
HOMOPOLYMER OF HDI	28182-81-2	7.5 E-5	68 F	25% to 40%
*TOLUENE	108-88-3	22.00	68 F	10% to 25%
OSHA PEL: 100 PPM -TWA				
OSHA PEL: 150 PPM - STEL				
ACGIH TLV: 50 PPM - TWA (SKIN)				
ACGIH TLV 150 PPM - STEL (SKIN)				

*** Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.**

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING RANGE: 208.4 F TO 446.0 **SPECIFIC GRAVITY (H2O=1):** 0.9703
BOILING POINT: 208.4 F
VAPOR DENSITY: HEAVIER THAN AIR **EVAPORATION RATE:** SLOWER THAN ETHER
COATING V.O.C.: 361.04 G/L **MATERIAL V.O.C.:** 201.45 G/L
SOLUBILITY IN WATER: INSOLUBLE
APPEARANCE AND ODOR: CLEAR WITH ODOR OF SOLVENT

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 39.92 **METHOD USED:** CLOSED CUP
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.2 **UPPER:** 7.0

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Water spray may be ineffective. If water is used, fog nozzles are preferred. Water may be used to cool closed containers to prevent pressure build-up and possible auto-ignition or explosion when exposed to extreme heat.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep containers tightly closed. Isolate from heat, sparks, electrical equipment and open flames. Closed containers may explode when exposed to extreme heat. Application to hot surfaces requires special precautions. Self-contained breathing apparatus should be worn by firefighters.

SECTION V - REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID

Temperatures above maximum storage temperature. Avoid exposure to heat, sparks, or open flames.

INCOMPATIBILITY (MATERIALS TO AVOID)

Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

By fire - CO, CO2, nitrogen oxides and traces of HCN, TDI and HDI.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

========== SECTION VI - HEALTH HAZARD DATA ==========

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Persons with asthmatic type conditions, chronic bronchitis or other chronic respiratory diseases or recurrent skin eczema or sensitization should be excluded from working with this product.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Can cause irritation to skin, eyes and respiratory tract. Symptoms may be watering of eyes, dryness of throat, coughing, headache, tightness in chest or burning sensation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Allergic reactions may occur in some individuals. Headache, dizziness or nausea may be experienced by some as a result of exposure to solvents.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Drink water to dilute. Do not induce vomiting. Consult a physician.

HEALTH HAZARDS (ACUTE AND CHRONIC)

During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

CARCINOGENICITY: NTP CARCINOGEN: No **IARC MONOGRAPHS:** No **OSHA REGULATED:** No

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Asthmatic type conditions, chronic bronchitis, other chronic respiratory disease or recurrent skin eczema/sensitization.

EMERGENCY AND FIRST AID PROCEDURES

Eye Contact: Flush with water for 15 minutes. Consult a physician. Skin Contact: Wash affected area with soap and water. Remove contaminated clothing. Consult a physician. Inhalation: Remove to fresh air. Consult a physician. Ingestion: Drink water to dilute. Do not induce vomiting. Consult a physician.

========== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE ==========

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate non-essential personnel. Remove all sources of ignition. Ventilate the area. Equip clean-up crew with self-contained breathing apparatus. Dike spill. Cover with sawdust, vermiculite or Fuller's earth. Collect in open containers.

WASTE DISPOSAL METHOD

Conform to Federal, State and Local regulations. Empty containers must be handled carefully due to product residue and flammable solvent vapor.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Do not store above 100 degrees F. Store in large quantities only in buildings designed to comply with OSHA 1910.106. Keep containers closed and upright to prevent leakage. Do not store or use near heat, sparks or flames.

OTHER PRECAUTIONS

Avoid prolonged or repeated contact with vapor or spray mist during application or curing.

========== SECTION VIII - CONTROL MEASURES ==========

RESPIRATORY PROTECTION

In outdoor or open areas, use NIOSH approved mechanical filter respirator. In restricted ventilation areas, use NIOSH approved chemical/mechanical filters to remove vapors and particulates. In confined areas, use NIOSH approved air line type respirators or hoods.

VENTILATION

Must be sufficient in volume and pattern to keep contaminant concentration below TLV (NIOSH) or PEL (OSHA).

PROTECTIVE GLOVES

Required, butyl rubber recommended.

EYE PROTECTION

Required. Use goggles, face shields or safety eyewear with side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Protective creams where skin contact is likely.

WORK/HYGIENIC PRACTICES

Wash hands before eating or using bathroom. Remove and wash contaminated clothing before reuse. Wear chemical resistant boots.

SECTION IX - DISCLAIMER

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MSDS for High Solids Matterhorn White Polyurethane Topcoat PG-6-W83

M A T E R I A L S A F E T Y D A T A S H E E T

24-hour Emergency Phone: 1-800-424-9300 **Page 1**
PRODUCT CODE: PG-6-W83

PRODUCT NAME: HIGH SOLIDS MATTERHORN WHITE POLYURETHANE TOPCOAT **HMIS CODES:** H C F R P
PRODUCT CODE: PG-6-W83 2 3 1 G

SECTION I - MANUFACTURER IDENTIFICATION

MANUFACTURER'S NAME: **Axon Products Inc**
ADDRESS : 307 Echelon Road
Greenville, SC,
INFORMATION PHONE : 864 299-2819 **DATE PRINTED** : 4/13/2007

SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION

REPORTABLE COMPONENTS	CAS NUMBER	VAPOR PRESSURE mm Hg	@ TEMP	WEIGHT PERCENT
METHYL NORMAL AMYL KETONE ACGIH TLV: 50 PPM SSHA 100 PPM TWA	110-43-0	2.80	68 F	10% to 25%
*XYLENE OSHA PEL: 100 PPM ACGIH TLV: 100 PPM	1330-20-7	2.4	68 F	1% to 10%

*** Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.**

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING RANGE: 279.0 F TO 304.0 **SPECIFIC GRAVITY (H2O=1):** 1.4313
BOILING POINT: 279.0 F
VAPOR DENSITY: HEAVIER THAN AIR **EVAPORATION RATE:** SLOWER THAN ETHER
COATING V.O.C.: 374.02 G/L **MATERIAL V.O.C.:** 373.92 G/L
SOLUBILITY IN WATER: INSOLUBLE
APPEARANCE AND ODOR: OPAQUE WITH ODOR OF SOLVENT

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 80.00 F **METHOD USED:** TCC
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.0 **UPPER:** 7.9

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Water spray may be ineffective. If water is used, fog nozzles are preferred. Water may be used to cool closed containers to prevent pressure build-up and possible auto-ignition or explosion when exposed to extreme heat.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep containers tightly closed. Isolate from heat, sparks, electrical equipment and open flames. Closed containers may explode when exposed to extreme heat. Application to hot surfaces requires special precautions. Self-contained breathing apparatus should be worn by firefighters.

SECTION V - REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID

Temperatures above maximum storage temperature. Avoid exposure to heat, sparks, or open flames.

INCOMPATIBILITY (MATERIALS TO AVOID)

Water, amines, strong bases, alcohols, metal compounds and surface active materials.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

By fire - CO, CO2, nitrogen oxides.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

========== SECTION VI - HEALTH HAZARD DATA ==========

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Persons with asthmatic type conditions, chronic bronchitis or other chronic respiratory diseases or recurrent skin eczema or sensitization should be excluded from working with this product.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Can cause irritation to skin, eyes and respiratory tract. Symptoms may be watering of eyes, dryness of throat, coughing, headache, tightness in chest or burning sensation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Allergic reactions may occur in some individuals. Headache, dizziness or nausea may be experienced by some as a result of exposure to solvents.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Drink water to dilute. Do not induce vomiting. Consult a physician.

HEALTH HAZARDS (ACUTE AND CHRONIC)

During emergency conditions, overexposure to decomposition products may cause a health hazard. Acute and chronic inhalation may occur if exposed to limits above TLV. Symptoms of irritation include redness, burning, itching eyes, dry ness of throat and tightness of chest. Acute and chronic skin contact will occur if exposed above TLV. Symptoms of irritation. Consult physician if swelling, rash, scaling or blistering occurs.

CARCINOGENICITY: NTP CARCINOGEN: No **IARC MONOGRAPHS:** No **OSHA REGULATED:** No

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Asthmatic type conditions, chronic bronchitis, other chronic respiratory disease or recurrent skin eczema/sensitization.

EMERGENCY AND FIRST AID PROCEDURES

Eye Contact: Flush with water for 15 minutes. Consult a physician. Skin Contact: Wash affected area with soap and water. Remove contaminated clothing. Consult a physician. Inhalation: Remove to fresh air. Consult a physician. Ingestion: Drink water to dilute. Do not induce vomiting. Consult a physician.

========== SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE ==========

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate non-essential personnel. Remove all sources of ignition. Ventilate the area. Equip clean-up crew with self-contained breathing apparatus. Dike spill. Cover with sawdust, vermiculite or Fuller's earth. Collect in open containers.

WASTE DISPOSAL METHOD

Conform to Federal, State and Local regulations. Empty containers must be handled carefully due to product residue and flammable solvent vapor.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Do not store above 100 degrees F. Store in large quantities only in buildings designed to comply with OSHA 1910.106. Keep containers closed and upright to prevent leakage. Do not store or use near heat, sparks or flames.

OTHER PRECAUTIONS

Avoid prolonged or repeated contact with vapor or spray mist during application or curing.

========== SECTION VIII - CONTROL MEASURES ==========

RESPIRATORY PROTECTION

In outdoor or open areas, use NIOSH approved mechanical filter respirator. In restricted ventilation areas, use NIOSH approved chemical/mechanical filters to remove vapors and particulates. In confined areas, use NIOSH approved air line type respirators or hoods.

VENTILATION

Must be sufficient in volume and pattern to keep contaminant concentration below TLV (NIOSH) or PEL (OSHA). Exhaust air may need to be cleaned by scrubber or filters to reduce environmental contamination.

PROTECTIVE GLOVES

Required. Chemical resistant gloves. Cover as much as exposed skin area as possible with appropriate clothing.

EYE PROTECTION

Required. Use goggles, face shields or safety eyewear with side shields. Contact lenses should not be worn.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

If protective creams are used keep the area protected only by the cream to a minimum.

WORK/HYGIENIC PRACTICES

Wash hands before eating or using bathroom. Remove and wash contaminated clothing before reuse. Wear chemical resistant boots.

========== SECTION IX - DISCLAIMER ==========

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MSDS for Polyurethane Curing Solution PH-34

M A T E R I A L S A F E T Y D A T A S H E E T

24-hour Emergency Phone: 1-800-424-9300 **Page 1**
PRODUCT CODE: PH-34

PRODUCT NAME: POLYUETHANE CURING SOLUTION **HMIS CODES:** H C F R P
PRODUCT CODE: PH-34 2 3 1 G

========== SECTION I - MANUFACTURER IDENTIFICATION ==========

MANUFACTURER'S NAME: **Axon Products Inc**
ADDRESS : 307 Echelon Road
Greenville, SC,
INFORMATION PHONE : 864 299-2819 **DATE PRINTED** : 5/29/2007

========== SECTION II - HAZARDOUS INGREDIENTS/SARA III INFORMATION ==========

REPORTABLE COMPONENTS	CAS NUMBER	VAPOR PRESSURE mm Hg	@ TEMP	WEIGHT PERCENT
HOMOPOLYMER OF HDI	28182-81-2	7.5 E-5	68 F	40% to 60%
METHYL ETHYL KETONE	78-93-3	70	68 F	25% to 40%
OSHA PEL: 300 PPM - STEL				
OSHA PEL: 200 PPM - TWA				
ACGIH TLV: 300 PPM - STEL				
N-BUTYL ACETATE	123-86-4	1.25	68 F	1% to 10%
OSHA PEL: 150 PPM, ACGIH TLV: 150 PPM				
METHYL NORMAL AMYL KETONE	110-43-0	2.80	68 F	1% to 10%
ACGIH TLV: 50 PPM				
SSHA 100 PPM TWA				
CYCLOHEXANONE	108-94-1	2	68 F	1% to 10%
OSHA VPEL: 25 PPM TWA				
ACGIH TLV: 25 PPM TWA				
*METHYL ISOBUTYL KETONE	108-10-1	16	68 F	1% to 10%
OSHA VPEL: 50 PPM - TWA				
OSHA VPEL: 75 PPM - STEL				
,ACGIH TLV: 50 PPM - TWA				
,ACGIH TLV: 75 PPM - STEL				
*TOLUENE	108-88-3	22.00	68 F	1% to 10%
OSHA PEL: 100 PPM -TWA				
OSHA PEL: 150 PPM - STEL				
ACGIH TLV: 50 PPM - TWA (SKIN)				
ACGIH TLV 150 PPM - STEL (SKIN)				

*** Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.**

========== SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS ==========

BOILING RANGE: 175.0 F TO 446.0 **SPECIFIC GRAVITY (H2O=1):** 0.9947
BOILING POINT: 175.0 F
VAPOR DENSITY: HEAVIER THAN AIR **EVAPORATION RATE:** SLOWER THAN ETHER
COATING V.O.C.: 370.27 G/L **MATERIAL V.O.C.:** 314.56 G/L
SOLUBILITY IN WATER: INSOLUBLE
APPEARANCE AND ODOR: CLEAR WITH ODOR OF SOLVENT

========== SECTION IV - FIRE AND EXPLOSION HAZARD DATA ==========

FLASH POINT: 23.00 **METHOD USED:** TCC
FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.1 **UPPER:** 11.5

EXTINGUISHING MEDIA: FOAM, CO2, DRY CHEMICAL, WATER FOG

SPECIAL FIREFIGHTING PROCEDURES

Water spray may be ineffective. If water is used, fog nozzles are preferred. Water may be used to cool closed containers to prevent pressure build-up and possible auto-ignition or explosion when exposed to extreme heat.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep containers tightly closed. Isolate from heat, sparks, electrical equipment and open flames. Closed containers may explode when exposed to extreme heat. Application to hot surfaces requires special precautions. Self-contained breathing apparatus should be worn by firefighters.

SECTION V - REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID

Temperatures above maximum storage temperature. Avoid exposure to heat, sparks, or open flames.

INCOMPATIBILITY (MATERIALS TO AVOID)

Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS

By fire - CO, CO2, nitrogen oxides and traces of HCN, TDI and HDI.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

SECTION VI - HEALTH HAZARD DATA

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Persons with asthmatic type conditions, chronic bronchitis or other chronic respiratory diseases or recurrent skin eczema or sensitization should be excluded from working with this product.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Can cause irritation to skin, eyes and respiratory tract. Symptoms may be watering of eyes, dryness of throat, coughing, headache, tightness in chest or burning sensation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Allergic reactions may occur in some individuals. Headache, dizziness or nausea may be experienced by some as a result of exposure to solvents.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Drink water to dilute. Do not induce vomiting. Consult a physician.

