PREPRODUCTION INITIATIVE-NELP
PRESERVATION/DEHUMIDIFICATION SYSTEM
TEST PLAN

SITE: NAS JRB FORT WORTH, TX

1.0 PURPOSE

To identify a dehumidification process that will minimize the generation of hazardous waste associated with aircraft/support equipment (SE) preservation maintenance.

2.0 OBJECTIVE

To quantify the reduction in hazardous material usage and hazardous waste generation and the affiliated cost savings associated with aircraft/SE preservation through the use of a Preservation/Dehumidification System (PDS).

3.0 BACKGROUND

The PDS uses dehumidification to protect aircraft armament, SE, and armament weapons support equipment (AWSE) from material degradation during periods of non-use. The system may also be used to protect aircraft and aircraft components. Dehumidification prevents macroscopic corrosion/degradation of aircraft/SE by minimizing the detrimental effects of environmental moisture. Items in dehumidified storage may be preserved indefinitely without the cyclic cleaning, preservation, and maintenance operations required by conventional preservation techniques. In effect, dehumidified storage reduces the use of hazardous protective and cleaning materials.

3.1 Preservation

The essence of aircraft and SE preservation is to protect critical exposed surfaces from the insidious destructive effects of the outside environment. Events such as rain, salt spray, corrosive chemical spills, direct sunlight, and high temperatures cause fairly rapid material deterioration and system breakdown if the system is inadequately protected during storage. Material degradation (in the form of corrosion or fungus) is the result of an electrochemical reaction fed by moisture and oxygen. Moisture is found in the air as humidity and can damage areas that are accessible to air. Water intrusion/condensation occurs routinely in areas that are hidden from casual inspection. As a result, significant pitting/crevice/intergranular corrosion and bacterial growth will occur if appropriate protective measures are not taken. Corrosion preventive compounds (CPCs) are currently used to displace the water and act as a surface barrier; however, CPCs only protect those areas on which it is applied and must be periodically renewed.

3.2 Dehumidification

Dehumidification (DH) is a process that removes moisture from the air. By extracting moisture from the air, the specific humidity and the relative humidity (R/H) is reduced to a level whereby the dew point temperature cannot be attained during the normal day-to-night thermal cycle. In a given storage area, daytime and nighttime air temperatures can vary as much as 40°F. This change in temperature affects the ability of the surrounding air to hold water. For example, at a daytime temperature of 70°F, the air can hold more than 100 grains of water per pound of air (specific humidity). However, at a lower nighttime temperature of 40°F, the air can only hold about 30 grains of water per pound of air. During the cooling transition from 70°F to 40°F, the excess moisture will condense onto nearby cool surfaces—such as aircraft skins and/or equipment structures. Depending on the humidity, the condensation and heavy dew might be obvious or may be microscopic (but no less destructive). Dehumidified air that is constantly circulated throughout a storage space will eventually extract moisture from inaccessible areas. Dynamic DH—the most effective means for dehumidifying large storage spaces—uses a dehumidifier to mechanically extract moisture from the air. When system equilibrium is achieved, the dynamic DH process stabilizes to a desired R/H range in which condensation will not take place with a drop in temperature.

R/H is expressed as a percent of saturation of water in air at a given temperature and pressure. Warm air holds more water than cold air. When air is completely saturated with water, it is at 100% humidity. If the air becomes warmer, more room for water is created. If the air becomes cooler, water is forced to leave the air and condense on surrounding surfaces. This condensation affects materials by conducting small electrical currents—activating corrosion of metals and giving life to bacteria and fungus. R/H below 50% dramatically slows the corrosion process. Conversely, R/H above 50% increases the corrosion process.

Certain materials can exist in a wide range of R/H without incurring damage, whereas other materials require a much narrower range. For instance, rubber and plastics can be safely stored in a R/H environment of up to 80%, but some metallic materials are best protected in a range of 35% to 40% R/H. Some polymeric materials will deteriorate under constant exposure to very low R/H levels (<25%), and still other materials are very sensitive to electrostatic discharge at low R/H levels. Aircraft, components and equipment are made of a variety of materials; therefore, the compromise range of 30% to 40% R/H has been chosen for the average day-to-night temperature change.

