QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES

TITLE	**TROUBLESHOOTING AND EMERGENCY MAINTENANCE PROCEDURES FOR THE REMOTE HIGH-RESOLUTION DIGITAL CAMERA SYSTEM (RDCS-100)**
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1.0   PURPOSE AND APPLICABILITY

The purpose of on-site troubleshooting and emergency maintenance is to assure quality data capture and minimize data loss by performing operational checks that will verify proper system operation and/or quickly identify the probable source of a camera system malfunction. This technical instruction (TI) describes on-site troubleshooting and emergency maintenance procedures for the Remote High-Resolution Digital Camera System (RDCS-100), and is referenced in SOP 4120, *Automatic Camera System Maintenance*.

Site operators should be fully trained and supplied with a *Site Operator's Manual for Remote High-Resolution Digital Camera Systems* that contains detailed routine site operator maintenance and troubleshooting procedures for the specific camera monitoring system located at the site. Additional manufacturer instruction booklets and a supply of Visibility Monitoring Status/Assessment Sheets are also provided.

Close personal communications should be maintained between Air Resource Specialists, Inc. (ARS) and site operators throughout the monitoring effort. Operators are encouraged to call or notify ARS by e-mail if they have any questions or problems. Many problems can be fully resolved over the telephone.

2.0   RESPONSIBILITIES

2.1   PROJECT MANAGER

The project manager shall coordinate with the site operator, his/her supervisor, field specialist, and data coordinator concerning the requirements and completion of specific troubleshooting procedures.

2.2   FIELD SPECIALIST

The field specialist shall:

- Coordinate with the project manager, the site operator, his/her supervisor, and data coordinator concerning the schedule and requirements of specific troubleshooting procedures.

- Train the site operator in all phases of specific troubleshooting procedures necessary for on-site resolution of instrument problems.

- Document all technical support provided to the site operator.

2.3   DATA COORDINATOR

The data coordinator shall:

- Coordinate with the project manager, the site operator, his/her supervisor, and field specialist concerning the requirements and completion of specific troubleshooting procedures.

- Identify possible instrument malfunction and contact the site operator to schedule troubleshooting procedure implementation.

- Verify that scheduled troubleshooting visits are performed and notify the site operator or his/her supervisor if he/she fails to make a scheduled visit.

- Provide technical support to the site operator via telephone to identify and resolve system problems. Document all technical support given to the site operator.

- Coordinate the replacement and repair of all system components and support hardware.

- Review all site documentation completed by the site operator for accuracy and completeness. File all documentation and correspondence.

- Enter the results of all performed procedures into the site-specific Quality Assurance Database.

- Document all capital instrumentation changes and maintain inventory records in the ARS Purchase Order/Inventory Database.

2.4   SITE OPERATOR

The site operator shall:

- Coordinate with his/her supervisor, the project manager, data coordinator, and field specialist concerning the requirements and completion of specific troubleshooting procedures.

- Perform all procedures described in this TI.

- Thoroughly document all troubleshooting procedures on the Visibility Monitoring Status/Assessment Sheet; mail the white copy of the completed sheet to the data coordinator and maintain the yellow copy on site.

- Report any noted inconsistencies and troubleshooting efforts immediately to the data coordinator.

3.0   REQUIRED EQUIPMENT AND MATERIALS

3.1   SITE VISIT EQUIPMENT

Equipment and materials generally required to support a routine site visit or scheduled maintenance include:

- Medium and small flat-blade screwdriver

- Small Phillips-head screwdriver

- Medium adjustable wrench

- Keys for enclosure and padlocks

- Spare camera batteries (4 AA Ni-MH)

- Spare Personal Digital Assistant (PDA) batteries (2 AAA alkaline)

- Paperclip for resetting the PDA

- Lens tissue and cleaner

- Voltmeter

- Site Operator's Manual for Remote High-Resolution Digital Camera Systems, containing:

  – SOP 4120, *Automatic Camera System Maintenance*

  – TI 4120-3800, *Routine Site Operator Maintenance Procedures for the Remote High-Resolution Digital Camera System (RDCS-100)*

  – TI 4120-3900, *Troubleshooting and Emergency Maintenance Procedures for the Remote High-Resolution Digital Camera System (RDCS-100)*

