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Effects of Technology Based Interactive Multimedia on Training of Laminators at General Dynamics Armament & Technical Products Manufacturing

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Effects of Technology Based Interactive Multimedia on Training of Laminators at General Dynamics Armament & Technical Products Manufacturing

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By

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Signature Page

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Approved by: _____ _____
John M. Ritz, Ed.D. Date
Graduate Program Director

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Chapter I

Introduction

At General Dynamics Armament and Technical Products (GDATP), Marion Operations, high tech composites are used to fabricate various parts for military and commercial aircraft. Skin laminators working in the clean room on the GE Device program are tasked with hand lay up of fairly complex parts of this nature. The work instructions have been continuously updated and revised as new and better techniques and methods have been developed. However, in the case of several highly operator dependant operations, it has been found to be necessary to re-train operators on a continual basis.

The necessity of re-training is usually signaled by a sharp rise in defects and scrap rates due to one particular attribute, usually porosity. Porosity is a condition in a composite material which is manifest by lower density indicating poor compaction and resulting in reduced strength.

When parts with porosity begin to show up, an engineer and/or an engineering technician typically spends several hours on each of two shifts re-training and reminding the operators of the importance of the correct execution and technique needed to address the defect. Because these parts have a lead time of about five working days from the time of lamination to the time the discrepancies are discovered, there are a number of scrap parts in process before the problem is realized and addressed. More parts are scraped because of defects in porosity.

In a recent memorandum the quality engineer assigned to the program wrote, "The process has never been very robust, but is trending up since September. At the current rate, the skins will generate 18-20+ nonconforming parts in February" (email message from Roger Poe, January 28, 2005). This message was in reference to the porosity in the skins. This has been a persisting problem throughout the course of the program.

Statement of the Problem

The purpose of this study was to identify instructional strategies that would enhance the retention of training knowledge of skin laminators, thus increasing productivity and reducing scrap at General Dynamics Armament & Technical Products facilities.

Hypothesis

To guide this study, the following hypothesis was established:

H_1: For skin laminators working in the clean room at General Dynamics Armament & Technical Products, traditional methods of training, in conjunction with technology based interactive multimedia, will result in an increase in retention over a longer period of time with less direct human training needed.

Background and Significance

The GE Device program is currently into the sixth year of production. During this time many improvements have been made in the processing and, in joint efforts with the customer, to re-design production methods to produce aircraft parts. Defects have

been greatly reduced through the implementation of shop aids, improved work instructions, and education and training of laminators in various methods and techniques for fabricating high tech composite parts.

However, there remain defect producing practices that have been present since the beginning of production which have proven more difficult to address and resolve. One of these is a particular defect in skins, porosity, originating in the clean room. The operations performed by the skin laminators are complex and highly operator and technique dependent. It was discovered early on that re-training of the operators in the operations and techniques necessary to reduce or eliminate this defect was effective but for a relatively short period of time requiring regular retraining every two to six weeks. The need for the re-training is made evident by the sharp increase in defects and subsequent scrap. Although no data were collected and analyzed to determine the root cause of the defects, it was assumed by production, as well as program management, that the root cause was operator's inattentiveness to detail over time.

The results of this study will be applied to other programs at GDATP, possibly resulting in increased efficiency, reduced scrap, and more efficient training methods for the entire facility. If the problems are solved, this training technique could be shared on an industry wide basis.

Limitations

This study will be limited to the GE Device clean room and to skin laminators only. The traditional training when needed will be conducted by the process engineer or the engineering technician as has been the practice in past. The defects in the past have

not been distributed evenly among the seven laminators. This makes it necessary to use the entire group as the population and past data from the same individuals as the control data. An interactive multimedia training program will be produced by the process - engineer. The interactive PowerPoint file will be authored incorporating visual and audio components. Computers in the clean room will be used by the laminators to view the training program.

Assumptions

It was assumed that the skin laminators represent a statistically diverse group and that there are no appreciable individual differences in the ability of a group of skin laminators over a period of approximately six months. It was also assumed that the process engineer has the necessary educational background and technical expertise to author an effective interactive multimedia training tool. It was assumed that the laminator's attitude toward the training was not biased. The assumptions were also made that the processes and materials will remain relatively constant. These assumptions were made based on past data. It was assumed that for the purposes of this investigation, WBT or Web based training would be considered equivalent to training delivered to a computer via a CD.

Procedures

The study was conducted in the GE Device clean room where traditional training has taken place in the past and where the facilities are in place to deliver the interactive multimedia training. The training sessions were administered once weekly and the results compared with past data. A training time sheet will be used and data entered by

the process engineer and/or clean room supervisor to record when the program is viewed by individual laminators.

Definition of Terms

The following terms are defined to assist the reader:

DoD: United States Department of Defense.

GDATP: General Dynamics Armament and Technical Products.

Clean room: A room where temperature, humidity, and possible contaminants are controlled.

Process Engineer: The engineer responsible for process improvement and work instructions in the clean room. This engineer is primarily responsible for the quality of the product.

Engineering Technician: An individual usually with a high school diploma or a two year technical degree with extensive experience in the fabrication and processing of high tech composites assigned to one process engineer as an aide.

Skin: One component of an assembly produced for use on military aircraft.

High Tech Composite: A high strength to weight ratio material produced from two or more different materials, usually fibers and a resin or matrix which binds the fibers together.

Porosity: A condition in a composite material which is manifest by lower density indicating poor compaction and resulting in reduced strength.

WBT: Web-based training. Refers to instruction that is delivered over the internet or over a company's Intranet.

WWW: World wide web.

NDI: Non-destructive inspection of a part using ultra-sonic sound waves.

Overview of Chapters

Chapter I has introduced the reader to the problem to be studied, i.e., to identify instructional strategies that would enhance the retention of training knowledge of skin laminators at GDATP facilities. The hypothesis was that the use of multimedia technology based interactive training will improve performance and retention of skin laminators was stated. The background of skin laminators and the problems encountered with the retention of skills and techniques in the laminating of skins was presented. The significance of reduced scrap and improved efficiency in the business as a whole was stated. The limitations were stated and the assumptions that the skin laminators were a random sample of the total lamination worker population at GDATP. It was stated that the laminators' attitude toward the training was not biased. The assumptions were also made that the processes and materials would remain relatively constant. It was assumed that for the purposes of this investigation, WBT or Web based training would be considered equivalent to training delivered on a computer via a CD. The procedures for the administration of the instrument and the collection and analysis of the data were presented. And a list of definitions of technical terms related to the aerospace industry and definitions of terms related to multi-media based instruction were listed.