HEALTH HAZARDS (ACUTE AND CHRONIC)

During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.

CARCINOGENICITY: NTP CARCINOGEN: No **IARC MONOGRAPHS:** No **OSHA REGULATED:** No

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Asthmatic type conditions, chronic bronchitis, other chronic respiratory disease or recurrent skin eczema/sensitization.

EMERGENCY AND FIRST AID PROCEDURES

Eye Contact: Flush with water for 15 minutes. Consult a physician. Skin Contact: Wash affected area with soap and water. Remove contaminated clothing. Consult a physician. Inhalation: Remove to fresh air. Consult a physician. Ingestion: Drink water to dilute. Do not induce vomiting. Consult a physician.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate non-essential personnel. Remove all sources of ignition. Ventilate the area. Equip clean-up crew with self-contained breathing apparatus. Dike spill. Cover with sawdust, vermiculite or Fuller's earth. Collect in open containers.

WASTE DISPOSAL METHOD

Conform to Federal, State and Local regulations. Empty containers must be handled carefully due to product residue and flammable solvent vapor.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Do not store above 100 degrees F. Store in large quantities only in buildings designed to comply with OSHA 1910.106. Keep containers closed and upright to prevent leakage. Do not store or use near heat, sparks or flames.

OTHER PRECAUTIONS

Avoid prolonged or repeated contact with vapor or spray mist during application or curing.

========== SECTION VIII - CONTROL MEASURES ==========

RESPIRATORY PROTECTION

In outdoor or open areas, use NIOSH approved mechanical filter respirator. In restricted ventilation areas, use NIOSH approved chemical/mechanical filters to remove vapors and particulates. In confined areas, use NIOSH approved air line type respirators or hoods.

VENTILATION

Must be sufficient in volume and pattern to keep contaminant concentration below TLV (NIOSH) or PEL (OSHA).

PROTECTIVE GLOVES

Required, butyl rubber recommended.

EYE PROTECTION

Required. Use goggles, face shields or safety eyewear with side shields.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Protective creams where skin contact is likely.

WORK/HYGIENIC PRACTICES

Wash hands before eating or using bathroom. Remove and wash contaminated clothing before reuse. Wear chemical resistant boots.

========== SECTION IX - DISCLAIMER ==========

The information contained herein is based on data considered accurate, but no warranty is expressed or implied. Users assume all responsibility and liability for loss or damage arising from the handling and use of our products, whether used alone or in combinations. Although hazardous materials are listed, we cannot guarantee these are the only ones that exist.

Appendix B
MSDSs for Industrial Maintenance Coatings for Water Storage Tank

MSDS for Amerlock Sealer Cure Res

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT AND COMPANY INFORMATION

PPG Industries, Inc.
One PPG Place
Pittsburgh, PA 15272

EMERGENCY PHONE NUMBERS (412) 434-4515 (U.S.)
(24 hours/day):
(514) 645-1320 (Canada)
01-800-00-21-400 (Mexico)
0532-83889090 (China)

PRODUCT SAFETY/MSDS INFORMATION: (412) 492-5555 7:00 a.m. - 4:30 p.m. EST

Product ID: AK-0A (0882)
PRODUCT NAME: AMERLOCK SEALER CLEAR RES
SYNONYMS: None
ISSUE DATE: 12/08/2006
EDITION NO.: 3
CHEMICAL FAMILY: MIXTURE

EMERGENCY OVERVIEW:

CAUSES EYE IRRITATION. MAY CAUSE SLIGHT SKIN IRRITATION. PROLONGED OR REPEATED CONTACT MAY CAUSE AN ALLERGIC SKIN REACTION.VAPOR AND/OR SPRAY MIST MAY BE HARMFUL IF INHALED.HARMFUL IF SWALLOWED. This product is not expected to present any unusual hazards under fire or spill conditions. Read entire MSDS before use.

SECTION 2 - COMPOSITION INFORMATION

The following ingredient(s) marked with an "x" are considered hazardous under applicable U.S. OSHA and/or Canadian WHMIS regulations. If no ingredients are listed, then there are no U.S. OSHA and/or Canadian WHMIS hazardous ingredients in this product.

Material/ CAS Number	Percent	Hazardous
EPOXY RESIN 25068-38-6	60- 100	X
NEOPENTYL GLYCOL DIGLYCIDYL ETHER 17557-23-2	10 - 30	X

SECTION 3 - HAZARDS IDENTIFICATION

ACUTE OVEREXPOSURE EFFECTS

EYE CONTACT:
Causes eye irritation. Redness, itching, burning sensation and visual disturbances may indicate excessive eye contact.

SKIN CONTACT:
May cause slight skin irritation. Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.

SKIN ABSORPTION:
Skin absorption not expected to occur. Prolonged or repeated contact may cause an allergic skin reaction.

INHALATION:
Vapor and/or spray mist may be harmful if inhaled.

INGESTION:
Harmful if swallowed.

SIGNS & SYMPTOMS OF OVEREXPOSURE:
Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Not applicable.

CHRONIC OVEREXPOSURE EFFECTS
Avoid long-term and repeated contact.

The effects of long-term, low level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the prevention of all contact with this material to avoid any effects from repetitive acute exposures. See Section 11, of this MSDS for a detailed list of chronic health effects information available on individual ingredients in this product.

SECTION 4 - FIRST AID MEASURES

If ingestion, irritation, any type of overexposure or symptoms of overexposure occur during or persists after use of this product, contact a POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN immediately; have Material Safety Data Sheet information available.

EYE CONTACT:
Remove contact lens and pour a gentle stream of warm water through the affected eye for at least 15 minutes. If irritation persists, contact a poison control center, emergency room, or physician as further treatment may be necessary.

SKIN CONTACT:
Run a gentle stream of water over the affected area for 15 minutes. A mild soap may be used if available. If any symptoms persist, contact a poison control center, emergency room, or physician as further treatment may be necessary.

INHALATION:
Remove from area to fresh air. If symptomatic, contact a poison control center, emergency room or physician for treatment information.

INGESTION:
Gently wipe or rinse the inside of the mouth with water. Sips of water may be given if person is fully conscious. Never give anything by mouth to an unconscious or convulsing person. Do Not induce vomiting. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.

SECTION 5 - FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES
FLASHPOINT: 212 Degrees F (100 Degrees C)
FLASHPOINT TEST METHOD:
Pensky-Martens Closed Cup
UEL: Not Available.
LEL: Not Available.
AUTOIGNITION TEMPERATURE:
Not Available.

EXTINGUISHING MEDIA:
Use National Fire Protection Association (NFPA) Class B extinguishers (carbon dioxide, dry chemical or universal aqueous film forming foam) designed to extinguish NFPA Class IIIB combustible liquid fires.

PROTECTION OF FIREFIGHTERS:
Water spray may be ineffective. Water spray may be used to cool closed containers that are exposed to extreme heat. If water is used, fog nozzles are preferable. Firefighters should wear self-contained breathing apparatus and full protective clothing.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
The curing process of this two component product is an exothermic reaction. As the mixture nears the end of its potlife, it increases in temperature rapidly. The mixed product gels and may smoke. Contact with the material or the container may cause burns. To avoid the increase in temperature, spread the material out or mix it with a bucket of sand. Material not known to be explosive. May produce hazardous decomposition products when exposed to extreme heat. Extreme heat includes, but is not limited to, flame cutting, brazing, and welding.

SECTION 6 - ACCIDENTAL RELEASE MEASURE

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Provide maximum ventilation. Only personnel equipped with proper respiratory, skin, and eye protection should be permitted in the area. Remove all sources of ignition. Take up spilled material with sand, vermiculite, or other noncombustible absorbent material and place in clean, empty containers for disposal. Only the spilled material and the absorbant should be placed in this container.

SECTION 7 - HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORAGE:
If this material is part of a multiple component system, read the Material Safety Data Sheet(s) for the other component or components before blending as the resulting mixture may have the hazards of all of its parts.
STORAGE:
Do not store above 120 degrees F.(48 degress C.). Store large quantities in buildings designed and protected for storage of NFPA Class IIIB combustible liquids.

SECTION 8 - EXPOSURE CONTROLS & PERSONAL PROTECTION

ENGINEERING CONTROLS:
Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 8 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.

PERSONAL PROTECTIVE EQUIPMENT
EYES:
Wear safety glasses with side shields.
SKIN/GLOVES:
Wear protective clothing to prevent skin contact. Apron and gloves should be constructed of: rubber. No specific permeation/degradation testing have been done on protective clothing for this product. Recommendations for skin protection are based on infrequent contact with this product. For frequent contact or total immersion, contact a manufacturer of protective clothing for appropriate chemical impervious equipment. The decision whether to clean or discard contaminated clothing should be based on the chemicals contaminating them. Some chemicals can cause skin irritation, sensitization or other health effects if the cleaning process does not remove all traces of them. Consult a safety professional to determine whether clothing contaminated with this product can be safely cleaned and reused.
RESPIRATOR:
Where ventilation is inadequate, use a NIOSH- approved air purifying respirator with the appropriate chemical cartridges or positive- pressure, air-supplied respirator. Read the respirator manufacturer's instructions and literature carefully to determine the type of airborne contaminants against which the respirator is effective, its limitations, and how it is to be properly fitted and used. Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 2 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.
GENERAL HYGIENE - ESTABLISHED EXPOSURE LIMITS
If Threshold Limit Values (TLVs) have been established by ACGIH, OSHA, Ontario or PPG, they will be listed below. These limits are intended for use in the practice of industrial hygiene as guidelines or recommendations in the control of potential workplace health hazards. These limits are not a relative index of toxicity and should not be used by anyone without industrial hygiene training.

Key: ACGIH=American Conference of Governmental Industrial Hygienists; OSHA=Occupational Safety and Health Administration; TLV=Threshold Limit Value; TWA=Time Weighted Average; PEL=Permissible Exposure Limit (1989 Vacated values); IPEL=Internal Permissible Exposure Limit; Ceiling=TLV or PEL Ceiling Limit; STEL=TLV or PEL Short-Term Exposure Limit; Skin= Skin Absorption Designation. [C- Ceiling Limit; S-Potential Skin Absorption; R-Respirable Dust]
Additional Information Not applicable.

SECTION 9 - PHYSICAL & CHEMICAL PROPERTIES

(FORMULA VALUES, NOT SALES SPECIFICATIONS)

SPECIFIC GRAVITY:	1.136
PHYSICAL STATE:	Liquid
Percent Solids:	100.00
Percent Volatile by Volume:	.010
pH:	Not available.
ODOR THRESHOLD:	Not available.
Vapour Pressure:	N.A. mmHg
ODOR/APPEARANCE:	Viscous liquid with an odor characteristic of the solvents listed in Section 2.
VAPOR DENSITY:	HEAVIER THAN AIR
Evaporation Rate:	0
BOILING POINT OR RANGE:	Not available.
Freezing Point or Range:	Not Applicable.
Melting Point or Range(°C):	Not Applicable.
Partition coefficient (n-octanol/water):	Not Applicable.
WEIGHT PER GALLON:	9.47 (U.S.) / 11.3 (IMPERIAL)

SECTION 10 - STABILITY AND REACTIVITY

STABILITY:
This product is normally stable and will not undergo hazardous reactions.
CONDITIONS TO AVOID:
None Known.
INCOMPATIBLE MATERIALS:
Avoid contact with strong alkalies, strong mineral acids, or strong oxidizing agents.
HAZARDOUS POLYMERIZATION:
None Known.
HAZARDOUS DECOMPOSITION PRODUCTS:
- Carbon monoxide - Carbon dioxide - Lower molecular weight polymer fractions

SECTION 11 - TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Material/ CAS Number	Percent	ORAL LD50 (g/kg)	DERMAL LD50 (g/kg)	INHALATION LC50 (mg/l)
EPOXY RESIN 25068-38-6	60- 100	2.00 g/kg	2.00 g/kg	Not Available
NEOPENTYL GLYCOL DIGLYCIDYL ETHER 17557-23-2	10 - 30	4.50 g/kg	Not Available	Not Available

CHRONIC TOXICITY
Ingredient Target Organ/Chronic Effects:
- Carcinogen - Mutagen

Mutagenicity Toxicity:
This has not been tested for this product.

Reproductive Toxicity:
This has not been tested for this product.

SUPPLEMENTAL HEALTH INFORMATION:

Material/ CAS Number	Percent	Ingredient Specific Animal Data:
NEOPENTYL GLYCOL DIGLYCIDYL ETHER 17557-23-2	10 - 30	Possible cancer hazard. Long-term exposure to an ingredient(s) in this product has produced tumors in laboratory animals.

SECTION 12 - ECOLOGICAL INFORMATION

POTENTIAL ENVIRONMENTAL EFFECTS
Ecotoxicity: No Information Available.

ENVIRONMENTAL FATE
Mobility: No information available.
Biodegradation: No information available.
Bioaccumulation: No Information Available.

PHYSICAL/CHEMICAL

Hydrolysis: No information available.
Photolysis: No information available.

SECTION 13 - DISPOSAL CONSIDERATIONS

Provide maximum ventilation, only personnel equipped with proper respiratory and skin and eye protection should be permitted in the area. Take up spilled material with sawdust, vermiculite, or other absorbent material and place in containers for disposal.

Waste material must be disposed of in accordance with federal, state, provincial and local environmental control regulations. Empty containers should be recycled by an appropriately licensed reconditioner/salvager or disposed of through a permitted waste management facility. Additional disposal information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.

SECTION 14 - TRANSPORTATION INFORMATION

Proper Shipping Name: Paint- Non-Regulated Goods
NOS Technical Name: None
Hazard Class: None
Subsidiary Class(es): None
UN Number: None
Packing Group: None

USA - RQ Hazardous Substances: None
USA-RQ Hazardous Substance Threshold Ship Weight: None
Marine Pollutant Name: None

SECTION 15 - REGULATORY INFORMATION

INVENTORY STATUS
U.S. TSCA: This product and/or all of its components are listed on the U.S. TSCA Inventory or is otherwise exempt from TSCA Inventory reporting requirements.
FEDERAL REGULATIONS
US Regulations

Material/ CAS Number	Percent	CERCLA HS - RQ (LBS)	SARA EHS- TPQ (LBS)	SARA 313
EPOXY RESIN 25068-38-6	60- 100	Not Listed	Not Listed	Not Listed
NEOPENTYL GLYCOL DIGLYCIDYL ETHER 17557-23-2	10 - 30	Not Listed	Not Listed	Not Listed

SARA 311/312
Health (acute): Yes
Health (chronic): Yes
Fire (flammable): No
Pressure: No
Reactivity: No
WHMIS HAZARD CLASS: - Class D, Division 2, Subdivision A - Class D, Division 2, Subdivision B

STATE/PROVINCIAL REGULATIONS
Additional Information
Key: IARC- International Agency on the Research of Cancer; ACGIH- American Conference of Governmental Industrial Hygienists; NTP- National Toxicology Program *Denotes chemical as NTP Known Carcinogen; + Denotes NTP Possible Carcinogen; OSHA- Occupational Safety and Health Administration.