  – Manufacturer's instruction booklets

  – Visibility Monitoring Status/Assessment Sheets

- Pen or pencil

3.2   INVENTORY

It is imperative that any capital instrumentation changes made as a result of troubleshooting or emergency maintenance be thoroughly documented. Specific model and serial numbers of the exchanged enclosure, camera, solar panel, and/or Personal Digital Assistant (PDA) should be documented for future reference by the data coordinator in the site-specific Quality Assurance Database and ARS Purchase Order/Inventory Database. Any on-site changes made should be documented by the site operator on a Visibility Monitoring Status/Assessment Sheet or Photographic Monitoring Network Quality Assessment Log (described in Section 4.0). Capital equipment exchange procedures are discussed in Section 4.4.

4.0   METHODS

All procedures described in this TI refer to the Remote High-Resolution Digital Camera System (RDCS-100), which consists of five major components:

- A high-resolution digital camera with zoom lens and integrated scripting

- A custom-designed controller

- A PDA (Personal Digital Assistant) palm computer interface

- A battery-backed power system (AC or solar power)

- A lockable environmental enclosure

Many AC-powered remote high-resolution digital camera systems also contain a system heater and window defroster kit. These supplemental components assure ongoing data collection and minimize window condensation for sites located in colder northern climates.

This section includes four (4) major subsections:

4.1 General Information
4.2 Troubleshooting and Emergency Maintenance Procedures
4.3 Final System Verification Check
4.4 Capital Equipment Exchange Procedures

4.1   GENERAL INFORMATION

Maintaining a camera system includes prompt detection and emergency maintenance when the system fails to function properly. The troubleshooting and emergency maintenance process should progress as outlined below to ensure ongoing, consistent data collection.

- A system malfunction is detected by the site operator during routine maintenance of the system or by the data coordinator during review of memory card images.

- The site operator applies defined troubleshooting procedures to test the system and notifies ARS of his/her findings. The data coordinator diagnoses the problem and suggests specific action. The operator initiates the corrective action, tests the system, and again notifies the data coordinator of his/her findings.

- If the system appears to be operating normally, the operator returns it to service and visits the site periodically before the next regularly scheduled visit.

- When the site operator cannot identify or resolve a camera system-related problem or if the site operator is not available to address the malfunction, the data coordinator ships a complete backup camera system to the site as quickly as possible, along with a Photographic Monitoring Network Quality Assurance Log. Site operators exchange the equipment, document the exchange on the log, and ship the malfunctioning unit to ARS for evaluation and repair. (A backup inventory of 5% - 10% of the total network is recommended (e.g., 1 backup system for every 10 units)).

- The site operator documents all problems, troubleshooting, and corrective actions on the Visibility Monitoring Status/Assessment Sheet. The documentation should include:

  – Date of noted malfunction

  – Actual or estimated amount of data loss

  – Steps taken to test system components

  – Corrective action taken

  – Current operational status

- All troubleshooting and emergency maintenance communication documentation will be retained in the site-specific Quality Assurance Database for future reference. The data coordinator will continue to monitor images for reoccurrence or resolution of the problem.

Site operators can often diagnose and solve equipment problems in the field, reducing costly site visits or loss of data. Two good practices to follow in troubleshooting are: 1) start with simple checks and then progress towards the more complicated, and 2) test the system by individual testable component.

The following manufacturers' instruction booklets provide additional reference and are located in the Site Operator's Manual for Remote High-Resolution Digital Camera Systems:

- Kodak digital camera instruction booklet
- PDA palmtop computer instruction booklet

4.2   TROUBLESHOOTING AND EMERGENCY MAINTENANCE PROCEDURES

Before reporting problems or calling for assistance to diagnose an equipment problem, follow this troubleshooting sequence:

1)   Check the problem areas listed in Table 4-1.

2)   Follow the component troubleshooting procedures described in the following subsections.

3)   Document the results of troubleshooting so the data coordinator can review the problem accurately.

4)   Refer to the Site Operator's Manual for Remote High-Resolution Digital Camera Systems when necessary.