The remainder of this paper will address a review of existing literature, a detailed explanation of the methods and procedures to be used in conducting the research and collecting the data, an analysis of the data, and a summary of the findings with recommendations based on the findings.

Chapter II

Review of Literature

In this chapter, a discussion of the need for training on the GE Device program is presented. A review of several previously conducted studies on technology based training is then presented followed by a summary of the chapter.

Training on the GE Device Program

The purpose for this study was to investigate effective strategies for instruction of skin lamination operators on the GE Device program**.** During the past five years, several different methods of instruction have been used with varying degrees of success. These have included initial classroom type traditional training conducted by the plant training department and continuing on-the-job training conducted by the responsible engineer and/or the engineering technician.

The parts fabricated by the skin laminators are very costly and as a result, present a substantial monetary loss when one is scrapped. The customer has demanded a significant annual reduction in the price they must pay for these parts. One way this is achievable is through reduction of the number of scrapped parts. The process of lamination in the GE Device area involves the hand placement of approximately 20 precut individual prepreg plies placed with a predetermined orientation on a steel tool called a mold. The proper orientation and order placed on the mold of each ply is designed to give the finished product quasi-homogeneous mechanical properties. Each prepreg ply consists of a fabric type material woven from high tensile strength quartz or carbon fibers and then saturated or “impregnated” with an appropriate epoxy resin. The

orientation of each ply and the order in which it is placed in the stack build-up is important in the determination of the mechanical properties of the finished part because the load bearing portion of the composite or the fibers have a very high strength in tension but very little strength in compression or bending. During lamination, it is imperative that each ply be pressed and worked into the previous ply, particularly in any concave areas where bridging of one ply to the next is most likely to occur. Although the epoxy resin will become very non-viscous at one point during autoclave cure, air trapped in the part may not be completely expelled from between plies and will negatively impact the mechanical properties of the skin. Large air pockets are called voids. Above a certain percentage of air, gas or very small voids contained within a specified volume of material is designated as porosity. Porosity is detected in a cured laminate using ultra-sonic inspection techniques or NDI. An investigation of the use of technology based interactive multimedia as a means to enhance the effectiveness of training for skin laminators will be reviewed.

Technology Based Training

In this study, an attempt was made to search the available literature for evidence that correlations exist between the independent variable of technology based interactive multimedia training and the dependent variable of increased retention over a longer period of time with less direct human training needed. It was found that much literature available on the effectiveness of technology based interactive multimedia training focuses on Web-based training (WBT). WBT refers to the communication of information over the World Wide Web with the intent of providing instruction (Kurtus, 1997). Training delivered via a computer makes it possible for students, the instructor, and subject matter

experts to be in different locations at different times and yet still be brought together through the use of computers. Although in some cases involving attitudinal changes or heavy involvement of hands-on practice, the use of WBT should not be used (Chamers & Lee, 2004).

In a study made by Saunders and Klemming (2003), it was found that most students found it helpful to have training materials on either a floppy disk or a CD, as this enabled working with it when a network connection was not possible. It was also interesting to note that a majority of the students used in this study felt that technology based interactive multimedia should be used to supplement traditional classroom instruction and not replace it. From this study it was found that the average examination mark obtained during the year previous to the use of technology based interactive multimedia was 42 compared with an average mark of 52 percent for the following year when technology based interactive multimedia was used.

In a study of nurses being trained in fire safety using traditional instructor-led training and computer based training as the two independent variables and knowledge gained and retention of training as the dependent variables, it was found that the nurses trained using computer based training learned more about the subject than the control group which received traditional teacher based training only. However, there was no significant difference in the amount of training retained between the two groups when tested three months following the instruction (Harrington & Walker, 2004).

Hong, McGee, and Howard (2000) found that the multi-media learning environment titled, "Astronomy Village®: Investigating the Universe™", was effective in

teaching 9th grade students astronomy content and problem-solving skills. The treatment group was instructed using traditional teaching methods enhanced with use of "Astronomy Village". The control group was instructed using traditional teaching methods only. The students in this study were given a pretest and a posttest which revealed a significant increase in the treatment group as compared with the control group in both conceptual understanding and problem solving skills.

In another study comparing the use of an electronic manual versus a print manual used for training novice users in the use of a music score editor, it was found that users of the electronic manual learned more. They also accessed the manual more frequently, and had a more positive attitude toward the documentation than those using the print manual (Gimenez & Saenz de Jubera, 2001). In a questionnaire provided the students following the study, a greater percentage of the students using the print manual would have preferred to use the electronic manual than those using the electronic manual would have preferred using the print manual.

McIntyre (1997) states that the atmosphere of control using technology based interactive multimedia empowers the learner and contributes to boosting their level of self-efficacy. This in turn plays a key role in performance. This is due to the ability of the learner to adjust the levels of difficulty, adjust the pace, and provide the ability to review information.

Summary

The subject of instruction using technology based interactive multimedia has been studied in a variety of settings with the majority of findings supporting the use of

technology based interactive multimedia for purposes of instruction. When used in conjunction with traditional forms of instruction, technology based interactive multimedia can increase the knowledge acquired and enhance the learning experience. It has not, however, been shown to extend the time that knowledge is retained. The next chapter of this paper will address a detailed explanation of the methods and procedures used in conducting the research and collecting the data.

Chapter III

Methods and Procedures

This study was conducted as experimental research. In the sections to follow, the population, research variables, design of the instrument, clean room procedures, methods of data collection, data analysis, and a summary are documented.

Population

The population was the group of operators specified as laminators working at General Dynamics Armament & Technical Products, Marion Operations. This was a total of 156 people working in a total of three plants. Most laminators at GDATP have at the least a high school diploma while some have some college experience. It was decided to study a sample of the entire population of laminators at GDATP, Marion Operations. This sample was composed of seven laminators, three males and four females, working on the GE Device program. The sample group had an average of nine years experience in lamination. The sample group ranged from 35 to 60 years of age with an average age of 44. The seven laminators in the sample group all had basic computer skills.

Research Variables

The independent variable in this study was the method of delivery of training to laminators. Traditional methods of training were originally presented to laminators in the form of classroom instruction and reinforced with on the job training conducted by company training personnel, the project engineer, and the engineering technician. Follow up training was conducted on an as needed basis as was indicated by defective or scrap

parts. This training was then compared with instruction delivered to the laminators using technology based interactive media in the form of a computer program delivered using Microsoft PowerPoint. The dependant variable was the number of discrepant parts produced during the time traditional training methods were used versus the number of discrepant parts produced during the time period that the PowerPoint program was used.