Through the use of dynamic DH, PDS cyclically extracts moisture from the air and recirculates it to the space requiring protection. PDS removes destructive levels of moisture from the storage environment—eliminating macroscopic material corrosion and degradation without the use of chemicals. DH protects assets during inactivity without the need for corrosion-inhibiting, water-displacing compounds required by conventional preservation methods. As a result, hazardous waste and associated disposal costs are reduced. In addition, DH significantly reduces the maintenance actions required to maintain an asset in active/RFI status.

The PDS will use a dehumidifier to dynamically dry the air of a shrouded covered storage space. The evaluation will be conducted for 1 year to evaluate the reduction and minimization of hazardous waste. The assets monitored will include (but are not limited to): SE, AWSE, aircraft armament, and aircraft components. The evaluation will be conducted in accordance with the project operation guidelines identified herein. **The evaluation will not hinder the availability of the assets being stored.**

5.0 RESPONSIBILITIES

- **Project Sponsor:** NAWCAD Lakehurst, Code 11X71JB, shall provide overall NELP policy and program management and funding in support of the project.

- **Project Manager:** LMTC-P NADEP NORIS, Code 4.3.4.6, shall:

  - be responsible for the overall integrity of the project, including equipment replacement/procurement
  - assist the equipment contractor with a site survey
  - identify the equipment required for the project and assist the Contracting Officer with equipment procurement
  - generate and maintain this project plan
  - generate a memorandum of agreement (MOA) among all activities participating in the project
  - provide engineering and management support during the initiation, operation, and conclusion of the project (to include site visits)
  - collect historical and project data
  - generate quarterly reports to be distributed to the Project Sponsor, Project Facilitator, and Contract Officer
  - generate a final report based on, but not limited to, historical data, monthly reports, and personnel interviews
  - act as a point of contact (POC) for technical assistance.

- **Contracting Officer:** NAVAIRSYSCOM, AIR 2.5.2.4.1, shall procure equipment and services required in support of the project.

- **Project Facilitator:** COMNAVAIRESFOR, Code N4213, shall approve site selection, identify a Site Coordinator, and provide final disposition of equipment at the end of the program.

- **Site Coordinator:** AIMD, NAS JRB Fort Worth, shall assist the equipment contractor with a site survey; maintain the integrity of the system; schedule and perform preventive maintenance as identified in this plan; and generate reports for distribution to the Project Manager.

- **Equipment Contractor** shall:

– assist project managers and facilitators with a site survey
– procure, install, integrate, test, and burn-in the system in accordance with the Statement of Work and in the presence of the LMTC-P representative
  – provide on-site training on the operation, servicing, maintenance, troubleshooting, and repair of the PDS and associated equipment
  – provide the LMTC-P with all related operating and maintenance manuals
  – provide warranties on all equipment associated with the PDS (warranties must be 2 years on parts and labor).

6.0 SYSTEM DESCRIPTION

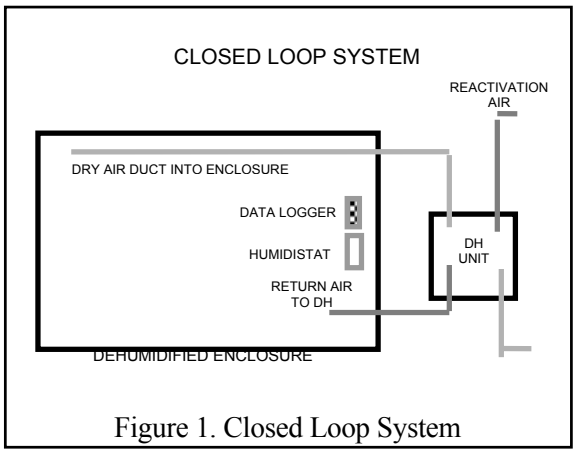

Figure 1. Closed Loop System

The PDS will be set-up within Bunker 4252 at NAS Fort Worth, Texas. The space is no larger than 4,480 ft^2, is a permanent concrete structure, and measures 150' long x 50' wide x 25' high. The building has double rolling doors on each end, lighting on the inside, and electrical power. Phone lines will be provided as government-furnished equipment. The building is in a fenced area controlled by a security force. The system will be a "turnkey system" comprised of an interior hangar/building drop shroud, dehumidifier, automated/computer-controlled monitoring system (DACS) with remote control capabilities via modem. The shroud will be installed inside the bunker using existing eyebolts attached to interior walls. The shroud will contain roof and side curtains. The dehumidifier will maintain the shrouded environment between 30% to 40 % R/H. The dry air will be recirculated from the dehumidifier to the shrouded space in a closed loop by ducting placed in accordance with the guidelines herein. The DACS monitor and sensor system will be set-up inside the dehumidified shroud per the set-up guidelines identified herein. The system will monitor and record temperature, humidity, dew point, vapors (LEL), and equipment operating time for data collection. The system will provide reports on all recorded measurements at selected intervals.