Table 4-1

Troubleshooting Procedures for the
Remote High-Resolution Digital Camera System (RDCS-100)

Standard Settings/Operational Requirements Checklist		
Camera	Capture mode; power OFF	
	Capture menu standard settings:	
	Picture Type:	Still
	White Balance:	Daylight
	Watermark:	None
	Advanced Exposure Modes:	Programmed AE
	Advanced Focus Modes:	Manual focus (infinity)
	Preferences:	Standard time
	Kodak Scripts:	Resolution series (high, 1792 x 1200 pixels) (super quality, minimal compressed JPG)
	Flash option: OFF	
	Operational requirements:	4 AA size 1.5-volt alkaline or 4 AA size 1.2-volt Ni-MH rechargeable batteries (32° to 104°F temperature range)
Controller	Green light flashing, cable connections secure to all components	
	Operational requirements:	10-14V battery voltage
PDA (Personal Digital Assistant)	Power OFF, connection to controller is not critical to operate RDCS-100	
	Operational requirements:	2 AAA size 1.5-volt alkaline batteries

Troubleshooting Procedures		
Component to be Checked	Problem	Malfunction Possibilities/Corrective Action
Camera	Camera shuts off unexpectedly	• Check and replace internal AA camera batteries.
	Ready light is red	• Memory card is not inserted into camera.
	Camera won't take automatic photograph	• Check cable connections. • Verify that the camera is on. • The Status Display reads Full. The memory card is full. • Take test photo using PDA
	Camera won't take manual photograph	• Verify that the camera is on, by pressing top of solenoid. • Automatic script was not stopped. • Take test photo using PDA
	Camera does not turn on	• Batteries are not installed properly. • Check cable connections to camera and solenoid.
	Picture is too light	• Verify that the flash is off. • Verify that the light meter is properly aligned with enclosure portal.
	Stored pictures are damaged	• The memory card was removed when the Ready light was blinking.
	Picture is not clear	• The lens is dirty. • Verify Capture menu focus settings.

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Table 4-1 (Continued)

Troubleshooting Procedures for the
Remote High-Resolution Digital Camera System (RDCS-100)

Troubleshooting Procedures		
Component to be Checked	Problem	Malfunction Possibilities/Corrective Action
Controller	Time is incorrect	• Check controller date and time in Troubleshooting menu on the PDA. If off by > 1 minute, reset the controller date and time in same menu.
	Site code is incorrect	• If site code display is incorrect on View Controller Status menu, reset in Enter Site Information menu. Incorrect site code will adversely affect both the .dat file and off-site data handling procedures.
	Power/light not flashing	• Verify proper controller 12v battery cable connections. Disconnect and replug into power if necessary.
	Program not functioning	• Retrieve temperature/battery voltage and verify 2-way communication between PDA and controller. • Check cable connections. • Review controller cycle counter in the Troubleshooting menu on the PDA.
PDA (Personal Digital Assistant)	Screen display is blank	• Check to ensure the power button is turned on. • Tap the contrast button and adjust contrast (refer to PDA manufacturers' manual). • Ensure batteries are fresh and properly installed. Change batteries monthly; an icon on top of the screen in the Main menu shows the battery supply status. • Perform a soft reset. Use a paperclip to gently press the reset button on the back of the PDA.
	Cannot access PalmCam menu	• Go to the Main menu and make sure All is displayed at the top. Scroll down if it is not and select the PalmCam icon. • If PalmCam icon is not displayed then the software has been erased and needs to be re-installed from a PC using a HotSync operation. • A hard reset was performed on the PDA and erased the programming.
	PalmCam menu experiences "Fatal Exception" error	• Exit and re-entry of PalmCam software malfunctioned. Perform a soft reset by using a paperclip to gently press the reset button on the back of the PDA.

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Table 4-1 (Continued)

Troubleshooting Procedures for the
Remote High-Resolution Digital Camera System (RDCS-100)

Troubleshooting Procedures		
Component to be Checked	Problem	Malfunction Possibilities/Corrective Action
Power Supply:	Do not have power (using AC power/battery)	• Check cable connections from the battery charger. • Check LED light on battery charger; green indicates power is on and charging, red indicates fully charged. • The gel cell is a rechargeable battery. Check voltage with PDA. • Check gel cell battery voltage with a voltage meter.
	Do not have power (using solar power)	• Check that the LED light is on to DC charge regulator. • Check fuse inside yellow inline fuse holder. Replace if dead (5 amp). • Check voltage output with voltage meter; connected to battery should be 15-20 volts. Without battery connection to DC charge regulator should be 22volts on a sunny day.
Enclosure	Condensation appears in the enclosure	• Check for leaks or improperly tightened door seal clamps. • If applicable: verify that the window defroster component is functioning properly.

