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*Final Report*

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**PennSTAR Project**

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*Pennsylvania Spray Technique Analysis and Research*

*May 2006*

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**Pennsylvania College of Technology**

PENNSTATE



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## **Executive Summary**

The Pennsylvania Spray Technique Analysis and Research (PennSTAR) program received funding from the Pennsylvania Department of Environmental Protection (DEP) in April 2001. This program was designed to be operated and managed by the Pennsylvania College of Technology (PCT) located in Williamsport, Pennsylvania. The primary activity of this program was to provide demonstrations to auto body technicians and refinishers in the field of collision repair to help reduce the amount of Volatile Organic Compounds (VOC's) and Hazardous Air Pollutants (HAP's) being released into the atmosphere and at the same time reduce costs to collision repair facilities. The project utilized a mobile unit (truck and trailer) to visit collision repair facilities statewide and perform demonstrations to industry professionals and emerging painters (students) in an effort to improve their Transfer Efficiency (TE) when applying materials (paint and related materials) in automotive repair applications.

Following an initial startup period, the first demonstration occurred in July 2001. During the course of the funding period which concluded on March 31, 2006, a total of 352 persons had participated in PennSTAR demonstrations. During this period the mobile unit visited 70 locations and performed demonstrations for both industry technicians as well as students enrolled in collision repair education.

A program target of 25 percent increase in TE was proposed, and subsequently the program realized an average of 25.93 percent increase in TE. Using the assumption that each participant will spray an average of eight fenders and hoods per week, the decrease in VOC's released into the atmosphere will be 77,088 pounds per year, and a total savings in material costs of \$1,635,392 per year will be realized by Pennsylvania collision repair businesses. PCT views this as a substantial contribution to improving air quality and a significant reduction in costs to Pennsylvania collision repair facilities.

## Introduction

With the introduction of Pennsylvania's regulation requiring the use of High Volume, Low Pressure (HVLP) spray guns, the issue of TE began to be discussed. HVLP guns had the potential of increasing application TE from 20 – 25 percent, the average prior to the regulation, to 65 – 80 percent TE. The introduction of the National Rule, which regulated the use of lower VOC coatings, also reduced VOC emissions. There remained areas, however, which if addressed could further reduce the VOC/HAP emissions. A study conducted by Pacific Northwest Pollution Prevention Research Center in 1992 clearly identified that training and experience could increase the TE of an individual painter by 30 percent. Though the use of more efficient guns was regulated, just using these guns did not guarantee that they would be used to their full potential. Painters who were trained to use these efficient guns *in an efficient way* would be the key to significantly lowering emissions. Additionally, training paint technicians to clean equipment in an enclosed vessel could further reduce emissions by 10 percent.

The PennSTAR demonstration was developed to introduce paint professionals in Pennsylvania to the new requirements for use of HVLP spray equipment and the regulations regarding the cleaning of spray equipment. It was also designed to demonstrate to painters a more efficient way of paint application.

The reductions of VOC's disbursed through TE were the focus of the demonstrations. Although not targeted for the demonstrations, reductions in VOC emissions could also be measured through cleaning or proper use of under-coatings. Consistent with the grant proposal initially presented to DEP, a 25 percent increase of TE was set as the target, and it was proposed that a technician's overall TE after training would be 60 percent or greater.

Over the length of the program, 352 technicians participated in the demonstration process. They were predominately male, varying in experience from students in training to seasoned technicians with 15 years or more experience. Topics introduced and demonstrated to the participants were:

- Coatings application and TE
- State regulations regarding the use of compliant spray guns
- Proper cleaning of spray equipment
- Ways to reduce the amount of surface preparations cleaners
- Proper selection and use of undercoats

## **Demonstration Process**

Each PennSTAR demonstration was scheduled as a two-day, approximately twelve-hour, program. On the first day, each painter-participant was given a hood and fender that had been prepared for this purpose. These pieces had previously been weighed to three significant positions (thousandths) beyond the decimal (0.001), in grams. Using the paint system that the technician was familiar with, paint would be prepared according to the manufacturer's recommendations, and a sample was prepared and weighed to thousandths to determine the percent of solids in the reduced solution. The paint was placed in the painter's paint gun of choice, preferably the gun used daily. The gun would then be weighed as previously explained.