SECTION 16 - OTHER INFORMATION

Hazard Rating Systems
NFPA Rating: 2 10
HMIS Rating: 2*10

Rating System: 0=Minimal, 1=Slight, 2=Moderate, 3=Serious, 4=Severe, *=Chronic Effects.

HMIS=Hazardous Materials Identification System; NFPA=National Fire Protection Association;

Safe handling of this product requires that all of the information on the MSDS be evaluated for specific work environments and conditions of use.

PREPARED BY: Product Safety Department
REASON FOR REVISION: Section 1 has been updated. Date. Edition. Updated MSDS format.

This Material Safety Data Sheet has been prepared in accordance with Canada's Workplace Hazardous Materials Information System (WHMIS) and the OSHA Hazard Communication Standard (29 CFR 1910.1200), the supplier notification requirements of SARA Title III, Section 313 and other applicable right-to-know regulations.
Additional environmental information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.
AK-0A 000001 (00437370.001)(12/07/06)
061206, 000, 0882

*** END OF MSDS ***

MSDS for Amerlock Sealer Cure

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT AND COMPANY INFORMATION

PPG Industries, Inc.
One PPG Place
Pittsburgh, PA 15272

EMERGENCY PHONE NUMBERS (412) 434-4515 (U.S.) (24 hours/day):
(514) 645-1320 (Canada)
01-800-00-21-400 (Mexico)
0532-83889090 (China)

PRODUCT SAFETY/MSDS INFORMATION: (412) 492-5555 7:00 a.m. - 4:30 p.m. EST

Product ID: AK-0B (0882)
PRODUCT NAME: AMERLOCK SEALER CURE
SYNONYMS: None
ISSUE DATE: 07/12/2007
EDITION NO.: 4
CHEMICAL FAMILY: MIXTURE

EMERGENCY OVERVIEW:

CAUSES IRREVERSIBLE EYE DAMAGE. MAY BE CORROSIVE. THIS PRODUCT CONTAINS A MATERIAL WHICH CAUSES SKIN BURNS. MAY BE HARMFUL IF ABSORBED THROUGH THE SKIN. PROLONGED OR REPEATED CONTACT MAY CAUSE AN ALLERGIC SKIN REACTION.VAPOR AND/OR SPRAY MIST HARMFUL IF INHALED. VAPOR IRRITATES EYES, NOSE, AND THROAT. VAPOR GENERATED AT ELEVATED TEMPERATURES IRRITATES EYES, NOSE AND THROAT. MAY CAUSE IRRITATION AND/OR ALLERGIC RESPIRATORY REACTION IN LUNGS.HARMFUL OR FATAL IF SWALLOWED. STABLE - HAZARDOUS REACTIONS POSSIBLE AT EXTREMELY HIGH TEMPERATURES/PRESSURES. This product is not expected to present any unusual hazards under fire or spill conditions. Read entire MSDS before use.

SECTION 2 - COMPOSITION INFORMATION

The following ingredient(s) marked with an "x" are considered hazardous under applicable U.S. OSHA and/or Canadian WHMIS regulations. If no ingredients are listed, then there are no U.S. OSHA and/or Canadian WHMIS hazardous ingredients in this product.

Material/ CAS Number	Percent	Hazardous
FURFURYL ALCOHOL 98-00-0	10 - 30	X
POLYOXY PROPYLENE DIAMINE 9046-10-0	10 - 30	X
DIISODECYL PHTHALATE 68515-49-1	7 - 13	X
BENZYL ALCOHOL 100-51-6	5 - 10	X
PROPRIETARY MIXED CYCLOALIPHATIC AMINES Proprietary	5 - 10	X
PROPRIETARY TERTIARY AMINE Proprietary	1 - 5	X
TRIETHYLENE TETRAMINE 112-24-3	0.5-1.5	X
NONYL PHENOL 84852-15-3	0.5-1.5	X

SECTION 3 - HAZARDS IDENTIFICATION

ACUTE OVEREXPOSURE EFFECTS

EYE CONTACT:
This product contains a material which causes irreversible eye damage. Redness, itching, burning sensation and visual disturbances may indicate excessive eye contact.

SKIN CONTACT:
May be corrosive. This product contains a material which causes skin burns. Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.

SKIN ABSORPTION:
May be harmful if absorbed through the skin. Prolonged or repeated contact may cause an allergic skin reaction.

INHALATION:
Vapor and/or spray mist harmful if inhaled. Vapor irritates eyes, nose, and throat. Vapor generated at elevated temperatures irritates eyes, nose and throat. May cause irritation and/or allergic respiratory reaction in lungs.

INGESTION:
Harmful or fatal if swallowed.

SIGNS & SYMPTOMS OF OVEREXPOSURE:
Repeated exposure to high vapor concentrations may cause irritation of the respiratory system and permanent brain and nervous system damage. Eye watering, headaches, nausea, dizziness and loss of coordination are indications that solvent levels are too high. Intentional misuse by deliberately concentrating and inhaling the contents can be harmful or fatal. Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Not applicable.

CHRONIC OVEREXPOSURE EFFECTS
Avoid long-term and repeated contact.
Repeated exposure to vapors above recommended exposure limits (see Section 8) may cause irritation of the respiratory system and permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents can be harmful or fatal.
The effects of long-term, low level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the prevention of all contact with this material to avoid any effects from repetitive acute exposures. See Section 11, of this MSDS for a detailed list of chronic health effects information available on individual ingredients in this product.

SECTION 4 - FIRST AID MEASURES

If ingestion, irritation, any type of overexposure or symptoms of overexposure occur during or persists after use of this product, contact a POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN immediately; have Material Safety Data Sheet information available.

EYE CONTACT:
Remove contact lens and pour a gentle stream of warm water through the affected eye for at least 15 minutes. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.

SKIN CONTACT:
Run a gentle stream of water over the affected area for 15 minutes. A mild soap may be used if available. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.

INHALATION:
Remove from area to fresh air. If symptomatic, contact a poison control center, emergency room or physician for treatment information.

INGESTION:
Gently wipe or rinse the inside of the mouth with water. Sips of water may be given if person is fully conscious. Never give anything by mouth to an unconscious or convulsing person. Do Not induce vomiting. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.

SECTION 5 - FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES
FLASHPOINT: 212 Degrees F (100 Degrees C)
FLASHPOINT TEST METHOD:
Pensky-Martens Closed Cup
UEL: Not Available.
LEL: 1.3
AUTOIGNITION TEMPERATURE:
Not Available.
EXTINGUISHING MEDIA:
Use National Fire Protection Association (NFPA) Class B extinguishers (carbon dioxide, dry chemical or universal aqueous film forming foam) designed to extinguish NFPA Class IIIB combustible liquid fires. Water spray may be ineffective. Water spray may be used to cool closed containers to prevent pressure build-up and possible autoignition or explosion when exposed to extreme heat.
PROTECTION OF FIREFIGHTERS:
Fire-fighters should wear self-contained breathing apparatus and full protective clothing.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
The curing process of this two component product is an exothermic reaction. As the mixture nears the end of its potlife, it increases in temperature rapidly. The mixed product gels and may smoke. Contact with the material or the container may cause burns. To avoid the increase in temperature, spread the material out or mix it with a bucket of sand. Keep this product away from heat, sparks, flame, and other sources of ignition (i.e., pilot lights, electric motors, static electricity). Invisible vapors can travel to a source of ignition and flash back. Do not smoke while using this product. Keep containers tightly closed when not in use. Closed containers may explode when overheated. Do not apply to hot surfaces. Toxic gases may form when this product comes in contact with extreme heat. May produce hazardous decomposition products when exposed to extreme heat. Extreme heat includes, but is not limited to, flame cutting, brazing, and welding.

SECTION 6 - ACCIDENTAL RELEASE MEASURE

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Provide maximum ventilation. Only personnel equipped with proper respiratory, skin, and eye protection should be permitted in the area. Remove all sources of ignition. Take up spilled material with sand, vermiculite, or other noncombustible absorbent material and place in clean, empty containers for disposal. Only the spilled material and the absorbant should be placed in this container.

SECTION 7 - HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORAGE:
Vapors may collect in low areas. If this material is part of a multiple component system, read the Material Safety Data Sheet(s) for the other component or components before blending as the resulting mixture may have the hazards of all of its parts. Containers should be grounded when pouring. Avoid free fall of liquids in excess of a few inches.
STORAGE:
Do not store above 120 degrees F.(48 degress C.). Store large quantities in buildings designed and protected for storage of NFPA Class IIIB combustible liquids.

SECTION 8 - EXPOSURE CONTROLS & PERSONAL PROTECTION

ENGINEERING CONTROLS:
Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 8 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.

PERSONAL PROTECTIVE EQUIPMENT

EYES:
Wear chemical-type splash goggles and full face shield when possibility exists for eye contact due to splashing or spraying liquid, airborne particles, or vapors.
SKIN/GLOVES:
Wear protective clothing sufficient to cover exposed skin surfaces. For applications where skin contact is likely and impermeable clothing is necessary, select clothing constructed of: butyl rubber. No specific permeation/degradation testing have been done on protective clothing for this product. Recommendations for skin protection are based on infrequent contact with this product. For frequent contact or total immersion, contact a manufacturer of protective clothing for appropriate chemical impervious equipment. Clean contaminated clothing and shoes.
RESPIRATOR:
Overexposure to vapors may be prevented by ensuring proper ventilation controls, vapor exhaust or fresh air entry. A NIOSH- approved air purifying respirator with the appropriate chemical cartridges or a positive-pressure, air-supplied respirator may also reduce exposure. Read the respirator manufacturer's instructions and literature carefully to determine the type of airborne contaminants against which the respirator is effective, its limitations, and how it is to be properly fitted and used. Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 2 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.
GENERAL HYGIENE - ESTABLISHED EXPOSURE LIMITS
If Threshold Limit Values (TLVs) have been established by ACGIH, OSHA, Ontario or PPG, they will be listed below. These limits are intended for use in the practice of industrial hygiene as guidelines or recommendations in the control of potential workplace health hazards. These limits are not a relative index of toxicity and should not be used by anyone without industrial hygiene training.

Material/ CAS Number	Percent	ACGIH TLV	ACGIH STEL	OSHA PEL	OSHA STEL
FURFURYL ALCOHOL 98-00-0	10 - 30	S- 10 ppm	15 ppm	S- 10 ppm	15 ppm

Material/ CAS Number	Percent	Ontario TWA	Ontario STEL	PPG IPEL	PPG STEL
FURFURYL ALCOHOL 98-00-0	10 - 30	S- 10 ppm	15 ppm	Not established	Not established
TRIETHYLENE TETRAMINE 112-24-3	0.5-1.5	S- 0.5 PPM	Not established	1 ppm	Not established

Key: ACGIH=American Conference of Governmental Industrial Hygienists; OSHA=Occupational Safety and Health Administration; TLV=Threshold Limit Value; TWA=Time Weighted Average; PEL=Permissible Exposure Limit (1989 Vacated values); IPEL=Internal Permissible Exposure Limit; Ceiling=TLV or PEL Ceiling Limit; STEL=TLV or PEL Short-Term Exposure Limit; Skin= Skin Absorption Designation. [C- Ceiling Limit; S-Potential Skin Absorption; R-Respirable Dust]
Additional Information Not applicable.

SECTION 9 - PHYSICAL & CHEMICAL PROPERTIES

(FORMULA VALUES, NOT SALES SPECIFICATIONS)

SPECIFIC GRAVITY:	1.016
PHYSICAL STATE:	Liquid
Percent Solids:	78.34
Percent Volatile by Volume:	19.450
pH:	Not available.
ODOR THRESHOLD:	Not available.
Vapour Pressure:	21.8 mmHg

ODOR/APPEARANCE: Viscous liquid with an odor characteristic of the solvents listed in Section 2.
VAPOR DENSITY: HEAVIER THAN AIR
Evaporation Rate: 1
BOILING POINT OR RANGE: 230 - 338Degrees F
Freezing Point or Range: Not Applicable.
Melting Point or Range(°C): Not Applicable.
Partition coefficient (n-octanol/water): Not Applicable.
WEIGHT PER GALLON: 8.47 (U.S.) / 10.1 (IMPERIAL)

SECTION 10 - STABILITY AND REACTIVITY

STABILITY:
This product is normally stable but may undergo hazardous reactions at extremely high temperatures and pressures.
CONDITIONS TO AVOID:
None Known.
INCOMPATIBLE MATERIALS:
Avoid contact with strong alkalies, strong mineral acids, or strong oxidizing agents.
HAZARDOUS POLYMERIZATION:
None Known.
HAZARDOUS DECOMPOSITION PRODUCTS:
- Carbon monoxide - Carbon dioxide - Oxides of nitrogen - Hydrocarbons - Amines

SECTION 11 - TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Material/ CAS Number	Percent	ORAL LD50 (g/kg)	DERMAL LD50 (g/kg)	INHALATION LC50 (mg/l)
FURFURYL ALCOHOL 98-00-0	10 - 30	.13 g/kg	.66 g/kg	.93 mg/l 4 hr
POLYOXY PROPYLENE DIAMINE 9046-10-0	10 - 30	1.66 g/kg	.76 g/kg	Not Available
BENZYL ALCOHOL 100-51-6	5 - 10	1.23 g/kg	2.00 g/kg	Not Available
PROPRIETARY MIXED CYCLOALIPHATIC AMINES Proprietary	5 - 10	Not Available	1.00 g/kg	Not Available
PROPRIETARY TERTIARY AMINE Proprietary	1 - 5	Not Available	1.24 g/kg	Not Available
TRIETHYLENE TETRAMINE 112-24-3	0.5-1.5	2.50 g/kg	.81 g/kg	Not Available
NONYL PHENOL 84852-15-3	0.5-1.5	.58 g/kg	2.14 g/kg	Not Available

CHRONIC TOXICITY
Ingredient Target Organ/Chronic Effects:
- Birth defects - Bone - Fetotoxin - Respiratory sensitizer - Blood - Liver - Teratogen - Carcinogen - Kidney - Nasal lining - Brain - Central nervous system - Lung

Mutagenicity Toxicity:
This has not been tested for this product.
Reproductive Toxicity:
This has not been tested for this product.