Instrument Design

An interactive PowerPoint program was used as the instrument. The program was created by the author of this study. The program included interactive buttons which initiated animations visually demonstrating the proper actions and techniques required in the lamination of skins. Because the GE Device program was a DoD classified program, the instrument used, by virtue of the visual aspect of the program, was deemed classified by the security officer assigned to the program and as such was able to be viewed only by persons working on the GE Device program with a current DoD issued secret security clearance and a need to know. The tutorial required approximately 15 minutes to view.

Clean Room Procedures

The instruction took place in the clean room where the lamination of skins was performed. During the first four weeks of the study, instruction in the clean room took place in the traditional form as had been done in the past. That is, the laminators were visited daily by the process engineer or engineering technician and observed. Any questions the laminators had were addressed and instruction was performed on an individual basis as deemed necessary from observations made by the process engineer or the engineering technician. The four weeks following the initial phase of the study, an

interactive PowerPoint program was loaded onto the computer in the clean room and each laminator was required to go through the program once weekly for a period of four weeks. A weekly record of each laminator's completion of the multi media instruction was kept by the area supervisor on GDATP training form TMF001. A sample TMF001 form from this study is presented in Appendix A. Refresher instruction performed by the process engineer or the engineering technician was conducted on an as needed basis as was the case in the past. Previous training records for the seven laminators involved in the study were obtained from the company training department.

Methods of Data Collection

To determine the effectiveness of the training, pass/fail data with respect to the presence of porosity were collected. These data were recorded in the paperwork required to accompany each part through the fabrication process from the receiving of raw material through shipment of the part to the customer. Once the part had finished production and had successfully passed all inspections, the data were transferred to an electronic database maintained at the Marion facility of GDATP. Should the part fail any one of four separate inspections during the production phase, a non-conformance document was written stating the nature of the non-conformance, the disposition of the part whether it was rework, repair, or scrap, and the corrective action required to eliminate the non-conformance. Data sheets collected during the course of this study are presented in Appendix B. The non-conformance then became a permanent part of the data package that accompanied the part. If the part was dispositioned as scrap, the part was destroyed, the associated paperwork archived, and the data entered into the database.

Data from past parts was retrieved from the database and then compared with data obtained from parts fabricated following implementation of the instrument.

Statistical Analysis

The data collected was entered into a statistical software program titled "Minitab"™ Version 13.3. Measures of central tendency and the t-test were performed to determine if there was a significant difference in training methods.

Summary

This chapter has detailed the training methods used and the relevant information pertaining to the skin laminators, or population group, at GDATP, Marion Operations. The instrument used was a PowerPoint tutorial created by the author of this study. The procedures used were documented and the methods of data collection were described. The software used to evaluate the data using statistics was noted. In the next chapter, the findings of this study will be documented and the results of the statistical analysis performed on the data will be presented.

Chapter IV

Findings

In this chapter, the findings of this study are presented. The purpose of this study was to identify instructional strategies that would enhance the retention of training knowledge of skin laminators, thus increasing productivity and reducing scrap at General Dynamics Armament & Technical Products facilities. This chapter will present the findings of this project and will follow with a summary.

Findings

During this study, data were collected on a total of 354 parts which were fabricated by the sample population group of seven laminators. One hundred-seventy-seven parts were laminated prior to the implementation of the computer based training between the dates of 15th of June, 2005, and the 21st of July, 2005. One hundred-seventy-seven parts were laminated following the implementation of the computer based training between the dates of 22nd of July, 2005, and the 18th of August, 2005. The parts were all laminated by the same seven laminators. A summary of the data is presented in Table 1.

Of the 177 parts laminated prior to the implementation of the instrument, 18 were scrapped due to the presence of porosity in the laminate. Of the 177 skins laminated following implementation of the instrument, 10 were scrapped due to porosity in the laminate. The total number of parts fabricated and the number scraped before and after implementation of the instrument is presented in Figure 1.

Table 1. Summary of Findings

	Before Implementation of the Instrument				After Implementation of the Instrument			
Laminator	Total Laminated	Accepted	Rejected	% Rejected	Total Laminated	Accepted	Rejected	% Rejected
1	33	29	4	12.1%	25	22	3	12.0%
2	8	7	1	12.5%	30	30	0	0.0%
3	35	35	0	0.0%	36	36	0	0.0%
4	6	6	0	0.0%	6	6	0	0.0%
5	34	30	4	11.8%	34	28	6	17.6%
6	35	29	6	17.1%	27	26	1	3.7%
7	26	23	3	11.5%	19	19	0	0.0%
Total	**177**	**159**	**18**	**9.3%**	**177**	**167**	**10**	**4.8%**

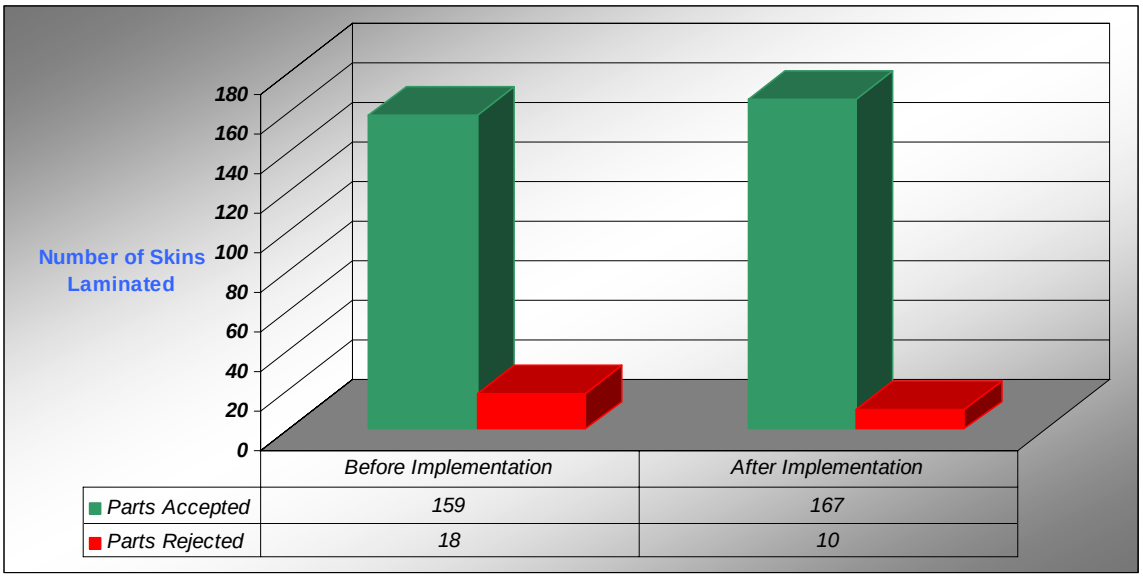

Figure 1. Effects of Technology Based Interactive Training on Productivity

Of the seven laminators used in this study, four produced fewer scrap parts following implementation of the training and two laminators produced no scrap parts either before or after implementation of the instrument. One laminator produced more scrap parts following implementation of the instrument than before. This is shown in Figure 2.

