STEAM VAPOR CLEANING EJECTION SEAT
FRAMES AND COMPONENTS
TECHNICAL EVALUATION

by

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19 March 2003

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An evaluation was performed using the Buddy Steamer System and Mini-Max Cleaning & Waste Management System® and the Arma-Sol® solutions. Both systems involved aqueous cleaning using steam-generation. Arma-Sol® is considered a good corrosion inhibitor but not a rust preventative. Corrosion prevention procedures must be implemented within 24 hr of Arma-Sol® application. The steam vapor cleaning process is optimal when individual components are removed and/or disassembled as part of the normal task. This ensures that water is not trapped. Disassembly can be time and labor-intensive and is beyond Organizational level authority. It is part of the normal Intermediate and Depot level process. It is recommended that steam vapor cleaning not be authorized at the Organizational level, but it is strongly recommended for Intermediate and Depot level seat maintenance. The steam vapor cleaner will result in net annual savings of $308,090 for the Navy.
SUMMARY

Current method of cleaning aircraft ejection seats consists of applying an organic solvent or Isopropyl Alcohol by brush or low lint cloth. This method of cleaning the ejection seat and/or ejection seat components is extremely labor-intensive and generates significant quantities of cleaning residue, which must be disposed of as HAZMAT.

An evaluation was performed using the Buddy Steamer System and Mini-Max Cleaning & Waste Management System® and the Arma-Sol® solutions. Both the Buddy and Mini-Max systems involved aqueous cleaning using steam-generation. The Buddy Steamer System was deemed unsuitable for our application and won’t be considered further in this report.

Arma-Sol® is considered a good corrosion inhibitor but not a rust preventative. Corrosion prevention procedures must be implemented within 24 hr of Arma-Sol® application.

The steam vapor cleaning process is optimal when individual components are removed and/or disassembled as part of the normal task. This ensures that water is not trapped. Disassembly can be time and labor-intensive and is beyond Organizational level authority. It is part of the normal Intermediate and Depot level process. It is recommended that steam vapor cleaning not be authorized at the Organizational level, but it is strongly recommended for Intermediate and Depot level seat maintenance. The steam vapor cleaner will result in net annual savings of $308,090 for the Navy.
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1.0 INTRODUCTION

1.1 This report describes and documents the results of our Affordable Readiness Initiative to evaluate the steam vapor cleaning process on Navy ejection seats (reference 1).

1.2 PROBLEM STATEMENT

1.2.1 Current method of cleaning aircraft ejection seats consists of applying an organic solvent or Isopropyl Alcohol by brush or low lint cloth. This method of cleaning the ejection seat and/or ejection seat components is extremely labor-intensive and generates significant quantities of cleaning residue, which must be disposed of as HAZMAT.

1.2.2 Each year, our naval industrial base is further restricted from using specific Ozone Depleting Substances (ODSs) used in the cleaning of aircraft parts. As a result, less effective means of cleaning components are usually implemented, almost invariably increasing labor/material costs and/or often decreasing the quality of the cleaned surfaces.

1.3 PROPOSED SOLUTION

1.3.1 Recommend investigation into the use of Mini-Max Cleaning & Waste Management System® manufactured by PDQ Precision, Inc. The system involves aqueous cleaning using superheated steam generated on-site via portable steam-generation units. Although PDQ Precision produces numerous models of the steam-generators (appendix A), there are three units that were included in the investigation. Two units are shown below:

190 PSI Standard Pressure Mini-Max Modular II, P/N 6609-2
295 PSI High Output Pressure Mini-Max Modular II, P/N 6609-22
(This is the same unit as above; however, it has a different pressure output)
1.3.2 The Mini-Max Cleaners are excellent cleaners and degreasers and can remove oil, grease, sand, rust, carbon, burnt propellants, and/or flux. They are currently in use in the medical and automotive industries and are in limited use within the DoD (weapons and firearms cleaning).

1.3.3 The Mini-Max Cleaning & Waste Management System® provides the following potential benefits:

   a. Complete safety for the user and environment.
   b. Elimination or extreme reduction of solvent and HAZMAT disposal requirements.
   c. Equipment portability and flexibility in use.
   d. Cleaning without total disassembly.
   e. Cleaning in inaccessible areas.
   f. Minimal safety equipment requirements.
   g. Practically maintenance free.

1.3.4 Appendix B is a draft SAFE paper describing the steam vapor cleaning system to be presented at the September 2002 SAFE Symposium in Jacksonville, Florida.

1.4 IMPLEMENTATION PLAN

1.4.1 Purpose: To evaluate various aqueous cleaning systems on aircraft ejection seats/ejection seat components and nonejection seat components, using superheated steam from portable steam-generation units.

1.4.2 Portable Steam-Generation Units To Be Evaluated (appendix A):

   a. 1 each, Mini-Max Mod II 190 PSI, NSN 4250-01-470-7094.
   b. 1 each, Mini-Max Hand Held 190 PSI, NSN 4940-01-409-0148.
   c. 2 each, Mini-Max Mod II 295 PSI, NSN 4250-01-470-7091.
   d. 1 each, Mini-Max Mod IV 295 PSI, NSN 4250-01-470-7097.
   e. 1 each, Mini-Max Mod IV 190 PSI, NSN 4250-01-470-7095.
   f. 2 each, Buddy Steamer.
1.4.3 Evaluation Sites of Portable Steam-Generation Units:

a. USMC Miramar, 1 each 190 PSI Hand Held, 1 each 295 PSI Mod II, and 1 each Buddy Steamer.
b. Whidbey Island, 1 each 190 PSI Mod II and 1 each 295 PSI Mod II.
c. NADEP JAX, 1 each 190 PSI Mod IV.
d. NADEP NORIS, 1 each 295 PSI Mod IV.

1.4.4 Management of Portable Steam Vapor Cleaning Evaluation Program:

a. Andy Herring is the project manager with oversight of the entire program.
b. A. J. Yost is responsible for overall technical aspects of the program.
c. Team members (Dennis Crowley, Ray Kwan, Jose Santiago, and Roger Grimes) assisted with the daily operations of the evaluation program.

1.4.5 Objectives of the Portable Steam Vapor Cleaning Evaluation Program

1.4.5.1 Establishment of effectiveness in terms of time and cost savings, improvements in cleaning effectiveness of the various steam vapor cleaning units. A test plan (appendix C) was prepared outlining the evaluation process.

1.4.5.2 Site Reports: Each site submitted weekly reports citing items cleaned, by what system, degree of success, observational comments, containers of solvent saved, and show cost/time savings on forms provided via Fax or E-mail (see Survey Form, appendix D).