SUPPLEMENTAL HEALTH INFORMATION:

Material/ CAS Number	Percent	Ingredient Specific Animal Data:
FURFURYL ALCOHOL 98-00-0	10 - 30	In inhalation studies with experimental animals, furfuryl alcohol increased the incidence of nasal and kidney tumors.
DIISODECYL PHTHALATE 68515-49-1	7 - 13	Prenatal oral exposure of di-isodecyl phthalate (DIDP) to rats causes abnormal fetal skeletal development, reduced weight gains and survival of pups and urinary tract abnormalities. DIDP exposure did not cause reproductive toxicity.
TRIETHYLENE TETRAMINE 112-24-3	0.5-1.5	Repeated applications of triethylenetetramine to the skin of guinea pigs resulted in liver degeneration, damage to the kidneys and brain, and reproductive/teratogenic effects.

SECTION 12 - ECOLOGICAL INFORMATION

POTENTIAL ENVIRONMENTAL EFFECTS
Ecotoxicity: No Information Available.

ENVIRONMENTAL FATE
Mobility: No information available.
Biodegradation: No information available.
Bioaccumulation: No Information Available.

PHYSICAL/CHEMICAL
Hydrolysis: No information available.
Photolysis: No information available.

SECTION 13 - DISPOSAL CONSIDERATIONS

Provide maximum ventilation, only personnel equipped with proper respiratory and skin and eye protection should be permitted in the area. Take up spilled material with sawdust, vermiculite, or other absorbent material and place in containers for disposal.
Waste material must be disposed of in accordance with federal, state, provincial and local environmental control regulations. Empty containers should be recycled by an appropriately licensed reconditioner/salvager or disposed of through a permitted waste management facility. Additional disposal information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.

SECTION 14 - TRANSPORTATION INFORMATION

Proper Shipping Name: Paint- Non-Regulated Goods
NOS Technical Name: None
Hazard Class: None
Subsidiary Class(es): None
UN Number: None
Packing Group: None

USA - RQ Hazardous Substances: None
USA-RQ Hazardous Substance None
Threshold Ship Weight:
Marine Pollutant Name: None

SECTION 15 - REGULATORY INFORMATION

INVENTORY STATUS
U.S. TSCA: This product and/or all of its components are listed on the U.S. TSCA Inventory or is otherwise exempt from TSCA Inventory reporting requirements.
FEDERAL REGULATIONS
US Regulations

Material/ CAS Number	Percent	CERCLA HS - RQ (LBS)	SARA EHS- TPQ (LBS)	SARA 313
FURFURYL ALCOHOL 98-00-0	10 - 30	Not Listed	Not Listed	Not Listed
POLYOXY PROPYLENE DIAMINE 9046-10-0	10 - 30	Not Listed	Not Listed	Not Listed
DIISODECYL PHTHALATE 68515-49-1	7 - 13	Not Listed	Not Listed	Not Listed
BENZYL ALCOHOL 100-51-6	5 - 10	Not Listed	Not Listed	Not Listed
PROPRIETARY MIXED CYCLOALIPHATIC AMINES Proprietary	5 - 10	Not Listed	Not Listed	Not Listed
PROPRIETARY TERTIARY AMINE Proprietary	1 - 5	Not Listed	Not Listed	Not Listed
TRIETHYLENE TETRAMINE 112-24-3	0.5-1.5	Not Listed	Not Listed	Not Listed
NONYL PHENOL 84852-15-3	0.5-1.5	Not Listed	Not Listed	Not Listed

SARA 311/312
Health (acute): Yes
Health (chronic): Yes
Fire (flammable): No
Pressure: No
Reactivity: No
WHMIS HAZARD CLASS: - Class D, Division 2, Subdivision A - Class D, Division 2, Subdivision B - Class E - Class D, Division 1, Subdivision B

STATE/PROVINCIAL REGULATIONS
CALIFORNIA PROP. 65: WARNING: This product contains a chemical known to the State of California to cause cancer. WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.
Additional Information
Key: IARC- International Agency on the Research of Cancer; ACGIH- American Conference of Governmental Industrial Hygienists; NTP- National Toxicology Program *Denotes chemical as NTP Known Carcinogen; + Denotes NTP Possible Carcinogen; OSHA- Occupational Safety and Health Administration.

SECTION 16 - OTHER INFORMATION

Hazard Rating Systems
NFPA Rating: 3 11
HMIS Rating: 3*11

Rating System: 0=Minimal, 1=Slight, 2=Moderate, 3=Serious, 4=Severe, *=Chronic Effects.

HMIS=Hazardous Materials Identification System; NFPA=National Fire Protection Association;

Safe handling of this product requires that all of the information on the MSDS be evaluated for specific work environments and conditions of use.

PREPARED BY: Product Safety Department

REASON FOR REVISION: Section 11 has been updated. Section 1 has been updated. Section 15 has been updated. Section 3 has been updated. Section 4 has been updated. Section 5 has been updated. Section 6 has been updated. Section 13 has been updated. Section 7 has been updated. Section 8 has been updated. Section 9 has been updated. Section 10 has been updated. Date. Edition.
Updated MSDS
format.

This Material Safety Data Sheet has been prepared in accordance with Canada's Workplace Hazardous Materials Information System (WHMIS) and the OSHA Hazard Communication Standard (29 CFR 1910.1200), the supplier notification requirements of SARA Title III, Section 313 and other applicable right-to-know regulations.
Additional environmental information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.
AK-0B 000001 (00454822.003)(07/11/07)
070327, 000, 0882

*** END OF MSDS ***

MSDS for PSX 700 Montu Tan

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT AND COMPANY INFORMATION

PPG Industries, Inc.
One PPG Place
Pittsburgh, PA 15272

EMERGENCY PHONE NUMBERS (412) 434-4515 (U.S.) (24 hours/day):
(514) 645-1320 (Canada)
01-800-00-21-400 (Mexico)
0532-83889090 (China)

PRODUCT SAFETY/MSDS INFORMATION: (412) 492-5555 7:00 a.m. - 4:30 p.m. EST

Product ID: PX700127 (0882)
PRODUCT NAME: PSX 700 MONTU TAN RESIN
SYNONYMS: None
ISSUE DATE: 07/31/2007
EDITION NO.: 3
CHEMICAL FAMILY: MIXTURE

EMERGENCY OVERVIEW:

CAUSES SEVERE EYE IRRITATION. CAUSES PRIMARY SKIN IRRITATION. PROLONGED OR REPEATED CONTACT MAY CAUSE AN ALLERGIC SKIN REACTION.VAPOR AND/OR SPRAY MIST MAY BE HARMFUL IF INHALED. VAPOR IRRITATES EYES, NOSE, AND THROAT.HARMFUL IF SWALLOWED.STABLE - HAZARDOUS REACTIONS POSSIBLE AT EXTREMELY HIGH TEMPERATURES/PRESSURES. This product is not expected to present any unusual hazards under fire or spill conditions. Read entire MSDS before use.

SECTION 2 - COMPOSITION INFORMATION

The following ingredient(s) marked with an "x" are considered hazardous under applicable U.S. OSHA and/or Canadian WHMIS regulations. If no ingredients are listed, then there are no U.S. OSHA and/or Canadian WHMIS hazardous ingredients in this product.

Material/ CAS Number	Percent	Hazardous	
PROPRIETARY SILICONE Proprietary	15 - 40	X	
PROPRIETARY EPOXY Proprietary	15 - 40	X	
TITANIUM DIOXIDE 13463-67-7	5 - 10	X	
BIS(PENTAMETHYLPIPERIDYL) SEBACATE 41556-26-7	1 - 5	X	
POLYOXYETHYLENE NONYLPHENYL ETHER PHOSPHATE 68412-53-3	1 - 5	X	
(As Glycol ethers) 68412-53-3	*	X	See Sections 8 and 15 for information.

SECTION 3 - HAZARDS IDENTIFICATION

ACUTE OVEREXPOSURE EFFECTS

EYE CONTACT:
Causes severe eye irritation. Redness, itching, burning sensation and visual disturbances may indicate excessive eye contact.
SKIN CONTACT:
Causes primary skin irritation. Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.
SKIN ABSORPTION:
Skin absorption not expected to occur. Prolonged or repeated contact may cause an allergic skin reaction.
INHALATION:
Vapor and/or spray mist may be harmful if inhaled. Vapor irritates eyes, nose, and throat.
INGESTION:
Harmful if swallowed.
SIGNS & SYMPTOMS OF OVEREXPOSURE:
Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Not applicable.
CHRONIC OVEREXPOSURE EFFECTS
Avoid long-term and repeated contact.
This product either contains formaldehyde or is capable of releasing formaldehyde above 0.5 ppm under certain conditions. If this product contains free formaldehyde, formaldehyde will be listed as an ingredient in Section 2 and 11 of this MSDS; if formaldehyde is not specifically listed, this product contains ingredients capable of releasing formaldehyde under certain conditions. Formaldehyde is a known cancer hazard, a skin sensitizer and a respiratory sensitizer. Trimethoxysilanes are capable of forming methanol if hydrolyzed or ingested. If swallowed, methanol may be harmful or fatal or cause blindness.
The effects of long-term, low level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the prevention of all contact with this material to avoid any effects from repetitive acute exposures. See Section 11, of this MSDS for a detailed list of chronic health effects information available on individual ingredients in this product.

SECTION 4 - FIRST AID MEASURES

If ingestion, irritation, any type of overexposure or symptoms of overexposure occur during or persists after use of this product, contact a POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN immediately; have Material Safety Data Sheet information available.
EYE CONTACT:
Remove contact lens and pour a gentle stream of warm water through the affected eye for at least 15 minutes. If irritation persists, contact a poison control center, emergency room, or physician as further treatment may be necessary.
SKIN CONTACT:
Run a gentle stream of water over the affected area for 15 minutes. A mild soap may be used if available. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.
INHALATION:
Remove from area to fresh air. If symptomatic, contact a poison control center, emergency room or physician for treatment information.
INGESTION:
Gently wipe or rinse the inside of the mouth with water. Sips of water may be given if person is fully conscious. Never give anything by mouth to an unconscious or convulsing person. Do Not induce vomiting. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.

SECTION 5 - FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES
FLASHPOINT: 207 Degrees F (97 Degrees C)
FLASHPOINT TEST METHOD:
Pensky-Martens Closed Cup
UEL: Not Available.
LEL: Not Available.
AUTOIGNITION TEMPERATURE:
Not Available.

EXTINGUISHING MEDIA:
Use National Fire Protection Association (NFPA) Class B extinguishers (carbon dioxide, dry chemical or universal aqueous film forming foam) designed to extinguish NFPA Class IIIB combustible liquid fires.
PROTECTION OF FIREFIGHTERS:
Water spray may be ineffective. Water spray may be used to cool closed containers that are exposed to extreme heat. If water is used, fog nozzles are preferable. Firefighters should wear self-contained breathing apparatus and full protective clothing.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
Closed containers may explode or burst (due to the build-up of steam pressure) when exposed to extreme heat. May produce hazardous decomposition products when exposed to extreme heat. Extreme heat includes, but is not limited to, flame cutting, brazing, and welding.

SECTION 6 - ACCIDENTAL RELEASE MEASURE

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Provide maximum ventilation. Only personnel equipped with proper respiratory, skin, and eye protection should be permitted in the area. Remove all sources of ignition. Take up spilled material with sand, vermiculite, or other noncombustible absorbent material and place in clean, empty containers for disposal. Only the spilled material and the absorbant should be placed in this container.

SECTION 7 - HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORAGE:
If this material is part of a multiple component system, read the Material Safety Data Sheet(s) for the other component or components before blending as the resulting mixture may have the hazards of all of its parts.
STORAGE:
Protect from freezing.

SECTION 8 - EXPOSURE CONTROLS & PERSONAL PROTECTION

ENGINEERING CONTROLS:
Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 8 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.

PERSONAL PROTECTIVE EQUIPMENT
EYES:
Wear chemical-type splash goggles when possibility exists for eye contact due to splashing or spraying liquid, airborne particles, or vapors.
SKIN/GLOVES:
Wear protective clothing to prevent skin contact. Apron and gloves should be constructed of: neoprene rubber or nitrile rubber. No specific permeation/degradation testing have been done on protective clothing for this product. Recommendations for skin protection are based on infrequent contact with this product. For frequent contact or total immersion, contact a manufacturer of protective clothing for appropriate chemical impervious equipment. Clean contaminated clothing and shoes.
RESPIRATOR:
Where ventilation is inadequate, use a NIOSH- approved air purifying respirator with the appropriate chemical cartridges or positive- pressure, air-supplied respirator. Read the respirator manufacturer's instructions and literature carefully to determine the type of airborne contaminants against which the respirator is effective, its limitations, and how it is to be properly fitted and used. Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 2 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.
GENERAL HYGIENE - ESTABLISHED EXPOSURE LIMITS
If Threshold Limit Values (TLVs) have been established by ACGIH, OSHA, Ontario or PPG, they will be listed below. These limits are intended for use in the practice of industrial hygiene as guidelines or recommendations in the control of potential workplace health hazards. These limits are not a relative index of toxicity and should not be used by anyone without industrial hygiene training.

Material/ CAS Number	Percent	ACGIH TLV	ACGIH STEL	OSHA PEL	OSHA STEL
TITANIUM DIOXIDE 13463-67-7	5 - 10	10 mg/m³	Not established	10 mg/m³	Not established

Material/ CAS Number	Percent	Ontario TWA	Ontario STEL	PPG IPEL	PPG STEL
TITANIUM DIOXIDE 13463-67-7	5 - 10	10 MG/m³	Not established	Not established	Not established

Key: ACGIH=American Conference of Governmental Industrial Hygienists; OSHA=Occupational Safety and Health Administration; TLV=Threshold Limit Value; TWA=Time Weighted Average; PEL=Permissible Exposure Limit (1989 Vacated values); IPEL=Internal Permissible Exposure Limit; Ceiling=TLV or PEL Ceiling Limit; STEL=TLV or PEL Short-Term Exposure Limit; Skin= Skin Absorption Designation. [C- Ceiling Limit; S-Potential Skin Absorption; R-Respirable Dust]
Additional Information Not applicable.