Throughout the monitoring effort, ARS and site operators maintain close, personal communications. Call ARS immediately if any inconsistencies are noted or if any questions arise. Many problems can be resolved through telephone consultation.

ARS may be reached using the following methods:

Telephone: 970/484-7941
FAX: 970/484-3423
E-mail: info@air-resource.com

If the person you need to speak with is not in, ask to be directed to another or leave a message including your name, location, and a brief description of the problem(s) or need(s). You may also leave an e-mail message, especially after business hours or for a step-by-step follow-up.

Data collection errors or discrepancies observed by the data coordinator during image review can also initiate required corrective action. All requested maintenance or troubleshooting procedures performed must be thoroughly documented by the site operator on the Visibility Monitoring Status/Assessment Sheet and by the data coordinator in the site-specific Quality Assurance Database.

4.2.1 <u>Camera</u>

Various camera problems may be caused and remedied by the following:

CHANGE BATTERIES

To change the camera batteries:

- Open the battery door.

- Slide the inside battery cover toward the back of the camera and then lift it away from the camera.

- Insert fresh batteries as indicated on the battery cover.

- Close and lock the inside battery cover and battery door.

EXCHANGE MEMORY CARD

To exchange the memory card:

- Open the memory card door.

- Insert the memory card so that the pin-connector edge of the card enters the camera first.

- Ensure the small lip on the memory card is toward the front of the camera.

SECURE CABLES

Check to ensure all cables are properly and securely connected.

The interface cable (yellow) runs from the controller to the camera serial port. It provides the connection between the controller and the Kodak camera scripting program to activate the camera, store images and .DAT file information on the internal memory card, and power down the camera.

The camera power cable (red) runs from the controller to the camera AC adapter port and solenoid shaft. It powers the camera in addition to the camera's internal 4 AA Ni-MH batteries. The cable also powers the solenoid shaft to depress the camera's power button.

TURN OFF FLASH

The display on the top of the camera shows the current settings. The camera must be turned on and in the Capture mode to view and interact with the standard Capture menu (Table 4-1) settings.
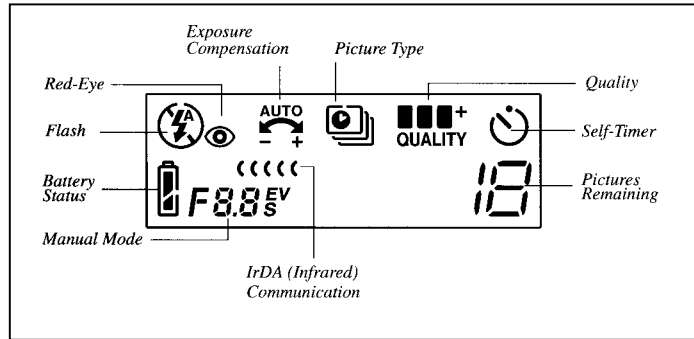
Ensure the flash is off. (See Figure 4-1).

Figure 4-1. Camera Display on Top of Camera.

To change the flash:

- Press the **solenoid** to power the camera. Press the **Stop Script** button when the camera display appears on the back of the camera.

- Set the Mode dial to **Capture**.

- Press **Scroll** (located on the top of the camera) to scroll through the first four functions on the Status display: Flash, Exposure, Picture Type, and Quality.

- When the function you want to change is flashing, press **Select** (located on the top of the camera) to toggle through the choices for the active function.

RESET ALIGNMENT   The camera alignment must remain constant from one memory card to the next. To ensure proper alignment:

- Observe the display on the back of the camera during the process of an automatic or test photograph. Verify that the vista alignment matches the site-specific alignment photograph provided in the site operator's manual.

- Access the PDA Enter Site Information menu. Highlight the **Verify Camera Alignment** item to activate the instructions for manually viewing the current and adjusted vista alignment.

