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ENGINEERING DATA TRANSMITTAL

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1	1	Cog. Eng. AF Pardini	A F Pardini	4/15/96	N1-21	JA Harvey			S7-07		
1	1	Cog. Mgr. DS Dutt	Dale Dutt		N1-21	RA Huckfeldt			R3-01		
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1	1	KL Bennett	K L Bennett	4/16/96	N1-21						

18. AF Pardini — A F Pardini 4/15/96 — Signature of EDT Originator — Date

19. Authorized Representative for Receiving Organization — Date

20. DS Dutt — Dale Dutt 4-16-96 — Cognizant Manager — Date

21. DOE APPROVAL (if required)
Ctrl No. _____
☐ Approved
☐ Approved w/comments
☐ Disapproved w/comments

BD-7400-172 (04/94)

Post Delivery Test Report for the Light Duty Utility Arm Optical Alignment System (OAS)

Allan F. Pardini
Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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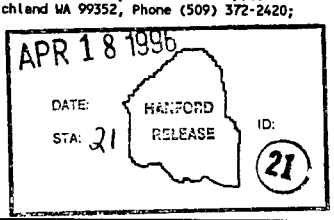
Key Words: LDUA, Optical Alignment System (OAS) common video end effector (CVEE), Labview, Nondestructive Examination

Abstract: This report documents the post delivery testing of the Optical Alignment System (OAS) LDUA system, designed for use by the Light Duty Utility Arm (LDUA) project. The post delivery test shows by demonstration that the optical alignment system is fully operational to perform the task of aligning the LDUA arm and mast with the entry riser during deployment operations within a Hanford Site waste tank.



Karen A. Noland 4/18/96
Release Approval Date

Release Stamp

Approved for Public Release

CONTENTS

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1.0 INTRODUCTION

This report documents the post delivery testing of the Optical Alignment System (OAS), LDUA system number 6250, designed for use by the Light Duty Utility Arm (LDUA) project. The post delivery test was performed by the Remote System and Sensor Applications (RSSA) group and the Nondestructive Examination (NDE) group. The post delivery test shows by demonstration that the optical alignment system is fully operational to perform the task of aligning the LDUA arm and mast with the entry riser during deployment operations within a Hanford Site waste tank. The test did not include radiation testing or all environmental testing. These factors were reviewed during the design phases of the project and were deemed acceptable based on published data on radiation and environmental components used in the camera designs. Testing of the purge system to meet the requirements of NFPA 70 National Electrical Code (1993), Class 1 Division 1, Group B requirements, NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment (1993), and Hanford Safety Class 1 requirements for shutdown of the system was not performed. Full testing to meet these requirements will be performed during the overall LDUA qualification test. The OAS did undergo pressure and decon testing to demonstrate end effector integrity. An additional test to verify maximum external temperature of the OAS under normal operations was performed and documented. Completion of this post delivery test report signifies that the OAS is ready for integration testing with the LDUA Supervisory Data Acquisition System (SDAS) and precision calibration of the laser sensors as part of WHC-SD-WM-TC-070, Rev, 0, *Calibration, Grooming, and Alignment of the LDUA Optical Alignment Scope* (Potter 1995).

2.0 DESCRIPTION OF TEST

The system under test is the LDUA system 6250, OAS. The property number is a Westinghouse Savannah River Company number, 00375309. The system tested included the OAS end effector, common video end effector electronics (CVEE), and the CVEE power supply. The OAS is the first alignment system developed for the LDUA program as part of the new technologies initiated through the Department of Energy's Office of Science and Technology. Figure 1 shows the OAS end effector which includes an internal camera, laser projectors, and proximity sensors.

Attachment 1 is the completed acceptance test describing each step of the test. Attachment 2 is the completed Nondestructive Examination (NDE) report. Attachment 3 is a computer printout of the Labview virtual instruments that were loaded to operate this system during testing.

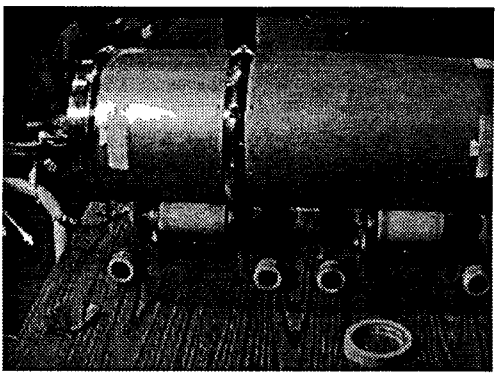

FIGURE 1 OPTICAL ALIGNMENT SYSTEM (OAS) END EFFECTOR

3.0 TEST RESULTS

The OAS system performed satisfactory during the post delivery test. All system requirements were evaluated against the criteria in the test procedure. Three exceptions occurred during the post delivery test. Two of these were noted to clarify the "Focus" function during normal operation. The third was to indicate failure of a component under possible operation conditions. The exceptions were as follows:

Exception #1: In procedure step #10, it was noted that the "NEAR" focus was to be used to focus the object in the "TELE" mode. In reality, the NEAR and FAR focus work together, therefore it is necessary to use either the NEAR or FAR focus depending on where you are in the focus range. This exception is therefore resolved.

Exception #2: Same as exception #1, but for the "FAR" focus instead.