SECTION 9 - PHYSICAL & CHEMICAL PROPERTIES

(FORMULA VALUES, NOT SALES SPECIFICATIONS)

SPECIFIC GRAVITY:	1.328
PHYSICAL STATE:	Liquid
Percent Solids:	99.53
Percent Volatile by Volume:	.720
pH:	Not available.
ODOR THRESHOLD:	Not available.
Vapour Pressure:	4.8 mmHg
ODOR/APPEARANCE:	Viscous liquid with an odor characteristic of the chemical family and any solvents listed in Section 2.
VAPOR DENSITY:	HEAVIER THAN AIR
Evaporation Rate:	32
BOILING POINT OR RANGE:	280- 311Degrees F
Freezing Point or Range:	Not Applicable.
Melting Point or Range(°C):	Not Applicable.
Partition coefficient (n-octanol/water):	Not Applicable.
WEIGHT PER GALLON:	11.07 (U.S.) / 13.2 (IMPERIAL)

SECTION 10 - STABILITY AND REACTIVITY

STABILITY:
This product is normally stable but may undergo hazardous reactions at extremely high temperatures and pressures.
CONDITIONS TO AVOID:
None Known.
INCOMPATIBLE MATERIALS:
Avoid contact with strong alkalies, strong mineral acids, or strong oxidizing agents.
HAZARDOUS POLYMERIZATION:
None Known.
HAZARDOUS DECOMPOSITION PRODUCTS:
- Carbon monoxide - Carbon dioxide - Oxides of nitrogen - Oxides of phosphorus - Lower molecular weight polymer fractions - Silicon oxides

SECTION 11 - TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Material/ CAS Number	Percent	ORAL LD50 (g/kg)	DERMAL LD50 (g/kg)	INHALATION LC50 (mg/l)
TITANIUM DIOXIDE 13463-67-7	5 - 10	10.00 g/kg	Not Available	Not Available
BIS(PENTAMETHYLPIPERIDYL) SEBACATE 41556-26-7	1 - 5	3.13 g/kg	Not Available	Not Available

CHRONIC TOXICITY
Ingredient Target Organ/Chronic Effects:
- Carcinogen - Lung

Mutagenicity Toxicity:
This has not been tested for this product.
Reproductive Toxicity:
This has not been tested for this product.

SUPPLEMENTAL HEALTH INFORMATION:

Material/ CAS Number	Percent	Ingredient Specific Animal Data:
TITANIUM DIOXIDE 13463-67-7	5 - 10	This product contains titanium dioxide. Animals inhaling massive quantities of titanium dioxide dust in a long-term study developed lung tumors. Studies with humans involved in manufacture of this pigment indicate no increased risk of cancer from exposure.

SECTION 12 - ECOLOGICAL INFORMATION

POTENTIAL ENVIRONMENTAL EFFECTS
Ecotoxicity: No Information Available.

ENVIRONMENTAL FATE
Mobility: No information available.
Biodegradation: No information available.
Bioaccumulation: No Information Available.

PHYSICAL/CHEMICAL

Hydrolysis: No information available.
Photolysis: No information available.

SECTION 13 - DISPOSAL CONSIDERATIONS

Provide maximum ventilation, only personnel equipped with proper respiratory and skin and eye protection should be permitted in the area. Take up spilled material with sawdust, vermiculite, or other absorbent material and place in containers for disposal.
Waste material must be disposed of in accordance with federal, state, provincial and local environmental control regulations. Empty containers should be recycled by an appropriately licensed reconditioner/salvager or disposed of through a permitted waste management facility. Additional disposal information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.

SECTION 14 - TRANSPORTATION INFORMATION

Proper Shipping Name: Paint- Non-Regulated Goods
NOS Technical Name: None
Hazard Class: None
Subsidiary Class(es): None
UN Number: None
Packing Group: None

USA - RQ Hazardous Substances: None
USA-RQ Hazardous Substance None
Threshold Ship Weight:

Marine Pollutant Name: None

SECTION 15 - REGULATORY INFORMATION

INVENTORY STATUS
U.S. TSCA: This product and/or all of its components are listed on the U.S. TSCA Inventory or is otherwise exempt from TSCA Inventory reporting requirements.
FEDERAL REGULATIONS
US Regulations

Material/ CAS Number	Percent	CERCLA HS - RQ (LBS)	SARA EHS-TPQ (LBS)	SARA 313
PROPRIETARY SILICONE Proprietary	15 - 40	Not Listed	Not Listed	Not Listed
PROPRIETARY EPOXY Proprietary	15 - 40	Not Listed	Not Listed	Not Listed
TITANIUM DIOXIDE 13463-67-7	5 - 10	Not Listed	Not Listed	Not Listed
BIS(PENTAMETHYLPIPERIDYL) SEBACATE 41556-26-7	1 - 5	Not Listed	Not Listed	Not Listed
POLYOXYETHYLENE NONYLPHENYL ETHER PHOSPHATE 68412-53-3	1 - 5	Not Listed	Not Listed	Not Listed
(As Glycol ethers) 68412-53-3	*	Not Listed	Not Listed	Listed

SARA 311/312
Health (acute): Yes
Health (chronic): Yes
Fire (flammable): No
Pressure: No
Reactivity: No
WHMIS HAZARD CLASS: - Class D, Division 2, Subdivision A - Class D, Division 2, Subdivision B

STATE/PROVINCIAL REGULATIONS
Additional Information

Material/ CAS Number	Percent	IARC Group 1(Known Human Carc.)	IARC Group 2A (Probable Carc.)	IARC 2B (Suspected Carc.)	ACGIH Carc.	NTP Known Carc.	OSHA Carc.
TITANIUM DIOXIDE 13463-67-7	5 - 10	N	N	Y	N	N	N

Key: IARC- International Agency on the Research of Cancer; ACGIH-American Conference of Governmental Industrial Hygienists; NTP-National Toxicology Program *Denotes chemical as NTP Known Carcinogen; + Denotes NTP Possible Carcinogen; OSHA-Occupational Safety and Health Administration.

SECTION 16 - OTHER INFORMATION

Hazard Rating Systems
NFPA Rating: 2 1 1
HMIS Rating: 2*1 1

Rating System: 0=Minimal, 1=Slight, 2=Moderate, 3=Serious, 4=Severe, *=Chronic Effects.

HMIS=Hazardous Materials Identification System; NFPA=National Fire Protection Association;

Safe handling of this product requires that all of the information on the MSDS be evaluated for specific work environments and conditions of use.

PREPARED BY: Product Safety Department
REASON FOR REVISION: Section 1 has been updated. Section 3 has been updated. Section 2 has been updated. Changes to this section may also result in changes in sections 8, 11 and/or 15. Section 4 has been updated. Section 8 has been updated. Section 10 has been updated. Section 16 has been updated. Date. Edition.
Updated MSDS
format.

This Material Safety Data Sheet has been prepared in accordance with Canada's Workplace Hazardous Materials Information System (WHMIS) and the OSHA Hazard Communication Standard (29 CFR 1910.1200), the supplier notification requirements of SARA Title III, Section 313 and other applicable right-to-know regulations.
Additional environmental information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.
PX700127 000002 (00474096.001)(07/30/07)
070727, 000, 0882

*** END OF MSDS ***

MSDS for PSX 700 Cure

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT AND COMPANY INFORMATION

PPG Industries, Inc.
One PPG Place
Pittsburgh, PA 15272

EMERGENCY PHONE NUMBERS (412) 434-4515 (U.S.) (24 hours/day):
(514) 645-1320 (Canada)
01-800-00-21-400 (Mexico)
0532-83889090 (China)

PRODUCT SAFETY/MSDS INFORMATION: (412) 492-5555 7:00 a.m. - 4:30 p.m. EST

Product ID: PX700-B (0882)
PRODUCT NAME: PSX 700 CURE
SYNONYMS: None
ISSUE DATE: 12/07/2006
EDITION NO.: 3
CHEMICAL FAMILY: MIXTURE

EMERGENCY OVERVIEW:
CAUSES IRREVERSIBLE EYE DAMAGE. MAY CAUSE SKIN BURNS. MAY BE HARMFUL IF ABSORBED THROUGH THE SKIN.DUST AND VAPOR IRRITATES EYES, NOSE AND THROAT. VAPOR AND/OR SPRAY MIST MAY BE HARMFUL IF INHALED.HARMFUL IF SWALLOWED.STABLE - HAZARDOUS REACTIONS POSSIBLE AT EXTREMELY HIGH TEMPERATURES/PRESSURES. This product is not expected to present any unusual hazards under fire or spill conditions. Read entire MSDS before use.

SECTION 2 - COMPOSITION INFORMATION

The following ingredient(s) marked with an "x" are considered hazardous under applicable U.S. OSHA and/or Canadian WHMIS regulations. If no ingredients are listed, then there are no U.S. OSHA and/or Canadian WHMIS hazardous ingredients in this product.

Material/ CAS Number	Percent	Hazardous	
PROPRIETARY SILANE Proprietary	60- 100	X	
DIBUTYLTIN DIACETYLACETONATE 22673-19-4	3 - 7	X	
(As organic Tin Cmpnds) 22673-19-4	*	X	See Sections 8 and 15 for information.

SECTION 3 - HAZARDS IDENTIFICATION

ACUTE OVEREXPOSURE EFFECTS

EYE CONTACT:
This product contains a material which causes irreversible eye damage. Redness, itching, burning sensation and visual disturbances may indicate excessive eye contact.

SKIN CONTACT:
May cause skin burns. Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.

SKIN ABSORPTION:
May be harmful if absorbed through the skin.

INHALATION:
Dust and vapor irritates eyes, nose and throat. Vapor and/or spray mist may be harmful if inhaled.

INGESTION:
Harmful if swallowed.

SIGNS & SYMPTOMS OF OVEREXPOSURE:
Dryness, itching, cracking, burning, redness, and swelling are conditions associated with excessive skin contact.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Not applicable.

CHRONIC OVEREXPOSURE EFFECTS
Avoid long-term and repeated contact.
The effects of long-term, low level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the prevention of all contact with this material to avoid any effects from repetitive acute exposures. See Section 11, of this MSDS for a detailed list of chronic health effects information available on individual ingredients in this product.

SECTION 4 - FIRST AID MEASURES

If ingestion, irritation, any type of overexposure or symptoms of overexposure occur during or persists after use of this product, contact a POISON CONTROL CENTER, EMERGENCY ROOM OR PHYSICIAN immediately; have Material Safety Data Sheet information available.

EYE CONTACT:
Remove contact lens and pour a gentle stream of warm water through the affected eye for at least 15 minutes. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.

SKIN CONTACT:
Run a gentle stream of water over the affected area for 15 minutes. A mild soap may be used if available. Contact a poison control center, emergency room or physician right away as further treatment will be necessary

INHALATION:
Remove from area to fresh air. If symptomatic, contact a poison control center, emergency room or physician for treatment information.

INGESTION:
Gently wipe or rinse the inside of the mouth with water. Sips of water may be given if person is fully conscious. Never give anything by mouth to an unconscious or convulsing person. Do Not induce vomiting. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.

SECTION 5 - FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES
FLASHPOINT: 205 Degrees F (96 Degrees C)
FLASHPOINT TEST METHOD:
Pensky-Martens Closed Cup
UEL: Not Available.
LEL: Not Available.
AUTOIGNITION TEMPERATURE:
Not Available.
EXTINGUISHING MEDIA:
Use National Fire Protection Association (NFPA) Class B extinguishers (carbon dioxide, dry chemical or universal aqueous film forming foam) designed to extinguish NFPA Class IIIB combustible liquid fires.
PROTECTION OF FIREFIGHTERS:
Water spray may be ineffective. Water spray may be used to cool closed containers that are exposed to extreme heat. If water is used, fog nozzles are preferable. Firefighters should wear self-contained breathing apparatus and full protective clothing.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
Material not known to be explosive. May produce hazardous decomposition products when exposed to extreme heat. Extreme heat includes, but is not limited to, flame cutting, brazing, and welding.

SECTION 6 - ACCIDENTAL RELEASE MEASURE

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Provide maximum ventilation. Only personnel equipped with proper respiratory, skin, and eye protection should be permitted in the area. Remove all sources of ignition. Take up spilled material with sand, vermiculite, or other noncombustible absorbent material and place in clean, empty containers for disposal. Only the spilled material and the absorbant should be placed in this container.

SECTION 7 - HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORAGE:
If this material is part of a multiple component system, read the Material Safety Data Sheet(s) for the other component or components before blending as the resulting mixture may have the hazards of all of its parts.

STORAGE:
Do not store above 120 degrees F.(48 degress C.). Store large quantities in buildings designed and protected for storage of NFPA Class IIIB combustible liquids.

SECTION 8 - EXPOSURE CONTROLS & PERSONAL PROTECTION

ENGINEERING CONTROLS:
Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 8 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.

PERSONAL PROTECTIVE EQUIPMENT

EYES:
Wear chemical-type splash goggles and full face shield when possibility exists for eye contact due to splashing or spraying liquid, airborne particles, or vapors.

SKIN/GLOVES:
Wear protective clothing sufficient to cover exposed skin surfaces. For applications where skin contact is likely and impermeable clothing is necessary, select clothing constructed of: rubber. No specific permeation/degradation testing have been done on protective clothing for this product. Recommendations for skin protection are based on infrequent contact with this product. For frequent contact or total immersion, contact a manufacturer of protective clothing for appropriate chemical impervious equipment. The decision whether to clean or discard contaminated clothing should be based on the chemicals contaminating them. Some chemicals can cause skin irritation, sensitization or other health effects if the cleaning process does not remove all traces of them. Consult a safety professional to determine whether clothing contaminated with this product can be safely cleaned and reused.

RESPIRATOR:
Where vapors are present, an appropriate NIOSH-approved air purifying respirator with organic vapor cartridges or positive- pressure, air-supplied respirator is required. Read the respirator manufacturer's instructions and literature carefully to determine the type of airborne contaminants against which the respirator is effective, its limitations, and how it is to be properly fitted and used. Provide general dilution or local exhaust ventilation in volume and pattern to keep the concentration of ingredients listed in Section 2 below the lowest suggested exposure limits, the LEL below the stated limit, and to remove decomposition products during welding or flame cutting.

GENERAL HYGIENE - ESTABLISHED EXPOSURE LIMITS
If Threshold Limit Values (TLVs) have been established by ACGIH, OSHA, Ontario or PPG, they will be listed below. These limits are intended for use in the practice of industrial hygiene as guidelines or recommendations in the control of potential workplace health hazards. These limits are not a relative index of toxicity and should not be used by anyone without industrial hygiene training.

Material/ CAS Number	Percent	ACGIH TLV	ACGIH STEL	OSHA PEL	OSHA STEL
DIBUTYLTIN DIACETYLACETONATE 22673-19-4	3 - 7	0.1 MG/m³	0.2 MG/m³	0.1 MG/m³	Not established
(As organic Tin Cmpnds) 22673-19-4	*	S- 0.1 MG/m³	0.2 MG/m³	0.1 mg/m³	Not established

Material/ CAS Number	Percent	Ontario TWA	Ontario STEL	PPG IPEL	PPG STEL
DIBUTYLTIN DIACETYLACETONATE 22673-19-4	3 - 7	0.1 MG/m³	Not established	Not established	Not established
(As organic Tin Cmpnds) 22673-19-4	*	S- 0.1 MG/m³	Not established	Not established	Not established

Key: ACGIH=American Conference of Governmental Industrial Hygienists; OSHA=Occupational Safety and Health Administration; TLV=Threshold Limit Value; TWA=Time Weighted Average; PEL=Permissible Exposure Limit (1989 Vacated values); IPEL=Internal Permissible Exposure Limit; Ceiling=TLV or PEL Ceiling Limit; STEL=TLV or PEL Short-Term Exposure Limit; Skin= Skin Absorption Designation. [C- Ceiling Limit; S-Potential Skin Absorption; R-Respirable Dust]
Additional Information Not applicable.

