TECHNICAL MEMORANDUM
MATERIALS ENGINEERING LABORATORY
NADEP NORTH ISLAND

DATE: 7/24/00

SUBJ: Follow up evaluation of DCM Clean Air Products hepa-vac system.

REFERENCE: (a) Technical Memorandum, March 23 2000, E. Schwab RE: Evaluation of DCM Clean Air Products Hepa-vac System.
(b) NAVAIR 01-1A-21

1. Purpose

The purpose of these procedures was to evaluate the DCM Clean Air Products system that has the potential of eliminating the need for a dust collection booth when grinding composite materials.

2. Background

Grinding of composite surfaces, particularly graphite, produces nuisance dust that is detrimental to operators and surrounding aircraft. As a result, precautions are taken to ensure dust is controlled to the greatest degree possible. Firstly those performing the repair are required to wear respiration. Secondly the work is performed within an enclosed booth under negative pressure. These measures are effective because the parts requiring this treatment are moderate in size and can be removed from the aircraft. With the E/F, it will become impossible to remove and transport composite parts to a dust collection booth for repair. In addition, composite application on the E/F has broadened to a much larger percentage increasing the potential composite repair workload on the floor of building 94.

The result of these compounding factors is a need to develop a new methodology for elimination/reduction of airborne composite waste in repair procedures. DCM has been working with various DOD agencies for some time in this field and shows promising potential for future on-aircraft repair. The current system employs perforated grinding discs and a cowling in coordination with a high flow hepa-vac that collects the dust at the point of generation. The vacuum has been integrated into a grinder for ease of use. Use of similar DCM equipment in the past has resulted in the loss of operator dexterity due to the presence of an attached vacuum collection hose. DCM has since re-designed their equipment from what is supplied in the generic tool kit (ref. b, Table 8-2, Item 13, Pt# 3156AS133-1) in an attempt to resolve the dexterity issue. The shroud has be shortened in depth and reduced in radius to increase visibility in addition to a modified vacuum assembly to improve tool dexterity. An evaluation by the lab (ref. a), indicated that DCM has been successful in this attempt with system DCM# 151082 and laid the groundwork for further assessment.

3. Test Procedure

On a composite laminate, two 4-inch diameter partial thickness damage removal procedures were performed. Scarfing procedures were performed as outlined below to a depth of 10 plies. Firstly the DCM system was utilized to machine the scarf, particulate measurements taken, and the machining cell cleaned out. Then the current method of grinding in association with a stationary vacuum pickup hose was used to machine the scarf and particulate measurements taken. All procedures were performed without exhaust flow in a fixed volume machining cell (cleaned chemical hood with lowered door) on fresh butcher paper. All particle readings refer to those within the range of .5 to 10 microns. Ambient particle readings were taken for several minutes prior to work in order to establish baselines. During damage removal readings were taken within four feet of work every 60 seconds.

Damage Repair Procedure

1. Prepare four-inch diameter region for damage removal on laminate.
2. Using particle counter take several ambient room reading immediately prior to damage removal.
3. Secure vacuum attachment and/or establish vacuum
4. Remove damage to four-inch diameter and 10-ply depth with 90° grinder and 2" sanding disk.
5. Remove debris as necessary with vacuum by hand.
6. Upon completion take a final reading on Portacount unit
7. Note any debris on the part and working surface

4. Test Results

Included are two graphs (Fig.1 & 2) that demonstrate the effectiveness of the DCM system. The vertical marker on the chart indicates the beginning of the damage removal procedures. During evaluation of the DCM system the ambient particle count dropped significantly inside the enclosure (fig. 1). The independent grind and vacuum procedure showed a significant spike in airborne particles from four feet within four minutes of grinding (fig. 2). Averages pertaining to the removal of material are taken five minutes into the procedure to completion. The difference in baselines can be attributed to the lab environment during testing and does not relate information about either method of damage removal. The average variation from baseline seen with the DCM system is negative by 104K particles overall where as the standard procedure shows an increase in airborne particles by a dramatic 313K. The machining cell subsequent to machining operations is shown in figures 3 and 4 for both methods of vacuum collection. Little if any composite dust is present following machining using the DCM system.