1.4.5.3 Team members worked with the Depot shops and provided on-hands assistance.

1.4.5.4 Depot shops personnel were responsible for the annotation of the survey forms and the weekly submittal of the survey forms to on-site engineering.

1.4.5.5 NADEP Jacksonville engineering (Jose Santiago) ensured the accuracy and completeness of the survey forms submitted by NADEP Jacksonville personnel.

1.4.5.6 AIMD Whidbey Island ejection seat shop supervisor (Roger Grimes) ensured the accuracy and completeness of the survey forms by the AIMD personnel.

1.4.6 Program Evaluation Duration: The program started 1 May 2001 and ended 30 September 2001. Naval Message DTG 051944Z JUL 01 (reference 2) from NADEP Cherry Point authorized Organizational limited use of the steam vapor cleaning systems.

1.4.7 Items Evaluated:

a. SJU17(V)-1/A, 2/A, 3/A, 4/A, 5/A, 6/A, and 9/A.
b. SJU-5/A and 6/A.
c. MK GRU7A-1 and 2.
d. MK GRUEA 7 (PILOT, ECMO 1, 2, and 3).
e. ESCAPAC 1E-1 (PILOT, COPILOT, SENSO, and TACCO).

1.4.8 Ejection Seat Areas and/or Components Not Authorized for Steam Vapor Cleaning

1.4.8.1 SJU17(V)-1/A, 2/A, 3/A, 4/A, 5/A, 6/A, and 9/A:

a. Sequencer - shall not be subjected to steam vapor. Were removed prior to Main Beam cleaning.

b. LH/RH Pitot Static Mechanism Assemblies - Pitot head orifices were plugged to prevent moisture intrusion. Also, applied tape to the Pitot Static Port on the main beam assembly to prevent moisture intrusion.

1.4.8.2 Shoulder Harness Reels were not subjected to steam vapor cleaning, except at a Depot, and were removed prior to Main Beam cleaning.

1.4.9 Protective Clothing Requirement:

a. Water and heat repellant gloves.

b. Goggles or face shield.

c. Water and heat repellant apron.

1.4.10 Materials Required To Prevent Moisture Intrusion:

a. Plugs used in orifice plugging.

b. Tape (plater's or low adhesive).

1.4.11 Manuals Requiring Revision (if steam vapor cleaning is approved):

a. NAVAIR 13-1-44.

b. AS-700AC-MDB-000.

c. NAVAIR 13-30-69.

d. NAVAIR 13-30-41.

e. NAVAIR 13-30GR-1.

f. NAVAIR 01-1A-509.
2.0 DISCUSSION

2.1 ORGANIZATIONAL LEVEL MAINTENANCE CONCERNS AND COMMENTS

2.1.1 A 115 V, 30 amp power female receptacle is not available at most sites. A permanent female wall receptacle is needed which will increase the cost and infrastructure requirements. Mini-Max Cleaning & Waste Management System® comes supplied with proper female wall receptacles from the manufacturer. However, facilities must be wired to adapt to this female wall receptacle, thereby increasing labor costs.

2.1.2 It needs additional agitation/detergents to provide effective cleaning.

2.1.3 A 190 PSI unit is ineffective, awkward to use, and lacks endurance.

2.1.4 It is easy for inexperienced users to use tap water although warning decals can minimize problem.

2.1.5 Condensation formed on cleaning surface needs drying with shop filtered dry air, which may already be in place.

2.1.6 Gloves and PPE are required with QA/Safety Officer approval.

2.1.7 A 448-day inspection is the most suitable place for use of the steam vapor cleaner for the SJU-5/6 seats.

2.1.8 Loose paint will be removed and affected areas need to be treated in accordance with NAVAIR 01-1A-509.

2.1.9 Due to the fact that the majority of ejection seat maintenance is being performed prior to deployment, steam vapor cleaner use aboard ship was not evaluated.

2.1.10 Positive comments by Organizational level suggested additional uses such as aircraft panels, Environmental Control System (ECS) components, canopy brackets, ducting, and cockpits.

2.2 INTERMEDIATE/DEPOT LEVEL EVALUATION

2.2.1 Material Costs

2.2.1.1 NADEP North Island uses Isopropyl Alcohol to clean seat components. NAS Whidbey Island uses Toluene to clean tools and PD680 to clean seat components. The cost of materials is as follows:
### Nomenclature

<table>
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<th>Cost</th>
<th>Quantity</th>
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<th>Unit Price</th>
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<tr>
<td>Arma-Sol® Wash</td>
<td>$379.20</td>
<td>100 gallons</td>
<td>6850-01-412-4364</td>
<td>$3.79/gallon</td>
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<tr>
<td>Arma-Sol® Dry</td>
<td>$379.20</td>
<td>100 gallons</td>
<td>6850-01-412-4375</td>
<td>$3.79/gallon</td>
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<tr>
<td>Toluene</td>
<td>$6.81</td>
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<td>6810-00-281-2002</td>
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<td>PD680</td>
<td>$21.68</td>
<td>5 gallons</td>
<td>6850-00-274-5421</td>
<td>$4.34/gallon</td>
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<td>Isopropyl Alcohol</td>
<td>$24.84</td>
<td>5 gallons</td>
<td>6810-00-855-6160</td>
<td>$4.97/gallon</td>
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2.2.1.2 The Arma-Sol® solutions are available in concentrate form and premixed. The concentrate solutions need 1 gallon of distilled or deionized water to be added to form a useable liquid. The cost of water is considered negligible and is readily available in the Navy.

2.2.1.3 Appendix D shows the material cost savings as reported by the NADEP North Island, NADEP Jacksonville, and NAS Whidbey Island. The average component cost is $1.37 to steam vapor clean, compared with $2.60 using existing methods. Annually, the depots spend $7,200 on cleaning solvents. Using the steam vapor cleaner, the depots would spend $3,793, realizing an annual savings of $3,406.

2.2.1.4 Components that are steam vapor cleaned do not require hazardous material disposal. It costs the depots $14,000 annually to dispose of used chemicals. The only residue is solid waste that can be disposed of with other solid waste after the moisture evaporates.

2.2.1.5 The estimated total materials/disposal costs savings is $17,406 annually.

2.2.2 Labor Man-Hour Savings

2.2.2.1 Appendix D shows the labor man-hour savings as reported by the NADEP North Island, NADEP Jacksonville, and NAS Whidbey Island. The average depot man-hour savings to steam vapor clean each component is 16 min compared to existing methods. The depots currently spend $344,400 in labor costs annually cleaning. Using the steam vapor cleaner will result in $254,400 annual savings.