7.0 EQUIPMENT

- **Two 600 CFM desiccant wheel type dehumidifiers** with:

  – Weatherproof D/H housing
  – Reactivation and process blowers
  – Process and reactivation cleanable roughing filters

- Reactivating heaters sized for 220V/3ph/60 Hz electrical utility with energy modulation features
- Fully automatic and manual operation
- 10% LEL vapor sensors and vapor sensor control
- Reactivation inlet and outlet weather hoods
- Process inlet transition
- Disposable 30% air filter and frame
- 10% air filter and frame
- Skid with casters
- Knife switch disconnect
- 50 foot power cable.

- **Shroud system** made of translucent, lightweight, strong material with the following features:

  - Non-rigid corners, walls, and ceilings, suspended or supported
  - Translucent
  - Flame-resistant material in accordance with National Fire Protection Agency and Underwriter Laboratory fire/flame resistant requirements (NFPA 701)
  - Material with the vapor transmission rate of 0.08 g/100 in^2 in 24 hours.

- **Data Acquisition and Control System (DACS)** with the following features:

  - Monitoring system sensors to collect, display, and record R/H, temperature, and dew point of ambient and controlled environments, LEL, equipment operating time, faults, and fault causes
  - Ability to control the running cycle of at least two dehumidifiers
  - Modem communication
  - Two computer monitoring stations located within the dehumidified space and at designated POC site
  - Ability to run automatically without user interface
  - Ability to record monitored sensor data and store with backup for a period of no less than 1 year
  - Ability to report, via charts and graphs, all recorded measurements at selectable intervals
  - Visual and audio alarm system identifying DH shutdown by LEL sensor.

- **Portable Monitoring and Analysis System (PMAS)** to facilitate field measurements of R/H and temperature over extended periods of time and to assess DACS remotely. The PMAS shall have the following features:

  - Battery-powered
  - Intel Pentium-based processor
  - Active Matrix, 10.4", 65K color liquid crystal display
  - PCMCIA type III card slot

- Infrared port
- User-replaceable 772 MB hard drive
- Modem communication capability
- Dual lithium ion batteries
- Software required to retrieve, store, graph, and report the sensor data logger information
- Battery-powered sensors and optical data transfer
- Maximum of 16,000 data point collection
- Programmable sample rate: 2 seconds to 2 hours between samples
- Three R/H and temperature data loggers with a sensor range of 0% to 100% at an accuracy of +/-2% at 25°C and -40°F to +158°F at an accuracy of +/-0.8°F.

- **Air distribution system** will transport air via ducting from the dehumidifier to the shroud interior, move it throughout the shroud interior, and return the shroud air to dehumidifier.

- **The following ancillary equipment** shall be included:

  - Calibration kits for all system sensors
  - Manufacturer kits of recommended spares to maintain dehumidifiers, DACS, and PMAS for 3 years
  - One additional sensor of each type
  - Repair kit for shroud system
  - Two hygrothermographs; wind-up type with weekly drum chart
  - Spare hygrothermograph drum charts sufficient for 2 years of operation.

8.0 PLAN OF ACTION AND MILESTONES (POA&M)

The project will be performed in the following phases (identified in chronological order). A "T" indicates that travel will be required.

- **Pre-Startup: 5.5 months**

  - *Site Survey*: 32 hours (T) *Timeline*: 2 days

The survey shall take approximately 2 days and shall consist of a thorough evaluation of the site facilities, personnel, and operations. The information gathered from the site surveys will be compiled in a material listing (generated by the equipment contractor), which will be used to develop the project plan. The site survey will require the LMTC-P representatives to travel to the evaluation site.