Exception #3: In procedure step #14, during the temperature test, the line lasers stopped working. This occurred when the temperature rose to around 70 °C. All other systems (dot lasers, proximity lasers, and camera) functioned normally at the maximum temperature of 94 °C. It has been noted that the line lasers are not mandatory for OAS alignment during LDUA operations. Therefore this exception is resolved in that the line lasers do not need to be available for LDUA alignment. In all actuality, during the alignment process, the lighting system will be used very sparingly and only one or two sets of lights (2 light pairs) will be on for short durations of time. The OAS will not get nearly as hot as during this test, therefore the line lasers will probably be available for riser alignment if needed. The line lasers function normally after they have cooled down.

The temperature test in step #14 provided verification that the maximum external temperature of the protected enclosure was below the autoignition temperature of the flammable gas within the waste tank. The gas of concern in Hanford's waste tanks has been hydrogen which has an autoignition temperature of 520 °C. Figure 2 is a graphical display of the temperature rise of the OAS end effector until the temperature stabilized. The maximum temperature reached during the test was 94 °C. This value is far below the autoignition temperature of hydrogen.

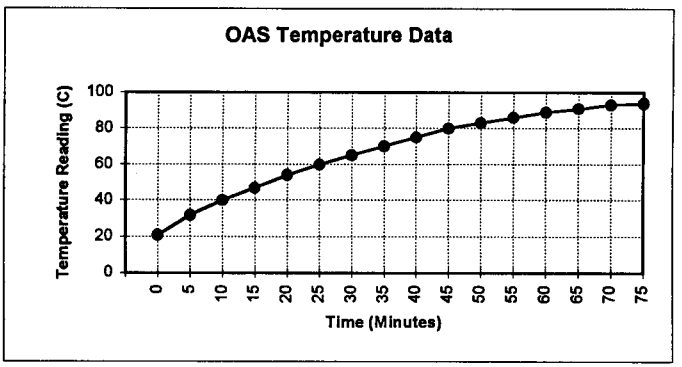

FIGURE 2 OAS TEMPERATURE DATA

The decon test provided verification that the OAS end effector would not leak a substantial amount during the decon spray process. The OAS was brought to a downtown car wash and sprayed using a rinse nozzle which was operated at approximately 1000 psi. The spray wand was held at a distance of approximately 8 inches from the OAS and was moved from top to bottom (OAS was setting vertical on the ground) in approximately 3 seconds. The spraying was done in 4 passes, 90 degrees apart around the circumference of the end effector. The OAS was dried off externally and then disassembled at its midpoint so the interior of the end effector could be examined. It was noted that a small amount of water did leak into the end effector, approximately 1 cubic centimeter. This seemed to originate near the center band (o-ring joint area where the dot lasers project) and when the OAS was laid horizontally it ran down circumferentially and gathered in the lower section. The amount of leakage was acceptable under the conditions of this test. During actual deployment, a bead of high temperature sealant will be applied to the seam area to discourage any water intrusion during deconning.

A pressure/leak test was performed to demonstrate integrity of the OAS under operating pressures of +/- 7 inches of water. The system showed no visible degradation. A leak rate was measured to be approximately 14 standard cubic centimeters per second (14 STD CC / Sec) at the normal operating pressure of the LDUA. This leak rate is considered to be acceptable. The majority of this leak was concentrated around the lower o-ring assembly near the front viewing

end of the OAS. The LDUA team may consider it acceptable to use a high temperature sealant and seal the lower o-ring joint at a later time. This will still allow the OAS to be separated at the mid point joint for maintenance purposes.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The post delivery test of the OAS demonstrated that the end effector system functioned according to design criteria established in WHC-SD-TD-FRD-003, Rev. 1, *Functions and Requirements for the Light-Duty Utility Arm Integrated System* (Kiebel 1996).

5.0 DISPOSITION OF TEST ITEM

The OAS end effector is now ready for integration testing with the LDUA SDAS system and precision calibration of the laser sensors as part of WHC-SD-WM-TC-070, Rev. 1, *Calibration, Grooming, and Alignment of the LDUA Optical Alignment Scope* (Potter 1995). It will remain in the Fuels and Materials Examination Facility (FMEF) until the completion of qualification testing.

6.0 REFERENCES

NFPA, 1993, *National Electrical Code*, National Fire Prevention Association, Batterymarch Park, Quincy, Massachusetts.

Kiebel, G. R., 1996, *Functions and Requirements for the Light-Duty Utility Arm Integrated System*, WHC-SD-TD-FRD-003, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Potter, J. D., 1995, *Calibration, Grooming, and Alignment of the LDUA Optical Alignment Scope*, WHC-SD-WM-TC-070, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

ATTACHMENT 1

COMPLETED POST DELIVERY TEST PROCEDURE
FOR THE
LIGHT DUTY UTILITY ARM
OPTICAL ALIGNMENT SYSTEM (OAS)

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TABLE OF CONTENTS

Post Delivery Test Procedure
for
Light Duty Utility Arm Optical Alignment System (OAS)

APPROVAL SHEET

This document provides for the post delivery testing of the Optical Alignment System end effector used for aligning the Light Duty Utility Arm (LDUA) with the tank entry riser.