2.2.2.2 The average Intermediate level man-hour savings is 60 min to steam vapor clean seat assemblies compared with existing methods. Additionally, it was reported that 2 hr of time was saved while cleaning tools. Annually, 400 seats are cleaned at Intermediate level for an annual savings of 400 Intermediate level man-hours. With a burdened man-hour cost of $90.71, this translates into annual cost savings of $36,284.

2.2.3 Depot and Intermediate Level Maintenance Concerns and Comments

2.2.3.1 Small parts were difficult to clean due to the difficulty of holding them. Using a mesh basket, the parts tended to blow around.

2.2.3.2 With filters installed in the spray booth fan exhaust, steam can build up inside the booth, obscuring vision.
2.2.3.3 Without detergent and physical brushing, cleaning was ineffective on extremely dirty surfaces.

2.2.3.4 Steam vapor cleaning is effective with use of detergent when cleaning larger components like a main beam assembly. However, water removal from external surfaces and orifices took considerable effort with dry shop air.

2.2.3.5 Condensation formed on cleaning surface requires drying with shop filtered dry air.

2.2.3.6 Intermediate level maintenance personnel are cleaning partially assembled seats with unauthorized components removed. The seat is too large to fit the spray booth, but cleaning can be done on the shop floor. Cleaning was effective with enormous time-savings over existing cleaning methods. Appendix E documents how the Intermediate level maintainers use the steam vapor cleaner.

2.2.4 Navy Aircrew Common Ejection Seat (NACES) Component Evaluation

2.2.4.1 In-service Management Panel (IMP) exhibited no internal moisture upon disassembly after steam vapor cleaning.

2.2.4.2 Moisture was found inside the Barostatic Release Unit (BRU) after steam vapor cleaning. O-rings appeared to be in normal condition, although water droplets were present. Lubricated surfaces appeared unaffected by steam vapor cleaning process.

2.2.4.3 The catapult manifold valve exhibited internal moisture upon disassembly after steam vapor cleaning.

2.2.4.4 The pitot tube showed extensive moisture in the static port screen, but no moisture was found in the other internal areas.

2.3 LABORATORY ANALYSES

2.3.1 Corrosion

2.3.1.1 Materials laboratory testing was performed at NADEP North Island, California, to independently verify effectiveness of the Arma-Sol® solution as a rust inhibitor. The testing was performed as follows:

a. Seven identical bare 4120 steel plates were Garnet blasted and rinsed in alcohol. Five were subjected to exposure in heated deionized water or heated deionized water with Arma-Sol® rust inhibitors. One of the remaining plates was immersed for 2.5 min in deionized water with Arma-Sol® dry solution and the other with Arma-Sol® wash.
b. The two bare plates, which were exposed to deionized water, had visible pitting after 10 min. The plate that was immersed in the 160-deg water had a band of pits along the lower edge where remaining water was held by surface tension. The plate exposed to 200-deg water did not retain any liquid water along the lower edge; therefore, there was no band of pits at this location. The plates exposed to water solution with Arma-Sol® did not display pit initiation until 24 hr later.

2.3.1.2 Arma-Sol® does appear to provide a limited temporary protection against flash corrosion compared to deionized water. Arma-Sol®, wash and dry types, should be used in the steam vapor cleaner as a temporary corrosion inhibitor. After steam vapor cleaning, corrosion treatment should be performed within 24 hr in accordance with NAVAIR 01-1A-509. Appendix F provides more details of the corrosion testing.

2.3.2 O-Ring Deterioration

2.3.2.1 Appendix G documents the laboratory testing of potential deterioration of the O-rings from the super heated steam. The Materials Laboratory at NADEP Jacksonville has stated that the heat generation of 300°F, in the steam vapor cleaning process, will neither accelerate deterioration nor damage O-rings used on Navy ejection seats. The O-rings in question, MS28775 and MS29513, are rated at a 275°F maximum temperature allowed. These O-rings are now superseded by SAE-AS28775 and SAE-AS29513, respectively, but specification requirements remain the same. The steam vapor cleaning process will, however, remove any MIL-PRF-32033 lubricant, which supersedes the VV-L-800 lubricant, exposed to the steam spraying action. Required lubricant will need to be replaced after cleaning.

3.0 RESULTS

3.1 At the conclusion of the steam vapor cleaning process/equipment evaluation, it was deemed that five of the six models procured were inadequate for the particular application. It was found that this equipment did have qualities that would prove beneficial to a wide range of aircraft platforms. The one model that proved to be sufficient in all categories was the 295 PSI Modular IV, built by PDQ Precision Inc. The other models lacked sufficient pressure or did not provide continuous pressure, which called for a short, stand-down period, until the pressure built back up. Further, it was deemed necessary for this steam vapor cleaning process/equipment to be used only by the Intermediate and Depot level of maintenance. This is due to the fact that water intrusion is imminent and repair/overhaul can only be performed at these levels. Finally, it was found that, after using this cleaning method, corrosion prevention procedures must be implemented immediately, if a corrosion inhibitor is not used. If an inhibitor is used, then corrosion prevention procedures must be performed within 24 hr.
4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Water entrapment limits usefulness of the steam vapor cleaning process. The steam vapor cleaning process is optimal when individual components are removed and/or disassembled as part of the normal task. This ensures that water is not trapped. Disassembly can be time and labor-intensive and is beyond Organizational level authority, but it is part of the normal Intermediate and Depot level process. It is, therefore, recommended that steam vapor cleaning not be authorized at the Organizational level. It is, however, strongly recommended for Intermediate and Depot level seat maintenance. It was also noted that the steam vapor cleaning process could be useful for nonegress aircraft applications such as aircraft panels, ECS components, canopy brackets, ducting, and cockpits.

4.2 As reported by NADEP North Island Materials Lab, Arma-Sol® is considered a good corrosion inhibitor but not a rust preventative. Corrosion prevention procedures must be implemented within 24 hr of Arma-Sol® application. If Arma-Sol® solution is not used, corrosion prevention procedures must be implemented immediately in accordance with the applicable maintenance instructions.

4.3 Limits on the use of steam vapor cleaning on ejection seat components for Intermediate and Depot level process will be issued via changes in the applicable Intermediate and Depot level manuals and/or instructions.