  - *Identify and procure required equipment*: 80 hours *Timeline*: 2.5 months

Based on the site survey material listing and preliminary research, the Project Manager will identify all equipment required for successful implementation of the project. In addition, the Project Manager will help the Contract Officer procure

the equipment. The identified timeline includes a 2 month manufacturer lead-time.

– *Project plan development*: 160 hours *Timeline*: 2.5 months

The project plan will be prepared by the program managing activity and will be the primary operations document. It will include the following elements: Purpose, Objective, Background, Project, Responsibilities, Data Collecting Procedures, POA&Ms, Project Set-Up, Project Equipment, and Operating and Maintenance Procedures. In addition to this project plan, a memorandum of agreement will be established among all participating activities to ensure compliance with the established plan and to ensure the success of the project.

– *Collection of historical information*: 80 hours (T) *Timeline*: 3 weeks

Historical performance and maintenance information shall be collected on the items stored during the evaluation. This information will establish a performance baseline and will be used as comparison data for the final project analysis.

- **Start-Up Requirements: 2.5 months**

– *Site Preparation*: 40 hours (T) *Timeline*: 1 month

During site preparation, required site upgrades or improvements identified and reported by the equipment contractor will be made by the contractor and/or Project Facilitator prior to equipment installation. One representative from the LMTC-P will oversee/assist the contractor and travel to the site to confirm that the site is acceptable for equipment installation in accordance with this project plan.

– *Equipment Setup*: 40 hours (T) *Timeline*: 1 month

The equipment will be installed at the project site by representatives of the equipment contractor, the Project Facilitator, and the Project Manager.

– *Burn-in*: 40 hours (T) *Timeline*: 10 days

During the burn-in, the operation of the equipment will be evaluated, and appropriate procedure and/or equipment configuration changes will be made by the equipment contractor per the SOW or the Project Facilitator. The Project Manager will assist as necessary. One representative from the LMTC-P will oversee and witness the start of system and oversee the entire burn-in phase.

Note: The dehumidifier connections shall be as airtight as possible. The unit shall be turned on and allowed to run continuously for the initial drawdown of the R/H. The general enclosure R/H shall be periodically monitored. This should identify system airflow leaks or enclosure seal problems, which should be immediately corrected. Access into the dehumidified space should be limited until the R/H has stabilized.

– *Training:* 40 hour (T) *Timeline*: 1 week
All pertinent representatives from the Project Facilitator commands and the Program Manager shall be trained on the operation, maintenance, and repair of the equipment prior to project initiation. The 1 week training classes shall be arranged by the equipment contractor and shall include classroom and practical instruction.

– *Equipment turn-over and project activation*
The Project Manager will accept all equipment from the equipment contractor and initiate the test when a successful equipment burn-in has been accomplished. The inspection intervals and data collection should begin once the R/H is stabilized (between 30% and 40%) and the system appears to be functioning properly.

– *Item Induction*
SE shall be prepared and maintained for DH per the Type III, short-term preservation requirements of NAVAIR 17-1-125. In addition, all fluids (except hydraulic) must be changed. Hydraulic fluid must be checked for contaminants and moisture content. If moisture is present, hydraulic fluid must be changed. Installation of barrier material or covers is not required. When SE is removed from dehumidified storage, each item must undergo a one time inspection (per NAVAIR 17-1-125 and/or the applicable MRCs) to include those inspections not accomplished when preserved. Ensure that a Form 1 is initiated and completed upon performing induction, any maintenance, and/or withdrawal actions per the recordkeeping instructions in this plan.

Note: At present, only SE will be placed in dehumidified storage. All other items require the approval of the Project Facilitator.

- **Operation: 1 year**

– *Maintenance services for system equipment*: 40 hours
Preventive maintenance and minor repairs shall be performed by the Site Coordinator. The Project Manager will be responsible for providing technical assistance as needed. Log all maintenance/repair actions on a 4790/51 form for all equipment supporting the storage. PDS maintenance shall include the following inspections.

➢ **Daily Inspection**

a. Check enclosure for obvious compromises (*e.g.,* tears, moisture intrusion).
b. Check security and general condition of the site (*e.g.,* look for open doors and windows, clutter, and obvious safety hazards).
c. Check hygrothermograph for proper operation (*e.g.,* recording pens are working and the traces are legible).

d. Check dehumidifier for obvious malfunctions (*e.g.,* check no fault light, unit "on" setting, setting of humidistat, and pressure differential) and adjust as necessary.
e. Make entry into site logbook; note dehumidifier run time.