To determine if there was a significant difference between the number of parts laminated and rejected before implementation of the instrument and those rejected following implementation of the instrument, a t-test was performed. The resulting t value was 1.58. This is shown in Table 2.

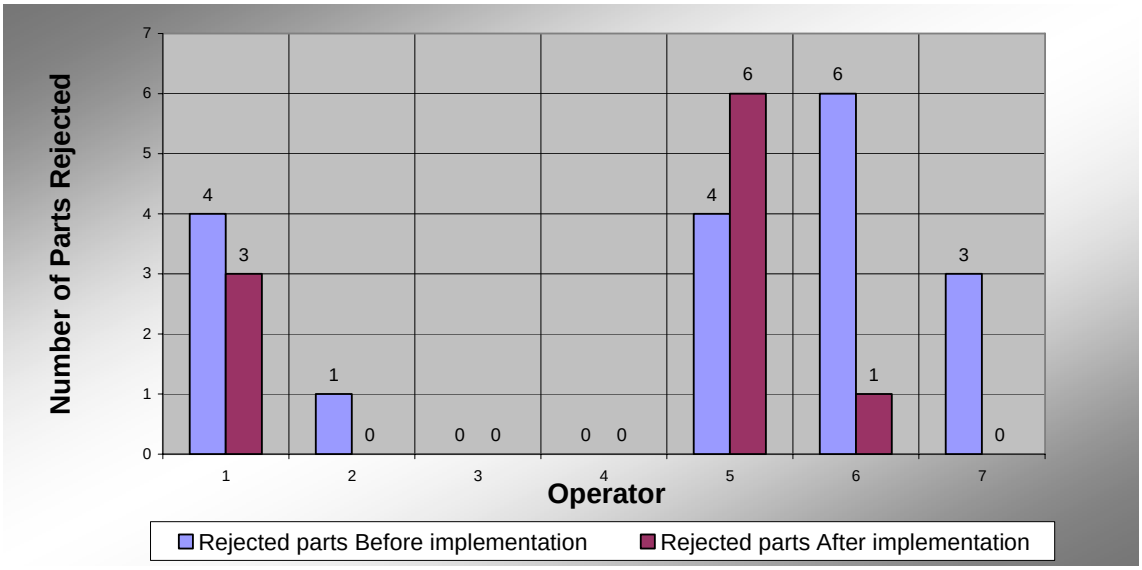

Figure 2. Rejected Parts, by Operator, Before and After Implementation

Table 2. Results of Two-sample t test

```
Two-sample T for Reject_Before vs Reject_After

           N      Mean     StDev   SE Mean
Reject_B  177     0.102     0.303     0.023
Reject_A  177     0.056     0.232     0.017

Difference = mu Reject_Before - mu Reject_After
       Estimate for difference:  0.0452
   95% CI for difference: (-0.0112, 0.1016)
T-Test of difference = 0 (vs not =): T-Value = 1.58  P-Value = 0.116  DF = 329
```

Summary

In this chapter the data collected for this research project were presented and summarized. The data was analyzed using a t-test for statistical significance.

In Chapter V, a summary of the study will be presented. This will be followed by conclusions drawn from the data presented in this chapter and recommendations based on the conclusions drawn.

Chapter V

Summary, Conclusions, and Recommendations

This chapter summarized the questions that prompted this study, the approach taken to answer those questions, and the results of the study that followed. This chapter also contains the conclusions drawn from the data collected during the study and recommendations for further possible study based on the conclusions drawn.

Summary

The purpose of this study was to identify instructional strategies that would enhance the retention of training knowledge of skin laminators, thus increasing productivity and reducing scrap at General Dynamics Armament & Technical Products facilities. The hypothesis was that for skin laminators working in the clean room at General Dynamics Armament & Technical Products, traditional methods of training used in conjunction with technology based interactive multimedia would result in an increase in retention over a longer period of time with less direct human training needed.

The GE Device program at General Dynamics Armament & Technical Products was currently into the sixth year of production. Hand laminated skins were a subcomponent of a device used in the production of military aircraft. The parts were fairly complex with a long lead time in manufacture and were fabricated from costly materials. During this time period, the processes and techniques for production were continually improved and updated. However, in the case of several critical operations necessary for laminators to make an acceptable part, continual retraining of laminators

was necessary in order to prevent defective parts and consequently lost material, labor, and assets.

This study was limited to seven skin laminators working on one program in a single production area. The same group of laminators was considered to be the test group and the control group. The results of this study were limited by a small test population, seven laminators, and the necessity of using defectives or interval data.

An interactive multimedia training program using Microsoft PowerPoint® was created by the author of this study. The program included interactive photos of critical processes and techniques necessary for the lamination of an acceptable part. The training program was placed on a desktop computer in the work area and made available to the skin laminators for viewing on a regular basis.

The number of defective parts produced before and after the implementation of the training program was tracked and the results tabulated and analyzed. The study was performed in a DoD classified environment which rendered the instrument used a classified document. The instrument was therefore able to be viewed only by a small group of people within the department with a DoD secret security clearance and a need to know the information contained.

Data were collected from paperwork required by the customer to accompany each part through production. This paperwork contained information pertaining to material used, dates of operations, processing performed, people completing each task, and inspection records of each part. This information was archived in an electronic file kept, by contract, for 20 years following completion of the part.

The data were collected and presented. Because the data were interval data, a t-test was performed to determine if there was a statistically significant difference in the number of discrepant parts produced as a result of the implementation of the interactive multimedia training program. The number of defective parts laminated before and the number of defective parts laminated after implementation of the interactive PowerPoint program was tabulated and analyzed using MiniTab®.

Conclusions

The results of the t-test were 1.58 and the p value at the 0.05 level of significance was 0.116. This result showed no statistical significance between the two different methods of training given the laminators and the number of defective parts produced. The hypothesis that skin laminators given traditional methods of training in conjunction with technology based interactive multimedia would result in an increase in retention over a longer period of time with less direct human training required must then be rejected. An explanation for the one laminator, laminator number five, producing more defective parts following implementation of the instrument than before can not be drawn.

Recommendations

The number of defective parts produced following the implementation of the computer based training by the laminators was reduced from 18 defects in 177 parts to 10 defects in 177 parts manufactured. This represented a reduction in scrap parts of 4.5 percent. Although shown to be statistically not significant, these results are encouraging to this researcher and would seem to justify more study of this problem.