SECTION 9 - PHYSICAL & CHEMICAL PROPERTIES

(FORMULA VALUES, NOT SALES SPECIFICATIONS)

SPECIFIC GRAVITY:	.952
PHYSICAL STATE:	Liquid
Percent Solids:	100.00
Percent Volatile by Volume:	.000
pH:	Not available.
ODOR THRESHOLD:	Not available.
Vapour Pressure:	Not Applicable.
ODOR/APPEARANCE:	Viscous liquid with an odor characteristic of the solvents listed in Section 2.
VAPOR DENSITY:	HEAVIER THAN AIR
Evaporation Rate:	0
BOILING POINT OR RANGE:	Not available.
Freezing Point or Range:	Not Applicable.
Melting Point or Range(°C):	Not Applicable.
Partition coefficient (n-octanol/water):	Not Applicable.
WEIGHT PER GALLON:	7.93 (U.S.) / 9.5 (IMPERIAL)

SECTION 10 - STABILITY AND REACTIVITY

STABILITY:
This product is normally stable but may undergo hazardous reactions at extremely high temperatures and pressures.

CONDITIONS TO AVOID:
None Known.

INCOMPATIBLE MATERIALS:
Avoid contact with strong alkalies, strong mineral acids, or strong oxidizing agents.

HAZARDOUS POLYMERIZATION:
None Known.

HAZARDOUS DECOMPOSITION PRODUCTS:
- Carbon monoxide - Carbon dioxide - Oxides of nitrogen - Hydrocarbons - Oxides of tin - Silicon oxides

SECTION 11 - TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Material/ CAS Number	Percent	ORAL LD50 (g/kg)	DERMAL LD50 (g/kg)	INHALATION LC50 (mg/l)
PROPRIETARY SILANE Proprietary	60- 100	1.78 g/kg	4.00 g/kg	Not Available
DIBUTYLTIN DIACETYLACETONATE 22673-19-4	3 - 7	2.00 g/kg	Not Available	Not Available

CHRONIC TOXICITY
Ingredient Target Organ/Chronic Effects:
- None known
Mutagenicity Toxicity:
This has not been tested for this product.
Reproductive Toxicity:
This has not been tested for this product.

SUPPLEMENTAL HEALTH INFORMATION:

SECTION 12 - ECOLOGICAL INFORMATION

POTENTIAL ENVIRONMENTAL EFFECTS.
Ecotoxicity: No Information Available.

ENVIRONMENTAL FATE
Mobility: No information available.
Biodegradation: No information available.
Bioaccumulation: No Information Available.

PHYSICAL/CHEMICAL

Hydrolysis: No information available.
Photolysis: No information available.

SECTION 13 - DISPOSAL CONSIDERATIONS

Provide maximum ventilation, only personnel equipped with proper respiratory and skin and eye protection should be permitted in the area. Take up spilled material with sawdust, vermiculite, or other absorbent material and place in containers for disposal.
Waste material must be disposed of in accordance with federal, state, provincial and local environmental control regulations. Empty containers should be recycled by an appropriately licensed reconditioner/salvager or disposed of through a permitted waste management facility. Additional disposal information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.

SECTION 14 - TRANSPORTATION INFORMATION

Proper Shipping Name: Paint
NOS Technical Name: None
Hazard Class: 8
Subsidiary Class(es): None
UN Number: UN3066
Packing Group: II

USA - RQ Hazardous Substances: None
USA-RQ Hazardous Substance None
Threshold Ship Weight:
Marine Pollutant Name: None

SECTION 15 - REGULATORY INFORMATION

INVENTORY STATUS
U.S. TSCA: This product and/or all of its components are listed on the U.S. TSCA Inventory or is otherwise exempt from TSCA Inventory reporting requirements
FEDERAL REGULATIONS

US Regulations

Material/ CAS Number	Percent	CERCLA HS - RQ (LBS)	SARA EHS- TPQ (LBS)	SARA 313
PROPRIETARY SILANE Proprietary	60- 100	Not Listed	Not Listed	Not Listed
DIBUTYLTIN DIACETYLACETONATE 22673-19-4	3 - 7	Not Listed	Not Listed	Not Listed

SARA 311/312
Health (acute): Yes
Health (chronic): Yes
Fire (flammable): No
Pressure: No
Reactivity: No
WHMIS HAZARD CLASS: - Class D, Division 2, Subdivision B

STATE/PROVINCIAL REGULATIONS
Additional Information
Key: IARC- International Agency on the Research of Cancer; ACGIH- American Conference of Governmental Industrial Hygienists; NTP- National Toxicology Program *Denotes chemical as NTP Known Carcinogen; + Denotes NTP Possible Carcinogen; OSHA- Occupational Safety and Health Administration.

SECTION 16 - OTHER INFORMATION

Hazard Rating Systems
NFPA Rating: 3 11
HMIS Rating: 3*11

Rating System: 0=Minimal, 1=Slight, 2=Moderate, 3=Serious, 4=Severe, *=Chronic Effects.

HMIS=Hazardous Materials Identification System; NFPA=National Fire Protection Association;

Safe handling of this product requires that all of the information on the MSDS be evaluated for specific work environments and conditions of use.

PREPARED BY: Product Safety Department
REASON FOR REVISION: Section 2 has been updated. Changes to this section may also result in changes in sections 8, 11 and/or 15. Section 14 has been updated. Date. Edition.
Updated MSDS
format.

This Material Safety Data Sheet has been prepared in accordance with Canada's Workplace Hazardous Materials Information System (WHMIS) and the OSHA Hazard Communication Standard (29 CFR 1910.1200), the supplier notification requirements of SARA Title III, Section 313 and other applicable right-to-know regulations.
Additional environmental information is contained on the Environmental Data Sheet for this product, which can be obtained from your PPG representative.
PX700-B 000001 (00433848.003)(12/06/06)
061114, 000, 0882

*** END OF MSDS ***

Appendix C
MSDSs for Coating at Barstow Marine Base

MSDS for MIL-DTL-64159 CARC Topcoat

MATERIAL SAFETY DATA SHEET

F93N505
02 00

DATE OF PREPARATION
Sep 8, 2008

SECTION 1 — PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NUMBER
F93N505
PRODUCT NAME
MIL-DTL-64159, Type II Coating, Water Dispersible Aliphatic Polyurethane, CARC, Brown 383, 30051
MANUFACTURER'S NAME
THE SHERWIN-WILLIAMS CO.
101 Prospect Avenue N.W.
Cleveland, OH 44115

Telephone Numbers and Websites

Regulatory Information	(216) 566-2902
Medical Emergency	(216) 566-2917
Transportation Emergency*	(800) 424-9300
**for Chemical Emergency ONLY (spill, leak, fire, exposure, or accident)*	

SECTION 2 — COMPOSITION/INFORMATION ON INGREDIENTS

% by Weight	CAS Number	Ingredient	Units	Vapor Pressure
4	872-50-4	1-Methyl-2-Pyrrolidone		
		ACGIH TLV	Not Available	1 mm
		OSHA PEL	Not Available	
0.1	1333-86-4	Carbon Black		
		ACGIH TLV	3.5 MG/M3	
		OSHA PEL	3.5 MG/M3	
8	1308-38-9	Chromium Oxide		
		ACGIH TLV	0.5 MG/M3	
		OSHA PEL	0.5 MG/M3	

% by Weight	Ingredient
4.05	Chromium III (as Cr)

SECTION 3 — HAZARDS IDENTIFICATION

HMIS Codes

Health	2*
Flammability	0
Reactivity	0

ROUTES OF EXPOSURE
INHALATION of vapor or spray mist.
EYE or SKIN contact with the product, vapor or spray mist.
EFFECTS OF OVEREXPOSURE
EYES: Irritation.
SKIN: Prolonged or repeated exposure may cause irritation.
INHALATION: Irritation of the upper respiratory system.

In a confined area vapors in high concentration may cause headache, nausea or dizziness.
SIGNS AND SYMPTOMS OF OVEREXPOSURE
Redness and itching or burning sensation may indicate eye or excessive skin exposure.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
May cause allergic respiratory and/or skin reaction in susceptible persons or sensitization. This effect may be delayed several hours after exposure.
Persons sensitive to isocyanates will experience increased allergic reaction on repeated exposure.
CANCER INFORMATION
For complete discussion of toxicology data refer to Section 11.

SECTION 4 — FIRST AID MEASURES

EYES: Flush eyes with large amounts of water for 15 minutes. Get medical attention.
SKIN: Wash affected area thoroughly with soap and water.
Remove contaminated clothing and launder before re-use.
INHALATION: If any breathing problems occur during use, **LEAVE THE AREA** and get fresh air. If problems remain or occur later, **IMMEDIATELY** get medical attention.
INGESTION: Do not induce vomiting. Get medical attention immediately.

SECTION 5 — FIRE FIGHTING MEASURES

FLASH POINT	LEL	UEL	FLAMMABILITY CLASSIFICATION
Not Applicable	N.A.	N.A.	Not Applicable

EXTINGUISHING MEDIA
Carbon Dioxide, Dry Chemical, Alcohol Foam
UNUSUAL FIRE AND EXPLOSION HAZARDS
Closed containers may explode (due to the build-up of pressure) when exposed to extreme heat.
During emergency conditions overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Obtain medical attention.
SPECIAL FIRE FIGHTING PROCEDURES
Full protective equipment including self-contained breathing apparatus should be used.
Water spray may be ineffective. If water is used, fog nozzles are preferable. Water may be used to cool closed containers to prevent pressure build-up and possible autoignition or explosion when exposed to extreme heat.

SECTION 6 — ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
- Remove all sources of ignition. Ventilate the area.
- Remove with inert absorbent.

SECTION 7 — HANDLING AND STORAGE

STORAGE CATEGORY
Not Applicable
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE
Keep container closed when not in use. Transfer only to approved containers with complete and appropriate labeling. Do not take internally. Keep out of the reach of children.

SECTION 8 — EXPOSURE CONTROLS/PERSONAL PROTECTION

PRECAUTIONS TO BE TAKEN IN USE
NO PERSON SHOULD USE THIS PRODUCT, OR BE IN THE AREA WHERE IT IS BEING USED, IF THEY HAVE CHRONIC (LONG-TERM) LUNG OR BREATHING PROBLEMS OR IF THEY EVER HAD A REACTION TO ISOCYANATES.
Use only with adequate ventilation.
Avoid contact with skin and eyes. Avoid breathing vapor and spray mist.
Wash hands after using.
This coating may contain materials classified as nuisance particulates (listed "as Dust" in Section 2) which may be present at hazardous levels only during sanding or abrading of the dried film. If no specific dusts are listed in Section 2, the applicable limits for nuisance dusts are ACGIH TLV 10 mg/m3 (total dust), 3 mg/m3 (respirable fraction), OSHA PEL 15 mg/m3 (total dust), 5 mg/m3 (respirable fraction).
VENTILATION
Local exhaust preferable. General exhaust acceptable if the exposure to materials in Section 2 is maintained below applicable exposure limits. Refer to OSHA Standards 1910.94, 1910.107, 1910.108.
RESPIRATORY PROTECTION
Where overspray is present, a positive pressure air supplied respirator (TC19C NIOSH/MSHA approved) should be worn. If unavailable, a properly fitted organic vapor/particulate respirator approved by NIOSH/MSHA for protection against materials in Section 2 may be effective. Follow respirator manufacturers directions for use. Wear the respirator for the whole time of spraying and until all vapors and mists are gone. **NO PERSONS SHOULD BE ALLOWED IN THE AREA WHERE THIS PRODUCT IS BEING USED UNLESS EQUIPPED WITH THE SAME RESPIRATOR PROTECTION RECOMMENDED FOR THE PAINTERS.**
When sanding, wirebrushing, abrading, burning or welding the dried film, wear a particulate respirator approved by NIOSH/MSHA for protection against non-volatile materials in Section 2.
PROTECTIVE GLOVES
To prevent skin contact, wear gloves which are recommended by glove supplier for protection against materials in Section 2.
EYE PROTECTION
Wear safety spectacles with unperforated sideshields.
OTHER PROTECTIVE EQUIPMENT
Use barrier cream on exposed skin.

OTHER PRECAUTIONS

This product must be mixed with other components before use. Before opening the packages, READ AND FOLLOW WARNING LABELS ON ALL COMPONENTS.

SECTION 9 — PHYSICAL AND CHEMICAL PROPERTIES

PRODUCT WEIGHT	9.75 lb/gal	1168 g/l
SPECIFIC GRAVITY	1.17	
BOILING POINT	212 - 396° F	100 - 202° C
MELTING POINT	Not Available	
VOLATILE VOLUME	64%	
EVAPORATION RATE	Slower than ether	
VAPOR DENSITY	Heavier than air	
SOLUBILITY IN WATER	N.A.	

VOLATILE ORGANIC COMPOUNDS (VOC Theoretical - As Packaged)

1.11lb/gal	134g/l	Less Water and Federally Exempt Solvents
0.45lb/gal	54g/l	Emitted VOC

SECTION 10 — STABILITY AND REACTIVITY

STABILITY — Stable

CONDITIONS TO AVOID

None known.

INCOMPATIBILITY

None known.

HAZARDOUS DECOMPOSITION PRODUCTS

By fire: Carbon Dioxide, Carbon Monoxide , Oxides of Nitrogen, possibility of Hydrogen Cyanide , Oxides of Metals in Section 2

HAZARDOUS POLYMERIZATION

Will not occur

SECTION 11 — TOXICOLOGICAL INFORMATION

CHRONIC HEALTH HAZARDS

Carbon Black is classified by IARC as possibly carcinogenic to humans (group 2B) based on experimental animal data, however, there is insufficient evidence in humans for its carcinogenicity.

Chromium III is considered the active species in cancer induction, but Chromium III compounds do not cross the cell wall. However, there is some evidence that Chromium III compounds of respirable particle size may be taken up by the cells in the lung.

TOXICOLOGY DATA

CAS No.	Ingredient Name			
872-50-4	1-Methyl-2-Pyrrolidone			
		LC50 RAT	4HR	Not Available
		LD50 RAT		4200 mg/kg
1333-86-4	Carbon Black			
		LC50 RAT	4HR	Not Available
		LD50 RAT		Not Available
1308-38-9	Chromium Oxide			
		LC50 RAT	4HR	Not Available
		LD50 RAT		Not Available

SECTION 12 — ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

No data available.

SECTION 13 — DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

Waste from this product may be hazardous as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261.

Waste must be tested for extractability to determine the applicable EPA hazardous waste numbers.

Incinerate in approved facility. Do not incinerate closed container. Dispose of in accordance with Federal, State/Provincial, and Local regulations regarding pollution.

SECTION 14 — TRANSPORT INFORMATION

US Ground (DOT)

Not Regulated for Transportation.