Approvals:

End Effector Cognizant Engineer, Design Agent — Allan F. Pardini — Date 3/29/96

Technical Lead Engineer, Design Authority — Gary R. Kiebel — Date 3/29/96

LDUA Test Director — Kenneth L. Bennett — Date 3/29/96

Safety — Travis M. Amundson — Date 3/28/96

POST DELIVERY TEST PROCEDURE

LIGHT DUTY UTILITY ARM OPTICAL ALIGNMENT SYSTEM (OAS)

1.0 TEST ITEM IDENTIFICATION

The system under test is the Light Duty Utility Arm (LDUA) system 6250, Optical Alignment System (OAS). The property number is a Westinghouse Savannah River Company number, 00375309. The system to be tested includes the end effector and control electronics.

2.0 GENERAL DESCRIPTION

The objective of the test is to show by demonstration that the optical alignment system is fully operational to perform the task of aligning the LDUA arm and mast with the entry riser during deployment operations within a Hanford waste tank. The test will not include radiation testing or all environmental testing. These factors were reviewed during the design phases of the project and were deemed acceptable based on published data on radiation and environmental components used in the camera designs. Testing of the purge system to meet the requirements of NFPA 70 National Electrical Code (1993), Class 1 Division 1, Group B requirements, NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment (1993), and Hanford Safety Class 1 requirements for shutdown of the system will not be performed during this test. Full testing to meet these requirements will be performed during the overall LDUA qualification test. Testing will include a pressure test to verify end effector integrity under the normal operating pressures, a decon spray test to assure that water does not leak into the end effector, and an additional test to verify maximum temperature of the camera under normal operations. Upon completion of this post delivery test, the OAS will be ready for integration testing with the LDUA Supervisory Data Acquisition System (SDAS).

3.0 TEST CONDITION LIMITS

Test conditions which could cause the test to be aborted would be a loss of power in the facility, or complete failure of the camera system to perform its intended functions. If either of these occur, the test will be suspended until the problems are resolved. After problem resolution, the test will be resumed. If necessary, sections of the test may be repeated at the discretion of the end effector cognizant test engineer.

3.1 EXCEPTIONS

Exceptions noted during the execution of the test procedure shall be recorded in the spaces provided in Appendix A. If an exception is noted, applicable signatures must obtained prior to continuing the test procedure. If no exceptions occur, write "none" and continue the procedure.

4.0 INSTRUMENTS AND CALIBRATION

A temperature indicating device will be used to measure the temperature of the outside of the camera from initial startup until a stabilized maximum temperature is reached. This device will have a current

calibration sticker from the Standards Laboratory. During pressure testing, a pressure gauge will be used to measure pressures inside of the end effector. This sensor shall have a current calibration sticker from the Standards Laboratory.

5.0 FACILITIES, EQUIPMENT, AND MATERIALS

The OAS will be tested in the Fuels and Materials Examination Facility (FMEF) on the 42' -6'' level and in the Nondestructive Examination Laboratory in 306E. The equipment and materials listed below are necessary to perform this post delivery test:

- OAS camera system, including Common Video End Effector Electronics (CVEE), CVEE power supply, and LDUA test umbilical
- Computer (486 or better PC running Windows 3.11 with program software Labview 3.1.1)
- 110VAC power source and power strip
- Calibrated temperature indicating device and thermocouple
- Calibrated pressure gauge
- Leak test equipment (to be provided by NDE group)
- Laser Safety Glasses
- Water, water hose, and spray nozzle
- Miscellaneous (e.g. duct tape, common tools, etc.)

6.0 SAFETY

The OAS system is a completely enclosed camera system, therefore no external wires or mechanical assemblies will be exposed as a shock hazard. Exposed wiring at the Hypertronic connections is low voltage.

The OAS does contain three laser systems.

The first system produces lines of laser light when projected axially from the end effector onto a surface. There are four of these lasers which are class IIIa.

The second system produces laser dots when projected axially from the end effector onto a surface. There are four of these lasers which are class IIIa.

The third system is made up of laser proximity sensors located symmetrically on the ends of the end effector. They project radially outward to measure the distance from the end effector to the riser wall. There are eight of these lasers which are class IIIa.

All laser systems have visible light wavelengths between 680 nm and 690 nm. LDUA personnel will use appropriate laser safety glasses when working with the lasers where direct beam exposure is likely. All LDUA personnel will read and adhere to the laser safety plan.

During temperature testing, the surface of the end effector may reach

approximately 140 degrees Celsius, therefore care must be taken by test personnel during this testing. A sign reading "HOT, DO NOT TOUCH", will be located next to the end effector.

7.0 MAINTENANCE AND FAILURES

There are no components within the OAS which should require maintenance during the testing period. If any component fails during the testing period, and it can be replaced immediately, then the condition shall be documented under the exception portion of Appendix A and testing shall continue. If the failure is catastrophic (component cannot be readily replaced or needs to be reordered) then the procedure will be stopped and repeated at a later date.

The extent of the OAS post delivery test should be short in duration, so no test interruptions are expected.

8.0 TEST DATA

Test data from the temperature and pressure measurements will be logged into the appropriate sections of Appendix A. A graphical plot depicting temperature versus time will be documented in an Post Delivery Test Report. During the post delivery test the witnesses will sign off in appropriate sections of the test procedure to indicate that the equipment is operating as expected.

9.0 PERSONNEL REQUIREMENTS

All personnel involved in the performance of this test shall print and sign their name, initials, position, and date of signature prior to beginning the testing in the personnel record section of Appendix A.