More research needs to be done in this area. The type of interactive multimedia training used in this study may have a greater impact on workers in different industries with different job descriptions. With the proper techniques and analysis, this method of instruction could prove to be an effective tool in reducing time spent training and retraining workers by training and professional people. This method of training could also become a valuable tool in reducing scrap and saving money.

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Appendix A

Route Form To:

EHS COORDINATOR FOR SAFETY RELATED TRAINING
FORM TMF001

REV. F

TRAINING COORDINATOR FOR ALL OTHER TRAINING

DATE: 6-7-05

***OFFICE USE ONLY*: INTERNAL TRANSCRIPT___ EXTERNAL TRANSCRIPT___ EVENT #_____**

TRAINING RECORD OF ATTENDANCE

LMS CATALOG TITLE AND NUMBER:_____

TRAINING DESCRIPTION_____Brough Skin Lamination_____

APPLICABLE SPECIFICATIONS:_____

TRAINING LOCATION ___GE Device Clean Room_____

DATE_07/22/2005___TIME_10-15minutes_SESSION_____LENGTH_____(HRS)PAGE_____OF_____

INSTRUCTOR(S)___PowerPoint Computer Presentation__

PLEASE USE BLACK INK ONLY AND PRINT NEATLY

Employee Name	Clock #	Dept. #	Supervisor Name
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Appendix B

Sample Data

Skins Laminated Before Implementation of the Instrument									Skins Laminated After Implementation of the Instrument								
S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept	S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept
185	303104771	7B	3	15-Jun	1	10	2890	Yes	362	303104772	5A	2	22-Jul	1	10	2938	Yes
186	303104771	7B	23	15-Jun	2	10	2890	No	363	303104772	3D	19	22-Jul	3	11	2938	Yes
187	303104771	7B	19	15-Jun	3	11	2890	Yes	364	303104772	3D	11	22-Jul	5	10	2938	Yes
188	303104771	7B	10	16-Jun	4	9	2893	Yes	365	303104772	3D	13	22-Jul	3	10	2938	Yes
189	303104771	7B	15	16-Jun	5	9	2893	No	366	303104772	3D	0	22-Jul	2	10	2938	Yes
190	303104771	7B	17	16-Jun	5	9	2893	Yes	367	303104772	3D	20	23-Jul	4	9	2938	Yes
191	303104771	7B	7	16-Jun	6	11	2893	Yes	362	303104772	3D	17	23-Jul	5	11	2938	Yes
192	303104771	7B	0	16-Jun	3	11	2893	Yes	369	303104772	3D	7	23-Jul	3	11	2938	Yes
193	303104771	3C	14	16-Jun	1	11	2893	Yes	370	303104772	3D	15	23-Jul	5	8	2938	Yes
194	303104771	3C	2	16-Jun	3	11	2893	Yes	371	303104772	3D	16	23-Jul	3	8	2938	Yes
195	303104771	3C	5	16-Jun	2	10	2893	Yes	372	303104772	3D	6	24-Jul	4	9	2939	Yes
196	303104771	3C	12	16-Jun	6	10	2893	Yes	373	303104772	3D	10	25-Jul	7	11	2939	Yes
197	303104771	3C	16	16-Jun	1	10	2893	Yes	374	303104772	3D	5	25-Jul	5	9	2939	Yes
198	303104771	3C	6	17-Jun	4	9	2895	Yes	375	303104772	3D	14	25-Jul	3	9	2939	Yes
199	303104771	3C	1	17-Jun	4	10	2895	Yes	376	303104772	3D	1	25-Jul	7	9	2939	Yes
200	303104771	3C	3	17-Jun	6	10	2895	Yes	377	303104772	3C	3	25-Jul	3	11	2939	Yes
201	303104771	3C	23	17-Jun	6	10	2895	No	378	303104772	3C	4	25-Jul	5	10	2946	Yes
202	303104771	3C	4	17-Jun	1	9	2895	No	379	303104772	3C	23	25-Jul	2	10	2939	Yes
203	303104771	3C	20	17-Jun	3	11	2895	Yes	380	303104772	3C	8	26-Jul	4	11	2941	Yes
204	303104771	3C	19	17-Jun	3	10	2895	Yes	381	303104772	3C	2	26-Jul	6	9	2941	Yes
205	303104771	3C	18	17-Jun	1	10	2895	Yes	382	303104772	3C	13	26-Jul	2	10	2941	Yes
206	303104771	3C	11	20-Jun	4	11	2897	Yes	383	303104772	3C	0	26-Jul	5	9	2941	Yes
207	303104771	3C	5	20-Jun	6	11	2897	Yes	384	303104772	3C	20	26-Jul	3	11	2941	Yes
208	303104771	3C	16	20-Jun	6	10	2897	No	385	303104772	3C	11	26-Jul	7	10	2941	Yes
209	303104771	7D	14	20-Jun	3	11	2897	Yes	386	303104772	9D	19	26-Jul	3	8	2941	Yes
210	303104771	7D	2	20-Jun	1	9	2897	Yes	387	303104772	9D	16	26-Jul	2	10	2941	Yes
211	303104771	7D	0	20-Jun	3	11	2897	Yes	388	303104772	9D	15	27-Jul	6	11	2946	Yes
212	303104771	7D	10	20-Jun	5	9	2897	Yes	389	303104772	9D	7	27-Jul	7	11	2946	Yes
213	303104771	7D	17	20-Jun	5	10	2897	Yes	390	303104772	9D	17	27-Jul	5	9	2946	Yes
214	303104771	7D	7	20-Jun	1	10	2897	Yes	391	303104772	9D	3	27-Jul	6	10	2946	Yes
215	303104448	1B	6	20-Jun	2	10	2897	Yes	392	303104772	9D	23	27-Jul	3	9	2946	Yes
216	303104448	1B	12	21-Jun	4	9	43953	Yes	393	303104772	9D	10	27-Jul	2	10	2946	Yes
217	303104448	1B	13	21-Jun	6	10	43953	Yes	394	303104772	3B	14	27-Jul	2	10	2946	Yes
218	303104448	1B	15	21-Jun	6	11	43953	Yes	395	303104772	3B	1	27-Jul	7	9	2946	Yes
219	303104448	1B	18	21-Jun	1	9	43953	Yes	396	303104772	3B	5	28-Jul	3	11	2946	Yes
220	303104448	1B	20	21-Jun	5	11	43953	Yes	397	303104772	3B	6	28-Jul	6	10	2947	Yes
221	303104448	1B	1	21-Jun	3	9	43953	Yes	398	303104772	3C	2	27-Jul	7	9	2947	Yes
222	303104448	1B	23	21-Jun	3	10	43953	Yes	399	303104772	3B	20	28-Jul	3	9	2947	Yes
223	303104448	1C	3	21-Jun	1	10	43953	Yes	400	303104772	3B	13	27-Jul	7	11	2947	Yes
224	303104448	1C	4	21-Jun	5	10	43953	Yes	401	303104772	3B	11	28-Jul	2	9	2947	Yes
225	303104448	1C	19	22-Jun	5	9	2901	Yes	402	303104772	3B	19	29-Jul	6	11	2947	Yes
226	303104448	1C	6	22-Jun	6	11	2901	Yes	403	303104772	3B	0	29-Jul	5	9	2947	Yes
227	303104448	1C	0	22-Jun	6	10	2901	Yes	404	303104772	3B	16	29-Jul	3	9	2947	Yes
228	303104448	1C	11	22-Jun	1	9	2901	Yes	405	303104772	3B	8	29-Jul	7	10	2947	Yes
229	303104448	1C	2	22-Jun	7	10	2901	Yes	406	303104772	3B	12	29-Jul	2	11	2950	Yes
230	303104772	6A	14	22-Jun	7	11	2901	Yes	407	303104772	3B	18	29-Jul	2	9	2950	Yes
231	303104772	6A	10	22-Jun	3	9	2901	Yes	408	303104772	3B	11	01-Aug	5	9	2950	Yes
232	303104772	6A	5	22-Jun	3	11	2901	Yes	409	303104772	3B	19	01-Aug	1	9	2950	Yes
233	303104772	6A	16	22-Jun	5	11	2901	Yes	410	303104896	2B	2	02-Aug	6	10	2952	No
234	303104772	6A	7	22-Jun	1	10	2901	Yes	411	303104772	9C	20	01-Aug	3	11	2950	Yes
235	303104772	6A	8	23-Jun	6	9	2902	Yes	412	303104772	9C	0	01-Aug	5	10	2950	No
236	303104772	6A	17	23-Jun	6	11	2902	Yes	413	303104772	9C	3	01-Aug	7	9	2950	Yes
237	303104772	6A	3	23-Jun	5	9	2902	Yes	414	303104772	9C	1	01-Aug	7	8	2950	Yes
238	303104772	6A	13	23-Jun	1	9	2902	Yes	415	303104896	2A	7	01-Aug	1	10	2950	Yes
239	303104772	2C	23	23-Jun	7	11	2902	Yes	416	303104896	2A	5	01-Aug	3	10	2950	Yes
240	303104772	2C	1	23-Jun	3	9	2902	Yes	417	303104896	2A	16	01-Aug	2	11	2952	Yes