Canada (TDG)
Not Regulated for Transportation.
IMO
Not Regulated for Transportation.

SECTION 15 — REGULATORY INFORMATION

SARA 313 *(40 CFR 372.65C)* SUPPLIER NOTIFICATION

CAS No.	CHEMICAL/COMPOUND	% by WT	% Element
872-50-4	1-Methyl-2-Pyrrolidone	4	
	Chromium Compound	8	4.0

CALIFORNIA PROPOSITION 65
WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.
TSCA CERTIFICATION
All chemicals in this product are listed, or are exempt from listing, on the TSCA Inventory.

SECTION 16 — OTHER INFORMATION

This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

The above information pertains to this product as currently formulated, and is based on the information available at this time. Addition of reducers or other additives to this product may substantially alter the composition and hazards of the product. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

Appendix D
MSDS for Typical Garnet Media

Garnet - Material Safety Data Sheet

IDENTITY (as used on labels and lists)

Beach Mineral Garnet Abrasives Grains and Filtration Sand

SECTION I

Manufacturer's Name	Beach Minerals Company India Ltd
Address	32-2, Halls Road, Egmore Chennai - 600 008, INDIA.
	Phone : +91 4214 7780, 4214 7790 Fax : +91 4214 6000 e-Mail : info@bmcindia.net URL : www.bmcindia.net

SECTION II - Hazardous Ingredients / Identify information

Specific chemical identity: Beach Mineral Garnet is a natural mixture of Almandite garnet with the chemical composition of Fe_3Al_2 Mg (SiO_4) 3 and other trace minerals as per CAS No for Almandite garnet 1302-62-1.

Hazardous components: The following substances are present and are regulated by OSHA or ACGIH limits.

Substance	WT %	OSHA-ACGIH Limit*
Nuisance dust	na	15 mg/cu.m
Respirable dust	na	5 mg/cu.m
Crystalline silica	<0.5%	0.10 mg/cu.m

*If these levels are exceeded respiratory protection must be employed.

SECTION III - Physical and Chemical Characteristics

Melting Point	- Circa 1300^{0}C / 23720 F
Specific Gravity (H_2O = 1.0)	- 4.10 g/cm3
Solubility in Water	- Insoluble
Appearance and Odor	- Reddish brown color grains; no odor

SECTION IV - Fire and Explosion Hazard Data

Flash Point	- Material is a non-flammable solid
Flammable Limits	- N/A
LEL	- N/A
UEL	- N/A
Extinguishing Media	- Use extinguishing media suitable for the surrounding fire. As appropriate to fire; Fire fighters should

Special Fire Fighting Procedures	-	be protected from nuisance dust.
Unusual Fire and Explosion Hazards	-	None

SECTION V - Reactivity Data

Product Stability	-	Inert & Stable
Conditions to avoid	-	Material is a stable natural mineral, so it requires no special handing
Incomparability (Materials to avoid)	-	None Known
Hazardous Decomposition or Byproducts	-	None Known
Hazardous Polymerization	-	Will not occur
Conditions to Avoid	-	None Known

SECTION VI - Health Hazard Data

Routs of Entry

Inhalation	-	Possible
Skin	-	None
Ingestion	-	None

Health Hazards (Acute & Chronic)

None Known, use care to limit possible exposure to nuisance dust may cause eye, throat/lungs irritation during blast cleaning.

Carcinogenicity NTP	-	Contains less than 0.5% free silica
Carcinogenicity IARC Mono	-	No. 42
OSHA Regulated	-	0.1 mg/m3

Signs and Symptoms of Exposure

Exposure to nuisance dust may cause eye, throat, or lung irritation, coughing or shortness or breath.

Medical Conditions Generally Aggravated by Exposure

Chronic bronchitis, emphysema and other lung diseases may be aggravated by exposure to dust.

Emergency and First Aid Procedures

EYE CONTACT: Wash eyes with water to flush out dust particles.

SKIN CONTACT: Wash affected area with soap and Water.

SECTION VII - Precautions for Safe Handing and Use

Precautions when Spill-out or reuse	-	Sweep or vacuum material for disposal
Disposal Precautions	-	Follow state or local guideline and regulations for disposal. Material contaminated in use may require special disposal requirements.
Handling, Storing and Use	-	Use good housekeeping practices to reduce dust. Incorporate methods of dust control to maintain airborne dust. Use material only for the purpose intended.

SECTION VIII - Control Measures

Ventilation	-	Provide sufficient mechanical ventilation to maintain dust exposure below threshold limit value.
Hand & Eye Protection	-	Wear protective apparel and safety glasses with side shields for use in the blasting environment
Protective apparels	-	Wear Hearing protection when working near blast cleaning operations
Working Practice	-	Keep a clean safe working environment and monitor work practices.

Beach Minerals Company - info@bmcindia.net
Phone + 91 44 4214 7780 Fax + 91 44 4214 6000

In Tune With Nature and Its Gifts

Garnet - Technical Data Sheet

Chemical Composition (Typical - wt%)

Silica	SiO_2	36%
Iron	Fe_2O_3	32%
Alumina	Al_2O_3	23%
Magnesium	MgO	6%
Calcium	CaO	1%
Manganese	MnO	1%
Titanium	TiO_2	< 1%

Physical Characteristic

Specific Gravity	4.10 g/cm3
Hardness	7.5+ (moh Scale)
Chloride Content	Less than 25 ppm
Bulk Density	145 lb / ft3
Colour	Reddish Pink, Reddish Brown
Acid Solubility (HCL)	Less than 1%
Conductivity	Less than 125 µs /cm
Melting point	1,300°C
Grain Shape	Sub angular

Mineralogical Composition (Typical)

Almandite Garnet	97 - 98%
Ilmenite	Less than 2%
Quartz (free silica)	Less than 1.0%
Others	Less than 0.5%

Packaging

- 25 kg multi-ply valve type paper bag
- 25 kg HDPE bag with PE liner
- Loose in 1 M.T and 2 M.T HDPE bulk bags with inner PE liner
- 80 x 25 kg bags shrink wrapped to pallets or stuffed on HDPE bulk bags
- Other packaging modes could be taken up on request

Sieve Analysis

MM	Mesh	Percentage Retention					
		12/ 24 Mesh	20/ 24 Mesh	20/60 Mesh	30/ 60 Mesh	80 Mesh	120 Mesh
1.400	12	0					
0.850	20	30-40	0-5	0-5			
0.600	30	40-50	50-70	10-25	0		

0.425	40	0-5	10-20	25-50	0-10	0	
0.300	50		0-10	25-45	45-60	0-10	
0.250	60			0-15	10-25	20-40	0
0.180	80			0-5	5-20	20-50	0-10
0.150	100				0-1	0-10	20-40
0.125	120						40-60
	Pan						0-10

Beach Minerals Company - info@bmcindia.net
Phone + 91 44 4214 7780 Fax + 91 44 4214 6000

Appendix E
MSDSs for Coatings at San Diego Navy Maintenance Center

MSDS for TGIC Powder Coating

CARDINAL INDUSTRIAL FINISHES -- POLYESTER POWDER COATING, TGIC SERIES -- 8010-00N077982

========== Product Identification ==========

Product ID:POLYESTER POWDER COATING, TGIC SERIES
MSDS Date:04/15/1996
FSC:8010
NIIN:00N077982
MSDS Number: CDZSG
=== Responsible Party ===
Company Name:CARDINAL INDUSTRIAL FINISHES
Address:1329 POTRERO AVE
City:SOUTH EL MONTE
State:CA
ZIP:91733
Country:US
Info Phone Num:818-444-9274
Emergency Phone Num:800-424-9300 (CHEMTREC)
Preparer's Name:RICHARD A STEWART
CAGE:65860
=== Contractor Identification ===
Company Name:CARDINAL INDUSTRIAL FINISHES
Address:1329 POTERO AVE
Box:City:SOUTH EL MONTE
State:CA
ZIP:91733
Country:US
Phone:818-444-9274 OR 213-283-9335
CAGE:65860

========== Composition/Information on Ingredients ==========

Ingred Name:CARBON BLACK VP: 0.0 @ 20C
CAS:1333-86-4
RTECS #:FF5800000
Fraction by Wt: 0-5%
OSHA PEL:3.5 MG/M3
ACGIH TLV:3.5 MG/M3

Ingred Name:1,3,5-TRIGLYCIDYL ISOCYANURATE VP: 0.0 @ 20C (MFR INVALID CAS # 2451-62-2)
CAS:2451-62-9
RTECS #:XZ1994900
Fraction by Wt: 0-10%
OSHA PEL:N/K
ACGIH TLV:N/K

Ingred Name:2H-AZEPIN-2-ONE, HEXAHYDRO-; (E-CAPROLACTAN) VP: 0.0 @ 20C (MFR INVALID CAS #14505-60-2)
CAS:105-60-2
RTECS #:CM3675000
Fraction by Wt: 0-5%
OSHA PEL:N/K
ACGIH TLV:N/K
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:BARIUM SULFATE VP: 0.0 @ 20C

CAS:7727-43-7
RTECS #:CR0600000
Fraction by Wt: 0-25%
OSHA PEL:15 MG/M3 TDUST
ACGIH TLV:10 MG/M3 TDUST

Ingred Name:RESP PROT: CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.
RTECS #:9999999ZZ

Ingred Name:OTHER PROT EQUIP: PREVENT REPEATED/PROLONGED SKIN CONT W/GB PROT HAND CREAM. WEAR IMPERVIOUS CLTHG & CHEM RESIST BOOTS.
RTECS #:9999999ZZ

========== Hazards Identification ==========

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.
Routes of Entry: Inhalation:YES Skin:YES Ingestion:NO
Reports of Carcinogenicity:NTP:NO IARC:YES OSHA:NO
Health Hazards Acute and Chronic:ACUTE: EYES: CAN CAUSE IRRITATION AND REDNESS, TEARING OR BLURRED VISION. SKIN: IRRITATION, RASH AND DERMATITIS POSSIBLE FROM PROLONGED EXPOSURE. INHALATION: COUGHING, SNEEZING, NASAL IRRITATION, HEAD ACHE, DIZZINESS, NAUSEA, WEAKNESS.
Explanation of Carcinogenicity:CARBON BLACK: IARC MONO ON EVAL OF CARCIN RISK OF CHEMICALS TO MAN, VOL 65, PG 24-27, 1995: GROUP 2B. ANIMAL: LUNG.
Effects of Overexposure:SEE HEALTH HAZARDS.
Medical Cond Aggravated by Exposure:PREEXISTING RESPIRATORY CONDITIONS, PREEXISTING SKIN DISORDERS.

========== First Aid Measures ==========

First Aid:EYES: FLUSH WITH WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION IMMEDIATELY SKIN: WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. INHALATION: REMOVE TO FRESH AIR. IF BREATHI NG IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. GET MEDICAL ATTENTION. INGESTION: INDUCE VOMITING. KEEP PERSON WARM AND QUIET. GET MEDICAL ATTENTION.

========== Fire Fighting Measures ==========

Extinguishing Media:FOAM, DRY CHEMICAL, CARBON DIOXIDE, WATER FOG.
Fire Fighting Procedures:WEAR NIOSH APPROVED SCBA & FULL PROTECTIVE EQUIPMENT .
Unusual Fire/Explosion Hazard:WHEN EXPOSED TO EXTREME HEAT, DECOMP PRODS MAY YIELD OXIDES OF CARBON & NITROGEN/TOX FUMES. NOTE: THIS PROD IS A DRY POWDER & UNDER NORM OPERATING (SUP DAT)

========== Accidental Release Measures ==========

Spill Release Procedures:REFER TO OTHER SECTIONS OF THIS MSDS. ELIMINATE ALL IGNITION SOURCES. SWEEP UP SPILLS AND PLACE IN DRUM OR OTHER SEALABLE CONTAINER. AVOID GENERATING DUST FROM CLEAN UP MATERIAL.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

========== Handling and Storage ==========

Handling and Storage Precautions:STORE IN COOL, DRY PLACE & PROTECT

FROM BREAKAGE. AVOID STORING AT TEMPS > 80F. AVOID EXCESS MOISTURE/EXTREME HEAT.
Other Precautions:DO NOT ALLOW POWDER DUST TO ACCUM NEAR MACHINERY/SOURCES OF IGNIT. POWDER COATINGS SHOULD BE APPLIED ONLY W/PROPER APPLICATION EQUIP W/IN PROPERLY VENTD CTL ENCLOSURE. POWDER COATING EQUIP SHOULD BE G ROUNDED AT ALL TIMES TO PVNT (SUP DAT)

========== Exposure Controls/Personal Protection ==========

Respiratory Protection:IF TLV OF PROD/ANY COMPONENT IS EXCEEDED, NIOSH APPRVD AIR SUPP RESP IS ADVISED IN ABSENCE OF ENVIRON CTL. OSHA REGS ALSO PERMIT OTHER NIOSH RESP UNDER SPECIFIED CNDTNS (SEE YOUR SFTY EQUIP SUPPLIER). ENGINEERING/ADMINISTRATIVE (ING 5)
Ventilation:PROVIDE SUFFICIENT MECH (GENERAL AND/OR LOCAL EXHAUST) VENT TO CONTROL DUST ACCUMULATION & MAINTAIN EXPOS BELOW TLV.
Protective Gloves:IMPERVIOUS GLOVES .
Eye Protection:ANSI APPRVD CHEM WORKERS GOGGLES .
Other Protective Equipment:ANSI APPROVED EMERGENCY EYEWASH & DELUGE SHOWER . HAND CREAM SUGGESTED FOR MANUAL SPRAY EQUIP. (ING 6)
Work Hygienic Practices:WASH HANDS BEFORE EATING OR USING RESTROOM. SMOKE IN SMOKING AREAS ONLY.
Supplemental Safety and Health
EXPLO HAZ: CNDTNS PRESENTS MIN RISK OF FIRE/EXPLO. HOWEVER, PROPER STOR & CAUTION IN HNDLG & USE PRACTICES SHOULD BE USED AT ALL TIMES. OTHER PREC: STATIC ELEC BUILD-UP (OSHA 29 CFR 1910.107). NO OPEN FLAMES/SOURCES OF IGNIT/SPK PRODUCING EQUIP SHALL BE LOCATED W/IN 20 FEET OR POWDER USE, UNLESS SEPARATED BY PARTITION.

========== Physical/Chemical Properties ==========

Vapor Pres:SEE INGS
Vapor Density:HVR/AIR
Spec Gravity:1.2-1.8
Appearance and Odor:POWDER OF VARIOUS COLORS
Percent Volatiles by Volume:<2

========== Stability and Reactivity Data ==========

Stability Indicator/Materials to Avoid:YES
STRONG OXIDIZERS.
Stability Condition to Avoid:EXTREME TEMPERATURES.
Hazardous Decomposition Products:NONE SPECIFIED BY MANUFACTURER.