Note: manual alignment procedures display the vista for a 50mm zoom setting only. Verify final zoom setting and alignment by taking a test or automatic photograph with the PDA, and observing the alignment displayed on the back of the camera.

Proper alignment with the enclosure port is important with respect to vista alignment as well as proper light metering.

Observe the camera lens and light meter from the front exterior of the enclosure. The port alignment must be such that the camera lens and light meter are as close to center (unobstructed as possible). Refer to Figure 4-2. Both components must be clearly visible to properly meter and photograph the observed vista.
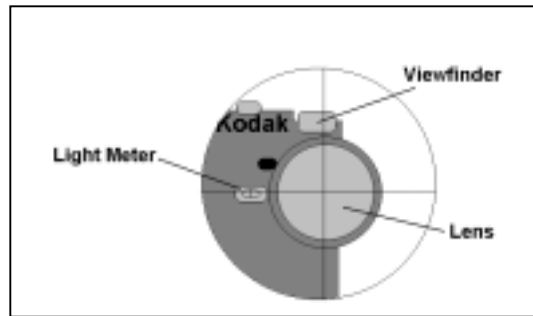

Figure 4-2. Diagram of Proper Port Alignment.

4.2.2   <u>Controller</u>

The controller controls the camera functions. Controller settings are displayed on the PDA Controller Status menu. Various controller discrepancies can be reviewed and/or modified under the PDA Troubleshooting menu.
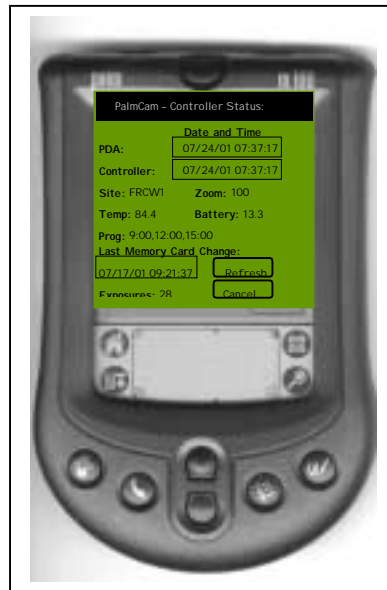

Figure 4-3. View Controller Status Menu.

| SET CONTROLLER DATE AND TIME | Verify on the Controller Status menu that the date and time correctly displays and is <1 minute different than displayed PDA time. |

- Go to the Troubleshooting menu and set the controller date and time.

OBSERVE CONTROLLER
CYCLE COUNTER

During normal operations the controller may experience a power surge or mis-synchronized with communication from the camera.

The controller will automatically reset itself and clock; however, the cycle counter will increment for each reset.

- Report any major (>2) increases observed in the cycle counter to the ARS data coordinator.

- Reset the controller cycle counter when problems (if any) have been resolved.

SECURE CABLES

Check to ensure all cables are properly and securely connected.

The PDA HotSync cable (black) runs from the palmtop HotSync connection to the controller. It transfers the PalmCam remote configuration information and activation commands to the controller. The controller can operate independently of the PDA after the initial transfer is completed. This cable can be disconnected at the palmtop end if necessary.

4.2.3 Personal Digital Assistant (PDA)

Various camera problems may be caused and remedied by the following:

CHANGE BATTERIES

To install fresh batteries in the PDA:

- Press the latch on the battery door and lift the battery door away from the PDA.

- Install two AAA alkaline batteries into the battery compartment.

- Insert the battery door back into place so that it is flush with the back of the PDA and "clicks" into position. NOTE: When changing batteries, replace them quickly. The built-in backup power maintains memory of your data for a period of up to one minute.

VERIFY SITE
PARAMETERS

Verify correct site parameters by accessing the PDA Enter Site Information menu:

- To change any site information documented, highlight the recorded item and press the **Text** icon ![abc] on the PDA.

- Use the PDA keyboard to correct the item.

- To change the number of observations collected, select the *site-specific data collection schedule* of your choice from the drop-down menu.

- Press the **Save** button to save any changes made. Wait for the *Database Updated* message to appear. Note you must have the PDA connected to the cable in order to update the controller's memory.