Skins Laminated Before Implementation of the Instrument									Skins Laminated After Implementation of the Instrument								
S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept	S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept
241	303104772	2C	4	23-Jun	3	11	2902	Yes	418	303104896	2A	6	02-Aug	5	9	2952	Yes
242	303104772	2C	20	23-Jun	5	9	2902	Yes	419	303104896	2A	17	02-Aug	7	11	2952	Yes
243	303104772	2C	15	23-Jun	1	10	2902	Yes	420	303104896	2A	10	02-Aug	1	10	2952	Yes
244	303104772	2C	18	23-Jun	7	10	2902	Yes	421	303104896	2A	23	02-Aug	7	10	2952	Yes
245	303104772	2C	2	24-Jun	5	9	2906	Yes	422	303104896	2A	14	02-Aug	1	9	2952	Yes
246	303104772	2D	5	24-Jun	6	11	2906	Yes	423	303104896	2A	4	02-Aug	3	11	2952	Yes
247	303104772	2D	7	24-Jun	5	11	2906	Yes	424	303104896	2B	5	02-Aug	2	10	2952	Yes
248	303104772	2D	12	24-Jun	7	9	2906	Yes	425	303104896	2B	7	02-Aug	2	9	2953	Yes
249	303104772	2D	11	24-Jun	6	11	2906	Yes	426	303104896	2B	0	03-Aug	3	10	2953	Yes
250	303104772	2D	14	24-Jun	7	9	2906	Yes	427	303104896	2B	19	03-Aug	6	9	2953	Yes
251	303104772	2D	19	24-Jun	1	9	2906	Yes	428	303104896	2B	11	03-Aug	3	11	2953	Yes
252	303104772	2D	0	24-Jun	1	10	2906	Yes	429	303104896	2B	3	03-Aug	1	9	2953	No
253	303104772	2D	10	27-Jun	6	9	2909	Yes	430	303104896	2B	1	03-Aug	7	9	2953	Yes
254	303104772	2D	6	27-Jun	6	10	2909	Yes	431	303104896	2B	20	03-Aug	1	9	2953	Yes
255	303104772	2D	16	27-Jun	5	11	2909	Yes	432	303104896	2B	18	03-Aug	5	11	2953	Yes
256	303104772	2D	3	27-Jun	3	9	2909	Yes	433	303104896	2B	12	03-Aug	7	8	2953	Yes
257	303104772	2D	4	27-Jun	1	11	2909	Yes	434	303104896	2B	13	03-Aug	2	10	2953	Yes
258	303104772	2D	23	27-Jun	3	10	2909	Yes	435	303104896	2B	8	03-Aug	2	8	2953	Yes
259	303104772	2D	1	27-Jun	7	10	2909	Yes	436	303104896	2C	15	04-Aug	6	11	2956	Yes
260	303104772	2D	13	28-Jun	6	10	2911	No	437	303104896	2C	5	04-Aug	6	11	2956	Yes
261	303104772	2A	20	28-Jun	5	11	2911	Yes	438	303104896	2C	6	04-Aug	5	11	2956	Yes
262	303104772	2A	15	27-Jun	1	10	2909	Yes	439	303104896	2C	14	04-Aug	1	9	2956	No
263	303104772	2A	18	27-Jun	5	10	2909	Yes	440	303104896	2C	4	04-Aug	3	9	2956	Yes
264	303104772	2A	17	27-Jun	7	11	2909	Yes	441	303104896	2C	10	04-Aug	7	10	2956	Yes
265	303104772	1A	14	28-Jun	1	9	2911	Yes	442	303104896	2C	2	04-Aug	5	10	2956	Yes
266	303104772	1A	11	28-Jun	6	10	2911	Yes	443	303104896	2C	23	04-Aug	7	8	2956	Yes
267	303104772	1A	5	28-Jun	3	9	2911	Yes	444	303104896	2C	17	04-Aug	3	8	2956	Yes
268	303104772	1A	2	28-Jun	5	9	2911	Yes	445	303104896	1D	16	04-Aug	1	10	2956	Yes
269	303104772	1A	19	28-Jun	7	9	2911	Yes	446	303104896	1D	0	05-Aug	1	9	2961	No
270	303104772	1A	0	28-Jun	3	10	2911	Yes	447	303104896	1D	1	05-Aug	6	9	2961	Yes
271	303104772	1A	8	28-Jun	1	10	2911	Yes	448	303104896	1D	20	05-Aug	5	10	2961	Yes
272	303104772	1A	7	28-Jun	2	10	2911	Yes	449	303104896	2D	3	05-Aug	5	10	2961	Yes
273	303104772	1A	12	29-Jun	6	11	2913	Yes	450	303104896	2D	11	05-Aug	7	11	2961	Yes
274	303104772	1A	10	29-Jun	5	9	2913	Yes	451	303104896	2D	19	05-Aug	7	10	2961	Yes
275	303104772	1C	4	29-Jun	1	10	2913	No	452	303104896	2D	7	05-Aug	6	10	2961	Yes
276	303104772	1C	1	29-Jun	6	10	2913	Yes	453	303104896	2D	12	05-Aug	2	10	2961	Yes
277	303104772	1C	23	29-Jun	3	10	2913	Yes	454	303104896	2D	18	05-Aug	2	11	2963	Yes
278	303104772	1C	3	29-Jun	3	9	2913	Yes	455	303104896	2D	13	05-Aug	2	10	2961	Yes
279	303104772	2A	17	29-Jun	7	8	2913	Yes	456	303104772	9B	10	08-Aug	6	8	2963	Yes
280	303104772	2A	15	29-Jun	7	11	2913	Yes	457	303104772	9B	23	08-Aug	5	10	2963	Yes
281	303104772	2A	18	29-Jun	5	10	2913	Yes	458	303104772	9B	2	08-Aug	3	10	2963	Yes
282	303104772	2A	16	29-Jun	2	11	2916	Yes	459	303104772	9B	4	08-Aug	6	10	2963	Yes
283	303104772	2A	6	30-Jun	6	11	2916	Yes	460	303104772	9B	14	08-Aug	3	10	2963	Yes
284	303104772	2A	20	30-Jun	5	9	2916	Yes	461	303104772	9B	5	08-Aug	5	10	2963	Yes
285	303104772	2B	19	30-Jun	7	9	2916	No	462	303104772	9B	16	08-Aug	2	10	2963	Yes
286	303104772	2B	2	30-Jun	3	11	2916	Yes	463	303104772	9B	6	08-Aug	2	8	2963	Yes
287	303104772	2B	0	30-Jun	6	9	2916	Yes	464	303104772	9B	17	09-Aug	5	10	2965	Yes
288	303104772	2B	13	30-Jun	3	10	2916	Yes	465	303104772	9B	3	09-Aug	6	10	2965	Yes
289	303104772	2B	11	29-Jun	7	8	2916	No	466	303104772	9A	19	09-Aug	3	10	2965	Yes
290	303104772	2B	14	30-Jun	1	9	2916	Yes	467	303104772	9A	11	09-Aug	1	10	2965	Yes
291	303104772	2B	8	30-Jun	1	10	2916	Yes	468	303104772	9A	0	09-Aug	2	10	2965	Yes
292	303104772	2B	7	30-Jun	5	9	2916	Yes	469	303104772	9A	1	09-Aug	2	10	2965	Yes
293	303104772	2B	5	30-Jun	2	10	2916	Yes	470	303104772	9A	20	09-Aug	2	10	2965	Yes
294	303104772	2B	12	11-Jul	5	9	2919	Yes	471	303104772	9A	12	10-Aug	6	11	2967	Yes