The operation of the equipment will be performed by the LDUA end effector cognizant engineer and/or designated end effector technician. This person will perform the operations and the LDUA end effector cognizant engineer will sign off the associated steps as to their acceptance. Temperature and pressure data may be transcribed by the end effector technician.

10.0 WITNESSES

All witnesses will be notified immediately proceeding the beginning of the test. They shall witness the procedure and concur the successful completion of specific steps with either their signature or their initials and date. If exceptions are noted and are acceptable then the LDUA cognizant engineer shall record the exception, write in the resolution, and sign and date. All other specific witnesses addressed in the exception shall also sign and date. If the exception is such that no immediate resolution is attainable, the test will be aborted until the problems are resolved. Once resolved the test will be repeated at a later date.

It is expected that the complete test will last no more than 8 hours.

11.0 PROCEDURE

Appendix A provides the step-by-step procedure for testing the OAS. Appendix A also includes the personnel record, pressure data, and the

temperature data sheet. Appendix B provides pictures of the components used as part of this post delivery test. It provides a visual reference to those components described in the test procedure.

12.0 DISPOSITION OF TEST ITEM

All test materials will remain in the FMEF test facility for future use. The actual end effector system tested will now be ready for integration testing with the LDUA SDAS system.

13.0 DATA SHEETS

No further data sheets will be necessary to support the testing of this end effector system. All verifications of testing will be signed directly within this procedure under Appendix A.

APPENDIX A

LIGHT DUTY UTILITY ARM OPTICAL ALIGNMENT SYSTEM (OAS) POST DELIVERY TEST PROCEDURE

This procedure will be used to perform the actual post delivery testing of the OAS system. As each step is performed signatures shall be logged onto the procedure in the blank spaces as indicated.

Step 1: Notify all witnesses (to include End Effector Cognizant Engineer, NDE personnel, and End Effector Technician) immediately prior to commencing the test.

DECONTAMINATION TEST

Step 2: Transport the OAS to a facility which has a high pressure water wash system (~500 psi). Seal the end of the OAS with a gasket seal and cover plate. Set the OAS upright on a piece of foam at ground level. Use a metal pole secured to the top of the OAS to stabilize during the wash down.

WARNING, WATER SPRAY AT 500 PSI CAN BE HAZARDOUS. USE CARE TO ASSURE THAT PERSONNEL ARE PROTECTED FROM THE SPRAY.

Using the high pressure water spray, rinse the exterior of the OAS uniformly. Move the spray wand from top to bottom, covering the length of the OAS in roughly 3 seconds. Perform this spray test at 0 degrees, 90 degrees, 180 degrees, and finally at 270 degrees around the circumference of the OAS. Discontinue the water rinse and immediately dry off the exterior of the OAS. Disassemble the middle portion of the OAS so that the interior of the OAS can be examined for any water intrusion. Reassemble after assessment has been made.

Duration of water spray: ~12 secs total

Fan angle of water spray: 60 degrees

Distance from nozzle to OAS: ~ 8 inches

Estimate of water pressure: 1000 psi at nozzle.

Estimate of water intrusion: 1 cc

Verification: A.F. Pardini 3/28/96
EE Cog. Date

Exceptions/Notes:
Approximately 1 cc of water was noticed in the lower portion of the camera area.

This completes the decon test.

PRESSURE/LEAK TEST

Step 3: Transport the OAS end effector, cover plate assembly, and calibrated pressure gauge to the 306E facility. The NDE group will perform an information only pressure/leak test. This test will provide a visual assessment of the integrity of the OAS when subjected to a +/- 7 inches of water pressure, and a quantitative assessment of the leak rate out of the OAS under the assumed maximum purge pressure of 7 inches of water. The post delivery test report will include the NDE test data.

Verification: A.F. Pardini 4/1/96
EE Cog. Date

Exceptions/Notes:

The leak rate is approximately 14 STD cc/sec at LDUA normal operating pressure of 2.5 inches of water.

This completes pressure testing.

FUNCTIONALITY TEST

Step 4: Transport the OAS to the mezzanine level of FMEF. Position the OAS on the nylon test fixtures used for OAS testing. Connect the LDUA umbilical between the CVEE box and the connectors on the OAS. The Hypertronic connectors have been pre-marked. Only the end effector cognizant engineer or his designee can perform this step. Connect all other wiring as show in the Figure 1. This test configuration will test the end effector, the wiring interface between the end effector and the CVEE which will be located in the At Tank Instrument Enclosure (ATIE), and the operation of the

CVEE. Since the LDUA is not yet at Hanford, this test configuration will simulate the final conditions. Complete integration testing will be performed as the components are completed and assembled. Full testing will be performed during LDUA qualification testing.

Verification: A.F. Pardini / 4/1/96
EE Cog. Date

Exceptions/Notes:

None.