Observe the exposure counter on the top of the camera and verify with the exposure counter on the Controller Status menu. Document the number of images that were taken during the monitoring period.

TROUBLESHOOTING   Access the Troubleshoot menu on the PDA. A series of system checks are available. To test any item, highlight the item and press the **OK** button. Document observed readings on the Visibility Monitoring Status/Assessment Sheet.

RESET   If the PDA or system locks up during any test, perform the following steps:

- Wait up to 2 minutes to allow the PDA to time-out, or wait up to 5 minutes for the camera to time-out.

- Disconnect the HotSync cable at the PDA jack. Attempt to activate the PalmCam Remote interface from the PDA Home menu. Wait for the database to be read successfully. Return to the Troubleshoot menu and try another system check.

If the PDA still does not respond to pushed buttons or tapping the screen, you may need to perform a soft reset to get the PDA running again.

- Use the tip of an unfolded paper clip (or similar object without a sharp tip), to gently press the **Reset** button inside the hole on the back panel of the PDA palmtop.

SECURE CABLES   Check to ensure all cables are properly and securely connected.

The PDA HotSync cable (black) runs from the palmtop HotSync connection to the controller. It transfers the PalmCam remote configuration information and activation commands to the controller. The controller can operate independently of the PDA after the initial transfer is completed. This cable can be disconnected at the palmtop end if necessary.

4.2.4   <u>Power Supply</u>

Check the 12 volt rechargeable battery with a voltmeter. The battery should read between 12 and 14 volts.

Verify all cable connections are correct and secure.

12V BATTERY CABLE (GREEN)	This cable runs from the +/- connections of the 12V battery to the controller. It provides continuous power to the controller, as well as supporting power from the controller to other components.
SOLAR (DC) BATTERY CHARGER CABLE (BLUE)	This cable runs from the photovoltaic charge controller to the 12V battery cable jack. It provides solar power through the charge control device to the 12V rechargeable battery.
AC BATTERY CHARGER CABLE (BLUE)	This cable runs from the AC battery charger to the 12V battery cable jack. It provides AC power through the AC battery charger to the 12V rechargeable battery.

4.2.5   <u>Enclosure</u>

If water or large amounts of dust are found inside the camera enclosure:

TIGHTEN CLAMPS	Make sure that all perimeter clamps on the enclosure are firmly tightened after every visit. The enclosure is designed to seal out the elements and should do so if all clamps are secure.
EXAMINE SEALANT	To determine where leaks may be occurring, examine the sealant at enclosure joints (the tops and sides of the sunshield and around the window and portal perimeters). If obvious, attempt to correct the problem and/or call ARS to discuss possible solutions.
EXAMINE SYSTEM COMPONENTS	Carefully examine the camera system components for signs of damage from water or dirt. If damage is suspected, call ARS for instructions.
CONDENSATION	Condensation on the inside of the enclosure window is a common problem during periods of high humidity. Packages of desiccant (a substance that absorbs moisture) are available from ARS by request. When placed inside the enclosure and changed frequently, desiccant greatly reduces the amount of condensation.

A supplemental window-defroster kit is available for AC-powered RDCS-100 systems. To obtain this component, contact the ARS data coordinator or program manager.

4.3   FINAL SYSTEM VERIFICATION CHECK

A thorough review of all system components and camera settings should be made following any component (or system) replacement or troubleshooting effort. Verify proper automatic operation by observing the system during a scheduled monitoring period (i.e., when the camera is scheduled to take an image) or by verifying settings in the controller's menus. The camera should snap an image.

Verify the system periodically between scheduled site visits to ensure ongoing operation. The data coordinator will review all memory cards as soon as possible to ensure correct image exposure and camera function.

4.4   CAPITAL EQUIPMENT EXCHANGE PROCEDURES

When the site operator cannot identify or resolve a camera-related problem or is not available to address the malfunction, ARS ships a backup camera system or system component to the site as quickly as possible. Site operators exchange the equipment and ship the malfunctioning unit to ARS for evaluation and repair. All camera systems returned to ARS are routinely cleaned and tested for correct operation before being placed back into service.

Note that backup equipment and system components must be available to accommodate emergency system replacement with minimal data loss. Where no backup equipment is available, no data are collected until the system or system component can be repaired and returned to the site.