Skins Laminated Before Implementation of the Instrument									Skins Laminated After Implementation of the Instrument								
S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept	S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept
295	303104772	1B	10	11-Jul	6	8	2919	Yes	472	303104772	9A	7	10-Aug	6	9	2967	Yes
296	303104772	1B	4	11-Jul	6	8	2919	Yes	473	303104772	9A	10	10-Aug	5	11	2967	Yes
297	303104772	1B	1	11-Jul	1	9	2919	No	474	303104772	9A	4	10-Aug	1	10	2967	Yes
298	303104772	1B	23	11-Jul	7	8	2919	Yes	475	303104772	9A	2	10-Aug	1	9	2967	Yes
299	303104772	1B	3	11-Jul	7	8	2919	Yes	476	303104772	8D	23	10-Aug	5	11	2967	Yes
300	303104772	1B	17	11-Jul	3	11	2919	Yes	477	303104772	8D	14	10-Aug	1	10	2967	Yes
301	303104772	1D	18	11-Jul	3	11	2919	Yes	478	303104772	8A	16	10-Aug	2	10	2967	Yes
302	303104772	1D	15	11-Jul	5	8	2919	Yes	479	303104772	8A	5	10-Aug	2	10	2967	Yes
303	303104772	1D	5	12-Jul	1	9	2921	Yes	480	303104772	8A	6	11-Aug	6	11	2968	Yes
304	303104772	1D	7	12-Jul	3	8	2921	Yes	481	303104772	8A	18	11-Aug	5	9	2968	Yes
305	303104772	1D	0	12-Jul	3	8	2921	Yes	482	303104772	8A	20	11-Aug	1	9	2968	Yes
306	303104772	1D	20	12-Jul	5	9	2921	No	483	303104772	8A	1	11-Aug	3	11	2968	Yes
307	303104772	1D	2	12-Jul	7	9	2921	Yes	484	303104772	8A	19	11-Aug	6	9	2968	Yes
308	303104772	1D	19	12-Jul	6	8	2921	Yes	485	303104772	8A	3	11-Aug	5	11	2968	No
309	303104772	4C	13	12-Jul	7	8	2921	Yes	486	303104772	8A	0	11-Aug	3	11	2968	Yes
310	303104772	4C	11	12-Jul	6	8	2921	Yes	487	303104772	8A	11	11-Aug	1	10	2968	Yes
311	303104772	4C	16	12-Jul	5	8	2921	Yes	488	303104772	8A	17	11-Aug	2	10	2968	Yes
312	303104772	4C	6	12-Jul	1	9	2924	Yes	489	303104772	8A	23	12-Aug	4	11	44579	Yes
313	303104772	4C	8	13-Jul	5	9	2924	Yes	490	303104772	8B	10	12-Aug	4	9	44579	Yes
314	303104772	4C	10	13-Jul	7	11	2924	Yes	491	303104772	8B	14	12-Aug	6	11	44579	No
315	303104772	4C	3	13-Jul	6	9	2924	No	492	303104772	8B	4	12-Aug	5	9	44579	Yes
316	303104772	4C	4	13-Jul	1	9	2924	Yes	493	303104772	8B	2	12-Aug	5	9	44579	Yes
317	303104772	5B	23	13-Jul	7	8	2924	Yes	494	303104772	8B	5	12-Aug	6	11	44579	Yes
318	303104772	5B	1	13-Jul	5	11	2926	No	495	303104772	8B	7	12-Aug	3	9	44579	Yes
319	303104772	5B	18	13-Jul	6	11	2924	Yes	496	303104772	7A	16	12-Aug	3	11	44579	Yes
320	303104772	5B	17	14-Jul	4	9	2931	Yes	497	303104772	7A	15	12-Aug	6	10	44579	Yes
321	303104772	5B	12	13-Jul	3	11	2924	Yes	498	303104772	7A	12	12-Aug	3	10	44579	Yes
322	303104772	5B	15	13-Jul	3	8	2924	Yes	499	303104772	7A	13	15-Aug	5	9	2974	No
323	303104772	5B	13	14-Jul	5	9	2931	Yes	500	303104772	7A	19	15-Aug	1	9	2974	Yes
324	303104772	5D	7	18-Jul	6	9	2931	Yes	501	303104772	7A	20	15-Aug	3	11	2974	Yes
325	303104772	5D	11	14-Jul	1	9	2931	Yes	502	303104772	7A	0	15-Aug	5	9	2974	No
326	303104772	5D	0	18-Jul	5	9	2931	Yes	503	303104772	7A	1	15-Aug	1	11	2974	Yes
327	303104772	5D	19	18-Jul	7	11	2931	No	504	303104772	7A	3	15-Aug	3	11	2974	Yes
328	303104772	5D	2	18-Jul	6	9	2931	Yes	505	303104772	7A	11	15-Aug	5	10	2974	Yes
329	303104772	5D	20	18-Jul	7	11	2931	Yes	506	303104772	7A	18	15-Aug	3	10	2974	Yes
330	303104772	5D	5	18-Jul	1	11	2931	Yes	507	303104772	7A	17	15-Aug	1	10	2974	Yes
331	303104772	5D	16	18-Jul	5	9	2931	Yes	508	303104772	7A	12	15-Aug	2	10	2974	Yes
332	303104772	5D	12	18-Jul	3	10	44232	Yes	509	303104772	7A	15	15-Aug	2	10	2975	Yes
333	303104772	5D	15	18-Jul	2	9	44232	Yes	510	303104772	7C	5	16-Aug	5	9	2975	Yes
334	303104772	5D	10	19-Jul	6	8	44232	No	511	303104772	7C	6	16-Aug	6	11	2975	Yes
335	303104772	5D	4	18-Jul	3	9	44232	Yes	512	303104772	7C	23	16-Aug	1	10	2975	Yes
336	303104772	5D	14	19-Jul	5	9	44232	No	513	303104772	7C	4	16-Aug	3	11	2975	Yes
337	303104772	5D	3	19-Jul	1	10	44232	Yes	514	303104772	7C	2	16-Aug	5	10	2975	Yes
338	303104772	5D	23	19-Jul	3	11	44232	Yes	515	303104772	7C	14	16-Aug	6	9	2975	Yes
339	303104772	5D	6	19-Jul	3	8	44232	Yes	516	303104772	7C	10	16-Aug	1	9	2975	Yes
340	303104772	5D	8	19-Jul	7	10	44232	Yes	517	303104772	7C	7	16-Aug	3	10	2975	Yes
341	303104772	5D	1	19-Jul	7	10	44232	Yes	518	303104772	7C	16	16-Aug	2	8	2975	Yes
342	303104772	5D	11	20-Jul	6	8	2934	Yes	519	303104772	7C	3	17-Aug	5	9	2977	No
343	303104772	5D	20	20-Jul	5	9	2934	Yes	520	303104772	7C	19	17-Aug	1	9	2977	Yes
344	303104772	5D	13	20-Jul	1	9	2934	Yes	521	303104772	7C	20	17-Aug	3	11	2977	Yes
345	303104772	4B	19	20-Jul	7	10	2934	Yes	522	303104772	7C	1	17-Aug	5	9	2977	Yes
346	303104772	4B	0	20-Jul	3	11	2934	Yes	523	303104772	7C	11	17-Aug	1	9	2977	Yes
347	303104772	4B	2	20-Jul	1	10	2934	Yes	524	303104772	7C	0	17-Aug	3	10	2977	Yes
348	303104772	4B	5	20-Jul	5	10	2934	Yes	525	303104772	7C	17	17-Aug	6	11	2977	Yes