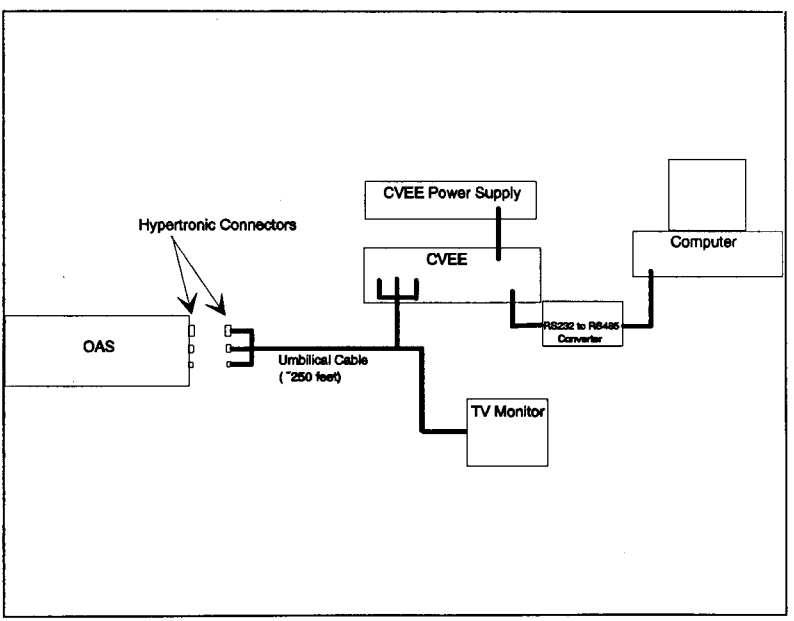

Figure 1 TEST CONFIGURATION

Step 5: Plug in the power cord supplying power to the CVEE, computer, monitor, , TV monitor, and CVEE power supply chassis. Power up the system. This power up will include turning on each supply on the front of the CVEE power supply chassis using the toggle switches. LED's above each of the toggle switches should light up.

Verification: A.F. Pardini / 4/1/96
EE Cog. Date

Exceptions/Notes:

None

Step 6: Record the make and model of the computer system.
Computer: AST Premmia 486/33 Model # Premmia 4/33

Turn on computer power. Also record version of software used.

Windows Software: Version 3.11 Windows for Workgroups

Labview Software: Version 3.1.1

Record the list of virtual instruments and their revision level that are booted on the system and include in the post delivery test report.

Computer system shall now be in "boot" procedure. Wait until it has booted into the "Labview" window. The OAS has a black and white video camera inside. The separate television monitor should provide a visual feed from the OAS camera. If no picture is present, make sure all coaxial connections have been made. If the camera system has failed, suspend the test.

Step 7: Double click on the "Labview" icon. The "untitled 1" window will come up. Open the file called "CVEES", then open "Unit.LLB", and then open "CVEES Main.VI". The "CVEES Screen Selection" should be on the monitor. Using the run command ("arrow") directly below the word file, run the VI. When this instruction is pressed, the "Init Mode Control Screen" will be on the monitor. Press the blue "Screen

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Labview is a trademark of National Instruments Corporation, Austin, TX

Select" button. The next screen should be the "CVEES Screen Selection" as before. Now press the OAS End Effector button.

Step 8: The OAS main function control screen (virtual instrument) should now be operational. To test this, touch the G1 button with the mouse and click. A pair of lights on the OAS should turn on. If not, make sure all power connections are on and perform the boot procedure again. If there still is no function control suspend the test.

Verification: A.F. Pardini / 4/1/96
EE Cog. Date

Exceptions/Notes:

None

Step 9: Position the OAS so that objects can be viewed in both the near field and far field. Each set of lights will now be tested. Using the mouse button click on the G1 button. The first pair of lights should come on. Verify that they are on and are bright. Turn off G1. Now turn on G2. Again verify that they are on and are bright. Turn off G2. Repeat these steps for G3 and G4. After each light pair has been shown to operate properly, turn on all light pairs and verify they are all on and are bright. Turn off all the lights except G1.

Verification: A.F. Pardini / 4/1/96
EE Cog. Date

Exceptions/Notes:

None

Step 10: In this step we will test the camera control functions, zoom, focus, and iris. The slider to the right of the control buttons is a speed controller. To begin with position the speed controller to the mid point for each function. Using the "TELE" in function, zoom the camera in until it stops. Using the "NEAR" focus function adjust the focus until it is sharp and in focus. Using the "CLOSE" iris function, close the iris until the image is dark. Now "OPEN" the iris until it stops or lights wash out the camera view. Now return the iris to a point where the image looks clear and has appropriate lighting. Now use the "WIDE" zoom out function to zoom out until it stops. Use the "FAR" focus until the image is clear and sharp. Inadequate light may cause the image to be slightly blurred. Use additional light pairs as needed to get clear image.
To test the function speed controls, slide each slider to near the 1.0 position, and push each camera control function. The speed at which each function occurs should be increased from the midpoint speed. Do the same with the slider at near the 0.0 point. Note, if the slider is at 0.0, no voltage may be getting to the drive motors and the functions will not work.

Verification: A.F. Pardini 4/1/96
EE Cog. Date

Exceptions/Notes:

Exception to 5th sentence. It should read - Using the "NEAR" or "FAR" focus function . . .

Exception to 10th sentence. It should read - Use the "FAR" or "NEAR" focus . . .