- **7 Day Inspection**

a. Perform daily inspection.
b. Change the hygrothermograph paper roll(s) or disc(s) and print out humidity, dew point, and temperature data for the week in graph form.
c. Make additional entry into site logbook; note reactivation air temperature.

Note: When changing the chart on the hygrothermograph, ensure that the spring is wound properly, that the start date is documented on the new chart, and that the horizontal time scale matches the day and time of the inspection. Ensure the following information is on the removed hygrothermograph paper roll/disc: start date (initialed), stop date (initialed), hygrothermograph part number, and location (building and position) of the hygrothermograph.

- **28 Day Inspection**

a. Perform daily and 7 day inspections.
b. Inspect the dehumidifier unit as follows:

1. Inspect the desiccant wheel for contamination and deterioration due to plugged channels.

Note: The wheel should last many years if the filters are kept clean and contaminants are not allowed to reach the desiccant channels.

2. Check and clean filters; replace with new filter(s) as necessary.
3. Lubricate bearings, if applicable, and clean seals.
4. Inspect for cracks and deterioration in drive belts, replace if faulty.
5. Inspect heater elements for breaks; replace or repair if necessary.

c. Visually inspect the ducting for obvious cracks and mechanical damage. Replace if not fit for use.
d. Compile the R/H data and print out R/H, dew point, and temperature data for the month in graph form.
e. Generate a monthly report per this project plan.

- **56 Day Inspection**

a. Perform daily, 7 day, and 28 day inspections.
b. Inspect humidistat and compare against hygrothermograph readings.

c. Inspect the humidistat sensor unit for an accumulation of dust and dirt. If necessary, clean with a soft bristle brush and wiping cloth. For a more thorough cleaning, refer to the manufacturer's manual.

- **180 Day Inspection**

a. Perform daily, 7 day, 28 day, and 56 day inspections.
b. Randomly inspect 10% of stored items for corrosion, dirt, degradation, etc. Correct per applicable technical publication. Log all actions on an OPNAV FORM 4790/51 and Form 1 for each item.

- **Calibration**

Calibrate data recorders, hygrothermographs, vapor sensors, and temperature controllers on dehumidifiers per manufacturer's specifications. If this information is unavailable, calibrate all equipment supporting the storage site **annually**. The gas vapor sensor shall be calibrated every **6 months**.

- **Corrective Actions**

a. ***Enclosure Compromise***. Per manufacturer's recommendations, fix/mend enclosure compromise within **24 hours** of recognizing the incident. The use of plastic sheeting, preservation tape, caulking, and liquid foam may be used to properly seal the enclosure. Document all corrective actions in site logbook.
b. ***DACS Malfunction***. Notify Project Manager for corrective action and document in site logbook.
c. ***Hygrothermograph Malfunction***. Adhere to the following procedures.

1. If the chart paper binds up, correct it. If it occurs a second time, replace the hygrothermograph.
2. If paper is changed prematurely (midweek), place the used paper in a plastic bag and attach it to the indicator for the next data collection operation.
3. Replace the paper roll/disc to coincide with **7 day** maintenance interval. Document corrective action in site logbook.

d. ***High/Low Humidity Indications*** (outside the 30% to 40% humidity range)

If < 30%

1. Correct within **24 hours** of acknowledging the low R/H. Document corrective action in site logbook and notify Project Manager.
2. Compare hygrothermograph or data logger data with DACS. If found faulty, replace hygrothermograph or data logger.

3. Check humidistat controls/sensors. If malfunctioning, correct per manufacturer's manual. If operating properly, proceed to step 4.
4. If local weather conditions identify low R/H occurrences, check for leaks in the enclosure. If local weather conditions do not identify a low R/H condition, shut down system and check the dehumidifier controls; refer to DH troubleshooting guide.