4.4 Cost benefits: The steam vapor cleaner will result in net annual savings of $308,090 for the Navy.

**ANNUAL SAVINGS**

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<td>Hazardous Material Savings</td>
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<td>Intermediate Level Labor Savings</td>
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</tr>
<tr>
<td>Total Savings</td>
<td>$308,090</td>
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REFERENCES


2. NAVAIRDEPOT CHERRY POINT NC msg dtg 051944Z JUL 01.
APPENDIX A
MINI-MAX CLEANING BROCHURE
ENDORSEMENTS

AIRCRAFT CLEANER / WATER IN 2 WEEKS COST $360.00. WITH MINI-MAX WASTE DISPOSAL SYSTEM REDUCED TO TWO PIG MATS, DISPOSAL COST ABOUT .80 CENTS EVERY TWO WEEKS.

PARTS CLEANED: TIME OUT FROM 4 HOURS TO 1.5 HRS PER 100- PARTS AND CLEANED FAR BETTER THAN BY HAND.

CONTINUOUS CLEANING.

COMMERCIAL IN USE BY MANY OF THE GOVERNMENT CONTRACTORS AS WELL AS MANY MAJOR CORPORATIONS.

P-2 MESSAGE (PAST) U.S.N.: P-2 POLLUTION OPPORTUNITY IDENTIFIED: MINI-MAX SYSTEM REPLACES SOLVENT CLEANING AND DEGREASING. THE TECHNOLOGY USES DISTILLED WATER, COMPARED TO CURRENT CLEANING PROCEDURES THIS TECHNOLOGY SAVES LABOR AND ASSOCIATED COSTS.

PORTABLE STEAM CLEANING SYSTEM (MINI-MAX) enviro.nfesc.navy.mil/p2library/11-7_497.html
APPENDIX B
SAFE REPORT OF STEAM VAPOR CLEANING EGRESS SYSTEMS
MAINTENANCE & CLEANING OF US NAVY ESCAPE SYSTEMS USING SUPERHEATED-STEAM GENERATING SYSTEMS

Andrew C. Herring
Logistics Management Specialist
Aircrew Escape System Fleet Support Team
NAVAIR Depot Cherry Point, NC

ABSTRACT

The current method of cleaning aircraft ejection seats consists of applying an organic solvent or isopropyl alcohol by brush or low lint cloth. This method of cleaning the ejection seat/or ejection seat components is extremely labor-intensive and generates significant quantities of cleaning residue. This residue must be disposed-of as HAZ-MAT.

Each year, our naval industrial base is further restricted from using specific Ozone Depleting Substances, in the cleaning of aircraft parts. As a result, less effective means of cleaning components are usually implemented.

The Aircrew Escape Systems Fleet Support Team (AESFST) has procured five models of a special portable steam cleaning system (figure 1), for evaluation. The use of steam is to eliminate or greatly reduce the use of organic solvents and isopropyl alcohol, as well as man-hours in the cleaning of naval ejection seats/components. These five models show potential, from other steam cleaning systems, due to their portability and the steam pressures they produce. Their pressure production ranges from 190 to 300psi. This system uses distilled or de-ionized water as a cleaning solution to generate steam at a temperature of 500 degrees Fahrenheit.

The attractiveness of this system, to the AESFST, is that with this high temperature steam, the item being cleaned becomes virtually dry after steam spray is removed.

The evaluation is being performed by the Fleet maintainers at: MCAS Miramar; MCAS Beaufort; NAS North Island; NAS Oceana, NAS Kingsville and by NAVAIR Depots North Island and Jacksonville.

The evaluation is underway and the key factor of moisture intrusion will determine what seats/components (if any) are cleared for this type of cleaning.

The AESFST submitted an article, on our evaluation of the Mini-Max cleaning and waste management system, to the Navy Environmental News, magazine (Currents), which publishes new ideas and trends in environmental policy and compliance. The evaluation was featured in the winter, 2001 edition.

Figure 1. Jumbo Model

INTRODUCTION

The evaluation of steam cleaning ejection seats and/or their components was an idea conceived while trying to find ways of saving money, in Aircrew Systems. The US Navy has a program called “Affordable Readiness” in which any program/platform may submit cost saving initiatives that will reap a cost savings over a ten year period. Only the highest saving and most beneficial initiatives are approved. This initiative is being sponsored, by the Program Manager, PMA-202, Naval Air Systems Command. It should be understood that this evaluation is to determine which seats and components can be cleaned by Organizational and Intermediate Levels of maintenance. (Figure 2)
DISCUSSION

The cleaning equipment being evaluated (Figure 3) is a patented, off-the-shelf technology, system that was originally developed to address instant sterilization and autoclave pre-cleaning, for the medical and dental professions. However, wider applications have been found in the military for cleaning everything from weapons to electronics. High temperature is maintained on the surface long enough for the steam to vaporize or liquidate the oil/grease, and displace the dirt. The residue, can effectively, be blown away, by the steam pressure, along with any steam condensation. The steam pressure production ranges from 190 to 300psi. This system uses distilled or de-ionized water as a cleaning solution, to generate steam at a temperature of 500 degrees Fahrenheit. The design of the steam producing equipment does not allow any steam to be stored under pressure, as in conventional steam boilers, thus providing a safe environment for the operator. The water content of the super-heated steam is low, with approximately one gallon of liquid water being needed for an 8-hour shift of continuous use. As a precautionary effort against flash surface oxidation, we will be applying a proprietary oxidation inhibitor, which is non-toxic, non-flammable and biodegradable, in conjunction with the steam. We will be testing this oxidation inhibitor to see how long the prevention lasts and to what degree.

METHOD

All research and investigation will be performed by the Aircrew Escape Systems Fleet Support Team Detachments at NADEPs Cherry Point, North Island and Jacksonville, with technical assistance from the NADEP North Island Materials Engineering Laboratory personnel. Organizational and Intermediate level testing, of the steam cleaning equipment, will be accomplished at MCAS Miramar, NAS NORIS Squadrons and AIMD as well as NAS Whidbey Island’s AIMD, NAS Kingsville (Contractor maintained), NAS Oceana, MCAS Beaufort. Response sheets will be collected weekly from each site performing the evaluation. The data collected on these response sheets will reflect the performance of the equipment, quantities of material and man-hours required versus quantities required using normal cleaning methods. Upon completion of the evaluations (if the benefits are proven and the safety and readiness of the escape systems equipment are not compromised), the cleaning equipment showing the best results will be put into normal service at NADEPs NORIS, Jacksonville and benefiting squadrons.
BIOGRAPHY

Andy Herring is employed by NAVAIRSYSCOM in the discipline of fleet support logistics. Mr. Herring is currently aligned as a Logistics Element Manager of Supply serving the Aircrew Escape Systems Fleet Support Team at Cherry Point, NC. He is also the logistics manager of the SJU-5/A, 6/A, GRUEA-7, and GRU-7A ejection seats. Mr. Herring has 29 years aviation maintenance experience at the “D” level and 3 years at the “O” and “I” levels. He graduated from the Naval Aviation Depot Norfolk Apprentice School in 1971 and has served in many aspects of aircraft overhaul and management.
NAVAIR DEPOT NORTH ISLAND
STEAM CLEANING EVALUATION TEST PLAN

1. Steam cleaning evaluation will be performed with steam cleaners utilizing various pressures and capacities. The 4.6 Engineering Team will monitor the process with weekly feedback from North Island seat shop. The cleaning effectiveness systems will be evaluated along with cost and time savings.