These exceptions cause no problems and are acceptable. A.F.P. 4/1/96

Step 11: Turn off all of the lights on the OAS. Position a vertical surface out in front (at approximately 10 feet) of the OAS providing a backstop for laser testing. To first test the point lasers, click the mouse on either "A" button on the point lasers control diagram. Two of the point lasers should turn on. These lasers should be diametrically opposite of each other. Turn off these lasers. Now click the mouse on either "B" button on the point laser control diagram. The other two point lasers should turn on. These lasers should also be diametrically opposite of each other and 90 degrees from the previous laser set. Turn off these lasers. Now move the vertical surface approximate 30 feet away from the OAS (if possible). Turn on all four point lasers. Using the television monitor observe the camera view of the point lasers. Verify that they can easily be seen by adjusting the iris control and minimizing lighting. Turn off all lasers and camera lighting. Return the vertical surface to its original position (at approximately 10 feet).
Note: Lasers may not be exactly aligned. Actual calibration and alignment of these sensors will be performed as part of the Test Procedure for Calibration, Grooming, and Alignment of the LDUA Optical Alignment Scope, WHC-SD-WM-TC-070, Rev. 0.

Verification: A. F. Pardini / 4/1/96
EE Cog. Date

Exceptions/Notes:

None.

Step 12: Now to test the line lasers, click the mouse on either "A" button on the line lasers control diagram. Two of the line lasers should turn on. Now click the mouse on either "B" button on the line laser control diagram. The other two point lasers should turn on. The image you should see on the vertical surface should resemble a tic-tac-toe configuration. Turn off these lasers. Now move the vertical surface approximate 30 feet away from the OAS (if possible). Turn on all four line lasers. Using the television monitor observe the camera view of the line lasers. Verify that they can easily be seen by adjusting the iris control and minimizing lighting. Turn off all lasers and camera lighting. Remove the vertical surface.

Verification: A.F. Pardini 4/1/96
EE Cog. Date

Exceptions/Notes:

None

Step 13: We will now test the proximity sensors for function testing only. Actual calibration testing of these sensors will be performed as part of the Test Procedure for Calibration, Grooming, and Alignment of the LDUA Optical Alignment Scope, WHC-SD-WM-TC-070, Rev. 0.
Using the displacement lasers button, turn on all proximity sensors. All eight sensors should come on all together. Verify all sensors are on by holding ones hand over the optical windows located around the circumference of the OAS. Using a flat surface (piece of wood will do) move the surface up to the face of the optical window, then slowly move it away. Verify that each reading on the displacement laser diagram changes in a predictable manner and is approximately the same for each sensor (readings should be very similar). Turn off the displacement lasers.

Verification: A.F. Pardini 4/1/96
EE Cog. Date

Exceptions/Notes:

None.

This completes the OAS functionality test.

CAMERA TEMPERATURE TEST

Step 14: Place the OAS in a position so that the heat from the lights will not cause any hazard. Connect the temperature indicating device to the front face of the OAS using a thermocouple under the cap screw next to the lighting.

Instrument name and manufacturer: Digital Thermometer, Omega

Model Number: HH-99J

Standards Lab Number: 770-79-06-008

Expiration Date: 11/1/96

On the temperature data sheet, record the initial temperature (no camera lights). Turn on all lights using buttons G1 through G4. Leave the camera lights on and begin taking temperature data and documenting on the temperature data sheet.

WARNING: CAMERA LIGHTS WILL GET HOT. ASSURE PERSONNEL ARE PROTECTED AGAINST THE HAZARDS.

Data will be taken every 5 minutes until the temperature stabilizes (temperature has stabilized when the temperature change over a 5 minute interval is 2 degrees or less for three consecutive readings). After completion, shut off the lights and remove the thermocouple.

Verification: A. F. Pardini / 4/1/96
EE Cog. Date

Exceptions/Notes:

All camera functions were checked at maximum temperature, 94 C. All functions worked except the line lasers. They no longer functioned at approximately 70 C. The line lasers are not critical to LOWA alignment therefore this exception is closed. AFP. 4/1/96

This completes the temperature test.

This completes the post delivery test of the OAS. To shutdown the system, choose the blue "Screen Select" button on the OAS VI. Then choose the blue "System Stop" button. You may now close all windows in the normal manner and power down the system.

FINAL POST DELIVERY TEST APPROVAL RECORD

This post delivery test has been completed and all exceptions resolved to the satisfaction of all applicable witnesses and that the Optical Alignment System is now available for integration with the Light Duty Utility Arm Supervisory Data Acquisition System. Further calibration testing of laser sensors will be performed as part of the Test Procedure for Calibration, Grooming, and Alignment of the LDUA Optical Alignment Scope, WHC-SD-WM-TC-070, Rev. 0.

LDUA End Effector Cognizant Engineer A F. Pardini Date 4/1/96

TEMPERATURE DATA SHEET

The temperature of the OAS system is taken to verify that the external temperature of the protected enclosure is sufficiently below the autoignition temperature of the flammable gas within the waste tank. The temperature reading is taken with the thermocouple located adjacent to the lights on the camera module which is expected to be the hottest area.

TIME (MIN)	TEMPERATURE READING (degrees C)
0	21
5	32
10	40
15	47
20	54
25	60
30	65
35	70
40	75
45	80
50	83
55	86
60	89
65	91
70	93
75	94

PERSONNEL RECORDS

NAME PRINT	NAME SIGN	INITIALS	POSITION	DATE
A.F. Pardini	A.F. Pardini	A.F.P.	LDUA Cog. Eng.	3/28/96
C.M. Smith	C.M. Smith	C.M.S.	ME Test Engr.	3-28-96
W.D Purdy	W.D Purdy	W.D.P.	NDE Level II	3-29-96
J. K. KEVE	John K Keve	J.K.	NDE Level III	3-29-96
B. Hopkins	B Hopkins	B.H.	NDE Level II	3-29-96

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APPENDIX B

LIGHT DUTY UTILITY ARM

OPTICAL ALIGNMENT SYSTEM COMPONENTS

Figures 2, 3, and 4 show the components used in the post delivery testing of the optical alignment system.