Each painter was asked to paint the two items (hood and fender) using the technique each normally followed. The technicians were videotaped while they prepared and then painted the objects. Following the painting of the two objects, each participant's paint gun was weighed again to determine the amount of paint that had been sprayed.

The painters were then asked to clean their equipment as they normally would but with filmed documentation of the process. A container of their normal cleaning solvent was available to them, and the exact amount in the container was measured (in milliliters) prior to the cleaning process. When the technician had completed the cleaning process, the solvent was measured again to determine the amount used in the process. The time needed for setting up and completing this segment of the training process averaged three to four hours.

During the next segment of the demonstration process, the hood and fender painted by each participant was weighed again to determine the amount of material that had been deposited on them. The amount of paint loss from the previous segment was calculated (weight of paint in the gun before painting minus the amount of paint in the gun after painting). The weight of paint used to finish the objects was determined (weight before painting plus the weight of the objects after painting). The amount of paint on the two objects was then subtracted from the amount of paint used in spraying to determine

the amount of paint lost to the atmosphere, or the percent of TE. The two panels were measured in multiple (13 to 25) locations to obtain an average film thickness reading. The time needed for this weight and calculations portion of the demonstration was generally from one to one and one-half hours. (If force drying was available, this would be done the previous day, thus providing a significant savings in demonstration time.)

After the above-explained preliminary measurements and documenting of pre-demonstration techniques used by technicians (participants), the actual demonstration would take place. The majority of the demonstration event was devoted to technique using the LaserTouch<sup>tm</sup> spray gun trainer, which has multiple laser aiming devices to help the participant with distance, proper gun angle, uniform coating thickness, and improved TE. The participants were each given the opportunity to view themselves as taped, to review their previous technique in comparison to their newly learned techniques. This demonstration period took an average of five to six hours.

Following the demonstration, each participant was directed to spray two parts (hood and fender), which were identical to the parts sprayed as the “pre-test” (pre-demonstration spraying) done the day before. The test was conducted in the exact manner as the pre-demonstration test; all measurements were duplicated to reduce the margin of error. This demonstration period required three to four hours.

The participants were each informed of their TE improvement from pre-demonstration to post-demonstration sprayings. This demonstration program was developed with a 25 percent improvement target. It is believed that following this training the refinisher should have a TE of 60 percent or more. The time necessary to review and discuss the results averaged four to five hours.

Total time for the complete demonstration was usually between 12 and 15 hours. Variables were the number of technicians in the session and their level of previous spray painting experience and/or training.

## Demonstration Delivery

The proposal was developed around the plan that PennSTAR would deliver the training to collision repair facilities using a mobile delivery system. The PennSTAR program research director designed, commissioned, and equipped the training trailer. The completely equipped trailer was towed to each participating collision repair facility by the PennSTAR instructor. The assumption was that shop personnel would be more likely to participate in the demonstration if it took place in the familiarity and convenience of their own workplace. It was also proposed that the shop owners or managers would better support this method, as the employees would not incur missed work time by the need to travel to and from the PennSTAR training.

All required measuring equipment, panels, computing equipment, communications and recording equipment, cleaning equipment, and classroom delivery materials were contained within the trailer. The only items the repair facility needed to supply were the participants (painters and others that would be using spray equipment), a place to spray the panels (spray booth), and curing equipment, if available.

On the first day of each demonstration, the previously prepared panels and other materials arrived at the demonstration facility in the trailer. The materials were unloaded, the PennSTAR instructor presented the directions, and the participants would complete the pre-test as described. (See *Demonstration Process*.)

Though the PennSTAR trailer was fully equipped, it was also necessary to have a home base to prepare the equipment between demonstration days. The base chosen was the Collision Repair department and laboratories of the Pennsylvania College of Technology (PCT) located in Williamsport, Pennsylvania. The home base was to be equipped with a working area to prepare the panels needed for the pre- and post-tests, to maintain and clean the equipment, and an office for scheduling the demonstrations and record keeping.



A remote office was equipped off-campus, at the home of the PennSTAR scheduling / recordkeeping coordinator. The coordinator was able to communicate between the prospective clients, the PennSTAR instructor(s), directors, funding agency of the grant (DEP), and other support personnel. Clients were able to contact PennSTAR for inquiry and scheduling by phone, fax, and via a Web site.