2. Perform physical testing for water intrusion. Testing performed on various tapes to establish which tapes stand up to steam/water without losing physical adhesive properties with minimum of residue. This tape will be used to prevent steam/water intrusion at mating surface joints and small bores in component surfaces. Also validate integrity and effectiveness of plugged or sealed orifices against water intrusion.

3. Perform physical testing to ensure paint chipping, peeling, or softening does not occur during steam cleaning process.

4. Submit ejection seat components to the steam cleaning process, disassembly, and inspect process for cleanliness. Precautions will be in place to safeguard against trapped water. Inspect for presence of water intrusion will be carried out the component. If water intrusion is present, the component will immediately be disassembled and dried.

5. Laboratory testing of the component O-ring seals to verify the absence or presence of degradation from being subjected to heated temperatures during the steam cleaning process. Also verify that the solutions used in steam cleaning process are compatible with O-rings.

6. Provide independent laboratory testing of effectiveness of the Arma-Sol solution in providing rust inhibiting protection. Testing will also verify whether Arma-Sol is effective and superior to using distilled water only or existing rust preventative solutions. The evaluation will be performed as follows:

   a. Immerse one freshly sandblasted bare steel panel for a 2.5-minute exposure in the diluted Arma-Sol Dry maintained at 200 deg. F. The panel is a 4"X6" steel sheet (4130 steel) and will be immersed in a 2000 ml. beaker filled to 2000 ml of the solution. After immersion the sample would be lifted out (using weld wire hook already pre-attached) and hung to dry in a different area.

   b. A second panel would be exposed for 2.5 minutes in the Arma-Sol Wash (properly diluted and again at 200 deg. F.) then moved to the Arma-Sol Dry beaker for a 2.5-minute exposure. Document of any noticeable corrosion will be achieved by using a digital camera photographing the specimen at 30 minutes, 1 hour, 6 hours and 24 hours after removing panel from solution.
6. As a control for our experiment, a second phase of testing would use two other identically treated panels but expose them for 1 minute in one of two 2000ml beakers again filled to 2000 ml. One would have only DI (distilled / deionized) water and the second would have DI water with a standard rust inhibitor (Turco Rust Bloc) our cleaning procedure described above would be repeated.

Conclusions from the lab: I have finished the brief test and both the Arma-Sol and the Turco Rust Bloc were effective in delaying corrosion. As might be expected, corrosion was more rapid in the unconditioned panels. The fact that the hot corrosion with deionized water (no additives) if only from the fact that the hot steel tends to evaporate water faster.

7. Test plan to also include concurrent field testing at Naval Air Station Whidbey Island,
APPENDIX D
STEAM VAPOR CLEANING EVALUATION REPORTS
### PORTABLE STEAM CLEANING SYSTEM
### DEPOT LEVEL EVALUATION SURVEY

#### SEAT TYPE/POSITION GRU-7 Components

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dale Starkey NORIS</td>
<td>Shoulder Reel MB300-1334</td>
<td>5/2/01</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>1 pt</td>
<td>MINI-MAX Modular IV Noxious venting stinks up shop, making throat raw.</td>
</tr>
</tbody>
</table>

*NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".*

**WARNING:**

Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
# Portable Steam Cleaning System
## Depot Level Evaluation Survey

### Table: Seat Type/Position Components

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>McNurlan, H.L.</td>
<td>4 Drogue Guns MBEU300-1555</td>
<td>5/10/01</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>0</td>
<td>1 1/4</td>
<td></td>
<td>Needs better exhaust fan, can’t see parts. Exhaust stinks, throat becomes sore.</td>
</tr>
</tbody>
</table>

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

**WARNING:**

Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pilot tubes etc.
### PORTABLE STEAM CLEANING SYSTEM DEPOT LEVEL EVALUATION SURVEY

**SEAT TYPE/POSITION** SJU-5/6 Components  **SEAT SERIAL NUMBER**

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crowe NORIS</td>
<td>MBEU69541</td>
<td>5/11/01</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Crowe NORIS</td>
<td>MBEU69564-1</td>
<td>5/16/01</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".*

**WARNING:**
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
## PORTABLE STEAM CLEANING SYSTEM
### DEPOT LEVEL EVALUATION SURVEY

#### SEAT TYPE/POSITION  S-3 Components

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of Water Used</th>
<th>Cost of Solvent Saved</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lara NORIS</td>
<td>Seat Bucket</td>
<td>5/15/01</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>30</td>
<td>1 qt</td>
<td>It didn't remove dirt</td>
<td></td>
</tr>
<tr>
<td>Lara NORIS</td>
<td>Seat part</td>
<td>5/15/01</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>1 hr</td>
<td>2 qt</td>
<td>Small part hard to hold</td>
<td></td>
</tr>
</tbody>
</table>

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

**WARNING:**
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
PORTABLE STEAM CLEANING SYSTEM
DEPOT LEVEL EVALUATION SURVEY

SEAT TYPE/POSITION S-3 Components

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walt Frazier NORIS</td>
<td>Inertia Reel 0113347-01</td>
<td>5/21/01</td>
<td>4 (10 Best)</td>
<td>8 (10 Best)</td>
<td>5 (10 Best)</td>
<td>+10 Minutes</td>
<td>Water Used</td>
<td>Solvent Saved</td>
<td>¼ gal</td>
</tr>
<tr>
<td>Walt Frazier NORIS</td>
<td>Inertia Reel 0113347-01</td>
<td>5/21/01</td>
<td>4 (10 Best)</td>
<td>8 (10 Best)</td>
<td>5 (10 Best)</td>
<td>+10 Minutes</td>
<td>Water Used</td>
<td>Solvent Saved</td>
<td>¼ gal</td>
</tr>
</tbody>
</table>

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

WARNING:
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pilot tubes etc.
### PORTABLE STEAM CLEANING SYSTEM
#### DEPOT LEVEL EVALUATION SURVEY

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
</table>
| Walt Frazier        | Time Delay MB200-603        | 6/6/01 | 5              | 5           | 2            | 0            | 1 qt        |         | MINI-MAX Modular IV  
Cleaned as complete unit. Cleaned small parts with solvent. |