DCM Hepa-Vac/Grinder		Standard Grinder/Ind. Vacuum	
AVG.	478684	AVG.	748495
AVGBaseline	582571	AVGBaseline	435058
Particle Delt	-103887	Particle Delt	313437

5. Discussion / Conclusion

Even though the standard grinder and vacuum operation utilized a high flow Hepa-Vac, the independence of the two allowed a significant amount of debris to accumulate. Not only did the particle counter show a marked increase in airborne particles; the part built up debris over the grinding surface that had to be removed periodically by hand (see fig. 4). The DCM system however kept the working surface clear and required no additional cleaning to finish the procedure (see fig. 3). The reduction of airborne debris over the duration of the DCM testing is more likely a result of continued particle settling than a measure of the systems effectiveness. It is important to note is that there is no significant increase in airborne particles during damage removal.

The DCM Hepa-Vac system is highly effective in keeping all particles to a minimum throughout composite grinding. Although it is difficult do assign a percentage to captured particles without a clean room, upon completion of the initial procedure there were approximately 18% fewer particles within the hood. This system provides a great advantage to the artisan by utilizing a versatile configuration and keeping the workspace clean while potentially eliminating the need for a grinding booth. Pending evaluation and approval by safety and industrial hygiene the DCM system will allow realization of on-aircraft grinding of composite substrates during repairs performed in building 94. This system has potential for use on board aircraft carriers as well.

6. Recommendations

- This product should be purchased for use in performing composite repairs on-aircraft in building 94 prior to arrival of the F/A-18 E/F aircraft for depot processing.

- This system should be evaluated for aircraft carrier use to allow on-aircraft repairs to be performed on the hangar deck.

- Safety and industrial hygiene should conduct additional investigations of this equipment to ensure their requirements have been satisfied.

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Figure 1. DCM Hepa-Vac Grinder