The demonstration delivery cycle continued at the home base (PCT) with each of the panels previously used by participants being unloaded from the trailer and weighed and measured for film thickness to calculate post-test TE percentage and change. These results were recorded and reported to the participant, the research data of the director, the Northern Iowa STAR program records, and to the participating departments of DEP.

On-site preparation of the panels, trailer, and spray equipment was then completed for the next scheduled demonstration session. Preparing each hood and fender for the next PennSTAR participant involved cleaning, stripping, re-cleaning, and repairing as needed, then doing exact measurements again. This procedure took approximately 45-60 minutes per item.

For each demonstration, two hoods and two fenders were required for use by each participant. That is, if six paint technicians were to participate, twenty-four pieces total were prepared for that demonstration. The prepared pieces were then packed on specially designed supports within the trailer for transit to the next training site.

Following the demonstration, each participant received a certificate indicating completion of the demonstration and the post-test percentage of TE they had achieved. A supplement to the certificate listed both beginning and post-test percentages of TE of the participant with an extrapolation of savings to both the environment (pounds of VOC's/HAP's reduced per year) and in reduced material cost to the repair facility (dollars saved per year by that employee as a result of his or her improved TE).

The demonstration delivery process also required response to inquiries from refinishing businesses and other going concerns as they learned of the program. The program coordinator provided front-line response to these inquiries. Pre-scheduling tasks

routinely included clarifying program content and benefits, explaining MERR regulations, and compliance responsibilities of the business.

Upon clarifying that the PennSTAR program was of interest to the inquirer, the coordinator would continue communications by explaining the PennSTAR demonstration process and the time and space requirements to prospective clients. An average of six communications between parties often including combinations of phone, fax, and e-mail contacts were required to confirm a training session and to register participants.

The PennSTAR program was launched in May 2001, and concluded on the last day of March 2006.

## **Program Outcomes**

Throughout the length of the demonstration program, the target goal of 25 percent increase of average technician TE was met. However, the target population of participants changed from the majority of the participants being experienced technicians with a few students in the beginning to the majority of the participants being students with a few experienced technicians in the final two years of the program. The percent of improvement was greater in the students because less experienced participants responded better to training and had less long-term experiential habits to change.

The shift in population came about due to the original target audience not making itself readily available for demonstration opportunities. The demonstration was offered without charge to local businesses as a benefit of DEP funding of the program. The instructor and demonstration equipment went to the participant's place of business. It was thought that having the demonstration take place at the participant's place of business would facilitate transfer of new skills and that knowledge acquisition would be better. Yet, while many employers expressed appreciation of those accommodations and interest in the demonstration, only one facility scheduled the free demonstration for approximately every ten facilities that inquired.

Even though the amount of contacts was significant, especially in the first two years as DEP summer interns made personal contact to collision repair facilities, the inquiries did not translate into large numbers of demonstration opportunities. In total, 30 Pennsylvania shops received PennSTAR demonstrations, most within the first two years of the program, with an average of three technicians being trained at each demonstration.

After the first two years, secondary and post-secondary vocational collision students were marketed, and the shift toward student population began. As the demonstrations shifted to the student population, larger numbers of participants could be included. At the close of the program, 352 participants in all had received the PennSTAR demonstration during 70 visits, which averaged five participants per demonstration.

## **Conclusion**

As in many undertakings, some assumptions and estimates proved accurate while others required adjustment after the study. In the case of the PennSTAR demonstration, commercial clients' willingness to complete training was overestimated; and though there was good response to summer intern promotion, relatively few of the telephone and Internet contacts translated into demonstration participation. Conversely, the amount of physical preparation between training periods was significant. For example, each fender or hood required 45 to 60 minutes to prepare for the next demonstration.

At the conclusion of the program, 352 participants had been served with an average of 25.93 percent increase in TE. Using the program's assumption that each participating technician will spray an average of eight fenders and hoods per week, the decrease in VOC's released into the atmosphere will be 77,088 pounds per year and a total savings in material costs of \$1,635,392 per year to Pennsylvania collision repair businesses will be realized. In addition, overwhelmingly positive exit responses by the technicians attest to the usefulness of the program.