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

**WARNING:**

Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
PORTABLE STEAM CLEANING SYSTEM  
DEPOT LEVEL EVALUATION SURVEY

SEAT TYPE/POSITION: S-3B; STAPACS  
SEAT SERIAL NUMBER: DEC148, DEC304, DEC396, DEC021

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hicks NAS NI</td>
<td>Sector Assy D115-88-1 &amp; -2</td>
<td>6/7/01</td>
<td>6*</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1 qt</td>
<td>1 qt</td>
<td>$6          * Cleans bearings good, but no noted savings in other areas.</td>
</tr>
<tr>
<td>Hicks NAS NI</td>
<td>Sector Gyro D115096-1</td>
<td>6/7/01</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>None</td>
<td>1 qt</td>
<td>1 qt</td>
<td>$6          Wire brushing still required.</td>
</tr>
</tbody>
</table>

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

**WARNING:**  
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
## PORTABLE STEAM CLEANING SYSTEM
### DEPOT LEVEL EVALUATION SURVEY

**SEAT TYPE/POSITION S-3 and GRUEA7 Components**

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of Water Used</th>
<th>Solvent Saved</th>
<th>Cost of Water Used</th>
<th>Solvent Saved</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walt Frazier NORIS</td>
<td>Misc S-3 parts</td>
<td>7/12/01</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>+1 hr</td>
<td>½ gal</td>
<td></td>
<td></td>
<td></td>
<td>MINI-MAX Modular II Ran this unit out of steam too often. Soaked with detergent.</td>
</tr>
<tr>
<td>Walt Frazier NORIS</td>
<td>S-3 Inertia Reel 0113347-01</td>
<td>7/13/01</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>+1 hr</td>
<td>½ gal</td>
<td></td>
<td></td>
<td></td>
<td>MINI-MAX Modular IV Used wand with this big unit. This keeps up steam. Soaked in detergent. Serial # 512, 628</td>
</tr>
<tr>
<td>Walt Frazier NORIS</td>
<td>GRUEA7 Inertia Reel, MS300-1334</td>
<td>7/13/01</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>+1 hr</td>
<td>1 gal</td>
<td></td>
<td></td>
<td></td>
<td>Same as above Serial #11546, 4958</td>
</tr>
<tr>
<td>Walt Frazier NORIS</td>
<td>S-3 Inertia Reel 0113347-01</td>
<td>7/24/01</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>+1 hr</td>
<td>1 gal</td>
<td></td>
<td></td>
<td></td>
<td>Same as above Serial # 196, 595</td>
</tr>
<tr>
<td>Walt Frazier NORIS</td>
<td>GRUEA7 TDM MB200-601</td>
<td>7/24/01</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>+1.5 hrs</td>
<td>1 gal</td>
<td></td>
<td></td>
<td></td>
<td>Same as above Serial # MB0187, MB0942, 13400, MC2129, 13403</td>
</tr>
</tbody>
</table>

*NOTE:* Compared to existing cleaning method, which shall be considered rated at a “5”.

**WARNING:**

Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
# PORTABLE STEAM CLEANING SYSTEM
## DEPOT LEVEL EVALUATION SURVEY

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alvin A. Kochler NORIS</td>
<td>Pitot (NACES) MBEU146230</td>
<td>6/8/01</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>2 oz</td>
<td>4 oz</td>
<td>MINI-MAX MOD II Need to be little more powerful</td>
</tr>
<tr>
<td>Alvin A. Kochler NORIS</td>
<td>IMP MBEU145713</td>
<td>6/8/01</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>10 oz</td>
<td>4 oz</td>
<td>Same</td>
</tr>
<tr>
<td>Alvin A. Kochler NORIS</td>
<td>EGI MBEU147780</td>
<td>6/8/01</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>1 oz</td>
<td>2 oz</td>
<td>Same</td>
</tr>
<tr>
<td>Alvin A. Kochler NORIS</td>
<td>BRU MBEU146265</td>
<td>6/8/01</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>1 oz</td>
<td>2 oz</td>
<td>Same</td>
</tr>
</tbody>
</table>

*NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".  
WARNING: Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.*
# Portable Steam Cleaning System
## Depot Level Evaluation Survey

**Seating Type/Position:** Martin-Baker GRUEA7 __ **Seat Serial Number:** 1602; 1603; 1604; 1605

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of</th>
<th>Cost of</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamley AIMD W1 800 Div</td>
<td>Hand-tools Toolbox -1</td>
<td>8/14/01</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>2 hrs</td>
<td>¾ gal</td>
<td>3 qts</td>
<td>MINI-MAX MOD II</td>
</tr>
<tr>
<td>Hamley AIMD W1 800 Div</td>
<td>Hand-tools Toolbox -5</td>
<td>8/15/01</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>2 hrs</td>
<td>¾ gal</td>
<td>3 qts</td>
<td></td>
</tr>
<tr>
<td>Bellis AIMD W1 800 Div</td>
<td>Hand-tools Toolbox -3</td>
<td>8/15/01</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>2 hrs</td>
<td>¾ gal</td>
<td>3 qts</td>
<td></td>
</tr>
<tr>
<td>Kraft AIMD W1 800 Div</td>
<td>Pilot Seat GRUEA7 -1</td>
<td>8/20/01</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>1 hr</td>
<td>¾ gal</td>
<td>3 qts</td>
<td>Did not use on in closed items: TDM, TRM, Drogue Gun,</td>
</tr>
<tr>
<td>Hamley AIMD W1 800 Div</td>
<td>ECMO-1 Seat GRUEA7 -2</td>
<td>8/20/01</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>1 hr</td>
<td>¾ gal</td>
<td>3 qts</td>
<td>Parachute Lock etc</td>
</tr>
<tr>
<td>Jackson AIMD W1 800 Div</td>
<td>ECMO-2 Seat GRUEA7 -4</td>
<td>8/20/01</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>1 hr</td>
<td>¾ gal</td>
<td>3 qts</td>
<td></td>
</tr>
<tr>
<td>Bellis AIMD W1 800 Div</td>
<td>ECMO-3 Seat GRUEA7 -3</td>
<td>8/20/01</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>1 hr</td>
<td>¾ gal</td>
<td>3 qts</td>
<td></td>
</tr>
</tbody>
</table>

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

**WARNING:**
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pilot tubes etc.
## PORTABLE STEAM CLEANING SYSTEM DEPOT LEVEL EVALUATION SURVEY