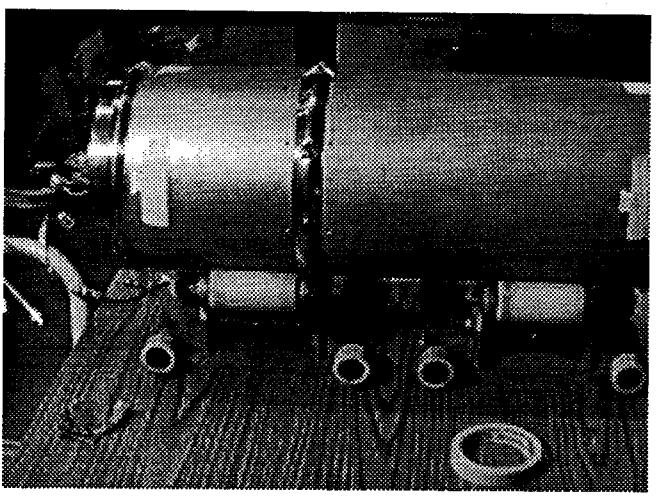

Figure 2 Optical Alignment System on Test Fixture

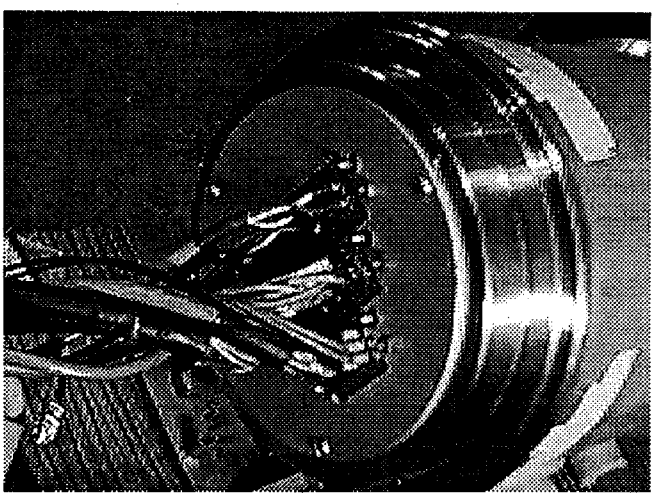

Figure 3 Hypertronic Connection

Figure 4 Computer Interface

ATTACHMENT 2

NONDESTRUCTIVE EXAMINATION LEAK TEST REPORT OF THE OPTICAL ALIGNMENT SYSTEM (OAS)

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Westinghouse Hanford Company

NDE LEAK TEST PROCEDURE AND TEST REPORT UL-100

NON DESTRUCTIVE EXAMINATION

306 BLDG., 300 AREA - TEL. 376-5401

Job No. 96-25

Requestor	Company	Project/System/Work Package/Traveler No.
A. PARDINI	WHC	LIGHT DUTY UTILITY ARM END EFFECTOR. THE OPTICAL ALIGNMENT SYSTEM (OAS) H1B01

MSIN	Bldg.	Area
N1-23	4706	400

Acceptance Std.	Section	Para.	Date	NA	Dwg. No.	NA
FOR INFORMATION ONLY						

TEST CONDITIONS

- Temperature AMB. Device ID ____ [X] NA
- Barometric Pressure AMB. [ ] NA
- Test Pressure 7 INCHES OF WATER [ ] NA
- Gas NITROGEN [ ] NA
- Concentration APPROX. 100 % [ ] NA
- Other ____ [X] NA
- Bubble Solution ____ [X] NA
- Batch No. ____
- Gage 1 ~~504-31-04~~ S34-28-09-005 [ ] NA
- Range 0-10 IN. OF H20
- Calib. Exp. 3-12-99
- Mass Flow Meter ~~Gage 2 504-31-04~~ 679-28-03-024 [ ] NA
- Range 0-10K SCCM N2
- Calib. Exp. 9-8-96
- Relief Valve ____ [X] NA

TEST EQUIPMENT [X] NA

- Manufacturer ____
- Ident. No. ____
- Mach. Sen. ____ Atm/cc/sec/Div
- Std. No. 584-40-03- ____
- Std. Leak ____ Atm/cc/sec
- Calib. Exp. ____

SYSTEM SENSITIVITY [X] NA

[ ] Same as MSLD Calib. or:

- Sensitivity ____ Atm/cc/sec/Div
- Std. No. ____
- Std. Leak ____ Atm/cc/sec
- Calib. Exp. ____

ADDITIONAL STD. [X] NA

- Sensitivity ____ Atm/cc/sec/Div
- Std. No. ____
- Std. Leak ____ Atm/cc/sec
- Calib. Exp. ____

NCR [X] NA

Cleaning [X] NA

WHC PROCEDURE NO. [X] NA

- [ ] NDT-LT-6000 Rev. ____
- Appendix ____ Rev. ____
- [ ] Special Tech. No. ____
- [ ] Work Inst. ____

TEST TIME

- He Response Time ____ [X] NA
- He Accum. Time ____ [X] NA
- Soak Time ____ [X] NA
- Additional Times ____ [X] NA

Weld No., Part No., or Serial No.	Acc.	Rej.	No Rel. Ind.	Comments
OPTICAL ALIGNMENT SYSTEM (OAS)				POSITIVE AND NEGATIVE PROOF TEST AT 7 INCHES OF WATER APPEARED TO CAUSE NO PHYSICAL DAMAGE . PERFORMED LEAK RATE TEST USING A MASS FLOW METER . THE AVERAGED LEAKAGE FLOW RATE AT 1.0, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0 & 7.0 INCHES OF WATER ARE RESPECTIVELY 6.00, 10.75, 14.00, 16.59, 20.58, 23.34, 27.75 & 31.5 SCC/S (SEE ATTACHED DATA SHEET).