========== Disposal Considerations ==========

Waste Disposal Methods:REUSE OR RECYCLE WHENEVER POSSIBLE. DESTROY WASTE SOLIDS BY INCINERATION, OR DISPOSE OF IN AN APPROVED LANDFILL IN ACCORDANCE WITH LOCAL, STATE, AND FEDERAL REGULATIONS.

MSDS for Copper Antifouling Coating

MATERIAL SAFETY DATA SHEET

Sales Order: {SalesOrd}

SUPER KL BLACK

MSDS Revision No:	A0 -2
MSDS Revision Date:	01/07/2004

International.

International Paint Inc.

6001 Antoine Drive

Houston, Texas 77091

EMERGENCY NUMBERS:	
(800) 424-9300	CHEMTREC (USA)
(703) 527-3887	CHEMTREC (Intl)
(800) 854-6813	Poison Control Center
CUSTOMER SERVICE:	(Non-Emergency)
(800) 589-1267	International Paint
(800) 631-7481	Interlux

1. GENERAL INFORMATION

Product Identity: SUPER KL BLACK

Bulk Sales Reference No: NK93

IMPORTANT: Read this MSDS before handling or disposing of this product, and provide this information to the employee, customers, and users of this product. PLEASE NOTE THE MSDS REVISION NUMBER AT THE TOP OF THIS PAGE. If the MSDS Revision Number posted at the top of this page does not match the MSDS Revision Number on the product label, please contact Customer Service at the phone number included above for the correct MSDS. This product is covered by the OSHA Hazard Communication Standard and this document has been prepared in accordance with requirements of this standard.

NOTICE: OSHA hazardous chemicals are listed in Section 2 if present at 1% or more. Carcinogens and extraordinarily/special hazardous chemicals are listed in Section 2 if present at .1% or more. Additional regulatory information for specific chemical categories is included in Section 15.

2. HAZARDOUS INGREDIENT INFORMATION

CAS No.	Ingredient Name & %	Source	Exposure Data
000095-63-6	Pseudocumene 1.0 - 10% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	25 ppm TWA; 125 mg/m3 TWA
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data

001317-38-0	Copper oxide 1.0 - 10% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	0.1 mg/m3 TWA (fume)100 mg/m3 IDLH (fume, as Cu)
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
001317-39-1	Copper(+1) oxide 50 - 75% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	1 mg/m3 TWA (as Cu)100 mg/m3 IDLH (dusts and mists, as Cu)
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
001330-20-7	Xylenes (o-, m-, p- isomers) 1.0 - 10% by Weight	OSHA:	100 ppm TWA; 435 mg/m3 TWA150 ppm STEL; 655 mg/m3 STEL
		ACGIH:	100 ppm TWA150 ppm STEL
		NIOSH:	No Data Available
		Supplier:	No Data Available
		OHSA, CAN:	100 ppm TWAEV; 435 mg/m3 TWAEV150 ppm STEV; 650 mg/m3 STEV
		Mexico:	100 ppm TWA; 435 mg/m3 TWA150 ppm STEL; 655 mg/m3 STEL
		Brazil:	78 ppm TWA; 340 mg/m3 TWA
		Source	**Health Data**
		NIOSH:	Central nervous system depressant; respiratory and eye irritation
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: Yes; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
001333-86-4	Carbon black 1.0 - 10% by Weight	OSHA:	3.5 mg/m3 TWA
		ACGIH:	3.5 mg/m3 TWA
		NIOSH:	3.5 mg/m3 TWA; 0.1 mg/m3 TWA (as PAH, carbon black in presence of polycyclic aromatic hydrocarb1750 mg/m3 IDLH
		Supplier:	No Data Available
		OHSA, CAN:	3.5 mg/m3 TWAEV
		Mexico:	3.5 mg/m3 TWA7 mg/m3 STEL
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Lung cardiovascular
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: Yes; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
007440-50-8	Copper 1.0 - 10% by Weight	OSHA:	0.1 mg/m3 TWA (fume); 1 mg/m3 TWA (dusts and mists)
		ACGIH:	0.2 mg/m3 TWA (fume); 1 mg/m3 TWA (dusts and mists, as Cu)
		NIOSH:	1 mg/m3 TWA (dusts and mists)100 mg/m3 IDLH (dusts and mists)
		Supplier:	No Data Available
		OHSA, CAN:	0.2 mg/m3 TWAEV (fume); 1 mg/m3 TWAEV (dusts and mists)
		Mexico:	0.2 mg/m3 TWA (fume, dusts and mists)2 mg/m3 STEL (dust, as Cu); 1 ppm STEL (dust and spray, as Cu); 2 mg/m3 STEL (dust and spray, a
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	Upper respiratory irritation
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
008050-09-7	Rosin 1.0 - 10% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	No Data Available
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**

		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

CAS No.	Ingredient Name & %	Source	Exposure Data
064742-95-6	Petroleum naphtha, light aromatic 1.0 - 10% by Weight	OSHA:	No Data Available
		ACGIH:	No Data Available
		NIOSH:	No Data Available
		Supplier:	No Data Available
		OHSA, CAN:	No Data Available
		Mexico:	No Data Available
		Brazil:	No Data Available
		Source	**Health Data**
		NIOSH:	No Data Available
		Source	**Carcinogen Data**
		OSHA:	Select Carcinogen: No
		NTP:	Known Carcinogen: No; Suspected Carcinogen: No
		IARC:	Group 1: No; Group 2A: No; Group 2b: No; Group 3: No; Group 4: No

3. HAZARD IDENTIFICATION

Overview:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Avoid contact with eyes, skin and clothing. Contains 1,2,4-Trimethylbenzene which can cause central nervous system depression, anemia and bronchitis.
Inhalation:	May be harmful or fatal if inhaled. Causes nose and throat irritation. Vapors may affect the brain or nervous system causing dizziness, headache or nausea.
Eyes:	Causes severe eye irritation. Do not get in eyes.
Skin:	Causes skin burns. May be harmful if absorbed through the skin.
Ingestion:	Harmful if swallowed. May cause abdominal pain, nausea, vomiting, diarrhea, or drowsiness.
Chronic Effects:	Contains an ingredient which can cause organ damage (See Section 2 and Section 15 for each ingredient). Possible cancer hazard. Contains an ingredient which may cause cancer based on animal data (See Section 2 and Section 15 for each ingredient). Risk of cancer depends on duration and level of exposure.
HMIS Rating:	Health: Unknown Flammability: Unknown Reactivity: Unknown

4. FIRST AID MEASURES

General:	Remove contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean or destroy contaminated shoes.
Inhalation:	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Eyes:	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.
Skin:	In case of contact, immediately flush skin with soap and plenty of water. Get medical attention immediately.
Ingestion:	If swallowed, immediately contact Poison Control Center at 1-800-854-6813. DO NOT induce vomiting unless instructed to do so by medical personnel. Never give anything by mouth to an unconscious person.

5. PROTECTIVE EQUIPMENT AND CONTROL MEASURES

Respiratory:	Select equipment to provide protection from the ingredients listed in Section 2 of this document. Ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness or if air monitoring demonstrates dust, vapor, or mist levels are above applicable limits, wear an appropriate, properly fitted respirator (NIOSH approved) during and after application. Follow respirator manufacturer's directions for respirator use. FOR USERS OF 3M RESPIRATORY PROTECTION ONLY: For information and assistance on 3M occupational health and safety products, call OH&ESD Technical Service toll free in U.S.A. 1-800-243-4630, in Canada call 1-800-267-4414. Please do not contact these numbers regarding other manufacturer's respiratory protection products. 3M does not endorse the accuracy of the information contained in this Material Safety Data Sheet.
Eyes:	Do not get in eyes. Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, safety glasses, chemical goggles, and/or head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Skin/Hand:	Protective equipment should be selected to provide protection from exposure to the chemicals listed in Section 2 of this document. Depending on the site-specific conditions of use, protective gloves, apron, boots, head and face protection may be required to prevent contact. The equipment must be thoroughly cleaned, or discarded after each use.
Engineering Controls:	Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation.
Other Work Practices:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, using toilet facilities, etc. Promptly remove soiled clothing and wash clothing thoroughly before reuse. Shower after work using plenty of soap and water.

6. FIRE AND EXPLOSION INFORMATION

Flash Point:	F: 80 C: 27
Lower Explosive Limit (LEL):	.6 (%vol in air) at Normal Atmospheric Temp and Pressure
Fire and Explosion Hazards:	Flammable liquid and vapor. FLAMMABLE/COMBUSTIBLE MATERIALS: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks) creating a vapor explosion hazard. Runoff to sewers may create fire or explosion hazard. Containers may explode when heated.
Fire Fighting Procedures:	**Also Reference Emergency Response Guide Number:** Not Determined

7. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
pH:	Not Determined
Specific Gravity:	2.591557
Boiling Point (F):	279
Vapor Density:	Heavier than air
VOC Content (lbs):	Refer to the Technical Data Sheet for this product.
Evaporation Rate:	Slower than ether

8. STABILITY AND REACTIVITY DATA

General:	This product is stable and hazardous polymerization will not occur.
Incompatible Materials:	Strong oxidizing agents.
Hazardous Decompostion:	May produce hazardous fumes when heated to decomposition as in welding. Fumes may produce Carbon Dioxide and Carbon Monoxide.

9. HANDLING AND STORAGE

Storage Temperature:	Store between 32 and 120 F
Handling and Storage Precautions:	Keep away from heat, sparks and flame. Do not smoke. Extinguish all flames and pilot lights, and turn off stoves, heaters, electric motors and other sources of ignition during use and until all vapors are gone. Vapors may cause flash fire or ignite explosively. Prevent build-up of vapors by opening all windows and doors to achieve cross-ventilation. Do not get in eyes, on skin or clothing. Close container after each use. Wash thoroughly after handling.

10. TOXICOLOGICAL DATA

General:	NOTICE: Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. No additional information provided for this product. See Section 2 for chemical specific data.

11. ECOLOGICAL DATA

General:	No additional information provided for this product. See Section 2 for chemical specific data.

12. ACCIDENTAL RELEASE MEASURES

Spill Response Procedures:	ELIMINATE ALL IGNITION SOURCES (no smoking, flares, sparks or flames in immediate area). Use only non-sparking equipment to handle spilled material and absorbent. Do not touch or walk through spilled material. Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand, or other non-combustible material and transfer to containers. Use non-sparking tools to collect absorbed material.
Public Safety:	CALL CHEMTREC at (800)-424-9300 for emergency response. Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering. LARGE SPILLS: Consider initial downwind evacuation for at least 300 meters (1000 feet). **Also, Reference Emergency Response Guide Number: Not Determined**

13. DISPOSAL CONSIDERATION

Waste Disposal:	Dispose of in accordance with local, state and federal regulations. (Also reference RCRA information in Section 15 if listed).

14. TRANSPORTATION INFORMATION

DOT (Domestic Surface Transportation)		IMO / IMDG (Ocean Transportation)	
DOT Proper Shipping Name:		**IMDG Proper Shipping Name:**	
CONSUMER COMMODITY, ORM-D		CONSUMER COMMODITY, ORM-D	
DOT Hazard Class:	NR	**IMDG Hazard Class:**	Not Regulated
UN / NA Number:	Not Regulated	**UN Number:**	Not Regulated
DOT Packing Group:	Not Regulated	**IMDG Packing Group:**	Not Regulated
CERCLA/DOT RQ:	74 gal. / 1590 lbs.	**System Reference Code:**	5

15. REGULATORY INFORMATION

Regulatory Overview:	The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented. All ingredients of this product are listed on the TSCA (Toxic Substance Control Act) Inventory or are not required to be listed on the TSCA Inventory. **Note:** Any chemical ingredients listed in Section 15, that do not also appear in Section 2, are contained in the product at a concentration below the applicable OSHA threshold level of 1% or 0.1%.
WHMIS Classification:	Not Determined

Regulatory List	Product Ingredients on List
DOT Marine Pollutants (10%):	
(No Product Ingredients Listed)	
DOT Severe Marine Pollutants (1%)	
007440-50-8	Copper
EPCRA 311/312 Chemicals and RQs (>.1%) :	
007440-50-8	Copper : 5000 lb final RQ (no reporting of releases of this hazardous substance is required if the diame
000100-41-4	Ethyl benzene : 1000 lb final RQ; 454 kg final RQ
001330-20-7	Xylenes (o-, m-, p- isomers) : 100 lb final RQ; 45.4 kg final RQ
EPCRA 302 Extremely Hazardous (>.1%) :	
(No Product Ingredients Listed)	
EPCRA 313 Toxic Chemicals (>.1%) :	
007440-50-8	Copper
001317-38-0	Copper oxide
001317-39-1	Copper(+1) oxide
000100-41-4	Ethyl benzene
000095-63-6	Pseudocumene
001330-20-7	Xylenes (o-, m-, p- isomers)
Mass RTK Substances (>1%) :	
001333-86-4	Carbon black
007440-50-8	Copper
000095-63-6	Pseudocumene
001330-20-7	Xylenes (o-, m-, p- isomers)
Mass Extraordinarily Haz Sub (>.01%) :	
014808-60-7	Quartz
Penn RTK Substances (>1%) :	
001333-86-4	Carbon black
007440-50-8	Copper
000095-63-6	Pseudocumene
001330-20-7	Xylenes (o-, m-, p- isomers)
Penn Special Hazardous Substances (>.01%) :	
001333-86-4	Carbon black
Rhode Island Hazardous Substances (>.1%) :	
001333-86-4	Carbon black
007440-50-8	Copper
000100-41-4	Ethyl benzene
001330-20-7	Xylenes (o-, m-, p- isomers)
RCRA Status (>.01%) :	
(No Product Ingredients Listed)	
N.J. RTK Substances (>1%) :	
001333-86-4	Carbon black
007440-50-8	Copper
000095-63-6	Pseudocumene
001330-20-7	Xylenes (o-, m-, p- isomers)
N.J. Special Hazardous Substances (>.01%) :	
001330-20-7	Xylenes (o-, m-, p- isomers)
N.J. Env. Hazardous Substances (>.1%) :	
007440-50-8	Copper
001317-38-0	Copper oxide
001317-39-1	Copper(+1) oxide
000100-41-4	Ethyl benzene
000095-63-6	Pseudocumene
001330-20-7	Xylenes (o-, m-, p- isomers)
Proposition 65 - Carcinogens (>0%):	
001333-86-4	Carbon black
014808-60-7	Quartz
014464-46-1	Silica, cristobalite
Proposition 65 - Female Repro Toxins (>0%):	
(No Product Ingredients Listed)	
Proposition 65 - Male Repro Toxins (>0%):	
(No Product Ingredients Listed)	
Proposition 65 - Developmental Toxins (>0%):	
(No Product Ingredients Listed)	

16. OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

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