### SEAT TYPE: POSITION GRUE A7 Components

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Clean Rating</th>
<th>Date</th>
<th>Drying Time (Min)</th>
<th>Ease of Use *</th>
<th>Gallons of Water Used</th>
<th>Cost of Solvent Saved</th>
<th>Solvent Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truman AIDM WI</td>
<td>MB300-765</td>
<td>10</td>
<td>11/19/01</td>
<td>10</td>
<td>2</td>
<td>2/5 gal</td>
<td>1/5 gal</td>
<td></td>
</tr>
<tr>
<td>Truman AIDM WI</td>
<td>MB300-263</td>
<td>10</td>
<td>11/19/01</td>
<td>10</td>
<td>2</td>
<td>2/5 gal</td>
<td>1/5 gal</td>
<td></td>
</tr>
<tr>
<td>Truman AIDM WI</td>
<td>MB300-120</td>
<td>10</td>
<td>11/19/01</td>
<td>10</td>
<td>3</td>
<td>3/5 gal</td>
<td>1/5 gal</td>
<td></td>
</tr>
<tr>
<td>Truman AIDM WI</td>
<td>MB300-489</td>
<td>10</td>
<td>11/20/01</td>
<td>9</td>
<td>5</td>
<td>3/5 gal</td>
<td>1/5 gal</td>
<td></td>
</tr>
<tr>
<td>Truman AIDM WI</td>
<td>MB200-438</td>
<td>10</td>
<td>11/20/01</td>
<td>9</td>
<td>15</td>
<td>1/5 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truman AIDM WI</td>
<td>MB200-562</td>
<td>10</td>
<td>11/20/01</td>
<td>9</td>
<td>20</td>
<td>1 gal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NOTE: Compared to existing cleaning method, which shall be considered rated at a 1/5*. **WARNING:** Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pilot tubes etc.

---

APPENDIX D
# Portable Steam Cleaning System
## Depot Level Evaluation Survey

## Seat Type/Position GRUEA7 Components

<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of Water Used</th>
<th>Solvent Saved</th>
<th>Cost of Water Used</th>
<th>Solvent Saved</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truman AIMD WI</td>
<td>MBB300-765</td>
<td>11/20/01</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>2</td>
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<td>Truman AIMD WI</td>
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<td>11/21/01</td>
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<tr>
<td>Truman AIMD WI</td>
<td>Guillotine MB200-438</td>
<td>11/21/01</td>
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<td>1 gal</td>
<td></td>
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</tbody>
</table>

*NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

**WARNING:**
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
<table>
<thead>
<tr>
<th>User Name &amp; Depot</th>
<th>Item Cleaned &amp; Part Number</th>
<th>Date</th>
<th>Clean Rating *</th>
<th>Drying Time</th>
<th>Ease of Use *</th>
<th>Time Savings</th>
<th>Gallons of Water Used</th>
<th>Solvent Saved</th>
<th>Cost of Water Used</th>
<th>Solvent Saved</th>
<th>Type of Steam Cleaner Used and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truman AIMD WI</td>
<td>HRO Parts MB200-660</td>
<td>11/26/01</td>
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<td>RMI MB300-1200</td>
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<tr>
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<td>Guillotine MB200-438</td>
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<td>Firing Head MBEU14966</td>
<td>11/27/01</td>
<td>10</td>
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<td>10</td>
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<td>1 gal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* NOTE: Compared to existing cleaning method, which shall be considered rated at a "5".

**WARNING:**
Do not use steam cleaning system on sequencer and enclosed component assemblies. Unsealed components may trap moisture resulting in corrosion. For cleaning the seat as a whole, remove the Sequencer, cap off pitot tubes etc.
NADEP NORIS MINI-MAX STEAM CLEANING
COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01
ARTISAN: Dale Starkey
NOMENCLATURE: Pitot
PART NUMBER: MBEU146230
SERIAL NUMBER: 0118
EXTERNAL CLEANLINESS:

PRE-DISASSEMBLY
TEST RESULTS:

<table>
<thead>
<tr>
<th>ACTUAL</th>
<th>N/A</th>
<th>REQUIRED LIMIT</th>
<th>PASSED</th>
<th>FAILED</th>
</tr>
</thead>
</table>

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS | EXTRA FIRM | NORMAL | RUNNY |

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS | DRIED/HARD OUT | NORMAL |

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE | NO MOISTURE EXHIBITED |

COMMENTS:
1. Static port screen exhibited extensive moisture.
2. Upper and lower pistons did not exhibit moisture.
3. Interior of pitot arm appeared dry.
4. Inlet chambers were dry.
NADEP NORIS MINI-MAX STEAM CLEANING
COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01
ARTISAN: Dale Starkey
NOMENCLATURE: Catapult Manifold Valve
PART NUMBER: MBEU147780
SERIAL NUMBER: DG 6261
EXTERNAL CLEANLINESS: Very Clean

PRE-DISASSEMBLY
TEST RESULTS:

ACTUAL N/A REQUIRED LIMIT PASSED/FAILED

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS EXTRA FIRM NORMAL RUNNY

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS DRIED/HARD OUT NORMAL

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE X NO MOISTURE EXHIBITED

COMMENTS:
1. Exhibited moisture at inlet connector (cartridge) bore.
2. Exhibited moisture in quick release pin bore.
NADEP NORIS MINI-MAX STEAM CLEANING
COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01

ARTISAN: Dale Starkey

NOMENCLATURE: Barostatic Release Unit (BRU)

PART NUMBER: MBEU146265

SERIAL NUMBER: DH 0335

EXTERNAL CLEANLINESS: Very Clean

PRE-DISASSEMBLY
TEST RESULTS:

ACTUAL_ N/A_ REQUIRED LIMIT_ PASSED_ /FAILED_

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS_ X_ EXTRA FIRM_ NORMAL_ X_ RUNNY_

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS_ X_ DRIED/HARD OUT_ NORMAL_ X_

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE_ X_ NO MOISTURE EXHIBITED

COMMENTS:
1. Traces of moisture under tape.
2. Release piston and chamber were wet
3. Firing pin assy and gears/pinions were dry.
4. Plugged cartridge chamber exhibited lots of moisture inside.
5. Parts exhibited light lubrication.
6. Moisture was present inside pipe assy MBEU147432.
NADEP NORIS MINI-MAX STEAM CLEANING
COMPONENT TEST/INSPECTION/DISASSEMBLY RECORD SHEET

DATE: 6/8/01
ARTISAN: Dale Starkey
NOMENCLATURE: Multi-Purpose Initiator (IMP)
PART NUMBER: MBEU145713
SERIAL NUMBER: DH 1271
EXTERNAL CLEANLINESS: Very Clean