Skins Laminated Before Implementation of the Instrument									Skins Laminated After Implementation of the Instrument								
S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept	S/N	Lot	Roll	Tool	Lam Date	Laminator	Bagger	Cure	Accept
349	303104772	4B	7	20-Jul	6	8	2934	Yes	526	303104772	7C	18	17-Aug	6	11	2977	Yes
350	303104772	4B	17	20-Jul	3	10	2934	Yes	527	303104772	7C	13	17-Aug	2	10	2977	Yes
351	303104772	4B	16	20-Jul	2	8	2934	Yes	528	303104772	7C	12	17-Aug	2	10	2977	Yes
352	303104772	4B	3	21-Jul	7	11	2935	Yes	529	303104772	7C	23	18-Aug	4	9	2979	Yes
353	303104772	4B	1	21-Jul	6	9	2935	Yes	530	303104772	7C	16	18-Aug	6	11	2979	Yes
354	303104772	4B	23	21-Jul	6	10	2935	No	531	303104772	7C	5	18-Aug	5	11	2979	Yes
355	303104772	5A	4	21-Jul	1	9	2935	Yes	532	303104772	7C	6	18-Aug	1	11	2979	Yes
356	303104772	5A	10	21-Jul	3	9	2935	Yes	533	303104772	7C	2	18-Aug	3	11	2979	Yes
357	303104772	5A	14	21-Jul	5	9	2935	Yes	534	303104772	7B	14	18-Aug	1	9	2979	Yes
358	303104772	5A	6	21-Jul	1	11	2935	No	535	303104772	7B	10	18-Aug	5	9	2979	Yes
359	303104772	5A	15	21-Jul	5	10	2935	Yes	536	303104772	7B	4	18-Aug	3	10	2979	Yes
360	303104772	5A	8	21-Jul	7	8	2935	Yes	537	303104772	7B	15	18-Aug	6	11	2979	Yes
361	303104772	5A	18	21-Jul	3	8	2935	Yes	538	303104772	7B	7	18-Aug	1	10	2979	Yes