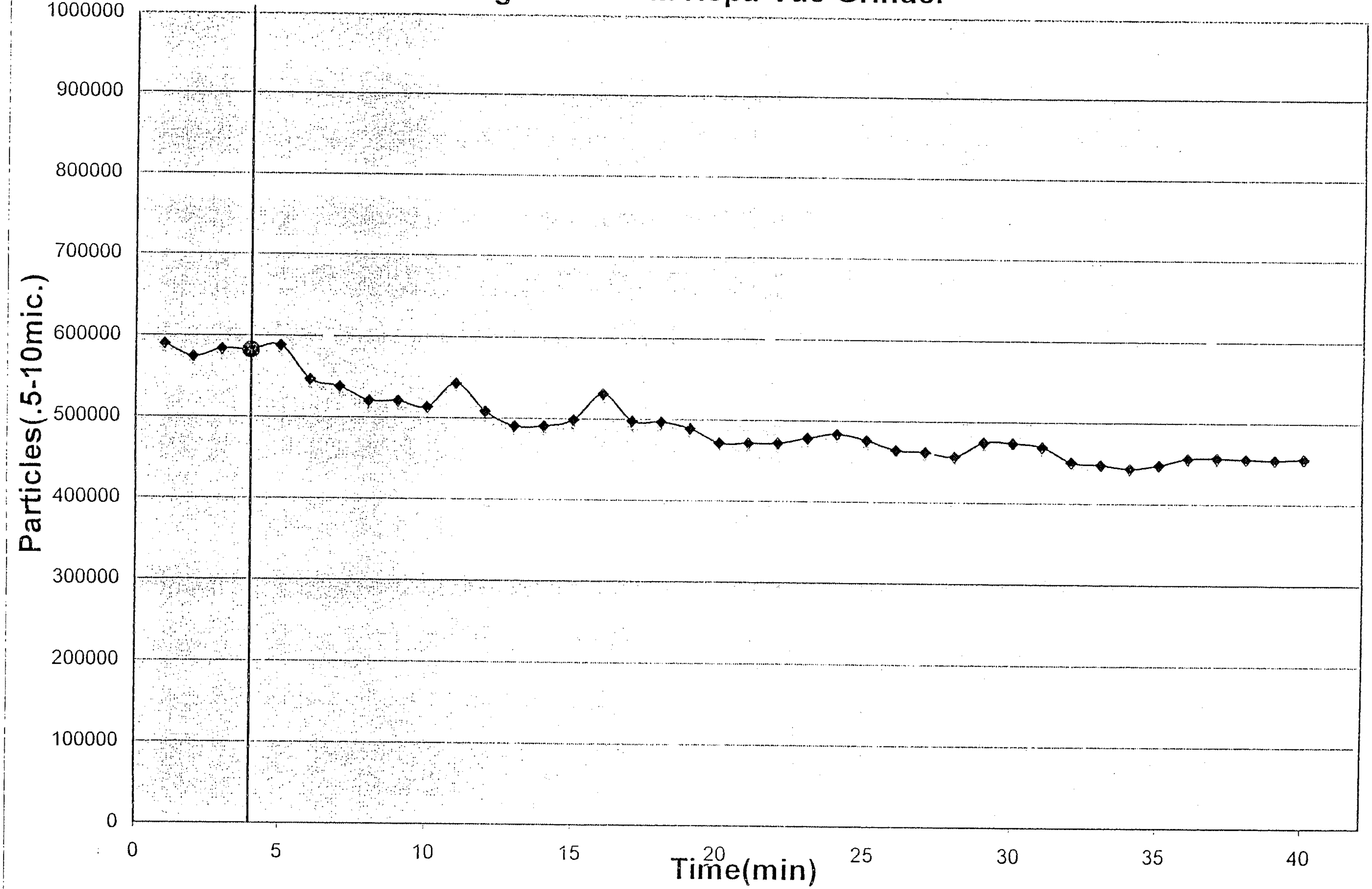
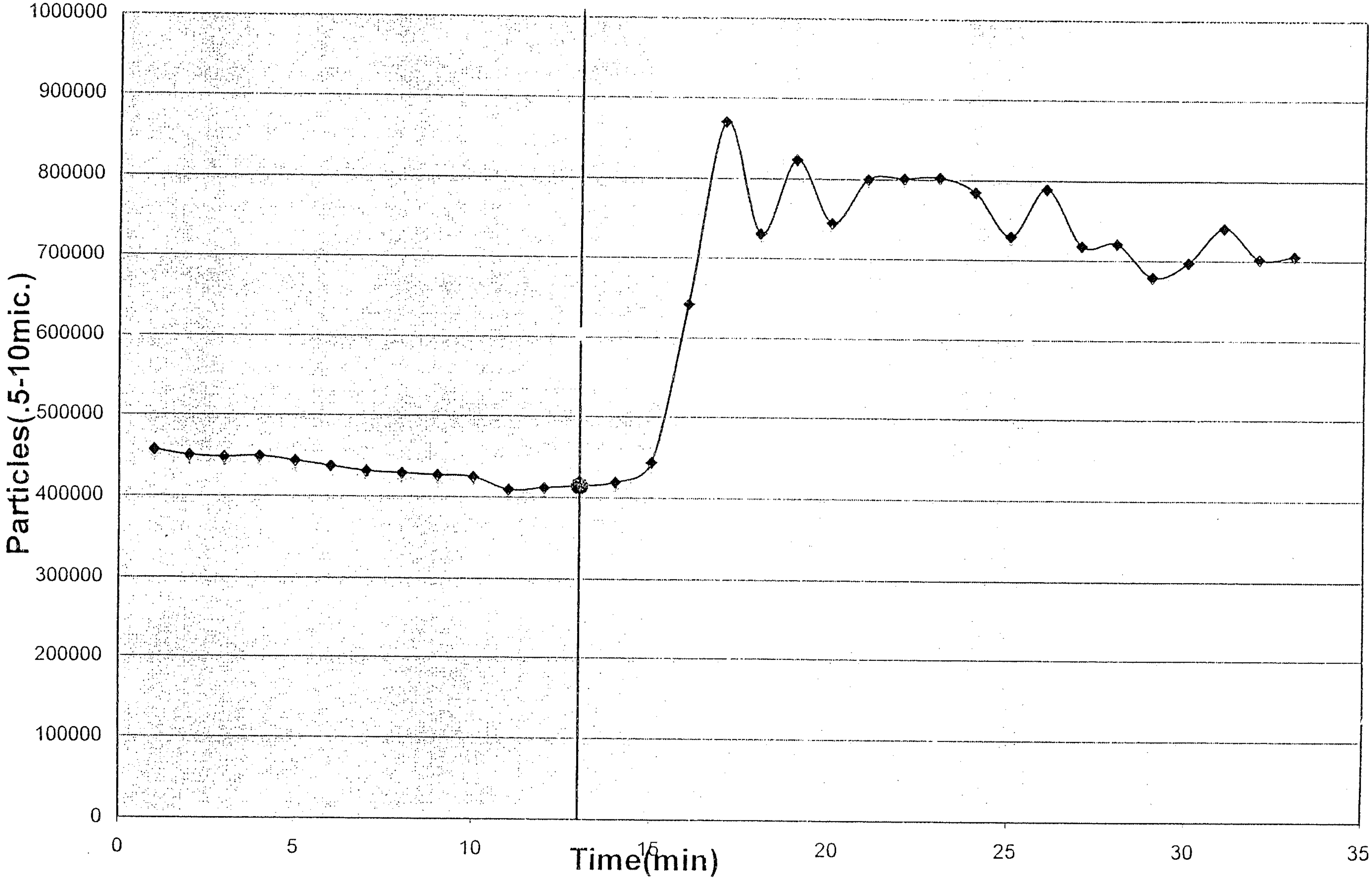