PRE-DISASSEMBLY TEST RESULTS:

<table>
<thead>
<tr>
<th>ACTUAL</th>
<th>REQUIRED LIMIT</th>
<th>PASSED/FAILED</th>
</tr>
</thead>
</table>

CONDITION OF LUBRICANT:

EXHIBITS WATER DROPLETS __NO__  EXTRA FIRM______  NORMAL __X____  RUNNY______

CONDITION OF O-RINGS:

EXHIBITS WATER DROPLETS __NO__  DRIED/HARD OUT______  NORMAL __X____

TEAR DOWN OBSERVATIONS:

EXHIBITED MOISTURE___________  NO MOISTURE EXHIBITED __X__

COMMENTS:
1. Cable cylinder was dry. 3. Start switches were dry.
2. Bridle piston exhibited no moisture and was well lubed. 4. Connector compartment was dry.
APPENDIX E
WHIDBEY ISLAND AIMD VISIT REPORT
APPENDIX F
MATERIALS LABORATORY REPORT OF
CORROSION RESULTING FROM STEAM VAPOR CLEANING
## Analytical Report

<table>
<thead>
<tr>
<th>Requester</th>
<th>Receipt Date</th>
<th>Control Number</th>
<th>Report Date</th>
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<tbody>
<tr>
<td>A. Yost, Code 43520</td>
<td>26 JUN 01</td>
<td>In House</td>
<td>25 SEP 01</td>
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<table>
<thead>
<tr>
<th>Reference Task Assignment</th>
<th>Report number</th>
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</thead>
<tbody>
<tr>
<td>Corrosion Test Panels in support of processing ejection seat hardware</td>
<td>ME-006-01</td>
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<table>
<thead>
<tr>
<th>Parent Equipment</th>
<th>(Aircraft/Engine Model No., BUNO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/A-18</td>
<td></td>
</tr>
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</table>

Five identical bare 4130 steel panels (4" X 6" X 0.062") were garnet blasted and then rinsed in alcohol. Each of the five was subjected to exposures in heated deionized water or heated deionized water with selected corrosion-inhibiting additives. After removing each panel from the heated 2000 ml. beaker(s), the progress of corrosion was documented after 10 minutes, one hour and 24 hours using a digital camera. Test panels were hung to dry after exposure in the Materials Engineering Laboratory at a convenient location near a wall.

A 2 ounce sample of Arma-Sol's proprietary Wash and Arma_Sol's Dry concentrate were each added to separate gallons of deionized water. One coupon was immersed for 2.5 minutes in the Dry solution, a second for 2.5 minutes in deionized water and a third for 2.5 minutes in Arma-Sol Wash followed by 2.5 minutes in the Arma-Sol Dry solution. All solutions were kept at 195°F - 205°F. Two other identically prepared steel test panels were immersed in heated deionized water heated to 160°F for one minute except that one of the beakers of water had an addition of Turco's RustBloc (10% concentration).

The two bare panels exposed to deionized water only had visible pitting after 10 minutes. The panel that was immersed in the 160°F water had a band of pits along the lower edge where remaining water was held by surface tension. The panel exposed to 200°F water did not retain any liquid water along its lower edge and therefore there was no band of pits at this location. The panels exposed to water solutions with additives (either RustBloc or the Arma-Sol additives) did not display pit initiation until the evaluation at 24 hours.

Since these test panels were exposed (left to dry) to a somewhat "sheltered" laboratory environment, it would be prudent to use a factor of safety when comparing these test results to parts processed in the Depot cleaning Shops. Production parts have more access to the prevailing westerly winds carrying sea salt. An estimate of corrosion initiating within 12 hours, after exposure to deionized water with corrosion inhibiting additives, would seem reasonable.

### ORIGINATOR
E. Duffy

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62 APPENDIX F
After 10 minutes
After 24 hours
After 10 minutes
APPENDIX G
MATERIALS LABORATORY REPORT OF
O-RING DETERIORATION FROM SUPER HEATED STEAM
MATERIAL ENGINEERING SERVICES REQUEST

SMH (DISTRIBUTE ORIGINAL AND ONE COPY)

TO: Materials Mechanical Engineering Branch (4.3.5)

FROM: Naval Vehicle Mechanical Engineering (4.3.5)

JOHN SAMITTO, EXT 123

SUBMITTED BY: 3-N Santiago

DATE: 24-Nov-01

JOB NO: FAM 5101

REQUIRED FOR:

[ ] [ ] [ ] [ ] [ ] [ ] [ ]

NAP IS TO BE NO.

Service Request

Use of Cleaning Systems (Steam-Vac) on Ejection Seats

[ ] URGENT [ ] ROUTINE

Ejection Seat Components

1. A Steam-Vac (Mini max) machine is currently used in the seat shop to clean seat parts. The Steam-Vac machine provides an outlet temperature of 300 deg fahrenheit (right outside the probe). The probe is maintained a minimum of 1 inch away from the seat component.

2. Seat components use MS28775 and MS28513 series o-rings. According to the MS28775 and MS28513 spec, the max operating temperature allowed for the o-ring is 275 deg f.

3. This machine is also to be used by squadrons at the "O" level. The intent is to use this machine to clean seat components with o-rings installed inside the seat part. Lubricants like VV-L-800 are also used to lubricate internal areas of seat components.

Request Materials Lab assistance to determine if it is safe to clean seat components with o-rings inside the part. The question is, Can Mini-Max be used on seat parts and the o-rings be safe for use.

Same question applies for the lubricants like VV-L-800.

4. Please call when MESR is ready.

ATTACH all applicable correspondence (NARVJAXNOT 4130.2 Series)

FILE Control No.: None

REPLY

Note: (1) MS28775 was canceled and superseded by SAE-AS28775 on 29 Sep 00. Material and dimensional requirements remain the same.

(2) MS28513 was canceled and superseded by SAE-AS28513 on 1 Mar 01. Material and dimensional requirements remain the same.

(3) The VV-L-800 specification was canceled and superseded by MIL-FRF-32033 on 24 Jul 00. Material requirements and physical properties remain the same.

1. Use of the Steam-Vac (Mini max) machine for cleaning ejection seats, under conditions as described in Paragraph 1, will not accelerate deterioration nor damage either o-ring.

2. The cleaning process will, however, remove any MIL-FRF-32033 lubricant exposed to the action of the machine. Required lubricant will need to be replaced after cleaning.

3. Point of contact: Mike Butts, 4.3.4.4, 542-3444 ext 123.

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8725 John J. Kingman Road, Suite 0944, Ft. Belvoir, VA 22060-6218