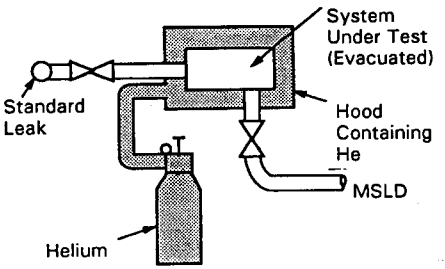
Technique Pre Approval [X] NA — LT Level/Date

Technician	Level	Interpreted by	LT Level II	Reviewed by
B. HOPKINS B. Hopkins	II	B. HOPKINS B. Hopkins	II	John L Kim
Date of Examination 4-1-96		Date 4-1-96		Date 4-4-96

A-6001-492 (11/94)

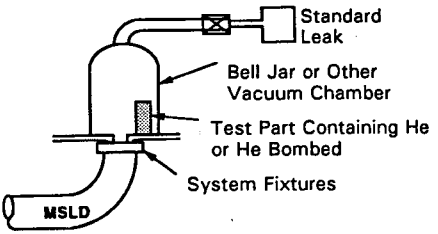
I

☐ Hood Method (Total Leak Rate)
☐ Std. Leak at MSLD



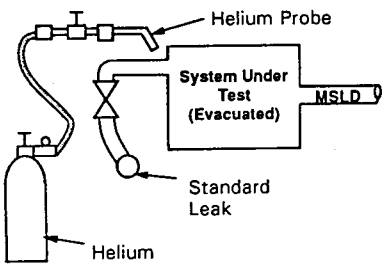
II

☐ Bell Jar (Hood)



III

☐ Helium Tracer Probe (Leakage Location)



IV

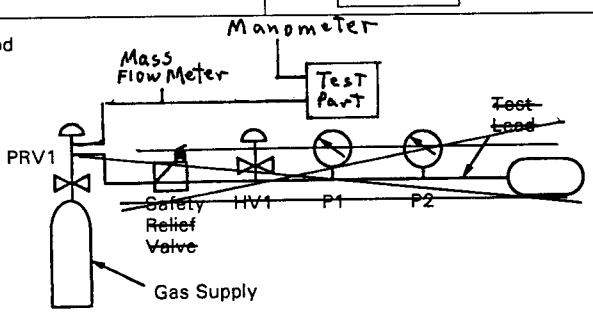
☐ Detector Probe (Leakage Location)
Quick Test Probe Length _____
Response Time _____
Std. No. _____
Std. Leak _____ Atmcc/sec

☐ Leakage Location
System Under He Pressure
Calib. Exp. _____
Sensitivity
_____ Atmcc/sec/Div

☐ He Accumulation Method
System Under He Pressure
Plastic Wrap
MSLD

V

☒ Pressure Method



A-6001-492R (11/94)

Job No. 96-25
4-1-96

LUDA, Optical ALignment System (OAS)

Manometer 534-28-09-005 Exp. 3-12-99 0-10 in. H_2O
MKS Flow Meter 679-28-03-024 Exp. 9-8-96 0-10,000 SCCM

Positive and Negative Pressure Test of 7 in. H_2O appeared to cause no damage.

Leak Rate Test

in. H_2O	Flow
1.0	042 x 10 = 420 ÷ 60 = 7.00 scc/s
2.0	068 x 10 = 680 ÷ 60 = 11.33 scc/s
2.5	084 x 10 = 840 ÷ 60 = 14.00 scc/s
3.0	099 x 10 = 990 ÷ 60 = 16.50 scc/s
4.0	128 x 10 = 1280 ÷ 60 = 21.33 scc/s
5.0	141 x 10 = 1410 ÷ 60 = 23.50 scc/s
6.0	165 x 10 = 1650 ÷ 60 = 27.50 scc/s
7.0	195 x 10 = 1950 ÷ 60 = 32.50 scc/s
1.0	030 x 10 = 300 ÷ 60 = 5.00 scc/s
2.0	061 x 10 = 610 ÷ 60 = 10.17 scc/s
2.5	084 x 10 = 840 ÷ 60 = 14.00 scc/s
3.0	100 x 10 = 1000 ÷ 60 = 16.67 scc/s
4.0	119 x 10 = 1190 ÷ 60 = 19.83 scc/s
5.0	139 x 10 = 1390 ÷ 60 = 23.17 scc/s
6.0	168 x 10 = 1680 ÷ 60 = 28.00 scc/s
7.0	183 x 10 = 1830 ÷ 60 = 30.50 scc/s

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ATTACHMENT 3

LABVIEW VIRTUAL INSTRUMENTS USED DURING POST DELIVERY PROCEDURE

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