Figure 2. Standard 2" Grinder



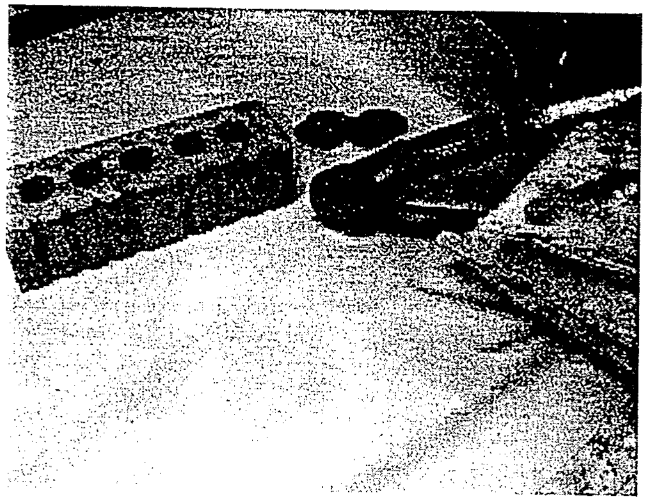


FIGURE 3. DCM Hepa-Vac 2" grinder subsequent to damage removal, showing little if any composite dust.

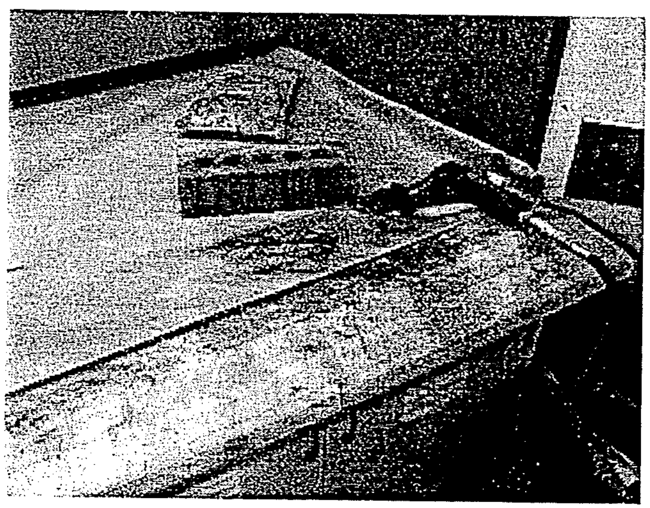


FIGURE 4. Standard 2" grinder independent of vacuum subsequent to damage removal, showing a considerable amount dust.