If >40%

1. Correct within **16 hours** of acknowledging the high R/H. Document corrective action in site logbook and notify Project Manager.
2. Compare hygrothermograph or data logger data with DACS. If found faulty, replace hygrothermograph or data logger.
3. Check humidistat controls/sensors. If malfunctioning, correct per manufacturer's manual. If operating properly, proceed to step 4.
4. If local weather conditions identify high R/H occurrences, check for leaks in the enclosure and ducting; reseal if found. If no apparent leaks are found or if the condition persists after sealing, inspect the DH unit per manufacturer's troubleshooting guide.
5. If the protected space is exposed to humidity levels exceeding 50% for longer than **48 hours**, the items to be dehumidified must be thoroughly inspected for corrosion.

e. ***Power Failure.*** If the system(s) is shut down due to a site power failure and this compromises the effectiveness of the system, a generator shall be activated to support the test. The generator shall support the storage site until the cause of the power failure is rectified.

– *Monitoring services*: 192 hours (T)
One LMTC-P representative shall visit the project site a minimum of once every 2 months to collect preliminary data and to evaluate project progress.

– *Recordkeeping*
Data pertaining to item induction, maintenance, withdrawal man hours, material cost, and waste generation/disposal will be collected and analyzed in addition to the temperature, dewpoint, and R/H information. For data verification, the site must be equipped with a hygrothermograph or data logger.

- **Stored Items.** Retain inventory of stored items. Tag each item stored with an identifying date and level of preservation. On a 4790/51 form, all pre- and post-preservation procedures must be documented.

- **Storage Site.** A logbook shall be kept to document the following information:

a. Date and time of inspection or any enclosure compromise
b. Inspections performed or description of enclosure compromise
c. Site maintenance actions performed

d. Corrective actions on PDS equipment
e. Dehumidifier run time
f. Reactivation air temperature (120°F minimum), from dehumidifier thermostat
g. R/H reading(s) from hygrothermograph(s)
h. Name of person who performed the inspection or entered enclosure.

The information in the logbook can help establish a preventive maintenance cycle for the equipment at each site. Maintain a file of the hygrothermograph papers and logbooks.

- **Form 1.** Initiate and maintain a Form 1 for one item of each type of SE, armament, or AWSE stored at the project site.

- **Reports**

a. ***Weekly Reports:*** A weekly report should be produced and maintained with or in the logbook. The report should identify the hours during which the enclosure experienced the following humidity levels and include a graph of the daily average humidity level.

1. Above 40%: _____ hours
2. 30% - 40%: _____ hours
3. Under 30%: _____ hours

b. ***Monthly Reports:*** Each month, the Site Coordinator shall generate a monthly report that summarizes the status of the project site using information documented in the site logbook, Form 1(s), hygrothermograph temperature/humidity readings, and any other information unattainable via the PMAS. The report shall be submitted to the Project Manager and copied to the Project Facilitator.

c. ***Progress Reports:*** Every 3 months, the Project Manager shall analyze and organize the information from monthly reports and data accessed by the PMAS into a progress report for the Project Sponsor.

- **Shut-down/Project Completion: 4 months**

– *Disestablish sites*: 40 hours (T) *Timeline*: 1 week
On completion of the project, one LMTC-P representative shall travel to the project site (not to exceed 1 week) to interview project sponsor personnel and assess condition of equipment.

– *PDS equipment disposition*: 40 hours + material *Timeline*: 1 month
As required, the Project Manager shall arrange to transfer custody of, package, and ship the equipment from the project site to a location identified by the Project Facilitator.

– *Final report* *Timeline*: 3 months
The Project Manager will generate a final report that summarizes the project process, successes, problems, and data analysis and establishes the reduction in hazardous waste generation and disposal costs.

FORM 1. PRESERVATION MATERIAL/MAN HOUR EXPENDITURE RECORD

ACTIVITY/STATION:	NOMENCLATURE:
LOCATION:	PART NO:.
TEC:	S/N:
[1]PUBLICATION:	
CHECK ONE: o GSE o AWSE o AC o AC COMP	
PRESERVATION ACTION: o INDUCTION o MAINTENANCE o MAINTENANCE WASH o WITHDRAWAL	

[2]PRES LEVEL	[1]MHRS REQUIRED	MHRS EXPENDED 1 YR (A)	QTY IN PRES (B)	TOTAL MHRS EXPENDED (A X B)
1				
2				
3				

[2]PRES LEVEL	[2]MATERIAL ITEM #	MATERIAL AMOUNT (LBS)	WASTE AMOUNT (LBS)
1			
2			
3			

NOTES: 1. REFER TO MRCS. OR NAVAIR 17-1-125
2. PER NAVAIR 17-1-125 OR NAVAIR 15-01-500.

COMMENTS: